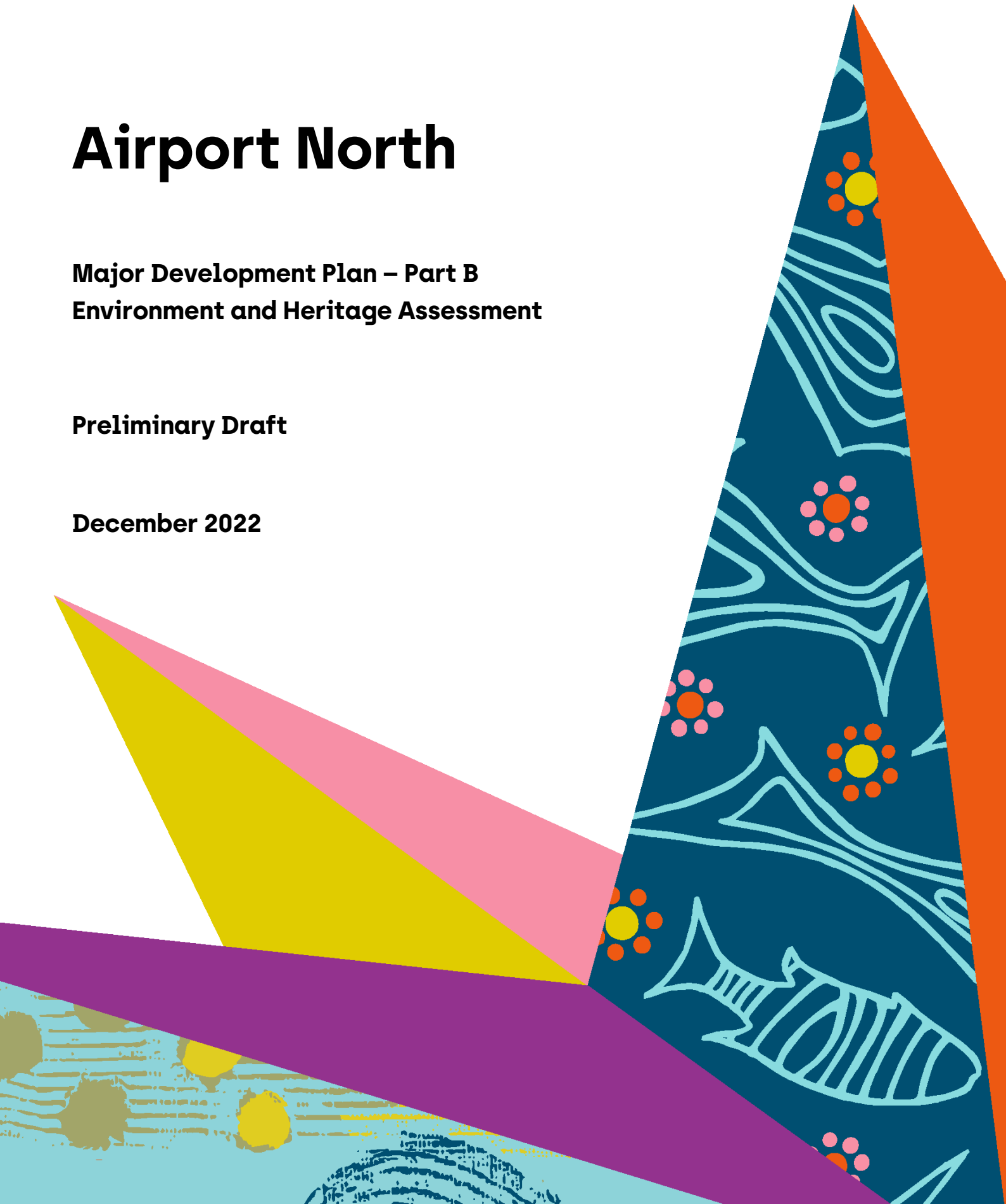
Perth Airport

Airport North

Major Development Plan – Part B
Environment and Heritage Assessment

Preliminary Draft

December 2022



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While all care has been taken in the preparation of this Preliminary Draft Major Development Plan:

- It is based on certain forecasts and assumptions, and Perth Airport makes no claim as to the accuracy or completeness of any of the information or the likelihood of any future matter,
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ACKNOWLEDGEMENT OF COUNTRY

Boorloo worlak kornt kaadatj Wadjak moort Noongar boodja-k wer baalabang kalyakoorl noyinang Noongar boodja-k. Ngalak kaadatj Noongar Birdiya koora-koora yeyi wer boordakan.

Perth Airport acknowledges the Whadjuk Noongar people as the Traditional Custodians of this region and respects their ongoing connection to this land. We pay our respects to Elders past, present and emerging.

We welcome feedback on the Perth Airport Preliminary Draft Major Development Plan for Airport North.

Written public comment submissions can be made online at perthairport.com.au/majordevelopmentplans or sent to the address below between **Friday 2 December 2022 and 5pm (WST) Thursday 2 March 2023**:

Major Development Plan

Perth Airport Pty Ltd

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Queries regarding this Preliminary Draft Major Development Plan should be directed to telephone 08 9478 8888 or via email mdp@perthairport.com.au.

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1 Introduction

1.1 Background

Perth Airport Pty Ltd has prepared this Part B Major Development Plan (MDP) for the Airport North precinct, which comprises a 248.03 hectare (ha) area in the northern extent of the Perth Airport estate. The proposed MDP is consistent with the existing Perth Airport 2020 Master Plan (approved 2 March 2020) and proposes to establish a range of land uses within the Airport North MDP area, including:

- Stormwater management infrastructure, including drainage basins and drainage swales.
- Areas of retained environmental values, including areas of intact native vegetation, wetlands (including Munday Swamp) and associated wetland buffer zones.
- Areas of retained heritage values.
- Areas of proposed revegetation.
- Subdivided commercial lots.
- An integrated public road network and adjacent landscaping.
- Areas retained for airport services.
- Provision for a future rail spur from the adjacent freight rail network.

To facilitate the above, the scope of the approval being sought is broadly classified as ‘site clearing and preparation’ and includes vegetation clearing, earthworks and other site preparation, service diversions and installations, road network construction and landscaping and signage.

A concept plan for the Airport North MDP has been prepared by Grimshaw (2022) and is shown in Figure 1-1.

The total disturbance area (TDA) (213.65 ha) of the MDP is shown in Figure 1-2. The TDA represents the portion of the MDP which is proposed to be developed or impacted (including areas to be impacted and then revegetated) and excludes areas that are proposed to be retained in their current form (for example, areas of vegetation and wetlands to be retained).

This report (Part B) provides details around the environmental and heritage considerations for the Airport North project and is intended to be read in conjunction with Part A.

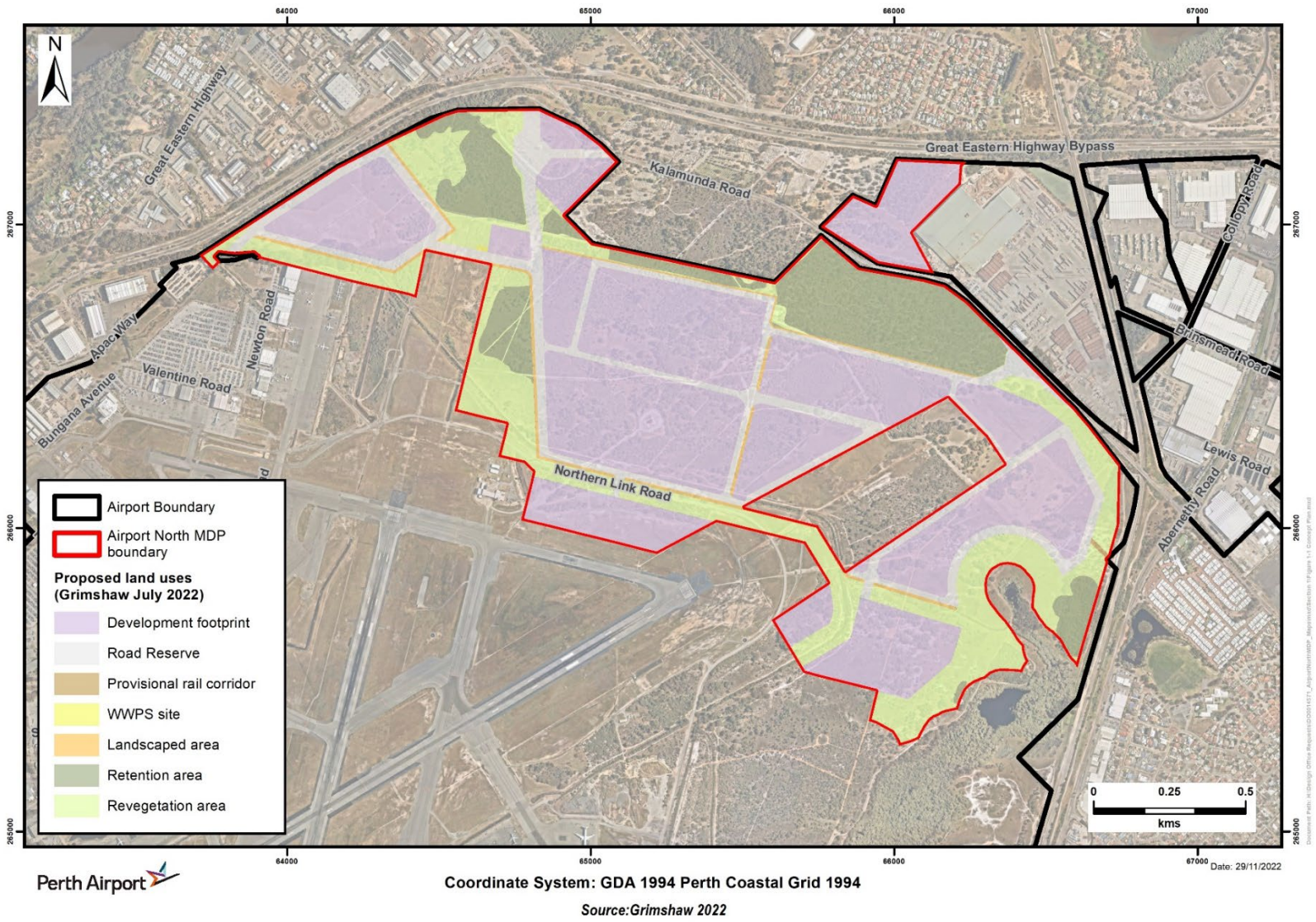

Figure 1-1: Proposed Airport North MDP Concept Plan

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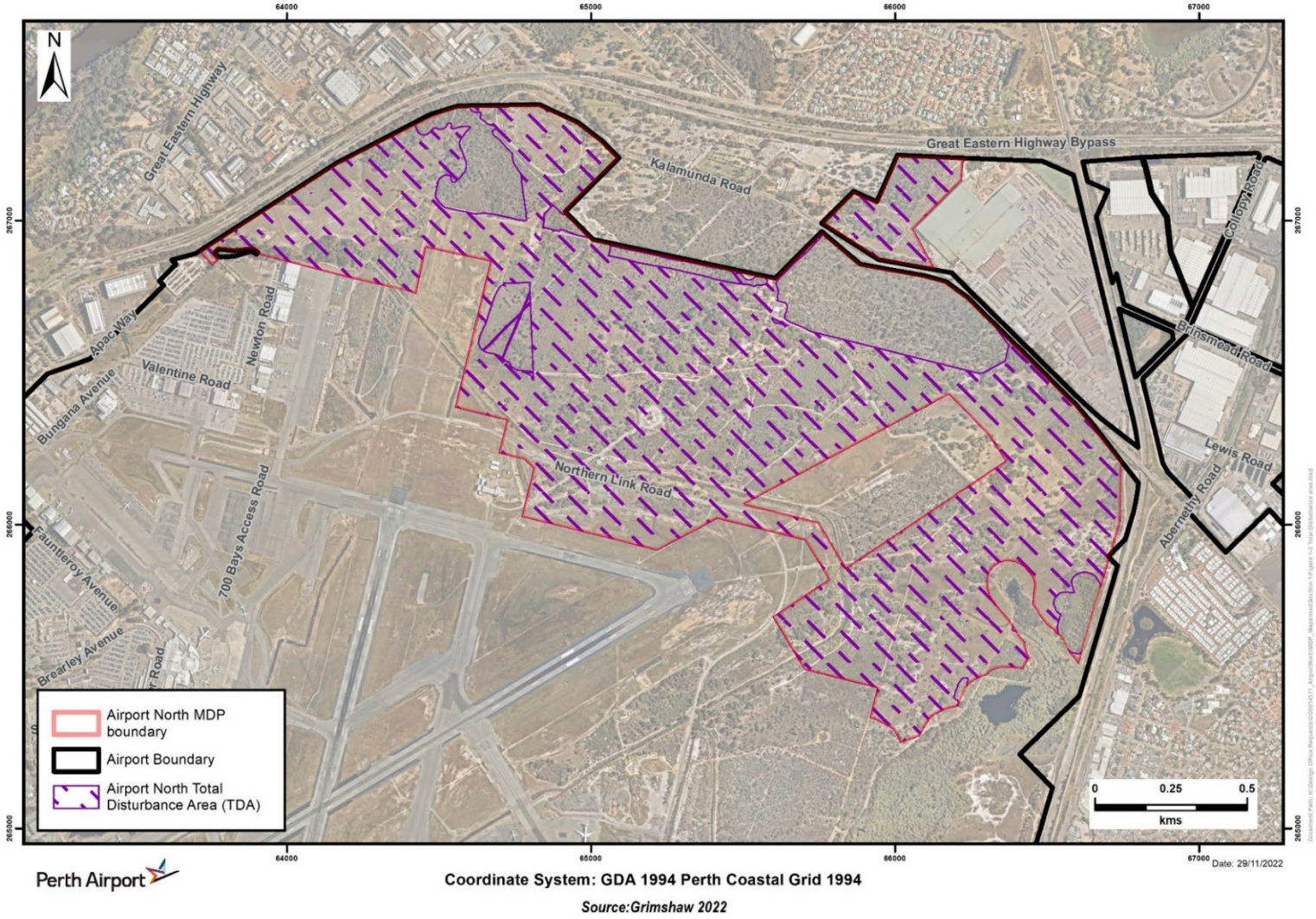

Figure 1-2: Total Disturbance Area

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1.2 Purpose

A review of the baseline environmental and heritage conditions for the Airport North project area was undertaken based on desktop assessment and field studies in addition to consideration of potential impacts associated with the construction and operation of the project. The content of each section of this report is summarised in Table 1-1.

Table 1-1: Summary of Part B report sections

Section	Content
1	Introduction of the proposed Airport North MDP, including a summary of the environmental and heritage impact assessment and legislative context.
2	Discussion of the environmental context of the MDP area.
3-9	A description of each environmental and heritage factor relevant to the proposed MDP and documentation of the impact assessment for each factor. 3 – Flora and Vegetation 4 – Fauna 5 – Water Resources 6 – Wetlands 7 – Soils and Geology 8 – Noise, Vibration and Air Quality 9 - Heritage
10	A holistic assessment of the impacts of the MDP to the 'whole of environment', within Commonwealth land, based on the Commonwealth Government *Significant Impact Guidelines 1.2.*
11	Discussion of the proposed overarching environmental management measures and consistency of the proposed MDP with the existing Perth Airport Environment Strategy.
12	Description of the proposed offsets strategy.

1.3 Legislative Context and Approval Process

Perth Airport is located on Commonwealth land and as such any planning or development proposals are subject to assessment and approval under Commonwealth legislation. Some State legislation may apply under the provisions of the *Commonwealth Places (Application of Laws) Act 1970*, typically for activities for which Commonwealth legislation does not exist. Where State and Commonwealth legislation conflicts, Commonwealth legislation takes precedence.

The Airport North MDP, and the applicable environmental and heritage considerations, will be subject to approval processes pursuant to the Commonwealth *Airports Act 1996* (*Airports Act*) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Section 91 of the *Airports Act 1996* (Cth) (*Airports Act*) requires an MDP to include an assessment of the environmental impacts that might reasonably be expected to be associated with the development and the plans for ameliorating, preventing and addressing environmental impacts. Section 160 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) requires the Minister administrating the *Airports Act* (Federal Minister for Infrastructure, Transport, Regional Development and Local Government) to obtain advice from the Minister responsible for the EPBC Act (Federal Minister for the Environment and Water) for the adoption or implementation of an airport's MDP.

The EPBC Act provides the Commonwealth framework for, amongst other things, protecting and managing nationally important flora, fauna, ecological communities and heritage places that are defined in the EPBC Act as Matters of National Environmental Significance (MNES). The EPBC Act also confers jurisdiction over actions that have the potential to make a significant impact on the environment where the actions affect, or are taken on, Commonwealth land or are carried out by a Commonwealth agency.

Under Part 13 of the EPBC Act, a permit is required for any action that may kill, injure, take, trade, keep or move a member of a threatened species or ecological community. As this project may impact Banksia Woodlands of the Swan Coastal Plain, an application for this permit will be submitted to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) to align with the MDP process.

This report has been prepared in accordance with the EPBC Act and the following associated guidelines:

1.3.1 Significant Impact Guidelines 1.1

Matters of National Environmental Significance, Significant Impact Guidelines (DoE, 2013) (Guidelines 1.1). Guidelines 1.1 provides guidance on determining whether an action is likely to have a significant impact on a matter protected under national environmental law and whether assessment and approval is required under the EPBC Act. The MNES protected under national environmental law include:

- World heritage properties,
- National heritage places,
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed),
- Nationally threatened species and ecological communities,
- Migratory species,
- Commonwealth marine areas,
- The Great Barrier Reef Marine Park,
- Nuclear actions, and
- A water resource, in relation to coal seam gas development and large coal mining development.

1.3.2 Significant Impact Guidelines 1.2

Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies, Significant Impact Guidelines 1.2 (DESEWPaC, 2013) (Guidelines 1.2). Guidelines 1.2 provides guidance for any person who proposes to take an action which is situated on or may have an impact on Commonwealth land, or for representatives of Commonwealth agencies who propose to take an action that may impact on the environment anywhere in the world. It requires a "Whole of Environment" assessment for projects undertaken on Commonwealth Land.

1.4 Impact Assessment Process

The following process has been applied to assess the potential environmental and heritage impacts of the project as per the scope defined within Part A report and meets the self-assessment requirements of Guideline 1.2 (refer Figure 1-3):

1. Baseline environmental studies,
2. Define the Environmental Context for the project. This includes identification of environmental and heritage components and features that may be impacted, either directly or indirectly. For the purposes of this document, the term "environmental and heritage components and features" is referred to as "Factors" in this assessment,
3. Identify and assess potential impacts for each environmental and heritage factor. This includes potential indirect and offsite impacts,
4. Identification of appropriate mitigation and management of potential impacts, and

5. Determine significance of potential impacts. This can be based on guidelines and policies relevant to the environmental and/or heritage factor. For example, the significance criteria in Guideline 1.1 is applied in this document to determine significance of potential impacts to flora and fauna.

Figure 1-3 Self-Assessment Requirements of EPBC Significant Impact Guidelines 1.2

Source: EPBC Significant Impact Guidelines 1.2

1.5 Impact Assessment Project Area

The development of the Airport North project area will be designed to minimise its environmental footprint, whilst attracting new businesses and complementing existing business precincts within the Perth Airport estate. The total area of the Airport North project is 248.03 hectares and up to 104.71 hectares of native vegetation is proposed to be cleared for development.

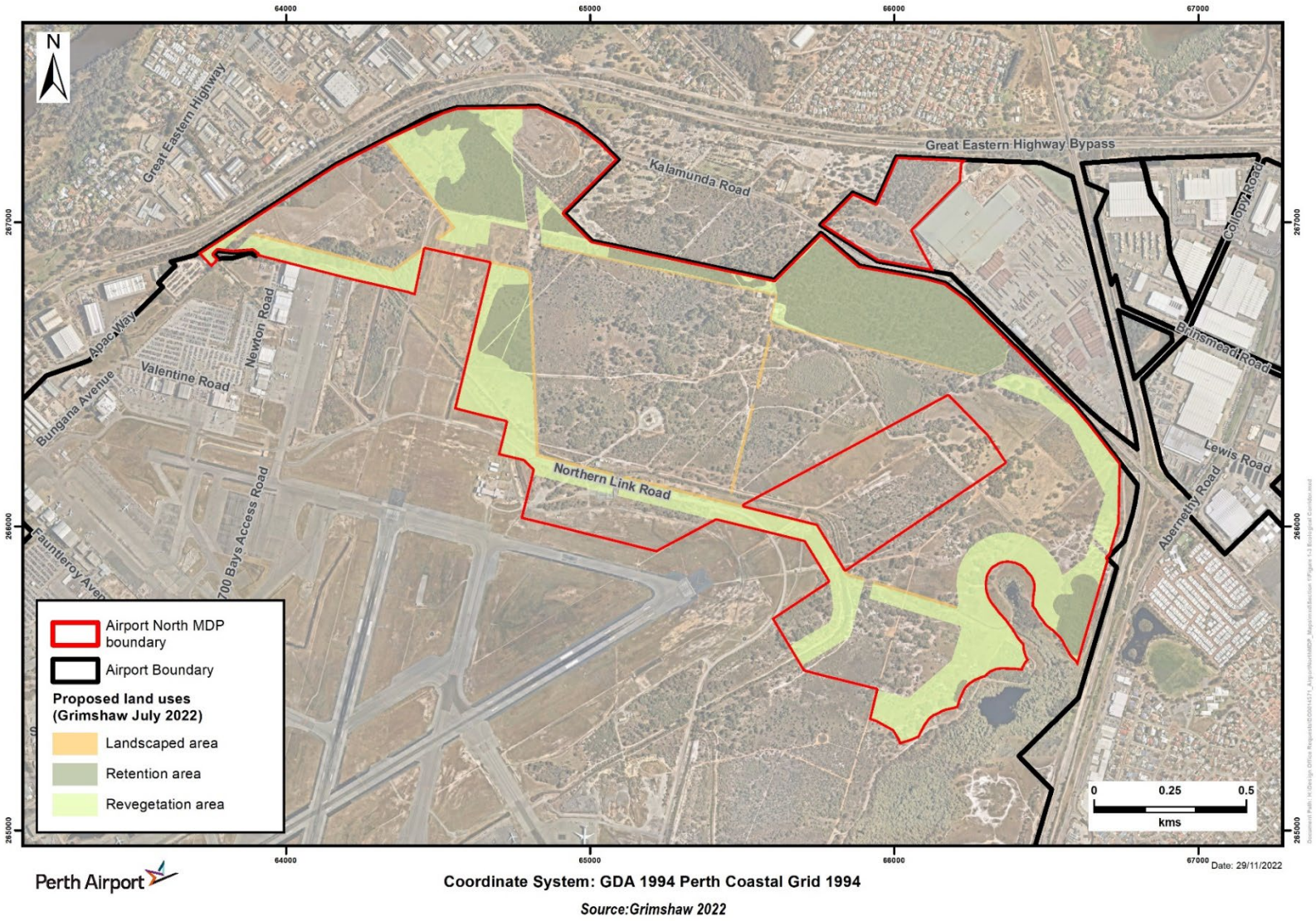

Figure 1-4 Ecological Corridors proposed within Airport North MDP

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1.6 Cumulative Impacts

Cumulative impacts are the successive, incremental, and combined environmental impacts of one or more activities. Airport North is one in a series of development projects planned within the Perth Airport estate as detailed in Master Plan 2020. These projects are summarised in Table 1-2.

Table 1-2: Major development projects proposed for the Perth Airport estate

Project	Project description	Project status	Project Area (hectare)	Project Impact Area (hectare)
Airport North (this project)	Multi-use development of the Airport North precinct.	Planning Stage	248.03	213.65
New Runway Project	New parallel runway for Perth Airport.	Approved	292.8	292.8
Airport West (South)	Commercial development of the Airport West precinct.	Planning Stage	65.5	65.5
Airport Central	Upgrades to central terminal precinct and supporting infrastructure including apron, taxiways and carparks.	Planning Stage	213.62	212.14
Airport South	Commercial development of airport estate's Southern Precinct.	Conceptual Planning	Not defined yet	Not defined yet
Cumulative Total			819.95	784.09

Potential impacts from the New Runway Project and Airport Central have been refined through a 'smart design process' and the total impact area are unlikely to be realised. That is, impacts will be reduced, and the cumulative impacts noted above are worst case scenario.

2 Environmental Context

2.1 Environmental Impact Scoping

It is important to understand the environmental context of the Airport North project area to ascertain the environmental features that are likely to be impacted. As such, this section defines the environmental context of the project area, in accordance with the definition of Whole of Environment required by Guideline 1.2. and identifies the following;

- The environmental and heritage matters/features in the area where the action will take place,
- The environmental or heritage factors which are likely to be impacted by the action and which therefore require assessment,
- Any sensitive and vulnerable areas,
- Any rare, endemic, unusual, important or otherwise valuable factors of the environment, and
- The history, current use and condition of the environment.

The environmental context of the MDP area and potential impacts associated with the implementation of the project are presented in the following sections of this document.

2.1.1 Soils and Geology

Desktop studies and intrusive investigations have been conducted for the project area. Some Areas of Potential Environmental Concern (APEC) relating to per-and poly-fluoroalkyl substances (PFAS) and Acid Sulphate Soils (ASS) have been identified as warranting further assessment, which is addressed in Section 7.

2.1.2 Water (Surface Water and Groundwater)

The airport estate is located on the Swan Coastal Plain near the base of the Darling Scarp and within 500 metres of the Swan River. Groundwater beneath the estate sits at a shallow depth (surface to four metres below ground level) as an unconfined water table within the highly permeable sands of the Bassendean Dunes and as a semi-confined aquifer in the Guildford Formation. Groundwater flow direction ranges from westerly to north-westerly direction across the airport estate.

The hydrological features within the airport estate include:

- Munday Swamp in the north-east corner of the estate, and
- the drainage network within the airport estate (Northern Main Drain (NMD) and Southern Main Drain (SMD)).

The impacts of groundwater changes are discussed in Section 5.4.

Surface water flows through the airport estate via the two main drains; the NMD and the SMD. These drains generally flow east to west and have been constructed as extensions and modifications to naturally occurring watercourses. The NMD receives surface flow from Poison Gully (located to the east of the airport estate) and Munday Swamp. Both drains discharge into the Swan River.

The MDP area is adjacent to Munday Swamp and incorporates a 100 m buffer between the development area and the swamp. Factors identified as relevant and warranting further assessments in Sections 5 and 6 are:

- Surface water
- Groundwater
- Stormwater infrastructure
- Wetlands

Flora and Vegetation

A Vegetation and Flora Survey was conducted across the airport estate by Woodman Environmental Consultants (2020). Key findings relating to flora and vegetation across the MDP area include:

- Over half of the MDP area is comprised of vegetation in a 'degraded' or 'completely degraded' condition (approximately 50.82% of the MDP area); the vegetation condition in the remainder of the area comprises 'Excellent' (10.68%), 'Very Good' (20.05%), and 'Good' (16.27%). Approximately 2% is revegetation.
- No vegetation in the project area is in pristine condition due to the presence of weed species, and disturbance from feral animals and vehicle tracks.
- 58.56 ha of the Commonwealth-listed threatened ecological community (TEC), Banksia Woodlands of the Swan Coastal Plain mapped, wilth33.07 ha requiring removal and a further 0.31 ha indirectly impacted
- 14.49 ha of the State-listed *Corymbia calophylla – Eucalyptus marginata* Woodlands SCP 3b TEC, will require removal.
- One Commonwealth-listed threatened flora species, *Conospermum undulatum* (T) will be impacted with 12 individuals requiring removal.
- Approximately 97.91 ha of the vegetation within the MDP area is infested with *Phytophthora cinnamomi* (dieback).
- Six WA Priority Listed species are likely to be impacted.

Factors identified to be relevant to the project and therefore warranting further assessment include (refer Section 3):

- Banksia Woodland of the Swan Coastal Plain TEC (EPBC Act Listed).
- SCP 3b *Corymbia calophylla – Eucalyptus marginata* Woodlands TEC (Listed under the *Biodiversity Conservation Act 2016* (WA) (the BC Act)).
- *Conospermum undulatum* (T) listed as "Vulnerable" under both the EPBC and BC Acts.
- State Listed Priority Flora Species, including:
  - *Johnsonia pubescens* subsp. *cygnorum* (P2).
  - *Jacksonia gracillima* (P3).
  - *Myriophyllum echinatum* (P3).
  - *Schoenus pennisetis* (P3).
  - *Stylidium longitubum* (P4).
  - *Verticordia lindleyi* subsp. *lindleyi* (P4).
- Remnant native vegetation.

2.1.3 Fauna

Key findings from investigations for fauna across the MDP area include:

- The development of the project impacts several vegetation substrate associations including 74.3 ha of woodlands, 10.28 ha of heathland, 95.75 ha of grassland and 1.79 ha of drains .
- Ten conservation significant fauna have been recorded or are highly likely to occur within the MDP area. These include:
  - Three MNES, being the Forest Red-tailed Black-Cockatoo (FRTBC), Baudin's Black-Cockatoo (BBC) and Carnaby's Black-Cockatoo (CBC). These Black-Cockatoo species have high conservation significance and forage within the project area, but there is no evidence they currently breed within the project area;

- Three species listed as WA Priority Listed Species by the State Department of Biodiversity, Conservation and Attractions (DBCA), being Quenda (Southern Brown Bandicoot), Rakali (water-rat), and a native bee (Woolybush Bee), and Four bird species being the Peregrine Falcon, Glossy Ibis, Fork-tailed Swift, Blue-billed Duck.

Factors identified to be relevant to the project and therefore warranting further assessment include (see Section 4:

- Carnaby's Black-Cockatoo
- Forest Red-tailed Black-Cockatoo
- Baudin's Black-Cockatoo
- Quenda
- Rakali
- Woolybush Bee, *Hylaeus globulferus*
- Whole of Fauna Environment

2.1.4 Conservation and Special Use Areas

Figure 2-1 shows Conservation and Special Use Areas within a 15km radius of Perth Airport. The MDP proposed works are not expected to impact any of these Conservation or Special Use Areas

2.1.5 Heritage Places and Items

Key findings from investigations for heritage values within the MDP area include:

- Four registered and three lodged Aboriginal heritage sites were confirmed to be located within the MDP area.
- The three lodged sites are currently being assessed by the Department of Planning, Lands and Heritage (DPLH) .
- Munday Swamp and Surrounding Bushland is listed an Indicative Place on the Commonwealth Heritage list. While the MDP boundary excludes the Munday Swamp site, parts of the surrounding bushland sites falls within the MDP development area.
- In addition to being a registered Aboriginal heritage site, Allawah Grove has been identified as potentially having other cultural heritage values and is currently being assessed by the Heritage Council of Western Australia for listing under the *Heritage Act 2018* (WA).

A historic archaeological assessment identified an area in the eastern section of the MDP area, as containing remnant structures and artefacts associated with the early to mid-twentieth century processing of the land for suburban and semi-rural residential development. However, the Heritage Council of Western Australia has not initiated an assessment of the site.

In response to the heritage values within the MDP area, two heritage sites have been excluded from the development footprint and a 100m ecological buffer zone has been designed around Munday Swamp. The MDP layout has also included provision for heritage interpretation places.

Factors identified as being relevant to the project therefore warranting further assessment, refer Section 9, include:

- Four Registered Aboriginal heritage sites
- Three Other Heritage Places (OHPs), classified as 'lodged' sites
- Munday Swamp and Surround Bushland as an Indicative Place on the Commonwealth Heritage List.
- Please note that whilst the new *Aboriginal Cultural Heritage Act 2021* (WA) (the ACH Act) has been passed and will supersede the AH Act, it was not in full force at the time this document was written. All steps are being taken to ensure that the development complies with the new legislation.

2.1.6 People and Communities

A socio-economic assessment has been completed for the MDP proposal, which describes the human environment surrounding the MDP area and broader airport estate. Refer to Section 7 of the Part A MDP for details.

Aircraft noise exposure levels, both in the air and on the ground, are detailed in Section 10.1 of the Part A MDP.

Factors/issues identified as being relevant to the construction phase of the Airport North project and which therefore require further assessment include:

- PFAS impacted soil (refer Section 7) and groundwater (refer Section 5)
- Asbestos and metal containing soil (refer Section 7)
- Construction dust (refer Section 8), and
- Construction noise and vibration (refer Section 8).

It should be noted that these issues are addressed under the *Airports Act* Regulations and specifically via the Construction Environment Management Plan (CEMP) which is considered, approved, administered and monitored by the Airport Environment Officer from the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA).

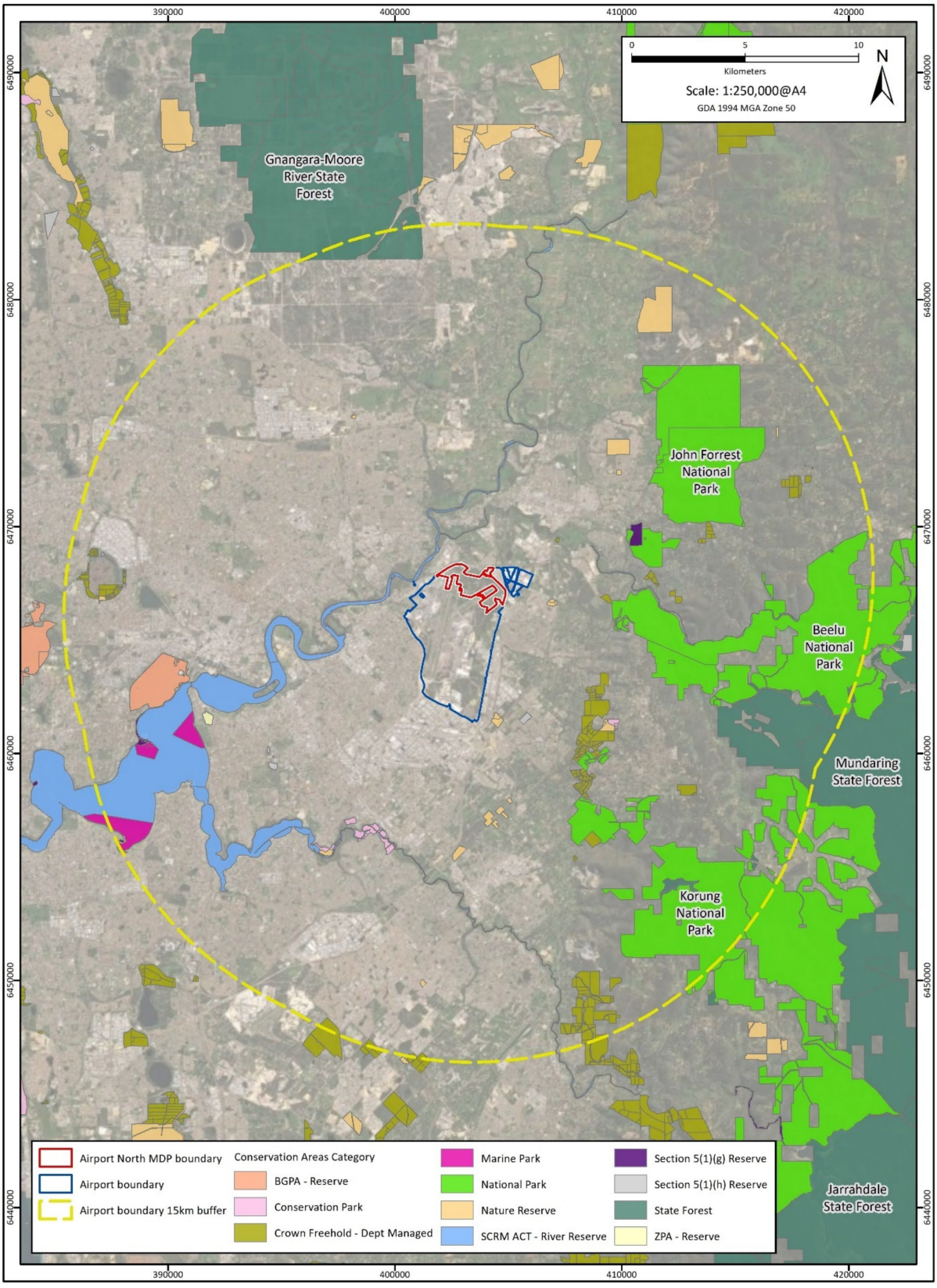


Figure 2-1: Conservation and Special Use Areas within 15km radius of Perth Airport

Source: DBCA (2020)

3 Flora and Vegetation

This section provides detail on the:

- Existing flora and vegetation within and surrounding the project area, and
- Flora and vegetation impact assessment (including direct, indirect and offsite impacts) and associated mitigation and avoidance measures. Impacts are considered for the following factors that are known to occur within or adjacent to the project area:
  - Native vegetation,
  - Banksia Woodlands of the Swan Coastal Plain TEC (EPBC Act Listed),
  - *Corymbia calophylla – Eucalyptus marginata* woodlands (SCP3b) TEC (BC Act Listed), and
  - State Listed Priority Flora Species, including:
    - Johnsonia pubescens subsp cygnorum, P2,
    - *Jacksonia gracillima*, P3,
    - *Schoenus pennisetis,* P3,
    - *Stylidium longitubum*, P4, and
    - *Verticordia lindleyi* subsp. *lindleyi* P4.

3.1 Legislative and Policy Context

The project area is located on Commonwealth land, therefore impacts on flora and vegetation are considered under the following:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act),
- Significant Impact Guidelines 1.1: Matters of National Environmental Significance (DoE 2013) (Guideline 1.1), and
- Significant Impact Guidelines 1.2: for Actions on or impacting upon Commonwealth land and actions by Commonwealth agencies (DSEWPaC, 2013) (Guideline 1.2).

Guideline 1.2 requires that all potential impacts resulting from airport projects (on Commonwealth land) are assessed. This includes both EPBC Act protected flora and vegetation (Matters of National Environmental Significance (MNES)) and non-MNES flora and vegetation and is known as a "Whole of Environment" approach, covering MNES and non MNES impacts. This "Whole of Environment" approach to flora covers the assessment of potential impacts (direct, indirect and offsite), mitigation and significance to MNES, state listed species and other remnant native vegetation. Guideline 1.2 is considered in conjunction with Guideline 1.1 which includes criteria for assessing the significance of potential impacts to flora that may:

- lead to a long-term decrease in the size of a population,
- reduce the area of habitat of a species,
- fragment an existing population into two or more populations,
- adversely affect habitat critical to the survival of a species,
- disrupt the breeding cycle of a population,
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat,
- introduce disease that may cause the species to decline, or
- interfere with the recovery of the species.

Biodiversity in Western Australia is also protected under the Western Australian *Biodiversity Conservation Act 2016* (BC Act), which replaced the WA *Wildlife Conservation Act 1950* at the start of 2019. State and local matters, such as listed species and communities, are also considered in this assessment as part of the "Whole of Environment" approach to flora. In addition to the EPBC Act and Guideline 1.1, this report has been developed in consideration of the following policy documents and guidelines:

- Environmental Protection Authority (EPA) (2000) Position Statement No. 2: Clearing of Native Vegetation,
- Environmental Protection Authority (EPA) (2008) Environmental Guidance for Planning and Development, Guidance Statement No. 33,
- Environmental Protection Authority (EPA) (2016). Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment,
- Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community.

3.2 Methodology

The approach used in the impact assessment of the MDP on Flora and Vegetation outlined in Plate 3-1 is based on the Commonwealth Government Guidelines 1.1 and Guidelines 1.2. This approach assesses the environmental context within the MDP's Total Disturbance Area (TDA).

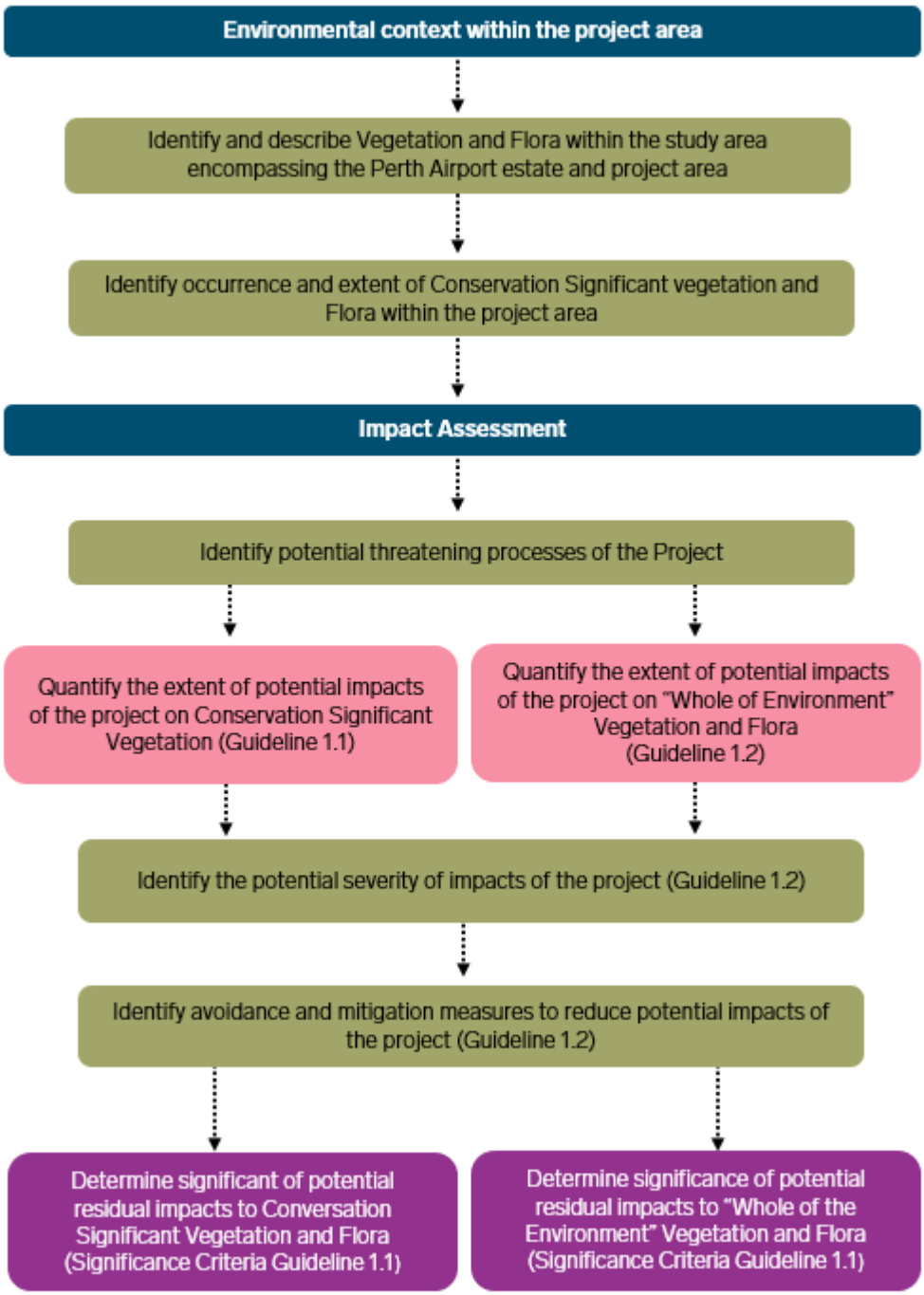


Plate 3-1: Flora and Vegetation Impact Assessment Methodology

3.3 Existing Flora and Vegetation

1.1.1 Vegetation Types

There are nine vegetation types identified within the MDP area. These are described in Table 3-3 and mapped in Figure 3-2.

Approximately 56.2% of the MDP area comprises native vegetation, totalling approximately 140 ha. The remaining 43.8% of the MDP area comprises areas of revegetation, previous revegetation, or cleared/developed areas, totalling approximately 123.5 ha.

Table 3-1: Vegetation community types within the MDP area

Vegetation type and description		FCT	Extent within TDA (ha)	Extent within retention area (ha)	Total extent within MDP area (ha)	Percent within AN MDP (%)
VT 1	Low isolated trees of *Melaleuca preissiana* over mid to low shrubland of mixed species over low open rushland over low spare forbland, in depressions on flats that are seasonally waterlogged, on grey-brown or grey-black sandy loam.	SCP 5	19.13	4.85	23.98	9.67%
VT 3	Low woodland to open woodland dominated by *Melaleuca preissiana* over mid open shrubland of mixed species over low sedgeland and rushland to open sedgeland and rushland of mixed species, in depressions or drainage lines that are seasonally inundated, on grey or brown sandy loams.	SCP 5	-	2.04	2.04	0.82%
VT 4	Tall sparse shrubland of *Melaleuca rhaphiophylla* over mid shrubland of *Melaleuca lateritia* over low forbland and tussock grassland of mixed species, in basins that are seasonally inundated, on grey-black sandy clay.	SCP 11	7.08	0.21	7.29	2.94%
VT 9	Mid forest of *Corymbia calophylla* over mid to low shrubland of mixed species over low sedgeland and forbland, on lower to mid slopes of broad rises, on grey sandy loam.	SCP 3b	14.49	0.87	15.36	6.19%

Vegetation type and description		FCT	Extent within TDA (ha)	Extent within retention area (ha)	Total extent within MDP area (ha)	Percent within AN MDP (%)
VT 10	Isolated mid trees of *Corymbia calophylla* over open low woodland of *Melaleuca preissiana* over mid to low open shrubland to shrubland of mixed species over low rushland and sedgeland to open rushland and sedgeland of mixed species, on lower slopes of broad rises and flats that are seasonally waterlogged, on grey or white sand or sandy loam.	SCP 4	13.06	0.00	13.06	5.27%
VT 11	Mid to low shrubland of mixed species over low open rushland and sedgeland on lower slopes of broad rises and flats that are seasonally waterlogged, on brown sand.	SCP 4	0.24	0.00	0.24	0.10%
VT 12	Mid woodland of *Eucalyptus marginata* subsp. *marginata* over low woodland of *Allocasuarina fraseriana*, *Banksia menziesii* and *Banksia attenuata* over mid open to sparse shrubland of mixed species over low open shrubland of mixed species over low open to sparse sedgeland and rushland of mixed species, on dunes and low rises on grey sand.	SCP 23a	32.84	22.8	55.64	22.43%
VT 13	Low woodland to open forest of *Banksia menziesii*, *B. attenuata* and occasionally *Eucalyptus todtiana* over tall sparse shrubland over mid open to sparse shrubland of mixed species over low open shrubland of mixed species over low open to sparse sedgeland and rushland of mixed species, on dunes and low rises on grey sand.	SCP 23a	5.70	2.81	8.51	3.43%
VT 14	Low forest of *Melaleuca rhaphiophylla* and *Eucalyptus rudis* over low sparse forbland dominated by *Lemna disperma* in basins that are apparently semi-permanently or permanently inundated, on black sandy clay.	SCP 13	0.01	0.75	0.76	0.31%
D	Disturbed vegetation - highly degraded land with occasional native species present, however no intact vegetation structure and too few native taxa present to allocate a vegetation type or description.	N/A	12.16	0.02	12.18	4.91%

Vegetation type and description		FCT	Extent within TDA (ha)	Extent within retention area (ha)	Total extent within MDP area (ha)	Percent within AN MDP (%)
Native vegetation type sub-total			104.71	34.36	139.07	56.07%
R	Revegetation - historically disturbed areas revegetated with locally sourced seed of native species.	N/A	5.40	0.00	5.4	2.18%
C	Cleared / developed areas	N/A	103.54	0.01	103.55	41.75%
Revegetation and cleared sub-total			108.94	0.01	108.95	43.93%
Total			213.65	34.37	248.03	100.0%

Source: Umwelt 2022

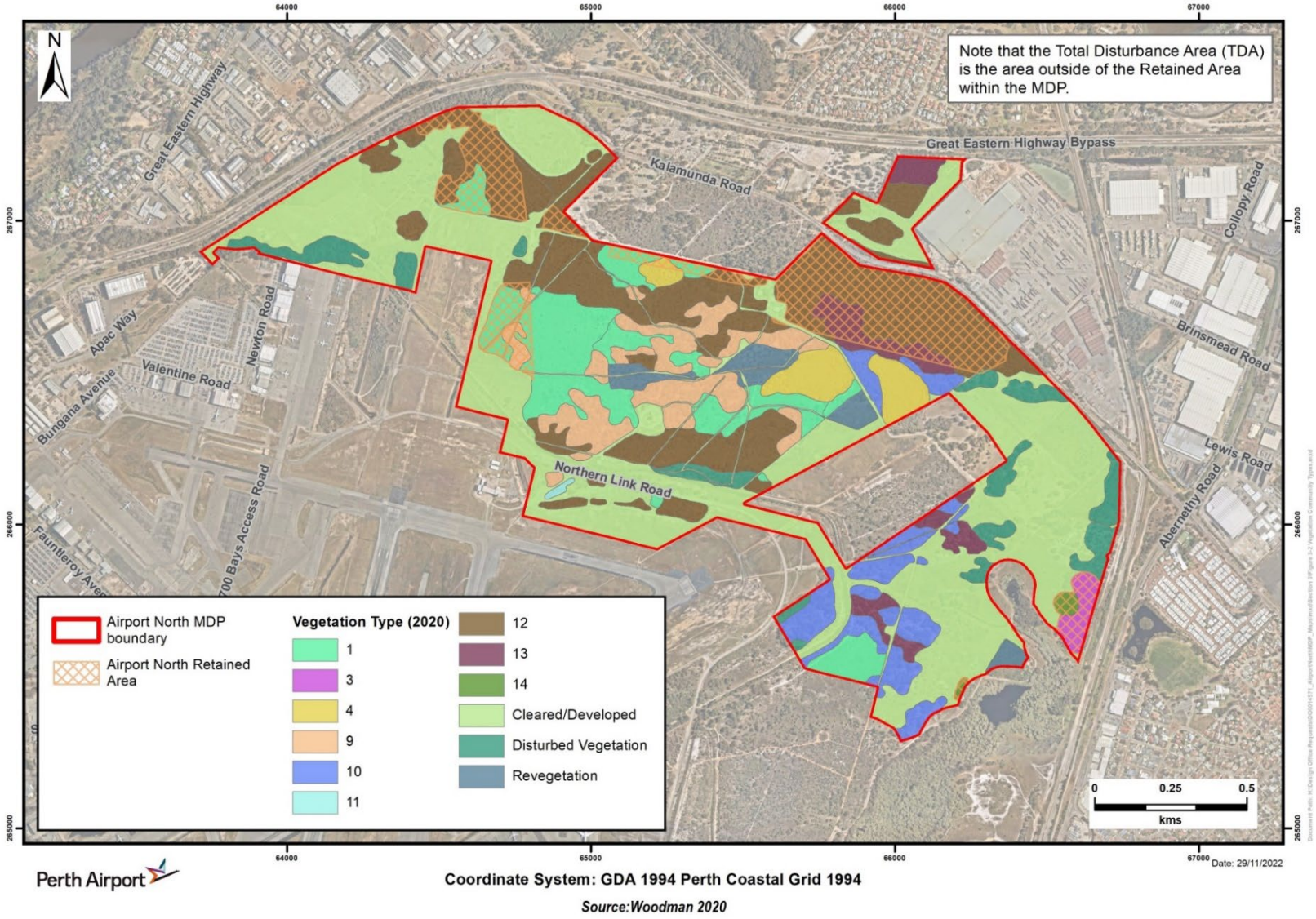


Figure 3-1: Vegetation Types in the Airport North project area

3.3.1 Vegetation Condition

The condition of vegetation within the MDP area ranges from Completely Degraded to Excellent . The extent of each condition category is outlined in Table 3-2 and shown in Figure 3-1.

Approximately 103.55ha, representing 42% of the Airport North MDP area, is Completely Degraded (Cleared/Developed). The remaining 139.07ha is comprised of native vegetation and revegetation with 116.56 ha mapped in the categories of Good to Excellent condition.

No vegetation in the MDP is in Pristine condition due to the presence of weed species or disturbance, including that caused by feral animals and vehicle tracks.

Table 3-2: Summary of vegetation condition within the Airport North project area

Vegetation condition category (Keighery 1994)	Extent within TDA (ha)	Percent of TDA	Extent within retention area (ha)	Total extent within MDP area (ha)	Percent within MDP area
Excellent	7.37	3.45 %	19.11	26.48	10.68%
Very good	42.50	19.89 %	7.24	49.74	20.05%
Good	32.57	15.25 %	7.77	40.35	16.27%
Degraded	22.27	10.42 %	0.23	22.51	9.07%
Total area of remnant vegetation – Degraded to Pristine	**104.71**	**49.01 %**	**34.36**	**139.08**	**56.07**
Completely degraded (Cleared/Developed)	103.5	48.46 %	0.01	103.55	41.75
Revegetation	5.40	2.53 %		5.40	2.08
Total	213.65		**34.37**	**248.03**	

Source: Umwelt 2022

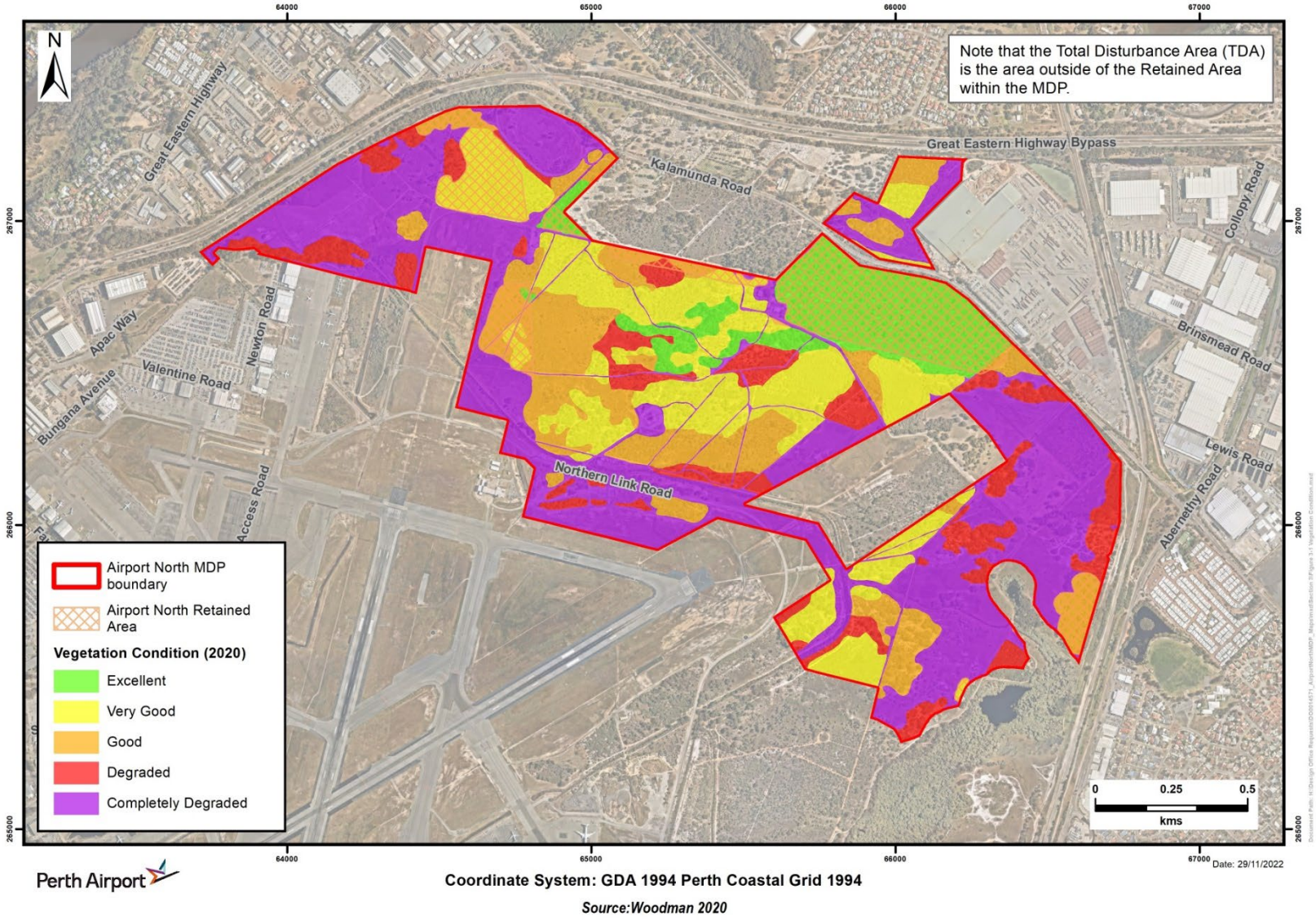


Figure 3-2: Vegetation Condition

3.3.2 Threatened Ecological Communities

Two threatened ecological communities occur within the Airport North project area, as outlined in **Table 3-4** and shown in **Figure 3-3**.

Table 3-3: Threatened ecological communities within the MDP area

Ecological community	EPBC Act listing	State listing	Corresponding vegetation type	Extent within TDA (ha)	Extent within retention area (ha)	Total extent within MDP (ha)
SCP3b - Corymbia calophylla - Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain	NA	Vulnerable	VT 9	15.4	-	15.4
Banksia Woodlands of the Swan Coastal Plain / Banksia dominated woodlands of the Swan Coastal Plain IBRA region	Endangered	Priority 3	VT 12 VT 13	31.9	27.2	59.1

Source: Umwelt 2022

Banksia Woodland of the Swan Coastal Plain (VT 12 and 13)

The Banksia Woodland of the Swan Coastal Plain community, listed as Endangered at a Commonwealth level, encompasses a number of sub-communities and Floristic Community Types (FCTs) that are also listed individually as priority ecological communities (PECs) at a state level. Within the MDP area, this includes the 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region' Priority 3 ecological community.

To confirm the occurrence of the EPBC Act listed community, an assessment was completed against the Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community. This assessment confirmed that specific patches of vegetation types 12 and 13 meet the key diagnostic criteria (location and physical environment; soils and landform; structure; and composition) and are therefore representative of the EPBC Act listed community.

SCP 3b Corymbia calophylla - Eucalyptus marginata woodlands (VT 9)

The SCP3b *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain ecological community has been determined to occur within the MDP area. Whilst the community is not listed under the EPBC Act, it has been endorsed as a TEC by the WA Minister for the Environment, specifically being listed as 'Vulnerable' (VU).

Bush Forever Areas

Remnant vegetation within the airport estate has previously been identified as an area of regionally significant bushland through the Government of Western Australia's Bush Forever project (Bush Forever Site 386). The Perth Airport and adjacent bushland site was ''subject to endorsed Master Plan" (WAPC 2000, cited in Umwelt 2022). Bush Forever designation does not impose additional assessment requirements to Commonwealth land, such as the Perth Airport estate. Notwithstanding this, the potential impacts to this Bush Forever site are considered through the assessment of whole of environment (remnant native vegetation).

Previous Reported Communities Found not to Occur Within or Adjacent to the Project Area

A number of other significant ecological communities have been reported to occur within the wider airport estate; however, were confirmed as being absent from the MDP area. These include:

- SCP20a - *Banksia attenuata* woodland over species rich dense shrublands.
- SCP20b - *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain
- SCP07 - Herb rich saline shrublands in clay pans / Clay pans of the Swan Coastal Plain
- SCP21c - Low lying *Banksia attenuata* woodlands or shrublands
- SCP15 – Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain.

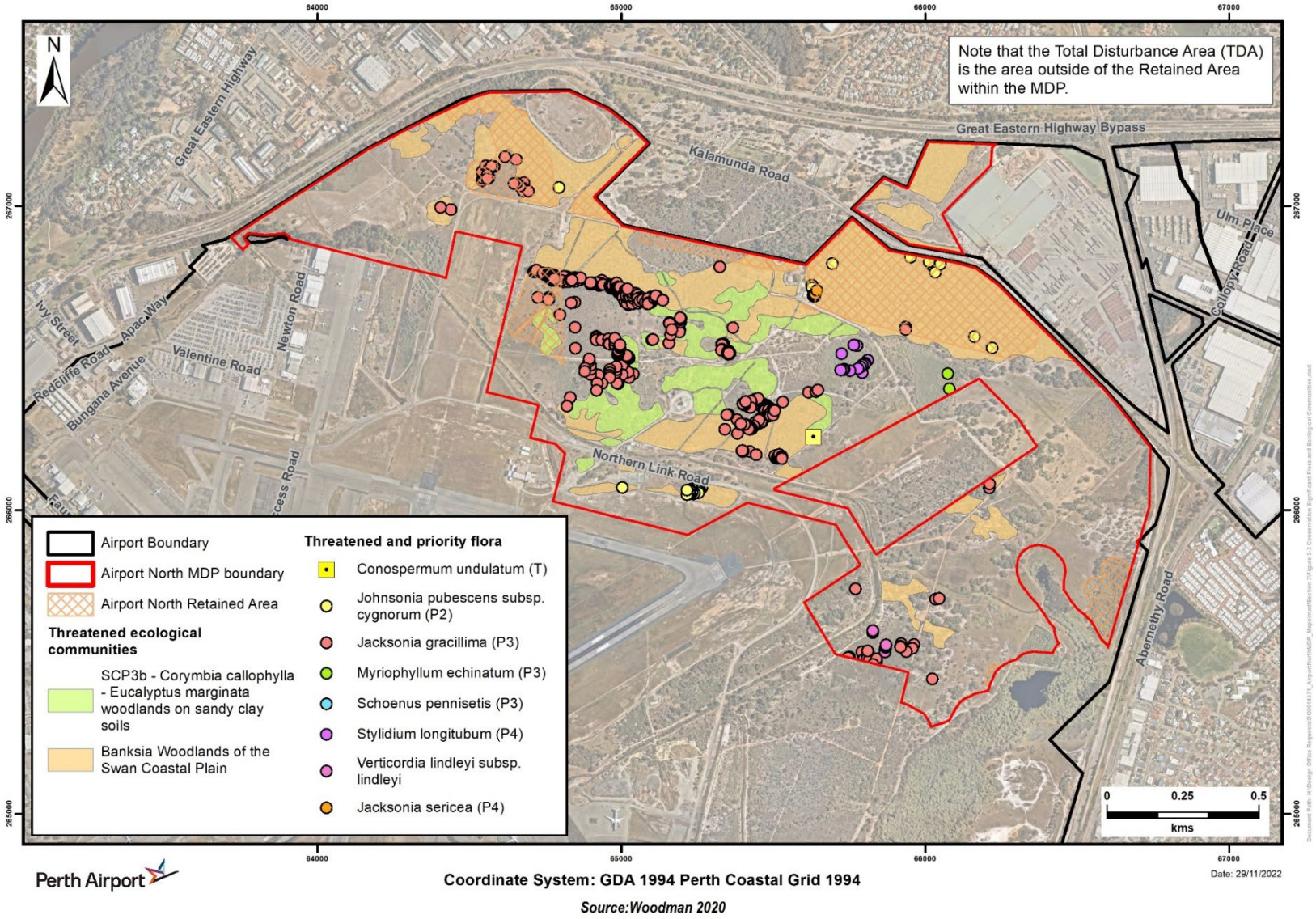


Figure 3-3: Conservation Significant Flora and Ecological Communities

Perth Airport

3.3.3 Conservation Significant Flora

Based on the findings of the desktop assessment, and other records from field surveys and targeted significant flora surveys specifically for *Conospermum undulatum* and *Macarthuria keigheryi*, seven conservation significant flora species were confirmed as present within the MDP area. No plants of *M. keigheryi* are located within the Airport North MDP.

Table 3-4: Conservation significant flora within the MDP area

Species	EPBC Act conservation status	WA conservation status	Individuals within Airport North project area	Total individuals recorded on Airport Estate	Percentage within TDA (%)
Conospermum undulatum	Vulnerable	Vulnerable			
Johnsonia pubescens subsp. cygnorum	-	Priority 2			
Jacksonia gracillima	-	Priority 3			
Myriophyllum echinatum	-	Priority 3			
Schoenus pennisetis	-	Priority 3			
Stylidium longitubum	-	Priority 4			
Verticordia lindleyi **subsp**. *lindleyi*	-	Priority 4			

Source: Umwelt 2022

The locations of the conservation significant flora species are shown in **Figure 3-3**.

In addition, the following species are reported within the airport estate, but were not found to be present within the MDP area:

- *Macarthuria keigheryi* (Endangered)i
- *Poranthera moorokatta* (P2)
- *Byblis gigantea* (P3)
- *Haemodorum loratum* (P3)
- *Isopogon autumnalis* (P3)
- *Platysace ramosissima* (P3)
- *Schoenus benthamii* (P3)
- *Stylidium aceratum* (P3)
- *Styphelia filifolia* (P3)
- *Jacksonia sericea* (P4)
- *Ornduffia submersa* (P4)

3.3.4 Weeds

A total of 103 introduced non-native flora taxa have been recorded within the airport estate. Of these, 51 taxa have been recorded within the MDP area. Of the 51 introduced flora occurring within the MDP area, five are Declared Pests under WA *Biosecurity and Agriculture Management Act 2007* (BAM Act), of which one is also recognised as a Weed of National Significance, as listed in **Table 3-6**.

In the context of impacts to the condition of remnant vegetation across the airport estate, four weed species are considered to be of most importance, as infestations of these species now occupy a significant portion of the understorey in a number of areas of remnant vegetation. All four of these species occur within the MDP area and are listed in **Table 3-6**.

Table 3-5: Key weed species within the MDP area

Taxon	Common Name	Declared Pest (BAM Act)	Weed of National Significance	Weeds of most importance
**Asparagus asparagoides*	Bridal creeper	Y	Y	
**Echium plantagineum*	Paterson's curse	Y		
**Ehrharta calycina*	Perennial veldtgrass			Y
**Eragrostis curvula*	African lovegrass			Y
**Gomphocarpus fruticosus*	Narrow leaf cotton bush	Y		
**Lotus subbiflorus*	Hairy birdsfoot trefoil			Y
**Moraea flaccida*	One leaf cape tulip	Y		
**Watsonia meriana* var. *bulbillifera*	Bubil watsonia			Y
Zantedeschia aethiopica	Arum Lily	Y		

Source: Umwelt 2022

3.3.5 Disease

A dieback disease (*Phytophthora cinnamomi*) assessment was undertaken in 2017 by Dieback Treatment Services within the airport estate. The assessment was conducted in accordance with guidelines set out by the *Phytophthora Dieback Interpreters Manual for Lands Managed by the Department of Parks and Wildlife Forest and Ecosystems Management*. Presence of *Phytophthora* disease was determined through the observation of host plant health and landscape vegetation change and was supported by strategic sampling of soil and plant tissue. During 2021, an assessment of the uninfested areas of remnant vegetation within the airport estate was undertaken (Glevan Consulting 2021).

Figure 3-4 shows the dieback status within MDP area. The areas of each dieback category are summarised in Table 3-7. Only 22.86 ha (19.22%) of the MDP area was determined to be uninfested by dieback; 16.03 ha of this area has been included in the MDP's areas of retained vegetation. The remaining 225.17 ha (90.78%) of the MDP area is either confirmed to be infested by dieback or assumed to be infested by dieback due to these areas being downslope of adjacent infected areas.

Table 3-6: Dieback assessment

Dieback status	Extent within TDA (ha)	Percent of Airport North TDA	Retained area (ha)	Total extent within MDP area (ha)	Percent of Airport North MDP
Uninfested	6.83	3.20%	16.03	22.86	9.22%
Infested	82.87	38.79%	15.04	97.91	39.48%
Excluded	123.95	58.02%	3.30	127.25	51.53%
Total	213.66	100.00%	34.37	248.03	100.00%

Source: Glevan Dieback Treatment Services 2021

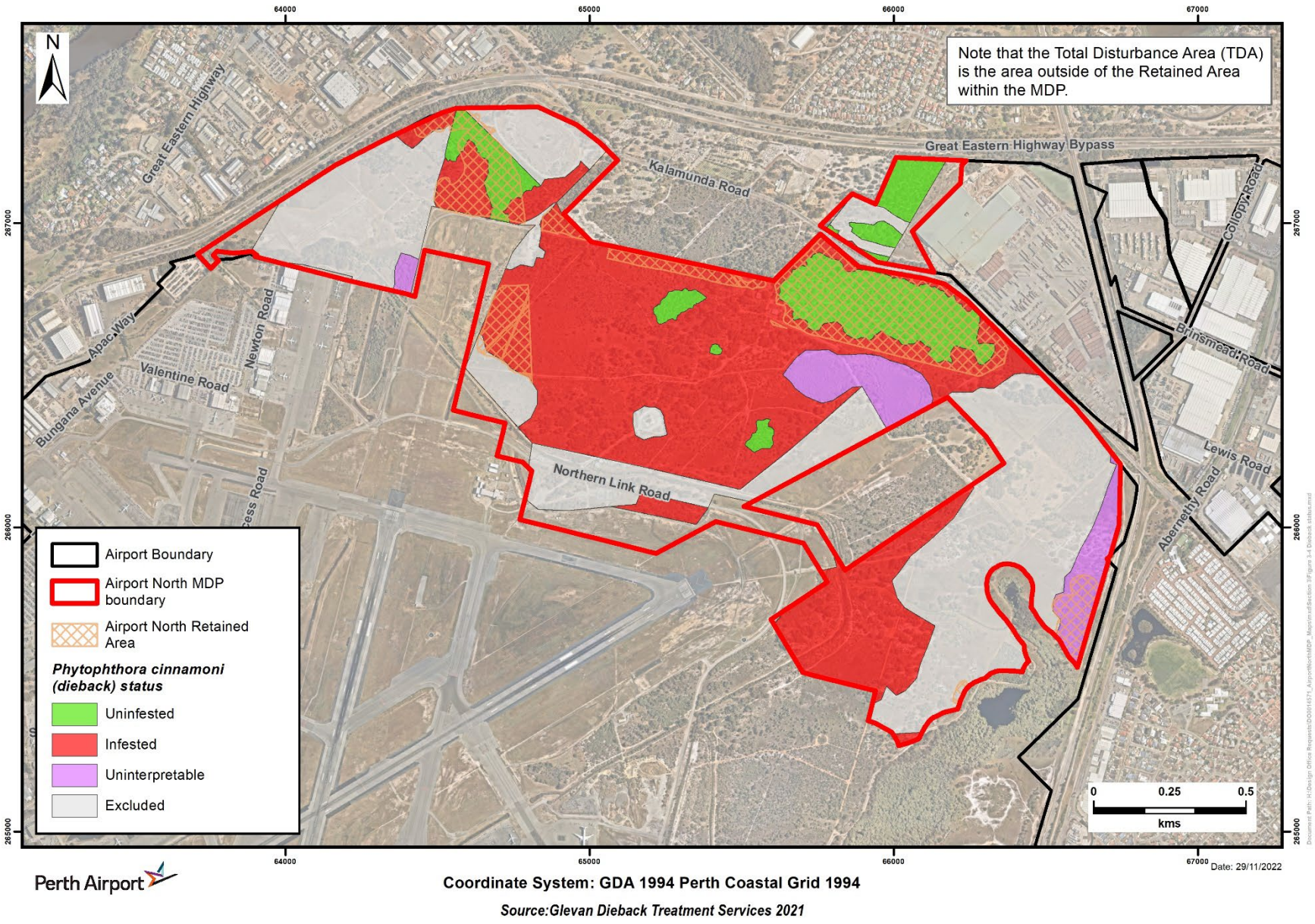


Figure 3-4: *Phytophthora cinnamomi* (dieback) Status

3.4 Impact Assessment – Banksia Woodlands TEC

3.4.1 Overview of Values

The EPBC act lists the Banksia Woodlands of the Swan Coastal Plain community as Endangered. This TEC is considered equivalent to the state Banksia dominated woodlands of the Swan Coastal Plain IBRA region Priority Ecological Community (PEC) (P3)..

The Conservation Advice (DoEE 2016) indicates the extent of the Banksia Woodlands remaining on the Swan Coastal Plain bioregion is approximately 336,490 ha. Of the current extent, 81,830 ha (24.4%) is within reserves. In total about 60% of the original extent of the community has been cleared. The community has become heavily fragmented with the number of patches being divided from around 132 into over 12,000 patches. The original median patch size estimate of 146 ha has been reduced to 1.6 ha (Commonwealth of Australia 2016).

The Woodman Environmental Consulting (2020) Flora and Vegetation Survey identified the presence of Banksia Woodlands TEC within the Perth Airport estate, including within the project area. The survey was conducted in accordance with the approved Conservation Advice (DoEE 2016).

The MDP area contains 58.56 ha of Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands TEC) of varying vegetation condition, as shown in **Figure 3-5** and detailed in **Table 3-8**. There are four patches of the Banksia Woodlands TEC in the TDA with condition ranging from excellent to degraded.

Table 3-7: Banksia Woodlands TEC by condition category

Banksia Woodlands TEC condition category	Extent within TDA (ha)	Extent within retention area (ha)	Total extent within MDP area (ha)	
Pristine	-	-	-	-
Excellent	1.91	18.95	20.86	35.62%
Very good	14.57	4.95	19.52	33.33%
Good	12.78	1.57	14.35	24.50%
Degraded	3.82	0.02	3.84	6.56%
Completely degraded	-	-	-	-
Total[1]	33.07	25.49	58.56	100.0%

[1]Any discrepancies in totals are due to rounding

Source: Umwelt 2022

3.4.2 Direct Impacts and Associated Avoidance/Mitigation Measures

Table 3-9 summarises the area and condition of each Banksia Woodland patch within the Airport North MDP and directly impacted by proposed development. Planning of the TDA will reduce, by 25.49 ha, the area potentially directly impacted by the Airport North TDA to 33.07 ha, representing 22.87% of the total extent of this TEC in the airport estate.

Figure 3-5 shows the location of the Banksia Woodlands TEC Patches 13, 14, 15 and 16 potentially directly impacted by the Airport North TDA.

Whilst the above impacts of implementing the proposed MDP works are unavoidable, the MDP layout has been strategically designed to retain selected areas of the Banksia Woodland TEC in the north of the MDP area. Specifically, the strategy was to:

- Avoid clearing of Excellent and Very good condition vegetation wherever possible
- Avoid clearing of vegetation which is largely uninfested by Dieback
- Provide connectivity through a series of clusters of the TEC to maximise the ongoing viability of the TEC, create a corridor for fauna to move freely and link known Aboriginal heritage sites

Approximately 25.49 ha of the TEC occurrence within the MDP area is proposed to be retained as a direct avoidance measure, as detailed in Table 3-8 and Table 3-9. Section 1.6 provides further discussion around impact avoidance measures provided in the MDP layout with further details provided in Part A MDP.

The severity and proposed avoidance/mitigation of the potential direct and indirect impacts of the Airport North MDP and TDA on the Banksia Woodland TEC are summarised in Table 3-10.

Figure 3-6 shows the remaining areas of eligible TEC outside the Airport North TDA that have been mapped. There are patches that extend outside of the survey area that are beyond the scope of this assessment. The Conservation Advice (DoEE 2016) incorporates buffers with a minimum of 20 m, but optimally up to 50 m around areas of the TEC to protect the integrity of the Banksia Woodlands TEC patch from edge effects. Indirect impacts are discussed in the following section.

Table 3-8 Condition and area of Banksia Woodlands TEC in the Airport North project area

Within Airport North MDP								
Patch No. (refer Figure 3-6 for Patch Locations)	Area (ha) of patch condition rating within MDP					Area of Patch Within the MDP (ha)	Total Area of Patch (ha)	
	Excellent	Very Good	Good	Degraded	Completely degraded			
13		0.75		0.97		1.72	5.85	
14			6.83	0.32		7.15	7.17	
15	20.86	17.44	6.07	2.55		46.91	47.22	
16		1.33	1.45			2.79	2.81	
Total Area of Condition (ha)	20.86	19.52	14.35	3.84		58.56 (58.91)[2]	63.05	
Area of Condition in airport estate (ha)	**22.28**	**79.12**	**35.48**	**6.49**	**1.27**	**-**	**144.63**	
% of Condition in airport estate	15.40%	54.70%	24.53%	4.48%	0.88%	--	-	-
TEC in MDP as a % of area within airport estate	93.64%	24.67%	40.43%	59.20%	0.00%	40.49%	-	-
Within Total Disturbance Area								
Patch No	Area (ha) of patch condition rating within TDA					Area of Patch Within the TDA (ha)	Total Area of Patch (ha)	Area of Patch Remaining (ha)
	Excellent	Very Good	Good	Degraded	Completely degraded			
13	0.00	0.75	0.00	0.97	0.00	1.72	5.85	4.13
14	0.00	0.00	6.83	0.32	0.00	7.15	7.17	0.02
15	1.91	12.49	4.50	2.53	0.00	21.42	47.22	25.80
16	0.00	1.33	1.45	0.00	0.00	2.79	2.81	0.02
Total Area of Condition (ha)	**1.91**	**14.57**	**12.78**	**3.82**	**0.00**	**33.07**	**63.05**	**29.98**
Area of Condition in airport estate (ha)	22.28	79.12	35.48	6.49	1.27	-	144.63	-
% of Condition in airport estate	15.40%	54.70%	24.53%	4.48%	0.88%	-	-	-
TEC in TDA as a % of area within airport estate	8.58%	18.41%	36.01%	58.86%	0.00%	22.87%	-	-

Note: Data from Woodman Environmental, 2020a, cited within Umwelt 2022
[1] Yellow cells indicate that remainder of Patch no longer meets criteria
[2] Total Potential Impact: Direct and Indirect

Source: Umwelt 2022

Table 3-9: Severity of Potential Direct and Indirect Impacts of the Airport North TDA on the Banksia Woodland TEC and Associated Avoidance or Mitigation Measures

Impact Type	Impacting Process	Discussion (Potential Impacts)	Severity	Proposed Avoidance/ Mitigation measures
Direct impact	Clearing	The Airport North MDP will potentially impact 58.56 ha of Banksia Woodland TEC: This represents: • 40.49 % of local extent within the airport estate • 0.0098% of the extent of the Banksia Woodland TEC remaining on the Swan Coastal Plain bioregion	Severe	Project redesigned to reduce clearing of the entire Airport North MDP area. Avoidance of direct and indirect impact to 25.53 ha (of Patch 15) Banksia Woodland TEC with proposed adjacent revegetation works.
Indirect Impact	Clearing	0.31 ha (comprising the remaining 0.02 ha of Patch 14, 0.27 ha of Patch 15 and 0.02 ha of Patch 16) will no longer meet criteria and are therefore considered potentially indirectly impacted by the Airport North TDA. Total of 33.38 ha direct and indirect impact of Airport North TDA.	Severe	Complete avoidance is not feasible due to the nature of locating infrastructure. Avoidance and retention of 4.13 ha of Patch 13. Avoidance and retention of 25.53 ha of Patch 15 with proposed adjacent revegetation works.
Indirect impact	Unintentional clearing outside the project area	There is potential for unintentional clearing of remaining small areas of Banksia Woodland TEC outside the Airport North TDA	Minor	A CEMP will address the design and operations for clearing area and demarcate (signage/fencing) exclusion zones for areas needing protection. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Habitat fragmentation	Fragmentation of Patch 15, leaving two smaller patches that meet criteria.	Severe	Avoidance is not feasible due to the nature of locating infrastructure Revegetation areas provide some linkage and connectivity between remaining patches. That is, one smaller area of patch 15 retained will be connected to the larger area through revegetation.
Indirect impact	Changes in genetic Diversity	The potential reduction in the area of the patches will reduce the local genetic diversity.	Severe	Avoidance is not feasible due to the nature of locating infrastructure. Revegetation areas provide some linkage and connectivity between remaining patches.

Impact Type	Impacting Process	Discussion (Potential Impacts)	Severity	Proposed Avoidance/ Mitigation measures
Indirect impact	Introduction and/or spread of weeds	Although weeds occur throughout the airport estate, the movement of soil into and around the airport North TDA may introduce or spread weed into adjacent area of Banksia Woodland TEC.	Minor	A CEMP will address soil hygiene to prevent introduction and spread of weeds The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Spread of Disease - Dieback	Much of the area of remnant vegetation in the Airport North TDA is infested with dieback. Unintentional spread will accelerate the rate of infestation.	Minor	A CEMP will address soil hygiene procedures to prevent introduction and spread of dieback. Soil hygiene procedures to further prevent introduction and spread of dieback will be addressed in the CEMP The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Change in bushfire regime	Increase burning may adversely affect the vegetation, however native plants are adapted to fire and the vegetation is likely to recover after burning with management of weed invasion.	Minor	Perth Airport currently maintains a fuel load management fire regime
Indirect impact	Groundwater hydrological changes	Changes in groundwater hydrology are predicted for the potential cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP in areas of retained Banksia Woodlands TEC within the Airport North MDP. Maximum groundwater levels (shallowest from soil surface) are predicted to increase by less than 0.2m (AQ2, 2022). Depth to groundwater ranges from 1.0-2.0 m over the area potentially decreasing to 0.8 to 1.8m from the soil surface and unlikely to impact the Banksia Woodlands TEC. Minimum (deepest from soil surface) groundwater levels are predicted to increase by up to less than 0.6m (AQ2, 2022), Minimum groundwater levels range from 2.0-4.0+m from the soil surface over the area, potentially decreasing to 1.4-3.4m from the soil surface. This additional water may have a Low-Moderate risk-of impact with potential for supporting vegetation with higher groundwater levels (DoW 2009). Considering the declining rainfall in the Perth area, with	Minor	The Perth Airport has committed to a project design that has minimal changes to the hydrology and minimal effects on vegetation in the surrounding area. Airport estate hydrology will be managed through the Perth Airport groundwater monitoring program and management Plans should include: • Monitoring groundwater within areas of retained Banksia Woodland TEC, • Identify changes in groundwater levels that trigger management actions to protect the integrity of the retained Banksia Woodland TEC, • Monitoring of dieback disease, with management actions to mitigate potential spread of the disease in the Banksia Woodland TEC.

Impact Type	Impacting Process	Discussion (Potential Impacts)	Severity	Proposed Avoidance/ Mitigation measures
		consequent reduction in recharge to groundwater, changes in the remnant vegetation are likely small and may not be detectable (Dow 2009). Rising groundwater levels may increase the rate of dieback infection and severity of disease expression by P. cinnamomi (Shearer and Dillon, 1996) in uninfested retained areas of Banksia Woodland TEC that are surrounded by infested areas.	Minor - Moderate	

Source: Umwelt 2022

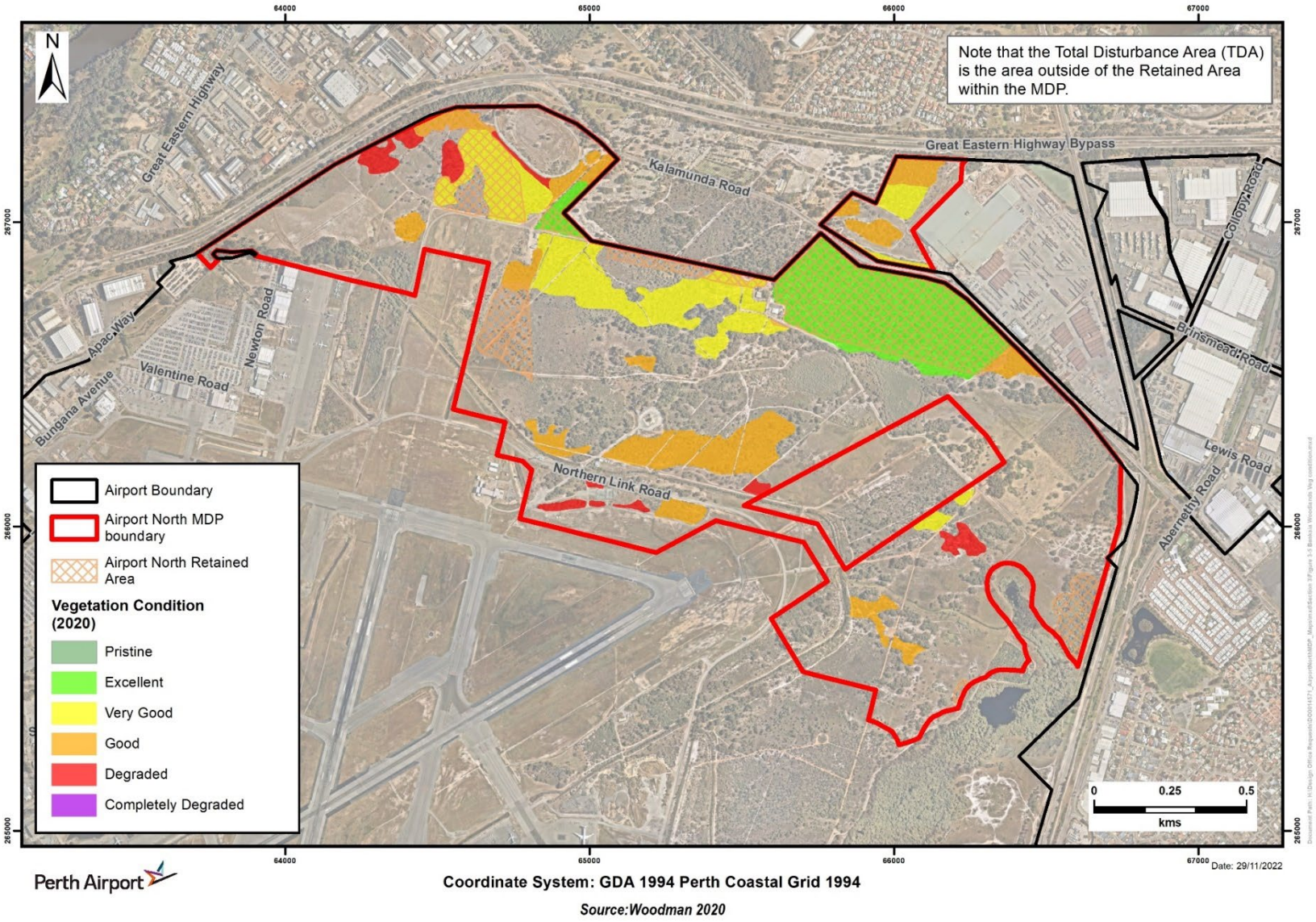


Figure 3-5: Banksia Woodland TEC Vegetation Condition

Perth Airport

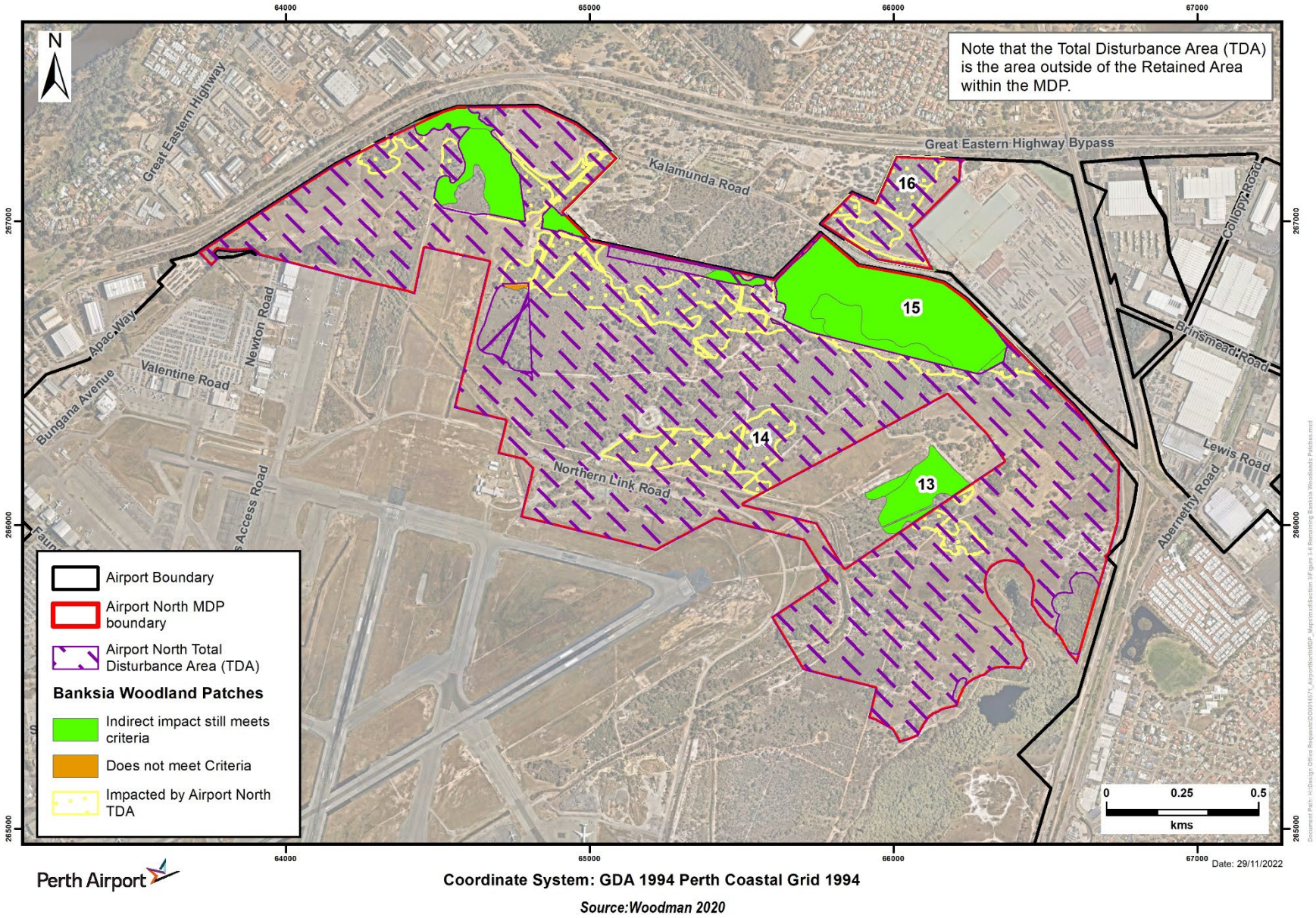


Figure 3-6 Remaining Banksia Woodlands TEC Patches Adjacent to the Airport North TEC

Perth Airport

3.4.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

The Severity of threatening processes and proposed avoidance/mitigation of the potential indirect impacts of the Airport North project on the Banksia Woodland TEC are summarised in Table 3-10.

Portions of Patch 15 and very small portion of patches 14 and 16 are outside the Airport North TDA. For Patch 15, three remaining fragments meet criteria (Table 3-11). Table 3-11 shows that following clearing of the TDA, the remaining areas (0.02 ha) of Patch 14 and 16 will no longer meet the minimum patch size and the remaining fragments of Patch 15 (0.27 ha) will also no longer meet the patch size criteria. Therefore, the small areas of these three remaining patches are also included in the total area of potential impact by the Airport North TDA. A total of 33.38 ha of Banksia Woodland TEC will potentially be directly and indirectly impacted by the Airport North TDA.

Following clearing for the Airport North TDA, portions of two of the impacted patches (Patches 13 and 15, see Figure 3-6) of Banksia Woodland TEC will remain adjacent to the Airport North TDA.

Table 3-10 Area and Condition of Eligible Banksia Woodland TEC Patches Potentially Indirectly Impacted by the Airport North Total Disturbance Area (TDA)

Patch Number (refer Figure 3-6 for Patch Locations)	Area (ha) of condition of remaining patch that no longer meet criteria				Total Area of Patch Remaining (ha)	Area of Patch Outside TDA That no longer meets Criteria (ha)	Remaining area of Patch that Meets Criteria (ha)
	Excellent	Very Good	Good	Degraded			
13	-	-	-	-	4.13	0	4.13
14	-	-	-	0.02	0.02	0.02	0.00
15	0.03	0.04	0.17	0.03	25.80	0.27	25.53
16	-	-	0.02	-	0.02	0.02	0.00
Total Area of TEC potentially indirectly Impacted Outside Airport North TDA (ha)	**0.03**	**0.04**	**0.19**	**0.05**	-	**0.31**	
Total Area of Patches That Meet Criteria	-	-	-	-	-	-	**29.66**

[1] Yellow cells indicate fragment of Patch no longer meets criteria for the Banksia Woodland TEC
Any discrepancies in totals are due to rounding

Source: Umwelt 2022

3.4.4 Significance of Residual Impacts

The potential impacts resulting from the clearing of Banksia Woodlands TEC within the TDA is likely to trigger four of the seven significant impact criteria for endangered ecological communities (Umwelt 2022), as outlined in **Table 3-12**. Considering the occurrence of Banksia Woodland TEC within the Airport North TDA, most of which is dieback infested, represents 22.08% of the occurrence in the airport estate, the potential impact of the Airport North TDA are unlikely significant at the local scale.

Cumulatively, the Airport North TDA, Airport Central TDA, Airport West (South) MDP and New Runway Project (NRP) potentially trigger four of the seven significant impact criteria. Together they potentially impact 91.01 ha of Banksia Woodland TEC, representing 62.92% of the occurrence in the airport estate; this is considered likely a significant residual impact at the local scale.

At a regional scale, the 33.38 ha potentially impacted by the Airport North TDA represents 0.0098% of the extant area of the Banksia Woodland TEC on the Swan Coastal Plain. The potential cumulative 91.01 ha impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP represent less than 0.0270 % of the extant area of the Banksia Woodland TEC on the Swan Coastal Plain as of 2016 (Umwelt 2022). Cumulative impacts would likely be greater due to other developments across the Swan Coastal Plain, but no recent community information exists.

Approximately 24.3% (81,830 ha) of the estimated regional extent (336,490 ha) of the Banksia Woodlands TEC is located in reserves (DoEE 2016). Due to the large remaining area, much in conservation reserves, the potential impact of the Airport North TDA, and the cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP, on the Banksia Woodland TEC are unlikely significant with respect to the survival of the ecological community across its range.

Table 3-11: Assessment of potential impacts of the Airport North TDA on the Banksia Woodlands TEC against Significant Impact Guideline Criteria

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	
	Airport North TDA	Cumulative projects - Airport North TDA, Airport Central TDA, Airport West (South) and NRP
Reduce the extent of an ecological community	**Likely to occur** A total of 33.38 ha of Banksia Woodland TEC of varying condition is potentially impacted as part of the Airport North TDA	**Likely to occur** A total of 91.01 ha of Banksia Woodland TEC of varying condition is potentially impacted by the Airport North TDA, Airport Central TDA, Airport West (South) and NRP
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	**Likely to occur** Clearing for the Airport North MDP will be restricted to the Airport North TDA. The retained remnant vegetation potentially includes 25.80 ha of Patch 15 that is fragmented into three sub-patches	**Likely to occur** Potential clearing of vegetation including Banksia Woodlands TEC will increase fragmentation and edge effects on the remaining Banksia Woodlands TECs Patch 15
Adversely affect habitat critical to the survival of an ecological community	**Unlikely to occur** The 33.38 ha of Banksia Woodlands TEC to be impacted (direct and indirect) represents a very small fraction (0.0096%) of the TEC remaining on the Swan Coastal Plain and is unlikely to be critical to the survival of the Banksia Woodlands TEC as a whole	**Unlikely to occur** The 91.01 ha of Banksia Woodlands TEC to be cleared represents a very small fraction (0.0270 %) of the TEC remaining on the Swan Coastal Plain and is unlikely to be critical to the survival of the TEC as a whole
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	**Unlikely to occur** 33.38 ha of Banksia Woodlands TEC proposed to be permanently impacted represents 0.0098 % of the TEC remaining on the Swan Coastal Plain and unlikely to be critical to the survival of the TEC as a whole.	**Unlikely to occur** An area of 91.01 ha (representing 0.027 % of the TEC remaining) will potentially be permanently cleared represents 0.027 % of the TEC remaining on the Swan Coastal Plain and is unlikely to be critical to the survival of the TEC as a whole.

