MFS Oakden Station

Human Health and Ecological Risk Assessment

South Australian Metropolitan Fire Service

26 June 2024

→ **The Power of Commitment**

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Executive Summary

South Australian (SA) Metropolitan Fire Service (MFS) commissioned GHD Pty Ltd (GHD) to undertake a human health and ecological risk assessment (HHERA) for the per- and polyfluoroalkyl substances (PFAS) impacts associated with the historical use of aqueous film forming foam (AFFF) at the MFS Oakden Fire Station (hereafter referred to as 'the site'). The site is located at 700 Grand Junction Road, Oakden, South Australia 5086.

The vacant land adjacent to the site to the east, south and west (hereafter referred to as 'the Development Area') is currently owned by Urban Renewal Authority (Renewal SA) and is proposed to be subdivided and developed for residential and open space land uses. GHD understands that Renewal SA has allocated a portion of the lands adjacent to the site for future fire station expansion and that MFS is considering leasing this land. However, the exact area and configuration is under negotiation. This area is hereafter referred to as 'the Buffer Area'.

The main migration pathway for PFAS impacts at the site is stormwater flow, with runoff from the site discharging to a network of drains that run along Grand Junction Road and into a channel that crosses a series of paddocks and flows into Dry Creek, approximately 400 m from the site.

This Report provides an HHERA for PFAS identified in the following areas (shown in Figure 1 in Appendix A):

– **Zone 1** – The site.
– **Zone 2** – The Buffer Area that may be considered for retention by MFS, including three separate strips of land located immediately to the west (Zone 2a), east (Zone 2b), and south (Zone 2c) of the site. Note that MFS may not retain this zone, and it could potentially be developed for residential use.
– **Zone 3** – The remainder of the Renewal SA Development Area.
– **Zone 4** – The receiving environment for the Grand Junction Road stormwater drain, including the drain/swale and Dry Creek.

These four zones, collectively referred to as 'the Investigation Area', are the focus of this Report. The HHERA estimates the potential risk to people and the environment from exposure to PFAS within the Investigation Area.

Summary of HHERA outcomes

The table below summarises the exposure scenarios considered in the HHERA and the relevant conclusions.

Receptor	Where?	Exposure pathway	Potential risks
Human health risks			
MFS personnel	The MFS site (Zone 1)	Incidental ingestion or inhalation of soil, dust, groundwater, and surface water	Low
	Buffer Area (Zone 2)	Incidental ingestion or inhalation of soil, dust, and groundwater	Low
Future residents of the Development Area	Zone 2a and 2b	Incidental ingestion or inhalation of soil/dust. Consumption of homegrown fruit and vegetables	Low
	Zone 2c	Incidental ingestion or inhalation of soil/dust.	Low
	Zone 3	Incidental ingestion or inhalation of soil/dust. Consumption of homegrown fruit and vegetables	Low
Maintenance and construction workers	The MFS site (Zone 1)	Incidental ingestion or inhalation of soil/dust.	Low
	Buffer Area (Zone 2)		Low
	Zone 3		Low
Recreational users of Dry Creek	Dry Creek	Incidental ingestion or inhalation of sediment and surface water.	Low

Ecological risks			
Terrestrial organisms	The site (Zone 1) and Buffer Area (Zone 2)	Soil direct ingestion and uptake	Low
		Soil indirect exposure (food chain)	Low
	Zone 3	Soil direct ingestion and uptake, and soil indirect exposure (food chain)	Low
Aquatic, and semi-aquatic organisms	Dry Creek	Direct ingestion and uptake of surface water and sediment	Low
		Indirect exposure to contaminated surface water through the food chain	Low

Overall, the HHERA indicates that:

– Zone 1 (the MFS site) is suitable for ongoing use as a fire station. Contact with PFAS in soil could be minimised by implementing appropriate occupational health and safety protocols for intrusive works in PFAS-affected areas.
– Zones 2a and Zone 2b of the Buffer Area are suitable for the proposed low-density residential use.
– Zone 2c of the Buffer Area is suitable for the proposed medium-density residential use (e.g., town home).
– Zones 2a, 2b and 2c of the Buffer Area are suitable for MFS acquisition and use.
– Zone 3 (the Development Area) is suitable for the proposed mixed low and medium-density residential use.
– The presence of PFAS within the Investigation Area is unlikely to have measurable adverse effects on the environment.

The weight of available evidence suggests that the removal of vegetation in the Development Area is unlikely to significantly impact the migration of PFAS in shallow groundwater. Adding more trees, especially to the west and downstream of the site, along with removing the PFAS source, is likely to limit the movement of PFAS in the shallow groundwater system identified beneath the site.

The key data gaps, uncertainties, and limitations associated with the HHERA are:

– The potential for impacts to extend to the Q1 aquifer has not been confirmed via intrusive investigations; however, the existing geological data suggests that the groundwater impacts are unlikely to seep vertically into the Q1 aquifer due to a clay confining layer.
– Seasonal effects on the shallow groundwater system are still being assessed.
– There is uncertainty surrounding the temporal variability in the flux of PFAS from the MFS site via surface water into the Dry Creek. However, the available dataset covers different weather conditions and indicates that the MFS is a minor contributor to the ambient PFAS impacts in Dry Creek.

This Report is subject to, and must be read in conjunction with, the limitations set out in Section 1.6 and the assumptions and qualifications contained throughout the Report.

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1. Introduction

This Report provides a human health and ecological risk assessment (HHERA) for the per- and polyfluoroalkyl substances (PFAS) impacts associated with the historical use of aqueous film forming foam (AFFF) at the MFS Oakden Fire Station (hereafter referred to as 'the site').

The site is located at 700 Grand Junction Road, Oakden, South Australia. A site location plan is presented in Figure 1 in Appendix A. The site is located approximately 9.5 kilometres north-north-east of the Adelaide central business district. Approximately 45.8 hectares of vacant land adjacent to the site to the east, south and west is currently owned by Urban Renewal Authority (Renewal SA). This area comprises multiple parcels of land intended to be subdivided and developed for residential and open space use.

1.1 Background

South Australian (SA) Metropolitan Fire Service (MFS) commissioned GHD Pty Ltd (GHD) to investigate the nature and extent of PFAS at the site. The results of the PFAS investigations undertaken within and surrounding the site are presented in the following two reports:

– GHD (2023a) *MFS Oakden Station - Detailed Site Investigation* – dated 17 November 2023 (also referred to as “the DSI”).
– GHD (2024) *MFS Oakden Station - Supplementary Detailed Site Investigation* – in preparation (also referred to as “the supplementary DSI”).

These investigations included the collection of soil, groundwater and biota (grass and tree) samples from the site and the portion of the Renewal SA land that falls within the parcels around the site (hereafter referred to as “the Development Area”) as shown in Figure 1 and 2, Appendix A. GHD understands that MFS is considering acquiring or leasing the portions of the Development Area immediately surrounding the Fire Station (hereafter referred to as “the Buffer Area”).

Stormwater flow is the main pathway via which PFAS impacts migrate from the site, with stormwater generated at the site discharging into a network of open and underground drains on Grand Junction Road. The Grand Junction Road drains discharge into a channel/swale that crosses a series of paddocks in a north-westerly direction before flowing into Dry Creek, approximately 400 meters north and downgradient of the site. The DSI and Supplementary DSI also included collecting surface water and sediment samples from the drain/swale and Dry Creek environments, hereafter as “the receiving environment”.

This Report provides a HHERA for the PFAS identified in the following key zones (identified in Figure 1 in Appendix A):

– **Zone 1** – The site.
– **Zone 2** – The Buffer Area, including three separate strips of land located immediately to the west (Zone 2a), east (Zone 2b), and south (Zone 2c) of the site. Note that MFS may not retain this zone, and it could potentially be developed for residential use.
– **Zone 3** – The remainder of the Development Area.
– **Zone 4** – The receiving environment for the Grand Junction Road stormwater drain, including the drain/swale and Dry Creek.

These four zones collectively are referred to as 'the Investigation Area'. The HHERA estimates the potential risk to human health and the environment that may be associated with the presence of PFAS within the Investigation Area.

This Report is subject to and must be read in conjunction with the limitations set out in Section 1.6 and the assumptions and qualifications contained throughout the Report.

1.2 Objectives of the HHERA

The purpose of this HHERA is to assist MFS to manage the PFAS impacts at the site under the following potential future scenarios:

– Scenario 1 – The Buffer Area and Development Area are developed for residential use.
– Scenario 2 – MFS acquires or leases the Buffer Area (or part of it), and it remains in its current condition under their management.

Specifically, the primary objective of this HHERA is to assess the potential risks to human health and the environment that may be associated with PFAS contamination within the Investigation Area under the land use patterns related to both Scenario 1 and Scenario 2.

Scenario 1 would include the removal of vegetation immediately adjacent to the site, and the South Australian Environment Protection Authority (SA EPA) has also requested that this HHERA specifically consider the potential impacts to the fate and transport of PFAS in groundwater, where this to occur.

1.3 Risk Assessment Framework and Methodology

The HHERA has been prepared with reference to the following legislation and guidance:

– National Environmental Protection Council (NEPC, 1999) *National Environment Protection (Assessment of Site Contamination) Amendment Measure* 1999, as amended 2013 (the "ASC NEPM"):
– EnHealth (2012a) *Australian exposure factor guidance*.
– EnHealth (2012b) Environmental health risk assessment: guidelines for assessing human health risks from environmental hazards.
– Australian and New Zealand Governments (ANZG, 2018) *Australia and New Zealand Fresh Water and Marine Water Quality Guidelines*.
– Heads of EPAs Australia and New Zealand (HEPA, 2020) *PFAS National Environmental Management Plan, version 2.0 (the "PFAS NEMP")*.
– National Health and Medical Research Council (NHMRC, 2019), *Guidance on Per and Polyfluoroalkyl substances (PFAS) in Recreational Water.*
– National Health and Medical Research Council / Natural Resource Management Ministerial Council (NHMRC/NRMMC, 2011) *Australian Drinking Water Guidelines,* updated September 2022 ('the ADWG').
– Food Standards Australia New Zealand (FSANZ, 2017) *Report on Perfluorinated Chemicals in Food*.
– SA EPA (2019) *Guidelines for the assessment and remediation (GAR) of site contamination, Environment Protection Authority, South Australia*, revised November 2019.
– SA Government (2015) *Environment Protection (Water Quality) Policy (WQEPP)*, version 1.7.2020.

Guidance provided by international agencies has been referenced where required and consistent with these guidelines and legislation.

Human health and ecological risk assessments in Australia primarily follow the methodologies outlined in the ASC NEPM (NEPC, 1999). Fundamental to the HHERA process is the development of a Conceptual Site Model (CSM), which is a description of the plausible mechanisms ('pathways'), by which people and ecosystems ('receptors') may be exposed to chemicals in the environment ('sources'). Potential risks to human health and the environment cannot occur unless there is a complete exposure pathway associated with a source of contamination. Conversely, complete exposure pathways do not by default, indicate a receptor will be at risk; the risk assessment process is used to evaluate the extent of the potential risks.

The key steps in the ASC NEPM HHERA process are outlined in Plate 1.1 overleaf and can be summarised as follows:

- ***Problem identification:*** establishes the objectives of the HHERA, evaluates the available data and establishes a preliminary CSM.
- ***Receptor* identification:** identifies the human and ecological species that may be at risk and evaluates the level of acceptable risk in the context of the ecological values that need to be protected.
- ***Toxicity* assessment:** establishes the relationships between PFAS exposure and potential health and ecological effects, using published toxicological information.
- ***Exposure assessment:*** produces estimates of the PFAS exposure that may be experienced by the identified human and ecological receptors of the Investigation Area and within the Investigation Area.
- ***Risk characterisation:*** combines the results of the toxicity assessment and exposure assessment, to provide numerical estimates of the potential health and ecological risks to relevant receptors.
- ***Uncertainty and sensitivity assessment:*** evaluates the uncertainty associated with the HHERA and sensitivity of the assessment outcomes to the various assumptions and inputs.

The issues identification process for this HHERA is outlined in Sections 3 and the human health risk assessment (HHRA) and ecological risk assessment (ERA) are presented in Section 4 and Section 5 respectively.

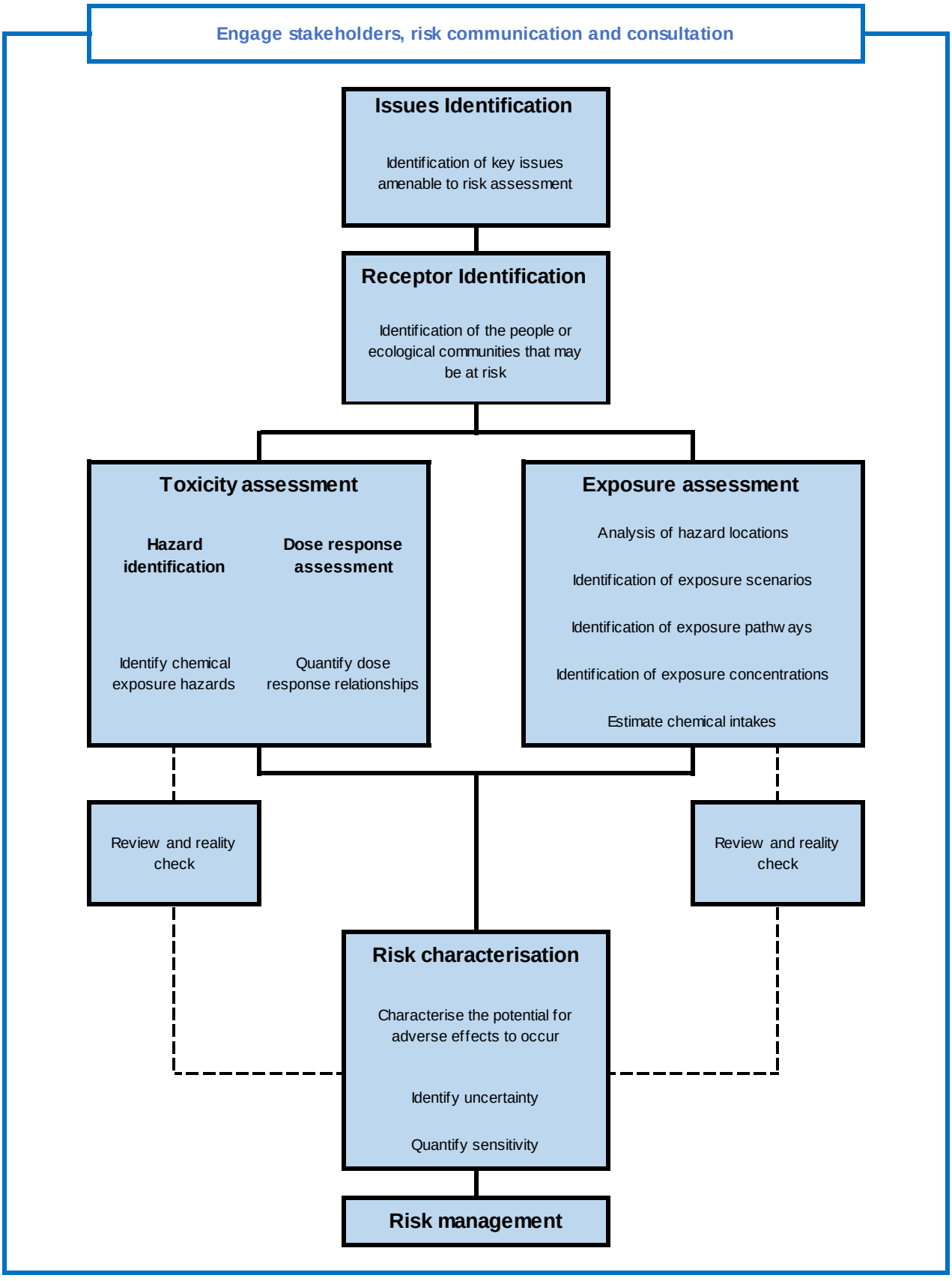

Plate 1.1 *HHERA methodology (enHealth, 2012a)*

1.4 Overview of PFAS

PFAS is a large family of manufactured chemicals used in Australia and around the world in various commercial processes, household products, and specialty applications. The physical and chemical properties of PFAS impart oil and water repellence, temperature resistance and friction reduction, making them useful to consumers and industry.

Firefighting foams containing perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) as active ingredients were once used extensively worldwide and within Australia, including at fire stations and fire training facilities. Perfluorohexane sulfonate (PFHxS) was also commonly found in firefighting foam as an impurity of its manufacturing process.

Scientists have identified many individual PFAS compounds, but the individual PFAS that generally account for the majority of the PFAS mass in environmental samples include the following:

– Perfluoroalkyl sulfonates (PFSA), of which PFOS and PFHxS are the most well-studied.
– Perfluoroalkyl carboxylates (PFCA), of which PFOA is the most well-studied.
– Fluorotelomers (FtS), including 8:2 FtS and 6:2 FtS.
– Perfluoroalkyl sulfonamides.

The guidelines produced by Australian environmental regulators, as detailed in Section 1.3, have focused on PFOS, PFHxS, and PFOA, with PFOS and PFHxS being the predominant PFAS identified within the site and the Investigation Area. PFOS and PFHxS, as well as PFOA, are therefore the focus of this HHERA. The other PFAS that have been detected at relatively lower concentrations within the Investigation Area have been evaluated in Sections 4.4.2 and 5.4.2.

1.5 Data Sources

This HHERA draws primarily upon the dataset collected from within the Investigation Area by GHD (2023a; 2024) and other publicly available data. A consolidated dataset is presented in Appendix B.

1.6 Limitations

This Report has been prepared by GHD for the South Australian Metropolitan Fire Service and may only be used and relied on by South Australian Metropolitan Fire Service for the purpose agreed between GHD and South Australian Metropolitan Fire Service as set out in Section 1.2 of this Report.

GHD otherwise disclaims responsibility to any person other than the South Australian Metropolitan Fire Service arising in connection with this report. GHD also excludes implied warranties and conditions to the extent legally permissible.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in the Report and are subject to the scope limitations set out in the Report.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD described in this report (refer Section(s) 1.7 of this Report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this Report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this Report.

GHD has prepared a human health and ecological receptors exposure model ("Model") for, and for the benefit and sole use of, South Australian Metropolitan Fire Service to support the assessment of human health and ecological risks at the site and within the Investigation Area and must not be used for any other purpose or by any other person.

The Model is a representation only and does not reflect reality in every aspect. The Model contains simplified assumptions to derive a modelled outcome. The actual variables will inevitably be different to those used to prepare the Model. Accordingly, the outputs of the Model cannot be relied upon to represent actual conditions without due consideration of the inherent and expected inaccuracies. Such considerations are beyond GHD's scope.

The information, data and assumptions ("Inputs") used as inputs into the Model are from publicly available sources or provided by or on behalf of the South Australian Metropolitan Fire Service, (including possibly through stakeholder engagements). GHD has not independently verified or checked Inputs beyond its agreed scope of work. GHD's scope of work does not include review or update of the Model as further Inputs becomes available.

The Model is limited by the mathematical rules and assumptions that are set out in the Report or included in the Model and by the software environment in which the Model is developed.

The Model is a customised model and not intended to be amended in any form or extracted to other software for amending. Any change made to the Model, other than by GHD, is undertaken on the express understanding that GHD is not responsible, and has no liability, for the changed Model including any outputs.

1.7 Assumptions, inclusions and exclusions

This Report has been prepared with reference to the guidance presented in Section 1.3 and incorporates the following key considerations:

- This HHERA is limited to assessing the risks to human health and the environment associated with exposure to PFAS in soil, surface water, groundwater, sediment and biota within the Investigation Area. Other potential contaminants, exposure media and areas have not been considered.
- The term PFAS refers to a large number of perfluorinated and polyfluorinated substances. The analytical suite adopted for this assessment incorporated 28 compounds, including PFOS, PFHxS and PFOA, which are the primary focus of this Report.
- The toxicity endpoints used in this HHERA were consistent with the guidance provided by Australian health and environmental regulators at the time of reporting.
- The findings presented within this Report are primarily based on the field and analytical results referenced in Section 1.5. The assessment of the potential for health and ecological risks is based on the conditions at the time of sampling and in the areas sampled.
- The HHERA is based on the information in the Renewal SA conceptual design provided to GHD and provided at the end of Appendix A. This plan indicates that most of the Development Area will be used for low-density residential purposes, while Zone 2c, located south of the site, will be designated for medium-density residential use (i.e., townhouses with limited soil access).

2. Investigation Area setting

A detailed description of the Investigation Area is presented in the DSI and supplementary DSI reports (GHD, 2023a; 2024). A summary of this information is provided herein.

2.1 Investigation Area identification

Site identification information for the MFS Oakden Fire Station is summarised in Table 2.1. A site location plan showing key site features is presented in Figure 1 in Appendix A.

Table 2.1 Summary of site identification information

Item	Detail
Site address:	700 Grand Junction Road, Oakden, SA 5086
Certificate of Title:	CR 5759/678
Legal description (Parcel ID)[a]:	H106100 S1655 in the Area Named Oakden, Hundred of Yatala
Local government authority:	City of Port Adelaide Enfield
Current zoning:	Master Planned Neighbourhood
Property Owner:	South Australian Metropolitan Fire Service
Current site use:	Operational Fire Station
Area:	4,802 m^2
Site elevation:	87 m AHD
[a] Based on cadastral data provided by the Government of South Australia Location SA Map Viewer	

A conceptual design plan of the Development Area and Buffer Area is provided at the end of Appendix A. This zone occupies the land east, south, and west of the MFS Fire Station and is currently owned by Renewal SA. The Development Area and Buffer Area comprise multiple parcels of land designated for subdivision and development for residential and open space land uses, as summarised in Table 2.2. As outlined in Section 1.1, the Buffer Area can be acquired or leased by MFS instead of being developed.

Table 2.2 Summary of land use within the Development Area

Zone	Details	Legal description (Parcel ID)[a]	Current land use	Proposed future land use
2a	The Buffer Area immediately to the west of the site covering approximately 4,600 m^2 (or 0.46 hectares).	D134433 A8000	Open space, including grass and trees	Retention by MFS as a buffer *or* Low-density residential land use, with limited open space areas and roadways
2b	The Buffer Area immediately east of the site covering approximately 2,400 m^2 (or 0.24 hectares).	Part of D134433 A8002		
2c	The Buffer Area immediately south of the site covering approximately 5,000 m^2 (or 0.5 hectares).	Part of D134433 A8002		
3	The remainder of the Renewal SA Development Area, to the west, east and south of Zone 2	Parts of D130734 A1001 and D134433 A8001	Cleared area in preparation for residential development	Low-density residential land use and open space
4	Dry Creek (within the Investigation Area)	Part of D42140 A4	Department for Correctional Services Reserve	Unchanged
[a] Based on cadastral data provided by the Government of South Australia Location SA Map Viewer				

2.2 Investigation Area description

A description of the Investigation Area is provided herein. Additional details are provided in Appendix G.

2.2.1 MFS site (Zone 1)

The site is currently used as an operational fire station. The onsite infrastructure consists of the following (refer to Figure 2 in Appendix A):

– The main building, including an engine bay on the northern half of the site.
– Two storage sheds (historical storage of PFAS) and a training tower near the southern site boundary.
– A decommissioned diesel underground storage tank (UST) near the eastern boundary.
– A paved rear yard (including concrete wash-down slab) in the southern half of the site.
– Designated car parking bays to the south of the main building, adjacent to the western boundary and south of the decommissioned UST.
– A front garden with a 6 to 10 m wide unsealed strip comprising trees and shrubs along its eastern, southern and western boundaries.
– A watering system was also observed around the station and was reportedly installed to keep sub-surface clayey soils moist and thus mitigate structural cracking in the station building.
– The site is largely covered by hard surfaces with limited areas of exposed soil. Various mature trees are present along the site's perimeter, particularly River Red Gums (*Eucalyptus camaldulensis*) (Project Green, 2023).

Table 2.3 Site photographs

<table>
<tr><td> </td><td>
</td></tr>
<tr><td>Photograph A: North-western corner of the fire station, facing south. Fire station building in the background. Stormwater inspection pipes are present within the garden bed and in the foreground.</td><td>Photograph B: North-eastern corner of the fire station, facing south. Entrance to the fire station from Grand Junction Rd.</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Photograph C: South-eastern corner of the fire station, facing east. Garden bed with trees (predominantly Eucalyptus spp.) and shrubs bordering the fenceline of the site.</td><td>Photograph D: Southwestern corner of the fire station, facing south. Wood chips placed within garden beds.</td></tr>
</table>

2.2.2 Buffer Area (Zone 2) and Development Area (Zone 3)

The Buffer Area (Zone 2) can be described as follows

– Zone 2a, to the western section of the site, comprises
  - A narrow, fenced strip of land (approximately 7 m wide) on the site boundary. This area contains limited trees (primarily *Eucalyptus spp.*) and shrubs.
  - Cleared grassed area that, at the time of reporting, was used as a laydown area for the Renewal SA development works.
– Zone 2b and Zone 2c, to the east and south of the site respectively, are currently grassed vacant land sparsely vegetated with mature trees including Blue Gum (*Eucalyptus leucoxylon ssp leucoxylon*), Weeping Myal (*Acacia pendula*), Sugar Gum (*Eucalyptus cladocalyx*), and River Red Gum (*Eucalyptus camaldulensis*) (Project Green, 2023). Remnants (garden beds and rubble) of former residential housing is also present with the eastern buffer zone.

It is understood that Zone 2 will be developed with mixed low- and medium-density residential lots unless MFS retains parts of this zone.

Table 2.4 Zone 2 photographs

Photograph A: Buffer area west of fire station, with immature and mature trees (primarily Eucalyptus spp.), grass and weed species.

Photograph B: Buffer area south-west of fire station.

Photograph C: Buffer area southeast of fire station. Predominantly grass species and weeds.

Photograph D: Buffer area along the eastern boundary of the site. Remnants of garden beds (rosemary) from former residential property in the foreground.

At the time of reporting, earthmoving activities associated with the Renewal SA development were progressing within the Development Area, with residential housing plots and roadways demarcated. Photographs of Zone 3 at the time of reporting are provided in Table 2.5.

Table 2.5 Zone 3 photographs

Photograph A: Development area adjacent to the western boundary of the fire station. Road development in progress.	**Photograph B: Development area west of the fire station. Stage 1 and Stage 2 development is progressing in the background.**

The Renewal SA conceptual design indicates that Zone 2 (if MFS does not retain it) and Zone 3 will be developed into a mixed medium-density and low-density residential area. There are also some reserve (green) areas within Zone 3.

Project Green (2023) conducted a tree assessment throughout the area, which Renewal SA currently owns. The assessment examined 204 trees, determining that 145 trees qualify for protection as regulated trees, and an additional 59 trees meet the criteria for significant status under the *SA Planning, Development & Infrastructure Act 2016*.

2.2.3 Dry Creek (Zone 4)

Surface water runoff from the MFS site is collected in onsite stormwater drains. It is routed to the municipal stormwater system along the southern side of Grand Junction Rd. Approximately 300 m west of the site, the stormwater flows under the road and discharges into an earthen swale. The runoff from this swale combines with water from another earthen swale, originating directly across Fosters Rd before flowing into Dry Creek. Both swales are located in a vacant, grassed field under the Department for Correctional Services custodianship.

Dry Creek is an incised, shallow channel that carries urban stormwater through Adelaide's northern suburbs, with multiple stormwater outlets discharging directly into Dry Creek throughout its flow path. Originating from the Lofty Ranges, these channels merge into a single channel upstream of the Investigation Area at Modbury. Downstream of the Investigation Area, near Parafield, Dry Creek becomes a channelised stormwater drain before discharging into the Port River marine environment via Swan Alley Creek.

Extensive urban expansion has led to the proliferation of invasive weed species along the riparian zone of Dry Creek, while stormwater runoff has contributed to erosion along the creek bed and banks (SA EPA, 2008a; SA EPA, 2008b).

The general characteristics of Dry Creek within Zone 4 can be summarised as follows:

– Dry Creek ranges from approximately 1 to 5 meters in width and 0.5 meters in depth outside periods of high flow.
– The riparian zone has a low gradient and is largely vegetated, with weed species predominant.
– A road crossing is near sampling point SW04, which appears to limit the connection among pools during dry periods.
– The creek bed comprises various natural substrates, including large rocks, pebbles, sands, silts, and detritus.

– Dry Creek is characterised by limited or no water flow and disconnected pools during dry conditions. During wet conditions, stormwater collected across the surrounding urban areas discharge into Dry Creek, resulting in a rapid increase in water level and flow, as shown in photographs D to F in Table 2.6.

Table 2.6 Zone 4 photographs – dry conditions were observed on 26 March 2024, while wet conditions on 31 May 2024

Photograph A: Swale drain north of Grand Junction Rd, looking south, directly across Fosters Rd. Wet conditions	**Photograph B: Swale drain north of Grand Junction Rd, looking north. Near location SED07. Steep eroded embankments. Wet conditions**
Photograph C: Swale drain north of Grand Junction Rd, approximately 70 m south of Dry Creek, looking north. Near location SED04. Moderately sloped grass embankments with reeds in sections.	**Photograph D: The confluence of the swale drain and Dry Creek. Near location SED09. Moderately sloped, rocky embankments and grass slopes with overhanging trees. Wet conditions**

Photograph E: Dry Creek, approximately 4.5 km upstream of the fire station, facing east/upstream. Near location SW05 Grassed embankments with overhanging trees and reeds. Wet conditions

Photograph F: Dry Creek, approximately 4.5 km upstream of the fire station, facing west/downstream. Near location SW5. Grassed embankments with overhanging trees and reeds. Wet conditions

Photo G: Sampling points SW03 and SED09, in the point where the swale discharges into Dry Creek during dry conditions

Photo H: Location of SW04, facing east (upstream) during dry conditions. A road crossing is present at this location.

Photo I: Location SW02, downstream of the discharge point. Facing north. Dry conditions. The rocky formation in the background is associated with historical mining activities.	***Photo J: Location SW02, downstream of the discharge point. Facing south. Dry conditions.***

2.3 Environmental setting

The environmental setting of the Investigation Area is summarised in Table 2.7.

Table 2.7 Investigation Area environmental setting summary

Element	Summary
Topography	The topography of the Investigation Area is relatively flat, gently sloping to the north/northwest towards Dry Creek. Dry Creek and the swale drain that connects the site's stormwater system to Dry Creek are incised waterways with moderate to steep and generally unstable banks. The Investigation Area is part of the Adelaide Plains between Gulf St Vincent to the west and the Mount Lofty Ranges to the east. The site sits at an elevation of approximately 87 m AHD.
Geology	GHD (2023a) indicates the geology underlying the site is Pooraka Formation, consisting of clay, sand and carbonate earth, silty with gravel lenses. The geology encountered in the Investigation Area during intrusive works was generally consistent with the regional geology and can be summarised as follows: – 0 - 0.2 m bgl – Silty sands, reworked natural. – 0.2 - 1.0bgl – Clayey sands, reworked natural. – 1.0 - 3.0 m bgl – Clay, low to medium plasticity, natural. – 3.0 – 6.0 m bgl – Clay, medium to high plasticity, natural. – 6.0 – 15 m bgl – Sand, clayey sand low plasticity.
Regional hydrogeology	The hydrological characteristics of the Investigations Area can be summarised as follows (Gerges, 2006): – **Quaternary sedimentary aquifers**: Up to three quaternary aquifers were identified as Q1 to Q3 to increase depth. The main aquifer lithology is characterised by clay and silt (confining beds) with interbedded sand, gravel and thin sandstone (aquifers). These aquifers are between 3 metres below ground level (m bgl) and 100 m bgl. – **Tertiary aquifers**: Two tertiary confined aquifers are located below the Quaternary aquifers. Each Tertiary aquifer consists mainly of thin layers of fine sand with low yield. They are relatively independent; each aquifer consists of several stratigraphic units with various lithologies and thicknesses. The first Tertiary aquifer (T1) is recognised as the superior aquifer in terms of salinity and yield. – **Fractured rock aquifer**: A Precambrian fractured rock aquifer is believed to be the primary source of recharge to the lower Quaternary aquifers and the deeper Tertiary aquifers. – This zone's general groundwater flow direction in the Quaternary, Tertiary and fractured rock aquifers is towards the northwest. – Site-specific hydrogeological information is provided in Section 2.3.1
Climate	Adelaide has dry and warm summers with low rainfall. The annual rainfall at Adelaide Pooraka (Bureau of Meteorology weather station no. 23026), which reports data since 1876, totals 481 mm. Typically, the wettest month occurs in June, with an average of 64 mm of rainfall, while February is typically the driest, receiving only 18 mm of rainfall on average.

2.3.1 Local hydrogeology

In 2023, GHD (2023a) identified a shallow/perched groundwater system within the western portion of the MFS site that extended off-site to the west. The groundwater gradient was to the west-northwest. The soil profile in this area comprises a shallow sand, silty sand, or clayey sand layer extending from the surface to approximately 1.2 - 2.0 m bgl and underlain by a medium to high plasticity clay with low permeability. The standing water levels reported in the shallow groundwater system in August to September 2023 ranged from 1.2 to 1.7 m bgl.

Further investigation suggested that the perched water might be related to a water leak. A plumber inspected the site in November 2023 and found a leaking tap connected to the irrigation system, which was subsequently repaired. In April 2024, the standing groundwater levels in the shallow groundwater system ranged from 1.7 - 2.0 m bgl (GHD, 2024).

In 2024, GHD (2024) also conducted a more detailed study of the shallow aquifer by installing two additional wells (MW04 and MW06; refer to Figure 5 in Appendix A) downgradient (west) of the site. Both wells were dry in 2024. Overall, the available evidence suggests that leaks and rainfall may contribute the presence of a shallow perched groundwater system within and immediately to the west of the site but that this groundwater system is limited in spatial extent.

Available data indicate that the regional Q1 aquifer is at depths greater than 15 m bgl (GHD, 2023a). This deeper groundwater unit has not been investigated by GHD (2023a; 2024), but migration of PFAS from the shallow aquifer to the Q1 aquifer is considered to pose a low risk based on the following:

– A medium to high plasticity clay layer is present beneath the shallow/ perched groundwater system ranging between three and five meters in thickness.
– GHD (2024) collected three opportunistic soil samples from a clay vertical profile exposed in a trench (see Table 2.8) excavated during development works (unrelated to GHD investigations) along the western boundary of Zone 2a. Samples were collected from depths ranging from 2.5 m bgl and 5.7 m bgl and tested for permeability (refer to the GHD 2024 report for more details). Results reported permeability coefficients ranging from 5×10^{-10} to 6×10^{-10} m/s. SA Water (2019) indicates that these permeability coefficients are typical of homogeneous natural or very well-engineered, practically impermeable clays.
– The presence of this relatively impermeable unit is considered to represent an aquitard beneath the shallow perched system which would restrict downward migration of contaminants to any underlying aquifers.
– The spatial and temporal extent of the shallow groundwater system identified downgradient of the site is limited.

On this basis, migration of contaminated groundwater from the shallow aquifer to the Q1 aquifer is considered negligible, and investigation of the Q1 aquifer is not warranted.

Table 2.8 ***Photographs of the trench from which clay samples were collected for permeability testing (excavated as part of the development works)***

Photograph A: Clay profiled seen from within the trench	**Photograph B: Overview of the trench. The site boundary is visible on the upper right side of the photograph**

2.3.2 Hydrology of the Investigation Area

The drainage system of the Investigation Area is shown in Figure 1 (Appendix A) and can be summarised as follows:

On-site:

– Buildings, concrete hardstand areas and pavers predominantly cover the site. Stormwater runoff from these areas is collected via onsite drains, most flowing into underground stormwater drains offsite.
– The drain receiving stormwater from the site is located along the western site boundary. This drain flows into the council stormwater system near the northwestern corner of the site.
– During heavy rainfall, temporary surface water pooling occurs in the southern yard, potentially leading to vertical infiltration through the pavers.
– Historically, after exercises or incidents involving AFFF usage, equipment and tanks were washed down in the rear yard. Subsequently, a dedicated wash-down bay was installed for trucks, with the runoff directed towards the garden in the southern portion of the site or discharged off-site via the stormwater system.
– Previously, there was a sump (Fire Water Pump Tank) on the eastern side of the rear yard, which was decommissioned (filled) in 2021. Historically, The sump held approximately 10 kL of water, circulated during exercises, and replenished with rainwater and mains water from appliances. MFS staff occasionally noted the presence of AFFF in the sump, giving the water a foamy appearance (GHD, 2023a).

Off-site:

– The offsite council stormwater system runs beneath Grand Junction Road, continues along the road to the west, and ultimately discharges into an open channel/swale that flows into Dry Creek.
– An artificial retention pond was located approximately 220 meters west of the site and connected to the council's stormwater system along Grand Junction Road through an ephemeral creek. Ongoing development activities have altered this water body, making it no longer visible in aerial photography.

GHD (2023a) collected three surface (0 – 0.1 m bgl) sediment samples (SED01 – SED 03; refer to Figure 7 in Appendix A) from the base of the ephemeral creek and retention pond (dry at the time of sampling); PFAS were not detected, and therefore this area was excluded from the Investigation Area of this HHERA.

2.4 Human use of the Investigation Area

2.4.1 Land use

The site (Zone 1), Buffer Area (Zone 2), and Development Area (Zone 3) are zoned as Master Planned Neighbourhood under the *City of Port Adelaide Enfield Development Plan*. The site is used as an operational fire station, whereas the Development Area and Buffer Areas are presently undergoing development for mixed low and medium residential purposes. If MFS retains the Buffer Area, it could be used on a limited basis for recreational purposes.

Dry Creek (Zone 4) is designated as an open space and is accessible to the public for recreational purposes. A bitumen and gravel walking and cycling trail network is running along Dry Creek. The land where the swale connects the urban stormwater system on Grand Junction Road to Dry Creek is owned by the South Australia Government's Adelaide Women's Prison. The land surrounding the swale is regularly maintained and cleared based on a review of historical aerial photographs available on NearMaps.

2.4.2 Groundwater use

The site and its surrounding areas are served by a reticulated water supply.

GHD searched for registered groundwater wells within a ~2 km radius of the site using the SA WaterConnect Database in May 2024 (refer to Figure 3 in Appendix A). Results can be summarised as follows:

– 164 registered wells were identified, with 54 listed as backfilled, dry, abandoned, or unused.
– One well was registered for potential domestic (recreational) use, three for irrigation, and 99 for investigation/monitoring/environmental purposes. No purpose was recorded for 61 registered wells.
– The well, registered for domestic/recreational purposes, is located approximately 1.3 km south and upgradient of the site.
– One irrigation well is located 2 km northwest of the site within an area occupied by sports fields and potentially downgradient of the site. This well is installed in the Q1 aquifer. The other irrigation wells are 900 m and 1.2 km to the site's south and east (upgradient).

The SA WaterConnect Database reports electrical conductivities in Quaternary and Tertiary aquifers ranging from 800 to 8,020 µS/cm.

Electrical conductivity (EC) values ranging from 1,989 µS/cm (well MW03) to 13,921 µS/cm (well GW01) were reported by GHD (2023a; 2024) in the local shallow/perched groundwater system (<2 m bgl). These salinity levels and the limited spatial extent of the shallow groundwater make it unsuitable for extraction and beneficial use.

2.4.3 Surface water use

Dry Creek is affected by elevated nutrient levels, fine sediment, and stormwater runoff (SA EPA, 2008a; SA EPA, 2008b). A detailed assessment of the quality of this waterway is provided in Section G-3-2 of Appendix G. Based on the available information, it is considered unlikely that water is extracted for beneficial purposes.

Insufficient water is present in Dry Creek, and it is unlikely to support regular recreational activities involving full immersion in the water (e.g., swimming). However, recreational activities, such as wading, may occur intermittently in Dry Creek. Fishing is unlikely to occur in Dry Creek, as it is characterised by shallow water depths with limited

passage and connectivity between pools, especially during dry periods, which restricts the presence of edible fish (refer to Section 5.3.1).

2.5 Ecological values of the Investigation Area

A search of the government-managed databases and tools, including the *NatureMaps* database and EPBC Act Protected Matters Search Tool (DCCEEW, 2024) (refer to Appendix G) indicates that there are no protected areas within the Investigation Area.

2.5.1 The Site, Buffer Area, and Development Area (Zone 1, 2 and 3)

The operation areas of the site are largely covered with hardstands and are associated with limited environmental values. The strip of land (~10 m wide) along the boundary of the site and the Buffer Area contains remnant eucalyptus trees, with acacia, shrubland and grassland understorey (refer to the photographs in Section 2.2), which may be used by small avian and reptilian fauna. Following the completion of the Renewal SA development, open spaces and residential gardens may also be used by small avian and reptilian fauna.

GHD observed several koalas within the site boundary and the wider Development Area during fieldwork. This observation corresponds with information obtained from government-managed databases and tools, which document the presence of koalas (Appendix G).

2.5.2 The receiving environment (Zone 4)

The quality of surface water in South Australia is protected under the *Environment Protection (Water Quality) Policy 2015*. To facilitate the completion of an ERA in an aquatic environment, it is necessary to define the level of protection afforded a water body, which is based on considerations including the condition of the waterway, community values, and associated management goals. ANZG (2018) recognises three categories of current or desired waterway conditions, including:

– High conservation or ecological value systems (99% species protection) – effectively unmodified or highly valued ecosystems, typically occurring in national parks and conservation reserves or remote and inaccessible locations.
– Slightly to moderately disturbed systems (95% species protection) – ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity. The biological communities remain healthy, and ecosystem integrity is largely retained.
– Highly disturbed systems (80-90% species protection) – Measurably degraded ecosystems of lower ecological value, such as sections of harbours serving coastal cities and urban streams receiving road and stormwater runoff.

For the purpose of this report, Dry Creek has been classified as a slightly to moderately disturbed system based on the following:

– The SA EPA (2008a; 2008b) has conducted two aquatic ecosystem assessments of Dry Creek at two sites located approximately 2 km and 6 km upstream of the Investigation Area. Results indicated that Dry Creek was in very poor to poor conditions based on the following:
  - Affected by nutrient enrichment, fine sediment and stormwater.
  - Sparse macroinvertebrate community dominated by species tolerant of pollution.
  - Excessive growths of algae and aquatic plants
  - Degraded riparian vegetation is invaded by weeds.
– The swale drain that links the underground municipal drainage system with Dry Creek flows is dry outside of periods of stormwater flow and is vegetated primarily with grass and reeds.
– The SA EPA (2008a; 2008b) indicates that Dry Creek is an urban stream receiving large stormwater runoff volumes. The land use within the Dry Creek catchment is mainly urban and includes residential, recreational, commercial, and industrial (including extractive operations) uses.
– Dry Creek discharges to the Port River Estuary, which is a disturbed ecosystem impacted by elevated nutrient, metals, and pathogen levels, as well as PFAS (SA EPA, 2017).

3. Problem identification

The following discussion focuses on the PFAS sources, pathways and receptors relevant to the Investigation Area.

This section also presents a Tier 1 screening assessment of the dataset for the Investigation Area. The Tier 1 screening assessment process involves the comparison of the measured PFAS concentrations with the conservative human health and ecological screening levels provided by National or International Guidelines. The Tier 1 screening levels are designed to be well below the concentrations at which adverse health or environmental effects could occur and, therefore, PFAS concentrations lower than these values are unlikely to present a risk to people and the environment. The aim of the Tier 1 screening process was to focus this Report on the PFAS exposure scenarios requiring more detailed assessment within subsequent sections.

3.1 Sources, pathways and receptors

3.1.1 PFAS sources

The primary source of PFAS at the site was the historical use and storage of AFFF containing PFAS. Historical activities associated with AFFF are as follows:

– Historical storage and use of PFAS-containing AFFF in training exercises.
– Washdown of equipment, trucks, and appliances.
– Historical storage of PFAS-impacted water in the former storage tank/sump.

Secondary sources of PFAS are currently present in the soils, pavers, and groundwater near the site.

3.1.2 Migration pathways

The DSI (GHD, 2023a) indicates that PFAS is migrating offsite via the following pathways:

– Leaching of PFAS adsorbed to soil, pavers and concrete infrastructure during rainfall events and:
  - Surface water runoff, which primarily discharges to the Grand Junction Road stormwater system and Dry Creek
  - Overland surface water runoff to Zone 2 and Zone 3
  - Vertical infiltration to shallow groundwater
– Groundwater flow:
  - Lateral migration of shallow groundwater to the northwest
  - Uptake of shallow groundwater by deep-rooted plants
– Airborne (spray) migration of AFFF solutions from the site to Zone 2 and Zone 3 during historical AFFF use.
– Bioaccumulation in terrestrial and aquatic organisms.

3.1.3 Receptors and exposure pathways

The exposure pathways evaluated in this HHERA can be summarised as follows:

Human health

– Incidental ingestion of PFAS in surface soil by users of the site and Investigation Area, including MFS workers, and construction/maintenance workers (current and future) and inhabitants of the Renewal SA development (future).
– Consumption of produce (e.g. fruit and vegetables) grown within the Renewal SA development area (future), with PFAS bioaccumulation potentially occurring directly from soil or via deep-rooted plants interacting with shallow groundwater.

– Incidental ingestion of PFAS in surface water and sediment by recreational users of Dry Creek (current and future).

Ecological receptors within Dry Creek:

– Aquatic organisms exposed to PFAS via direct ingestion and uptake of surface water and sediment.
– Higher trophic level aquatic and semi-aquatic species exposed to PFAS via the consumption of aquatic organisms (food chain exposure).

The following exposure pathways have been excluded from the HHERA:

– *Human consumption of trees and grass* – The DSI (GHD, 2023a) included the sampling of eucalyptus trees and grass to inform the completion of the ERA. No complete source-pathway-receptor linkage is associated with these matrices for current or future human users of the Investigation Area.
– *Dermal exposure to PFAS* - Although the dermal absorption of PFAS can occur to a limited extent, dermal uptake makes a negligible contribution to PFAS exposure under normal circumstances (refer to Section C-2-5 of Appendix C). Specific consideration has, therefore, not been given in the HHRA to the dermal absorption of PFAS.
– *Consumption of fruit and vegetables grown at the MFS site* – GHD understands that no fruit and vegetables are grown at the MFS site and that this is an MFS policy. This exposure pathway has, therefore, not been assessed in the HHRA.

3.2 Nature and extent of contamination

The data presented in this section is based on the sampling undertaken within the Investigation Area, as presented in Appendix B. Sampling locations are shown in Figure 4 to Figure 6, Appendix A.

3.2.1 Adopted screening levels

The screening levels adopted for the Tier 1 assessment of risks to human users and the environment of the Investigation Area are summarised in Table 3.1.

It is noted that, to date, Australian regulators have not endorsed screening levels for the Tier 1 assessment of the ecological risks associated with PFAS in terrestrial plants. The PFAS NEMP (HEPA, 2020) provides Tier 1 screening levels for mammals and birds' consumption of aquatic biota. Still, these do not apply to terrestrial plant samples and have not been adopted in this assessment.

Table 3.1 Summary of PFAS Tier 1 screening levels

Exposure scenario		PFHxS	PFOS	PFOS +PFHxS	PFOA	Source
Human health screening levels						
Zone 1 – MFS Fire station						
Soil and pavers	Workers – Incidental ingestion or inhalation of soil/dust	14 mg/kg	14 mg/kg	14 mg/kg	50 mg/kg	Site-specific HIL[1] for urban fire stations (GHD, 2023b)
Zones 2a, 2b and 3 – Buffer Area planned to be used for low-density residential purposes						
Soil – low density residential area	Future residents – Incidental ingestion or inhalation of soil/dust and produce consumption	0.01 mg/kg	0.01 mg/kg	0.01 mg/kg	0.1 mg/kg	HEPA (2020) Residential with accessible soil (HIL A)[1]
Zones 2c – Buffer Area planned to be used for medium-density residential purposes						
Soil – medium density residential	Future residents – Incidental ingestion or inhalation of soil/dust	2 mg/kg	2 mg/kg	2 mg/kg	20 mg/kg	HEPA (2020) Residential with accessible soil (HIL B)
Zone 2 – If MFS acquires this zone						
Soil	MFS Personnel	14 mg/kg	14 mg/kg	14 mg/kg	50 mg/kg	Site-specific HIL[1] for urban fire stations (GHD, 2023b)
Receiving environment (Dry Creek and drainage lines)						
Sediment	Incidental ingestion during recreational use	1 mg/kg	1 mg/kg	1 mg/kg	10 mg/kg	HEPA (2020) Recreational (HIL C) [1]
All zones						
Groundwater	MFS workers, resident – non-potable domestic use	2 µg/L	2 µg/L	2 µg/L	10 µg/L	NHMRC (2019) Recreational water
Surface water and onsite discharges	Recreational users of Dry Creek and MFS staff					
Ecological screening levels						
Soil	Direct exposures	-	1 mg/kg	-	10 (0.005)[2]mg/kg	HEPA (2020) Ecological direct exposure
	Indirect (food chain) exposures	-	0.01	-	0.005[3]	HEPA (2020) Ecological indirect exposure
	Direct exposures	-	0.13 µg/L	-	220 µg/L	HEPA (2020) Freshwater (FW) 95% species protection

Surface water and groundwater		-	0.48 µg/L	-	-	ANZG (2023) FW 95% species protection
	Indirect exposure (food chain)	-	0.00023 µg/L	-	19 µg/L	HEPA (2020) FW 99% species protection
		-	0.0091 µg/L	-	-	ANZG (2023) FW 99% species protection
Notes: '-' indicates that no criteria were available; [1] HIL = health investigation levels; [2] Interim criterion for direct exposure to PFOA in soil for reptiles, based on the Draft PFAS 3.0 (HEPA, 2022); [3] Indirect exposure criterion for PFOA based on the Draft PFAS 3.0 (HEPA, 2022).						

Approach to the Tier 1 assessment of health risks due to PFAS in soil

The PFAS NEMP (HEPA, 2020) provides human health-based investigation levels (HILs) for the soil under four land use and exposure scenarios:

– *Residential with garden/accessible soil (HIL A)* – This includes incidental ingestion of soil and assumes that vegetable and fruit plants are grown at the property and homegrown produce provides up to 10% of fruit and vegetable intake.
– *Residential with minimal opportunities for soil access (HIL B)* – This includes incidental soil ingestion and assumes minimal fruit and vegetable production.
– *Public open space (HIL C)* – Relevant for public open spaces such as parks, playgrounds, and playing fields.
– *Industrial/commercial (HIL D)* – Relevant to industrial and commercial activities.

GHD (2023b) derived site-specific HIL for urban fire stations. Hence, these HILs have been adopted to evaluate risks to site users via direct contact with soil. A copy of the GHD (2023b) report is available upon request.

The residential lots to the west (Zone 2a) and east (Zone 2b) of the site range from approximately 256 to 422 m^2, which is indicative of low-density residential development and the possible future presence of private gardens with areas of accessible soil. Similar lot sizes will be present in Zone 3. As such, the HIL A assessment criteria apply to these plots.

The subdivided parcels south of the MFS Oakden Station (Zone 2c) are <200m^2 in size. According to the developer, these parcels will be primarily under a roof or paved with a townhome built on the southern portion and a paved driveway north of the townhome (GHD, 2023a). HIL B assessment criteria apply to these areas based on the proposed development plans and parcel sizes. Public open spaces representative of HIL C are also present as the reserve lots depicted in Figure 2 in Appendix A.

The PFAS NEMP (HEPA, 2020) does not provide assessment criteria specific to construction or maintenance workers; therefore, this scenario has been assessed separately.

Australian regulators have not endorsed screening levels for the Tier 1 assessment of PFAS in pavers or similar material. Without an alternative published alternative, the soil HILs have been adopted.

Approach to the Tier 1 assessment of ecological risks due to PFAS in soil

The PFAS NEMP (HEPA, 2020) ecological screening levels have been adopted as follows:

– *Ecological direct exposure* – The criterion (1 mg/kg) is based on the health-based HIL C, not ecotoxicity-based information.
– *Ecological indirect exposure* – The criterion for PFOS (0.01 mg/kg) is based on the exposure of secondary consumers via the food chain.

The current PFAS NEMP (HEPA, 2020) does not provide an indirect exposure ecological criterion for PFOA in soil. However, the draft PFAS NEMP 3.0 (HEPA, 2022) recommends the following:

– An indirect exposure ecological criterion of 0.005 mg/kg
– An interim screening value of 0.005 mg/kg for PFOA where reptiles may be exposed directly to soil.

These guidelines have been adopted for completeness.

Australian regulators have not endorsed screening levels for the Tier 1 assessment of PFAS in pavers or similar material. Since paved areas do not provide habitats for ecological receptors, ecological criteria are irrelevant and have not been considered.

Approach to the Tier 1 assessment of ecological risks due to PFAS in water

The current ecological WQG for PFOS, as presented in the PFAS NEMP (HEPA, 2020), was derived in 2015 as interim guideline values for PFOS. These values precede the publication of the Warne *et al.* (2018) methodology that underpins the ANZG (2018) WQG and do not incorporate ecotoxicity studies published in recent years. Due to the limitations of the current ecological WQG for PFOS, as presented in the PFAS NEMP (HEPA, 2020), these values are currently being updated. In May 2023, ANZG (2023) released a revised ecological WQG for PFOS for public consultation. For completeness, the PFAS NEMP and ANZG (2023) WQG have been adopted for this assessment.

As discussed in Section 2.5, Dry Creek is a slightly to moderately disturbed ecosystem. ANZG (2018) recommends that water quality guidelines (WQG) for the protection of 99% of species are adopted for the Tier 1 screening assessment of bioaccumulative substances such as PFAS in slightly to moderately disturbed ecosystems (rather than the 95% species protection values). This cautious approach to the assessment of bioaccumulative substances is suggested because WQG are typically derived based on ecotoxicity studies undertaken in the laboratory over relatively short durations, and these kinds of studies do not capture:

– The potential for higher trophic level aquatic and terrestrial species to experience harmful effects via food chain exposures (i.e., biomagnification) or
– The potential for bioaccumulative toxicants to be associated with intergenerational effects by maternal transfer of accumulated toxicants to offspring.

In this context, ANZG (2018) does not require the use of this more conservative approach to the Tier 1 screening assessment of bioaccumulative substances in circumstances where:

1. A separate weight-of-evidence (WoE) process is used to assess the potential for harmful indirect effects to aquatic and terrestrial species due to bioaccumulation or
2. The WQG is high or very high in reliability, and a significant proportion of the ecotoxicity studies used to derive the WQG are multigenerational (specifically > 30% of the ecotoxicity dataset and for > 3 taxa groups).

No aquatic biota samples have been collected during the field investigations (GHD, 2023a; 2024). The comparison of surface water analytical results with the WQG for the protection of 99% of species has therefore been used for the Tier 1 screening assessment of the potential for harmful effects to higher trophic level species via PFAS bioaccumulation in aquatic food chains (indirect exposure) (Point 1 above).

ANZG (2023) draft of revised WQG for PFOS in freshwater systems included several chronic partial-generation, full-generation or multi-generation studies, with multigenerational studies available for eight of the 35 species (23%) included in the derivation of these values (Point 2 above). On this basis, it is considered reasonable to undertake the screening assessment of the risks associated with direct exposure to PFAS by lower trophic level organisms inhabiting Investigation Area waterways via the comparison of PFAS concentrations in water samples with the PFAS NEMP WQG for the protection of 95% of species.

Approach to the Tier 1 assessment of PFAS in sediments

To date, screening levels have not been endorsed by Australian regulators for the Tier 1 assessment of PFAS in sediments. The Tier 1 screening assessment of the health and ecological risks posed by the presence of PFAS in Investigation Area sediment has therefore been undertaken as follows:

– *Human health screening assessment*:
– In the absence of an appropriate published alternative, the PFAS NEMP soil HIL C values for recreational land uses (HIL C) have been adopted for the screening assessment of sediments.
– The HIL C values allow for daily contact with PFAS-impacted soil by young children for periods of up to 2 hours. In this context, this approach is considered likely to be conservative for the usage patterns of Investigation Area waterways.
– *Ecological screening assessment*

– No relevant Tier 1 screening levels have been endorsed for sediment by Australian regulators. The analytical results obtained for sediment have, therefore, been assessed qualitatively.

3.2.2 Summary of the dataset

A consolidated dataset is provided in Appendix B, with sampling locations shown in Figure 3 to Figure 6, Appendix A. A summary of the samples collected and analysed for PFAS during the previous investigations is provided in Table 3.2.