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	
	Airport North TDA	Cumulative projects - Airport North TDA, Airport Central TDA, Airport West (South) and NRP
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting.	**Likely to occur** All flora species are proposed to be permanently removed from 33.38 ha of Banksia Woodlands TEC of varying condition.	**Likely to occur** All flora species are proposed to be permanently removed from 91.01 ha of Banksia Woodlands TEC of varying condition.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.	**Likely to occur** The Airport North TDA will potentially permanently remove 33.38 ha (22.67%) of Banksia Woodlands TEC of varying quality from 144.63 ha of the TEC occurrence within the airport estate.	**Likely to occur** The cumulative potential impacts of the Airport North TDA, Airport West (South) Project and the NRP will potentially permanently remove up to 91.01 ha (62.92%) of Banksia Woodlands TEC of varying quality from 144.63 ha of the TEC occurrence within the airport estate
Interfere with the recovery of an ecological community	**Not applicable** No recovery actions of the Banksia Woodland TEC are currently underway or proposed within the airport estate.	**Not applicable** No recovery actions of the Banksia Woodland TEC are currently underway or proposed within the airport estate.

Source: Umwelt 2022

3.4.5 Cumulative Impacts

Patches of the Banksia Woodlands TEC are located across the airport estate, Figure 3-7. The Airport North TDA, Airport Central TDA, Airport West (South) MDP and NRP all involve the clearing of areas of the TEC, giving rise to a total cumulative impact of 91.01 ha of TEC, which is summarised in Table 3-13.. This project increases the cumulative impact from 47.4% to 62.92% for the entire estate.

Table 3-12: The potential cumulative impacts of the Airport North MDP, Airport West (South) MDP and the NRP on the extent of Banksia Woodlands TEC in the airport estate

Project Area	Area of Condition (ha)					Total Area (ha)
	Excellent	Very Good	Good	Degraded	Completely Degraded	
Airport North	1.94	14.61	12.97	3.87	0.00	33.38
Airport Central	0.76	7.25	2.24	0.00	0.00	10.24
New Runway Project	0.50	32.33	5.34	1.96	1.27	41.40
Airport West (South)	-	5.79	-	0.20	0.00	5.99
Cumulative Area	3.20	59.98	20.55	6.03	1.27	91.01
Area in airport estate	22.28	79.12	35.48	6.49	1.27	144.63
Cumulative area as a % within the airport estate	14.36%	75.81%	57.92%	92.97%	100%	62.92%

Source: Umwelt 2022

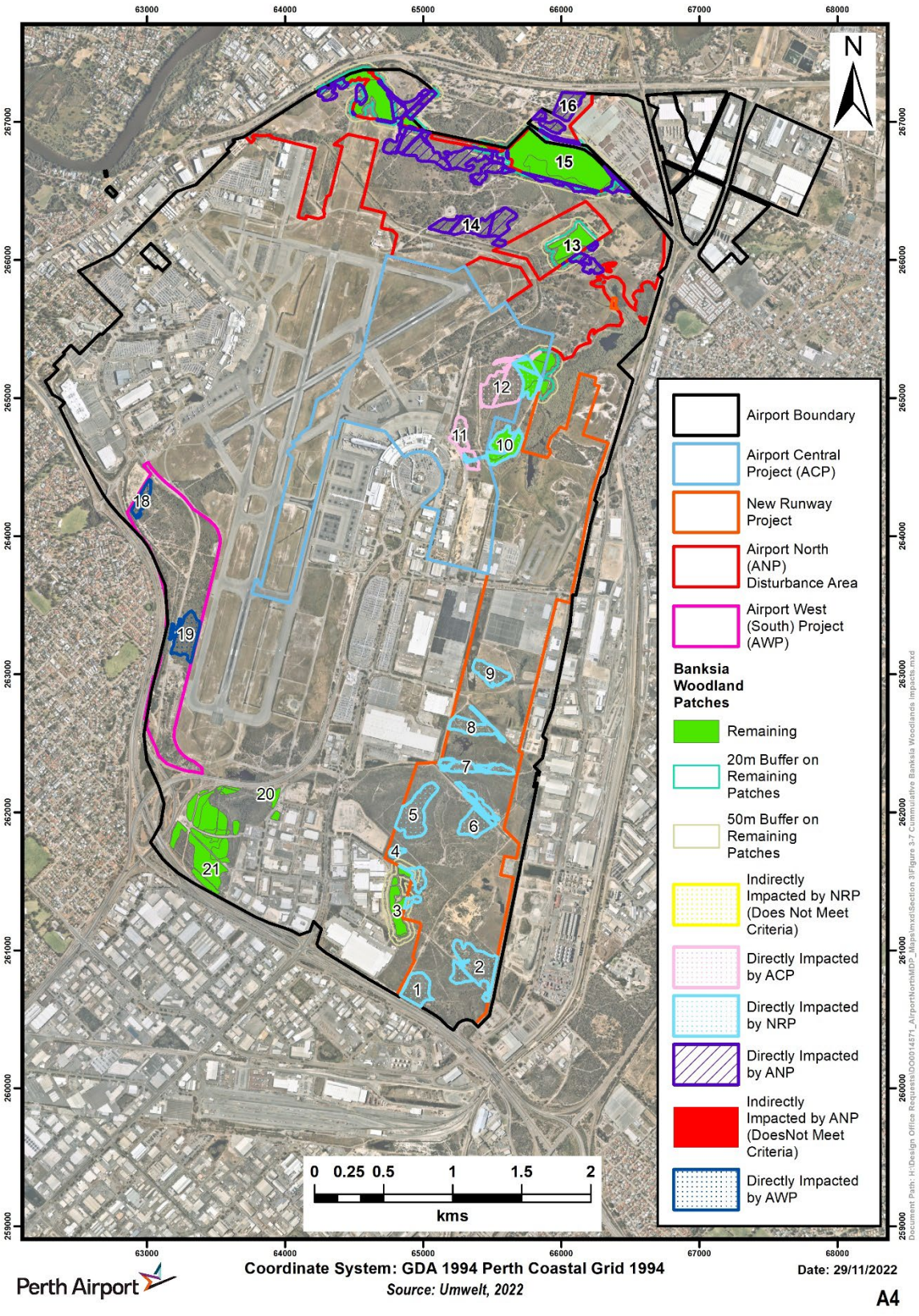


Figure 3-7 Cumulative Impacts of the Airport North project, Airport West (South), NRP and proposed Airport Central TDA to Banksia Woodlands TEC

3.4.6 Offsets

The proposed action will result in some residual impact to the Banksia Woodlands TEC, through the direct and permanent removal and indirect impact of up to 33.38 ha. This impact is unavoidable due to the removal of vegetation and subsequent development. Section 12 outlines the proposed offset to address the residual impact to the Banksia Woodlands TEC.

3.5 Impact Assessment – SCP 3b Corymbia calophylla – Eucalyptus marginata woodlands TEC

3.5.1 Overview of Values

There are 15.6 ha of the State-listed *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain (floristic community type 3b as originally described in Gibson et al. (1994)) (hereafter referred to SCP 3b TEC).

TEC (Vulnerable) within the Airport North MDP area with a vegetation condition of Good (Figure 3-8). The description of the presence of SCP3b TEC in this report is based on the Woodman Environmental (2020) survey as this is the most recent mapping undertaken.

The SCP3b TEC is not a component of the Banksia Woodlands TEC and not listed under the EPBC Act.

An additional 1.04 ha of the community occurs outside of the MDP area on the airport estate. The identification of the community within the airport estate represents an extension of the previously known range of the community, by approximately 15 km.

3.5.2 Direct Impacts and Associated Avoidance/Mitigation Measures

The MDP area contains 15.6 ha of the state-listed SCP3b TEC of varying vegetation condition, as shown in **Figure 3-8.** A total of 14.49 ha SCP3b TEC is potentially impacted by the Airport North TDA and 0.86 ha is retained in two patches in very good and excellent condition. As there are no size or Condition criteria, the remaining area is a patch of SCP 3b.

Every effort has been taken throughout conceptual design to avoid areas of this TEC in Excellent and Very good condition, however, due to other fixed constraints, for example airspace protection limitations, the placement of buildings is largely limited to the central area of the MDP, forcing other essential infrastructure to fall around those areas. Throughout detailed design, Perth Airport will continue to refine essential infrastructure requirements and will seek to avoid the clearing of this TEC as a priority design criterion.

Notwithstanding this, these impacts are unavoidable due to the location of the community in relation to the MDP layout. Whilst some areas of existing vegetation within the MDP area have been identified for retention, this has targeted the largest, most contiguous and intact areas of native vegetation, which are uninfested from dieback, in order to maximise the ongoing viability of these values. The occurrences of the SCP3b TEC within the MDP area did not fit these criteria, as the vegetation is spread across multiple, non-contiguous patches, making it difficult to achieve a potential retention outcome which would be as comparatively viable in the long-term. Redesign of an offline basin has achieved a retention of 0.87 ha within the MDP.

The potential direct and indirect impacts of the Airport North TDA on SCP 3b TEC are summarised in Table 3-14.

3.5.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

The potential indirect impacts of the MDP on SCP 3b TEC, as well as the associated impact avoidance and mitigation measures, are outlined in Table 3-14.

Table 3-13: The potential indirect impacts of the MDP on the SCP3b TEC and associated avoidance or mitigation measures

Impact Type	Impacting Process	Discussion (Potential Impacts)	Severity	Proposed Avoidance/ Mitigation measures
Direct impact	Clearing	The Airport North TDA will potentially impact 14.49 ha of SCP 3b TEC: This represents 88.41% of its local extent within the airport estate.	Severe	Avoidance of 0.86t ha has been achieved through redesign of offline basins. Avoidance of the majority of SCP 3b TEC is not feasible due to the nature of locating infrastructure.
Indirect impact	Unintentional clearing outside the project area	There is potential for unintentional clearing of SCP 3b TEC retained within the MDP outside the TDA	Minor	A CEMP will address the design and operations for clearing area, and demarcate (signage/fencing) exclusion zones for areas needing protection
Indirect impact	Habitat fragmentation	The Airport North TDA potentially clears 14.49 ha of SCP 3b leaving 0.86 ha of the community within the MDP.	Severe	Avoidance is not feasible due to the nature of locating infrastructure
Indirect impact	Changes in genetic Diversity	The potential 14.49 ha reduction in the community will reduce the local genetic diversity of the community, with lack of other areas of this community in proximity to the remaining area.	Severe	Avoidance is not feasible due to the nature of locating infrastructure
Indirect impact	Introduction and/or spread of weeds	There is potential for weed invasion into the remaining 0.86 ha area SCP 3b within the Airport North MDP through soil movement during construction and via wind dispersal.	Minor	A CEMP will address soil hygiene to prevent introduction and spread of weeds The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Spread of Disease – Dieback	The remaining areas of SCP 3b within the Airport North MDP are already dieback infested.	Minor	A CEMP will address soil hygiene procedures to prevent introduction and spread of dieback The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Change in bushfire regime	Increase burning may adversely affect the remaining 0.86 ha of SCP 3b however native plants are adapted to fire and the vegetation are likely to recover after burning with management of weed invasion.	Minor	Perth Airport currently maintains a fuel load management fire regime

Impact Type	Impacting Process	Discussion (Potential Impacts)	Severity	Proposed Avoidance/ Mitigation measures
Indirect impact	Groundwater hydrological changes	Changes in groundwater levels in areas outside the Airport North TDA areas has potential to impact the SCP 3b vegetation. There is unlikely to be indirect impacts to the remaining 0.86 ha of SCP 3b within the Airport North MDP from the potential cumulative impacts of the Airport Central TDA, proposed Airport North TDA, Airport West (South) and NRP to groundwater hydrology. Groundwater modelling predicts changes in the maximum and minimum water levels of less than 0.1 m to groundwater in areas of retained SCP 3b within the proposed Airport North MDP area. As such, the risk -of-impact is low.	Minor	The Perth Airport has committed to a project design that has minimal changes to the hydrology and minimal effects on vegetation in the surrounding area. Airport estate hydrology will be managed through the Perth Airport groundwater monitoring program. Management Plans should include: • Monitoring groundwaters within areas of retained SCP 3b vegetation, including frequency, • Identify changes in groundwater levels that trigger management actions to protect the integrity of the retained remnant vegetation,

Source: Umwelt 2022

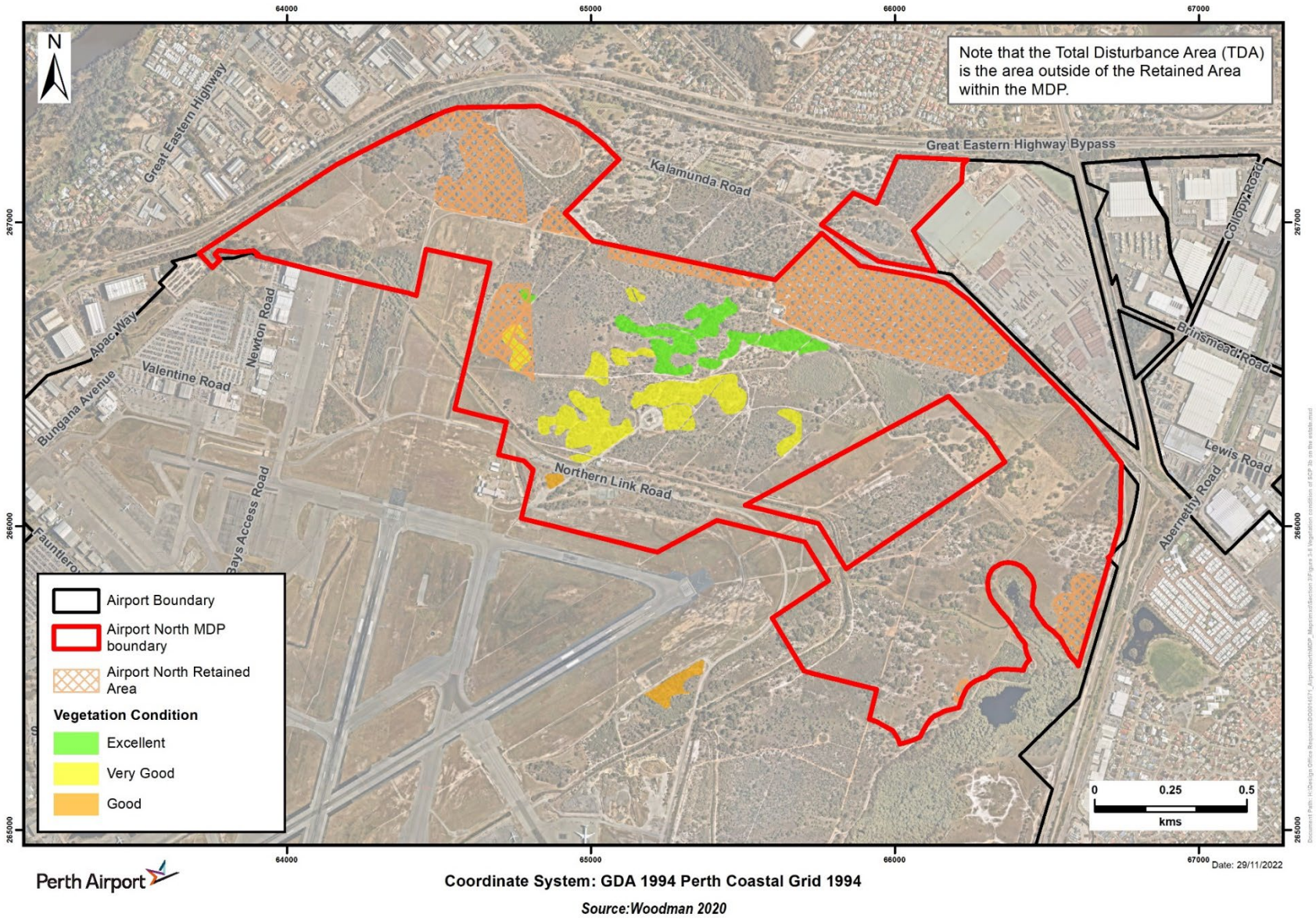


Figure 3-8: SCP3b TEC Vegetation Condition

Perth Airport

3.5.4 Significance of Residual Impacts

The potential impacts resulting from the clearing of 14.49 ha SCP3b TEC within the TDA area is likely to trigger six of the seven significant impact criteria for endangered ecological communities, as outlined in **Table 3-15**, indicating a potentially significant impact on the occurrences of this TEC .

The cumulative impact of Airport North TDA and Airport Central TDA potentially impacts 15.53 ha of the SCP 3b which, as noted above, is likely to trigger six of the seven criteria indicating a potentially significant impact on the occurrences of this ecological community within the airport estate. There was no SCP 3b TEC recorded within the Airport West (South) or NRP areas.

The location of the new occurrence of this community within the airport estate is a 15km northerly extension of its recorded range. The isolated airport estate occurrence of 16.39 ha is predominately dieback infested. There are 15 other known locations with a total extent of 260.0 ha of this TEC, over approximately 100 km range, however, details regarding condition of vegetation at these locations is limited.

The potential direct impacts of the MDP on the SCP 3b TEC will reduce the community's extent by 14.49 ha representing 88.41% of the 16.39 ha occurrence in the airport estate. Although the 14.49 ha occurrence is predominately dieback infested, this does not appear to be adversely affecting its condition. Therefore, this clearing is a significant potential impact at the local scale.

The significance of the potential impacts of the Airport North TDA and the potential cumulative impacts of the Airport North TDA and Airport Central TDA on TEC SCP 3b at the community scale, (addressing the Significant Impact Criteria, **Table 3-15**), is reflected by the reported occurrences and reported extent of the community. The potential impacts of the Airport North TDA and the potential cumulative impacts of the Airport North TDA and Airport Central TDA on TEC SCP 3b is likely significant at the regional scale.

Table 3-14: Assessment of potential impacts to the SCP 3b TEC against the Significant Impact Guideline Criteria

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	Cumulative projects[1] -Airport North TDA and Airport Central TDA[2],
Reduce the extent of an ecological community	**Likely to occur** 14.49 ha of SCP 3b is proposed to be removed as part of the Airport North TDA	**Likely to occur** 15.53 ha of SCP 3b is proposed to be cleared
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	**Likely to occur** The remaining 0.86 ha of SCP 3b in the Airport North MDP is isolated from the other 1.04 ha area of the community within the Airport Central MDP	**Unlikely to occur** The remaining 0.86 ha of SCP 3b in the Airport North MDP is an isolated occurrence.
Adversely affect habitat critical to the survival of an ecological community	**Likely to occur** The 14.49 ha of SCP 3b in the Airport North TDA represents 5.57 % of the community's reported extent. The airport estate is a new occurrence adding to the previous 15 known occurrences. The airport estate is also at the northern extent of its range.	**Likely to occur** The 15.53 ha of SCP3 in the Airport North TDA and Airport Central TDA represents 5.97 % of the community's reported extent. The airport estate is a new occurrence adding to the previous 15 known occurrences. The airport estate is also at the northern extent of its range.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	**Likely to occur** The Airport North TDA potentially permanently clears 14.49 ha of the SCP 3b community. The area of SCP3 in the Airport North TDA represents 5.57 % of the community's 260.0 ha reported	**Likely to occur** The Airport North TDA and Airport Central TDA potentially permanently clear 15.53 ha of the SCP 3b community, represents 5.97 % of the community's 260.0 ha reported extent. The airport estate is a new occurrence

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	Cumulative projects[1] -Airport North TDA and Airport Central TDA[2],
	extent. The airport estate is a new occurrence adding to the previous 15 known occurrences. The airport estate is also at the northern extent of its range.	adding to the previous 15 known occurrences. The airport estate is also at the northern extent of its range.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	**Likely to occur** 14.49 ha of SCP 3b is proposed to be cleared in the Airport North TDA.	**Likely to occur** 15.53 ha of SCP 3b is proposed to be cleared in the Airport North TDA and Airport Central TDA
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	**Likely to occur** The Airport North TDA will potentially permanently remove 14.49 ha of SCP 3b community within the airport estate	**Likely to occur** 15.53 ha of SCP 3b is proposed to be cleared in the Airport North TDA and Airport Central TDA
Interfere with the recovery of an ecological community	**Not applicable** No recovery actions of SCP 3b TEC are currently underway or proposed within the airport estate	**Not applicable** No recovery actions of SCP 3b TEC are currently underway or proposed within the airport estate

[1] There is no SCP 3b in Airport West (South) project or NRP

[2] Data from Umwelt (2022)

Source: Umwelt 2022

3.5.5 Cumulative Impacts

The potential cumulative impact of 15.53ha of SCP 3b representing 94.75% of the extent in the airport estate comprises:

- 14.49 ha within the Airport North TDA
- 1.04 ha within the Airport Central TDA,

There was no occurrence of SCP 3b TEC within the Airport West (South) or NRP.

The cumulative impacts are likely significant at the local scale. At a regional scale, the recorded occurrence of the SCP 3b TEC is limited, and the extent of the community appears to be limited. The potential regional impacts of the MDP on the SCP3b TEC are therefore considered significant.

Cumulative impacts of the Airport North TDA and Airport Central TDA on TEC SCP 3b are both likely significant at the regional scale.

3.5.6 Offsets

The proposed action will result in some residual impact to the SCP 3b TEC, through the direct and permanent removal of up to 14.49 ha. This impact is unavoidable due to the removal of vegetation and subsequent development. Section 12 outlines the proposed offset to address the residual impact to the SCP 3b TEC.

3.6 Impact Assessment – Conospermum undulatum

3.6.1 Overview of Values

Conospermum undulatum (Wavy-leaved Smokebush) is an erect compact shrub growing up to 2 m high occurring on grey or yellow-orange clayey sand, usually on flats or dunes. This threatened species is listed as Vulnerable under the BC Act and the EPBC Act. The population at the airport estate is considered an important population in the species' recovery plan.

All 205 records of this species are located within the Perth Metropolitan Area and the adjacent Darling Escarpment, over a range of approximately 16 km extending from Belmont towards Roleystone. A review of available data by Woodman Environmental (2000) determined that these records correspond to 32 populations; however, only 28 of these are extant. A total of 11,412 individuals are known across all populations outside of the airport estate. One population is considered to occur within the airport estate, containing 237 individuals, see Figure 3-9.

3.6.2 Direct and Indirect Impacts and Associated Avoidance/Mitigation Measures

Implementation of the MDP will result in direct impacts to *C. undulatum* through clearing activities. The Airport North MDP and TDA potentially impacts on 12 individuals of *C. undulatum* in one location representing 5.06 % of the airport population. All plants in the Airport North MDP are within the TDA. The severity of potential direct and indirect impacts of the Airport North TDA, and the avoidance and mitigation measures for *C. undulatum* are outlined in Table 3-16

Occurrences of the species within the MDP area do not align with the proposed retention areas. The retention areas were selectively chosen as they represent the largest, most contiguous and intact areas of native vegetation, which are uninfested from dieback, which do not align with occurrences of *C. undulatum* but represent good quality Banksia Woodlands TEC

Table 3-15: Potential indirect impacts of the MDP on *C. undulatum* and associated avoidance or mitigation measures

Impact Type	Impacting Process	Discussion	Severity	Proposed Avoidance/mitigation Measures
Direct impact	Clearing	The Airport North TDA will potentially impact 12 Individuals of *C. undulatum*. This represents: • 5.06 % of plants within the airport estate, and • 0.11 % of the total 11,412 known plants recorded by the DBCA. The Recovery Plan for *C. undulatum* identifies the airport populations as an important sub-population/ population for the long term survival of the species (Department of Environment and Conservation, 2009)	Severe	Avoidance is not feasible due to the nature of locating infrastructure Perth Airport is supporting studies into the potential for establishing new populations in suitable habitat through evaluations of propagations techniques and translocations.
Indirect impact	Unintentional clearing outside the project area	Not applicable as there are no plants in close proximity to the Airport North TDA	Not applicable	Not applicable
Indirect impact	Habitat fragmentation	Not applicable as there are no plants in proximity to the Airport North TDA	Not applicable	Not applicable
Indirect impact	Changes in genetic Diversity	The potential reduction in 12 plants will contribute to reducing the local genetic diversity of the species in within the airport estate. Cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP result in the retention of 19 *C. undulatum* plants reducing the genetic diversity. This significant impact was assessed via the NRP approval.	Moderate Severe	Avoidance is not feasible due to the nature of locating infrastructure Perth Airport is supporting studies into the potential for establishing new populations in suitable habitat through evaluations of propagations techniques and translocations.
Indirect impact	Introduction and/or spread of weeds	Although weeds occur throughout the airport estate, the movement of soil into and around the project area may introduce or spread weed into adjacent area of remnant vegetation	Minor	A CEMP will address soil hygiene to prevent introduction and spread of weeds The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Spread of Disease – Dieback	Most of the area of remnant vegetation within and surrounding the project area is infested with dieback. Unintentional spread	Minor	A CEMP will address soil hygiene procedures to prevent introduction and spread of dieback

Impact Type	Impacting Process	Discussion	Severity	Proposed Avoidance/mitigation Measures
		has the potential to accelerate the rate of infestation into the small areas remaining uninfested areas		The CEMP will be approved by Perth Airport following review by the DITRCDA AEO. Plant translocations will consider risk of introducing and spreading dieback.
Indirect impact	Change in bushfire regime	Increased burning may adversely affect the vegetation, however native plants are adapted to fire and the vegetation is likely to recover after burning with management of weed invasion.	Minor	Perth Airport currently maintains a fuel load management fire regime.
Indirect impact	Groundwater hydrological changes	There are no retained *C. undulatum* plants in the MDP and therefore no potential for indirect impacts. Changes in groundwater hydrology are predicted for the potential cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP in areas of retained *C. undulatum* plants. Increases in groundwater levels are predicted to be less than 0.1m for the maximum levels and less than .03m for the minimum levels within the area of the retained plants (AQ2 2022). The retained plants are at the edge of a sub-populations' occurrence along a dune. This suggest the lower lying wetter soil are less suitable habitat for the species. With minimum groundwaters decreasing depth to groundwater from 1-2m+ to 0.7-1.7m+ the risk-of-impact (DoW 2029) is likely Low to Moderate. *C. undulatum* may be affected by Phytophthora dieback (DoEE 2018). Rising groundwater levels may increase the rate of dieback infection and severity of disease expression by P. cinnamomi (Shearer and Dillon, 1996) in uninfested retained plants with *C. undulatum* that are surrounded by infested areas.	Minor - Moderate Severe	The Perth Airport has committed to a project design that has minimal changes to the hydrology and negligible effects on vegetation in the surrounding area. If translocation of plants occurs within the Airport North remnant vegetation areas management plans should include: • Monitoring groundwaters within areas with retained *C. undulatum* plants, including frequency. • Identify changes in groundwater levels that trigger management actions to protect the retained *C. undulatum* plants. • Monitoring of dieback disease, with management actions to mitigate potential spread of the disease in the remnant vegetation supporting *C. undulatum*

Source: Umwelt 2022

3.6.3 Significance of Residual Impacts

The Airport North TDA potentially impacts 5.03 % (12 individuals) of *C. undulatum* (T) within the airport estate population that is considered an important population to the long-term survival of the species (Umwelt 2022).

The potential impact triggers two of the nine Significant impact criteria (Table 3-17) on a sub population that is at the edge of the species distribution**.** The genetic study by Delnevo *et al.* (2022) proposed the likely presence of divergent *C. undulatum* sub-populations within the airport estate that may contain unique genetic variability for the species. The potential impacts of the Airport North TDA on the isolated sub-population within the airport estate is likely significant at the local and regional scale.

Cumulatively the Airport North TDA, Airport Central TDA, Airport West (South) and NRP potentially trigger four of the seven significant impact criteria (see Table 3-17).

The potential cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and the NRP represents 1.91 % (218 plants) of the total regionally known population of 11,412 *C. undulatum* (T) individuals. However, the airport population is an important population with the potential cumulative impacts likely significant at the regional scale.

Table 3-16: Assessment of the potential impacts of the MDP against the significance criteria for *C. undulatum*

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	
	Airport North MDP	Cumulative projects - Airport North MDP, Airport West (South) MDP and NRP MDP
Lead to long-term decrease in the size of an important population of a species	**Likely to occur** The *C. undulatum* Recovery Plan identifies the Airport population as important to the long term survival of the species. The proposed clearing from the Airport North TDA will remove 5.03 % (12 individuals) of the known individuals (237) within the Airport estate.	**Likely to occur** The *C. undulatum* Recovery Plan identifies the Airport population as important to the long term survival of the species. The proposed clearing for the Airport North TDA, Airport West (South) project and NRP will remove 91.98% (218 individuals) of the known individuals (237) within the Airport estate.
Reduce the area of occupancy of an important population)	**Likely to occur** The area occupied by the plants will be permanently cleared. The *C. undulatum* Recovery Plan identifies the Airport populations as important to the long term survival of the species.	**Likely to occur** The area occupied by the plants will be permanently cleared. The *C. undulatum* Recovery Plan identifies the Airport populations as important to the long term survival of the species.
Fragment an existing important population into two or more populations	**Unlikely to occur** All plants of the single location within the Airport North MDP will be removed.	**Unlikely to occur** A single population of 19 plants will remain in a small area of remnant native vegetation within the airport estate.
Adversely affect habitat critical to the survival of a species	**Unlikely to occur** The 12 plants within the Airport North TDA represent a small portion (0.11%) of the recorded total population of 11,412 outside the airport estate.	**Unlikely to occur** The plants within the Airport North TDA, Airport Central TDA, Airport West (South) and NRP represent a small portion (1.91 %) of the recorded total population of 11,412 outside the airport estate.
Disrupt the breeding cycle of an important population	**Unlikely to occur** The *C. undulatum* Recovery Plan identifies the Airport populations as important to the long term survival of the species. A small portion (5.06 %) of individuals will be permanently removed from the reproductive population at the Airport estate.	**Likely to occur** The *C. undulatum* Recovery Plan identifies the Airport populations as important to the long term survival of the species. A large portion (91.98 %) of individuals will be permanently removed from the reproductive population at the Airport state.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the	**Unlikely to occur** The Airport North TDA will result in the loss of 12 plants from a recorded total population of 11,412 individuals. This represents 0.11 % of the known individuals. The Airport North TDA potentially removes	**Unlikely to occur** The cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP will result in the loss of 218 plants from a recorded total population of 11,412 individuals, representing 1.91 % of the known individuals.

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	
	Airport North MDP	Cumulative projects - Airport North MDP, Airport West (South) MDP and NRP MDP
species is likely to decline	5.06 % of a population (that is considered important) on the western edge of its known range. Recorded populations for the species extend over a range of 21 km and is unlikely to decline.	Cumulatively the Airport North TDA, Airport Central, Airport West (South) and NRP potentially remove 91.98 % of an important population on the western edge of its known range within the airport estate. Recorded populations extend over 21 km and the species is unlikely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely to occur** Invasive species are not expected to impact other locations of C. undulatum. Management Plans are likely to protect plants in remaining habitat from the impacts of invasive species	**Unlikely to occur** Invasive species are not expected to impact the remaining locations of *C. undulatum*. Management Plans are likely to protect plants in remaining habitat from the impacts of invasive species
Introduce disease that may cause the species to decline	**Unlikely to occur** Management Plans are likely to protect remaining plants from indirect impacts	**Unlikely to occur** Management Plans are likely to protect remaining plants from indirect impacts
Interfere substantially with the recovery of the species.	**Unlikely to occur** The C. undulatum Recovery Plan identifies the airport populations as important to the long term survival of the species. A small portion (5.06 %) of individuals will be permanently removed from the reproductive population at the airport estate.	**Likely to occur** The *C. undulatum* Recovery Plan identifies the airport populations as important to the long term survival of the species. A large portion (91.98 %) of individuals will be permanently removed from the reproductive population at the airport state.

Source: Umwelt 2022

3.6.4 Cumulative Impacts

A total of 237 *C. undulatum* individuals have been recorded across the airport estate. *C. undulatum* is not present in Airport Central MDP or Airport West (South).

Cumulatively, the Airport North TDA, Airport Central TDA, Airport West (South) and the NRP potentially impacts 218 plants, representing 91.98 % of the population within the airport estate that is likely significant at the local scale (Umwelt 2022), see Table 3-18.

The potential cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and the NRP represents 1.91 % (218 plants) of the total regionally known population of 11,412 *C. undulatum* (T) individuals. However, the airport population is an important population with the potential cumulative impacts likely significant at the regional scale.

Table 3-17: The potential cumulative impacts of the Airport North MDP, Airport West (South) MDP and the NRP on *C. undulatum* individuals in the airport estate

Project Area	Number of individuals	Percentage of the airport estate population
Airport North	12	5.06%
New Runway Project	206	86.9%
Airport West (South)	0	0%
Airport Central	0	0%
Rest of the estate	19	8.02%
Total	237	100%

Source: Umwelt 2022

3.6.5 Offsets

Proposed actions to offset the likely significant impact of clearing 5.06 % (12 individuals) of *C. undulatum* (T) of individuals within the airport estate population are presented in Section 12.

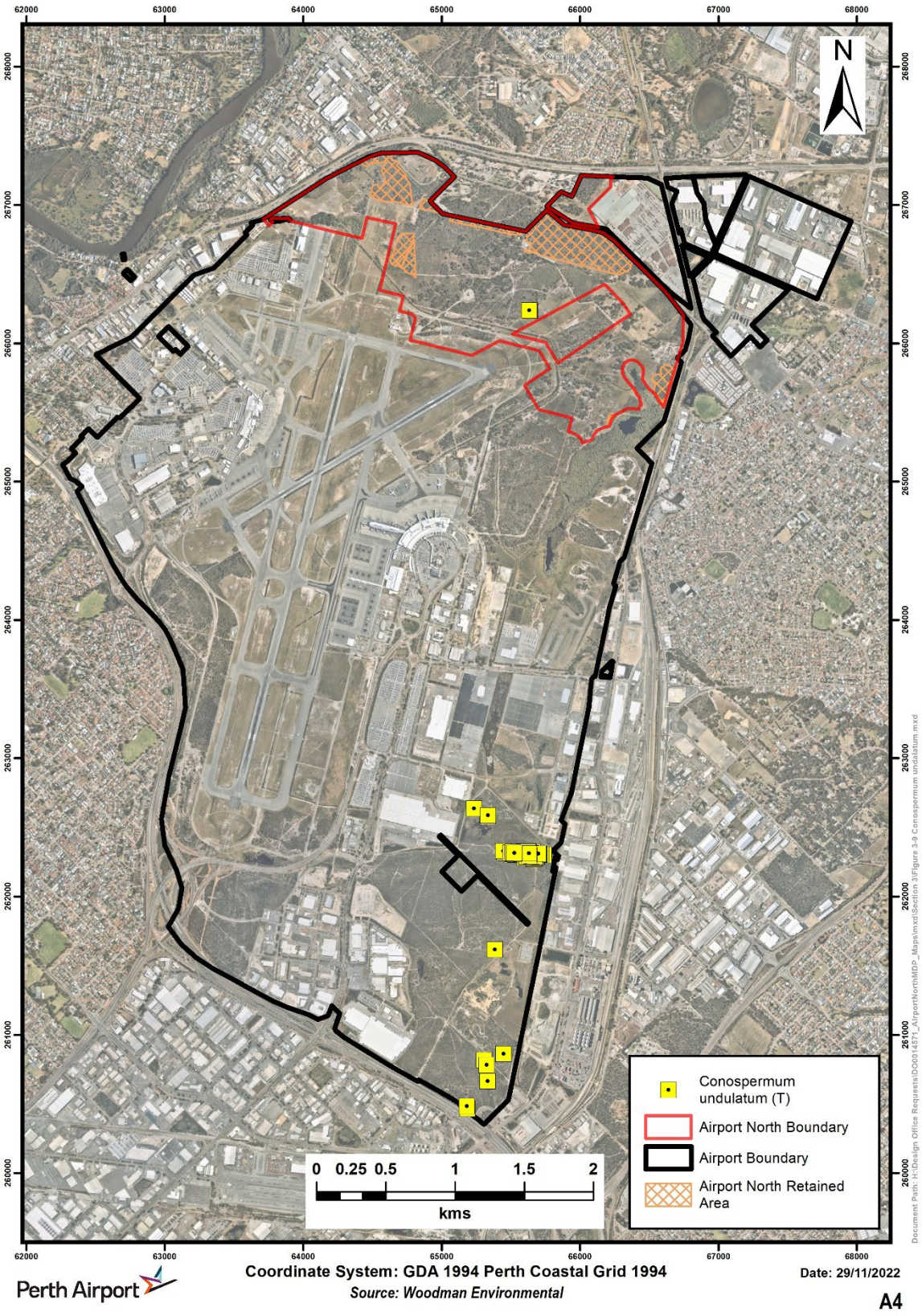


Figure 3-9: *C. undulatum* Occurrences within airport estate

3.7 Impact Assessment – Priority Flora Species

3.7.1 Overview of Values

Six Priority (P) flora species were recorded within the MDP area, see **Figure 3-3**. The listing as a Priority species denotes further survey is required to determine their status and potential for being listed as conservation significant under the State's BC Act. **Table 3-19** provide a description of each species and details the number of extant populations known to exist across Western Australia.

Table 3-18: Priority flora species within the TDA

Species	Priority	Description	No. extant populations
Johnsonia pubescens subsp. *cygnorum*	P2	A tufted perennial herb, growing to 0.25 m high, which generally occurs on flats that are often seasonally wet. It is known to occur over a range of approximately 70 km, from the Perth Metro area in the north to 5 km east of Pinjarra to the south. The recording of species within the airport estate slightly extends its known range northwards	13
Jacksonia gracillima	P3	A spreading shrub growing to 1.5 m high occurring on sandy flats and in wetlands. It is known to occur over a range of approximately 195 km, from Forrestfield in the north to Busselton in the south. The airport estate represents the northern most known extent of the range of this species	15
Myriophyllum echinatum	P3	An erect, semi-aquatic annual herb, growing to 0.03 m high, occurring on winter-wet clay flats. It is known to occur over a range of approximately 255 km, from near Gingin in the north to south of Busselton in the south. The airport estate is within the known range of this species.	12
Schoenus pennisetis	P3	A tufted annual, grass-like or herb, growing to 0.15 m high on grey or peaty sand or sandy clay in swamps and winter-wet depressions. It is known to occur over a range of approximately 550 km, from 70 km east of Geraldton in the north to 10 km south east of Busselton in the south. The airport estate is within the known range of this species.	15
Stylidium longitubum	P4	An erect ephemeral herb, growing to 0.12 m high on sandy clay in seasonal wetlands. It is known to occur over a range of approximately 450 km, from 25 km north west of Eneabba in the north to 10 km south east of Busselton in the south. The airport estate is within the known range of this species.	40
Verticordia lindleyi subsp. *lindleyi*	P4	An erect shrub growing up to 0.75 m, occurring in winter-wet depressions with sand and sandy clay. It is known to occur over a range of approximately 205 km, from 19 km south east of Cervantes in the north to Serpentine in the south. The airport estate is located within the known range of this species.	60

Source: Umwelt 2022

3.7.2 Direct and Indirect Impacts and Associated Avoidance/Mitigation Measures

The potential impacts of the MDP on Priority flora is based on data from the Environmental surveys (Umwelt 2022). Targeted surveys for Priority flora species were completed for all suitable habitat areas of the airport estate. For the purpose of this impact assessment on Priority flora a data set was derived with all historical records in now cleared areas and duplicates were excluded from the analysis. The revised dataset is considered to reflect the extant locations and number of individuals of Priority flora in the airport estate (Umwelt 2022).

Table 3-20 provides a summary of the potential direct impacts of the TDA on the reported locations of each of the Priority flora species, see **Figure 3-3**. As illustrated in **Figure 3-3**, the inclusion of areas of retained vegetation within the MDP area has avoided impacts to several reported Priority flora species locations.

The impacts outlined in Table 3-20 are unavoidable given these occurrences do not align with the proposed retention areas, which have been selectively chosen as they represent the largest, most contiguous and intact areas of native vegetation, which are uninfested from dieback.

Table 3-21 summarises the potential direct and indirect impacts of the MDP on Priority Flora and the associated avoidance and mitigation measures.

Table 3-19 Summary of the Potential Direct and Indirect Impacts of the Airport North Total Disturbance Area (TDA) on Priority Flora (modified data from Woodman Environmental 2020a, cited in Umwelt 2022)

		Airport Estate		Airport North MDP		Airport North TDA		Regional Occurrences	
Species	Cons. Code*	Reported number of Locations	Reported number of plants	Reported number of plants	% of plants in airport estate	Reported number of plants	% of plants in airport estate	Number of known extant Populations	Airport population as % of known extant populations
Johnsonia pubescens subsp. *cygnorum*	P2	467	1912	126	4.07	78	4.08	13	7.69
Jacksonia gracillima	P3	1544	4379	672	12.83	562	12.83	15	6.66
Myriophyllum echinatum	P3	2	2	2	100.00	2	100	12	8.33
Schoenus pennisetis	P3	4	4	1	25.00	1	25.00	15	6.66
Stylidium longitubum	P4	138	3068	582	18.97	582	18.97	At least 40	<2.50
Verticordia lindleyi subsp. *lindleyi*	P4	129	369	14	3.79	14	3.79	At least 60	<1.66

*Conservation Code as presented by DPaW (2014)

Source: Umwelt 2022

Table 3-20: Summary of the direct and indirect impacts of the MDP on the each of the Priority Flora species

Impact Type	Impacting Process	Discussion (Potential impacts)	Severity	Proposed Avoidance/mitigation Measures
Direct impact	Clearing	Potential direct impacts of the Airport North MDP to the six Priority flora are summarised in **Table 3-20**.	Severe	Retained areas results in the avoidance of direct impacts to: 48 ***Johnsonia pubescens*** subsp. ***cygnorum*** plants 110 ***Jacksonia gracillima*** plants
Indirect impact	Unintentional clearing outside the project area	Known locations of *Johnsonia pubescens* subsp. *cygnorum,* and *Jacksonia gracillima* occur adjacent to the Airport North TDA boundary and are at risk of potential indirect impacts.	Minor	A CEMP will address the design and operations for clearing area, and demarcate (signage/fencing) exclusion zones for areas needing protection The CEMP will be approved by Perth Airport following review by the DITRCDA AEO..
Indirect impact	Habitat fragmentation	The Airport North TDA potentially results in fragmentation of the remaining *Johnsonia pubescens* subsp. *cygnorum,* and *Jacksonia gracillima* habitat.	Moderate	Avoidance is not feasible due to the nature of locating infrastructure
Indirect impact	Changes in genetic Diversity	The potential reduction in plants will contribute to reducing the local genetic diversity of the Priority Flora in the local area.	Moderate	Avoidance is not feasible due to the nature of locating infrastructure
Indirect impact	Introduction and/or spread of weeds	Although weeds occur throughout the airport estate, the movement of soil into and around the Airport North TDA may introduce or spread weed into adjacent area of remnant vegetation	Minor	A CEMP will address soil hygiene to prevent introduction and spread of weeds The CEMP will be approved by Perth Airport following review by the DITRCDA AEO..
Indirect impact	Spread of Disease – Dieback	Most of the area of remnant vegetation within and surrounding the Airport North TDA is infested with dieback. Unintentional spread will accelerate the rate of infestation into the remaining uninfested areas	Minor	A CEMP will address soil hygiene procedures to prevent introduction and spread of dieback The CEMP will be approved by Perth Airport following review by the DITRCDA AEO..
Indirect impact	Change in bushfire regime	Increased burning may adversely affect the vegetation, however native plants are adapted to fire and the vegetation is likely to recover after burning with management of weed invasion.	Minor	Perth Airport currently maintains a fuel load management fire regime

Impact Type	Impacting Process	Discussion (Potential impacts)	Severity	Proposed Avoidance/mitigation Measures
Indirect impact	Groundwater hydrological changes	Changes in groundwater hydrology are predicted for the potential cumulative impacts of the Airport Central TDA, proposed Airport North TDA, Airport West (South) and NRP in areas of retained native vegetation in the MDP. The predicted changes potentially impact the associated priority flora of *Johnsonia pubescens* **subsp.** *cygnorum* and *Jacksonia gracillima*. Both species are associated with wetter soil. Maximum groundwater levels (shallowest from soil surface) are predicted to increase by less than 0.2m (AQ2, 2022). Depth to groundwater ranges from 1.0-2.0 m over the area potentially decreasing to 0.8 to 1.8m from the soil surface and unlikely to impact the Priority flora. Minimum (deepest from soil surface) groundwater levels are predicted to increase by less than 0.6m (AQ2, 2022), Minimum groundwater levels range from 2.0-4.0+m from the soil surface over the area, potentially decreasing to 1.4-3.4m from the soil surface. This additional water may have a Low-Moderate risk-of impact with potential for supporting vegetation, with higher groundwater levels (DoW 2009) Considering the declining rainfall in the Perth area, with consequent reduction in recharge to groundwater, changes in the vegetation are likely small and may not be detectable (Dow 2009). The additional groundwater potentially favours *Johnsonia pubescens* **subsp.** *cygnorum a*nd *Jacksonia gracillima*. Rising groundwater levels may increase the rate dieback infection and severity of disease expression by *P. cinnamomi* (Shearer and Dillon, 1996) in uninfested retained areas of remnant vegetation that are surrounded by infested areas. Groundwater modelling indicates potential decreases in the maximum groundwater levels within the area of retained native vegetation the of less than 0.1-0.2m: Within the Low risk-of -impact (DoW 2009). No decreases in the minimum groundwater levels are predicted.	Minor	The Perth Airport has committed to a project design that has minimal changes to the hydrology and negligible effects on vegetation in the surrounding area. Airport estate hydrology will be managed through the Perth Airport groundwater monitoring program. Management Plans should include: • Monitoring groundwaters within areas of retained remnant vegetation with priority flora, including frequency, • Identify changes in groundwater levels that trigger management actions to protect the priority flora, • Monitoring of dieback disease, with management actions to mitigate potential spread of the disease in the remnant vegetation and associated priority flora.

Source: Umwelt 2022

3.7.3 Significance of Residual Impacts

The ranking used to assess the significance of potential impacts of the Airport North TDA and the cumulative impacts of the Airport North TDA, Airport West (South), NRP and proposed Airport Central TDA on Priority Flora is set out in Umwelt 2022, Section 5.5.4.

Table 3-22 summarizes the significance of the potential impacts of the Airport North TDA and the cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP on the Priority Flora at the local and regional scale.

The significance of the potential impacts of the Airport North TDA and the cumulative impacts of the Airport North TDA, Airport West (South) and NRP to each Priority Flora species is discussed in further detail in Section 5.5.5 of the Umwelt 2022 Supplementary Report.

Table 3-21 The Significance of Potential Impacts of the Airport North Total Disturbance Area (TDA) and the Potential Cumulative Impacts of the Airport North Total Disturbance Area (TDA), Airport West (South) (AWP) Project and NRP on Priority Flora

Species	Project area	Ranking of potential Impact at the Local Scale of the Airport Estate	Ranking of potential Impact at the Regional Scale
Johnsonia pubescens subsp. *Cygnorum* (P2)	Airport North TDA	**Low -**4.08 % of individuals in airport estate potentially impacted	**Low** Species has a wide distribution over 70 km with 13 extant populations including two on conservation tenure. The airport estate population is a new population, extending range by 15km to the north, and represent 7.69 % of extant populations.
	Cumulative (Airport North TDA, Airport Central TDA, AWP and NRP)	**High –** 55.23 % of individuals in airport estate potentially impacted	
Jacksonia gracillima (P3)	Airport North TDA	**Low -**12.83 % of individuals in airport estate potentially impacted	**Low** Species has a wide distribution over 195 km with15 extant populations including five on conservation tenure. The airport estate population is the northern most extent and represent 6.66 % of extant populations.
	Cumulative (Airport North TDA, Airport Central TDA, AWP and NRP)	**High –** 81.96 % of individuals in airport estate potentially impacted	
Myriophyllum echinatum (P3)	Airport North TDA	**High –** 100 % of individuals in airport estate potentially impacted	**Low** Species has a wide distribution over 255 km with 12 extant populations, including those on conservation tenure. The small airport estate population represent 8.33 % of extant populations.
	Cumulative (Airport North TDA, Airport Central TDA, AWP and NRP)	**High –** 100 % of individuals in airport estate potentially impacted	

Species	Project area	Ranking of potential Impact at the Local Scale of the Airport Estate	Ranking of potential Impact at the Regional Scale
Schoenus pennisetis **(P3)**	Airport North TDA	**Moderate** – 25.00% of individuals in airport estate potentially impacted	**Low** Species has a wide distribution over 550 km with 16 extant populations, including two on conservation tenure. The small airport estate population represent 6.66 % of extant populations.
	Cumulative (Airport North TDA, Airport Central TDA, AWP and NRP)	**High** – 100% of individuals in airport estate potentially impacted	
Stylidium longitubum **(P4)**	Airport North TDA	**Low** – 18.97 % of individuals in airport estate potentially impacted	**Low** Species has a wide distribution over 450 km with 40+ extant populations, including eight on conservation tenure. The airport estate population represent less than 2.5 % of extant populations.
	Cumulative (Airport North TDA, Airport Central TDA, AWP and NRP)	**High** – 94.75 % of individuals in airport estate potentially impacted	
Verticordia lindleyi subsp. Lindleyi **(P4)**	Airport North TDA	**Low** – 3.79 % of individuals in airport estate potentially impacted	**Low** Species has a wide distribution over 205 km with 60+ extant populations, including ten on conservation tenure. The airport estate population represent less than 1.66 % of extant populations.
	Cumulative (Airport North TDA, Airport Central TDA, AWP and NRP)	**High** – 78.59 % of individuals in airport estate potentially impacted	

Source: Umwelt 2022

3.7.4 Cumulative Impacts

Figure 3-10 presents the known locations of Priority Flora across the airport estate that are potentially cumulatively impacted by the Airport North TDA, Airport West (South) project and NRP.

Table 3-23 summarises the potential cumulative impacts of the Airport North TDA, Airport West (South) MDP, NRP and the proposed Airport Central TDA on Priority Flora.

1.1.2 Anticipated Outcome

The implementation of the MDP and the clearing of the TDA will result in a single local scale significant residual impact to the Priority Flora species *Myriophyllum echinatum* (P3). If the Airport North TDA, Airport Central TDA, Airport West (South) MDP and the NRP are implemented they will result in a cumulative significant impact to all six Priority Flora species at the local scale. However, the cumulative impact will not result in a significant impact at the regional scale.

Table 3-22 Summary of the Impacts of the Airport North Total Disturbance Area (TDA) and the Cumulative Impacts of the Airport North Total Disturbance Area (TDA), Airport Central TDA, Airport West (South) and NRP on Priority Flora

Species	Cons. Code*	Airport Estate		Airport North MDP		Airport North TDA		Airport North TDA, Airport Central, Airport West (South) and NRP		Regional Occurrence	
		Reported number of Locations	Reported number of plants	Reported number of plants	% of plants in Airport Estate	Reported number of plants	% of plants in Airport Estate	Reported number of plants	% of plants in Airport Estate	Number of known extant Populations	Airport population as % of known extant populations
Johnsonia pubescens subsp. *Cygnorum*	P2	467	1912	126	4.08	78	4.08	1056	55.23	13	7.69
Jacksonia gracillima	P3	1544	4379	672	12.83	562	12.83	3589	81.96	15	6.67
Myriophyllum echinatum	P3	2	2	2	100.00	2	100	2	100.0	12	8.33
Schoenus pennisetis	P3	4	4	1	25.00	1	25.00	4	100.0	15	6.66
Stylidium longitubum	P4	138	3068	582	18.97	582	18.97	2907	94.75	At least 40	<2.50
Verticordia lindleyi subsp. *Lindleyi*	P4	129	369	14	3.79	14	3.79	290	78.59	At least 60	<1.67

*Conservation Code as presented by DpaW (2014)

Source: Umwelt 2022

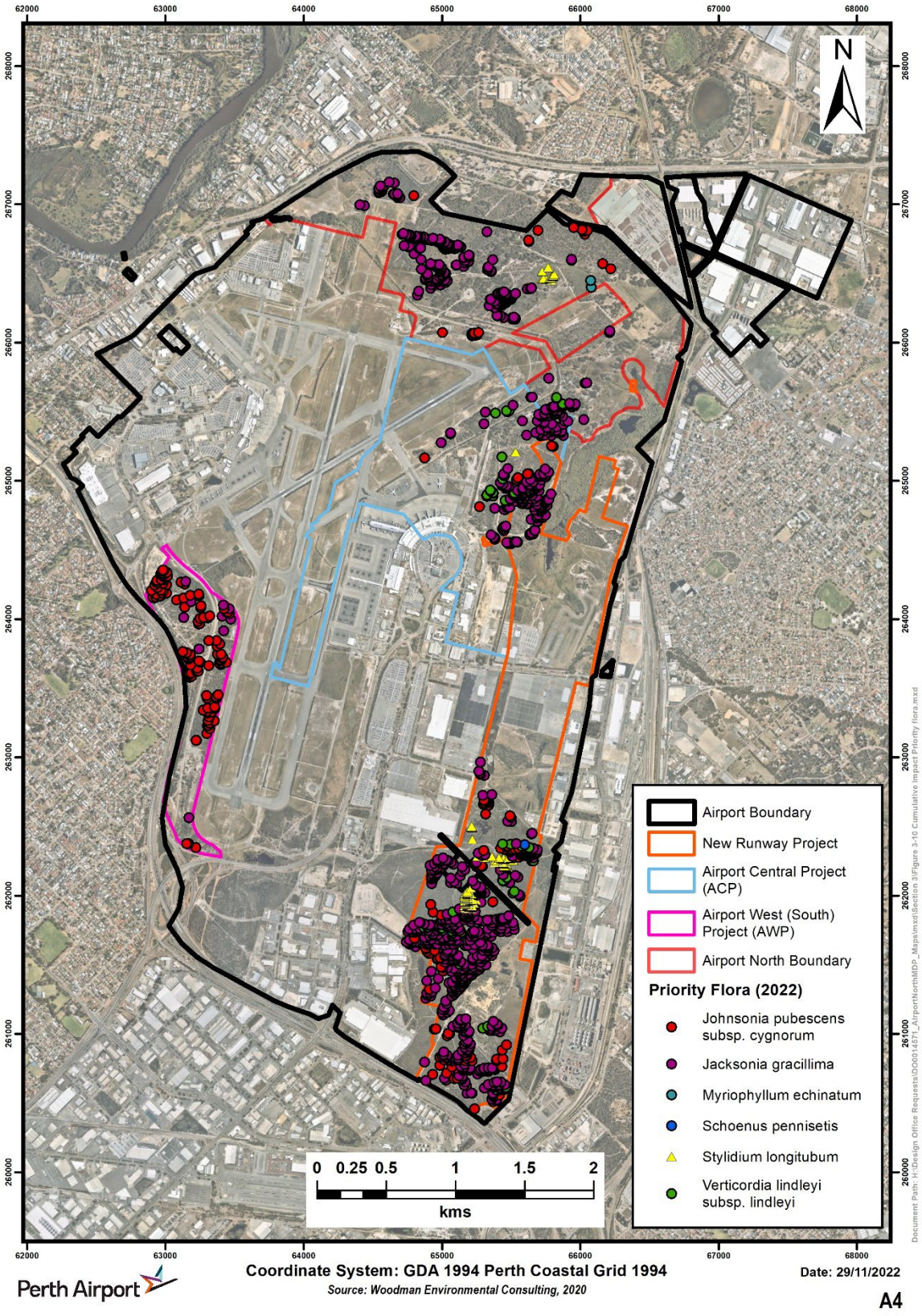


Figure 3-10 Cumulative impacts of the Airport North, Airport West (South), NRP and proposed Airport Central on Priority Flora

3.8 Impact Assessment – Remnant Native Vegetation

3.8.1 Overview of Values

The conservation value of remnant vegetation within the airport estate is influenced by the large amount of clearing which has already occurred on the eastern Swan Coastal Plain. At the broader regional scale, clearing has been for agriculture while within the local region, clearing has been for industry and residential land use. This historical land development has increased the importance of the relatively small amount of native vegetation which remains, especially within the Perth Metropolitan Area. For the purpose of this impact assessment on remnant vegetation, the local area encompasses the airport estate while the regional area encompasses the Swan Coastal Plain within the Perth Metropolitan Area (DPLH 2021, cited within Umwelt 2022) (approximately 290,000 ha),) with an estimated 23.5 % occurrence (75innamo. 68,000 ha) of remnant vegetation (DPIRD 2020, cited within Umwelt 2022).

The MDP area occurs within the Swan Coastal Plain 2 IBRA subregion (dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (Melaleuca) in swampy areas).

The three vegetation associations potentially impacted by the MDP are:

- Bassendean 1001, of which 11,394 ha of the vegetation association is extant representing 21.38 % of the pre-European extent. Of the current vegetation association extent, 14.07 % is within the conservation estate.
- Bassendean 1009, of which 1,046 ha of the vegetation association is extant representing 18.85 % of the pre-European extent. Of the current vegetation association extent, 0.31 % is within the conservation estate.
- Bassendean 1018, of which 1,195 ha of the vegetation association is extant representing 14.92% of the pre-European extent. Of the extant vegetation association, 1.11 % is within the conservation estate.

The State's Environmental Protection Authority (EPA) has determined that the threshold area below which species loss appears to accelerate exponentially at an ecosystem level is 30% of the pre-clearing extent of the vegetation type. The EPA considers an area of 10% or less of the pre-clearing extent to be representing "endangered" vegetation and recommends that ecological communities in constrained areas of the Swan Coastal Plain are maintained at above 10% of the pre-clearing extent.

Remnant vegetation within the airport estate has previously been identified as an area of regionally significant bushland through the Government of Western Australia's Bush Forever project (Bush Forever Site 386). Bush Forever designation does not impose additional assessment requirements to Commonwealth land, such as the airport estate. Notwithstanding this, the potential impacts to this Bush Forever site are considered through this assessment of whole of environment (remnant native vegetation).

3.8.2 Direct Impacts and Associated Avoidance/Mitigation Measures

As detailed in **Table 3-2**, the MDP TDA will result in direct impacts to 104.71 ha of remnant native vegetation. For the Airport North TDA, 78.73% of the remnant vegetation was rated in Good to Excellent condition and 21.27 % in Degraded condition. 34.12 ha of the retained vegetation was in good to excellent condition.

The potential impacts of the Airport North MDP and TDA on the three Bassendean Associations are shown in Table 3-24.

Table 3-23 Potential impacts of the Airport North MDP and TDA to Bassendean Associations

Project area	Vegetation Association area (ha)		
	Bassendean 1001	Bassendean 1009	Bassendean 1018
Airport North MDP	96.34	8.74	33.99
Airport North TDA	75.13	6.72	22.86
Retained area	**21.21**	**2.02**	**11.13**

Note: Any discrepancies in totals are due to rounding

The areas of remnant native vegetation in the MDP TDA recorded to be in excellent condition may be considered locally significant as they represent patches of comparatively high native species diversity within otherwise degraded vegetation. Surveys over the MDP TDA have identified the presence of the EPBC listed threatened flora species *Conospermum undulatum*. The remnant native vegetation may be considered locally significant representing habitat for conservation significant Priority flora: six priority flora species are considered to be present within the Airport North TDA.

The final design of the MDP will minimise clearing of native vegetation; however, direct impacts to native vegetation will be unavoidable due to the nature of the infrastructure design.

The severity of potential direct impacts of the Airport North TDA on remnant native vegetation are summarised in Table 3-25.

3.8.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

The potential indirect impacts of the Airport North TDA to remnant native vegetation and proposed avoidance and mitigation measures are summarised in Table 3-25.

Table 3-24: Potential direct and indirect impacts to remnant vegetation within the TDA and associated avoidance or mitigation measures

Impact Type	Impacting Process	Discussion (Potential impacts)	Severity	Proposed Avoidance/mitigation Measures
Direct impact	Clearing	The Airport North MDP potentially directly impacts: • 139.07 ha of remnant native vegetation: This represents 28.50 % of local extent within the airport estate. • 96.34 ha of Bassendean association 1001 • 8.74 ha Bassendean association 1009 • 33.99 ha of Bassendean association 1018 However only 104.71 ha of remnant native vegetation will be impacted within the Airport North TDA.	Severe	Reducing the disturbance footprint to the Airport North TDA retains: • **34.37 ha of remnant vegetation, reducing clearing to 104.71 ha representing 21.46 % of local extent within the airport estate. Retention/Avoidance of:** • **21.21 ha of Bassendean association 1001** • **2.02 ha of Bassendean association 1009** • **11.13 ha of Bassendean association 1018** Topsoil from cleared areas of remnant vegetation (managed to address risks of weeds and dieback) is to be beneficially used in areas of revegetation.
Indirect impact	Unintentional clearing outside the project area	There is potential for unintentional clearing of areas of Remnant Vegetation outside the Project area	Minor	A CEMP will address the design and operations for clearing area and demarcate (signage/fencing) exclusion zones for areas needing protection. Disturbed areas can be rehabilitated. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO..
Indirect impact	Habitat fragmentation	Clearing for the Airport North MDP is likely to result in isolated areas of remnant vegetation	Severe	The creation of corridors comprising remnant native vegetation and revegetation contributes to linkage and connectivity between the areas of retained remnant native vegetation.
Indirect impact	Changes in genetic diversity	The potential reduction in the area of the remnant native vegetation will reduce local genetic diversity. This may have a greater impact on Threatened and Priority Flora	Severe	Reducing the disturbance footprint to the Airport North TDA retains 34.37 ha of remnant vegetation reducing impacts to genetic diversity. The creation of corridors comprising remnant native vegetation and revegetation contributes to linkage and connectivity between the areas of retained remnant native vegetation. Topsoil beneficially used (managed to address risks of weeds and dieback) from cleared areas of remnant vegetation, for revegetation contributes to retaining some genetic diversity within the Airport North MDP area.

Impact Type	Impacting Process	Discussion (Potential impacts)	Severity	Proposed Avoidance/mitigation Measures
Indirect impact	Introduction and/or spread of weeds	Although weeds occur throughout the airport estate, the movement of soil into and around the project area may introduce or spread weed into adjacent area of remnant vegetation	Minor	A CEMP will address soil hygiene to prevent introduction and spread of weeds The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Spread of Disease – Dieback	Much of the area of remnant vegetation in the Airport North TDA is infested with dieback. Unintentional spread may accelerate the rate of infestation.	Minor	A CEMP will address soil hygiene procedures to prevent introduction and spread of dieback The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Indirect impact	Change in bushfire regime	Increased burning may adversely affect the vegetation, however native plants are adapted to fire and the vegetation likely to recover after burning with management of weed invasion	Minor	Perth Airport currently maintains a fuel load management fire regime
Indirect impact	Groundwater hydrological changes	Changes in groundwater hydrology are predicted for the potential cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and NRP in areas of retained native vegetation within the Airport North MDP. Maximum groundwater levels (shallowest from soil surface) are predicted to increase by less than 0.2m. Depth to groundwater ranges from 1.0-2.0 m over the area potentially decreasing to 0.8 to 1.8m from the soil surface and unlikely to impact the Remnant vegetation. Minimum (deepest from soil surface) groundwater levels are predicted to increase by up to less than 0.6m, Minimum groundwater levels range from 2.0-4.0+m from the soil surface over the area, potentially decreasing to 1.4-3.4m from the soil surface. This additional water may have a Low-Moderate risk-of impact with potential for supporting vegetation with higher groundwater levels. Considering the declining rainfall in the Perth area, with consequent reduction in recharge to groundwater, changes in the remnant vegetation are likely small and may not be detectable. Rising groundwater levels may increase the rate of dieback infection and severity of disease expression by P. 78innamomic	Minor Minor-Moderate	The Perth Airport has committed to a project design that has minimal changes to the hydrology and minimal effects on vegetation in the surrounding area. Airport estate hydrology will be managed through the Perth Airport groundwater monitoring program Management Plans should include: • Monitoring groundwaters within areas of retained remnant vegetation, including frequency. • Identify changes in groundwater levels that trigger management actions to protect the integrity of the retained remnant vegetation. • Monitoring of dieback disease, with management actions to mitigate potential spread of the disease in the remnant vegetation.

Impact Type	Impacting Process	Discussion (Potential impacts)	Severity	Proposed Avoidance/mitigation Measures
		(Shearer and Dillon, 1996) in uninfested retained areas of remnant vegetation that are surrounded by infested areas.		

Source: Umwelt 2022

3.8.4 Significance of Residual Impacts

The potential impacts of the TDA on remnant native vegetation is likely to trigger four of the seven significant impact criteria for endangered ecological communities (Umwelt 2022), as outlined in Table 3-26.

Cumulatively, impacts of the Airport North TDA, Airport Central TDA, Airport West (South) and the NRP are likely to trigger four of the seven significant impact criteria for endangered ecological communities.

Table 3-25: Assessment of likelihood of significant impacts of the MDP to remnant vegetation

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	
	Airport North MDP	Cumulative impacts
Reduce the extent of an ecological community	**Likely to occur** The Airport North TDA potentially impacts on: • 104.71 ha of remnant vegetation of varying condition representing 21.46% of remnant vegetation within the airport estate reducing the extent of remnant native vegetation from 23.26 % to 18.27 % of the airport estate • 75.13 ha Bassendean Association 1001 • 6.72 ha Bassendean Association 1009 • 22.86 ha of Bassendean Association 1018.	**Likely to occur** Cumulatively the projects potentially impact on: • 321.74 ha of remnant vegetation of varying condition representing 65.94% of remnant vegetation within the airport estate reducing the extent of remnant native vegetation from 23.26 % to 7.92 % of the airport estate • 130.28 ha of Bassendean Association 1001 • 6.75 ha Bassendean Association 1009 • 185.98 ha of Bassendean Association 1018.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	**Likely to occur** The Airport North TDA potentially reduces the extent of remnant vegetation resulting in fragmentation of the remaining remnant vegetation. Corridors of retained remnant vegetation and revegetation provides for some level of linkage and connectivity between the areas of remnant native vegetation.	**Likely to occur** Cumulatively the projects potentially reduce the extent of remnant vegetation contributing to fragmentation with smaller areas of remnant vegetation remaining with some level of linkage provided by corridors of retained remnant vegetation and revegetation.
Adversely affect habitat critical to the survival of an ecological community	**Unlikely to occur** The potential impacts of the Airport North TDA are unlikely to be critical to the survival of remnant vegetation, or the Bassendean associations on the SCP.	**Unlikely to occur** The potential cumulative impacts of the projects are unlikely critical to the survival of remnant vegetation or Bassendean associations 1001 and 1009 on the SCP. The remaining pre European extent of Bassendean association 1018 of 12.60% is approaching the 10% representing endangered.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	**Unlikely to occur** Within the Airport North TDA an area of 104.71 ha of remnant vegetation will potentially be permanently cleared. The potential impacts of the Airport North TDA are unlikely to be critical to the survival of remnant vegetation, or the Bassendean associations on the SCP.	**Unlikely to occur** An area of 321.74 ha of remnant vegetation will potentially be permanently cleared. The potential cumulative impacts of the projects are unlikely critical to the survival of remnant vegetation or Bassendean associations 1001 and 1009 on the SCP. The remaining pre-European extent of Bassendean association 1018 of 12.60% is approaching the 10% representing endangered.

Significant Impact Criteria (under Guideline 1.1)	Likelihood and rationale	
	Airport North MDP	Cumulative impacts
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	**Likely to occur** All vegetation is proposed to be cleared within the Airport North TDA potentially impacting on: • 104.71 ha of remnant vegetation of varying condition • 75.13 ha Bassendean Association 1001, • 6.72 ha Bassendean Association 1009, and • 22.86 ha of Bassendean Association 1018.	**Likely to occur** All vegetation is proposed to be cleared potentially impacting on: • 321.74 ha of remnant vegetation of varying condition • 130.28 ha of Bassendean Association 1001, and • 6.75 ha Bassendean Association 1009, and • 185.98 ha of Bassendean Association 1018.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	**Likely to occur** All vegetation is proposed to be cleared within the Airport North TDA potentially impacting on: • 104.71 ha of remnant vegetation of varying condition • 75.13 ha Bassendean Association 1001 • 6.72 ha Bassendean Association 1009 • 22.86 ha of Bassendean Association 1018. Clearing of the Airport North TDA may potentially contribute to a reduction in the integrity of the remaining remnant vegetation within the airport estate. Construction activities are unlikely to encourage the spread of weeds and dieback into adjacent remaining areas of remnant vegetation.	**Likely to occur** All vegetation is proposed to be cleared potentially impacting on: • 321.74 ha of remnant vegetation of varying condition • 130.28 ha of Bassendean Association 1001 • 6.75 ha Bassendean Association 1009 • 185.98 ha of Bassendean Association 1018. Clearing of the Airport North TDA may potentially contribute to a reduction in the integrity of the remaining remnant vegetation within the airport estate. Construction and activities are unlikely to encourage the spread of weeds and dieback into adjacent remaining area of remnant vegetation.
Interfere with the recovery of an ecological community	**Not applicable** No recovery actions for remnant vegetation are currently underway or proposed within the airport estate.	**Not applicable** No recovery actions for remnant vegetation are currently underway or proposed within the airport estate.

Source: Umwelt 2022

3.8.5 Cumulative Impacts

The potential cumulative impacts of the proposed Airport North TDA, Airport Central TDA, Airport West (South) and NRP on the extent of remnant native vegetation with respect to vegetation condition are summarised in Table 3-27.

Table 3-26: The potential cumulative impacts on remnant native vegetation

Project area	Area of condition (ha)					Total area (ha)
	Excellent	Very Good	Good	Degraded	Completely Degraded	
Airport North TDA	7.37	42.50	32.57	22.27[1]	-	**104.71**
Airport Central TDA	11.46	15.05	5.44	9.99	-	**41.94**
AWP	-	22.97	11.24	2.78	-	**36.99**
NRP	7.64	91.54	17.45	21.47	1.27	**138.10[2]**
Total	**26.47**	**172.06**	**66.71**	**56.51**	**1.27**	**321.74**

Note: any discrepancies in totals are due to rounding
[1]Excludes 5.40 ha of revegetation
[2]Excludes 1.27 ha of completely degraded Banksia Woodland TEC

Source: Umwelt 2022

The potential cumulative impacts of the proposed Airport North TDA, Airport Central TDA, Airport West (South) and NRP on the extent of the Bassendean Associations are summarised in Table 3-28.

Table 3-27: The potential cumulative impacts on the Bassendean Associations

Project area	Bassendean Association		
	1001	1009	1018
Airport North TDA	75.13	6.75	**22.86**
Airport Central TDA	18.15	-	**23.79**
Airport West (South)	36.99	-	**-**
NRP	-	-	**139.35**
Potential impact of Airport North TDA as % of extant Association	0.66	0.64	**1.91**
Potential % of Pre-European area remaining after Airport North TDA implemented	21.24	18.73	**14.64**
Total Area (ha) of Association potentially impacted by Airport North TDA, Airport Central TDA, AWP and NRP	**130.28**	**6.75**	**185.98**
Total potential cumulative impact of Airport North TDA, Airport Central TDA, AWP and NRP as a % of extant Association	1.14	0.64	**15.56**
Potential % of Pre-European area remaining after TDA, Airport Central TDA, AWP and NRP implemented	**21.14%**	**18.73%**	**12.60%**

Note: Any discrepancies in totals are due to rounding

Source: Umwelt 2022

3.8.6 Anticipated Outcome

At the local scale, the Airport North TDA potentially impacts 104.71 ha of remnant vegetation (21.46% of the area of remnant vegetation within the airport estate) reducing the extent of remnant native vegetation from 23.26% to 18.27% of the airport estate that is unlikely significant at the local scale.

Cumulatively the Airport North TDA, Airport Central TDA, Airport West (South), and the NRP potentially impacts 321.74 ha of remnant. vegetation (65.94% of the area of remnant vegetation within the airport estate). This potentially reduces the extent of remnant native vegetation from 23.26% to 7.92% of the airport estate that is likely significant at the local scale.

At the regional scale, the current extents of the vegetation associations are below the threshold of 30% of pre-clearing extent which the EPA (2000,) considers species loss appears to accelerate. The Airport North TDA potentially reduces the extent of Bassendean 1001, 1009 and 1018 to 21.24%, 18.73% and 14.64%, respectively of the pre-European extent: this is above the 10% level representing "endangered" (EPA 2000). In this context, the impact of the Airport North TDA on remnant vegetation at the regional scale will contribute to the decline of vegetation of the Bassendean 1001, 1009 and 1018 Associations toward the 10% endangered threshold, however, is unlikely significant.

The cumulative impacts of the Airport North TDA, Airport Central TDA, Airport West (South), and the NRP potentially reduces the extent of Bassendean 1001, 1009 and 1018 to 21.14%, 18.73% and 12.60%, respectively of the pre-European extent: This is above the 10% level representing "endangered" (EPA 2000). In this context, the cumulative impact of the Airport North TDA, Airport Central TDA, Airport West (South), and the NRP on remnant vegetation at the regional scale will contribute to the decline of vegetation of the Bassendean 1001, 1009 and 1018 Associations toward the 10% endangered threshold, however, is unlikely significant.

4 Fauna

This section provides details on the:

- Existing fauna species and habitat within and surrounding the project area, and
- Fauna impact assessment (including direct, indirect and offsite impacts) and associated mitigation and avoidance measures. Impacts are considered for the following factors that are known to occur within or adjacent to the project area:
- General Fauna Environment (Whole of Environment Fauna),
- Carnaby's Black-Cockatoo,
- Baudin's Black-Cockatoo,
- Forest Red-Tailed Black-Cockatoo,
- Quenda,
- Woollybush Bee, and
- Water-Rat.

4.1 Legislative and Policy Context

Impacts on fauna within the MDP area are considered against the following Commonwealth and State legislation and policy:

- Commonwealth
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- EPBC Act referral guidelines for three threatened black-cockatoo species (DSEWPaC 2012a)
- Revised draft referral guidelines for three threatened black-cockatoo species: Carnaby's, Baudin's and the Forest Red-tailed Black-Cockatoos (DEE 2017)
- Significant Impact Guidelines 1.1
- Significant Impact Guidelines 1.2.

State

- Biodiversity Conservation Act 2016
- EPA Position Statement No 3 – Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002)
- EPA Guidance Statement No 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004)
- EPA Environmental Factor Guideline – Terrestrial Fauna (EPA 2016)
- EPA Technical Guidance - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020)
- EPA Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (Hyder et al. 2010).
- In recognition of overall biodiversity and species not listed under legislation, such species are addressed under the "Whole of Environment fauna" category developed for this assessment.

4.2 Methodology

4.2.1 The 'Values and Impacts Approach'

Bamford Consulting Ecologists have developed a methodology for identifying and assessing project impacts to fauna from the guidance for fauna investigations for impact assessment provided by the Commonwealth (DCCEEW) and State Environment Protection Authority (EPA).

The methodology is referred to as the 'values and impacts approach' and is used to assess the significance of an area for fauna species and the potential impacts to fauna, the method is summarised in Plate 4-1. The initial steps involve assembling an expected-species list for the project area and then assessing those species for individual conservation significance. The values and impacts approach then examines fauna values within the project area, including:

- The overall fauna assemblage, in terms of uniqueness, completeness and richness.
- The vegetation and substrate associations (VSAs) present (that provide habitat for fauna).
- The patterns of biodiversity across the landscape.
- Ecological processes upon which the fauna depend.

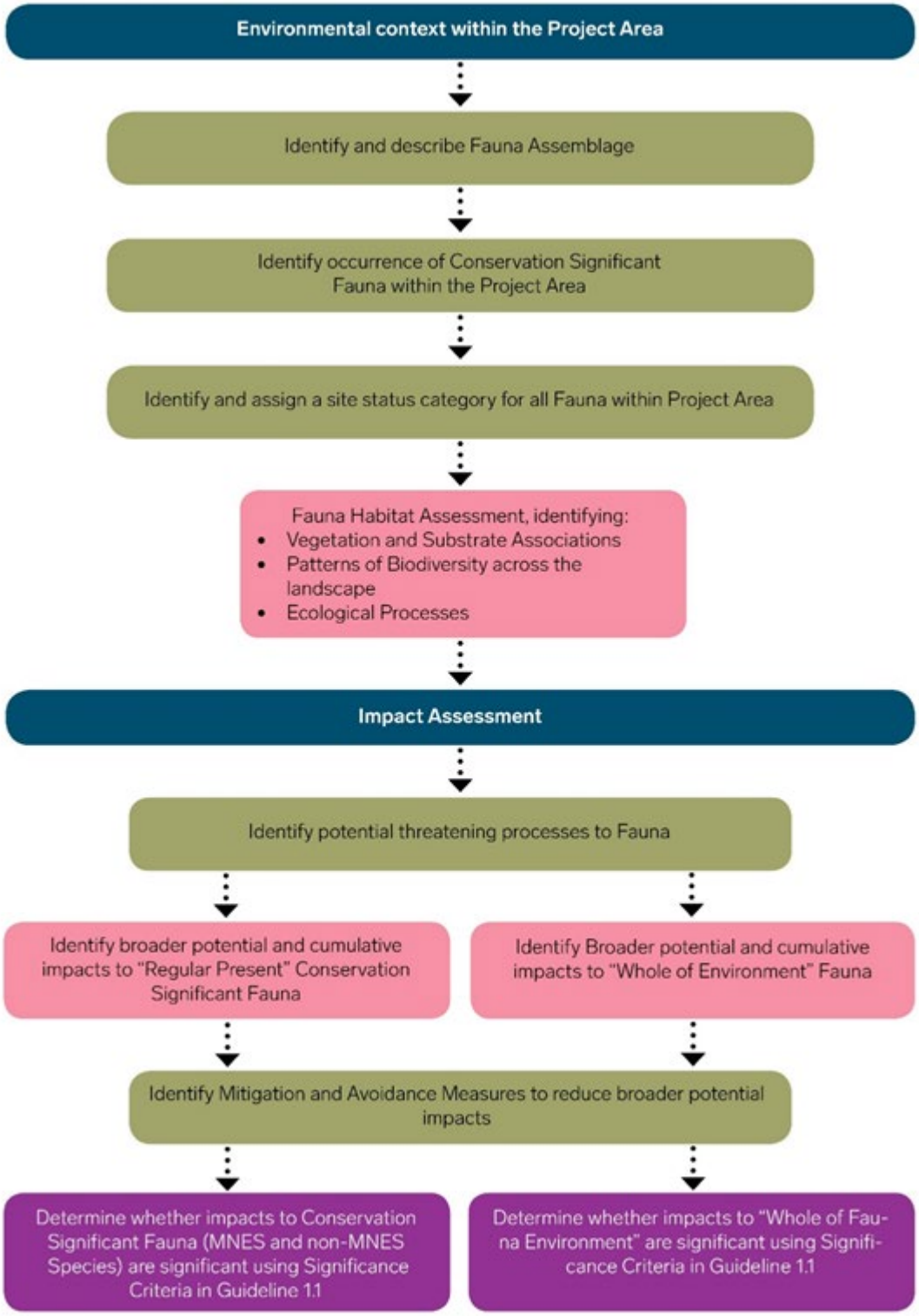


Plate 4-1 Fauna Impact Assessment Methodology

4.2.2 Impact Assessment Process

The impact assessment process involves reviewing the fauna values identified through the desktop assessment and field investigations with respect to the project and impacting processes. Impact assessment criteria are based on the severity of impacts on the fauna assemblage and regularly present conservation significant fauna and were quantified on the basis of predicted population change. Population change can be the result of direct habitat loss and/or impacts upon ecological processes.

Table 4-2 provides magnitude assessment criteria for impacts upon fauna based on:

- Estimated percentage fauna population decline within the immediate area of the surroundings.
- The effect of the decline upon the conservation status of a recognised taxon (recognisably discrete genetic population, sub-species or species).

Table 4-1: Assessment criteria for impacts upon fauna

Impact category	Observed Impact
Negligible	Effectively no population decline; at most few individuals impacted and any decline in population size within the normal range of annual variability.
Minor	Population declines temporary (recovery after end of project such as through rehabilitation) or permanent, but <1% within 12km radius. No change in viability or conservation status of taxon.
Moderate	Permanent population decline 1-10% within 12km radius. No change in viability or conservation status of taxon.
Major	Permanent population decline >10% within 12km radius. No change in viability or conservation status of taxon.
Critical	Taxon extinction within 12km radius and/or change in viability or conservation status of taxon.

Source: BCE 2022

Significant impacts may occur if:

- There is direct impact upon a fauna habitat and the habitat is rare, a large proportion of the habitat is affected and/or the habitat supports significant fauna.
- There is direct impact upon regularly present conservation significant fauna.
- Ecological processes are altered, and this affects large numbers of species or large proportions of populations, including significant species.

4.2.3 Cumulative Impacts

Cumulative impacts are the successive, incremental, and combined environmental impacts of one or more activities. Bamford Consulting Ecologists (2022) assessed the cumulative impacts of Perth Airport's planned development projects to fauna.

Airport North is one in a series of development projects planned within the Perth Airport estate as detailed in the Perth Airport Master Plan 2020.

For the purposes of this MDP, cumulative impacts are defined as those impacts from all the combined proposed development projects within the Perth Airport estate for which an envelope has been defined). Other industrial and urban development's outside the airport estate were not considered in the assessment.

Cumulative impacts are considered for each of the Regularly Present MNES and non-MNES Species, and the Whole of Environment.

4.3 Existing Environment

4.3.1 Fauna Assemblage

Bamford Consulting Ecologists (2020) identified 194 vertebrate fauna species with the potential to occur within the Perth Airport estate (of which the MDP area only comprises the northern component). Of these 194 species, 170 have either been recorded or considered highly likely to occur within the estate, as summarised in Table 4-4. A total of 24 species are considered locally extinct.

The fauna assemblage of the MDP area is unusual given it exists in a region of extensive regional clearing and development. The assemblage is likely to be substantially intact but is likely to be losing species.

Table 4-2: Composition of the vertebrate fauna assemblage of the airport estate

	No. potential species	Recorded	Highly Likely	Locally extinct
Fish	5 (1 int.)	1 (1 int.)	1	**3**
Frogs	12	10	1	**1**
Reptiles	43	22	10	**11**
Birds	121 (7 int.)	99 (4 int.)	13 (1 int.)	**9 (2 int.)**
Mammals	13 (5 int.)	12 (5 int.)	1	**0**
Total	**194 (13 int.)**	**144**	**26**	**24**

Int = introduced

Source: Bamford Consulting Ecologists, 2022

4.3.2 Conservation Significant Fauna

Of the 170 species of vertebrate fauna that have been recorded or that are highly likely to occur on the airport estate, 40 are considered to be of conservation significance and still present or highly likely to be present:

- Six species (all birds) are listed under State or Commonwealth Acts. As such, these species are conservation significant (level 1).
- Four species are identified as 'Priority' species by the WA DBCA, but not are not listed under State or Commonwealth Acts. This includes one bird, two mammal and one invertebrate species. These species are considered conservation significant (level 2).

An additional thirty species, whilst not falling within either category of conservation significance, were considered to be of local significance by Bamford Consulting Ecologists (2020).

The ten conservation significant fauna species are detailed in **Table** 4-6. . Conservation significant species that are known or expected to be a resident or regular visitor to the MDP area have been considered further as part of the environmental impact assessment process, given they are the key fauna species at risk of being impacted through implementation of the proposed MDP works. Whilst considered only an irregular visitor, Baudin's black cockatoo has also been considered on a precautionary basis, due to more recent observation of the species utilising habitat within the airport estate and changing preferences for all black cockatoo species over the last 20 years, however the species is still considered to be an irregular visitor.

Table 4-3: Conservation significant fauna species recorded or highly likely to occur within the MDP area

Type	Species	Common name	Conservation status	Presence	Likely occurrence
Conservation significance level 1 (species listed under State or Commonwealth Acts)					
Bird	*Apus pacificus*	Fork-tailed Swift	Migratory (EPBC Act)	Highly likely	Irregular visitor
Bird	*Calyptorhynchus banksii naso*	Forest Red-tailed Black-Cockatoo	Vulnerable (EPBC Act)	Recorded	Regular visitor
Bird	*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo	Endangered (EPBC Act)	Recorded	Irregular visitor
Bird	*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo	Endangered (EPBC Act)	Recorded	Regular visitor
Bird	*Falco peregrinus*	Peregrine Falcon	State-listed	Highly likely	Irregular visitor
Bird	*Plegadis falcinellus*	Glossy Ibis	Migratory (EPBC Act)	Highly likely	Irregular visitor
Conservation significance level 2 (species listed as 'Priority' by WA DBCA but not under legislative Acts)					
Invertebrate	*Hylaeus globuliferus*	Woolybush bee	State – Priority 3	Highly likely	Resident
Mammal	*Hydromys chrysogaster*	Water-rat, Rakali	State – Priority 4	Recorded	Resident
Mammal	*Isoodon fusciventer*	Quenda, Southern Brown Bandicoot	State – Priority 4	Recorded	Resident
Bird	*Oxyura australis*	Blue-billed Duck	State – Priority 4	Highly likely	Irregular visitor

Source: Bamford Consulting Ecologists, 2022

4.3.3 Locally Extinct Fauna

Bamford Consulting Ecologists identified the following as locally extinct conservation significant fauna within the airport estate.

Western Swamp Tortoise

The Western Swamp Tortoise *Pseudemydura umbrina* has not been recorded alive at the airport estate since September 1970 (ca. 52 years). The record consisted of the capture of a single juvenile animal "at airport swamps adjacent Hardey Road" (Western Swamp Tortoise database maintained by the DBCA), leading to the suggestion that the Five Mile Swamp area in the southern part of estate harboured a Western Swamp Tortoise population at least until the early 1970s (Burbidge et al. 2010, cited within BCE 2022). Furthermore, Kuchling and Burbidge (1996, cited within BCE 2022) provided anecdotal accounts of the species in the Perth Airport area from several long-term residents, with dates from the early 1940s, late 1960s/early 1970s, and 1995 with the latter being of a shell only.

This presumed population was not monitored, and no specimens were found during surveys in 1995 (Kuchling and Burbidge 1996, cited within BCE 2022) and 2005 (Burbidge and Kuchling 2005, cited within BCE 2022). The latter survey was a brief habitat assessment, although the 1995 survey was intensive, using trapping methods developed during decades of research on the species at Twin Swamps and Ellen Brook Nature Reserves. The authors, however, did caution that their survey was slightly delayed from the ideal seasonal timing and suggested that it could not be concluded that the species was extinct at Perth Airport at the time of their survey, and that further surveys were warranted. As such, an additional and intensive

survey was carried out in 2021/2022 (Rodriguez and Kuchling 2022, cited within BCE 2022) and while again no specimens were found, it was again concluded that local extinction could not be assumed. It is worth noting that the species has also not been detected in other fauna investigations carried out on the estate since 1994.

Burbidge et al. (2010, cited within BCE 2022) note the original distribution of the species as from "near Pearce Airforce Base south to Perth Airport" but provide no detail of the airport records. They give the current distribution of the species as Ellen Brook and Twin Swamps Reserves. Wetlands on the estate, however, are considered to provide the largest area of habitat suitable for the species and are identified as a potential release site for captive-bred tortoises in the Western Swamp Tortoise Recovery plan (2010). From 1996 to 2014, Perth Airport was engaged in discussions with the Western Swamp Tortoise Recovery regarding the conservation of wetlands in the north of the estate and around Munday Swamp. Suitable wetlands are extensive across the estate and are mapped by Kuchling and Burbidge (1996, cited within BCE 2022) and Rodriguez and Kuchling (2022, cited within BCE 2022). The habitat assessment conducted in 2005 (Burbidge and Kuchling 2005) concluded that at least some of the wetlands remained suitable for the species but that some may require water supplementation to extend the hydroperiod and offset the effect of declining rainfall. Upon further investigation, Geo and Hydro (2014, cited within BCE 2022) concluded that hydrogeological conditions at the northern wetlands were no longer suitable for the species (without supplementation). The estate wetlands were not included by Dade (2013, cited within BCE 2022) in a review of potential relocation sites, possibly due to concerns with the effects of declining rainfall. Despite this, the estate wetlands remain as potential relocation sites in the Western Swamp Tortoise Recovery Plan (2010, cited within BCE 2022), which is due for review in 2024.

Despite the low likelihood of the Western Swamp Tortoise persisting anywhere on the estate, it is extremely hard to find when present at low densities. There have been only two (and inconclusive) comprehensive surveys for the species since the 1970 record, and that record falls well within the lifespan of the species (80-90 years; G. Kuchling pers. comm., cited within BCE 2022). Given the extremely high conservation significance of the species, even one or two specimens would be important in terms of the genetic richness of the species' population. Airport North includes a wetland area that was identified as a potential release site for captive-bred tortoises in the Western Swamp Tortoise Recovery Plan (2010), but this was not included in the 2021/2022 survey as it was judged to no longer have a sufficient hydro-period (Rodriguez and Kuchling 2022, cited within BCE 2022). As such, it has been assessed that the Western Swamp Tortoise is 'Probably Locally Extinct' as a species although formerly occurred in the airport estate.

Invertebrates

Two conservation significant invertebrate species, the crickets *Throscodectes xiphos* (Priority 1) and *Austrosaga spinifer* (Priority 2), may formerly have occurred in the MDP area, but are now considered to be locally extinct. Some suitable habitat is present in the MDP area, with approximately 25 ha of Woodland and 13 ha of heathland. Some on-ground searching for these species including head-torching and light-trapping, was carried out in early 2019 within the airport estate and neither was found. The timing of these surveys was consistent with activity periods of the species determined from specimen records held by the WA Museum. While a single survey cannot confirm absence, the conclusion that these species are locally extinct was made based upon the survey result, the lack of any other recent records in the broader region, and the high level of disturbance across the MDP area and the airport estate. Furthermore, the Graceful Sun-Moth (*Synemon gratiosa*) was searched for in 2010 and it was concluded that the species was absent due to low habitat quality (Huang and Bamford 2010, cited within BCE 2022).

4.3.4 Vegetation Substrate Associations

Five types of vegetation substrate associations (VSAs) have been defined using a combination of vegetation mapping, soil types, fauna survey results, interpretation of aerial photography and ground-truthing. VSA identified within the MDP area are outlined in Table 4-7 and shown in Figure 4-1.

Table 4-4: Vegetation substrate associations within the MDP area

Vegetation substrate association	MDP (ha)	TDA (ha)	Retained (ha)
Woodland	97.62	70.65	26.97
Riparian Woodland	3.65	3.65	0.00
Damp Heathland	12.41	10.28	2.13
Grassland	100.95	95.75	5.20
Drains/Wetlands	1.79	1.79	0.00
Cleared and built areas (includes Maintained grasslands)	31.61	31.52	0.09
Total	**248.03**	**213.64**	**34.39**

Source: Bamford Consulting Ecologists 2022

Woodlands support the greatest range of reptile and bird species, including many of conservation significance. All three black-cockatoo species have been recorded foraging in woodland; Carnaby's Black-Cockatoo focusses on areas with a high proportion of Banksia, while the Forest Red-tailed and Baudin's Black-Cockatoos favour Marri. The Woodlands also potentially provide nesting sites for black cockatoos. Woodlands support the Quenda and are where many of the frogs spend their non-breeding season. The conservation significant invertebrate *H. globuliferus* should it occur, is most likely to occur in Banksia woodland areas.

The rich assemblage of flowering plants in woodlands supports nectarivorous fauna from birds to insects. Riparian woodlands also provide often dense cover for species such as Quenda and Rakali, and the seasonally damp soils may support short-range endemic invertebrates. A few reptile species appear to be most common in riparian woodlands and the flooded gum (*Eucalyptus rudis*) readily forms hollows used by a range of fauna.

Damp Heathlands provide dense cover favoured by some bird species (e.g. Splendid Fairy-wren and White-browed Scrubwren), and the persistence of these species may depend upon this sort of shelter. Quenda are also most abundant in this dense, low vegetation.

Built areas are of low value for fauna but even small areas of plantings within built areas allow species to move through otherwise hostile environments. Cleared areas with introduced or isolated native trees can be used for foraging by black cockatoos. Constructed drains in the project area support aquatic invertebrates, seasonal breeding by frogs, the Rakali and potentially small numbers of conservation significant waterbirds, such as Blue-billed Duck. Long-necked Tortoises are abundant in wetlands and some drains around Perth Airport. Drains, while artificial, provide a network along which aquatic fauna, and fauna associated with riparian vegetation, can move through the landscape.

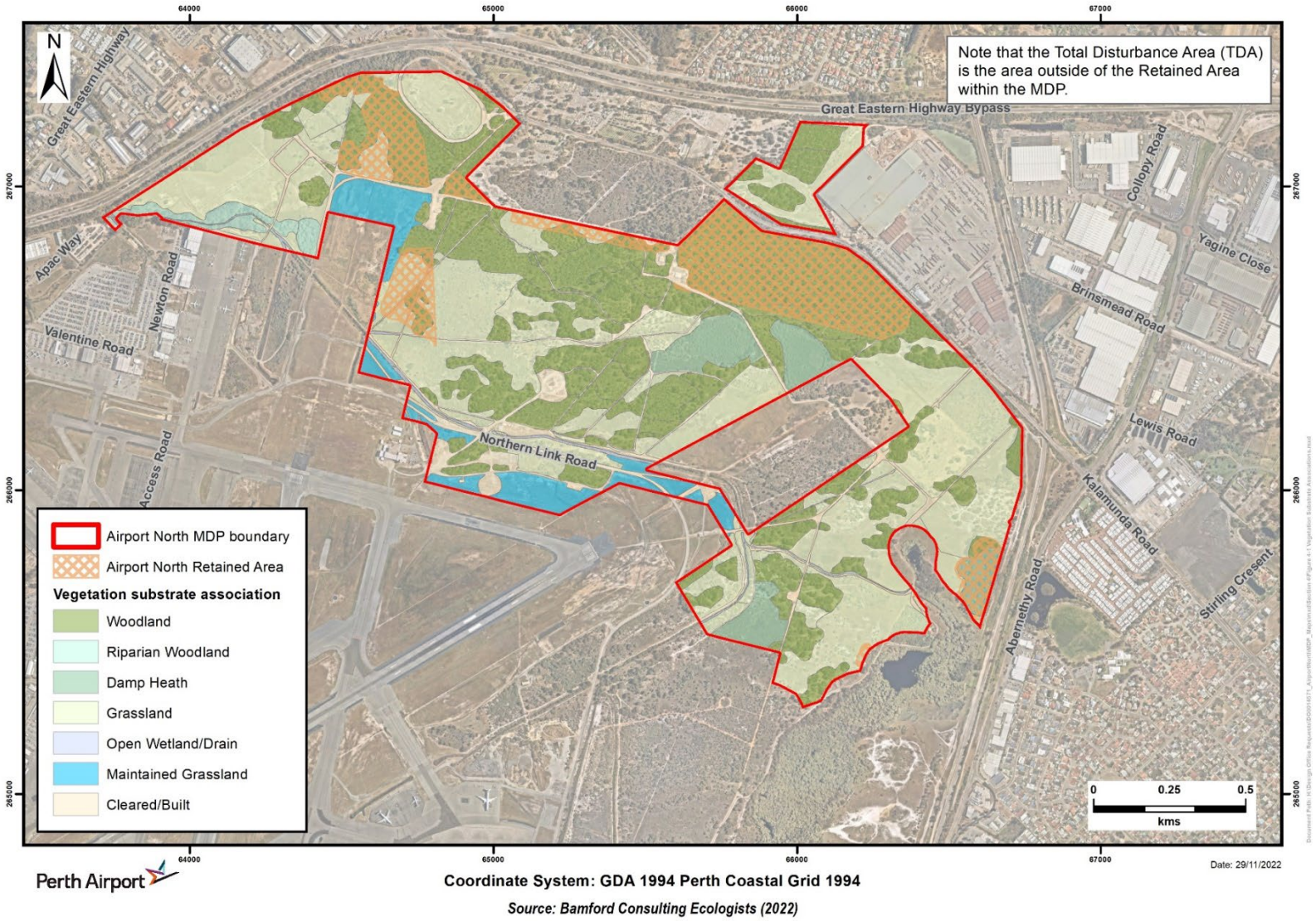


Figure 4-1: Vegetation Substrate Associations

4.3.5 Fauna Linkages

Within the MDP area, the fauna assemblage has varying levels of dependence of native vegetation and linkage between patches. Three main groups are identified:

- Species that are more or less independent of native vegetation (c. 30% of the assemblage)
- Species that rely on native vegetation but readily move between patches (c. 52%)
- Species that are very reliant on native vegetation and require connectivity (and in some cases a high level of regional vegetation cover) to persist (c. 17%). This category of species is particularly vulnerable to habitat loss and fragmentation.