Table 3.2 Summary of samples collected and analysed for PFAS

Zone	Soil	Pavers	Groundwater	Surface water	Sediment	Biota[3]
Zone 1	42	5	Three sampling rounds 8 samples were collected in dry conditions	Three sampling rounds: 2 samples were collected in dry conditions 1 in wet conditions[1]	Not applicable	3
Zone 2a	34	Not applicable	1 – dry conditions	Not applicable	Not applicable	4
Zone 2b	17	Not applicable	Not applicable	Not applicable	Not applicable	2
Zone 2c	59	Not applicable	Not applicable	Not applicable	Not applicable	7
Zone 3	48	Not applicable	Not applicable	Not applicable	3 [2]	5
Zone 4	2[4]	Not applicable	Not applicable	Two sampling rounds with: 3 samples were collected in dry conditions 4 in wet conditions[1]	One sampling round 6 samples were collected in dry weather	0

[1] Surface water collected at the site included discharge from a hydrant and stormwater from flushing the site's outdoor pavement or following the rainfall event occurred on 31 May 2024

[2] Sediment samples from the former ephemeral drainage line and retention pond within the Development Area

[3] Biota samples comprised 16 tree leaves, 3 tree trunks, 1 three branch, and one grass. The biota dataset collected to inform this ERA was opportunistic, with readily available samples collected during the sampling events. The biota sampling did not attempt to collect sufficient samples to fully understand the subtleties of PFAS bioaccumulation in the terrestrial environment of the Development Area.

[4] Two soil samples were collected while installing groundwater monitoring well MW04, located downgradient of the site, on the northern side of Grand Junction Road.

The following is noted with regard to the rationale for the sampling undertaken:

Zones 1, 2 and 3

– Soil sampling was focused on understanding the nature and extent of PFAS impacts in soil.
– Groundwater samples were collected onsite and offsite towards the west and northwest, in line with the inferred flow direction of the shallow/perched aquifer.
– The biota dataset collected to inform the ERA was opportunistic, with readily available samples collected during the sampling events. The biota sampling did not attempt to collect sufficient samples to fully understand the subtleties of PFAS bioaccumulation in the terrestrial environment of the Development Area.

Zone 4

– Five surface water and six sediment samples have been taken from the open swale drain that collects stormwater from the site and discharges it to Dry Creek.
– Samples were also taken in Dry Creek upstream and downstream of the swale drain discharge point.
– Notably, surface water sample SW01 was collected on 26 March 2024 from the open swale drain connecting the site's stormwater drainage system to Dry Creek. GHD collected this sample on a dry day following the flushing of the site stormwater system with a hydrant. Hence, sample SW01 is primarily representative of stormwater generated at the site. Under a rainfall event, surface water at this location would be diluted from stormwater flowing from other properties.

– One ambient sediment sample (SED07) was collected from an open drain/swale that is not connected to the site but discharges into Dry Creek. This drain was dry at the time of sampling.

3.2.3 Screening assessment outcomes

A consolidated dataset is provided in Appendix B. Sampling locations are presented in Appendix A.

A comparison of the PFOS, PFHxS and PFOA concentrations measured in the Investigation Area zones with the adopted screening levels is provided in Table 3.3 to Table 3.6.

Table 3.3 Tier 1 screening assessment of Zone 1 (MFS site) results

Parameter		PFHxS	PFOS	PFHxS+PFOS	PFOA
Soil					
Maximum soil concentration (mg/kg)		0.135	*3.79*	3.92	*0.0521*
Screening Level	**Health guideline (Site-specific HIL)**	**14**	**14**	**14**	**50**
	Ecological guideline (indirect)	-	*0.01*	-	*0.005*
	Ecological guideline (direct)	-	1	-	10 (0.005)[a]
Pavers					
Maximum paver concentration (mg/kg)		0.046	0.124	0.171	<0.005
Screening Level	**Health guideline (Site-specific HIL)**	**14**	**14**	**14**	**50**
Groundwater					
Maximum groundwater concentration (µg/L)		***170***	***35***	***200***	***11***
Screening Level	PFAS NEMP 99% species protection	-	0.00023	-	19
	ANZG (2023) 99% species protection	-	0.0091	-	-
	PFAS NEMP 95% species protection	-	0.13	-	220
	ANZG (2023) 95% species protection	-	0.48	-	-
	PFAS NEMP Recreational Water guideline (NHMRC, 2019)	***2***	***2***	***2***	***10***
Surface water (hydrant and stormwater discharge)					
Maximum surface water concentration (µg/L)		0.36	0.35	0.71	0.04
Screening Level	PFAS NEMP 99% species protection	-	0.00023	-	19
	ANZG (2023) 99% species protection	-	0.0091	-	-
	PFAS NEMP 95% species protection	-	0.13	-	220
	ANZG (2023) 95% species protection	-	0.48	-	-
	PFAS NEMP Recreational Water guideline (NHMRC, 2019)	***2***	***2***	***2***	***10***
Biota					
Maximum biota (leaves) concentration (mg/kg ww)		0.059	0.032	0.091	<0.01

Notes

Exceedances of the Tier 1 screening criteria are highlighted with relevant colours and fonts.

"-" indicates that no screening levels are available.

[a] Interim criterion for direct exposure to PFOA in soil for reptiles, based on the Draft PFAS 3.0 (HEPA, 2022)

Table 3.4 Tier 1 screening assessment of Zone 2 (Buffer Area) results

Parameter		PFHxS	PFOS	PFHxS+PFOS	PFOA
Soil in low-density residential areas					
Zone 2a – Maximum soil concentration (mg/kg)		0.0370	*0.066*	0.066	0.0005
Zone 2b – Maximum soil concentration (mg/kg)		0.0002	*0.011*	*0.011*	<0.0002
Screening Level	**Health guideline (Site-specific HIL)**	**14**	**14**	**14**	**50**
	Health guideline (HIL A)	0.01	0.01	0.01	0.1
	Health guideline (HIL C)	*1*	*1*	*1*	*10*
	Ecological guideline (indirect)	-	*0.01*	-	*0.005*
	Ecological guideline (direct)	-	1	-	10 (0.005)[a]
Soil in medium-density residential areas					
Zone 2c – Maximum soil concentration (mg/kg)		0.210	*0.220*	0.220	*0.0072*
Screening Level	**Health guideline (Site-specific HIL)**	**14**	**14**	**14**	**50**
	Health guideline (HIL B)	2	2	2	20
	Health guideline (HIL C)	*1*	*1*	*1*	*10*
	Ecological guideline (indirect)	-	*0.01*	-	*0.005*
	Ecological guideline (direct)	-	1	-	10 (0.005)[a]
Groundwater					
Zone 2a – Maximum groundwater concentration (µg/L)		0.95	1	1.95	0.07
Screening Level	PFAS NEMP 99% species protection	-	0.00023	-	19
	ANZG (2023) 99% species protection	-	0.0091	-	-
	PFAS NEMP 95% species protection	-	0.13	-	220
	ANZG (2023) 95% species protection	-	0.48	-	-
	PFAS NEMP Recreational Water guideline (NHMRC, 2019)	***2***	***2***	***2***	***10***
Biota					
Zone 2a – Maximum biota concentration (mg/kg ww)		0.008	0.001	0.009	<0.001
Zone 2b – Maximum biota concentration (mg/kg ww)		<0.001	0.001	0.001	<0.001
Zone 2c – Maximum biota concentration (mg/kg ww)		0.14	0.007	0.15	<0.01

Notes

Exceedances of the Tier 1 screening criteria are highlighted with relevant colours and fonts.

"-" indicates that no screening levels are available.

[a] Interim criterion for direct exposure to PFOA in soil for reptiles, based on the Draft PFAS 3.0 (HEPA, 2022)

Table 3.5 Tier 1 screening assessment of results from Zone 3 (Development Area)

Parameter		PFHxS	PFOS	PFHxS+PFOS	PFOA
Soil					
Maximum soil concentration (mg/kg)		<0.005	0.0098	0.0098	<0.005
Screening level	Health guideline (HIL A)	0.01	0.01	0.01	0.1
	Health guideline (HIL C)	1	1	1	10
	Ecological guideline (indirect)	-	*0.01*	-	*0.005*
	Ecological guideline (direct)	-	1	-	10 (0.005)[a]
Sediments					
Maximum surface water concentration (mg/kg)		<0.005	<0.005	<0.005	<0.005
Screening Level	Health guideline (HIL C)	1	1	1	10
Biota					
Maximum biota (leaves) concentration (mg/kg ww)		0.011	0.005	0.016	<0.01

Notes

Exceedances of the Tier 1 screening criteria are highlighted with relevant colours and fonts

"-" indicates that no screening levels are available.

[a] Interim criterion for direct exposure to PFOA in soil for reptiles, based on the Draft PFAS 3.0 (HEPA, 2022)

Table 3.6 Tier 1 screening assessment of results from Zone 4

Parameter		PFHxS	PFOS	PFHxS+PFOS	PFOA
Surface water					
Dry Creek – upstream of discharge point – maximum surface water concentration (µg/L)		0.011	0.01	0.021	0.006
Dry Creek – downstream of discharge point – maximum surface water concentration (µg/L)		0.008	0.014	0.022	0.015
Open channel connecting the stormwater system to Dry Creek – maximum surface water concentration (µg/L)		0.031	0.086	0.116	0.044
Ambient stormwater from the urban area to the southwest of the site		0.001	0.0021	0.0031	0.001
Screening Level	PFAS NEMP 99% species protection	-	0.00023	-	19
	ANZG (2023) 99% species protection	-	0.0091	-	-
	PFAS NEMP 95% species protection	-	0.13	-	220
	ANZG (2023) 95% species protection	-	0.48	-	-
	PFAS NEMP Recreational Water guideline (NHMRC, 2019)	***2***	***2***	***2***	***10***
Sediments					
Dry Creek – upstream of discharge point – maximum sediment concentration (mg/kg)		<0.005	<0.005	<0.005	<0.005
Dry Creek – downstream of discharge point – maximum sediment concentration (mg/kg)		<0.005	<0.005	<0.005	<0.005
Open channel connecting the stormwater system to Dry Creek – maximum sediment concentration (mg/kg)		<0.005	<0.005	<0.005	<0.005
Ambient location - drainage channel/swale not connected to the site – maximum sediment concentration (mg/kg)		<0.005	<0.005	<0.005	<0.005
Screening Level	Health guideline (HIL C)	1	1	1	10

Notes

Exceedances of the Tier 1 screening criteria are highlighted with relevant colours and fonts

"-" indicates that no screening levels are available.

Summary of the Tier 1 HHRA and Tier 1 ERA are presented in Table 3.7 and Table 3.8 respectively:

Table 3.7 Summary of CSM for human receptors

Receptor	Exposure scenario	Exposure media	Exposure pathways	Evaluation of exposure pathway	Further risk assessment Included
Zone 1 – MFS site					
MFS staff	Operation of the MFS fire station.	Soil and pavers	Incidental ingestion or inhalation of soil/dust.	PFAS concentrations in onsite soil and paver samples were well below the site-specific HIL.	No
		Groundwater	Incidental ingestion	Onsite groundwater reported PFOS+PFHxS concentrations above the NHMRC (2019) recreational criteria. However, most of the site is sealed, groundwater is not extracted, and the opportunities to encounter groundwater are limited.	No
		Surface water	Incidental ingestion	Surface water collected on-site included discharge from a hydrant and stormwater flowing following a rainfall event. Concentrations of PFAS were lower than the recreational criteria of the NHMRC (2019). Direct contact with stormwater will be minimal under normal circumstances.	No
Maintenance and construction workers	Intrusive work (e.g. installing pipework)	Soil	Incidental ingestion or inhalation of soil/dust.	Tier 1 screening levels specific to this exposure scenario are unavailable, but exposure during subsurface works, typically of short duration, will generally be minimal. Occupational health and safety protocols (e.g. washing hands) should be considered to minimise the potential for PFAS exposure during extensive subsurface works undertaken in primary PFAS source areas.	No
Zone 2 – Buffer Area (if it is Developed for residential purposes)					
Future residents of Zones 2a	Residential with accessible soil, including production of homegrown fruit and vegetables	Soil	Incidental ingestion or inhalation of soil/dust.	PFOS+PFHxS concentrations in soil samples collected from Zones 2a exceeded the PFAS NEMP HIL A.	Yes PFOS+PFHxS
			Consumption of homegrown fruit and vegetables		
		Groundwater		PFAS has been identified in groundwater, and Tier 1 screening levels relevant to plant uptake are not available	
Future residents of the Zones 2b		Soil	Incidental ingestion or inhalation of soil/dust.	PFAS concentrations in soil samples collected from Zones 2b exceeded the PFAS NEMP HIL A.	Yes PFOS+PFHxS
			Consumption of homegrown fruit and vegetables		
		Groundwater		Zone 2b is upgradient of the site.	No
Future residents of Zone 2c	Residential with limited soil access	Soil	Incidental ingestion or inhalation of soil/dust.	PFAS concentrations in soil samples collected from Zones 2c were below the PFAS NEMP HIL B.	No

Recreational users of Zones 2a, 2b and 2c	Recreational activities	Soil	Incidental ingestion or inhalation of soil/dust.	PFAS concentrations in soil samples collected from Zones 2c were below the PFAS NEMP HIL C.	No
Maintenance and construction workers	Construction works	Soil	Incidental ingestion or inhalation of soil/dust.	The PFAS NEMP does not provide assessment criteria specific to construction workers. Hence, the PFAS impacts identified in soil within Zone 2 have been further assessed in this Report.	Yes PFOS+PFHxS
Zone 2 – Buffer Area (if it is retained by MFS)					
MFS staff	Operation of the MFS fire station.	Soil	Incidental ingestion or inhalation of soil/dust.	PFAS concentrations in soil samples were lower than the site-specific HILs.	No
Zone 3 – Development Area					
Future users of the Zone 3	Residential use with accessible soil, including the production of homegrown fruit and vegetables	Soil	Incidental ingestion or inhalation of soil/dust. Consumption of homegrown fruit and vegetables	PFAS concentrations in soil samples collected from Zone 3 were lower than the PFAS NEMP (HEPA, 2020) HIL A, HIL B, and HIL C, with PFAS not detected in the majority of samples.	No
Maintenance and construction workers	Intrusive work (e.g. installing pipework)	Soil	Incidental ingestion or inhalation of soil/dust.		No
Zone 4 – Dry Creek					
Recreational users of the Investigation Area	Recreational activities in the receiving environment (Zone 4)	Sediment	Incidental ingestion	PFAS concentrations were below the PFAS NEMP (HEPA, 2020) HIL C.	No
		Surface water	Incidental ingestion	PFAS concentrations in surface water were below the NHMRC (2019) screening levels for the recreational use of water.	No

Table 3.8 Summary of the exposure scenarios progressed to the ERA

Receptor	Exposure scenario	Exposure media	Exposure pathways	Screening assessment outcomes	Further risk assessment included
Zone 1 – MFS site					
Terrestrial organisms	Use of the site (Zone 1)	Soil	Direct ingestion and uptake	PFOS+PFHxS and PFOA concentrations above the direct soil exposure criteria for ecological receptors were identified in Zone 1 in BH04 (MW02), S1, and/or S2. BH04 (MW02) is located in the rear paved yard of the station, making the underlying soil effectively inaccessible to fauna and flora. Sampling points S1 and S2 are in the small unpaved strip along the southern side of the site, but these exceedances are of limited relevance in the context of the ongoing use of the site as a fire station.	No
		Plants	Indirect exposure (food chain)	The soil samples collected from Zone 1 reported PFOS+PFHxS concentrations above the Tier 1 screening levels for indirect exposure. PFOS and PFHxS were detected in eucalyptus tree leaves, trunk, and grass samples collected from Zones 1. Koalas have been identified in the Investigation, and they feed exclusively on eucalyptus leaves.	Yes PFOS+PFHxS
Zone 2 – Buffer Area					
Terrestrial organisms	Use of the Buffer Area (Zones 2a, 2b, 2c)	Soil	Direct ingestion and uptake	The soil samples collected from Zones 2a, 2b, and 2c reported PFOS+PFHxS concentrations lower than the direct soil exposure screening criteria for ecological receptors. In Zone 2c, two samples collected from BH64 reported PFOA concentrations up to 0.0072 mg/kg, marginally above the draft direct exposure criterion for reptiles proposed by the draft PFAS NEMP 3.0 (HEPA, 2022) of 0.005 mg/kg. However, these exceedances were found in non-accessible deep soil (1.9 to 2.5 m bgl), and PFOA was not detected in most of the soil samples collected in Zone 2c.	No
		Plants	Indirect exposure (food chain)	The soil samples collected from Zones 2 reported PFOS+PFHxS concentrations above the Tier 1 screening levels for indirect exposure. PFOS and PFHxS were detected in plant samples collected from Zones 2. Koalas have been identified in the Investigation, and they feed exclusively on eucalyptus leaves.	Yes PFOS+PFHxS
Zone 3 – Development Area					
Terrestrial organisms	Use of Zone 3	Soil	Direct and indirect exposures	The soil samples collected from Zone 3 reported PFOS+PFHxS and PFOA concentrations lower than the direct soil exposure screening criteria for ecological receptors.	No
		Plants (particularly eucalyptus)	Consumption of plants (food chain exposures)	The soil samples collected from Zone 3 reported PFOS+PFHxS and PFOA concentrations lower than the indirect soil exposure screening criteria for ecological receptors. PFOS+PFHxS were identified in plant samples, but the development underway for Zone 3 is such that this area will provide minimal suitable habitat for koalas in the medium to long term.	No

Zone 4 – Dry Creek					
Aquatic and semi-aquatic organisms	Use of Dry Creek	Surface water	Direct ingestion and uptake	All receiving environment surface water samples had PFAS concentrations below the PFAS NEMP and ANZG (2023) WQG for the protection of 95% of species, and PFAS were not detected in sediments.	No
		Sediment			
		Surface water	Food chain exposures	All surface water samples collected from Dry Creek reported PFOS+PFHxS concentrations above the PFAS NEMP and ANZG (2023) WQG for the protection of 99% of species. PFOA concentrations were below the PFAS NEMP WQG for the protection of 99% of species.	Yes PFOS+PFHxS

Based on the available data, the extent of the PFAS impacts associated with the site can be summarised as follows:

- **Soil** – exceedances of relevant criteria for human health and ecological receptors are delineated and do not extend beyond Zones 1 and 2. Impacts have also been delineated vertically with deeper samples (>2 m bgl) reporting PFAS concentrations below the adopted health-based and ecological criteria.
- **Groundwater** – PFAS has been identified in shallow/perched groundwater in Zone 1, Zone 2a, and Zone 3 (to the west of the site). Still, the available evidence (Section 2.3.1) suggests that the shallow groundwater system is limited in spatial extent and has occurred, at least partially, as a result of onsite leaks. The shallow aquifer also does not appear to extend to the receiving environment of Dry Creek and, to date, has been delineated by shallow wells installed near Grand Junction Road that have been dry.
- **Sediment** – PFAS were not detected in sediment samples.
- **Surface water** – Delineation of PFAS contamination associated with the site in surface water is impractical. However, the ambient concentrations of PFAS along Dry Creek were of the same order of magnitude as those measured downstream of the MFS site, indicating the presence of multiple sources of PFAS in the catchment area.

3.3 Fate and transport of PFAS in shallow groundwater

The development of the Buffer Area (Zone 2) would require the removal of vegetation immediately adjacent to the site, and the SA EPA has requested that this HHERA specifically consider the potential fate and transport of PFAS in groundwater, where this is to occur.

The presence and movement of PFAS in shallow groundwater can be significantly affected by vegetation. Removing vegetation downstream of a PFAS source introduces complex dynamics related to groundwater flow, PFAS bioaccumulation, and specific environmental conditions. The lines of evidence related to the site and Development Area can be summarised as follows:

- **Bioaccumulation of PFAS by vegetation** – Research indicates that plants can accumulate PFAS in their biomass, extracting it from groundwater and soil (Evangelou & Robinson, 2022). This process reduces the migration of PFAS. The Development Area downstream of the MFS site has been cleared since at least 2009, based on a review of Nearmap Australia Pty Ltd aerial photographs. Hence, the bioaccumulation of PFAS by plants in shallow groundwater downstream of the site has been limited for at least the last 15 years.
- **Groundwater characteristics** – The shallow groundwater to the west of the site in the Development Area varies with rainfall and potentially with water leakage from the site. During wetter periods, PFAS may migrate from the site into offsite areas to the northwest via groundwater flow. Still, the available evidence does not suggest that this has been a significant migration pathway to date.
- **Vegetation development plan** – GHD understands that the western boundary of the MFS site will maintain its current vegetation. GHD also understands that Renewal SA plans to introduce a one-tree per residential lot requirement for the development area. This will increase the density of vegetation downgradient of the site.
- **PFAS source** – MFS has shifted to using PFAS-free firefighting foam, minimising the primary input of PFAS into soil and shallow groundwater. The concentration of PFAS in secondary sources of contamination (soil, pavers, groundwater) will gradually decrease over time.

In summary, managing the limited vegetation in the Development Area to the west of the site is unlikely to significantly impact the migration of PFAS in shallow groundwater. Adding more trees, especially to the west and downstream of the site, along with removing the PFAS source, is likely to limit the movement of PFAS in the shallow groundwater system identified beneath the site.

3.4 Evaluation and adequacy of the dataset

3.4.1 Data Quality

Evaluation of the quality of the data included in this HHERA are provided in the DSI (GHD, 2023a) and Supplementary DSI (GHD, 2024) and can be summarised as follows:

– Fieldwork was undertaken in general accordance with GHD standard operating procedures (SOPs), which are a set of uniform and systematic methods based on national guidance provided in the ASC NEPM and PFAS NEMP (HEPA, 2020).
– National Association of Testing Authorities (NATA) accredited laboratories performed laboratory analysis according to their own quality assurance systems. Laboratory data validation (undertaken as part of the DSI and Supplementary DSI) included assessment of results for laboratory (method) blanks, laboratory control spikes, surrogate and matrix spikes and duplicate samples. These were compared against laboratory data quality limits. Where results were outside of the recommended limits, these were investigated and discussed. GHD considers that the analytical and laboratory results outside the recommended limits acceptable.
– Field data validation included assessing results for field intra-laboratory and inter-laboratory duplicate samples, rinsate blanks, and trip blanks. These were compared against AS4482.1: 2005, NEPM 2013 - Schedule B(3), and Data Quality Objectives (DQOs).
– Based on the results of the laboratory QA/QC sampling analyses, it is considered that the data quality is suitable for its intended use and to meet the objectives of the investigation.

3.4.2 Dataset uncertainty and limitations

Key uncertainties and limitations of the available dataset include the following:

– There is uncertainty surrounding the temporal variability in the flux of PFAS from the MFS site via surface water into the Dry Creek, where water flow may vary seasonally and in response to rainfall events. GHD completed two rounds of surface water sampling along Dry Creek, one under dry and one under wet conditions. Results showed that PFAS concentrations in surface water downstream of the MFS site remained similar (same order of magnitude) to those measured upstream, reflecting ambient levels. It is noted that stormwater flow is the primary mechanism via which PFAS migrates from the site into Dry Creek, and short-term increases in the flux of PFAS through the Investigation Area may occur under certain conditions.
– Seasonal effects on the shallow groundwater system are still being assessed.
– The potential for impacts to extend to the Q1 aquifer has not been confirmed via intrusive investigations; however, the existing geological data suggests that the groundwater impacts are unlikely to seep vertically into the Q1 aquifer due to a clay confining layer.

4. Human Health Risk Assessment

This section presents a Tier 2 human health risk assessment (HHRA) for the following scenarios:

– Zones 2a and 2c are used for low-density residential purposes, where residents may be exposed to PFAS via direct contact with soil and dust and by consuming vegetables and fruit produced within the property.
– Construction workers labouring within Zones 2a and 2c, in the event that Renewal SA develops the Buffer Area (or a portion of it).

The primary focus of this Tier 2 HHRA is PFOS+PFHxS, which is the predominant PFAS identified in soil, groundwater, biota, and surface water across the Investigation Area. A Tier 2 HHRA has not been undertaken for PFOA, as the Tier 1 HHRA did not identify PFOA concentrations above the relevant, health-based screening levels in the samples collected offsite. Other PFAS (including PFOA) have been considered in the uncertainty and sensitivity analysis (Section 4.4).

A Tier 2 HHRA has not been undertaken for the MFS site (Zone 1), the Development Area (Zone 3) or the receiving environment (Zone 4) based on the outcomes of the Tier 1 HHRA (refer to Section 3.2.3).

4.1 Toxicity assessment

A toxicity assessment determines whether human exposure to a chemical could cause an increase in the incidence of an adverse health condition (NEPC, 1999). The outcome of the toxicity assessment process is a set of toxicity criteria that are compared with exposure estimates to evaluate risk associated with chemical exposure pathways.

A detailed toxicity assessment for PFAS is presented in Appendix C. In accordance with the ASC NEPM (NEPC, 1999) Schedule B4, the toxicity assessment for this HHRA includes two elements:

1. *Hazard Identification*, which examines the toxicokinetic characteristics of PFOS+PFHxS and the capacity of PFOS+PFHxS to cause adverse health effects.
2. *Dose Response assessment* examines the quantitative relationships between PFOS+PFHxS exposure and health effects to determine the levels of exposure that could give rise to adverse effects.

The toxicity assessment process characterised the absorption of PFOS+PFHxS and identified toxicity reference values (TRVs), a measure of tolerable daily exposure published by Food Standards Australia and New Zealand FSANZ (2017) for these chemicals. These parameters are summarised in Table 4.1.

Table 4.1 Summary of toxicological input parameters

Chemical	Toxicity assessment input parameters	Source
Toxicity reference values		
PFOS, PFHxS (sum)	20 ng/kg/day*	FSANZ (2017)
Absorption parameters		
Dermal absorption	Low (assumed at 0.01 unitless)	OEH (2019); ATSDR (2021); EFSA (2020)
Gastrointestinal absorption	100%	FSANZ (2017)
* ng/kg/day is nanograms per kilogram of body weight per day		

4.2 Human exposure assessment

The exposure assessment process aims to estimate the chemical exposures experienced by the receptors identified in the CSM (NEPC, 1999). In the case of this HHRA, the level of risk posed by PFAS in soil and groundwater west of the MFS site has been assessed by considering the following exposure scenarios:

– Future residents of Zones 2a and 2b (children and adults) who may come into direct contact with PFAS present in surface soil and dust and who may consume home-grown fruit and vegetables grown in contaminated soil and up-taking shallow groundwater. This scenario represents a conservative usage pattern of Zones 2a and 2b.
– Intrusive maintenance and construction workers who may come into direct contact with PFAS present in soil within Zones 2a, 2b, and 2c during development works.

4.2.1 Exposure scenarios

The exposure scenarios included in this HHRA are summarised in Table 4.2.

Table 4.2 Summary of exposure scenarios included in the HHRA

Scenario	Exposure scenario	Exposure pathway
Future residents of Zones 2a and 2b		
Low-density residential land is used with accessible soil for growing edible vegetables and fruits and for the consumption of homegrown products.	Direct contact with soil and dust	Incidental ingestion and inhalation
	Consumption of produce (e.g., fruit and vegetables) accumulating PFAS from soil and shallow/perched groundwater.	Domestic consumption of homegrown produce
Intrusive maintenance and construction workers (Zones 2a, 2b and 2c)		
Construction/development and intrusive maintenance works	Direct contact with soil and dust	Incidental ingestion and inhalation

The HHRA did not include the production and consumption of poultry and eggs in Zones 2a and 2b due to the limited size of the proposed lots and the highly urbanised settings.

4.2.2 Exposure parameters

The approaches outlined in the ASC NEPM (NEPC, 1999) have been used to select exposure assessment inputs that are adequately protective of future residents of Zones 2a and 2b and workers labouring within the Buffer Area, as follows:

– General physical characteristics and dietary ingestion rates have been sourced from the ASC NEPM (NEPC, 1999), enHealth (2012a; 2012b) and FSANZ (2017).
– The ASC NEPM (NEPC, 1999) Schedule B7 provides behavioural and exposure duration assumptions for standard exposure scenarios, and the values relevant to residential settings have been adopted.
– In the calculations of HIL A guidelines, the ASC NEPM assumes that households could source an average of 10% of their fruit and vegetables from domestic sources. This assumption has also been adopted in this assessment, although it is likely to be conservative in the context of the Renewal SA development.
– The fruit and vegetable consumption rates used by OEH (2019) to derive the PFAS NEMP HILs have been used to estimate the risks associated with the domestic consumption of produce (refer to Appendix E).
– The soil ingestion rate adopted by Friebel and Nadebaum (2011) has been used for construction and maintenance workers. As a conservative approach, it has been assumed that workers may labour within the Buffer Area for a full working year (i.e. 240 days in a 1-year period).
– Exposures to PFOS+PFHxS may be associated with releases attributable to identified sources of contamination and impacts that originate from other sources in the wider environment and exposure in occupational settings. A background exposure assumption of 10% has been adopted in this assessment as a reasonable representation of the long-term background exposures experienced by the Australian population (refer to Appendix D for more details)

The exposure parameters incorporated into the HHRA are detailed in Appendix E. The uncertainty associated with key exposure parameters has been evaluated in the Sensitivity Analysis (Section 4.4).

4.2.3 Exposure assessment calculations

The modelling algorithms used to estimate the PFAS exposures for future residents and construction/maintenance workers, as well as the modelling inputs and outputs, are provided in Appendix E.

A detailed description of the modelling approach used to estimate the transfer of PFAS from soil and groundwater into homegrown produce, as well as direct contact with soil and dust, is provided in Appendix D.

4.2.4 Exposure point concentrations

Exposure point concentrations (EPC) are the contaminant concentrations that are used in a quantitative HHRA to estimate exposure. The GHD investigations have included the analysis of PFAS in soil and groundwater samples collected in the Buffer Area (Section 3.2). Due to the relatively limited number of data points and sampling rounds available, the exposure estimates in this HHRA have been based upon the maximum PFOS+PFHxS concentrations measured in soil and groundwater in each zone, as summarised in Table 4.3.

Table 4.3 Exposure point concentrations used in HHRA modelling

Location	Media	Relevant sample IDs	PFOS+PFHxS concentration	Fraction of PFHxS (% of PFOS+PFHxS)
Zone 2a	Soil	SS04	0.066 mg/kg	0%
	Groundwater	TW01	1.95 µg/L	48%
Zone 2b	Soil	BH36	0.011 mg/kg	0%
	Groundwater	No samples were collected in Zone 2a, which is upgradient of the site		
Zone 2c	Soil	BH26	0.22 mg/kg	0%
	Groundwater	No samples were collected in Zone 2c, which is upgradient of the site		

4.3 Risk characterisation

In this HHRA, the risk characterisation process aims to combine the toxicity and exposure assessment results to estimate the risks associated with exposure to PFAS within the Buffer Area.

4.3.1 Methodology

To evaluate whether the PFAS concentrations measured in Zones 2a, 2b and 2c could represent a health risk, the TRVs detailed in Section 4.1 were compared with the PFAS intake rates calculated via the methodology outlined in Section 4.2.2. Specifically:

– The ratio of the estimated PFOS+PFHxS intake to the PFOS+PFHxS TRV was calculated for each exposure pathway. This ratio is termed a Hazard Quotient (HQ).
– All the HQs were summed to derive an overall Hazard Index (HI).

A degree of conservatism is built into the toxicity and exposure assessment processes and therefore, the calculated HIs have been interpreted as follows.

– HI ≤1: Indicates an exposure scenario where there is a low risk that PFOS+PFHxS intake will exceed the TRV
– HI >1 and ≤10: Indicates an exposure scenario where there is a moderate risk that PFOS+PFHxS intake will exceed the TRV
– HI >10: Indicates an exposure scenario where there is a high risk that the PFOS+PFHxS intake will exceed the TRV.

The equations used in the risk characterisation process are outlined in Appendix E.

4.3.2 Outcomes

Table 4.4 presents a summary of the risk characterisation outcomes for future users of Zone 2.

Table 4.4 Summary of risk characterisation – future users of Zone 2

Exposure pathway	Hazard Quotient		
	Child	Adult	Construction / maintenance workers
Zone 2a			
Incidental ingestion of soil	0.02	0.003	0.01
Inhalation of soil and dust	0.00001	0.00001	0.000004
Home-grown produce consumption	0.43	0.28	Not applicable
Total HI	**0.45**	**0.28**	**0.01**
Zone 2b			
Incidental ingestion of soil	0.003	0.0004	0.002
Inhalation of soil and dust	0.000001	0.000001	0.000001
Home-grown produce consumption	0.06	0.04	Not applicable
Total HI	**0.06**	**0.04**	**0.002**
Zone 2c			
Incidental ingestion of soil	Low risk*	Low risk*	0.04
Inhalation of soil and dust	Low risk*	Low risk*	0.00001
Home-grown produce consumption	Low risk*	Low risk*	Not applicable
Total HI	**Low risk***	**Low risk***	**0.04**

Indicates an HQ or HI ≤1.
Indicates an HQ or HI >1 and ≤10.
Indicates an HQ or HI >10
* Low risk derived based on the Tier 1 screening assessment (Section 0)

Table 4.4 indicates a **low risk** that PFOS+PFHxS in the Buffer Area will result in PFOS+PFHxS intakes above the TRV. The consumption of homegrown fruit and vegetables contributed most significantly to the risk estimates for the future residential development, and it is noted that the exposure assumptions used in the assessment (e.g. 10% of fruit and vegetable consumption sourced from within the Buffer Area) are highly conservative in the context of the Renewal SA development.

The results of the HHRA indicate that the Buffer Area is suitable for the proposed future residential land use. Zones 2a, 2b and 2c would also be suitable for MFS personnel and recreational use if they were to be retained by MFS (refer to Section 0). Construction activities undertaken within the Buffer Area would also represent a low health risk to workers.

4.4 HHRA uncertainty and sensitivity analysis

4.4.1 Uncertainty analysis

The uncertainty analysis identifies the assumptions and data gaps associated with the HHRA. The main areas of uncertainty identified for this assessment include:

– Exposure Assessment – variability in future residents' land use patterns
– Toxicity Assessment – a range of TRV have been adopted internationally for PFOS and PFHxS.
– Risk Characterization – reliance on modelling approaches to estimate PFAS exposure risks.

The approaches used to reduce the uncertainty associated with this HHRA have been to use site-specific data wherever possible and to adopt conservative assumptions from reputable Australian and international agencies in the absence of site-specific data. Health conservative assumptions applied in this assessment include:

– The households could source an average of 10% of their fruit and vegetables from domestic sources despite the limited dimension of the allocated lots.
– All homegrown fruit and vegetables are grown in contaminated soil containing the maximum concentration of PFOS+PFHxS measured in each zone.
– Impacted shallow groundwater represents 50% of homegrown plant water uptake. Plants would likely be irrigated with town water and receive significant water from rainfall (mitigating risks).
– Maximum PFOS+PFHxS concentrations in soil measured in each zone were adopted as EPC.
– The use of toxicological data recommended by Australian health agencies and intended to be well below any threshold for adverse health effects (based on no-observed-adverse-effect levels, with several safety factors applied to account for issues such as variability within populations)

Given the factors outlined above, the uncertainty in this assessment has been considered by erring on the side of the overestimation of potential health risks.

Key areas of uncertainty, which could influence the outcomes of the HHRA, include:

– Variability in patterns of land use
– The presence of PFAS other than PFOS and PFHxS in the environment.
– Spatial variability in PFAS concentrations in soil.
– The sensitivity of the assessment outcomes to these inputs is further evaluated in Section 4.4.2.

4.4.2 Sensitivity analysis

In a sensitivity analysis, key input parameters are varied to determine the degree to which these changes influence the risk estimates. A sensitivity analysis can, therefore, be used to help characterise uncertainty and identify the key parameters influencing risk assessment.

The sensitivity analysis has focused on future children residents of Zone 2a. Health risks were recalculated by varying the following parameters:

– Domestic consumption rates of vegetables and fruits as this exposure pathway reported the highest risk estimates
– Background exposure assumptions
– Soil EPC
– The presence of PFAS other than PFOS and PFHxS.

Appendix F presents the sensitivity analysis results for key variables, including an evaluation of the sensitivity of the HHRA outcomes to each key variable. Overall, the sensitivity analysis demonstrated that the report outcomes are relatively insensitive to the key areas of uncertainty identified in Section 4.4.1. Across the range of input parameters evaluated, the outcomes of the HHRA generally did not change.

5. Ecological Risk Assessment

This section presents an ERA for the aquatic environment of Dry Creek downstream of the MFS site and the terrestrial environment of the site and Development Area.

In Section 3, the PFAS NEMP ecological screening levels were used to provide a Tier 1 assessment of direct and indirect (food chain) risks that could occur in association with the presence of PFAS in the Investigation Area. The results of this screening assessment can be summarised as follows:

Terrestrial environments

– With the exception of a limited number of soil samples collected onsite (Zone 1), the PFOS+PFHxS concentrations measured in Investigation Area soils have generally been below or of the same order of magnitude as the PFAS NEMP direct exposure screening levels. Most of Zone 1 is covered by buildings and pavers, and there are only small areas of unsealed surfaces, such as garden beds with trees and shrubs, along the site boundaries. **Therefore, direct exposure to PFAS in soil represents a low risk to terrestrial organisms inhabiting the Investigation Area and has not been considered in detail in this ERA**.
– The PFOS+PFHxS concentrations measured in Zone 1 and Zone 2 have exceeded the PFAS NEMP indirect exposure screening criteria for ecological receptors, and PFOS and PFHxS were detected in eucalyptus tree leaves, trunk, and grass samples collected from around the site. **This ERA has, therefore, evaluated whether PFAS impacts may represent a risk to terrestrial food chains in the vegetated areas around the site boundary.**

Aquatic environments

– The PFOS, PFHxS, and PFOA concentrations measured in the Investigation Area receiving environment (i.e. the swale drain and Dry Creek) have been below the PFAS NEMP WQG for the protection of 95% of species **Direct exposure to PFAS, therefore, represent a low risk to aquatic organisms inhabiting the receiving environment, and this has not been considered in detail in this ERA**.
– The PFOS and PFHxS concentrations measured in the Investigation Area receiving environment have generally been above the PFAS NEMP WQG for the protection of 99% of species. **This ERA has, therefore, evaluated whether PFAS impacts may represent a risk to aquatic food chains in the areas downstream of the site.**

This ERA is focused on PFOS and PFHxS, the main PFAS detected in the Investigation Area. Other PFAS are discussed qualitatively in Section 5.3.

5.1 Receptor identification

The receptor identification process focuses on identifying the species at risk and the ecological values that need to be protected (NEPC, 1999). Due to the diversity of species present within the environment, it is not possible to undertake a detailed evaluation of ecological risk for all flora and fauna exposed to PFAS. However, in this ERA, site-specific information has been used to identify local species or communities that are most sensitive and representative of a broader class of organisms that may be present.

The ecological receptors relevant to the investigation area have been identified based on government-managed databases and tools and an ecologist's inspection of the investigation area. Appendix G provides a detailed summary of this information.

Table 5.1 summarises the ecological receptor groups that may be exposed to PFAS via the food chain in the Investigation Area.

Table 5.1 Summary of receptor groups present in Zones 1, 2, and 3 – terrestrial environments

Receptor group	Primary exposure mechanism	Zone 1 – the site	Zone 2 – Buffer Area	Zone 3 – Development Area
Terrestrial mammals	Bioaccumulation and dietary exposure (food chain)	Koalas (*Phascolarctos cinereus*) have been identified at the site and the Development Area and may be exposed to PFAS via consumption of eucalyptus leaves. Following the completion of the Renewal SA development, there will be limited remnant habitat for koalas. Still, koalas could theoretically inhabit the strip of land around the site boundary and the Buffer Area if MFS retains the Buffer Area.		
Terrestrial birds		The operation areas of the site are largely covered with hardstand and are associated with limited environmental values. The strip of land (~10 m wide) along the boundary of the site and the Buffer Area contains remnant eucalyptus trees, with acacia, shrubland and grassland understorey, which may be used by small avian and reptilian fauna. Following the completion of the Renewal SA development, open spaces and residential gardens may also be used by small avian and reptilian fauna. A variety of avifauna and reptiles potentially forage within the site and Development Area, including magpielark (*Grallina cyanoleuca cyanoleuca*) and welcome swallow (*Hirundo neoxena neoxena*), red-bellied black snake (*Pseudechis porphyriacus*), eastern bluetongue (*Tiliqua scincoides*) and skinks (*Morethia adelaidensis* and *Hemiergis peronii*).		
Terrestrial reptiles				

Table 5.2 Summary of receptor groups present in Zone 4 – aquatic environment

Receptor group	Primary exposure mechanism	Zone 4 – Dry Creek
Dry Creek		
Semi-aquatic birds and waterbirds	Bioaccumulation and dietary exposure (food chain)	Various bird species have been observed along Dry Creek within the Investigation Area. Species that may feed on aquatic macroinvertebrates, amphibians and small-sized fish (if present) Include the magpie-lark (*Grallina cyanoleuca*), white-faced Heron (*Egretta novaehollandiae*), kookaburra (*Dacelo novaeguineae)* and chestnut teal duck (*Anas castanea*).
Semi-aquatic mammals		Semi-aquatic mammals such as the water rat (*Hydromys chrysogaster*) have not been observed along Dry Creek or reported in the online databases but could be present.
Aquatic and semi-aquatic reptiles and amphibians		Aquatic or semi-aquatic species that have not been observed but which may be present in Dry Creek include the eastern long-necked turtle (*Chelodina longicollis*) and the vulnerable Macquarie River turtle (*Emydura macquarii*). Frogs have also been observed, including the common froglet (*Crinia signifera*) and banjo frog (*Limnodynastes dumerilii*)

The swale drain that links the Grand Junction Road stormwater system with Dry Creek provides limited structural habitats for aquatic and semi-aquatic species. The vegetation is predominantly reeds, and the waterway is a semi-artificial incised channel that is usually dry outside of stormwater flow events. The waterway has minimal vegetation, and the land has been completely cleared. As a result, although higher trophic level organisms may use the swale drain intermittently, it is unlikely to provide primary foraging habitat for aquatic or semi-aquatic species, including waterbirds and mammals, and food chain exposures have not been assessed in this portion of the receiving environment.

5.2 ERA for terrestrial environments (Zone 1, 2 and 3)

The soil samples collected from the vegetated area around the boundary of the site reported PFOS+PFHxS concentrations of up to 0.11 mg/kg. The area of exposed surface soil impact reporting PFOS+PFHxS concentrations greater than 0.01 mg/kg is approximately 1 hectare and is limited to the boundary of the site and Buffer Area.

Two samples (S01 and BH04_0.5-0.65) collected from the same area in the southern portion of Zone 1, immediately adjacent to the paved rear yard, wash-down slab and storage shed reported a relatively higher PFOS+PFHxS concentration of 3.92 and 1.3 mg/kg, respectively. This hotspot of impact has not been specifically

considered in this ERA due to the operational nature of this area. A photograph taken in the vicinity of S01 is provided below.

Plate 5.1 Photograph taken in the vicinity of soil sampling location S01 and BH04

It is noted that, in the event that the Buffer Area is developed, most of residual trees in this area will be removed and infrastructure such as roads and buildings will be constructed, reducing the environmental value of this area.

5.2.1 Qualitative assessment

The PFAS NEMP (HEPA, 2020) sources the Tier 1 screening level for PFOS in soil (0.01 mg/kg) from the Canadian Council of Ministers of the Environment (CCME, 2021) *Scientific criteria document for the development of the Canadian soil and groundwater quality guidelines for the protection of environmental and human health: perfluorooctane sulfonate (PFOS)*. CCME (2021) derived soil quality guidelines for various mammalian and avian receptors, including primary, secondary, and tertiary consumers. These guidelines were based on PFAS intake calculations across multiple exposure pathways: consumption of PFAS-contaminated food, direct soil ingestion, dermal contact, contaminated drinking water, and inhalation of dust. An area use factor of 1 was adopted, assuming species spend their entire lives in the PFAS impacted area. No criteria were derived for PFOA and PFHxS.

CCME (2021) used the calculated PFAS intakes and a tolerable daily intake (TDI) for mammals and birds of 0.0011 mg/kg bw/day and 0.0077 mg/kg bw/day respectively to derive soil quality guidelines for a range of terrestrial receptor groups. The lowest guideline (0.01 mg/kg) was derived on the basis of the PFAS intakes estimated for insectivorous mammals.

A summary of the soil quality guidelines calculated by CCME (2021) for other receptor groups is provided in Table 5.3.

Table 5.3 Summary of soil quality guidelines derived by CCME (2021) for primary, secondary, and tertiary consumers

Receptor group	Species	Feeding guild	Diet	CCME PFOS soil quality guideline (mg/kg)	Maximum soil PFOS+PFHxS concentrations (mg/kg)
Primary consumers	Meadow vole (*Microtus pennsylvanicus)*	Herbivorous mammal	Plants	2.2	**Zone 1 (vegetated boundary locations):** 0.11[a] **Zone 2a**: 0.066 **Zone 2b**: 0.014 **Zone 2c**: 0.22 **Zone 3**: 0.0098
	Rock dove (*Columba livia*)	Herbivorous bird	Plants	6.2	
Secondary consumers	Common (masked) shrew (*Sorex araneus*)	Insectivorous mammal	2.5% plants, 95% invertebrates, 2.5% small mammals	0.01	
	Deer mouse (*Peromyscus maniculatus*)	Omnivorous mammal	50% plant, 50% invertebrates	0.17	
	American robin (*Turdus migratorius*)	Omnivorous bird	60% plants, 40% invertebrates	0.33	
Tertiary consumers	Wolf (*Canis lupus*)	Carnivorous mammal	Mammals	2.6	
	Red fox (*Vulpes vulpes*)	Omnivorous mammal	15% plants, 25% invertebrates, 60% mammals and birds	0.63	

Notes

[a] This concentration excludes soil samples collected beneath paved areas as they are not accessible to receptors and sampling point SS01 and BH04 as discussed in Section 5.2.

The strip of land (~10 m wide) along the boundary of the site and the Buffer Area contains remnant eucalyptus trees, with acacia, shrubland and grassland understorey, which may be used by small avian and reptilian fauna. Following the completion of the Renewal SA development, open spaces and residential gardens may also be used by small avian and reptilian fauna. The highest PFOS+PFHxS concentration reported in the vegetated area around the boundary of the site (0.11 mg/kg) was below the guidelines for primary and tertiary consumers and omnivorous birds, which are most relevant to these receptor groups, which is indicative of low-risk.

The maximum concentrations of PFOS+PFHxS detected in the soil in the vegetated area around the site's boundary were above the CCME (2021) guidelines for insectivorous mammals. The indicator species used in these calculations was:

– The common shrew (*Sorex araneus*), which is a small (< 20 g) mammal typically found in Canadian scrubland, grassland, and deciduous woodlands. The diet of this species consists primarily of insects and other invertebrates. They have a relatively high dietary requirement due to the combination of their small body weight, the cold Canadian climate and a lifecycle that does not include winter hibernation.

Native species filling a similar ecological niche in the Oakden region, as identified via desktop receptor identification searches (Appendix G), include:

– Yellow-footed antechinus (*Antechinus flavipes*)
– Red-tailed phascogale (*Phascogale calura*)

These small (<100 g) insectivorous marsupials prefer scrubby habitats with low ground cover and shelter (e.g., dry forests and eucalypt woodlands). Given the use of the site in support of firefighting activities, the construction underway in the Development Area and the urbanised site setting, there are significant limitations to the suitability of the habitat provided by the site and Buffer Area for small insectivorous mammals. The PFAS NEMP (HEPA, 2020) criterion for ecological indirect exposure to PFOS is of limited relevance in this setting, and the exceedances of these values are not indicative of a likely ecological risk, particularly given the intensive residual development underway for Zone 3 (and possibly Zone 2).

CCME (2021) does not provide guidelines relevant to reptiles, but the PFOA concentrations in exposed surface soil were below the criterion provided in the draft PFAS NEMP (HEPA, 2022) for direct exposure to reptiles.

Overall, the available lines of evidence do not suggest that the PFAS concentrations that have been identified in exposed surface soils in the area surrounding the site are likely to adversely affect terrestrial organisms that may inhabit the area.

5.2.2 Additional quantitative assessment for koalas

Observations made during the fieldwork indicate that a population of koalas (*Phascolarctos cinereus*) uses the Investigation Area, including the vegetated areas immediately surrounding the site. Koalas are mammalian primary consumers that feed mainly on Eucalyptus leaves.

A review of the soil dataset collected from Zone 1, 2 and 3, in the context of the CCME (2021) guidelines (refer to Section 5.2.1) does not indicate that PFAS impacts in this area are likely to adversely affect koalas. However, the DSI and Supplementary DSI identified PFAS, particularly PFOS and PFHxS, in eucalyptus tree leaves and trunks and in grass samples collected across the site and Development Area. To date, Australian regulators have not endorsed screening levels for the Tier 1 assessment of PFAS in terrestrial plants; therefore, further assessment of the implications of these detections for koalas has been undertaken for completeness.

A quantitative model has been used to estimate the intake of PFOS+PFHxS by koalas. The food web modelling approach includes defining an appropriate toxicity reference value (TRV), estimating PFOS+PFHxS intake and comparing the TRV with the exposure estimates, with each of these steps discussed herein.

It is noted that this assessment is only relevant if MFS retains the Buffer Area. If the Buffer Area is redeveloped, most residual trees in this area will be removed, and the area will not be suitable for koalas.

Ecotoxicity assessment

A TRV is the dose of a chemical (in mg/kg/day) that will not cause adverse effects to an ecological receptor group associated with chronic exposure. In this ERA, TRVs have been used to evaluate the risk associated with daily dosage estimates derived using exposure modelling. Appendix H provides a detailed ecotoxicity assessment for koalas and identifies the most appropriate TRV. The TRVs adopted in this ERA are summarised in Table 5.4.

Table 5.4 TRVs adopted in the ERA for koalas

Chemical	Receptor group	Toxicity Reference Values (TRV) – NOAEL	Toxicity Reference Values (TRV) – LOAEL	Reference
PFOS+PFHxS	Mammals (koalas)	0.1 mg/kg/day	0.2 mg/kg/day	FSANZ (2017); Conder *et al.* (2020)

Exposure assessment

The exposure assessment produces estimates of the PFAS exposure that may be experienced by the identified ecological receptors (NEPC, 1999). The key elements of the exposure assessment can be summarised as follows:

– *Food chain modelling methodology*: Exposure assumptions appropriate to koalas have been used to estimate the PFOS+PFHxS exposures that may be experienced by koalas foraging within the vegetated area around the boundary of the site. While some uncertainty is associated with this approach, it has been used to provide an understanding of the potential risk level. The food chain modelling equations are presented in Appendix I.

– *Exposure Parameters*: The exposure parameters for koalas are also summarised in Appendix I. Exposure parameters include ingestion rates for food, soil and water, the type and proportion of each dietary item and home range. Generally, the exposure parameters were sourced from the scientific literature. For parameters not available in literature sources, exposure parameters were derived from literature published for other similar species. In the absence of values from the literature, conservative assumptions have been made using professional judgment.

– *Home range and area use*: The area use factor (AUF) is the food web modelling input that describes the percentage of time spent by indicator species (i.e., koalas) within the ecological assessment zone (i.e., the site and Development Area). An AUF of 0.2 has been adopted in this ERA based on the following:

  - Koalas have a natural home range of approximately 1 to 1.5 hectares (DEW, 2024). However, in urban areas, the shape and size of their home ranges will usually be larger as koalas may be forced to move

between separated vegetated areas via ecological corridors. Urban habitat fragmentation appears to be present in the Investigation Area and will be exacerbated by the Renewal SA development.

- Desley *et al.* (2020) conducted a study in the Mornington Peninsula, Victoria, examining koala habitat use and movements within an urbanised area. Their findings revealed koala home ranges of 9.1 hectares for males and 4.3 hectares for females, with koalas showing frequent movement over short distances (69 meters for males and 50 meters for females).
- The vegetated area around the boundary of the site, where PFAS has been identified, is approximately 1 hectare in size.

– *Bioavailability*: The ASC NEPM (NEPC, 1999) defines bioavailability as the proportion of the intake of a substance that is absorbed into the body. 'Bioavailability' can be separated into two distinct elements:

1. The ability of the substance to be liberated from a medium (e.g., plant or meat) within the gut or lung – often referred to as bio-accessibility.
2. The ability of the substance to enter the bloodstream and be taken up by the body's organs once it has entered the lung or gut – this is often referred to as bioavailability (NEPC, 2013).

The toxicity data derived from experiments involving direct oral administration of PFAS to an animal intrinsically incorporates bioavailability, as defined in Point 2 above. There has been limited research into the bioaccessibility of PFAS in different media, and therefore, a conservative assumption of 100% bioaccessibility has been adopted for this assessment.

– *Exposure point concentrations (EPC)*: EPC represent the contaminant concentrations in media used in the risk characterisation process to estimate exposure for key ecological receptor groups. The EPC used in the exposure assessment are summarised in Appendix I and are as follows:

- The maximum concentration of PFOS+PFHxS measured in tree leaves (see Section 3.2.3) has been used to evaluate indirect (food chain) exposures as a conservative approach.
- The maximum concentrations of PFOS+PFHxS measured in soil samples collected in the vegetated area around the boundary of the site and Buffer Area (0.22 mg/kg) have been used to evaluate direct exposures as a conservative approach.
- The grass sample BIO4_GRASS was excluded from the EPC because koalas do not feed on grass, and the PFOS concentration in this sample was one order of magnitude higher than in Eucalyptus leaves. This data point has, however, been incorporated in the sensitivity analysis (Section 5.3). Similarly, results for tree trunk and branch samples were excluded from the EPC, as PFAS were either not detected in these biota samples or detected at concentrations lower than in leaf samples.
- Koalas generally do not need to drink water, as they obtain sufficient liquids from Eucalyptus leaves (DEW, 2024). Therefore, the model excluded exposure to PFAS via consumption of surface water.

Risk characterisation

In the ecological risk characterisation process, the toxicity and exposure assessment results are combined to estimate the potential risks to koalas inhabiting the site and Development Area. PFOS and PFHxS have been identified in most plant biota samples collected from within the site and Development Area. To evaluate whether these impacts could represent a risk to primary consumers feeding within the Investigation Area, the TRVs detailed above were compared with the estimated PFAS intake rates, as follows:

– The ratio of the estimated PFAS intake to the PFAS TRV was calculated for each exposure pathway (i.e., soil ingestion and consumption of tree leaves). This ratio is termed a Hazard Quotient (HQ).

– All HQs were summed to derive an overall Hazard Index (HI).

Calculations are provided in Appendix I.

A degree of conservatism is built into the ecotoxicity and exposure assessment processes, and therefore, the risk characterisation process has considered both the HI_{NOAEL} and HI_{LOAEL} values, as follows:

– NOAEL HI ≤ 1: Indicates an exposure scenario with a low risk of chronic adverse effects to koalas.

– NOAEL HI >1 and LOAEL HI ≤1: Indicates a scenario where the PFAS intakes estimated for koalas exceed that at which no adverse chronic effects have been measured. The magnitude of any adverse effects cannot be reliably estimated, and therefore, there is a moderate risk of chronic adverse effects for koalas.
– LOAEL HI >1: Indicates a scenario where the PFAS intakes estimated for koalas exceed that at which adverse chronic effects have been measured. It is, therefore, plausible that koalas could experience measurable chronic adverse effects (e.g., growth, reproduction, or development) and the risk is classified as high.

Table 5.5 summarises the risk characterisation outcomes for koalas within the site and Development Area.

Table 5.5 Summary of ecological risk characterisation results for food chain exposures

Exposure pathway	HI_{NOAEL}	HI_{LOAEL}
Total HI	**0.03**	**0.01**

Table 5.5 shows that the PFOS+PFHxS HI_{NOAEL} calculated for koalas is less than 1. This indicates that the presence of PFAS in the soil and plants in the vegetated area around the site's boundary poses a **low risk to koalas**. This outcome aligns with the assessment undertaken in Section 5.2.1, based on the CCME (2021) criteria.

5.3 ERA for aquatic environments (Zone 4)

This section provides a qualitative assessment of food chain exposure risks to higher trophic level organisms inhabiting Dry Creek. No biota data is available to support a quantitative assessment. As discussed in Section 5.1, the open channel/swale connecting the stormwater drainage system to Dry Creek does not provide structural habitats for aquatic and semi-aquatic species, and, therefore, it is not further assessed in this ERA.

A detailed description of Dry Creek is provided in Appendix G. As outlined in Section 5.1, the organisms that may be exposed to PFAS within Dry Creek include terrestrial birds that consume aquatic organisms (e.g. kookaburras), waterbirds (e.g. white-faced heron), semi-aquatic mammals (e.g. water rats), reptiles (e.g. turtles) and amphibians.

5.3.1 Weight of evidence assessment

The weight of evidence process involves evaluating qualitative, semi-quantitative, or quantitative evidence to assess the quality of an aquatic system (ANZG, 2018). It requires assessing the data's quality, quantity, relevance, and congruence from various sources.

The PFOS+PFHxS concentrations measured in the nine surface water samples collected from five locations along Dry Creek under both dry and wet conditions ranged between 0.0031 and 0.022 µg/L and exceeded the PFOS criterion for protecting 99% of species of 0.00023 µg/L. However, a clear distinction is not apparent in the dataset between the PFAS concentrations in Dry Creek upstream and downstream of the swale drain, as illustrated in Table 5.6. Overall, the water samples collected to date do not suggest that the stormwater discharges from the site are materially changing the PFAS concentrations in Dry Creek relative to those related to other sources.

Table 5.6 Summary of PFAS results in surface water samples

Location		Sum of PFHxS and PFOS (µg/L)			PFAS (Sum of Total) (µg/L)		
		Mar-24	Apr-24	May-24	Mar-24	Apr-24	May-24
SW_ DISCHARGE	Stormwater discharge from site	0.02	0.15	0.71	0.068	0.35	1.158
SW06	Stormwater, cross-gradient of site	-	-	0.0031	-	-	0.010
SW01	Swale drain, downstream from site	0.116	-	-	0.331	-	-
SW07		-	-	0.036	-	-	0.07
SW02	Dry Creek, upstream of the swale drain	0.021	-	0.011	0.051	-	0.044
SW05		-	0.012	0.009	-	0.0798	0.025
SW03	Dry Creek, downstream of swale drain	0.016	-	0.010	0.053	-	0.038
SW04		0.022	-	0.010	0.092	-	0.042

There is limited information available about the PFAS background concentrations in South Australia. However, according to the draft PFAS NEMP 3.0 (HEPA, 2022), the levels of PFAS in the environment will likely vary depending on the type and intensity of land use. The PFOS concentrations identified via the ambient sampling programs undertaken in Victoria and Queensland, as detailed in the draft PFAS NEMP 3.0, are summarised in Table 5.7.

Table 5.7 Summary of ambient monitoring undertaken in Victoria and Queensland (HEPA, 2022)

Catchment land use	Victorian sampling program outcomes		Queensland sampling program outcomes	
	Range of PFOS concentrations (µg/L)	Sites with PFOS detections (%)	Range of PFOS concentrations (µg/L)	Sites with PFOS detections (%)
Remote (>85%)	<0.0002 to 0.0002	20%	<0.0001 to 0.0001	11%
Agricultural (>60%)	<0.0002 to 0.009	75%	<0.0001 to 0.0011	53%
Urban (>40-50%)	0.0007 to 0.081	100%	<0.0001 to 0.037	83%

The data presented in Table 5.7 demonstrate that while PFAS are man-made chemicals, due to the diversity of purposes they have been used (refer to Section 1.4), they are often present in aquatic environments in urban areas. The samples collected within Dry Creek have demonstrated measurable PFOS and PFHxS concentrations that align with those reported in other urban catchments across Australia, with these comparisons highlighting the limited value of the PFAS NEMP 99% species protection value for PFOS in urban settings, where PFAS is ubiquitous:

It is also noted that while the PFOS+PFHxS concentrations in Dry Creek (between 0.0031 and 0.022 µg/L) are one to two orders of magnitude above the PFAS NEMP 99% species protection value of 0.00023 µg/L, they are of a similar order of magnitude to the 99% species protection value of 0.0091 µg/L proposed by ANZG (2023)

As outlined in Section 3.2.1, using the 99% species value in the Tier 1 screening assessment of slightly to moderately disturbed waterbodies is a precautionary approach rather than a mechanistic link to food chain exposure risks. Based on the results summarised in Table 5.6, it is likely that some bioaccumulation of PFAS occurs in lower trophic level organisms inhabiting Dry Creek, both upstream and downstream of the site. Near the site, Dry Creek is, however, associated with habitat limitations (e.g. limited passage and connectivity between pools during dry periods, altered flora and fauna communities, nutrient enrichment and degraded riparian environments). These limitations are expected to reduce the suitability of Dry Creek for fish and large aquatic macroinvertebrates, the extent to which birds, aquatic mammals and aquatic reptiles forage in this area and therefore, the extent PFAS biomagnifies in the aquatic food chains, relative to more diverse aquatic environments.

Overall, the available evidence suggests that PFAS discharges from the site are unlikely to be associated with measurable adverse effects on higher trophic-level organisms that may access the Dry Creek area (e.g., waterbirds).

5.4 ERA uncertainty and sensitivity analysis

5.4.1 ERA uncertainty analysis

The uncertainty analysis identifies the data gaps and sources of uncertainty assumptions associated with the ERA. The main areas of uncertainty identified for this assessment include:

– *Scenario uncertainty,* including incomplete information about the habits of ecological receptors.
– *Parameter uncertainty,* including temporal and spatial variability in the PFAS concentration in abiotic and biotic media and the presence of other PFAS.
– *Model uncertainty,* including the use of conservative modelling approaches and assumptions.

The approach to reduce the uncertainty associated with this ERA has been to use site-specific data wherever possible. Soil samples were collected across Zone 1, Zone 2, and Zone 3 to reduce parameter uncertainty, and Zone 4 was subject to sediment and surface water monitoring and multiple upstream and downstream locations. The Investigation Area was also subject to a desktop receptor identification process and a high-level survey by an ecologist.

– When site-specific exposure parameters were not available, conservative assumptions were selected from the published literature, including the following:
– The use of the maximum PFOS+PFHxS concentrations measured in each area in the risk characterisation process.
– The use of ecotoxicological data (WQG and TRV) is intended to be well below any threshold for measurable adverse effects.
– The general use of conservative food chain modelling approaches for koalas

Given the factors outlined above, the uncertainty in this assessment has been generally taken into account by erring on the side of the overestimating of potential ecological risks.

Throughout the risk characterisation process, several specific areas of uncertainty and data gaps with the potential to influence the outcomes of the ERA are discussed in the sensitivity analysis (Section 5.4.2).

5.4.2 ERA sensitivity analysis

Temporal and spatial adequacy

While seasonality is captured to a certain extent in the dataset, there are limitations to the dataset regarding evaluating the impact of variability in surface water flow on the flux of PFAS through the Investigation Area, both from the site and the wider catchment. Given that stormwater flow is the primary mechanism via which PFAS migrates from the site into Dry Creek, during periods where there is an increase in the flow of stormwater from the site into Dry Creek, there could likely be short-term increases in the flux of PFAS through the Investigation Area. Similarly, PFAS flux through the Investigation Area, resulting from stormwater inputs across the wider catchment, will also increase during wet weather events.

GHD investigations involved surface water sampling under dry (nearly stagnant) and wet (flowing) conditions. Worst-case scenario, PFAS concentrations in stormwater outflow from the site were artificially generated at the site using hydrants during dry weather. Notably, PFAS concentrations in stormwater leaving the site during rainfall events were similar. PFAS concentrations in Dry Creek downstream of the site were comparable to those measured upstream and below the 95% species protection values.

In this ERA, the highest PFOS+PFHxS concentrations were used in the Tier 1 screening assessment and as the EPCs in the food chain modelling, indicating low risks for ecological receptors.

The spatial distribution of sampling locations is considered appropriate, as surface water samples were collected at the discharge point and upstream and downstream of the site, providing consistent results.

The dataset's limitations are unlikely to significantly change the ERA outcomes. Overall, the dataset is considered adequate from both a temporal and spatial perspective.

Presence of other PFAS

This ERA focuses on PFOS, PFHxS and PFOA, which are the PFAS with Australian guidelines. Various PFAS other than PFOS and PFHxS have been identified in soil, surface water and biota. Consideration has also been given to the presence of PFAS other than PFOS+PFHxS within the Investigation Area.

The concentration of total PFAS in surface water samples collected from Dry Creek was lower than the PFAS NEMP (HEPA, 2020) 95% species protection value. Hence, the presence of other PFAS would not change the outcomes of the Tier 1 ERA.

Limited ecological survey data

While laboratory toxicity studies and food chain models are useful in inferring the effects of exposure, they may not accurately quantify area-specific population-level effects. Detailed ecological surveys or studies were not undertaken as a component of this ERA, and investigation area data on the structure and function of the communities was limited. While this limitation is acknowledged, a study of this complexity was outside the scope of this ERA.

Food chain modelling inputs

Estimating the extent to which koalas foraging within the Investigation Area will be exposed to PFAS is inherently uncertain. For example, estimating exposure parameters such as ingestion rates for PFAS-impacted food and soil is difficult. These factors will vary between individuals (e.g., extent to which individuals forage within a certain area) and over time (e.g., at different phases of the reproductive cycle).

In a sensitivity analysis, key input parameters are varied to determine how these changes influence the risk estimates. Therefore, a sensitivity analysis can help characterise uncertainty and identify the key parameters influencing risk assessment. Ecological risks were recalculated by varying the following parameters:

– Concentrations of PFOS+PFHxS in soil
– Concentrations of PFOS+PFHxS in leaves
– Presence of other PFAS
– The AUF
– Soil ingestion rates
– Food consumption rates
– Ecotoxicity TRV inputs.

Appendix J presents the sensitivity analysis results for the variables listed above, including an evaluation of the sensitivity of the ERA outcomes to each key variable. The sensitivity analysis demonstrated that the report outcomes are relatively insensitive to the key areas of uncertainty identified in Section 5.3. Across the range of input parameters evaluated, the ERA outcomes did not change.

6. Summary of Outcomes

This Report provides a HHERA for PFAS identified in the following key zones at the MFS Oakden site:

– **Zone 1** – The site.

– **Zone 2** – The Buffer Area that may be considered for retention by MFS, including three separate strips of land located immediately to the west (Zone 2a), east (Zone 2b), and south (Zone 2c) of the site. Note that MFS may not retain this zone, and it could potentially be developed for residential use.

– **Zone 3** – The remainder of the Development Area.

– **Zone 4** – The receiving environment for the Grand Junction Road stormwater drain, including the drain/swale and Dry Creek.

The HHERA estimates the potential risk to people and the environment from exposure to PFAS.

Table 6.1 summarises the exposure scenarios considered in the HHERA and the conclusions relevant to each scenario.

Table 6.1 HHERA conclusion summary

Receptor	Where?	Exposure pathway	Potential risks	Comments
Human health risks				
MFS personnel	The MFS site (Zone 1)	Incidental ingestion or inhalation of soil, dust, groundwater, and surface water	Low	The PFAS concentrations measured in on-site soil and surface water runoff were below the site-specific HILs and the NHMRC (2019) recreational screening levels. Several lines of evidence indicate low exposure risks to PFAS associated with MFS personnel. Groundwater on-site reported PFAS concentrations above the NHMRC (2019) recreational screening levels, but groundwater is not extracted, and the opportunities to encounter groundwater are limited.
	Buffer Area (Zone 2)	Incidental ingestion or inhalation of soil, dust, and groundwater	Low	The PFAS concentrations measured in soil and groundwater within the Buffer Area (Zone 2) were below site-specific HILs and the NHMRC (2019) recreational criteria screening levels, respectively.
Future residents of the Development Area	Zone 2a and 2b	Incidental ingestion or inhalation of soil/dust. Consumption of homegrown fruit and vegetables	Low	Concentrations of PFOS+ PFHxS detected in soil samples collected from Zone 2 exceeded the PFAS NEMP A for low-density residential use. A Tier 2 HHRA was conducted. Site-specific quantitative modelling shows that the PFAS concentrations in soil and groundwater within Zones 2a and 2b pose a low risk to future residential users of the site.
	Zone 2c	Incidental ingestion or inhalation of soil/dust.	Low	The PFAS concentrations measured in the soil in Zone 2c were below the PFAS NEMP HIL B for medium-density residential use with minimal opportunities for soil access.
	Zone 3	Incidental ingestion or inhalation of soil/dust. Consumption of homegrown fruit and vegetables	Low	Concentrations of PFAS in soil samples were lower than the PFAS NEMP HIL A for low-density residential use with garden/accessible soil.

Maintenance and construction workers	The MFS site (Zone 1)	Incidental ingestion or inhalation of soil/dust.	Low	At the MFS site, maintenance and construction workers' contact with PFAS in soil is generally low. Contact can be reduced further by implementing appropriate occupational health and safety protocols when carrying out intrusive work in PFAS-affected areas.
	Buffer Area (Zone 2)		Low	The PFAS NEMP does not provide assessment criteria specific to construction and maintenance workers. Quantitative modelling shows that the PFAS concentrations in soil within Zone 2 pose a low risk to maintenance and construction workers.
	Zone 3		Low	PFAS was not detected in most samples. Where detected, PFAS concentrations in soil samples were lower than the PFAS NEMP HIL A, the most protective Tier 1 screening criteria.
Recreational users of Dry Creek	Dry Creek	Incidental ingestion or inhalation of sediment and surface water.	Low	PFAS concentrations in sediment and surface water were below the PFAS HIL C and the NHMRC (2019) screening levels for recreational use, respectively.
Ecological risks				
Terrestrial organisms	The site (Zone 1) and Buffer Area (Zone 2)	Soil direct ingestion and uptake	Low	Two out of 152 soil samples exceeded the PFAS NEMP ecological criterion for direct exposure to PFAS in soil. A weight of evidence assessment indicated low risks to ecological receptors via direct contact.
		Soil indirect exposure (food chain)	Low	The soil samples collected from Zones 1, 2a, 2b, and 2c reported PFAS concentrations above the PFAS NEMP indirect exposure screening criteria for secondary consumers. A Tier 2 ERA was carried out. A detailed review of the methodology used to derive the PFAS NEMP (HEPA, 2020) ecological indirect exposure criterion in soil indicates that the PFOS concentrations measured in the Development Area soil pose low risks to secondary and tertiary consumers through both direct and indirect exposure pathways. PFAS were detected in eucalyptus tree leaves, trunk, and grass samples collected from the site and Development Area. Quantitative exposure modelling indicated that the PFAS concentrations measured in soil and eucalyptus leaves represent a low risk to koalas.
	Zone 3	Soil direct ingestion and uptake and soil indirect exposure (food chain)	Low	The soil samples collected from Zone 3 reported PFAS concentrations lower than the PFAS NEMP direct and indirect exposure screening criteria.
Aquatic and semi-aquatic organisms	Dry Creek	Direct ingestion and uptake of surface water and sediment	Low	All surface water samples had PFAS concentrations below the PFAS NEMP WQG for the protection of 95% of species, and PFAS were not detected in sediments.
		Indirect exposure to contaminated surface water through the food chain	Low	All surface water samples reported PFAS concentrations above the PFAS NEMP WQG for the protection of 99% of species. A Tier 2 ERA was conducted. The qualitative ERA for higher trophic-level aquatic organisms suggests that the presence of PFAS in Dry Creek surface water is unlikely to have measurable adverse effects on higher trophic-level organisms (e.g., waterbirds).

Overall, the HHERA indicates that:

– Zones 2a, 2b and 3 of the Buffer Area are suitable for the proposed low-density residential use (unrestricted).
– Zone 2c of the Buffer Area is suitable for the proposed medium-density residential use (e.g., town home).
– Zones 2a, 2b, and 2c of the Buffer Area are suitable to be acquired and used by MFS.

– The presence of PFAS within the Investigation Area is unlikely to have measurable adverse effects on the environment.

The weight of available evidence suggests that the removal of vegetation in the Development Area is unlikely to significantly impact the migration of PFAS in shallow groundwater. Adding more trees, especially to the west and downstream of the site, along with removing the PFAS source, is likely to limit the movement of PFAS in the shallow groundwater system identified beneath the site.

The key data gaps, uncertainties, and limitations associated with the HHERA are:

– The potential for impacts to extend to the Q1 aquifer has not been confirmed via intrusive investigations; however, the existing geological data suggests that the groundwater impacts are unlikely to seep vertically into the Q1 aquifer due to a clay confining layer.
– Seasonal effects on the shallow groundwater system are still being assessed.
– There is uncertainty surrounding the temporal variability in the flux of PFAS from the MFS site via surface water into the Dry Creek. However, the available dataset covers different weather conditions and indicates that the MFS is a minor contributor to the ambient PFAS impacts in Dry Creek.

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Appendices

Appendix A

Figures

Data Disclaimer

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Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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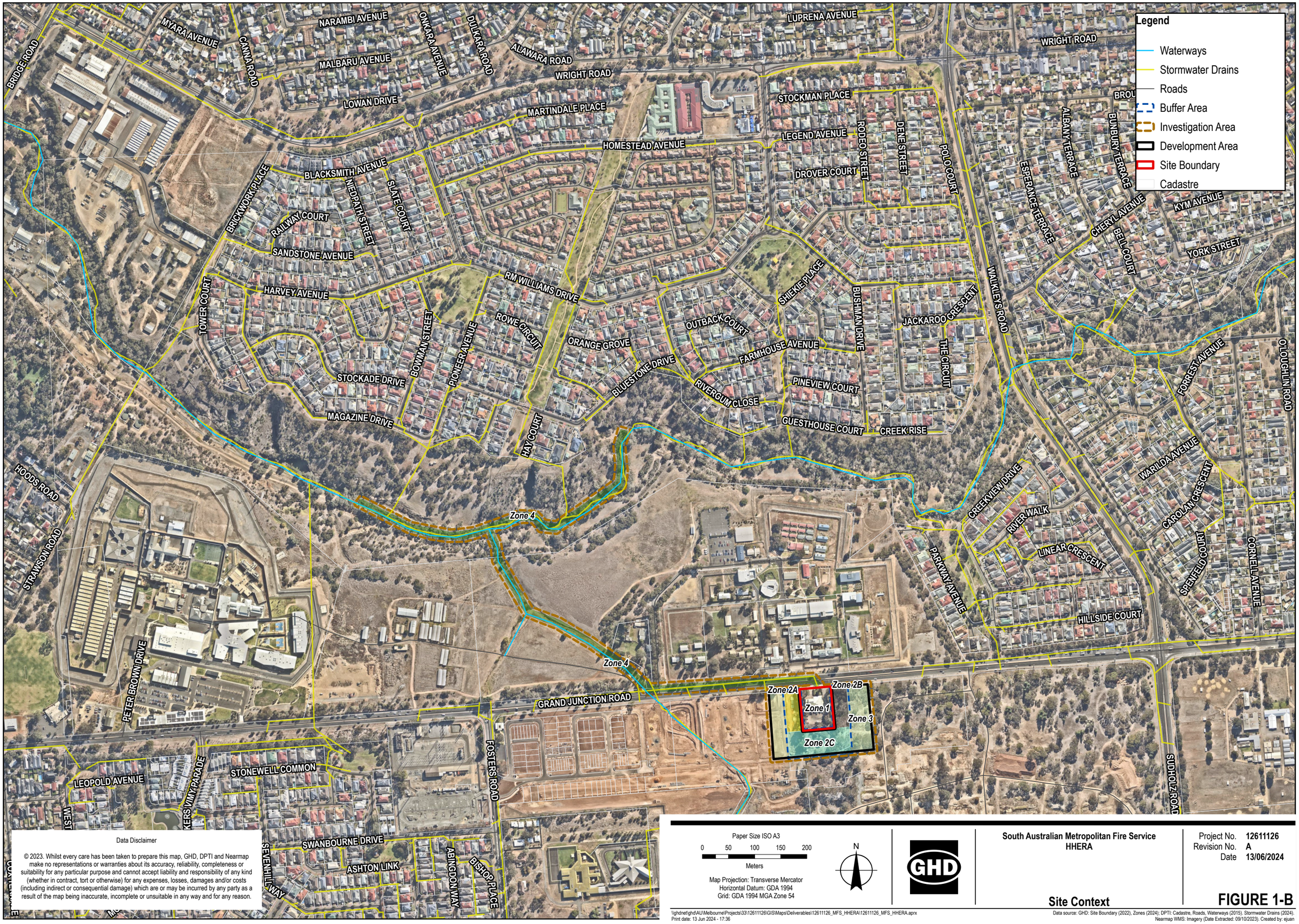
Investigation Area Location Plan

Project No. **12611126**
Revision No. **A**
Date **13/06/2024**

FIGURE 1

\\ghdnet\ghd\AU\Melbourne\Projects\33\12611126\GIS\Maps\Deliverables\12611126_MFS_HHERA\12611126_MFS_HHERA.aprx
Print date: 13 Jun 2024 - 17:31

Data source: GHD: Site Boundary (2022), Zones (2024); DPTI: Cadastre, Roads, Waterways (2015). Stormwater Drains (2024). Nearmap WMS: Imagery (Date Extracted: 09/10/2023). Created by: ejuan



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Paper Size ISO A3

0 50 100 150 200

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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Project No. **12611126**
Revision No. **A**
Date **13/06/2024**

Site Context

FIGURE 1-B

\\ghdnet\ghd\AU\Melbourne\Projects\33\12611126\GIS\Maps\Deliverables\12611126_MFS_HHERA\12611126_MFS_HHERA.aprx
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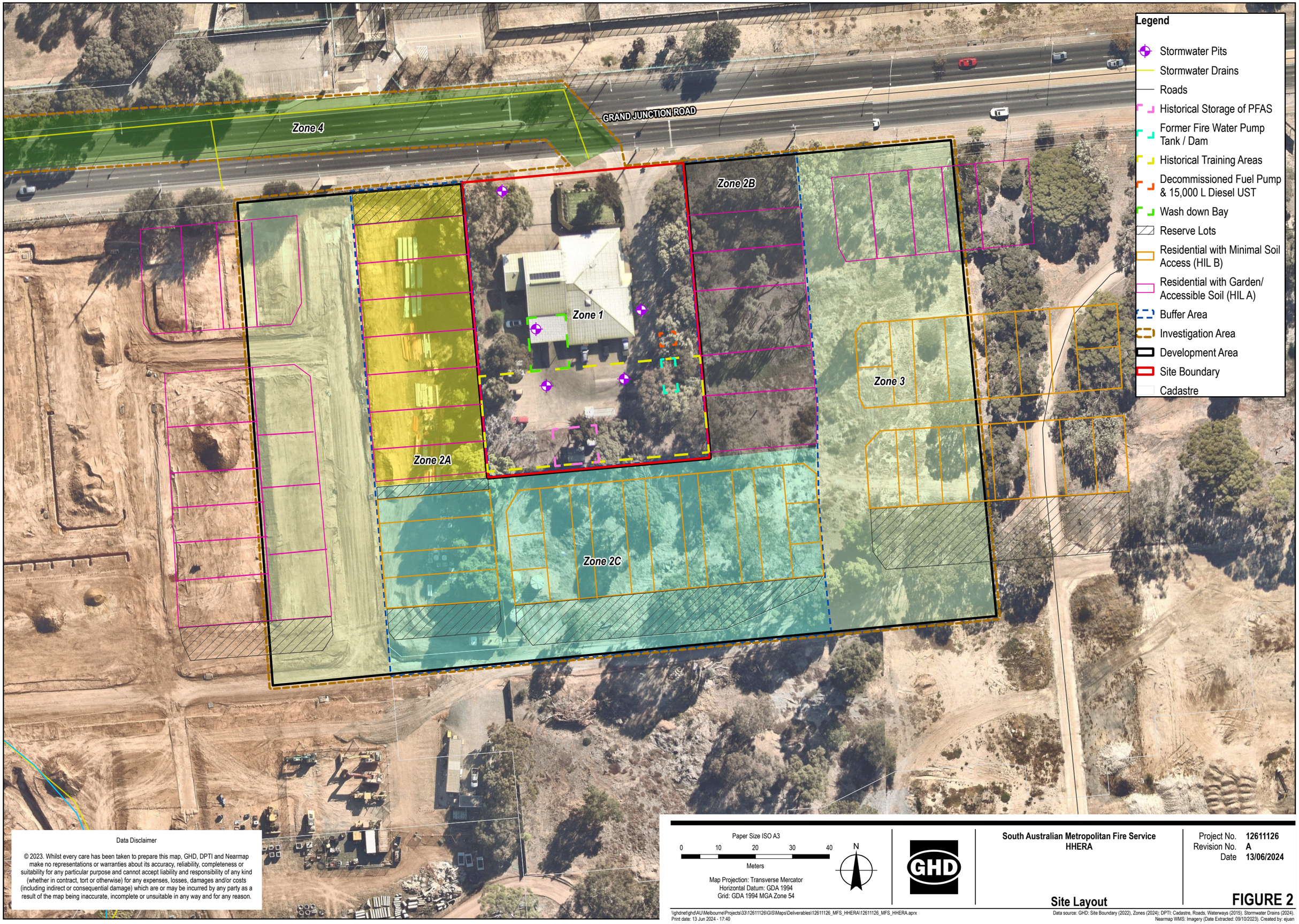

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Paper Size ISO A3

0 10 20 30 40

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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South Australian Metropolitan Fire Service
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Project No. **12611126**
Revision No. **A**
Date **13/06/2024**

Site Layout

FIGURE 2

\\ghdnet\ghd\AU\Melbourne\Projects\33\12611126\GIS\Maps\Deliverables\12611126_MFS_HHERA\12611126_MFS_HHERA.aprx
Print date: 13 Jun 2024 - 17:40

Data source: GHD: Site Boundary (2022), Zones (2024); DPTI: Cadastre, Roads, Waterways (2015). Stormwater Drains (2024). Nearmap WMS: Imagery (Date Extracted: 09/10/2023). Created by: ejuan

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Paper Size ISO A3

0 100 200 300 400 500

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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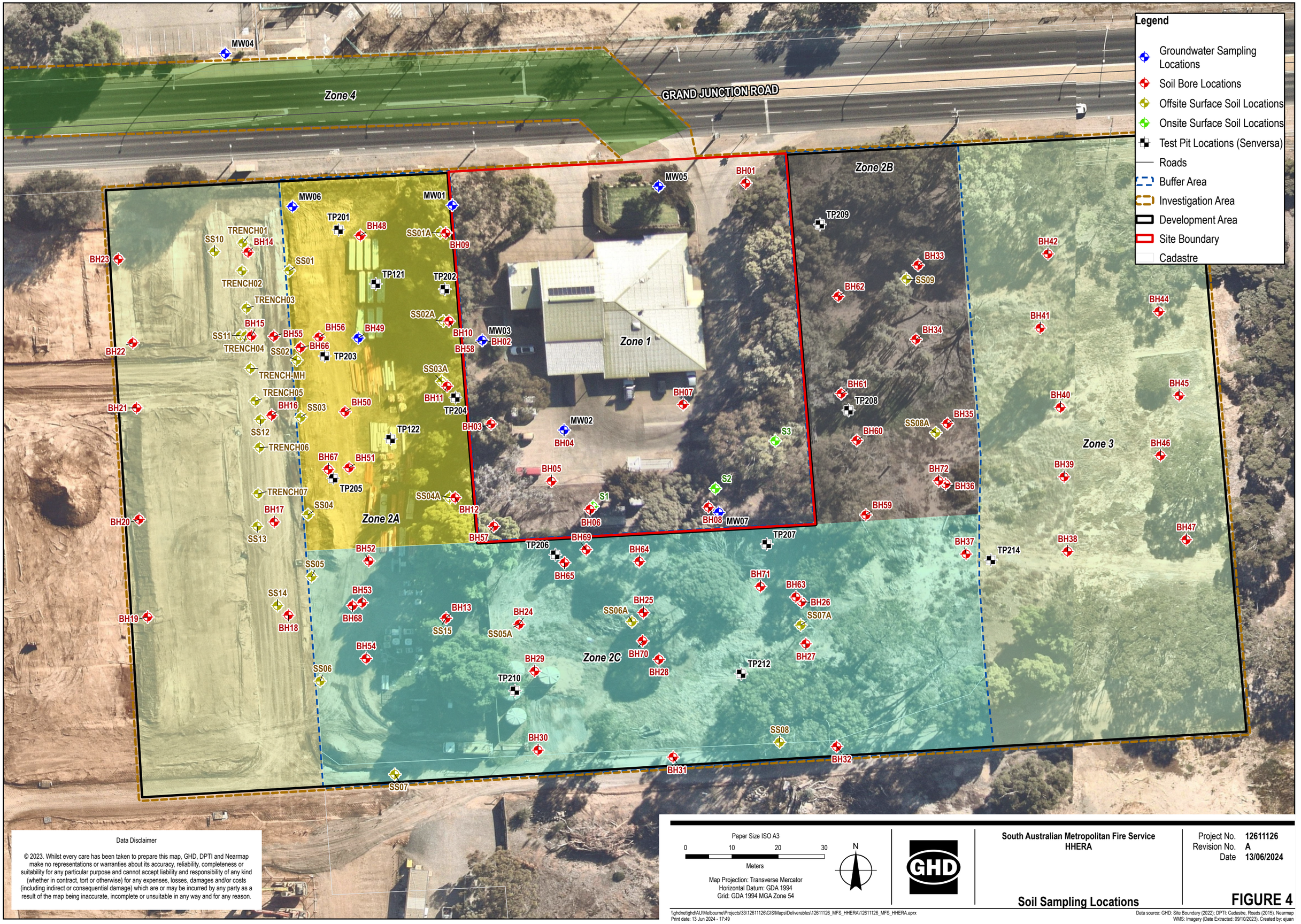
Groundwater Bore Search - 2 km radius from site

Project No. **12611126**
Revision No. **A**
Date **13/06/2024**

FIGURE 3

\\ghdnet\ghd\AU\Melbourne\Projects\33\12611126\GIS\Maps\Deliverables\12611126_MFS_HHERA\12611126_MFS_HHERA.aprx
Print date: 13 Jun 2024 - 17:42

Data source: GHD: Site Boundary (2022), Zones (2024); DPTI: Cadastre, Roads, Waterways (2015). Stormwater Drains (2024). Nearmap WMS: Imagery (Date Extracted: 09/10/2023). Created by: ejuan



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Paper Size ISO A3

0 10 20 30

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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Project No. **12611126**
Revision No. **A**
Date **13/06/2024**

Soil Sampling Locations

FIGURE 4

\\ghdnet\ghd\AU\Melbourne\Projects\33\12611126\GIS\Maps\Deliverables\12611126_MFS_HHERA\12611126_MFS_HHERA.aprx
Print date: 13 Jun 2024 - 17:49

Data source: GHD: Site Boundary (2022); DPTI: Cadastre, Roads (2015). Nearmap WMS: Imagery (Date Extracted: 09/10/2023). Created by: ejuan

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Paper Size ISO A3

0 5 10 15 20

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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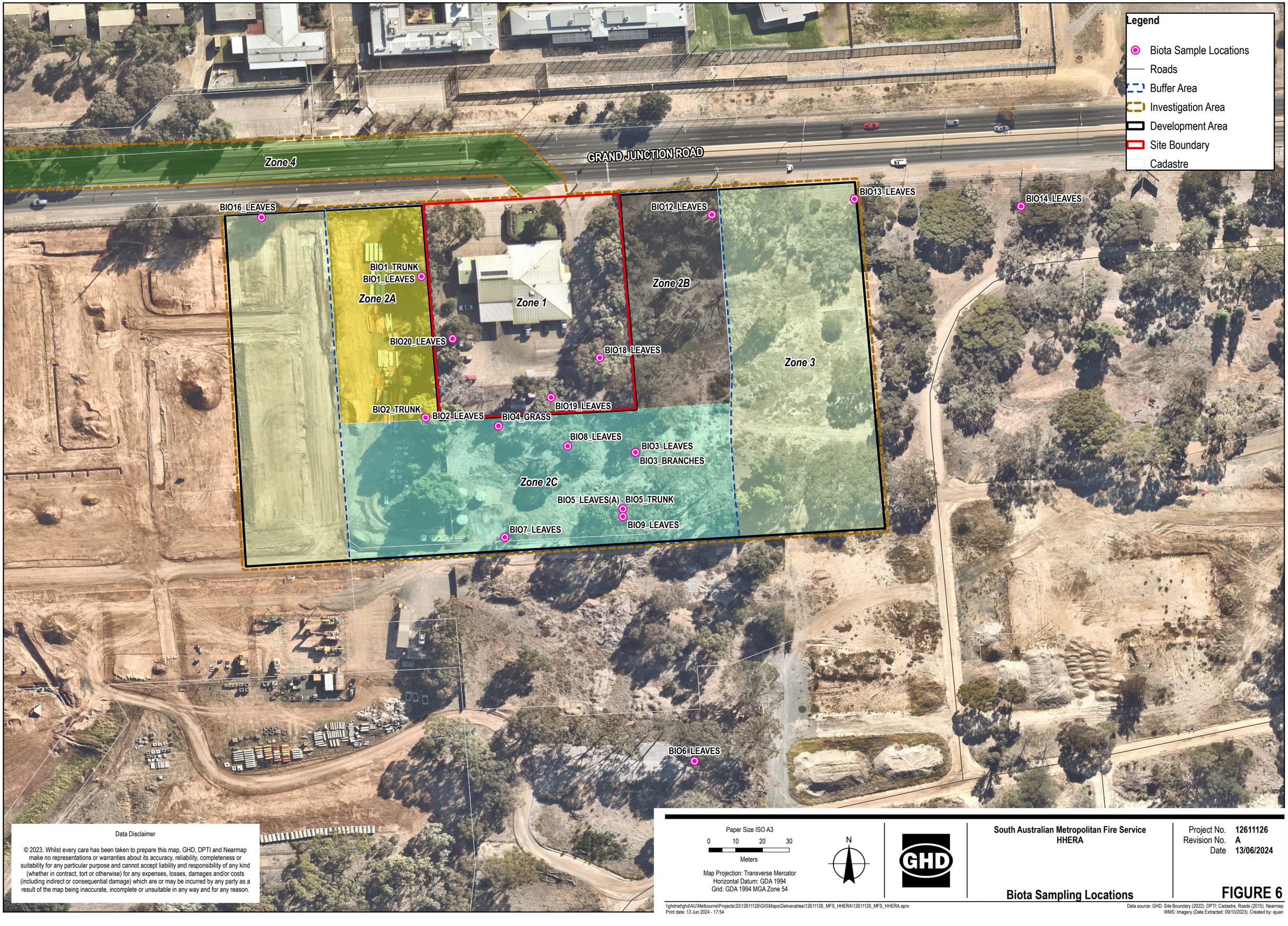
Groundwater Sampling Locations

Project No. **12611126**
Revision No. **A**
Date **13/06/2024**

FIGURE 5

\\ghdnet\ghd\AU\Melbourne\Projects\33\12611126\GIS\Maps\Deliverables\12611126_MFS_HHERA\12611126_MFS_HHERA.aprx
Print date: 13 Jun 2024 - 17:52

Data source: GHD: Site Boundary (2022), Location Samples (2024); DPTI: Cadastre, Roads, Waterways (2015). Stormwater Drains (2024). Nearmap WMS: Imagery (Date Extracted: 09/10/2023). Created by: ejuan



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Paper Size ISO A3

0 10 20 30

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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South Australian Metropolitan Fire Service
HHERA

Project No. 12611126
Revision No. A
Date 13/06/2024

Biota Sampling Locations

FIGURE 6

\\ghdnet\ghd\AU\Melbourne\Projects\33\12611126\GIS\Maps\Deliverables\12611126_MFS_HHERA\12611126_MFS_HHERA.aprx
Print date: 13 Jun 2024 - 17:54

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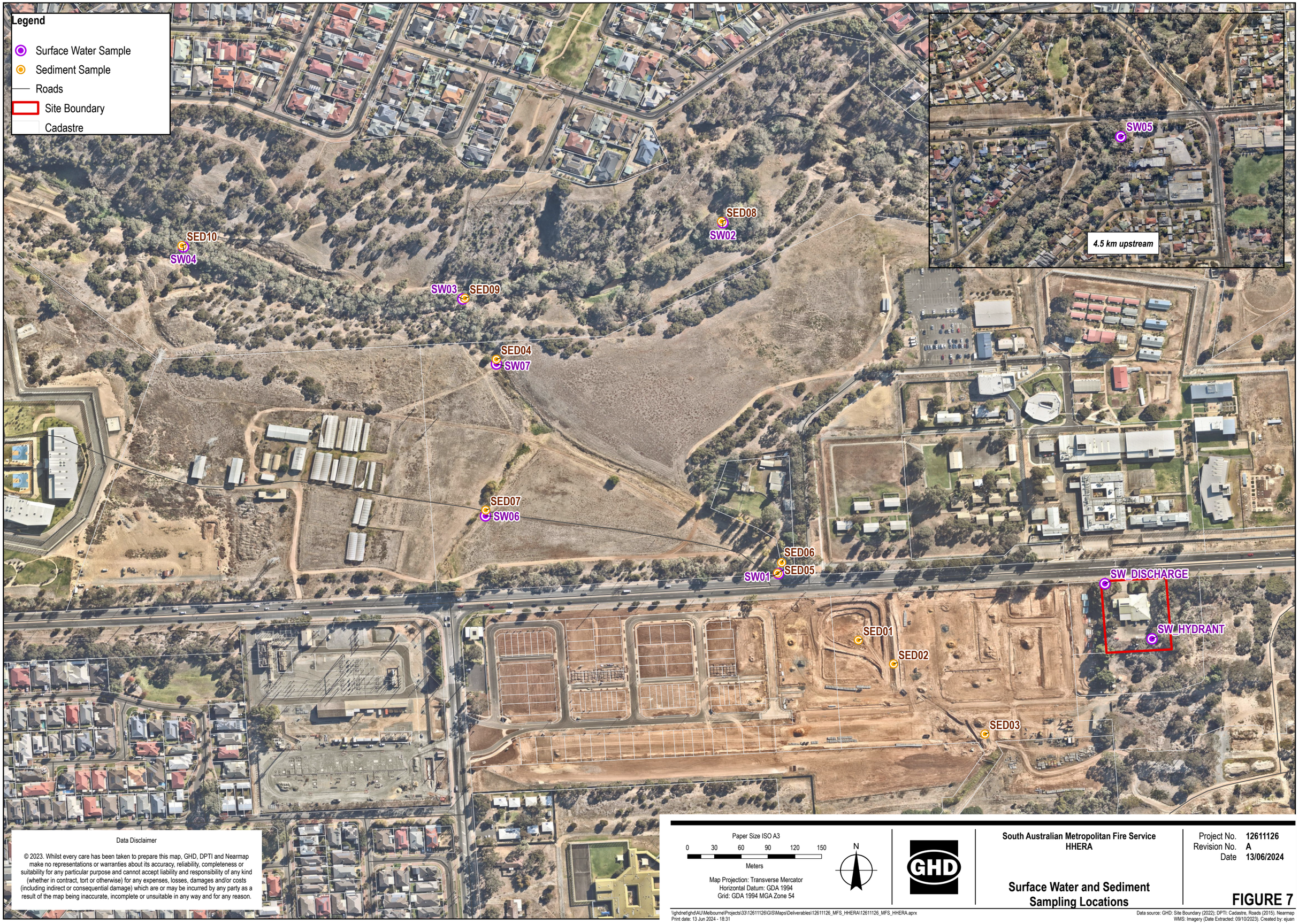

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Paper Size ISO A3

0 30 60 90 120 150

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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South Australian Metropolitan Fire Service
HHERA

Surface Water and Sediment Sampling Locations

Project No. 12611126
Revision No. A
Date 13/06/2024

FIGURE 7

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Print date: 13 Jun 2024 - 18:31

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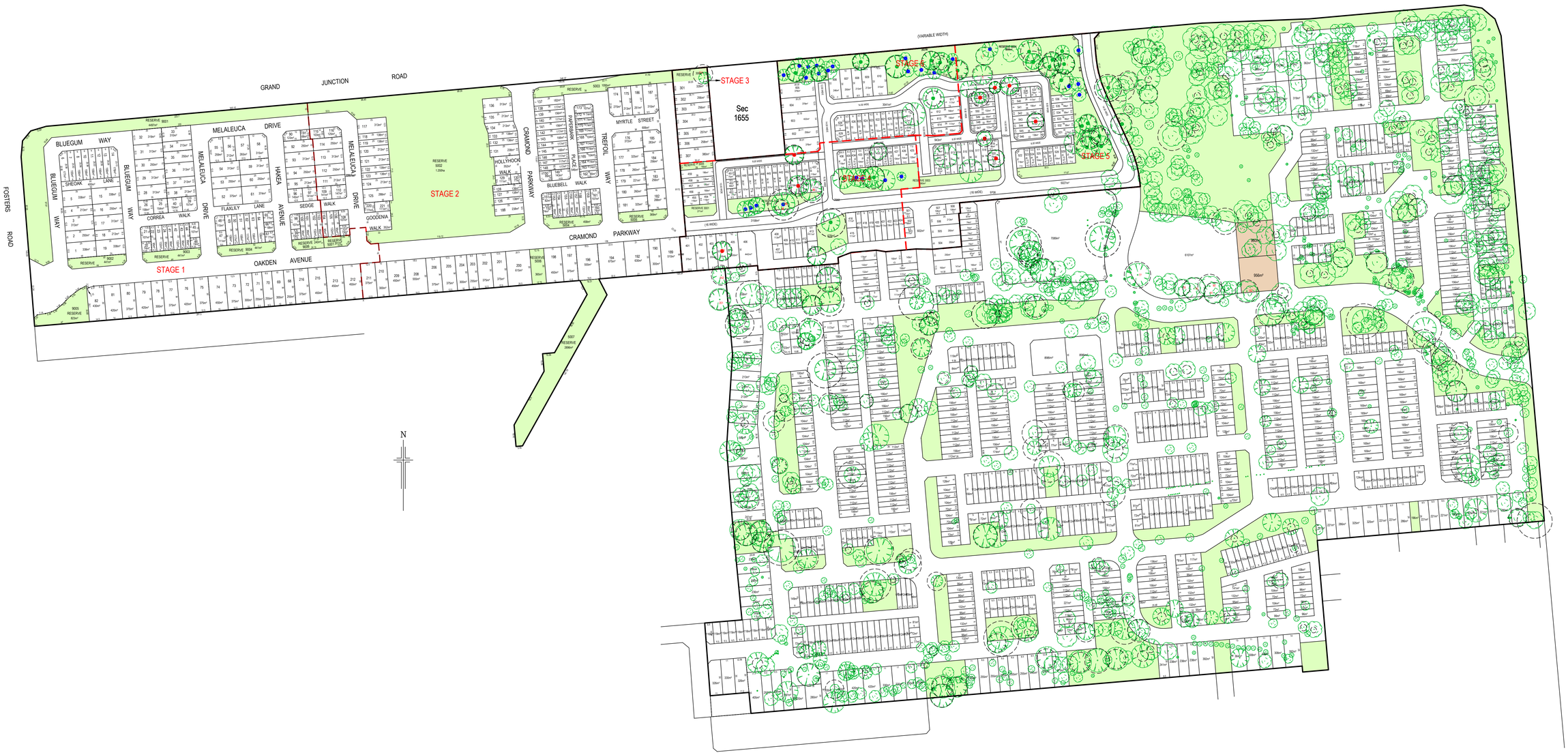

GRAND JUNCTION ROAD
FOSTERS ROAD
STAGE 1
STAGE 2
STAGE 3
STAGE 4
STAGE 5
Sec 1655
BLUEGUM WAY
MELALEUCA DRIVE
HAKEA AVENUE
OAKDEN AVENUE
CRAMOND PARKWAY
MYRTLE STREET
TREFOIL WAY
PAPERBARK PLACE
HOLLYHOCK WALK
BLUEBELL WALK
SEDGE WALK
FLAXLILY LANE
CORREA WALK
SHEOAK LANE
GOODENIA WALK
(VARIABLE WIDTH)
N
0 15 30 60 90 120 150
m
1:1500 @ B1

Appendix B

Consolidated analytical dataset

Table 1a
Consolidated Soil Dataset

						Regulated PFAS				PFAS - Perfluoroalkyl Sulfonic Acids				PFAS - Perfluoroalkyl Carboxylic Acids				PFAS - Perfluoroalkyl Carboxylic Acids				PFAS - Perfluoroalkyl Carboxylic Acids		PFAS - Perfluoroalkyl Sulfonamide		PFAS - Perfluoroalkyl Sulfonamide						PFAS - Perfluoroalkyl Sulfonamide			PFAS - Perfluoroalkyl Sulfonamide	PFAS - Fluorotelomer Sulfonic Acids			PFAS - Fluorotelomer Sulfonic Acids					PFAS - Other
						Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Sum of PFHxS and PFOS	Perfluorooctanoic acid (PFOA)	Perfluoropropanesulfo-nic acid (PFPrS)	Perfluorobutane sulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctane sulfonamide (FOSA)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Sum of 28 EPA PFAS (PFOS + PFOA)*	PFAS (Sum of Total)	Sum of anthesh PFAS (PFHxS + PFOS + PFOA)*	PFAS (Sum of Total)(WA DER List)	Perfluorooctane sulfonate (PFOS)
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						0.0002	0.0002	0.0002	0.0002	0.005	0.0002	0.0002	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0005	0.0005	0.0002	0.0005	0.0005	0.0002	0.0005	0.0005	0.0005	0.0005	0.005	0.0002	0.005	0.0002	0.005	0.005
PFAS NEMP 2.0 2020 Ecological indirect exposure							**0.01**		**0.005**																																
PFAS NEMP 2.0 2020 Ecological direct exposure							1		10									10																								
PFAS NEMP 3.0 2022 Ecological direct exposure for reptiles									0.005									10																								
PFAS NEMP 2.0 2020 Ecological indirect exposure – Dryelwood sites							0.14																																		
PFAS NEMP 2.0 2020 Residential with garden/accessible soil (HIL A)						0.01	0.01	0.01	0.1									0.1																								
PFAS NEMP 2.0 2020 Public open space (HIL C)						*1*	*1*	*1*	*10*									*10*																								
PFAS NEMP 2.0 2020 Residential w/ min opportunities for soil access (HIL B)						2	2	2	20									20																								
SSHL Metropolitan (staffed) station						14	14	14	50									50																								
Location Code	**Date**	**Field ID**	**Zone**	**Lab Report**	**Depth (metres)**																																				
Zone 1 - The site (Fire Station site)																																								
S1	26 Sep 2018	S1	1	ES1828831	0 - 0.2	0.135	**3.79**	3.92	**0.0521**	-	0.0025	0.0039	0.0300	0.0110	0.009	0.0153	0.115	0.0098	0.0521	0.0021	0.0006	0.0003	0.0008	<0.0002	<0.0005	0.0110	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005	-	4.17	-	3.60	-
S2	26 Sep 2018	S2	1	ES1828831	0 - 0.3	0.0020	**0.0575**	0.0593	**0.0064**	-	<0.0002	<0.0002	<0.0003	0.0024	0.006	0.0136	0.0140	0.0052	0.0064	0.0028	0.0017	0.0008	0.0004	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	0.0083	0.0060	<0.0005	-	0.112	-	0.0900	-
S3	26 Sep 2018	S3	1	ES1828831	0 - 0.2	0.0045	**0.0657**	0.07	0.0028	-	0.0004	0.0004	0.0006	0.0030	0.006	0.0053	0.0077	0.0032	0.0028	0.0030	0.0009	0.0016	0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	0.0003	<0.0005	0.0013	0.0030	0.0005	-	0.107	-	0.0849	-
BH01	18 Jul 2023	BH01_0-0.1	1	1009731	0 - 0.1	<0.005	0.0054	0.0054	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0054	<0.05	0.0054	<0.01	<0.005
		BH01_0.85-0.95	1	1013609	0.85 - 0.95	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH01_1.4-1.5	1	1009731	1.4 - 1.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH01_2.25-2.35	1	1013609	2.25 - 2.35	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH02	19 Jul 2023	BH02_0-0.1	1	1009731	0 - 0.1	<0.005	**0.11**	0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.11	<0.05	0.11	<0.01	<0.005
		BH02_1.4-1.5	1	1013609	1.4 - 1.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH02_2.7-2.8	1	1009731	2.7 - 2.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH03	19 Jul 2023	BH03_0.5-0.6	1	1009731	0.5 - 0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH03_1.5-1.7	1	1009731	1.5 - 1.7	<0.005	0.01	**0.01**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	<0.05	0.01	0.01	<0.005
		BH03_3.2-3.3	1	1013609	3.2 - 3.3	0.014	<0.005	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.014	<0.05	0.014	<0.01	<0.005
		BH03_4.9-5.0	1	1013609	4.9 - 5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH04	18 Jul 2023	BH04_0.5-0.65	1	1009731	0.5 - 0.65	0.13	**1.2**	1.33	0.016	<0.005	0.0064	0.0076	0.022	<0.005	<0.005	0.0093	0.021	0.0080	0.016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.074	<0.005	<0.005	1.216	1.5009	1.346	1.4647	0.0066
		BH04_2.5-2.6	1	1009731	2.5 - 2.6	0.016	0.0078	0.0238	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0078	<0.05	0.0238	0.0238	<0.005
		BH04_2.9-3.0	1	1013609	2.9 - 3	0.0095	<0.005	0.0095	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0095	<0.05	<0.005	<0.01	<0.005
BH05	19 Jul 2023	BH05_0.08-0.18	1	1009731	0.08 - 0.18	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH05_3.0-3.15	1	1009731	3 - 3.15	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH06	18 Jul 2023	BH06_0.4-0.5	1	1009731	0.4 - 0.5	0.096	**0.019**	0.115	<0.005	<0.005	<0.005	0.0073	<0.005	<0.005	<0.005	<0.005	0.0083	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.019	0.1306	0.115	0.1233	<0.005
		BH06_2.9-3.0	1	1009731	2.9 - 3	0.0072	<0.005	0.0072	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0072	<0.05	0.0072	<0.01	<0.005
		BH06_4.4-4.5	1	1013609	4.4 - 4.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH07	18 Jul 2023	BH07_0.08-0.2	1	1009731	0.08 - 0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH07_2.8-2.9	1	1009731	2.8 - 2.9	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH08	18 Jul 2023	BH08_0-0.1	1	1009731	0 - 0.1	<0.005	**0.066**	0.066	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.066	0.066	0.066	0.066	<0.005
		BH08_1.9-2.0	1	1009731	1.9 - 2	0.014	**0.018**	0.032	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.018	<0.05	0.032	0.032	<0.005
		BH08_2.9-3.0	1	1013609	2.9 - 3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH08_4.9-5.0	1	1013609	4.9 - 5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH57	05 Sep 2023	BH57_0-0.1	1	1024020	0 - 0.1	0.014	**0.093**	0.107	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.093	0.107	0.107	0.107	<0.005
		BH57_1.4-1.5	1	1024020	1.4 - 1.5	0.05	<0.005	**0.05**	<0.005	<0.005	0.011	0.0081	<0.005	<0.005	<0.005	<0.005	0.0084	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0775	0.05	0.0694	<0.01	<0.005
		BH57_2.9-3.0	1	1025806	2.9 - 3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH58	05 Sep 2023	BH58_0-0.1	1	1024020	0 - 0.1	<0.005	**0.019**	0.019	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.019	<0.05	0.019	0.019	<0.005
		BH58_2.1-2.3	1	1025806	2.1 - 2.3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH58_3.9-4.0	1	1024020	3.9 - 4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
MW01	24 Jul 2023	MW01_0-0.1	1	1012039	0 - 0.1	<0.005	0.0058	0.0058	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0058	<0.05	0.0058	<0.01	<0.005
		MW01_1.5-1.7	1	1012039	1.5 - 1.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
MW02	24 Jul 2023	MW02_0.08-0.2	1	1012039	0.08 - 0.2	<0.005	0.0094	0.0094	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0094	<0.05	0.0094	<0.01	<0.005
		MW02_3.9-4.0	1	1012039	3.9 - 4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
MW03	24 Jul 2023	MW03_0.3-0.4	1	1012039	0.3 - 0.4	0.0064	**0.036**	0.0424	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.036	<0.05	0.0424	0.0424	<0.005
		MW03_5.9-6.0	1	1012039	5.9 - 6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
MW05	22 Mar 2024	MW05_1.4-1.5	1	1082921	1.4 - 1.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		MW05_3.9-4.0	1	1082921	3.9 - 4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
Zone 2a - Buffer Area to the West of the Site - Planned to be Developed for Low-Density Residential Use with garden/accessible soil																																								
TP121	16 Mar 2022	TP121_0.5-0.8	2a	EM2204661	0.5 - 0.8	0.0003	<0.0002	0.0003	<0.0002	-	<0.0002	-	-	-	<0.001	<0.0002	0.0005	<0.0002	<0.0002	-	-	-	-	-	-	-	-	-	-	-	-	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-
TP122	16 Mar 2022	TP122_0.0-0.2	2a	EM2204661	0 - 0.2	<0.0002	**0.0366**	0.0366	0.0002	-	<0.0002	-	-	-	<0.001	<0.0002	<0.0002	<0.0002	0.0002	-	-	-	-	-	-	-	-	-	-	-	-	<0.0005	0.0083	0.0060	<0.0005	-	0.112	-	0.0900	-
		TP122_0.5-0.7	2a	EM2204661	0.5 - 0.7	0.0007	**0.013**	0.0137	<0.0002	-	<0.0002	-	-	-	<0.001	<0.0002	0.0004	<0.0002	<0.0002	-	-	-	-	-	-	-	-	-	-	-	-	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-
TP201	15 May 2023	TP201_0.0-0.2	2a	EM2308637	0 - 0.2	<0.0002	0.0012	0.0012	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	0.0012	-	0.0012	-
TP202	15 May 2023	TP202_0.0-0.1	2a	EM2308637	0 - 0.1	0.0008	0.0041	0.0049	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	0.0010	0.0006	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	0.0068	-	0.0068	-
TP203	15 May 2023	TP203_0.0-0.2	2a	EM2308637	0 - 0.2	<0.0002	0.0014	0.0014	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	0.0014	-	0.0014	-
TP204	15 May 2023	TP204_0.0-0.2	2a	EM2308637	0 - 0.2	0.0002	**0.0193**	0.0195	0.0005	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	0.0015	0.0004	0.0002	0.0005	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	0.0226	-	0.0221	-
		TP204_0.3-0.5	2a	EM2310314	0.3 - 0.5	0.0033	0.0035	0.0068	<0.0002	-	0.0006	0.0004	<0.0002	<0.0002	<0.001	0.0027	0.0032	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	0.0140	-	0.0136	-
TP205	15 May 2023	TP205_0.0-0.2	2a	EM2308637	0 - 0.2	<0.0002	0.0038	0.0038	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	0.0038	-	0.0038	-
BH09	23 Aug 2023	BH09_0.9-1.0	2a	1020822	0.9 - 1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH10	23 Aug 2023	BH10_0.4-0.5	2a	1020822	0.4 - 0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

					Regulated PFAS				PFAS - Perfluoroalkyl Sulfonic Acids				PFAS - Perfluoroalkyl Carboxylic Acids				PFAS - Perfluoroalkyl Carboxylic Acids		PFAS - Perfluoroalkyl Carboxylic Acids		PFAS - Perfluoroalkyl Sulfonamide		PFAS - Perfluoroalkyl Sulfonamide			PFAS - Perfluoroalkyl Sulfonamide	PFAS - Fluorotelomer Sulfonic Acids			PFAS - Fluorotelomer Sulfonic Acids					PFAS - Other
					Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Sum of PFHxS and PFOS	Perfluorooctanoic acid (PFOA)	Perfluoropentanesulfo nic acid (PFPeS)	Perfluorobutane sulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctane sulfonamide (FOSA)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	6:2 Fluorotelomer sulfonic acid (4:2 FTS)	8:2 Fluorotelomer sulfonic acid (6:2 FTS)	10:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Sum of NS EPA PFAS (PFOS + PFOA)*	PFAS (Sum of Total)	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	PFAS (Sum of Total)(WA DER List)	PFAS (Sum of Total)	Perfluorooctane sulfonate (PFOS)
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.0002	0.0002	0.0002	0.0002	0.005	0.0002	0.0002	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0005	0.0005	0.0002	0.0005	0.0005	0.0005	0.0005	0.005	0.0002	0.005	0.0002	0.005
PFAS NEMP 2.0 2020 Ecological indirect exposure						**0.01**		**0.005**																												
PFAS NEMP 2.0 2020 Ecological direct exposure						1		10									10																				
PFAS NEMP 3.0 2022 Ecological direct exposure for reptiles								0.005									10																				
PFAS NEMP 2.0 2020 Ecological indirect exposure – Dryelwood sites						0.14																														
PFAS NEMP 2.0 2020 Residential with garden/accessible soil (HIL A)					0.01	0.01	0.01	0.1									0.1																				
PFAS NEMP 2.0 2020 Public open space (HIL C)					*1*	*1*	*1*	*10*									*10*																				
PFAS NEMP 2.0 2020 Residential w/ min opportunities for soil access (HIL B)					2	2	2	20									20																				
SSHL Metropolitan (staffed) station					14	14	14	50									50																				