The fauna assemblage within the MDP area has some connection to vegetation to the north (vegetation within the Guildford cemetery) and south (vegetation within the wider Perth Airport estate), but limited connectivity within the broader landscape beyond the Perth Airport estate. Connectivity is important in ensuring that fauna can move between fragments of native vegetation and is therefore currently limiting.

4.4 Impact Assessment – Carnaby's Black Cockatoo

4.4.1 Overview of Values

Carnaby's Black Cockatoo (CBC) is the most abundant of the three black cockatoo species within the Perth Airport estate, as well across the Swan Coastal Plain of the Perth region generally. It is normally a non-breeding migrant, being most abundant from late summer to mid-winter. The species is present on the Perth Airport estate in large numbers, with flocks of several hundred observed (typically in the autumn) and is therefore likely to utilise the MDP area.

CBC does not currently breed within the MDP area or the wider Perth Airport estate and is considered unlikely to do so, but the species is known to breed elsewhere on the Swan Coastal Plain in small numbers. The nearest possible (but unconfirmed breeding) is in the Bushmead Rifle Range, approximately 4 km to the north-east. Breeding activity is more likely to the east, beyond the Darling Escarpment within the historical breeding range of the species.

No CBC roosting sites or roosting activity was recorded within the MDP area or wider airport estate, although there are some known roost sites for white-tailed black cockatoos (either Carnaby's or Baudin's) from the *Great Cocky Count* in the region.

Notwithstanding, the MDP area contains 88 trees (48 marri and 40 jarrah) which meet the generic criteria for a potential black cockatoo breeding habitat tree, being native trees with a diameter at breast height (DBH) of 500 mm or greater. As shown in **Figure 4-2**, of these 88 trees:

- 81 are within the TDA (43 Marri and 38 Jarrah)
- 77 trees within the TDA and 7 trees within the retention area do not contain any hollows suitable for black cockatoos.
- Four trees contain hollow/s potentially suitable for use by black cockatoo due to their visible morphology (size, orientation, height) within the TDA, however no evidence of any black cockatoo use was observed.
- No trees contain any hollows where evidence of previous or active black cockatoo nesting was observed (such as chew marks around hollows, cockatoos entering/emerging from hollow).

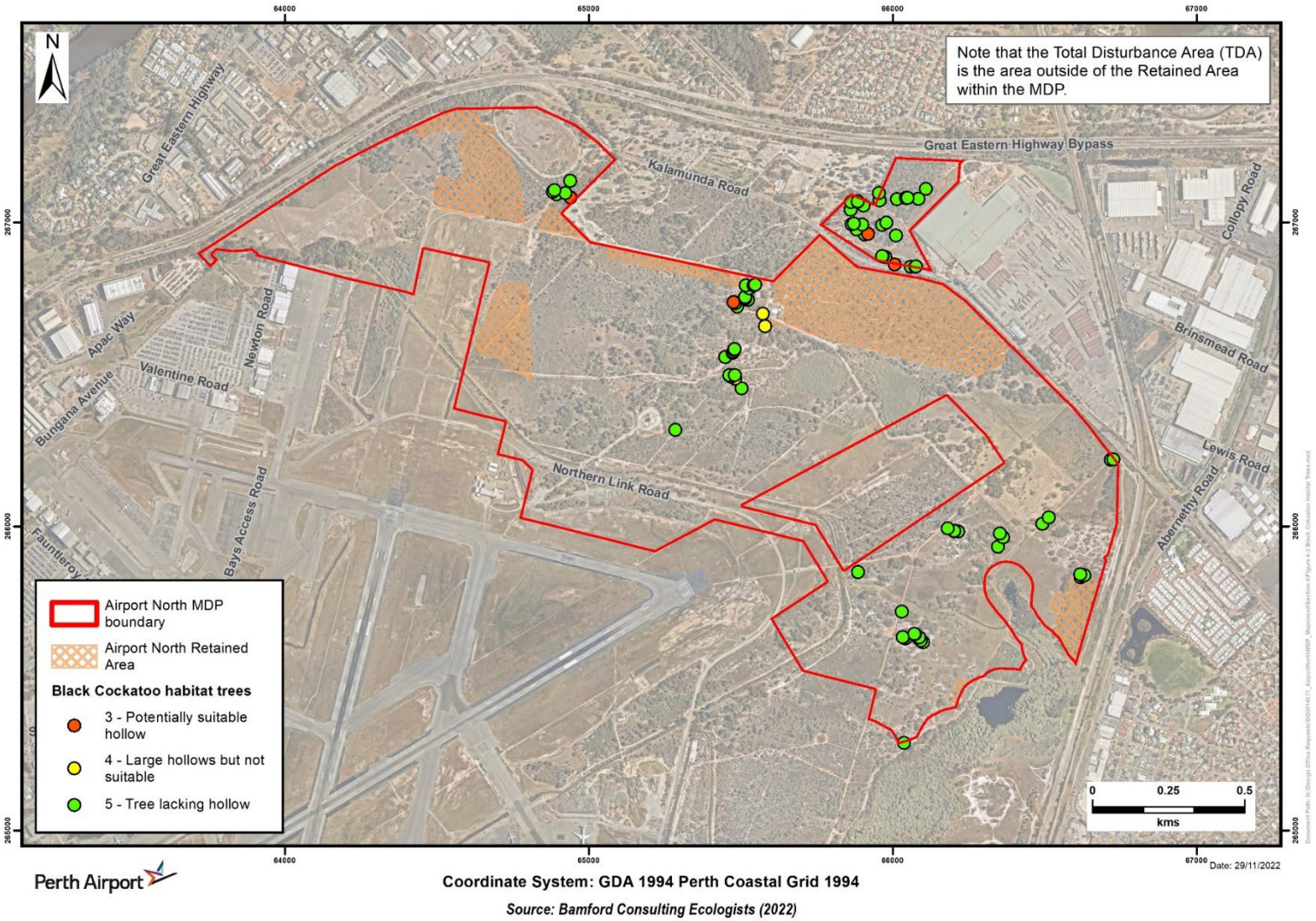


Figure 4-2: Black Cockatoo Habitat Trees

Foraging habitat for Carnaby's Black-Cockatoo was recorded in the project area (Foraging Habitat Assessment provided in Appendix 7 of Bamford Consulting Ecologists, 2022). Approximately 214.62 ha of the MDP area and 180.33 ha of the TDA provide some foraging value for Carnaby's Black-Cockatoo with a foraging value (condition) score of between 1 (negligible to low foraging value) to 6 (high foraging value) (Table 4-9). Approximately 13.5% (33.41 ha) of the MDP area and 15.6% (33.31 ha) of the TDA had no foraging value (Score 0) for the species. The distribution of foraging habitat for the species in the project area is shown in Figure 4-3.

Table 4-5 Carnaby's black cockatoo foraging habitat

SCORE BASED ON VEGETATION CHARACTERISTICS (OUT OF 6)	IMPACT AREAS (HA) PER FORAGING HABITAT VEGETATION SCORE		
	MDP	TDA	RETAINED
1 – Negligible to Low	111.83	104.5	7.33
2 – Low	1	1	0
3 – Low to Moderate	12.49	11.65	0.85
4 – Moderate	63.64	46.42	17.22
5 – Moderate to High	23.02	14.12	8.9
6 – High	2.64	2.64	0
Total	**214.62**	**180.33**	**34.29**

Source: BCE 2022

Figure 4-4 presents the potential Carnaby's Black-Cockatoo feeding habitat within the 12 km radius as mapped by DBCA (2021a,b, cited within BCE 2022). The darker orange areas on the map represent the potential Carnaby's Black-Cockatoo Feeding Habitat in the Jarrah Forest IBRA region and lighter orange areas are for the Swan Coastal Plain IBRA region. There is c. 7078.08 ha of potential Carnaby's Black-Cockatoo feeding habitat in the region.

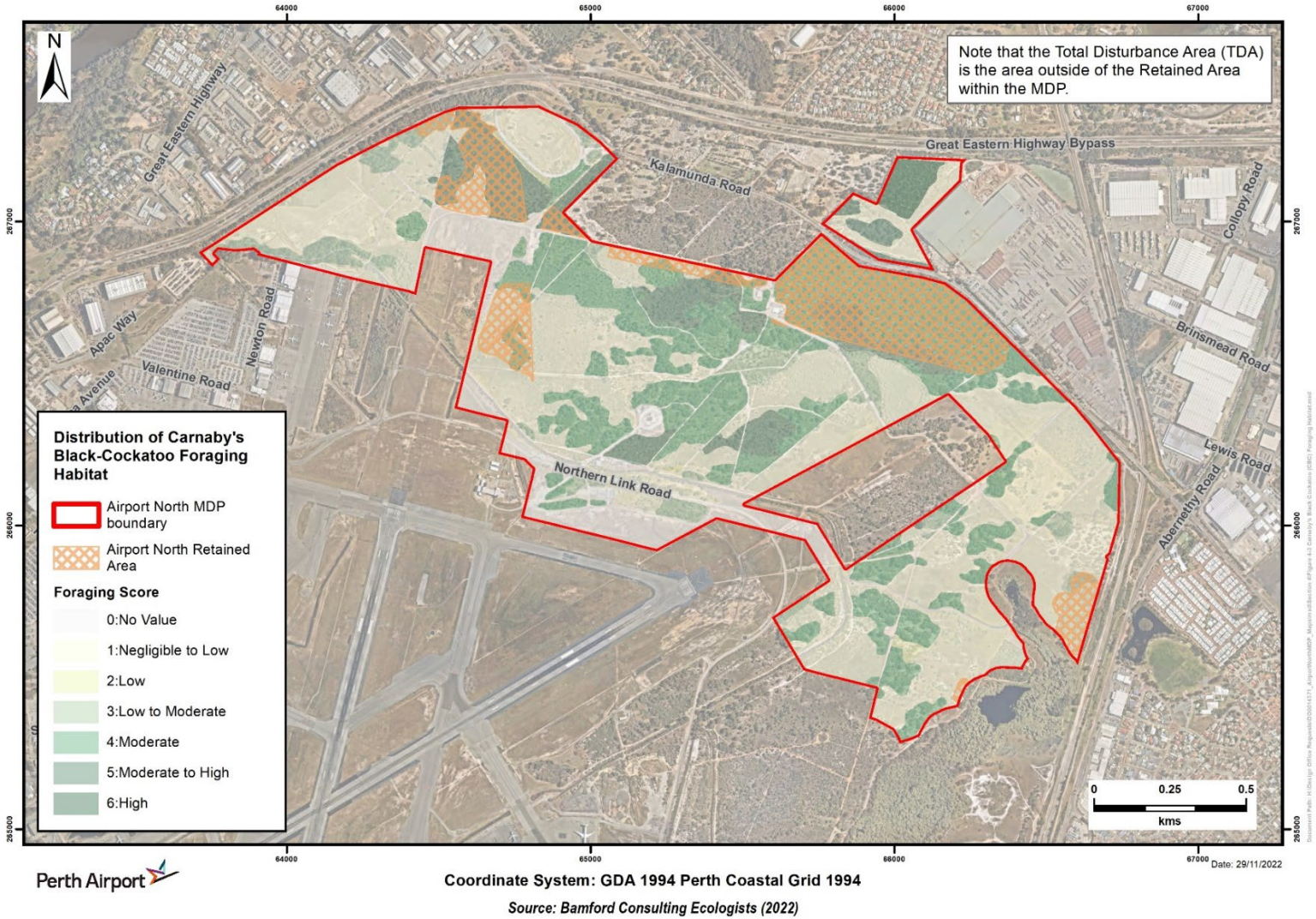


Figure 4-3: Carnaby's Black Cockatoo (CBC) Foraging Habitat

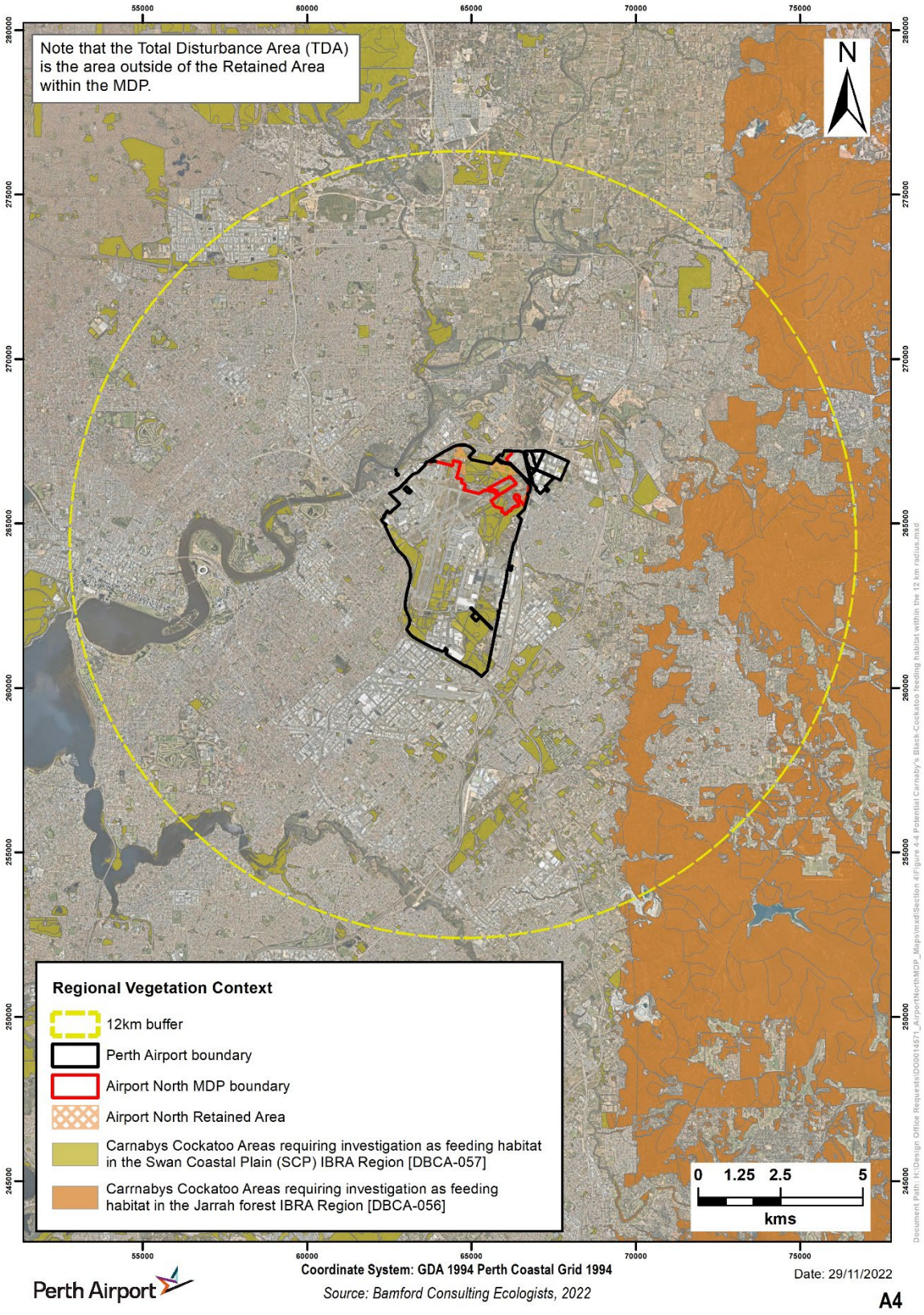


Figure 4-4 Potential Carnaby's Black Cockatoo feeding habitat within 12 km radius

4.4.2 Direct Impacts and Associated Avoidance/Mitigation Measures

Implementation of the proposed MDP (based on the defined total disturbance area) will result in the loss of:

- 180.33 ha of foraging habitat (in the TDA), ranging in value from 'negligible to low to 'high' value
- 81 potential black cockatoo habitat trees, which includes 4 trees with potentially suitable hollows for black cockatoo usage.

Whilst the above impacts of implementing the proposed MDP are unavoidable, the MDP layout has been strategically designed to retain selected areas of CBC habitat in the north of the MDP area . This will result in avoidance of some potential impacts to CBC, through the strategic protection and retention of habitat, where development could have been proposed in an alternative layout. The following habitat values are proposed to be retained through implementation of the MDP:

- 34.29 ha of foraging habitat, ranging in value from 'low to moderate' to 'high value'
- Seven potential black cockatoo habitat trees.

The proposed retention areas within the MDP have targeted the largest, most contiguous and intact areas of habitat which will maximise the ongoing viability of black cockatoo habitat and maximise the potential for its continued use by the species.

4.4.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Indirect impacts to CBC have been considered in relation to the known threatening processes for fauna and their ecosystem function, and how the proposed MDP scope may contribute to or affect these. These potential impacts, as well as the associated avoidance and mitigation measures, are outlined in **Table 4-10**.

Table 4-6: Summary of impacts to Carnaby's black cockatoo

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Direct	Habitat loss leading to population decline /local extinction	Minor	Loss of 180.33 ha of CBC foraging habitat (Scores 1-6 only) will occur as a result of the Airport North development. This comprises 63.18 ha of moderate to high quality foraging habitat and 117.15 ha of negligible to low quality foraging habitat. Foraging habitat remaining within a 12 km radius is in the order of approximately 7,078.08 ha (DBCA CBC feeding habitat mapping). Removing 180.33 ha of CBC foraging habitat will result in a decline of 2.5% in carrying capacity within that region. Loss of 4 potential nest-trees that currently bear suitable hollows (Rank 3) and 77 potential nest-trees that do not presently have suitable hollows (Rank 4 and Rank 5). CBC is not known to breed in the project area.	Avoidance of 34.29 ha of foraging habitat for CBC within the MDP area. Well-defined and rationalised clearing footprint that further avoids sensitive habitat where possible within the TDA. Landscape planting foraging species suitable for CBC. Replant degraded areas.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Population Fragmentation	Negligible	CBC is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. Development of Airport North is unlikely to result in fragmentation of existing populations.	Avoidance of 34.29 ha of foraging habitat for CBC within the MDP area. Replanting to replace/ enhance connectivity.
Indirect (ecosystem function)	Degradation of surrounding habitat within the estate due to weed invasion	Negligible	The development of Airport North will result in all native vegetation being cleared from the TDA, except for approximately 34.3 ha of CBC foraging habitat within the proposed retention areas. Surrounding remnant native vegetation within the estate may be impacted by weeds. However, impacts are likely to be negligible and can be managed with existing weed management protocols. No offsite impacts as a result of weed invasion are expected.	Weed management during earthworks. Active weed management post-development to rehabilitate degraded areas.
Direct	Ongoing Mortality	Negligible	Ongoing mortality can occur during project operations; for example, from birds colliding with approaching and departing planes (runway adjacent to the project area) and from vehicle strike. Bird strike may decrease due to removal of vegetation from the project area	Road speeds reduced in areas of high fauna activity. Avoid black-cockatoo forage trees along high-speed roads.
Indirect (ecosystem function)	Species interactions	Negligible	Not relevant to CBC. However, existing feral management procedures need to be continued.	Not applicable.
Indirect (ecosystem function)	Changes to Hydroecology	Negligible	There may be a risk to habitat used by CBC due to altered hydrology (such as increased surface water runoff), although with standard management procedures, the risk is considered low. There could be some off-site hydrological change, but this would also not affect habitat for the species.	Understand and manage local hydrology. Ensure standard approaches minimise hydrological change.
Indirect (ecosystem function)	Changes to Fire Regime	Minor	Altered fire regimes could affect the quality of foraging habitat such as suppression of flowering by banksias for a few years after fire.	Existing fire management and suppression around the airport estate.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Dust, light, vibration, noise	Negligible	Not relevant to CBC as the species is very tolerant of noise and light in urban environments.	Legal environmental limits.

Source: BCE 2022

4.4.4 Significance of Residual Impacts

The potential impacts resulting from the clearing of CBC habitat within the MDP area could trigger two of the nine significant impact criteria (EPBC Guideline 1.1 (DoE, 2013)) for endangered fauna species (BCE 2022), as outlined in **Table 4-11**. The loss of foraging habitat could alter the local distribution of the species and reduce its abundance at the regional level, but is not expected to have a significant impact at the species scale. This impact can be considered to be major at the level of the surrounding airport estate, and moderate in the regional context (within 12km).

Table 4-7: Assessment of significance of residual impacts to Carnaby's black cockatoo

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Lead to a long-term decrease in the size of a population (or an important population).	Likely to occur. CBC is a regular non-breeding migrant to the project area and airport estate. Native vegetation within the TDA does provide some foraging habitat (180.33 ha of varied value, from low to high), and c. 2.5% of foraging habitat within 12 km. The impact is likely to be a shift in the local distribution and abundance of the species in the project area. It is uncertain if this represents a decline in an important population, but there will be a decline in the number of the species, or their period of occupancy, at a regional level (12 km). At present, breeding does not occur in the project area, but there may be some breeding within 12 km to the east.
Reduce the area of occupancy of the species (or an important population).	Likely to occur. Loss of the native vegetation will alter the local distribution and abundance of the CBC, resulting in a reduction in their local abundance. They are likely to still occur in the immediate region and remain as visitors (but in reduced numbers) to the airport estate.
Fragment an existing population (or important population) into two or more populations.	Unlikely to occur. No barrier to movement. CBC is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. Development of Airport North is unlikely to result in fragmentation of existing populations.
Adversely affect habitat critical to the survival of a species.	Unlikely to occur. Native vegetation within the TDA does provide some low to high foraging habitat (180.33 ha). The impact is likely to be a shift in the local distribution and abundance of the species but is not critical to the survival of the species.
Disrupt the breeding cycle of a population (or important population).	Unlikely to occur. Some loss of potential nest-trees at a localised scale, however breeding is not confirmed within the project area. Breeding of the CBC may occur within 12 km, and thus a small loss of foraging habitat for a few breeding pairs may occur; this would represent a very small part of the foraging range of those pairs.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely to occur. Localised loss of foraging habitat (180.33ha) will occur with clearing of native vegetation within the Airport North area. The loss of foraging habitat will lead to a decline in abundance at the local scale, but is not critical to the survival of the species. Offsets within the Perth region are proposed to ensure there will be no overall loss of foraging habitat.
Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.	Unlikely to occur. Feral species and other competitors (e.g. feral bees, cats and foxes) are likely to be present in the region, but can be managed with onsite environmental procedures.
Introduce disease that may cause the species to decline.	Unlikely to occur.

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
	The CEMP will address soil hygiene to prevent introduction and spread of weeds. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Interfere with the recovery of the species.	Unlikely to occur. Localised impacts. Broad-scale threatening processes (i.e. habitat loss) are of greatest concern for the species. No active, direct recovery measures are currently undertaken in Airport North or across the airport estate. The project is unlikely to interfere with the recovery of the species provided that vegetation clearing is offset as required.

Source: BCE 2022

4.4.5 Cumulative Impacts

Cumulative impacts have been determined based on the combined total disturbance areas associated with multiple proposals currently under consideration across the airport estate. In this context, the following cumulative impacts are relevant to CBC across the airport estate:

- Cumulative loss of 510.47 ha of foraging habitat, ranging in foraging value from 'Negligible to Low' to 'high' value.
- Cumulative loss of 265 potential habitat trees (195 marri and 70 jarrah). Of these, 16 have hollows suitable for use by black cockatoos. However, the species is considered unlikely to breed within the airport estate.
- Given there is no known roosting sites within Perth Airport estate, no cumulative loss of such habitat is anticipated.
- Cumulative impacts of known proposed projects at Perth Airport (see Table 4-12) to CBC are expected at the local- (major impact within the airport estate) and regional- (moderate impact within 12 km) scales but these are not expected to be significant at the species-scale (effectively no population decline across the species' range with, at most, a few individuals impacted and any decline in population size within the normal range of annual variability).

Table 4-8 Cumulative loss (foraging habitat or potential nest-trees) to black-cockatoos within the Perth Airport estate (for projects within known boundary).

Impact	Airport North (this MDP)	Airport West	New Runway Project	Airport Central	Total
Carnaby's Black-Cockatoo Foraging Habitat (ha)	180.33	48.2	232.7	49.24	510.47
Forest-Red-tailed Black-Cockatoo Foraging Habitat (ha)	83.11	26.8	63.9	22.54	196.35
Baudin's Black-Cockatoo Foraging Habitat (ha)	83.11	26.8	63.9	22.54	196.35
Potential black-cockatoo nest-trees that bear hollows *†	9 (7 + 2)	3 (0 + 3)	25 (8 + 17)	0 (0 + 0)	37 (15 + 22)
Potential black-cockatoo nest-trees with no hollows *∞	72 (31 + 41)	30 (1 + 29)	108 (22 + 86)	18 (1 + 17)	228 (55 + 173)

Values are based on the Airport Central (TDA), Airport North (TDA), New Runway Project and Airport West (South) areas.
* The number of Jarrah and Marri trees are presented in parentheses, respectively.
† Known or potential nest-trees with a rank of 1 to 4.

∞ Potential nest-trees with a rank of 5.

4.4.6 Anticipated Outcome

Whilst the proposed MDP works will provide for the retention of approximately 34.29 ha of CBC foraging habitat, the residual impacts of the proposed MDP development on CBC will be the loss of 180.33 ha of foraging habitat (of varying value to the species) and 79 potential habitat trees (but only four with suitable hollows). This impact can be considered to be major at the level of the surrounding airport estate, and moderate in the regional context (within 12km). Given the quantum of the residual impact on CBC foraging habitat and based on an assessment against the significant impact criteria, the residual impact at the species scale is not considered to be significant.

4.5 Impact Assessment – Baudin's Black Cockatoo

4.5.1 Overview of Values

Baudin's Black Cockatoo (BBC) is primarily a species inhabiting the tall eucalypt forests of the South-West, with the Perth region being at its northern limit of range. The species is present, and breeds, in the forests of the Darling Escarpment, situated to the east of Perth. Recent surveys (post 2018) suggest that the species may forage within the Perth Airport estate and within the MDP area more often than previously thought, but the species is still considered likely to be an irregular visitor.

As outlined in Table 4-12, approximately 110.68 ha of the MDP area and 83.11 ha of the TDA provide some foraging value for Baudin's Black-Cockatoo with a foraging value score of between 1 (negligible to low foraging value) to 5 (moderate to high foraging value), out of a possible total score of six. There are 59.18 ha of moderate to high foraging habitat (score 4 and 5) for this species within the MDP area and 41.40 ha within the TDA, and 51.50 ha of negligible to low foraging habitat (score 1 to 3) for this species within the MDP area and 41.71 ha within the TDA. Approximately 55.4% (137.35 ha) of the MDP area and 61.1% (130.53 ha) of the TDA had no foraging value (Score 0) for the species. The distribution of foraging habitat for the species in the project area is shown in **Figure 4-5**

Table 4-9 Summary of Baudin's Black-Cockatoo vegetation characteristics foraging habitat in the Project Area

Score based on vegetation characteristics (out of 6)	Impact areas (ha) per foraging habitat vegetation score		
	MDP	TDA	RETAINED
1 – Negligible to Low	20.01	16.59	3.42
2 – Low	8.38	8.07	0.31
3 – Low to Moderate	23.11	17.05	6.06
4 – Moderate	9.89	8.85	1.04
5 – Moderate to High	49.29	32.55	16.74
6 – High	0	0	0
Total	110.68	83.11	27.57

Source: Bamford Consulting Ecologists, 2022

No BBC roosting sites or roosting activity was recorded within the MDP area or wider Perth Airport estate, although there are some known roost sites for white-tailed black cockatoos (either Carnaby's or Baudin's) from the *Great Cocky Count* in the region.

Whilst the MDP area contain 88 trees which meet the generic criteria for a potential black cockatoo breeding habitat tree (as discussed in **Section 4.5**), these are not considered relevant to BBC given the species is not known to breed on the Swan Coastal Plain and is therefore unlikely to breed within the Perth Airport estate. The other two black-cockatoo species show some ecological flexibility, but the more specialised foraging behaviour of BBC may mean it is less likely to make changes to its breeding behaviour.

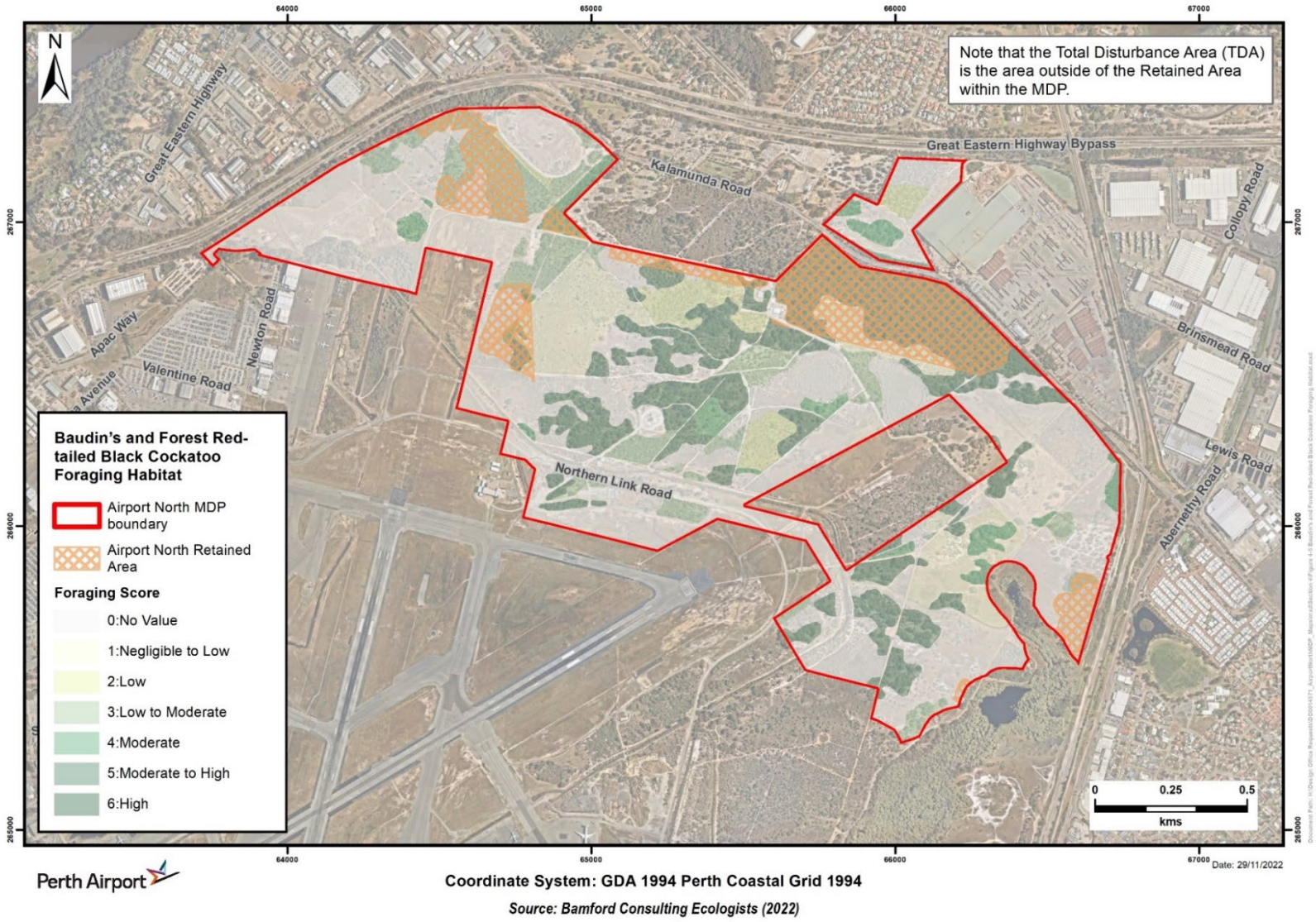


Figure 4-5: Baudin's and Forest Red-tailed Black Cockatoo Foraging Habitat

Perth Airport

4.5.2 Direct Impacts and Associated Avoidance/Mitigation Measures

Implementation of the proposed MDP (based on the defined total disturbance area) will result in the loss of:

- 83.11 ha of foraging habitat (in the TDA).
- 81 potential black cockatoo habitat trees, which includes four trees with potentially suitable hollows for black cockatoo usage.

Whilst the above impacts of implementing the proposed MDP scope are unavoidable, the MDP layout has been strategically designed to retain selected areas of BBC habitat in the north of the MDP area. This will result in avoidance of some potential impacts to BBC, through the strategic protection and future retention of habitat, where development could have been proposed in an alternative layout. The following habitat values are proposed to be retained through implementation of the MDP:

- 27.57 ha of foraging habitat.
- Seven potential black cockatoo habitat trees.

The proposed retention areas within the MDP have targeted the largest, most contiguous and intact areas of habitat which will maximise the ongoing viability of black cockatoo habitat and maximise the potential for its continued use by the species. Table 4-14 and Section 1.6 provide further discussion around impact avoidance measures provided in the MDP layout.

4.5.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Indirect impacts to BBC have been considered in relation to the known threatening processes for fauna and their ecosystem function, and how the proposed MDP works may contribute to or affect these. These potential impacts, as well as the associated avoidance and mitigation measures, are outlined in Table 4-14..

Table 4-10: Potential impacts to Baudin's Black Cockatoo

Impact type	Threatened process	Significance	Discussion	Avoidance or mitigation measure/s
Direct	Habitat loss leading to population decline /local extinction	Moderate	Loss of 83.11 ha of foraging habitat (Scores 1-6 only) will occur as a result of the Airport North development, but on current knowledge this is used irregularly. Foraging habitat remaining within a 12 km radius is in the order of approximately 8,427.61 ha (comprising all Heddle vegetation complexes). Removing 83.11 ha of BBC foraging habitat will result in a decline of 1.0% in carrying capacity within that region.	Avoidance of 27.57 ha of foraging habitat for BBC within the MDP area. Well-defined and rationalised clearing footprint that further avoids sensitive habitat where possible within the TDA. Plant with foraging species suitable for BBC. Replant degraded areas and revegetation areas.
Indirect (ecosystem function)	Population Fragmentation	Negligible	BBC is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. Development of the project area is unlikely to result in fragmentation of existing populations.	Avoidance of 27.57 ha of foraging habitat for BBC within the MDP area. Replanting to replace/ enhance connectivity.

Impact type	Threatened process	Significance	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Degradation of surrounding habitat within the estate due to weed invasion	Negligible	The development of Airport North will result in all native vegetation being cleared from the TDA, except for approximately 34.3 ha of BBC foraging habitat within the proposed retention areas. Surrounding remnant native vegetation within the estate may be impacted by weeds. However, impacts are likely to be negligible and can be managed with existing weed management protocols. No offsite impacts as a result of weed invasion are expected.	Weed management during earthworks. Active weed management post-development to rehabilitate degraded areas.
Direct	Ongoing Mortality	Negligible	Ongoing mortality can occur during project operations; for example from birds colliding with approaching and departing planes (runway adjacent to Airport North) and from vehicle strike. Bird strike may decrease due to removal of vegetation from the project area.	Road speeds reduced in areas of high fauna activity. Avoid black-cockatoo forage trees along high-speed roads.
Indirect (ecosystem function)	Species interactions	Negligible	Not relevant to BBC. However, existing feral management procedures need to be continued.	Not applicable.
Indirect (ecosystem function)	Changes to Hydroecology	Negligible	There may be a risk to habitat used by BBC due to altered hydrology (such as increased surface water runoff), although with standard management procedures the risk is considered low. There could be some off-site hydrological change, but this would also not affect habitat for the species.	Understand and manage local hydrology. Ensure standard approaches minimise hydrological change.
Indirect (ecosystem function)	Changes to Fire Regime	Minor	Altered fire regimes could affect the quality of foraging habitat but the key food plant for the species in the area (marri) is a tall tree likely to be affected only by high intensity fires. Such fires are unlikely to occur with current and proposed fire management.	Existing fire management and suppression around the airport estate.
Indirect (ecosystem function)	Dust, light, vibration, noise	Negligible	Not relevant to BBC as the species is very tolerant to noise and light in urban environments.	Legal environmental limits.

Source: BCE 2022

4.5.4 Significance of Residual Impacts

Based on this assessment, using EPBC Guideline 1.1 (DoE 2013) significance criteria, none of the nine significance criteria are expected to be triggered for Baudin's black cockatoo as a result of implementing the proposed MDP scope (BCE 2022), as outlined in **Table 4-15**.

This impact can be considered to be major at the level of the surrounding airport estate, and minor in the regional context (within 12km). The loss of foraging habitat could alter the local distribution of the species, but this is not expected to have a significant impact on the local population or at the species scale. The loss of potential nest-trees, with no evidence of breeding within the TDA, is not expected to have a significant impact at the species scale.

Table 4-11: Assessment of significance of residual impacts to Baudin's black cockatoo

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Lead to a long-term decrease in the size of a population (or an important population).	**Unlikely to occur.** Native vegetation within the project area does provide some foraging habitat and comprises c. 1.0% of foraging habitat within 12 km. The impact is likely to be a shift in the local distribution and abundance of the species but not to result in a population decline. At present breeding does not occur in the project area but there may be some breeding within 12 km to the east. Despite the proportion of foraging habitat in the project area, on current observations the species is an irregular foraging visitor and therefore actual impact from loss of foraging habitat on the local population is expected to be negligible.
Reduce the area of occupancy of the species (or an important population).	**Unlikely to occur.** Loss of the native vegetation may alter the local distribution and abundance of the BBC, but based on current behaviour of the birds they are irregular visitors so the impact will be a reduction in the frequency with which birds visit the project area.
Fragment an existing population (or important population) into two or more populations.	**Unlikely to occur.** No barrier to movement. BBC is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. Development of the project area is unlikely to result in fragmentation of existing populations.
Adversely affect habitat critical to the survival of a species.	**Unlikely to occur.** The project area is not situated in primary nesting or foraging habitat for this species. Very minor loss of preferred foraging habitat used only infrequently. Adjacent foraging habitat available outside the project area.
Disrupt the breeding cycle of a population (or important population).	**Unlikely to occur.** Some loss of potential nest-trees at a localised scale, however breeding not confirmed within the project area. Breeding of BBC may occur within 12 km, and thus a small loss of foraging habitat of a few breeding pairs may occur.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	**Unlikely to occur.** Localised loss of foraging habitat (83.11 ha) will occur with development of native vegetation within the project area, but it is currently used only irregularly by the species. Offsets will to some degree minimise long term impacts associated with vegetation clearing.
Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.	**Unlikely to occur.** Feral species and other competitors (e.g. feral bees, cats and foxes) are likely to be present in the region, but can be managed with onsite environmental procedures.
Introduce disease that may cause the species to decline.	**Unlikely to occur.**

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
	The CEMP will address soil hygiene to prevent introduction and spread of weeds. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Interfere with the recovery of the species.	**Unlikely to occur.** Localised impacts. Broad-scale threatening processes (i.e. habitat loss) are of greatest concern for the species. No active, direct recovery measures are currently undertaken in the project area or airport estate. The project is unlikely to interfere with the recovery of the species, provided that vegetation clearing is offset.

Source: BCE 2022

4.5.5 Cumulative Impacts

Cumulative impacts have been determined based on the combined total disturbance areas associated with multiple proposals currently under consideration across the airport estate, as outlined in Table 4-12. In this context, the following cumulative impacts are relevant to Baudin's Black Cockatoo across the airport estate:

- Cumulative loss of 196.35 ha of foraging habitat, ranging in foraging value from 'Negligible to Low' to 'moderate to high' value.
- Cumulative loss of 265 potential habitat trees (195 marri and 70 jarrah). Of these, 16 have hollows suitable for use by black cockatoos. However, the species is considered unlikely to breed within the Perth Airport estate, and even less likely than the other two species of black cockatoo.
- Given there are no known roosting sites within Perth Airport estate, no cumulative loss of such habitat is anticipated.
- Cumulative impacts of known proposed projects at Perth Airport to BBC are expected at the local- (major impact within the airport estate) and regional- (moderate impact within 12 km) scales but these are not expected to be significant at the species-scale.

4.5.6 Anticipated Outcome

Whilst the MDP will provide for the retention of approximately 27.57 ha of BBC foraging habitat, the residual impacts of the MDP on BBC will be the loss of 83.11 ha of foraging habitat (of varying value to the species) and 81 potential habitat trees (but only four with suitable hollows). This impact can be considered to be major at the level of the surrounding airport estate, and minor in the regional context (within 12km). The loss of foraging habitat could alter the local distribution of the species, but this is not expected to have a significant impact on the local population or at the species scale.

4.6 Impact Assessment – Forest Red-tailed Black Cockatoo

4.6.1 Overview of Values

The Forest Red-tailed Black-Cockatoo (FRTBC) has undergone a recent (since about 2010) influx onto the Swan Coastal Plain in the Perth area. The species was not recorded within the Perth Airport estate in early site-specific surveys, but has been regularly observed since 2008,, and is considered a regular visitor to the MDP area. Small numbers of FRTBCs occur around the airport estate more or less consistently.

The FRTBC has similar foraging preferences to Baudin's black cockatoo. The amount of quality native foraging habitat within the Airport North area and airport estate is small, so the presence of the species is probably supported by exotic plants within and outside the area. As outlined in Table 4-16 and shown in Figure 4-5, approximately 110.68 ha of the MDP area and 83.11 ha of the TDA provide some foraging value for FRTBC with a foraging value score of between 1 (negligible to low foraging value) to 5 (moderate to high foraging value), out of a possible total score of six. FRBC foraging evidence has been routinely observed within the MDP area.

Table 4-12 Summary of Forest Red-tailed Black-Cockatoo vegetation characteristics foraging habitat in the Project Area

SCORE BASED ON VEGETATION CHARACTERISTICS (OUT OF 6)	IMPACT AREAS (HA) PER FORAGING HABITAT VEGETATION SCORE		
	MDP	TDA	(RETAINED)
1 – Negligible to Low	20.01	16.59	3.42
2 – Low	8.38	8.07	0.31
3 – Low to Moderate	23.11	17.05	6.06
4 – Moderate	9.89	8.85	1.04
5 – Moderate to High	49.29	32.55	16.74
6 – High	0	0	0
Total	110.68	83.11	27.57

Source: Bamford Consulting Ecologists, 2022

No FRTBC roosting sites or roosting activity was recorded within the MDP area or wider Perth Airport estate, although there are some known roost sites for FRTBC from the Great Cocky Count in the region.

The FRBC does not currently breed within the MDP area or the wider Perth Airport estate and is considered unlikely to do so, but the species is known to breed elsewhere on the Swan Coastal Plain in small numbers. It also breeds nearby (within 12 km) in forests along the Darling Escarpment. The nearest possible (but unconfirmed) breeding is in the Bushmead Rifle Range area, approximately 4 km to the north-east. Breeding is more likely to the east, along the Darling Escarpment within the species more traditional breeding range. Notwithstanding, the MDP areas contain 88 trees which meet the generic criteria for a potential black cockatoo breeding habitat tree, as discussed in Section 4.5.

4.6.2 Direct Impacts and Associated Avoidance/Mitigation Measures

Implementation of the proposed MDP (based on the defined total disturbance area) will result in the loss of:

- 83.11 ha of foraging habitat, ranging in value from 'negligible to low' to 'moderate to high' value.
- 81 potential black cockatoo habitat trees, which includes four trees with potentially suitable

hollows for black cockatoo usage.

Whilst the above impacts of implementing the proposed MDP are unavoidable, the MDP layout has been strategically designed to retain selected areas of FRTBC habitat in the north of the MDP area. This will result in avoidance of some potential impacts to FRTBC, through the strategic protection and future retention of habitat, where development could have been proposed in an alternative layout. The following habitat values are proposed to be retained through implementation of the MDP:

- 27.57 ha of foraging habitat ranging in value from 'negligible to low' to 'moderate to high' value
- Seven potential black cockatoo habitat trees.

The proposed retention areas within the MDP have targeted the largest, most contiguous and intact areas of habitat which will maximise the ongoing viability of black cockatoo habitat and maximise the potential for its continued use by the species. Table 4-17 and Section 1.6 provides further discussion around impact avoidance measures provided in the MDP layout.

4.6.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Indirect impacts to FRTBC have been considered in relation to the known threatening processes for fauna and their ecosystem function, and how the proposed MDP development may contribute to or affect these. These potential impacts, as well as the associated avoidance and mitigation measures, are outlined in Table 4-17.

Table 4-13: Potential impacts to Forest Red-tailed Black Cockatoo

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Direct	Habitat loss leading to population decline /local extinction	Moderate	Loss of 83.11 ha of foraging habitat will occur as a result of the Airport North development, but on current knowledge this is used irregularly. This comprises 41.40 ha of moderate to high quality foraging habitat and 41.71 ha of negligible to low quality foraging habitat. Foraging habitat remaining within a 12 km radius is in the order of approximately 8,427.61 ha (comprising all Heddle vegetation complexes). Removing 83.11 ha of FRTBC foraging habitat will result in a decline of 1.0% in carrying capacity within that region. Loss of 4 potential nest-trees that currently bear suitable hollows (Rank 3) and 77 potential nest-trees that do not presently have suitable hollows (Rank 4 and Rank 5). FRTBC is not known to breed in the project area.	Avoidance of 27.57 ha of foraging habitat for FRTBC within the MDP area. Well-defined and rationalised clearing footprint that further avoids sensitive habitat where possible within the TDA. Plant with foraging species suitable for the FRTBC. Replant degraded areas.
Indirect (ecosystem function)	Population Fragmentation	Negligible	The FRTBC is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. Development of the project area is unlikely to result in fragmentation of existing populations.	Avoidance of 27.57 ha of foraging habitat for FRTBC within the MDP area. Retention of areas of habitat. Replanting to replace/ enhance connectivity.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Degradation of surrounding habitat within the estate due to weed invasion	Negligible	The development of Airport North will result in all native vegetation being cleared from the TDA, except for approximately 34.3 ha of FRTBC foraging habitat within the proposed retention areas. Surrounding remnant native vegetation within the estate may be impacted by weeds. However, impacts are likely to be negligible and can be managed with existing weed management protocols. No offsite impacts as a result of weed invasion are expected.	Weed management during earthworks. Active weed management post-development to rehabilitate degraded areas.
Direct	Ongoing Mortality	Negligible	Ongoing mortality can occur during project operations; for example, from birds colliding with approaching and departing planes (runway adjacent to Airport North and from vehicle strike). Bird strike may decrease due to removal of vegetation from the project area.	Road speeds reduced in areas of high fauna activity. Avoid black-cockatoo forage trees along high-speed roads.
Indirect (ecosystem function)	Species interactions	Negligible	Not relevant to FRTBC. However, existing feral management procedures need to be continued.	Not applicable.
Indirect (ecosystem function)	Changes to Hydroecology	Negligible	There may be a risk to habitat used by the FRTBC due to altered hydrology (such as increased surface water runoff), although with standard management procedures the risk is considered low. There could be some off-site hydrological change, but this would also not affect habitat for the species.	Understand and manage local hydrology. Ensure standard approaches minimise hydrological change.
Indirect (ecosystem function)	Changes to Fire Regime	Minor	Altered fire regimes could affect the quality of foraging habitat but the key food plant for the species in the area (marri) is a tall tree likely to be affected only by high intensity fires. Such fires are unlikely to occur with current and proposed fire management.	Existing fire management and suppression around the airport estate.
Indirect (ecosystem function)	Dust, light, vibration, noise	Negligible	Not relevant to the FRTBC as the species is very tolerant to noise and light in urban environments.	Legal environmental limits.

Source: BCE 2022

4.6.4 Significance of Residual Impacts

Based on this assessment, using EPBC Guideline 1.1 (DoE, 2013), two of the nine significance criteria are expected to be triggered for FRTBC as a result of implementing the proposed MDP (BCE 2022), as outlined in **Table 4-18**.

This impact can be considered to be major at the level of the surrounding airport estate, and moderate in the regional context (within 12km). The loss of foraging habitat could alter the local distribution of the species, but this is not expected to have a significant impact on the local population or at the species scale. The loss of potential nest-trees, with no evidence of breeding within the TDA, is not expected to have a significant impact at the species scale.

Table 4-14: Assessment of significance of residual impacts to Forest Red-tailed Black Cockatoo

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Lead to a long-term decrease in the size of a population (or an important population).	Likely to occur. The FRTBCis a regular non-breeding visitor to the project area and airport estate. Native vegetation within the TDA does provide some foraging habitat (83.11 ha of varied value, from low to high), and c. 1.0% of foraging habitat within 12 km. The impact is likely to be a shift in the local distribution and abundance of the species. It is uncertain if this represents a decline in an important population, but there may be a small decline in the number of the species present, or the period of occupancy, at a regional level (12km). At present breeding does not occur in the project area, but there may be some breeding within 12 km to the east.
Reduce the area of occupancy of the species (or an important population).	Likely to occur. Loss of the native vegetation of the estate will alter the local distribution and abundance of the FRTBC resulting in a reduction in their local abundance. They are likely to still occur in the immediate region and remain as visitors (but in reduced numbers) to the airport estate.
Fragment an existing population (or important population) into two or more populations.	Unlikely to occur. No barrier to movement. The FRTBC is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. Development of the project area is unlikely to result in fragmentation of existing populations.
Adversely affect habitat critical to the survival of a species.	Unlikely to occur. Native vegetation within the TDA does provide some low to high foraging habitat (83.11 ha). The impact is likely to be a shift in the local distribution and abundance of the species but is not critical to the survival of the species.
Disrupt the breeding cycle of a population (or important population).	Unlikely to occur. Some loss of potential nest-trees at a localised scale, however breeding is not confirmed within the project area. Breeding of the FRTBC may occur within 12 km, and thus a small loss of foraging habitat of a few breeding pairs may occur.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely to occur. Feral species and other competitors (e.g. feral bees, cats and foxes) are likely to be present in the region, but can be managed with onsite environmental procedures.
Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.	Unlikely to occur. The CEMP will address soil hygiene to prevent introduction and spread of weeds. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Introduce disease that may cause the species to decline.	Unlikely to occur. Localised impacts. Broad-scale threatening processes (i.e. habitat loss) are of greatest concern for the species. No active, direct recovery measures are currently undertaken in the project area or airport estate. The project is unlikely to interfere with the recovery of the species provided that vegetation clearing is offset.

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Interfere with the recovery of the species.	Likely to occur. The FRTBC is a regular non-breeding visitor to the project area and airport estate. Native vegetation within the TDA does provide some foraging habitat (81.2 ha of varied value, from low to high), and c. 0.9% of foraging habitat within 12 km. The impact is likely to be a shift in the local distribution and abundance of the species. It is uncertain if this represents a decline in an important population, but there may be a small decline in the number of the species present, or the period of occupancy, at a regional level (12km). At present breeding does not occur in the project area, but there may be some breeding within 12 km to the east.

Source: BCE 2022

4.6.5 Cumulative Impacts

Cumulative impacts have been determined based on the combined total disturbance areas associated with multiple proposals currently under consideration across the Perth Airport estate. In this context, the following cumulative impacts are relevant to FRTBC across the airport estate:

- Cumulative loss of 196.35 ha of foraging habitat, ranging in foraging value from 'Negligible to Low' to 'High' value.
- Cumulative loss of 265 potential habitat trees (195 marri and 70 jarrah). Of these, 16 have hollows suitable for use by black cockatoos. However, the species is considered unlikely to breed within the airport estate.
- Given there is no known roosting sites within airport estate, no cumulative loss of such habitat is anticipated.
- Cumulative impacts of known proposed projects at Perth Airport to FRTBC are expected at the local- (major impact within the airport estate) and regional- (moderate impact within 12 km) scales but these are not expected to be significant at the species-scale.

4.6.6 Anticipated Outcome

Whilst the MDP scope will provide for the retention of approximately 27.57 ha of FRTBC foraging habitat, the residual impacts of the MDP on FRTBC will be the loss of 83.11 ha of foraging habitat (of varying value to the species) and 81 potential habitat trees (but only four with suitable hollows). Given the quantum of the residual impact on FRTBC foraging habitat and based on an assessment against the significant impact criteria, the residual impact at the species scale is not considered to be significant.

4.7 Impact Assessment – Quenda

4.7.1 Overview of Values

The Quenda is abundant across the Perth Airport estate, including within the MDP area. Evidence of the species (e.g. tracks and foraging holes) have been found in all locations visited, including native vegetation, in areas where weeds provide dense cover and even in garden beds. However, animals in garden beds probably represent a very small proportion of the population and may represent displaced individuals.

Within the MDP area, quenda habitat is associated with areas of grassland, damp heathland and woodland (including riparian woodland). In total, the TDA area contains approximately 180.33 ha of quenda habitat, see Figure 4-6.

Based on the outcomes of the various baseline and technical fauna surveys completed across the Perth Airport estate to date, the size of the quenda population within the estate has been estimated. This is based on approximate densities of quenda individuals that each habitat was observed to support.

While this categorisation is simplistic, it does allow undeveloped parts of the Airport North area to be assigned a Quenda value, for a population estimate to be made and for proportional population impacts to be calculated based upon areas of the three broad habitat types. Quenda population estimates for each habitat type within the MDP area are outlined in **Table 4-19**.

The total Quenda population within the MDP area is therefore considered to be in the order of 202 individuals, with 157 of these in the TDA and 45 in the proposed retention areas.

Table 4-15: Estimated quenda population within MDP area

Habitat type	MDP Area (ha)	TDA Area (ha)	Estimated population supported by habitat within TDA (no. individuals)	Estimated population supported by habitat within retention area (no. individuals)	Total Estimated population supported by habitat within MDP (no. individuals)
Grassland	100.95	95.75	24	1	25
Damp heathland	12.41	10.28	29	6	35
Woodland (including riparian woodland)	101.27	74.3	104	38	142
Total	214.63	180.33	157	45	202

Source: BCE 2022

Quenda persist in the region; outside of the Airport North TDA and outside of the airport estate. A map of regional Quenda records (from a DBCA Threatened, Specially Protected, and priority fauna database search, and also from a search of the Atlas of Living Australia database) is presented in Figure 4-7. Quenda have been recorded throughout parts of the urban/commercial matrix as well as in areas of remnant native vegetation. It is expected that these regional Quenda populations will be unimpacted by development at Airport North.

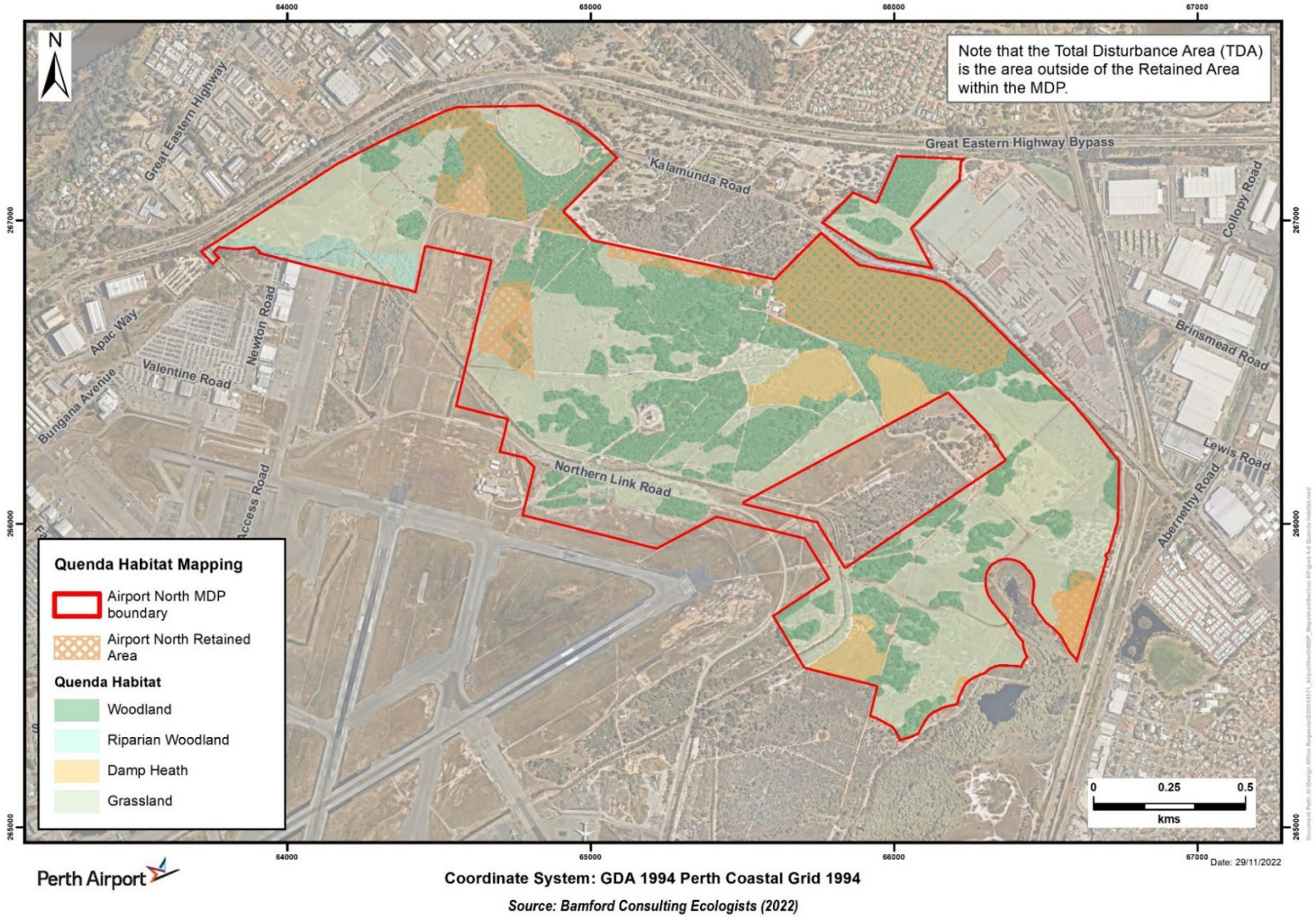


Figure 4-6: Quenda Habitat

Perth Airport

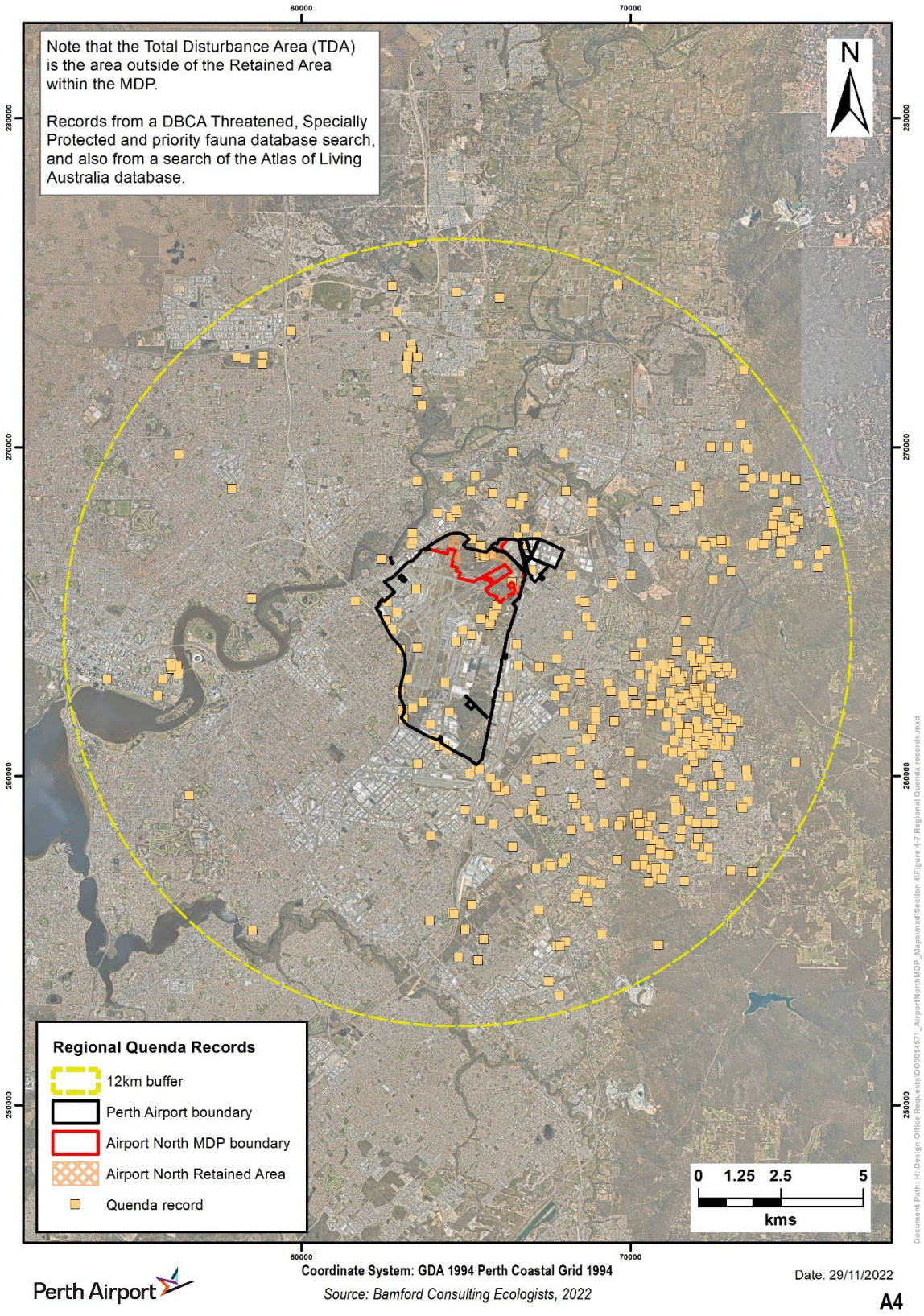


Figure 4-7 Regional Quenda records.

4.7.2 Direct Impacts and Associated Avoidance/Mitigation Measures

Implementation of the MDP will result in the loss of 180.33 ha of quenda habitat, which is estimated to support a population of approximately 157 individuals. Of this, 84.58 ha is ideal habitat, supporting 133 of the individuals. Translocation of animals will occur prior to clearing. It is anticipated that there will be a decrease in the local population of quenda within the airport estate, given the reduced availability of habitat.

Whilst the above impacts of implementing the proposed MDP are unavoidable, the MDP layout has been strategically designed to retain selected areas of quenda habitat within the MDP area. This will result in avoidance of some potential impacts to quenda, through the strategic protection and future retention of habitat, where development could have been proposed in an alternative layout. In this context, up to 34.3 ha of quenda habitat is anticipated to be retained, which is estimated to support a population of approximately 45 individuals.

The proposed retention areas within the MDP have targeted the largest, most contiguous and intact areas of habitat which will minimise the likelihood of quenda interactions with the proposed development land uses. Additionally, ecological corridors have been designed to provide coverage for movement between retention areas. Table 4-20 and **Section 1.6** provides further discussion around impact avoidance measures provided in the MDP layout.

4.7.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Indirect impacts to Quenda have been considered in relation to the known threatening processes for fauna and their ecosystem function, and how the proposed MDP may contribute to or affect these. These potential impacts, as well as the associated avoidance and mitigation measures, are outlined in **Table 4-20**.

Table 4-16: Potential impacts to Quenda

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Direct	Habitat loss leading to population decline/local extinction	Moderate	Loss of up to 180.33 ha of Quenda habitat may occur as a result of the Airport North project. The TDA currently has an approximate population of 157 individuals, thus the loss of habitat and resultant population decline within the project area could result in a population decline in the order of 7.9% across a 12 km radius.	Approximately 13.9% (34.3 ha) of the available Quenda habitat within the MDP is proposed to be retained. Well-defined and rationalised clearing footprint that avoids sensitive habitat where possible. Replant degraded areas and if possible, connect remnants and re-plantings with corridors of native vegetation. Translocate animals prior to clearing.
Indirect (ecosystem function)	Population Fragmentation	Moderate	The Quenda population within the Airport North area provides connectivity with populations in the northern area of the airport estate and into the broader region. The loss of individuals from the project area will reduce connectivity and further fragment remaining populations.	Ecological corridors designed to enable connectivity of retained patches. Retention of areas of habitat. Replanting to replace/ enhance connectivity.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Degradation of surrounding habitat within the estate due to weed invasion	Minor	The development of Airport North may result in the loss of up to 180.33 ha of Quenda habitat, but some native vegetation will be retained elsewhere on the airport estate. Retained areas may be at increased risk of weed invasion and the carrying capacity of these areas could be reduced as a result, although Quenda will utilise degraded vegetation.	Weed management during earthworks. Active weed management post-development to rehabilitate degraded areas.
Direct	Ongoing Mortality	Moderate; reduced to Minor assuming proposed mitigation	Ongoing mortality from vehicle strike can occur during project operations and is a concern for the proposed project.	Provide signage and reduce road speeds in areas of high fauna activity. Implement wildlife underpasses if suitable locations can be identified.
Indirect (ecosystem function)	Species interactions	Moderate; reduced to Minor assuming proposed mitigation	Impacts due to species interactions (i.e. predation by feral cats) are likely to increase due to habitat loss and fragmentation.	Existing control of feral species. Extend fox control to include cats. Dieback Management.
Indirect (ecosystem function)	Changes to Hydroecology	Negligible	Offsite impacts due to hydrological change are likely to be negligible as modifications to surface water hydrology will be strictly managed onsite. It is unlikely that Quenda habitat surrounding the project area would be impacted by hydrological change, although Quenda will utilise many different vegetation types.	Understand and manage local hydrology. Ensure standard approaches minimise hydrological change. Development of Living Stream corridor sections within Airport North.
Indirect (ecosystem function)	Changes to Fire Regime	Negligible	Not relevant to Quenda given the lack of habitat that will be retained in the project area. Surrounding habitat (outside of the project area, but within the estate) can be managed with existing fire management protocols.	Existing fire management and suppression around the airport estate.
Indirect (ecosystem function)	Dust, light, vibration, noise	Negligible	Not relevant to Quenda as the species is tolerant to noise and light in urban environments.	Legal environmental limits.

Source: BCE 2022

4.7.4 Significance of Residual Impacts

An assessment of the residual impacts to quenda for the MDP area has been undertaken using the significant impact criteria outlined in Significant Impact Guidelines 1.1. Based on this assessment, four of the nine significance criteria are expected to be triggered for Quenda as a result of implementing the proposed MDP works (BCE 2022), as outlined in **Table 4-21**.

This impact could be major at the level of the surrounding airport estate, and moderate in the regional context (within 12km). The loss of habitat could alter the local distribution of the species, but this is not expected to have a significant impact at the species scale.

Table 4-17: Assessment of significance of residual impacts to quenda

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Lead to a long-term decrease in the size of a population (or an important population).	**Likely to occur.** Approximately 180.33 ha of woodland, damp heathland and grassland may be impacted as a result of the Airport North project, leading to a decrease in the size of the local population.
Reduce the area of occupancy of the species (or an important population).	**Likely to occur.** Loss of 180.33 ha of Quenda habitat from the Airport North TDA will alter the local distribution and abundance of the Quenda resulting in a significant reduction in local abundance. They are likely to still occur in bushland to the north and other areas of the airport estate (e.g., in gardens, and verges).
Fragment an existing population (or important population) into two or more populations.	**Likely to occur.** The proposed clearing of 180.33 ha of Quenda habitat within the Airport North TDA is likely to result in further fragmentation of existing local populations.
Adversely affect habitat critical to the survival of a species.	**Unlikely to occur.** Quenda are widespread across the Swan Coastal Plain and Perth hills. Although 180.33 ha of Quenda habitat will be removed, the habitat within the project area is not critical to the survival of the species and some adjacent habitat is available within and outside the airport estate.
Disrupt the breeding cycle of a population (or important population).	**Likely to occur.** Breeding will be disrupted within the Airport North area but may continue (albeit at a much-reduced rate) after the construction phase as some individuals move back into gardens and verges within the project area. It is expected that breeding outside the project area and estate will continue undisrupted.
Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.	**Unlikely to occur.** Localised loss of Quenda habitat (180.33 ha) will occur with development of native vegetation within the Airport North area. While localised declines will occur, impacts will not lead to a decline of the species.
Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.	Unlikely to occur. Feral species and other competitors (e.g., feral cats and foxes) are likely to be present in the region but can be managed with onsite environmental procedures.
Introduce disease that may cause the species to decline.	Unlikely to occur. The CEMP will address soil hygiene to prevent introduction and spread of weeds. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Interfere with the recovery of the species.	Unlikely to occur. Localised impacts. Broad scale threatening processes (e.g. habitat loss, feral predators) are of greatest concern for the species. Feral predator control currently occurs across the airport estate and benefits the Quenda; this will presumably continue where appropriate.

Source: BCE 2022

1.1.3 Cumulative Impacts

Cumulative impacts have been determined based on the combined total disturbance areas associated with multiple proposals currently under consideration across the Perth Airport estate, as outlined in **Section 1.7**. In this context, the following cumulative impacts are relevant to quenda across the airport estate:

- Damp heathland (102.47 ha) – 287 individuals.
- Woodlands (187.07 ha) - 262 individuals.
- Grasslands (220.84 ha) - 55 individuals.

The Airport North components of the above are taken from the TDA only and exclude the animals expected to persist within the retained areas.

The cumulative total Quenda population within the three project areas is therefore considered to be in the order of 604 individuals (in 510.38 ha), see Table 4-22. This represents approximately 59.4% of Quenda individuals, and 70.4% Quenda habitat, within the airport estate. With retention of some native vegetation, rehabilitation and habitat creation, a much-reduced population will remain following substantial population decline.

Table 4-18 Cumulative loss (habitat or individuals) to Quenda within the Perth Airport estate (for projects with a known boundary)

Impact	Airport Central	Airport West	New Runway Project	Airport North (this MDP)	Total
Quenda Habitat (ha)	49.25	48.10	232.70	180.33	**510.38**
Quenda individuals	71	64	312	157	**604**

Values are based on the Airport Central (TDA), Airport North (TDA), New Runway Project and Airport West (South) areas.

Source: BCE 2022

Cumulative impacts of known proposed projects at Perth Airport are expected to be major at both the local scale within the airport estate and regionally within 12 km but these are not expected to be significant at the species-scale.

1.1.4 Anticipated Outcome

Based on the assessment above, approximately 180.33 ha of quenda habitat will be permanently removed for the development, representing approximately 84% of the quenda habitat within the MDP area. Despite some habitat retention and some potential for habitat creation, there will be a substantial and permanent population decline.

Pre-clearing trapping and relocation to a suitable release site will reduce direct mortality, and the remaining population will be assisted through a revegetation program designed to create interconnected habitat through the built landscape. Other measures to assist remaining population include signage and potential underpasses to reduce road strike and control of feral predators. The regional (within a 12 km radius) population will persist.

4.8 Impact Assessment – Water Rat (Rakali)

4.8.1 Overview of Values

The Rakali is present in the local area, but probably restricted to permanent wetlands along Abernethy Road and the Swan River, with seasonal dispersal into Munday Swamp and along the main drains which flow through the airport estate, including the MDP area (Figure 4-8). Drains may provide connectivity for Rakali between the Abernethy Road wetlands and the Swan River.

The only record of the Rakali is a feeding platform in Munday Swamp, located to the south-east of the MDP area. As Munday Swamp is seasonal, this suggests that an animal had been present the previous winter and it was speculated that the Rakali may be an occasional visitor as individuals disperse along drains and from wetlands nearby. The Rakali is only a visitor to Munday Swamp, and given the swamp is not a part of the MDP area and the existing main drain will be maintained in some form, the potential impacts to the species are considered minimal.

4.8.2 Direct Impacts and Associated Avoidance/Mitigation Measures

The development of the MDP area will result in the loss of 1.79 ha of Rakali habitat associated with existing artificial drains used by the species to move through the MDP area and airport estate. However, the MDP layout proposes the primary alignment of the existing main drainage to be maintained as a drainage corridor, with sections converted into Living Streams, and as such this will avoid impacts to the species associated with a potential loss in habitat connectivity and linkage functionality. The programme of converting drains into 'Living Streams' may benefit the species by providing improved connectivity and more permanent wetland habitat. These impacts on the Rakali are discussed in Table 4-23.

4.8.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Indirect impacts to Rakali have been considered in relation to the known threatening processes for fauna and their ecosystem function, and how the proposed MDP may contribute to or affect these. These potential impacts, as well as the associated avoidance and mitigation measures, are outlined in Table 4-23.

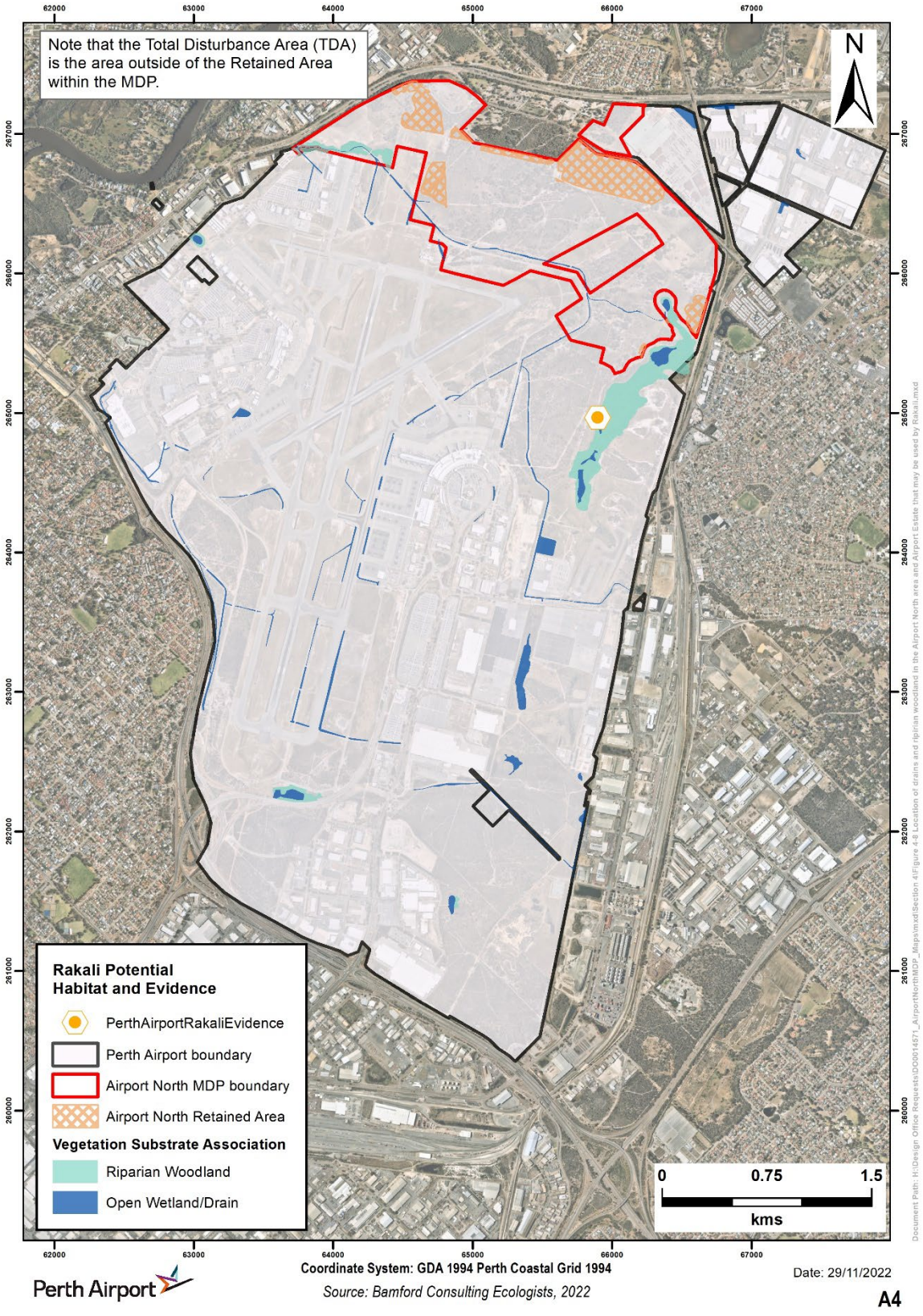


Figure 4-8 Location of drains and riparian woodland in the Airport North area and Airport estate that may be used by Rakali.

Table 4-19: Potential impacts to Rakali

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Direct	Habitat loss leading to population decline/extinction	Negligible	The modification of habitat (1.79 ha of existing drains) will occur as a result of the Airport North project.	Replanting drains to replace/ enhance habitat and connectivity. Conversion of several sections of the Northern Main Drain into a Living Stream which may provide more habitat than was previously available. Well-defined and rationalised clearing footprint that avoids Rakali habitat (i.e. drains) where possible.
Indirect (ecosystem function)	Population Fragmentation and Survival	Minor	The modification of 1.79 ha of drains from within the Airport North area will change the way Rakali move through the area, e.g. between wetlands located east of the project area through to the Swan River (west of the project area).	Clearing designed to retain drains/linkage where possible and installation of new drains where drains are removed. Replanting drains (as Living Streams) to replace/ enhance connectivity.
Indirect (ecosystem function)	Degradation of surrounding habitat within the estate due to weed invasion	Negligible	Impacts from weed invasion are expected to be negligible with standard weed management procedures	Weed management during earthworks. Active weed management post-development to rehabilitate degraded areas.
Direct	Ongoing Mortality	Minor	Ongoing mortality from vehicle strike can occur during project operations and is a concern for the Airport North project. Impacts to Rakali are considered minor as the species usually moves through the landscape via drains.	Provide signage and reduce road speeds in areas of high fauna activity. Implement wildlife underpasses if suitable locations can be identified.
Indirect (ecosystem function)	Species interactions	Minor	Impacts from species interactions assumed to be Minor as the species persists in areas where feral species are present. Existing controls on feral species may be of assistance.	Existing control of feral species. Extend Fox control to include Cats.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Hydroecology	Minor assuming controls	The Rakali is sensitive to hydrological change but both surface and sub-surface hydrology will be managed within the Airport North area, across the airport estate and off-site. The Perth Airport currently has a program of converting drains into 'Living Streams' and this may benefit the Rakali.	Understand and manage local hydrology. Ensure standard approaches minimise hydrological change. Replant drains.
Indirect (ecosystem function)	Changes to Fire Regime	Negligible/ Minor	Vegetated drains and wetland areas provide key habitat for the Rakali. While vegetation in these can burn, the impact upon the Rakali is expected to be slight as it is partly aquatic.	Existing fire management around the airport estate.
Indirect (ecosystem function)	Dust, light, vibration, noise	Negligible	Not relevant to Rakali as the species is very tolerant to noise and light in urban environments.	Legal environmental limits.

Source: BCE 2022

4.8.4 Significance of Residual Impacts

An assessment of the residual impacts to rakali for the MDP area has been undertaken using the significant impact criteria outlined in Significant Impact Guidelines 1.1 (DoE 2013). Based on this assessment, none of the significance criteria are expected to be triggered for Rakali as a result of implementing the proposed MDP works (BCE 2022), as outlined in **Table 4-24**.

The overall impact can be considered to be minor at the level of the surrounding airport estate, and negligible in the regional context (within 12 km).

Table 4-20: Assessment of significance of residual impacts to Rakali

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Lead to a long-term decrease in the size of a population (or an important population).	**Unlikely to occur** Artificial Drains provide key habitat, and the species is likely to use these to move through the Airport North area and airport estate. Such movement is likely to be seasonal only as the drains are currently dry for part of the year. Approximately 1.79 ha of drains will be modified as a part of the project. While there will be some modification of existing drains, other drains will be created and replanted, providing some suitable habitat and net benefit for the Rakali. It is unlikely that the development of the project will lead to a long-term decrease in the size of the population.
Reduce the area of occupancy of the species (or an important population).	**Unlikely to occur**

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
	If present, the modification of some drains (currently 1.79 ha) within the Airport North area may temporarily alter the distribution and abundance of the Rakali, but with new drains being created and planted it is unlikely to reduce the area of occupancy. Most records of the species are located along the Swan River (located approximately 3.5 km west of the project area).
Fragment an existing population (or important population) into two or more populations.	**Unlikely to occur** The modification of some drains within the Airport North area may alter the local movement of the species. The proposed project is unlikely to result in fragmentation of existing local populations as newly created and planted drains will provide some corridors for the species to move through the landscape.
Adversely affect habitat critical to the survival of a species.	**Unlikely to occur** Rakali are widespread across the Swan Coastal Plain and Perth hills. Although some drains will be modified, the habitat within the Airport North area is not critical to the survival of the species and adjacent habitat is available outside the project area e.g. vegetated drains located within the airport estate, Ollie Worrell Reserve and the Swan River.
Disrupt the breeding cycle of a population (or important population).	**Unlikely to occur** It is unlikely that the development of Airport North project will disrupt the breeding cycle of a population. There is no evidence that Rakali are breeding in the project area or airport estate. Some disturbance may occur during the construction phase until the drains are reinstalled. It is expected that breeding outside the project area (e.g. along the Swan River) will continue undisrupted.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	**Unlikely to occur** While the proposed Airport North project may modify some of the available habitat, it is unlikely that the species will decline.
Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.	**Unlikely to occur** Feral species and other competitors (e.g. feral cats and foxes) are likely to be present in the region, but can be managed with onsite environmental procedures.
Introduce disease that may cause the species to decline.	**Unlikely to occur** The CEMP will address soil hygiene to prevent introduction and spread of weeds. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Interfere with the recovery of the species.	**Unlikely to occur** No active, direct recovery measures are currently undertaken in the Airport North area, airport estate or region.

Source: BCE 2022

4.8.5 Cumulative Impacts

Cumulative impacts have been determined based on the combined total disturbance areas associated with multiple proposals currently under consideration across the airport estate, as outlined in **Section 1.7**. In this context, cumulative impacts resulting from the loss of 13.46 ha of Rakali habitat, as shown in Table 4-25, including existing drains used by the species to move through the airport estate and landscape are anticipated. However, the programme of converting drains into 'Living Streams' may benefit the species by providing improved connectivity and more permanent wetland habitat.

The Rakali is only a visitor to Munday Swamp, and as the swamp is not identified for development, the impact would be considered minimal.

Table 4-21 Cumulative loss (habitat) to Rakali within the Perth Airport estate (for projects with a known boundary)

Impact	Airport Central	Airport West	New Runway Project	Airport North (this MDP)	Total
Rakali Habitat (ha)	4.07	2.00	5.60	1.79	**13.46**

Values are based on the Airport Central (TDA), Airport North (TDA), New Runway Project and Airport West (South) areas.

Source: BCE 2022

Cumulative impacts of known proposed projects at Perth Airport to Rakali are expected at the local-scale (minor impact within the airport estate) but these are not expected to be significant at the regional- or species-scales.

4.8.6 Anticipated Outcome

It is not expected that any EPBC significance criteria will be triggered for the Rakali. The proposed action will result in the modification of up to 1.79 ha of habitat associated with drains, which provide linkage functionality between habitat areas for the species. While there will be some modification to existing drains to accommodate the development, other drains will be created and replanted, providing key habitat and potentially a net benefit for the Rakali. Revegetated drains will aid in the movement of the species across the built landscape.

The overall impact can be considered to be minor at the level of the surrounding airport estate, and negligible in the regional context (within 12km). The loss or alteration of habitat could temporarily disrupt movement through the landscape, but this is not expected to have a significant impact at the species scale. The proposed action is unlikely to result in a significant residual impact to the Rakali.

4.9 Impact Assessment – Woollybush Bee *Hylaeus globuliferus*

4.9.1 Overview of Values

There is little information available on the distribution and habitat of the Woollybush bee *Hylaeus globuliferus*. Records from the DBCA database show that the species has been recorded from Perth on the northern Swan Coastal Plain up to Jurien Bay and Eneabba. The species has also been recorded at several locations between Lake Grace and the Fitzgerald River National Park in the south-west of the state.

The species is known to forage on the flowers of Woollybush (*Adenanthos cygnorum*) and *Banksia attenuata*, which are both present in Banksia woodland vegetation within the MDP area. Approximately 8.51 ha of potential habitat occurs within the MDP area, comprising 5.70 ha within the TDA and 2.81 ha within the retained areas, as shown in **Figure 4-9**.

Field investigations, including targeted searches, have not identified the species within the Perth Airport estate, but some likelihood of presence remains, and advice from the WA Museum is that the species may be more widespread and common than realised. Searching for the species tends to be difficult as they are highly seasonal, and thus can only be found during a short time window. Survey work within the Perth Airport estate has included diurnal netting around Woollybush for the bee. The timing of these surveys was consistent with activity periods of the species determined from specimen records held by the WA Museum, although flowering of Woollybush was poor which would affect the detectability of *H. globuliferus*.

The precautionary approach can therefore be taken that the species is present and that impacts are likely to be proportional to loss of its preferred habitat in the MDP area. A likely scenario is that *H. globuliferus* is present or at least a regular visitor, but that it is more widespread in the greater region than previously believed.

It is difficult to ascertain the availability of suitable *H. globuliferus* habitat within the region, however 2414.00 ha of the remaining vegetation extent within a 12 km radius (BCE, 2022) may contain patches of suitable vegetation (Bassendean, Cannington, Forrestfield and Southern River vegetation complexes). If the proportion of suitable bee-habitat in these regional areas is similar to that of the whole MDP area (c. 7.5%; 8.51 ha of bee-habitat out of 113.68 ha of remnant vegetation) then 181.05 ha of regional habitat may be present. The TDA therefore contains c. 3.2% of the regional habitat.

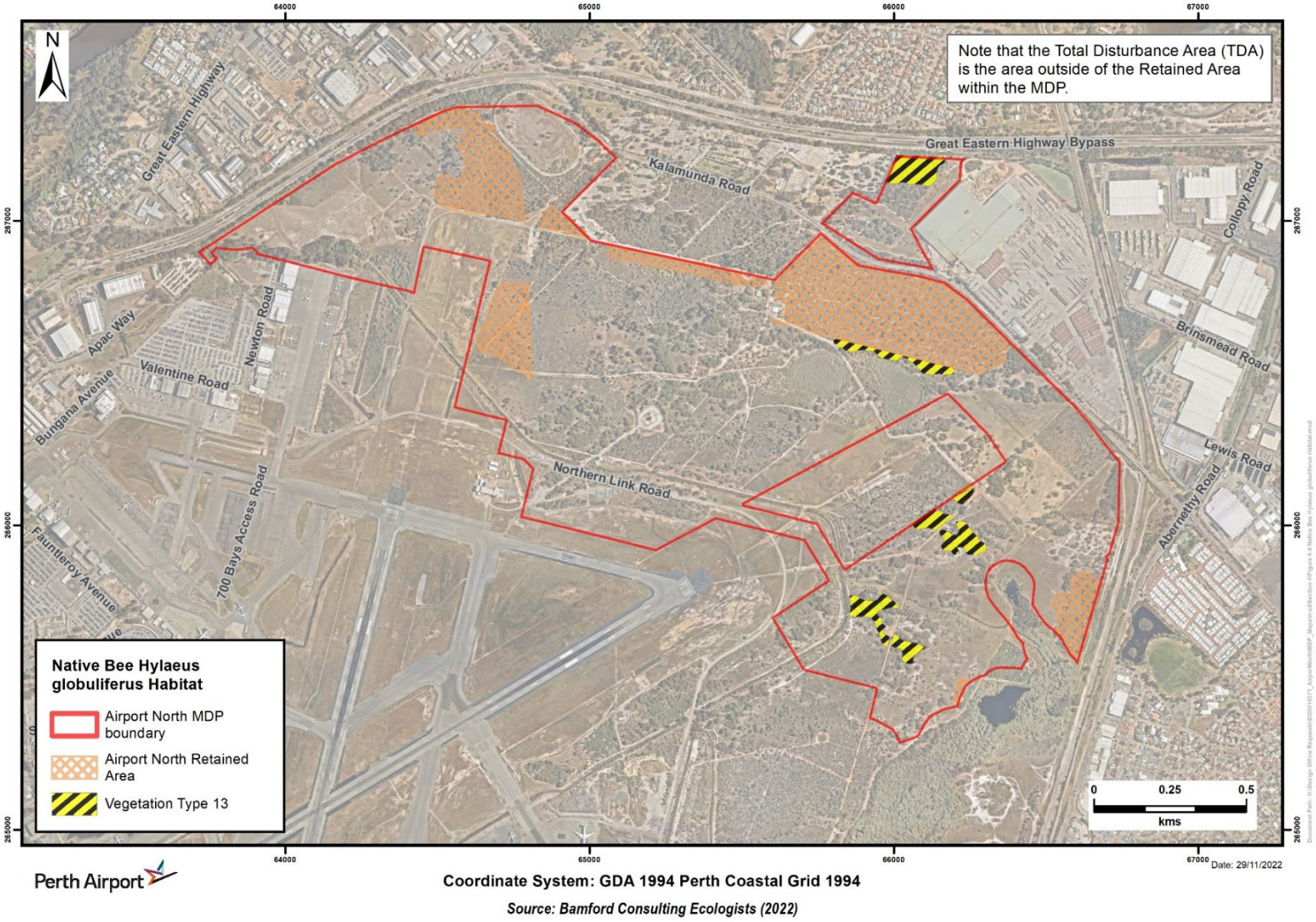


Figure 4-9: Woollybush Bee *Hylaeus globuliferus* Habitat

Perth Airport

4.9.2 Direct Impacts and Associated Avoidance/Mitigation Measures

The development of Airport North will result in the loss of 5.7 ha of suitable habitat for the species, associated with areas of Banksia Woodland.

The MDP layout also provides for the retention of up to 2.81 ha of suitable habitat for the species, within areas of retained vegetation, providing for some avoidance of potential impacts. **Section 1.6** provides further discussion around impact avoidance measures provided in the MDP layout.

4.9.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Indirect impacts to the Woollybush bee have been considered in relation to the known threatening processes for fauna and their ecosystem function, and how the proposed MDP works may contribute to or affect these. These potential impacts, as well as the associated avoidance and mitigation measures, are outlined in Table 4-26

Table 4-22: Potential impacts to the Woollybush bee

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Direct	Habitat loss leading to population decline/local extinction	Moderate	Loss of up to 5.70 ha of foraging habitat (Banksia Woodland with *Adenanthos cygnorum*) may occur as a result of the proposed Airport North project and is significant due to the scarcity of habitat for the species in a 12 km radius (approximately 3.2% of the estimated 181.05 ha of regional habitat).w	Well-defined and rationalised clearing footprint that avoids sensitive habitat where possible; an estimated 2.81 ha of suitable habitat will be retained, representing 33.0% of suitable habitat in the MDP. Plant revegetation area and verges with foraging species suitable for the Woollybush bee e.g. *Adenanthos cygnorum* (Woollybush). Replant degraded areas if possible, with species preferred by the Woollybush bee.
Indirect (ecosystem function)	Population Fragmentation and Survival	Minor	The loss of up to 5.70 ha of Banksia Woodland is likely to result in further fragmentation of the local population.	Clearing designed to retain corridors/linkage where possible. Ecological corridors designed to enable connectivity of retained patches. Replanting to replace/ enhance connectivity.
Indirect (ecosystem function)	Degradation of surrounding habitat within the estate due to weed invasion	Minor	Impacts from weed invasion are expected to be negligible with standard weed management procedures. Woollybush is a native plant species that actually responds well to some disturbance.	Weed management during earthworks. Active weed management post-development to rehabilitate degraded areas.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Direct	Ongoing Mortality	Minor	Ongoing mortality during project operations is uncertain, but if a population is present, the proportion at risk from mortality such as that due to roadkill is probably very small.	Not applicable.
Indirect (ecosystem function)	Species interactions	Negligible	Not relevant to the Woollybush bee.	Not applicable.
Indirect (ecosystem function)	Hydroecology	Negligible	Probably not relevant to the Woollybush bee assuming local hydrology is managed to prevent any significant changes.	Understand and manage local hydrology. Ensure standard approaches minimise hydrological change
Indirect (ecosystem function)	Changes to Fire Regime	Negligible - Minor	The reduced area of retained habitat, if indeed it supports the bee, will be more vulnerable to a single fire event.	Existing fire management and suppression around the estate.
Indirect (ecosystem function)	Dust, light, vibration, noise	Minor	Impacts of dust, light, vibration and noise are not well known. The species must be tolerant to some degree, as it is present in the urban environment.	Legal environmental limits.

Source: BCE 2022

4.9.4 Significance of Residual Impacts

An assessment of the significance of the residual impacts to the Woollybush bee for the MDP has been undertaken using the significant impact criteria outlined in Significant Impact Guidelines 1.1 (DoE 2013). Based on this assessment, five of the nine significance criteria are expected to be triggered for the Woollybush bee as a result of implementing the proposed MDP works (BCE 2022), as outlined in Table 4-27.

If present in the project area, there will be a permanent local population decline due to habitat loss. Assuming that the species is present, which is uncertain, this impact can be considered to be moderate at the local level for the surrounding airport estate, and moderate in the regional context (within 12km). The loss of foraging habitat could alter the local distribution of the species, but this is not expected to have a significant impact at the species scale.

Table 4-23: Assessment of significance of residual impacts to the Woollybush bee

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Lead to a long-term decrease in the size of a population (or an important population).	Likely to occur The Woollybush bee may be a regular visitor to the project area. Banksia Woodland (with *A. cygnorum*) is present within the project area and provides foraging habitat for the species. Approximately 5.70 ha of habitat will be impacted as a result of the project (3.2% of estimated habitat area within 12 km). This is considered significant due to the lack of suitable habitat for the species in the region (within a 12 km radius). The impact is likely to be a shift in the local distribution and abundance of the species and a permanent decline in the population at the project area.
Reduce the area of occupancy of the species (or an important population).	Likely to occur Loss of Banksia Woodland (with *A. cygnorum*) at the project area may alter the local distribution and abundance of the Woollybush bee resulting in a significant reduction in their local abundance. They may still occur in gardens, verges and the immediate region, but will be reduced due to the loss of key habitat within the project area.
Fragment an existing population (or important population) into two or more populations.	Likely to occur The proposed clearing of 5.70 ha of Woollybush bee habitat within the project area is likely to result in fragmentation of existing local populations if present.
Adversely affect habitat critical to the survival of a species.	Unlikely to occur The Woollybush bee has been recorded on the northern Swan Coastal Plain, south-eastern wheatbelt and south coast of Western Australia. Although 5.70 ha of Woollybush bee habitat will be removed, the habitat within the Airport North area is not likely to be critical to the survival of the species.
Disrupt the breeding cycle of a population (or important population).	Likely to occur It is unknown if the Woollybush bee is breeding at the project area. If the species is, then breeding will be disrupted. It is expected that breeding outside the project area will continue undisrupted.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Likely to occur Localised loss of Woollybush bee habitat (5.70 ha) will occur as a result of the development of the project. Removal of habitat will lead to a decline of the species at the project level.
Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.	Unlikely to occur The introduced Honey Bee may adversely affect the Woollybush bee, but the Honey Bee is already present and unlikely to be favoured by development of Airport North. Feral species are thus unlikely to impact the Woollybush bee.
Introduce disease that may cause the species to decline.	Unlikely to occur The CEMP will address soil hygiene to prevent introduction and spread of weeds. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Interfere with the recovery of the species.	Unlikely to occur Localised impacts. Broad-scale threatening processes (i.e. habitat loss) are of greatest concern for the species. No active, direct recovery measures are currently undertaken in the Airport North area, airport estate or region.

Source: BCE 2022

4.9.5 Cumulative Impacts

Cumulative impacts have been determined based on the combined total disturbance areas associated with the four projects with defined envelopes currently under consideration across the Perth Airport estate, as outlined in Section 1.7. In this context, cumulative impacts of approximately 38.46 ha of Banksia Woodland (with *Adenanthos cygnorum*) and known *H. globuliferus* habitat are anticipated as summarised in Table 4-28. Impacts to the species are likely to be proportional to loss of their preferred habitat across the project areas. Impacts to the Woollybush bee are likely to be significant due to the lack of suitable habitat outside the airport estate.

Table 4-24 Cumulative loss (habitat) to Hylaeus globuliferus within the Perth Airport Estate (for projects with a known boundary)

Impact	Airport Central	Airport West	New Runway Project	Airport North (this MDP)	Total
Hylaeus globuliferus Habitat (ha)	7.26	4.90	20.60	5.70	38.46

Values are based on the Airport Central (TDA), Airport North (TDA), New Runway Project and Airport West (South) areas.

Source: BCE 2022

Cumulative impacts of known proposed projects at Perth Airport to *H. globuliferus* are expected at the local- (major impact within the airport estate) and regional-scales (major impact within 12 km) but these are not expected to be significant at the species-scale.

4.9.6 Anticipated Outcome

Approximately 5.70 ha of Banksia Woodland with *A. cygnorum* will be permanently removed for construction of the MDP proposal which represents circa 67% of the *H. globuliferus* habitat within the MDP area. This impact can be considered to be moderate at the local level of the surrounding airport estate, and moderate in the regional context (within 12km). The loss of foraging habitat could alter the local distribution of the species, but this is not expected to have a significant impact at the species-scale.

Standard mitigation measures and proposed additional management measures will reduce impacts to some degree, but a decline in the abundance and some localised loss of the species is expected. Therefore, the MDP is likely to result in a significant residual impact to the Woollybush bee.

4.10 Impact Assessment – Whole of Environment - Fauna

4.10.1 Overview of Values

A detailed description of the Whole of Environment fauna within and adjacent to the Airport North area is provided in BCE 2022 and summarised below. A desktop study of the fauna assemblage within the MDP area identified 194 vertebrate species as potentially occurring: five fish, 12 frogs, 43 reptiles, 112 birds (six introduced) and 13 mammals (five introduced). Several species that may have occurred within the MDP area historically are now considered to be locally extinct (see **Section 4.4.4**), leaving a current assemblage of approximately 170 vertebrate species.

The assemblage is notable for a suite of species (particularly sedentary birds and reptiles) that have declined in the Perth area but persist in the large tracts of native vegetation on the airport estate. Several of the species were noted as being of interest on the Swan Coastal Plain, as they are better-known from landscapes further east, which reflects the location of the MDP area close to the escarpment.

Woodlands support the greatest range of reptile and bird species, including many of conservation significance. Woodlands are particularly notable for supporting black-cockatoos, and heathlands for supporting Quenda. Grassland and damp heathlands within the MDP area are likely to support populations of common reptile and bird species. Constructed drains in the MDP area, while artificial, may be important for facilitating fauna movements through the landscape and support seasonal breeding by frogs, aquatic invertebrates, the Rakali and potentially small numbers of conservation significant waterbirds, such as Blue-billed Duck.

The invertebrate assemblage within the MDP area is poorly documented and species-rich groups such as micro-wasps are likely to be present and may include undescribed species. The field investigations did record a suite of invertebrate species suggesting that the invertebrate assemblage is substantially intact.

Impacts of particular importance with respect to the fauna assemblage include the introduction of feral species and changes to hydrology.

4.10.2 Direct Impacts and Associated Avoidance/Mitigation Measures

MDP works will result in the loss of several Vegetation Substrate Association (VSA) types within the TDA area including Woodland (74.30 ha), Damp Heathland (10.28 ha), Grassland (95.75 ha) and artificial drains (1.79 ha), a total area of 182.12 ha. A further 31.52 ha of already cleared/built lands, with negligible to no value for fauna, are also within the TDA.

The impacts to the Whole of Environment fauna resulting from the MDP works were assessed against the Significant Impact Guidelines 1.1 (DoE 2013) in BCE 2022. Impacts to non-MNES conservation significant species such as Quenda, Rakali and Woollybush bee are assessed in **Sections 4.8**, **4.9** and **4.10**. The outcomes of the assessment are presented in Table 4-29

4.10.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

The assessment of indirect and offsite impacts to the Whole of Environment fauna is presented in **Table 4-29**.

Table 4-25: Potential impacts to the Whole of Environment fauna and proposed mitigation measures

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Direct	Habitat loss leading to population decline/ extinction	Moderate	Loss of 182.12 ha of various VSAs will result in population declines at a local level for a wide suite of native fauna species, including common and conservation significant species. This will likely result in a localised reduction in a number of species e.g. sedentary, insectivorous birds such as fairy-wrens, thornbills, scrubwrens, robins, whistlers and shrike-thrush, and some reptile and mammal species, e.g. Quenda.	Avoidance and retention of 34.39 ha of various VSAs within the MDP area. Well-defined and rationalised clearing footprint that avoids habitat where possible. Establishment of ecological corridors to assist with connectivity between remnant patches. Pre-clearing trapping and relocation, e.g. reptiles. Revegetate degraded areas.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Population Fragmentation and Survival	Minor	The MDP area is situated in a highly urbanised and fragmented landscape. Loss of 182.12 ha of fauna habitat in the TDA may affect local movement patterns of some bird and mammal species such as the Quenda, which at present may rely on native vegetation for the persistence of local populations. Obstructions associated with the MDP area, such as roads and drainage channels may also affect movement of small, terrestrial species.	Clearing designed to retain corridors/linkage where possible. Replanting to replace/ enhance connectivity. Creating biodiverse gardens. 'Living Stream' approach to drains to create wildlife corridors.
Indirect (ecosystem function)	Degradation of surrounding habitat within the airport estate due to weed invasion	Minor	Weed invasion of the MDP area is currently high in parts of the native vegetation and weed invasion will be a risk in the native vegetation that is retained. Weeds are likely to be managed intensively in Living Streams in the future and will need to be managed in retained native vegetation.	Weed management during earthworks. Active weed management post-development to rehabilitate degraded areas and throughout.
Direct	Ongoing mortality	Minor to Moderate	Direct mortality of common species during clearing and construction is unavoidable but can be minimised for some species, e.g. Bobtail, Quenda, through pre-clearing trapping and relocation. Increased mortality can occur during project operations; for example, from roadkill, animals striking infrastructure and entrapment in trenches. Some species, however, will be vulnerable to increased and ongoing mortality such as from roadkill; these include mammals and reptiles that will persist in greatly reduced and fragmented populations, such as Bobtail, Quenda and Rakali.	Pre-clearing fauna relocation. Provide signage and reduce road speeds in areas of high fauna activity. Reduced road speeds during construction period. Install wildlife underpasses for Quenda and some other fauna if suitable locations can be identified.
Indirect (ecosystem function)	Species interactions	Moderate, but reduced to Minor assuming feral animal control is practiced.	Feral species are a conservation concern for some native fauna, and at present the control of Foxes is believed to have contributed to the flourishing Quenda population in the MDP area. Control of Foxes and Cats will be even more important with reduced populations of bird, mammals and reptile species.	Existing control of feral species. Extending Fox control to include Cats to reduce predation pressure on small mammals and birds.

Impact type	Threatened process	Impact category	Discussion	Avoidance or mitigation measure/s
Indirect (ecosystem function)	Hydroecology	Negligible to Minor	Once the MDP area is developed, fauna will be heavily reliant on managed landscapes where hydrology will be managed with drains to ensure vegetation and wetlands are protected. Therefore, fauna species that rely on wetlands and wetland-vegetation, e.g. fish, frogs and some bird species, are likely to be protected. The provision of sections of Living Streams may benefit several fauna species.	Maintain the local hydrology. Ensure standard approaches minimise hydrological change. Replant drains, as a part of the Living Streams program.
Indirect (ecosystem function)	Changes to Fire Regime	Moderate	Once the MDP area is developed, intensive management may result in of the reduced severity and intensity of fire. Although Living Streams could be subject to infrequent and possibly intense fires. Species that occur at low densities would be vulnerable to such fires.	Existing fire management around the estate.
Indirect (ecosystem function)	Dust, light, vibration, noise	Minor	Impacts of dust, light, vibration and noise upon fauna are difficult to predict. Given the current setting of native vegetation in the MDP area, fauna is already exposed to high levels of noise, light, and vibration. Separation distances will be reduced, and this may be a concern for some invertebrates, but the consequences are largely unknown. Mobile species such as birds may leave the area to avoid high levels of noise and vibration.	Legal environmental limits. Direct lighting away from retained native vegetation.

Source: BCE 2022

4.10.4 Significance of Residual Impacts

An assessment of the residual impacts to Whole of Environment fauna for the MDP has been undertaken using the significant impact criteria outlined in Significant Impact Guidelines 1.1 (DoE 2013). Based on this assessment, four of the nine significance criteria are expected to be triggered as a result of implementing the proposed MDP works (BCE 2022), as outlined in Table 4-30.

Residual impacts at a local level are expected to be permanent and significant, since many native species of fauna are reliant on the native vegetation that will be removed from the Airport North area. However, common (whole of environment) fauna species present within the Airport North area are widespread across the airport estate and where native vegetation is currently retained in the region, including the Swan Coastal Plain; therefore at a regional level the impact on these species is low.

Table 4-26: Assessment of significance of residual impacts to fauna

Significant Impact Guidelines 1.1 criteria	Likelihood and rationale
Lead to a long-term decrease in the size of a population (or an important population).	Likely to occur Loss of 182.12 ha of woodlands, heathlands, grasslands and drains in the Airport North TDA will result in permanent population declines at a local level for a wide suite of native fauna species, including common and some conservation significant species (e.g. Quenda). Some birds (not MNES or Priority) vulnerable to habitat loss and fragmentation may become locally extinct.
Reduce the area of occupancy of the species (or an important population).	Likely to occur The removal of 182.12 ha of woodlands, heathlands, grasslands and drains will reduce the area of occupancy for a wide suite of native fauna species.
Fragment an existing population (or important population) into two or more populations.	Likely to occur The removal of 182.12 ha of woodlands, heathlands, grasslands and drains, and the development of the site, will alter the local movement of some native fauna species. The plan to retain/enhance connectivity thorough the development will reduce the effect of fragmentation but some impact may occur when combined with habitat loss.
Adversely affect habitat critical to the survival of a species.	Unlikely to occur Common native fauna species found within the Airport North area are widespread across the Swan Coastal Plain. Although 182.12 ha of woodlands, heathlands, grasslands and drains will be cleared, the habitat within the project area is not critical to the survival of many of the species.
Disrupt the breeding cycle of a population (or important population).	Unlikely to occur The development of the project will affect some populations rather than breeding cycles per se.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Likely to occur Localised loss of 182.12 ha will occur as a result of the development of the project. Removal of native vegetation and drains will result in population declines at a local level for a wide suite of native fauna species.
Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.	Unlikely to occur Feral species and other competitors (e.g. feral cats and foxes) are likely to be present in the region, but can be managed with onsite environmental procedures.
Introduce disease that may cause the species to decline.	Unlikely to occur The CEMP will address soil hygiene to prevent introduction and spread of weeds. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.
Interfere with the recovery of the species.	Unlikely to occur No active, direct recovery measures are currently undertaken in the project area, airport estate or region.

Source: BCE 2022

4.10.5 Cumulative Impacts

The entire airport estate covers an area of approximately 2,015 ha. The total known area of the currently proposed developments, i.e. Airport North MDP, Airport Central, Airport West (South) MDP and the New Runway Project is 784.08 ha (38.9% of the estate). Of this combined development footprint, approximately 66.8% (523.84 ha; 25.9% of the estate) is fauna habitat that will be impacted as a result of the four proposed projects.

The development of these four projects will result in the loss of large areas of several key VSA types including Woodland (178.22 ha), Damp Heathland (102.47 ha), Grassland (220.84 ha) and Drains (13.46 ha) and represents a significant portion of habitat within the local area. This clearing will result in population declines at a local level for a wide suite of native fauna species, including common and conservation significant species. This would impact several species, e.g. sedentary, insectivorous birds and some reptile and mammal species e.g. Quenda. Some non-MNES or Priority birds vulnerable to habitat loss and fragmentation may become locally extinct on the airport estate. The construction of the development projects will alter the local movement of some native fauna species. Mobile species such as birds may vacate the airport estate for more favourable habitats.

Although cumulative impacts at a local level are expected to be permanent and significant, many common species present within the airport estate are widespread across the Swan Coastal Plain and therefore at a species level, the cumulative impact on common species are not significant.

4.10.6 Anticipated Outcome

It is likely that four of the nine significance criteria under Guidelines 1.1 (DoE 2013) will be triggered for the Whole of Environment fauna. There will be permanent population declines at a local level due to habitat loss and fragmentation in the MDP area. Approximately 182.12 ha of fauna habitat will be cleared and this represents a significant portion of habitat within the local area.

Standard mitigation measures and proposed additional management measures will reduce impacts to some degree. However the MDP is likely to result in a significant residual impact to local populations of many species of birds and reptiles. A decline in the abundance and localised loss of the species is also expected. Some species will remain and can be assisted through a revegetation program designed to create interconnected habitat through the MDP area, e.g. Rakali in Living Streams.

Residual impacts at a local level are expected to be permanent and significant, since many native species of fauna are reliant on the native vegetation that will be removed from the MDP area. However, common (Whole of Environment) fauna species present within the MDP area are widespread across the airport estate and where native vegetation is currently retained in the region, including the Swan Coastal Plain; therefore, at a regional level the impact on these species is not significant.

Cumulative impacts to the Whole of Environment fauna are expected to be significant at the local (major impact within the airport estate) and regional (moderate impact within 12 km) scales, but these are not expected to be significant at the species-scale (effectively no population decline across any species' range with, at most, a few individuals impacted and any decline in population size within the normal range of annual variability).

5 Water Resources

The information provided in this section is based on Aurecon's stormwater and groundwater impact assessment report for Airport North, entitled *Airport North Stormwater and Groundwater Environmental Impact Assessment* (Aurecon, 2022).

This section provides details on:

- Water resources (groundwater, surface water) within and surrounding the project area.
- Impact assessment (including direct and indirect impacts) and associated mitigation and avoidance measures on the following water resource matters that are known to occur within or adjacent to the project area:
  - Groundwater
  - Surface Water
- Wetlands are discussed in further detail in Section 6.

5.1 Legislative and Policy Context

The environmental impacts from changes to hydrology on Commonwealth land are covered by the EPBC Act and consequently Guidelines 1.2 which are assessed via MDP submission. In addition, impacts on water resources within the MDP area are considered against the following State legislation and policy:

- Rights in Water and Irrigation Act 1914
- State Planning Policy 2 - Environment and Natural Resources
- State Planning Policy 2.9 – Water Resources.

Water resources management in Western Australia is currently organised under six separate acts in Western Australia by DWER. *The Rights in Water and Irrigation Act* 1914 (RIWI Act) establishes the legislative framework for managing and allocating water resources in Western Australia and is most relevant to activities on Perth Airport. Being on Commonwealth land, activities on the estate are exempt from licensing under the RIWI Act.

State Planning Policy 2.9 – Water Resources, and State Planning Policy 2 - Environment and Natural Resources, establish the State's planning framework for the management of water resources. They provide clarification and guidance to decision-makers when considering water resources in land-use planning strategies. The objectives of these policies are to:

- Protect, conserve, and enhance water resources that are identified as having significant economic, social, cultural and/or environmental values.
- Assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources.
- Promote and assist in the management and sustainable use of water resources.

Where applicable, guidance has been taken from the state planning policy when designing and managing the hydrology on the airport estate.

Legislation relating directly to Munday Swamp is the *Aboriginal Cultural Heritage Act 2021* (WA) (ACH Act) and the *Aboriginal Heritage Act 1972* (WA) (AH Act). The ACH Act was passed in December 2021 and is currently in a transition period, during which parts of the AH Act remain in effect. Both Acts recognise Munday Swamp as important and lists the swamp as an Aboriginal heritage site. Any approvals for site works required to manage the stormwater impacts to Munday Swamp are considered under the AH Act during the transition period and thereafter under the ACH Act process. This is described in Section 9.

Munday Swamp is located within a larger area listed on the Commonwealth Department of Climate Change, Energy, the Environment and Water's Directory of Important Wetlands in Australia, as a 'nationally important wetland.' However, it notes Munday Swamp "is designated by FAC [Federal Airports Corporation] as a conservation management priority area, unless unavoidably required for aviation purposes, i.e. a parallel runway." (It should be noted that the entry onto the database was in 1995 which was prior to the airport being privatised, hence the FAC reference.)

5.2 Methodology

5.2.1 Stormwater assessment

Stormwater design criteria

The concept for Perth Airport's stormwater design criteria relating to airside infrastructure is to protect all runways and taxiways from a 1% Annual Exceedance Probability (AEP) storm event. Implementing this concept across the estate means that flood water on the airport estate would only be a limiting factor for aircraft movements in extreme rainfall events.

Stormwater flood modelling has shown that the existing Northern Main Drain (NMD) and Southern Main Drain (SMD) network flood during a 10% AEP storm event. To protect the new and the existing runways and taxiways, an upgrade of the main drainage networks is required across the airport estate. There will be upgrades to the majority of the section of the NMD that passes through the Airport North MDP boundary.

The main drain infrastructure will be developed to provide the capacity to cater for rainfall runoff from the estate and to meet inflows and peak storage requirements from upstream sources to the same values that existed in 1997 when the management of the airport was privatised. This will help to ensure that Perth Airport does not increase the risk of flooding downstream of the estate boundary due to any major developments being undertaken. This is consistent with the commitment described in the Perth Airport Master Plan 2020.

Most of the new drainage infrastructure throughout the estate will be in the form of larger open channels and new stormwater storage areas. The storage areas will temporarily store water until the downstream network has the capacity to drain the stored water. The channels and the detention areas will all have the capacity to handle a 1% AEP storm event based on 1997 external peak inflow rates, as well as the runoff from existing and planned developments on the airport estate as described in the Perth Airport Master Plan 2020.

The invert levels of the NMD and SMD at the upstream and downstream boundaries allow the drains to have relatively flat gradients within the airport estate and be gravity fed. The original alignments of the NMD and SMD were created in the low-lying areas of the estate. The proposed realignments will require some construction to occur 'uphill' from the low-lying areas resulting in some invert levels being deeper within the estate than at the airport boundaries. Therefore, there will be sections of the drains that are deeper and wider than needed for conveying the stormwater, but advantage is taken of this by using the channels as in-line storage during larger storm events. The design has considered the interaction of these deeper sections with the seasonal groundwater levels within the airport estate in order to avoid groundwater drawdown being caused by the evaporation of exposed groundwater.

The key design criteria are summarised in Table 5-1.

Table 5-1: Stormwater design criteria

Design Criteria
The use of the 2019 Australian Rainfall and Runoff Guidelines (ARR 2019) to estimate discharges from the catchment areas external to and within the airport estate.
Limiting outflows from the airport estate to the same discharge values that existed in 1997 when the management of the Airport was privatised. This is consistent with the commitment described in the Perth Airport Master Plan 2020.
For airside infrastructure, protect all runways and taxiways from a 1% annual exceedance probability (AEP) storm event.
Assessment of the 1% AEP event to include a consideration of climate change in accordance with the ARR 2019 guidelines.
Application of the Perth Airport Living Stream design guidelines (Syrinx Environmental, 2019) to inform the design of the NMD in select areas.
Detention basins on the airport estate are required to drain within a 48 hour period to limit the attraction of birds.
The temporal discharge pattern for the 1% AEP event (Hydrograph) at the NMD outlet will not be significantly altered.
The design will consider "managing runoff generated from small rainfall events (very frequent to frequent events) is consistent with the Decision Process for Stormwater Management in Western Australia (DWER 2017)". The flows emanating from the catchment are directed through Living Streams and vegetated swales both within the Central MDP area and North MDP the receiving Northern Main Drain, which in accordance with the MDS will be designed as a Living Stream. (DWER 2017).

Source: Aurecon 2022

Master Drainage Strategy

Stormwater assessment for the airport estate has been undertaken as part of the 2022 update of the 2017 Perth Airport Master Drainage Strategy (MDS).

The following two scenarios assessed for the MDS update have informed this impact assessment:

- 1997 Pre-lease case – includes development at 1997 which is the commencement time for PAPL's lease to operate the airport.
- Ultimate development case – based on future planned land uses for aeronautical and commercial development in accordance with the Airport Master Plan (2020). This includes the New Runway, Airport Central, Airport South and Airport North MDPs.

Specialised hydrologic and hydraulic modelling software has been used to represent each development scenario and determine trunk drainage requirements. Output from the modelling includes confirmation of trunk drainage channel details, peak water levels, discharges, flow depths, inundation extents and peak velocities. Modelling was conducted for the 1%, 2% and 10% AEP events.

Assessment Approach

An 'Ultimate' development scenario model was developed for the estate based on aeronautical and non-aeronautical land uses shown in the 2020 Perth Airport Master Plan. The MDS update included an update of hydrologic modelling to address ARR 2019 requirements and provision of revised flows for inclusion in the hydraulic modelling for the 1%, 2% and 10% AEP design storm events for all development scenarios. Refinement of NMD trunk drainage design for the Ultimate development case was undertaken to confirm 1997 Pre-lease discharge limits are not exceeded, and the NMD outlet hydrograph is not significantly altered. This process was undertaken in an iterative manner, responding to the groundwater modelling results, which in turn were influenced by the NMD design.

Climate Change Consideration

The stormwater design criteria include the requirement for the assessment of the 1% AEP event to consider climate change in accordance with the ARR 2019 guidelines. The key parameter adjusted as part of this approach is rainfall intensity. The process requires consideration of the effective service life of the infrastructure being assessed; Perth Airport is considered to fall into the longer planning horizon where climate change should be considered. Further detail on climate change considerations can be found in Section 3.2.4 of the Aurecon EIA (2022).

5.2.2 Groundwater assessment

Groundwater design criterion

The Perth Airport principal groundwater design criterion is to reduce any groundwater drawdown within retained wetlands within and bordering the airport estate to as low as reasonably practical such that a significant ecological impact is avoided.

Groundwater modelling

A groundwater model was developed for the airport estate and the surrounding groundwater catchment to predict groundwater levels across the estate for the existing development conditions and a future development scenario that includes the Airport North MDP. The prediction of existing conditions uses the current configuration of land use, while the prediction of ultimate conditions includes changes to the alignment of the NMD, as well as changes to simulate the impact of the New Runway Project on groundwater levels. Comparisons of the modelled existing and development scenario groundwater levels were expressed as change (drawdown/mounding) contours, with the degree of change representing the groundwater impact.

The modelling study was completed consistent with the Australian Groundwater Modelling Guidelines and is described in detail in the *Airport Estate Groundwater Modelling* report (AQ2, 2021). The model is based on the principles of a Water Balance in that it considers all available groundwater inputs and outputs, in particular the interactions between stormwater drainage inverts and groundwater. The key points for the groundwater model are:

- The model covers the airport estate and the surrounding groundwater catchment.
- Features of the groundwater model include:
  - Aquifer and aquitard units of the hydrogeological system.
  - Rainfall recharge to the system, including recharge rates for different land uses across the model domain. Recharge is calculated using an analytical approach, which estimates recharge to groundwater based on a Water Balance for the unsaturated zone and underlying groundwater. The approach integrates losses from the vadose zone from tree water use, understorey vegetation and bare soil evaporation to calculate recharge to groundwater. The approach uses daily recorded rainfall to calculate a monthly recharge total to groundwater.
  - Groundwater inflow from upstream and groundwater outflow to downstream.
  - Evaporative flux from shallow water tables and groundwater dependent vegetation.
  - Groundwater discharge to drains (current and proposed future alignments of the Northern Main Drain (NMD) and the Southern Main Drain (SMD)).
  - Groundwater abstraction from the airport estate irrigation bores and other licensed bores across the model domain.
- The groundwater model uses the Modflow Surfact (Hydrogeologic Inc, 1996) groundwater modelling code to simulate saturated groundwater flow only, using an equivalent porous media approach.
- The model is classified as Class 2 according to the National Water Commission Guidelines (Barnett *et al*, 2012, cited within Aurecon 2022).

Assessment approach

The calibrated groundwater model was used to predict groundwater conditions across the airport estate in response to the proposed future development. The future development includes:

- The new runway to be located on the eastern side of the airport estate (already approved).
- Airport North the subject of this MDP.
- Airport Central the subject of a separate MDP.

The impacts of future development scenarios on groundwater levels were modelled iteratively in response to changes to the civil and drainage designs, which in turn responded to the outputs of the groundwater modelling.

The implementation of the proposed future development across the estate, including the associated recharge and evapotranspiration, and other key conditions included in model predictions, are outlined below:

- Model predictions were completed using a monthly time increment using the long term rainfall record for Perth Airport and allowed the impacts of development to be simulated under a range of hydrological conditions.
- To allow for the impacts of climate change, the later years of the rainfall record (1970 to 2018) were used, as this represents a period with lower recorded rainfall than the period prior to 1970. These conditions were used to predict groundwater impacts as they are considered to be more representative of current and future climate conditions.
- Evapotranspiration (ET) zones were updated to include additional paved areas and cleared areas associated with the construction of the new runway and taxiways and the proposed development within Airport Central and Airport North, i.e. an increase in paved areas and an associated reduction in vegetated areas.
- The elevation of the ET surface was updated to reflect the design cut and fill associated with the future development.
- Predictions were run to assess the impact of the realignment of the NMD and its associated basins.
- Recharge zones were updated similarly to evapotranspiration zones.
- The paved / developed areas associated with Airport North are assumed to be developed such that there is limited recharge to groundwater from these areas, i.e., stormwater is collected and disposed of off-site via the NMD, with only selected areas recharged.
- Drainage and the updates to land use associated with the Airport Central MDP and the New Runway Project were assumed to be implemented from the start of the modelling prediction.

The modelling results are expressed as hydrographs at key locations and as groundwater level change contours expressed as the maximum, minimum and average levels over the 49 year prediction period.

1.1.5 Water quality

Perth Airport monitors water quality in the NMD at its upstream and downstream boundaries. The stormwater contains the expected pollutants from an urban and former farmland catchment. With the exception of PFAS, there is no specific pollution issue within the Airport North MDP area that Perth Airport is currently required to manage apart from the standard stormwater industry issues considered as part of Water Sensitive Urban Design.

Data from the monitoring program for both surface water and groundwater has been utilised to create a baseline for this assessment which includes data of the following analytes:

- Hydrocarbons
- Inorganics (metals)
- Nutrients
- Pesticides

- Physical parameters
- Fluorotelomer Sulfonates, Perfluoro Carboxylates, Perfluoro Sulfonates, Perfluorooctane Sulfonamides and Sulfonamido Ethanols, collectively known as Perfluoroalkyl & Polyfluoroalkyl Substances (PFAS).

The concept for the design of the main drains on the airport estate is to, where possible, construct the drains as open channels and vegetate them to create Living Streams as described in the *Perth Airport Living Stream Design Guidelines* (Syrinx Environmental, 2019). Living Streams provide a healthy ecosystem for microbes to perform bioremediation and biotransformation of environmental pollutants such as hydrocarbons (e.g. oil), nutrients, and various metals.

Local provenance vegetation is planned to be used where suitable. Water quality improvement is achieved by aquatic vegetation and natural biological processes helping to oxygenate the water and removing nutrients plus non-nutrient contaminants. The development of Living Streams within the estate supports the natural surface-water management and control of peak flows, as well as improving water quality prior to discharge of the stormwater off the estate. Figure 5-1 provides two example cross-sections through the proposed Living Stream design.

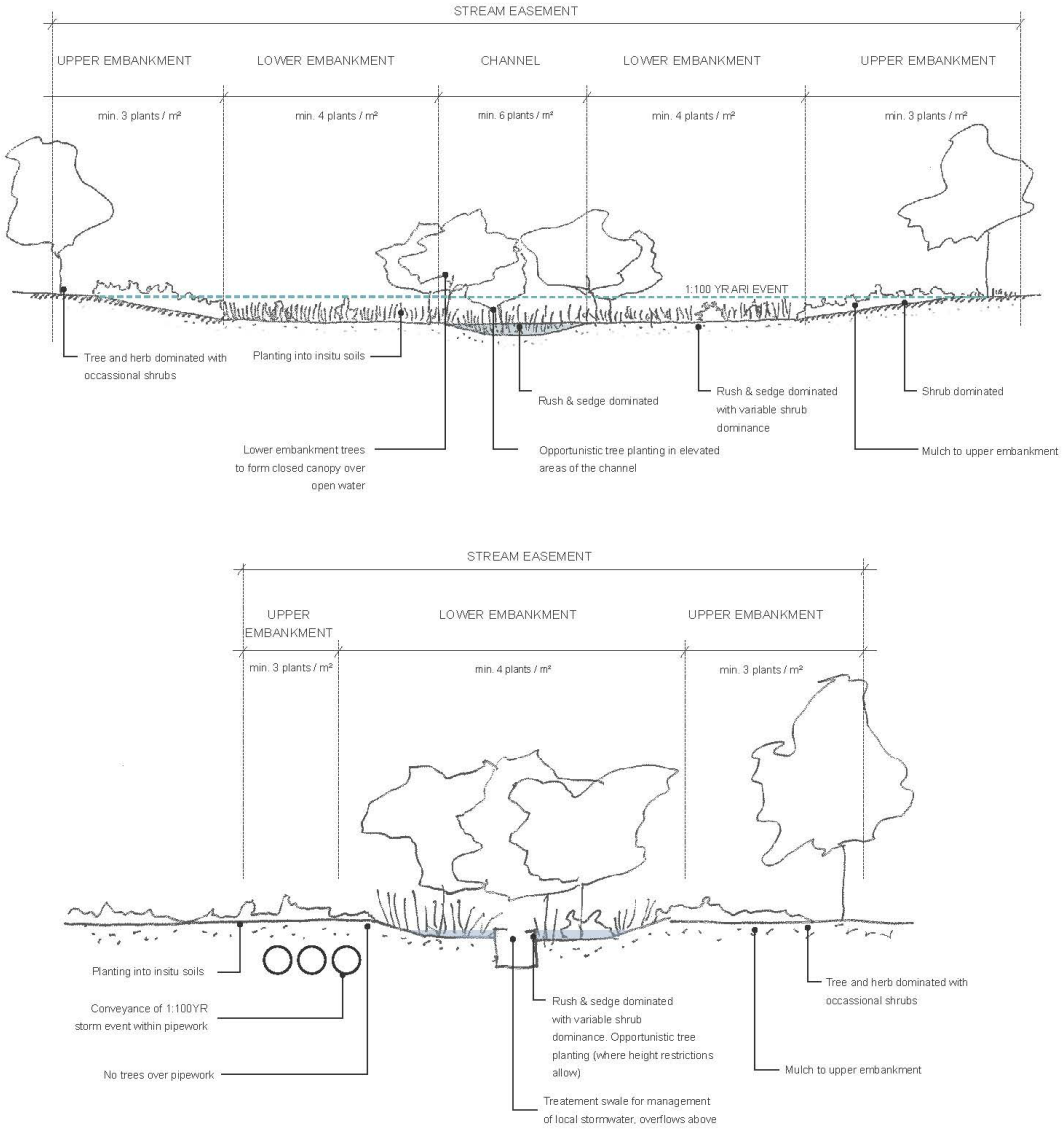


Figure 5-1: Example Living Stream cross-sections (Syrinx Environmental, 2019)

5.3 Receiving environment

1.1.6 Existing Context

Climate

Perth Airport experiences a temperate Mediterranean climate characterised by hot, dry summers and mild, wet winters. Summer generally lasts from December to late March, with February typically the hottest month. The last few decades show a trend of declining rainfall in the southwest[1].

The closest Bureau of Meteorology (BoM) weather station is located at Perth Airport (Site number: 009021, located at 31.93 °S, 115.98 °E)[2]. Climate data for the Perth region, sourced from the Perth Airport weather station, is presented in Table 5-2 and Figure 5-2 below.

Table 5-2 Climate statistics for Perth Airport (data from 1944 - 2021)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	31.8	31.9	29.8	25.7	21.8	19.0	18.0	18.6	20.2	22.8	26.1	29.2	24.6
Mean minimum temperature (°C)	17.1	17.5	16.0	13.0	10.4	9.0	8.0	8.1	8.9	10.3	12.8	15.0	12.2
Mean rainfall (mm)	10.8	15.1	16.4	39.6	97.8	154.4	154.2	118.7	72.3	42.6	26.3	11.1	760.4

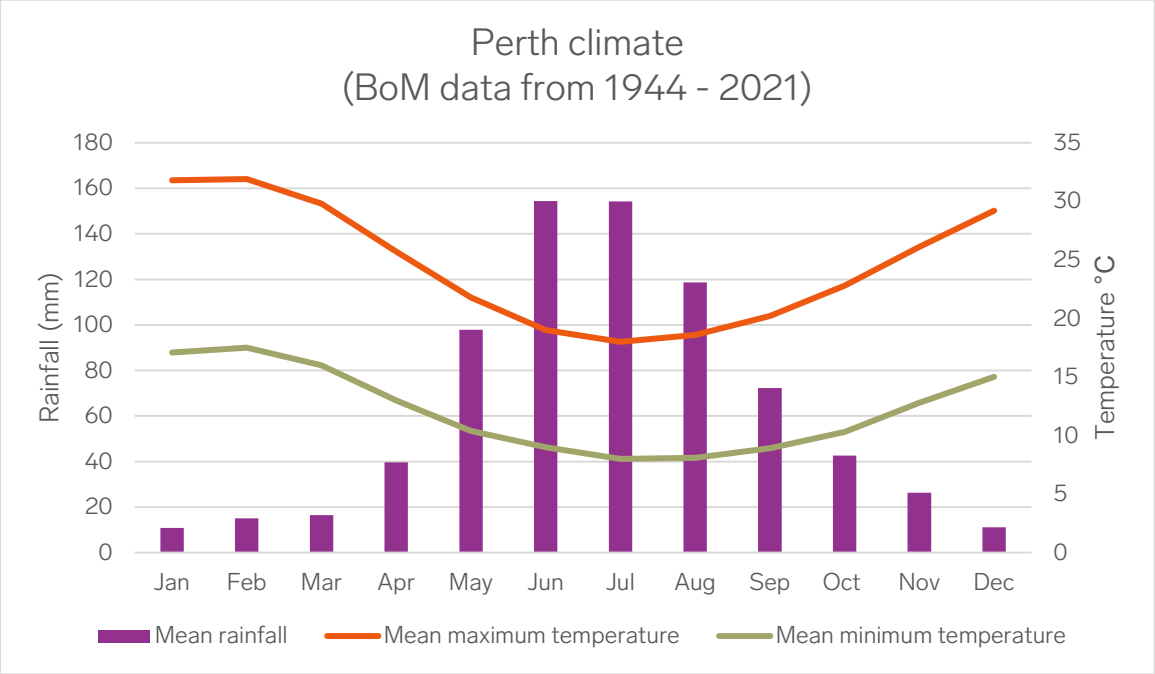


Figure 5-2: Mean temperature and rainfall for Perth Airport

[1] https://www.watercorporation.com.au/Our-water/Climate-change-and-WA/Climate-and-Perth
[2] http://www.bom.gov.au/climate/data/stations/

Perth Airport

Groundwater

5.3.1.1 Aquifers

Three aquifers have been identified within the airport estate (ordered from shallow to deep):

- Superficial aquifer.
- Kings Park aquifer.
- Mirrabooka aquifer.

The deeper regional aquifer systems, the Leederville and Yarragadee, exist within the airport estate. There is a limited hydraulic connection between the shallower Leederville aquifer and the mainly shale and siltstone confining layers (aquitards) within the overlying Kardinya Shale Member of the Osborne Formation and the Kings Park Shale.

5.3.1.2 Recharge

The Superficial aquifer is recharged directly by rainfall infiltration, with measured groundwater levels responding to seasonal variations in rainfall. Stormwater runoff via drains may also contribute to groundwater recharge to the Superficial aquifer. Across the airport estate, the amount of rainfall recharge to groundwater will vary based on land use, the depth to groundwater and vegetation cover.

Recharge into the Kings Park and Mirrabooka aquifers is likely to occur by downward leakage from the Superficial aquifer.

5.3.1.3 Groundwater levels and flow direction

The DWER Perth Groundwater Atlas[3] presents the inferred minimum and maximum historical groundwater level contours for the Perth region. These are shown Figure 5-3 and Figure 5-4.

Groundwater levels across the airport estate and surrounding areas have been measured in monitoring bores installed into the Superficial aquifer. The monitoring indicates:

- Groundwater levels across the airport estate vary with topography and are at depths of 0.3 to 9mbgl
  (i.e. 6.5 to 21mAHD).
- The seasonal water table fluctuation is approximately 0.6 to 1.6m, with an average of around 1.2m across the estate.
- Variations in water levels can usually be correlated with variations in rainfall. Peaks in the groundwater levels generally occur 1 to 3 months after peaks in rainfall. The time lag between peak rainfall and peak measured water level generally increases with the measured depth to the water.
- No long term trend decline in water levels is evident in monitoring data from recent years due to reductions in annual rainfall.

The regional groundwater direction is from the Darling Scarp (i.e. ~32mAHD) westward towards the Swan River (i.e. ~1mAHD). The local groundwater flow direction is generally radial from a local groundwater high east of the airport estate. Groundwater flow directions across the airport estate are north-west, west and south-west, towards the Swan River.

[3] https://www.water.wa.gov.au/maps-and-data/maps/perth-groundwater-atlas

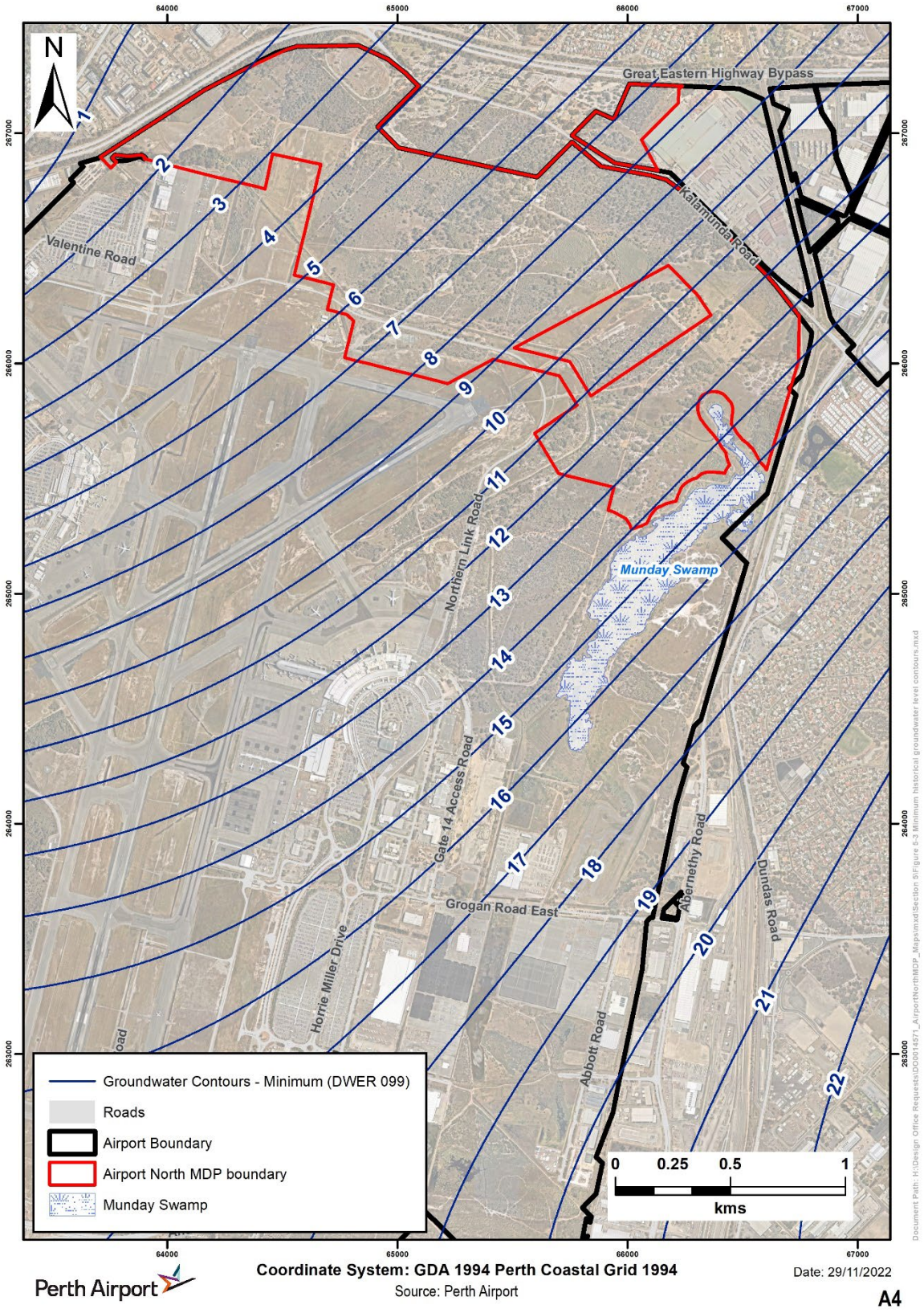


Figure 5-3: Minimum historical groundwater level contours

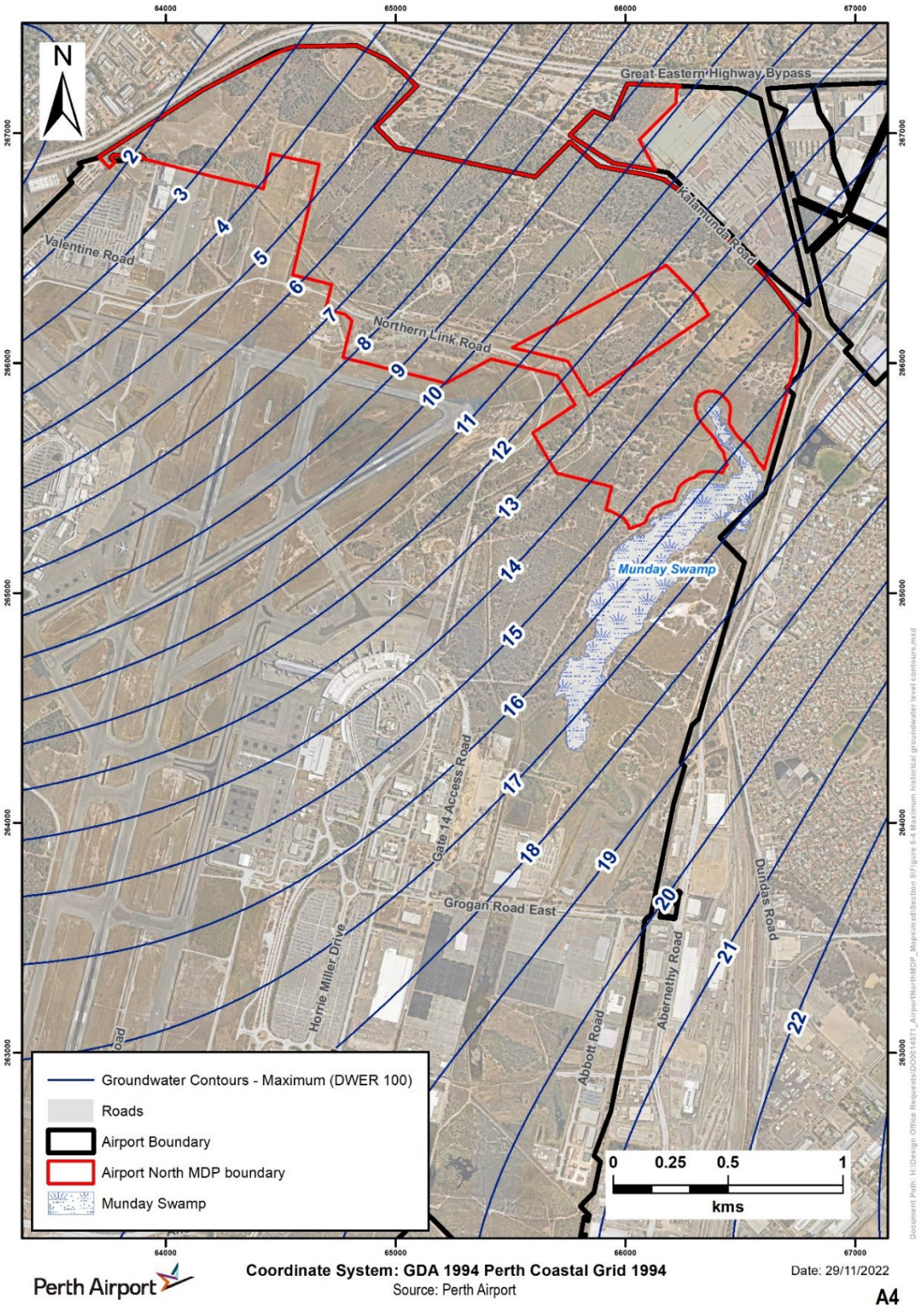


Figure 5-4: Maximum historical groundwater level contours

5.3.1.3.1 Groundwater discharge

Groundwater from the Superficial aquifer is predominantly discharged into the Swan River, with small amounts of groundwater discharged into the Canning River system. Groundwater discharge also occurs via:

- The extensive network of stormwater drains across the airport estate, i.e. the NMD and SMD, mostly during the winter season when, in some locations, the groundwater table elevation exceeds the invert level of the drains.
- Direct evaporation from swamps (such as Munday Swamp or Runway Swamp) and bare soil where the water table is shallow.
- Evapotranspiration from vegetation.
- Downward flow into the Kings Park and Mirrabooka aquifers, where the hydraulic head gradient is downward, especially where the superficial lithology is sandy.

5.3.1.3.2 Groundwater quality

Site water quality data for the Superficial aquifer suggests that groundwater is generally fresh, with an average Total Dissolved Solids (TDS) of 500mg/L. In some areas, higher TDS values have been measured; however, these higher TDS values are interpreted to be from evapo-concentration of salts in low lying swamps or drains. These salts are then subsequently flushed into the groundwater and diluted via natural recharge processes.

pH values range between 5 and 8, with an average of 7, indicating neutral groundwater conditions, with some areas with acidic conditions. Acidic conditions could be due to the in-situ oxidation of acid sulfate soils (ASS) associated with the seasonal fluctuations in groundwater levels.

Groundwater chemistry within the Superficial aquifer is normally a sodium-chloride type, with some areas of water being sodium-bicarbonate-chloride type, i.e. associated with rainfall recharge at the 'top' of the catchment.

Perth Airport maintains a network of groundwater monitoring bores, which are typically monitored on a quarterly basis. The monitoring results are judged against accepted limits for 80+ water pollutants set out in Schedule 2 to the *Airports (Environment Protection) Regulations 1997*. The monitoring bores of relevance to this assessment are shown in Figure 5-5. Table 5-3 lists any exceedances of the accepted limits at monitoring bores, dating back to 2018. From the limited number of exceedances, relative to the 80+ limits in the regulations, it is considered that the groundwater quality within the airport estate is acceptable, and the airport's operations do not appear to be adversely affecting it.

5.3.1.3.3 PFAS contamination

A detailed site investigation across the airport estate in 2019 identified that PFAS contamination exists in the groundwater (Senversa, 2019). The airport's groundwater monitoring regime has confirmed the presence of PFAS, the detections are presented in Table 5-3. PFAS contaminated groundwater has the potential to enter the stormwater drainage system in areas where the drain inverts are in close proximity to or below the seasonal groundwater level. PFAS contaminated groundwater that has ponded in the bottom of a drainage channel has the potential to be flushed through the Northern Main Drain and offsite during a rainfall/storm event.

To manage the offsite release of PFAS via the NMD, Perth Airport currently treats all surface water (up to 20 L/s) to below 0.13ug/L at a treatment plant located on the western boundary of the airport estate, upstream from the NMD's outlet. The treatment involves abstracting surface water from the NMD near the western boundary of the airport estate and pumping it through treatment vessels containing an absorbent media and ion exchange resin, which removes PFAS from the water (Strategen-JBS&G, 2020, cited within Aurecon 2022).

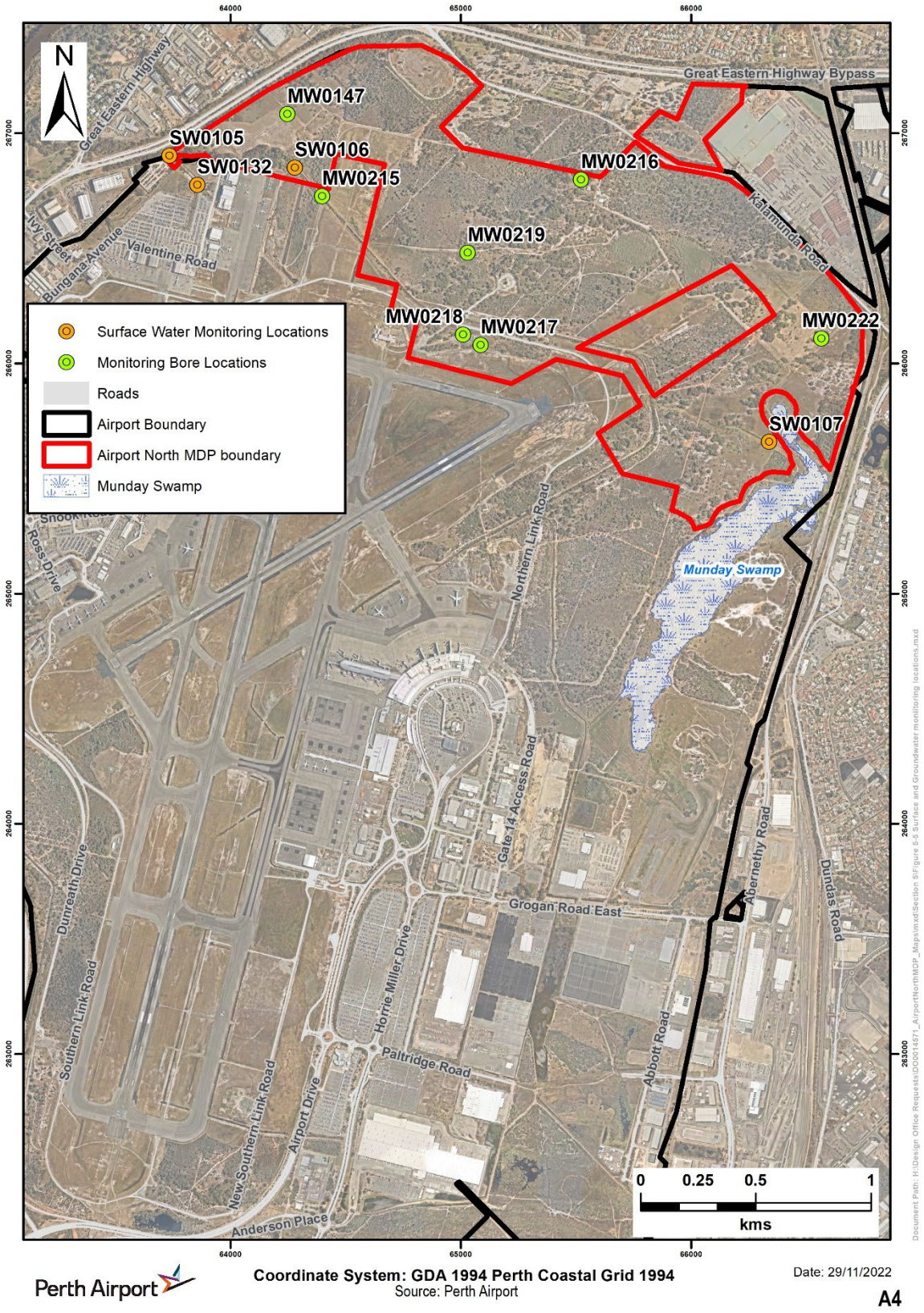


Figure 5-5: Surface and Groundwater monitoring locations

Table 5-3: Groundwater quality - Analyte exceedances since 2018

Sample point	Sample date and time	Analyte (mg/L)	Schedule 2 Freshwater criteria (mg/L)	Measured Concentration (mg/L)
MW0147	20/07/2021 15:50:00 *08/11/2018 15:05:00	Aluminium	0.1	0.12
		Ammonia	0.02	0.026
		Copper	0.002	0.002
		Tin	0.000008	<0.001
		Zinc	0.005	0.012
		Total Nitrogen	0.1	1.1
		Total Phosphorus	0.005	0.02
		pH	6.5 - 9	5.5*
MW0215	29/01/2020 11:00:00 *08/12/2021 12:44:00 **07/07/2020 10:20:00 ***23/04/2018 2:10:00 PM ****08/12/2021 12:44:00	Benzene	0.3	<1
		Ethylbenzene	0.14	<1
		Toluene	0.3	<1
		Ammonia	0.02	0.057
		Copper	0.002	0.003**
		Tin	0.000008	<0.001
		Zinc	0.005	0.053***
		Total Nitrogen	0.1	0.8****
		Total Phosphorus	0.005	0.44****
MW0216	29/01/2020 08:00:00 *20/07/2021 13:50:00 **07/07/2020 09:07:00 03/12/2021 10:15:00*** 03/12/2021 10:15:00****	Benzene	0.3	<1
		Ethylbenzene	0.14	<1
		Toluene	0.3	<1
		Ammonia	0.02	0.024*
		Copper	0.002	0.002**
		Tin	0.000008	<0.001
		Zinc	0.005	0.006***
		Total Nitrogen	0.1	0.2***
		Total Phosphorus	0.005	0.04***
		pH	6.5 - 9	6.22****
MW0217	30/01/2020 11:00:00 20/10/2021 11:23:00* 26/04/2018 10:11:00** 01/02/2018 10:30:00***	Benzene	0.3	<1
		Ethylbenzene	0.14	<1
		Toluene	0.3	1
		Aluminium	0.16	0.12*
		Ammonia	0.02	0.061**

Sample point	Sample date and time	Analyte (mg/L)	Schedule 2 Freshwater criteria (mg/L)	Measured Concentration (mg/L)
		Cadmium	0.0002	0.0005***
		Lead	0.001	0.003***
		Tin	0.000008	<0.001
		Zinc	0.005	0.006*
		Total Nitrogen	0.1	2.4*
		Total Phosphorus	0.005	0.03*
		pH	6.5 - 9	5.92*
MW0218	30/01/2020 10:18:00 20/10/2021 10:38:00* 01/02/2018 09:50:00** 09/07/2020 10:00:00***	Benzene	0.3	<1
		Ethylbenzene	0.14	<1
		Toluene	0.3	<1
		Ammonia	0.02	0.73*
		Copper	0.002	0.002**
		Iron	1	4.9*
		Tin	0.000008	<0.001
		Zinc	0.005	0.009***
		Total Nitrogen	0.1	1.3*
		Total Phosphorus	0.005	0.02*
		pH	6.5 - 9	6.46*
MW0219	29/01/2020 10:06:00 20/07/2021 14:36:00* 03/12/2021 11:40:00** 03/12/2021 11:40:00*** 26/01/2022 12:40:00****	Benzene	0.3	<1
		Ethylbenzene	0.14	<1
		Toluene	0.3	1
		Aluminium	0.16	0.26*
		Ammonia	0.02	0.025**
		Copper	0.002	0.003*
		Nickel	0.00015	0.017***
		Tin	0.000008	<0.001
		Total Nitrogen	0.1	1.8***
		Total Phosphorus	0.005	0.06***
		pH	6.5 - 9	6.3****
MW0222	01/12/2021 15:10:00 08/11/2018 10:07:00*	Aluminium	0.16	0.3
		Ammonia	0.02	0.071
		Copper	0.002	0.003*
		Tin	0.000008	<0.001

Sample point	Sample date and time	Analyte (mg/L)	Schedule 2 Freshwater criteria (mg/L)	Measured Concentration (mg/L)
		Zinc	0.005	0.012*
		Total Nitrogen	0.1	2.1
		Total Phosphorus	0.005	0.19

Source: Aurecon 2022

Table 5-4 Groundwater quality - PFAS detects

Sample point	Number of samples (Sum of PFOS and PFHxS (ug/L))	Number of detects (Sum of PFOS and PFHxS (ug/L))	Percentage of detects (Sum of PFOS and PFHxS (ug/L))	Number of samples (Perfluorooctanoic Acid (PFOA) (ug/L))	Number of detects (Perfluorooctanoic Acid (PFOA) (ug/L))	Percentage of detects (Perfluorooctanoic Acid (PFOA) (ug/L))
MW0147	4	4	100%	4	4	100%
MW0215	16	16	100%	16	16	100%
MW0216	17	17	100%	17	17	100%
MW0217	15	15	100%	15	15	100%
MW0218	15	15	100%	15	15	100%
MW0219	16	16	100%	16	16	100%
MW0222	5	5	100%	4	5	80%

Source: Aurecon 2022

5.3.1.4 Groundwater dependent ecosystems

Munday Swamp is the closest groundwater dependent wetland located east of the Airport North MDP, and is immediately adjacent, but outside of the MDP boundary. This wetland provides a permanent water source and, as such, supports a range of fauna. The existing Munday Swamp surface water and groundwater interactions can be summarised as:

- Water is composed of surface water runoff from two Water Corporation drains that are external to the airport estate and the NMD during and following rainfall events, with groundwater contribution when groundwater levels are close or at the surface.
- The relationship between Munday Swamp and the groundwater table is dynamic, with periods where the swamp acts as a recharge source to groundwater, periods where there is groundwater throughflow in the swamp, and periods where it acts as a groundwater sink / discharge when water levels are below the surface (i.e. evapotranspiration through soil profile) with there being the potential to dry out and a disconnection of groundwater from the surface.

Other vegetation and wetlands within the airport estate are likely to rely on rainfall and overland water flow events, with the vegetation in the low laying areas (i.e. swamps) partially relying on groundwater. The vegetation sources water from the soil moisture in the unsaturated zone above the water table; therefore, any major changes to the groundwater levels (drawdown) may potentially impact the vegetation.

5.3.1.5 Other groundwater users

Existing groundwater use within the airport estate has been assessed via the DWER Water Register Database of licenced registered users. According to this database, there are currently 134 licenced groundwater users within a 7 km radius of the airport estate that have licenced drawpoints (bores) to abstract water from the Superficial aquifer.

A total of 87 licenced groundwater users are currently abstracting water (a total of 62,883,600kL/year) from the Superficial aquifer within the area included in this groundwater assessment. The airport estate abstracts water for irrigation purposes using 25 licensed bores.

Additionally, unlicensed private residential users are likely to draw a small but undefined quantity of water from the Superficial aquifer for reticulation purposes.

5.3.1.6 Existing Stormwater Infrastructure

The airport estate is located on the Swan Coastal Plain near the base of the Darling Scarp and is within 500m of the Swan River.

The principal hydrological features within or adjacent to the Airport North MDP area include:

- Munday Swamp.
- Northern Main Drain (NMD), see Figure 5-6: Existing surface water features .

5.3.1.7 Northern Main Drain

The NMD is an open, unlined channel for most of its length through the airport estate. Poison Gully, which has its source near the top of the Darling Scarp, feeds into the upstream end of the NMD, where it crosses the airport estate's eastern boundary. The NMD drains one of the 30 major stormwater catchments of the Swan Canning rivers system and has a catchment upstream of the estate of 1,326 ha.

The two Water Corporation scheme drains that enter the airport estate discharge directly into Munday Swamp. During times of high flow, the NMD reaches capacity and overflows into the southern end of Munday Swamp. When Munday Swamp reaches capacity, it overflows at its northern end and drains into the NMD. Within the estate, the NMD drains the Airport North MDP area south of Kalamunda Road, the majority of the Airport Central MDP area, the majority of the existing cross runway (06/24), just under half of the existing main runway (03/21), a small portion of the Airport West Precinct, and the northern half of the New Runway Project.

Perth Airport administers the drain within the estate, the Water Corporation administers its two scheme drains, and the City of Kalamunda manages Poison Gully upstream of the estate. The City of Swan manages the NMD downstream of the estate (where it is known as Limestone Creek).

5.3.1.8 Munday Swamp

Munday Swamp is a freshwater wetland with surface and groundwater inflows, see Figure 5-6: Existing surface water features . The swamp falls within a larger area that is mapped as a lake (permanently inundated basin) by the State's Department of Biodiversity, Conservation and Attractions (DBCA). The swamp is also a wetland of national importance.

The surface water within the swamp is predominantly an expression of the groundwater that generally flows from east to west across the swamp area. As such, the swamp is sensitive to any drawdown of groundwater that may occur as a result of development within the airport estate.

Aerial photographic records show a drying trend over the past 20 years. This may be related to the declining rainfall experienced in the southwest of Western Australia attributable to the climate shift which has occurred since 1974. With the current cycle of decreasing rainfall, members of the Airport's Environment Team report that most of the swamp now dries out over summer.

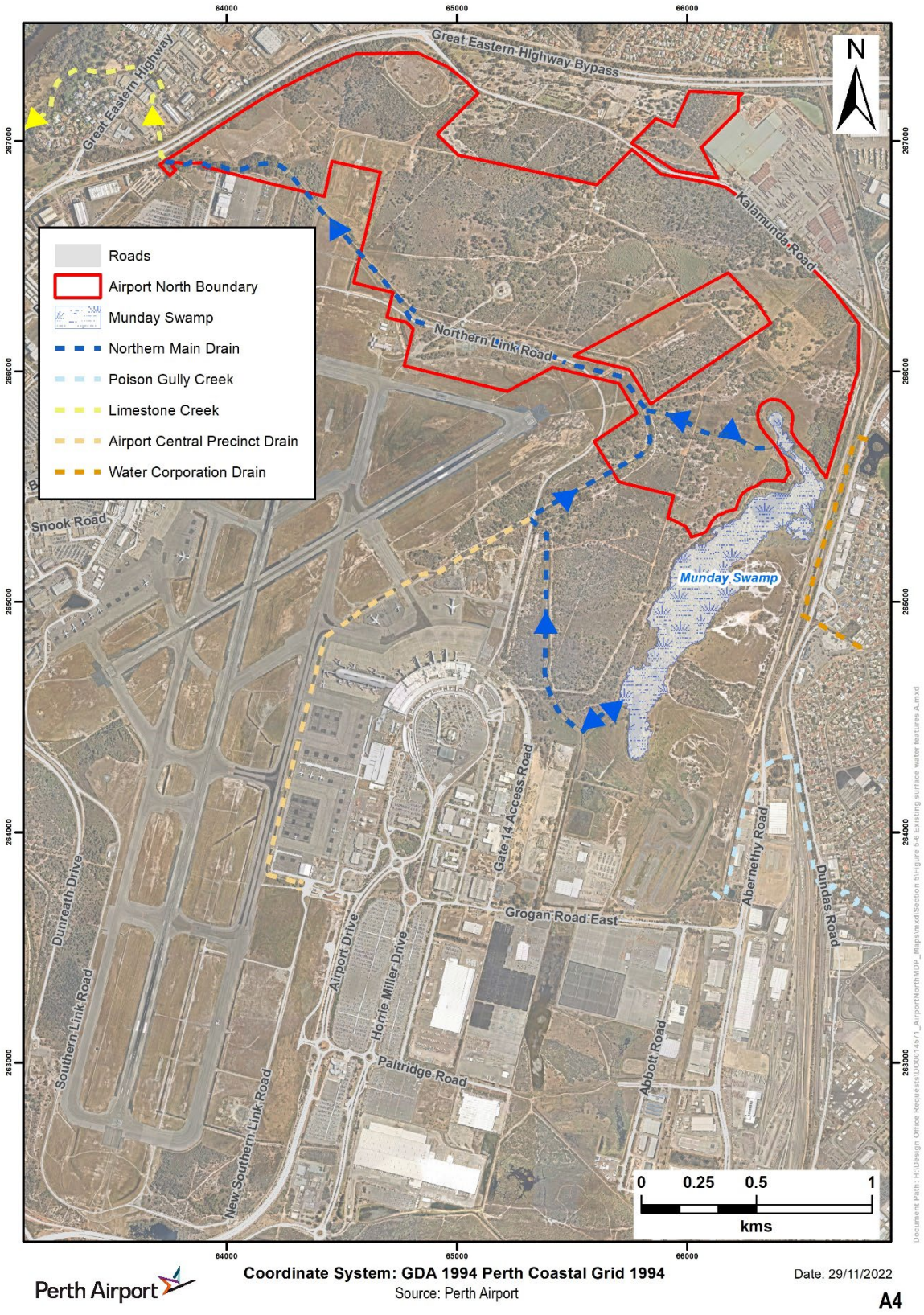


Figure 5-6: Existing surface water features

5.3.1.9 Surface water quality

Perth Airport has been monitoring surface water and groundwater since being granted the lease for the airport estate in 1997. Results are submitted to the Commonwealth Department of Infrastructure, Transport, Regional Development, Communication and the Arts (DITRDCA). The monitoring program covers the airport estate and is a risk-based approach with higher risk areas/locations with 'high' readings being monitored more often than other areas. There are no known areas of surface quality concern, though PFAS has been recorded within the NMD, and a treatment plant is located before the NMD's outlet from the airport estate.

Water quality results from recent sampling events between January 2018 and April 2022 are provided in Table 5-5. The monitoring results are compared against accepted limits for 80+ freshwater pollutants set out in Schedule 2 to the *Airports (Environment Protection) Regulations 1997*. The surface water sampling locations relevant to this assessment are shown in Figure 5-5. Table 5-5 lists any exceedances of the accepted limits. From the limited number of exceedances, relative to the 80+ limits in the regulations, it is considered that the surface water quality within the airport estate is acceptable, and the airport's operations do not appear to be adversely affecting it.

There are known locations of PFAS contamination within certain subleases granted by PAPL within the Airport North MDP, but due to the nature of PFAS the contamination is not bound by the lease areas and they have potentially extended throughout the surrounding area. PFAS frequently make their way into stormwater runoff in both free and particulate-bound states, as they are water soluble. Some PFAS species like perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) have higher hydrophobicity, indicating they have an elevated tendency to enter stormwater bound to particulate matter rather than freely. During rainfall events, PFAS from the surface soils may dissolve in the surface water runoff or may remain bound to the particulate and get transported to the surface water channels by overland flow. The PFAS may flow through the stormwater channels, including the NMD, to the treatment plant on the western side of the Perth Airport estate. The PFAS surface water quality detections are presented in Table 5-6.

Table 5-5: Surface water quality – Analyte exceedances

Sample point	Sample date and time	Analyte (mg/L)	Schedule 2 Freshwater criteria (mg/L)	Measured Concentration (mg/L)
SW0105	21/01/2019 13:36:00 09/11/2018 15:03:00* 28/01/2020 11:10:00** 10/03/2020 10:12:00*** 24/01/2022 13:08:00**** 22/07/2021 11:20:00*****	Benzene	0.3	<1
		Ethylbenzene	0.14	<1
		Hexachlorobutadiene	0.0001	<0.001*
		Pentachlorophenol	0.00005	<0.001*
		Toluene	0.3	<1
		Aluminium	0.1	0.16**
		Copper	0.002	0.004**
		Tin	0.000008	<0.001***
		Zinc	0.005	0.011****
		Total Nitrogen	0.1	0.4****
		Total Phosphorus	0.005	0.38****
		pH	6.5 - 9	6.3*****
SW0106	09/11/2018 13:52:00 21/01/2019 12:33:00*	Ethylbenzene	0.14	<1
		Toluene	0.3	<1

Sample point	Sample date and time	Analyte (mg/L)	Schedule 2 Freshwater criteria (mg/L)	Measured Concentration (mg/L)
	19/07/2021 12:00:00** 08/12/2021 12:19:00*** 22/04/2022 12:00:00****	Aluminium	0.1	0.19
		Ammonia	0.02	0.035*
		Copper	0.002	0.003**
		Tin	0.000008	<0.001***
		Zinc	0.005	0.018**
		Total Nitrogen	0.1	0.6****
		Total Phosphorus	0.005	0.02****
SW0107	30/08/2021 08:46:00 08/07/2020 14:48:00* 19/07/2021 11:25:00** 21/10/2021 09:43:00*** 30/11/2021 12:55:00**** 21/09/2021 09:27:00*****	Aluminium	0.1	0.11
		Ammonia	0.02	0.049
		Copper	0.002	0.005
		Iron	1	1.9*
		Tin	0.000008	<0.001**
		Zinc	0.005	0.008***
		Total Nitrogen	0.1	2.8****
		Total Phosphorus	0.005	1****
		pH	6.5 – 9	6.4
SW0132	22/11/2021 14:00:00 24/01/2022 11:57:00*	Ammonia	0.02	0.032
		Copper	0.002	0.003
		Tin	0.000008	<0.001
		Zinc	0.005	0.019
		Total Nitrogen	0.1	0.6*
		Total Phosphorus	0.005	0.02*

Exceedances displayed are the most recent from January 2018 to April 2022. SW107 most recent data is from November 2021 due to the channel being dry.

Source: Aurecon 2022

Table 5-6 Surface water quality - PFAS detects

Sample point	Number of samples (PFOS)	Number of detects (PFOS (ug/L))	Percentage of detects (PFOS (ug/L))	Number of samples (Perfluorooctanoic Acid (PFOA) (ug/L))	Number of detects (Perfluorooctanoic Acid (PFOA) (ug/L))	Percentage of detects (Perfluorooctanoic Acid (PFOA) (ug/L))
SW0105	100	100	100%	100	92	92%
SW0106	16	16	100%	16	16	100%
SW0107	9	9	100%	9	9	100%
SW0132	9	9	100%	9	9	100%

Source: Aurecon 2022

5.3.2 1997 Pre-Lease case

5.3.2.1 Inflow and outflow rates

The Pre-Lease case establishes the acceptable inflows and outflows from the airport estate that need to be maintained. The Perth Airport Master Plan (2020) includes a commitment to limit the flows that leave the Airport estate via the NMD and the SMD to the discharges that would have occurred in 1997. The NMD is the principal drain for the Airport North MDP, thus the SMD is not considered further in this MDP.

The 1997 Pre-Lease RAFTS model includes 334 sub-catchments, covering a total area of 2633 ha and includes the Airport North MDP area. The outcome of applying the ARR 2019 design event hydrology means that higher flows are predicted from each of the upstream external catchments when compared to the ARR 1987 approach. The increase in flows is primarily related to the ARR 2019 ensemble temporal patterns, with the ARR 2019 increase in rainfall intensity from 6 to 12-hour durations also contributing to the increased peak flow and longer critical duration than the ARR 1987 approach.

The 2017 MDS and revised 1997 Pre-Lease discharges for NMD for the modelled design events are detailed in Table 5-7. The NMD outflows are a combination of all stormwaters leaving the airport estate at these locations; this includes open channel flow, culvert flow and any overland flow at each outflow location. For the NMD, the main difference occurs for the 1% AEP event where overflow from SMD flows across and combines with the NMD flows.

Table 5-7: NMD outlet discharge limits for 1997 Pre-Lease case

AEP (%)	2017 MDS (ARR 1987) Pre-Lease case (m^3/s)	ARR 2019 Pre-Lease case (Critical duration/TP) (m^3/s)
10%	7.6	6.3 (9hr/TP7)
2%	10.3	10.1 (9hr/TP10)
1%	12.0	17.1 (18hr/TP4)
TP = ARR 2019 Temporal Pattern		

Source: Aurecon 2022

5.3.2.2 Hydrographs

The ARR 2019 approach uses ten rainfall temporal patterns for each duration; in comparison, ARR 1987 used only one. In addition to maintaining the outflow rates from the airport estate, it was determined that it was necessary to retain the existing temporal discharge pattern so as not to impact existing downstream flow outside of the airport estate. Figure 5-7 illustrates the temporal pattern at the NMD outfall for the three modelled design events.

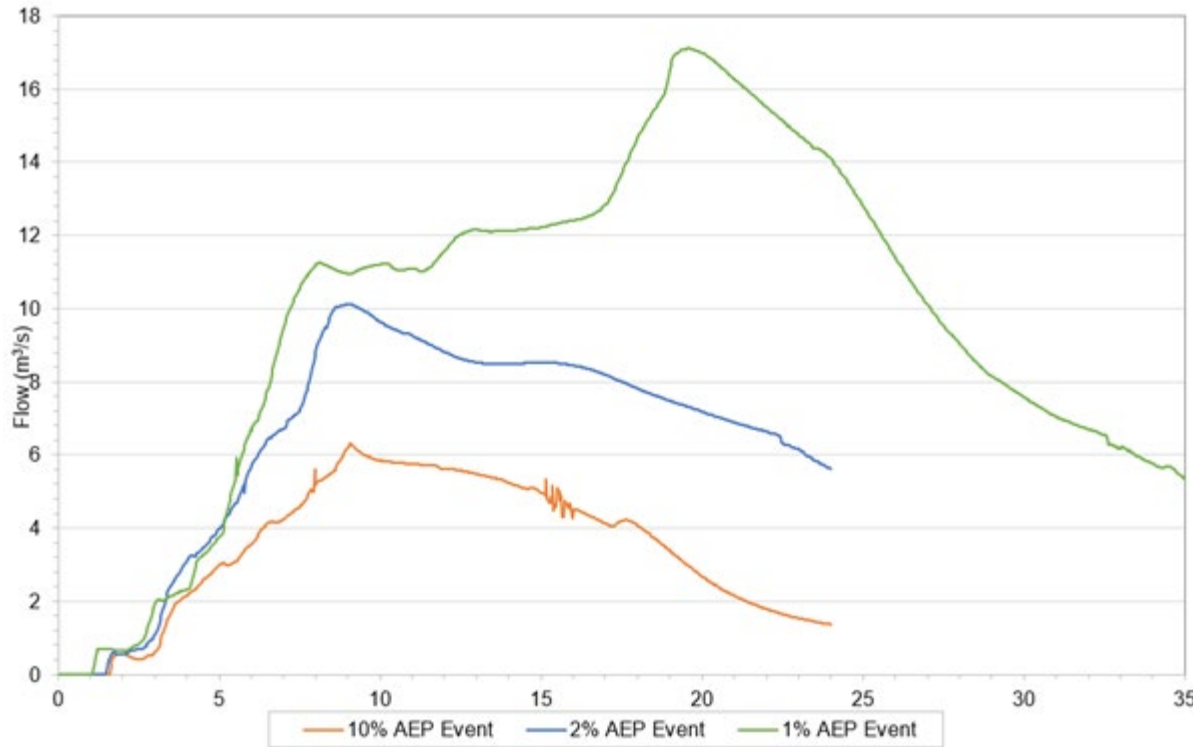


Figure 5-7: NMD outlet discharge hydrograph

Source: Aurecon 2022

5.4 Impact Assessment of Airport North MDP

The development of the Airport North MDP may result in impacts to groundwater and surface water/stormwater. The impact assessment is based the developed concept design for the MDP area, noting this may be subject to change as the design progresses. Identified key construction activities and their potential associated direct and indirect impacts on surface water and groundwater are discussed in Table 5-8 along with associated mitigation measures.

In order to determine whether or not an action is likely to have a significant impact on the environment it is necessary to consider the total adverse impact of the action in the context of the environment which will be impacted, particularly those elements of the environment which are sensitive or valuable in accordance with the Significant Impact Guidelines 1.2 (DSEWPaC, 2013). For this assessment the criteria from the Significant Impact Guidelines 1.2 relevant to this assessment include:

- Impacts on water resources
- Pollutants, chemicals, and toxic substances
- Impacts on landscapes and soils

Table 5-8 contains the assessment of potential groundwater and surface water impacts during the construction and operational phases of Airport North.

Table 5-8 Assessment of potential groundwater and surface water impacts during construction and operation

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
Surface water / Stormwater	Construction	Clearance of vegetation	Indirect	Clearance of vegetation may increase runoff volume, frequency and rate of discharges to drainage lines due to modified (shortened) flow paths and reduced infiltration and evapotranspiration.	Medium	Minimising vegetation clearance where feasible. Any areas that can be retained will be retained where practicable. A CEMP will be developed. Erosion and Sediment controls to be included in CEMP. Clearing will be undertaken in accordance with the Clearing Procedure (Perth Airport 2021). Monitoring for groundwater and surface water, pre-construction, during construction and post construction will be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	Low
			Indirect	Clearance of vegetation with a total disturbed area of 213.5 ha would leave soils exposed and increase the risk of erosion in these areas during construction, which would increase the rate of sediment-laden, nutrient filled stormwater that may be transported from cleared areas into the drainage lines.	Medium	Minimising vegetation clearance where feasible. Any areas that can be retained will be retained where practicable. A CEMP will be developed. Erosion and Sediment controls to be included in CEMP. Clearing will be undertaken in accordance with the Clearing Procedure (Perth Airport 2021). Monitoring for groundwater and surface water, pre-construction, during construction and post construction will be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
			Indirect	An increase of sediment in stormwater and increased volumes of stormwater may result in an increase of PFAS mobilisation in the disturbed areas.	**Medium**	Minimising vegetation clearance where feasible. Any areas that can be retained will be retained where practicable. A CEMP will be developed. Erosion and Sediment controls and PFAS controls to be included in CEMP. Clearing would be undertaken in accordance to the Clearing Procedure (Perth Airport 2021). PFAS risk assessment to be conducted and conformance with the PFAS National Environmental Management Plan. Treatment of surface water at the NMD treatment plant to continue as required until source remediation has occurred. Monitoring for groundwater and surface water, pre-construction, during construction and post construction will be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	**Low**
		Drain refill	Indirect	Filling in the redundant drain may cause localised increase runoff volume, frequency, and rate of discharges due to changed drainage scenario.	**Medium**	A CEMP will be developed Fill used would adhere to Fill Management Guidelines (Perth Airport 2018). Monitoring for groundwater and surface water, pre-construction, during construction and post construction will be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	**Low**
		Earthworks / Pipe construction	Indirect	Earthworks may intercept historical legacy contamination (metals) and release into the drainage lines during earthworks.	**High**	A CEMP will be developed, unexpected finds and contamination controls to be included in CEMP.	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
						Monitoring for groundwater and surface water, pre-construction, during construction and post construction will be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	
			Indirect	Earthworks may intercept historical legacy PFAS contamination and release to receiving drainage lines during earthworks	High	The design concept for avoiding the mobilisation of potentially polluted groundwater in or adjacent to the known areas is to not excavate below the seasonal high groundwater level. Where that cannot be achieved due to invert levels, then pipes will be used to convey the minor storm events with overland flow occurring for additional rainfall runoff from larger storm events. A CEMP will be developed. PFAS risk assessment to be conducted and conformance with the PFAS National Environmental Management Plan. Monitoring for groundwater and surface water, pre-construction, during construction and post construction would be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	Low
			Indirect	Earthworks may intercept and cause the mobilisation of problem soils (ASS, PASS and Saline soils) into drainage lines	Medium	A CEMP will be developed. Preparation and implementation of Acid Sulfate Soil Management Plan (ASSMP) in accordance with Water Quality Australia's National Acid Sulfate Soils Guidance. Management Plan. ASMP approved by Perth Airport following review by DITRDCA AEO.	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
						Monitoring for groundwater and surface water, pre-construction, during construction and post construction will be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	
			Indirect	Earthworks increases the surface area of soils exposed and may increase the rate of sediment-laden, nutrient filled stormwater being transported from cleared areas into drainage lines.	Medium	A CEMP will be developed Erosion and Sediment controls to be included in CEMP. Monitoring for groundwater and surface water, pre-construction, during construction and post construction will be undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	Low
			Indirect	Increased erosion and sediment mobilisation from earthworks to local and downstream environments from runoff from non-stabilised areas	Medium	A CEMP will be developed. Erosion and Sediment controls to be included in CEMP.	Low
		Construction of pavement	Indirect	Concrete process water is caustic and typically has a high pH value ranging between 11 and 12. It contains dissolved solids including sulphates and hydroxides from cement, oil and grease from equipment and derivatives from chemical admixtures and asphalt normally contains hydrocarbons. During the pouring and shortly after pouring if not contained this process water may be transported to drainage lines.	Medium	A CEMP will be developed Where practicable, process water will be contained and pouring will not occur during wet weather events.	Low
			Indirect	Flattening and compaction of the surface may cause changes to overland flows and increase volume, frequency, and rate of surface runoff.	Medium	A CEMP will be developed. Erosion and Sediment controls to be included in CEMP. Drainage design to consider overland flows.	Low
		Discharges	Direct	Dewater which requires discharging to the environment has the potential to impact water	Medium	A CEMP will be developed.	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
				quality depending on the quality of the water. Discharges may occur from sediment basins, dewatering and water quality treatment plants or other construction activities		Preparation and implementation of Dewatering Management Plan and ASSMP in accordance with Water Quality Australia's National Acid Sulfate Soils Guidance. Dewatering Management Plan to be approved by Perth Airport following review by the DITRDCA AEO.	
		General Construction	Indirect	Use and maintenance of vehicles and equipment as well as chemicals for construction, during the construction phase these chemicals and fuels during wet weather events may be transported to the drainage lines.	Medium	A CEMP will be developed, hydrocarbon and chemical management controls to be included in CEMP.	Low
			Indirect	Waste materials such as concrete, plasterboard, timber, asphalt, and contaminated soil spreading via surface run-off to near site drainage pathways.	Medium	A CEMP will be developed, waste management controls included.	Low
		Stockpiles	Indirect	Material stored in stockpiles, including construction material, and excavated (non-contaminated and contaminated) material may be transported to drainage lines if not stored correctly.	High	A CEMP will be developed, stockpile controls included. Stockpiling will be conducted in accordance with the Stockpile Procedure (Perth Airport 2021)	Low
		Leaks and Spills	Direct	Potentially harmful chemicals and substances could accidentally be released to the stormwater system during construction. Fuels, leaks from equipment and chemicals used during construction be transported to the drainage lines.	High	A CEMP will be developed, hydrocarbon and chemical management controls inclusive of spill requirements to be included.	Low
Groundwater		Stormwater basin construction	Direct	Stormwater basin construction may interact with groundwater. If dewatering is required for the basin, groundwater would be pulled into	Medium	A CEMP will be developed. Preparation and implementation of Dewatering Management Plan and ASSMP	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
				the basin excavation resulting in localised draw down in the surrounding area.		in accordance with Water Quality Australia's National Acid Sulfate Soils Guidance. Dewatering Management Plan to be approved by Perth Airport following review by the DITRCDA AEO.	
			Direct	Stormwater basin construction may interact with groundwater. If dewatering is required for the basin groundwater would be pulled into the excavated area, thus mobilising the PFAS plume towards this area.	High	A CEMP will be developed. PFAS risk assessment to be conducted and conformance with the PFAS National Environmental Management Plan. Preparation and implementation of a Dewatering Management Plan. The dewatering management plan should address migration of PFAS contamination, and where possible, to dewater within the identified PFAS plume. Dewatered PFAS-impacted groundwater to be stored and disposed of appropriately.	Low
		Pipe installation	Direct	Pipe installation required earthworks and laying of pipe within a known PFAS contaminated area. If the depth of the pipe/excavations cross the water table, dewatering would be required. Impact from dewatering could mobilise the existing contamination plume into the existing drainage channel.	High	A CEMP will be developed. Preparation and implementation of Dewatering Management Plan. If dewatering is to occur for the pipe installation, it would be preferable to dewater within the identified PFAS plume. PFAS risk assessment to be conducted and conformance with the PFAS National Environmental Management Plan. Dewatered PFAS-impacted groundwater to be stored and disposed of appropriately.	Low
		General Construction	Indirect	Use and maintenance of vehicles and equipment as well as chemicals for construction, during the construction phase these chemicals and fuels during wet weather	Medium	A CEMP will be developed.	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
				events may be transported to the aquifer through infiltration.			
		Stockpiles	Indirect	Contamination including metals, PFAS and ASS/PASS may be transported to the aquifer through leaching and infiltration to potentially non-contaminated area if not stored correctly.	High	A CEMP will be developed. Stockpiling would be conducted in accordance with the Stockpile Procedure (Perth Airport 2021)	Low
		Leaks and Spills	Indirect	Potentially harmful chemicals and substances could accidentally infiltrate to the aquifer if not stored correctly. Fuels, leaks from equipment and chemicals used during construction be transported through infiltration to the aquifer.	High	A CEMP will be developed. The CEMP would contain an Accidental Spills Procedure and outline correct storage and handling of chemicals and substances.	Low
		Construction of Pavement	Indirect	Concrete process water is caustic and typically has a high pH value ranging between 11 and 12. It contains dissolved solids including sulphates and hydroxides from cement, oil and grease from equipment and derivatives from chemical admixtures and asphalt normally contains hydrocarbons, during the pouring and shortly after pouring if not contained, may be transported via infiltration to the aquifer.	Medium	A CEMP will be developed. Where practicable, process water would be contained and pouring would not occur during wet weather events.	Low
		Clearance of vegetation	Indirect	Increased runoff due to clearance also means a reduced infiltration to groundwater as such less recharge to groundwater.	Medium	Minimising vegetation clearance where feasible. Any areas that can be retained will be retained where practicable. A CEMP will be developed Clearing undertaken in accordance with the Clearing Procedure (Perth Airport 2021)	Low
		Earthworks	Indirect	Increased runoff due to clearance also means a reduced infiltration to groundwater as such less recharge to groundwater.	Medium	A CEMP will be developed.	Low
			Indirect	Interception of groundwater during earthworks may cause groundwater to seep into the	Medium	A CEMP will be developed.	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
				excavated areas causing localised reductions in groundwater levels.			
		Dewatering	Direct	When groundwater seeps into excavated areas, these areas would require dewatering. Dewatering would cause a localised drawdown of the surrounding areas as water continues to seep into the excavated area.	Medium	A CEMP will be developed. Preparation and implementation of Dewatering Management Plan and ASSMP in accordance with Water Quality Australia's National Acid Sulfate Soils Guidance. Management Plan approved by Perth Airport following review by DITRDCA AEO.	Low
			Direct	If dewatering is required for the basin groundwater would be pulled into the excavated area, thus mobilising the PFAS plume towards this area.	High	A CEMP will be developed. Preparation and implementation of Dewatering Management Plan. The dewatering management plan should address migration of PFAS contamination, and where possible, to dewater within the identified PFAS plume. Dewatered PFAS-impacted groundwater to be stored and disposed of appropriately.	Low
		Drain refill	Direct	Filling in the redundant drain may cause localised changes in groundwater levels.	Medium	A CEMP will be developed. Methodology for fill replacement should consider groundwater levels.	Low
Sensitive receiving environment		All works	Offsite	Water quality downstream may be impacted as a result of construction activities. This includes the Swan River and associated threatened ecological communities as identified in the EPBC Act Protected Matters Report presented in Appendix A, Aurecon 2022.	Medium	A CEMP will be developed. Monitoring of groundwater and surface water, pre-construction, during construction and post construction e undertaken to monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	Low
		All works	Indirect	Works conducted within the North MDP which have the potential to impact groundwater levels have the potential to alter groundwater levels at Munday Swamp which is a Wetland of	Medium	A CEMP will be developed. Monitoring of groundwater and surface water, pre-construction, during construction and post construction be undertaken to	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
				National Importance. However due to the construction activities within the North MDP boundary, these impacts are limited. These impacts include PFAS mobilisation offsite.		monitor impacts. The monitoring frequency and reporting of results will be included in the CEMP.	
Surface water / Stormwater	Operation	Vegetation Clearing	Indirect	Reduced vegetation may increase runoff volume, frequency, and rate of discharges to drainage line due to modified (shortened) flow paths and reduced infiltration and evapotranspiration.	Medium	Drainage design to include collection of surface water runoff.	Low
		Pavement	Indirect	Increased impervious surfaces may increase runoff volume, frequency, and rate of discharges to drainage line due to modified (shortened) flow paths and reduced infiltration and evapotranspiration.	Medium	Drainage design to include collection of surface water runoff.	Low
		Redundant Drain	Indirect	Removing an open channel and replacement with a culvert reduces the stormwater capacity of that catchment and thus greater unmanaged runoff.	Medium	Drainage design to include collection of surface water runoff. NMD to be planted as a Living Stream	Low
		Leaks and Spills	Indirect	Leaks and Spills of fuels and chemicals stored on site or from vehicles and planes may experience an accidental spill, transported to the waterways may cause downstream water quality issues.	Medium	Operational Environmental Management Plan (OEMP) and accidental spill procedure would be in place to mitigate measures from major spills. Proposed Living Streams within the site would provide treatment of stormwater entering NMD.	Low
		Pavement use	Indirect	Vehicle/Machinery use of the new pavement would increase load of pollutants including inorganics, organics and macro-pollutants included shredded tyres. Wet weather events would transport polluted stormwater to the nearby drainage lines.	Medium	Drainage design to include collection of surface water runoff and retained section of NMD would include a treatment train and proposed Living Streams would provide treatment of stormwater entering NMD.	Low
Groundwater		Vegetation Clearing	Indirect	Reduced vegetation would reduce infiltration and thus groundwater recharge.	Medium	Proposed Living Streams downstream of site would provide location for infiltration to	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
						occur in the vicinity of where the rain would fall.	
		Stormwater Basin	Direct	Stormwater basin construction may introduce a localised area of higher recharge and thus groundwater mounding may occur below the stormwater basin.	Medium	Design of the stormwater basin to take into consideration groundwater conditions.	Low
		Pavement	Indirect	Increased impervious surfaces would increase runoff volume, frequency and rate of discharges to drainage line due to modified (shortened) flow paths and reduced infiltration and evapotranspiration.	Medium	Proposed Living Streams downstream of site would provide location for infiltration to occur in the vicinity of where the rain would fall.	Low
		Pipe	Direct	The pipe section is based on the concept design from Cossill & Webley 2020.. If the pipe crosses the water table, a barrier may be created, the effect of that barrier will be dependent on the depth at which the barrier crosses the water table. If the pipe crosses the water table and sand fill material is installed around the pipe, this could create a preferential flow path parallel to the pipe work and may result in PFAS contaminated groundwater expanding laterally along the length of the pipework. As the pipework is proposed to be in the similar direction to downgradient groundwater flow this would create an accelerated section of groundwater drawing PFAS impacted groundwater downstream.	High	Drainage design to take into consideration of PFAS mobilisation within groundwater. This should include modelling of flow paths against design criteria to assess the risks associated with changing flow paths and expansion of the PFAS plume as a result of the design. PFAS risk assessment to be conducted and conformance with the PFAS National Environmental Management Plan.	Low
		Redundant Drain	Direct	Removing an open change reduces localised recharge to groundwater.	Medium	Drainage design to consider the reduction of recharge due to the removal of the open drain and provide alternative methods of recharge either upgradient or nearby to reduce the impact of reduced recharge. Design to consider increasing post-	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
						construction recharge via detention basins and/or local irrigation.	
		Leaks and Spills	Indirect	Leaks and Spills of fuels and chemicals stored on site or from vehicles and Planes may experience an accidental spill, transported to the waterways may cause downstream water quality issues.	Medium	OEMP and accidental spill procedure would be in place to mitigate measures from major spills.	Low
		Pavement use	Indirect	Vehicle/machinery use of the new pavement would increase load of pollutants including inorganics, organics and macro-pollutants included shredded tyres. Wet weather events would transport polluted stormwater to the nearby drainage lines.	Medium	Drainage design to include collection of surface water runoff. Proposed Living Streams downstream of site would provide treatment of stormwater within the NMD before this water infiltrates to the groundwater system.	Low
		Drainage	Direct	Underground drainage systems and open channels have to possibility to interact and disturb the localised groundwater flow. However, the risk is low as the deviation would be minimal.	Low	Not required, impact is considered low.	Low
Sensitive Receiving Environments		Drainage	Offsite	Water quality downstream may be impacted as a result of the above construction activities. This includes the Swan River and associated threatened ecological communities as identified in the EPBC Act Protected Matters Report. These impacts include PFAS mobilisation offsite from the pipe.	Medium	Drainage design downstream includes retained NMD including a treatment train and Living Stream (offsite) which would provide treatment of water flowing to the Swan River. Existing treatment is provided by the NMD treatment plant for PFAS contamination and would continue as required until source remediation has occurred.	Low
			Indirect	Munday Swamp which is a Wetland of National Importance. The increase of impervious surfaces in the Airport North MDP has an effect of reduced recharge which would result in lower groundwater levels at Munday Swamp.	High	Drainage design to consider the reduction of recharge due to the removal of the open drain and provide alternative methods of recharge either upgradient or near the Wetland to reduce the impact of reduced recharge. Considerations to include	Low

Impact type	Phase	Activity	Direct/ Indirect /Offsite	Potential impacts	Risk	Proposed avoidance / mitigation measures	Residual Risk
						increasing post-construction recharge via detention basins and/or local irrigation. Swales and the retained NMD provide locations for infiltration to occur, Living Streams also provide recharge. Upstream in adjacent NRP MDP the retention basin provides recharge and flow to Munday Swamp.	

Source: Aurecon 2022

5.5 Cumulative Impact Assessment Modelling

5.5.1 Stormwater management concept design

A concept design for stormwater infrastructure has been completed as part of the Master Drainage Strategy 2017 update (Aurecon, 2022b) and includes a drainage regime for the northern portion of the New Runway Project, Airport Central MDP and Airport North MDP areas. This design forms the Ultimate Development Case scenario described in Section 5.2.1.1 and its performance against the design criteria determines its environmental impact.

The Airport North MDP concept design by Cossill & Webley (2020) includes a redirection of the NMD with a section being installed as a pipe to bypass the identified PFAS plume. The concept design also includes an offline basin which would act as capacity and treatment. It is being considered that Living Streams would be installed as part of the open channel sections for as much of the NMD as feasibly possible to provide capacity and treatment before the water flows offsite.

The New Runway Project (NRP) will divert the upstream end of the NMD from its junction with Poison Gully northward into Munday Swamp via a series of retention and settlement basins see Figure 5-8. This diversion is approved via the NRP MDP. Water will re-enter the NMD once the Munday Swamp outlet weir overtops. As part of the NRP MDP works, the existing Munday Swamp outlet will be upgraded to an engineered structure/weir.

The majority of the section of the existing Northern Main Drain that passes through the Airport Central MDP boundary will become redundant following the diversion and will be infilled. The existing precinct drainage channel that passes through the Airport Central MDP area will continue to channel stormwater from this area into the NMD.