Location Code	**Date**	**Field ID**	**Zone**	**Lab Report**	**Depth (metres)**																																	
Zone 2c - Buffer Area to the South of the Site - Planned to be Developed for Medium-Density Residential Use with Minimal Opportunities for Soil Access																																					
TP206	15 May 2023	TP206_0.0-0.2	2c	EM2308637	0 - 0.2	0.0010	**0.112**	0.133	0.0006	-	<0.0002	<0.0002	<0.0002	0.0020	<0.001	0.0002	0.0004	<0.0002	0.0006	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.116	-	0.114	-
		TP206_0.5-0.7	2c	EM2310314	0.5 - 0.7	0.0070	**0.126**	0.133	0.0021	-	<0.0002	<0.0002	0.0028	<0.0002	<0.001	0.0004	0.0006	0.0002	0.0021	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.139	-	0.136	-
		TP206_0.8-1.0	2c	EM2310619	0.8 - 1	0.0196	**0.0406**	0.0662	0.0018	-	0.0013	**0.0010**	0.0028	<0.0002	<0.001	0.0007	**0.0016**	0.0002	0.0018	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.0696	-	0.0658	-
TP207	15 May 2023	TP207_0.0-0.2	2c	EM2308637	0 - 0.2	0.0014	**0.102**	0.103	0.0012	-	<0.0002	<0.0002	<0.0002	0.0013	<0.001	0.0011	0.0006	0.0005	0.0012	0.0021	0.0007	0.0009	0.0003	<0.0002	<0.0005	0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	0.112	-	0.107	-
		TP207_0.3-0.5	2c	EM2310314	0.3 - 0.5	0.0011	**0.122**	0.123	0.0006	-	<0.0002	<0.0002	0.0004	0.0004	<0.001	0.0007	0.0002	0.0004	0.0006	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.126	-	0.125	-
		TP207_0.8-1.0	2c	EM2310619	0.8 - 1	0.0040	**0.0356**	0.0396	0.0013	-	<0.0002	<0.0002	0.0015	<0.0002	<0.001	0.0003	<0.0002	0.0004	0.0013	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.0431	-	0.0416	-
TP210	15 May 2023	TP210_0.0-0.1	2c	EM2310314	0 - 0.1	<0.0002	0.0027	0.0027	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.0027	-	0.0027	-
TP212	15 May 2023	TP212_0.0-0.1	2c	EM2310314	0 - 0.1	0.0003	0.0081	0.0084	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.0084	-	0.0084	-
TP214	15 May 2023	TP214_0.0-0.1	2c	EM2310314	0 - 0.1	<0.0002	0.0033	0.0033	0.0004	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0005	-	0.0037	-	0.0037	-
BH13	24 Aug 2023	BH13_0.4-0.5	2a	1020822	0.4 - 0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH24	24 Aug 2023	BH24_0.5-0.6	2c	1020822	0.5 - 0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH25	24 Aug 2023	BH25_0.4-0.5	2c	1020822	0.4 - 0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH26	24 Aug 2023	BH26_0.4-0.5	2c	1020822	0.4 - 0.5	<0.005	**0.22**	0.22	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.22	<0.05	0.22	<0.01	<0.005
BH27	24 Aug 2023	BH27_0.01-0.11	2c	1020822	0.01 - 0.11	<0.005	**0.014**	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.014	<0.05	0.014	0.014	<0.005
		BH27_0.4-0.45	2c	1020822	0.4 - 0.45	<0.005	0.0057	0.0057	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.0057	<0.05	0.0057	<0.01	<0.005
BH28	24 Aug 2023	BH28_0.01-0.11	2c	1020822	0.01 - 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH28_0.2-0.3	2c	1020822	0.2 - 0.3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH29	24 Aug 2023	BH29_0.01-0.06	2c	1020822	0.01 - 0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH29_0.25-0.3	2c	1020822	0.25 - 0.3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH37	25 Aug 2023	BH37_0.01-0.1	2c	1020822	0.01 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH37_0.4-0.5	2c	1020822	0.4 - 0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH52	04 Sep 2023	BH52_0.01-0.15	2a	1024020	0.01 - 0.15	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH53	04 Sep 2023	BH53_0.01-0.15	2a	1024020	0.01 - 0.15	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH54	04 Sep 2023	BH54_0.0-0.15	2a	1024020	0 - 0.15	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH54_2.4-2.5	2a	1024020	2.4 - 2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH63	05 Sep 2023	BH63_0.9-1.0	2c	1024020	0.9 - 1	0.016	<0.005	0.016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.016	<0.05	0.016	0.016	<0.005
		BH63_1.4-1.5	2c	1025806	1.4 - 1.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
BH64	05 Sep 2023	BH64_0.01-0.1	2c	1024020	0.01 - 0.1	<0.005	**0.17**	0.17	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.17	0.17	0.17	0.17	<0.005
		BH64_1.4-1.5	2c	1025806	1.4 - 1.5	0.038	**0.083**	0.121	<0.005	<0.005	<0.005	0.012	0.019	<0.005	<0.005	<0.005	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.083	0.14	0.121	0.121	<0.005
		BH64_1.9-2.0	2c	1028287	1.9 - 2	0.18	<0.005	0.18	**0.0072**	<0.005	0.012	0.011	0.0090	<0.005	<0.005	<0.005	**0.021**	<0.005	0.0072	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.0072	0.2402	0.1872	0.2202	<0.005
		BH64_2.4-2.5	2c	1033088	2.4 - 2.5	0.21	<0.005	0.21	**0.0061**	0.0074	0.022	0.025	<0.005	<0.005	<0.005	0.0059	0.036	<0.005	0.0061	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.0061	0.3124	0.2161	0.28	<0.005
BH65	05 Sep 2023	BH65_0.01-0.1	2c	1024020	0.01 - 0.1	<0.005	**0.063**	0.063	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.063	0.063	0.063	0.063	<0.005
		BH65_1.9-2.0	2c	1025806	1.9 - 2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
		BH65_2.4-2.5	2c	1024020	2.4 - 2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
BH68	25 Mar 2024	BH68_2.0-2.2	2a	1082921	2 - 2.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
	25 Mar 2024	BH68_2.9-3.0	2a	1082921	2.9 - 3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
BH69	25 Mar 2024	BH69_0.7-0.8	2c	1082921	0.7 - 0.8	<0.005	**0.012**	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.012	<0.05	0.012	0.012	<0.005
	25 Mar 2024	BH69_2.9-3.0	2c	1082921	2.9 - 3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
BH70	25 Mar 2024	BH70_3.9-4.0	2c	1082921	3.9 - 4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
	25 Mar 2024	BH70_4.9-5.0	2c	1082921	4.9 - 5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
BH71	25 Mar 2024	BH71_2.2-2.3	2c	1082921	2.2 - 2.3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
	25 Mar 2024	BH71_2.9-3.0	2c	1082921	2.9 - 3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
MW07	22 Mar 2024	MW07_1.9-2.0	2c	1082921	1.9 - 2	0.0069	**0.072**	0.0789	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.072	0.0789	0.0789	0.0789	<0.005
		MW07_9.4-9.5	2c	1082921	9.4 - 9.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005	<0.005
SS05	18 Jul 2023	SS05	2c	1009731	0 - 0.1	<0.005	0.0087	0.0087	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.0087	<0.05	0.0087	<0.01	<0.005
SS06	18 Jul 2023	SS06	2c	1009731	0 - 0.1	<0.005	**0.029**	0.029	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.029	<0.05	0.029	0.029	<0.005
SS07	18 Jul 2023	SS07	2c	1009731	0 - 0.1	<0.005	**0.041**	0.041	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.041	<0.05	0.041	0.041	<0.005
SS08	18 Jul 2023	SS08	2a	1009731	0 - 0.1	<0.005	**0.014**	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.014	<0.05	0.014	0.014	<0.005
SS05A	28 Feb 2024	SS05A	2a	345327	0 - 0.1	<0.0001	0.001	0.001	<0.0001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.001	0.001	<0.01	<0.01	<0.005
SS06A	28 Feb 2024	SS06A	2a	345327	0 - 0.1	<0.0001	0.0009	0.0009	<0.0001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.0009	0.0009	<0.01	<0.01	<0.005
SS07A	28 Feb 2024	SS07A	2a	345327	0 - 0.1	<0.0001	<0.001	<0.001	<0.0001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.01	<0.01	<0.005
SS15	26 Jul 2023	SS15	2a	1011049	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH30	24 Aug 2023	BH30_0.01-0.11	3c	1020822	0.01 - 0.11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
		BH30_0.25-0.3	3c	1020822	0.25 - 0.3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Table 1b
Analytical Paver Results

					Regulated PFAS				PFAS - Perfluoroalkyl Sulfonic Acids					PFAS - Perfluoroalkyl Carboxylic Acids						PFAS - Perfluoroalkyl Carboxylic Acids				PFAS - Perfluoroalkyl Sulfonamide			PFAS - Perfluoroalkyl Sulfonamide				PFAS - Fluorotelomer Sulfonic Acids			PFAS - Fluorotelomer Sulfonic Acids	PFAS - Sums				PFAS - Other
					Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Sum of PFHxS and PFOS	Perfluorooctanoic acid (PFOA)	Perfluoropropanesulfonic acid (PFPrS)	Perfluorobutane sulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorodecanesulfonic acid (PFDS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctane sulfonamide (FOSA)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Sum of US EPA PFAS (PFOS + PFOA)*	PFAS (Sum of Total)	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	PFAS (Sum of Total)(WA DER List)	Perfluorononane sulfonate (PFNS)
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.0002	0.0002	0.0002	0.0002	0.005	0.0002	0.0002	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0005	0.0005	0.0002	0.0005	0.0005	0.0002	0.0005	0.0005	0.0005	0.0005	0.005	0.0002	0.005	0.0002	0.005
Metropolitan (staffed) Station***					14	14	14	50																															
Location Code	**Date**	**Field ID**	**Lab Report**	**Depth**																																			
BH04	18 Jul 2023	BH04_PAVER	1009731	0 - 0.08	<0.005	0.08	0.08	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	0.08	0.08	0.08	0.08	<0.005
BH05	19 Jul 2023	BH05_PAVER	1009731	0 - 0.08	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
BH07	18 Jul 2023	BH07_PAVER	1009731	0 - 0.08	<0.005	0.0091	0.0091	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	0.0091	<0.05	0.0091	<0.01	<0.005
MW02	24 Jul 2023	MW02_PAVER	1012039	0 - 0.08	0.044	0.078	0.122	<0.005	<0.005	0.0073	0.0076	<0.005	<0.005	<0.005	<0.005	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	0.078	0.1509	0.122	0.1433	<0.005
MW03	24 Jul 2023	MW03_PAVER	1012039	0 - 0.08	0.046	0.124*	0.171*	<0.005	0.005	0.0095	0.0077	<0.005	<0.005	<0.005	<0.005	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	0.083	0.1712	0.129	0.1585	<0.005

Note:
*Higher QA/QC result reported
**For intensively developed sites with no secondary consumers and minimal potential for indirect ecological exposure, a higher criterion of up to 0.14 mg/kg is appropriate
***Derivation of site-specific health investigation levels for urban and regional fire stations (GHD, June 2023)

					Regulated PFAS				PFAS - Perfluoroalkyl Sulfonic Acids						PFAS - Perfluoroalkyl Carboxylic Acids										PFAS - Perfluoroalkyl Sulfonamide							PFAS - Fluorotelomer Sulfonic				PFAS - Sums			
					Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Sum of PFHxS and PFOS	Perfluorooctanoic acid (PFOA)	Perfluorobutane sulfonic acid (PFBS)	Perfluorodecanesulfonic acid (PFDS)	Perfluorononane sulfonate (PFNS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluoropropanesulfonic acid (PFPrS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluorobutanoic acid (PFBA)	Perfluorodecanoic acid (PFDA)	Perfluorododecanoic acid (PFDoDA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid (PFNA)	Perfluoropentanoic acid (PFPeA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluoroundecanoic acid (PFUnDA)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-Methyl perfluorooctane sulfonamidoethanol (MEFOSE)	Perfluorooctane sulfonamide (FOSA)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	PFAS (Sum of Total)	PFAS (Sum of Total)(WA DER List)	Sum of US EPA PFAS (PFOS + PFOA)*	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.01	0.01	0.05	0.01	0.1	0.05	0.01	0.01
PFAS NEMP 2.0 2020 Recreational Water					2	2	2	10																														
PFAS NEMP (HEPA, 2020) Freshwater 99% species protection						**0.00023**		**19**																														
PFAS NEMP (HEPA, 2020) Freshwater 95% species protection						*0.13*		*20*																														
Location Code	**Date**	**Field ID**	**Zone**	**Lab Report**																																		
TW01	14 Sep 2023	TW01	2a	1026487	0.95	***1***	1.95	0.07	0.25	<0.01	<0.01	0.06	0.16	0.18	0.06	<0.01	<0.01	0.04	0.28	<0.01	0.07	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.05	<0.01	3.12	2.72	1.07	2.02
MW01	03 Aug 2023	MW01	1	1013592	0.08	***0.19***	0.27	0.12	0.05	<0.01	<0.01	<0.01	<0.01	0.02	0.35	<0.01	<0.01	0.55	0.78	0.02	1.1	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.1	<0.01	3.36	3.32	0.31	0.39
	14 Sep 2023	MW01		1026487	0.02	**0.03**	0.05	0.02	0.03	<0.01	<0.01	<0.01	0.04	<0.01	0.15	<0.01	<0.01	0.12	0.37	<0.01	0.73	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.05	<0.01	1.51	1.47	0.05	0.07
	04 Apr 2024	MW01		1084731	0.1	***0.14***	0.24	0.06	0.07	<0.01	<0.01	<0.01	0.06	0.02	0.45	<0.01	<0.01	0.46	1.2	0.01	1.9	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.14	<0.01	4.61	4.52	0.2	0.3
MW02	03 Aug 2023	MW02	1	1013592	170	***35#2***	200	11#2	30.7#2	<0.01	0.15#2	8.7#2	12#2	30	5.1#2	<0.01	<0.01	4.6#2	46.9#2	<0.01	10	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.94#2	<0.01	342.46#2	296#2	46#2	208.7
	14 Sep 2023	MW02		1026487	96#2	***32#2***	128#2	6.5#2	13#2	<0.01	<0.06#1	7.9#2	6.1#2	12#2	2.6#2	<0.01	<0.01	2.1#2	25#2	<0.01	5.4#2	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.25#2	<0.01	208.89#2	182.85#2	38.5#2	134.5#2
	04 Apr 2024	MW02		1084731	81.4#2	***7.86#2***	89.3#2	3.57#2	11.3#2	<0.01	<0.01	3.83#2	4.2	8.94#2	1.7	<0.01	<0.01	2.03#2	18#2	<0.01	4.4#2	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.28#2	<0.01	143#2	130#2	8.6	70.6
MW03	14 Sep 2023	MW03	1	1026487	0.04	**0.04**	0.08	<0.01	0.02	<0.01	<0.01	<0.01	0.03	<0.01	<0.05	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.05	<0.01	0.14	0.11	0.04	0.08
	04 Apr 2024	MW03		1084731	0.77	***0.26***	1.03	0.05	0.33	<0.01	<0.01	0.03	0.39	0.1	0.11	<0.01	<0.01	0.09	0.19	<0.01	0.15	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.05	<0.01	2.47	1.95	0.31	1.08

Notes:
#1 LOR raised due to matrix interference.
#2 Higher QA/QC result reported.

Well ID	Date Sampled	Temp (°C)	pH	Dissolved oxygen (mg/L)	Oxidation-reduction	Electrical conductivity
MW01	03/08/2023	18.5	7.54	1.64	-14.4	3,216
	14/09/2023	19.8	6.92	0.65	-102.3	13,921
	04/04/2024	21.3	6.85	0.09	-141.0	4,020
MW02 (BH04)	03/08/2023	18.3	6.81	2.88	419.2	2,514
	14/09/2023	18.9	7.08	1.12	37.9	7,612
	04/04/2024	24.3	6.85	1.89	270.7	3,779
MW03 (BH58)	14/09/2023	16.8	7.71	0.51	51.6	1,989
	04/04/2024	22.2	7.43	1.30	-222.3	4,502
MW04	04/04/2024	Dry				
MW05	04/04/2024	Dry				
MW06	04/04/2024	Dry				
MW07	04/04/2024	Dry				
TW01 (BH49)	14/09/2023	19.9	7.79	1.39	102.6	6,994

The above field parameters are indicative of the following:

Well ID	Date	Surveyed top of casing (m AHD)	Surveyed Ground Level (m AHD)	Depth to Groundwater (m bTOC)	Relative groundwater level (m AHD)
MW01	03/08/2023	81.343	81.401	1.735	79.608
	04/04/2024			2.047	79.296
MW02 (BH04)	03/08/2023	81.471	81.558	1.033	80.438
	04/04/2024			2.303	79.168
MW03 (BH58)	14/09/2023	81.588	81.752	1.170	80.418
	04/04/2024			1.661	79.927
TW01 (BH49)	14/09/2023	80.945	80.547	1.439	79.506
MW04	04/04/2024	Not surveyed	Not surveyed	Dry	
MW05	04/04/2024	Not surveyed	Not surveyed	Dry	
MW06	04/04/2024	Not surveyed	Not surveyed	Dry	
MW07	04/04/2024	Not surveyed	Not surveyed	Dry	

	Regulated PFAS				PFAS - Perfluoroalkyl Sulfonic Acids						PFAS - Perfluoroalkyl Carboxylic Acids										PFAS - Perfluoroalkyl Sulfonamide							PFAS - Fluorotelomer Sulfonic				PFAS - Sums			
	Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Sum of PFHxS and PFOS	Perfluorooctanoic acid (PFOA)	Perfluorobutane sulfonic acid (PFBS)	Perfluorodecanesulfonic acid (PFDS)	Perfluorononane sulfonate (PFNS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluoropropanesulfonic acid (PFPrS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluorobutanoic acid (PFBA)	Perfluorodecanoic acid (PFDA)	Perfluorododecanoic acid (PFDoDA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid (PFNA)	Perfluoropentanoic acid (PFPeA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluoroundecanoic acid (PFUnDA)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-Methyl perfluorooctane sulfonamidoethanol (MEFOSE)	Perfluorooctane sulfonamide (FOSA)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	PFAS (Sum of Total)	PFAS (Sum of Total)(WA DER List)	Sum of US EPA PFAS (PFOS + PFOA)*	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.001	0.001	0.005	0.001	0.005	0.005	0.001	0.001
PFAS NEMP 2.0 2020 Freshwater - 99% - high conservation value systems		0.00023		19																															
ANZG (2023) WQG - Freshwater - 99% - high conservation value systems		**0.0091**																																	
PFAS NEMP 2.0 2020 Freshwater - 95%-slightly-moderately disturbed system		0.13		220																															
ANZG (2023) WQG - Freshwater - 95% - high conservation value systems		*0.48*																																	
PFAS NEMP 2.0 2020 Recreational Water	2	2	2	10																															

Location Code	Date	Field ID	Zone	Lab Report																																	
Zone 1 - The site (Fire Station site)																																					
SW_HYDRANT	26 Mar 2024	SW_HYDRANT	1	1082921	<0.001	0.0007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	<0.005	<0.001
SW_DISCHARGE	26 Mar 2024	SW_DISCHARGE	1	1082921	0.007	0.013	0.02	0.003	0.006	<0.001	<0.001	<0.001	0.003	0.002	<0.005	0.001	<0.001	0.001	0.008	<0.001	0.008	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	0.013	0.003	0.068	0.062	0.016	0.023
	04 Apr 2024			1084731	0.05	*0.1*	0.15	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.05	<0.01	<0.01	<0.01	0.02	<0.01	0.04	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	0.08	0.02	0.35	0.33	0.1	0.15
	##########	SW_DISCHARGE	1	1103952	0.36#1	0.35	0.71	0.040#1	0.024#1	<0.001	<0.001	0.036#1	0.014	0.023#1	0.013	<0.001	<0.001	0.016#1	0.067	<0.001	0.055	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	0.14	0.02	1.158	1.085	0.39	0.75
Zone 4 - Upstream of Dry Creek																																					
SW02	26 Mar 2024	SW02	4	1082921	0.011	0.01	0.021	0.006	0.004	<0.001	<0.001	<0.001	<0.001	0.001	<0.005	0.001	<0.001	0.003	0.007	<0.001	0.008	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.051	0.049	0.016	0.027
	##########	SW02	4	1103952	0.003#2	0.0077	0.0107	0.004#2	0.002#2	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.001	<0.001	0.002	0.007	<0.001	0.009	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0437	0.0427	0.012	0.0147
SW05	09 Apr 2024	SW05	4	1087760	0.005	0.0072#1	0.0118	0.006	0.006	<0.001	0.002	<0.001	0.006	<0.001	0.011	<0.001	<0.001	0.007	0.009	<0.001	0.021	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0798	0.0718	0.013	0.0178
	##########	SW05	4	1103952	0.002#1	0.0066	0.0086	0.003#1	0.001#1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	0.002	<0.001	0.001	0.004	<0.001	0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0246	0.0226	0.01	0.0116
Zone 4 - Downstream of Dry Creek																																					
SW03	26 Mar 2024	SW03	4	1082921	0.007	0.0085	0.0155	0.008	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	0.001	<0.001	0.003	0.01	<0.001	0.011	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0525	0.0515	0.017	0.0235
	##########	SW03	4	1103952	0.003#1	0.0065	0.0095	0.004#1	0.002#1	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.001	<0.001	0.002	0.006	<0.001	0.007	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0375	0.0365	0.011	0.0135
SW04	26 Mar 2024	SW04	4	1082921	0.008	0.014	0.022	0.015	0.006	<0.001	<0.001	<0.001	0.001	<0.001	0.009	0.003	<0.001	0.006	0.015	0.002	0.013	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.092	0.086	0.029	0.037
	##########	SW04	4	1103952	0.003#1	0.0067	0.0097	0.004#1	0.002#1	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.001	<0.001	0.002	0.007	<0.001	0.008	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0417	0.0407	0.011	0.0137
	##########	FD01	4	1103952	0.003#1	0.0065	0.0095	0.004#1	0.002#1	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.001	<0.001	0.002	0.007	<0.001	0.008	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0415	0.0405	0.011	0.0135
Zone 4 - Open drainage channel/swale connecting the stormwater drainage system to Dry Creek																																					
SW01	26 Mar 2024	SW01	4	1082921	0.031#1	0.086#1	0.116#1	0.044#1	0.0117#1	<0.001	<0.001	0.0055#1	0.007#1	0.0053#1	0.0317#1	0.0021#1	<0.001	0.01#1	0.0366#1	0.0016#1	0.0348#1	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	0.027#1	0.011#1	0.331#1	0.316#1	0.13#1	0.154#1
SW07	##########	SW07	4	1103952	0.004#1	0.032	0.036	0.004#1	0.002#1	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001	0.003	0.006	<0.001	0.006	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	0.006	<0.001	0.07	0.07	0.036	0.04
Ambient stormwater location - Open drainage channel/swale eventually discharging to Dry Creek																																					
SW06	##########	SW06	-	1103952	0.001#1	0.0021	0.0031	0.001#1	0.001#1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.001	0.001#1	0.002	<0.001	0.002	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005	<0.001	0.0101	0.0101	0.003	0.0041

Notes:
#1 Higher QA/QC result reported.
#2 Quantification of linear and branched isomers has been conducted as a single total response using the relative response factor for the corresponding linear/branched standard.

			Nutrients			Metals															
			Ammonia as N	Nitrate (as N)	Nitrite (as N)	Arsenic	Arsenic (filtered)	Cadmium	Cadmium (filtered)	Chromium (III+VI)	Chromium (III+VI) (filtered)	Copper	Copper (filtered)	Lead	Lead (filtered)	Mercury	Mercury (filtered)	Nickel	Nickel (filtered)	Zinc	Zinc (filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.01	0.02	0.02	0.001	0.001	0.0001	0.0002	0.001	0.001	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.005	0.005
ANZG (2018) - FW - 95% (updated 26 July 2021)			**0.9#1**	**2.4#2**		**0.013#3**					**0.001#4**		**0.0014**		**0.0034**				**0.011**		**0.008**
ANZG (2018) - FW - 99% (updated 26 July 2021)*									0.00006								0.00006				
ADWG 2011 Human-Health Recreational (v3.7 updated 2022)				112.9#6	9.1#7	0.1		0.02				20		0.1		0.01		0.2			
Location Code	**Date**	**Lab Report Number**																			
SW02	09 Apr 2024	1087760	0.2	<0.02	<0.02	0.001	-	<0.0002	-	<0.001	-	<0.001	-	<0.001	-	<0.0001	-	<0.001	-	0.01	-
	31 May 2024	1103952	0.09	0.38	<0.02	**<0.001**	**<0.001**	<0.0002	<0.0002	0.002	<0.001	0.004	0.003	0.002	<0.001	<0.0001	<0.0001	0.001	0.001	0.025	**0.019**
SW03	09 Apr 2024	1087760	0.4	<0.02	<0.02	0.002	-	<0.0002	-	<0.001	-	0.002	-	<0.001	-	<0.0001	-	0.003	-	0.011	-
	31 May 2024	1103952	0.06	0.44	<0.02	0.002	**<0.001**	<0.0002	<0.0002	0.002	<0.001	0.005	**0.003**	0.002	<0.001	<0.0001	<0.0001	0.001	0.001	0.028	**0.016**
SW04	09 Apr 2024	1087760	**1.0**	<0.02	<0.02	0.001	-	<0.0002	-	<0.001	-	0.001	-	<0.001	-	<0.0001	-	<0.001	-	0.011	-
	31 May 2024	1103952	0.06	0.86	<0.02	0.001	**<0.001**	<0.0002	<0.0002	0.002	0.001	0.005	**0.002**	0.002	<0.001	<0.0001	<0.0001	0.001	<0.001	0.029	**0.016**
SW05	09 Apr 2024	1087760	0.2	<0.02	<0.02	0.002	-	<0.0002	-	<0.001	-	0.004#5	-	0.003	-	<0.0001	-	0.001	-	0.032	-
	31 May 2024	1103952	0.07	0.21	<0.02	**<0.001**	**<0.001**	<0.0002	<0.0002	0.001	<0.001	0.005	**0.004**	0.003	<0.001	<0.0001	<0.0001	**<0.001**	**<0.001**	0.066	**0.035**
SW06	31 May 2024	1103952	0.01	0.27	<0.02	0.002	0.002	<0.0002	<0.0002	<0.001	<0.001	0.005	**0.004**	**<0.001**	<0.001	<0.0001	<0.0001	0.002	0.002	0.015	**0.012**
SW07	31 May 2024	1103952	0.03	0.03	<0.02	0.002	0.002	<0.0002	<0.0002	<0.001	<0.001	0.008	**0.007**	**<0.001**	<0.001	<0.0001	<0.0001	0.002	0.002	0.014	**0.013**
SW_Discharge	09 Apr 2024	1087760	0.1	**0.45**	<0.02	0.003	-	<0.0002	-	0.003	-	0.014	-	<0.001	-	<0.0001	-	0.002	-	0.039	-
	31 May 2024	1103952	0.05	0.14	<0.02	0.003	0.002	<0.0002	<0.0002	0.068	**0.054**	0.017	**0.004**	0.006	<0.001	<0.0001	<0.0001	0.004	0.002	0.16	**0.022**

Notes:

#1 Measured as NH3-N at pH 8

#2 Values taken from "Updating nitrate toxicity effects on freshwater aquatic species, 2013"

#3 In absence of total As guideline, As (V) guideline has been adopted.

#4 In absence of total Cr guideline, Cr (VI) guideline has been adopted.

#5 Higher QA/QC result reported.

#6 Guideline value calculated by dividing Nitrate (as Nitrate) value (50 mg/L) by 4.427

#7 Guideline value calculated by dividing Nitrite (as Nitrite) value (30 mg/L) by molecular weight (3.2967033).

* Cadmium and mercury are considered bioaccumulative and therefore the 99% species protection level was adopted for these two chemicals.

Environmental Standards

Department of Agriculture and Water Resources, 2018 updated July 2021, ANZG (2018) - FW - 95% (updated 26 July 2021)

Department of Agriculture and Water Resources, 2018 updated July 2021, ANZG (2018) - FW - 99% (updated 26 July 2021)

National Health and Medical Research Council, January 2022, ADWG 2011 Recreational (v3.7 updated 2022)

	Inorganics		Cyanide	Acidity & Alkalinity										Major Ions										Minor Ions	Chlorine	Nutrients								
	pH (Lab)	Total Dissolved Solids	Cyanide (Total)	Alkalinity (Carbonate as CaCO3)	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Hydroxide as CaCO3)	Alkalinity (total as CaCO3)	Hardness as CaCO3	Calcium	Magnesium		Potassium	Sodium	Chloride	Sulfate	Fluoride	Bromide	Chlorine (Free Residual)	Ammonia as N	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrogen (Organic)	Phosphorus (Total)	Arsenic	Arsenic (filtered)	Cadmium	Cadmium (filtered)	Chromium (III+VI)	Chromium (III+VI) (filtered)
	pH units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL	0.1	10	0.005	10	20	20	20	5	0.5	0.5		0.5	0.5	1	5	0.5	1	0.1	0.01	0.02	0.02	0.05	0.2	0.2	0.2	0.01	0.001	0.001	0.0002	0.0002	0.001	0.001
ADWG 2011 Recreational (v3.7 updated 2022)			0.8												5,000[#1]	15				112.9[#2]	9.1[#3]						0.1	0.1	0.02	0.02		
ANZG (2018) - FW - 95% (updated 26 July 2021)			0.007[#4]																0.9[#5]	2.4[#6]							0.013[#7]	0.013[#7]			0.001[#8]	0.001[#8]
ANZG (2018) - FW - 99% (updated 26 July 2021)																													0.00006	0.00006		

Location Code	Date	Lab Report Number																															
SW_DISCHARGE	04 Apr 2024	1084731	7.6	370	<0.005	<10	310	<20	310	110	26	11		7.2	69	100	42	0.8	<1	<0.1	0.02	0.17	<0.02	0.18	1.3	1.1	1.08	0.03	0.002	0.001	<0.0002	<0.0002	0.002	0.002
MW01	04 Apr 2024	1084731	7.2	12,000	<0.005	<10	1,000	<20	1,000	1,600	94	340		54	4,300	6,900	750	3.5	27	<0.1	0.12	0.09	<0.02	0.09	0.6	0.5	0.38	0.02	0.005	0.002	<0.0002	<0.0002	<0.001	<0.001

Comments

#1 Not specifically guideline value: >500mg/L can have purgative effects
#2 Guideline value calculated by dividing Nitrate (as Nitrate) value (50 mg/L) by 4.427
#3 Guideline value calculated by dividing Nitrite (as Nitrite) value (30 mg/L) by molecular weight (3.2967033).
#4 Cyanide as un-ionised HCN, measured as [CN].
#5 Measured as NH3-N at pH 8
#6 Values taken from "Updating nitrate toxicity effects on freshwater aquatic species, 2013"
#7 In absence of total As guideline, As (V) guideline has been adopted.
#8 In absence of total Cr guideline, Cr (VI) guideline has been adopted.
#9 Quantification of linear and branched isomers has been conducted as a single total response using the relative response factor for the corresponding linear/branched standard.

Environmental Standards

National Health and Medical Research Council, January 2022, ADWG 2011 Recreational (v3.7 updated 2022)
Department of Agriculture and Water Resources, 2018 updated July 2021, ANZG (2018) - FW - 95% (updated 26 July 2021)
Department of Agriculture and Water Resources, 2018 updated July 2021, ANZG (2018) - FW - 99% (updated 26 July 2021)

Metals																										Surfactants
Copper	Copper (filtered)	Iron	Iron (filtered)	Lead	Lead (filtered)	Mercury	Mercury (filtered)	Molybdenum	Molybdenum (filtered)	Nickel	Nickel (filtered)	Selenium	Selenium (filtered)	Silver	Silver (filtered)	Tin	Tin (filtered)	Zinc	Zinc (filtered)	MBAS Calculated as MW: 288	Perfluorobutane sulfonic acid (PFBS)	Perfluorodecanesulfonic acid (PFDS)	Perfluorononane sulfonate (PFNS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorooctane sulfonic acid (PFOS)	Perfluoropropanesulfonic acid (PFPrS)
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
0.001	0.001	0.05	0.05	0.001	0.001	0.0001	0.0001	0.005	0.005	0.001	0.001	0.001	0.001	0.005	0.005	0.005	0.005	0.005	0.005	200	0.01	0.01	0.01	0.01	0.01	0.01
20	20			0.1	0.1	0.01	0.01	0.5	0.5	0.2	0.2	0.1	0.1	1	1											
0.0014	0.0014			0.0034	0.0034		0.0006			0.011	0.011	0.011	0.011	0.00005	0.00005			0.008	0.008							
						0.00006																				
0.025	0.015	0.2	<0.05	0.001	<0.001	<0.0001	<0.0001	<0.005	<0.005	0.002	0.002	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	0.04	0.028	<200	0.02[#9]	<0.01	<0.01	<0.01	0.10[#9]	0.02
<0.001	<0.001	3.9	<0.05	<0.001	<0.001	<0.0001	<0.0001	<0.005	<0.005	0.004	0.004	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	800	0.07[#9]	<0.01	<0.01	<0.01	0.14[#9]	0.06

Table 4
Sediment Consolidated Results

	Regulated PFAS				PFAS - Perfluoroalkyl Sulfonic Acids					PFAS - Perfluoroalkyl Carboxylic Acids			PFAS - Perfluoroalkyl Carboxylic Acids			PFAS - Perfluoroalkyl Carboxylic Acids		PFAS - Perfluoroalkyl Carboxylic Acids		PFAS - Perfluoroalkyl Sulfonamide	PFAS - Perfluoroalkyl Sulfonamide			PFAS - Perfluoroalkyl Sulfonamide	PFAS - Fluorotelomer Sulfonic Acids			PFAS - Fluorotelomer Sulfonic Acids					PFAS - Other
	Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Sum of PFHxS and PFOS	Perfluorooctanoic acid (PFOA)	Perfluoropropanesulfo nic acid (PFPrS)	Perfluorobutane sulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorodecanesulfon ic acid (PFDS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctane sulfonamide (FOSA)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Sum of 5/3 EPA PFAS (PFOS + PFOA)*	PFAS (Sum of Total)	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	PFAS (Sum of Total)(WA DER List)	Perfluorononane sulfonate (PFNS)
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.0002	0.0002	0.0002	0.0002	0.005	0.0002	0.0002	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0002	0.0005	0.0005	0.0005	0.0002	0.0005	0.0005	0.0005	0.0005	0.005	0.0002	0.005
PFAS NEMP 2.0 2020 Public open space (HIL C)	1	1	1	10																												

Location Code	Date	Field ID	Zone	Lab Report	Depth (metres)																																							
Zone 3 - drainage swale (ephemeral creek) located about 200 m west of the site																																										
SED01	24 Aug 2023	SED01	3	1020822	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
SED02	24 Aug 2023	SED02	3	1020822	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
SED03	24 Aug 2023	SED03	3	1020822	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
Zone 4 - Upstream of Dry Creek																																										
SED08	26 Mar 2024	SED08	4	1082921	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
Zone 4 - Downstream of Dry Creek																																										
SED09	26 Mar 2024	SED09	4	1082921	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
SED10	26 Mar 2024	SED10	4	1082921	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
Zone 4 - Open drainage channel/swale connecting the stormwater drainage system to Dry Creek																																										
SED04	26 Mar 2024	SED04	4	1082921	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
SED05	26 Mar 2024	SED05	4	1082921	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005
Zone 4 - Ambient location - drainage channel/swale not connected to the site																																										
SED07	26 Mar 2024	SED07	4	1082921	0 - 0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.05	<0.005	<0.01	<0.005

	Regulated PFAS				PFAS - Perfluoroalkyl Sulfonic				PFAS - Perfluoroalkyl Carboxylic Acids											PFAS - Perfluoroalkyl Sulfonamide							PFAS - Fluorotelomer Sulfonic				PFAS - Sums	
	Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Sum of PFHxS and PFOS	Perfluorooctanoic acid (PFOA)	Perfluorobutane sulfonic acid (PFBS)	Perfluorodecanesulfonic acid (PFDS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluorobutanoic acid (PFBA)	Perfluorodecanoic acid (PFDA)	Perfluorododecanoic acid (PFDoDA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid (PFNA)	Perfluorooctanoic acid (PFOA)	Perfluoropentanoic acid (PFPeA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluoroundecanoic acid (PFUnDA)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-Methyl perfluorooctane sulfonamidoethanol (MEFOSE)	Perfluorooctane sulfonamide (FOSA)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	PFAS (Sum of Total)	Sum of US EPA PFAS (PFOS + PFOA)*
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.005	0.002	0.002	0.005	0.002	0.05	0.005	0.002	0.01	0.005	0.001	0.001	0.001	0.001	0.001	0.001
Field ID	**Date**	**Zone**	**Lab Report**																													
Zone 1																																
BIO18_LEAVES	26/03/2024	1	347722	0.03	0.012	0.041	<0.01	0.045	<0.001	0.001	0.011	<0.02	<0.02	<0.02	<0.001	0.012	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.001	0.11	0.012
BIO19_LEAVES	26/03/2024	1	347722	0.023	0.004	0.027	<0.01	0.13	<0.001	<0.001	0.038	<0.02	<0.02	<0.02	0.001	0.053	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	0.002	<0.001	0.25	0.004
BIO20_LEAVES	26/03/2024	1	347722	0.059	0.032	0.091	<0.01	0.14	<0.001	0.002	0.043	<0.02	<0.02	<0.02	0.001	0.032	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.001	0.31	0.032
Zone 2a																																
BIO1_LEAVES	7/12/2023	2	339767	0.002	<0.01	0.002	<0.001	<0.001	<0.01	<0.001	<0.001	<0.02	<0.02	<0.02	<0.001	<0.001	<0.005	<0.001	0.007	<0.005	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	0.001	<0.001	0.01	<0.001
BIO1_TRUNK	7/12/2023	2	339767	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BIO2_LEAVES	7/12/2023	2	339767	0.008	0.001	0.009	<0.001	0.004	<0.001	<0.001	0.003	0.038	<0.002	<0.002	<0.001	0.004	<0.001	<0.001	0.007	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	0.064	0.001
BIO2_TRUNK	7/12/2023	2	339767	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	0.006	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	0.006	<0.001
Zone 2b																																
BIO3_BRANCHES	7/12/2023	2	339767	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	0.001	0.001
BIO3_LEAVES	7/12/2023	2	339767	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zone 2c																																
BIO7_LEAVES	26/03/2024	2	347722	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.02	<0.02	<0.02	<0.001	<0.001	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BIO8_LEAVES	26/03/2024	2	347722	0.004	0.007	0.011	<0.01	0.016	<0.001	<0.001	0.005	<0.02	<0.02	<0.02	<0.001	0.004	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.001	0.035	0.007
BIO9_LEAVES	26/03/2024	2	347722	<0.001	<0.001	<0.001	<0.01	0.004	<0.001	<0.001	<0.001	<0.02	<0.02	<0.02	<0.001	<0.001	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.001	0.004	<0.001
BIO4_GRASS	7/12/2023	2	339767	0.14	0.004	0.15	<0.001	0.013	<0.001	<0.001	0.018	0.008	<0.002	<0.002	<0.001	0.016	<0.001	<0.001	0.008	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	0.21	0.004
BIO5_LEAVES(A)	7/12/2023	3	339767	0.006	<0.005	0.006	<0.005	0.013	<0.005	<0.001	0.006	<0.02	<0.02	<0.02	<0.005	<0.005	<0.01	<0.005	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.005	0.025	<0.001
BIO5_LEAVES(B)	7/12/2023	3	339767-A	0.003	<0.002	0.003	<0.005	0.008	<0.01	<0.001	0.003	<0.02	<0.02	<0.02	<0.001	<0.001	<0.01	<0.005	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.001	0.015	<0.001
BIO5_TRUNK	7/12/2023	3	339767	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zone 3																																
BIO6_LEAVES	26/03/2024	3	347722	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.02	<0.02	<0.02	<0.001	<0.001	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BIO12_LEAVES	26/03/2024	3	347722	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.02	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BIO13_LEAVES	26/03/2024	3	347722	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.02	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BIO14_LEAVES	26/03/2024	3	347722	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.02	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.002	<0.002	<0.005	<0.002	<0.05	<0.005	<0.002	<0.01	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BIO16_LEAVES	26/03/2024	3	347722	0.011	0.005	0.016	<0.01	0.002	<0.001	<0.001	0.001	<0.02	<0.02	<0.02	0.001	0.002	<0.01	<0.01	<0.02	<0.05	<0.02	<0.02	<0.05	<0.02	<0.5	<0.05	<0.02	<0.1	<0.05	<0.001	<0.001	0.021	<0.001	0.044	0.005

	Inorganics		Cyanide	Acidity & Alkalinity					Major Ions							Minor Ions	Chlorine	Nutrients								Metals																											Surfactants
	pH (Lab)	Total Dissolved Solids	Cyanide (Total)	Alkalinity (Carbonate as CaCO3)	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Hydroxide as CaCO3)	Alkalinity (total as CaCO3)	Hardness as CaCO3	Calcium	Magnesium	Potassium	Sodium	Chloride	Sulfate	Fluoride	Bromide	Chlorine (Free Residual)	Ammonia as N	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrogen (Organic)	Phosphorus (Total)	Arsenic	Arsenic (filtered)	Cadmium	Cadmium (filtered)	Chromium (III+VI)	Chromium (III+VI) (filtered)	Copper	Copper (filtered)	Iron	Iron (filtered)	Lead	Lead (filtered)	Mercury	Mercury (filtered)	Molybdenum	Molybdenum (filtered)	Nickel	Nickel (filtered)	Selenium	Selenium (filtered)	Silver	Silver (filtered)	Tin	Tin (filtered)	Zinc	Zinc (filtered)	MBAS Calculated as MW: 288
	pH units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L
EQL	0.1	10	0.005	10	20	20	20	5	0.5	0.5	0.5	0.5	1	5	0.5	1	0.1	0.01	0.02	0.02	0.05	0.2	0.2	0.2	0.01	0.001	0.001	0.0002	0.0002	0.001	0.001	0.001	0.001	0.05	0.05	0.001	0.001	0.0001	0.0001	0.005	0.005	0.001	0.001	0.001	0.001	0.005	0.005	0.005	0.005	0.005	0.005	200
Date	**Field ID**	**Lab Report**																																																		
04 Apr 2024	MW01	1084731	7.2	12,000	<0.005	<10	1,000	<20	1,000	1,600	94	340	54	4,300	6,900	750	3.5	27	<0.1	0.12	0.09	<0.02	0.09	0.6	0.5	0.38	0.02	0.005	0.002	<0.0002	<0.0002	<0.001	<0.001	<0.001	<0.001	3.9	<0.05	<0.001	<0.001	<0.0001	<0.0001	<0.005	<0.005	0.004	0.004	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	800
04 Apr 2024	SW_DISCHARGE	1084731	7.6	370	<0.005	<10	310	<20	310	110	26	11	7.2	69	100	42	0.8	<1	<0.1	0.02	0.17	<0.02	0.18	1.3	1.1	1.08	0.03	0.002	0.001	<0.0002	<0.0002	0.002	0.002	0.025	0.015	0.2	<0.05	0.001	<0.001	<0.0001	<0.0001	<0.005	<0.005	0.002	0.002	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	0.04	0.028	<200

Appendix C

Toxicity Assessment supplementary information

C-1 Introduction

A toxicity assessment determines whether human exposure to a chemical could cause an increase in the incidence of an adverse health condition (NEPC, 1999). The outcomes of the toxicity assessment process are a set of toxicity criteria that are compared with exposure estimates to evaluate risk associated with chemical exposure pathways.

In accordance with the ASC NEPM (NEPC, 1999) Schedule B4, the toxicity assessment for this HHRA includes two elements:

1. *Hazard Identification*, which examines the capacity of PFOS+PFHxS to cause adverse health effects.
2. *Dose Response assessment*, which examines the quantitative relationships between PFOS+PFHxS exposure and health effects, to determine the levels of exposure that could give rise to adverse effects.

Reference has been made primarily to the toxicological information published by FSANZ (2017) which was used to establish the current Australian guidelines for PFOS, PFOA, and PFHxS, as published in the PFAS NEMP (HEPA, 2020). Consideration has also been given to pertinent information from the following sources:

– US Agency for Toxic Substances and Disease Registry (ATSDR)
– International Agency for Research on Cancer (IARC)
– European Food Safety Authority (EFSA)
– US Environmental Protection Agency (EPA)
– World Health Organization (WHO)
– Published scientific literature.

C-2 Hazard identification

Numerous studies have been undertaken into the possible health effects of PFAS in humans. Most human studies attempt to identify a relationship between levels of PFAS in the blood and a health effect but results to date (at the time of preparing this HHRA) have been inconsistent. Additional difficulties arise when seeking to extrapolate from animal to human studies, as humans and animals have been found to react differently to exposure to PFOS and PFOA, with profound differences in the toxicokinetics and toxicodynamics observed (ATSDR, 2021).

C-2-1 Acute toxicity

Acute exposures are typically defined as those occurring over a period of 14 days or less. Contaminated land risk assessments generally focus on chronic effects, but acute effects can be important in some circumstances and should not be ignored in hazard identification process.

The limited data available for humans has not identified acute toxicity associated with exposure to PFOS or PFHxS through inhalation, ingestion, dermal or ocular contact (ATSDR, 2021). Acute toxicity is, therefore, unlikely to be associated with exposure to the PFAS concentration measured in soil collected from within the Investigation Area and acute exposures have not been considered further in this HHRA.

C-2-2 Chronic toxicity – animal studies

Animal studies have indicated that chronic exposure of PFOS in mice, rats and monkeys can result in increased liver weight, liver cell hypertrophy, histopathological changes to lungs, decreased hormone levels and immunotoxicity (Bae et al., 2015). Reproductive and developmental toxicity have also been observed in animal studies, but generally at doses similar or only marginally lower than that which also produced maternal toxicity (ATSDR, 2021; EFSA, 2020; FSANZ, 2017). EFSA (2020) concluded that PFOS has been shown to cause a reduced response to vaccination (T-cell dependent antibody response) at doses where no other toxicity was evident.

Limited animal studies have indicated that chronic exposure to PFHxS in rats can result in increased liver weights, histopathological changes to lungs and thyroid glands and haematological effects (Butenhoff et al., 2009). The predominant effects identified for PFOA in rodents have also been adverse effects on the liver, via a mechanism that FSANZ (2017) does not consider relevant to humans. Other effects of PFOA in animal studies include effects on body and organ weights, immunotoxicity and hypoglycaemia (FSANZ, 2017). Similarly, to PFOS, reproductive and developmental toxicity, including decreased offspring weights and neurodevelopmental effects have also been observed in animal studies for PFOA at doses lower than those associated with maternal toxicity (ATSDR, 2021; FSANZ, 2017).

Limited data is available to evaluate the toxicity of many of the other individual PFAS compounds, but ATSDR (2021) and EFSA (2020) identified animal toxicological studies on perfluoroalkyl carboxylates (PFCAs) – e.g., perfluorohexanoic acid (PFHxA), perfluorobutanoic acid (PFBA), and perfluoroheptanoic acid (PFHpA) – perfluoroalkyl sulfonates (PFSAs) including perfluorobutane sulfonic acid (PFBS), perfluorononanoic acid (PFNA) and perfluorooctane sulfonamide (FOSA) and the US EPA (2023a) has published drinking water standards for PFHxS, PFNA and PFBS. The toxic effects of compounds other than PFOS have generally been identified in animal studies undertaken on these compounds at doses several orders of magnitude higher than for PFOS and PFOA, but the dataset for these other compounds is limited (EFSA, 2020; ATSDR, 2021).

The most consistent endpoint identified in the studies undertaken on other PFAS compounds were liver weight effects, disturbances in lipid metabolism and hepatotoxic effects. Many PFAS also decreased the levels of thyroid hormones and some compounds increased relative kidney weight (EFSA, 2020; ATSDR, 2021). Developmental toxicity studies identified for a subset of these other PFAS compounds identified increased fetal and/or neonatal mortality and reduction in fetal weight and/or postnatal growth, at similar or slightly lower doses than those exerting maternal toxicity. Effects on male reproductive parameters have also been reported for PFCAs including PFNA and PFDA and immune system effects have been identified for PFNA and PFDA (EFSA, 2020; ATSDR, 2021).

C-2-3 Chronic toxicity – epidemiological studies

Epidemiological studies typically involve the analysis of associations between PFAS exposure (e.g., concentrations in environmental matrices and humans) and human diseases and health endpoints.

The Australian Government commissioned an independent Expert Health Panel to identify potential health impacts associated with PFAS exposure and to identify priority areas for further research (Buckley et al., 2017). This panel found that scientific research indicated consistent links between human exposure to PFAS and the following adverse health outcomes:

– Increased levels of cholesterol in the blood
– Increased levels of uric acid in the blood
– Reduced kidney function
– Alterations in some indicators of immune response
– Altered levels of thyroid hormones and sex hormones
– Later age for starting menstruation in girls and earlier menopause in women
– Lower birth weight in babies.

Notably, the differences in health effects reported in the scientific literature between people who have experienced high and low levels of PFAS exposure were generally small, with the health of the people with the highest exposure generally still within normal ranges for the general population. The Panel concluded that "*there is mostly limited or no evidence for any link with human disease*". These conclusions are generally consistent with those reported by FSANZ (2017) for epidemiological studies.

In a recent review undertaken by EFSA (2020) it was concluded that epidemiological studies provide evidence for an association between exposure to PFAS and increased serum levels of cholesterol. Associations between PFAS exposure and increased serum levels of the liver enzymes were also identified but the magnitude of these associations was small (~3%) and there were no associations identified with liver disease. EFSA (2020) also concluded that epidemiological studies provide insufficient evidence of associations between PFAS exposure and reproductive outcomes, neurodevelopment outcomes, growth in infancy or childhood, neurobehavioral, neuropsychiatric, cognitive outcomes, thyroid function, changes in kidney function or serum levels of uric acid.

In 2021, the Society of Environmental Toxicology and Chemistry (SETAC) convened a review of the health risks associated with exposure to PFAS. Overall, it was concluded that, based on animal studies and the available epidemiological data that there was strong evidence that the following were sensitive toxicity endpoints for human exposure to PFAS:

– Suppression of immune response
– Alteration of thyroid hormones
– Disruption of liver metabolism
– Reproductive and developmental effects (Fenton, et al., 2021)

Overall, all the reviewing bodies identified that there was limited epidemiological information available for compounds other than PFOS and PFOA.

C-2-4 Carcinogenicity

In December 2023, the International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization (WHO), evaluated the carcinogenicity of PFOA and PFOS. The classifications derived can be summarised as follows:

– The IARC classified PFOA as *carcinogenic to humans* (Group 1) on the basis of sufficient evidence for cancer in experimental animals and strong mechanistic evidence (for epigenetic alterations and immunosuppression) in exposed humans. There was also limited evidence for cancer in humans (renal cell carcinoma and testicular cancer) and strong mechanistic evidence in human primary cells and experimental systems (for epigenetic alterations and immunosuppression, as well as several other key characteristics of carcinogens).
– The IARC classified PFOS as *possibly carcinogenic to humans* (Group 2B), on the basis of strong mechanistic evidence across test systems, including in exposed humans (for epigenetic alterations and immunosuppression, as well as several other key characteristics of carcinogens). There was also limited evidence for cancer in experimental animals and inadequate evidence regarding cancer in humans.

At the time of reporting the classification document had not been published by the IARC but a summary of the classification was documented by Zahm *et al.* (2024). The US EPA (2023a) has recently reviewed the available human epidemiological and animal toxicity studies and concluded that a classification of "*Likely to Be Carcinogenic to Humans*" is applicable, as "*the weight of evidence is sufficient to demonstrate carcinogenic potential to humans but does not reach the weight of evidence for the descriptor 'Carcinogenic to Humans'*". The details of this classification can be summarised as follows:

– The PFOS classification is primarily based several epidemiological studies that report an elevated risk of bladder, prostate, kidney, and breast cancers after chronic PFOS exposure. The detailed review undertaken by US EPA (2023b), however, concluded that the study designs, analyses, and mixed results do not allow for a definitive conclusion on the relationship between PFOS exposure and cancer outcomes in humans. A single chronic animal cancer bioassay was identified to support the classification, whereby tumorigenesis was identified in male and female rats. This study was the same study referenced in the reviews undertaken by EFSA (2020) and FSANZ (2017).
– The PFOA classification is based on the evidence of kidney and testicular cancer in humans and pancreatic and kidney tumours in rats. The detailed review undertaken by US EPA (2023c) concluded that PFOA may act through multiple carcinogenic modes of action.
– The risks associated with exposure to potentially carcinogenic compounds can be assessed as follows:
– *Non-threshold toxicity*: For genotoxic carcinogens there is no evidence of a threshold level of exposure for carcinogenicity. These compounds are assessed using a non-threshold approach, whereby it is assumed that there is a proportional relationship between dose and carcinogenicity at low concentrations
– *Threshold toxicity*: For non-genotoxic carcinogens, there is a level of exposure, below which there is no appreciable cancer risk. These compounds are assessed using a threshold approach, whereby it is assumed that there is unlikely to be an appreciable risk of deleterious carcinogenic effects during a lifetime at concentrations below an adopted TRV.

EFSA (2020) and FSANZ (2017) reviewed the weight of evidence from *in vitro* and *in vivo* genotoxicity studies, and concluded that the toxicity of PFOS and PFOA occurs through non-genotoxic threshold mechanisms. The ATSDR (2021) and EFSA (2020) also noted that human epidemiology studies did not find a consistent correlation between PFOS exposure and cancer incidence in occupational and general population studies. Hence, the EFSA (2020) FSANZ (2017) adopt a threshold approach to the assessment of PFAS exposure (i.e. the use of threshold TRV). Conversely, the US EPA (2023a) has assumed low dose linearity for both PFOS and PFOA (i.e., a non-threshold to dose response assessment) as a conservative approach, is an absence of definitive information supporting a single, scientifically justified mode of action.

At the time of reporting, FSANZ maintain the stance that available toxicological information on PFAS suggests threshold toxicity as opposed to non-threshold toxicity. As such, a threshold approach has been adopted in this HHRA for the PFAS dose response assessment, in line with the approach adopted by FSANZ (2017) and other international jurisdictions.

C-2-5 Toxicokinetics

Gastrointestinal absorption

In animal studies, PFOS and PFOA are rapidly and virtually completely absorbed (>95%) through the gastrointestinal tract. The limited data that is available for PFHxS also suggests rapid and virtually complete (>95%) gastrointestinal absorption (FSANZ, 2017). Similar patterns of gastrointestinal absorption have been reported for other PFSAs, including PFHxS, and for PFCAs including PFHxA, PFBA and PFHpA (EFSA, 2020). On this basis, it has been assumed that 100% of PFAS in water matrices (e.g., surface water and groundwater) may be absorbed into the gastrointestinal tract.

Dermal absorption

The functional groups of some PFAS compounds can dissociate into anions or cations in aqueous solution, depending upon pH. Due to their low acid dissociation constants, PFAS compounds such as PFOS and PFOA are predominantly present in a dissociated state in the aqueous phase, under typical environmental conditions (ITRC, 2022). The dermal permeability of chemicals is influenced by the state of ionization, with non-ionized forms of chemicals being more readily absorbed than the dissociated forms (USEPA, 2004). Hence, although limited data is available regarding the propensity of PFAS to be absorbed through the skin, it is expected that, under normal conditions, the dermal absorption of these compounds is negligible.

In two studies cited by ATSDR (2021) and EFSA (2020), 0.05% of the dose of PFOA applied to skin was absorbed under normal conditions. The estimated dermal penetration coefficients from these studies were approximately $1x10^{-6}$ centimetres per hour (cm/hour) (Fasano et al., 2005) and $4.4x10^{-5}$ cm/hr (Franko et al., 2012), with the latter value estimated for PFOA dissolved in acetone and for skin pre-treated with glycerol, both of which may have enhanced PFOA absorption.

While dermal permeability data was not identified for PFOS, the dermal permeability of this compound is also expected to be low under normal environmental and skin conditions.

Distribution, metabolism, and elimination

Following absorption, PFAS are widely distributed in the body, with the highest concentrations generally found in the liver, kidneys, and blood. However, the distribution pattern depends on the compound, species, and administration dose/route. PFAS can also be transferred to the foetus during pregnancy and to nursing infants during breastfeeding. In vivo and in vitro studies suggest that PFSA and PFCA are not metabolised within the body (ATSDR, 2021).

Elimination of PFAS occurs primarily in the urine. The elimination rates (half-lives) vary widely across animal species and even between sexes of the same species, and among PFAAs with different functional groups and carbon chain lengths. In humans, the estimated half-lives for short-chain PFAS (such as PFBA and PFHxA) range from a few days to approximately one month, whereas for compounds with a long perfluoroalkyl chain length (such as PFOA, PFHxS or PFOS), it can be several years (EFSA, 2020). The estimated range of half-lives for elimination of PFOA, PFOS and PFHxS, as presented by Pizurro *et al.* (2019) are 2.3 to 8.5 years, 3.3 to 5.4 years and 5.3 to 15.5 years respectively.

C-3 Dose response assessment

As discussed in Section C-2-4, this HHRA focuses on potential threshold risks linked to PFAS exposure. The hazard identification process (Section C-2) suggests that PFAS has relatively low acute toxicity following oral and dermal exposures and that dermal uptake is negligible. The focus of this HHRA is, therefore, the potential chronic PFAS exposures that may occur in association with oral exposure to PFOS and PFHxS.

Chronic health risks are assessed by comparing the estimated intake doses with toxicity reference values (TRVs). For threshold chemicals, TRVs are a measure of tolerable daily exposure and include values that are referenced by different agencies using a range of terms, including acceptable daily intake (ADI), tolerable daily intake (TDI), reference dose (RfD) or minimal risk level (MRL).

These values estimate the daily dose of a chemical to the human population (including sensitive subpopulations) that is likely to be without risk of deleterious non-cancer effects during a lifetime. TRVs for PFOS+PFHxS are typically expressed in ng/kg of body weight/day.