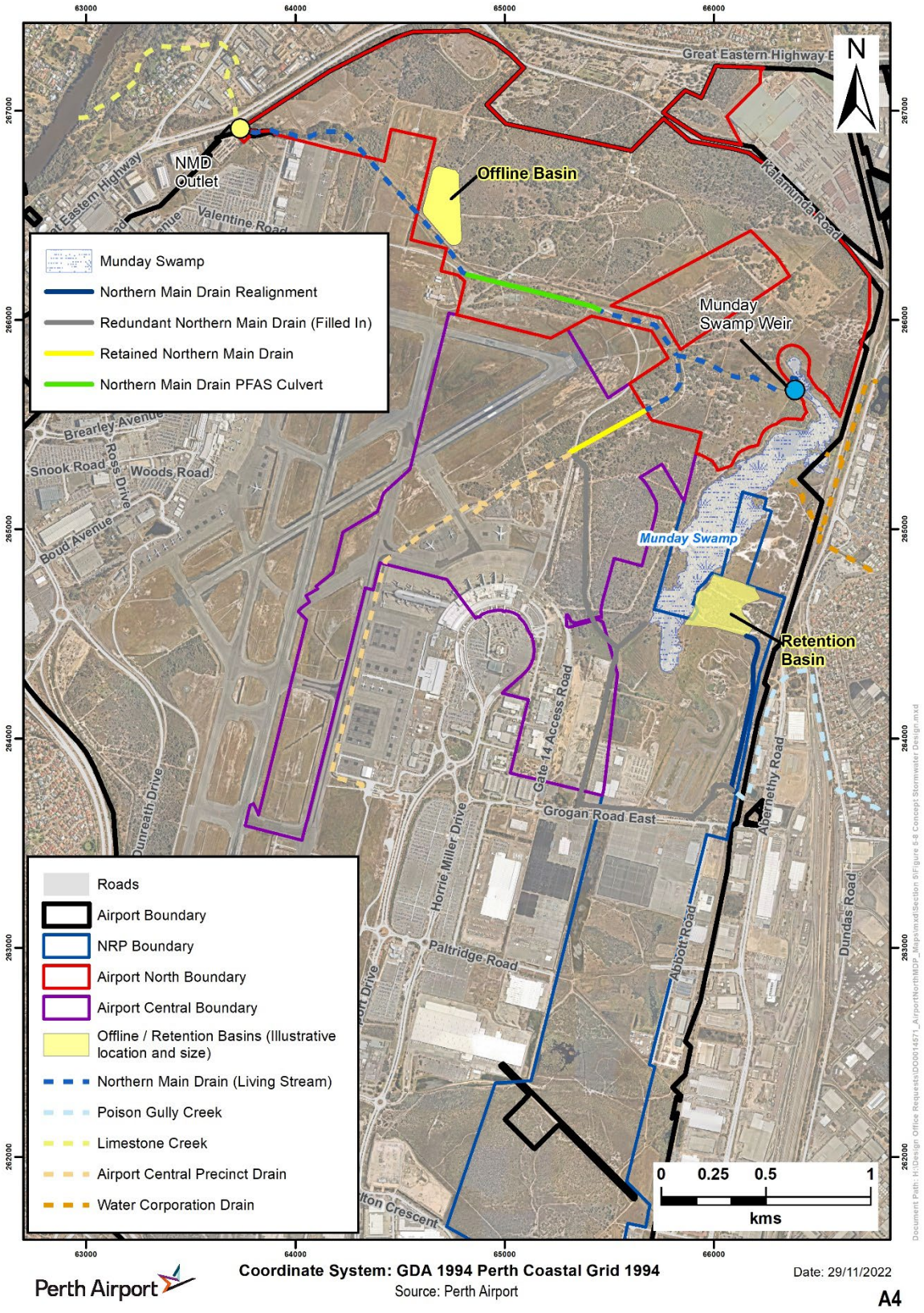


Figure 5-8 Concept Stormwater Design

5.5.2 Stormwater modelling results

The 2017 MDS ultimate development case hydrologic model covering the airport estate and adjacent catchments was updated to reflect the 2020 Perth Airport Master Plan (Aurecon, 2022). The 2017 hydrologic model was refined with the following key amendments included:

- Inclusion of the updated ARR 2019 flows.
- Refinement of the model's sub-catchments to include the proposed Airport North MDP development layout.
- Revision of the realignment of NMD downstream of Poison Gully. The alignment drains into the proposed basins and then into Munday Swamp.
- Revised outlet channel alignment from Munday Swamp.
- Removal of the Munday Swamp southern end infill (as included in the NRP MDP).

With these updates and refinements, the SMD and NMD systems essentially operate as two separate drainage systems with no real interaction occurring within the hydraulic model extents for events up to and including the 1% AEP event. Each system has been modelled and assessed separately in the hydraulic model. As the drainage of the Airport North MDP area is handled by the NMD, the SMD is excluded from any further discussion.

A series of strategic concept level design scenarios have been assessed for the NMD, with the design being progressively refined with each scenario. The Aurecon 2022 EIA, Section 5.2.2, details three ultimate development case scenarios modelled, being Online Detention Basins (within Airport North MDP), No Basins, and Offline Basin (within Airport North MDP). The scenario 3 – Offline basin hydrograph was judged to be sufficiently similar to the Pre-Lease Case to meet the design criteria (Figure 5-9).

A review of the performance of the offline basin with respect to the requirement to drain within 48 hours was undertaken for the 1% AEP event. The hydraulic model results show that water levels remain elevated for 20+ hours but that the basin empties within the required 48 hours.

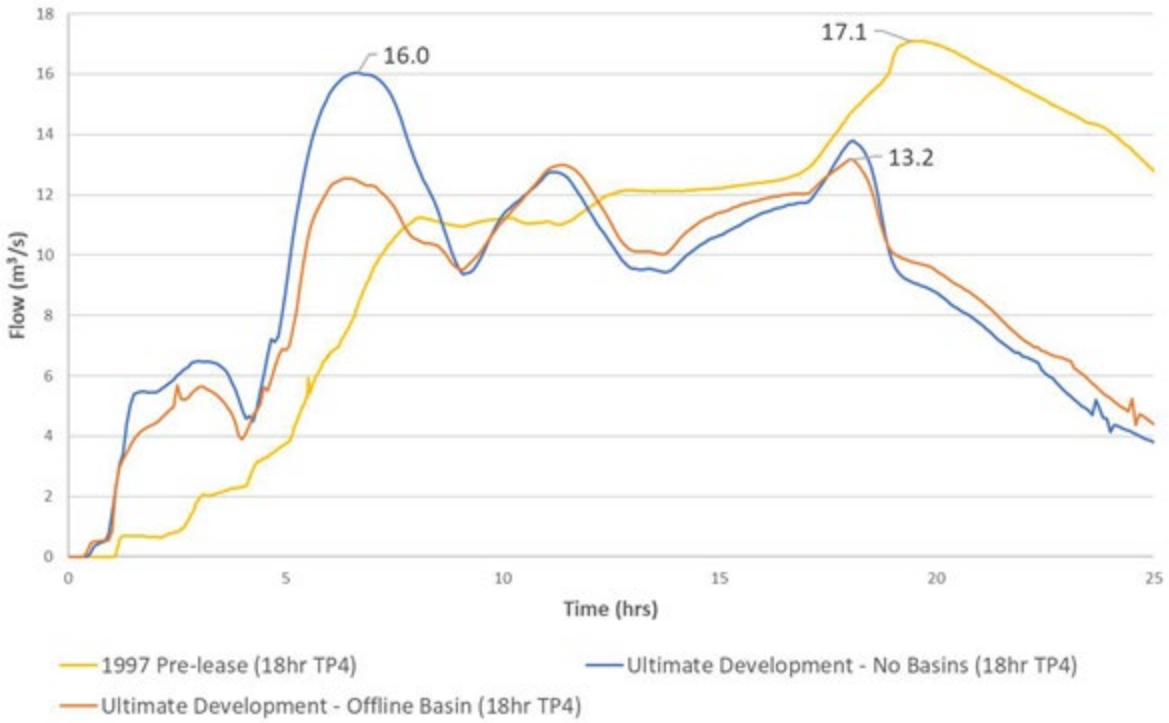


Figure 5-9: Pre-lease Case, 'no basins' and 'offline basin' cases – NMD Outflow – 1% AEP (18h/TP4)

Source: Aurecon 2022

5.5.2.1 Arrived at NMD outlet discharges

Adopting Scenario 3 (offline basin) as the Ultimate Development Case, the hydraulic model was run for a range of durations for the 1%, 2% and 10% AEP design events. Table 5-9 presents a summary of the NMD outlet discharges for the 1997 Pre-Lease Case and the Ultimate Development Case. The 1997 Pre-lease Case discharge limit is met for the 1% AEP event and exceeded for the 2% and 10% AEP events. The design iterations have focused on the 1% AEP event as this was the adopted design criteria. To achieve the 2% and 10% limits, some refinement of the offline basin will be required during the detailed design stages of the Airport North MDP.

Table 5-9: NMD Peak Outflow Summary – ARR 2019 hydrology

Event	1997 Pre-Lease Case NMD Outflow (m^3/s)	Ultimate Development Case NMD Outflow (m^3/s)	Difference (m^3/s)
10% AEP	6.3 (9hr/TP7)	11.2 (4.5hr/TP6)	+4.9
2% AEP	10.1 (9hr/TP10)	13.5 (3hr/TP7)	+3.4
1% AEP	17.1 (18hr/TP4)	14.5 (3hr/TP7)	-2.6

Source: Aurecon 2022

5.5.2.2 Summary of NMD outcomes

- The diversion of the NMD channel into Munday Swamp leads to Munday Swamp providing significant attenuation of stormwater flows from the upstream catchment area, delaying the peak of upstream runoff into NMD downstream of Munday Swamp relative to the Pre-Lease case.
- The Airport North MDP area is located in the lower reaches of the NMD; with the associated increased impervious area, runoff from this area occurs more quickly than in the Pre-Lease case and leads to higher, 'peakier' flows into the NMD.
- The Airport North MDP's offline basin will counter these higher flows and changes in timing by collecting and detaining runoff from the Airport North MDP area. Further design development on the detention solution is required to achieve the optimum balance between delaying runoff from the Airport North MDP area and interaction with the attenuated flows out of Munday Swamp. This is a complex balance that will require further detailed modelling and ultimately will lock in detention provisions for the Airport North MDP, including how all portions of the MDP area drain into the NMD.
- With the offline basin in place, the volume of "early" discharge is reduced, and the outlet hydrograph is judged to be sufficiently similar to the Pre-Lease case to meet the design criteria.
- For the modelled offline basin option, the 1997 Pre-Lease case NMD outlet discharge limits are met for the 1% AEP event. Detailed design refinement of the basin's outlet structures will be required to achieve the NMD's outlet discharge limits for the 2% and 10% AEP events.
- In parallel with the trunk drainage modelling, detailed groundwater modelling has been carried out. Drawdown results from the groundwater modelling were used to refine the trunk drainage design to minimise its impact on groundwater drawdown.
- The design criteria for the NMD (see Section 5.2.1.1) have been met, such that the NRP, Airport Central MDP and Airport North MDP are not anticipated to give rise to any significant stormwater related environmental impacts.

5.5.3 Groundwater modelling results

The groundwater modelling results are presented as change contours across the Airport North MDP area. These contours are generated by subtracting the predicted future development groundwater levels from the existing levels (as of June 2021) and illustrate the change in the level. By applying the historical rainfall data for the period 1970-2018 to the future development conditions, groundwater levels were predicted at monthly intervals for a future period of 49 years. The results at any given location within the model's domain, when presented as a hydrograph, illustrate a pattern of fluctuating groundwater levels, from minimum levels in the drier summer months to maximums in the wetter winter months. An example hydrograph is presented for illustration purposes in Figure 5-10.

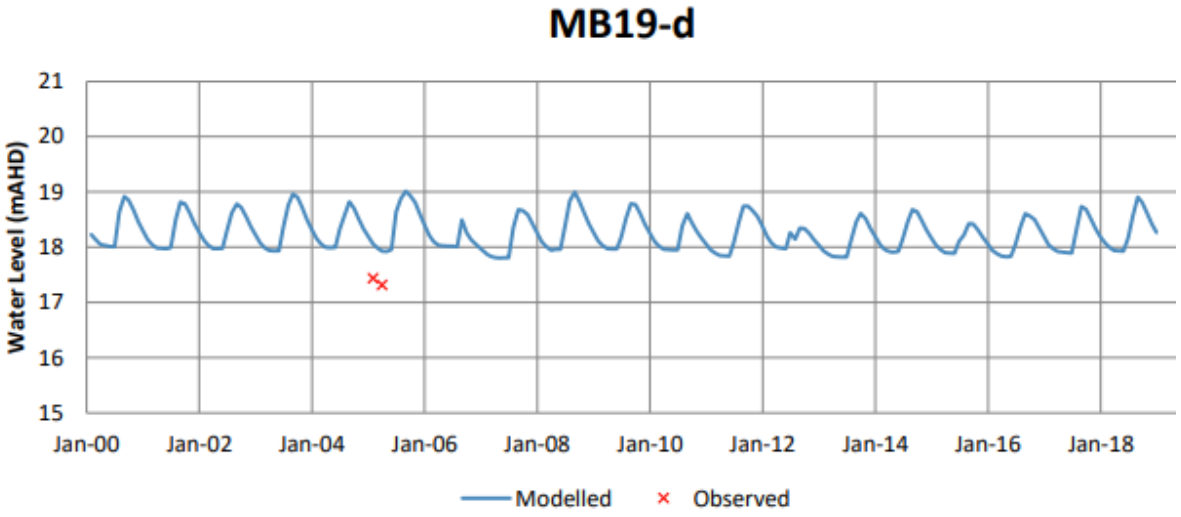


Figure 5-10: Example of a hydrograph generated from modelled results.

Source: Aurecon 2022

The model produces hydrographs for a matrix of locations across the model's domain; the change contours are generated from results at each of these locations. While any number of statistical parameters can be derived from a hydrograph, to illustrate the worse case and average changes, contours were generated for the following parameters:

- The maximum change to the maximum groundwater levels, this is a worse case as it is only likely to occur once during the 49 year prediction period.
- The maximum change to the minimum groundwater levels, this is a worse case as it is only likely to occur once during the 49 year prediction period.
- The change to the average groundwater level across the 49 year prediction period is taken as a measure of the long-term impact.

The generated contours are presented in Figure 5-11, Figure 5-12 and Figure 5-13 (AQ2, 2022).

Negative values, shown in green, represent no change or an increase in groundwater level (mounding), while positive values, shown in yellow, represent a decrease in water level (drawdown).

As the development of Airport North will increase the impermeable area, there is the opportunity to capture and infiltrate rainfall as part of the stormwater drainage system. The use of sub-soil drains in areas that will be subject to mounding presents another opportunity to capture and redirect water for infiltration elsewhere. Therefore, the detailed design of the Airport North drainage system, will incorporate a groundwater recharge system that will address the localised cone of drawdown.

In addition to the protection of Munday Swamp, the Airport North MDP includes the retention of other areas of native vegetation and wetlands, principally along its northern boundary. As with the removal of the aforementioned mound, earthworks to level the area and land-use changes were initially predicted to cause groundwater drawdown that could adversely impact these retained areas. Therefore, a recharge system will also be implemented to prevent groundwater drawdown.

Predicted groundwater level changes across the Airport North MDP area are limited to 0.2m of drawdown and up to 0.8m of mounding. With the inclusion of the infiltration regime, it is considered that the design criterion is met and that there are no significant environmental impacts resulting from the predicted changes to groundwater levels across the Airport North MDP area.

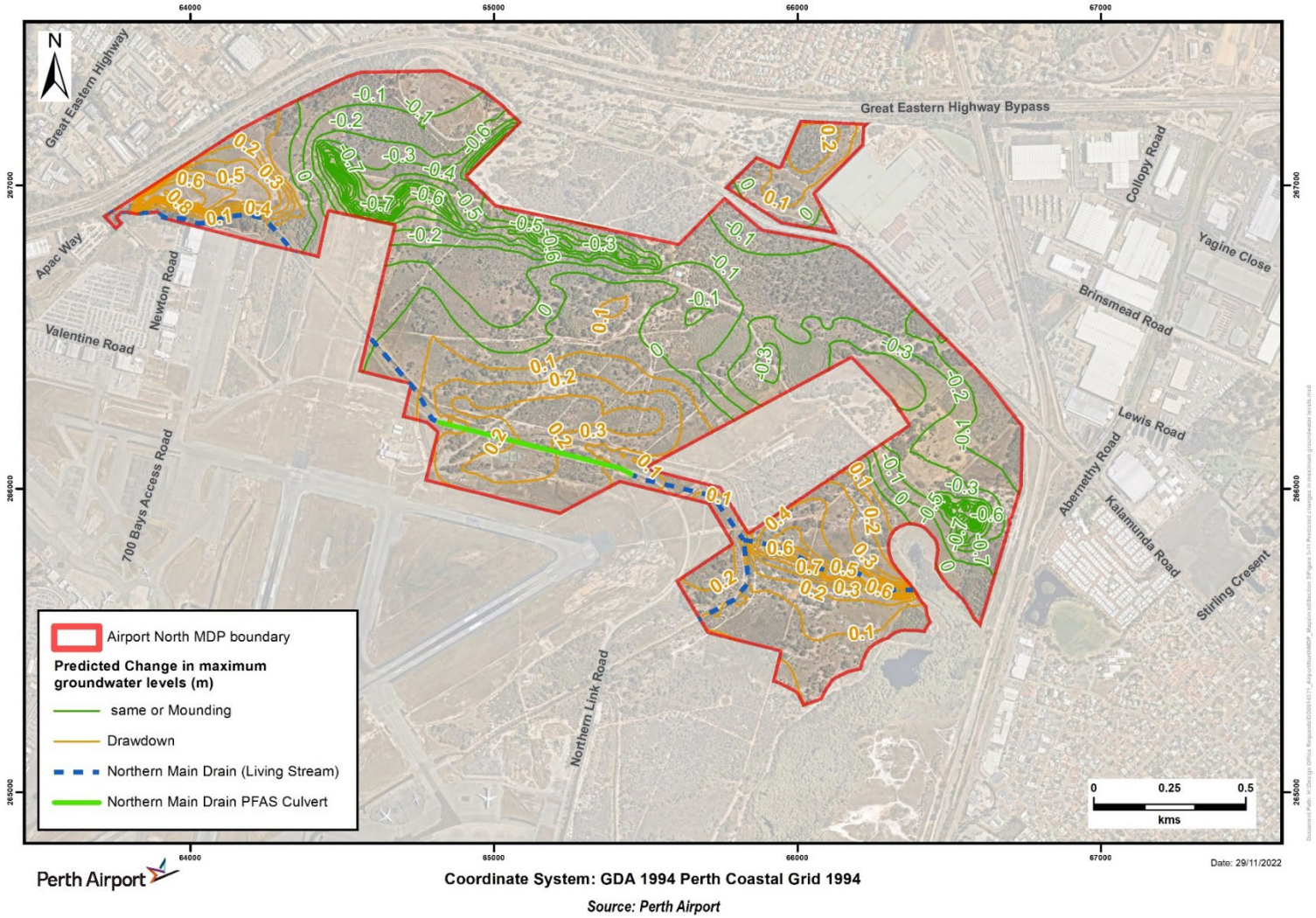


Figure 5-11: Predicted changes in maximum groundwater levels

Perth Airport

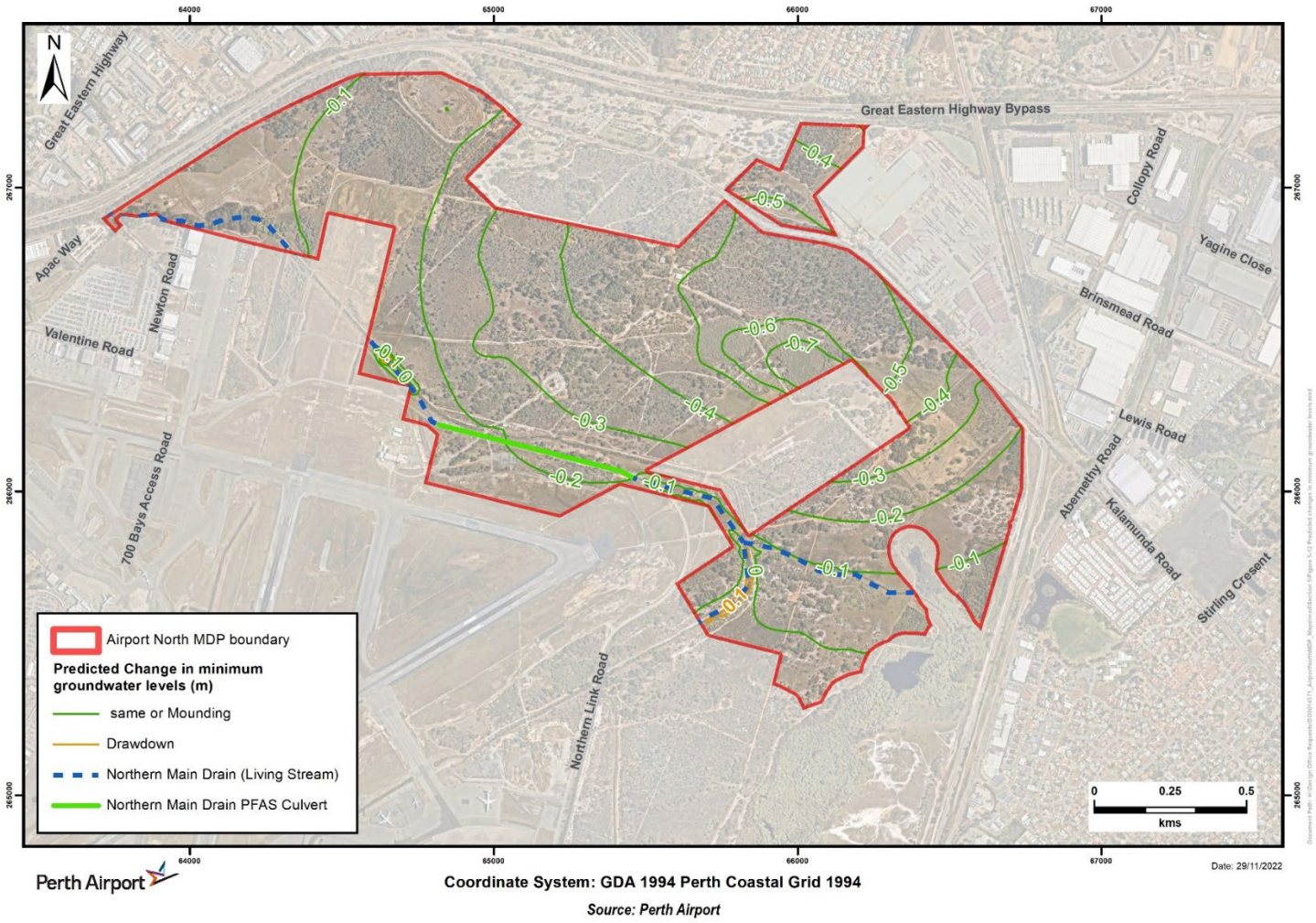


Figure 5-12: Predicted changes in minimum groundwater levels

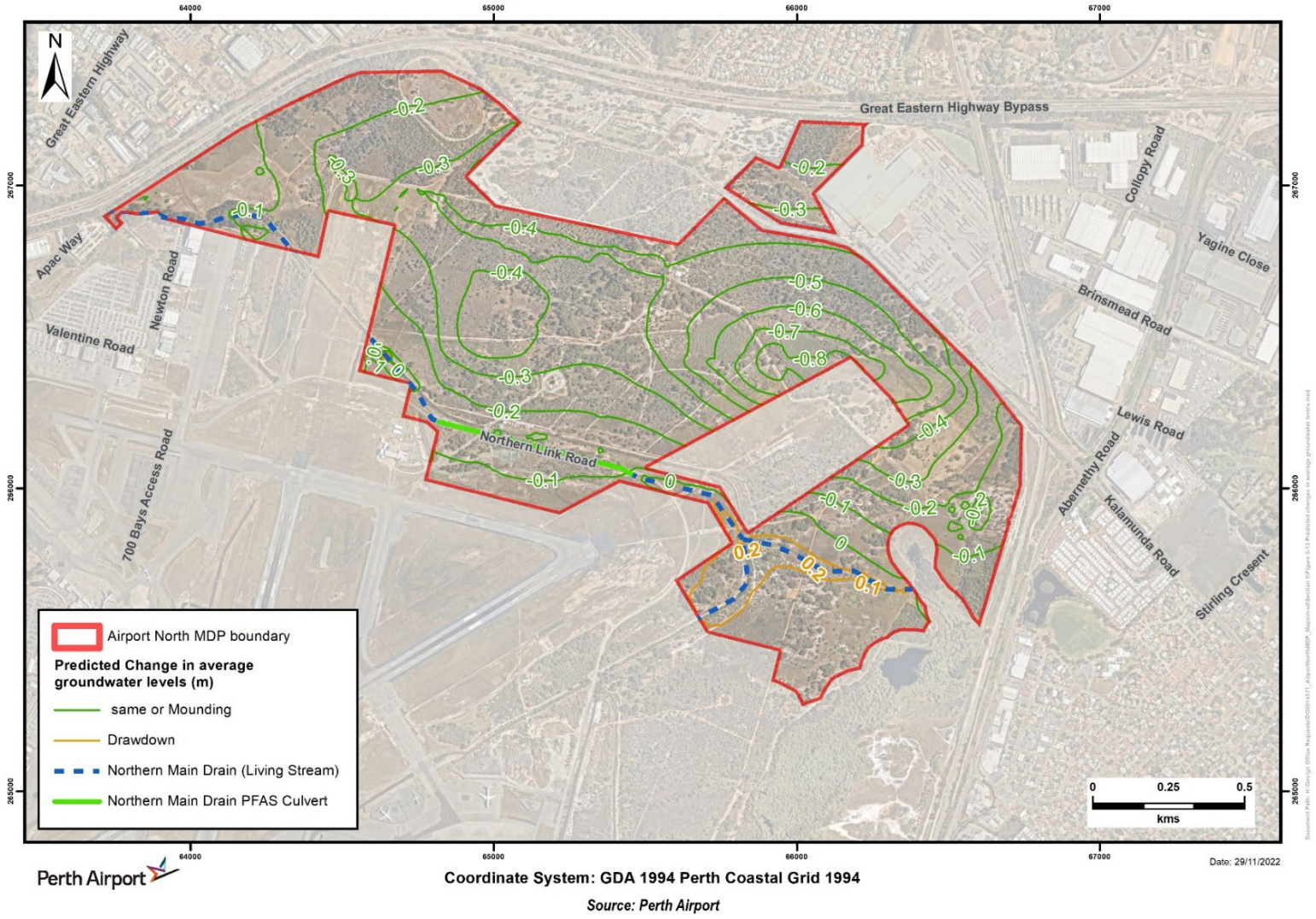


Figure 5-13: Predicted changes in average groundwater levels

5.5.4 Cumulative Impacts Summary

The Airport North MDP is one of three development projects planned within the Perth Airport estate that are located within the catchment of the estate's Northern Main Drain (NMD). All three projects are wholly or partly reliant on the realignment of the NMD to provide stormwater drainage. Therefore, the design of the NMD has had to respond to the combined hydrological changes brought about by all three potential projects. The primary combined changes that have the potential to cause a cumulative hydrological impact are:

- Increased flow rates at the outfall of the NMD that either exceed the Pre-Lease Case flow rates or have a temporal pattern (hydrograph) that is significantly different from that of the Pre-Lease Case.
- Changes to groundwater levels that will influence the hydrological regime of retained wetlands.
- Increased hardstand/broadscale removal of vegetation and infiltration areas

The three projects are detailed in Airport's 2020 Master Plan and summarised in Table 5-10.

Table 5-10: Major development projects proposed with the catchment of the NMD

Project	Project description	Project status	Project area (ha)
Airport Central (this report)	Upgrades to infrastructure, including aprons, taxiways surrounding the international terminal at Perth Airport	Conceptual Planning	212.1
Airport North	Multi-use development of Perth Airport estate's Northern Precinct	Conceptual Planning	213.7
New Runway Project	New parallel runway for Perth Airport	Approved	292.8
Cumulative Total			715.6

Source: Aurecon 2022

For the purposes of this assessment, cumulative impacts are defined as impacts arising from the combination of the proposed development projects in Table 5-10. Development outside of the catchment of the NMD (for example Airport West (South)) has not been considered in this assessment. The Airport West (South) development is located within the Southern Main Drain catchment.

5.5.4.1 Northern Main Drain

The design of the NMD is sufficient to ensure that there are no significant hydrological impacts arising from the operation of the Airport Central MDP, Airport North MDP and New Runway Project.

5.5.4.2 Changes to groundwater

The groundwater model was progressed in an iterative fashion and considered the design features of the NMD within the boundaries of all three projects listed in Table 5-10, together with the earthworks, vegetation clearing, rehabilitation and retention associated with each project. In effect, the model provides a Water Balance across the entire area that these three projects cover.

Groundwater change contours have been generated across the three combined MDP boundaries and are presented in Figure 5-14, Figure 5-15: Predicted cumulative changes in minimum groundwater levels, and Figure 5-16: Predicted cumulative changes in average groundwater levels (AQ2, 2022). Negative values, shown in green, represent no change or an increase in groundwater level (mounding), while positive values, shown in red, represent a decrease in water level (drawdown).

The primary focus of this cumulative groundwater impact assessment is drawdown across the nationally and culturally significant Munday Swamp wetland.

In accordance with the Significant Impact Guidelines 1.1 (DoE, 2013) in relation to Munday Swamp the following conclusion can be made:

- Hydrographs for two locations within the swamp are provided in Figure 5-17 and Figure 5-18, which overlay predicted future levels on existing levels (sourced from AQ2, 2022). These two hydrographs illustrate that across the 49 year future prediction period, no significant change in the seasonal groundwater fluctuations is predicted.
- These contours and hydrographs demonstrate that the groundwater criterion of reducing any groundwater drawdown within retained wetlands within and bordering the airport estate to as low as reasonably practical has been met.

In accordance with the Significant Impact Guidelines 1.2 (DSEWPaC, 2013), in relation of impacts on water resources, modelling with predicted groundwater level changes across the Airport North MDP area of 0.2m of drawdown and up to 0.8m of mounding has been used. Based on this modelling, and the application of mitigation measures and considerations in detailed design of North MDP the predicted changes of water table levels and water quality impacts would be deemed not likely to significantly impact the environment.

In accordance with the Significant Impact Guidelines 1.2 (DSEWPaC, 2013) in terms of pollutants, chemicals, and toxic substances, the construction of the pipe and earthworks and if dewatering is required downgradient of identified PFAS plume after the application of mitigation measures, these impacts would be deemed not likely to significantly impact the environment.

An assessment against the significant impact guidelines can be found in Section 5.4 of Aurecon 2022. Assessment against the Significant Impact Guidelines 1.1 (DoE, 2013) and 1.2 (DSEWPaC, 2013) has identified that based on modelling and after the implementation of mitigation measures the residual impact is reduced to as low as reasonably practicable and not likely to significantly impact the environment, respectively.

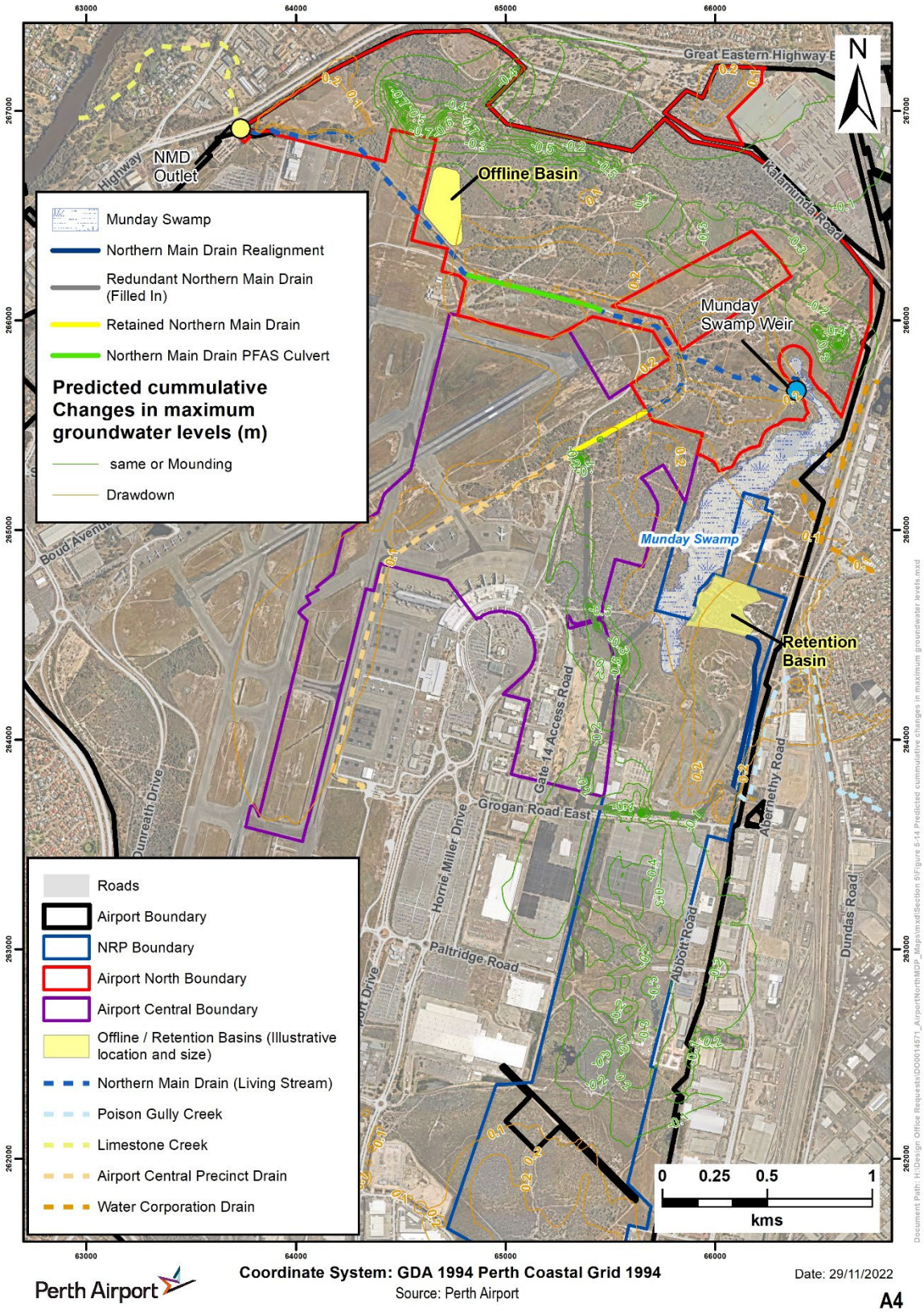


Figure 5-14: Predicted cumulative changes in maximum groundwater levels

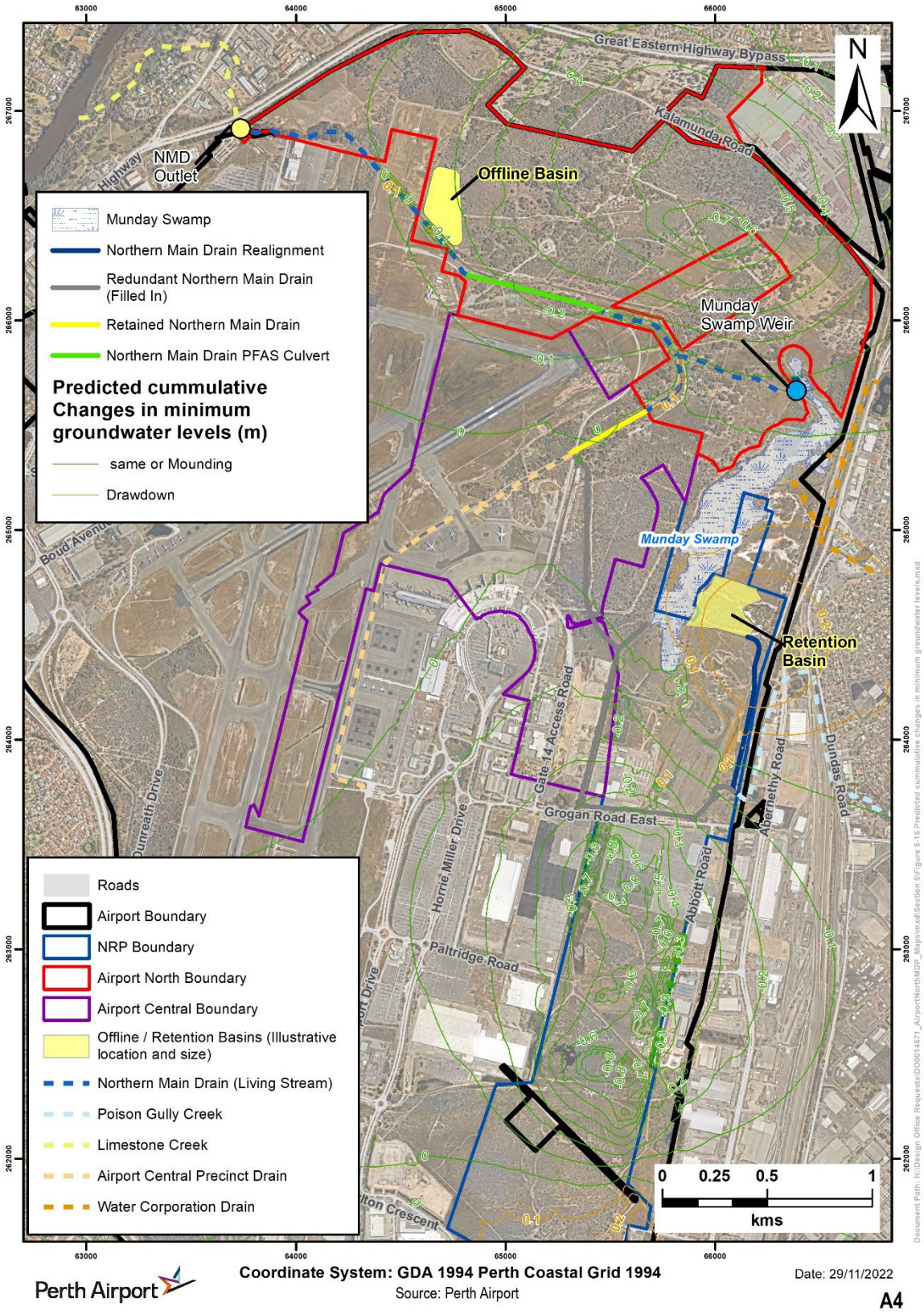


Figure 5-15: Predicted cumulative changes in minimum groundwater levels

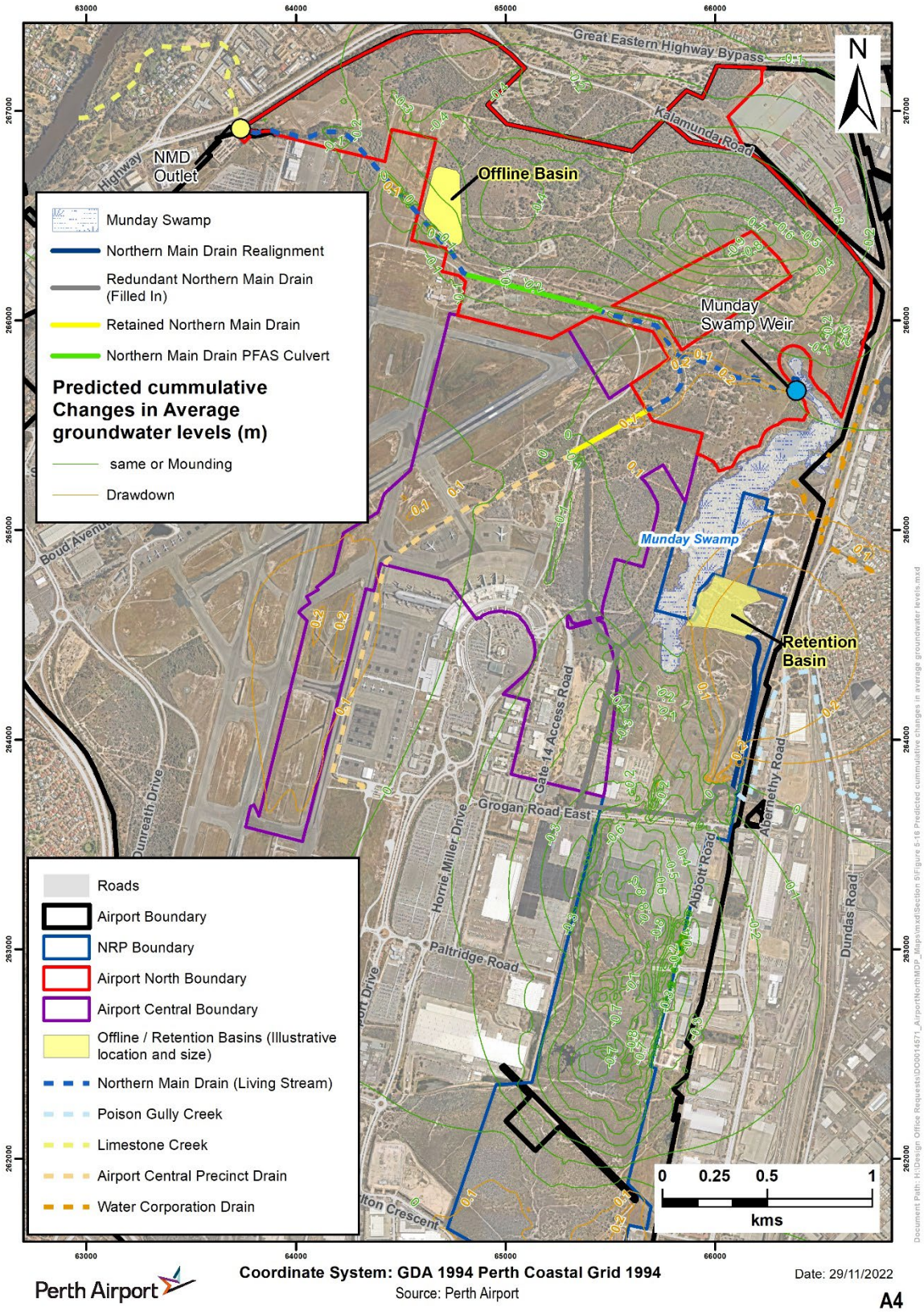


Figure 5-16: Predicted cumulative changes in average groundwater levels

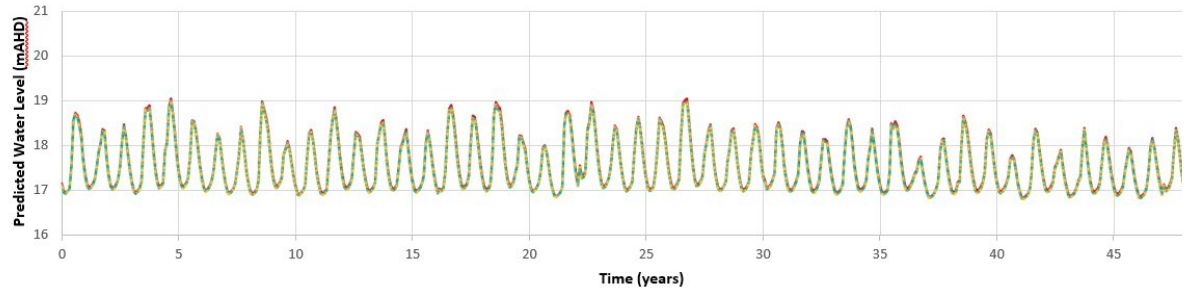


Figure 5-17: Hydrograph – northern extent of Munday Swamp, predicted existing and future groundwater levels

Source: Aurecon 2022

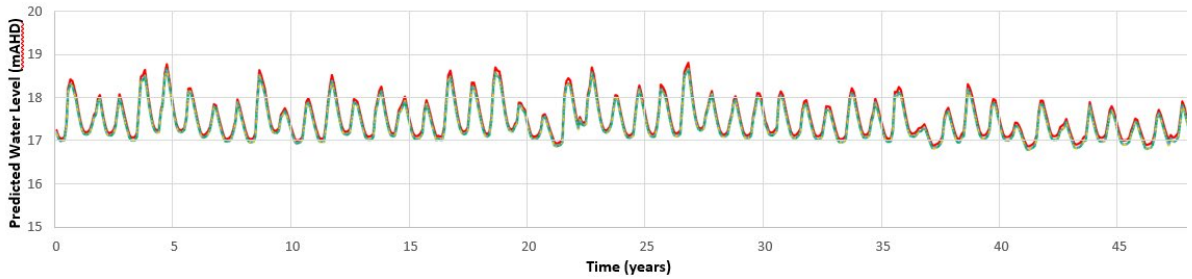


Figure 5-18: Hydrograph – midsection of Munday Swamp, predicted existing and future groundwater levels

Source: Aurecon 2022

5.6 Conclusions

The realignment and upgrading of the NMD, together with the provision of storage basins and placing a section of the drain within a culvert, ensures that the development of the MDP area has no significant adverse impacts on the local hydrological regime or quality.

The implementation of the NMD design in conjunction with the development of the Airport North MDP will mean that it is unlikely that significant hydrological related environmental impacts will arise either directly, indirectly or in combination with the New Runway Project and the Airport Central MDP (Aurecon 2022).

Key impacts from the North MDP may arise from:

- Reduced localised infiltration from the redundant NMD
- Increased runoff and reduced recharge due to increase of pavement area
- Existing contamination (PFAS and metals) transported offsite through the drainage design – note the existing Perth Airport PFAS treatment plant operating within the NMD for PFAS removal to a nominated criteria prior to discharge from the estate
- Increased pollution of stormwater from increased hardstand areas

Potential impacts from the Airport North MDP are considered low risk and can be managed through a number of mitigation measures including a CEMP, OEMP, existing policies, procedures and the proposed drainage design for the wider area.

6 Wetlands

The information provided in this section is based on Eco Logical Australia's (ELA) wetland impact assessment report for the Airport North project, titled *Airport North Major Development Plan - Wetland Assessment* (ELA, 2022). ELA (2022) undertook a thorough process to assess project impacts on the project area's wetland values.

6.1 Legislative and Policy Context

Impacts on wetlands within the MDP area are considered against the following Commonwealth and State legislation and policy:

Commonwealth:

- The EPBC Act
- Significant Impact Guidelines 1.2

State:

- A methodology for the evaluation of wetlands on the Swan Coastal Plain, WA (DBCA 2017a)
- Wetland identification and delineation: information for mapping and land use planning on the Swan Coastal Plain (DBCA 2017b)

In Western Australia the term wetland is used to refer to areas that are permanently, seasonally or intermittently waterlogged or inundated with water (DBCA 2019a; cited within ELA 2022). The wetlands found within WA have been mapped at varying scales. Perth Airport is located on the Swan Coastal Plain (SCP), where detailed mapping has been undertaken at a scale of 1:25,000 (DBCA 2019a; cited within ELA 2022). The Geomorphic Wetlands Swan Coastal Plain (GWSCP) dataset is accepted by WA planning and regulatory bodies (e.g. Environment Protection Authority (EPA)) as the primary dataset for wetlands within the region. This mapping was originally compiled by Hill et al. (1996) and is modified by DBCA as the current dataset custodian as new information becomes available.

Each wetland within the GWSCP dataset has been evaluated and assigned a management category that provides guidance on how these wetlands should be managed and protected. The three management categories used are Conservation Category Wetland (CCW), Resource Enhancement Wetland (REW) and Multiple Use Wetland (MUW) (Table 6-1).

Table 6-1 Management categories and objectives for wetlands on the SCP

Management category	Description	Management objectives
Conservation Category Wetland (CCW)	Wetlands which support a high level of attributes and functions.	Highest priority Objective: to preserve and protect the existing conservation values of the wetlands. No development or clearing is deemed appropriate. Any activity that may lead to further loss or degradation is inappropriate.
Resource Enhancement Wetland (REW)	Wetlands which may have been partially modified but still support substantial ecological attributes and functions.	Priority wetlands Objective: manage, restore and protect towards improving their conservation value. Have the potential to be restored to Conservation Category by restoring wetland function, structure and biodiversity.
Multiple Use Wetland (MUW)	Wetlands with few remaining important attributes and functions.	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through land care.

Source: Adapted from DBCA 2017a (ELA, 2022).

At a Commonwealth level, wetlands can be recognised as being of international importance (Ramsar wetlands) or national importance. There are no Ramsar wetlands within the airport estate. Nationally important wetlands are listed in the *Directory of Important Wetlands in Australia*, an online inventory first published in 1993, which acts as a knowledge base and tool for wetland managers. Although Ramsar wetlands are specifically protected under the EPBC Act as MNES, nationally important wetlands do not have any specific level of statutory protection. There are 120 wetlands in Western Australia recognised in the directory; of those, eight occur on Commonwealth land and one occurs at Perth Airport ('Perth Airport Woodland Swamps').

Wetlands within the airport estate were considered of national importance at the time of listing as they meet four out of six criteria that identify a nationally important wetland (Environment Australia 2001):

- Criteria 1: It is a good example of a wetland type occurring within a biogeographic region in Australia.
- Criteria 3: It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles or provides a refuge when adverse conditions such as drought prevail.
- Criteria 5: The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level.
- Criteria 6: The wetland is of outstanding historical significance or cultural significance.

Refer to Section 2 of the ELA (2022) report for further details.

6.2 Methodology

6.2.1 Wetland Identification and Validation

In 2019, Eco Logical Australia conducted a Wetland Identification and Validation Assessment to review the GWSCP mapping boundaries and evaluation category values of all wetlands within the Perth Airport estate (ELA, 2019) and assigned wetland identifications (IDs) for each wetland on the estate (Figure 6-1). These IDs have been used in this MDP for consistency.

The review was undertaken as the DBCA's GWSCP dataset (Figure 6-2), and the boundary of the mapped nationally important wetlands, did not adequately reflect the significant development and modification to the wetlands systems within the airport estate. The assessment was undertaken in accordance with the methodology and recommendations provided in the DBCA guidance A methodology for the evaluation of wetlands on the Swan Coastal Plain (DBCA 2017a).

The GWSCP dataset includes large portions of the airport estate mapped as CCW (228 ha), REW (265 ha) and MUW (651 ha) management category wetlands. GWSCP mapping is somewhat outdated and specifically within the airport estate, many areas are now cleared and occupied by Airport infrastructure. The remaining wetland areas have also been subjected to disturbance over time and changes to hydrology which have impacted wetland values. Major drainage lines have been constructed, redirected and upgraded to manage surface water flows and shallow groundwater tables affecting development of the site; as well as to convey stormwater from large urban catchments upgradient of the airport estate through to the Swan River.

DBCA (2017a) provides guidance on assigning an appropriate management category (Table 6-1) to a wetland. The evaluation of wetlands is based primarily on their attributes and functions, independent of decisions regarding protection and management of the wetlands. This methodology was used to determine an appropriate management category (i.e. CCW, REW or MUW) for the wetlands across the airport estate. While DBCA is yet to formally endorse the updated mapping which can take some time, the mapping reflects the most current information available and is the most contemporary understanding of wetland values in this area.

The assessment resulted in the identification of 40 priority wetlands (considered commensurate with CCW or REW management categories) within the Perth Airport site, of which twelve are intersected by the Airport North MDP (ELA 2019).

Information provided in this Section relates to mapping and evaluation of the twelve wetlands intersected by the Airport North boundary. Information on the basis for mapping and evaluation of wetlands outside of the Airport North boundary is included in Appendix A of ELA 2022.

6.2.2 Wetland Impact Assessment

The wetland impact assessment was undertaken in accordance with Guidelines 1.2 and included:

- An analysis and validation of current State and Commonwealth mapping and evaluation categories for wetlands occurring within and surrounding the project area, using the GWSCP dataset,
- A description of potential direct impacts to wetlands occurring within the project area,
- A description of potential indirect/offsite impacts to wetlands occurring outside the project area, and
- A discussion around the significance of removing wetlands within the project area, on broader wetland values.

Significant Impact Guideline 1.2 (DSEWPaC 2013), provides no specific guidance on determination of significance in relation to wetlands, other than to advise that the determination of significance should consider environmental context, the severity and nature of potential impacts and planned avoidance, mitigation and management.

In order to assist in defining the magnitude of significance of residual impacts, the terminology and criteria in Table 6-3 have been adopted for this assessment.

Table 6-2: Magnitude of significance terminology and criteria for wetlands

Magnitude description	Criteria
Major Adverse	Impacts to a wetland recognised as being of international (Ramsar listed) or national significance resulting in permanent and substantial loss of the values underpinning this significance.
High Adverse	A permanent or medium to long term deterioration in the ecological values or supporting processes of a wetland recognised as being of international or national significance. Impacts to wetlands considered commensurate with Conservation category such that they are no longer consistent with this management category or loss of extensive areas of wetlands commensurate with Resource Enhancement category.
Moderate Adverse	Impacts to wetlands considered commensurate with Conservation category which result in a measurable decrease in the functional area of the wetland or loss of moderate scale areas of wetlands commensurate with Resource Enhancement category.
Minor Adverse	Loss of small areas of wetlands commensurate with Resource enhancement category or further deterioration of the ecological values of these wetlands. Changes to wetland supporting hydrological regimes which do not result in impacts to defining attributes or values. Short term or temporary impacts to wetland values.
Negligible	Impacts would be beneath levels of detection, impacts that are consistent with seasonal variations, within the normal bounds of variation, or impacts that are within the margin of forecasting error.

Multiple use wetlands (MUW) were excluded from the impact assessment as they are not defined as significant ecosystems and are not likely to be sensitive or vulnerable to impacts, are not rare, endemic, unusual, important or otherwise valuable (Significant Impact Guideline 1.2). This approach is consistent with State and Federal government guidance on assessing impacts to the environment on Commonwealth land.

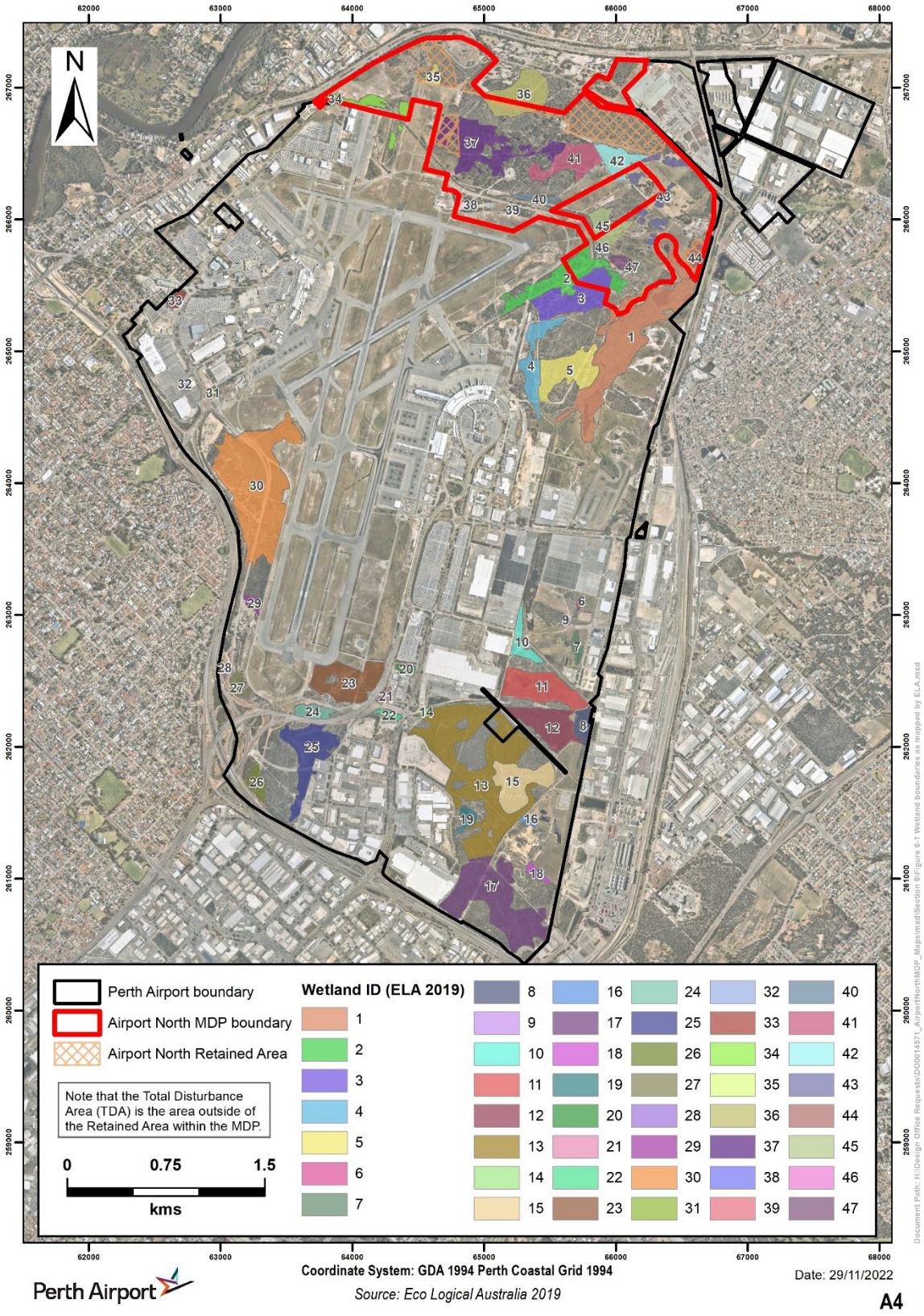


Figure 6-1 Wetland boundaries as mapped by ELA

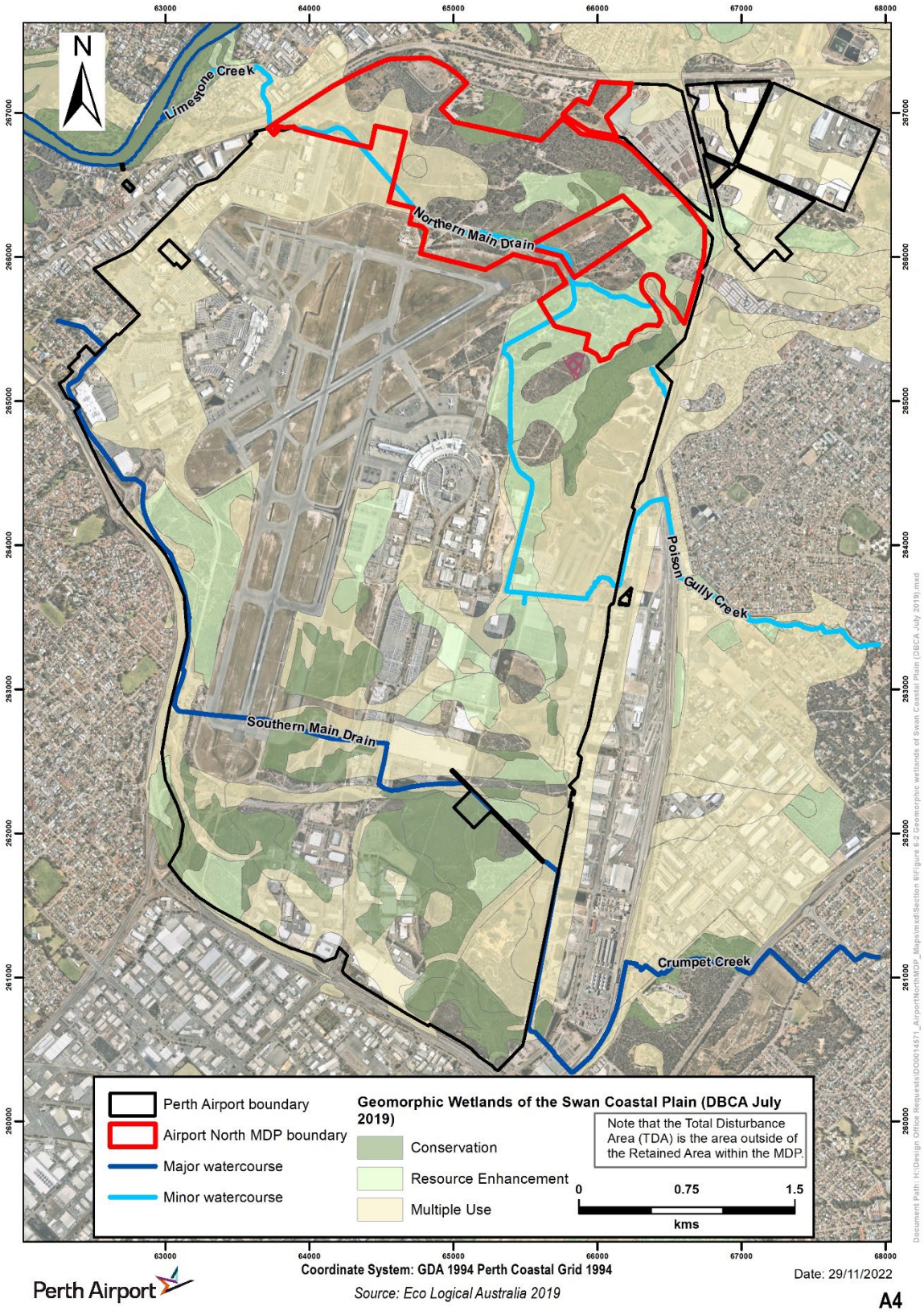


Figure 6-2 Geomorphic wetlands of Swan Coastal Plain (DBCA July 2019)

6.3 Existing Environment

6.3.1 Regional Context

Wetlands on the Swan Coastal Plain vary in several characteristics including size, shape and hydrology as a result of their physical setting and development processes. These wetlands are grouped in 'consanguineous' suites, using common features such as geomorphic setting and origin. The airport estate is within the 'Mungala' consanguineous suite. DBCA (2017a; cited within ELA 2022) has reported that the Mungala suite covers approximately 25,978.6 ha of wetlands, and of that, the wetlands within the Perth Airport cover approximately 1,143 ha.

Mapped wetland areas with remnant vegetation are predominantly restricted to the northern, eastern and southern boundaries of the airport estate. According to the GWSCP dataset, wetlands cover approximately 70% of the remaining vegetated portion (as mapped by Woodman 2020) of the airport estate.

Land surrounding the airport estate has largely been cleared for urban development, with a number of REWs and CCWs mapped across and adjacent to the northern and eastern boundaries of the airport estate (ELA 2022). The Swan River is a CCW waterway which lies approximately 440 m from the north-west corner of the estate.

6.3.2 Existing Wetlands

The site-specific assessment undertaken for this MDP provides the most accurate assessment of the existing wetlands within the MDP area. Based on the revised wetland boundaries and reassignments, a total of 12 priority (CCW and REC) wetlands were found partially or wholly within the MDP area (ELA 2022). This includes five CCW and seven REW wetlands as detailed in **Table 6-4** and shown in Figure 6-3.

The MDP wetlands were historically part of extensive inter-connected wetland systems, however, they have been significantly altered through filling and the introduction of major open drainage structures, such as the NMD which is evident in aerial imagery dating from circa 1974 (ELA 2022), prior to airport privatisation. A large portion of these wetland systems have been cleared and the remaining mapped wetland areas are dissected by roads including some classed as high ecological value wetlands (CCW) and some intersecting areas of mapped 'Perth Airport Woodland Swamp'.

Under the Commonwealth *Directory of Wetlands of National Importance* (DoE 2019), the 'Perth Airport Woodland Swamp' is located to the east and south of the main runway covering Munday Swamp, Runway Swamp and Link Road Swamp and located within the MDP area. The State's *Directory of Important Wetlands in Australia* (DBCA 2019) contains a different wetland boundary, which more accurately reflects the present wetland boundary.

Table 6-3: CCW and REW wetlands within the MDP area

Wetland ID	Assigned management category (ELA 2019)	Total area of wetland (ha)	Area intersecting MDP area (ha)
1	CCW	33.1	1.3
3	CCW	12.4	2.8
36	CCW	11.6	3.7
41	CCW	8.3	8.3
42	CCW	5.4	4.9
CCW sub-total			21.0
2	REW	12.9	5.9
35	REW	1.3	1.3
37	REW	17.6	17.6
44	REW	2.6	2.6
45	REW	5.6	2.7
46	REW	0.4	0.4
47	REW	1.7	1.7
REW sub-total			32.2
Total			53.2

Source: ELA 2022

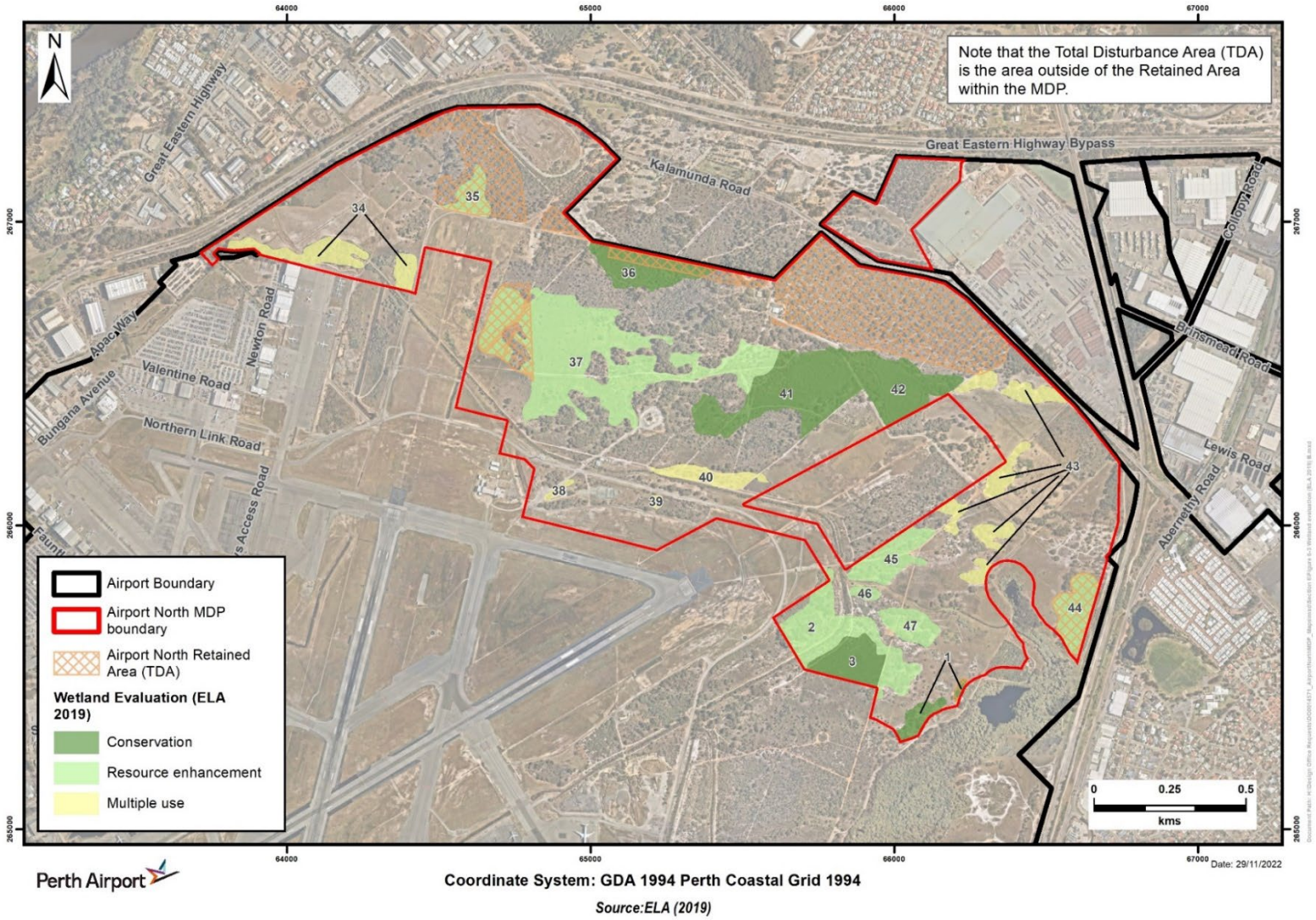


Figure 6-3: Airport North existing wetlands

6.4 Impact Assessment – Wetlands

6.4.1 Direct Impacts and Associated Avoidance/Mitigation Measures

Direct impacts to a number of priority wetlands have been avoided or mitigated during the planning of Airport North (Figure 6-3). In particular, adverse clearing impact within Munday Swamp (Wetland 1), and Wetland 44 will be completely avoided. In addition, portions of Wetlands 35, 36, 37 and 45 have been avoided and will be managed to retain ecological values, as far as this is compatible with hydrological changes.

Based on the most up to date wetland boundary remapping and evaluation at Perth Airport (ELA 2019), clearing will directly impact some or all of nine priority wetlands (Wetlands 1, 2, 3, 36, 37, 41, 42, 45, 46 and 47) as a result of implementation of the Airport North project. A further two wetlands, Wetlands 1 and 35, have areas within the mapped Total Disturbance Area (TDA), but these areas are designated for revegetation only. The total direct impact to wetlands and their associated vegetation and fauna habitat, as indicated by their occurrence within the disturbance area, is approximately 45.3 ha within the TDA, comprising 19.6 ha of wetlands considered commensurate with CCW and 25.7 ha of wetlands considered commensurate with REW.

Of these wetland areas, a portion (4.3 ha) of cleared (i.e. tracks), Completely Degraded and Degraded wetland vegetation is proposed to be revegetated (Figure 6-4). Some areas of revegetation are proposed solely to link, buffer, and protect existing wetland values, whilst others will serve a dual purpose of linking wetland remnants and providing stormwater conveyance through the replacement of conventional drainage channels with a 'Living Stream'.

Although the scale of direct loss of wetlands within the Airport North project area is moderate and some areas of revegetation are proposed, the impact of clearing represents a complete (i.e. high intensity, permanent and irreversible) loss of 14% of priority wetlands within the airport estate. Discussion relating to the significance of potential impacts of the Airport North project is provided in Section 6.5.3.

Quantified impacts to the five CCW and seven REW area detailed in Table 6-5. Direct impact values (extent within TDA) are listed inclusive of areas of revegetation works.

Table 6-4: Impact, retention and revegetation areas of wetlands within the MDP

Wetland ID	Assigned management category	Extent within TDA (ha)[1]	Extent within TDA to be revegetated	Extent to be revegetated	Total extent (ha) and proportion (%) of wetlands within MDP area	
1	CCW	1.1[1]	1.1	0.2	1.3	2.5%
3	CCW	2.8[1]	0.02	0.0	2.8	5.3%
36	CCW	2.6[1]	0.7	1.2	3.7	7.0%
41	CCW	8.3	NA	NA	8.3	15.6%
42	CCW	4.9	NA	NA	4.9	9.2%
CCW sub-total		19.6	1.8	1.4	21.0	39.5%
2	REW	5.9[1]	1.8	0.0	5.9	11.0%
35	REW	0.03[1]	0.03	1.3	1.3	2.5%
37	REW	15.0[1]	0.4	2.6	17.6	33.1%
44	REW	0.0	NA	NA	2.6	4.8%
45	REW	2.7[1]	0.05	0.0	2.7	5.2%
46	REW	0.4[1]	0.2	0.0	0.4	0.7%
47	REW	1.7[1]	0.03	0.0	1.7	3.2%
REW sub-total		25.7[1]	2.6	6	32.2	60.5%
Total		45.3[1]	4.33		53.2	100.0%

Note 1: Includes revegetation areas

Source: Adapted from ELA 2022

To mitigate the impact of proposed wetland clearing within the MDP, the proposed TDA will retain, either partially or fully, five wetlands within the MDP area, covering 7.9 ha, including:

- Full retention of (100%) of wetland 44 (REW, 2.64 ha of which 2.57 ha is within the MDP area);
- Substantial retention of a portion (97%) of wetland 35 (REW, 1.32, 1.29 ha of which will be retained, and 0.03 ha revegetated);
- Retention of a portion (17%) of wetland 1 that lies within the MDP area (CCW, 33.1 ha, of which 0.2 ha of the 1.3 ha within the MDP area will be retained, and the rest revegetated);
- Retention of a portion (31%) of wetland 36 that lies within the MDP area (CCW, 11.6 ha, of which 1.2 ha of the 3.7ha within the MDP area will be retained); and
- Retention of a portion (15%) of wetland 37 that lies within the MDP area (REW, 17.6 ha, of which 2.6 ha of the 17.6 ha within the MDP area will be retained).

The MDP also includes the provision of revegetation of the drainage basin along sections of the realigned NMD, which is intended to mimic the characteristic morphology and vegetation of a natural stream as far as practicable. Once established, the drainage basin could in the long-term provide some ecological linkages between the retained wetlands and Munday Swamp. A total of 4.3 ha of the wetlands impact area will be revegetated (Figure 6-4), including 1.1 ha of Munday Swamp vegetation that is currently in 'Degraded' condition, and will only be impacted for the purposes of revegetation and restoration to higher wetland values.

A Wetland Restoration and Management Plan will be prepared to guide the maintenance and, where possible, the enhancement of retained wetlands. The CEMP will ensure that these retained wetlands are not adversely impacted during construction works within the MPD project area.

The clearing of 45.3 ha of wetlands proposed as part of the MDP works represents a complete, i.e. high intensity, permanent and irreversible, or partial loss of priority wetlands within the MDP area. Therefore, the severity of the impact to this area in the context of the Significant Impact Guidelines 1.2 would be categorised as 'severe'. This does not in itself indicate significance of impact to wetlands as a whole and must be considered within the environmental context in which it is proposed to occur.

6.4.2 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

In addition to the direct impacts of clearing, retained wetland areas have potential to become altered due to indirect impacts. The Airport North development could result in indirect impacts to wetlands through:

- Construction impacts;
- Fragmentation and loss of supporting habitat within Airport North;
- Increased light and noise;
- Disturbance (e.g. through increased pedestrian or vehicular access);
- Changes to surface and groundwater regimes that support wetland values through realignment of drainage lines or altered infiltration rates within Airport North; or
- Introduction or movement of existing contaminants through changes to groundwater or stormwater flow pathways.

A number of wetlands in close proximity to Airport North are proposed to be cleared or significantly altered under the Airport Central, Airport West and New Runway projects. As such, potential indirect impacts to wetlands intersecting the boundary of these MDPs have not been considered, apart from Munday Swamp where there is a clear intention to minimise impacts and maintain existing wetland values as far as practicable.

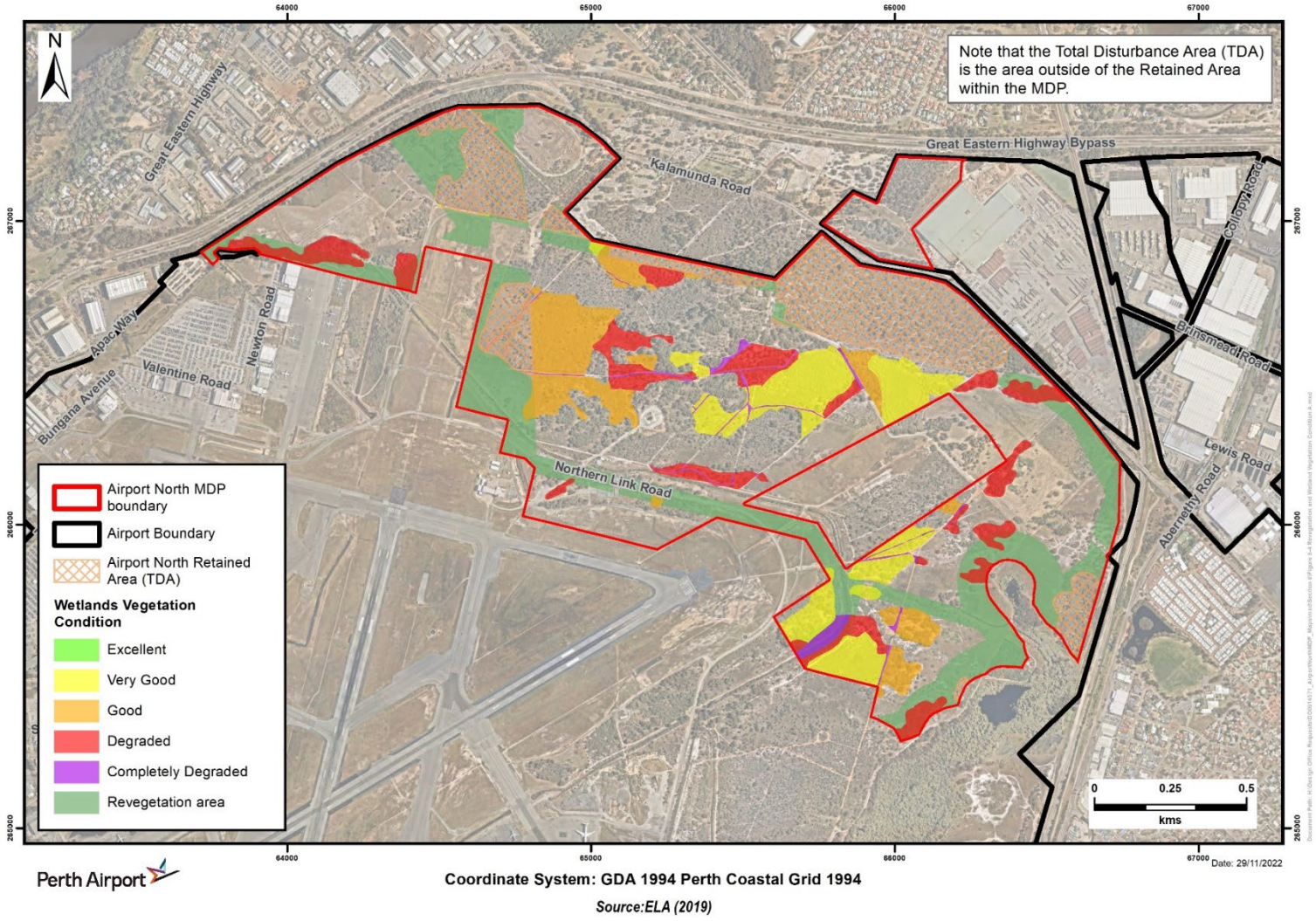


Figure 6-4: Airport North revegetation areas and wetland vegetation condition

6.4.2.1 Construction impacts

Without appropriate management, retained wetland areas could be indirectly impacted due to construction activities at Airport North which give rise to; uncontained emissions, erosion and surface water flows, dust, increased pedestrian or vehicular access, introduction or spread of dieback or weeds, and temporary groundwater drawdown due to dewatering or abstraction for construction purposes.

A CEMP for the Airport North project will be developed which includes, but is not limited to, management actions to address these threats to retained wetlands over the construction period. This plan will include monitoring to assess performance of the management measures against specific targets.

Measures to protect retained wetlands from indirect impacts during construction of Airport North will include:

- Access to Munday Swamp and other retained or adjacent wetland areas, will be managed, in order to prevent unauthorised access to the wetland other than for necessary revegetation and revegetation works.
- Where temporary drawdown is required to facilitate construction, a separate ASSMP and Dewatering Management Plan will be developed in accordance with Water Quality Australia's National Acid Sulfate Soils Guidance to manage the specific risks associated with construction related groundwater drawdown. The Management Plan will be approved by Perth Airport following review by DITRDCA AEO.

A specific construction groundwater and surface water monitoring plan will be developed, including the collection of baseline data to establish appropriate triggers and thresholds for water quality during the construction period.

With the application of appropriate management and monitoring measures, indirect impacts due to construction of the Airport North development will be minimised.

6.4.2.2 Fragmentation and loss of supporting habitat

Clearing for the Airport North development will leave a number of small wetland fragments, with the remaining portions at higher risk of edge effects, and potentially less able or unable to maintain ecosystem processes due to reduced size. This is likely to be the case for the 0.12 ha remnant of Wetland 2 (0.9% of the current wetland boundary), which falls outside the boundary of any of the MDPs. This remnant is not likely to retain values commensurate with a priority wetland.

Although larger sized patches of Wetlands 35, 36, 37, 42 and 45 are planned to be retained (either inside or outside of the MDP), clearing of 14% of priority wetlands within the airport estate, as well as additional upland areas, will result in habitat fragmentation and loss of a substantial portion of supporting habitat for retained wetlands. The Airport North clearing area contains a range of habitat types including transitional and upland areas that may support wetland fauna species during different stages of their lifecycle. Removal of wetlands, fauna corridors and fauna habitat is likely to lead to the loss of some biodiversity processes and could impact on wetland fauna populations in retained wetland areas.

Wetland invertebrate fauna richness has been found to be influenced by proximity to other wetlands, due to fauna that actively disperse between adjacent wetlands (Horwitz et al. 2009 cited within ELA 2022), and could therefore be affected by fragmentation and loss of a large proportion of the current wetland area.

A number of frog species that are known to inhabit Perth Airport wetlands spend a portion of their life cycle in vegetated upland areas during the non-breeding season (e.g. Moaning Frog and Banjo Frog or Pobblebonk). These frogs typically can travel long distances between habitats, however a portion of the frog population of Munday Swamp is likely to utilise habitat within Airport North due to the close proximity to the Swamp. As a result, clearing of the habitat within Airport North is likely to result in an adverse impact to population numbers of some frog species in Munday Swamp, with clearing causing substantial mortality of the adult population of Moaning Frog and Banjo Frog in particular (M Bamford pers. comm.). Impacts to fauna are assessed within Section 4.

The potential indirect impacts to Munday Swamp resulting from the cumulative loss of surrounding wetland areas will be mitigated by the inclusion of a 100m buffer between the proposed development area and the swamp. This buffer will contain areas of retained wetland and revegetation. The establishment of the Living Stream, will provide further mitigation.

6.4.2.3 Increased light and noise

As discussed in Section 4, impacts of noise and light on fauna are difficult to predict. In the case of Munday Swamp, this wetland already has a level of exposure to these impacts, and further impacts are likely under the approved New Runway Project. Proposed revegetation of a 100m buffer on Munday Swamp within the Airport North project boundary will provide some buffer to noise and light resulting from the Airport North project. Increased light and noise from Airport North are not expected to contribute any further impacts to the wetland faunal assemblage of Munday Swamp in excess of those already proposed and approved under the New Runway Project.

Light and noise from commercial and industrial activities could contribute to impacts on fauna within MDP North retained wetlands due to increased proximity of roads and infrastructure, with potential to result in the loss or decline of sensitive fauna species.

6.4.2.4 Disturbance

Areas of proposed revegetation around Wetlands 35, 44 and Munday Swamp are likely to provide some buffering from potential threats such rubbish, trampling, increased weeds and dieback spread. Other retained wetlands may be subject to a higher level of disturbance due to proximity to infrastructure and increased public access. This will be managed by demarcation of clear public access points and routes, and fencing where necessary.

Without management, some level of degradation of wetland values at retained wetlands is possible due to trampling, rubbish and weed ingress. A wetland monitoring and adaptive management plan will be developed to minimise the risk of disturbance from these threats and guide management of those wetlands that will be retained. This could include fencing of sensitive areas where necessary, to exclude pedestrian and vehicle access.

6.4.2.5 Altered hydrology

The Airport North project has the potential to impact on wetland water levels due to an increase in impervious surfaces leading to reduced infiltration, a change in the location and depth of drain inverts that currently constrain maximum groundwater levels, and alteration of localised wetland surface water catchments. In addition, the retained portion of Wetland 37 is situated within a basin area identified for management of stormwater, with resultant surface inundation from the NMD identified in a 1% AEP event (based on preliminary design).

Design for the NMD realignment was achieved through an iterative modelling process. One of the design criteria for the realignment was to reduce any groundwater drawdown at retained wetlands.

Over-all the modelling suggests that it may be possible to prevent drawdown of the regional groundwater table within the vicinity of retained Wetlands 35, 36, 44 and Munday Swamp through management of recharge (i.e. targeted infiltration of Airport North run-off). As detailed design progresses, further refinement of the hydrological model, complemented with baseline water monitoring, would improve the certainty around future wetland hydrological regimes.

Perth Airport are currently developing a wetland monitoring and adaptive management plan for retained areas of priority wetlands, with the objective of maintaining the biodiversity of these wetlands. Under this plan, water levels will be monitored, along with a range of biological indicators of wetland health. Where a prolonged change to water levels with potential to result in ecological impacts is determined to be due to development, response actions such as artificial augmentation of wetland water levels or re-direction of stormwater will be considered.

Apart from Munday Swamp and Wetland 37, current and proposed surface water drainage does not interact with the retained wetland areas, and changes to surface water flow pathways (apart from localised overland or subsurface flows) are not likely to impact on the hydrological regimes of retained wetlands. In the case of Munday Swamp, surface water flows from within the Swamp enter Airport North via a weir. All upstream flows and the operation of the weir have been assessed and approved as park of the New Runway Project MDP. No additional surface water flows from Airport North infrastructure will be directed towards the Swamp.

6.4.2.6 Introduction or movement of contaminants

Airport North is known to be contaminated in both soils and groundwater from historic fire fighting activities undertaken by Air Services Australia. In particular, contamination exists in and around the Aviation Rescue and Fire Fighting Service with per- and poly-fluoroalkyl substances (PFAS). An estate wide PFAS management plan is being developed, to be approved by Commonwealth regulators and efforts are on-going to determine the extent and required management of contamination. The Airport North drainage design concept for minimising the further mobilisation of the PFAS in or adjacent to known areas includes using pipes through affected areas.

Further detailed design of the NMD will incorporate structural controls to intercept and treat surface run-off from Airport North infrastructure (via swales and biofilters or similar). Post-development surface water catchment boundaries ensure that stormwater generated within the Airport North project boundary is directed to the NMD downstream of Munday Swamp, avoiding any interaction with this sensitive receptor and impacts to water quality within the swamp. Surface run-off from developed areas of Airport North will be directed away from retained Wetlands 35, 36 and 44 via drainage channels to the NMD.

Activities within Airport North will be guided by a groundwater and surface water monitoring and management plan. This is likely to minimise the risk of any future contaminants impacting on retained wetland areas.

6.4.2.7 Summary of indirect impacts on retained portions of Airport North wetlands

After implementation of the Airport North project, a number of wetlands will be lost through direct impacts of clearing (or clearing of the majority of the wetland leaving the small areas remaining unlikely to retain all original wetland values and functions). Of the remainder, indirect impacts will require on-going management to ensure that wetland values and functions are protected as far as practicable in the context of a highly altered landscape.

Table 6-6 provides a summary of the predicted or possible outcomes for wetland areas that could be indirectly impacted by the Airport North project. Key considerations for wetland areas that may be indirectly impacted by development include:

- Munday Swamp (Wetland 1) and Wetland 44 will be buffered from a range of potential impacts through provision of an improved vegetated buffer separating the wetlands from the Airport North development. In addition to ecosystem health, buffering of Munday Swamp will preserve the significance of cultural sites (including artefacts, hunting place, plant resource value and mythological properties) and maintain seasonal dispersal habitat for Rakali.
- Wetland fauna (invertebrate and vertebrate) and potentially some flora species at the retained wetlands are likely to be impacted by the loss of 14% of existing airport estate priority wetlands, fragmentation and loss of supporting habitat, including loss of some species and reduction in population numbers.
- Retained wetland areas will require active monitoring and management of hydrological regimes to ensure current values, or values commensurate with a priority wetland are maintained as far as practicable.
- A Wetland Monitoring and Adaptive Management Plan is being developed to provide for the monitoring and management of wetland areas that have the ability to retain priority wetland (CCW or REW) functions and attributes. This estate-wide plan will be implemented prior to and over the construction period and is expected to mitigate some indirect impacts to retained wetlands as a result of the Airport North development.

Table 6-5: Summary of possible indirect impacts to retained CCW and REW wetlands

ID	Evaluation	Total area (ha)	Direct impact (ha)	Indirect impact
1	CCW	33.12	1.09	Direct disturbance of 1.09 ha is for the purpose of revegetation only. A 100 m revegetated buffer will minimise a range of potential impacts to Munday Swamp Wetland fauna are likely to be impacted by loss of supporting habitat, leading to a reduction in fauna diversity and population numbers. Outcomes for Munday Swamp will be subject to monitoring and adaptive management of hydrological impacts.

ID	Evaluation	Total area (ha)	Direct impact (ha)	Indirect impact
2	REW	12.89	5.86	A 0.12 ha retained fragment outside of the Airport North MDP is unlikely to retain current ecological values due to its small size. Remainder of wetland will be cleared under the Airport Central MDP.
3	CCW	12.36	2.81	Not applicable, as remainder of the wetland will be impacted under the Airport Central MDP.
35	REW	1.32	0.03	Direct disturbance of 0.03 ha is for the purpose of revegetation only, with 1.29 ha retained. The outcome for the wetland will be subject to monitoring and adaptive management of hydrological impacts, aimed at retention of priority wetland status. There is likely to be a decrease in ecological values due to increased access and loss of supporting habitat. Wetland fauna are likely be to impacted by loss of supporting habitat, increased light and noise, increased human access and proximity of infrastructure, leading to a reduction in fauna diversity and population numbers.
36	CCW	11.60	2.59	Direct disturbance of 0.66 ha out of the 2.59 ha is for the purpose of revegetation only. Revegetation works will be conducted to improve vegetation cover within degraded areas and old access tracks, increasing connectivity between the 7.86 ha outside of the estate boundary and the 1.2 ha of retained wetland area within the estate boundary. Outcomes for the retained and revegetated portion of wetland inside of the airport estate boundary will be subject to monitoring and adaptive management of hydrological impacts. Wetland fauna may be impacted by loss of supporting habitat, increased light and noise, increased human access and proximity of infrastructure, leading to a reduction in fauna diversity and population numbers.
37	REW	17.62	14.99	The remaining 2.63 ha will be retained and protected via a constructed barrier. Revegetation works, accounting for 0.41 ha of the 'impact area' (cleared tracks) will improve the overall wetland remnant by de-fragmentising/consolidation. Outcomes for this wetland may be subject to monitoring and adaptive management of hydrological impacts in order to retain priority wetland status. Indirect impacts could alter the ecological values due to increased access, altered hydrology and loss of supporting habitat.
42	CCW	5.42	4.87	A retained 0.55 ha fragment may retain some wetland values but are unlikely to remain commensurate with current CCW status due to its reduced size, increased access, altered hydrology and loss of supporting habitat. Outcomes for this wetland may be subject to monitoring and adaptive management of hydrological impacts in order to retain priority wetland status.
44	REW	2.64	0	Revegetation will assist buffering of some impacts from Airport North. Outcomes for this wetland will be subject to monitoring and adaptive management of hydrological impacts. Wetland fauna may be impacted by loss of supporting habitat, increased light and noise and increased human access, leading to a reduction in fauna diversity and population numbers.
45	REW	5.57	2.74	Indirect impacts to 2.83 ha due to increased access, altered hydrology and loss of supporting habitat. Outcomes for this wetland may be subject to monitoring and adaptive management of hydrological impacts in order to remain a priority wetland.

6.4.3 Significance of Residual Impacts

The sensitivity, value and quality of each wetland being impacted has been defined using its evaluation category (CCW or REW) as mapped by ELA (2019) and assessed as per significance criteria presented within Table 6-3.

In 2004, the Western Australian EPA estimated that approximately 80% of wetlands on the SCP had already been lost due to progressive development activities (urban development and agriculture), and of the remaining wetlands only 15% represented high ecological value wetlands (CCWs). As such, wetlands on the Swan Coastal Plain can be considered to have surpassed critical thresholds for cumulative impacts such that any further loss of CCW wetlands is generally considered to be significant. This is reflected in the criteria.

Certain impacts to REW wetlands have also been defined as significant in the criteria. This reflects the regional and local environmental context of Perth Airport wetlands and the fact that these wetlands occur within a regionally significant fragmented bushland/wetland linkage, with the overall value of these wetlands greater than the sum of the individual wetlands themselves. REW wetlands with Perth Airport have increased value due to the presence of a high number of adjoining wetlands of conservation significance.

The clearing of wetlands considered commensurate with CCWs within the Airport North MDP boundary is considered High Adverse significance. This includes all of wetland 41; the portion of Wetlands 3 and 42 within the Airport North MDP boundary; and the southern extent of Wetland 36 which is within the Airport North MDP, excluding areas of this wetland to be retained or revegetated. Due to known cumulative impacts to extensive areas of wetlands considered commensurate with REWs, loss of these wetlands within Perth Airport also fits the criteria for High Adverse significance. Within Airport North, clearing of REWs includes the full extent of Wetlands 46 and 47; the portion of Wetland 2 and 45 within the Airport North MDP boundary; and the majority of Wetland 37, excluding the portions to be retained or rehabilitated.

A number of potential indirect impacts are also classified as High Adverse significance. This includes the remaining portions of Wetland 2 (REW; 0.12 ha retained outside of the Airport North MDP) and Wetland 42 (CCW; 0.55 ha retained outside of the Airport North MDP). The wetland 2 remnant is unlikely to retain ecological values long-term due to its small size. Although the Wetland 42 remnant may retain some wetland values, it is not likely to remain commensurate with current CCW status due to its substantially reduced size, increased access, altered hydrology and loss of supporting habitat.

Development and implementation of a CEMP will provide guidance for management of construction dewatering, baseline investigations and monitoring and an on-going adaptive management plan for retained wetlands to ensure that other potential indirect impacts to retained wetlands as a result of the Airport North project are not significant. However there is a small chance that some ecological values could deteriorate, if actions are not undertaken to ensure post-development groundwater levels do not cause localised groundwater levels to change.

It is considered that impacts of Minor Adverse significance are possible for retained areas of Wetlands 35, 37 and 45 (up to 6.5 ha of wetland commensurate with REW). An impact of Moderate to High Adverse significance is possible for retained portions of Wetland 36 (up to 9.8 ha of CCW both inside and outside the Perth Airport estate). The possibility of significance to these wetlands as a result of indirect impacts cannot be ruled out without a better understanding of existing and post development localised wetland hydrology and/or the viability of engineering solutions to address any future hydrological impacts.

Any significant impacts to Wetland 44 or Munday Swamp as a result of hydrological changes associated with the Airport North MDP are considered unlikely given a high level of commitment to maintaining the heritage values associated with Munday Swamp and the current intention to supplement groundwater levels as a means of controlling water levels within the Swamp. A Negligible to Minor Adverse impact to Munday Swamp (up to 33.12 ha of CCW) is expected as a result of impact to wetland fauna through loss of adjacent wetlands and supporting habitat.

Excluding consideration to revegetation works that will improve wetland values (i.e. vegetation cover) rather than cause adverse impact, the TDA of the Airport North project would result in direct impact to up to 19.6 ha of CCW and 25.7 ha of REW. The direct loss of up to 45.3 ha of wetland, which is approximately 14% of the wetland areas within the Perth Airport estate retaining priority ecological values (equivalent to a CCW or REW). Despite significant historical disturbance, these wetlands have been assessed as either wetlands of the highest priority or wetlands having rehabilitation potential.

Considering the historical loss of wetlands on the Swan Coast Plain, the largely Good to Very Good condition of the MDP area's wetland vegetation and the context of these wetlands within a broader mosaic of wetland and bushland vegetation within the airport boundary, the direct loss of up to 19.6 ha of CCW and up to 25.7 ha of REW, is likely to be considered significant residual impact. The significance of indirect impacts are not yet fully understood and will be further explored though detailed design and opportunities for mitigation though the development of the Estate's Adaptive Wetland Monitoring and Management Plan and CEMP.

Direct impacts to wetland areas within Airport North are considered unavoidable, however as part of the larger Masterplan, some wetlands areas are planned for retention. Hydrology of these areas will be managed to protect wetlands values, as far as this is consistent with broader airport objectives.

6.4.4 Cumulative Impacts

Apart from the Airport North project, there are a number of existing and planned projects, including the approved New Runway Project, and Airport West (South) and Airport Central, which is currently under assessment. Table 6-7 lists known cumulative impacts to Perth Airport wetlands based on implementation of the New Runway Project, Airport West (South), and the proposed Airport Central and Airport North.

Table 6-6: Cumulative impacts to CCWs and REWs (adapted from ELA 2022)

Project	Management Category[1]	
	CCW (ha)	REW (ha)
Current total within airport estate	177.1	133.7
Airport North - direct[2]	19.6	25.7
Airport North – indirect[3]	1.7	5.6
Airport West (South) MDP- direct impacts only	-	36.4
Airport Central - direct	13.7	14.5
Airport Central - indirect	0.1	-
New Runway Project MDP- direct impacts only	79.8	17.8
Cumulative impact – direct clearing only	113.1 (63.9%)	94.4 (70.6%)
Cumulative impact– direct and Indirect[2]	114.9 (64.9%)	**100 (74.8%)**

Note 1: Areas are based on current mapping of wetland categories
Note 2: Currently includes revegetation areas
Note 3: Significance of indirect impact to be determined

Source: Adapted from ELA 2022

In combination with the Airport West (South), Airport Central and the New Runway Project, a total of approximately 113.1 ha of CCW and 94.4 ha of REW are proposed to be cleared (Note: area includes revegetation areas).

The loss of the majority of wetland vegetation across the airport is likely to contribute to further decreased value associated with the remaining remnants. This is due to the loss of broader values relating to regional linkages, as well as impacts to viability as a result of fragmentation and decreased functional area.

Cumulative impacts to Munday Swamp due to the loss of a majority of surrounding wetlands and habitat is likely to be seen primarily in the form of altered faunal assemblages. A number of wetland species that range into upland habitats during part of their life cycle, or rely on large areas of functional habitat, may experience population declines within the swamp and other species could disappear from the swamp altogether.

The potential indirect impacts to Munday Swamp resulting from the cumulative loss of surrounding wetland areas is planned to be mitigated to some extent through the development of the NMD as a Living Stream; a constructed or retrofitted stormwater conveyance channel that mimics the characteristics (morphology and vegetation) of a natural stream. The NMD Living Stream could in the long-term re-establish some ecological linkages between wetland remnants and Munday Swamp, though not approaching the values currently provided by surrounding wetlands and habitat.

In combination with the predicted impacts attributable to Airport West (South), New Runway Project and Airport Central (in draft) as well as predicted future impacts to wetlands likely as a result of foreseeable future projects within the Perth Airport estate, the impacts to wetlands arising from Airport North are therefore likely to be considered significant.

6.4.5 Anticipated Outcome

The MDP will give rise to significant direct and cumulative residual impacts to priority wetlands.

6.5 Summary of Outcomes

Of the 21.0 ha CCW occurring within the MDP area, 1.4 ha will be retained and 19.6 ha will be cleared, with 1.8 ha of 'impact area' to be improved via revegetation. Revegetation work will be undertaken within several wetlands, and notably at a section of degraded vegetation on the periphery of Munday Swamp in order to improve vegetation condition. This improved 100 m wide vegetation corridor will provide a buffer between the MDP area and the most significant wetland feature of the airport estate. Of the 32.2 ha of REW occurring within the MDP area, 6.5 ha will be retained and 25.7 ha will be cleared, with 2.6 ha of this 'impact area' to be revegetated.

Offsets are discussed in Section 12.0.

7 Soils and Geology

This section provides details on:

- Soils and geology within the Airport North project area.
- Impact assessment (including direct, indirect and offsite impacts) and associated mitigation and avoidance measures on the following soil and geology matters that are known to be relevant to the project:
  - Land Contamination,
  - PFAS, and
  - Acid Sulfate Soils (ASS).

7.1 Legislative and Policy Context

Impacts on soils and geology within the MDP area are considered against the following international, Commonwealth and State legislation and policy:

International

- Best Practice Erosion and Sediment Control (International Erosion and Sediment Control Association (Australasia) (IECA) 2008)
- PFAS National Management Plan, Version 2.0 (Heads of EPA Australia and New Zealand 2020).

Commonwealth

- EPBC Act 1999
- Airports (Environment Protection) Regulations 1997 (AEPR)
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (National Environment Protection Council, amended May 2013).

State

- State Planning Bulletin 64 – Acid Sulfate Soils (ASS) (Western Australian Planning Commission)
- Identification and Management of ASS and Acidic Landscapes (DWER 2015a)
- Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (DWER 2015b)
- Contaminated Sites Act 2003 and associated Regulations
- Assessment and Management of Contaminated Sites (DWER 2014).

7.2 Existing Environment

7.2.1 Regional Context

The Swan Coastal Plain comprises five major geomorphological systems (landforms) that lie parallel to the coast. From west to east these are Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf. The MDP area is situated on the Bassendean Dune and Pinjarra Plain landforms.

The Bassendean Dune System consists of very old, leached sands to various depths and is the oldest of the three dunes systems occurring on the Swan Coastal Plain. Sands within this system contain very little silt or clay and very low levels of nutrient elements.

Soils of the Pinjarra Plain are complex and comprise a successive layering of soils formed from erosion of material from the Darling Scarp and east of the scarp. These soils consist of alluvial flats extending from the base of the scarp to interface with the Bassendean Dunes.

7.2.2 Soil and Geological Conditions

Soils within the MDP area are summarised in Table 7-2 with their extent shown in Figure 7-1: Soil Types

Table 7-1: Summary of soils with the MDP area

Code	Soil Zone	Description
212	Bassendean	Mid-Pleistocene Bassendean sand. Fixed dunes inland from coastal dune zone. Non-calcareous sands, podsolised soils with low-lying wet areas.
213	Pinjarra	Alluvial deposits (early Pleistocene to Recent) between the Bassendean Dunes Zone and the Darling Scarp, colluvial and shelf deposits adjacent to the Darling Scarp. Clayey to sandy alluvial soils with wet areas. Mid-Pleistocene Bassendean sand. Fixed dunes inland from coastal dune zone. Non-calcareous sands, podsolised soils with low-lying wet areas.

Source: DPIRD 2020

The superficial geology encountered during the Detailed Site Investigation (DSI) undertaken in 2019 (Senversa 2019) indicates that there is fill material within the disturbed portions of the MDP area comprised of brown sand and sandy gravel. Underlying the fill material, and areas that have had little or no disturbance, is predominately sand.

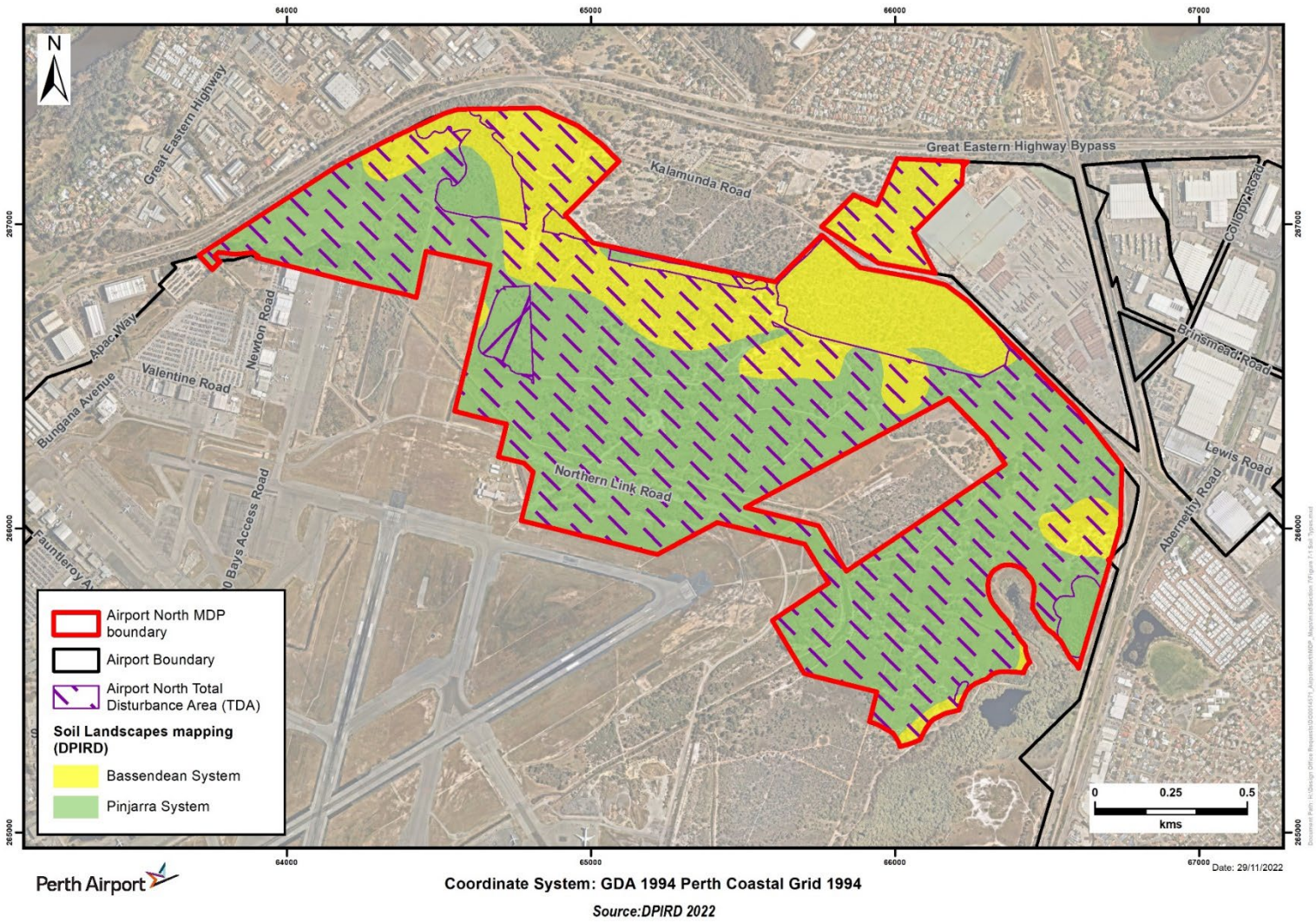


Figure 7-1: Soil Types

Perth Airport

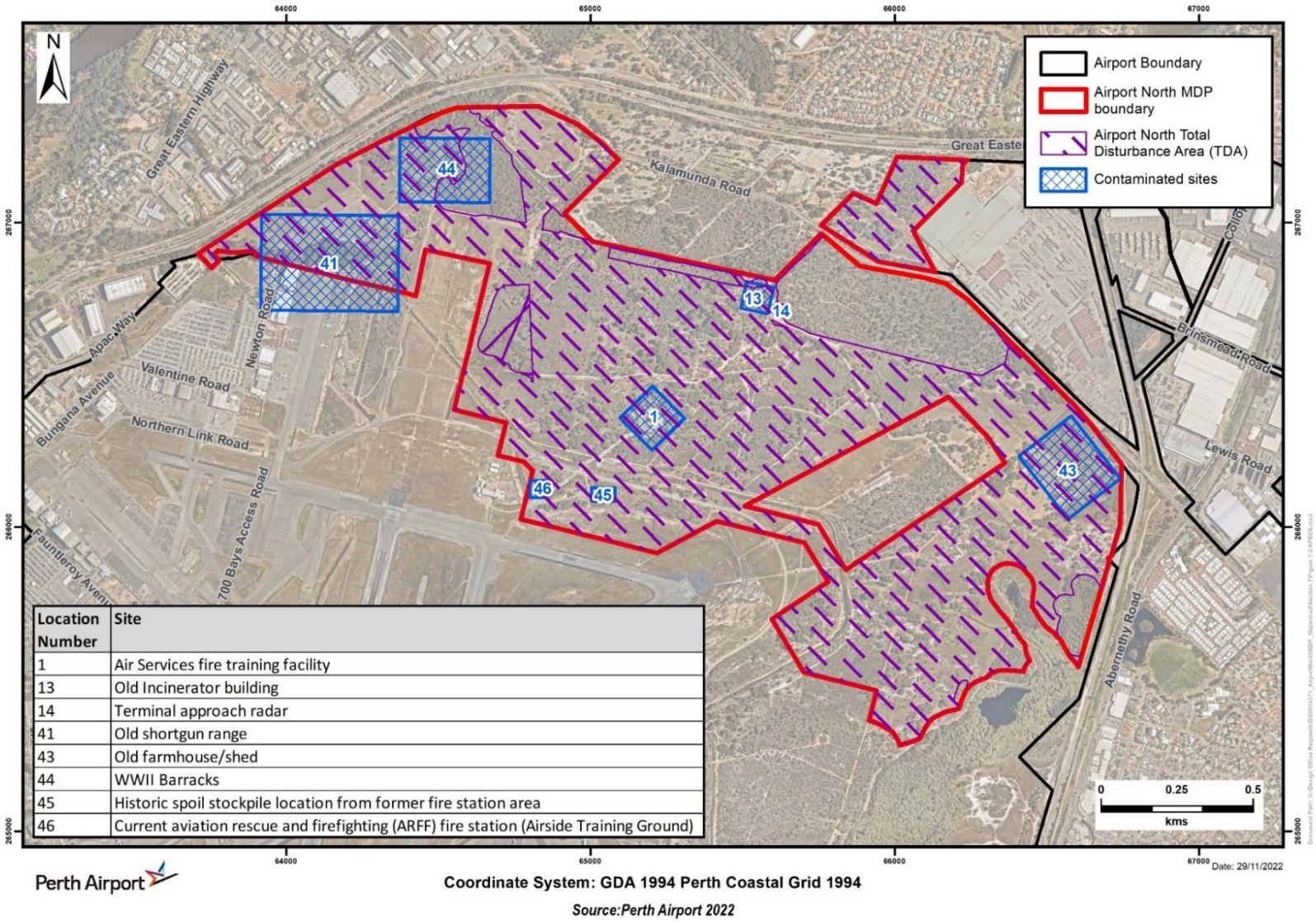
7.2.3 Historical and Existing Land Uses

Perth Airport maintains a contaminated sites database which identifies areas of the airport estate where known or suspected contamination exists. The database contains eight individual Areas of Potential Environmental Concern (APEC) within the MDP area, which are summarised in **Table 7-3** below. The locations of the APEC are shown in **Figure 7-2**.

Table 7-2: Known or suspected contaminated sites within the MDP area

Location number	Site	Contaminants of potential concern
1	Air Services fire training facility	PFAS
13	Old incinerator building	PFAS & hydrocarbons
45	Historic spoil stockpile location from former fire station area	PFAS
46	Current aviation rescue and firefighting (ARFF) fire station (Airside Training Ground)	PFAS
14	Terminal approach radar	Hydrocarbons
41	Old shotgun range	Metals
43	Old farmhouse/shed	Asbestos
44	WWII Barracks	Asbestos

Source: Perth Airport 2022



Location Number	Site
1	Air Services fire training facility
13	Old Incinerator building
14	Terminal approach radar
41	Old shortgun range
43	Old farmhouse/shed
44	WWII Barracks
45	Historic spoil stockpile location from former fire station area
46	Current aviation rescue and firefighting (ARFF) fire station (Airside Training Ground)

Figure 7-2: Areas of Potential Environmental Concern

Perth Airport

7.2.4 Per- and poly-fluoroalkyl substances (PFAS)

7.2.4.1 Overview

Perfluoroalkyl & Polyfluoroalkyl Substances (PFAS) are a group of manufactured chemicals that have been used since the 1950s. Aqueous Film Forming Foams (AFFF) containing PFAS have been used internationally in firefighting activities since the 1960s.

During their use and storage within the airport estate, AFFF was released to the environment through firefighting activities; while being used on hydrocarbon spills as fire prevention, and during training activities. AFFF may have also been released to the environment during the maintenance, cleaning and testing of firefighting equipment, as well as through spills and leaks from the storage and transfer of AFFF.

7.2.4.2 Historical Investigations

Three individual PFAS Areas of Potential Environmental Concern (APEC) exist within the MDP area, and another one immediately adjacent. These areas are shown on **Figure 7-3** and listed below:

- Current fire training ground (APEC 3a)

  The firefighting ground was constructed in early 1980s and is used for fire training exercises which included the use of AFFF. The firefighting ground contains a fire training plane and helicopter located on top of a bunded concrete pad which drains into a treatment pond. During rainfall events, runoff from the concrete pad is passed through a micro filter, before being discharged into the nearby drain.

- Old incinerator building (APEC 3b)

  The old Incinerator building is located to the north of the fire training ground. The potential exists for firefighting activities to have been undertaken in this area.

- Current ARFF fire station (APEC 4a)

  A portion of the current ARFF fire station, used for airside training purposes, is located within the MDP area with the remainder of the fire station immediately adjacent to the MDP area. A location within this training area was found to have elevated concentrations of PFAS. This location is in the vicinity of the training aeroplane adjacent to the current ARFF fire station. Training activities that included the use of AFFF may have taken place at this location, giving rise to the elevated concentrations.

- Historic spoil containment stockpile from former fire station (APEC 4b)

  During the demolition of the former ARFF fire station, excavated spoil was removed and placed in High Density Polyethylene (HDPE) containment cells located to the east of the current fire station. In late 2021, Air Services Australia removed and disposed of the material contained within the stockpiles.

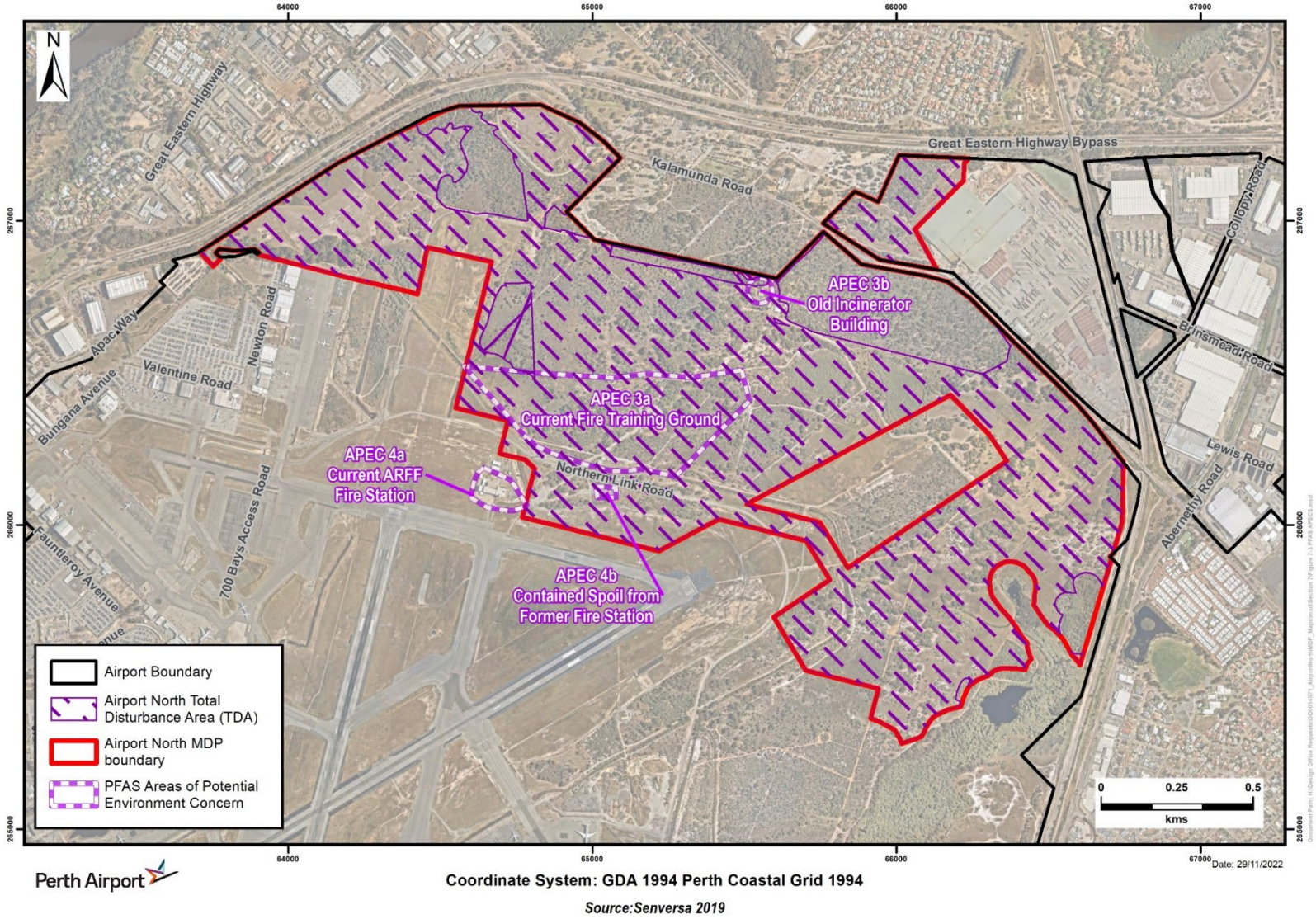


Figure 7-3: Areas of Potential Environmental Concern (PFAS)

ASSESSMENT CRITERIA

The following PFAS National Management Plan (HEPA 2020) criteria were referred to when considering the PFAS concentrations in soil found within the MDP area:

7.2.4.3 Soil

- Human health screening criteria values for public open space (PFOS/PFHxS = 1 mg/kg).
- Human health screening criteria values for commercial/ industrial land use (PFOS/PFHxS = 20 mg/kg).
- Ecological guideline values for commercial/industrial land use for direct (PFOS 1 mg/kg) and/or indirect (PFOS 0.01 mg/kg) exposure.

7.2.4.4 Water

- Human health screening criteria values for recreational use water (PFOS/PFHxS = 2 µg/L).
- Freshwater and marine water guideline values for 95% species protection (PFOS – 0.13 µg/L).

7.2.4.5 PFAS Regulatory Requirements

The PFAS National Management Plan (HEPA 2020) recognises that environmental legislation in many jurisdictions includes obligations and duties to prevent environmental harm, nuisances and contamination. **Table 7-4** presents the actions outlined in HEPA (2020) that will enable a responsible person or organisation to demonstrate compliance with the obligations and duties, together with proposed actions to comply with these during the construction works within the MDP area. The Preliminary Management Actions are not intended to be an exclusive list of all actions required to address environmental harm, nuisances and contamination, and further actions may be required, including as regulatory requirements develop.

Table 7-3 PFAS NEMP (HEPA, 2020) Actions to comply with environmental legislation obligations and duties

PFAS NEPM (HEPA, 2020) Actions	Preliminary Management Action
Understanding the PFAS content of products, articles and materials and/ or presence of PFAS contamination, for example, by determining the concentrations of PFAS present and/or the nature and location of PFAS sources	A suitably qualified environmental consultant has completed a PSI and DSI across the airport estate to assess the nature and extent of PFAS within soil, sediment, concrete, groundwater and surface water. **(complete)**
Understanding the environmental values that may be impacted by the contamination, both on and offsite, such as: determining the surface water and groundwater environments, determining what the water is used for, considering important issues including any offsite movement, PFAS transformations, and exposure pathways to receptors	The DSI includes a review of potential onsite and offsite human and ecological receptors. **(complete)** A risk assessment will be completed to determine if source-pathway-receptor linkages exist and if an unacceptable risk is posed to identified receptors.
Taking all reasonable and practicable measures to prevent or minimise potential environmental harm from PFAS-related activities and contamination, such as: ensuring PFAS wastes, contaminated materials and products are effectively stored and/or remediated to prevent release, and having appropriate contingency plans to deal with leaks and spillage	The DSI provides an understanding of any PFAS impacts so that appropriate management and mitigation measures can be further considered and implemented. A PFAS Management Plan will be prepared detailing the proposed management measures.
Undertaking appropriate monitoring to check the effectiveness of management measures implemented and to assess the extent and impacts of any contamination	Subject to any Management Plan, PFAS levels in groundwater and surface water may need to be monitored throughout construction. The frequency and duration of the monitoring will be appropriate for the duration of the construction works. Any soils to be excavated and removed from PFAS impacted areas will undergo appropriate testing to ensure suitable reuse or offsite disposal.

PFAS NEPM (HEPA, 2020) Actions	Preliminary Management Action
Ensuring proper disposal of PFAS-contaminated waste, for example, by properly characterising waste and sending it to a facility licensed to accept it, noting dilution is not acceptable for example in soil, air, compost or other wastes or products	Any material that cannot be retained will be required to undergo testing in accordance with the appropriate guidelines and to the satisfaction of the receiving waste management facility.
Ensuring PFAS-contaminated materials for reuse, including reused waste, are appropriately managed to prevent harm to land use, human health and the environment	Any reuse of PFAS-contaminated materials will need to be appropriately managed in line with an approved Management Plan, developed based on Human Health and Ecological Risk Assessment guidelines and in accordance with the NEMP 2.0.
Ensuring environmental regulators and any persons or organisations likely to be adversely affected by any releases are promptly advised of any incidents and contamination	Any Management Plan will identify relevant site stakeholders and will detail the incident reporting procedure.

Source: HEPA 2020; Perth Airport 2022

7.2.4.6 Baseline Conditions

Table 7-5 presents a summary of the maximum PFAS concentrations recorded at each of the four APECs during the historical investigations for the mediums soil, sediment, groundwater and surface water, and indicates if the relevant assessment criteria, listed in **Section 7.3.4.2.1**, are exceeded.

Table 7-4: Summary of PFAS sampling results

Location number	Site	Maximum PFAS concentrations		
		Medium	Concentration	Exceedance
APEC 3a	Air Services fire training facility	Soil	PFOS = 30.0 mg/kg PFHxS + PFOS = 31.2 mg/kg	Yes Yes
		Groundwater	PFOS = 1,510 µg/L PFHxS + PFOS = 2,160 µg/L	Yes Yes
		Surface water	PFOS = 33.1 µg/L PFHxS + PFOS = 34.3 µg/L	Yes Yes
APEC 3b	Old incinerator building	Soil	PFOS = 0.716 mg/kg PFHxS + PFOS = 0.716 mg/kg	Yes Yes
		Groundwater	PFOS = 1,020 µg/L PFHxS + PFOS = 1,360 µg/L	Yes Yes
APEC 4a	Current aviation rescue and firefighting fire station (airside training ground)	Soil	PFOS = 0.0017 mg/kg PFHxS + PFOS = 0.0084 mg/kg	No No
		Sediment	PFHxS + PFOS = 0.0006 mg/kg	No
		Groundwater	PFOS = 7.05 µg/L PFHxS + PFOS = 15.2 µg/L	Yes Yes
		Surface water	PFHxS + PFOS = 0.97 µg/L	Yes
APEC 4b	Sealed/contained spoil from former fire station area	Soil	PFOS = 0.0118 mg/kg PFHxS + PFOS = 0.0121 mg/kg	Yes Yes

Location number	Site	Maximum PFAS concentrations		
		Groundwater	PFOS = 2.42 µg/L PFHxS + PFOS = 21.6 µg/L	Yes Yes

Source: Senversa 2019

7.2.4.6.1 Soils

The analytical data collected in the most recent investigation (Senversa 2019) is comparable to historical investigations indicating that PFAS contamination persists in the soil and groundwater within the MDP area. This investigation reports that the PFAS contamination within the MDP area is predominately limited to the fire training ground and the old incinerator building, as illustrated in **Figure 7-4**, where the use of AFFF historically occurred.

7.2.4.6.2 Sediment

An investigation of the sediments of the NMD was completed in 2018. The investigation sought to determine if sediments indicate that an ongoing source of leachable PFAS and/or adsorbed PFAS on mobile particulates exists. The investigation found that PFOS concentrations ranged between below the laboratory Limit of Reporting (LOR) and 0.031 mg/kg, with the highest concentrations recorded adjacent to and downstream of the fire training ground. These sediment concentrations are above the soil ecological indirect exposure guideline value (PFOS 0.01 mg/kg, noting there was no applicable criteria for sediment) indicating a potential risk to ecological receptors.

7.2.4.6.3 Groundwater

Consistent with soil impacts, the PFAS concentrations in groundwater are highest within the vicinity of the fire training area and old incinerator building. PFAS concentrations were relatively low or below detection limits in the monitoring wells positioned up-hydraulic gradient of the MDP area and are lower in the western portions of the MDP area. PFAS concentrations exceeded the recreational use criteria and/or the ecological freshwater (and marine water) assessment criteria in the majority of groundwater samples. The human health recreational water use was also exceeded in half of the groundwater samples. PFAS concentrations in groundwater samples collected down-hydraulic gradient, towards the western boundary of the MDP area, exceed the ecological guidelines, but are below the recreational guidelines and the non-potable use guidelines (10 x drinking water guidelines).

As PFAS has a moderate mobility and is highly persistent with low degradation, the PFAS concentrations in groundwater may pose an unacceptable risk to ecological and human receptors within the MDP area and down hydraulic gradient of the MDP area via transport in groundwater flows.

7.2.4.6.4 Surface Water

Surface water concentrations are above the freshwater and marine water guideline values across the MDP area including within the NMD, indicating that a risk may be posed to ecological receptors within the surface water bodies. Elevated PFAS concentrations are consistently recorded in the surface water of the NMD as shown in Table 7-6, though these are orders of magnitude lower than the groundwater PFAS concentrations recorded in the vicinity of the PFAS APECs.

Groundwater discharge to the NMD in the vicinity of the fire training ground is considered to be one of the main sources of PFAS impacts in the drainage channel. The PFAS concentrations in the NMD indicate that it acts as a pathway for the migration of PFAS from the airport estate to offsite receptors including the Swan River, via Limestone Creek. Due to the presence of PFAS, such as from fire-fighting foams, Limestone Creek is classified as Contaminated – restricted use in accordance with the Contaminated Sites Act 2003.

Table 7-5 PFAS concentrations in surface water of the Northern Main Drain downstream of the fire training ground

Date	PFOS (µg/L)	PFHxS (µg/L)	PFOA (µg/L)
14/09/2020	0.28	0.69	0.022
7/07/2020	0.14	0.48	0.011
10/03/2020	0.95	2.5	0.073
28/01/2020	0.95	2.6	0.087
15/04/2019	2.1	2.7	0.22
21/01/2019	1.3	2.9	0.11
9/11/2018	1.1	2.3	0.092
17/08/2018	0.26	0.42	0.02
23/04/2018	1.6	1.4	0.12
29/01/2018	1.3	2.7	0.1

Assessment criteria:
Human health screening criteria values for recreational use water (PFOS/PFHxS = 2 µg/L).
Freshwater and marine water guideline values for 95% species protection (PFOS = 0.13 µg/L).

Source: JBS&G 2020

Although Perth Airport did not cause the PFAS contamination as it occurred due to activities prior to ownership, as a responsible corporate citizen, to manage the offsite release of PFAS via the NMD, Perth Airport currently treats all surface water (up to 20 L/s) to below the recreational guidelines on the western boundary of the MDP area prior to offsite discharge to the Swan River, via Limestone Creek. The treatment involves abstracting surface water from the NMD near the western boundary of the airport estate and pumping it through treatment vessels containing an absorbent media (GAC and Ion exchange) which reduces PFAS from the water.

During most significant rainfall events the discharge rate in the NMD exceeds 20 L/s and the treatment process becomes ineffective. However, the rainfall dilutes the PFAS concentration to below the recreational guidelines, removing the need for treatment.

7.2.4.6.5 Concrete

The assessment of concrete has not been completed during recent investigations; however, additional investigations completed on the wider airport estate have detected PFAS in the concrete samples above the laboratory limit of detection. As such, assessment of concrete will likely need to be completed in areas where concrete is proposed to be removed, to assess if it poses any risks to human health or ecological receptors and to inform the appropriate disposal or reuse of the material.

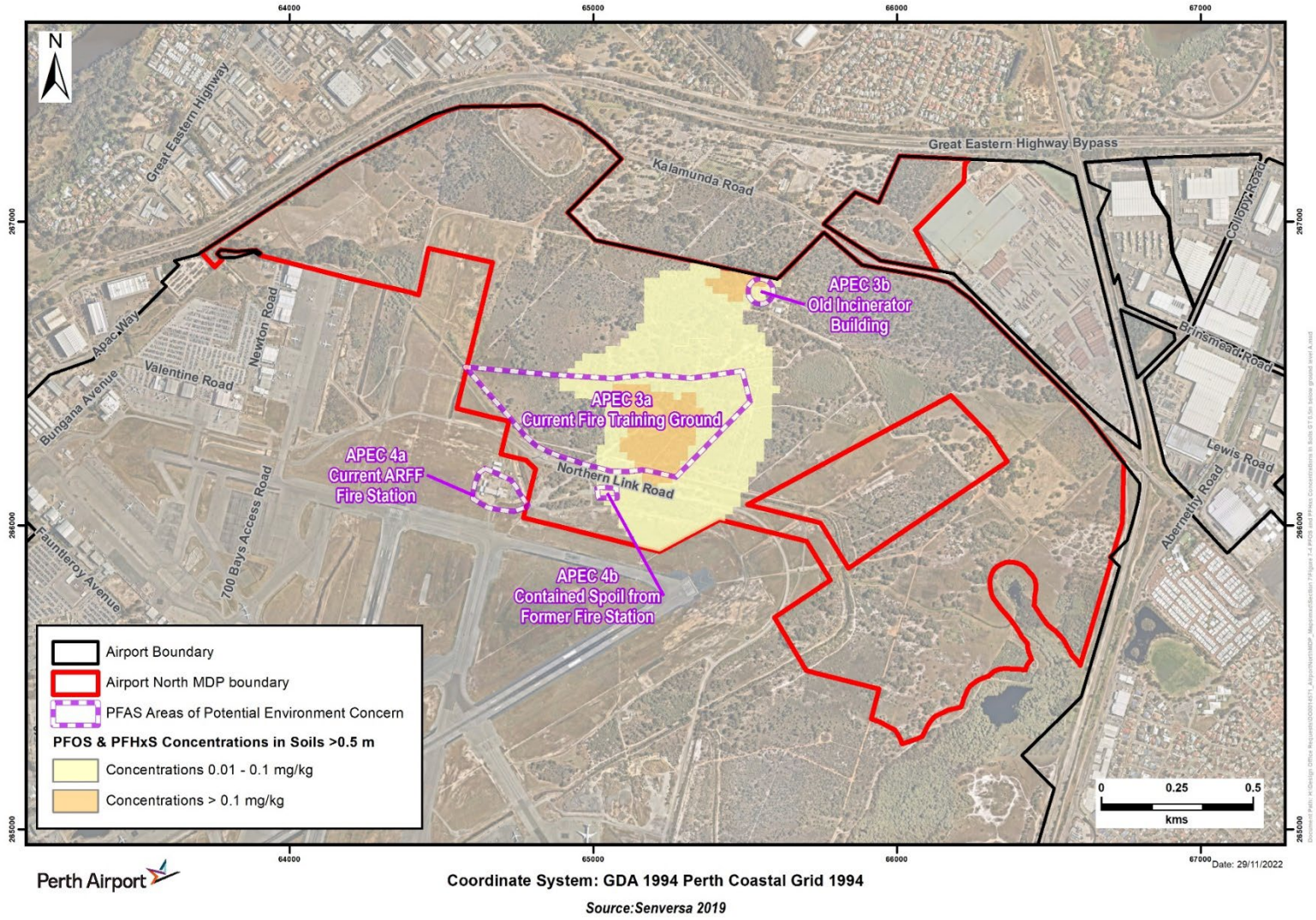


Figure 7-4: PFOS & PFHxS Concentrations in Soils >0.5 m below ground level

7.2.5 Petroleum Hydrocarbons

Operational and decommissioned Underground Storage Tanks (UST) used for the storage of hydrocarbons exist within the airport estate and have the potential to cause contamination. Two such USTs were used within the MDP area.

A UST was located at the terminal approach radar site and was removed in 2011. The other UST is recorded at the old incinerator building, and it is unknown whether this has been removed or only decommissioned. A site inspection undertaken in 2018 and a review of historical aerial photographs, did not show any indication of UST removal related earthworks. Both locations are shown in **Figure 7-2**.

Soil samples taken in the vicinity of the terminal approach radar and the old incinerator building during an investigation in 2017 did not report any Total Recoverable Hydrocarbons (TRH) or Benzene, Toluene, Ethylbenzene or Xylene (BTEX) concentration above the laboratory limit of reporting (LOR). Groundwater samples collected in these areas, including immediately down hydraulic gradient of the terminal approach radar and old incinerator building, did not detect any concentrations of TRH or BTEX above the laboratory LOR.

Based on the results of the historical investigations, any residual contamination impacts associated with the former USTs are not likely to be significant, as such these impacts have not been assessed further in this MDP.

7.2.6 Asbestos Containing Material

During an investigation in 2017, fragments of Potentially Asbestos Containing Material (PACM) were identified in the surface soils surrounding the former WWII barracks (Allawah Grove) and the former old farmhouse/shed, see **Figure 7-2**. The asbestos was observed to be non-friable and attributed to building materials from former structures. The investigation concluded that the asbestos fragments may pose a risk to future construction workers and ultimate land users within the developed MDP area.

7.2.7 Metals

A shotgun range was formerly located within the western portion of the MDP area. The possible presence of lead in the soil means this location has the potential to be a contaminated site. A Detailed Site Investigation (DSI) of this location was conducted in 2021 to determine the contamination status of the soils, and the corresponding management or remediation requirements (Western Environmental, 2021).

One exceedance of lead in soil sampling was noted, reporting a concentration of 480 mg/kg, slightly exceeding the adopted ecological assessment criteria for areas of ecological significance (470 mg/kg). The sediment and surface water sampling program was undertaken to assess the potential for contaminants associated with on-site run-off to accumulate within the NMD. No exceedances of heavy metals were reported in sediments, however minor exceedances of copper and zinc were reported in surface waters.

The groundwater sampling indicated minor exceedances of copper, lead and zinc concentrations above the adopted guidelines (ANZG 90% species protection in freshwater and Airport Regulation accepted levels for water pollution in freshwater), and arsenic (Guidelines for Managing Risks in Recreational Water- Health) in sampled on and off-site groundwater wells.

Based on the results of the soil, sediment, surface water and groundwater investigation, a revision of the risks associated with COPCs has been undertaken for the Site, which identified that a low risk of harm to human health and the environment is generally present in association with on-site sources (i.e., relating to the former shooting range) (Western Environmental, 2021).

Whilst exceedances of metals were observed in surface waters and groundwater beneath the Site, it is concluded that the elevated concentrations are likely associated with naturally occurring background concentrations, particularly considering the position of the samples in respect to inferred groundwater flow direction and the location of the NMD in the broader context of the Perth Airport precinct (Western Environmental, 2021).

7.2.8 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils containing iron sulfide minerals (notably pyrite) formed under saturated anoxic conditions. In an undisturbed state below the water table, these soils are benign and non-acidic and are not considered as contamination; they are typically referred to as Potential Acid Sulfate Soils (PASS). However, if the soils are exposed to the atmosphere through activities such as drainage excavations or dewatering, the sulfides may react with oxygen to form sulfuric acid; they are typically referred to as Actual Acid Sulfate Soils (AASS).

An assessment of the WA Department of Water and Environmental Regulation's (DWER) ASS mapping indicates that the risk of ASS occurring within the MDP area is predominately 'moderate to low risk', with small areas of 'high to moderate' risk, and other areas identified as 'extremely low probability of occurrence' as shown in **Figure 7-5**.

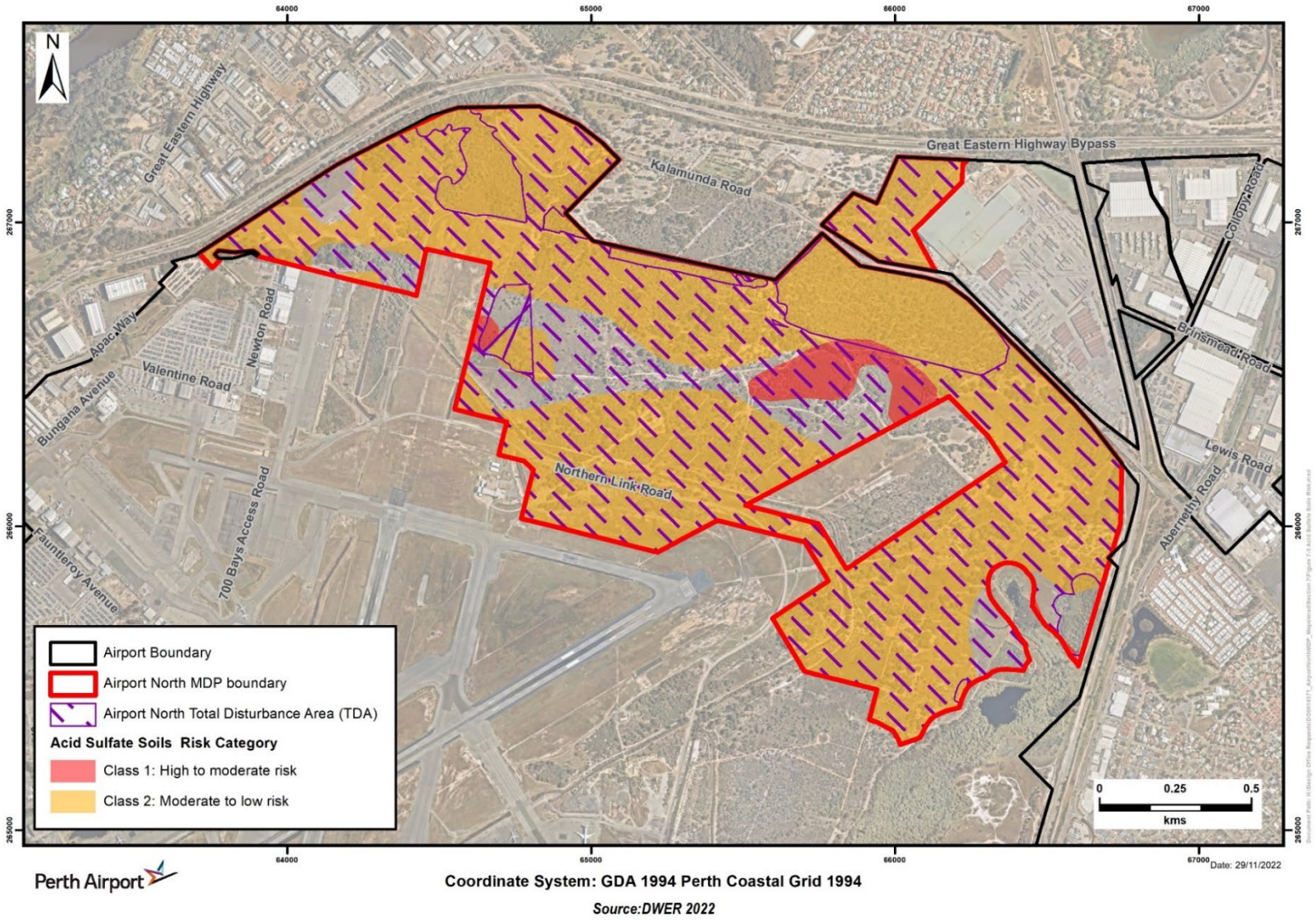


Figure 7-5: Acid Sulfate Soils Risk

Perth Airport

7.3 Impact Assessment – PFAS, Asbestos and Metals

Based on the current understanding of the contamination status of the project area PFAS, asbestos and metals are considered to be Contaminates of Potential Concern (COPC). Historical investigations do not indicate that hydrocarbons are a COPC within the MDP area.

7.3.1 Overview of PFAS Impacts

PFAS impacts in soil and groundwater are predominately located around the fire training ground and the old incinerator building and are at levels that require assessment in this MDP.

Complex interactions occur between the groundwater and surface water within the existing drainage network within the MDP area, which are influenced by rainfall events and seasonal variations. PFAS contaminated groundwater is known to discharge to the surface water drains within the MDP area. The NMD is known to convey the PFAS contamination to surface water bodies and additional ecological and human health receptors outside of the airport estate, including the Swan River. Perth Airport conducts a PFAS treatment program at the NMD prior to discharge from the airport estate. As illustrated in **Figure 7-4**, PFAS contaminated groundwater is migrating from the fire training area southwards, and potentially discharging into the NMD. Once in the drain, the PFAS concentrations in the groundwater are likely to be significantly diluted by the surface water, with historical monitoring results recording much lower concentrations.

7.3.2 Soils

7.3.2.1.1 Human Health Criteria

One soil sample collected during the Senversa (2019) investigation found PFOS concentrations exceeding the human health criteria for commercial/industrial land use at the fire training ground, indicating that soil at this location could potentially pose a risk to users via direct contact. The exceedance of this criteria was only reported at one location, implying that the impact is localised and not widespread.

7.3.2.1.2 Public Open Space Criteria

Although the PFAS concentrations exceed the public open space criteria, most of the contaminated area will be developed with commercial/industrial land uses where contact with existing soils will be negligible, so limiting any potential impact.

Bushland will be retained within the northern portion of the MDP area, which could be utilised by the public; and the PFAS concentrations are below the public open space criteria in these areas.

7.3.2.1.3 Ecological Guideline Values

PFAS concentrations exceed the ecological guideline values for direct and/or indirect exposure. However, the PFAS contamination is not widespread and generally limited to areas proposed for the construction of commercial/industrial land uses where the ultimate ecological value is likely to be minimal.

The historical investigations also found that the PFAS contaminated soil has given rise to elevated PFAS concentrations in generated leachate. The leachate generated from the soil samples produced concentrations that exceeded the ecological screening criteria for 95% species protection and the recreational use criteria, which indicates that ongoing leachate generation may pose a risk to ecological and human receptors at the point of discharge/exposure.

PFAS leachate generated from soils within the MDP area may provide a long-term ongoing source of groundwater contamination, even though the leachate concentrations are less than those reported in the groundwater.

The proposed MDP area land uses, hardstand areas, and the underground piping of stormwater, will minimise surface water infiltration, which will significantly reduce the leaching of PFAS from impacted soils to underlying groundwater and subsequent receptors. As such, the proposed development is likely to be beneficial in mitigating future exposure and mobilisation of PFAS, though the potential for future contamination remains.

7.3.3 Groundwater

7.3.3.1.1 Recreational Use and Ecological Freshwater Criteria

PFAS concentrations exceeded the recreational use criteria and/or the ecological freshwater (and marine water) assessment criteria in most of the groundwater samples. The human health recreational water use criteria were also exceeded in half of the groundwater samples.

7.3.3.1.2 Freshwater and Marine Water Guideline Values for 95% Species Protection

PFAS concentrations exceed the freshwater and marine water guideline values for 95% species protection, indicating that PFAS concentrations in groundwater may pose an unacceptable risk to ecological receptors where groundwater discharges to surface water bodies.

7.3.3.1.3 Ecological Assessment Criteria

PFAS concentrations in groundwater exceed ecological assessment criteria.

7.3.4 Overview of Asbestos Impacts

Asbestos fragments may release fibres and pose a risk to human health if disturbed and damaged during construction. An asbestos 'emu pick' of the asbestos contaminated area has been completed for the western portion of the MDP area and a further 'emu pick' will be completed before the commencement of construction/ground disturbance works for all relevant areas to remove all identifiable surficial asbestos fragments. The CEMP prepared for the MDP area will include measures to manage any asbestos fragments identified during the construction works that were invertedly not removed during the 'emu pick'.

7.3.5 Overview of Metals Impacts

Given the absence of widespread elevated lead concentrations in soils, the assessed risk of metal contamination at the Site associated with former shooting range is considered to be low. Based on the results of the soil, sediment, surface water and groundwater investigation, a low risk of harm to human health and the environment is generally present in association with o-site sources (i.e., relating to the former shooting range) (Western Environmental, 2021).

It is considered concentrations reported in sediment and surface waters within the NMD have not been impacted by historical on-site sources associated with the former shooting range.

7.3.6 Impacts and Associated Avoidance/Mitigation Measures

Table 7-7 provides a summary of potential direct from PFAS, Asbestos and Metals from the Airport North development and associated avoidance and mitigation measures. Management measures for water extraction and reinjection, as well as soil handling and placement will not lead to an unacceptable or increased risk to human health and/or the environment at the project site.

7.3.7 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Table 7-7 provides a summary of indirect and potential offsite impacts from PFAS, Asbestos and Metals from the Airport North development and associated avoidance and mitigation measures. The measures listed will be employed to address the significant indirect and offsite impacts.

Table 7-6 Summary of potential impacts from Contaminated Land and proposed mitigation measures

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE / MITIGATION MEASURE	SIGNIFICANCE
Direct	Exposure to PFAS contaminated soil.	Construction personnel may come into contact with PFAS contaminated soils during construction works. However, PFAS concentrations are below the human health screening criteria indicating that PFAS concentrations at the site do not pose a risk to human health.	A CEMP will be developed for assessing and managing contamination of soil and water during the project construction phase. The CEMP will address historical sources of contamination, and spills or releases from construction activities. The CEMP will be consistent with the ASC NEPM (1999, as amended May 2013), and the PFAS National Management Plan (HEPA, 2020). The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.. A project specific PFAS Management Plan will be prepared, inclusive of a conceptual site model, and all relevant controls adhered to ensure risks are as low as practically possible. The PFAS Management Plan will be approved by Perth Airport following review by the DITRCDA AEO. Any soils to be excavated and removed from PFAS impacted areas will undergo appropriate testing to ensure suitable re-use or off-site disposal.	Minor
Direct	Exposure of ecological receptors to PFAS contaminated soils.	Development of the site may expose soils to ecological receptors (flora and fauna). However, the proximity of potential ecological receptors will increase from known PFAS areas. Furthermore, PFAS concentrations are below the direct exposure pathway.	Further PFAS assessments may be required in areas designated for woodland and wetland retention, to assess risks to future site users. The majority of retention areas have been located away from identified APECs. A CEMP will be developed for assessing and managing contamination of soil and water during the project construction phase. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO..	Minor

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE / MITIGATION MEASURE	SIGNIFICANCE
			A project specific PFAS Management Plan will be prepared, inclusive of a conceptual site model, and all relevant controls adhered to ensure risks are as low as practically possible. The PFAS Management Plan will be approved by Perth Airport following review by the DITRCDA AEO. Any soils to be excavated and removed from PFAS impacted areas will undergo appropriate testing to ensure suitable re-use or off-site disposal.	
Direct	Exposure of site workers to PFAS contaminated groundwater through abstraction or intrusive works.	Groundwater may be abstracted during development or intercepted during excavational work. Small pockets of PFAS concentrations in groundwater are identified that exceed human health screening criteria indicating that groundwater may pose a risk to site workers.	A CEMP will be developed for assessing and managing contamination of soil and water during the project construction phase. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.. A project specific PFAS Management Plan will be prepared, inclusive of a conceptual site model, and all relevant controls adhered to ensure risks are as low as practically possible. The PFAS Management Plan will be approved by Perth Airport following review by the DITRCDA AEO. The ASSMP and Dewatering Management Plans will detail required management measures for the handling of abstracted PFAS contaminated groundwater. Any dewatering effluent will be managed in accordance with the ASS and Dewatering Management Plans. The ASS and Dewatering Management Plan will be approved by Perth Airport following review by the DITRCDA AEO. PFAS groundwater monitoring will be conducted during construction and dewatering, to ensure that operations do not cause an increase in PFAS concentrations compared to historical concentrations. Construction monitoring data will inform updates to the estate	Moderate

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE / MITIGATION MEASURE	SIGNIFICANCE
			Water Monitoring Program once construction is complete.	
Direct	Exposure of ecological receptors to PFAS contaminated groundwater through abstraction or intrusive works.	Groundwater may be abstracted during development or intercepted during excavational work. PFAS concentrations in groundwater exceed ecological assessment criteria. NMD improvement works/conversion to Living Stream may intersect with the groundwater plume allowing ingress of PFAS contaminated groundwater into the surface water drain.	A CEMP will be developed for assessing and managing contamination of soil and water during the project construction phase. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.. A project specific PFAS Management Plan will be prepared, inclusive of a conceptual site model, and all relevant controls adhered to. The PFAS Management Plan will be approved by Perth Airport following review by the DITRCDA AEO. Preparation of an Acid Sulfate Soils and Dewatering Management Plan will be considered for the MDP area detailing any required management measures for the handling of abstracted PFAS contaminated groundwater. Any dewatering effluent will be reinjected/reinfiltrated into the aquifer from which it was abstracted to prevent spreading any potential impacts in accordance with the ASS and Dewatering Management Plan. PFAS groundwater monitoring will be conducted during construction, with additional monitoring during dewatering, to ensure that operations are not causing an increase in PFAS concentrations compared to historical concentrations. The NMD will be converted to an enclosed 225impermeable culvert where it intersects the PFAS contaminated soil and groundwater plume. The culvert structure will minimise the ingress of PFAS contaminated groundwater discharged and is expected to reduce the mass of PFAS being transported offsite from the airport estate. As there is currently no control on this groundwater ingress into the open drain, this measure will deliver a significant improvement on	Moderate

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE / MITIGATION MEASURE	SIGNIFICANCE
			the existing situation and potentially mitigate the on and offsite impacts resulting from the continued migration of the plume (noting current PFAS treatment program in place). There is the potential that the culvert structure could act as a conduit for PFAS movement, and this will be investigated further in the detailed design to ensure measures are implemented to minimise mobilisation of PFAS. Monitoring data will inform updates to the Estate Water Monitoring Program once construction is complete.	
Direct	Exposure to PFAS contaminated surface water.	Construction personnel may come into contact with surface water at the site including during drain realignment works. PFAS concentrations in surface water could exceed the human health screening criteria indicating that surface may pose a risk to human health. However this is considered unlikely as PFAS concentrations are below the human health screening criteria indicating that PFAS concentrations at the site do not pose a risk to human health.	A CEMP will be developed for assessing and managing contamination of soil and water during the project construction phase. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.. A project specific PFAS Management Plan will be prepared, inclusive of a conceptual site model, and all relevant controls adhered to.	Moderate Minor?
Direct	Human exposure to asbestos and potentially metal contaminated soil	Construction personnel may encounter asbestos or metal contaminated soil at the site during earthworks and construction.	An 'emu pick' (to supplement the one already undertaken) will be completed in areas identified as containing asbestos before any ground disturbance, to remove all visible surficial asbestos fragment. Subsurface and stockpiled fill material at the Site will be assessed further to determine if there are any risks posed by potential contaminants in the material including but not limited to metals.	Minor

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE / MITIGATION MEASURE	SIGNIFICANCE
			The CEMP will include measures to manage any asbestos fragments identified during construction. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO..	
Direct	Exposure of ecological receptors to metal contaminated soils or waters.	Development of the site may expose metal contaminated soils to ecological receptors (flora and fauna). However, the proximity of potential ecological receptors to known metal contaminated areas will increase with implementation of the MDP and the likely risk is therefore considered low	A CEMP will be developed for assessing and managing contamination of soil and water during the project construction phase. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.. Subsurface and stockpiled fill material at the Site will be assessed further to determine if there are any risks posed by potential contaminants in material planned for beneficial reuse on the site including but not limited to metals.	Minor
Direct	Contamination spills.	Storage and use of fuels, oils etc is possible during development. Any spills/releases to soil, surface water and/or groundwater may potentially impact human and ecological receptors. Spills are likely to be localized.	Spill management procedures will be detailed within the CEMP. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.. All spills to be managed through CCCC process.	Minor
Indirect	Surface water discharge/surface water run-off of PFAS impacted groundwater.	The potential exists for modifications to the surface water network during development. Poor handling of surface water could result in discharge of PFAS water to off-site human and ecological receptors.	A CEMP will be developed for assessing and managing contamination of soil and water during the project construction phase. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO.. A project specific PFAS Management Plan will be prepared, inclusive of a conceptual site model, and all relevant controls adhered to ensure risks are as low as practically possible. The PFAS	Moderate

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE / MITIGATION MEASURE	SIGNIFICANCE
			Management Plan will be approved by Perth Airport following review by the DITRCDA AEO. Contaminant concentrations (including PFAS) in groundwater and surface water will be monitored throughout construction in accordance with the ASS and Dewatering Management Plans. The treatment of surface water from the NMD will continue during construction to ensure the migration of PFAS contaminated surface water to offsite areas is controlled (for flows up to 20 L/sec).	
Indirect	Exposure of off-site human receptors to PFAS contaminated groundwater through groundwater abstraction or intrusive works.	PFAS impacted groundwater may migrate off-site which could pose a risk to human receptors via groundwater abstraction or interception of groundwater in excavations. Construction works have the potential to disturb PFAS impacted soil and groundwater, potentially increasing the PFAS concentrations in groundwater migrating off-site.	A project specific PFAS Management Plan will be prepared, inclusive of a conceptual site model, and all relevant controls adhered to ensure risks are as low as practically possible. The PFAS Management Plan will be approved by Perth Airport following review by the DITRCDA AEO. Management measures for water extraction, handling and placement and soil placement will not lead to an unacceptable or increased risk to human health and/or the environment at the project site of off-site. Consideration will be given to PFAS ground and surface water monitoring during construction, including additional monitoring during dewatering, to compare concentrations during construction operations to historical concentrations.	Moderate
Indirect	Generation of dust and migration to off-site human and ecological receptors.	The clearing of vegetation and traffic movement across the site has the potential to generate dust which may mobilise to off-site areas. PFAS concentrations in dust exceed the residential levels of garden/accessible soil. However, the nearest resident properties are 150m beyond the Dundas	Dust Management measures to be included in the CEMP ie; dust suppression, staging the clearance of vegetation cover and avoiding earthworks during unfavourable weather conditions. The CEMP will be approved by Perth Airport following review by the DITRCDA AEO..	Minor

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE / MITIGATION MEASURE	SIGNIFICANCE
		Road, noting Dundas Road is approximately 800m east from the MDP boundary.		

7.3.8 Significance of Residual Impacts

Residual impacts in soil, groundwater and surface water will be managed in accordance with the CEMP for the construction works. The CEMP will include target criteria, along with contingency measures to be implemented if the MDP area derived trigger levels are exceeded. Periodic groundwater and surface water monitoring will be undertaken, and soil material movements will be tracked and monitored, to demonstrate that construction works are not causing an unacceptable increase in contamination risk or an increase in offsite release. Adherence to the CEMP will remove the potential for any significant residual construction impacts.

The placing of the section of the realigned NMD within a culvert (subject to further design) where it passes through the higher concentrations of PFAS contaminated soil and ground water plume, together with adherence to a site specific PFAS Management Plan are aimed at mitigating the potential for any significant adverse residual impacts during the post construction period. The culverting of the drain is likely to reduce the existing levels of PFAS being transported from groundwater to surface water, then offsite; hence, this measure will give rise to a significant beneficial residual impact following implementation of the project.

7.3.9 Cumulative Impacts

No significant cumulative impacts have been identified.

7.3.10 Anticipated Outcome

The identification of significant areas of PFAS contamination within the MDP area is the primary outcome of this assessment. The concept for the MDP area has considered potential PFAS contamination impacts through, for example, the placement of a section of the NMD in a culvert . These measures, together with the adherence to a CEMP and a PFAS Management Plan during construction work, result in there being no predicted significant adverse residual contamination impacts, and one significant beneficial residual impact, resulting from implementation of the proposed MDP works.

7.4 Impact Assessment – Acid Sulfate Soils

7.4.1 Overview of Impacts

Publicly available WA Government information indicates a 'moderate to low' probability of ASS occurrence across the majority of the MDP area, with small areas of 'high to moderate' probability of ASS occurrence.

Impacts associated with ASS are only likely to occur during excavation or dewatering activities, which expose PASS to oxygen. Once the areas of proposed excavation and dewatering requirements are defined, additional investigations will be undertaken to confirm the location of specific ASS risk. Any additional investigations will be undertaken in accordance with the DWER guidance document: *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (2015).

The DWER Interim Guideline on the Assessment and Management of PFAS (DER 2017) advises that:

"With respect to partitioning relationships between soil, sediment and water, leaching is highest around neutral pH and decreases in more acidic and alkaline conditions".

As such, the potential generation of any acidic conditions during the disturbance of acid sulfate soils is unlikely to increase the mobility of any present PFAS.

Table 7-8 provides a summary of the potential direct and indirect impacts and the proposed avoidance/mitigation measures.

Table 7-7 Summary of potential impacts from Acid Sulfate Soils and proposed mitigation measures

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE/ MITIGATION MEASURE	SIGNIFICANCE
Direct	Excavation activities exposing PASS to oxygen.	Impacts associated with ASS are only likely to occur during excavation or dewatering activities which expose PASS to oxygen. Once the areas of proposed excavation dewatering requirements are defined, additional investigations will be undertaken to confirm the location of specific ASS risk within the project area. The findings of this investigation will enable Perth Airport to further identify potential impacts associated with the Project and appropriate ASS management measures.	Additional investigations will be undertaken to confirm the location of specific ASS risk within the project area. Development of ASSMP and Dewatering Management Plans for the site in accordance with Water Quality Australia's National Acid Sulfate Soils Guidance. Management Plans approved by Perth Airport following review by DITRDCA AEO.	Minor
Direct	Dewatering activities exposing PASS to oxygen.	Impacts associated with ASS are only likely to occur during excavation or dewatering activities which expose PASS to oxygen. Once the areas of proposed excavation dewatering requirements are defined, additional investigations will be undertaken to confirm the location of specific ASS risk within the project area. The findings of this investigation will enable Perth Airport to further identify potential impacts associated with the Project and appropriate ASS management measures.	Additional investigations will be undertaken to confirm the location of specific ASS risk within the project area. Development of ASSMP and Dewatering Management Plans for the site. Management Plans approved by Perth Airport following review by DITRDCA AEO.	Minor
Direct	Disturbance of ASS resulting in the spread of existing PFAS.	The generation of acidic conditions during the disturbance of ASS is unlikely to increase the mobility of PFAS, if present. Therefore, the PFAS mobilisation risk as a result of ASS generation are considered to be low.	Development of ASSMP and Dewatering Management Plans for the site with consideration of potential PFAS interaction and risk. Management Plans approved by Perth Airport following review by DITRDCA AEO.	Minor
Direct	Exposed ASS contaminating	Impacts associated with ASS are only likely to occur during excavation or dewatering activities which expose PASS to oxygen.	Additional investigations will be undertaken to confirm the location of specific ASS risk within the project area.	Minor

IMPACT TYPE	IMPACTING PROCESS	DISCUSSION	PROPOSED AVOIDANCE/ MITIGATION MEASURE	SIGNIFICANCE
	surface and/or groundwater	Once the areas of proposed excavation dewatering requirements are defined, additional investigations will be undertaken to confirm the location of specific ASS risk within the project area. The findings of this investigation will enable Perth Airport to further identify potential impacts associated with the Project and appropriate ASS management measures.	Development of ASS and Dewatering Management Plans for the site. Management Plans approved by Perth Airport following review by DITRDCA AEO.	
Direct	Exposure of ecological receptors to ASS contaminated soils	Development of the site may expose soils to ecological receptors (flora and fauna). However, the proximity of potential ecological receptors will increase with implementation of the MDP and the likely risk is therefore considered low	Development of ASSMP and Dewatering Management Plan for the site. Management Plans approved by Perth Airport following review by DITRDCA AEO.	Minor
Indirect	Surface water discharge/surface water run-off of ASS impacted water	The potential exists for groundwater abstraction and modifications to the surface water network during development. Poor handling of ASS impacted material interaction with groundwater or surface water could result in discharge of ASS impacted water to off-site receptors.	Groundwater and surface water monitoring during construction. Triggers developed to ensure there are no unacceptable increase in contamination risk, no increase in off-site release risk, and no increase in risk to groundwater and surface water. Development of ASSMP and Dewatering Management Plans for the site. Management Plans approved by Perth Airport following reviewed by DITRDCA AEO.	Minor

7.4.2 Significance of Residual Impacts

ASS will be managed during construction works and dewatering activities through the ASSMP and Dewatering Management Plan. Regular monitoring of groundwater quality and surface water quality will be undertaken to demonstrate the ASS is being managed appropriately during the works. Contingency measures will be included in the ASS and Dewatering Management Plan (ASSDMP) and implemented where impacts are detected during periodic monitoring.

The management of any ASS risks will be in accordance with the management plan to minimising any increase in contamination risk, offsite release risk, and risk to groundwater and surface water. The generation of any residual impacts are likely to be minimal with the management measures in place, and likely to be quickly and effectively mitigated through proposed contingency measures.

Adherence to the ASSDMP will remove the potential for any significant residual impacts.

7.4.3 Cumulative Impacts

No significant cumulative impacts have been identified.

7.4.4 Anticipated Outcome

The risk of disturbing any PASS across the majority of the MDP area is “low to moderate”. In the unlikely event that any AASS is generated, it will be suitably managed through the measures to be detailed in an ASSDMP, such that there will be no significant residual impacts.

7.5 Summary of Outcomes

The risk of disturbing any PASS across the majority of the MDP is “low to moderate”.

If any ASS Soil is generated, it will be suitably managed through an ASSDMP, such that there will be no significant residual impacts resulting from implementation of the proposed MDP works.

8 Noise, Vibration and Air Quality

8.1 Legislative and Policy Context

Air and noise emissions and vibration are regulated by the *Airports (Environment Protection) Regulations 1997* (AEPR). The APER includes specific limits for certain activities at certain times of the day. They also provide other more general principles to avoid pollution and offensive noise that intrudes on individual, community or commercial amenity.

Regulation 4.01 of the AEPR requires airports to take all reasonable and practicable steps to avoid and/or minimise offensive pollution. This includes construction dust, noise and vibration.

The AEPR states that noise generated from construction, maintenance, or demolition of a building or other structure at an airport should not exceed 75 dBA $L_{10,15min}$ at the site of a sensitive receptor. Sensitive receptor is defined under Regulation 2.04 of the AEPR and means:

- a dwelling
- an impermanent dwelling in a place designed, or reserved, for impermanent dwellings (for example, a caravan park or residential marina)
- a hotel, motel or hostel
- a childcare institution, kindergarten, school, college, university or other educational institution
- a hospital, medical centre or nursing home
- a building that is a church or similar place of worship

The AEPR does not specify construction noise or vibration limits at the site of a commercial receptor. Noise and vibration impacts to commercial receptors are managed under the AEPR's general duty on airports to take all reasonable and practicable steps to avoid and/or minimise offensive pollution (Regulation 4.01 of AEPR).

8.2 Methodology

This section provides a qualitative assessment of potential impacts of construction dust, noise and vibration levels on sensitive receptors and commercial receptors (as defined under the AEPR).

8.3 Existing Environment

The Airport North MDP is located within the northernmost part of the airport estate, abutting the Great Eastern Highway Bypass in the north-west, Kalamunda road to the north-east and the freight railway line and Abernethy road to the east. Therefore, the existing noise environment within the MDP area is dominated by road and rail noise, in addition to noise related to the operation of the airport, e.g. aircraft take-offs and landings. There are no significant sources of dust within the immediate vicinity of the MDP area.

There are sensitive receptors to the west, north and east of the MDP area. In addition, Allawah Grove and Munday Swamp are also considered to be sensitive receptors due to their Aboriginal cultural heritage associations, and likewise Guildford Cemetery and potentially Allawah Grove for their European heritage associations.

8.4 Impact Assessment – Noise and Vibration

This section describes the noise and vibration impacts arising from construction activities within the MDP area on nearby sensitive and commercial receptors.

Noise generated from operations within the MDP area have been addressed in Part A of this MDP, along with ambient, or background noise and vibration levels.

Vibration from construction equipment is not expected to result in any impact to sensitive receptors. Vibration is most often assessed against the German Standard DIN 4150-3: 1999 which notes conservative frequency dependent values for peak particle velocity (mm/s) to determine limits for vibration that may be considered to cause damage to structures. Limits proposed are 5mm/s for standard dwellings and buildings and 3mm/s for vibration sensitive buildings, such as heritage buildings. Vibration from construction equipment will typically dissipate quickly, generally being within acceptable limits within 10-20m from the source. As major roads, which are a source of vibration, separate the nearest housing sensitive receptors from the proposed construction works, it is not anticipated that any construction related vibration be will discernible above baseline levels. Hence, vibration impacts on s housing sensitive receptors will be not significant.

8.4.1 Direct Impacts and Associated Avoidance/Mitigation Measures

Noise from construction plant and equipment dissipates with distance from the source, and it is expected that construction noise at the MDP area boundary would typically be within acceptable limits for normal working hours.

A range of measures for further reducing the impact of construction noise and vibration will be considered in the CEMP and implemented where reasonable and practicable, including:

- Limiting construction hours, having regard to the day of the week, work locations and distance to sensitive and commercial receptors.
- Specific noise management plans developed for any out of hours construction works, i.e. night works (7pm-7am), Sundays and/or Public Holidays,
- Best practice noise and vibration levels for equipment, including use of noise-compliant equipment, periodic compliance audit of equipment, use of broadband reverse alarms or quackers instead of reversing beepers etc.
- Noise and vibration monitoring and reporting, where required for works in close proximity to sensitive receptors.
- Regular communication with potentially affected businesses.
- Complaints management and response.

8.4.2 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Any construction noise leaving the MDP area boundary is unlikely to exceed existing noise from aircraft operating at the airport, and traffic on the local road network; therefore, any off-site noise impacts from construction works are not anticipated to be significant.

8.4.3 Cumulative Impacts

None anticipated.

8.4.4 Significance of Residual Impacts

None anticipated.

8.4.5 Anticipated Outcome

No change in the existing noise and vibration levels anticipated.

8.5 Impact Assessment – Air Quality

8.5.1 Overview of Impact

This section describes the impact of dust arising from construction activities in the MDP area on the sensitive receptors identified in Section 8.3.

Construction activities identified as those likely to generate the most significant amount of dust emissions during construction are as follows:

- Clearing and grubbing works.
- Scrapers removing topsoil.
- Excavation, movement and transportation of soil.
- Large trucks and other vehicles using unpaved roads.
- Wind erosion from exposed areas.
- Grading of temporary unsealed roads.

8.5.2 Direct Impacts and Associated Avoidance/Mitigation Measures

Based on studies and modelling previously completed for the New Runway Project, there is limited potential for sensitive receptors to be impacted by dust but there is potential for Perth Airport operations and industrial users on the estate to be impacted.

The dominant prevailing wind direction comes from the southwest, meaning that the wind will generally take any dust from construction works to the northeast of the MDP area. South westerly winds will largely transport any fugitive dust away from existing Perth Airport terminals, taxiways and runways.

Potential dust emissions during construction will be closely managed to ensure impact to sensitive receivers is mitigated. A CEMP will include standard measures for the management of dust during construction, including regular watering where required. Potential mitigation measures to reduce construction dust impacts include:

- Water carts/spraying on exposed soil, site roads and stockpiles.
- Use of dust suppressants for areas of site and/ or stockpiles that will not be disturbed for considerable periods.
- Wind breaks on stockpiles and exposed areas.
- Control of stockpiles including placement away from sensitive receptors, limiting height or total enclosure where possible.
- Restricting the movement of vehicles and plant on site to defined site roads.
- Maintaining a low speed limit on site roads to limit the production of dust.
- Install wheel wash stations at site exit points to public roads.
- Periodic use of street sweepers to clear dirt tracked from site onto public roads.

The implementation of these management measures will limit the potential for sensitive receptors to be impacted.

8.5.3 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

Winds from the west, south and east present the potential for transporting fugitive dust and emissions from the MDP construction site to external sensitive receptors. The adoption of the CEMP measures listed in Section 8.5.2, are anticipated to mitigate any dust impacts such that they are not significant.

8.5.4 Cumulative Impacts

None anticipated

8.5.5 Significance of Residual Impacts

With mitigation measures to be detailed in the CEMP implemented, it is expected that any impacts to sensitive receptors will not be significant.

8.5.6 Anticipated Outcome

No change in existing air quality anticipated.

8.6 Summary of Outcomes

No significant noise, vibration or air quality impacts are anticipated during the construction of the proposed MDP works.

9 Heritage

9.1 Legislative and Policy Context

Impacts on Aboriginal and European heritage within the MDP area are considered against the following Commonwealth and State legislation and policy:

Commonwealth

- *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act)
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (ATSIHP Act)
- *Airports Act 1996*
- The Burra Charter (Australian International Council on Monuments and Sites 2013)

State

- *Aboriginal Cultural Heritage Act 2021* (ACH Act)
- *Aboriginal Heritage Act 1972* (AH Act)
- *Heritage Act 2018* (Heritage Act)

9.1.1 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The EPBC Act establishes a National Heritage List of natural, historic and Indigenous places of outstanding heritage value and a Commonwealth Heritage List of natural, Indigenous and historic heritage places on Commonwealth lands and waters or under Australian Government control. The EPBC Act establishes additional protections of listed places by the requirement of management plans to ensure conservation of heritage values.

To be listed on the National Heritage List, a place must have 'outstanding' heritage values that are valuable to the Australian Community. The Commonwealth Heritage List requires 'significant' heritage values. The EPBC Act also establishes the Australian Heritage Council, to assess nominated places and advise the Minister.

For context, there are currently:

- Six Nominated Places and sixteen Listed Places on the National Heritage List in Western Australia.
- Sixteen Indicative Places and nineteen Listed Places on the Commonwealth heritage List in Western Australia. Most of the Listed Places on the Commonwealth List are defence related sites or Post Offices

In addition, the EPBC Act protects heritage on Commonwealth land and from actions undertaken by the Commonwealth. This heritage assessment therefore follows the requirements of Guidelines 1.2.

9.1.2 Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) (the ATSIHP Act) generally applies where State or Territory laws and processes prove ineffective. Under the ATSIHP Act, the responsible Minister can make temporary or long-term declarations to protect areas and objects of significance under threat of injury or desecration. The ATSIHP Act also encourages heritage protection through mediated negotiation and agreement between land users, developers and Aboriginal and Torres Strait Islander peoples.

9.1.3 Heritage Act 2018 (WA)

The *Heritage Act 2018* (WA) (the Heritage Act) provides for and encourages the conservation of places which have significance to cultural heritage in the State. The Heritage Council of Western Australia is the State advisory body on heritage matters and is vested with functions and powers under the Heritage Act. The Heritage Council determines the organisation's strategy, policies and makes key decisions on places to be entered into the State Register of Heritage Places and development referrals.

9.1.4 Aboriginal Cultural Heritage Act 2021 (WA)

The *Aboriginal Cultural Heritage Act 2021* (WA) (the ACH Act) has increased protection of Aboriginal cultural heritage by widening the definition of what is protected, as well as instituting mandatory consultation with Aboriginal people and roles for Aboriginal people in the protection of their own cultural heritage values. The ACH Act defines Aboriginal cultural heritage as both *the tangible and intangible elements that are important to the Aboriginal people of the State, and are recognised through social, spiritual, historical, scientific or aesthetic values as part of Aboriginal tradition*...[including]...*an Aboriginal place*...*an Aboriginal object*...*a cultural landscape*...[and]...*Aboriginal ancestral remains*.

The ACH Act will replace the Section 18 approvals process from July 2023 with a more consultative process that focuses on agreement making and free and informed prior consent. While part of the Act immediately came into effect upon Royal Assent, the current approvals processes, including the Section 18 permit to impact under the AH Act, will remain in effect during the transition period. Perth Airport has elected engage with the Whadjuk Noongar people and proceed with the Aboriginal Cultural Heritage Management Plan (ACHMP) process under the ACH Act.

9.1.5 Aboriginal Heritage Act 1972 (WA)

The AH Act requires consent from the Minister under Section 18 of the Act to impact upon Aboriginal heritage sites and objects. To obtain such a consent, a notice must be submitted to the Aboriginal Cultural Materials Committee (ACMC). This process can only be utilised up until July 2023.

The DPLH has developed the *Aboriginal Heritage Due Diligence Guidelines* (Due Diligence Guidelines) to assist proponents in meeting their statutory obligations under the AH Act. The Due Diligence Guidelines advocates the application of a precautionary approach to the assessment of risk to Aboriginal heritage to ensure all aspects of potential risk are considered and appropriate steps are applied to avoid or minimise damage to Aboriginal sites and objects. Perth Airport has adopted the precautionary approach to the assessment of risk to Aboriginal heritage and, where practical, applies appropriate steps to avoid or minimise damage to heritage.

9.2 Stakeholder Groups

9.2.1 South West Aboriginal Land and Sea Council

The South West Aboriginal Land and Sea Council (SWALSC) are the key native title support provider to the Noongar people, including the Whadjuk Noongar people. As part of the South West Native Title Settlement (the Settlement), the *Native Title Act 1993* (Cth) ceased to apply over the Settlement area (the south-west of WA) and instead the WA government signed six Indigenous Land Use Agreements (ILUAs) in compliance with that Act, recognising the six regional areas of the Noongar Nation. The Perth Airport estate is situated within the Whadjuk ILUA region.

9.2.1.1 Partnership Agreement Group

Perth Airport ensures consultation with Traditional Custodians and Aboriginal knowledge holders is aligned with the Commonwealth Government's Engage Early (DAWE 2016) and Ask First (Australian Heritage Commission 2002) guidelines for best practice Indigenous engagement.

The Partnership Agreement Group (PAG) is a partnership between Perth Airport and seven families who have a longstanding interest in heritage issues in the Perth metropolitan region. The Partnership Agreement was signed in 2009 and recognises the willingness of the signatories, representing Perth Airport, the Traditional Custodians and other Aboriginal Elders, to engage in good faith for the ongoing development of the airport and Aboriginal heritage.

Through the Partnership Agreement, Perth Airport commits to, but is not limited to:

- Identifying and acknowledging all relevant affected Indigenous peoples and communities.
- Committing to early engagement at the pre-referral stage.
- Building trust through early and ongoing communication for the duration of the project, including approvals, implementation and future management.

- Setting appropriate timeframes for consultation.
- Demonstrating cultural awareness.

9.3 Methodology

A desktop review of the project area focused on the identification of any registered or known sites of Aboriginal cultural heritage value and any historical heritage places within the Airport North MDP area and specifically TDA. The desktop research relies largely on:

- Previous archaeological and ethnographic surveys and assessments of the area,
- The AHIS database, maintained by the DPLH,
- The Australian Heritage Database, maintained by DCCEEW, and
- The inHerit portal, maintained by the State Heritage Office, which provides information about heritage places and listings in Western Australia.

Archaeological and ethnographic assessments were also conducted over the Airport North MDP area, to assess the impact of the proposed development to the heritage values, including:

- An Aboriginal Heritage Survey of the Airport North Precinct, including desktop research and both an ethnographic consultation and an archaeological survey in 2019 (Archae~aus and Ethnosciences, 2020).
- A Historical Archaeological Assessment: Portions of the Perth Airport estate, including both desktop and field research (Alliance Archaeology, 2020).
- A Desktop Study and Site Inspection of Previously Recorded Aboriginal Archaeological Sites within the Northern Portion of the Perth Airport estate (GJCRM, 2021).
- A second survey over the Airport North Development area, including sub surface testing; targeted site assessments and mapping and a Heritage Impact Assessment of the Airport North Precinct, Perth Airport was completed late November 2022.

The Archae~aus and Ethnosciences (2019) survey noted that the registered site, Munday Swamp: Poison Gully (DPLH ID3896), was located incorrectly in the DPLH public database; that the DPLH polygon for Allawah Grove (DPLH IS 3771) was incorrect; and recorded four as yet unrecorded potential scatter sites within the Airport North MDP footprint.

The GJCRM (2021) desktop investigation confirmed the incorrect mapping of site DPLH ID 3896 and noted that registered site Munday Swamp (DPLH ID 3933) was also located incorrectly on the DPLH database. Site DPLH ID3933 was later confirmed as one of the four scatter sites recorded in 2019 and the correct location of site DPLH ID 3896 was confirmed during the target site investigation.

Heritage Information Submission (HIS) Forms were submitted to the DPHL in 2021 and the Government database errors outlined above were corrected. The other sites recorded in 2019 are now listed as Other Heritage Places (OHPs) on the DPLH database, with the status as lodged sites.

The results of the 2020 Historical Archaeological Assessment has resulted in a submission of the Allawah Grove site to the Heritage Council for listing under the Heritage Act. This assessment is currently in process by the State Government.

9.4 Existing Environment

9.4.1 Regional Context

Perth Airport is located on the traditional lands of the Whadjuk People, a dialect group of the Noongar Nation. Whadjuk are the Traditional Custodians of the Derbarl Yerrigan (Swan River), its tributaries and surrounding hills, wetlands and floodplain. The Noongar Nation encompassed the entire south-western region of Western Australia and is thought to have encompassed 14 language groups within a large Cultural Block.

The Perth Airport estate contains sites that were utilised as meeting places, campgrounds, hunting areas and Lore grounds. They were created during the *Nyitting*, the Dreaming or creation time, by the *Waakarl* (Rainbow Serpent) and remain important to Whadjuk People and the wider Noongar Community to this day. There are also contemporary sites on the estate; sites that were used as base camps for resistance against colonisation, a government run Aboriginal Reserve and bushcamps. As the Traditional Custodians, the Whadjuk Noongar people maintain a strong interest in the airport estate and its operations.

Post-Colonial occupation of the land within the vicinity of the airport estate dates to the mid-late 1800s and is intrinsically related to the establishment of the Swan River Colony in 1829. The foundation of the Guildford townsite to the north-west of the MDP area occurred within the first years of the colony. It was chosen for its ideal location between the Swan and Helena Rivers and the townsite served as an inland river port and market centre for the surrounding agricultural districts.

9.4.2 Aboriginal Heritage

The AHIS database identifies eight registered and three lodged Aboriginal heritage sites within or immediately adjacent to the MDP area. However, several registered Aboriginal heritage sites have boundaries which DPLH have deliberately made broad and non-specific, to protect the exact location of the heritage values. Three of these sites intersect part of the MDP area but were confirmed not to actually occur within the MDP area (and instead occur in adjacent, nearby areas). These sites include:

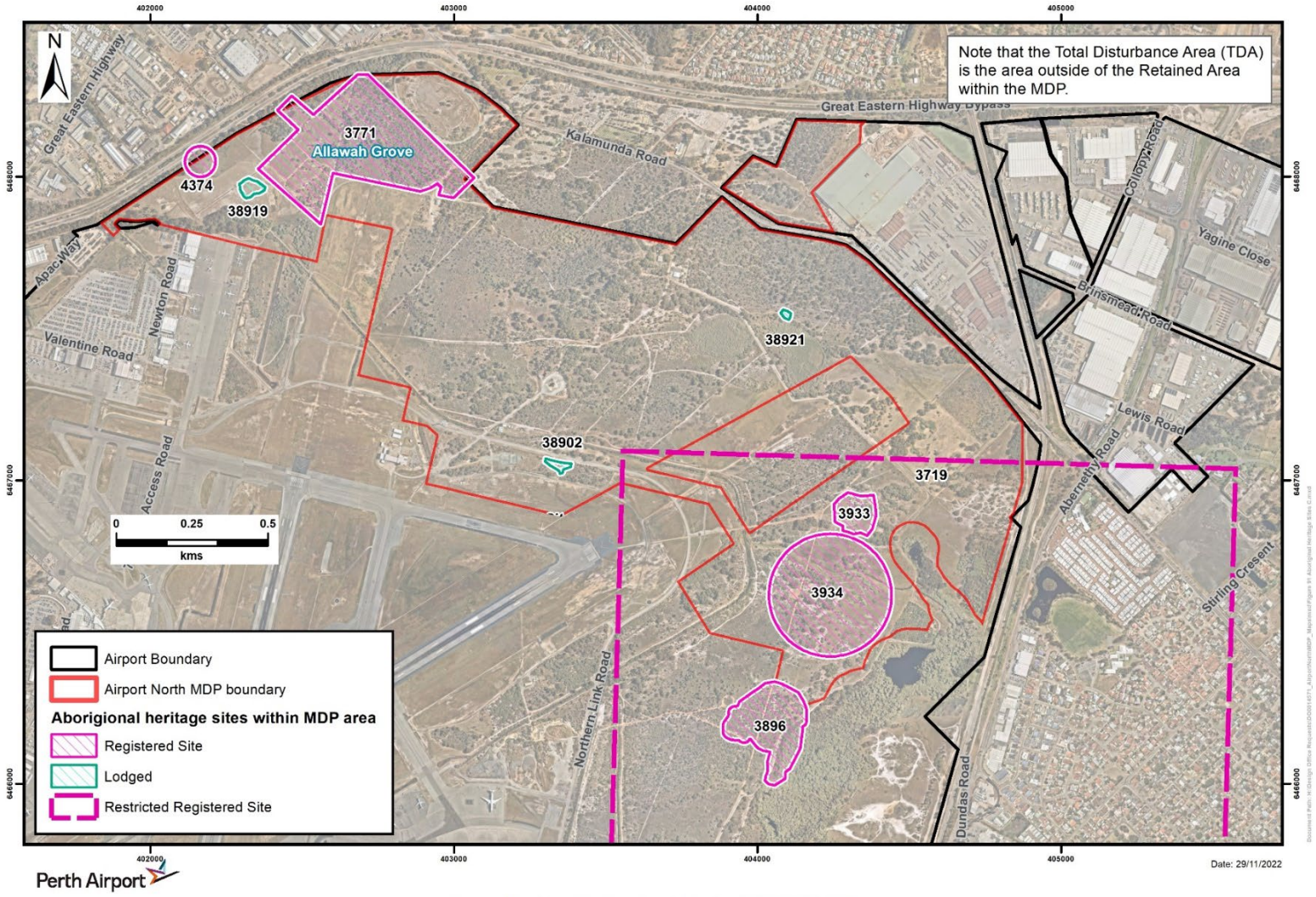
- DPLH 3608 Bridge Camps
- DPLH 3719 Munday Swamp, located directly adjacent to the MDP footprint
- DPLH 25023 Poison Gully Creek

A list of Aboriginal Heritage sites within and immediately adjacent to the Airport North MDP area is provided in Table 9-1 and a map showing sites within the MDP Area is shown in Figure 9-1

Table 9-1 Aboriginal Heritage sites within and immediately adjacent to the Airport North MDP area

Site ID	Site Name	Site Type	Status	Comment
3719	Munday Swamp	Ethnographic	Registered Site	Restricted boundary, site located immediately adjacent to the MPD area
3771	Allawah Grove	Camp	Registered Site	Site boundary has been updated and enlarged significantly based on new heritage information recorded in 2019 and submitted to the DPLH by Perth Airport in 2021.
3896	Munday Swamp: Poison Gully	Artefacts / Scatter	Registered Site	Site located immediately adjacent to the MPD area
3933	Munday Swamp	Artefacts / Scatter	Registered Site	Site boundary and location has been updated based on new heritage information recorded in 2019 and 2021, submitted to the DPLH by Perth Airport in 2021
3934	Munday Swamp	Artefacts /Scatter	Registered Site	Site is likely smaller than the polygon recorded on the DPLH database but the current site boundary likely encompasses the entire site.
4374	Airport: Koojan Avenue	Artefacts / Scatter	Registered Site	Site is likely mapped incorrectly on the DPLH database.
38902	PA19-01	Artefacts /Scatter	OHP: Lodged Site	Site has been submitted to the DPLH for assessment, outcome still pending.
38921	PA19-03	Artefacts /Scatter	OHP: Lodged Site	Site has been submitted to the DPLH for assessment, outcome still pending.
38919	PA19-04	Artefacts /Scatter	OHP: Lodged Site	Site has been submitted to the DPLH for assessment, outcome still pending.

Source: DPLH 2022; GJCRM 2021; Archae-aus 2019



Source: Aborigional Heritage Enquiry System (AHIS) DPLH, 2022

Figure 9-1: Aboriginal Heritage Sites

9.4.3 European Heritage

Allawah Grove, South Guildford (Place Number 26473) has been listed by the Heritage Council as an RHP – Assessed – Consultation (Preliminary). The site is being evaluated for potential listing under the Heritage Act.. The historical heritage assessment undertaken in 2020 noted that the Allawah Grove Aboriginal Reserve was taken over by the army in 1941 and used as an army camp during World War II. After the war, the site continued to be used as housing for non-Aboriginal people but was eventually handed over to the Department of Native Welfare in 1958. Presently Allawah Grove contains moderately thick bushland, and cleared and levelled ground, which has been heavily modified for airport use shown in Figure 9-2.

The study also identified the 'King Road' area in the eastern section of the MDP area, as containing remnant structures and artefacts associated with the early to mid-twentieth century use of the land for suburban and semi-rural residential development. The Heritage Council has not initiated an assessment of this site.

9.4.4 Natural Heritage

A search of the Commonwealth Heritage List identified one place that intercepts the MDP area, Munday Swamp and Surrounding Bushland (Place ID 105485). The site has been listed for its Natural Heritage values, however it is also noted that *Indigenous values are known to exist in* [the] *area*. Much of this site (~65%) is located outside of the MDP area, Figure 9-3 .

This site is classified as an Indicative Place on the Commonwealth Heritage List, meaning that data in relation to the potential site has been provided to or obtained by the Heritage Division and been entered into the database. However, a formal nomination has not been made and the Australian Heritage Council has not received the data for assessment.

The ecological and hydrological values and impacts associated with the proposed MDP works are assessed in the flora and vegetation, fauna and wetlands sections of this document.

9.5 Overview of Heritage Values

9.5.1 Aboriginal Cultural Heritage

9.5.1.1 Registered Site 3719 Munday Swamp

Registered Site 3719 Munday Swamp is a wetland that covers approximately 20 ha in the east of the Perth Airport estate. The project area intercepts the 'dithered' boundary of Site 3719 Munday Swamp. In some cases, the DPLH applies a 'dithered' boundary to protect the actual location of a culturally sensitive site. The DPLH has confirmed the actual boundary of Site 3719 (Munday Swamp) is outside the project area. Figure 9-2 shows Munday Swamp and Surrounding Bushland.

The site was originally recorded by archaeologists in 1979 and has since been the subject of numerous archaeological and ethnographic surveys. The AHIS register identifies Site 3719 as a site with ceremonial, mythological, hunting and campground, and plant resource values. It is also listed as an artefact scatter, indicating that archaeological material has been recorded at the site at a point in time, and may have been salvaged or may remain in situ.

The most common type of archaeological material recorded on the estate is quartz and the most common artefacts recorded during the recent excavations were quartz flakes. Quartz, originally sourced from coastal areas, was a popular material used by Noongar communities particularly in the manufacturing of cutting tools.

In addition, charcoal was recovered within Site 3719, allowing carbon dating to be undertaken. Dating indicated that Aboriginal occupation of the area ranged from 453 to 4,581 years before present (Howard, Coutant, O'Brien & Chisholm, 2017).

Munday Swamp supports a population of Oblong Turtles (*Chelodina oblonga*). Traditionally a stick was used to poke around and find the turtles in the mud, and their neck was then twisted to kill them quickly. Once the turtle had been cooked in hot ashes, it was prepared for eating in a special way; a sharp piece of shell from the front of the breastplate was broken off and used to carve (O'Connor, 1997). Traditional Custodians continue to hunt for turtle at Munday Swamp and collect paper-bark for painting. Perth Airport is committed to maintaining access to Munday Swamp for Traditional Custodians.

9.5.1.2 Registered Site 3771 Allawah Grove

Registered Site 3771 Allawah Grove is a former Aboriginal Reserve and is listed as a 'Camp' on the AHIS. The site was gazetted in 1910 as a Reserve for Perth's Aboriginal population and is a place of significance to many Aboriginal families in the Perth area. It was resumed by the Department of Defence for a period during the Second World War but reoccupied by Aboriginal people shortly after the war ended. The houses were eventually condemned in 1957 but Aboriginal people were permitted to continue to live there until the 1960s, when it was demolished. Figure 9-3 shows Allawah Grove site intersecting the Airport North MDP.

The site has been the focus of numerous research efforts by heritage researchers and the subject of at least one published photographic book, *On the Outskirts: Photographs of Allawah Grove Settlement, Perth* (Walley & Pushman, 2005) and multiple oral histories and exhibitions. Some concrete footings and other historical features remain *in situ* along with some landscaping features and numerous artefact scatters. Despite the poor condition of the site, it remains important to the Noongar community and is a rare example of an undeveloped metropolitan Aboriginal Reserve.

The ethnographic survey confirmed the significance of the Allawah Grove site, recorded in 1997 as being '*one of the most important historic/human/mundane sites in the Perth Metropolitan area*'. The consultation with Noongar and PAG representatives recorded the following considerations:

- The need to preserve the Allawah Grove site including the preservation of the extant foundations and remains of Allawah Grove and its fringe camps.
- The provision of Traditional Custodian access to Allawah Grove.
- Creation of a place at Allawah Grove for Noongar people.
- An oral history project focused on Allawah Grove.
- Appropriate recognition of land custodianship.
- Establish an interpretive heritage / Whadjuk culture walking trail
- Recognition of Aboriginal heritage throughout the broader airport estate, such as the naming of buildings, memorials, murals, displays and flying of the Aboriginal flag.
- The site's boundary has recently been enlarged based on a 2019 heritage survey report (Archae~aus, 2020) to more accurately reflect the extent of the original site.

9.5.1.3 Registered Site 3896 Munday Swamp: Poison Gully

Registered Site 3896 Munday Swamp: Poison Gully was originally recorded in the 1980s, initially in 1983 as three artefact scatters to the immediate west of the Munday Swamp water body. A total surface collection was carried out at the time. Two more sites were recorded in 1984 when another total surface collection and a subsurface investigation to 95cm were undertaken. This investigation determined that the site had recent and intense occupation (Strawbridge, 1984). The site was revisited in 2009 but no cultural material was recorded. The archaeologists conducting the survey suggested that three of the five scatters may no longer fulfil the criteria of Section 5 of the AH Act to be considered a registered site (Artefaxion, 2009).

At some point the site's mapped location on the DPLH database was moved from the edge of the Munday Swamp water body to the northern end of the cross-runway. This resulted in numerous errors, as targeted archaeological surveys were conducted over the incorrect location and no artefacts were recorded. However, pedestrian transects were conducted over the true location of the site and no cultural material was recorded (Terra Rosa, 2016, 2017; Archae~aus 2020).

In 2021 a survey was conducted over both the incorrectly mapped location from the DPLH database and the historical boundary of the site. Five pieces of potential cultural material were recorded within the historical boundary of the site (GJCRM, 2021). As a result of these findings the site location mapped on the DPLH database was updated and rectified it now clearly shows that the site lies immediately adjacent to the Airport North MDP area.

9.5.1.4 Registered Site 3933 Munday Swamp

Registered Site 3933 Munday Swamp was originally recorded in the 1970s as a sparse artefact scatter containing only quartz pieces, indicating Late Phase use of the site. Subject to a number of total surface collections in the 1980s, a subsurface investigation was undertaken in 1984 (Strawbridge), which determined three period of intense occupation followed by abandonment.

In 2009 the site was assessed to be *"probably destroyed"* (Artefaxion), as it had suffered impacts from historic land use and clearing. The site was mistakenly located on the public database to be ~350 m to the south west of the true location of the site but this has recently been rectified based on two heritage reports (Archae~aus, 2020; GJCRM, 2021).

9.5.1.5 Registered Site 3934 Munday Swamp

Registered Site 3934 Munday Swamp was originally recorded in the 1970s as a moderate artefact scatter of Middle to Very Late Phase occupation. Subject to a number of total surface collections in the 1980s, no significant artefact scatters have been recorded within the site over the last four decades and the current boundary of the site is not accurate.

9.5.1.6 Registered Site 4374 Airport: Koojan Avenue

Registered Site 4374 Airport: Koojan Avenue was originally recorded in 1970 as a quartz artefact scatter, indicating Late Phase use of the site. A total surface collection was made at the time and no significant artefact scatters have been recorded within the site over the last five decades.

In 2009 two quartz artefacts were recorded but the site was still assessed to be *"probably destroyed"* (Artefaxion) due to the development of the Great Eastern Highway Bypass by the State Government and its associated infrastructure. However, the current mapped location of this site is likely incorrect. PAPL is aiming to address this error within the DPLH database during the next surveys.

9.5.1.7 Lodged OHP 38902 PA19-01

Recorded in 2019 as an artefact scatter measuring 38 m (north / south) by 83 m (east / west), covering 1,806 m^2. The assemblage consists of 12 flaked quartz artefacts including bipolar pieces, cores and flake fragments. The artefacts were observed in the sandy clearing with stockpiles to the west and airport roads and tracks to the north and south. It was noted that additional artefacts might be obscured by vegetation.

9.5.1.8 Lodged OHP 38919 PA19-04

Recorded in 2019 as an artefact scatter measuring 65 m (north / south) by 88 m (east / west), covering 5720 m^2. The assemblage consists of 30 flaked quartz artefacts, including bipolar pieces, cores and flake fragments. A number of the cores are large. The artefacts were observed in an open sandy paddock, concentrated along a firebreak.

9.5.1.9 Lodged OHP 38921 PA19-03

Recorded in 2019 as an artefact scatter measuring 35 m (north / south) by 35 m (east / west), covering 1135 m^2. The assemblage consists of 30 flaked artefacts, including bipolar pieces, cores and flake fragments made from quartz and one fossiliferous chert core. The artefacts were observed in a slightly raised sandy area adjacent to a swamp immediately north of an airport track. It was noted that additional artefacts might be obscured by vegetation.

9.5.1.10 Indicative Place 105485

Indicative Place (105485) Munday Swamp and Surrounding Bushland shown in Figure 9-2 has been submitted to the Commonwealth Heritage List database for its natural heritage values but it has neither been assessed or listed. This site covers approximately 265 ha of bushland on the northern and north-western part of the estate, approximately 50% of which overlaps with the Airport North MDP area. The site is also noted to contain Indigenous values but given that Indicative Places are not listed places, the ecological and hydrological values and impacts associated with the Airport North project are assessed in the flora and vegetation, fauna and wetlands sections of this MDP.