The derivation of TRVs is a two-step process:

1. Defining a point of departure (POD)
2. Extrapolating from the POD for relevance to human exposure.

For threshold compounds the POD for the dose response assessment is typically the no-observed-adverse-effect level (NOAEL) or lowest-observed-adverse-effect level (LOAEL) derived from relevant animal or human data. To derive the TRVs for threshold health effects, the POD is typically adjusted downwards (i.e., made more conservative) to account for the uncertainty that is associated with extrapolation from experimental animals to humans and to account for the variability in the health responses of individuals. Downwards adjustments are also made to the POD in response to limitations in the available toxicological dataset (e.g., limited study durations or the absence of studies addressing specific potential endpoints) and when the POD is a LOAEL rather than a NOAEL. The adjustments are made using uncertainty factors (UF) of up to 10 for each potential source of uncertainty.

C-3-1 TRVs adopted in this HHRA – PFOS and PFHxS

FSANZ (2017) developed TRVs for oral exposure to PFOS+PFHxS, based upon the results of laboratory animal studies, with uncertainty factors applied to account for interspecies differences in toxicodynamics and differences between human populations. Due to the variability in half lives of PFOS by species, a pharmacokinetic modelling approach was used in conjunction with the NOAELs derived in animal studies to derive the following TRVs:

– For PFOS, FSANZ has recommended a TRV of 20 ng/kg bw/day based on decreased parental and offspring body weight gains in a multigeneration reproductive toxicity study in rats. The TRV was derived by applying pharmacokinetic modelling to the serum PFOS concentrations measured in experimental animals at the NOAELs in these and other critical studies, to calculate human equivalent doses (HED). An uncertainty factor of 30 was applied to the HED, which comprised a default factor of 3 to account for interspecies differences in toxicodynamics and a default factor of 10 for intraspecies differences in the human population.
– For PFHxS, there was insufficient toxicological and epidemiological information to derive a TRV. In the absence of a TRV, it is reasonable to conclude that the enHealth (2016) approach of using the TRV for PFOS is likely to be conservative and protective of public health as an interim measure. Effectively, this means that PFHxS and PFOS should be summed for the purposes of a dietary exposure assessment and risk characterisation. This is in line with the HHERA approach.

The FSANZ (2017) TRV adopted in this HHRA is detailed in Table C-1. This TRV is also recommended in the PFAS NEMP.

Table C-1 Summary of Toxicity Reference Values (FSANZ, 2017)

Chemical	Toxicity Reference Values
PFOS, PFHxS (sum)	20 ng/kg/day

C-3-2 Dose response uncertainties

A variety of international jurisdictions have assessed the toxicity of PFOS and PFHxS and published TRVs. The TRVs established for PFOS and PFHxS by EFSA (2020) and proposed (currently draft for public comment) by the US EPA (2023b) are lower than the values recommended by FSANZ (2017), suggesting that there is still controversy about PFAS and associated human health risk. The primary difference between the PFOS+PFHxS TRV derived by FSANZ (2017) and the values proposed by these other international agencies, is the approach used to incorporate immunotoxicity, as follows:

– The TRV adopted by EFSA (2020) (0.63 ng/kg/day, applicable to the sum of PFOS, PFHxS, PFOA and PFNA) is based on two human epidemiological studies. A study with children on the Faroe Islands showed various associations between the serum levels of individual PFAS and the sum of these four compounds and antibody responses against diphtheria and tetanus vaccinations (Grandjean et al., 2012). In addition, a more recent study on children from Germany (Abraham et al., 2020) showed an inverse association between serum levels of the sum of PFOA, PFNA, PFHxS and PFOS, and antibody responses against haemophilus influenzae type b, diphtheria, and tetanus in 1-year-old predominantly breastfed children.
– The TRV proposed by US EPA (2023b) (0.0079 ng/kg/day for PFOS alone) is based on the same Grandjean et al. (2012) as referenced by EFSA (2020). The primary difference between the two values relates to the application by US EPA (2023b) of an uncertainty factor of 10 to account for the potential for human variability. This was not deemed to be required by EFSA (2020) on the basis that the toxicity endpoint was a vaccine response (i.e., a possible reduction in disease prevention), rather than the direct measurement of the development of a disease. The TRVs also differed because the endpoint adopted by the US EPA (2023b) corresponded to the 95% lower confidence limit of a 5% change in antibody response, whereas the EFSA (2020) toxicity endpoint adopted a less conservative 10% change.
– The US EPA (2023b) has also proposed (but not officially adopted) a Maximum Contaminant Level (MCL) drinking water guidelines for PFOS and PFHxS of 4 ng/L individually. These MCLs represent the levels at which they can be reliably measured in drinking water, with the goal being an absence of PFOS and PFOA in drinking water.
– FSANZ (2017) acknowledged the potential immunotoxicity associated with exposure to PFOS, noting that there are both positive and negative studies showing associations for increasing PFOS concentrations to compromise antibody production in humans. Based on a review of the available studies undertaken by Drew and Hagen (2016) however, FSANZ (2017) concluded that PFOS effects on vaccine response are weak and not consistent for all vaccines. FSANZ (2017) also concluded that there is no convincing evidence for increased incidence of infectious disease associated with PFOS effects on human immune function, as the epidemiological studies that have observed decreased antibody response have not found significant increases in infection rates. In particular, Drew and Hagen (2016) noted that the NOAEL serum PFAS concentrations derived by Grandjean *et al.* (2012) are very low and that a number of environmental pollutants (e.g., polychlorinated biphenyls and mercury) could have been associated with altered levels of various antibodies in children.
– FSANZ[1] has undertaken a review of recent studies concerning the potential of PFAS to affect the human immune system. The review evaluated the relationship between PFAS and immune response to vaccinations, susceptibility to infections, and hypersensitivity responses, including allergy. The review concluded that new epidemiological studies provide some evidence of statistical associations between PFAS blood levels and impaired vaccine response, increased susceptibility to infectious disease and hypersensitivity responses but that causal relationships could not be established. At the time of reporting, based on this review, FSANZ did not consider immunomodulation as a suitable critical endpoint for quantitative risk assessment for PFAS.

Overall, the approach adopted by FSANZ to the potential immunotoxicity of PFOS+ PFHxS is more pragmatic than that recently adopted by EFSA and US EPA. The TRV recommended by FSANZ for PFOS+ PFHxS has been adopted in this assessment, as it is consistent with the current guidance provided by Australian health and environmental regulators.

[1] https://www.foodstandards.gov.au/publications/Documents/PFAS%20and%20Immunomodulatory%20Review%20and%20Update%202021.pdf

C-3-3 Bioavailability

The ASC NEPM (HEPA, 2020) defines bioavailability as the proportion of the intake of a substance, which is absorbed into the body. 'Bioavailability' can be separated into two distinct elements:

1. The ability of the substance to be liberated from a medium (e.g., plant or meat) within the gut or lung - often referred to as the bio-accessibility.
2. The ability of the substance to enter the bloodstream and be taken up by the body organs, once it has entered the lung or gut - this is often referred to as bioavailability (NEPC, 1999).

The toxicity data derived from experiments involving direct oral administration of PFAS to an animal or human intrinsically incorporates bioavailability as defined in Point 2 above. There has been limited research into bioaccessibility of PFAS in different media and therefore a conservative assumption of 100% bioaccessibility has been adopted in this assessment.

Appendix D

Human health exposure assessment supplementary information

D-1 Introduction

This appendix provides the technical details of the following aspects of the exposure assessment process:

– The data used to support the derivation of the background exposure assumption adopted in this HHRA.
– The methodologies used to estimate the relationship between PFAS concentrations in soil and groundwater and those in fruit and vegetables grown in Zones 2a and 2b.
– The data used to calculate the direct exposure associated with soil and dust.

GHD developed a quantitative PFAS exposure model based on the methodology presented in the ASC NEPM Schedule B7, *Guidelines on Derivation of Health-Based Investigation Levels*. The model, including input data, reference, and calculations, is presented in Appendix E.

D-2 Background exposure to PFAS

D-2-1 Overview

According to the ASC NEPM, background exposure in the context of this HHRA refers to exposure from sources not associated with the MFS site. Background exposures to PFOS and PFHxS may be associated with releases attributable to identified sources of contamination and impacts that originate from other sources in the wider environment (such as PFAS present in food, water, and consumer products) and exposure in occupational settings. In Australia, typical sources of PFAS exposure include:

Specific identifiable sources

– **Point sources**: Near facilities where PFAS have been extensively used (e.g., fire stations, Defence bases or major airports) high PFAS levels may be found in the environment.
– **Occupational exposure:** Historically, PFAS was a major component of products such as firefighting foams and, therefore, a number of occupational groups (e.g. firefighters) experienced higher PFAS exposures than the general population. However, these kinds of exposures have decreased in recent years, as PFAS is phased out.

General sources

– **Household products**: PFAS are widely used in many common household products and specialty applications and, therefore, most people living in developed nations have some PFAS in their body that is related to the day-to-day use of products containing PFAS. Concentrations of PFOS in blood serum have been decreasing over time, following a reduction in production and use of PFOS containing products (ATSDR, 2021; EFSA, 2020)
– **Wider environmental sources:** Due to the widespread distribution, mobility and persistence of PFAS in the environment, these compounds are ubiquitous in the waterways of urban environment and are frequently found in potable and non-potable water supplies and in the human food chain. For most people, food is the primary source of exposure to PFAS (EFSA, 2020).

Consistent with the guidance provided in the ASC NEPM (NEPC, 1999), these other sources of exposure should be included in the HHRA. The TRV is linked to a tolerable total intake from all sources, which includes the site under investigation and background sources. If there is a likelihood of significant background exposure, a portion of the TRV should be assigned to the background before comparing exposures from site contamination to the TRV.

It is standard practice internationally to include a factor in the development of water quality standards, termed the Relative Source Contribution (RSC). The ADWG (NHMRC/NRMMC, 2011) default RSC of 0.1 assumes that a person gets only 10% of their daily PFAS exposure from drinking water, with the other 90% assumed to come from other sources (e.g., food, soil). This approach has been adopted by Australian regulators in the derivation of drinking water guidelines for PFAS (DoH, 2019) but is not appropriate for use in a HHRA that incorporates site-specific estimates of PFAS exposure via multiple pathways.

D-2-2 Background exposure studies

A variety of studies have been undertaken both within Australia and internationally on background PFAS exposures. Key studies are summarised herein.

Based on Australian biomonitoring data collected between 2010 and 2011, a report prepared by the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE, 2017) estimated a background intake rate of 0.89 ng/kg per day for PFOS. This value represents approximately 4.5% of the TRV presented in Section 4.1.

A study undertaken on the general population in Norway by Poothong *et al.* (2020), assessed the relative PFAS exposure associated with the ingestion of food and drinks, inhalation of air, ingestion of dust and dermal absorption. Although a high degree of variability was noted between study participants and PFAS exposures were generally very low, diet was the predominant exposure pathway. For PFOS 95% and 3% of the total PFOS intake came from dietary intakes and air inhalation, respectively, with dust ingestion and dermal absorption contributing less than 1% of the PFOS total intake.

EFSA (2020) undertook an evaluation on the risks to human health related to the presence of PFAS in food, which included measuring the PFAS concentration in over 90,000 food samples from 16 countries. This study indicated that the mean PFAS concentrations measured in food were of the most relevance to the assessment of PFAS exposures at a population level and the lower bound exposure estimates aligned most closely to the available data on PFAS concentrations in human blood. The mean lower bound dietary PFAS exposure estimates across surveys and age groups were generally similar and can be summarised as follows:

– PFOS: 0.23 – 2.6 ng/kg/day (1.2% to 13% of the TRV presented in Section 4.1)
– PFHxS: 0.04 - 0.36 ng/kg/day (0.2% to 1.8% of the TRV presented in Section 4.1)

The groups with the highest dietary exposures, when expressed in units of ng/kg/day were young children and the very elderly. Seafood was the primary source of PFAS exposure in most of the populations studied, with PFAS concentrations in freshwater fish being greater than those in marine fish. EFSA (2020) reported that dietary PFAS exposure was dominated by PFOS, PFHxS, PFOA and PFNA, with these compounds contributing to 46% of total dietary PFAS exposure.

A formal dietary exposure assessment has not been undertaken for PFAS in Australia, due to deficiencies in the available dataset (FSANZ, 2017), but the *24th Australian Total Diet Study (ATDS)* (FSANZ, 2016) included the analysis of PFAS in a range of foods sampled from a range of different retail outlets representing the buying habits of most of the community. The ATDS reported no detections for PFOA and only two detections for PFOS out of 50 foods tested and the concentrations of PFOS were at very low levels (1 part per billion). On this basis, FSANZ (2017) concluded that dietary exposure to PFAS from the general Australian food supply is likely to be low, with substantial PFAS exposure from food generally only likely to occur at PFAS contaminated sites.

Thompson *et al.* (2010) outline a pharmacokinetic modelling approach to characterize exposure of Australians to PFOS. Key parameters for this model include the elimination rate constants and the volume of distribution within the body and the serum concentrations of PFOS measured in the Australian population. The pharmacokinetic modelling estimated PFOS intake rates of between 1.1 – 2.3 ng/kg/day, for males and females aged 11 to 75 years (note that these values were presented in a corrigendum to the primary paper). The average intake rate of 1.5 ng/kg/day represents 7.4% of TRV presented in Section 4.1. The authors of the paper note that physiological differences between adults and children mean that the children (<11 years), who were not included in the study, could demonstrate higher chemical intake rates than adults when expressed per unit of body weight.

Nilsson (2022) assessed the PFAS blood serum concentration in current and former employees of an Australian corporation providing firefighting services, where aqueous film forming foam (AFFF) had been previously used (from the 1980s up until 2010). The authors found that the mean (arithmetic) serum concentrations of PFOS (27 ng/mL), PFHxS (14 ng/mL), and perfluoroheptane sulfonate (PFHpS, 1.7 ng/mL) among the participating firefighters were higher than the mean concentration of the general Australian population. The authors also noted that the reported serum concentrations were associated with the previous use of PFOS/PFHxS based AFFF.

D-2-3 Background exposure estimates

Overall, the available studies suggest that background exposures to PFAS in the general population are likely to be very low and that the background exposures that do occur are likely to occur primarily via the dietary pathway. The background exposure estimates for PFOS+PFHxS, made based on the studies outlined above range from range from 4.5% (CRC CARE, 2017; dietary exposure to PFOS in Australia) to 14.8% (EFSA, 2020; upper end of the range of mean dietary exposures estimates across survey and age groups in Europe).

A background exposure assumption of 10% has been adopted in this assessment, as a reasonable representation of the long-term background exposures that may be experienced by the Australian population.

D-3 Residential exposure scenario

D-3-1 Incidental ingestion of soil and dust

The incidental ingestion of soil and dust is an important exposure pathway for soil-borne contaminants. Young children are particularly prone to ingesting soil and dust as they have greater contact with soil during play and have not developed the avoidance strategies used by older individuals. Soil ingestion can occur both in the outdoor environment and indoors, where soil has been tracked in on shoes or clothing or blown indoors by the wind (enHealth, 2012a).

Rates of soil and dust ingestion have been studied overseas, using the tracer element methodology. These studies have been reviewed in detail by the US EPA (2008) and based on the recommendations provided in this document, enHealth (2012a) recommends the following default soil and dust ingestion rates:

– Children 0 to 1 years: 60 mg/day.
– Children 1 to 15 years: 100 mg/day, noting that for older children in this age range, this default assumption is likely to be conservative.
– Adults: 50 mg/day.

EnHealth (2012a) notes that for residences with a garden it can be assumed that up to approximately 50% of indoor dust is outdoor soil, with the remainder typically originating from sources including cooking and heating, residues from building components, hair, fibres, moulds and pollens.

The soil and dust ingestion rates recommended by the ASC NEPM and enHealth (2012a) have been used as the basis for the assumptions adopted in this assessment, with adjustments made to reflect site-specific circumstances, as summarised in Table D.8.1.

Table D.8.1 Incidental soil ingestion rate assumptions

Exposure scenario	Receptor	Soil and dust ingestion rate (mg/day)	Rationale
Future residents of Zones 2a and 2b	Children under a low-density residential setting	100	The NSW OEH (2019) soil and dust ingestion rate for residential land uses.
	Adults under a low-density residential setting	50	The NSW OEH (2019) soil and dust ingestion rate for residential land uses.
	Construction and intrusive maintenance worker	330	The soil and dust ingestion rate recommended by Friebel and Nadebaum (2011) for intrusive workers

D-3-2 Inhalation of dust

The HHRA has considered exposure to PFAS via the inhalation of dust from contaminated soil, both indoors and outdoors, in line with the ASC NEPM approach. Calculations and input data are shown in Appendix E. Exposure via this pathway depends on three key factors, as discussed below.

1. **Outdoor dust concentrations** – For residential settings, soil-derived dust concentrations in outdoor air were calculated using an outdoor particulate emission factor (PEF_o) based on models presented in EA (2009) and US EPA (2002). These models relate the concentration of respirable dust particles (diameter <10 µm) in the air with wind speed (site-specific), surface cover (assumed to be 75% hard surface under residential settings, in line with the ASC NEPM), and the area of the investigated area (i.e., Zones 2a and 2b) occupied by exposed soil.

   The outdoor dust concentration was assumed to consist of 100% site-derived soil, a conservative approach.
2. **Indoor dust concentrations** – Soil-derived dust concentrations in indoor air were calculated using the approach proposed by EA (2009) that assumes indoor dust concentrations equilibrate with outdoor dust levels through natural building ventilation. Indoor air is considered to be enriched with dust compared to the outdoor environment due to the movement of dust indoors on, for instance, clothing and footwear. The indoor dust concentration (i.e., dust loading factor – DL) is assumed to be equal to the 95th percentile from Australian data (enHealth, 2012a), which is 39 µg/m^3. Approximately 50% of indoor dust was assumed to derived from the soil in Zones 2a and 2b, while the rest from other sources (largely resuspension of floor dust), in line with the ASC NEPM. Based on this assumption an indoor particulate emission factor (PEF_i) was calculated as shown in Appendix E.
3. **Dust lung retention factor** – In accordance with the ASC NEPM, a dust lung retention factor (LF) of 37.5% was used in this HHRA to estimate the percentage of respirable dust that is small enough to be retained in lungs and is associated with health effects.

D-3-3 Bioaccumulation in fruit and vegetables

This HHRA considered the bioaccumulation of PFAS in homegrown fruit and vegetables grown in Zones 2a and 2b via two migration pathways as follows:

– The uptake of PFAS from shallow groundwater in Zone 2a.
– The uptake of PFAS from soil in Zones 2a and 2b.

The critical factor determining the influence of PFAS concentrations in soil and shallow groundwater uptake on the PFAS concentrations in domestically produced fruit and vegetables, is the efficiency with which PFAS is transferred from the water and soil to plants.

The NSW Office of Environment and Heritage (OEH, 2019) details the methodologies used to derive the HILs adopted in the PFAS NEMP for PFAS in soil, with the HIL A values incorporating consideration of the uptake of PFOS and PFHxS impacts in soil by plants. The transfer factors adopted in this document for PFOS+PFHxS are as follows:

– Green vegetables: 0.2
– Root vegetables: 0.13
– Tuber vegetables: 0.05
– Tree fruit: 0.005

OEH (2019) also notes that while the extent to which PFHxS are transferred from soil to plant tissues is less studied than for PFOS, the available studies suggest that uptake from soil of shorter chain PFAAs (e.g. PFHxS) is greater than longer chain PFAAs (e.g. PFOS). Based on the geometric mean of the ratio of the transfer factors reported in the scientific literature for PFHxS relative to the those reported for PFOS, OEH (2019) multiplies the PFOS transfer factors by 6.9 to derive transfer factors relevant to PFHxS.

The draft PFAS NEMP 3.0 (HEPA, 2022) includes a review of the PFAS NEMP plant transfer factors. The updated transfer factors are generally consistent with the original values, with the exception of the tree fruit with a higher value (0.015) recommended.

The OEH (2019) document provides the most detailed review of PFOS, and PFHxS plant transfer factors published in an Australian guideline document. The OEH (2019) PFOS transfer factors for fruit and vegetables from soil have been adopted in this assessment with the recommended 6.9 scaling factor applied. The marginally higher transfer factor identified by HEPA (2022) has also been adopted for tree fruit, as a conservative approach.

Blaine *et al.* (2014) completed a study that assessed the relative effect of PFAS impacted biosolids and PFAS-impacted reclaimed water on the accumulation of PFAS by lettuce and strawberry plants in a soil media. The key results of this study were as follows:

– Approximately linear relationships between the PFOS and PFHxS concentrations in the reclaimed water and the concentrations in the lettuce tissue, with average wet weight transfer factors of 0.3 and 0.6. PFOS and PFHxS were not detected in strawberry plants irrigated with reclaimed water, with only short chain PFAS detected
– Lower transfer factors for PFOS and PFHxS were demonstrated in the irrigated lettuce plants grown in soils with higher concentrations of organic carbon, suggesting that the bioavailability of PFOS and PFHxS in irrigation water may have been reduced via complexing with organic carbon in soil.
– The transfer factors demonstrated by lettuce plants grown in PFAS-impacted biosolids-amended soils were lower than those demonstrated by lettuce plants irrigated with PFAS impacted reclaimed water. This difference was hypothesized to be related to the occurrence of immediate plant uptake of aqueous supplied PFAS, prior to adsorption in the soil
– The difference in the transfer factor associated with PFAS delivered via irrigation and biosolids amendment was greater for shorter chain compounds than for longer chain compounds, such as PFOS (carbon chain length 8) and PFHxS (carbon chain length 6).

The OEH (2019) review is specific to soil borne PFAS and the data presented by Blaine *et al.* (2014) suggests that PFOS and PFHxS in water may be more bioavailable. Limited studies specific to the assessment of PFAS uptake from groundwater or irrigation water have been identified and, therefore, the OEH (2019) transfer factors have been used as the basis for the exposure assessment in this HHRA. These values have, however, been adjusted upwards by a factor of 5, to reflect to possibility that PFOS and PFHxS contained in shallow groundwater may be more bioavailable than soil borne PFOS and PFHxS.

As a conservative approach is has been assumed that 50% of the water required by homegrown plants is obtained from shallow/perched groundwater within Zone 2a.

An impacted shallow aquifer is not known to be present in Zone 2b (upgradient of the site). Hence, this exposure pathway was not included for future residents of Zone 2b.

The plant transfer modelling algorithms and the modelling inputs and outputs is provided in Appendix E.

D-4 Intrusive maintenance workers and construction workers

The ASC NEPM does not provide default exposure assumptions for intrusive maintenance workers, but it is anticipated that the development of the Buffer Area could involve a concentrated period of work that may involve the disturbance of PFAS impacted soil, such as earthworks and the installation of subsurface infrastructure.

In the development of assessment levels for petroleum hydrocarbons, Friebel and Nadebaum (2011) adopt exposure duration, frequency and exposure time assumptions of 20 days per year and 9 hours per day, to reflect the exposure that may be experienced by workers during major subsurface upgrade or repair works. In this case, the HIL D exposure assumptions (i.e. 240 days per year and 9 hours per day) have been adopted, given that the Renewal SA development within the Buffer Area could take an extended period.

GHD adopted a PEF_o for outdoor air based on the 95th percentile outdoor dust concentrations reported by enHealth (2012a). This reflects open areas with poor groundcover that are used for activities, such as sporting games, that involve the generation of dust; this is considered appropriate for construction and maintenance workers. The soil and dust ingestion rate of 330 mg/day was adopted based on OEH (2019).

The exposure model inputs and equations are shown in Appendix E.

Appendix E

Human Health Risk Assessment modelling inputs and outputs

Area	Zone 2a
Exposure Meda	Groundwater
Exposure Scenario	Residential (Low Density)
Receptor Group	Children (2-6 years)
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Water quality inputs				
Concentration in water	**µg/L**	**1.95**	Maximum concentration in Zone 2a (TW01)	Site-specific
Concentration in water (C_w)	**mg/L**	**0.00195**	Maximum concentration in Zone 2a (TW01)	Site-specific
Percentage PFHxS	**%**	**48%**	Distribution of PFOS/PFHxS in TW01	Site-specific
Risk calculations				
HI_{Total}	-	**9.5E-02**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
HQ_{Garden}	-	**9.5E-02**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
Intake calculations				
$Intake_{Total}$	mg/kg/day	**1.7E-06**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Garden}$	mg/kg/day	**1.7E-06**	$Intake_{Garden} = \frac{C_{Garden}\ x\ IR_{Garden}\ x\ F_{HG_garden}\ x\ BIO\ x\ EF\ x\ ED}{BW\ x\ AT}$	
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	19	Mean body weight of children aged 2-6 years.	FSANZ (2017)
Averaging time (AT)	days	2190	Exposure duration x 365 days/yr	ASC NEPM
Exposure frequency (EF)	days/yr	365	Daily - permanent resident	NEPC (1999)
Exposure duration (ED)	years	6	Childhood	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Fruit and vegetable consumption exposure inputs				
Fraction of water up-taken from aquifer (F_{Water_Garden})	%	50%	Assumes that 50% of the water required by homegrown plants is from shallow impacted groundwater.	Assumption
Fraction of homegrown produce (F_{HG_Garden})	%	10%	Standard assumption for low density residential settings	ASC NEPM
Concentration in green vegetables ($C_{GreenVeg}$)	mg/kg	3.7E-03	$C_{Produce} = TF_{Produce}\ x\ C_w\ x\ F_{Water_Garden}$	OEH (2019)
Concentration in root vegetables ($C_{RootVeg}$)	mg/kg	2.4E-03		OEH (2019)
Concentration in tuber vegetables ($C_{TuberVeg}$)	mg/kg	9.3E-04		OEH (2019)
Concentration in fruit (C_{Fruit})	mg/kg	2.8E-04		OEH (2019)
Green vegetable consumption rate ($C_{GreenVeg}$)	kg/day	5.5E-02	Mean total fruit and vegetable consumption rates reported for the Australian population (2-6 years)	OEH (2019)
Root vegetable consumption rate ($C_{RootVeg}$)	kg/day	1.7E-02		
Tuber vegetable consumption rate ($C_{TuberVeg}$)	kg/day	2.8E-02		
Fruit consumption rate ($C_{FruitVeg}$)	kg/day	1.8E-01		
Transfer to green vegetables ($TF_{GreenVeg}$)	L/kg	3.83	The maximum wet weight transfer factor for each produce category in soil, adjusted upwards by a factor of 5, to reflect the potenital for PFAS in irrigation water to be more bioavailable than PFAS in soil. The PFOS+PFHxS transfer factor reflects the proportion of PFHxS in water and a multiplier of 6.9	OEH (2019)
Transfer to root vegetables ($TF_{RootVeg}$)	L/kg	0.96		OEH (2019)
Transfer to tuber vegetables ($TF_{TuberVeg}$)	L/kg	2.49		OEH (2019)
Transfer to fruits (TF_{Fruit})	L/kg	0.29		PFAS NEMP 3.0

Area	Zone 2a
Exposure Meda	Soil
Exposure Scenario	Residential (Low Density)
Receptor Group	Children (2-6 years)
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Soil quality inputs				
Concentration in soil (C_s)	**mg/kg**	**0.066**	Maximum concentration in Zone 2a (SS04)	Site-specific
Percentage PFHxS	**%**	**0%**	PFHxS was below the LoR in the majority of Zone 2a soil samples	Site-specific
Risk calculations				
HI_{Total}	-	**3.5E-01**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{Ingestion}$	-	**1.9E-02**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**1.5E-06**		
HQ_{Garden}	-	**3.3E-01**		
Intake calculations				
$Intake_{Total}$	mg/kg/day	**6.4E-06**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Ingestion}$	mg/kg/day	**3.5E-07**	$Intake_{Ingestion} = \frac{C_s\ x\ IR_s x\ EF\ x\ ED}{BW\ x\ AT}$	
$Intake_{Inhalation}$	mg/m^3	**9.2E-11**	$Intake_{Inhalation} = \frac{C_s\ x\ \left(\frac{1}{PEF_o}\ x\ ET_o + \frac{1}{PEF_i} x\ TF\ x\ ET_i\right) x\ LFx\ EF\ x\ ED}{AT}$	
$Intake_{Garden}$	mg/kg/day	**6.0E-06**	$Intake_{Garden} = \frac{C_{Garden}\ x\ IR_{Garden}\ x\ F_{HG_garden}\ x\ BIO\ x\ EF\ x\ ED}{BW\ x\ AT}$	
Pathway contribution calculations				
$Contribution_{Ingestion}$	%	5%	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculation
$Contribution_{Inhalation}$	%	0.001%		
$Contribution_{Homegrown_FruitVeg}$	%	95%		
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
$TRV_{Inhalation}$	mg/m^3	0.00007	Calculated based on the TRV and an adult inhaltion rate of $20m^3$/day	ASC NEPM
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	19	Mean body weight of children aged 2-6 years.	FSANZ (2017)
Averaging time (AT)	days	2190	Exposure duration x 365 days/yr. Multipled by 24 for inhalation exposures	ASC NEPM
Exposure frequency (EF)	days/yr	365	Daily - permanent resident	NEPC (1999)
Exposure duration (ED)	years	6	Childhood	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Soil ingestion exposure inputs				
Ingestion rate (IR_s)	mg/day	100	Average daily incidental soil ingestion rate	ASC NEPM
Inhalation exposure inputs				
Time Spent Outdoors (ET_o)	hr/day	4	Default value	ASC NEPM
Time Spent Indoors (ET_i)	hr/day	20	Default value	ASC NEPM
Fraction of indoor dust comprised of soil (TF)	-	0.0	Default value	ASC NEPM
Particle emission factor (PEF_o)	m^3/kg	4.5E+07	Calculated	ASC NEPM
Indoor dust factor (PEF_i)	m^3/kg	2.6E+07	Calculated	ASC NEPM
Lung retention factor (LF)	-	0.375	Default value	ASC NEPM
Fruit and vegetable consumption exposure inputs				
Fraction produced in impacted soil ($F_{IGarden}$)	%	100%	Site specific assumption - assumes that the produce garden has the maximum PFOS+PFHxS concentration reported in Zone 2a	Assumption
Fraction of homegrown produce (F_{HG_Garden})	%	10%	Standard assumption for low density residential settings	ASC NEPM
Concentration in green vegetables ($C_{GreenVeg}$)	mg/kg	1.3E-02	$C_{Produce} = TF_{Produce}\ x\ C_s\ x\ F_{IGarden}$	OEH (2019)
Concentration in root vegetables ($C_{RootVeg}$)	mg/kg	8.6E-03		OEH (2019)
Concentration in tuber vegetables ($C_{TuberVeg}$)	mg/kg	3.3E-03		OEH (2019)
Concentration in fruit (C_{Fruit})	mg/kg	9.9E-04		OEH (2019)
Green vegetable consumption rate ($C_{GreenVeg}$)	kg/day	5.5E-02	Mean total fruit and vegetable consumption rates reported for the Australian population (2-6 years)	OEH (2019)
Root vegetable consumption rate ($C_{RootVeg}$)	kg/day	1.7E-02		
Tuber vegetable consumption rate ($C_{TuberVeg}$)	kg/day	2.8E-02		
Fruit consumption rate ($C_{FruitVeg}$)	kg/day	1.8E-01		
Transfer to green vegetables ($TF_{GreenVeg}$)	-	0.20	The maximum wet weight transfer factor for each produce category in soil. The PFOS+PFHxS transfer factor reflects the proportion of PFHxS in water and a multiplier of 6.9	OEH (2019)
Transfer to root vegetables ($TF_{RootVeg}$)	-	0.05		OEH (2019)
Transfer to tuber vegetables ($TF_{TuberVeg}$)	-	0.13		OEH (2019)
Transfer to fruits (TF_{Fruit})	-	0.02		PFAS NEMP 3.0

Area	Zone 2a
Exposure Meda	Soil and groundwater
Exposure Scenario	Residential (Low Density)
Receptor Group	Children (2-6 years)
Chemicals of Potential Concern	PFOS+PFHxS

Risk calculations						
Parameter	**Units**	**Groundwater**	**Soil**	**All Media**	**Details**	**Source**
HI_{Total}	-	**0.09**	**0.35**	**0.45**	$HI = \sum HQ_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$HQ_{IncidentalIngestion}$	-	0.00	**0.02**	**0.02**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	0.00	**0.00**	**0.00**		
HQ_{Garden}	-	**0.09**	**0.33**	**0.43**		
Pathway contribution calculations						
$Contribution_{Ingestion_Incidental}$	%	0%	**4%**	**4%**	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculated based on ASC NEPM algorithms
$Contribution_{Inhalation}$	%	0%	**0%**	**0%**		
$Contribution_{Homegrown_FruitVeg}$	%	**21%**	**75%**	**96%**		
All Pathways	%	**21%**	**79%**	**100%**		

Soil-to-Air Particulate Emission Factor Calculations

Exposure Parameter	Abbreviation	Units	Parameter	References
Area of site	A_{site}	Acres	0.50	Assumed as default (minimum)
Constant	A	-	11.68	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	B	-	23.49	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	C	-	288.00	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Dispersion factor	Q/C	$g/m^2/s$ per kg/m^3	89.03	Calculated according to US EPA (2002) methodology $Q/C = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$
Fraction of vegetative cover	V	Unitless	0.75	ASC NEPM default assumption
Mean annual windspeed	U_m	m/s	6.1	Site specific - Based on the mean 3 pm wind speed recorded at Parafield Airport (BoM Station no. 023013) between 1939 and 2010
Equivalent threshold value	U_t	m/s	7.2	ASC NEPM, Schedule B8; default as per UK EA (2009)
Constant	x	Unitless	1.0	Constant from Cowherd *et al.* (1985) $x = 0.886\frac{U_t}{U_m}$
Windspeed distribution function	F_x	Unitless	1.308	Calculated according to ASC NEPM $F_x = 0.18 \times (8x^3 + 12x)\exp(-x^2)$
Indoor dust loading factor	DL	mg/m^3	0.039	ASC NEPM, Schedule B7; 95th percentile from Australian data (enHealth 2012)
Particulate emission factor outdoor	PEF_o	mg/m^3	4.5E+07	Relates the concentration of respirable dust particles (<10 µm) in the air with wind speed, vegetative cover and the area of the site occupied by exposed soil. Assumes 100% site-derived soil $PEF_o\ (m^3/kg) = \frac{Q/C \text{ x } 3600}{0.036 \text{ x } (1-V) \text{ x } (\frac{U_m}{U_t})^3 \text{ x } F_x}$
Particulate emission factor indoor	PEF_i	mg/m^3	2.6E+07	Indoor dust concentrations are assumed to equilibrate with outdoor dust concentrations through building ventilation. Indoor air is also enriched with dust compared to the outdoor environment, due to the movement of dust indoors on clothing, footwear, etc., as described by the indoor dust loading factor (DL) $PEF_i\ (m^3/kg) = \frac{1}{DL \times 10^{-6}}$

Area	Zone 2b
Exposure Meda	Soil
Exposure Scenario	Residential (Low Density)
Receptor Group	Children (2-6 years)
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Soil quality inputs				
Concentration in soil (C_s)	**mg/kg**	**0.011**	Maximum concentration in Zone 2b (BH36)	Site-specific
Percentage PFHxS	**%**	**0%**	PFHxS concentrations were less than LoR in the majority of Zone 2b samples	Site-specific
Risk calculations				
HI_{Total}	-	**5.9E-02**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{Ingestion}$	-	**3.2E-03**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**1.3E-06**		
HQ_{Garden}	-	**5.6E-02**		
Intake calculations				
$Intake_{Total}$	mg/kg/day	**1.1E-06**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Ingestion}$	mg/kg/day	**5.8E-08**	$Intake_{Ingestion} = \frac{C_s\ x\ IR_s x\ EF\ x\ ED}{BW\ x\ AT}$	
$Intake_{Inhalation}$	mg/m^3	**8.2E-11**	$Intake_{Inhalation} = \frac{C_s\ x\ \left(\frac{1}{PEF_o}\ x\ ET_o + \frac{1}{PEF_i} x\ TF\ x\ ET_i\right) x\ LFx\ EF\ x\ ED}{AT}$	
$Intake_{Garden}$	mg/kg/day	**1.0E-06**	$Intake_{Garden} = \frac{C_{Garden}\ x\ IR_{Garden}\ x\ F_{HG_garden}\ x\ BIO\ x\ EF\ x\ ED}{BW\ x\ AT}$	
Pathway contribution calculations				
$Contribution_{Ingestion}$	%	5%	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculation
$Contribution_{Inhalation}$	%	0.008%		
$Contribution_{Homegrown_FruitVeg}$	%	95%		
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
$TRV_{Inhalation}$	mg/m^3	0.00007	Calculated based on the TRV and an adult inhaltion rate of $20m^3$/day	ASC NEPM
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	19	Mean body weight of children aged 2-6 years.	FSANZ (2017)
Averaging time (AT)	days	2190	Exposure duration x 365 days/yr. Multipled by 24 for inhalation exposures	ASC NEPM
Exposure frequency (EF)	days/yr	365	Daily - permanent resident	NEPC (1999)
Exposure duration (ED)	years	6	Childhood	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Soil ingestion exposure inputs				
Ingestion rate (IR_s)	mg/day	100	Average daily incidental soil ingestion rate	enHealth (2012)
Inhalation exposure inputs				
Time Spent Outdoors (ET_o)	hr/day	4	Default value	ASC NEPM
Time Spent Indoors (ET_i)	hr/day	20	Default value	ASC NEPM
Fraction of indoor dust comprised of soil (TF)	-	0.5	Default value	ASC NEPM
Particle emission factor (PEF_o)	m^3/kg	4.5E+07	Calculated	ASC NEPM
Indoor dust factor (PEF_i)	m^3/kg	2.6E+07	Calculated	ASC NEPM
Lung retention factor (LF)	-	0.375	Default value	ASC NEPM
Fruit and vegetable consumption exposure inputs				
Fraction produced in impacted soil ($F_{IGarden}$)	%	100%	Equivalent to all produce grown in soil with the maximum Zone 2b PFAS concentration	Assumption
Fraction of homegrown produce (F_{HG_Garden})	%	10%	Standard assumption for low density residential settings	ASC NEPM
Concentration in green vegetables ($C_{GreenVeg}$)	mg/kg	2.2E-03	$C_{Produce} = TF_{Produce}\ x\ C_s\ x\ F_{IGarden}$	OEH (2019)
Concentration in root vegetables ($C_{RootVeg}$)	mg/kg	1.4E-03		OEH (2019)
Concentration in tuber vegetables ($C_{TuberVeg}$)	mg/kg	5.5E-04		OEH (2019)
Concentration in fruit (C_{Fruit})	mg/kg	1.7E-04		OEH (2019)
Green vegetable consumption rate ($C_{GreenVeg}$)	kg/day	5.5E-02	Mean total fruit and vegetable consumption rates reported for the Australian population (2-6 years)	OEH (2019)
Root vegetable consumption rate ($C_{RootVeg}$)	kg/day	1.7E-02		
Tuber vegetable consumption rate ($C_{TuberVeg}$)	kg/day	2.8E-02		
Fruit consumption rate ($C_{FruitVeg}$)	kg/day	1.8E-01		
Transfer to green vegetables ($TF_{GreenVeg}$)	-	0.20	The maximum wet weight transfer factor for each produce category in soil. The PFOS+PFHxS transfer factor reflects the proportion of PFHxS in water and a multiplier of 6.9	OEH (2019)
Transfer to root vegetables ($TF_{RootVeg}$)	-	0.05		OEH (2019)
Transfer to tuber vegetables ($TF_{TuberVeg}$)	-	0.13		OEH (2019)
Transfer to fruits (TF_{Fruit})	-	0.02		PFAS NEMP 3.0

Area	Zone 2b
Exposure Meda	Soil
Exposure Scenario	Residential (Low Density)
Receptor Group	Children (2-6 years)
Chemicals of Potential Concern	PFOS+PFHxS

Risk calculations					
Parameter	**Units**	**Soil**	**All Media**	**Details**	**Source**
HI_{Total}	-	**0.06**	**0.06**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{IncidentalIngestion}$	-	**0.003**	**0.003**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**0.000001**	**0.000001**		
HQ_{Garden}	-	**0.06**	**0.06**		
Pathway contribution calculations					
$Contribution_{Ingestion_Incidental}$	%	**5%**	**5%**	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{\ Total}}\ x\ 100\%$	Calculated based on ASC NEPM algorithms
$Contribution_{Inhalation}$	%	**0%**	**0%**		
$Contribution_{Homegrown_FruitVeg}$	%	**95%**	**95%**		
All Pathways	%	**100%**	**100%**		

Soil-to-Air Particulate Emission Factor Calculations

Exposure Parameter	Abbreviation	Units	Parameter	References
Area of site	A_{site}	Acres	0.50	Assumed as default (minimum)
Constant	A	-	11.68	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	B	-	23.49	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	C	-	288.00	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Dispersion factor	Q/C	$g/m^2/s$ per kg/m^3	89.03	Calculated according to US EPA (2002) methodology $Q/C = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$
Fraction of vegetative cover	V	Unitless	0.75	ASC NEPM default assumption
Mean annual windspeed	U_m	m/s	6.1	Site specific - Based on the mean 3 pm wind speed recorded at Parafield Airport (BoM Station no. 023013) between 1939 and 2010
Equivalent threshold value	U_t	m/s	7.2	ASC NEPM, Schedule B8; default as per UK EA (2009)
Constant	x	Unitless	1.0	Constant from Cowherd *et al.* (1985) $x = 0.886\frac{U_t}{U_m}$
Windspeed distribution function	F_x	Unitless	1.308	Calculated according to ASC NEPM $F_x = 0.18 \times (8x^3 + 12x)\exp(-x^2)$
Indoor dust loading factor	DL	mg/m^3	0.039	ASC NEPM, Schedule B7; 95th percentile from Australian data (enHealth 2012)
Particulate emission factor outdoor	PEF_o	mg/m^3	4.5E+07	Relates the concentration of respirable dust particles (<10 µm) in the air with wind speed, vegetative cover and the area of the site occupied by exposed soil. Assumes 100% site-derived soil $PEF_o\ (m^3/kg) = \frac{Q/C \text{ x } 3600}{0.036 \text{ x } (1-V) \text{ x } (\frac{U_m}{U_t})^3 \text{ x } F_x}$
Particulate emission factor indoor	PEF_i	mg/m^3	2.6E+07	Indoor dust concentrations are assumed to equilibrate with outdoor dust concentrations through building ventilation. Indoor air is also enriched with dust compared to the outdoor environment, due to the movement of dust indoors on clothing, footwear, etc., as described by the indoor dust loading factor (DL) $PEF_i\ (m^3/kg) = \frac{1}{DL \times 10^{-6}}$

Area	Zone 2a
Exposure Meda	Groundwater
Exposure Scenario	Residential (Low Density)
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Water quality inputs				
Concentration in water	**µg/L**	**1.95**	Maximum concentration in Zone 2a groundwater (TW01)	Site-specific
Concentration in water (C_w)	**mg/L**	**0.00195**	Maximum concentration in Zone 2a groundwater (TW01)	Site-specific
Percentage PFHxS	**%**	**48%**	Distribution of PFOS/PFHxS in TW01	Site-specific
Risk calculations				
HI_{Total}	-	**6.2E-02**	$HI = \sum HQ_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
HQ_{Garden}	-	**6.2E-02**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
Intake calculations				
$Intake_{Total}$	mg/kg/day	**1.1E-06**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Garden}$	mg/kg/day	**1.1E-06**	$Intake_{Garden} = \frac{C_{Garden}\ x\ IR_{Garden}\ x\ F_{HG_garden}\ x\ BIO\ x\ EF\ x\ ED}{BW\ x\ AT}$	
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	70	Mean body weight of adults	FSANZ (2017)
Averaging time (AT)	days	12775	Exposure duration x 365 days/yr	ASC NEPM
Exposure frequency (EF)	days/yr	365	Daily - permanent resident	NEPC (1999)
Exposure duration (ED)	years	35	Defailt adult residential duration	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Fruit and vegetable consumption exposure inputs				
Fraction of water up-taken from aquifer (F_{Water_Garden})	%	50%	Assumes that 50% of the water required by homegrown plants is from shallow impacted groundwater.	Assumption
Fraction of homegrown produce (F_{HG_Garden})	%	10%	Default assumption for low density residential settings	ASC NEPM
Concentration in green vegetables ($C_{GreenVeg}$)	mg/kg	3.7E-03	$C_{Produce} = TF_{Produce}\ x\ C_w\ x\ F_{Water_Garden}$	OEH (2019)
Concentration in root vegetables ($C_{RootVeg}$)	mg/kg	2.4E-03		OEH (2019)
Concentration in tuber vegetables ($C_{TuberVeg}$)	mg/kg	9.3E-04		OEH (2019)
Concentration in fruit (C_{Fruit})	mg/kg	2.8E-04		OEH (2019)
Green vegetable consumption rate ($C_{GreenVeg}$)	kg/day	1.5E-01	Mean total fruit and vegetable consumption rates reported for the Australian population (2+ years)	OEH (2019)
Root vegetable consumption rate ($C_{RootVeg}$)	kg/day	4.7E-02		
Tuber vegetable consumption rate ($C_{TuberVeg}$)	kg/day	6.0E-02		
Fruit consumption rate ($C_{FruitVeg}$)	kg/day	1.4E-01		
Transfer to green vegetables ($TF_{GreenVeg}$)	L/kg	3.83	The maximum wet weight transfer factor for each produce category in soil, adjusted upwards by a factor of 5, to reflect the potenital for PFAS in irrigation water to be more bioavailable than PFAS in soil. The PFOS+PFHxS transfer factor reflects the proportion of PFHxS in water and a multiplier of 6.9	OEH (2019)
Transfer to root vegetables ($TF_{RootVeg}$)	L/kg	0.96		OEH (2019)
Transfer to tuber vegetables ($TF_{TuberVeg}$)	L/kg	2.49		OEH (2019)
Transfer to fruits (TF_{Fruit})	L/kg	0.29		PFAS NEMP 3.0

Area	Zone 2a
Exposure Meda	Soil
Exposure Scenario	Residential (Low Density)
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Soil quality inputs				
Concentration in soil (C_s)	**mg/kg**	**0.066**	Maximum concentration in Zone 2a soil	Site-specific
Percentage PFHxS	**%**	**0%**	PFHxS was below the LoR in the majority of Zone 2a soil samples	Site-specific
Risk calculations				
HI_{Total}	-	**2.2E-01**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{Ingestion}$	-	**2.6E-03**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**7.8E-06**		
HQ_{Garden}	-	**2.2E-01**		
Intake calculations				
$Intake_{Total}$	mg/kg/day	**4.0E-06**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Ingestion}$	mg/kg/day	**4.7E-08**	$Intake_{Ingestion} = \frac{C_s\ x\ IR_s x\ EF\ x\ ED}{BW\ x\ AT}$	
$Intake_{Inhalation}$	mg/m^3	**4.9E-10**	$Intake_{Inhalation} = \frac{C_s\ x\ \left(\frac{1}{PEF_o}\ x\ ET_o + \frac{1}{PEF_i} x\ TF\ x\ ET_i\right) x\ LF x\ EF\ x\ ED}{AT}$	
$Intake_{Garden}$	mg/kg/day	**3.9E-06**	$Intake_{Garden} = \frac{C_{Garden}\ x\ IR_{Garden}\ x\ F_{HG_garden}\ x\ BIO\ x\ EF\ x\ ED}{BW\ x\ AT}$	
Pathway contribution calculations				
$Contribution_{Ingestion}$	%	1%	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculation
$Contribution_{Inhalation}$	%	0.012%		
$Contribution_{Homegrown_FruitVeg}$	%	99%		
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
$TRV_{Inhalation}$	mg/m^3	0.00007	Calculated based on the TRV and an adult inhaltion rate of $20m^3$/day	ASC NEPM
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	70	Mean body weight of adults	FSANZ (2017)
Averaging time (AT)	days	12775	Exposure duration x 365 days/yr. Multipled by 24 for inhalation exposures	ASC NEPM
Exposure frequency (EF)	days/yr	365	Daily - permanent resident	NEPC (1999)
Exposure duration (ED)	years	35	Defailt adult residential duration	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Soil ingestion exposure inputs				
Ingestion rate (IR_s)	mg/day	50	Average daily incidental soil ingestion rate	ASC NEPM
Inhalation exposure inputs				
Time Spent Outdoors (ET_o)	hr/day	4	Default value	ASC NEPM
Time Spent Indoors (ET_i)	hr/day	20	Default value	ASC NEPM
Fraction of indoor dust comprised of soil (TF)	-	0.5	Default value	ASC NEPM
Particle emission factor (PEF_o)	m^3/kg	4.5E+07	Calculated	ASC NEPM
Indoor dust factor (PEF_i)	m^3/kg	2.6E+07	Calculated	ASC NEPM
Lung retention factor (LF)	-	0.375	Default value	ASC NEPM
Fruit and vegetable consumption exposure inputs				
Fraction produced in impacted soil ($F_{IGarden}$)	%	100%	Assumes produce is produced in soil with the maximum PFOS+PFHxS concentrations measured in Zone 2a	Assumption
Fraction of homegrown produce (F_{HG_Garden})	%	10%	Site specific assumption - standard assumption as per ASC NEPM	ASC NEPM
Concentration in green vegetables ($C_{GreenVeg}$)	mg/kg	1.3E-02	$C_{Produce} = TF_{Produce}\ x\ C_s\ x\ F_{IGarden}$	OEH (2019)
Concentration in root vegetables ($C_{RootVeg}$)	mg/kg	8.6E-03		OEH (2019)
Concentration in tuber vegetables ($C_{TuberVeg}$)	mg/kg	3.3E-03		OEH (2019)
Concentration in fruit (C_{Fruit})	mg/kg	9.9E-04		OEH (2019)
Green vegetable consumption rate ($C_{GreenVeg}$)	kg/day	1.5E-01	Mean total fruit and vegetable consumption rates reported for the Australian population (2+ years)	OEH (2019)
Root vegetable consumption rate ($C_{RootVeg}$)	kg/day	4.7E-02		
Tuber vegetable consumption rate ($C_{TuberVeg}$)	kg/day	6.0E-02		
Fruit consumption rate ($C_{FruitVeg}$)	kg/day	1.4E-01		
Transfer to green vegetables ($TF_{GreenVeg}$)	-	0.20	The maximum wet weight transfer factor for each produce category in soil. The PFOS+PFHxS transfer factor reflects the proportion of PFHxS in water and a multiplier of 6.9	OEH (2019)
Transfer to root vegetables ($TF_{RootVeg}$)	-	0.05		OEH (2019)
Transfer to tuber vegetables ($TF_{TuberVeg}$)	-	0.13		OEH (2019)
Transfer to fruits (TF_{Fruit})	-	0.02		PFAS NEMP 3.0

Area	Zone 2a
Exposure Meda	Soil and groundwater
Exposure Scenario	Residential (Low Density)
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Risk calculations						
Parameter	**Units**	**Groundwater**	**Soil**	**All Media**	**Details**	**Source**
HI_{Total}	-	**6.2E-02**	**0.22**	**0.28**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{IncidentalIngestion}$	-	0.0E+00	**0.00**	**0.003**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	0.0E+00	**0.00**	**0.00001**		
HQ_{Garden}	-	**6.2E-02**	**0.22**	**0.28**		
Pathway contribution calculations						
$Contribution_{Ingestion_Incidental}$	%	0%	**1%**	**1%**	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculated based on ASC NEPM algorithms
$Contribution_{Inhalation}$	%	0%	**0%**	**0%**		
$Contribution_{Homegrown_FruitVeg}$	%	**22%**	**77%**	**99%**		
All Pathways	%	**22%**	**78%**	**100%**		

Soil-to-Air Particulate Emission Factor Calculations

Exposure Parameter	Abbreviation	Units	Parameter	References
Area of site	A_{site}	Acres	0.50	Assumed as default (minimum)
Constant	A	-	11.68	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	B	-	23.49	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	C	-	288.00	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Dispersion factor	Q/C	$g/m^2/s$ per kg/m^3	89.03	Calculated according to US EPA (2002) methodology $Q/C = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$
Fraction of vegetative cover	V	Unitless	0.75	ASC NEPM default assumption
Mean annual windspeed	U_m	m/s	6.1	Site specific - Based on the mean 3 pm wind speed recorded at Parafield Airport (BoM Station no. 023013) between 1939 and 2010
Equivalent threshold value	U_t	m/s	7.2	ASC NEPM, Schedule B8; default as per UK EA (2009)
Constant	x	Unitless	1.0	Constant from Cowherd *et al.* (1985) $x = 0.886\frac{U_t}{U_m}$
Windspeed distribution function	F_x	Unitless	1.308	Calculated according to ASC NEPM $F_x = 0.18 \times (8x^3 + 12x)\exp(-x^2)$
Indoor dust loading factor	DL	mg/m^3	0.039	ASC NEPM, Schedule B7; 95th percentile from Australian data (enHealth 2012)
Particulate emission factor outdoor	PEF_o	mg/m^3	4.5E+07	Relates the concentration of respirable dust particles (<10 µm) in the air with wind speed, vegetative cover and the area of the site occupied by exposed soil. Assumes 100% site-derived soil $PEF_o\ (m^3/kg) = \frac{Q/C \text{ x } 3600}{0.036 \text{ x } (1-V) \text{ x } (\frac{U_m}{U_t})^3 \text{ x } F_x}$
Particulate emission factor indoor	PEF_i	mg/m^3	2.6E+07	Indoor dust concentrations are assumed to equilibrate with outdoor dust concentrations through building ventilation. Indoor air is also enriched with dust compared to the outdoor environment, due to the movement of dust indoors on clothing, footwear, etc., as described by the indoor dust loading factor (DL) $PEF_i\ (m^3/kg) = \frac{1}{DL \times 10^{-6}}$

Area	Zone 2a
Exposure Meda	Soil
Exposure Scenario	Commercial
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Soil quality inputs				
Concentration in soil (C_s)	**mg/kg**	**0.066**	Maximum concentration in Zone 2a soil	Site-specific
Percentage PFHxS	**%**	**0%**	PFHxS was below the LoR in the majority of Zone 2a soil samples	Site-specific
Risk calculations				
HI_{Total}	-	**1.1E-02**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{Ingestion}$	-	**1.1E-02**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**3.8E-06**		
Intake calculations				
$Intake_{Total}$	mg/kg/day	**2.0E-07**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Ingestion}$	mg/kg/day	**2.0E-07**	$Intake_{Ingestion} = \frac{C_s\ x\ IR_s x\ EF\ x\ ED}{BW\ x\ AT}$	
$Intake_{Inhalation}$	mg/m^3	**2.4E-10**	$Intake_{Inhalation} = \frac{C_s\ x\ \left(\frac{1}{PEF_o}\ x\ ET_o + \frac{1}{PEF_i} x\ TF\ x\ ET_i\right) x\ LFx\ EF\ x\ ED}{AT}$	
Pathway contribution calculations				
$Contribution_{Ingestion}$	%	100%	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculation
$Contribution_{Inhalation}$	%	0%		
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
$TRV_{Inhalation}$	mg/m^3	0.00007	Calculated based on the TRV and an adult inhaltion rate of $20m^3$/day	ASC NEPM
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	70	Mean body weight of adults	FSANZ (2017)
Averaging time (AT)	days	10950	Exposure duration x 365 days/yr. Multipled by 24 for inhalation exposures	ASC NEPM
Exposure frequency (EF)	days/yr	240	Standard five day working week	NEPC (1999)
Exposure duration (ED)	years	30	Working life of 30 years	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Soil ingestion exposure inputs				
Ingestion rate (IR_s)	mg/day	330	Average daily incidental soil ingestion rate for a worker in a trench	Friebel and Nadebaum (2011)
Inhalation exposure inputs				
Time Spent Outdoors (ET_o)	hr/day	9	Default value	ASC NEPM
Particle emission factor (PEF_o)	m^3/kg	2.6E+07	Calculated	ASC NEPM
Lung retention factor (LF)	-	0.375	Default value	ASC NEPM

Area	Zone 2a
Exposure Meda	Soil and groundwater
Exposure Scenario	Commercial
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Risk calculations					
Parameter	**Units**	**Soil**	**All Media**	**Details**	**Source**
HI_{Total}	-	**0.01**	**0.01**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{IncidentalIngestion}$	-	**0.01**	**0.01**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**0.00**	**0.00**		
Pathway contribution calculations					
$Contribution_{Ingestion_Incidental}$	%	**100%**	**100%**	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculated based on ASC NEPM algorithms
$Contribution_{Inhalation}$	%	**0%**	**0%**		
All Pathways	%	**100%**	**100%**		