9.5.2 State Heritage

The Heritage Council of Western Australia has listed two sites that are located within or adjacent to the Airport North MDP area.

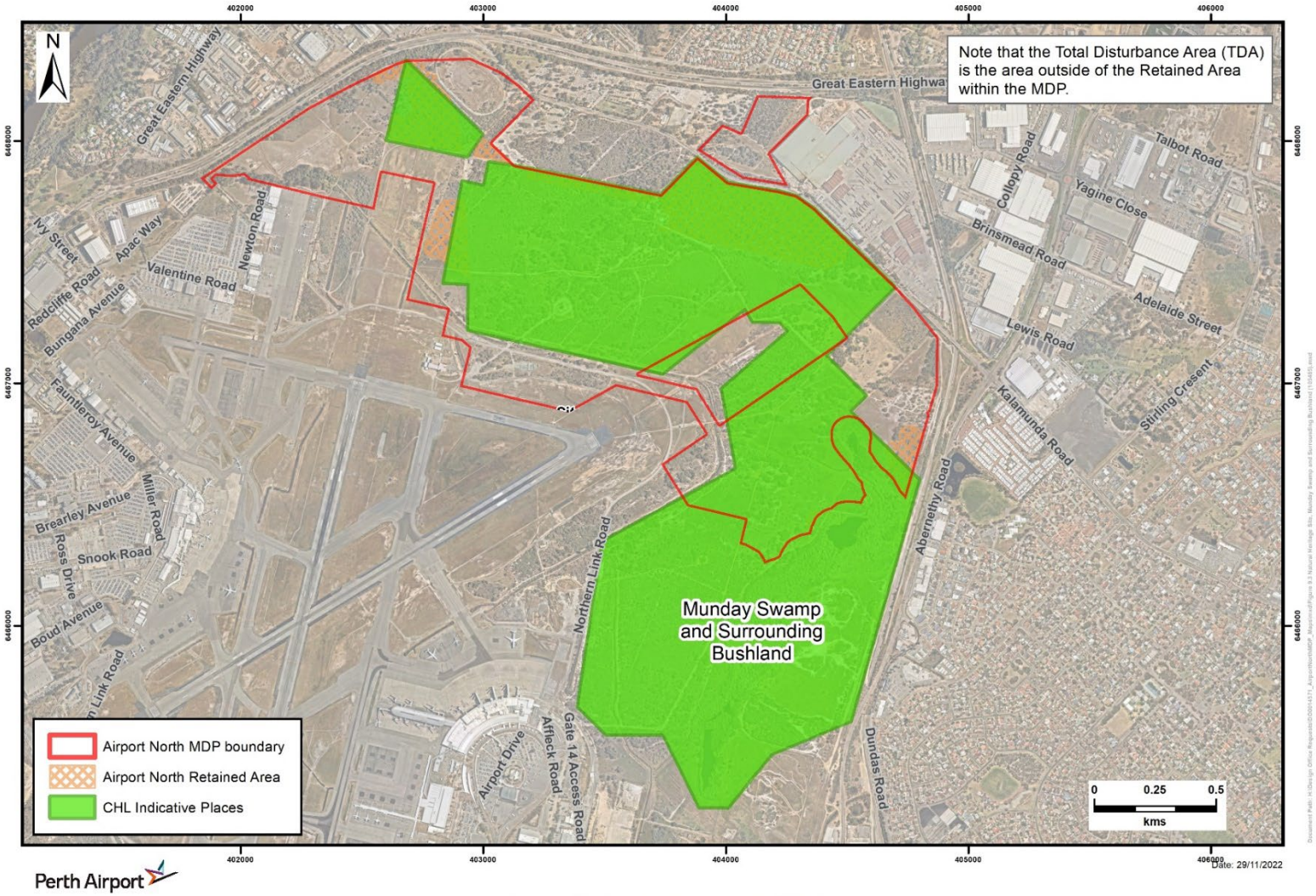
9.5.2.1 RHP - Consultation (Preliminary) 26473 Allawah Grove, South Guildford

Allawah Grove was submitted to the Western Australian Heritage Council in 2020 for possible inclusion in the State Heritage Register as a Historic Site, shown in Figure 9-3. The Council deemed the site as potentially having a significant level of cultural heritage value and are currently assessing the site. Given that the site is currently under assessment and that the site mirrors the registered Aboriginal site, the Allawah Grove site will be addressed as a single site.

9.6.2.2 Registered Heritage Place 04647 Early Graves Guildford Cemetery

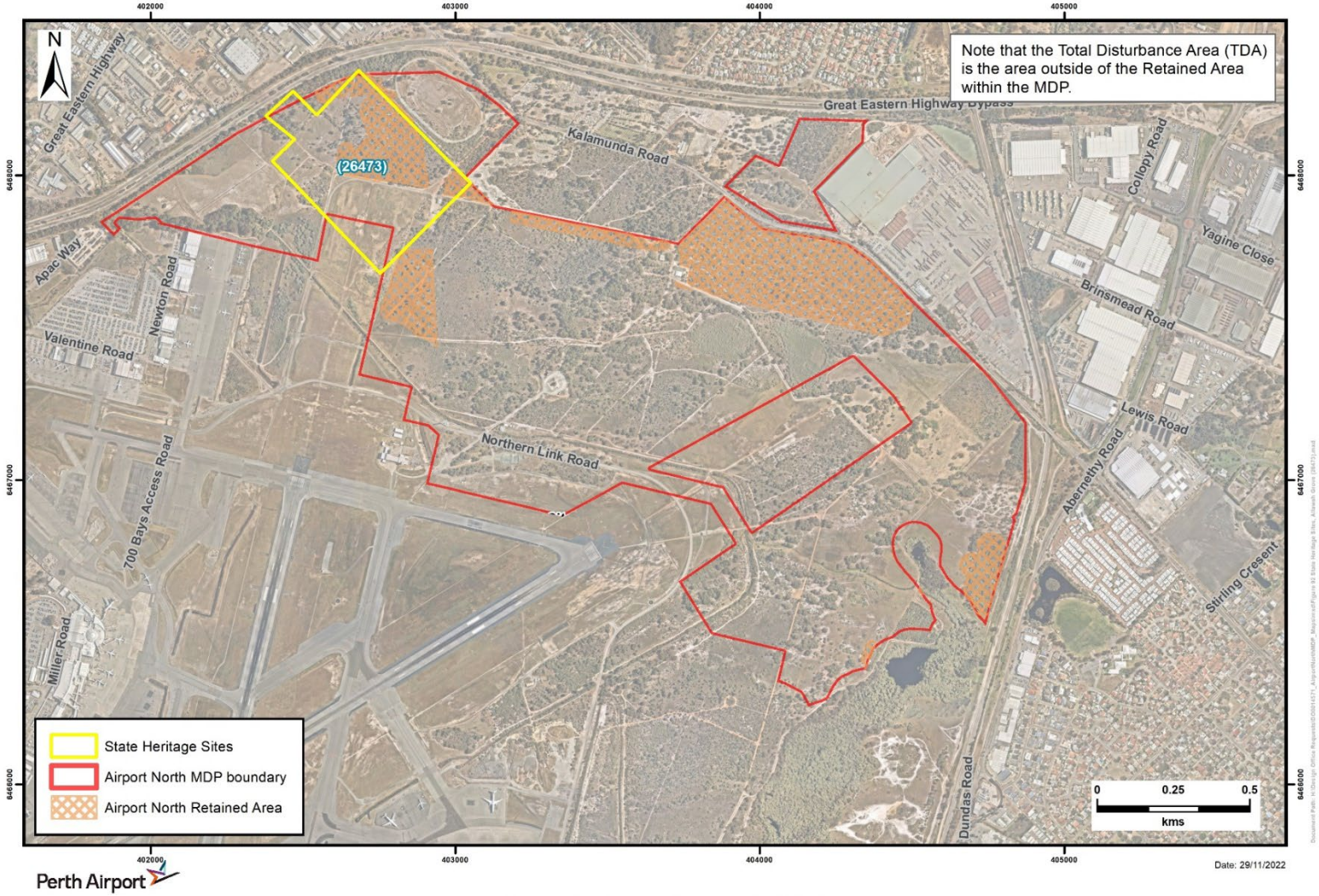
Registered Heritage Place 04647 Early Graves, Guildford Cemetery (1888+) was nominated to the Heritage Council in 1998 and registered in 2021. Among other reasons its significance was determined because *the place is a good representative example of the earliest burial sections of the municipal cemetery* (Heritage Council, 2021).

The site is not located on the Perth Airport estate but is adjacent to the Airport North development footprint.



Source: Aborigional Heritage Enquiry System (AHIS) DPLH, 2022

Figure 9-2: Munday Swamp and Surrounding Bushland



Source: Aborigional Heritage Enquiry System (AHIS) DPLH, 2022

Figure 9-3: Allawah Grove, South Guildford

9.6 Direct Impacts and Associated Avoidance/Mitigation Measures

The construction and operation of the MDP will directly impact areas with known Aboriginal, historical and natural heritage values. Consent to impact the Aboriginal heritage sites is being sought and Perth Airport is consulting with the PAG and the Whadjuk Traditional Custodians, through the SWALSC. An overview of the direct impacts to Heritage Sites is contained in Table 9-4 and a status of the Aboriginal Heritage sites against relevant legislation is contained in Table 9-3.

Table 9-2 Status of Directly Impacted Aboriginal Heritage sites and relevant legislation

Site ID	Site Name	Relevant Legislation			
		ACH Act	EPBC Act – National Heritage List	EPBC Act - Commonwealth Heritage List	Heritage Act
3771	Allawah Grove	Yes	No	Under Assessment	Under Assessment (ID 26473)
3933	Munday Swamp	Yes	No	Under Assessment	No
3934	Munday Swamp	Yes	No	Under Assessment	No
4374	Airport: Koojan Avenue	Yes	No	Under Assessment	No
38902	PA 19-01	Under Assessment	No	Under Assessment	No
38921	PA 19-03	Under Assessment	No	Under Assessment	No
38919	PA 19-04	Under Assessment	No	Under Assessment	No
105485	Munday Swamp and Surrounding Bushland	No	No	No	No

Source: DPLH 2022; DAWE 2020

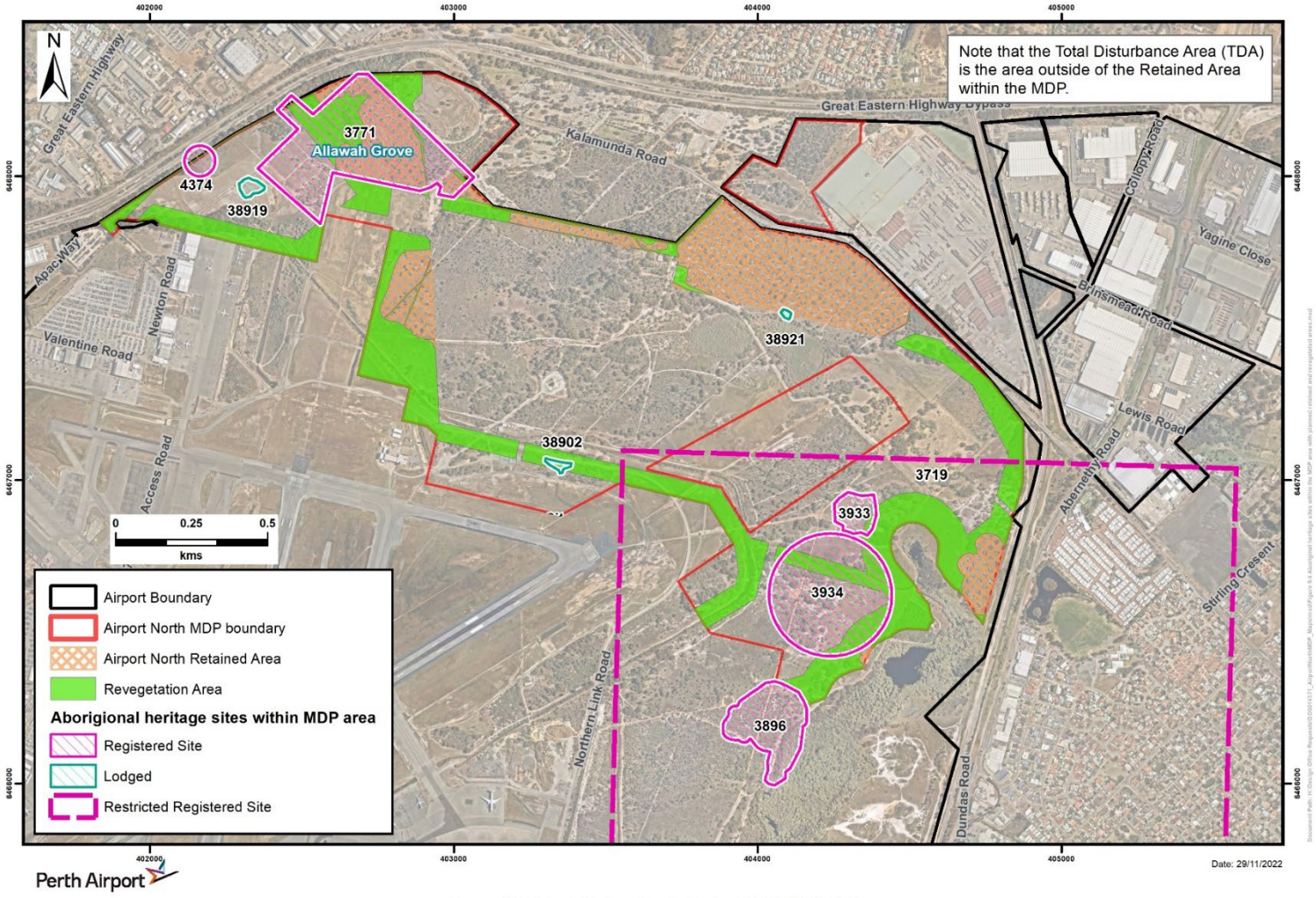
To avoid direct impacts to the important Munday Swamp (3719) site, a 100 m buffer has been designed around the wetland. This buffer will be regenerated from its current state to increase the value of the riparian vegetation around the water body.

To mitigate the impacts to Aboriginal cultural heritage values Perth Airport, a co-designed and Whadjuk endorsed Aboriginal Cultural Heritage Management Plan (ACHMP) will be developed for the project. In addition, the airport has committed to:

- Retaining the natural links between Munday Swamp and the Derbarl Yerrigan (Swan River) through the Living Stream.
- Establishing an interpretive heritage / Whadjuk culture walking trail from Munday Swamp, along the Living Stream to Allawah Grove.
- Funding an oral history project about Allawah Grove.
- Ensuring that Traditional Custodians will be involved with preparatory work, such as fauna relocation.
- Ensuring that Traditional Custodians are involved in landscape design and planting.
- Engaging Heritage Monitors to observe ground disturbing works during the development.
- Ensuring the visibility of Noongar language and culture throughout the precinct through such measures as naming projects.

- Factoring Aboriginal economic opportunities into the design and building stages of the development.
- Establishing a space for Whadjuk / Noongar people at the Allawah Grove site.

Figure 9-4 shows the Aboriginal Heritage sites within the Airport North MDP area within the planned retained and revegetated areas. In addition, Table 9-4 provides an overview of the known Heritage Sites that will be impacted by the Airport North MDP.



Source: Aborigional Heritage Enquiry System (AHIS) DPLH, 2022

Figure 9-4: Aboriginal heritage sites within the MDP area with planned retained and revegetated areas

Perth Airport

Table 9-3 Airport North Development Impact to known Heritage Sites

List	ID	Name	Status	Type	Comment
AHIS	3719	Munday Swamp	Registered	Artefacts / Scatter, Ceremonial, Mythological, Camp, Hunting Place, Plant Resource	No direct impacts; immediately adjacent to MDP area. Development includes a 100m buffer around the site, which will be improved vegetation.
AHIS	3771	Allawah Grove	Registered	Camp	Site boundary has been expanded to reflect data shown in aerial imagery. Some features from the Aboriginal Reserve are still *in-situ* but much of the site has been impacted by land use. ~ 40% of the site will be retained as high value remnant vegetation and a further ~20% of the site will be revegetated from its current state.
AHIS	3896	Munday Swamp: Poison Gully	Registered	Artefacts / Scatter	No direct impacts; immediately adjacent to MDP area and may be indirectly impacted.
AHIS	3933	Munday Swamp	Registered	Artefacts / Scatter	Direct impact to entire site. Site is within the TDA. Complete surface collection of site has occurred numerous times, site has been impacted by historical agriculture use.
AHIS	3934	Munday Swamp	Registered	Artefacts / Scatter	Direct impact to entire site. Site is within the TDA. Complete surface collection of site has occurred numerous times and site has been impacted by historical agriculture use.
AHIS	4374	Airport: Koojan Avenue	Registered	Artefacts / Scatter	Total surface collections of artefacts have occurred Direct impacts to entire site within airport estate. Part of the site which falls outside the airport estate boundary was likely destroyed by the Great Eastern Highway bypass construction in the late 1980s.
AHIS	38902	PA19-01	Lodged	Artefacts / Scatter	Direct impacts to entire site. Site has been heavily impacted by land use, it lies entirely within the TDA and mostly within the Living Stream alignment.
AHIS	38921	PA19-03	Lodged	Artefacts / Scatter	Site partially retained within retained remnant vegetation.

List	ID	Name	Status	Type	Comment
AHIS	38919	PA19-04	Lodged	Artefacts / Scatter	Direct impacts to entire site. Site has been heavily impacted by land use, it lies entirely within the TDA.
Commonwealth Heritage List	105485	Munday Swamp and Surrounding Bushland	Indicative Place	Natural Heritage Values	~50% of the site lies within the TDA, one third of that area lies within remnant retained areas.
Heritage List	26473	Allawah Grove	RHP – Consultation (Preliminary)	Historic Site	Site has been nominated for listing, based on both European and Aboriginal heritage values. Assessment is currently in progress. Proposed curtilage has over 80% overlap lodged and registered Aboriginal heritage sites.
Heritage List	04647	Early Graves, Guildford Cemetery	Registered	Other Built Type – Monument / Cemetery	Site is located adjacent to the airport estate, on Kalamunda Road. While there is no direct impact to the site from the proposed development, the site may be indirectly impacted.

9.7 Indirect and Offsite Impacts and Associated Avoidance/Mitigation Measures

The key significant site on the Perth Airport estate, Munday Swamp does not lie within the Airport North MDP area to further ensure the site is protected a 100m heritage buffer is planned to be established around the water body. This area is currently considered to be in a highly degraded condition and as part of the Airport North MDP, revegetation of the buffer will enhance the aesthetic and environmental values of Munday Swamp.

Munday Swamp has been disturbed as a result of historical surrounding land-use that included cattle grazing, and more recently, frequent illegal four-wheel drive and trail bike access. As part of the New Runway Project commitments and subsequent Section 18 (AH Act) conditions of consent, Perth Airport constructed a secure fence on the eastern boundary of the airport estate to prevent illegal vehicle access to Munday Swamp. Perth Airport consulted the PAG during the design of the Munday Swamp fence to ensure the fence provided adequate pedestrian access and did not impede access for Traditional Custodians.

Furthermore, Perth Airport has identified an opportunity to incorporate a sense of place that references Noongar and Aboriginal heritage and culture in the landscape design of the proposed development. The development of the sense of place will be a collaborative process with relevant Traditional Custodians.

9.8 Summary of Outcomes

The Airport North Development will impact upon Aboriginal cultural heritage values and potentially upon historic heritage values.

Perth Airport will comply with the ACH Act by developing a co-designed ACHMP with Traditional Owners by consulting with SWALSC and the Whadjuk Regional Corporation as well as the PAG. This consultation has already commenced and the Airport North ACHMP will ensure that Traditional Custodians are further aware of any proposed or likely impacts the Airport North Development may have to cultural heritage values and that impacts are mitigated through necessary measures.

Perth Airport remains committed to ongoing engagement with the Traditional Custodians, under the guidance of Perth Airport's Heritage Management Framework, in a manner that recognises the significance of the area to the Aboriginal community and acknowledges their strong link to the land on which Perth Airport is situated. Table 9-5 provides an overview of Perth Airport's Heritage Management Guiding Documents.

Additionally, Perth Airport's internal procedures guides the organization in planning development without unintentional and unapproved impact to Aboriginal heritage.

Table 9-4 Perth Airport Guiding Documents

Document	Scope
2009 Partnership Agreement (between Perth Airport and Traditional Custodians)	Commits Perth Airport to ongoing engagement and consultation with Traditional Custodians through the Partnership Agreement Group
Cultural Heritage Site Land Management Plan	Details relevant legislation and legislative obligations to inform the management of heritage on the airport estate. Includes detailed background and information such as definitions and supporting documentation.
Minor Works within Registered Aboriginal Sites Procedure	Guides Perth Airport staff to comply with current legislations when working within Registered Aboriginal Heritage Sites.
Aboriginal Heritage Monitoring Procedure	Guides Perth Airport staff, contractors and tenants on the engagement of Aboriginal Heritage Monitors during ground disturbing activity.
Airport North Aboriginal Cultural Heritage Management Plan (Future Document)	A co-designed ACHMP will be developed once investigations into the cultural heritage values of the MDP area have been completed.

10 Impacts to the Environment on Commonwealth Land

10.1 Overview

The MDP area is located on Commonwealth land associated with Perth Airport, therefore impacts to the environment require consideration as per Guideline 1.2. In the EPBC Act, the environment is defined as:

a. Ecosystems and their constituent parts including people and communities ('ecosystem' is defined in the EPBC Act as 'a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functioning unit').

b. Natural and physical resources.

c. Qualities and characteristics of locations, places and areas.

d. Heritage values of places ('heritage value' is defined in the EPBC Act as including 'the place's natural and cultural environment having aesthetic, historic, scientific or social significance, or other significance, for current and future generations of Australians. 'Indigenous heritage value' is defined as meaning 'a heritage value of the place that is of significance to Indigenous persons in accordance with their practices, observances, customs, traditions, beliefs or history'. Places includes those in the Register of the National Estate kept under the Australian Heritage Council Act (2003).

e. The social, economic and cultural aspects of a thing mentioned in paragraphs a, b or c.

10.2 Significant Impacts to the Environment

Table 10-1 provides a summary of the likely direct and indirect impacts of the MDP to the environment, as defined by the EPBC Act, and their significance. In conclusion, the Airport North MDP will likely significantly impact flora and vegetation, fauna, wetlands and heritage. Full details of these impacts are presented in Sections 3, 4, 5, 6 and 9 respectively.

Table 10-1: Summary of the assessment of the impact of the Airport North MPD on the environment

Environmental Context	Significance of Impacts
Impacts on landscapes and soils *(see Section 7)*	There are significant areas of PFAS contamination within the MDP area. Further assessment may be required prior to preparation of a Management Plan. The placement of a section of the NMD in a culvert minimises the pathway for PFAS to enter surface water and potentially be transported offsite; and will give rise to a significant beneficial residual impact. The potential impacts of PFAS transfer via the culvert will be further investigated prior to implementation and is subject to further design and assessment. The design of the MDP area, together with adherence to a CEMP during construction work, and a PFAS Management Plan, result in there being no predicted significant residual contamination impacts resulting from implementation of the proposed MDP scope. If any ASS Soil is generated, it will be suitably managed through an ASSDMP, such that there will be no significant residual impacts resulting from implementation of the proposed MDP. Periodic monitoring will be undertaken of groundwater and surface water, and soil material movements will be tracked and monitored to demonstrate that construction works are not causing an unacceptable increase in contamination risk or increase in off-site release.
Impacts on water resources *(see Sections 5 and 6)*	Wetlands Clearing associated with the MDP will result in the direct loss of 46.5 ha of wetlands. This equates to approximately 14.7% of wetlands mapped within the airport estate which retain ecological values equivalent to a CCW or REW. Despite significant historical disturbance, these wetlands have been assessed as either wetlands of the highest priority or wetlands having rehabilitation potential.

Environmental Context	Significance of Impacts
	Direct impacts to most of the wetland areas within the MDP area are unavoidable. Clearing within the MDP area will result in the direct loss of 18.2 ha of CCW . Considering the historical loss of wetlands on the Swan Coast Plain, the largely Good to Very Good condition of the MDP area's wetland vegetation and the context of these wetlands within a broader mosaic of wetland and bushland vegetation within the airport estate; this loss of wetlands is likely to be significant. Direct impacts to Munday Swamp will be avoided and installation of 100 m buffer. To mitigate the impact of wetland clearing, the MDP proposal has sought to retain either partially or fully four wetlands within the MDP area, covering 5.4 ha. A Wetland Restoration and Management Plan will be prepared to guide the maintenance and, where possible, the enhancement of the retained wetlands. The CEMP will ensure that retained wetlands are not adversely impacted during construct works within the MPD area. The MDP in combination with the Airport West (South) and the New Runway Project, give rise to a total of approximately 97.3 ha of CCW wetlands being cleared. The cumulative impacts to wetlands arising from MDP are therefore likely to be significant. Groundwater and Surface Water The realignment and upgrading of the NMD, together with the provision of storage basins and placing a section of the drain within a culvert, ensures that the development of the MDP area has no significant adverse impacts on the local hydrological regime or quality. It is unlikely that significant hydrological related environmental impacts will arise either directly, indirectly or in combination with the New Runway Project and the Airport Central MDP. Any construction works and excavation soils, including soil movements and vegetation clearing, may result in slight changes in the surface water and groundwater quality. The CEMP will detail surface water and groundwater management measures during the construction phase. As part of the CEMP, groundwater sampling will be undertaken to establish the baseline groundwater quality prior to commencement of development. Surface water and groundwater quality will be monitored throughout construction. Water extraction will be considered to ensure there is no unacceptable change in the surface water and groundwater quality. The excavation, movement and placement of soil will be considered to ensure there is no unacceptable change in the surface water and groundwater quality.
Pollutants, chemicals and toxic substances (see Section 11)	Impacts by pollutants, chemical and toxic substance are likely to be localised (if any) and the CEMP will detail appropriate management measures in line with the airport's Environment Strategy. No significant impacts are anticipated.
Impacts on flora and vegetation (see Section 3)	At the local scale, the TDA potentially impacts 104.71 ha of remnant vegetation of varying condition representing 21.46% of remnant vegetation within the airport estate. Implementation of the MDP will reduce the extent of remnant native vegetation from 23.26 % to 18.27 % of the airport estate. This loss is not significant impact at the local scale. At the regional scale, the current extent of the vegetation associations is below the EPA's threshold of 30% of the pre-European extent. The MDP potentially reduces the extent of Bassendean Associations 1001, 1009 and 1018 to 21.24%, 18.7 % and 14.64 %, respectively of the pre-European extent. This reduced extent is above the EPA's "endangered" threshold of 10%. This is not considered to constitute a significant impact to remnant vegetation. The remnant vegetation within the MDP area provides habitat for the Banksia Woodland TEC, listed under the EPBC Act and SCP 3b *(Corymbia calophylla – Eucalyptus marginata woodlands*) TEC, listed under the BC Act. The MDP will involve the clearing of the majority of the SCP 3b TEC within the airport estate, which is considered to be a significant impact. The Airport North TDA potentially impacts 5.03 % (12 individuals) of *Conospermum undulatum* (T) within the airport estate population that is considered an important population to the long-term survival of the species. The development will have a significant impact on *Conospermum undulatum* (T) The MDP works are considered to cause significant local impact to the Priority Flora species *Myriophyllum echinatum* (P3). The current proposed works, Airport Central, Airport West (South) and the New Runway Project will potentially give rise to significant cumulative impacts to six Priority Flora species, however the cumulative impact will not result in a significant impact at the regional scale.

Environmental Context	Significance of Impacts
Impacts on fauna *(see Section 4)*	There will be permanent population declines for a wide suite of native fauna species, including common and conservation significant species at a local level due to habitat loss in the MDP area. Up to 182.12 ha of fauna habitat will be cleared, which represents 85% of the quenda habitat within the MDP area. This will be mitigated through relocation and the retention of areas of native vegetation and the inclusion of ecological corridors. Foraging habitat and potential breeding habitat trees for three species of black cockatoo (CBC, BBC and the FRTBC), occurs within the MDP area. Although the MDP's design retains 34.29 ha of remnant vegetation, significant residual impacts to CBC and FRTBC are anticipated. There is 8.51 ha of suitable habitat for Woollybush bee species *Hylaeus globuliferus* within the MDP area. Clearing will impact 5.70 ha of this habitat, which is likely to result in a significant residual impact. The potential for direct impacts to fauna during construction, such as fauna interactions leading to mortality, can be avoided or mitigated through implementation of the CEMP, which will include management measures and actions , such as pre-clearing fauna trapping and relocation, as well as the use of fauna spotters during clearing works. Common fauna species present within the MDP area are widespread across the airport estate and are not reliant on the vegetation to be cleared; therefore, at a regional level the impact on these species is low.
Impacts on people and communities *(see Part A document and Section 8)*	A socio-economic assessment for the MDP identified and quantified the likely economic impacts of the development. This included employment modelling which estimates 6,231 construction jobs (1,109 direct, 5,122 indirect) and 6,200 operational jobs will be created, which will contribute $1.78 billion to the broader economy. This will support the economic contribution of Perth Airport to Western Australia's economy. The MDP is not expected to have a negative impact on people and communities outside of the airport estate for the following reasons: • The MDP will occur on Commonwealth land currently managed by Perth Airport. No residences or businesses will be needed to be removed to facilitate the project. • The MDP is consistent with the approved Perth Airport Master Plan 2020, and long-term State and local planning objectives for WA and localities adjacent to the airport estate. Construction dust, noise and vibration arising from the construction of the MDP works may impact on the amenity of visitors to the Guilford Cemetery. Measures to mitigate dust, noise and vibration will be incorporated into the CEMP and will include consultation with Metropolitan Cemeteries Board. With the implementation of these measures, dust, noise and vibration impacts are not anticipated to be significant.
Impacts on heritage *(see Section 9)*	The MDP area will intersect with four registered Aboriginal heritage sites and three lodged Aboriginal heritage sites. The MDP area also contains one site that is being assessed by the Heritage Council of WA for listing. This site overlaps substantially with a registered Aboriginal heritage site. Targeted site assessments and a subsurface investigation of the land outside of the registered heritage sites is being progressively completed in 2022. This work will inform the Heritage Impact Assessment. The proposed MDP works will be constructed and operated in line with a co-designed ACHMP and any conditions imposed by the Minister.

11 Overarching Environmental Management Measures

11.1 Perth Airport Environment Strategy

Perth Airport has an Environment Strategy, which is detailed in the approved Perth Airport Master Plan 2020. The Environment Strategy encompasses an Environmental Management Framework (EMF) which sets out how Perth Airport meets its obligations under Commonwealth and State legislation. The Perth Airport EMF is presented in Plate 11-1.

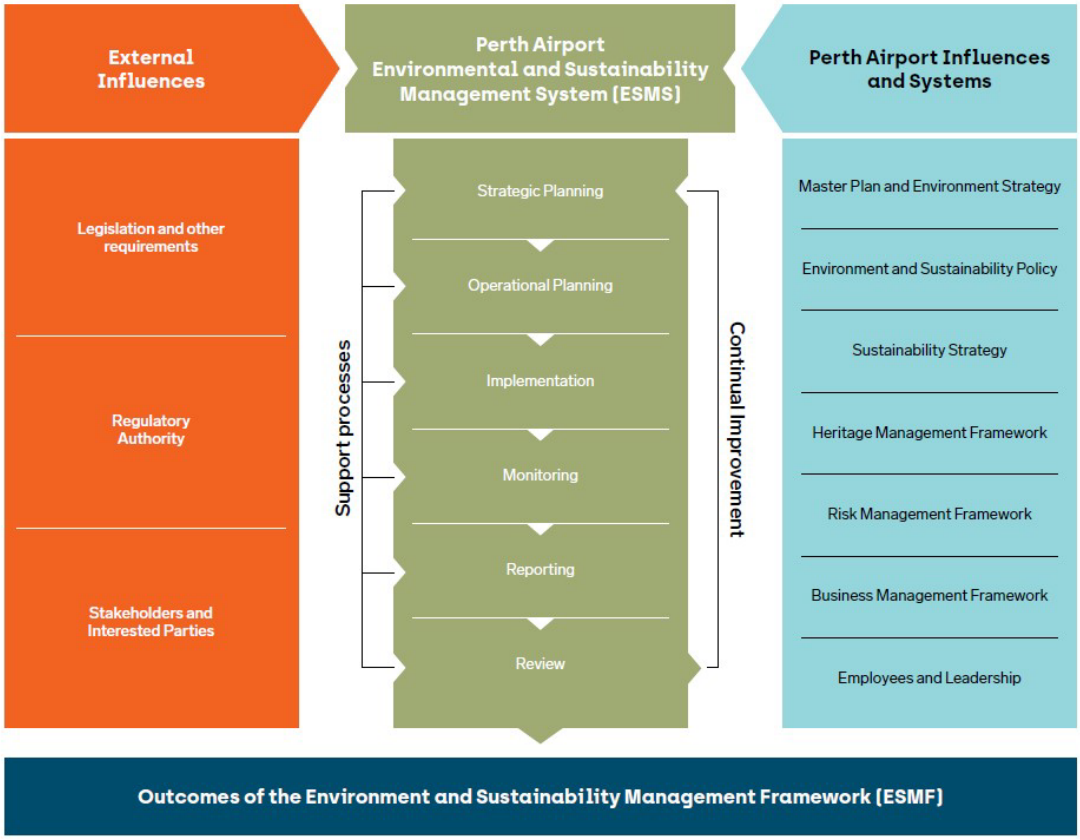


Plate 11-1: Perth Airport Environmental Management Framework

11.2 Construction Environmental Management Plan

It is Perth Airport's objective that all environment and heritage impacts during construction of the Airport North project are avoided or minimised as far as reasonably practicable. Extensive analysis and assessment has been conducted in the planning and design phases to achieve this outcome. However, there will be an unavoidable level of environment and heritage impact and disturbance attributable to the delivery of the Airport North project.

To enable the construction contractor and Perth Airport to develop an appropriate CEMP, this section outlines the key environmental and heritage issues to be addressed and the structure of the CEMP.

Perth Airport will ensure that the principles of the EMF are incorporated into the Airport North CEMP. The CEMP, and any subsequent environmental management plans, will be subject to approval by Perth Airport's Environment Manager (or delegate) after incorporation of any comments or recommendations made following the review by the Airport Environment Officer (AEO) appointed by DITRDCA in accordance with the *Airports (Environment Protection) Regulations 1997*. The CEMP is required to be approved prior to the commencement of any works as per the process demonstrated below.

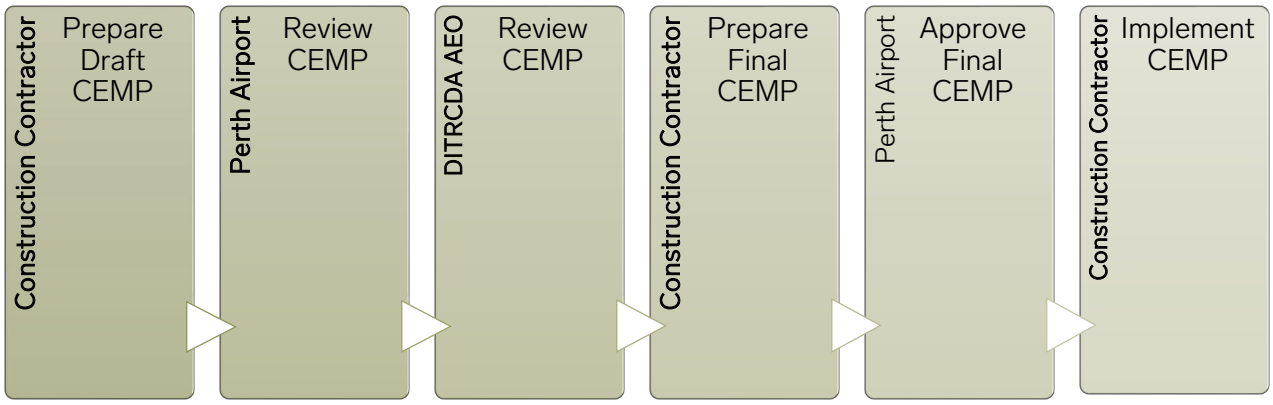


Plate 11-2 Construction Environmental Management Plan Approval Process

This section outlines the intended structure of the CEMP, which the construction contractor is expected to develop and implement during construction activities for the Airport North project. The CEMP must address the environmental aspects and develop mitigation measures for the impacts identified throughout this MDP. The construction contractor is expected to familiarise themselves with the background, context and environmental impact assessment described in the relevant technical chapters to assist with development of mitigation measures.

Perth Airport will maintain a high level of on-site supervision of the construction contractors. Environmental performance of potential contractors will be reviewed as part of the tender evaluation process. Regular audits and inspections will be conducted by Perth Airport's environment team with the frequency included in the CEMP. Subsequently, results from the audits and inspections will be reported to the DITRCDA AEO.

To effectively manage environmental impacts associated with the Airport North project, it was necessary to identify relevant environmental aspects and assess the significance of potential impacts. Environmental aspects and impacts are identified and described in the individual sections. A summary of potential impacts is summarised in Table 11-1.

Table 11-1 Summary of Potential Environmental Impacts

Aspects	Impacts	MDP Section
Flora and Vegetation	• Loss of Commonwealth and state-listed flora species and ecological communities from clearing of vegetation • Flora habitat fragmentation leading to change in microclimate • Potential spread of weeds and dieback	3
Fauna	• Loss of fauna habitats from clearing • Loss of biodiversity from clearing • Possible fragmentation of populations from clearing linked areas • Possible change in species interactions leading to possible populations declines and behaviour of species	4
Water Resources and Wetlands	• Clearing and filling wetlands • Acidification of surface or groundwater due to dewatering • Erosion and sedimentation from opening of new drains, vegetation clearing or earthworks • Lowering of groundwater affecting vegetation or structures • Introduction of weeds, pollutants or sediment due to construction works • Rise in groundwater levels due to vegetation clearing • Change in rainfall recharge pattern resulting in groundwater drawdown • Spills or leaks during construction or operation causing contamination of stormwater	5 and 6
Soils and Geology	• Disturbance of ASS resulting in impacts to surface water, groundwater or ecological receptors • Ground movement from dewatering, excavation or soil loading • Erosion and sedimentation • Impacts to surface or groundwater or ecological receptors from disturbance of existing hydrocarbon contaminants • Disturbance of asbestos containing material or soils with metal contamination • Exposure of contaminated groundwater (Per-and poly fluoroalkyl substances (PFAS) or acid sulfate soils) with impacts to works or ecological receptors • Contamination from spills during construction or operation • Contaminated runoff from pavement areas during operation	7
Ground-based noise, Vibration and Air Quality	• Excessive levels of dust and noise generated by construction activities impacting air quality	8
Heritage	• Possible disturbance of known heritage values from unauthorised clearing activities • Possible disturbance of unknown heritage values from ground works	9

The CEMP will address the construction phase of the project and include management measures outlined in this MDP, input from key technical specialists and any conditions of approval. The CEMP will address potential impacts and management measures for the following environmental factors:

- Fauna. This includes general measures to protect fauna as well as specific measures for:
  - Carnaby's Black-Cockatoo.
  - Baudin's Black-Cockatoo.
  - Forest Red-Tailed Black-Cockatoo.
  - Quenda.
  - Rakali.
  - Woollybush bee.
- Flora and vegetation. This includes general measures to protect flora and vegetation as well as specific measures for:
  - Remnant Native Vegetation.
  - Banksia Woodland TEC (EPBC Act Listed).
  - *Corymbia calophylla* – Eucalyptus marginata Woodlands SCP 3bTEC (BC Act Listed).
  - *Conospermum undulatum* (T) (EPBC Act and BC Act listed).
  - State Listed Priority Flora Species, including:
    - *Johnsonia pubescens* subsp. *cygnorum* (P2)
    - *Jacksonia gracillima* (P3).
    - *Myriophyllum echinatum* (P3).
    - *Schoenus pennisetis* (P3).
    - *Stylidium longitubum* (P4).
    - *Verticordia lindleyi* subsp. *lindleyi* (P4).
- Wetlands.
- Water resources.
- Soil Hygiene/Dieback management.
- Contaminated land – PFAS, ASS, Asbestos and Metal contaminated soils.
- Heritage.
- Weed management.
- Fire management.
- Construction dust, noise and vibration.

The CEMP will also include the following:

- Project management structure and reporting.
- Roles and responsibilities.
- Reporting requirements.
- Environmental training requirements and implementation program.
- Environmental risk management and assessment.
- Objectives for each environmental factor, as identified in this MDP and additional factors (such as waste) identified through risk assessment.
- Environmental management maps and diagrams.
- Stakeholder engagement and complaints management.
- Incident management and corrective actions.
- Audit, inspections, monitoring, review and reporting.
- Environmental management activities, controls and performance targets.
- Contingency and change management.
- Emergency contacts and procedures.

All construction mitigation measures identified in this MDP will be implemented through the CEMP.

12 Draft Airport North Offset Proposal

Residual impacts of the Airport North project to one MNES Threatened Ecological Community (TEC), two MNES protected species, one State listed TEC and Wetlands (in the context of Whole of Environment impact) will require consideration in terms of offset. These comprise:

EPBC Act, Matters of National Environmental Protection (MNES):

- Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (Banksia Woodlands, BWSCP TEC) – Endangered
- *Conospermum undulatum* - Vulnerable
- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) – Endangered
- Forest Red-tailed Black- Cockatoo (FRTBC, *Calyptorhynchus banksii naso*) – Vulnerable

State listed matter

- SCP3b - Corymbia calophylla - Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain (SCP 3b TEC) - Vulnerable

Whole of Environment, Environmental Value:

- Wetlands - Conservation Category (CCW) and Resource Enhancement Wetlands (REW)

Offsets in relation to the above have been identified in keeping with the requirements of the:

- EPBC Environmental Offsets Policy (the Offsets Policy) (DSEWPaC 2012a),
- Offsets Assessment Guide (the Offsets Guide) (DSEWPaC 2012b),
- Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain Ecological Community (Conservation Advice for Banksia Woodlands TEC) (Threatened Species Scientific Committee, 2016), and
- EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Black-Cockatoo, Calyptorhynchus latirostris (Endangered), Baudin's Black-Cockatoo, Calyptorhynchus baudinii, (Vulnerable) and Forest Red-Tailed Black-Cockatoo, Calyptorhynchus banksii naso (Vulnerable) (DSEWPaC. 2012c20).

This section of the document outlines the Offsets Guide inputs and outputs for the proposed offsets for the residual impacts resulting from the Airport North Project (Table 12-1).

Table 12-1 Maximum residual impact to environmental values within the Airport North MDP area

Environmental Values	EPBC Act Conservation Status	Quantified Impact
Banksia Woodlands of the Swan Coastal Plain ecological community – Threatened Ecological Community (TEC)	Endangered	33.38 ha
Conospermum undulatum	Vulnerable	12 individuals
Foraging habitat for: Carnaby's Black-Cockatoo (CBC) (*Calyptorhynchus latirostris*)	Endangered	180.33 ha

Environmental Values	EPBC Act Conservation Status	Quantified Impact
Foraging habitat for: Forest Black-Cockatoos (*Calyptorhynchus banksii naso*)	Vulnerable	83.11 ha
Potential Black Cockatoo Nesting Hollows	Endangered/ Vulnerable	4
3b TEC Swan Coastal Plain Threatened Ecological Community (SCP 3b TEC)	N/A	14.49
Wetlands (Conservation Category (CCW) and Resource Enhancement (REW))	N/A	44.2 ha (excludes Wetland 1)

Carnaby's Black-Cockatoos can forage on a larger range of plant species than Forest Red-tailed Black-Cockatoos, and as such, impacts for Carnaby's Black-Cockatoo have been considered separately to the Forest Red-tailed Black-Cockatoo species.

The proposed offsets for the Airport North project include an offsite land purchase component for residual impacts to the Banksia Woodlands TEC, with this offset also contributing to the offset required for residual impacts to Black-Cockatoos. A land purchase and/or restoration offset will comprise the remaining requirements to address the residual impacts to Black-Cockatoos. Wetlands residual impacts will be offset through either a land purchase or restoration component. A land purchase and/or restoration offset will comprise the requirements to address the residual impacts to SCP 3b TEC. The proposed offsets and associated impacts are illustrated in Figure 12-1.

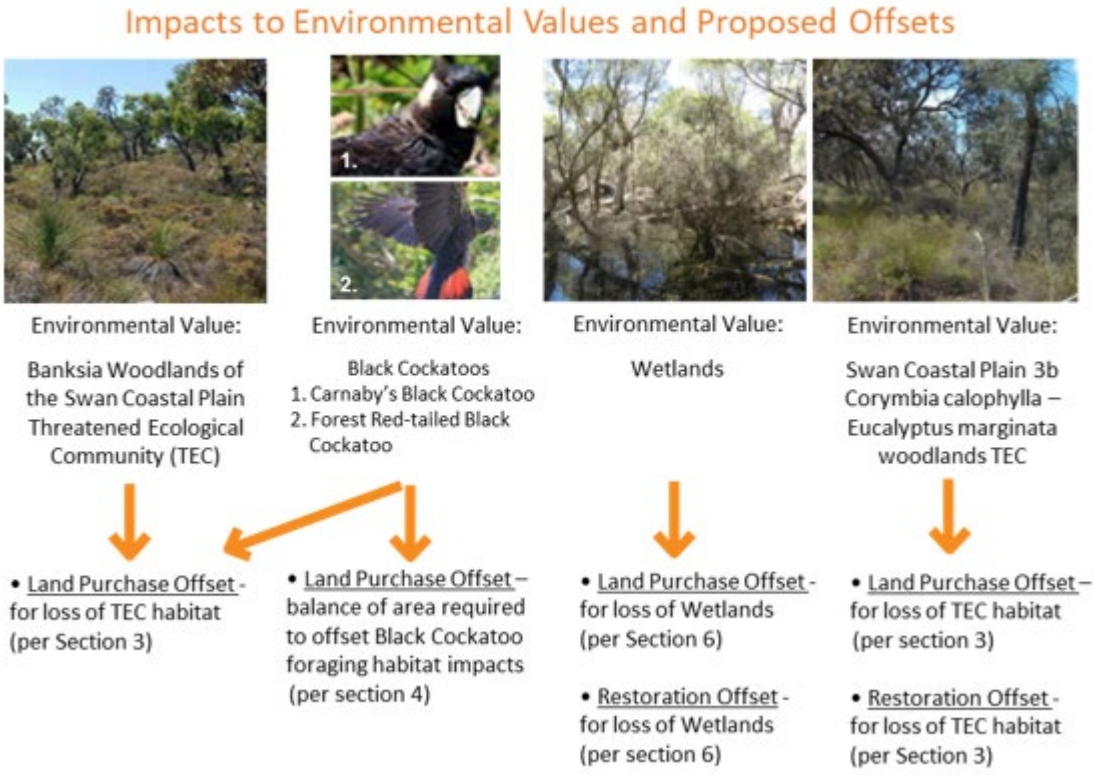


Figure 12-1 Overview of Proposed Offsets to mitigate residual impacts of the Airport North project

Source: Perth Airport

12.1 Application of the Offsets Guide

The Offsets Guide (DSEWPaC, 2012b) is used to support application of the EPBC Offsets Policy (DSEWPaC, 2012a). It is a calculation tool to assist in determining the suitability of offset strategies. It includes four parts:

- Matter of National Environmental Significance (MNES) assessment table,
- Impact Calculator,
- Offset Calculator, and
- Summary Box.

The document 'How to Use the Offsets Assessment Guide' (DSEWPaC, 2012c), together with consultation with the DCCEEW on various elements during the process of calculating the offsets, has been used to inform inputs to the Offsets Guide. Table 12-2 summarises the inputs required for completing the Offsets Guide.

Table 12-2 Required Inputs for the Offsets Assessment Guide

GUIDE PART	INPUT ITEM	EXPLANATION
MNES Table	MNES Table	The Offsets Assessment Guide requires the name and conservation status of the impacted protected matter as listed under the EPBC Act. Separate worksheets are required for each impacted protected matter. The Offsets Assessment Guide allows for overlapping offset requirements for multiple species/ecological communities if one offset can compensate for impacts to more than one species/ecological community. Where the matter is not an MNES, the values will default to those used by the State agency responsible for Offsets, Department of Water and Environmental Regulation (DWER)
Impact Calculator	Protected Matter Attributes	Protected matter attributes show the various options to calculate a suitable offset depending on a protected matter's habitat or ecology that a proposed action may be likely to impact. For example, area of habitat, area of community or birth rate. The attribute that most effectively captures the nature of the residual impact should be selected. The same attribute should be selected in both the impact calculator and the offset calculator.
	Impact Description Column	This column requires a description of the impacts that the proposed action is likely to have on the species/ecological community to be offset.
	Quantum of Impact	The quantum of impact assesses how big the impact is. It integrates considerations of the area of impact and quality of habitat to provide a total quantum of impact. Quality of habitat is based on the Habitat Quality Score.
	Information Source	This section requires a list of information sources on which the conclusions are based. These may include consultancy reports, vegetation mapping, scientific articles or field data. It does not affect the offset calculation but provides an important reference point.
Offset Calculator	Protected Matter Attributes	The same attribute should be selected in both the impact and offset calculators. Once selected, the total quantum of impact column is automatically populated from the impact calculator.
	Offset Description Column	The Offsets Assessment Guide requires a description of the proposed offset. This does not affect the calculation but provides important information about the proposed offset.
	Time Horizon Over Which Loss is Averted	This captures the time over which averted loss can be calculated. This is capped at 20 years or the life of an offset, whichever is shorter.
	Time until Ecological Benefit	This is the estimated time that it will take for the habitat quality improvement of the proposed offset to be realised. Shorter time frames until ecological benefits are realised are valued more highly than longer timeframes.
	Offset Start Area and Quality	This is the current area and quality of the proposed offset. It is based on the Habitat Quality Score (HQS) of the offset.
	Risk of Loss (%)	This considers risk of loss under two scenarios (with and without offset).

GUIDE PART	INPUT ITEM	EXPLANATION
		Risk of Loss (per cent) without offset: This is a percentage figure that describes the chance that the habitat on the proposed offset site will be completely lost over the foreseeable future (either the life of the offset or 20 years, whichever is shorter). Risk of Loss (per cent) with offset: This describes the chance that the habitat on the proposed offset site will be lost over the foreseeable future (either the life of the offset or 20 years, whichever is shorter), if the site becomes an offset.
	Confidence in Result (%)	Confidence in result is a percentage that records the level of certainty regarding the success of the proposed offset. Proposed offset actions that are designed to have a lower risk of failure should have a higher confidence in result score. For the "area of community" and "area of habitat" attributes, there are two components to which confidence in result relates: Change in habitat quality: the confidence in result captures the level of certainty about the successful achievement of the proposed change in quality. Averted loss: the confidence in result captures the level of certainty about the strength and effectiveness of the proposed risk-mitigation measures and the capacity of these measures to mitigate the risk of loss of the site.
	Net Present Value (adjusted hectares)	The Offsets Guide calculates the net present value of the proposed offset taking into account the annual probability of extinction, the time horizon and the adjusted gain. It is used to reflect the fact that a given benefit (i.e. improving habitat quality or averting loss) today holds more value for a protected matter than the same benefit realised in the future.
Summary of Inputs	Summary Box	The summary box incorporates the cost of the direct offset and the percentage of impact that has been offset to determine the cost associated with other compensatory measures. All values are automatically populated from the offset calculator.

Source: Perth Airport / DSEWPaC

12.2 Habitat Quality Score

A key input for the Offsets Assessment Guide is the Habitat Quality Score (HQS) for both the impact site and the proposed offset site. The HQS is a measure of how well a particular site supports a specific ecological community or threatened species and contributes to its ongoing viability. It needs to be assessed consistently in both the Impact and Offset Calculators of the Offsets Guide.

The HQS assessment methodology is shown in Figure 12-2 and is based on the following three components:

- Site condition is the condition of a site in relation to the ecological requirements of an ecological community or threatened species. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features.
- Site context is the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of an ecological community. This includes the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species or community.
- Stocking rate is the usage and/or density of a species at a particular site. This principle acknowledges that a particular site may have a high value for a particular threatened species, despite appearing to have poor condition and/or context. It includes considerations such as survey data for a site for a particular species population or, in the case of a threatened ecological community this may be a number of different populations. It also includes consideration of the role of the site population with regard to the overall species population viability or community extent.

Figure 12-2 Required components of a Habitat Quality Score (HQS)

Source: Perth Airport

These components contribute to the final HQS. However, the application of, and weighting given to, each component is dependent on the ecological requirements of the impacted species or ecological community.

Overall, key considerations in determining the habitat quality of threatened species or an ecological community include:

- Evaluation of the key ecological attributes of the species or ecological community (habitat requirements and variability, lifecycle and population dynamics, movement and distribution patters, and threatening processes); and
- Determination of site characteristics in relation to the species or ecological community ecology (site condition, site context and species stocking rate).

Further discussion on the HQS methodology that has been developed in line with requirements of the Offsets Assessment Guide specifically for the required offsets is outlined in the below listed sections.

Perth Airport has worked with suitable qualified experts and DAWE/DCCEEW on previous MDP approvals to develop habitat quality score methods for protected matters where relevant to ensure the quality at impact and offset site is consistently assessed both within the Airport Estate and at offset sites. These habitat quality methods have been applied for the relevant matters. Table 12-3 summarises the status of the Habitat Quality Score method for each protected matter.

Table 12-3: Summary of Habitat quality score determination

Protected Matter	Habitat Quality Score Method	Status
Banksia Woodlands of the Swan Coastal Plain ecological community – Threatened Ecological Community (TEC)	Developed by Woodman Environmental	Endorsed by DCCEEW
Foraging habitat for: Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*)	Developed by Bamford Consulting Ecologists	Endorsed by DCCEEW
Forest Black-Cockatoos (*Calyptorhynchus banksii naso*)	Developed by Bamford Consulting Ecologists	Endorsed by DCCEEW
Wetlands (Conservation Category and Resource Enhancement)[1]	Developed by DCCEEW*	In Draft
Swan Coastal Plain 3b Corymbia calophylla – Eucalyptus marginata woodlands TEC (SCP 3b TEC)	In Development	In Development

[1]It should be noted that previous Commonwealth MDP approvals have defined wetlands as "Wetland(s) means Wetland – Conservation Category and Wetland – Resource Enhancement".

"Wetland – Conservation Category means wetlands that support a high level of attributes and functions and has the highest priority management measures. This classification is determined within the Geomorphic Wetlands of the Swan Coastal Plain (GWSCP) dataset accepted by the Western Australian planning and regulatory bodies as the primary dataset for wetlands in the region."

"Wetland – Resource Enhancement means wetlands which may have been partially modified but still support substantial ecological attributes and functions and require priority management measures. This classification is determined within the GWSCP dataset accepted by Western Australian planning and regulatory bodies as the primary dataset for wetlands in the region."

** Method in draft format yet to be finalised*

12.3 Predicted Impacts of the Proposal

12.3.1 Banksia Woodlands TEC Impact Area

Up to 33.38 ha in four patches of Banksia Woodlands TEC impacted by Airport North will require offsets(Figure 12-3).

Woodman Environmental (2020) has conducted an estate-wide survey and assessment of the TEC and assessed patches that meet the requirements of Banksia Woodlands TEC as defined by the Conservation Advice (DoE 2016). Figure 12-4 provides the HQS of each of the Banksia TEC patches within the project area being impacted.

It is important to note that indirect impacts to Patch 14 (0.02), Patch 15 (0.27) and Patch 16 (0.02) are considered within the offset impacts assessed in this section for Airport North.

The overall HQS of Banksia TEC for the Airport North impact, based on individual patch habitat quality and weighted by area, is six out of ten as shown in Table 12-5.

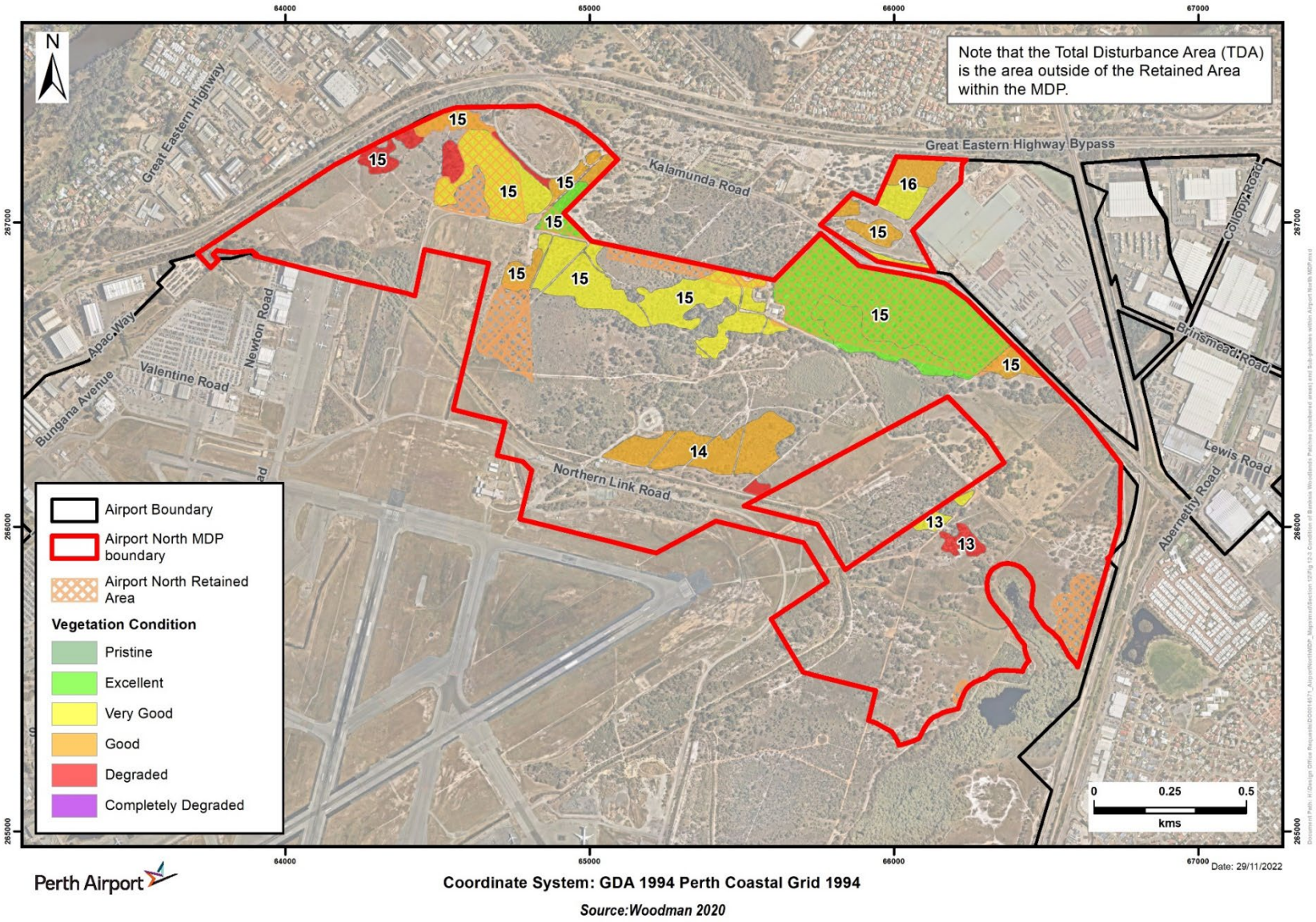


Figure 12-3 Condition of Banksia Woodlands TEC Patches (numbered areas) and Sub-patches within Airport North MDP

Table 12-4 Habitat Quality Score for Banksia Woodlands TEC at Impact Sites

COMPONENT	DCCEEW SUB-COMPONENTS	13	14	15	16
Site Condition (70%)	**Vegetation condition (Keighery 1994)** Pristine (100 Excellent (80) Very Good (60) Good (40) Degraded (20) Completely Degraded (0)	51.72	39.05	64.10	49.49
	Species richness Average native species richness within the top half of recorded range for the TEC (10) Less than average native species richness within the top half of the recorded range for the TEC (0)	10	10	10	10
	Presence of Threatened taxa Patch is critical habitat for and hosts Threatened taxa (10) Patch is critical habitat for Threatened taxa (5) Patch is not critical habitat for Threatened taxa (0)	5	5	5	5
	Contains State listed TEC/PEC Patch contains WA Floristic Community Type (FCT) listed as a State TEC (20) Patch contains WA Floristic Community Type (FCT) listed as a State PEC (10)	10	10	10	10
	Presence of Dieback Patch is Dieback free (10) Patch is partly Dieback free (5) Patch is Dieback infested (0)	5	5	5	5
	Condition Total (150)	81.72	69.05	94.10	79.49
	Condition Total /150 *70	**38**	**32**	**44**	**37**
Site Context (30%)	**Connectivity** Patch is continuous with remnant native vegetation and forms a corridor that links different landscape units (30) Patch is continuous with remnant native vegetation that forms a medium to large local remnant (20) Patch is in close proximity to (within 1 km) of other medium to large remnants (10) Patch is within 12 km*3 of other significant remnants and contributes to support of significant avifauna (i.e. known Black Cockatoo Breeding sites are located within 12km of the patch) (5) Patch is not within 12km of other remnants and is not known to support significant avifauna (0)	20	20	20	20
	Patch size 20ha (50) 10 - 20 (40) 5 -10ha (30) 2 - 5ha (20) <2ha (10)	30	30	50	20
	Site location and risk Patch located in an area where the TEC has been extensively cleared (10) Patch located at the geographical edge of the recorded range (10)	10	10	10	10
	Context Total (out of 100)	60	60	80	50
	Context score (Context total / 100 * 30)	**18**	**18**	**24**	**15**
Quality total (100)	**Condition Score + Context Score**	**56**	**50**	**68**	**52**
Quality (10)	**Quality total / 10**	**6**	**5**	**7**	**5**

Source: Perth Airport

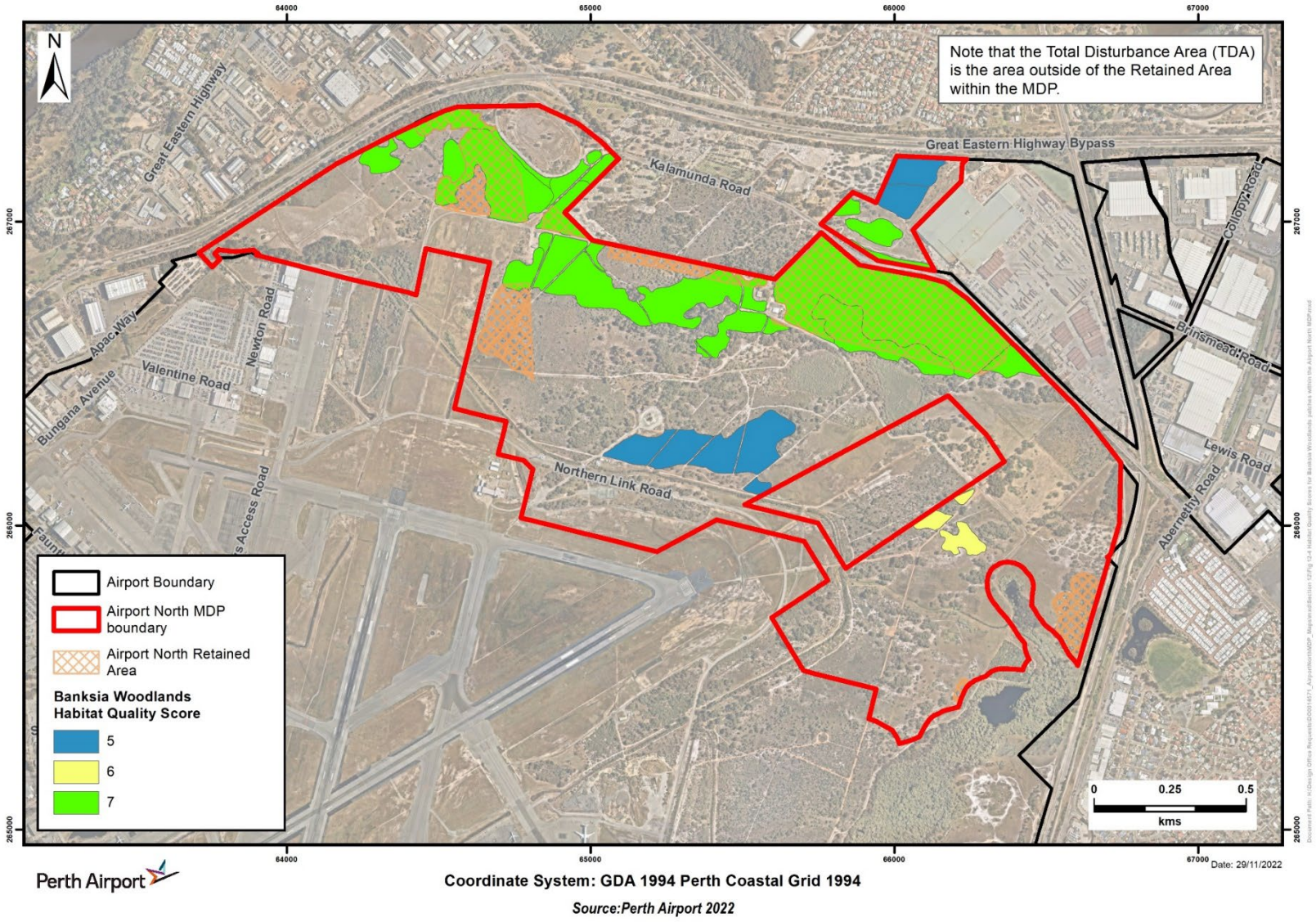


Figure 12-4 Habitat Quality Scores for Banksia Woodlands TEC patches within the Airport North MDP

Perth Airport

Table 12-5 Overall Banksia Woodlands TEC Habitat Quality Score for the Airport North project

PATCH NUMBER	IMPACT AREA (HECTARES)	HABITAT QUALITY SCORE (10)	WEIGHTED SCORE (AREA X HQS)	OVERALL HABIT QUALITY SCORE
13	1.72	5.61	10	
14	7.17	5.02	36	
15	21.55	6.79	146	
16	2.81	5.21	15	
Total	33.25		207	
Average				5.66
Weighted Average Score				6.22
Overall Habitat Quality Score (to nearest whole number)				6

Source: Perth Airport

12.3.2 Black-Cockatoo Foraging Habitat Impact Area

Bamford Consulting Ecologists (BCE 2020) conducted an estate-wide survey and assessment of the Black-Cockatoo species foraging habitat and suitable nesting trees. Foraging habits and habitats differ between those of the CBC and those of FRTBC. CBC forage on a larger range of plant species than FRTBC, including pasture grass weeds that account for the larger foraging area within the Airport North MDP. To account for this variability, impacts for CBC have been considered separately to the FRTBC. BCD (2022) conducted a habitat quality assessment as part of the Environmental Impact Assessment for Airport North to determine the HQS for offset assessment of the impact area (see Table 13, Table Appendix 7, BCE 2022).

The MDP will require clearing of up to 180.33 ha of CBC foraging habitat (Figure 12-5); and up to 83.11 ha of FRTBC foraging habitat (Figure 12-6). In addition, four potential Black Cockatoo nesting trees are within the TDA.

The HQS for CBC (4) and FRTBC (6) are presented in Table 12-6.

Table 12-6 Black-Cockatoo HQS of the Airport North MDP (BCE 2022)

TDA Area (ha)	Foraging score	Site Context (0 to 3)	Species Density / Presence (0 to 1)	HQS Score
Carnaby's Black-Cockatoo				
33.32	0	0	0	
104.5	1 – Negligible to Low	0	0	1
1	2 – Low	0	0	2
11.65	3 – Low to Moderate	3	1	7
46.42	4 – Moderate	3	1	8
14.12	5 – Moderate to High	3	1	9
2.64	6 - High	3	1	10
		Weighted Average Score		*3.95* ***(HQS 4)***
Forest Red-tailed Black-Cockatoo				
130.54	0	0	0	0
16.59	1 – Negligible to Low	0	0	1

TDA Area (ha)	Foraging score	Site Context (0 to 3)	Species Density / Presence (0 to 1)	HQS Score
8.07	**2 – Low**	0	0	**2**
17.05	**3 – Low to Moderate**	2	1	**6**
8.85	**4 – Moderate**	2	1	**7**
32.55	**5 – Moderate to High**	2	1	**8**
0.00	**6 - High**	2	1	**9**
			Weighted Average Score	*6.21* ***(HQS 6)***

Source: Bamford Consulting Ecologists, 2022

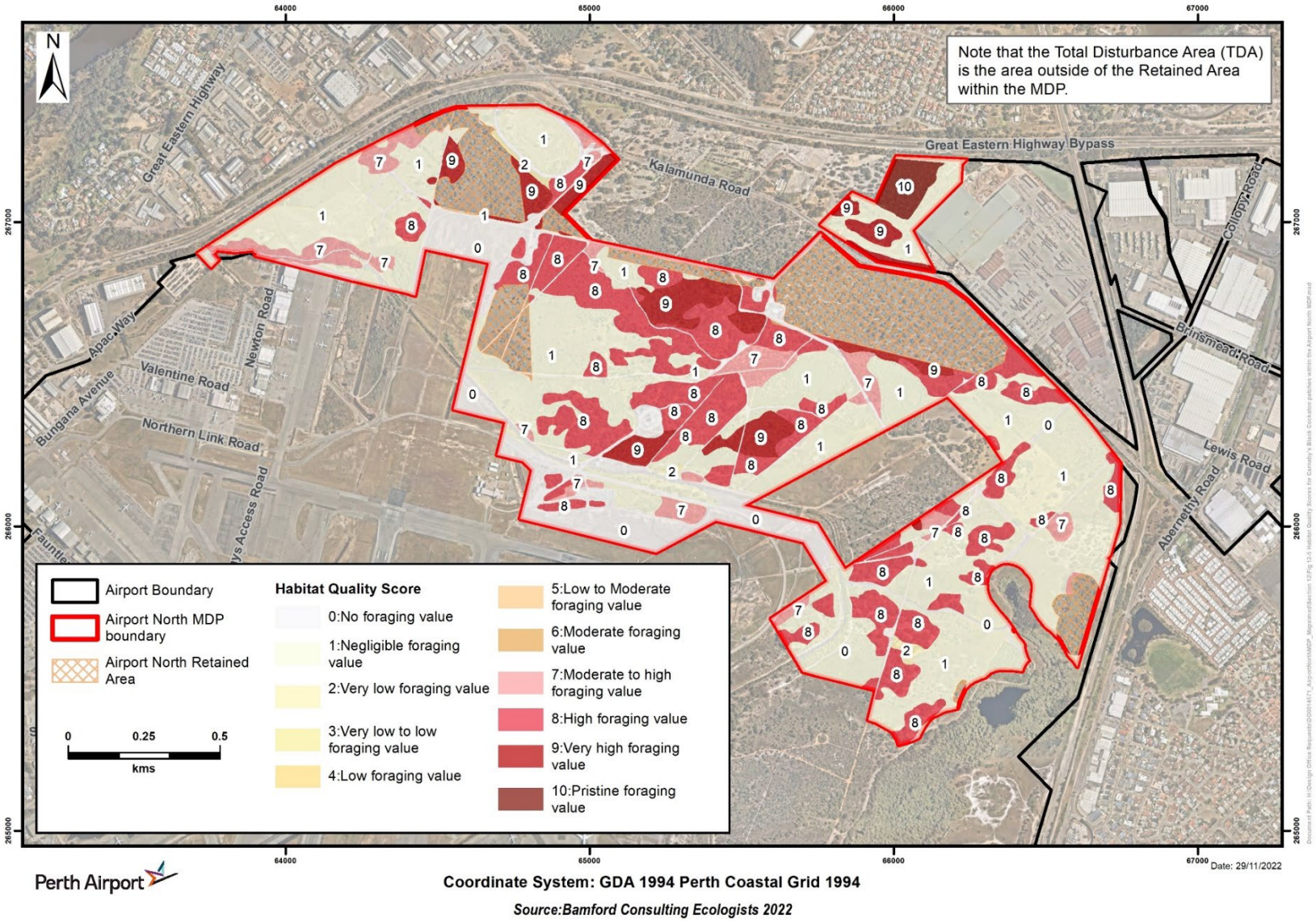


Figure 12-5 Carnaby's Black Cockatoo HQS

Perth Airport

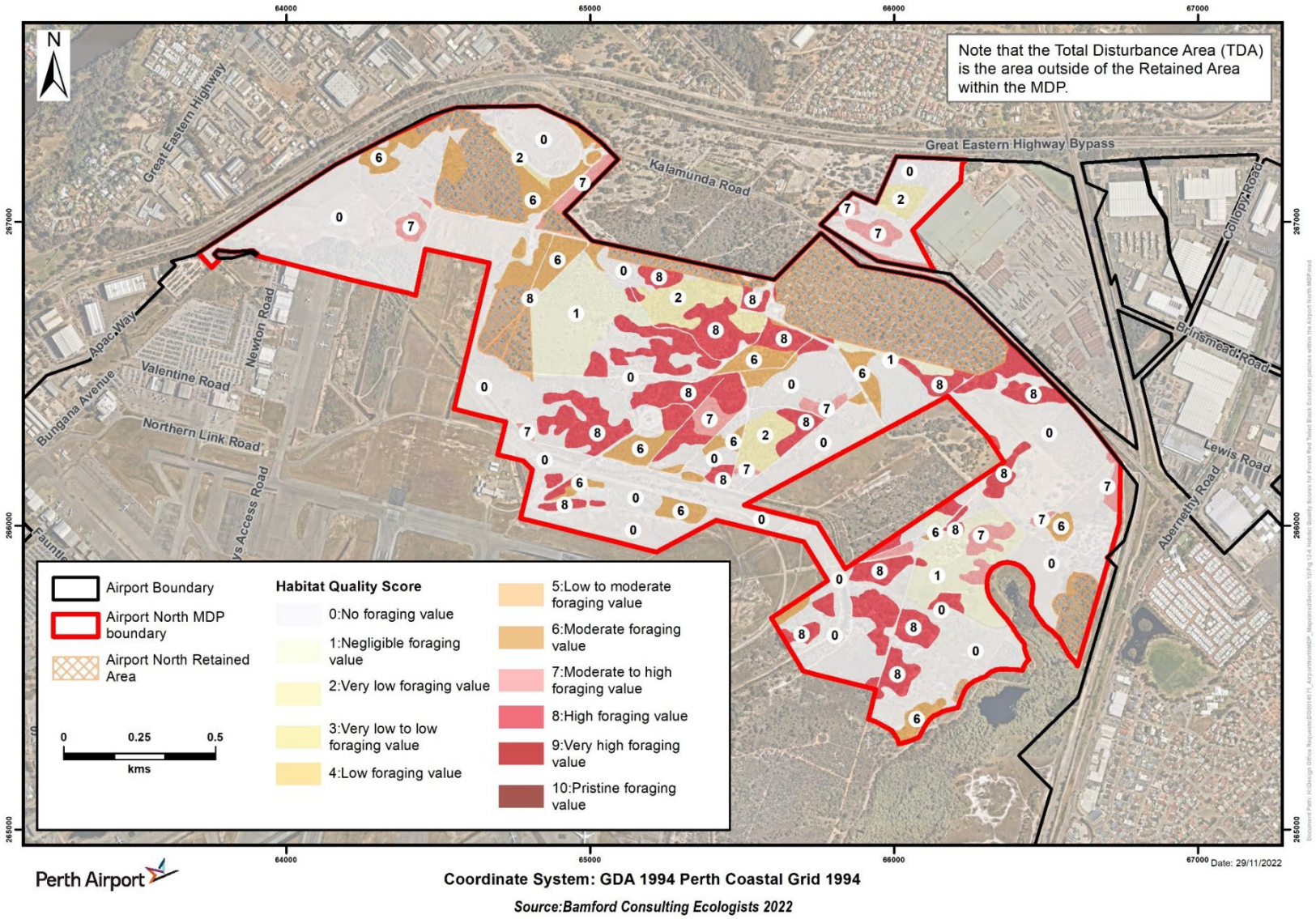


Figure 12-6 Forest Red-tailed Black Cockatoo HQS

12.3.3 Wetlands Impact Area

The Airport North MDP will result in the clearing of up to 45.3 ha of Wetlands comprised of 12 individual wetland with 5 CCW and 7 REW. These wetlands were assessed by Woodman Environmental (2000) during an estate-wide vegetation survey and were subsequently re-assessed and mapped by ELA (2019) during an estate-wide wetland assessment. Each wetland on the Estate has been assigned a number (Wetland ID) which has been used throughout this section for the purpose of identification and discussion of the MDP impact area wetlands (Table 12-7).

Table 12-7 Characteristics and area of wetlands located within the Airport North MDP disturbance area

Wetland ID	Area (ha) within MDP	Conservation Category (ELA 2019)
1[1]	1.1	Conservation Category Wetland
3	2.8	Conservation Category Wetland
36	2.6	Conservation Category Wetland
41	8.3	Conservation Category Wetland
42	4.9	Conservation Category Wetland
2	5.9	Resource Enhancement Wetland
35	0.03	Resource Enhancement Wetland
37	15.0	Resource Enhancement Wetland
45	2.7	Resource Enhancement Wetland
46	0.4	Resource Enhancement Wetland
47	1.7	Resource Enhancement Wetland

Note 1: Wetland vegetation not proposed for offsetting

A small area (1.1 ha) Munday Swamp (Wetland 1) currently sits within the TDA for the North MDP, however as this is solely for the purposes of undertaking restoration works and improving the 'Degraded' vegetation condition. The contributing offset for this work has not been considered here.

The four CCW (Excluding Munday Swamp) account for 44% (18.6 ha) of the total wetland area to be cleared, with 58% (25.7 ha) attributed to the seven REW (Figure 12-7). Vegetation condition varies from Completely Degraded to Excellent, with a majority of remnant wetland vegetation in Good to Very Good condition (Figure 12-7).

Table 12-8 and Figure 12-8 provide the proposed HQS (using the ***Wetland Evaluation of the Swan Coastal Plain*** [WESCP) HQS framework) of each of the 11 wetlands directly impacted by the MDP clearing. The overall HQS of directly impacted Wetlands, based on individual wetland HQS weighted by area (ha), is 5 out of 10 as shown in Table 12-9.

Table 12-8 Habitat Quality Score for the Wetland Impact Sites within Airport North MDP

		Wetland ID									
Component	Sub-Component	2	3	35	36	37	41	42	45	46	47
Site Condition (70%)	Wetland Condition EPBC Weighted: 89%	0.3	0.4	0.4	0.2	0.3	0.4	0.4	0.4	0.4	0.3
	Vegetation Complex Rarity EPBC Weighted: 11%	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1
	Condition Total	0.4	0.5	0.5	0.3	0.3	0.5	0.5	0.4	0.5	0.4
	Condition Score (Condition Total * 7)	2.5	3.7	3.4	2.1	2.3	3.2	3.4	2.9	3.7	2.8
Site Context (30%)	Habitat buffer EPBC Weighted: 29%	0.3	0.3	0.1	0.3	0.3	0.3	0.3	0.1	0.3	0.3
	Surrounding Bushland Viability EPBC Weighted: 42%	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.1	0.3	0.3
	Regional Linkages EPBC Weighted: 29%	0.2	0.2	0.0	0.1	0.0	0.2	0.2	0.1	0.2	0.2
	Context Total	0.7	0.7	0.4	0.7	0.6	0.7	0.7	0.3	0.7	0.7
	Context score (Condition Total * 3)	2.1	2.2	1.1	2.2	1.7	2.2	2.2	0.9	2.2	2.1
Wetland Unit HQS (out of 10)	Condition Score + Context Score	5	6	5	4	4	5	6	4	6	5

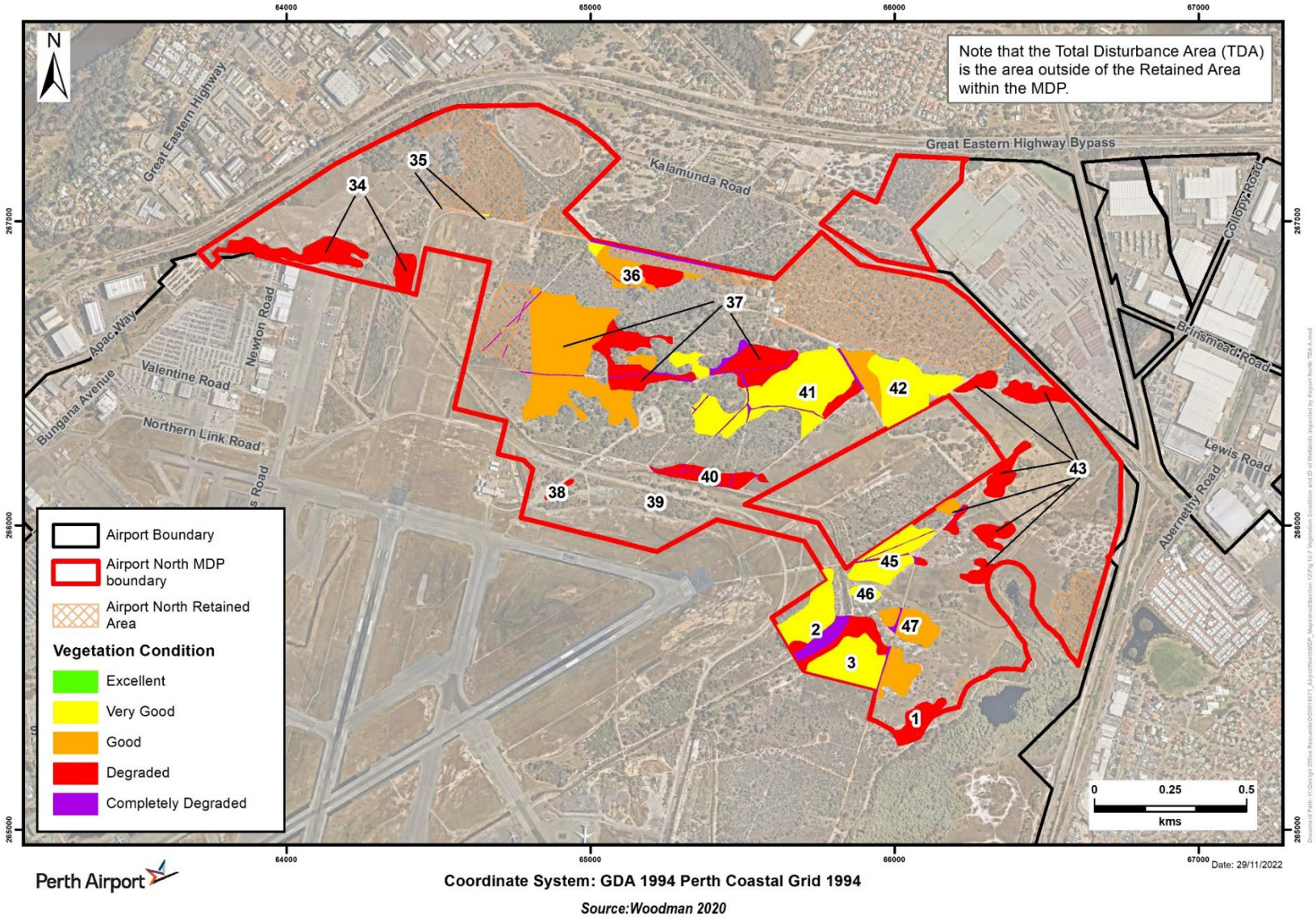


Figure 12-7 Vegetation Condition of Wetlands within the Airport North MDP

Perth Airport

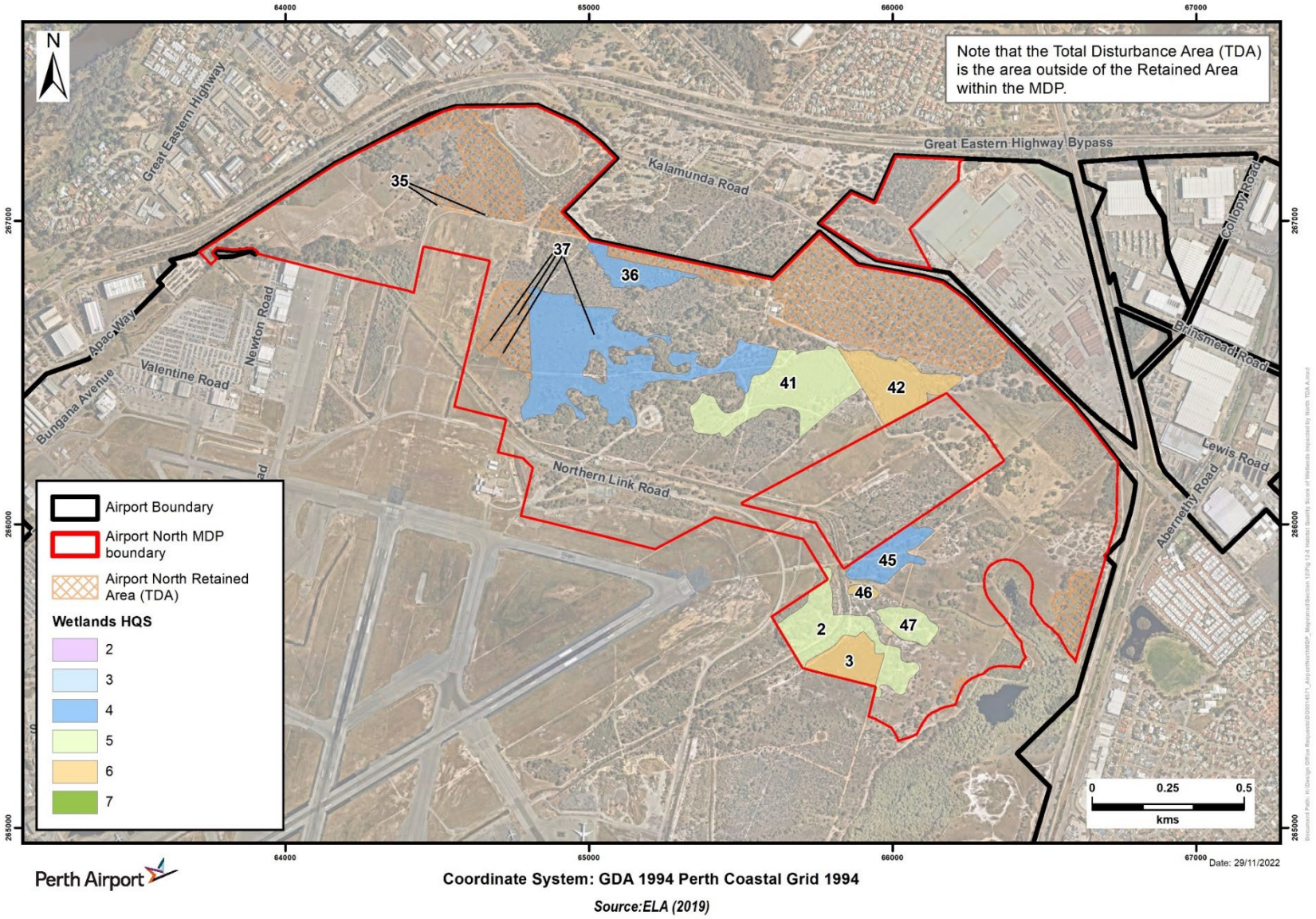


Figure 12-8 Habitat Quality Score of Wetlands impacted by clearing within the Airport North MDP

Perth Airport

Table 12-9 Overall Wetlands Habitat Quality Score for the Airport North MDP

Wetland ID	Impact Area (hectares)	Habitat Quality Score (10)	Weighted Score (Area HQS)	Overall Habit Quality Score
2	5.9	4.6	27.0	
3	2.8	5.9	16.4	
35	0.0	4.6	0.1	
36	2.6	4.3	11.2	
37	15.0	4.1	61.1	
41	8.3	5.4	44.4	
42	4.9	5.6	27.4	
45	2.7	3.8	10.5	
46	0.4	5.8	2.1	
47	1.7	4.9	8.2	
Total	44.2		208.3	
Average				4.89
Weighted Average Score				4.71
Overall Habitat Quality Score (to nearest whole number)				5

12.3.4 SCP 3b TEC Impact Area

The potential direct impacts of the MDP on the SCP 3b TEC will reduce the community's extent by 14.49 ha representing 88.41% of the 16.39 ha occurrences in the airport estate. Although the entire occurrence is predominately dieback infested, this does not appear to be adversely affecting its condition.

The significant residual impacts to 14.49 hectares of SCP 3b TEC impacted by Airport North will require offsets (Figure 12-9).

Perth Airport are working with West Australian ecological consultants to develop a Habitat Quality Score methodology specific to the SCP 3b TEC to enable assessment of both impact site and suitability of potential offset sites. This method will be presented to DCCEEW as an HQS methodology does not currently exist.

12.3.5 Conospermum undulatum Impact

A total of 12 individuals of *C. undulatum* impacted by Airport North will require offsets.

Perth Airport are working with West Australian ecological consultants to develop a Habitat Quality Score methodology specific to the SCP 3b TEC to enable assessment of both impact site and suitability of potential offset sites. This method will be presented to DCCEEW as an HQS methodology does not currently exist.

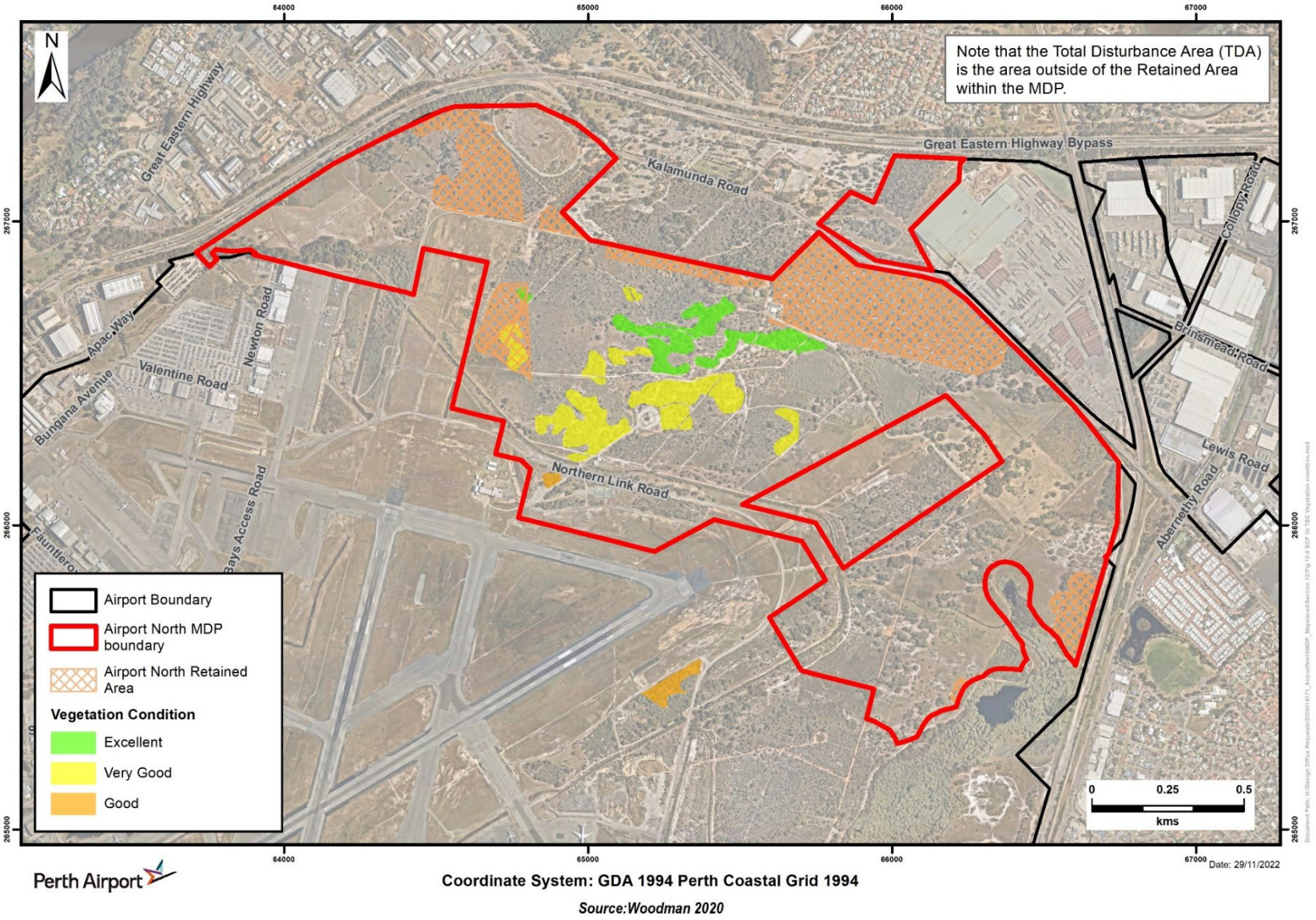


Figure 12-9 Vegetation Condition of impacted SCP 3b TEC within the Airport North MDP

Perth Airport

12.4 Proposed Offset Method

This section provides a general description on how each of the protected matters are proposed to be offset.

12.4.1 Proposed Offset Method for Banksia Woodlands TEC

Perth Airport are pursuing several options in developing a package of offsets to counterbalance the residual impacts of the Airport North MDP to Banksia Woodlands TEC. The finalised offset type is yet to be selected by Perth airport pending Spring survey results and negotiations with landowners and State departments. Perth airport intend that final selection of these options will occur prior to the submission of the Draft MDP.

Offset site(s) for land acquisition will be selected based on site characteristics with a preference given to land that:

- increases the size and or connectivity of existing patch/es of the Banksia Woodland TEC;
- has either secure tenure within the existing conservation estate, or is currently managed for the purposes of conservation, or will be vested in the State's conservation estate;
- has as few threats to the success of the restoration or retention as possible (e.g. significant or declared weeds, evidence of Phytophthora dieback etc.);
- will be acquired and conserved and/or restored TEC within the Swan Coastal Plain; and
- improves the condition of remnants and corridors in the Swan Coastal Plain through removing fragmentation and threats to the remnants.

Vegetation community types associated with the Banksia Woodlands TEC are relatively common on the central Swan Coastal Plain, therefore Perth Airport considers that it is highly likely it will be able to deliver sufficient offsets for the loss of up to 33.38 ha of Banksia Woodlands TEC.

12.4.1.1 Direct Offset: Land Acquisition

The method for offsetting 100% of the residual impact to the clearing of up to 33.38 ha of Banksia Woodlands TEC within the MDP, will be land purchased and transferred to DBCA to be managed as conservation estate (Land Acquisition).

Table 12-10 and Table 12-11 summarises the inputs and outputs of the Offsets Assessment Guide, for direct Land Purchase to offset 100% of the impact to 33.38 ha of the Banksia Woodland TEC. Based on the site information listed in Table 12-10, the direct offset requires 218 ha to address 100% of the loss of 33.38 ha of Banksia Woodland TEC habitat for the MDP.

The details of the final offset site(s) will be outlined within an Offset Management Plan (OMP) on finalisation of Spring survey results, negotiations with landowners and site endorsement by State/Federal environment departments.

Table 12-10 Summary of Preliminary Offsets Assessment Guide Inputs for Land Acquisition to offset 100% of Banksia Woodlands TEC impact

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	33.38	This value represents the maximum area of Impact to Banksia Woodlands within the Project area.
Quantum of impact – quality (HQS)	6	The Habitat Quality Score of the Banksia Woodlands impact area as defined by the Habitat Quality Scoring Framework.
Time over which loss is averted	20	It is expected that the offset site will be either part of an existing conservation estate or under an existing conservation covenant. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.