Area	Zone 2b
Exposure Meda	Soil
Exposure Scenario	Residential (Low Density)
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Soil quality inputs				
Concentration in soil (C_s)	**mg/kg**	**0.011**	Maximum concentration in Zone 2b	Site-specific
Percentage PFHxS	**%**	**0%**	PFHxS concentrations in Zone 2b have generally been less than LoR	Site-specific
Risk calculations				
HI_{Total}	-	**3.7E-02**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{Ingestion}$	-	**4.4E-04**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**1.3E-06**		
HQ_{Garden}	-	**3.7E-02**		
Intake calculations				
$Intake_{Total}$	mg/kg/day	**6.7E-07**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Ingestion}$	mg/kg/day	**7.9E-09**	$Intake_{Ingestion} = \frac{C_s\ x\ IR_s x\ EF\ x\ ED}{BW\ x\ AT}$	
$Intake_{Inhalation}$	mg/m^3	**8.2E-11**	$Intake_{Inhalation} = \frac{C_s\ x\ \left(\frac{1}{PEF_o}\ x\ ET_o + \frac{1}{PEF_i} x\ TF\ x\ ET_i\right) x\ LFx\ EF\ x\ ED}{AT}$	
$Intake_{Garden}$	mg/kg/day	**6.6E-07**	$Intake_{Garden} = \frac{C_{Garden}\ x\ IR_{Garden}\ x\ F_{HG_garden}\ x\ BIO\ x\ EF\ x\ ED}{BW\ x\ AT}$	
Pathway contribution calculations				
$Contribution_{Ingestion}$	%	1%	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculation
$Contribution_{Inhalation}$	%	0.012%		
$Contribution_{Homegrown_FruitVeg}$	%	99%		
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
$TRV_{Inhalation}$	mg/m^3	0.00007	Calculated based on the TRV and an adult inhaltion rate of $20m^3$/day	ASC NEPM
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	70	Mean body weight of adults	FSANZ (2017)
Averaging time (AT)	days	12775	Exposure duration x 365 days/yr. Multipled by 24 for inhalation exposures	ASC NEPM
Exposure frequency (EF)	days/yr	365	Daily - permanent resident	NEPC (1999)
Exposure duration (ED)	years	35	Defailt adult residential duration	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Soil ingestion exposure inputs				
Ingestion rate (IR_s)	mg/day	50	Average daily incidental soil ingestion rate	enHealth (2012)
Inhalation exposure inputs				
Time Spent Outdoors (ET_o)	hr/day	4	Default value	ASC NEPM
Time Spent Indoors (ET_i)	hr/day	20	Default value	ASC NEPM
Fraction of indoor dust comprised of soil (TF)	-	0.5	Default value	ASC NEPM
Particle emission factor (PEF_o)	m^3/kg	4.5E+07	Calculated	ASC NEPM
Indoor dust factor (PEF_i)	m^3/kg	2.6E+07	Calculated	ASC NEPM
Lung retention factor (LF)	-	0.375	Default value	ASC NEPM
Fruit and vegetable consumption exposure inputs				
Fraction produced in impacted soil ($F_{IGarden}$)	%	100%	Assumes produce grown in soil with the maximum Zone 2b PFOS+PFHxS concentration	Assumption
Fraction of homegrown produce (F_{HG_Garden})	%	10%	Default assumption for low density residential settings	ASC NEPM
Concentration in green vegetables ($C_{GreenVeg}$)	mg/kg	2.2E-03	$C_{Produce} = TF_{Produce}\ x\ C_s\ x\ F_{IGarden}$	OEH (2019)
Concentration in root vegetables ($C_{RootVeg}$)	mg/kg	1.4E-03		OEH (2019)
Concentration in tuber vegetables ($C_{TuberVeg}$)	mg/kg	5.5E-04		OEH (2019)
Concentration in fruit (C_{Fruit})	mg/kg	1.7E-04		OEH (2019)
Green vegetable consumption rate ($C_{GreenVeg}$)	kg/day	1.5E-01	Mean total fruit and vegetable consumption rates reported for the Australian population (2+ years)	OEH (2019)
Root vegetable consumption rate ($C_{RootVeg}$)	kg/day	4.7E-02		
Tuber vegetable consumption rate ($C_{TuberVeg}$)	kg/day	6.0E-02		
Fruit consumption rate ($C_{FruitVeg}$)	kg/day	1.4E-01		
Transfer to green vegetables ($TF_{GreenVeg}$)	-	0.20	The maximum wet weight transfer factor for each produce category in soil. The PFOS+PFHxS transfer factor reflects the proportion of PFHxS in water and a multiplier of 6.9	OEH (2019)
Transfer to root vegetables ($TF_{RootVeg}$)	-	0.05		OEH (2019)
Transfer to tuber vegetables ($TF_{TuberVeg}$)	-	0.13		OEH (2019)
Transfer to fruits (TF_{Fruit})	-	0.02		PFAS NEMP 3.0

Area	Zone 2b
Exposure Meda	Soil
Exposure Scenario	Residential (Low Density)
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Risk calculations					
Parameter	**Units**	**Soil**	**All Media**	**Details**	**Source**
HI_{Total}	-	**0.04**	**0.04**	$HI = \sum HQ_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$HQ_{IncidentalIngestion}$	-	**0.0004**	**0.0004**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**0.000001**	**0.000001**		
HQ_{Garden}	-	**0.04**	**0.04**		
Pathway contribution calculations					
$Contribution_{Ingestion_Incidental}$	%	**1%**	**1%**	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculated based on ASC NEPM algorithms
$Contribution_{Inhalation}$	%	**0%**	**0%**		
$Contribution_{Homegrown_FruitVeg}$	%	**99%**	**99%**		
All Pathways	%	**100%**	**100%**		

Soil-to-Air Particulate Emission Factor Calculations

Exposure Parameter	Abbreviation	Units	Parameter	References
Area of site	A_{site}	Acres	0.50	Assumed as default (minimum)
Constant	A	-	11.68	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	B	-	23.49	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Constant	C	-	288.00	US EPA (2002); default value for the assessment of fugitive dust emissions at small sites
Dispersion factor	Q/C	$g/m^2/s$ per kg/m^3	89.03	Calculated according to US EPA (2002) methodology $Q/C = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$
Fraction of vegetative cover	V	Unitless	0.75	ASC NEPM default assumption
Mean annual windspeed	U_m	m/s	6.1	Site specific - Based on the mean 3 pm wind speed recorded at Parafield Airport (BoM Station no. 023013) between 1939 and 2010
Equivalent threshold value	U_t	m/s	7.2	ASC NEPM, Schedule B8; default as per UK EA (2009)
Constant	x	Unitless	1.0	Constant from Cowherd *et al.* (1985) $x = 0.886\frac{U_t}{U_m}$
Windspeed distribution function	F_x	Unitless	1.308	Calculated according to ASC NEPM $F_x = 0.18 \times (8x^3 + 12x)\exp(-x^2)$
Indoor dust loading factor	DL	mg/m^3	0.039	ASC NEPM, Schedule B7; 95th percentile from Australian data (enHealth 2012)
Particulate emission factor outdoor	PEF_o	mg/m^3	4.5E+07	Relates the concentration of respirable dust particles (<10 µm) in the air with wind speed, vegetative cover and the area of the site occupied by exposed soil. Assumes 100% site-derived soil $PEF_o\ (m^3/kg) = \frac{Q/C \text{ x } 3600}{0.036 \text{ x } (1-V) \text{ x } (\frac{U_m}{U_t})^3 \text{ x } F_x}$
Particulate emission factor indoor	PEF_i	mg/m^3	2.6E+07	Indoor dust concentrations are assumed to equilibrate with outdoor dust concentrations through building ventilation. Indoor air is also enriched with dust compared to the outdoor environment, due to the movement of dust indoors on clothing, footwear, etc., as described by the indoor dust loading factor (DL) $PEF_i\ (m^3/kg) = \frac{1}{DL \times 10^{-6}}$

Area	Zone 2b
Exposure Meda	Soil
Exposure Scenario	Commercial
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Soil quality inputs				
Concentration in soil (C_s)	**mg/kg**	**0.011**	Maximum concentration in Zone 2b soil (BH36)	Site-specific
Percentage PFHxS	**%**	**0%**	PFHxS concentrations were less than LoR in the majority of Zone 2b samples	Site-specific
Risk calculations				
HI_{Total}	-	**1.9E-03**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{Ingestion}$	-	**1.9E-03**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**6.3E-07**		
Intake calculations				
$Intake_{Total}$	mg/kg/day	**3.4E-08**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Ingestion}$	mg/kg/day	**3.4E-08**	$Intake_{Ingestion} = \frac{C_s\ x\ IR_s x\ EF\ x\ ED}{BW\ x\ AT}$	
$Intake_{Inhalation}$	mg/m^3	**4.0E-11**	$Intake_{Inhalation} = \frac{C_s\ x\ \left(\frac{1}{PEF_o}\ x\ ET_o + \frac{1}{PEF_i} x\ TF\ x\ ET_i\right) x\ LFx\ EF\ x\ ED}{AT}$	
Pathway contribution calculations				
$Contribution_{Ingestion}$	%	100%	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{\ Total}}\ x\ 100\%$	Calculation
$Contribution_{Inhalation}$	%	0%		
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
$TRV_{Inhalation}$	mg/m^3	0.00007	Calculated based on the TRV and an adult inhaltion rate of $20m^3$/day	ASC NEPM
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	70	Mean body weight of adults	FSANZ (2017)
Averaging time (AT)	days	10950	Exposure duration x 365 days/yr. Multipled by 24 for inhalation exposures	ASC NEPM
Exposure frequency (EF)	days/yr	240	Standard five day working week	NEPC (1999)
Exposure duration (ED)	years	30	Working life of 30 years	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Soil ingestion exposure inputs				
Ingestion rate (IR_s)	mg/day	330	Average daily incidental soil ingestion rate for a trench worker	Friebel and Nadebaum (2011)
Inhalation exposure inputs				
Time Spent Outdoors (ET_o)	hr/day	9	Default value	ASC NEPM
Particle emission factor (PEF_o)	m^3/kg	2.6E+07	Calculated	ASC NEPM
Lung retention factor (LF)	-	0.375	Default value	ASC NEPM

Area	Zone 2b
Exposure Meda	Soil and groundwater
Exposure Scenario	Commercial
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Risk calculations					
Parameter	**Units**	**Soil**	**All Media**	**Details**	**Source**
HI_{Total}	-	**0.002**	**0.002**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{IncidentalIngestion}$	-	**0.002**	**0.002**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**0.000**	**0.000**		
Pathway contribution calculations					
$Contribution_{Ingestion_Incidental}$	%	**100%**	**100%**	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculated based on ASC NEPM algorithms
$Contribution_{Inhalation}$	%	**0%**	**0%**		
All Pathways	%	**100%**	**100%**		

Area	Zone c
Exposure Meda	Soil
Exposure Scenario	Commercial
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Parameter	Unit	Value	Details	Source
Soil quality inputs				
Concentration in soil (C_s)	**mg/kg**	**0.22**	Maximum concentration in Zone 2c soil (BH26)	Site-specific
Percentage PFHxS	**%**	**0%**	PFHxS was less than LoR in BH26	Site-specific
Risk calculations				
HI_{Total}	-	**3.8E-02**	$HI = \sum HQ_{All\ pathwways}$	Calculated - based on ASC NEPM algorithms
$HQ_{Ingestion}$	-	**3.8E-02**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**1.3E-05**		
Intake calculations				
$Intake_{Total}$	mg/kg/day	**6.8E-07**	$Intake_{Total} = \sum Intake_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$Intake_{Ingestion}$	mg/kg/day	**6.8E-07**	$Intake_{Ingestion} = \frac{C_s\ x\ IR_s x\ EF\ x\ ED}{BW\ x\ AT}$	
$Intake_{Inhalation}$	mg/m^3	**7.9E-10**	$Intake_{Inhalation} = \frac{C_s\ x\ \left(\frac{1}{PEF_o}\ x\ ET_o + \frac{1}{PEF_i} x\ TF\ x\ ET_i\right) x\ LFx\ EF\ x\ ED}{AT}$	
Pathway contribution calculations				
$Contribution_{Ingestion}$	%	100%	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{\ Total}}\ x\ 100\%$	Calculation
$Contribution_{Inhalation}$	%	0%		
General toxicity and exposure inputs				
TRV	mg/kg/day	0.00002	Based on body weight effects in animal reproductive toxicity studies	FSANZ (2017)
$TRV_{Inhalation}$	mg/m^3	0.00007	Calculated based on the TRV and an adult inhaltion rate of $20m^3$/day	ASC NEPM
Background	%	10%	Conservative assumption, calculated on the basis dietary concentrations in Europe and serum concentrations in the Australian population	EFSA (2020), FSANZ (2017), Thompson (2010)
Body weight (BW)	kg	70	Mean body weight of adults	FSANZ (2017)
Averaging time (AT)	days	10950	Exposure duration x 365 days/yr. Multipled by 24 for inhalation exposures	ASC NEPM
Exposure frequency (EF)	days/yr	240	Standard five day working week	NEPC (1999)
Exposure duration (ED)	years	30	Working life of 30 years	ASC NEPM
Oral bioavailability (BIO)	-	1	Assumes that ingested PFAS is largely bioaccessible	OEH (2019)
Soil ingestion exposure inputs				
Ingestion rate (IR_s)	mg/day	330	Average daily incidental soil ingestion rate for a trench worker	Friebel and Nadebaum (2011)
Inhalation exposure inputs				
Time Spent Outdoors (ET_o)	hr/day	9	Default value	ASC NEPM
Particle emission factor (PEF_o)	m^3/kg	2.6E+07	Calculated	ASC NEPM
Lung retention factor (LF)	-	0.375	Default value	ASC NEPM

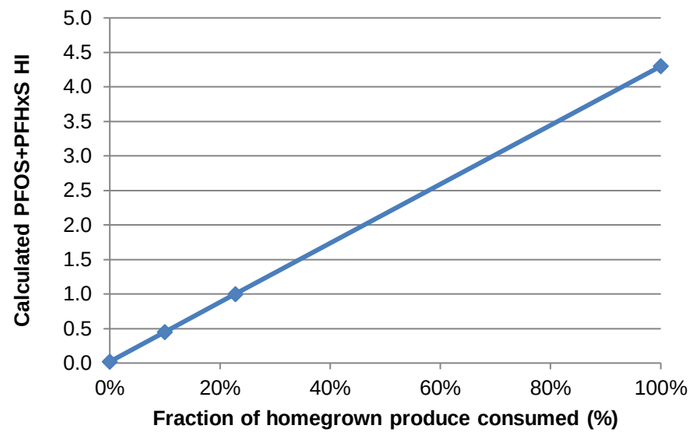
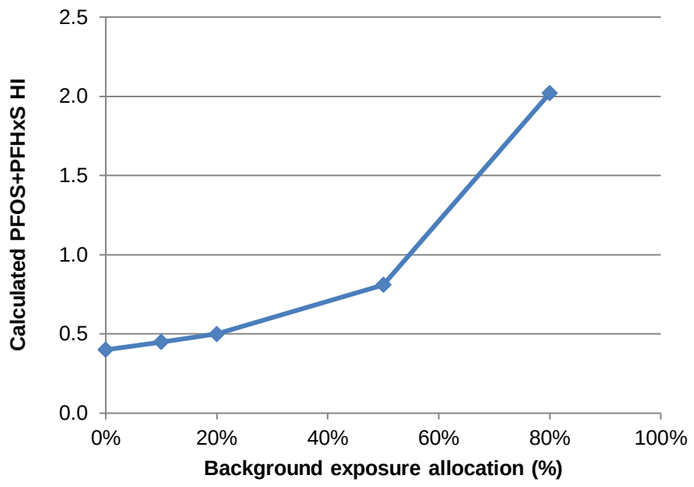
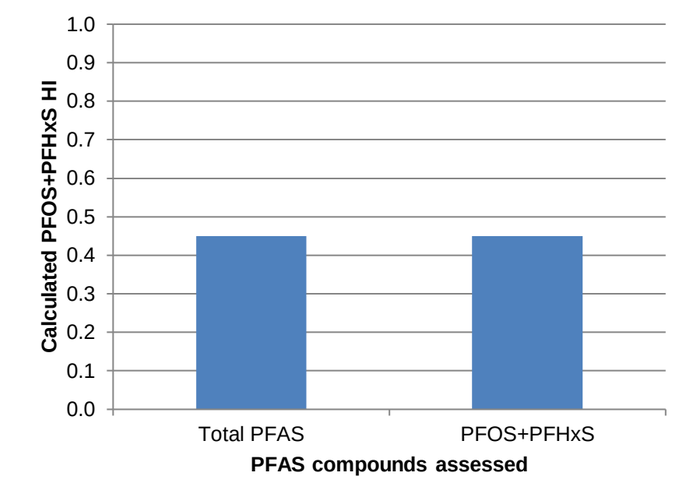
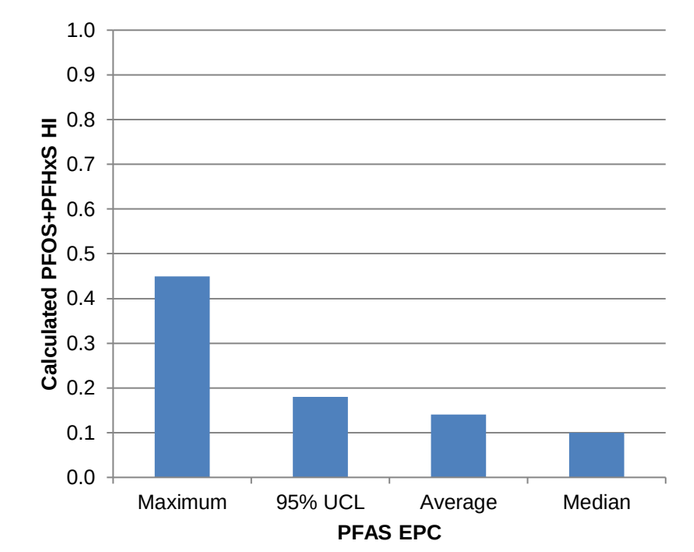
Area	Zone 2c
Exposure Meda	Soil and groundwater
Exposure Scenario	Commercial
Receptor Group	Adults
Chemicals of Potential Concern	PFOS+PFHxS

Risk calculations					
Parameter	**Units**	**Soil**	**All Media**	**Details**	**Source**
HI_{Total}	-	**0.038**	**0.038**	$HI = \sum HQ_{All\ pathways}$	Calculated - based on ASC NEPM algorithms
$HQ_{IncidentalIngestion}$	-	**0.038**	**0.038**	$HQ_{Pathway} = \frac{Intake_{Pathway}}{TRV\ x\ (100\% - Background)}$	
$HQ_{Inhalation}$	-	**0.000**	**0.000**		
Pathway contribution calculations					
$Contribution_{Ingestion_Incidental}$	%	**100%**	**100%**	$Contribution_{Pathway} = \frac{Intake_{Pathway}}{Intake_{Total}}\ x\ 100\%$	Calculated based on ASC NEPM algorithms
$Contribution_{Inhalation}$	%	**0%**	**0%**		
All Pathways	%	**100%**	**100%**		

Appendix F

Human Health Risk Assessment sensitivity analysis

Sensitivity Analysis - Future child resident of Zone 2a
Human Health Risk Assessment

Input Variable	Input Selection	Hazard Index (-)	% Change	Graphical Representation	Relative Variable Sensitivity	Relative Variable Uncertainty in HHRA
Domestic consumption rates of homegrown vegetables and fruit for Zone 2a children (% of total intake).						
100%	It assumes that all vegetables and fruits consumed by children are homegrown, plants grow in contaminated soil, and plants uptake shallow groundwater.	4.30	856%		Moderate: The HI varied by >900% across the range of inputs. Risks remain low (HI<1) up to a homegrown fruit and vegetable consumption of 68% of total intake. Above this value risks become moderate with HI>1 but <10.	Low: Fruit and vegetable consumption rates are likely to vary between individuals. However, given the setting of Zone 2a, it is implausible that more than 20% of the intake is homegrown.
23%	It assumes that 30% of vegetables and fruits consumed by children are homegrown, plants grow in contaminated soil, and plants uptake shallow groundwater.	1.00	122%			
10%	Standard residential setting (e.g., NEPM and PFAS NEMP) assumes 10% homegrown produce. This was adopted in the HHRA.	0.45	0%			
0%	Children consume no homegrown fruit and vegetables.	0.02	-96%			
The influence of the child background PFOS+PFHxS exposure allocation (%) on the HI for future child residents of Zone 2a						
80%	The background exposure assumption adopted by OEH (2019) in the derivation of the Health Investigation Levels presented in the PFAS NEMP	2.02	349%		Moderate: The HI varied by >300% across the range of inputs. The highest HI calculated is above 1 but well below 10. This indicates that risk would be low or moderate even in a scenario of elevated background exposure.	Moderate: Limited data are available regarding the background PFAS exposures experienced by the general population in Adelaide, but the available data suggests that this is relatively low in normal circumstances.
50%	Nominal intermediate background exposure allocation	0.81	80%			
20%	The background exposure assumption adopted in the derivation of drinking water quality guidelines for PFOS in the US	0.50	11%			
10%	Background exposure assumption adopted in this HHRA; a conservative assumption made to address the uncertainty associated with the limited data available regarding the toxic effects of PFAS mixtures and dietary PFAS exposures in Australia	0.45	0%			
0%	Representative of minimal background exposure - aligns with the background exposure estimates made by FSANZ (2017)	0.40	-11%			
Influence of other PFAS in soil on the HI for child future residents of Zone 2a						
Total PFAS	HI based on total PFAS concentration assuming same toxicity as PFOS (0.066 mg/kg)	0.45	0%		Low: PFOS was the only PFAS detected in SS04	Low: PFOS is the main PFAS in Zone 2a and only PFOS was reported in the soil sample that reported the maximum PFAS concentration.
PFOS+PFHxS	HI based on the maximum concentration of PFOS+PFHxS in soil (0.066 mg/kg)	0.45	0%			
Influence of soil EPC on the risk estimates for children in Zone 2a.						
Maximum	Maximum PFOS+PFHxS concentration in Zone 2a soil	0.45	0%		Moderate: The HI varied by ~80% across the range of inputs.	Moderate: The PFAS concentrations in soil vary spatially. A reasonable number of soil samples have been collected.
95% UCL	95% UCL mean PFOS+PFHxS concentration in Zone 2a soil	0.18	-60%			
Average	Average PFOS+PFHxS concentration in Zone 2a soil	0.14	-69%			
Median	Median PFOS+PFHxS concentration in Zone 2a soil	0.10	-78%			
	Value adopted in the risk characterisation process					

Appendix G

Ecological receptor identification

G-1 Introduction

The receptor identification process focuses on identifying the species that may be at risk and the ecological values that need to be protected (NEPC, 1999).

G-1-1 Legislative framework

In South Australia, Federal and State Government legislation that protects ecological communities, flora, and fauna, includes:

- The EPBC Act is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).
  - This database[2] contains data on the distribution of species related to the EPBC Act. The distributions are produced by ecologists in the Department using modelling software and environmental data to map the known and predicted areas of occurrence of EPBC Act listed species and habitat. The EPBC Act is administered by the Department of Climate Change, Energy, the Environment and Water (DCCEEW).
- The *Native Vegetation Act 1991*, which provides protection for native vegetation in South Australia from small ground covers and native grasses to large trees and water plants.
- *Landscape South Australia Act 2019* that protects biodiversity, the resources on which plants and wildlife depend on, and control activities that threaten them.
- *Fisheries Management Act 2007*, which controls conservation and management of the aquatic resources of South Australia including aquatic habitats, aquatic mammals, and exotic organisms.
- *Environment Protection (Water Quality) Policy 2015* provides a framework for managing protection of South Australian waters.

G-1-2 Data sources

The ecological receptors relevant to the Investigation Area and its surroundings have been identified based on observations made in the field and on government managed databases and tools. Table G.8.2 presents the published information sources utilised in this assessment.

Table G.8.2 Desktop information sources

Aspect	Information source
Aquatic ecosystem	*WaterConnect* and *Enviro Data SA* databases provided by the Government of South Australia (Department for Environment and Water).
Flora and fauna species including species and ecological communities of conservation significance	*NatureMaps* database and other resources provided by South Australia's Department for Environment and Water such as *eFloraSA* *Atlas of Living Australia* (2024)
Matters of National Environmental Significance (MNES)	EPBC Act Protected Matters Search Tool (DCCEEW, 2024)
Investigation Area-specific habitat and biota details	Observations made by GHD environmental scientists during the DSI (GHD, 2024)

A search area of ~3,600 hectares (refer to the maps reported at the end of this appendix) was adopted as part of the databases searches based on the following:

- The search area is significantly wider than the Investigation Area and includes all sampling locations to account for local ecological receptor movements.
- The search area considers both resident species and those that may migrate through or use the Investigation Area seasonally.

[2] https://www.dcceew.gov.au/environment/environmental-information-data/databases-applications/snes. Accessed on 27 March 2024.

The datasets extracted from the online databases including a map showing the location of threatened species are provided in at the end of this appendix.

G-2 Conservation Significant Features

A search of the EPBC Act database identified the following Matters of National Environment Significance within the Investigation Area:

– Two listed threatened ecological communities:
  - The endangered Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia; and
  - The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.
– 35 listed threatened species including the Australasian Bittern (*Botaurus poiciloptilus*), Sharp-tailed Sandpiper (*Calidris acuminata*), and the Australian Painted Snipe (*Rostratula australis*) that may feed on aquatic insects, crustaceans and molluscs and therefore be indirectly exposed to PFAS in the aquatic environment through the food web.
– 16 listed migratory bird species including species that may feed on freshwater aquatic organisms such as the Common Sandpiper (*Actitis hypoleucos*) and the Common Greenshank (*Tringa nebularia*).

The search did not identify any area listed under the Matters of National Environment Significance such as Ramsar wetlands.

G-3 Environmental features of the Investigation Area

Photographs and descriptions of the Investigation Area are provided in Section 2.2.

G-3-1 Terrestrial environments (Zones 1, 2 and 3)

The terrestrial environments within the Investigation Area are located within a densely developed urban setting. Surrounding areas include residential, commercial/industrial, and open space zones and Grand Junction Road runs directly north of Zones 1, 2, and 3.

The terrestrial environments in Zones 1, 2, and 3 (in the context of the future settings of the Development Area) are predominantly cleared of vegetation other than grass and scattered mature trees within maintained open green spaces. Substantial portions of these areas are (or will be) covered with buildings, roads, carparks, and various infrastructure. GHD understands that some vegetation will be retained or planted in the development.

Terrestrial flora

In 2023, Project Green (2023) conducted a tree audit within the Oakden Rise Development area, focusing on the region south and east of the MFS Fire Station, as vegetation to the west had been largely cleared. The objective was identifying trees regulated or deemed significant under the *SA Planning, Development & Infrastructure Act 2016*. The criteria for significant and regulated trees are defined as follows:

– "*A 'Significant' trees is defined as any tree in Metropolitan Adelaide which has a trunk circumference of 3 m or more – or, in the case of trees with multiple trunks, that have trunks with a total circumference of 3 m or more and an average circumference of 625 mm or more – measured at a point 1 m above natural ground level; or any tree identified as a 'Significant' tree in a Development Plan.*
– *A 'Regulated' tree is defined as any tree in Metropolitan Adelaide which has a trunk circumference of 2 m or more – or, in the case of trees with multiple trunks, that have trunks with a total circumference of 2 m or more and an average circumference of 625 mm or more – measured at a point 1 m above natural ground level*".

The outcomes of the tree audit conducted by Project Green (2023) are summarised as follows, with Plate G.8.1 showing the locations of identified regulated and significant trees:

– A total of 204 trees were assessed, with 145 identified as regulated and 59 as significant.
– Overall, the trees were deemed to be in good health, with 169 classified as in good health, 32 in fair health, and one in excellent health. Two trees were noted to have a short life expectancy due to poor health.
– The predominant species of tree included eucalyptus, with Sugar Gum (*Eucalyptus cladocalyx*) being the most common species (42 trees), followed by Flat Topped Yate (*Eucalyptus occidentalis*, 28 trees), River Red Gum (*Eucalyptus camaldulensis*, 26 trees), and Swamp Mallet (*Eucalyptus spathulate*, 23 trees).

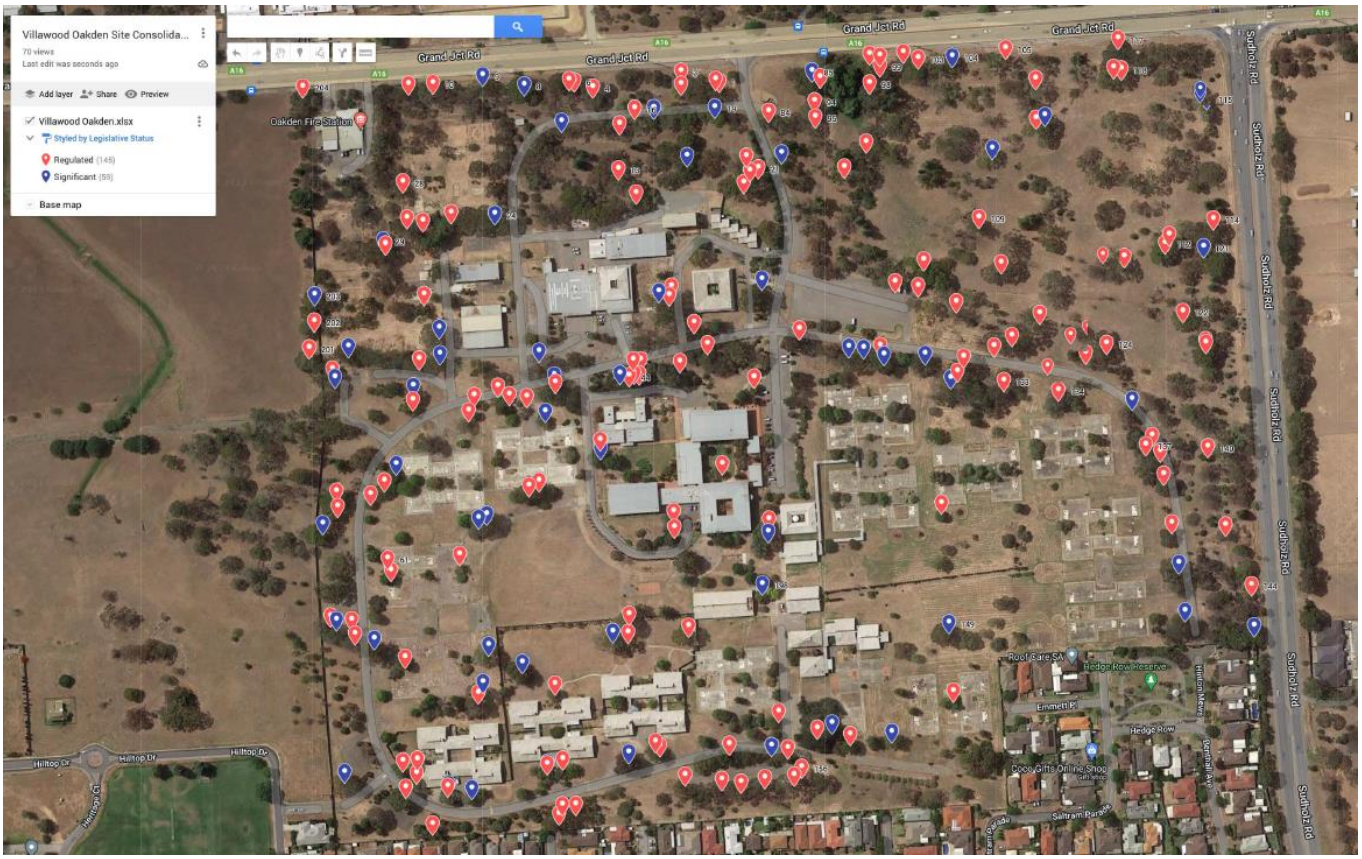


Plate G.8.1 Map showing the location of regulated and significant tree species identified by Project Green (2023)

Terrestrial fauna

Limited terrestrial species are recorded within Zone 1, 2 and 3 in the NatureMaps and Atlas of Living Australia databases. Terrestrial fauna reported in these databases within the wider search area however include the following:

– Avian species, including the Black-shouldered Kite (*Elanus axillaris*), Masked lapwing (*Vanellus miles*), Magpielark (*Grallina cyanoleuca cyanoleuca*), and Welcome Swallow (*Hirundo neoxena neoxena* and conservation significant species such as Diamond Firetail (*Stagonopleura guttata*) and Eastern Shriketit (*Falcunculus frontatus frontatus*).
– Mammalian species including koalas (*Phascolarctos cinereus)*, various rodents (mice and rats), possums (*Trichosurus vulpecula*), grey kangaroos (*Macropus fuliginosus*), and various bats.
– Reptile species including the red-bellied black snake (*Pseudechis porphyriacus*), eastern bluetongue (*Tiliqua scincoides)* and skinks (*Morethia adelaidensis* and *Hemiergis peronii*).

An EPBC Act Protected Matters Report search (refer to the end of this appendix) indicates the potential presence of a range of vulnerable, endangered and critically endangered terrestrial communities and species which may be present near the Investigation Area. They include:

– Two threatened ecological communities (refer to Section G-2).
– Two mammals – the Southern Brown Bandicoot (*Isoodon obesulus*) and the Grey-headed Flying-fox (*Pteropus poliocephalus*). While the Southern Brown Bandicoot could be present in the Investigation Area, a stable population of Grey-headed Flying-foxes is unlikely to be present in Zones 1, 2 and 3 given the limited vegetation and water sources.
– Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*)
– Several birds including the White-throated Needletail (*Hirundapus caudacutus*), and South Australian Bassian Thrush (*Zoothera lunulata halmaturina*).

Koalas, which are mammalian primary consumers, have been sighted within Zones 1, 2, and 3. While koalas are not classified as vulnerable, endangered, or critically endangered species under the EPBC Act, the DEWNR (2016) South Australian Koala Conservation and Management Strategy aims to conserve and manage koala habitat by developing and implementing "*options to protect koala habitat on public and private land*". Information relevant to the use of the Investigation Area by koalas can be summarised as follows:

– Koalas feed on leaves from about 40 species of Eucalyptus trees, including the River Red Gum (*Eucalyptus camaldulensis*) and Blue Gum (*Eucalyptus leucoxylon*) (DEW, 2024). Both the red and blue gum have been identified in the Investigation Area (Project Green, 2023). Hence, potential koala habitat is present within the Investigation Area.
– Koalas have a natural home range of approximately 1 to 1.5 hectare (DEW, 2024). However, in urban areas the shape and size of their home ranges will be usually larger as koalas may be forced to move between separated vegetated areas via ecological corridors. Urban habitat fragmentation appears to be present in the Investigation Area.
– In their home range, koalas will seek shelter trees and food trees. They tend to revisit these selected trees throughout the year.
– A koala typically eats between 500 – 1000 g of eucalypts per day. Koalas do not normally need to drink water as they obtain sufficient liquids from Eucalyptus leaves.
– Given the presence of koalas within the Investigation Area and the information provided above, koalas have been identified as receptors of interest.

G-3-2 Aquatic environment – Dry Creek (Zone 4)

Water quality and external stressors

Surface water samples were collected from within Dry Creek on 31 May 2024, following a rainfall event. Key results were as follows:

– Electrical conductivity values ranged from 433 to 1086 µS/cm and the water was well oxygenated (dissolved oxygen ranging from 5.43 to 9.41 mg/L) and had low to moderate turbidity.
– Concentrations of ammonia (up to 1 mg/L at SW04) exceeded the ANZG (2018) criterion for the protection of 95% of freshwater species (refer to Table 3b in Appendix B). Similar results were reported by the SA EPA (2008a; 2008b).
– Concentrations of filtered copper and zinc exceeded the ANZG (2018) criteria for protecting 95% of freshwater species (refer to Table 3b in Appendix B for details).

The SA EPA (2008a; 2008b) *Aquatic Ecosystem Condition Reports* for Dry Creek indicate the presence of the following stressors:

– Extensive weed growth in the riparian zone causing habitat disturbance.
– Limited riparian zone vegetation along the stream, providing minimal buffer protection from catchment land uses and, therefore, reducing habitat quality.
– Stormwater runoff causing high water velocities, containing nutrients and sediments and, therefore, causing habitat disturbance, algal growth and aquatic weeds.

– Limited macroinvertebrate community dominated by species tolerant of pollution.

Aquatic flora

– The terrestrial vegetation associated with Dry Creek in the vicinity of the Investigation Area is dominated by mixed *Eucalyptus* species, including the listed threatened Grey Box (*Eucalyptus microcarpa*) and Peppermint Box (*Eucalyptus odorata*), Willow Wattle (*Acacia salicina*) Woodland associations, and anthropogenic herb land. EBS Ecology (2011) described the ecological condition of these terrestrial environments as poor to moderate. Within the Investigation Area, this vegetated corridor forms a narrow buffer (typically 40 – 80 meters wide) between the waterway and surrounding by urban development.

– The riparian zone along Dry Creek primarily consists of aquatic vegetation, including woody weeds, grasses, and shrubs. EBS Ecology (2011) conducted an ecological survey along Dry Creek and in the vicinity of the Investigation Area, identifying various weeds including Desert Ash *(Fraxinus angustifolia*), Canary Island Palm (*Phoenix canariensis*), Tall Wheat-grass (*Thinopyrum elongatum*), African Boxthorn (*Lycium ferocissimum*), Golden Wreath Wattle (*Acacia saligna*), Blowfly Bush (*Rhamnus alaternus*), Olive (*Olea europaea ssp.*), and Castor Oil Plant (*Ricinus communis*).

Erosion of the creek banks is apparent within the Investigation Area, most likely due to high surface water flow following heavy rainfall events and subsequent stormwater discharges from upstream areas.

General aquatic fauna

Based on the NatureMaps database, various aquatic species have been identified along Dry Creek within the Investigation Area. The following species are of interest:

– The Macquarie River turtle (*Emydura macquarii*), a vulnerable species, as well as eastern long-necked turtle (*Chelodina longicollis*).
– Frogs including the common froglet (*Crinia signifera*), banjo frog (*Limnodynastes dumerilii*), and spotted marsh frog (*Limnodynastes tasmaniensis*).
– Conservation significant waterbirds such as the sharp-tailed and terek sandpiper (*Calidris acuminata and Xenus cinereus*) and latham's snipe (*Gallinago hardwickii*).
– Various water birds such as Eurasian coot (*Fulica atra australis*) and Pacific black duck (*Anas superciliosa*) – that feed largely on vegetable matter, but can also consume insects, invertebrates, and fish – as well as the Australian white ibis (*Threskiornis molucca molucca*) and white-faced heron (*Egretta novaehollandiae*) that feed on a variety of aquatic organisms including invertebrates, fish, and small amphibians.

A review of the Atlas of Living Australia (2024) database identified various aquatic macroinvertebrate species within the wider search area, including as yabbies (*Cherax destructor*), freshwater prawns (*Macrobrachium australiense*), and Australian paratya shrimp (*Paratya australiensis*), as well as a limited number of fish species (the Murray River rainbowfish, *Melanotaenia fluviatilis*, and the freshwater catfish, *Tandanus tandanus*).

Mammals including koalas (*Phascolarctos cinereus*), possums (*Trichosurus vulpecula*), western grey kangaroos (*Macropus fuliginosus*), and various rats and bats have also been identified within the wider search area.

An EPBC Act Protected Matters Report search (refer to the end of this appendix) indicates the potential presence of a range of vulnerable, endangered and critically endangered species which may be present near the Investigation Area. They include:

– Various water birds – such as the Australasian Bittern (*Botaurus poiciloptilus),* Sharp-tailed Sandpiper (*Calidris acuminata),* Australian Painted Snipe (*Rostratula australis),* South-eastern Hooded Robin *(Melanodryas cucullata cucullate),* Australian Fairy Tern (*Sternula nereis nereis*), and the Australian Painted Snipe (*Rostratula australis*).
– Terrestrial mammals – the Southern Brown Bandicoot (*Isoodon obesulus*) and the Grey-headed Flying-fox (*Pteropus poliocephalus*).
– The remainder of the species listed within the EPBC Act Protected Matters Report for the area surrounding the Investigation Area were typically migratory species and plants.

Aquatic macroinvertebrates

Macroinvertebrates are small, aquatic organisms without backbones that can be seen with the naked eye. They include insects, crustaceans, snails, worms, mites, and sponges. The composition of the macroinvertebrate community in a water system is an indicator of water quality (Waterwatch Australia, 2004) because:

– They are influenced by the physical, chemical, and biological conditions of the waterway
– They play a crucial role in the aquatic food web by consuming plants and being preyed upon by predators
– They have limited mobility and therefore show the effects of pollution in the waterway.
– They are abundant, easily sampled, and identifiable.

A senior ecologist from GHD conducted a high-level and qualitative assessment of the aquatic macroinvertebrate communities at four surface water sampling locations, SW02 to SW05 (see Figure 7 in Appendix A). The assessment methodology involved the following steps for each location:

– *Collection of macroinvertebrates* – The ecologist used a square micro-fibre aquatic macroinvertebrate net (dimension: 30 x 31.5 x 54 cm; mesh dimension: 0.3 x 0.9 mm) to collect a sample of macroinvertebrates. The net was submerged in water and moved with 2-meter strokes, conducting ten passes at each sampling location. The collected macroinvertebrates were then transferred to a water tray and then to a Petri dish for species identification.
– *Identification of macroinvertebrate species* – A microscope with 40x magnification was used in the field to identify the macroinvertebrates based on the Aquatic Macroinvertebrate Identification Key chart[3].
– *Data analysis* – Based on the presence and absence results, the ecologist calculated a pollution rating for each sampling location, indicating the range from very sensitive to very tolerant.

The macroinvertebrate survey was undertaken on 9 to 10 April 2024 during a dry period. Sixteen aquatic macroinvertebrate species were recorded. Table G.8.3 provides a summary of the macroinvertebrate species observed.

[3] **Macroinvertebrate chart (eq.edu.au)**

Table G.8.3 Aquatic Macroinvertebrates Field Species Results

Macroinvertebrate type*	Pollution Rating	Sample Location Species Presence			
		SW02	SW03	SW04	SW05
Mayfly Nymph	9			X	
Marsh Beetle	6			X	
Ceratopogonidae (Biting Midge Larvae)	4		X		
Whirling Beetle Larvae	4			X	
Chironomus plumosus (Non-biting Midge Larvae)	3	X		X	
Freshwater Shrimp	3		X		
Nymph Larvae	3		X		
Ponera Sp.	3		X		
Round Worm	3		X	X	X
Water Boatmen	2				X
Backswimmer	1			X	X
Culicidae (Mosquito Larvae)	1	X	X	X	X
Freshwater Snail	1				X
Copepod	NR	X	X	X	
Seed Shrimp	NR	X	X		X
Water Flea	NR	X	X	X	X
Species Richness (Total Number of Species)	**16**	**5**	**9**	**8**	**7**

Notes

* For most macroinvertebrate types the Aquatic Macroinvertebrate Identification Key chart provides taxonomic resolution to order level only.

Pollution Rating Species Rating: (10-8 = Very Sensitive, 7 – 6 Sensitive, 5 – 4 Tolerant, 3 – 1 Very Tolerant, NR = Not Rated)

Based on the species identified in Table G.8.3, pollution rating and healthy waterway indicator scores have been calculated based on the Aquatic Macroinvertebrate Identification Key chart. Table G.8.4 provides a summary of the Aquatic Macroinvertebrate Health of Waterway indicator scores for the section of Dry Creek included in the Investigation Area.

Table G.8.4 Aquatic Macroinvertebrate Health of Waterway indicator scores

Sample Location	Taxa Richness	Pollution Index	Signal Score	Pollution Rating
SW02 (Upstream)	2	13	6.5	Healthy
SW03 (Confluence with swale drain)	6	18	3.00	Mild Pollution
SW04 (Downstream)	6	27	4.5	Mild Pollution
SW05 (Reference Site)	5	7	1.4	Severe Pollution

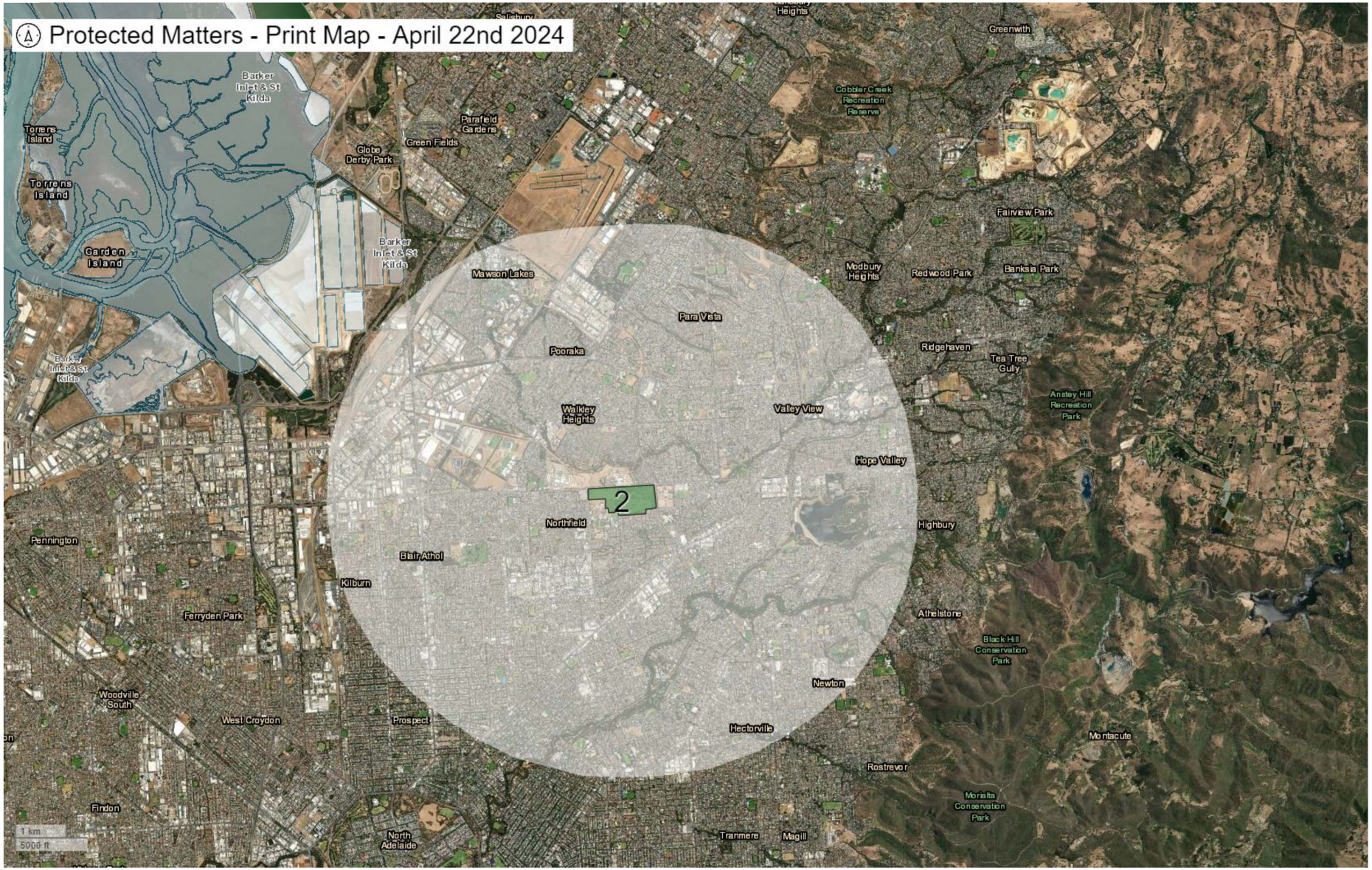
Notes

Pollution Rating Index: Signal Score (Greater than 5 = Healthy Waterway, 4-5 = Indicates Mild Pollution, 3-4 = Indicates Moderate Pollution, less than 3 = Could indicate Severe Pollution).

There are some limitations to this kind of high-level macroinvertebrate assessment and in particular it is acknowledged that pollution sensitivity can vary within an order at the family level. Overall, however, the following is noted.

– The data collected aligns with a macroinvertebrate survey conducted by the SA EPA (2008a) approximately 6 km upstream of the Investigation Area, which showed that Dry Creek hosts a sparse macroinvertebrate community dominated by species tolerant of pollution.

– The macroinvertebrate communities in the Investigation Area are variable and generally tolerant to pollution, which is typical of an urban waterway. A clear distinction was not apparent between the macroinvertebrate communities present upstream and downstream of the site.


Protected Matters - Print Map - April 22nd 2024
Barker Inlet & St Kilda
Torrens Island
Garden Island
Parafield Gardens
Green Fields
Globe Derby Park
Cobbler Creek Recreation Reserve
Greenwith
Fairview Park
Modbury Heights
Redwood Park
Banksia Park
Mawson Lakes
Para Vista
Pooraka
Ridgehaven
Tea Tree Gully
Anstey Hill Recreation Park
Walkley Heights
Valley View
Hope Valley
2
Northfield
Highbury
Pennington
Blair Athol
Kilburn
Ferryden Park
Athelstone
Black Hill Conservation Park
Newton
Woodville South
West Croydon
Prospect
Hectorville
Montacute
Rostrevor
Findon
Morialta Conservation Park
North Adelaide
Tranmere
Magill
1 km
5000 ft

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 27-Mar-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	35
Listed Migratory Species:	16

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	47
Commonwealth Heritage Places:	None
Listed Marine Species:	24
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	5
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat may occur within area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Stagonopleura guttata		
Diamond Firetail [59398]	Vulnerable	Species or species habitat likely to occur within area
Sternula nereis nereis		
Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area
Zoothera lunulata halmaturina		
South Australian Bassian Thrush, Western Bassian Thrush [67121]	Endangered	Species or species habitat likely to occur within area
MAMMAL		
Isoodon obesulus obesulus		
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat may occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
PLANT		
Caladenia tensa		
Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat likely to occur within area
Euphrasia collina subsp. osbornii		
Osborn's Eyebright [3684]	Endangered	Species or species habitat may occur within area
Glycine latrobeana		
Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat may occur within area
Olearia pannosa subsp. pannosa		
Silver Daisy-bush, Silver-leaved Daisy, Velvet Daisy-bush [12348]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Prasophyllum pallidum Pale Leek-orchid [20351]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum pruinosum Plum Leek-orchid [11821]	Endangered	Species or species habitat likely to occur within area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat may occur within area
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area
Swainsona pyrophila Yellow Swainson-pea [56344]	Vulnerable	Species or species habitat may occur within area
Tecticornia flabelliformis Bead Glasswort, Bead Samphire [82664]	Vulnerable	Species or species habitat may occur within area
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
Aprasia pseudopulchella Flinders Ranges Worm-lizard [1666]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat likely to occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
[Calidris canutus](#) Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Defence	
Commonwealth Land - Defence Service Homes Corporation [40454]	SA
Commonwealth Land - Defence Service Homes Corporation [40492]	SA
Defence - HAMPSTEAD BARRACKS [40090]	SA
Defence - Defence Housing Authority	
Commonwealth Land - Defence Housing Authority [40427]	SA
Commonwealth Land - Defence Housing Authority [40438]	SA
Commonwealth Land - Defence Housing Authority [40439]	SA
Commonwealth Land - Defence Housing Authority [40436]	SA
Commonwealth Land - Defence Housing Authority [40437]	SA
Commonwealth Land - Defence Housing Authority [40434]	SA
Commonwealth Land - Defence Housing Authority [40435]	SA
Commonwealth Land - Defence Housing Authority [40433]	SA
Commonwealth Land - Defence Housing Authority [40432]	SA
Commonwealth Land - Defence Housing Authority [40424]	SA
Commonwealth Land - Defence Housing Authority [40426]	SA

Commonwealth Land Name	State
Commonwealth Land - Defence Housing Authority [40429]	SA
Commonwealth Land - Defence Housing Authority [40423]	SA
Commonwealth Land - Defence Housing Authority [40420]	SA
Commonwealth Land - Defence Housing Authority [40425]	SA
Commonwealth Land - Defence Housing Authority [40422]	SA
Commonwealth Land - Defence Housing Authority [40431]	SA
Commonwealth Land - Defence Housing Authority [40430]	SA
Commonwealth Land - Defence Housing Authority [40421]	SA
Commonwealth Land - Defence Housing Authority [40418]	SA
Commonwealth Land - Defence Housing Authority [40419]	SA
Commonwealth Land - Defence Housing Authority [40417]	SA
Commonwealth Land - Defence Housing Authority [40416]	SA
Commonwealth Land - Defence Housing Authority [40415]	SA
Commonwealth Land - Defence Housing Authority [41558]	SA
Commonwealth Land - Defence Housing Authority [40331]	SA
Commonwealth Land - Defence Housing Authority [41498]	SA
Commonwealth Land - Defence Housing Authority [41499]	SA
Commonwealth Land - Defence Housing Authority [40428]	SA
Commonwealth Land - Defence Housing Authority [41500]	SA
Commonwealth Land - Defence Housing Authority [40443]	SA
Commonwealth Land - Defence Housing Authority [40442]	SA
Commonwealth Land - Defence Housing Authority [40441]	SA
Commonwealth Land - Defence Housing Authority [40466]	SA
Commonwealth Land - Defence Housing Authority [40467]	SA
Commonwealth Land - Defence Housing Authority [40460]	SA
Commonwealth Land - Defence Housing Authority [41497]	SA
Commonwealth Land - Defence Housing Authority [40444]	SA

Commonwealth Land Name	State
Commonwealth Land - Defence Housing Authority [40445]	SA
Commonwealth Land - Defence Housing Authority [40440]	SA
Education, Science and Training - Minister of Education Employment & Training	
Commonwealth Land - Minister of Education Employment & Training [41471]	SA
Transport and Regional Services - Australian National Railways Commission	
Commonwealth Land - Australian National Railways Commission [41603]	SA
Unknown	
Commonwealth Land - [40328]	SA
Commonwealth Land - [40505]	SA

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area overfly marine area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area
Sterna striata White-fronted Tern [799]		Migration route may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Unnamed (No.HA308)	Heritage Agreement	SA

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Nava-1 Cable System	2001/510	Controlled Action	Completed
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Upgrade & Revitalisation of Existing Rail Line	2010/5342	Not Controlled Action	Completed
Not controlled action (particular manner)			
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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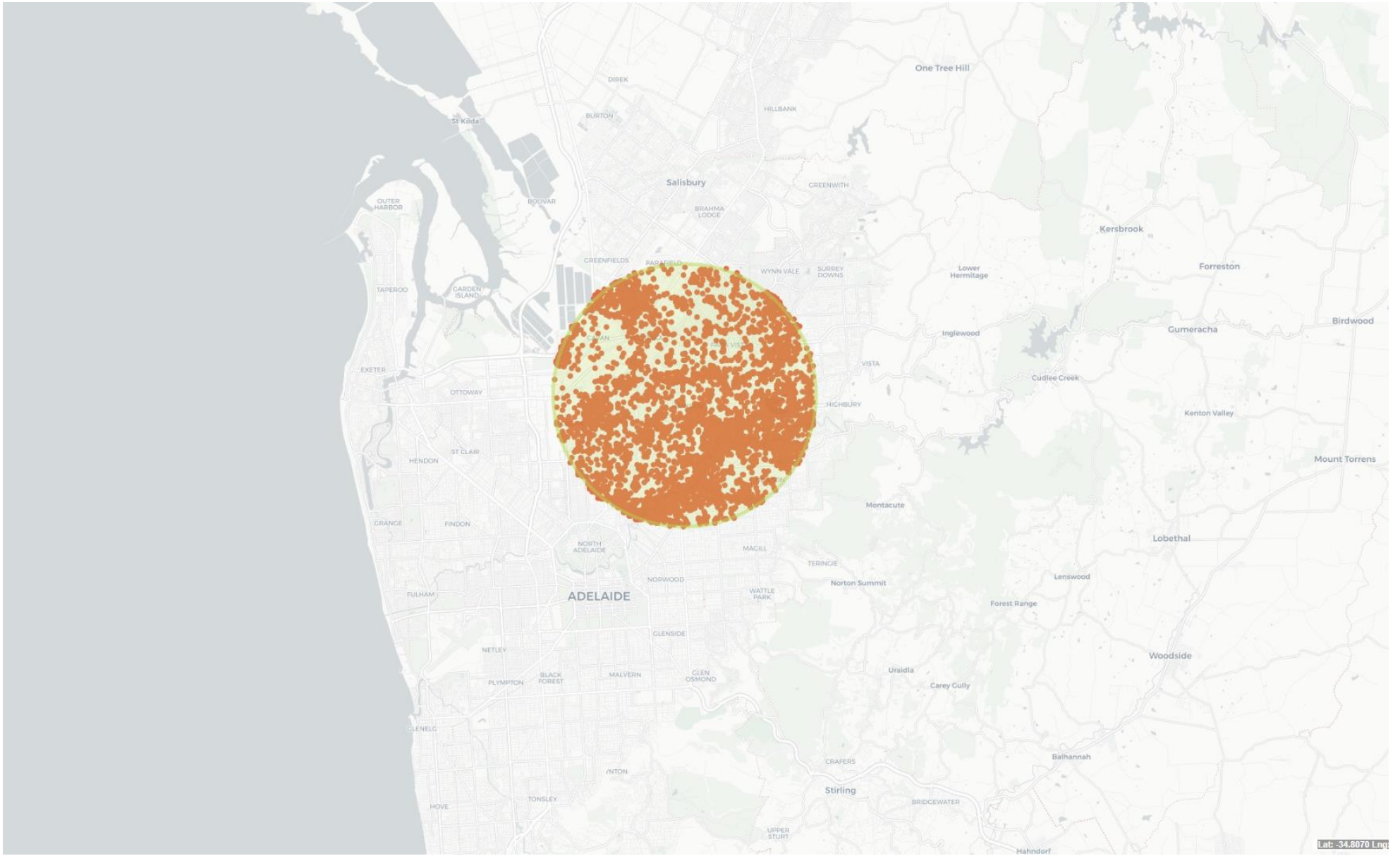
One Tree Hill
DIREK
HILLBANK
St Kilda
BURTON
Salisbury
GREENWITH
OUTER HARBOR
BOLIVAR
BRAHMA LODGE
Kersbrook
GREENFIELDS
PARAFIELD
WYNN VALE
SURREY DOWNS
Lower Hermitage
Forreston
TAPEROO
GARDEN ISLAND
Inglewood
Gumeracha
Birdwood
EXETER
VISTA
Cudlee Creek
OTTOWAY
HIGHBURY
Kenton Valley
ST CLAIR
HENDON
Mount Torrens
Montacute
GRANGE
FINDON
Lobethal
NORTH ADELAIDE
MAGILL
TERINGIE
NORWOOD
Lenswood
Norton Summit
FULHAM
ADELAIDE
WATTLE PARK
Forest Range
GLENSIDE
NETLEY
Woodside
Uraidla
PLYMPTON
BLACK FOREST
MALVERN
GLEN OSMOND
Carey Gully
GLENELG
Balhannah
CRAFERS
Stirling
TONSLEY
BRIDGEWATER
HOVE
UPPER STURT
Hahndorf
Lat: -34.8070 Lng

Species Name	Class	Genus	VernacularName
Limnodynastes tasmaniensis	Amphibia	Limnodynastes	Spotted Marsh Frog
Crinia signifera	Amphibia	Crinia	Common Froglet
Limnodynastes dumerilii	Amphibia	Limnodynastes	Eastern Banjo Frog
Litoria ewingii	Amphibia	Litoria	Brown Tree Frog
Litoria peronii	Amphibia	Litoria	Peron's Tree Frog
Phascolarctos cinereus	Mammalia	Phascolarctos	Koala
Gymnorhina tibicen	Aves	Gymnorhina	Australian Magpie
Grallina cyanoleuca	Aves	Grallina	Magpie-lark
Apis (Apis) mellifera	Insecta	Apis	Honey Bee
Pieris rapae	Insecta	Pieris	Cabbage White Butterfly
Jacaranda mimosifolia	Equisetopsida	Jacaranda	Jacaranda
Helminthotheca echioides	Equisetopsida	Helminthotheca	Ox-tongue
Eucalyptus porosa	Equisetopsida	Eucalyptus	Mallee Box
Acacia acinacea	Equisetopsida	Acacia	Gold-dust Wattle
Lolium arundinaceum	Equisetopsida	Lolium	Tall Fescue
Eragrostis curvula	Equisetopsida	Eragrostis	African Love-grass
Tribulus	Equisetopsida	Tribulus	
Acacia rupicola	Equisetopsida	Acacia	Rock Wattle
Anthocercis angustifolia	Equisetopsida	Anthocercis	Narrow-leaf Ray-flower
Juncus bufonius	Equisetopsida	Juncus	Toad Rush
Philotheca angustifolia subsp. angustifolia	Equisetopsida	Philotheca	Narrow-leaf Wax-flower
Taraxacum	Equisetopsida	Taraxacum	Garden Dandelion
Spyridium spathulatum	Equisetopsida	Spyridium	Spoon-leaved Spyridium
Rumex acetosella	Equisetopsida	Rumex	Sorrel
Helicoverpa punctigera	Insecta	Helicoverpa	Native Budworm
Anisops	Insecta	Anisops	
FORMICIDAE	Insecta		Ants
Agraptocorixa	Insecta	Agraptocorixa	
Heliothis punctifera	Insecta	Heliothis	Owlet Moth
Enithares woodwardi	Insecta	Enithares	Backswimmer
Sigara (Tropocorixa) truncatipala	Insecta	Sigara	Water Boatman
Agraptocorixa eurynome	Insecta	Agraptocorixa	Water Boatman
Sigara	Insecta	Sigara	
Naucoris congrex	Insecta	Naucoris	Creeping Water Bug
Anisops thienemanni	Insecta	Anisops	Backswimmer
Dolichoderus scabridus	Insecta	Dolichoderus	Dolly Ant
Eupoecila australasiae	Insecta	Eupoecila	Fiddler Beetle
Manorina (Myzantha) melanocephala	Aves	Manorina	Noisy Miner
Ocybadistes walkeri	Insecta	Ocybadistes	Green Grass-dart
Pholcus phalangioides	Arachnida	Pholcus	Cellar Spider
Anas (Anas) platyrhynchos	Aves	Anas	Common Mallard
Noctuinae	Insecta		
Oxalis pes-caprae	Equisetopsida	Oxalis	Soursob
Eolophus roseicapilla	Aves	Eolophus	Galah
Chenonetta jubata	Aves	Chenonetta	Australian Wood Duck
Gallinula (Gallinula) tenebrosa	Aves	Gallinula	Dusky Moorhen
Lampides boeticus	Insecta	Lampides	Long-tailed Pea-blue
Acrocephalus (Acrocephalus) australis	Aves	Acrocephalus	Australian Reed Warbler
Ocyphaps lophotes	Aves	Ocyphaps	Crested Pigeon
Anthochaera (Anthochaera) carunculata	Aves	Anthochaera	Red Wattlebird
Podiceps cristatus	Aves	Podiceps	Great Crested Grebe
Senecio vulgaris	Equisetopsida	Senecio	Common Groundsel
Threskiornis moluccus	Aves	Threskiornis	Australian White Ibis
Opisthoncus nigrofemoratus	Arachnida	Opisthoncus	
Anas (Anas) superciliosa	Aves	Anas	Pacific Black Duck
Chlorophyta			
AUCHENORRHYNCHA	Insecta		
Macropus fuliginosus melanops	Mammalia	Macropus	[black-faced Kangaroo]
Anthochaera (Anellobia) chrysoptera	Aves	Anthochaera	Little Wattlebird
Hypotaenidia philippensis	Aves	Hypotaenidia	Buff-banded Rail
Archimantis sobrina	Insecta	Archimantis	Large Brown Mantid
Dolomedes instabilis	Arachnida	Dolomedes	Nursery Web Spider
ACTINOPTERYGII	Actinopterygii		
Hemiergis peronii	Reptilia	Hemiergis	Lowlands Earless Skink
Danaus plexippus	Insecta	Danaus	Wanderer
Maratus griseus	Arachnida	Maratus	
Eulamprus quoyii	Reptilia	Eulamprus	Eastern Water-skink
Trichilogaster	Insecta	Trichilogaster	
Pinales	Equisetopsida		
Cacatua (Cacatua) galerita	Aves	Cacatua	Sulphur-crested Cockatoo
INSECTA	Insecta		Insects
Haliastur sphenurus	Aves	Haliastur	Whistling Kite
Typha domingensis	Equisetopsida	Typha	Cumbungi
Hemicordulia australiae	Insecta	Hemicordulia	Australian Emerald
Eristalinus (Lathyrophthalmus) punctulatus	Insecta	Eristalinus	Native Drone Fly
Phylidonyris (Meliornis) novaehollandiae	Aves	Phylidonyris	New Holland Honeyeater
Pemphredoninae	Insecta		
Agaricales	Agaricomycetes		
Diplacodes bipunctata	Insecta	Diplacodes	Wandering Percher
Microcarbo melanoleucos	Aves	Microcarbo	Little Pied Cormorant
Spilopelia chinensis	Aves	Spilopelia	Spotted Turtle-dove
Psephotus haematonotus	Aves	Psephotus	Red-rumped Parrot
Sonchus oleraceus	Equisetopsida	Sonchus	Common Sow-thistle
Araneus	Arachnida	Araneus	
Poaceae	Equisetopsida		Grasses
Oxyopes	Arachnida	Oxyopes	
Porphyrio (Porphyrio) porphyrio melanotus	Aves	Porphyrio	Australasian Purple Swamphen
Trichoglossus	Aves	Trichoglossus	
Platycercus (Platycercus) elegans	Aves	Platycercus	Crimson Rosella
Eucalyptus	Equisetopsida	Eucalyptus	Studley Park Gum
Portulaca oleracea	Equisetopsida	Portulaca	Munyeroo
LIMACIDAE	Gastropoda		
Junonia villida	Insecta	Junonia	Meadow Argus
LONCHAEIDAE	Insecta		Lonchaeid Flies
Coprinellus	Agaricomycetes	Coprinellus	
Passer (Passer) domesticus	Aves	Passer	House Sparrow
Volvopluteus gloiocephalus	Agaricomycetes	Volvopluteus	
Isopedella leai	Arachnida	Isopedella	
Columba (Columba) livia	Aves	Columba	Rock Dove
Amorbus alternatus	Insecta	Amorbus	Leaf-footed Bug
Agrotis infusa	Insecta	Agrotis	Bogong Moth
Laccaria fraterna	Agaricomycetes	Laccaria	
Delta bicinctum	Insecta	Delta	Wasp
Convolvulus angustissimus	Equisetopsida	Convolvulus	Blushing Bindweed
Hemiergis decresiensis	Reptilia	Hemiergis	Three-toed Earless Skink
Ischnura heterosticta	Insecta	Ischnura	Common Bluetail
Drymaplaneta	Insecta	Drymaplaneta	
Magnoliopsida	Magnoliopsida		
Aphis (Aphis) nerii	Insecta	Aphis	Oleander Aphid
Chlidonias (Pelodes) hybrida	Aves	Chlidonias	Whiskered Tern
Salpesia squalida	Arachnida	Salpesia	
Anas superciliosa X platyrhynchos	Aves	Anas	Geese
Poecilometis strigatus	Insecta	Poecilometis	Gum Tree Shield Bug
Bibio imitator	Insecta	Bibio	Garden Maggot
Vinca major	Equisetopsida	Vinca	Blue Periwinkle
Caedicia simplex	Insecta	Caedicia	Common Garden Katydid
Persicaria decipiens	Equisetopsida	Persicaria	Slender Knotweed
Dichondra repens	Equisetopsida	Dichondra	Kidney-weed
Coenosia	Insecta	Coenosia	
Platycercus (Violania) eximius	Aves	Platycercus	Eastern Rosella
Sylvicola dubius	Insecta	Sylvicola	Bee Fly
Chloris truncata	Equisetopsida	Chloris	Windmill Grass
Pogonortalis doclea	Insecta	Pogonortalis	Signal Fly
Turdus merula	Aves	Turdus	Eurasian Blackbird
Lythrum	Equisetopsida	Lythrum	
Lysimachia arvensis	Equisetopsida	Lysimachia	Pimpernel
Glossopsitta concinna	Aves	Glossopsitta	Musk Lorikeet
Pseudonaja textilis	Reptilia	Pseudonaja	Eastern Brown Snake
Maratus literatus	Arachnida	Maratus	Jumping Spider
Mutusca brevicornis	Insecta	Mutusca	Broad-headed Bug
Corvus mellori	Aves	Corvus	Little Raven
Egretta novaehollandiae	Aves	Egretta	White-faced Heron
LEPIDOPTERA	Insecta		Butterflies
APHIDIDAE	Insecta		
Ranunculus muricatus	Equisetopsida	Ranunculus	Pricklefruit Buttercup
Endoxyla cinereus	Insecta	Endoxyla	Carpenter Moth
Venator	Arachnida	Venator	

Echinoderma	Agaricomycetes	Echinoderma	
Anas gracilis	Aves	Anas	Grey Teal
Petrochelidon (Petrochelidon) ariel	Aves	Petrochelidon	Fairy Martin
Agrocybe	Agaricomycetes	Agrocybe	
EREBIDAE	Insecta		
Cacatua (Licmetis) sanguinea	Aves	Cacatua	Little Corella
Phrissogonus laticostata	Insecta	Phrissogonus	Geometer Moth
Parosteodes	Insecta	Parosteodes	
Ectopatria	Insecta	Ectopatria	
Pelecanus conspicillatus	Aves	Pelecanus	Australian Pelican
Pisolithus	Agaricomycetes	Pisolithus	
Cyclosa trilobata	Arachnida	Cyclosa	Three Lobed Spider
Nephila	Arachnida	Nephila	
BRACHYCERA	Insecta		
Zizina otis labradus	Insecta	Zizina	Common Grass-blue
Celaenia excavata	Arachnida	Celaenia	Bird Dropping Spider
Tiliqua scincoides	Reptilia	Tiliqua	Eastern Blue-tongue
Cyclocephala signaticollis	Insecta	Cyclocephala	
Hordeum murinum	Equisetopsida	Hordeum	Barley-grass
Ptilotula penicillata	Aves	Ptilotula	White-plumed Honeyeater
Poales	Equisetopsida		
Lampona	Arachnida	Lampona	
Streptopelia roseogrisea	Aves	Streptopelia	African Collared Dove
Enchylaena tomentosa	Equisetopsida	Enchylaena	Ruby Saltbush
Platalea (Platalea) regia	Aves	Platalea	Royal Spoonbill
Apricia jovialis	Arachnida	Apricia	Australian Jumping Spider
Musca domestica	Insecta	Musca	House Fly
Boerhavia dominii	Equisetopsida	Boerhavia	Tar Vine
Odontomyia decipiens	Insecta	Odontomyia	
Rostraria cristata	Equisetopsida	Rostraria	Annual Cats-tail
Dasineura glauca	Insecta	Dasineura	
Megachile (Eutricharaea)	Insecta	Megachile	
Phaulacridium vittatum	Insecta	Phaulacridium	Wingless Grasshopper
Tracheophyta			
Badumna	Arachnida	Badumna	
Cyprinus carpio	Actinopterygii	Cyprinus	European Carp
Scoparia exhibitalis	Insecta	Scoparia	
Vanellus (Lobipluvia) miles	Aves	Vanellus	Masked Lapwing
Armadillidium vulgare	Malacostraca	Armadillidium	
Euander lacertosus	Insecta	Euander	Strawberry Bug
Agaricineae	Agaricomycetes		
ARANEAE	Arachnida		Spiders
Anas	Aves	Anas	
Paralastor	Insecta	Paralastor	
Laccaria	Agaricomycetes	Laccaria	
Casuarina glauca	Equisetopsida	Casuarina	Swamp Oak
Dacelo (Dacelo) novaeguineae	Aves	Dacelo	Laughing Kookaburra
CALYPTRATAE	Insecta		
Lotus pedunculatus	Equisetopsida	Lotus	
Ectropis excursaria	Insecta	Ectropis	Twig Looper
LITHOBIOMORPHA	Chilopoda		
Chroicocephalus novaehollandiae	Aves	Chroicocephalus	Silver Gull
Banksia marginata	Equisetopsida	Banksia	Silver Banksia
Tasmanicosa	Arachnida	Tasmanicosa	Australian Union-jack Wolf Spiders
Trametes	Agaricomycetes	Trametes	
Cochlicella barbara	Gastropoda	Cochlicella	White Snail
Phalacrocorax (Phalacrocorax) sulcirostris	Aves	Phalacrocorax	Little Black Cormorant
Podargus strigoides	Aves	Podargus	Tawny Frogmouth
STYLOMMATOPHORA	Gastropoda		
Ischnura aurora	Insecta	Ischnura	Aurora Bluetail
Sturnus (Sturnus) vulgaris	Aves	Sturnus	Common Starling
Marasmius oreades	Agaricomycetes	Marasmius	
Malurus (Malurus) cyaneus	Aves	Malurus	Superb Fairy-wren
MITURGIDAE	Arachnida		Racing Stripe Spiders
Austrolestes annulosus	Insecta	Austrolestes	Blue Ringtail
Trichilogaster signiventris	Insecta	Trichilogaster	Gall Wasp
Austroagrion watsoni	Insecta	Austroagrion	Eastern Billabongfly
Riccia	Marchantiopsida	Riccia	
Laemostenus complanatus	Insecta	Laemostenus	Cosmopolitan Ground Beetle
AMPHIPODA	Malacostraca		
Harmonia conformis	Insecta	Harmonia	Common Spotted Ladybird
Rentinus dilatatus	Insecta	Rentinus	Planthopper
Ellipsidion humerale	Insecta	Ellipsidion	Bush Cockroach
Myrmecia pyriformis	Insecta	Myrmecia	Bull Ant
Melaleuca halmaturorum	Equisetopsida	Melaleuca	Swamp Paper-bark
PHOLCIDAE	Arachnida		Daddy-long-legs Spiders
Eucalyptus camaldulensis subsp. camaldulensis	Equisetopsida	Eucalyptus	River Red-gum
Casuarina cunninghamiana	Equisetopsida	Casuarina	River She-oak
Armadillidium	Malacostraca	Armadillidium	
BLATTODEA	Insecta		Cockroaches
LYGAEOIDEA	Insecta		
Ceryerda cursitans	Arachnida	Ceryerda	
Tharpyna campestrata	Arachnida	Tharpyna	Crab Spider
Ectropis bispinaria	Insecta	Ectropis	Geometer Moth
Coprinellus micaceus	Agaricomycetes	Coprinellus	
Stangeia xerodes	Insecta	Stangeia	Xerodes Plume Moth
Accipiter (Paraspizias) cirrocephalus	Aves	Accipiter	Collared Sparrowhawk
Boarmiini	Insecta		Geometer Moth
Ommatoiulus moreleti	Diplopoda	Ommatoiulus	Portuguese Millipede
Vittadinia gracilis	Equisetopsida	Vittadinia	Woolly New Holland Daisy
Malva parviflora	Equisetopsida	Malva	Small-flower Mallow
Belenois java	Insecta	Belenois	Caper White
Strepera (Neostrepera) versicolor	Aves	Strepera	Grey Currawong
Polistes (Polistella) humilis	Insecta	Polistes	Common Paper Wasp
Verbena bonariensis	Equisetopsida	Verbena	Purple-top Verbena
Anestia	Insecta	Anestia	
Emydura macquarii	Reptilia	Emydura	Macquarie River Turtle
Aedes	Insecta	Aedes	
Uromycladium	Pucciniomycetes	Uromycladium	
Fossombronia	Jungermanniopsida	Fossombronia	
Anthela	Insecta	Anthela	
Dodonaea viscosa	Equisetopsida	Dodonaea	Sticky Hop-bush
Poliocephalus poliocephalus	Aves	Poliocephalus	Hoary-headed Grebe
Vanessa kershawi	Insecta	Vanessa	Australian Painted Lady
Lipotriches (Austronomia) gracilipes	Insecta	Lipotriches	Sweat Bee
Proteuxoa	Insecta	Proteuxoa	
Hypochaeris glabra	Equisetopsida	Hypochaeris	Smooth Cat's Ear
Vespula germanica	Insecta	Vespula	European Wasp
Berula erecta	Equisetopsida	Berula	Water Parsnip
Anestia ombrophanes	Insecta	Anestia	Moth
Hydrocotyle verticillata	Equisetopsida	Hydrocotyle	Shield Pennywort
Heteronychus arator	Insecta	Heteronychus	African Black Beetle
Lucilia	Insecta	Lucilia	
Syntrichia papillosa	Bryopsida	Syntrichia	Screw Moss
Agaricus xanthodermus	Agaricomycetes	Agaricus	Yellow Stainer
Dindymus versicolor	Insecta	Dindymus	Harlequin Bug
HYMENOPTERA	Insecta		Wasps
Tamopsis	Arachnida	Tamopsis	
Vanellus (Lobipluvia) miles novaehollandiae	Aves	Vanellus	Southern Masked Lapwing
Cornu aspersum	Gastropoda	Cornu	Common Garden Snail
Anredera cordifolia	Equisetopsida	Anredera	Madeira Vine
Polistes (Polistella) humilis humilis	Insecta	Polistes	
Euodynerus (Euodynerus) angulatus	Insecta	Euodynerus	
Gavicalis virescens	Aves	Gavicalis	Singing Honeyeater
Dichondra	Equisetopsida	Dichondra	Kidney Weeds
Cerastium glomeratum	Equisetopsida	Cerastium	Common Mouse-ear Chickweed
Calystegia sepium	Equisetopsida	Calystegia	Large Bindweed
Olearia	Equisetopsida	Olearia	Daisy Bush
Latrodectus hasseltii	Arachnida	Latrodectus	Redback Spider
Cenchrus	Equisetopsida	Cenchrus	Buffel Grass
Hardenbergia violacea	Equisetopsida	Hardenbergia	Native Lilac
Pheidole	Insecta	Pheidole	
Acacia paradoxa	Equisetopsida	Acacia	Kangaroo Thorn
Bryophyta			
Archimantis	Insecta	Archimantis	
Orthetrum caledonicum	Insecta	Orthetrum	Blue Skimmer
Cernuella	Gastropoda	Cernuella	
Mictis profana	Insecta	Mictis	Crusader Bug

PENTATOMOIDEA	Insecta		
Mandalotus	Insecta	Mandalotus	
Sphenarches anisodactylus	Insecta	Sphenarches	
Asphodelus fistulosus	Equisetopsida	Asphodelus	Onion Weed
Teloschistes chrysophthalmus	Lecanoromycetes	Teloschistes	Golden-eye Lichen
Pteropus poliocephalus	Mammalia	Pteropus	Grey-headed Flying-fox
CICADELLIDAE	Insecta		Leafhoppers
Austrostipa	Equisetopsida	Austrostipa	Spear-grasses
Gryllini	Insecta		
Coprinus comatus	Agaricomycetes	Coprinus	Shaggy Mane
Ardea alba	Aves	Ardea	Great Egret
Megachile	Insecta	Megachile	
Lecanoromycetes	Lecanoromycetes		
Pterohelaeus	Insecta	Pterohelaeus	
Scleroderma	Agaricomycetes	Scleroderma	
Sitona discoideus	Insecta	Sitona	Sitona Weevil
Nyssus coloripes	Arachnida	Nyssus	Spotted Ground Swift Spider
Trioza	Insecta	Trioza	
Erodium	Equisetopsida	Erodium	Crowfoot
CHRYSOPIDAE	Insecta		
Riccia sorocarpa	Marchantiopsida	Riccia	Fleur-de-lys Crystalwort
Megachile lucidiventris	Insecta	Megachile	Bee
Threskiornis spinicollis	Aves	Threskiornis	Straw-necked Ibis
Chiromyza	Insecta	Chiromyza	
Juncus usitatus	Equisetopsida	Juncus	Common Rush
Nyctemera amicus	Insecta	Nyctemera	Moth
Coreinae	Insecta		
Primeuchroeus	Insecta	Primeuchroeus	
Rhagodia candolleana	Equisetopsida	Rhagodia	
Hogna	Arachnida	Hogna	
Clania	Insecta	Clania	
Hirundo (Hirundo) neoxena	Aves	Hirundo	Welcome Swallow
Calidris (Erolia) acuminata	Aves	Calidris	Sharp-tailed Sandpiper
Steatoda	Arachnida	Steatoda	
Cricotopus	Insecta	Cricotopus	
Chrysodeixis eriosoma	Insecta	Chrysodeixis	Green Looper Moth
Zygometis xanthogaster	Arachnida	Zygometis	Crab Spider
Hydromys chrysogaster	Mammalia	Hydromys	Water-rat
Megachile ferox	Insecta	Megachile	Bee
DERMAPTERA	Insecta		Earwigs
Siphanta	Insecta	Siphanta	
Cacatua (Licmetis) tenuirostris	Aves	Cacatua	Long-billed Corella
Cryptoblepharus pannosus	Reptilia	Cryptoblepharus	Ragged Snake-eyed Skink
Amegilla (Notomegilla) chlorocyanea	Insecta	Amegilla	Blue Banded Bee
Coccinella transversalis	Insecta	Coccinella	Transverse Ladybird
Dianella brevicaulis	Equisetopsida	Dianella	Small-flower Flax-lily
Dysphania ambrosioides	Equisetopsida	Dysphania	Mexican Tea
Tachybaptus novaehollandiae	Aves	Tachybaptus	Australasian Grebe
Ellipsidion	Insecta	Ellipsidion	
Scrobiger splendidus	Insecta	Scrobiger	
Arcitalitrus sylvaticus	Malacostraca	Arcitalitrus	
Rhytidoponera	Insecta	Rhytidoponera	
Robshelfordia circumducta	Insecta	Robshelfordia	Shelford's Cockroach
MOGOPLISTIDAE	Insecta		
Helpis minitabunda	Arachnida	Helpis	Bronze Aussie Jumping Spider
THERIDIIDAE	Arachnida		
Camponotus consobrinus	Insecta	Camponotus	Banded Sugar Ant
Nostoc commune	Cyanophyceae	Nostoc	Blue-green Alga
Tachystola hemisema	Insecta	Tachystola	Hemisema Moth
Plutella xylostella	Insecta	Plutella	Diamondback Moth
Centranthus ruber	Equisetopsida	Centranthus	Red Valerian
Pseudapines geminata	Insecta	Pseudapines	Pittosporum Bug
Richardsonianus australis	Hirudinida	Richardsonianus	
Lumbricus terrestris	Oligochaeta	Lumbricus	Twachel
Calolampra	Insecta	Calolampra	
Mallada	Insecta	Mallada	
Cairina moschata	Aves	Cairina	Muscovy Duck
Opisthoncus	Arachnida	Opisthoncus	
Neovulturnus	Insecta	Neovulturnus	
LYCOSIDAE	Arachnida		Wolf Spider
Papilio (Eleppone) anactus	Insecta	Papilio	Dainty Swallowtail
Plantago major	Equisetopsida	Plantago	Greater Plantain
Fulica atra	Aves	Fulica	Eurasian Coot
Melangyna (Austrosyrphus) viridiceps	Insecta	Melangyna	Hover Fly
GEOMETROIDEA	Insecta		
Dasypodia selenophora	Insecta	Dasypodia	Granny Moth
Scopula rubraria	Insecta	Scopula	Carpet Moth
Bryum preissianum	Bryopsida	Bryum	
Adversaeschna brevistyla	Insecta	Adversaeschna	Blue-spotted Hawker
Delena cancerides	Arachnida	Delena	Flat Huntsman Spider
Conium maculatum	Equisetopsida	Conium	Hemlock
Petrochelidon (Hylochelidon) nigricans	Aves	Petrochelidon	Tree Martin
Phalacrocorax (Phalacrocorax) carbo novaehollandiae	Aves	Phalacrocorax	Australasian Great Cormorant
Elaeagnus	Equisetopsida	Elaeagnus	
Plebs bradleyi	Arachnida	Plebs	Enamelled Spider
Tribonyx ventralis	Aves	Tribonyx	Black-tailed Native-hen
Tiliqua scincoides scincoides	Reptilia	Tiliqua	Common Blue-tongue
Senecio pterophorus	Equisetopsida	Senecio	African Daisy
Chinoneides tasmaniensis	Insecta	Chinoneides	Stilt Bug
Steganopsis melanogaster	Insecta	Steganopsis	
Cardiospermum grandiflorum	Equisetopsida	Cardiospermum	Balloon Vine
Echium plantagineum	Equisetopsida	Echium	Paterson's Curse
Limnodynastes dumerilii dumerilii	Amphibia	Limnodynastes	Pobblebonk Frog
CARABIDAE	Insecta		
Steatoda grossa	Arachnida	Steatoda	Tangle-web Spider
Falco (Falco) longipennis	Aves	Falco	Australian Hobby
Limacus flavus	Gastropoda	Limacus	Yellow Cellar Slug
Porcellionides pruinosus	Malacostraca	Porcellionides	
Anystis	Arachnida	Anystis	
Cenchrus clandestinus	Equisetopsida	Cenchrus	Kikuyu
Solidago	Equisetopsida	Solidago	Golden-rod
JULIDA	Diplopoda		
Armillaria	Agaricomycetes	Armillaria	
Lasioglossum (Homalictus) urbanum	Insecta	Lasioglossum	
Gallinula (Gallinula) tenebrosa tenebrosa	Aves	Gallinula	Australian Dusky Moorhen
Euphorbia	Equisetopsida	Euphorbia	Spurge
Arctotheca calendula	Equisetopsida	Arctotheca	Cape Weed
Medicago polymorpha	Equisetopsida	Medicago	Spineless Burr Medic
Eucalyptus gillii	Equisetopsida	Eucalyptus	Curly Mallee
Campion	Insecta	Campion	
Alternanthera pungens	Equisetopsida	Alternanthera	Khaki Weed
THOMISIDAE	Arachnida		Crab Spiders
Heteronympha merope	Insecta	Heteronympha	Common Brown Butterfly
Illeis galbula	Insecta	Illeis	Fungus-eating Ladybird
Aphyssura	Insecta	Aphyssura	
SCARABAEOIDEA	Insecta		
Acacia iteaphylla	Equisetopsida	Acacia	Flinders Range Wattle
CHLOROPIDAE	Insecta		Grass Flies
NOTONECTIDAE	Insecta		
Pseudechis porphyriacus	Reptilia	Pseudechis	Red-bellied Black Snake
Micronecta	Insecta	Micronecta	
Salsa	Arachnida	Salsa	
Hypnales	Bryopsida		
Torymus	Insecta	Torymus	
Lycium ferocissimum	Equisetopsida	Lycium	African Boxthorn
Philobota	Insecta	Philobota	
OLETHREUTINAE	Insecta		
Lipotriches (Austronomia) flavoviridis	Insecta	Lipotriches	Sweat Bee
Juncus amabilis	Equisetopsida	Juncus	Hollow Rush
Agaricomycetidae	Agaricomycetes		
Forficula auricularia	Insecta	Forficula	European Earwig
Tribulus terrestris	Equisetopsida	Tribulus	Goathead Burr
Sixalix atropurpurea	Equisetopsida	Sixalix	Pincushion
ARANEOMORPHAE	Arachnida		
Lasioglossum (Homalictus)	Insecta	Lasioglossum	
Chaetophyes	Insecta	Chaetophyes	
Podomyrma adelaidae	Insecta	Podomyrma	Muscleman Ant
Mentha diemenica	Equisetopsida	Mentha	Slender Mint

Carcinophora occidentalis	Insecta	Carcinophora	
Ardices glatignyi	Insecta	Ardices	
Anas (Nettion) castanea	Aves	Anas	Chestnut Teal
Rhipidura (Sauloprocta) leucophrys	Aves	Rhipidura	Willie Wagtail
ZODARIIDAE	Arachnida		Ant Spiders
Gambusia holbrooki	Actinopterygii	Gambusia	Eastern Gambusia
Solanum nigrum	Equisetopsida	Solanum	Black Nightshade
Plantae			
Opatrini	Insecta		
Christinus marmoratus	Reptilia	Christinus	Marbled Gecko
ONISCIDEA	Malacostraca		
Agaricaceae	Agaricomycetes		
Pyralis farinalis	Insecta	Pyralis	Meal Moth
ANIMALIA			Animals
Lampropholis guichenoti	Reptilia	Lampropholis	Pale-flecked Garden Sunskink
Gazania	Equisetopsida	Gazania	Gazania
Trifolium fragiferum	Equisetopsida	Trifolium	Strawberry Clover
Pottiaceae	Bryopsida		
Erigeron bonariensis	Equisetopsida	Erigeron	Flaxleaf Fleabane
Parentia dispar	Insecta	Parentia	Long-legged Fly
ICHNEUMONIDAE	Insecta		
PSITTACIFORMES	Aves		
Figulus lilliputanus	Insecta	Figulus	
Cyperus vaginatus	Equisetopsida	Cyperus	Stiff Flat-sedge
Boletales	Agaricomycetes		
Lachnagrostis filiformis	Equisetopsida	Lachnagrostis	Common Blown-grass
BLATTIDAE	Insecta		
OXYOPIDAE	Arachnida		Lynx Spiders
Carpobrotus	Equisetopsida	Carpobrotus	Pigface
MANTIDAE	Insecta		
Ipomoea indica	Equisetopsida	Ipomoea	Purple Morning-glory
Acrida conica	Insecta	Acrida	Giant Green Slant-face
Enithares	Insecta	Enithares	
Calostemma purpureum	Equisetopsida	Calostemma	Garland Lily
Nicotiana glauca	Equisetopsida	Nicotiana	Tree Tobacco
Zapornia pusilla	Aves	Zapornia	Baillon's Crake
Entomophthora	Entomophthoromycetes	Entomophthora	
Lipotriches (Austronomia) australica	Insecta	Lipotriches	Sweat Bee
SARCOPHAGIDAE	Insecta		
Geranium molle	Equisetopsida	Geranium	Soft Geranium
Agrotis ipsilon	Insecta	Agrotis	Owlet Moth
Anoplognathus montanus	Insecta	Anoplognathus	
Carduelis carduelis	Aves	Carduelis	European Goldfinch
OECOPHORIDAE	Insecta		
Schinus molle	Equisetopsida	Schinus	Pepper-tree
Iridomyrmex purpureus	Insecta	Iridomyrmex	Meat Ant
LYONETIIDAE	Insecta		
Adelium brevicorne	Insecta	Adelium	Ground Beetle Sp 1
Zantedeschia aethiopica	Equisetopsida	Zantedeschia	White Arum Lily
Coryphistes ruricola	Insecta	Coryphistes	Bark-mimicking Grasshopper
Xanthoria	Lecanoromycetes	Xanthoria	
Lomandra effusa	Equisetopsida	Lomandra	Scented Mat-rush
Goodenia varia	Equisetopsida	Goodenia	Sticky Goodenia
Gymnopilus junonius	Agaricomycetes	Gymnopilus	
Menetia greyii	Reptilia	Menetia	Grey's Menetia
Lunularia cruciata	Marchantiopsida	Lunularia	Crescent Moonwort
Alticini	Insecta		
Eucalyptus socialis	Equisetopsida	Eucalyptus	Red Mallee
Psittacula eupatria	Aves	Psittacula	Parrots
Agaricomycetes	Agaricomycetes		
GEOMETRIDAE	Insecta		
LAMIINAE	Insecta		
Adelium	Insecta	Adelium	
Senecio	Equisetopsida	Senecio	Groundsel
Liris	Insecta	Liris	
GRYLLACRIDIDAE	Insecta		
Idaea philocosma	Insecta	Idaea	Geometer Moth
Convolvulus arvensis	Equisetopsida	Convolvulus	Common Bindweed
Polypogon monspeliensis	Equisetopsida	Polypogon	Annual Beardgrass
Ricinus communis	Equisetopsida	Ricinus	Castor Oil Plant
Solanum elaeagnifolium	Equisetopsida	Solanum	Silver-leaf Nightshade
Eupoecila	Insecta	Eupoecila	
Utetheisa pulchelloides	Insecta	Utetheisa	Crimson Spotted Moth
Pseudocheirus peregrinus	Mammalia	Pseudocheirus	Common Ringtail Possum
Erythrogonys cinctus	Aves	Erythrogonys	Red-kneed Dotterel
Battarrea phalloides	Agaricomycetes	Battarrea	
Anthrenus	Insecta	Anthrenus	Museum Beetles
Plebs eburnus	Arachnida	Plebs	Bush Orb-weaver Spider
Oxyopes gracilipes	Arachnida	Oxyopes	Lynx Spider
Phyla canescens	Equisetopsida	Phyla	Lippia
Capusa	Insecta	Capusa	
Sclerotinia sclerotiorum	Leotiomycetes	Sclerotinia	
Porzana (Porzana) fluminea	Aves	Porzana	Australian Spotted Crake
Austrolestes analis	Insecta	Austrolestes	Slender Ringtail
Callistemon sieberi	Equisetopsida	Callistemon	River Bottlebrush
Bauhinia	Equisetopsida	Bauhinia	Mountain Ebony
Diomus notescens	Insecta	Diomus	Minute Two-spotted Ladybird
MANTISPIDAE	Insecta		
Phaps (Phaps) chalcoptera	Aves	Phaps	Common Bronzewing
NOCTUIDAE	Insecta		
Euryglossina (Euryglossina) hypochroma	Insecta	Euryglossina	Plasterer Bee
Himantopus himantopus leucocephalus	Aves	Himantopus	Pied Stilt
Solidago canadensis	Equisetopsida	Solidago	Golden Rod
Cerdistus	Insecta	Cerdistus	
Oxyopes amoenus	Arachnida	Oxyopes	
Chelodina (Chelodina) longicollis	Reptilia	Chelodina	Snake-necked Turtle
Anhinga novaehollandiae	Aves	Anhinga	Australasian Darter
Pittosporum angustifolium	Equisetopsida	Pittosporum	Native Willow
Orthodera ministralis	Insecta	Orthodera	Green Mantid
ACRIDIDAE	Insecta		
Rhagodia parabolica	Equisetopsida	Rhagodia	Mealy Saltbush
Sparaxis bulbifera	Equisetopsida	Sparaxis	Sparaxis
Artoriopsis	Arachnida	Artoriopsis	
Cynara cardunculus	Equisetopsida	Cynara	Cardoon
Pezizaceae	Pezizomycetes		
GASTERUPTIIDAE	Insecta		
Suillus collinitus	Agaricomycetes	Suillus	
MIRINI	Insecta		
HESPERIIDAE	Insecta		Skippers
Tinea pellionella	Insecta	Tinea	
Aspicilia cinerea	Lecanoromycetes	Aspicilia	
Entometa	Insecta	Entometa	
Acacia pycnantha	Equisetopsida	Acacia	Golden Wattle
Fulica atra australis	Aves	Fulica	Australian Eurasian Coot
Argiope protensa	Arachnida	Argiope	Orb-weaver Spider
Iridomyrmex rufoniger	Insecta	Iridomyrmex	Black Tyrant Ant
Catapodium rigidum	Equisetopsida	Catapodium	Rigid Fescue
POLYDESMIDA	Diplopoda		
Parentia vulgaris	Insecta	Parentia	
Oxyopes variabilis	Arachnida	Oxyopes	
Barnardius zonarius	Aves	Barnardius	Australian Ringneck
Syrphini	Insecta		
Simosyrphus grandicornis	Insecta	Simosyrphus	Hoverfly
Xanthoria parietina	Lecanoromycetes	Xanthoria	
Hemicordulia tau	Insecta	Hemicordulia	Tau Emerald
Oxalis bowiei	Equisetopsida	Oxalis	Bowie Wood-sorrel
Chrysocephalum	Equisetopsida	Chrysocephalum	
Camponotus	Insecta	Camponotus	
Paratemnopteryx	Insecta	Paratemnopteryx	
Eumerus obliquus	Insecta	Eumerus	
CHIRONOMINAE	Insecta		
Dynastinae	Insecta		
Trichilogaster acaciaelongifoliae	Insecta	Trichilogaster	Wattle Apple-gall Wasp
Bromus catharticus	Equisetopsida	Bromus	Prairie Grass
Viminaria juncea	Equisetopsida	Viminaria	Native Broom
COLUMBIFORMES	Aves		
Allocasuarina muelleriana	Equisetopsida	Allocasuarina	
Eucalyptus occidentalis	Equisetopsida	Eucalyptus	Swamp Yate

Fuligo septica	Myxogastrea	Fuligo	
Anisolabidinae	Insecta		
Poa annua	Equisetopsida	Poa	Annual Meadow-grass
Ptychostomum	Bryopsida	Ptychostomum	
CORIXOIDEA	Insecta		
CULICIDAE	Insecta		
Oryctolagus cuniculus	Mammalia	Oryctolagus	Rabbit
Phaneropterinae	Insecta		
Rattus rattus	Mammalia	Rattus	Black Rat
Avena sterilis	Equisetopsida	Avena	Sterile Oat
HEPIALIDAE	Insecta		
Phalaenoides glycinae	Insecta	Phalaenoides	Grapevine Moth
Acacia pendula	Equisetopsida	Acacia	Weeping Myall
Coleotichus costatus	Insecta	Coleotichus	Shield Bug
Ogyris amaryllis meridionalis	Insecta	Ogyris	Satin Azure (inland Subspecies)
Urtica urens	Equisetopsida	Urtica	Dwarf Nettle
Trifolium campestre	Equisetopsida	Trifolium	Hop Clover
Cycnogeton	Equisetopsida	Cycnogeton	
Arthropodium fimbriatum	Equisetopsida	Arthropodium	Nodding Chocolate Lily
Goodenia amplexans	Equisetopsida	Goodenia	Clasping Goodenia
Leratiomyces ceres	Agaricomycetes	Leratiomyces	
MIRIDAE	Insecta		
Hyalarcta nigrescens	Insecta	Hyalarcta	Ribbed Bagworm Moth
Aythya (Nyroca) australis	Aves	Aythya	Hardhead
Papyrius nitidus	Insecta	Papyrius	Ant
Tachysphex	Insecta	Tachysphex	
Gryllotalpa	Insecta	Gryllotalpa	
Pinus halepensis	Equisetopsida	Pinus	Aleppo Pine
ARANEIDAE	Arachnida		
Sisymbrium erysimoides	Equisetopsida	Sisymbrium	Smooth Mustard
SALTICIDAE	Arachnida		Jumping Spiders
Myrmecia gulosa	Insecta	Myrmecia	Giant Bull Ant
Cygnus atratus	Aves	Cygnus	Black Swan
GEKKONIDAE	Reptilia		Typical Geckos
Cryptachaea veruculata	Arachnida	Cryptachaea	Tangle-web Spider
Vanessa itea	Insecta	Vanessa	Australian Admiral
Rosaceae	Equisetopsida		Rose
Chrysidinae	Insecta		
Muscari comosum	Equisetopsida	Muscari	Tufted Grape Hyacinth
Aedes (Rampamyia) notoscriptus	Insecta	Aedes	
Phragmites australis	Equisetopsida	Phragmites	Common Reed
Cotoneaster	Equisetopsida	Cotoneaster	Cotoneaster
Dicyphini	Insecta		
Isopogon ceratophyllus	Equisetopsida	Isopogon	Horny Cone-bush
Backobourkia	Arachnida	Backobourkia	
Calandrinia eremaea	Equisetopsida	Calandrinia	Small Purslane
Pardalotus (Pardalotinus) striatus	Aves	Pardalotus	Striated Pardalote
Iridomyrmex	Insecta	Iridomyrmex	
Cyathus stercoreus	Agaricomycetes	Cyathus	
Acanthorhynchus tenuirostris	Aves	Acanthorhynchus	Eastern Spinebill
Cullen australasicum	Equisetopsida	Cullen	Native Scurf-pea
Myrmarachne	Arachnida	Myrmarachne	
Hedera	Equisetopsida	Hedera	Ivy
Acaulon	Bryopsida	Acaulon	
Anthomyia punctipennis	Insecta	Anthomyia	Fly
Hypericum perforatum	Equisetopsida	Hypericum	St. John's Wort
Aloina	Bryopsida	Aloina	
Agaricus	Agaricomycetes	Agaricus	
Rutilia	Insecta	Rutilia	
Eucalyptus camaldulensis	Equisetopsida	Eucalyptus	Red Gum
Aphis (Aphis) spiraecola	Insecta	Aphis	Apple Aphid
MANTODEA	Insecta		Mantises
Funaria hygrometrica	Bryopsida	Funaria	Common Cord-moss
Arthropodium strictum	Equisetopsida	Arthropodium	Chocolate Lily
Abantiades atripalpis	Insecta	Abantiades	
Supella (Supella) longipalpa	Insecta	Supella	
Tropaeolum majus	Equisetopsida	Tropaeolum	Nasturtium
Senecio spanomerus	Equisetopsida	Senecio	Native Groundsel
Tadorna (Casarca) tadornoides	Aves	Tadorna	Australian Shelduck
Missulena occatoria	Arachnida	Missulena	Red-headed Mouse Spider
CULICINAE	Insecta		
Lasioglossum	Insecta	Lasioglossum	
LEPISMATIDAE	Insecta		
Populus	Equisetopsida	Populus	Poplar
Cynara cardunculus subsp. flavescens	Equisetopsida	Cynara	Artichoke Thistle
Hibbertia exutiacies	Equisetopsida	Hibbertia	Prickly Guinea-flower
Lycoperdon	Agaricomycetes	Lycoperdon	
Austrolestes leda	Insecta	Austrolestes	Wandering Ringtail
Ectropis	Insecta	Ectropis	
Crepidotus	Agaricomycetes	Crepidotus	
Dysphania	Equisetopsida	Dysphania	
Setaria verticillata	Equisetopsida	Setaria	Whorled Pigeon Grass
Sidymella	Arachnida	Sidymella	
Schizophyllum commune	Agaricomycetes	Schizophyllum	Splitgill Mushroom
Ctenoplusia albostriata	Insecta	Ctenoplusia	
Cymbopogon ambiguus	Equisetopsida	Cymbopogon	Lemon Grass
HEMIPTERA	Insecta		Aphids
Colobopsis gasseri	Insecta	Colobopsis	
Platylobium obtusangulum	Equisetopsida	Platylobium	Holly Flat-pea
Netelia	Insecta	Netelia	
Hordeum glaucum	Equisetopsida	Hordeum	Northern Barley Grass
Hibbertia glebosa	Equisetopsida	Hibbertia	
Trichosurus vulpecula	Mammalia	Trichosurus	Common Brushtail Possum
Elanus axillaris	Aves	Elanus	Black-shouldered Kite
Rhipidura (Rhipidura) albiscapa	Aves	Rhipidura	Grey Fantail
Gymnorhina tibicen telonocua	Aves	Gymnorhina	Eyre Peninsula Australian Magpie
Myrtaceae	Equisetopsida		Myrtle Family
Dysphania pumilio	Equisetopsida	Dysphania	Small Crumbweed
Collybia	Agaricomycetes	Collybia	
BAETIDAE	Insecta		
Bjerkandera adusta	Agaricomycetes	Bjerkandera	
Riccia crystallina	Marchantiopsida	Riccia	Blue Crystalwort
Piptatherum miliaceum	Equisetopsida	Piptatherum	Rice Millet
Nysius	Insecta	Nysius	
Uresiphita ornithopteralis	Insecta	Uresiphita	Tree Lucerne Moth
Elephantodeta	Insecta	Elephantodeta	
Bidens pilosa	Equisetopsida	Bidens	Cobbler's Pegs
Lysiana exocarpi	Equisetopsida	Lysiana	Mistletoe
SPARASSIDAE	Arachnida		Huntsman Spiders
Amorbus	Insecta	Amorbus	
Sarcophaginae	Insecta		
CRABRONIDAE	Insecta		
Oxalis caprina	Equisetopsida	Oxalis	Goat's Foot
Falco (Tinnunculus) cenchroides	Aves	Falco	Nankeen Kestrel
Oenosandra boisduvalii	Insecta	Oenosandra	Boisduval S Autumn Moth
Gonocarpus micranthus	Equisetopsida	Gonocarpus	Creeping Raspwort
Plautia	Insecta	Plautia	
Podalonia tydei	Insecta	Podalonia	Wasp
Kennedia prostrata	Equisetopsida	Kennedia	Scarlet Runner
CRAMBIDAE	Insecta		
Araujia sericifera	Equisetopsida	Araujia	White Bladder-flower
Eumeninae	Insecta		
Rhynchocorini	Insecta		
Anthoxanthum odoratum	Equisetopsida	Anthoxanthum	Sweet Vernal-grass
Epyaxa	Insecta	Epyaxa	
Helicoverpa	Insecta	Helicoverpa	
Persectania dyscrita	Insecta	Persectania	Inland Armyworm
Panicum miliaceum	Equisetopsida	Panicum	Millet Panic
STAPHYLINIDAE	Insecta		
Cruria donowani	Insecta	Cruria	Crow Moth
Bryum	Bryopsida	Bryum	
Argiope	Arachnida	Argiope	
Gymnopilus allantopus	Agaricomycetes	Gymnopilus	
Micraspis frenata	Insecta	Micraspis	Striped Ladybird
Ocystola	Insecta	Ocystola	
ERIOPTERINI	Insecta		
Lobularia maritima	Equisetopsida	Lobularia	Sweet Alyssum
Pisolithus arhizus	Agaricomycetes	Pisolithus	

Latrodectus	Arachnida	Latrodectus	Widow Spiders
Callitris gracilis	Equisetopsida	Callitris	Slender Cypress-pine
Tandanus tandanus	Actinopterygii	Tandanus	Freshwater Catfish
Labium	Insecta	Labium	
Chelodina	Reptilia	Chelodina	
ANURA	Amphibia		BakuÂ‹bakuÂ‹
SCARABAEIDAE	Insecta		
Lotus	Equisetopsida	Lotus	Trefoil
Hednota	Insecta	Hednota	
Mycena	Agaricomycetes	Mycena	
Lachenalia	Equisetopsida	Lachenalia	Lachenalia
Biziura lobata	Aves	Biziura	Musk Duck
Asphondylia dodonaeae	Insecta	Asphondylia	
Enneapogon nigricans	Equisetopsida	Enneapogon	Black-head Grass
Anthrenus (Anthrenus) scrophulariae scrophulariae	Insecta	Anthrenus	
Carcinophora	Insecta	Carcinophora	
Oloptum	Equisetopsida	Oloptum	
Uraba lugens	Insecta	Uraba	Gum-leaf Skeletoniser
Badumna insignis	Arachnida	Badumna	Black House Spider
Senostoma	Insecta	Senostoma	
Pygophora apicalis	Insecta	Pygophora	
Austrotephritis poenia	Insecta	Austrotephritis	Primitive Crane Fly
Riccia subbifurca	Marchantiopsida	Riccia	Crystalwort
Vulpes vulpes	Mammalia	Vulpes	Fox
Parasola	Agaricomycetes	Parasola	
Sherardia arvensis	Equisetopsida	Sherardia	Field Madder
Papilio (Princeps) demoleus sthenelus	Insecta	Papilio	Chequered Swallowtail
Chlorophyllum rhacodes	Agaricomycetes	Chlorophyllum	
Cirsium vulgare	Equisetopsida	Cirsium	Spear Thistle
Tharrhalea	Arachnida	Tharrhalea	
Lagunaria patersonia	Equisetopsida	Lagunaria	Sally Wood
Cryptachaea	Arachnida	Cryptachaea	
FULGOROMORPHA	Insecta		Planthoppers
Dicaeum (Dicaeum) hirundinaceum	Aves	Dicaeum	Mistletoebird
Plantago	Equisetopsida	Plantago	Plantain
Nigella	Equisetopsida	Nigella	
Xerocomellus	Agaricomycetes	Xerocomellus	
Coracina (Coracina) novaehollandiae	Aves	Coracina	Black-faced Cuckoo-shrike
Myrmicinae	Insecta		
BRACONIDAE	Insecta		
Glycyphana (Glycyphaniola) stolata	Insecta	Glycyphana	
Agrotis munda	Insecta	Agrotis	Brown Cutworm Moth
Trifolium angustifolium	Equisetopsida	Trifolium	Narrow-leaf Clover
Heliotropium amplexicaule	Equisetopsida	Heliotropium	Blue Heliotrope
Lactuca	Equisetopsida	Lactuca	Lettuce
Comesperma volubile	Equisetopsida	Comesperma	Love Creeper
Ellipsidion australe	Insecta	Ellipsidion	Austral Ellipsidion Cockroach
Didymodon torquatus	Bryopsida	Didymodon	Beard Moss
Camponotus suffusus suffusus	Insecta	Camponotus	Sugar Ant
Cherax destructor	Malacostraca	Cherax	Common Yabbie
Peziza vesiculosa	Pezizomycetes	Peziza	
Persicaria	Equisetopsida	Persicaria	Smartweeds
Paraphilaeus daemelii	Arachnida	Paraphilaeus	Jumping Spider
EUMALACOSTRACA	Malacostraca		
Sceliphron laetum	Insecta	Sceliphron	Common Mud Daubler
Phalacrocorax (Phalacrocorax) carbo	Aves	Phalacrocorax	Great Cormorant
Eublemma	Insecta	Eublemma	
Fumaria capreolata	Equisetopsida	Fumaria	White-flowered Fumitory
Paurocoma	Insecta	Paurocoma	
Anthela varia	Insecta	Anthela	Lappet Moth
Amegilla	Insecta	Amegilla	
Elseyornis melanops	Aves	Elseyornis	Black-fronted Dotterel
Agapophytus annamariae	Insecta	Agapophytus	
Dichanthium sericeum	Equisetopsida	Dichanthium	Silky Blue-grass
Bryum argenteum	Bryopsida	Bryum	Silver Moss
Brassicaceae	Equisetopsida		Cabbage
Mataeomera	Insecta	Mataeomera	
Bulbine	Equisetopsida	Bulbine	Native Onion
Avena fatua	Equisetopsida	Avena	Wild Oats
Otiorhynchus cribricollis	Insecta	Otiorhynchus	Apple Weevil
Araceae	Equisetopsida		Arum Lily
ANATIDAE	Aves		Ducks
Sapromyza brunneovittata	Insecta	Sapromyza	Acalyptrate Fly
Euborellia annulipes	Insecta	Euborellia	Ring-legged Earwig
Sphaerocarpos texanus	Marchantiopsida	Sphaerocarpos	Texas Balloonwort
CALLIPHORIDAE	Insecta		
Diplacodes haematodes	Insecta	Diplacodes	Scarlet Percher
Vittadinia	Equisetopsida	Vittadinia	Fuzzweeds
Gryllodes sigillatus	Insecta	Gryllodes	Indian House Cricket
Lobelia anceps	Equisetopsida	Lobelia	Angled Lobelia
Alisma plantago-aquatica	Equisetopsida	Alisma	Water Plantain
Pittosporum undulatum	Equisetopsida	Pittosporum	Sweet Pittosporum
Abantiades	Insecta	Abantiades	
Nezara viridula	Insecta	Nezara	Green Vegetable Bug
Aizoon pubescens	Equisetopsida	Aizoon	Galenia
Melaleuca	Equisetopsida	Melaleuca	Tea-tree
Liquidambar styraciflua	Equisetopsida	Liquidambar	Sweetgum
Verbena incompta	Equisetopsida	Verbena	Purple-top Verbena
Hippodamia variegata	Insecta	Hippodamia	Spotted Amber Ladybird
Macraulacini	Insecta		
Teleogryllus commodus	Insecta	Teleogryllus	Black Field Cricket
Maratus leo	Arachnida	Maratus	Lion Peacock Spider
Heliotropium europaeum	Equisetopsida	Heliotropium	Common Heliotrope
Brachymeria	Insecta	Brachymeria	
Einadia nutans	Equisetopsida	Einadia	Climbing Saltbush
GRYLLOIDEA	Insecta		
Papaver	Equisetopsida	Papaver	Poppy
Stellaria media	Equisetopsida	Stellaria	Chickweed
Dianella revoluta	Equisetopsida	Dianella	Blueberry Lily
Haltichellinae	Insecta		
GEOPLANIDAE	Rhabditophora		
TORTRICINAE	Insecta		
Pezizomycotina			
PLECOPTERA	Insecta		Stoneflies
KALOTERMITIDAE	Insecta		
Asparagus asparagoides	Equisetopsida	Asparagus	Western Cape Bridal Creeper
Rhytidoponera metallica	Insecta	Rhytidoponera	Metallic Pony Ants
Erythrina	Equisetopsida	Erythrina	Coral Tree
Arundo donax	Equisetopsida	Arundo	Giant Reed
Calopompilus	Insecta	Calopompilus	
Fraxinus angustifolia	Equisetopsida	Fraxinus	Desert Ash
Sporobolus africanus	Equisetopsida	Sporobolus	Rat-tail Grass
Themeda triandra	Equisetopsida	Themeda	Kangaroo Grass
Sidnia kinbergi	Insecta	Sidnia	Crop Mirid
Temognatha flavomarginata	Insecta	Temognatha	
DYTISCIDAE	Insecta		
Eupitheciini	Insecta		
Spyridium vexilliferum	Equisetopsida	Spyridium	Winged Spyridium
Cryptocheilus bicolor	Insecta	Cryptocheilus	Orange Spider Wasp
Austrolestes	Insecta	Austrolestes	
Hydrellia tritici	Insecta	Hydrellia	Lawn Fly
Sagina	Equisetopsida	Sagina	Pearlwort
Euphorbia peplus	Equisetopsida	Euphorbia	Cancer Weed
Tragopogon porrifolius	Equisetopsida	Tragopogon	Salsify
Amanita farinacea	Agaricomycetes	Amanita	Australian Flour Lepidella
Pison spinolae	Insecta	Pison	Wasp
Camponotus aeneopilosus	Insecta	Camponotus	Golden Black Sugar Ant
Chrysomya	Insecta	Chrysomya	
Musca	Insecta	Musca	
Mus musculus	Mammalia	Mus	House Mouse
Clogmia albipunctata	Insecta	Clogmia	Moth Fly
Aedes (Ochlerotatus) camptorhynchus	Insecta	Aedes	Mosquito
Persectania ewingii	Insecta	Persectania	Southern Armyworm
Monopis icterogastra	Insecta	Monopis	Wool Moth
Araneus talipedatus	Arachnida	Araneus	Orb-weaver Spider
Euoniticellus	Insecta	Euoniticellus	
Silene	Equisetopsida	Silene	Catchfly
Resupinatus cinerascens	Agaricomycetes	Resupinatus	