Offset Calculator Attribute	Input/ Output	Explanation
Time until ecological benefit	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	6	The offset site to be selected will have a minimum HQS of 6 to achieve a like-for-like offset to the impact area, however this will be amended on selection of offset sites as preservation of higher quality areas is of greater benefit to the TEC and reduces the offset liability.
Future quality without offset (scale 1-10)	5	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	6	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	218	The area calculated using the EPBC Offsets Assessment Guide that meets 100% minimum criteria of Percentage of Impact Offset.
Risk of Loss (%) without offset	6	The risk of loss of 6 per cent has been allocated as this is the derived risk of loss of vegetation around the Perth Airport area. On final selection of offset sites, risk of loss will be updated to account for security of tenure as per the PAPL Risk of Loss framework (Perth Airport 2018).
Risk of loss (%) with offset	0	The offset site(s) chosen will be placed within a conservation estate. The offset should guarantee the protection of the site for the life of the permit.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	100.32	The offset adequately compensates for 100% of the impact.

12.4.2 Proposed Offset Method for Black-Cockatoos

Perth Airport are pursuing several options in developing a package of offsets to counterbalance the residual impacts of the Proposal to Black Cockatoo Foraging Habitat. The finalised offset site is yet to be selected by PAPL pending final offset site survey results, consultation with DBCA, negotiations with landowners, DCCEEW and State Government departments. Perth airport intend that final selection of these options will take prior to the submission of the Draft MDP.

Offset site(s) will be selected based on site characteristics with a preference given to land that:

- Increases the area of Black Cockatoo habitat that meets the species foraging requirements as per the HQS.
- Improves the condition of remnant vegetation and corridors within the species habitat range through removing fragmentation and threats to the remnants.
- Maximises 'like for like' offset outcomes.

Land purchased and managed for the purpose of meeting Banksia Woodlands TEC Land Acquisition Offset requirements (discussed in Sections 12.4.1.1) may also be utilised for Black Cockatoo foraging habitat offset, providing the site(s) selected meet the diagnostic criteria and the minimum HQS requirements for the targeted species.

Vegetation community types associated with Black Cockatoo Foraging Habitat (including the Banksia Woodlands TEC) are relatively common on the central Swan Coastal Plain, therefore Perth Airport considers that it is highly likely it will be able to deliver sufficient offsets for the loss of up to 180.33 ha of CBC habitat and up to 83.11 ha of FRTBC foraging habitat.

12.4.2.1 Direct Offset: Land Acquisition

To offset 100% of the residual impact to the clearing of up to 180.33 ha of CBC habitat, including up to 83.11 has of FRTBC habitat, Perth Airport propose to undertake land purchase of existing Black Cockatoo native foraging habitat and vesting within conservation estate.

A portion of the Land Acquisition Offset required for CBC may also be met by the Banksia Woodlands TEC Land Acquisition Offset (discussed in Section 12.4.1.1). Additionally, land purchased for FRTBC foraging habitat may also provide foraging habitat for CBC.

Based on the information listed in Table 12-11, the direct offset requires 522 ha to address 100% of the loss of 180.33 ha of CBC habitat and 290 ha to address 100% of the loss of 83.11 ha of FRTBC habitat.

The details of the final offset site(s) will be outlined within an OMP on finalisation of Spring survey results, negotiations with landowners and site endorsement by State/Federal environment departments.

Table 12-11 Summary of Preliminary Offsets Assessment Guide Inputs for Land Acquisition to offset 100% Carnaby's (CBC) and Forest Red-tailed Black-Cockatoo (grouped as FRTBC) foraging habitat impact

Offset Calculator Attribute	Input - CBC	Input - FBC	Explanation
Quantum of impact – area (ha)	180.33	83.11	These values represent the maximum area of Impact to CBC and FRTBC foraging habitat within the Project area, however these are expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	4	6	The Habitat Quality Score of the Black Cockatoo foraging habitat impact area as defined by the HQS Framework
Time over which loss is averted	20	20	It is expected that the offset site will be either part of an existing conservation estate or under an existing conservation covenant. If not, it will be transferred into conservation estate. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be considered.
Start quality (scale of 1-10)	4	6	The offset site(s) selected will have a minimum HQS equivalent to those of the Impact area to achieve a like-for-like offset, however, offset site selection aims to preserve areas of higher foraging value.
Future quality without offset (scale 1-10)	3	5	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	5	7	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management. Protection of the offset

Offset Calculator Attribute	Input - CBC	Input - FBC	Explanation
			site and management actions are also likely to lead to an improvement in habitat quality over time.
Size of offset area (ha)	522	290	The area which meets 100% minimum criteria of Percentage of Impact Offset.
Risk of Loss (%) without offset	2	2	As offset sites are yet to be finalised so 2% has been used based on an average of those LGA values. On final selection of offset sites, risk of loss will be updated to account for security of tenure as per the PAPL Risk of Loss framework (Perth Airport 2018).
Risk of loss (%) with offset	0	0	The offset should guarantee the protection of the site for the life of the permit.
Confidence in result - averted loss (%)	90	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	85	85	The high confidence score is supported by the established process of acquisition of an offset site and moderated slightly by the change in quality and management over a long time.
Percentage of impact offset *	100.11	100.13	The offset adequately compensates for 100% of the impact.

12.4.2.2 Direct Offset: Nesting Hollow replacement

Through application of the Offset Guide to offset the impact to 9 potential nesting hollows 22 replacement hollows are required to be obtained. Hollow replacements will be sourced via two options:

1) identification of existing hollows within Black Cockatoo foraging offset areas provided to satisfy the requirements to Black Cockatoo foraging impacts as set out in Section 12.4.2.1, or

2) through the installation and maintenance of nest hollows in known breeding areas. The location of nesting hollows will be determined in conjunction with the state DBCA to ensure these are strategically placed for beneficial use by Black Cockatoos.

12.4.3 Proposed Offset Method for Wetlands

Perth Airport are pursuing several options in developing a package of offsets to counterbalance the residual impacts of the MDP to wetlands. The finalised offset type is yet to be selected by Perth airport pending final survey results and negotiations with State Government departments.

In line with the EPBC Offset Policy which requires that the suitability of an offset should be assessed with reference to the impacted attribute, or protected matter, which is defined in this MDP as 'the environment as it relates to wetlands'. Perth Airport propose that the relevant impact that must be offset is the clearing of wetland area as a whole.

The definition of 'wetland' as provided in Section 6 of this MDP refers to two different classifications of wetland, being CCW and REW.

To achieve wetland offsets for this MDP, Perth Airport considers that CCW, or a REW, as defined above will be offset with the same wetland category or better.

To counterbalance the significant residual impacts due to clearing of up to 44.2 ha CCW and REW this strategy proposes the following options:

1) a Restoration Offset, involving the restoration and/or creation of cleared or degraded areas for additional and/or improved wetland within the Swan Coastal Plain,
2) a Land Acquisition Offset that consists of existing wetland or
3) an offset package providing a combination of both land acquisition and restoration (two-part approach).

Existing and/or future wetland habitat will be purchased (Land Acquisition Offset) or restored/created (Restoration Offset), managed for conservation purposes and added to the conservation estate.

The proposed offset site/s will be selected based on site characteristics with a preference given to land that:

- increases the area of functional wetlands within conservation estate;
- increases the size and/or connectivity and/or the quality of existing Wetlands;
- improve the condition of remnants and wetland linkage on the Swan Coastal Plain through reducing fragmentation and threats to the remnants;
- can be managed to have as few threats to the success of the restoration as possible (e.g. significant or declared weeds, evidence of Phytophthora dieback, water security/risk etc.); and
- has either secure tenure within the existing conservation estate, or is currently managed for the purposes of conservation, or will be vested in the State's conservation estate.

Perth Airport considers that it is likely it will be able to deliver sufficient offsets for the clearing of up to 44.2 ha of CCW and REW Wetlands using an offset package providing a combination of both land acquisition and restoration.. Wetlands are also often associated with areas of Banksia Woodlands TEC, for which Perth airport is already sourcing land purchase opportunities.

12.4.3.1 Direct Offset: Land Restoration

The following table summarises the inputs and outputs of the Offsets Guide, for land restoration to offset 100% of the clearing impact to 44.2 ha of Wetlands and based on the information listed, the Restoration Offset component would require 79 ha to address 100% of the impact to be offset for MDP Wetlands.

Table 12-12 Summary of Offsets Assessment Guide Inputs for Wetlands – Restoration Offset for Airport North MDP

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	44.2	This value represents the maximum area of direct impact to Wetlands within the Project area; however this is expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	5	The Habitat Quality Score of the Wetlands impact area as defined by the Habitat Quality Scoring Framework.
Time over which loss is averted	20	It is expected that the final Restoration Offset site will be either part of an existing conservation estate or under an existing conservation covenant. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	Perth Airport recognises that development of restored habitat will take 10 to 20 years to achieve. Habitat function and diversity will not be realised until mature trees dominate the Wetlands and the vegetation has achieved a state where nutrient cycles are in place and the vegetation has achieved a self-sustaining state.
Start quality (scale of 1-10)	3	The Restoration Offset site to be selected will be degraded/ highly degraded and will have a maximum HQS of 3.

Offset Calculator Attribute	Input/ Output	Explanation
Future quality without offset (scale 1-10)	2	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	5	The offset should be like-for-like regarding habitat quality, which would be a minimum score of 5 following restoration to reflect the quality of the impact site. As it is expected that remediation work will result in a higher HQS than the minimum required, these values will be adjusted within the Offset Management Plan.
Size of offset area (ha)	79	The area which meets 100% minimum criteria of Percentage of Impact Offset.
Risk of Loss (per cent) without offset	6	The risk of loss of 6 per cent has been allocated as this is the derived risk of loss of vegetation around the Perth Airport area. On final selection of offset sites, risk of loss will be updated to account for security of tenure as per the PAPL Risk of Loss framework (Perth Airport 2018).
Risk of loss (per cent) with offset	0	The offset site(s) chosen will be placed within a conservation estate. The offset should guarantee the protection of the site for the life of the permit.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	Leading practice restoration methods will be employed and a site suitable for restoration will be selected to ensure that confidence in the outcome is high. It is expected that the Project will have a long duration that will be informed by a monitoring program and adaptive management process to ensure restoration processes allow the site to achieve the target HQS.
Percentage of impact offset	100.4	The offset adequately compensates for 100% of the impact.

12.4.3.2 Direct Offset: Land Acquisition

For the purpose of establishing transparent, justifiable and applicable standards that will be used in determining required offsets once the final impact area of Wetlands is known and offset sites are finalised, a series of values have been selected as Offset Assessment Guide inputs. The below inputs are based on the assumption that 100% impact is required to be offset via Land Acquisition and management.

Based on the information listed in Table 12-13 the Land Acquisition Offset component would require 199 h to address 100% of the impact to be offset for MDP Wetlands.

Table 12-13 Summary of Offsets Assessment Guide Inputs for Wetlands – Land Acquisition Offset for Airport North MDP

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	44.2	This value represents the maximum area of direct impact to Wetlands within the Project area; however this is expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	5	The Habitat Quality Score of the Wetlands impact area as defined by the HQS Framework.

Offset Calculator Attribute	Input/ Output	Explanation
Time over which loss is averted	20	It is expected that the final Restoration Offset site will be either part of an existing conservation estate or under an existing conservation covenant. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	Perth Airport recognises that development of a Wetlands restored habitat will take 10 to 20 years to achieve. Habitat function and diversity will not be realised until mature trees dominate the Wetlands and the vegetation has achieved a state where nutrient cycles are in place and the vegetation has achieved a self-sustaining state.
Start quality (scale of 1-10)	5	The offset site to be selected will have a minimum HQS of 6 to achieve a like-for-like offset to the impact area, however offset site selection aims to preserve higher quality areas.
Future quality without offset (scale 1-10)	4	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	5	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	199	The area which meets 100% minimum criteria of Percentage of Impact Offset.
Risk of Loss (per cent) without offset	6	The risk of loss of 6 per cent has been allocated as this is the derived risk of loss of vegetation around the Perth Airport area. On final selection of offset sites, risk of loss will be updated to account for security of tenure as per the PAPL Risk of Loss framework (Perth Airport 2018).
Risk of loss (per cent) with offset	0	The offset site(s) chosen will be placed within a conservation estate. The offset should guarantee the protection of the site for the life of the permit.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	Leading practice restoration methods will be employed and a site suitable for restoration will be selected to ensure that confidence in the outcome is high. It is expected that the Project will have a long duration that will be informed by a monitoring program and adaptive management process to ensure restoration processes allow the site to achieve the target HQS
Percentage of impact offset	100.5	The offset adequately compensates for 100% of the impact.

12.4.4 Proposed Offset Method for SCP 3b TEC

Perth Airport are pursuing several options in developing a package of offsets to counterbalance the residual impacts of the Airport North MDP to SCP 3b TEC. The finalised offset type is yet to be selected by Perth airport pending spring survey results and negotiations with State departments.

To counterbalance the residual impacts of the Proposal of up to 14.49 ha to SCP 3b TEC this strategy proposes the following options:

(1) a Restoration Offset, involving the restoration and/or creation of cleared or degraded areas for additional and/or improved SCP 3b TEC within the Swan Coastal Plain

(2) a Land Acquisition Offset that consists of existing SCP 3b TEC or

(3) an offset package providing a combination of both land acquisition and restoration (two-part approach). Existing and/or future SCP 3b TEC habitat will be purchased (Land Acquisition Offset) or restored/created (Restoration Offset), managed for conservation purposes and added to the conservation estate.

The proposed offset site/s will be selected based on site characteristics with a preference given to land that:

- increases the area of SCP 3b TEC within conservation estate;
- increases the size and/or connectivity and/or the quality of existing SCP 3b TEC;
- improve the condition of remnants and SCP 3b TEC linkage in the Swan Coastal Plain through reducing fragmentation and threats to the remnants;
- can be managed to have as few threats to the success of the restoration as possible (e.g. significant or declared weeds, evidence of Phytophthora dieback, water security/risk etc.); and
- has either secure tenure within the existing conservation estate, or is currently managed for the purposes of conservation, or will be vested in the State's conservation estate.

Perth Airport considers that it will be able to deliver sufficient offsets for the loss of up to 14.49 has of SCP 3b TEC using an offset package providing a combination of both land acquisition and restoration.

12.4.5 Proposed Offset Method for *Conospermum undulatum*

Perth Airport propose both translocation and propagation for the offset package to counterbalance the significant residual impacts of the MDP to *C. undulatum* (Wavy-leaved Smokebush). All 12 plants are proposed to be translocated within the airport estate, preferentially within the retained patches of vegetation within the Airport North MDP, where suitable. An additional 9 plants are proposed to be propagated and translocated within the airport estate or external sites, resulting in a future value with offset of 21 individuals, providing for 103.96% of impact offset. This offset package provides conservation gain for *Conospermum undulatum*.

12.4.6 Consistency of Offset Proposal with the EPBC Offsets Policy

Table 12-14 demonstrates how the Proposed Offset is consistent with the principles of the Offsets Policy for each significant residual impact to environmental values.

Table 12-14 Consistency with EPBC Offset Policy

Offsets Policy Requirement	Banksia Woodlands: Land Acquisition	Black Cockatoos Foraging Habitat: Land Acquisition	Wetlands: Land Acquisition and Restoration	SCP 3b TEC: Land Acquisition and Restoration	C. Undulatum: Translocation and Propagation
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of a protected matter.	The proposed offset will provide an improved conservation outcome for area(s) of Banksia Woodland TEC by securing a conservation area, providing management and protection against future loss. The area secured will have a HQS equal to, or higher, than that of the impact site. These areas of Banksia Woodland TEC are currently not secure for conservation purposes but will be added to the conservation estate and managed by DBCA. Protection of the proposed sites will assist in reducing further fragmentation of the Banksia Woodlands TEC which has been identified as a key threat to the ecological community. The final offset site will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through proposed land management practices.	The proposed offset will provide an improved conservation outcome for area(s) of foraging habitat within the range of CBC and FRTBC by securing a conservation area, providing management and protection against future loss. The area secured will have a HQS equal to, or higher, than that of the impact site. These areas of foraging habitat are currently not secure for conservation purposes but will be added to the conservation estate and managed by DBCA. The proposed offset will be entirely native vegetation foraging habitat, which overall is expected to be of higher value to the species than approximately 95 ha of grasslands that may be occasionally foraged by CBC The final offset site will be selected to ensure that threats from weeds will be less than that of the impact from Airport North MDP and can be effectively managed through existing land management practices.	The proposed land acquisition offset(s) will provide an improved conservation outcome for area(s) of Wetland within the Swan Coastal Plain by securing a conservation area, providing management and protection against future loss. The area secured will have a HQS equal to, or higher, than that of the impact site. These areas of wetland are currently not secure for conservation purposes but will be added to the conservation estate and managed by DBCA. The proposed restoration offset(s) will deliver an improved conservation outcome for wetlands by improving vegetation condition (and incidentally water quality and fauna habitat) within areas requiring management and restoration activities supplementary to those currently in action or scheduled to take place. Sites have been chosen with consideration to state and federal prioritisation for wetland conservation areas and based on the impact area. The final offset site will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through existing land management practices.	The proposed land acquisition offset(s) will provide an improved conservation outcome for area(s) of 3b TEC within the Swan Coastal Plain by securing a conservation area, providing management and protection against future loss. The area secured will have a HQS equal to, or higher, than that of the impact site. These areas of SCP 3b TEC are currently not secure for conservation purposes but will be added to the conservation estate and managed by DBCA. The proposed restoration offset(s) will deliver an improved conservation outcome for SCP 3b TEC by improving vegetation condition within areas requiring management and restoration activities supplementary to those currently in action or scheduled to take place. The final offset site(s) will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through existing land management practices.	The proposed offset will preserve the genetic diversity of existing populations, establish new populations and/or supplement current populations at risk of loss. In addition to the Perth Airport translocation site the final offset site will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through existing land management practices.
Suitable offsets must be built around direct offsets but may include other compensatory measures.	The purchase and conservation of Banksia Woodland TEC is a direct offset.	The purchase and conservation of Black Cockatoo foraging habitat is a direct offset.	The purchase and conservation, as well as restoration of Wetlands is a direct offset.	The purchase and conservation, as well as restoration of SCP 3b TEC is a direct offset.	The translocation and propagation of *Conospermum undulatum* is a direct offset.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.	The proposed offset is appropriate and consistent with the DCCEEW policy, as it takes into account the Banksia Woodlands TEC level of statutory protection, specific attributes of the protected matter, the ongoing viability of the protected matter, the permanent nature of the residual impacts to the species, and the time taken to yield a conservation gain for the species, as indicated by the Offsets Assessments Guide.	The proposed offset is appropriate and consistent with the DCCEEW policy, as it takes into account CBC and FRTBC level of statutory protection, specific attributes of the protected matters, the ongoing viability of the protected matters, the permanent nature of the residual impacts to the species, and the time taken to yield a conservation gain for the species, as indicated by the Offsets Assessments Guide.	The proposed offset is supplementary to requirements under DCCEEW policy, as the MDP wetlands are not covered by any statutory protection. This offset takes into account specific attributes of Wetlands, the ongoing viability of wetlands, the permanent nature of the residual impacts to the MDP wetlands, and the time taken to yield a conservation gain, as indicated by the Offsets Assessments Guide.	The proposed offset is supplementary to requirements under DCCEEW policy, as the SCP 3b TEC is not covered by Federal statutory protection. This offset takes into account specific attributes of SCP 3b TEC, the ongoing viability of SCP 3b TEC, the permanent nature of the residual impacts to the TEC, and the time taken to yield a conservation gain, as indicated by the Offsets Assessments Guide.	The proposed offset is appropriate and consistent with the DCCEEW policy, as it takes into account the taxon's level of statutory protection, specific attributes of the protected matter, the ongoing viability of the protected matter, the permanent nature of the residual impacts to the species, and the time taken to yield a conservation gain for the species, as indicated by the Offsets Assessments Guide.
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protect matter.	The Airport North MDP will result in the clearing of up to 33.07ha of Banksia Woodland TEC and a further 0.31 ha indirectly impacted TEC that is currently exposed to significant threats from weeds and Phytophthora dieback. The proposed direct offset includes land purchase of a size and quality that balances the remainder of the residual impact as defined through use of the Offsets Guide.	The Airport North MDP will result in the clearing of 49.24 ha of CBC habitat, and 22.54 ha of FRTBC habitat. The proposed direct offset includes land acquisition of a size and quality that balances the remainder of the residual impact as defined through use of the Offsets Guide. The offset is of a size and scale proportionate to the residual impacts on	The Airport North MDP will result in the clearing of up to 45.3 ha of Wetlands that is currently exposed to significant threats from weeds and Phytophthora dieback. The proposed direct offset includes either a land purchase or land restoration, or a combination both, of a size and quality that balances the remainder of the residual impact as defined through use of the Offsets Guide.	The Airport North MDP will result in the clearing of up to 14.49 ha of SCP 3b TEC that is currently exposed to significant threats from weeds and Phytophthora dieback. The proposed direct offset includes either land purchase or land restoration, or a combination both, of a size and quality that balances the remainder of the residual impact as defined through use of the Offsets Guide.	The MDP will result in the clearing of up to 12 plants of *C. undulatum*. The proposed direct offset includes translocation, propagation, establishment of new populations or supplementing existing populations within current or future conservation estates that addresses the residual impact as defined through use of the Offsets Guide. The offset is of a size and scale proportionate to the residual impacts on

Offsets Policy Requirement	Banksia Woodlands: Land Acquisition	Black Cockatoos Foraging Habitat: Land Acquisition	Wetlands: Land Acquisition and Restoration	SCP 3b TEC: Land Acquisition and Restoration	C. Undulatum: Translocation and Propagation
	The offset is of a size and scale proportionate to the residual impacts on the protected matter, as indicated by the Offsets Guide. The final offset site will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through existing land management practices.	the protected matter, as indicated by the Offsets Guide. The final offset site will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through existing land management practices.	The offset is of a size and scale proportionate to the residual impacts as indicated by the Offsets Guide. The final offset site will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through existing land management practices.	The offset is of a size and scale proportionate to the residual impacts, as indicated by the Offsets Guide. The final offset site will be selected to ensure that threats from weeds will be less than that of the impact from the Airport North MDP and can be effectively managed through existing land management practices.	the protected matter, as indicated by the Offsets Guide.
Suitable offsets must effectively account for and manage the risk of the offset not succeeding.	The proposed Land Acquisition offset will be purchased for inclusion within conservation lands under appropriate management. The Offset Management Plan(s) (OMP) will be submitted to the Minister for the Environment for review and approval prior to implementation of the offset. The OMP(s) will have measurable completion criteria, risk assessments, monitoring and contingency measures to ensure offset is successful.	The proposed Land Acquisition offset will be purchased for inclusion within conservation lands under appropriate management. OMP(s) will be submitted to the Minister for the Environment for review and approval prior to implementation of the offset. The OMP(s) will have measurable completion criteria, risk assessments, monitoring and contingency measures to ensure offset is successful.	The proposed offset will be located within existing conservation lands under appropriate management (Restoration Offset), and/or on land purchased for inclusion into the conservation estate (Land Acquisition Offset). The Restoration Offset for the Project will be planned and implemented utilising the principles described in the Society for Ecological Restoration National Restoration Standards (2018). The proposed Restoration Offset will be implemented under an OMP that will include: - Restoration objectives - Completion criteria - Implementation methods - Monitoring and reporting program - Contingency actions - Site maintenance/management program The OMP(s) will be submitted to the Minister for the Environment for review and approval prior to implementation of the offset.	The proposed offset will be located within existing conservation lands under appropriate management (Restoration Offset), and/or on land purchased for inclusion into the conservation estate (Land Acquisition Offset). The Restoration Offset for the Project will be planned and implemented utilising the principles described in the Society for Ecological Restoration National Restoration Standards (2018). The proposed Restoration Offset will be implemented under an OMP that will include: - Restoration objectives - Completion criteria - Implementation methods - Monitoring and reporting program - Contingency actions - Site maintenance/management program The OMP(s) will be submitted to the Minister for the Environment for review and approval prior to implementation of the offset.	The proposed offset will be located within existing conservation lands under appropriate management, or on land that will be purchased and transferred to the conservation estate. The Proposed Offset will be implemented under a Propagation, Research and Monitoring Plan that is consistent with the requirements of the Interim Recovery Plan for the taxon and include: - Translocation and research objectives - Completion criteria for plant establishment and population viability - Implementation methods - Monitoring and reporting program - Contingency actions - Site maintenance/management program.
Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programmes.	The Airport North Proposed Offset is proposed solely to satisfy the requirements of the EPBC Act.	The Airport North Proposed Offset is proposed solely to satisfy the requirements of the EPBC Act.	The Airport North Proposed Offset is proposed solely to satisfy the requirements of the EPBC Act. Restoration efforts/expenditure will be additional to what is already agreed to under other schemes or programmes.	The Airport North Proposed Offset is proposed solely to satisfy the requirements of the EPBC Act. Restoration efforts/expenditure will be additional to what is already agreed to under other schemes or programmes.	The Proposed Offset is proposed solely to satisfy the requirements of the EPBC Act.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.	<u>Efficient</u> The Airport North Proposed Offset will directly offset the loss of the TEC through the application of existing knowledge and technology and securing conservation area(s) of Banksia Woodland TEC. <u>Effective</u> The Airport North Proposed Offset will establish a conservation area of Banksia Woodland larger than that is being cleared at the airport site. The offset will be situated to enhance the integrity, quality and extent of bushland and where possible improve ecological functions of the region. <u>Timely</u>	<u>Efficient</u> The Airport North Proposed Offset will directly offset the loss of Black-Cockatoo habitat, through the application of existing knowledge and technology in securing, restoring and conserving area(s) of CBC and FRTBC foraging habitat. <u>Effective</u> The Airport North Proposed Offset will establish a conservation area of quality Black-Cockatoo foraging habitat larger than being cleared for the MDP. The offset will be situated to enhance the integrity, quality and extent of urban bushland in order to improve ecological functions of the region.	<u>Efficient</u> The MDP Proposed Offset will directly offset the loss of impacted Wetlands through the application of existing knowledge and technology in securing, restoring and conserving area(s) of wetland. For restoration offsets, species establishment (where required) and weed management will be achieved through accepted practices utilised in other restoration and rehabilitation programs in WA. The offset will be chosen to ensure that an in situ natural landform and soil profile exists on the site that will reduce the requirement for expensive earthworks	<u>Efficient</u> The MDP Proposed Offset will directly offset the loss of impacted SCP 3b TEC through the application of existing knowledge and technology in securing, restoring and conserving area(s) of SCP 3b TEC. For restoration offsets, species establishment (where required) and weed management will be achieved through accepted practices utilised in other restoration and rehabilitation programs in WA. <u>Effective</u> The Airport North Proposed Offset will establish a conservation area of 3b TEC	<u>Efficient</u> The Proposed Offset will directly offset the loss of *C. undulatum* through the application of existing knowledge and technology. Population establishment will be achieved through accepted practices utilised in other translocation programs in WA. The translocation site(s) will be chosen to ensure it has an in situ natural landform and soil profile that closely replicates or matches that required for the taxon. <u>Effective</u> The Proposed Offset will preserve the genetic material of plants to be cleared and establish an area of habitat and population size within the Perth

Offsets Policy Requirement	Banksia Woodlands: Land Acquisition	Black Cockatoos Foraging Habitat: Land Acquisition	Wetlands: Land Acquisition and Restoration	SCP 3b TEC: Land Acquisition and Restoration	C. Undulatum: Translocation and Propagation
	The offset site will be secured and managed in accordance with the MDP Conditions and within 18 months of approval of the Offset Strategy. An OMP will be developed and approved within 18 months of approval of the Offset Strategy. Transparent The offset site(s) will be located on existing conservation lands or transferred to a conservation estate and as such will be subject to the oversight of the land manager. The proposed Offset will be managed under an OMP that will contain a monitoring and reporting requirement where applicable. Scientifically robust The offset areas will be surveyed by specialist ecologists using scientifically robust methods, with relevant data used to determine HQS in accordance with the approved HQS framework for Banksia Woodlands. Reasonable The proposed offset for the Airport North will maintain area(s) of Banksia Woodlands in the local region through the sound allocation of resources in a timely manner.	The offset site will also be chosen to have a size, shape and location to ensure that the foraging habitat will be subject to a reduced level of ecological threat compared to MDP area. Timely The offset site will be secured and managed in accordance with the MDP Conditions and within 18 months of approval of the Offset Strategy. An OMP will be developed and approved within 18 months of approval of the Offset Strategy. Transparent The offset site(s) will be located on existing conservation lands or transferred to a conservation estate and as such will be subject to the oversight of the land manager. The proposed Offset will be managed under an OMP that will contain a monitoring and reporting requirement where applicable. Scientifically robust The offset areas will be surveyed by specialist ecologists using scientifically robust methods, with relevant data used to determine HQS in accordance with the approved HQS framework for Black-Cockatoo foraging habitat. Reasonable The proposed offset for Airport North will maintain or improve the viability of Black-Cockatoos in the local region through the sound allocation of resources in a timely manner.	and the associated risks to Project outcomes. Effective The Airport North Proposed Offset will establish a conservation area of Wetlands on the Swan Coastal Plain larger than is being cleared for the MDP. The offset will be situated to enhance the integrity, quality and extent of urban Wetland and where possible improve ecological functions of the region. Timely The offset site will be secured and managed in accordance with the MDP Conditions and within 18 months of approval of the Offset Strategy. An OMP will be developed and approved within 18 months of approval of the Offset Strategy. The proposed Restoration Offset will be a long-term project that may not realise the full values of the target habitat for between 10 and 20 years. However, the establishment and associated management actions will improve the ecological functioning of the site over time in terms of hydrological function, habitat for flora and fauna and reductions in weed presence. Restoration offsets will adhere to key milestones detailed within the OMP(s). Transparent The offset site(s) will be located on existing conservation lands or transferred to a conservation estate and as such will be subject to the oversight of the land manager. The proposed restoration Offset will be managed under an OMP that will contain a monitoring and reporting requirement. Scientifically robust The offset areas will be surveyed by specialist ecologists using scientifically robust methods, with relevant data used to determine HQS in accordance with the approved HQS framework for Wetlands. The proposed restoration Offset will be based on the Society for Ecological Restoration National Restoration Standards (2018). The OMP will only be implemented following review and acceptance by the Minister for the Environment and respective land manager. Reasonable The proposed offset for Airport North has been developed to directly replace lost habitat, secure current habitat or by improving current habitat while enhancing	on the Swan Coastal Plain larger than is being cleared for the MDP. The offset will be situated to enhance the integrity, quality and extent of bushland and where possible improve ecological functions of the region. Timely The offset site will be secured and managed in accordance with the MDP Conditions and within 18 months of approval of the Offset Strategy. An OMP will be developed and approved within 18 months of approval of the Offset Strategy. The proposed Restoration Offset will be a long-term project that may not realise the full values of the target habitat for between 5 and 20 years. However, the establishment and associated management actions will improve the ecological functioning of the site over time in terms of hydrological function, habitat for flora and fauna and reductions in weed presence. Restoration offsets will adhere to key milestones detailed within the OMP(s). Transparent The offset site(s) will be located on existing conservation lands or transferred to a conservation estate and as such will be subject to the oversight of the land manager. The proposed restoration Offset will be managed under an OMP that will contain a monitoring and reporting requirement. Scientifically robust The offset areas will be surveyed by specialist ecologists using scientifically robust methods, with relevant data used to determine HQS in accordance with the approved HQS framework for SCP 3b TEC. The proposed restoration Offset will be based on the Society for Ecological Restoration National Restoration Standards (2018). The OMP will be implemented following review and acceptance by the Minister for the Environment and respective land manager. Reasonable The proposed offset for Airport North has been developed to directly replace lost habitat, secure current habitat or by improving current habitat while enhancing the existing conservation estate through improvement in habitat condition and extent. The proposed offset for the MDP will increase SCP 3b TEC area through	Metropolitan Area and surrounds larger than being cleared for the MDP. Timely The Proposed Offset will be a long-term Project. Establishment of the taxon may be achieved within 5 years, however the long-term survival and functioning of the population/s (i.e. viability) will be reliant on the habitat and as such the outcome timeframes are linked. Moreover, the establishment and associated management actions will gradually improve the ecological functioning of the site over time in terms of hydrological function, habitat for flora and fauna and reductions in weed presence. Transparent The Proposed Offset will be managed under the existing Propagation, Research and Monitoring Plan for the New Runway Project that contains a monitoring and reporting requirement. The offset site will be located on (or vested within) conservation lands and as such will be overseen by the land manager. Scientifically robust The Proposed Offset will be based on the Society for Ecological Restoration National Restoration Standards (2018). The Propagation, Research and Monitoring Plan will only be implemented following review and acceptance by the Minister for the Environment and respective land manager. The Propagation, Research and Monitoring Plan will only be implemented following review and acceptance by the DBCA and respective land manager. Reasonable Existing remnant land that constitutes suitable habitat for the taxon (that is within the species range, with a suitable soil type and pollinator distribution range) may not be readily available. Most of these areas are held in private property either highly degraded or too small to provide a secure long-term remnant without extensive management. The proposed offset will increase local population numbers through the sound allocation of resources in a timely manner.

Offsets Policy Requirement	Banksia Woodlands: Land Acquisition	Black Cockatoos Foraging Habitat: Land Acquisition	Wetlands: Land Acquisition and Restoration	SCP 3b TEC: Land Acquisition and Restoration	C. Undulatum: Translocation and Propagation
			the existing conservation estate through improvement in habitat condition and extent. The proposed offset for the MDP will increase Wetlands area through the sound allocation of resources in a timely manner.	the sound allocation of resources in a timely manner.	
Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitoring, audited and enforced.	Implementation of the offset will be in accordance with a documented agreement with the land manager, and an OMP approved by the Minister for the Environment, which will be measurable, able to be monitored, audited and enforced.	Implementation of the offset will be in accordance with a documented agreement with the land manager, and an OMP approved by the Minister for the Environment, which will be measurable, able to be monitored, audited and enforced.	Implementation of the offset will be in accordance with a documented agreement with the land manager, and an OMP and/or Restoration Management Plan(s) approved by the Minister for the Environment, which will be measurable, able to be monitored, audited and enforced.	Implementation of the offset will be in accordance with a documented agreement with the land manager, and an OMP and/or Restoration Management Plan(s) approved by the Minister for the Environment, which will be measurable, able to be monitored, audited and enforced.	Implementation of the offset will be in accordance with a formal agreement with the DBCA and a Propagation, Research and Monitoring Plan, approved by the Minister for the Environment, and which is able to be monitored, audited and enforced.

12.5 Proposed Offset Sites

12.5.1 Overview of Offset Requirements

Perth Airport are pursuing a number of options in developing a package of offsets to counterbalance the significant residual impacts of the Proposal to Banksia Woodland TEC, CBC, FRTBC, *Conospermum undulatum,* Wetlands and SCP3b TEC. The final offset sites are yet to be determined pending ecological survey results, selection and purchase of offsets and negotiations with State Government departments for inclusion within the State conservation estate.

The proposed offset components investigated for the MDP include options for Land Acquisition and Land Restoration. The offset area required has been calculated using the Offsets Calculator to provide an indication of area required to be sourced per protected matter/value (Table 12-15)

Where offset sites contained in this document provide offset values in excess of what is required for the MDP, only the areas/values required will be utilised for this MDP. The remainder of the areas/values will be banked for separate offsets required under other Perth Airport projects. By doing so, Perth Airport meets its offset obligation consistent with the EPBC offset policy, whilst developing a "bank" of advanced offsets for future projects.

Table 12-15: Maximum impact to protected matters within the Airport North MDP area and Offset Requirement Summary.

Protected Matter/Value	Offset Method	Impact Area within MDP (ha)	HQS within MDP	Offset Required as per OAG (offsets calculator)	
				Area	HQS
Banksia Woodlands TEC	Acquisition	33.38	6	218 ha	6
Carnaby's Black-Cockatoo - Foraging Habitat	Acquisition	180.33	4	1012 ha	4
Forest Red-tailed Black Cockatoos - Foraging Habitat	Acquisition	83.11	6	552 ha	6
Wetlands	Acquisition, Restoration	44.2	5	199 ha Acquisition or 79 ha Restoration	5
SCP 3b TEC	Acquisition, Restoration	14.49	TBC	TBC	TBC
Conospermum undulatum	Translocation, Propagation	12 individuals	NA	28 individuals	NA

12.5.2 Description of Offsets Under Review

The proposed components of the offset package are described below. Offset Sites 1, 2 and 3 have been subject to survey. Offset Sites 4 and 5 have been surveyed with the Fauna Survey complete and Flora and Vegetation spring survey results pending. The values of Offsets 6 are inferred (in part) through publicly available mapping, aerial imagery, or supplied historic survey data. Selection of optimal sites from shortlists for Offsets 7 and 8 will be refined and confirmed through additional survey (planned Spring 2022) and ongoing consultation with the DBCA and LGAs.

An overview of potential offsets currently under consideration are provided in Table 12-16. Further desktop and field investigations will be undertaken of shortlisted sites and further discussed with the DBCA to assess additional potential sites within the Swan Coastal Plain prior to the preferred site(s) being proposed within the MDP submission for assessment and acceptance of suitability.

Table 12-16 Overview of potential proposed offsets for the Airport North MDP

No.	Offset Site Details			Environmental Value Available (ha)				
	Offset Type	Offset Summary	Existing Tenure	Banksia Woodlands TEC	Carnaby's Black Cockatoo Foraging Habitat	Forest Black Cockatoo Foraging Habitat*	Wetlands	SCP 3b TEC
1	Direct	Land purchase and transfer to DBCA	Freehold	549.9	949.7	144.1	1.3	-
2	Direct	Land purchase and transfer to DBCA	Freehold	201.4	282.1	4.7	71.4	-
3	Direct	Land purchase and transfer to DBCA	Freehold	632.7	811.7	101	10.7	-
4	Direct	Land purchase and transfer to DBCA	Freehold	Est. 1,280	1289.5	14.1	TBC	-
5	Direct	Land purchase and transfer to DBCA	Freehold	Est. 117	272.5	140.8	-	-
6	Direct	Restoration works improvement/ remediation of Wetlands	City of Cockburn LGA	-	-	-	176	-
7	Direct	Restoration works improvement/ remediation of Wetlands	State or LGA Managed Lands	-	-	-	TBC	-
8	Direct	Restoration works improvement/ remediation of SCP 3b TEC	State or LGA Managed Lands	-	-	-	-	TBC
9	Direct	Translocation and Propagation of *Conospermum undulatum*	State or LGA Managed Lands	-	-	-	-	-
Total (ha /No.)			Acquisition	2,781 ha	3,615.5 ha	371.9	TBC	TBC
			Restoration/Creation				>176 ha	TBC

* FTRBC habitat shown is only that with an HQS of 6 or greater.

12.5.3 Proposed Land Acquisition Offset 1

12.5.3.1 Overview

Offset Site 1 (Site 1) is located approximately 100 km north of the Perth Airport on the Swan Coastal Plain. The privately owned site is currently under examination with the landowner, who has indicated they are receptive to sale of the property.

Perth Airport engaged Spectrum Ecology and Bamford Consulting Ecologists in 2021 to conduct ecological surveys at the property to assess and quantify the offset values of the site. Results of these assessments show that the proposed offset contains remnant vegetation supporting Banksia Woodland TEC (Spectrum 2022), CBC foraging habitat and FRTBC foraging habitat (BCE 2022b).

The Survey Area contained a substantial portion of vegetation mapped as 'Pristine' (41.2%) condition particularly in the north-east section of the property. The north-west boundary and southern section of the Survey Area displayed some signs of dieback but were still considered in 'Excellent' condition (51.4%). Areas mapped as 'Very Good' (3.0%) condition included areas of vegetation with typically more aggressive weeds. Some sections of the Site were mapped as 'Degraded' (0.1%) as they were previously cleared and allowed to regenerate.

12.5.3.2 Offset Value of Site - Overview

Site 1, if selected for offset, has potential to provide conservation gain for Banksia Woodlands TEC, CBC Foraging Habitat and FRTBC Foraging Habitat. The Offset Value of the site and proportion of impact offset are summarised below in Table 12-17.

Table 12-17: Offset Value of Offset Site 1

Environmental Values	Offset Required		Offset Value		% Impact Offset
	Area / No. (x)	HQS	Area / No. (x)	HQS	
Banksia Woodlands TEC	218 ha	6	549.9 ha	8	321.58%
Carnaby's Black-Cockatoo - Foraging Habitat	522 ha	4	949.7 ha	6	135.35%
Forest Red-tailed Black-Cockatoo Foraging Habitat	290 ha	6	144.1 ha *	7	38.73%
Wetlands	203 ha Acquisition or 95 ha Restoration	5	1.3 ha	Unknown	Unknown

* Area listed is that within the Lot that contains a value of HQS 6 or greater to meet the HQS offset requirements.

12.5.3.3 Management

If selected, Perth Airport propose to purchase Site 1 as a direct offset, which would be transferred to DBCA for conservation and management as per an approved OMP. Maintenance and management funds will be provided to DBCA to allow for establishment of the site within their maintenance regime. Transfer of the site to DBCA will mitigate the risk of loss of the site in perpetuity while management activities will be tailored to prevent reduction in habitat quality which would otherwise take place as a result of private ownership.

12.5.3.4 Banksia Woodlands TEC

Floristic survey results (Spectrum 2022) identified that the Banksia Woodland TEC is present within Site 1. The TEC area covers 549.9 ha, and comprises vegetation primarily in Excellent and Pristine condition, with some areas mapped as Very Good, Good and Degraded due to the edge effects of the property bordering agricultural land within one patch The overall HQS for the TEC has been calculated at 8.

Offset Site 1 would have potential to provide offset up to 321.58% of the impact to the Airport North Banksia Woodland TEC, however only 171 ha would be needed to meet the 100% offset requirement. A summary of Offsets Assessment Guide (OAG) Inputs for offset via Land Acquisition of the Site 1 Banksia Woodlands TEC is presented within Table 12-18.

Table 12-18: Summary of Offsets Assessment Guide Inputs for Offset via Land Acquisition of Offset Site 1 Banksia Woodlands TEC

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	33.38	This value represents the maximum area of Impact to Banksia Woodlands TEC within the Project area.
Quantum of impact – quality (HQS)	6	The HQS of the Banksia Woodlands TEC impact area as defined by the HQS Framework.
Time over which loss is averted	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	8	The offset site exceeds the minimum HQS of 5 to achieve a like-for-like offset to the impact area. Preservation of higher quality areas is of greater conservation benefit to the TEC.
Future quality without offset (scale 1-10)	7	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	8	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	549.9	The area of Banksia Woodlands TEC present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset
Risk of Loss (%) without offset	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture and has a mining exploration licence present. The site is also adjacent to an expanding landfill facility. Therefore, there is low to moderate risk (15-40%) that the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 % (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	321.58	If selected, the offset would compensate for greater than 100% of the impact.

12.5.3.5 Black Cockatoos

As Banksia Woodland TEC is a CBC foraging resource, the property as a whole scored 6 out of 10 using the Black Cockatoo HQS framework, comprising an area of 949.7 ha. Excluding areas with an HQS lower than 6, the property comprised 144.1 ha of suitable FRTBC foraging resource.

If selected, Site 1 would have potential to provide offset up to 135.35% of the impact to CBC foraging resource, however only 705 ha would be needed to meet the 100% offset requirement. Additionally, Site 1 would have potential to provide offset up to 38.73% of the impact to FRTBC foraging resource. A summary of Inputs for offset via Land Acquisition of the Site 1 Black Cockatoo foraging habitat is presented within Table 12-19.

Table 12-19: Summary of Offsets Assessment Guide Inputs for offsetting the Black Cockatoo Foraging Habitat impact area via Land Acquisition of Site 1

Offset Calculator Attribute	Input - CBC	Input - FRTBC	Explanation
Quantum of impact – area (ha)	180.33	83.1	This value represents the maximum area of Impact to Black Cockatoos within the Project area.
Quantum of impact – quality (HQS)	4	6	The HQS of the Black Cockatoo impact area as defined by the HQS Framework.
Time over which loss is averted	20	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	6	7	The offset site meets the minimum HQS to achieve a like-for-like offset to the impact area.
Future quality without offset (scale 1-10)	5	6	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	6	7	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	949.7	144.1	The foraging habitat present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset.
Risk of Loss (%) without offset	15	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture, and has a mining exploration license present. Therefore, there is low to moderate risk (15-40%) that the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	135.35	38.73	If selected, the offset would compensate for greater than 100% of the impact for CBC.

12.5.3.6 Wetlands

Ecological assessment by Spectrum (2022) indicate the site contains 1.3 ha of wetland in Very Good Condition. The WESCP Wetland HQS was unable to be conducted for this site, due to lack of intersecting spatial data. If selected for offset, further assessment may be required to determine the quality of the wetland.

12.5.3.7 Summary

The proposed offset contributions from Site 1 which may be used for the Airport North MDP offsets are presented within Table 12-20.

The offset site provides offset values in excess of what is required to offset Banksia Woodlands TEC and CBC Foraging Habitat. The site provides just over a third of the FRTBC Foraging Habitat requirements. If Site 1 is selected for the Airport North MDP Offset, only the areas/values required will be utilised, with the remainder of the areas/values banked for future offsets.

Prioritising areas of CBC foraging habitat, approximately 702 ha of the area may be used to provide 100% of the offset required for CBC foraging habitat. A total of 144 ha for offsetting FRTBC Foraging Habitat would be used to provide a portion of the offset required. Noting that there is some overlap of Banksia Woodland TEC with CBC foraging habitat, areas of FRTBC foraging habitat may also provide offset value against Banksia Woodland TEC, however this value can only be quantified once offset contribution boundaries are finalised.

Table 12-20: Proposed Offset Contributions (area) of Site 1

Environmental Values	Offset Value			Proportion of Offset Liability met by Offset (excluding banked areas)
	Total Area (ha)/ No.	Area/Value proposed to be banked for future offset	Area/Value proposed for Offset	% Impact Offset via OAG
Banksia Woodlands TEC	549.9 ha	378.9 ha	171 ha	100.00 %
Carnaby's Black-Cockatoo - Foraging Habitat	949.7 ha	247.7 ha	702 ha	100.05 %
Forest Black Cockatoo - Foraging Habitat	144.1 ha	0 ha	144.1 ha	38.73 %
Wetlands	1.3 ha	0	1.3 ha	Unknown

12.5.4 Proposed Land Acquisition Offset 2

12.5.4.1 Overview

Offset Site 2 (Site 2) is a private property of approximately 468 ha located about 100 km north of the Perth Airport on the Swan Coastal Plain.

Perth Airport engaged Spectrum Ecology and Bamford Consulting Ecologists in 2021 to conduct ecological surveys at the property to assess and quantify the offset values of the site. Results of these assessments show that the proposed offset contains remnant vegetation supporting Banksia Woodland TEC (Spectrum 2022), CBC foraging habitat and FRTBC foraging habitat (BCE 2022b).

Through discussions with DBCA, a reduced area of 283.44 ha within the Survey Area has been identified as acceptable for transfer into the conservation estate. Vegetation within the reduced area contains a substantial portion of vegetation mapped as 'Excellent' (93%) condition. Some sections of the site were mapped as 'Completely Degraded' (2%) as they were previously cleared for tracks and allowed to regenerate. The areas excluded from the potential offset site contained a large portion of agricultural land and farming infrastructure. Refer to the flora and vegetation assessment report (Spectrum 2022) for presentation of vegetation condition, vegetation type and conservation significant flora mapped across the site, and to BCE (2022b) for presentation of Black Cockatoo foraging scores.

12.5.4.2 Offset Value of Site - Overview

Site 2, if selected for offset, has potential to provide conservation gain for CBC Foraging Habitat, FRTBC Foraging Habitat, Banksia Woodlands TEC and Wetlands. The Offset Value of the site and proportion of impact offset are summarised below in Table 12-**21.**

Table 12-21: Offset Value of Offset Site 2

Environmental Values	Offset Required		Offset Value		% Impact Offset
	Area / No. (x)	HQS	Area / No. (x)	HQS	
Banksia Woodlands TEC	218 ha	6	201.4 ha	7	110.64%
Carnaby's Black-Cockatoo - Foraging Habitat	1012 ha	4	282.1 ha	5	37.43 %
Forest Black-Cockatoo - Foraging Habitat	552 ha	6	4.7ha*	7	1.26 %
Wetlands	203 ha Acquisition or 95 ha Restoration	5	71.4 ha	Unknown	Unknown

* Area listed is that within the Lot that contains a value of HQS 6 or greater to meet the HQS offset requirements

12.5.4.3 Management

If selected, Perth Airport propose to purchase Site 2 as a direct offset, which would be transferred to DBCA for conservation and management as per an approved OMP. Maintenance and management funds will be provided to DBCA to allow for establishment of the site within their maintenance regime. Transfer of the site to DBCA will mitigate the risk of loss of the site in perpetuity while management activities will be tailored to prevent reduction in habitat quality which would otherwise take place because of private ownership.

12.5.4.4 Banksia Woodlands TEC

Floristic survey results (Spectrum 2022) identified that the Banksia Woodlands TEC 'is present within Site 2. The TEC area covers 201.4 ha within the nominated Offset area, and comprises vegetation primarily in Excellent and Very Good condition within one patch The overall HQS for the Banksia Woodlands TEC has been calculated at 7.

Offset Site 2 would have potential to provide offset up to 110.64% of the impact to Banksia Woodlands TEC, however only 183 ha would be needed to meet the 100% offset requirement. A summary of the Inputs for offset via Land Acquisition of the Site 2 Banksia Woodlands TEC is presented within Table 12-22.

Table 12-22: Summary of Offsets Assessment Guide Inputs for Offset via Land Acquisition of Offset Site 2 Banksia Woodlands TEC

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	33.38	This value represents the maximum area of Impact to Banksia Woodlands TEC within the Project area.
Quantum of impact – quality (HQS)	6	The HQS of the Banksia Woodlands TEC impact area as defined by the HQS Framework.
Time over which loss is averted	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	7	The offset site exceeds the minimum HQS of 5 to achieve a like-for-like offset to the impact area. Preservation of higher quality areas is of greater conservation benefit to the TEC.
Future quality without offset (scale 1-10)	6	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	7	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	201.4	The area of Banksia Woodlands TEC potentially present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset,
Risk of Loss (%) without offset	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture and has a mining exploration license present. Therefore, there is low to moderate risk (15-40%) the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	110.64	If selected, the offset would compensate for greater than 100% of the impact.

12.5.4.5 Black Cockatoos

As Banksia Woodland TEC is a CBC foraging resource, the nominated offset area as a whole scored 5 out of 10 using the Black Cockatoo HQS framework, comprising an area of 279.5 ha. Excluding areas with an HQS lower than 6, the property comprised 4.7 ha of suitable Forest Black Cockatoo foraging resource.

If selected, Site 2 would have potential to provide offset up to 37.43% of the impact to CBC foraging resource (Table 12-23). Additionally, Site 2 would have potential to provide offset up to 1.26% of the impact to the FRTBC foraging resource. A summary of Inputs for offset via Land Acquisition of the Site 2 Black Cockatoo foraging habitat is presented within Table 12-23.

Table 12-23: Summary of Offsets Assessment Guide Inputs for offsetting the Black Cockatoo Foraging Habitat impact area via Land Acquisition of Site 2

Offset Calculator Attribute	Input - CBC	Input- FRTBC	Explanation
Quantum of impact – area (ha)	180.33	83.11	This value represents the maximum area of Impact to Black Cockatoos within the Project area.
Quantum of impact – quality (HQS)	4	6	The HQS of the Black Cockatoo impact area as defined by the HQS Framework.
Time over which loss is averted	20	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	20	The time over which a decline in habitat quality would be estimated to take, should the site not be used for offset and this decline not mitigated. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	5	7	The offset site meets or exceeds the minimum HQS to achieve a like-for-like offset to the impact area.
Future quality without offset (scale 1-10)	4	6	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	5	7	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	282.1	4.7	The area of Black Cockatoo foraging habitat present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset,
Risk of Loss (%) without offset	15	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture and has a mining exploration license present. Therefore, there is low to moderate risk (15-40%) that the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	37.43	1.26	If selected, the offset for CBC would compensate for over a third of the impact but only about 1% for FRTBC.

12.5.4.6 Wetlands

Ecological assessment by Spectrum (2022) indicate the site contains 71.4 ha of wetland in 'Excellent' and 'Very Good' Vegetation Condition. The WESCP Wetland HQS was unable to be conducted for this site, due to lack of intersecting spatial data. If selected for offset, further assessment may be required to determine the quality of the wetland.

12.5.4.7 Summary

The proposed offset contributions from Site 2 which may be used for Airport North MDP offsets are presented within Table 12-**24**.

The offset site provides offset values in excess of what is required to offset Banksia Woodlands TEC. Site 2 will provide just over a third of the required CBC foraging habitat and only about 1% of the required FRTBC foraging habitat. If Site 2 is selected for the MDP Offset, only the areas/values required will be utilised, with the remainder of the areas/values banked for future offsets.

Prioritising areas of CBC foraging habitat, approximately 183 ha of the area may be used to provide 100% of the offset required for MDP CBC foraging habitat. Noting that there is some overlap of Banksia Woodland TEC with Black Cockatoo foraging habitat, areas of CBC foraging habitat may also provide offset value against Banksia Woodland TEC, however this value can only be quantified once offset contribution boundaries are finalised.

Once Wetland HQS values are able to be determined for Site 2 a portion of the site may be used to contribute to the offset required for MDP Wetland impacts.

Table 12-24: Proposed Offset Contributions (area) of Site 2

Environmental Values	Offset Value			Proportion of Offset Liability met by Offset (excluding banked areas)
	Total Area (ha)/ No.	Area/Value proposed to be banked for future offset	Area/Value proposed for Offset	% Impact Offset via OAG
Banksia Woodlands TEC	201.4	18.4	183 ha[1]	100.53 %
Carnaby's Black-Cockatoo - Foraging Habitat	282.15	0	282.1 ha	37.43 %
Forest Black Cockatoo - Foraging Habitat	4.7	0	4.7 ha	1.26 %
Wetlands	71.4	TBC	TBC	TBC

[1]Value reflects that there is some overlap of Banksia Woodlands within the 282 ha of Carnaby's Black Cockatoo foraging habitat, however, until a proposed area is defined this can only be estimated.

12.5.5 Proposed Land Acquisition Offset 3

12.5.5.1 Overview

Offset Site 3 (Site 3) is a private property of approximately 1,610 ha located approximately 100 km north of the Perth Airport on the Swan Coastal Plain.

Perth Airport engaged Spectrum Ecology and Bamford Consulting Ecologists in 2021 to conduct ecological surveys at the property to assess and quantify the offset values of the site. Results of these assessments show that the proposed offset contains remnant vegetation supporting Banksia Woodland TEC, Wetlands (Spectrum 2022), CBC and FRTBC foraging habitat (BCE 2022b).

Through discussions with DBCA a reduced area of 815.3 ha split into two patches (687 ha and 128 ha respectively) within the Survey Area have been identified as acceptable for transfer into the conservation estate. Within this reduced area, the northern patch contains Wetlands and a portion of vegetation mapped as 'Very Good' (76%) condition, the southern patch contains a substantial portion of vegetation mapped as 'Excellent' (87%) condition. The areas excluded from the potential offset site but adjacent to these identified patches are large areas of disturbance caused by human activities through the clearing for agricultural activities such as grazing and for access tracks.

Refer to the flora and vegetation assessment report (Spectrum 2022) for presentation of vegetation condition, vegetation type and conservation significant flora mapped across the site, and to BCE (2022b) for presentation of Black Cockatoo foraging scores.

12.5.5.2 Offset Value of Site - Overview

Site 3, if selected for offset, has potential to provide conservation gain for and FRTBC Foraging Habitat, Wetlands and Banksia Woodlands TEC. The Offset Value of the site and proportion of impact offset are summarised below in Table 12-25.

Table 12-25: Offset Value of Offset Site 3

Environmental Values	Offset Required as per OAG		Offset Value		% Impact Offset
	Area / No. (x)	HQS	Area / No. (x)	HQS	
Banksia Woodlands TEC	218 ha	6	623.6 ha	7	347.57%
Carnaby's Black-Cockatoo - Foraging Habitat	1012 ha	4	811.7 ha	6	423.66 %
Forest Black-Cockatoo - Foraging Habitat	552 ha	6	127 ha*	7	125.87 %
Wetlands	203 ha Acquisition or 95 ha Restoration	5	10.7 ha	Unknown	Unknown

* Area listed is that within the Lot that contains a value of HQS 5 or greater to meet the HQS offset requirements

12.5.5.3 Management

If selected, Perth Airport propose to purchase Site 3 as a direct offset, which would be transferred to DBCA for conservation and management as per an approved OMP. Maintenance and management funds will be provided to DBCA to allow for establishment of the site within their maintenance regime. Transfer of the site to DBCA will mitigate the risk of loss of the site in perpetuity while management activities will be tailored to prevent reduction in habitat quality which would otherwise take place because of private ownership.

12.5.5.4 Banksia Woodlands TEC

Floristic survey results (Spectrum 2022) identified that the Banksia Woodlands TEC 'is present within Site 3. The TEC area covers 623.6 ha within the nominated Offset area and comprises vegetation primarily in Excellent and Very Good condition in two patches .The overall HQS for the TEC has been calculated at 7.

Offset Site 3 would have potential to provide offset up to 347.57% of the impact to the MDP Banksia Woodlands TEC, however only 183 ha would be needed to meet the 100% offset requirement. A summary of Inputs for offset via Land Acquisition of the Site 2 Banksia Woodlands TEC is presented within Table 12-26.

Table 12-26: Summary of Offsets Assessment Guide Inputs for Offset via Land Acquisition of Offset Site 3 Banksia Woodlands TEC

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	33.38	This value represents the maximum area of Impact to Banksia Woodlands TEC within the Project area; however this is expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	6	The HQS of the Banksia Woodlands TEC impact area as defined by the HQS Framework.
Time over which loss is averted	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	7	The offset site exceeds the minimum HQS of 5 to achieve a like-for-like offset to the impact area. Preservation of higher quality areas is of greater conservation benefit to the TEC.
Future quality without offset (scale 1-10)	6	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	7	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	623.6	The area of Banksia Woodlands TEC potentially present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset,
Risk of Loss (%) without offset	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture and has a mining exploration license present. Therefore, there is low to moderate risk (15-40%) the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	347.57%	If selected, the offset would compensate for greater than 100% of the impact.

12.5.5.5 Black Cockatoos

As Banksia Woodland TEC is a CBC foraging resource, the nominated offset area 3 as a whole scored 5 out of 10 using the Black Cockatoo HQS framework, comprising an area of 279.5 ha. Excluding areas with an HQS lower than 5, the property comprised 127.8 ha of suitable FRTBC foraging resource.

If selected, Site 3 would have potential to provide offset up to 115.68% of the impact to MDP CBC foraging resource, however only 702 ha would be needed to meet the 100% offset requirement (Table 12-27). Only the southern patch of Site 3 has the potential to provide offset up to 34.14% of the impact to the MDP FRTBC foraging resource (excluding areas of HQS < 5). A summary of Inputs for offset via Land Acquisition of the Site 3 Black Cockatoo foraging habitat is presented within Table 12-27.

Table 12-27: Summary of Offsets Assessment Guide Inputs for offsetting the Black Cockatoo Foraging Habitat impact area via Land Acquisition of Site 3

Offset Calculator Attribute	Input - CBC	Input - FRTBC	Explanation
Quantum of impact – area (ha)	180.33	83.11	This value represents the maximum area of Impact to Black Cockatoos within the Project area; however, this is expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	4	6	The HQS of the Black Cockatoo impact area as defined by the HQS Framework.
Time over which loss is averted	20	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	20	The time over which a decline in habitat quality would be estimated to take, should the site not be used for offset and this decline not mitigated. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	6	7	The offset site meets or exceeds the minimum HQS to achieve a like-for-like offset to the impact area.
Future quality without offset (scale 1-10)	5	6	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	6	7	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	811.7	127	The area of Black Cockatoo foraging habitat present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset,
Risk of Loss (%) without offset	15	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture and has a mining exploration license present. Therefore, there is low to moderate risk (15-40%) that the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.

Offset Calculator Attribute	Input - CBC	Input - FRTBC	Explanation
Confidence in result - averted loss (%)	90	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	115.68	34.14	If selected, the offset would compensate for greater than 100% of the impact.

12.5.5.6 Wetlands

Ecological assessment by Spectrum (2022) determined the northern patch of the site contains 10.7 ha of wetland in Good to Very Good Vegetation Condition. The WESCP Wetland Habitat Quality Score was unable to be conducted for this site, due to lack of intersecting spatial data. If selected for offset, further assessment may be required to determine the quality of the wetland.

12.5.5.7 Summary

The proposed offset contributions from Site 3 which may be used for Airport North MDP offsets are presented within Table 12-28.

The offset site provides offset values in excess of what is required to offset the MDP Carnaby's Black-Cockatoo Foraging Habitat, Forest Black-Cockatoo Foraging Habitat and Banksia Woodlands TEC as well as contributing towards Wetlands. If Site 3 is selected for MDP Offset, only the areas/values required will be utilised, with the remainder of the areas/values banked for future offsets.

Prioritising areas of Carnaby's Black Cockatoo foraging habitat, approximately 702 ha of the area may be used to provide 100% of the offset required for MDP Carnaby's Black Cockatoo foraging habitat. This site could also provide 127 ha for offsetting Forest Red-tailed Black-Cockatoo Foraging Habitat required for the MDP, providing 34.14% of the offset required. Noting that there is some overlap of BW TEC with Black Cockatoo foraging habitat, areas of Black Cockatoo foraging habitat may also provide offset value against BW TEC, however this value can only be quantified once offset contribution boundaries are finalised.

Once Wetland HQS values are able to be determined for Site 3 a portion of the site may be used to contribute to the offset required for MDP Wetland impacts.

Table 12-28: Proposed Offset Contributions (area) of Site 3

Environmental Values	Offset Value			Proportion of Offset Liability met by Offset (excluding banked areas)
	Total Area (ha)/ No.	Area/Value proposed to be banked for future offset	Area/Value proposed for Offset	% Impact Offset via OAG
Banksia Woodlands TEC	623.6	440.6	183 ha[1]	100.53 %
Carnaby's Black-Cockatoo - Foraging Habitat	811.7	109.7 ha	702	100.05 %
Forest Black Cockatoo - Foraging Habitat	127	0	127 ha	34.14 %
Wetlands	10.7	0	10.7 ha	Unknown

[1]Value reflects that there is some overlap of Banksia Woodlands within the 702 ha of Black Cockatoo foraging habitat, however, until a proposed area is defined this can only be estimated.

12.5.6 Proposed Land Acquisition Offset 4

12.5.6.1 Overview

Offset Site 4 (Site 4) is a private property of approximately 1679 ha located approximately 100 km north of the Perth Airport on the Swan Coastal Plain. The privately owned site is currently under examination with the landowner, who has indicated they are receptive to sale of the property.

Perth Airport engaged Bamford Consulting Ecologists in 2022 to conduct ecological assessment of the property, to assess and quantify the offset values of the site. Results of this assessment show that the proposed offset contains both CBC and FRTBC foraging habitat (BCE 2022b).

While the results of the flora survey is pending, much of the site was categorised as 'Banksia Woodland' during the Black Cockatoo foraging assessment (BCE 2022b), indicating that the Banksia Woodland TEC is likely to exist within the site. A flora survey is scheduled to take place in Spring 2022 to assess the potential value of Banksia Woodlands TEC at Site 4.

12.5.6.2 Offset Value of Site - Overview

Site 4, if selected for offset, has potential to provide conservation gain for CBC and FRTBC Foraging Habitat and potentially Banksia Woodlands TEC. The potential Offset Value of the site and proportion of impact offset are summarised below in Table 12-29.

Table 12-29: Offset Value of Offset Site 4

Environmental Values	Offset Required as per OAG		Offset Value		% Impact Offset
	Area / No. (x)	HQS	Area / No. (x)	HQS	
Banksia Woodlands TEC	218 ha	6	1280 ha	Est. 8[1]	748.53 %
Carnaby's Black-Cockatoo - Foraging Habitat	1012 ha	4	1289.5 ha	7	196.45 %
Forest Black-Cockatoo - Foraging Habitat	552 ha	6	14.11 ha*	6	3.55 %

[1] Assuming HQS is similar to that of adjacent Lot 2, to be confirmed by survey in Spring 2022

* Area listed is that within the Lot that contains a value of HQS 6 or greater to meet the HQS offset requirements

12.5.6.3 Management

If selected, Perth Airport propose to purchase Site 4 as a direct offset, which would be transferred to DBCA for conservation and management as per an approved OMP. Maintenance and management funds will be provided to DBCA to allow for establishment of the site within their maintenance regime. Transfer of the site to DBCA will mitigate the risk of loss of the site in perpetuity while management activities will be tailored to prevent reduction in habitat quality which would otherwise take place because of private ownership.

12.5.6.4 Banksia Woodlands TEC

A flora survey is being conducted in Spring 2022 to assess the potential value of Banksia Woodlands TEC at Site 4. While the results are pending, approximately 1,506 ha of the site was categorised as 'Banksia Woodland' during the Black Cockatoo foraging assessment (BCE 2022b), indicating that the Banksia Woodland TEC is likely to exist within the site. Additionally, Offset Site 1 'Lot 2' (Section 12.5.3) which has been assessed for Banksia Woodland TEC values (HQS 8) is near adjacent, with only a 300 m separation between sites.

It should be noted that Perth Airport have provided as much information as is currently available in this Offset Proposal, with further information to be provided when available during the provision of OMP or further versions of this MDP. For example, Perth Airport recognise that detailed flora surveys are pending, per above, but have made an assessment based on currently available information.

For the purposes of estimating the potential offset value of Banksia Woodland TEC at Site 4, the overall Banksia HQS for the TEC has been attributed a score of 8, as per that of Offset Site 1, Lot 2.

Offset Site 4 would have potential to provide offset up to 748.53% of the impact to Banksia Woodland TEC, however only 171 ha would be needed to meet the 100% offset requirement. A summary of Inputs for offset via Land Acquisition of the Site 4 Banksia Woodlands TEC is presented within Table 12-30.

Table 12-30: Summary of Offsets Assessment Guide Inputs for Offset via Land Acquisition of Offset Site 4 Banksia Woodlands TEC

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	33.38	This value represents the maximum area of Impact to Banksia Woodlands TEC within the Project area; however this is expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	6	The HQS of the Banksia Woodlands TEC impact area as defined by the HQS Framework.
Time over which loss is averted	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	8	The offset site exceeds the minimum HQS of 5 to achieve a like-for-like offset to the impact area. Preservation of higher quality areas is of greater conservation benefit to the TEC.
Future quality without offset (scale 1-10)	7	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	8	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	1280	The area of Banksia Woodlands TEC potentially present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset,
Risk of Loss (%) without offset	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture and has a mining exploration license present. Therefore, there is low to moderate risk (15-40%) the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	748.53	If selected, the offset would compensate for greater than 100% of the impact.

12.5.6.5 Black Cockatoos

As a Carnaby Black Cockatoo foraging resource, the property as a whole scored 7 out of 10 using the Black Cockatoo HQS framework, comprising an area of 1289.5 ha. Excluding areas with an HQS lower than 6, the property comprised 14.1 ha of suitable Forest Black Cockatoo foraging resource.

If selected, Site 4 would have potential to provide offset up to 196.45% of the impact to CBC foraging resource, however only 657 ha would be needed to meet the 100% offset requirement (Table 12-31: Summary of Offsets Assessment Guide Inputs for offsetting the Black Cockatoo Foraging Habitat impact area via Land Acquisition of Site 4). Additionally, Site 4 would have potential to provide offset up to 3.55% of the impact to FRTBC foraging resource offset requirement. A summary of Inputs for offset via Land Acquisition of the Site 4 Black Cockatoo foraging habitat is presented within Table 12-31.

Table 12-31: Summary of Offsets Assessment Guide Inputs for offsetting the Black Cockatoo Foraging Habitat impact area via Land Acquisition of Site 4

Offset Calculator Attribute	Input - CBC	Input - FRTBC	Explanation
Quantum of impact – area (ha)	180.33	83.11	This value represents the maximum area of Impact to Black Cockatoos within the Project area; however, this is expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	4	6	The HQS of the Black Cockatoo impact area as defined by the HQS Framework.
Time over which loss is averted	20	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	20	The time over which a decline in habitat quality would be estimated to take, should the site not be used for offsetting and this decline not mitigated. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	7	6	The offset site meets or exceeds the minimum HQS to achieve a like-for-like offset to the impact area.
Future quality without offset (scale 1-10)	6	5	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	7	6	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	1289.5	14.1	The area of Black Cockatoo foraging habitat present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset,
Risk of Loss (%) without offset	15	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture and has a mining exploration license present. Therefore, there is low to moderate risk (15-40%) that the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	196.45	3.55	If selected, the offset would compensate for greater than 100% of the impact to CBC but under 4% of the impact to FRTBC.

12.5.6.6 Summary

The proposed offset contributions from Site 4 which may be used for MDP offsets are presented within Table 12-32.

The offset site provides offset values in excess of what is required to offset CBC Foraging Habitat and likely Banksia Woodlands TEC and contributes towards FRTBC Foraging Habitat. If Site 4 is selected for MDP Offset, only the areas/values required will be utilised, with the remainder of the areas/values banked for future offsets.

171 ha for offsetting CBC Foraging Habitat, would be used to provide the offset required for the MDP. Noting that there is some overlap of Banksia Woodland TEC with CBC foraging habitat, areas of FRTBC foraging habitat may also provide offset value against Banksia Woodland TEC, however this value can only be quantified once offset contribution boundaries are finalised and spring surveys completed for Banksia Woodland TEC.

Table 12-32: Proposed Offset Contributions (area) of Site 4

Environmental Values	Offset Value			Proportion of Offset Liability met by Offset (excluding banked areas)
	Total Area (ha)/ No.	Area/Value proposed to be banked for future offset	Area/Value proposed for Offset	% Impact Offset via OAG
Banksia Woodlands TEC	Est. 1,280 ha	1,109 ha	171 ha	100.00 %
Carnaby's Black-Cockatoo - Foraging Habitat	1289.5ha	632.5 ha	657 ha	100.09 %
Forest Black Cockatoo - Foraging Habitat	14.1 ha	0 ha	14.1 ha	3.55 %

[7]Value reflects that there is some overlap of Banksia Woodlands within the 237 ha of Forest Black Cockatoo foraging habitat, however, until a Spring survey is conducted, proposed area defined, and a management boundary agreed with DBCA, this can only be estimated.

12.5.7 Proposed Land Acquisition Offset 5

12.5.7.1 Overview

Offset Site 5 (Site 5) is a private property of approximately 283 ha located approximately 80 km south of the Perth Airport on the Swan Coastal Plain. The privately owned site is currently under examination with the landowner, who has indicated they are receptive to sale of the property.

Perth Airport engaged Spectrum Ecology in 2022 to conduct ecological surveys at the property to assess and quantify the offset values of the site. Results of this assessment show that the proposed offset contains CBC and FRTBC foraging habitat (Spectrum 2022b).

While a detailed flora survey is pending, nearly half of the site was categorised as 'Banksia Woodland' during the reconnaissance flora and vegetation assessment (Spectrum 2022b), indicating that the Banksia Woodland TEC is likely to exist within the site. The flora survey is scheduled to take place in Spring 2022 to assess the potential value of Banksia Woodlands TEC at Site 5.

12.5.7.2 Offset Value of Site - Overview

Site 5, if selected for offset, has potential to provide conservation gain for CBC and FRTBC Foraging Habitat and potentially Banksia Woodlands TEC. The Offset Value of the site and proportion of impact offset, are summarised below in Table **12-33.**

Table 12-33: Offset Value of Offset Site 5

Environmental Values	Offset Required as per OAG		Offset Value		% Impact Offset
	Area / No. (x)	HQS	Area / No. (x)	HQS	
Banksia Woodlands TEC	218 ha	6	Est. 117 ha	Est. 6[1]	60.13 %
Carnaby's Black-Cockatoo - Foraging Habitat	1012 ha	4	272.5 ha	5	34.89 %
Forest Black-Cockatoo - Foraging Habitat	552 ha	6	140.8 ha*	6	35.40 %

[1] Assuming identified patches meet diagnostic criteria for Banksia Woodlands TEC, to be confirmed by survey in Spring 2022
* Area listed is that within the Lot that contains a value of HQS 6 or greater to meet the HQS offset requirements

12.5.7.3 Management

If selected, Perth Airport propose to purchase Site 5 as a direct offset, which would be transferred to DBCA for conservation and management as per an approved OMP. Maintenance and management funds will be provided to DBCA to allow for establishment of the site within their maintenance regime. Transfer of the site to DBCA will mitigate the risk of loss of the site in perpetuity while management activities will be tailored to prevent reduction in habitat quality which would otherwise take place because of private ownership.

12.5.7.4 Banksia Woodlands TEC

A flora survey is scheduled to take place in Spring 2022 to assess the potential value of Banksia Woodlands TEC at Site 5. While a detailed flora survey is pending, approximately 117 ha of the site was categorised as 'Banksia Woodland' during the reconnaissance flora and vegetation assessment (Spectrum 2022b), indicating that the Banksia Woodland TEC is likely to exist within the site. Two patches of Banksia Woodland TEC were identified in the Survey Area. Patch 1 and Patch 2 achieved a BW HQS of 5.3 and 7.0, respectively. The species richness, Threatened taxa, and TEC/PEC presence components were estimated and require a detailed flora and vegetation assessment to be accurately determined. Contextual information from the significant flora and vegetation desktop assessments was used to estimate HQS criteria that could not be accurately assessed with the level of field survey.

It should be noted that Perth Airport have provided as much information as is currently available in this Offset Proposal, with further information to be provided when available during the provision of OMP or further versions of this MDP. For example, Perth Airport recognise that detailed flora surveys are pending, but have made an assessment based on currently available information within the Spectrum assessment.

For the purposes of estimating the potential offset value of Banksia Woodland TEC at Site 5, the overall weighted HQS for the TEC has been attributed a score of 6.

Offset Site 5 would have potential to provide offset up to 60.13 % of the impact to Banksia Woodland TEC offset requirement. A summary of Inputs for offset via Land Acquisition of the Site 5 Banksia Woodlands TEC is presented within Table 12-34.

Table 12-34: Summary of Offsets Assessment Guide Inputs for Offset via Land Acquisition of Offset Site 5 Banksia Woodlands TEC

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	33.38	This value represents the maximum area of Impact to Banksia Woodlands TEC within the Project area.
Quantum of impact – quality (HQS)	6	The HQS of the Banksia Woodlands TEC impact area as defined by the HQS Framework.
Time over which loss is averted	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	The time over which improvement in habitat quality is estimated to take. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	6	The offset site exceeds the minimum HQS of 5 to achieve a like-for-like offset to the impact area. Preservation of higher quality areas is of greater conservation benefit to the TEC.
Future quality without offset (scale 1-10)	5	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	6	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	117	The area of Banksia Woodlands TEC potentially present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset.
Risk of Loss (%) without offset	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture. Therefore, there is low to moderate risk (15-40%) the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	60.13	If selected, the offset would compensate for greater than 50% of the impact.

12.5.7.5 Black Cockatoos

As a Carnaby Black Cockatoo foraging resource, the property as a whole scored 5 out of 10 using the Black Cockatoo HQS framework, comprising an area of 272.5 ha. Excluding areas with an HQS lower than 6, the property comprised 140.8 ha of suitable Forest Black Cockatoo foraging resource.

If selected, Site 5 would have potential to provide offset up to 34.89% of the impact to CBC foraging resource (Table 12-33). Additionally, Site 5 would have potential to provide offset up to 35.40% of the impact to FRTBC foraging resource offset requirement. A summary of Inputs for offset via Land Acquisition of the Site 5 Black Cockatoo foraging habitat is presented within Table 12-35.

Table 12-35 Summary of Offsets Assessment Guide Inputs for offsetting the Black Cockatoo Foraging Habitat impact area via Land Acquisition of Site 5

Offset Calculator Attribute	Input - CBC	Input - FBC	Explanation
Quantum of impact – area (ha)	180.33	83.11	This value represents the maximum area of Impact to Black Cockatoos within the Project area.
Quantum of impact – quality (HQS)	4	6	The HQS of the Black Cockatoo impact area as defined by the HQS Framework.
Time over which loss is averted	20	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	20	The time over which a decline in habitat quality would be estimated to take, should the site not be used for offset and this decline not mitigated. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.
Start quality (scale of 1-10)	5	6	The offset site meets or exceeds the minimum HQS to achieve a like-for-like offset to the impact area.
Future quality without offset (scale 1-10)	4	5	The offset site is likely to degrade in quality over the timeframe without protection.
Future quality with offset (scale 1-10)	5	6	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	272.5	140.8	The area of Black Cockatoo foraging habitat present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset,
Risk of Loss (%) without offset	15	15	This site exists within 'Rural' zoning, is deemed capable of supporting agriculture. Therefore, there is low to moderate risk (15-40%) that the site could be cleared over the next 20 years.
Risk of loss (per cent) with offset	5	5	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. DBCA have agreed to manage this site. This site has been allocated up to 5 per cent (low risk) of future loss because it is most difficult for these tenure types to be changed.

Offset Calculator Attribute	Input - CBC	Input - FBC	Explanation
Confidence in result - averted loss (%)	90	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of acquisition and protection of an offset site.
Confidence in result – change in habitat quality (%)	90	90	The high score is supported by the established process of acquisition and management of an offset site.
Percentage of impact offset	34.89	35.40	If selected, the offset would compensate for over a third of the impact.

12.5.7.6 Summary

The proposed offset contributions from Site 5 which may be used for MDP offsets are presented within Table 12-36.

The offset site provides a third of the offset values required to offset CBC and FRTBC Foraging Habitat and likely nearly two thirds of Banksia Woodlands TEC. If Site 5 is selected for MDP Offset, the entire area will be utilised which would provide 117 ha of Banksia Woodlands TEC, 272.5 ha of CBC Foraging Habitat and approximately 140 ha of the area (covering HQS >6) for FRTBC foraging habitat. Noting that there is some overlap of Banksia Woodland TEC with CBC foraging habitat, areas of FRTBC foraging habitat may also provide offset value against Banksia Woodland TEC, however this value can only be quantified once offset contribution boundaries are finalised and spring surveys completed for Banksia Woodland TEC.

Table 12-36: Proposed Offset Contributions (area) of Site 5

Environmental Values	Offset Value			Proportion of Offset Liability met by Offset (excluding banked areas)
	Total Area (ha)/ No.	Area/Value proposed to be banked for future offset	Area/Value proposed for Offset	% Impact Offset via OAG
Banksia Woodlands TEC	Est. 117 ha[1]	0	117 ha	60.13 %
Carnaby's Black-Cockatoo - Foraging Habitat	272.5 ha	0	272.5 ha	34.89 %
Forest Black Cockatoo - Foraging Habitat	140.8 ha*	0	140.8 ha	35.40 %

[1]Value reflects assessment of potential Banksia Woodlands patches however, until a Spring survey is conducted, this can only be estimated.
* Area listed is that within the Lot that contains a value of HQS 6 or greater to meet the HQS offset requirements

12.5.8 Proposed Land Acquisition Offset 6

12.5.8.1 Overview

Offset Site 6 is a group of wetlands south-west of the airport selected as an example of a proposed Restoration offset for MDP Wetlands. Should this offset be viable, Perth Airport will likely seek opportunity to provide restoration funding to additional wetlands within the LGA.

Perth Airport have provided as much information as is currently available in this Offset Strategy, with further information to be provided when available during the provision of OMP or further stages of this MDP.

12.5.8.2 Offset Value of Site – Overview

Site 6, if selected for offset, has potential to provide conservation gain for Wetlands. The Offset Value of the site and proportion of impact offset are summarised below in Table 12-37.

Table 12-37: Offset Value of Wetlands. Values are estimations based on OAG (offsets calculator)

Environmental Values	Offset Required as per OAG		Offset Value			
	Area / No. (x)	Minimum HQS	Area / No. (x)	HQS Start	End HQS	% Impact Offset via OAG
Wetlands	203 ha Acquisition or 95 ha Restoration	5	176 ha	6	7	121.3%

12.5.8.3 Management

A restoration management plan will be developed and included in the OMP for this site if selected.

12.5.8.4 Wetlands

Perth Airport propose to undertake or fund restoration works that would aim to improve vegetation condition to an average of Very Good at minimum, resulting in a wetland quality improvement to a score of 7 out of 10.

The offset site would have potential to provide offset up to 121.1% of the impact to MDP impacted wetlands, however only 146 ha would be needed to meet the 100% offset requirement. A summary of Inputs for offset via restoration are presented within Table 12-38 .

Table 12-38: Summary of Offsets Assessment Guide Inputs for Offset via Restoration of Wetlands

Offset Calculator Attribute	Input/ Output	Explanation
Quantum of impact – area (ha)	44.2	This value represents the maximum area of direct impact to Wetlands within the Project area; however this is expected to decrease on final clearing design.
Quantum of impact – quality (HQS)	5	The HQS of the Wetlands impact area as defined by the HQS Framework.
Time over which loss is averted	20	The offset site would be placed within a conservation estate with a guarantee for protection for the life of the permit. A timeframe of 20 years (the maximum number of years that can be entered into the Offsets Guide) has therefore been selected.
Time until ecological benefit	20	The time over which a decline in habitat quality would be estimated to take, should the site not be used for offset and this decline not mitigated. Also, the time over which improvement in habitat quality is estimated to take, with management. Values for change in habitat quality have been calculated using the 20-year value, as it is the maximum timeframe which can be entered into the Offsets Guide.

Offset Calculator Attribute	Input/ Output	Explanation
Start quality (scale of 0-10)	6	The offset site exceeds the minimum HQS of 5 to achieve a like-for-like offset to the impact area. Preservation of higher quality areas is of greater conservation benefit to Wetlands.
Future quality without offset (scale 1-10)	5	The offset site is likely to degrade in quality over the timeframe without protection. Identified risks for site degradation without management include increase in weed ingress and proliferation. While some management of the wetlands are being undertaken, the large degraded areas continue to pose a threat and therefore will continue to degrade over time unless a large scale restoration approach is undertaken.
Future quality with offset (scale 1-10)	7	Protection of the site is likely to reduce the impact of some threatening processes and halt the degradation which would otherwise occur without management.
Size of offset area (ha)	176	The area of Wetlands present within the Offset Site. This area input into the EPBC Offsets Assessment Guide indicates the Percentage of Impact Offset.
Risk of Loss (per cent) without offset	7	The risk of loss of 7 per cent has been allocated as this is the derived risk of loss of vegetation around the relevant LGA.
Risk of loss (per cent) with offset	5	The offset site would be managed via a conservation agreement under the EPBC Act between the landholder and Perth Airport.
Confidence in result - averted loss (%)	90	Degradation over time without management is likely within the Swan Coastal Plain, therefore there is high confidence that loss of habitat quality will be averted by the established process of additional protection of the offset site.
Confidence in result – change in habitat quality (%)	75	Leading practice restoration methods will be employed and the site has been selected to ensure that confidence in the outcome is high. It is expected that the Project will have a long duration that will be informed by a monitoring program and adaptive management process to ensure restoration processes allow the site to achieve the target HQS.
Percentage of impact offset	121.1	If selected, this is the value the percentage (%) of the impact that would be offset.

12.5.8.5 Summary

The proposed contributions from Site 6 to be used for the MDP offsets are presented within Table 12-39.

146 ha of the wetland are proposed to be made available for the MDP wetland Offset, providing 100.49 % of the offset for impacted MDP wetlands.

Table 12-39: Proposed Offset Contributions (area) of Site 6

Environmental Values	Offset Value			Proportion of Offset Liability met by Offset (excluding banked areas)
	Total Area (ha)	Area proposed to be banked for future offset	Area proposed for Offset	% Impact Offset via OAG
Wetlands	176 ha	30 ha	146 ha	100.49 %

12.5.9 Proposed Land Acquisition Offset 7: DBCA or LGA Managed Wetlands

12.5.9.1 Overview

Various sites are currently under consideration for restoration work within the Swan Coastal Plain. DCCEEW have provided Perth Airport with a method to prioritise wetlands (deemed 'like' or 'unlike') that may be selected as offset against impact to MDP wetlands.

Discussions are currently underway between Perth Airport and DBCA to source a wetland restoration area which functions as an efficient offset that provides a conservation gain suitable against the MDP impacted wetlands.

12.5.9.2 Offset Value of Site – Overview

As a specific location has not yet been selected for Site 7, the potential conservation gain cannot be accurately quantified. The potential Offset Value of the site and proportion of impact offset will be provided to DCCEEW within site details memorandums, further versions of this MDP and/or within the OMP.

Perth Airport commit to providing Wetland Offsets which equate to at least 100% of the MDP impact offset.

12.5.9.3 Management

Management of the proposed area will be undertaken by DBCA or an LGA, with funding provided by Perth Airport to complete restoration works and site management activities supplementary to what is currently undertaken. An OMP, incorporating a Restoration Management Plan, will be developed detailing the specific restoration objectives of this site. The site selected will be within DBCA managed lands or MRS (LGA) managed lands thus providing protection for conservation purposes over the long term.

12.5.10 Proposed Land Acquisition Offset 8: DBCA/LGA Managed SCP 3b TEC

12.5.10.1 Overview

Various sites are currently under consideration for restoration work within the Swan Coastal Plain. DCCEEW have provided Perth Airport with a method to prioritise vegetation (deemed 'like' or 'unlike') that may be selected as offset against impact to SCP 3b TEC.

Discussions are currently underway between Perth Airport and DBCA to source SCP 3b TEC restoration area(s) which function as an efficient offset that provides a conservation gain suitable against the MDP impacted SCP 3b TEC.

12.5.10.2 Offset Value of Site – Overview

As a specific location has not yet been selected for Offset 8, the potential conservation gain cannot be accurately quantified. The potential Offset Value of the site and proportion of impact offset will be provided to DCCEEW within site detailed memorandums, further versions of this MDP and/or within the OMP.

Perth Airport commit to providing SCP 3b TEC Offsets which equate to at least 100% of the MDP impact offset.

12.5.10.3 Management

Ultimate management of the proposed area will be undertaken by DBCA or an LGA, with funding provided by Perth Airport to complete restoration works and site management activities supplementary to what is currently undertaken. An OMP, incorporating a Restoration Management Plan, will be developed detailing the specific restoration objectives of this site. The site selected will be within DBCA managed lands or MRS (LGA) managed lands thus providing protection for conservation purposes over the long term.

12.5.11 Proposed Translocation and Propagation Offset 9

12.5.11.1 Overview

Perth Airport have separately engaged with Edith Cowan University (ECU) to develop a Propagation, Research and Monitoring Plan to address Offset requirements of the approved New Runway Project MDP. This Plan addresses offset requirements for both *Macarthuria keigheryi* and *Conospermum undulatum*. The Plan contributes to the New Runway Project offset requirements through both research (10%) and propagation (90%). It is proposed that the additional 9 plants of *Conospermum undulatum* required to meet the Airport North Offset requirements be propagated as part of this established propagation program using endemic genetic species.

The proposed offset package features both translocation and propagation. All 12 plants within the MDP are proposed to be translocated within the Airport Estate, preferentially within the retained patches of vegetation within the Airport North MDP, where suitable.

An additional 9 plants are proposed to be propagated and translocated within the Airport Estate or external sites, resulting in a future value with offset of 21 individuals, providing for 103.96% of impact offset.

12.5.11.2 Offset Value of Site – Overview

Perth Airport is currently liaising with ECU and the DBCA to identify suitable habitat for the establishment of *C. undulatum* populations to counteract the impact to these species. Several suitable sites have been located in areas of suitable soil type where these species still persist in low numbers or were known to exist previously but are now absent.

12.5.11.3 Management

Management of the translocation site (or sites), depending on their location, will either be undertaken by DBCA or an LGA or Perth Airport (in locations on airport estate only), with funding provided by Perth Airport for ongoing site management. The site selected will be within DBCA managed lands or MRS (LGA) managed lands thus providing protection for conservation purposes over the long term. Where selected sites are within the airport estate it will be managed via the Perth Airport Environment Strategy and potentially a conservation agreement under the EPBC Act. Further investigation and consultation with the relevant Commonwealth agencies is required to enable this. An OMP will be developed detailing the specific restoration objectives of this site.

12.5.11.4 Translocation and Propagation

Translocation of 12 and propagation of 9 *Conospermum undulatum* will provide offset of 100% of the impact to individuals present within the Airport North MDP. A summary of the inputs for offset via propagation is presented within Table 12-40.

Table 12-40: Offsets Assessment Guide input for C. undulatum

Offset Calculator Attribute	Input for C. undulatum	Explanation
Quantum of Impact - number of individuals	12	This value represents the number of individuals within the MDP area.
Time Horizon	5	The time horizon aligns with the New Runway Project Propagation, Research and Monitoring Plan timeframe.
Start value - number of individuals	0	Without the offset, all individuals would be removed. The translocation offset site(s) are to be selected in areas with suitable habitat, capable of establishment and/or population growth. The offset site(s) selected are unlikely to initially contain any or many individuals. Should individuals be present at the offset site(s), these individuals will not be counted towards future value with offset. Therefore, the start value is maintained at 0.
Future value without offset –	0	Without an offset, it is unlikely that the number of plants will increase.

Offset Calculator Attribute	Input for C. undulatum	Explanation
number of individuals		
Future value with offset - number of individuals	21	This is the number of individuals calculated using the EPBC Offsets Assessment Guide that meets 100% minimum criteria of Percentage of Impact Offset. It is proposed to consist of 12 individuals translocated from the original impact site and 9 individuals propagated.
Confidence in result (%)	60	Leading practice propagation and translocation methods will be employed to ensure that confidence in the outcome is as high as possible. In populating the offsets calculator, a confidence level of 60 per cent was used to provide a conservative view of the translocation Project. However, it is expected that the Project will be informed by a monitoring program and adaptive management process to ensure translocation processes allow the site to achieve the target future value
Percentage of impact offset	103.96	The offset adequately compensates for the impact to the species.

13 Conclusion

This Part B (Environment and Heritage Assessment) MDP has been prepared by Perth Airport to supplement Part A MDP, noting that both reports should be read in conjunction. The purpose of the overall MDP (Parts A and B combined) are to seek Commonwealth approval for works within Airport North precinct which will provide a range of future land uses.

An environmental assessment has been undertaken for the total 248.03 ha MDP area with the 213.5 ha TDA. Clearing of 104.71 ha of native vegetation is required for the development.

Cumulative impacts for Airport North have been considered including two already approved projects (New Runway Project and Airport West (South)) and also Airport Central, which is in the planning stage per this Airport North project.

Using the most recent Vegetation and Flora Survey (Woodman 2000) it was found that over 50% of the project area is comprised of 'completely degraded' or 'degraded' native vegetation areas with the remaining project area comprising vegetation in varying condition. No vegetation in the project area is in Pristine condition.

The Airport North project works will directly and indirectly impact 33.38 ha of the Commonwealth-listed TEC Banksia Woodlands of the Swan Coastal Plain to be removed in addition to 14.49 ha of State-listed SCP3b TEC. Furthermore, the recent Dieback Survey found that approximately 97.71 ha of the vegetation within the MDP area is infested with Phytophthora cinnamomi (Dieback). There will be 55 ha of retained areas containing the highest quality vegetation and habitat within the MDP to provide for ecological corridors and connectivity between remnant parcels. This will include a 100 m buffer around Munday Swamp and a 50 m wide corridor along the northern boundary of the MDP area, providing vegetated connectivity between the areas of retained vegetation and wetlands in the north of the MDP area and adjacent areas.

Fauna investigations found that the TDA of the Airport North project impacts several broad fauna habitat types including Woodland, Damp Heathland and Grassland, up to a total of approximately 180.33 ha. Ten conservation significant fauna were identified as being regularly present within the project area, including three MNES (including the FRTBC, CBC and BBC), three species list as Priority Species by the State Government (including Quenda (southern brown bandicoot), Rakali (water-rat) and one invertebrate (Woollybush bee species *Hylaeus globuliferus*)) and four bird species.

Twelve priority (CCW and REW) wetlands were found to be partially or wholly within the MDP area. This includes 5 CCW and 7 REW wetlands. Up to 45.3 ha of wetland vegetation will be directly impacted, including approximately 19.6 ha of wetlands considered commensurate with CCW and 25.7 ha of wetlands considered commensurate with REW. . Considering this, adverse clearing impacts have been completely avoided on Munday Swamp and other wetlands and will be managed in conjunction with buffer corridors will retain ecological values. In addition, there is provision for revegetation of area including the drainage basin and associated areas especially along the NMD. Once established, this 'Living Stream' will provide ecological linkages between the retained wetlands and Munday Swamp.

Significant residual impacts of the Airport North project to one MNES TEC, three protected species and Wetlands (in context of the Whole Environment impact) have been considered and an offset package has been proposed. Perth Airport have put forward a number of sites currently under consideration. The proposed offsets for the Airport North project include an offsite land purchase component for residual impacts to the Banksia Woodlands TEC, with this offset also contributing to the offset required for residual impacts to Black-Cockatoos. A land purchase and/or restoration offset will comprise the remaining requirements to address the residual impacts to Black-Cockatoos. Wetlands residual impacts will be offset through either a land purchase and/or restoration component.

Perth Airport are well advanced in securing properties for offsets and are also in discussion with State and Local Government for restoration opportunities. Perth Airport are confident that the necessary offsets in line with specialist expertise will be in place in a timely manner for Airport North works.

With regard to heritage, the Airport North MDP area intersects with four Registered and three lodged Aboriginal Sites. Munday Swamp is a key hydrological feature within the airport estate and is also an important heritage site. Munday Swamp is adjacent to the Airport North MDP area and the design of the project works ensure that no direct impacts to Munday Swamp will arise as a result of this project and indirect impacts are as low as reasonably practicable. There is recognition of the cultural significance of the MDP and wider airport estate and an interpretive heritage trail along the edge of the Living Stream will be installed connecting culturally significant wetlands on the east of the MDP (including Munday Swamp) with Allawah Grove in the west. Additionally, Perth Airport will engage Aboriginal heritage monitors where initial clearing and earthworks intersect with areas of potential cultural heritage value.

In terms of contamination, APEC include PFAS contaminated soil, surface and ground water, ASS, asbestos and metal containing soils. Implementation of the MDP may cause impacts to soil, groundwater and surface water and will be managed in accordance with the CEMP for the site construction works. Periodic monitoring will be undertaken for groundwater and surface water and soil material movements will be tracked and monitored to demonstrate that construction works are not causing an unacceptable increase in contamination risk or increase in off-site release. The CEMP will include target criteria, along with contingency measures to be implemented if the site derived trigger levels are exceeded. The generation of any residual impacts are anticipated to be minimal with management measures in place and likely to be quickly and effectively mitigated through proposed contingency measures. The realignment and upgrading of the NMD, together with the provision of storage basins and replacing a section of the drain with a culvert or pipe (subject to design), ensures that the development of the MDP area has no significant adverse impacts on the local regime or water quality.

The ultimate construction phase of the works has been considered and relevant factors identified are construction dust, noise and vibration. These, and other factors, will be addressed under the Airport Act Regulations and specifically via the CEMP which is reviewed by the Airport Environment Officer appointed by DITRDCA.

Perth Airport have conducted a detailed and considered environmental and heritage assessment for the Airport North MDP works, with the MDP to be presented to the Commonwealth for consideration following a 'due regard' process after significant community and stakeholder consultation as required under the Airports Act.

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