Caligavis chrysops	Aves	Caligavis	Yellow-faced Honeyeater
Lumbricus	Oligochaeta	Lumbricus	
Icerya purchasi	Insecta	Icerya	Cottony Cushion Scale
Plumbago auriculata	Equisetopsida	Plumbago	Cape Leadwot
Oechalia schellenbergii	Insecta	Oechalia	Predatory Shield Bug
Acacia ligulata	Equisetopsida	Acacia	Small Cooba
Celtis australis	Equisetopsida	Celtis	European Nettle Tree
Rumex	Equisetopsida	Rumex	Emex
PENTATOMIDAE	Insecta		
Plantago lanceolata	Equisetopsida	Plantago	Ribwort
Lomandra longifolia	Equisetopsida	Lomandra	Spiny-headed Mat-rush
Crypsiphona ocultaria	Insecta	Crypsiphona	Redlined Geometrid Moth
Allothereua maculata	Chilopoda	Allothereua	Species Of House Centipede
Verbena	Equisetopsida	Verbena	Verbena
Xanthagrion erythroneurum	Insecta	Xanthagrion	Red & Blue Damsel
Celatoblatta	Insecta	Celatoblatta	
Allocasuarina	Equisetopsida	Allocasuarina	
Colluricincla (Colluricincla) harmonica	Aves	Colluricincla	Grey Shrike-thrush
Olea europaea	Equisetopsida	Olea	Common Olive
Oxalis corniculata	Equisetopsida	Oxalis	Creeping Wood-sorrel
Helpis	Arachnida	Helpis	
Plantago coronopus	Equisetopsida	Plantago	Bucks-horn Plantain
Amanita xanthocephala	Agaricomycetes	Amanita	
Asplenium subglandulosum	Equisetopsida	Asplenium	Glandular Blanket-fern
DIPTERA	Insecta		Flies
Gminatus australis	Insecta	Gminatus	Assassin Bug
Ninox (Ninox) boobook	Aves	Ninox	Southern Boobook
Creophilus erythrocephalus	Insecta	Creophilus	Devil's Coach-horse
Bathyllus albicinctus	Insecta	Bathyllus	Froghopper
Cytisus scoparius	Equisetopsida	Cytisus	English Broom
Halyini	Insecta		
Amyema preissii	Equisetopsida	Amyema	Wire-leaf Mistletoe
Triquetrella papillata	Bryopsida	Triquetrella	Common Twine-moss
Carex appressa	Equisetopsida	Carex	Tall Sedge
Foeniculum vulgare	Equisetopsida	Foeniculum	Fennel
Oxalis sp. Pilbara (M.E.Trudgen 12725)	Equisetopsida	Oxalis	
CHRYSIDIDAE	Insecta		
Melanotaenia fluviatilis	Actinopterygii	Melanotaenia	Murray River Rainbowfish
Poecilohetaerus	Insecta	Poecilohetaerus	
Coprinus	Agaricomycetes	Coprinus	
Lathyrus tingitanus	Equisetopsida	Lathyrus	Tangier Pea
Fabriogenia	Insecta	Fabriogenia	
Cryptocheilus	Insecta	Cryptocheilus	
Myrmeleontini	Insecta		
Corcorax melanorhamphos	Aves	Corcorax	White-winged Chough
Neochmia (Aegintha) temporalis	Aves	Neochmia	Red-browed Finch
Miturga	Arachnida	Miturga	
Sonchus	Equisetopsida	Sonchus	Sowthistles
Cichorium intybus	Equisetopsida	Cichorium	Chicory
Hyleoides concinna	Insecta	Hyleoides	Species Of Yellowfaced Bee
ORTHOPTERA	Insecta		
Zizina otis	Insecta	Zizina	Common Grass-blue
Calliphorinae	Insecta		
BLABEROIDEA	Insecta		
Taractrocera papyria	Insecta	Taractrocera	White-banded Grass-dart
POLYZOSTERIINAE	Insecta		
Rutiliini	Insecta		
Homoneura	Insecta	Homoneura	
Chortoicetes terminifera	Insecta	Chortoicetes	Australian Plague Locust
Turneromyia	Insecta	Turneromyia	
Boletaceae	Agaricomycetes		
SYRPHIDAE	Insecta		Hoverflies
Fungi			
Tringa (Rhyacophilus) glareola	Aves	Tringa	Wood Sandpiper
Calliphora	Insecta	Calliphora	
Chalcites	Aves	Chalcites	
Ctenolepisma (Ctenolepisma) longicaudata	Insecta	Ctenolepisma	Silverfish
Mensularia radiata	Agaricomycetes	Mensularia	
Sarcophaga	Insecta	Sarcophaga	
Acacia notabilis	Equisetopsida	Acacia	Mallee Golden Wattle
Atriplex	Equisetopsida	Atriplex	Orache
Egretta garzetta	Aves	Egretta	Little Egret
Acholeplasmataceae	Mollicutes		
Venator spenceri	Arachnida	Venator	Wolf Spider
Megachile aurifrons	Insecta	Megachile	Bee
Trametes versicolor	Agaricomycetes	Trametes	Turkey-tail
Porcellio dilatatus	Malacostraca	Porcellio	
Leptocoris mitellatus	Insecta	Leptocoris	Scentless Plant Bug
Xanthorrhoea quadrangulata	Equisetopsida	Xanthorrhoea	Rock Grass-tree
Raveneliaceae	Pucciniomycetes		
Scaptomyza	Insecta	Scaptomyza	
Cuspicona simplex	Insecta	Cuspicona	Green Potato Bug
Correa glabra var. leucoclada	Equisetopsida	Correa	Rock Correa
ACALYPTRATAE	Insecta		
Rytidosperma setaceum	Equisetopsida	Rytidosperma	Small-flower Wallaby-grass
Syringa vulgaris	Equisetopsida	Syringa	Common Lilac
Plebs	Arachnida	Plebs	
Hebeloma	Agaricomycetes	Hebeloma	
Lepidosperma laterale	Equisetopsida	Lepidosperma	Tall Sword-sedge
Taylorilygus	Insecta	Taylorilygus	
Stathmopoda	Insecta	Stathmopoda	
Gymnopilus	Agaricomycetes	Gymnopilus	
Dampiera	Equisetopsida	Dampiera	
Tortula truncata	Bryopsida	Tortula	Common Pottia
Eucalyptus leucoxylon	Equisetopsida	Eucalyptus	Yellow Gum
Endoxyla	Insecta	Endoxyla	Baardi
CURCULIONIDAE	Insecta		
Romulea minutiflora	Equisetopsida	Romulea	Small-flower Onion-grass
Notoncus ectatommoides	Insecta	Notoncus	Pronged Epaulet Ant
Grimmia pulvinata	Bryopsida	Grimmia	
MYRMELEONTIDAE	Insecta		
Duranta erecta	Equisetopsida	Duranta	Sky Flower
Sphodrotes	Insecta	Sphodrotes	
Boerhavia	Equisetopsida	Boerhavia	Tarvines
Sidymella trapezia	Arachnida	Sidymella	Trapezium Crab Spider
Acacia acuminata	Equisetopsida	Acacia	Raspberry Jam
MUSCIDAE	Insecta		
Ricciaceae	Marchantiopsida		
Bolbitiaceae	Agaricomycetes		
Senna artemisioides	Equisetopsida	Senna	Desert Cassia
Eupeodes	Insecta	Eupeodes	
Atriplex patula	Equisetopsida	Atriplex	Spear Orache
Tortula	Bryopsida	Tortula	
Malva	Equisetopsida	Malva	Mallow
Allium triquetrum	Equisetopsida	Allium	Angled Onion
Crocidosema	Insecta	Crocidosema	
EURYGLOSSINAE	Insecta		
Chenopodium	Equisetopsida	Chenopodium	Fat Hen
Tenebrio molitor	Insecta	Tenebrio	Yellow Mealworm
Maratus	Arachnida	Maratus	
Zosterops lateralis	Aves	Zosterops	Silvereye
ISOPODA	Malacostraca		
Hippotion scrofa	Insecta	Hippotion	Scrofa Hawk Moth
Helina	Insecta	Helina	
Fletchamia quinquelineata	Rhabditophora	Fletchamia	
Dolomedes	Arachnida	Dolomedes	
Nostocaceae	Cyanophyceae		
Trichilogaster stefani	Insecta	Trichilogaster	
Scopula	Insecta	Scopula	
PHYSIDAE	Gastropoda		
Lasioglossum (Chilalictus)	Insecta	Lasioglossum	
Lupropini	Insecta		
Brachychiton populneus	Equisetopsida	Brachychiton	Kurrajong
Aglaotilla	Insecta	Aglaotilla	
Nidulariaceae	Agaricomycetes		
Adonis	Equisetopsida	Adonis	
Xanthium strumarium	Equisetopsida	Xanthium	Californian Burr
Urospermum picroides	Equisetopsida	Urospermum	False Hawkbit

Spoladea recurvalis	Insecta	Spoladea	
Syrphinae	Insecta		
Psathyrellaceae	Agaricomycetes		
Syneora gypsochroa	Insecta	Syneora	
Bacchini	Insecta		
Cyperaceae	Equisetopsida		Button Rush
Chloris virgata	Equisetopsida	Chloris	Feathertop Rhodes Grass
Bromus hordeaceus	Equisetopsida	Bromus	Soft Brome
Scytodes	Arachnida	Scytodes	
Anas (Anas) superciliosa superciliosa	Aves	Anas	
Eurema smilax	Insecta	Eurema	Small Grass-yellow
Asteraceae	Equisetopsida		Daisy
Macropus fuliginosus	Mammalia	Macropus	Western Grey Kangaroo
Stomorhina	Insecta	Stomorhina	
Sarcophaga (Bercaea)	Insecta	Sarcophaga	
Mallada signatus	Insecta	Mallada	Green Lacewing
Ceratitis capitata	Insecta	Ceratitis	Medfly
Pimelea stricta	Equisetopsida	Pimelea	Erect Riceflower
Parapalaeosepsis plebeia	Insecta	Parapalaeosepsis	Black Scavenger Fly
Gryllinae	Insecta		
Ulmus	Equisetopsida	Ulmus	Elm
Bothriochloa	Equisetopsida	Bothriochloa	
NOCTUOIDEA	Insecta		
Marsilea drummondii	Equisetopsida	Marsilea	Clover Fern
Phytoliriomyza pittosporophylli	Insecta	Phytoliriomyza	
Echthromorpha intricatoria	Insecta	Echthromorpha	Cream Spotted Ichneumon Wasp
Bacillariophyceae	Bacillariophyceae		
Drosera whittakeri	Equisetopsida	Drosera	Scented Sundew
Saprinus	Insecta	Saprinus	
Silene pseudoatocion	Equisetopsida	Silene	Nodding Catchfly
Clematis microphylla	Equisetopsida	Clematis	Small-leaved Clematis
Aloina aloides	Bryopsida	Aloina	
PSEUDOCOCCIDAE	Insecta		Mealy Bugs
Cormocephalus	Chilopoda	Cormocephalus	
Melanerythrus mactans	Insecta	Melanerythrus	Bug
Amaryllis belladonna	Equisetopsida	Amaryllis	Belladonna Lily
Deroceras	Gastropoda	Deroceras	
Myrmecia mandibularis	Insecta	Myrmecia	Toothless Bull Ant
Hippotion celerio	Insecta	Hippotion	Grapevine Hawk Moth
Agaricus bitorquis	Agaricomycetes	Agaricus	
Ptilotula penicillata penicillata	Aves	Ptilotula	Eastern White-plumed Honeyeater
Thyreus waroonensis	Insecta	Thyreus	Cuckoo Bee
Goodenia pinnatifida	Equisetopsida	Goodenia	Cut-leaf Goodenia
Agonoscelis rutila	Insecta	Agonoscelis	Horehound Bug
Artamus (Angroyan) cyanopterus	Aves	Artamus	Dusky Woodswallow
Melangyna	Insecta	Melangyna	
Nacoleia rhoeoalis	Insecta	Nacoleia	Grass Moth
Ficus carica	Equisetopsida	Ficus	Edible Fig
Servaea incana	Arachnida	Servaea	Jumping Spider
Bursaria spinosa	Equisetopsida	Bursaria	Sweet Native Blackthorn
Gallinago (Gallinago) hardwickii	Aves	Gallinago	Latham's Snipe
Rumex crispus	Equisetopsida	Rumex	Curled Dock
POLYPHAGA	Insecta		
Mycetozoa			
Biprorulus bibax	Insecta	Biprorulus	Spined Citrus Bug
Chalcopteroides	Insecta	Chalcopteroides	
Myrmecia	Insecta	Myrmecia	
Mesembryanthemum cordifolium	Equisetopsida	Mesembryanthemum	Heart-leaf Ice-plant
Poecilohetaerus aquilus	Insecta	Poecilohetaerus	Acalyptrate Fly
Myoporum parvifolium	Equisetopsida	Myoporum	Creeping Boobialla
Acanthiza (Subacanthiza) nana	Aves	Acanthiza	Yellow Thornbill
Volvopluteus	Agaricomycetes	Volvopluteus	
Cyperus eragrostis	Equisetopsida	Cyperus	Drain Flat-sedge
Dolichoderinae	Insecta		
Asparagus setaceus	Equisetopsida	Asparagus	
ARTHROPODA			Arthropods
Acacia melanoxylon	Equisetopsida	Acacia	Blackwood
Juncus	Equisetopsida	Juncus	Rushes
Chloris chloris	Aves	Chloris	European Greenfinch
EVANIIDAE	Insecta		
Macrobrachium australiense	Malacostraca	Macrobrachium	Freshwater Prawn
Parmeliaceae	Lecanoromycetes		
NEMATODA			
Amaranthaceae	Equisetopsida		Amaranth
Campopleginae	Insecta		
Solanum mauritianum	Equisetopsida	Solanum	Wild Tobacco Tree
Chlorobapta frontalis	Insecta	Chlorobapta	
Cerdistus rusticanoides	Insecta	Cerdistus	Robber Fly
Formicinae	Insecta		
Goniaea australasiae	Insecta	Goniaea	Gumleaf Grasshopper
Porcellio	Malacostraca	Porcellio	
VESPIDAE	Insecta		Potter Wasps
Gryllotalpa brachyptera	Insecta	Gryllotalpa	Mole Cricket
Limonium	Equisetopsida	Limonium	Sea-lavender
RHINOTERMITIDAE	Insecta		
Lispe	Insecta	Lispe	
Vicia sativa	Equisetopsida	Vicia	Common Vetch
Epthianura (Epthianura) albifrons	Aves	Epthianura	White-fronted Chat
Tecoma capensis	Equisetopsida	Tecoma	Cape Honeysuckle
Leocarpus	Myxogastrea	Leocarpus	
Camponotus nigriceps	Insecta	Camponotus	Black-headed Sugar Ant
Acacia	Equisetopsida	Acacia	Wattle
Pison	Insecta	Pison	
Sida	Equisetopsida	Sida	Paddy's Lucerne
Anoplognathus velutinus	Insecta	Anoplognathus	
Paspalum dilatatum	Equisetopsida	Paspalum	Paspalum
Cosmodes elegans	Insecta	Cosmodes	Green Blotched Moth
Accipiter (Leucospiza) fasciatus	Aves	Accipiter	Brown Goshawk
Creontiades dilutus	Insecta	Creontiades	Green Mirid
Agrotis	Insecta	Agrotis	
Rapistrum rugosum	Equisetopsida	Rapistrum	Giant Mustard
Dipogon lignosus	Equisetopsida	Dipogon	Common Dolichos Pea
Chlenias	Insecta	Chlenias	
Araneus circulissparsus	Arachnida	Araneus	Orb-weaver Spider
Platalea (Platibis) flavipes	Aves	Platalea	Yellow-billed Spoonbill
Australomisidia pilula	Arachnida	Australomisidia	Crab Spider
Nacoleia	Insecta	Nacoleia	
Palpita	Insecta	Palpita	
Cheiracanthium	Arachnida	Cheiracanthium	
HEMEROBIIDAE	Insecta		
Solanum laciniatum	Equisetopsida	Solanum	Cut-leaf Kangaroo-apple
Cyperus	Equisetopsida	Cyperus	
COLEOPTERA	Insecta		Beetles
Aeonium arboreum	Equisetopsida	Aeonium	Golden Tree Aeonium
Chloroclystis metallospora	Insecta	Chloroclystis	
Malva multiflora	Equisetopsida	Malva	
Chrysodeixis	Insecta	Chrysodeixis	
Brachythecium rutabulum	Bryopsida	Brachythecium	Rough-stalked Feather-moss
Agrocybe putaminum	Agaricomycetes	Agrocybe	
Porcellio laevis	Malacostraca	Porcellio	
Anomaloninae	Insecta		
Cherax	Malacostraca	Cherax	Yabbies
Persicaria capitata	Equisetopsida	Persicaria	Japanese Knotweed
Verbascum virgatum	Equisetopsida	Verbascum	Twiggy Mullein
Lemna	Equisetopsida	Lemna	Duckweed
Leratiomyces	Agaricomycetes	Leratiomyces	
Helius	Insecta	Helius	
Convolvulus cneorum	Equisetopsida	Convolvulus	Silverbush
Astroloma humifusum	Equisetopsida	Astroloma	Cranberry Heath
Sceliphron formosum	Insecta	Sceliphron	
Trichiocercus	Insecta	Trichiocercus	
DERMESTIDAE	Insecta		
Dodonaea viscosa subsp. spatulata	Equisetopsida	Dodonaea	Sticky Hop-bush
Tropidoderus	Insecta	Tropidoderus	
Salvia microphylla	Equisetopsida	Salvia	
Phascolarctos cinereus victor	Mammalia	Phascolarctos	
BOMBYLIIDAE	Insecta		Bee Flies
Cormocephalus aurantiipes	Chilopoda	Cormocephalus	Orange-footed Centipede

Ennominae	Insecta		Geometer Moth
Symplecta (Trimicra) pilipes	Insecta	Symplecta	
Pheropsophus	Insecta	Pheropsophus	
Agaricus campestris	Agaricomycetes	Agaricus	Field Mushroom
Afraflacilla	Arachnida	Afraflacilla	
Chrysodeixis argentifera	Insecta	Chrysodeixis	Tobacco Looper Moth
Oxyura australis	Aves	Oxyura	Blue-billed Duck
Calliphora (Calliphora) vicina	Insecta	Calliphora	European Blowfly
Cernuella virgata	Gastropoda	Cernuella	Vineyard Snail
Polyommatini	Insecta		
Glycyphana	Insecta	Glycyphana	
Vespinae	Insecta		
Siphanta acuta	Insecta	Siphanta	Green Planthopper
Syntrichia laevipila	Bryopsida	Syntrichia	Screw Moss
PHORIDAE	Insecta		Scuttle Flies
Servaea	Arachnida	Servaea	
Hydroprogne caspia	Aves	Hydroprogne	Caspian Tern
Eurymeloides	Insecta	Eurymeloides	
Sorghum halepense	Equisetopsida	Sorghum	Johnson Grass
Nycticorax caledonicus	Aves	Nycticorax	Nankeen Night-heron
Austrostipa eremophila	Equisetopsida	Austrostipa	Desert Spear-grass
Oriolus (Mimeta) sagittatus	Aves	Oriolus	Olive-backed Oriole
Eragrostis	Equisetopsida	Eragrostis	Love Grass
Tortula muralis	Bryopsida	Tortula	Common Wall-moss
Sigesbeckia orientalis	Equisetopsida	Sigesbeckia	Indian Weed
GEOPHILOMORPHA	Chilopoda		
Austrostipa elegantissima	Equisetopsida	Austrostipa	Feather Spear-grass
Coriolopsis	Agaricomycetes	Coriolopsis	
Ctenochares bicolorus	Insecta	Ctenochares	
Atriplex paludosa	Equisetopsida	Atriplex	Marsh Saltbush
Acacia saligna	Equisetopsida	Acacia	Golden Wreath Wattle
Lepus capensis	Mammalia	Lepus	Brown Hare
Anax papuensis	Insecta	Anax	Australian Emperor
Homoeosoma	Insecta	Homoeosoma	
Tecticornia arbuscula	Equisetopsida	Tecticornia	Shrubby Samphire
Brachymeria podagrica	Insecta	Brachymeria	
Grevillea ilicifolia	Equisetopsida	Grevillea	Holly-leaf Grevillea
Isopedella	Arachnida	Isopedella	
Melolonthinae	Insecta		
Phlyctinus callosus	Insecta	Phlyctinus	Garden Weevil
MAMMALIA	Mammalia		Mammals
TROMBIDIFORMES	Arachnida		
Micromus tasmaniae	Insecta	Micromus	Tasmanian Brown Lacewing
LEPTOCERIDAE	Insecta		
Strophariaceae	Agaricomycetes		
Galaxias maculatus	Actinopterygii	Galaxias	Common Galaxias
HELICOIDEA	Gastropoda		
Plutella	Insecta	Plutella	
Asphondylia tonsura	Insecta	Asphondylia	
Rattus norvegicus	Mammalia	Rattus	Brown Rat
Symplecta	Insecta	Symplecta	
Ramaria filicicola	Agaricomycetes	Ramaria	
Cerceris	Insecta	Cerceris	
Fraus polyspila	Insecta	Fraus	Chequered Fraus
Tapinella panuoides	Agaricomycetes	Tapinella	
Dichocrocis clytusalis	Insecta	Dichocrocis	
Australoactina	Insecta	Australoactina	
Marchantia polymorpha	Marchantiopsida	Marchantia	
Isturgia penthearia	Insecta	Isturgia	Geometer Moth
Galium aparine	Equisetopsida	Galium	Cleavers
Hypochaeris radicata	Equisetopsida	Hypochaeris	Cats-ear
Rhamnus alaternus	Equisetopsida	Rhamnus	Blowfly Bush
Callidemum hypochalceum	Insecta	Callidemum	Metallic Dodonaea Leaf Beetle
Exaireta spinigera	Insecta	Exaireta	Garden Soldier Fly
Caedicia	Insecta	Caedicia	
Culladia cuneiferellus	Insecta	Culladia	Grass Moth
Australomisidia	Arachnida	Australomisidia	
Hortophora biapicata	Arachnida	Hortophora	
Mituliodon tarantulinus	Arachnida	Mituliodon	Long-legged Sac Spider
Proteuxoa heliosema	Insecta	Proteuxoa	Owlet Moth
SPHECIDAE	Insecta		Mud-daubers
Pachycephala (Pachycephala) pectoralis fuliginosa	Aves	Pachycephala	South Australian Golden Whistler
Arum italicum	Equisetopsida	Arum	Italian Arum
Cladorhynchus leucocephalus	Aves	Cladorhynchus	Banded Stilt
Cyperus involucratus	Equisetopsida	Cyperus	Umbrella Plant
Jotus	Arachnida	Jotus	
Tepperia sterculiae	Insecta	Tepperia	Kurrajong Seed Weevil
Diuris pardina	Equisetopsida	Diuris	Leopard Orchid
Pompilinae	Insecta		
Leucocoprinus birnbaumii	Agaricomycetes	Leucocoprinus	
Cryptanusia	Insecta	Cryptanusia	
Circus approximans	Aves	Circus	Swamp Harrier
Maireana enchylaenoides	Equisetopsida	Maireana	Wingless Fissure-plant
Juncus pallidus	Equisetopsida	Juncus	Pale Rush
Pararguda nasuta	Insecta	Pararguda	Lappet Moth
Lucia limbaria	Insecta	Lucia	Grassland Copper
Hylaeus	Insecta	Hylaeus	
ULOBORIDAE	Arachnida		
Fletchamia	Rhabditophora	Fletchamia	
Gahnia sieberiana	Equisetopsida	Gahnia	Red-fruit Cutting-grass
Plegadis falcinellus	Aves	Plegadis	Glossy Ibis
Moraea setifolia	Equisetopsida	Moraea	Thread Iris
Fabaceae	Equisetopsida		
Ficinia nodosa	Equisetopsida	Ficinia	Knobby Club-rush
Adenanthos	Equisetopsida	Adenanthos	
GRYLLOTALPIDAE	Insecta		
Uloborus	Arachnida	Uloborus	
Hibiscus tiliaceus	Equisetopsida	Hibiscus	Cotton Tree
Charops	Insecta	Charops	
Tachyglossus aculeatus aculeatus	Mammalia	Tachyglossus	
Venatrix	Arachnida	Venatrix	
Tebenna micalis	Insecta	Tebenna	Small Thistle Moth
Orthorhinus cylindrirostris	Insecta	Orthorhinus	Elephant Weevil
Deroceras invadens	Gastropoda	Deroceras	Invasive Field Slug
Simaetha	Arachnida	Simaetha	
Enicospilus	Insecta	Enicospilus	
Ixia	Equisetopsida	Ixia	
Gynoplistia (Gynoplistia) bella	Insecta	Gynoplistia	Crane Fly
Chlorophyllum	Agaricomycetes	Chlorophyllum	
Robshelfordia	Insecta	Robshelfordia	
Phlebopus marginatus	Agaricomycetes	Phlebopus	Fungi
Wahlenbergia stricta	Equisetopsida	Wahlenbergia	Tall Bluebell
Lycoperdon pratense	Agaricomycetes	Lycoperdon	
Erigeron sumatrensis	Equisetopsida	Erigeron	Tall Fleabane
Einadia nutans subsp. nutans	Equisetopsida	Einadia	Climbing Saltbush
DIPLOPODA	Diplopoda		Millipedes
Suillus granulatus	Agaricomycetes	Suillus	
Smeringopus natalensis	Arachnida	Smeringopus	
Senna artemisioides subsp. zygophylla	Equisetopsida	Senna	Narrow-leaf Desert Cassia
Lycoperdon perlatum	Agaricomycetes	Lycoperdon	
Chauliognathus lugubris	Insecta	Chauliognathus	Plague Soldier Beetle
Austrosciapus proximus	Insecta	Austrosciapus	Long-legged Fly
LIBELLULOIDEA	Insecta		
APOIDEA	Insecta		Solitary Bees
Porpidia	Lecanoromycetes	Porpidia	
Atriplex nummularia	Equisetopsida	Atriplex	Old-man Saltbush
Dolophones	Arachnida	Dolophones	
Xanthium orientale	Equisetopsida	Xanthium	Californian Burr
Pentatominae	Insecta		
Nyssus	Arachnida	Nyssus	
Plumbago	Equisetopsida	Plumbago	
Cercis siliquastrum	Equisetopsida	Cercis	Judas Tree
Mycena leptocephala	Agaricomycetes	Mycena	
Clepsis	Insecta	Clepsis	
Ochetellus glaber	Insecta	Ochetellus	Black House Ant
Carpobrotus rossii	Equisetopsida	Carpobrotus	Karkalla
Callistemon viminalis	Equisetopsida	Callistemon	Creek Bottlebrush
Laeviscolia frontalis	Insecta	Laeviscolia	Parasitoid Wasp

Eristalis (Eristalis) tenax	Insecta	Eristalis	Drone Fly
Cupressaceae	Equisetopsida		Cypress Pine
Epyaxa sodaliata	Insecta	Epyaxa	Geometer Moth
Austrostipa nitida	Equisetopsida	Austrostipa	Balcarra Spear-grass
Chenopodium album	Equisetopsida	Chenopodium	Fat Hen
GNAPHOSIDAE	Arachnida		
Blakistonia aurea	Arachnida	Blakistonia	Adelaide Trapdoor Spider
Pholcus	Arachnida	Pholcus	
Sapromyza	Insecta	Sapromyza	
Carassius auratus	Actinopterygii	Carassius	Goldfish
Weissia controversa	Bryopsida	Weissia	Green-tufted Stubble-moss
Barbula calycina	Bryopsida	Barbula	Common Beard-moss
Rytidosperma	Equisetopsida	Rytidosperma	
Laxta jeanneae	Insecta	Laxta	Cockroach
Notoncus	Insecta	Notoncus	
Alstroemeria psittacina	Equisetopsida	Alstroemeria	Parrot Lily
Sepsis	Insecta	Sepsis	
Habronestes	Arachnida	Habronestes	
Lepidium africanum	Equisetopsida	Lepidium	Rubble Peppercress
Asterales	Equisetopsida		
Stenocotini	Insecta		
Athetis tenuis	Insecta	Athetis	Owlet Moth
Fissidens	Bryopsida	Fissidens	
Bembix	Insecta	Bembix	
Badumna longinqua	Arachnida	Badumna	Grey House Spider
POLYOMMATINAE	Insecta		
Leskiini	Insecta		
Macrotona	Insecta	Macrotona	
ARMADILLIDIIDAE	Malacostraca		
Austrostipa mollis	Equisetopsida	Austrostipa	Soft Speargrass
APIDAE	Insecta		
Tasmanicosa gilberta	Arachnida	Tasmanicosa	Gilbertâ€™s Wolf Spider
ANISOPTERA	Insecta		
Euphorbia maculata	Equisetopsida	Euphorbia	Eyebane
Grevillea	Equisetopsida	Grevillea	
Hypochaeris	Equisetopsida	Hypochaeris	Cat's Ear
Poecilometis	Insecta	Poecilometis	
CHIRONOMIDAE	Insecta		
NEPOMORPHA	Insecta		
Eragrostis minor	Equisetopsida	Eragrostis	Small Stink-grass
CERAMBYCINAE	Insecta		Powderkeg Longicorn
Sceliphrinae	Insecta		
Parvipsitta porphyrocephala	Aves	Parvipsitta	Purple-crowned Lorikeet
Rubus	Equisetopsida	Rubus	Blackberry
Philobota gonostropha	Insecta	Philobota	
Drymaplaneta semivitta	Insecta	Drymaplaneta	Gisborne Cockroach
Atriplex semibaccata	Equisetopsida	Atriplex	Berry Saltbush
Bromus diandrus	Equisetopsida	Bromus	Great Brome
Geastrum	Agaricomycetes	Geastrum	
Peucetia	Arachnida	Peucetia	
Chrysocephalum apiculatum	Equisetopsida	Chrysocephalum	Common Everlasting
Juncus kraussii	Equisetopsida	Juncus	Sea Rush
Austracris guttulosa	Insecta	Austracris	Spur-throated Locust
Eucalyptus sideroxylon	Equisetopsida	Eucalyptus	Mugga Ironbark
Phalacrocorax (Phalacrocorax) varius	Aves	Phalacrocorax	Pied Cormorant
Chasmanthe	Equisetopsida	Chasmanthe	Chasmanthe
Dufourea	Lecanoromycetes	Dufourea	
Paropsisterna intacta	Insecta	Paropsisterna	
Dicranolaius bellulus	Insecta	Dicranolaius	Red And Blue Beetle
Spathulina acroleuca	Insecta	Spathulina	Primitive Crane Fly
Drosera glanduligera	Equisetopsida	Drosera	Scarlet Sundew
Limnodynastes	Amphibia	Limnodynastes	
Torilis arvensis	Equisetopsida	Torilis	Spreading Hedge-parsley
Echinochloa colona	Equisetopsida	Echinochloa	Awnless Barnyard-grass
Poodytes gramineus	Aves	Poodytes	Little Grassbird
Glycyrrhiza glabra	Equisetopsida	Glycyrrhiza	Liquorice
Paropsides calypso	Insecta	Paropsides	
Odontomyia hunteri	Insecta	Odontomyia	
Pygophora	Insecta	Pygophora	
TORYMIDAE	Insecta		
MEMBRACOIDEA	Insecta		
Choerocoris paganus	Insecta	Choerocoris	Ground Shield Bug
Billardiera cymosa	Equisetopsida	Billardiera	Sweet Apple-berry
PHLAEOTHRIPIDAE	Insecta		
Polycarpon tetraphyllum	Equisetopsida	Polycarpon	Four-leaf Allseed
Pseudocrossidium crinitum	Bryopsida	Pseudocrossidium	Beard Moss
Oenothera	Equisetopsida	Oenothera	Clockweed
Dieuches notatus	Insecta	Dieuches	Seed Bug
Gomphocarpus cancellatus	Equisetopsida	Gomphocarpus	Broad-leaf Cotton-bush
Heterotermes	Insecta	Heterotermes	
Scopula optivata	Insecta	Scopula	Geometer Moth
Chaetophthalmus	Insecta	Chaetophthalmus	
Idiosoma	Arachnida	Idiosoma	
Eucalyptus saligna	Equisetopsida	Eucalyptus	Sydney Blue Gum
SPHINGIDAE	Insecta		
Anthrax confluensis	Insecta	Anthrax	Bee Fly
Tasmanocoenis tillyardi	Insecta	Tasmanocoenis	Mayfly
Perilampus	Insecta	Perilampus	
Xanthoparmelia	Lecanoromycetes	Xanthoparmelia	
Ardea alba modesta	Aves	Ardea	Great Egret
PTEROPHORIDAE	Insecta		
Nostoc	Cyanophyceae	Nostoc	
Persectania	Insecta	Persectania	
Suaeda australis	Equisetopsida	Suaeda	Austral Seablite
Litoria	Amphibia	Litoria	
Mentha	Equisetopsida	Mentha	Mint
Mcateella	Insecta	Mcateella	
Syntrichia	Bryopsida	Syntrichia	
Spyridium parvifolium	Equisetopsida	Spyridium	Dusty Miller
Rattus	Mammalia	Rattus	
AVES	Aves		Birds
Phalaris	Equisetopsida	Phalaris	Canary Grass
Steatoda capensis	Arachnida	Steatoda	Tangle-web Spider
Lasioglossum (Chilalictus) hemichalceum	Insecta	Lasioglossum	Sweat Bee
Physcia	Lecanoromycetes	Physcia	
Salsola australis	Equisetopsida	Salsola	Coast Saltwort
Brunotartessus fulvus	Insecta	Brunotartessus	Leafhopper
NITIDULIDAE	Insecta		
Physcia caesia	Lecanoromycetes	Physcia	
Mirabilis jalapa	Equisetopsida	Mirabilis	Marvel-of-peru
Stictonetta naevosa	Aves	Stictonetta	Freckled Duck
Entosthodon	Bryopsida	Entosthodon	
Periplaneta americana	Insecta	Periplaneta	American Cockroach
Carpobrotus glaucescens	Equisetopsida	Carpobrotus	Bluish Pigface
Gryllotalpa oya	Insecta	Gryllotalpa	
Leptocoris	Insecta	Leptocoris	
Chrysomya megacephala	Insecta	Chrysomya	
Lactuca serriola	Equisetopsida	Lactuca	Prickly Lettuce
Garrha pudica	Insecta	Garrha	Concealer Moth
Cynodon dactylon	Equisetopsida	Cynodon	Couch
Xanthopimpla rhapaloceros	Insecta	Xanthopimpla	
Sphenophorus brunnipennis	Insecta	Sphenophorus	La Plata Weevil
Eurymelini	Insecta		Gum Tree Hoppers
Microcarbo melanoleucos melanoleucos	Aves	Microcarbo	Australasian Little Pied Cormorant
Clitocybaceae	Agaricomycetes		
Entosthodon subnudus	Bryopsida	Entosthodon	Cord Moss
Scolopendra morsitans	Chilopoda	Scolopendra	
Dimorphotheca	Equisetopsida	Dimorphotheca	Cape Marigold
Heleina	Insecta		
SCYTODIDAE	Arachnida		
Panicum	Equisetopsida	Panicum	Panics
Artoria	Arachnida	Artoria	Australian Forest Runners
Plantago bellardii	Equisetopsida	Plantago	Hairy Plantain
Pandorea jasminoides	Equisetopsida	Pandorea	Bower Vine
Polistes	Insecta	Polistes	
PARADOXOSOMATIDAE	Diplopoda		
Oxalis	Equisetopsida	Oxalis	Wood Sorrel
Persicaria lapathifolia	Equisetopsida	Persicaria	Woolly Knotweed

Chrysotimus	Insecta	Chrysotimus	
Senecio hypoleucus	Equisetopsida	Senecio	Pale Groundsel
Typha	Equisetopsida	Typha	Cumbungi
Perga	Insecta	Perga	
PTEROPHOROIDEA	Insecta		
Orosius orientalis	Insecta	Orosius	Common Brown Leafhopper
Thripinae	Insecta		
Nacaduba biocellata	Insecta	Nacaduba	Two-spotted Line-blue
Sextius virescens	Insecta	Sextius	Green Treehopper
Tricholoma terreum	Agaricomycetes	Tricholoma	
Xanthorhoini	Insecta		
Actitis hypoleucos	Aves	Actitis	Common Sandpiper
Cycnogeton procerum	Equisetopsida	Cycnogeton	Common Water-ribbons
Oenothera stricta	Equisetopsida	Oenothera	Common Evening Primrose
Lecithocera	Insecta	Lecithocera	
Parathyginus	Insecta	Parathyginus	
Poecilohetaerus schineri	Insecta	Poecilohetaerus	Acalyptrate Fly
Thomisus spectabilis	Arachnida	Thomisus	Flower Spider
Tanacetum parthenium	Equisetopsida	Tanacetum	Feverfew
NEOPASIPHAEINAE	Insecta		
Lerista bougainvillii	Reptilia	Lerista	South-eastern Slider
Hemicordulia	Insecta	Hemicordulia	
Closterotomus norwegicus	Insecta	Closterotomus	Potato Bug
CULICOMORPHA	Insecta		
Senna artemisioides subsp. filifolia	Equisetopsida	Senna	Punty Bush
PLUTELLIDAE	Insecta		
Sphenella ruficeps	Insecta	Sphenella	Primitive Crane Fly
SCIARIDAE	Insecta		
Oxalis perennans	Equisetopsida	Oxalis	Native Sorrel
Cenchrus longisetus	Equisetopsida	Cenchrus	Feathertop
Polygonum aviculare	Equisetopsida	Polygonum	Prostrate Knotweed
Allocasuarina verticillata	Equisetopsida	Allocasuarina	Drooping Sheoak
Diplotaxis tenuifolia	Equisetopsida	Diplotaxis	Sand Rocket
Scleroderma citrinum	Agaricomycetes	Scleroderma	
Oxalis purpurea	Equisetopsida	Oxalis	One-o'clock
Aphidinae	Insecta		
Klambothrips myopori	Insecta	Klambothrips	
OESTROIDEA	Insecta		
Nymphicus hollandicus	Aves	Nymphicus	Cockatiel
Eremophila deserti	Equisetopsida	Eremophila	Turkey-bush
Heteropsilopus cingulipes	Insecta	Heteropsilopus	Long-legged Fly
Melaleuca decussata	Equisetopsida	Melaleuca	Totem-poles
Lepraria	Lecanoromycetes	Lepraria	
Aonidiella aurantii	Insecta	Aonidiella	California Red Scale Insect
Diplazon laetatorius	Insecta	Diplazon	
SYMPHYPLEONA	Collembola		
Lysimachia loeflingii	Equisetopsida	Lysimachia	
Myoporum platycarpum subsp. platycarpum	Equisetopsida	Myoporum	Sugarwood
Deroceras laeve	Gastropoda	Deroceras	Marsh Slug
Juncus acutus	Equisetopsida	Juncus	Sharp Rush
Pasiphilodes testulata	Insecta	Pasiphilodes	Geometer Moth
Chamaemelum	Equisetopsida	Chamaemelum	
Corymbia ficifolia	Equisetopsida	Corymbia	Red-flowering Gum
Zygodon	Bryopsida	Zygodon	
Thynninae	Insecta		
Lindneromyia	Insecta	Lindneromyia	
Modiola caroliniana	Equisetopsida	Modiola	Red-flowered Mallow
Tetragonia implexicoma	Equisetopsida	Tetragonia	Bower Spinach
Juncus flavidus	Equisetopsida	Juncus	Yellow Rush
Paratya	Malacostraca	Paratya	
Myoporum insulare	Equisetopsida	Myoporum	Common Boobialla
Acacia retinodes	Equisetopsida	Acacia	Wirilda
Smicrornis brevirostris occidentalis	Aves	Smicrornis	Southern Weebill
Coptotermes	Insecta	Coptotermes	
Egretta garzetta nigripes	Aves	Egretta	
POMPILIDAE	Insecta		
Microtropesa sinuata	Insecta	Microtropesa	Horse Fly
Perga affinis	Insecta	Perga	Spitfire Sawfly
Hardenbergia	Equisetopsida	Hardenbergia	
Atriplex suberecta	Equisetopsida	Atriplex	Sprawling Saltbush
Drymaplaneta communis	Insecta	Drymaplaneta	Common Shining Cockroach
Gasteruption	Insecta	Gasteruption	
Melaleuca lanceolata	Equisetopsida	Melaleuca	Dryland Tea-tree
Leucania	Insecta	Leucania	
Marsilea hirsuta	Equisetopsida	Marsilea	Hairy Nardoo
Genduara	Insecta	Genduara	
Avena barbata	Equisetopsida	Avena	Bearded Oats
Myxomycetes	Myxomycetes		
ANTHELIDAE	Insecta		
EPHYDROIDEA	Insecta		
Batracomorphus	Insecta	Batracomorphus	
Cloeon paradieniense	Insecta	Cloeon	Mayfly
Oxyopes elegans	Arachnida	Oxyopes	Lynx Spider
AGROMYZIDAE	Insecta		
Anonychomyrma	Insecta	Anonychomyrma	
Tulbaghia	Equisetopsida	Tulbaghia	
Microseris walteri	Equisetopsida	Microseris	Yam Daisy
Pinaceae	Equisetopsida		Maritime Pine
Larentiinae	Insecta		
Gryllotalpa australis	Insecta	Gryllotalpa	
Eragrostis cilianensis	Equisetopsida	Eragrostis	Lovegrass
Tradescantia fluminensis	Equisetopsida	Tradescantia	Wandering Jew
CHIRONOMINI	Insecta		
Senecio quadridentatus	Equisetopsida	Senecio	Cotton Groundsel
Pheladenia deformis	Equisetopsida	Pheladenia	Bluebeard Orchid
Lucilia sericata	Insecta	Lucilia	Green Blowfly
Papilio (Princeps) demoleus	Insecta	Papilio	Chequered Swallowtail
Aloina ambigua	Bryopsida	Aloina	
Diplogeomyza	Insecta	Diplogeomyza	
TERMITIDAE	Insecta		
Abantiades marcidus	Insecta	Abantiades	Ghost Moth
Polyporaceae	Agaricomycetes		
Pellenes	Arachnida	Pellenes	
Tecticornia	Equisetopsida	Tecticornia	Samphires
Bolbitius titubans	Agaricomycetes	Bolbitius	
Tremella fuciformis	Tremellomycetes	Tremella	
GRIPOPTERYGIDAE	Insecta		
Medicago arabica	Equisetopsida	Medicago	Spotted Medic
Hilara	Insecta	Hilara	
Grimmia	Bryopsida	Grimmia	
Cestrum parqui	Equisetopsida	Cestrum	Green Poison-berry
Oxyops fasciatus	Insecta	Oxyops	
Pipunculinae	Insecta		
Berosus	Insecta	Berosus	
Entometa fervens	Insecta	Entometa	Gum Snout Moth
CERAMBYCIDAE	Insecta		
Sidnia	Insecta	Sidnia	
Gahnia	Equisetopsida	Gahnia	Saw-sedges
Scaevola	Equisetopsida	Scaevola	Fan-flowers
Acacia salicina	Equisetopsida	Acacia	Cooba
Ocirrhoe unimaculata	Insecta	Ocirrhoe	Shield Bug
MUTILLIDAE	Insecta		
Crepidotus mollis	Agaricomycetes	Crepidotus	
Cortinarius archeri	Agaricomycetes	Cortinarius	
LYMNAEOIDEA	Gastropoda		
Brachychiton rupestris	Equisetopsida	Brachychiton	Queensland Rattle Tree
HETEROPTERA	Insecta		Reduviids
Lecanoraceae	Lecanoromycetes		
Paracardiophorus	Insecta	Paracardiophorus	
Eucalyptus melanophloia	Equisetopsida	Eucalyptus	Silver-leaved Ironbark
Monopis argillacea	Insecta	Monopis	
GASTROPODA	Gastropoda		
Crassula sieberiana	Equisetopsida	Crassula	Sieber Crassula
Capusa cuculloides	Insecta	Capusa	Geometer Moth
DICTYOPHARIDAE	Insecta		
Tachyglossus aculeatus	Mammalia	Tachyglossus	Short-beaked Echidna
Abantiades argentata	Insecta	Abantiades	Species Of Ghost Moth
Plusiinae	Insecta		

Monopis meliorella	Insecta	Monopis	
Aizoon	Equisetopsida	Aizoon	Galenia
Hydrotaea	Insecta	Hydrotaea	
HERSILIIDAE	Arachnida		Long-tailed Spiders
Melia azedarach	Equisetopsida	Melia	White Cedar
Agriopocoris	Insecta	Agriopocoris	
Austalis copiosa	Insecta	Austalis	
Milax gagates	Gastropoda	Milax	Jet Slug
Malacorhynchus membranaceus	Aves	Malacorhynchus	Pink-eared Duck
CLUBIONIDAE	Arachnida		Sac Spiders
TENTHREDINOIDEA	Insecta		
Pherbellia	Insecta	Pherbellia	
Chrysomyinae	Insecta		
Tringa (Glottis) nebularia	Aves	Tringa	Common Greenshank
Braconinae	Insecta		
Lasioglossum (Parasphecodes)	Insecta	Lasioglossum	
Hylaeus (Prosopisteron)	Insecta	Hylaeus	
Correa	Equisetopsida	Correa	Native Fuchsia
Dianella	Equisetopsida	Dianella	Flax Lillies
Koelreuteria	Equisetopsida	Koelreuteria	
Galium murale	Equisetopsida	Galium	Small Bedstraw
Leucania uda	Insecta	Leucania	Owlet Moth
Bolbitius	Agaricomycetes	Bolbitius	
Paraoxypilus tasmaniensis	Insecta	Paraoxypilus	
ARACHNIDA	Arachnida		
Postia pelliculosa	Agaricomycetes	Postia	
Asparagales	Equisetopsida		
CYPRINIDAE	Actinopterygii		Cyprinids
PYRALOIDEA	Insecta		
Schizobothrus flavovittatus	Insecta	Schizobothrus	Disappearing Grasshopper
Callibracon	Insecta	Callibracon	
Cyathus olla	Agaricomycetes	Cyathus	
Melaleuca quinquenervia	Equisetopsida	Melaleuca	Swamp Paperbark
Assara subarcuella	Insecta	Assara	
Mentha x piperita	Equisetopsida	Mentha	Peppermint
Niceteria macrocosma	Insecta	Niceteria	Macrocosma Moth
Pavonia hastata	Equisetopsida	Pavonia	Pink Pavonia
BOMBYCOIDEA	Insecta		
Cyrtophora crassipes	Arachnida	Cyrtophora	
Argoctenus	Arachnida	Argoctenus	
Entiminae	Insecta		
Maireana	Equisetopsida	Maireana	
Hymenochaetaceae	Agaricomycetes		
Tuberolachnus salignus	Insecta	Tuberolachnus	Giant Willow Aphid
Poecilometis alienus	Insecta	Poecilometis	Shield Bug
Hellula	Insecta	Hellula	
Juncus subsecundus	Equisetopsida	Juncus	Finger Rush
Megachile (Hackeriapis)	Insecta	Megachile	
Parentia	Insecta	Parentia	
TACHINIDAE	Insecta		Tachinid Flies
Mycena clarkeana	Agaricomycetes	Mycena	
Smeringopus	Arachnida	Smeringopus	
Polistinae	Insecta		
Caenoplanini	Rhabditophora		
Leptodictyum riparium	Bryopsida	Leptodictyum	Marsh Feather-moss
Anthrax proconcisus	Insecta	Anthrax	Bee Fly
Felis catus	Mammalia	Felis	Cat
Neodialineura nitens	Insecta	Neodialineura	
Stangeia	Insecta	Stangeia	
Poecilometis patruelis	Insecta	Poecilometis	Shield Bug
Convolvulus remotus	Equisetopsida	Convolvulus	Grassy Bindweed
Bulbine semibarbata	Equisetopsida	Bulbine	Leek Lily
Ficus	Equisetopsida	Ficus	Fig
Callistemon citrinus	Equisetopsida	Callistemon	Crimson Bottlebrush
Polyporales	Agaricomycetes		
Bryaceae	Bryopsida		
Lolium rigidum	Equisetopsida	Lolium	Wimmera Ryegrass
Agave americana	Equisetopsida	Agave	Century Plant
Amelora	Insecta	Amelora	
Diaphonia xanthopyga	Insecta	Diaphonia	
Salix	Equisetopsida	Salix	Willow
Faveria tritalis	Insecta	Faveria	Couchgrass Webworm Moth
Diaphorinae	Insecta		
Maireana brevifolia	Equisetopsida	Maireana	Short-leaf Bluebush
Mirabilis	Equisetopsida	Mirabilis	Mirabilis
Ardea pacifica	Aves	Ardea	White-necked Heron
Corymbia citriodora	Equisetopsida	Corymbia	Lemon-scented Gum
Spilostethus pacificus	Insecta	Spilostethus	Bug
Technomyrmex	Insecta	Technomyrmex	
Cassinia arcuata	Equisetopsida	Cassinia	Chinese Shrub
Sclerodermatineae	Agaricomycetes		
NEMATOCERA	Insecta		
Machaerina articulata	Equisetopsida	Machaerina	Jointed Twig-rush
VERTEBRATA			
Panicum effusum	Equisetopsida	Panicum	Hairy Panic
Cyperus congestus	Equisetopsida	Cyperus	Dense Flat-sedge
DYSDERIDAE	Arachnida		
Thalaina angulosa	Insecta	Thalaina	Angled Satin Moth
Melampsora ricini	Pucciniomycetes	Melampsora	
Calliphora (Paracalliphora) augur	Insecta	Calliphora	Lesser Brown Blowfly
Fulvifomes	Agaricomycetes	Fulvifomes	
Paropsides	Insecta	Paropsides	
Eucalyptus ovata	Equisetopsida	Eucalyptus	Swamp Gum
Melilotus albus	Equisetopsida	Melilotus	Bokhara Clover
Cleomaceae	Equisetopsida		
Apiomorpha	Insecta	Apiomorpha	
Pheidole megacephala	Insecta	Pheidole	African Big-headed Ant
Goniaea	Insecta	Goniaea	
Austrosciapus	Insecta	Austrosciapus	
Bryopsida	Bryopsida		
LAUXANIIDAE	Insecta		
Bothriochloa macra	Equisetopsida	Bothriochloa	Red-leg Grass
Caenoplana	Rhabditophora	Caenoplana	
Cryptocheilus australis	Insecta	Cryptocheilus	
Erigeron canadensis	Equisetopsida	Erigeron	Canadian Fleabane
Proteuxoa tibiata	Insecta	Proteuxoa	Owlet Moth
Prolasius	Insecta	Prolasius	
Xanthogaleruca luteola	Insecta	Xanthogaleruca	Elm Leaf Beetle
Stenotaphrum secundatum	Equisetopsida	Stenotaphrum	Buffalo Grass
TORTRICIDAE	Insecta		
Veronica	Equisetopsida	Veronica	Hebe
Aristida behriana	Equisetopsida	Aristida	Brush Wire-grass
Ehrharta erecta	Equisetopsida	Ehrharta	Panic Veldt-grass
Ceromya	Insecta	Ceromya	
Mythimna (Pseudaletia) convecta	Insecta	Mythimna	Common Armyworm Moth
Delma molleri	Reptilia	Delma	Gulfs Delma
Chlorophyllum brunneum	Agaricomycetes	Chlorophyllum	
Camponotus suffusus	Insecta	Camponotus	Golden Flumed Sugar Ant
Pelargonium	Equisetopsida	Pelargonium	Stork's Bill
Tricholoma austrocolossum	Agaricomycetes	Tricholoma	
Holocnemus	Arachnida	Holocnemus	
Centaurium tenuiflorum	Equisetopsida	Centaurium	Branched Centaury
Spondyliaspidinae	Insecta		
Physciaceae	Lecanoromycetes		
Anthosachne scabra	Equisetopsida	Anthosachne	Wheatgrass
Taxeotis	Insecta	Taxeotis	
Syllitus rectus	Insecta	Syllitus	
Cacatua (Cacatua) galerita galerita	Aves	Cacatua	Eastern Sulphur-crested Cockatoo
Epichrysocharis	Insecta	Epichrysocharis	
HALICTIDAE	Insecta		
Basidiomycota			
Archipini	Insecta		Leafroller Moth
Aphis fabae	Insecta	Aphis	Black Bean Aphid
Avena	Equisetopsida	Avena	Oat
Peziza	Pezizomycetes	Peziza	
Cenchrus setaceus	Equisetopsida	Cenchrus	Fountain Grass
Ulvophyceae	Ulvophyceae		
Corvus	Aves	Corvus	

Caryophyllales	Equisetopsida		
BLABERIDAE	Insecta		
Proteuxoa nuna	Insecta	Proteuxoa	Owlet Moth
Porcellionides	Malacostraca	Porcellionides	
Nostocales	Cyanophyceae		
Erigeron	Equisetopsida	Erigeron	Fleabane
Danaus petilia	Insecta	Danaus	Lesser Wanderer
Morethia adelaidensis	Reptilia	Morethia	Saltbush Morethia Skink
Deroceras reticulatum	Gastropoda	Deroceras	Grey Field Slug
Euzosteria	Insecta	Euzosteria	
Syndesus cornutus	Insecta	Syndesus	Lucanid Decay Borer
Teloschistaceae	Lecanoromycetes		
Syntrichia antarctica	Bryopsida	Syntrichia	Bristly Screw-moss
STERNORRHYNCHA	Insecta		Whiteflies
Orsillinae	Insecta		
Myrmecia nigriscapa	Insecta	Myrmecia	Bull Ant
Olearia ramulosa	Equisetopsida	Olearia	Twiggy Daisy-bush
Caenoplana coerulea	Rhabditophora	Caenoplana	
Stereum illudens	Agaricomycetes	Stereum	
Pseudofoenus	Insecta	Pseudofoenus	
Acacia myrtifolia	Equisetopsida	Acacia	Myrtle Wattle
Holoplatys invenusta	Arachnida	Holoplatys	Jumping Spider
Euryopis	Arachnida	Euryopis	
Euryops chrysanthemoides	Equisetopsida	Euryops	Boneseeds
Laxta	Insecta	Laxta	
Anthrax maculatus	Insecta	Anthrax	Bee Fly
Lamprima aurata	Insecta	Lamprima	Golden Stag Beetle
Brassica tournefortii	Equisetopsida	Brassica	Wild Turnip
Anabarhynchus	Insecta	Anabarhynchus	
Oophorini	Insecta		
Malurus (Musciparus) leucopterus	Aves	Malurus	White-winged Fairy-wren
Duma florulenta	Equisetopsida	Duma	Tangled Lignum
Flavoparmelia	Lecanoromycetes	Flavoparmelia	
Lantanophaga	Insecta	Lantanophaga	
Passiflora edulis	Equisetopsida	Passiflora	Common Passionfruit
Asilinae	Insecta		
Oxycarenus (Oxycarenus) luctuosus	Insecta	Oxycarenus	Cottonseed Bug
Cupressus sempervirens	Equisetopsida	Cupressus	Pencil Pine
Myoporum petiolatum	Equisetopsida	Myoporum	Sticky Boobialla
Syzeuctus	Insecta	Syzeuctus	
Megachile nigrovittata	Insecta	Megachile	
Pardalotus (Pardalotus) punctatus	Aves	Pardalotus	Spotted Pardalote
Cotula australis	Equisetopsida	Cotula	Common Cotula
Epicyme rubropunctaria	Insecta	Epicyme	Geometer Moth
Camponotus ephippium	Insecta	Camponotus	Jumbuck Sugar Ant
Sondra	Arachnida	Sondra	
Dasineura	Insecta	Dasineura	
Opisthoncus sexmaculatus	Arachnida	Opisthoncus	
Astraeus hygrometricus	Agaricomycetes	Astraeus	
Cryptops	Chilopoda	Cryptops	
Sterrhinae	Insecta		
ICHNEUMONOIDEA	Insecta		
Lasioglossum (Chilalictus) lanarium	Insecta	Lasioglossum	Sweat Bee
Crypsiphona	Insecta	Crypsiphona	
Eucalyptus grandis	Equisetopsida	Eucalyptus	Flooded Gum
Hordeum	Equisetopsida	Hordeum	Barley
Aseroe rubra	Agaricomycetes	Aseroe	Anemone Stinkhorn Fungus
Glycaspis	Insecta	Glycaspis	
Leucopogon parviflorus	Equisetopsida	Leucopogon	Coast Beard-heath
BLATTOIDEA	Insecta		
Suillus	Agaricomycetes	Suillus	
Pseudognaphalium luteoalbum	Equisetopsida	Pseudognaphalium	Jersey Cudweed
Leucojum aestivum	Equisetopsida	Leucojum	Snowflake
Corymbia maculata	Equisetopsida	Corymbia	Spotted Gum
Tiliqua rugosa	Reptilia	Tiliqua	Shingle-back
Neostorena	Arachnida	Neostorena	
Oenochroma vinaria	Insecta	Oenochroma	Grevillea Looper Moth
Pyralis	Insecta	Pyralis	
Melaleuca nesophila	Equisetopsida	Melaleuca	Showy Honey Myrtle
Hylaeus (Prosopisteron) aralis	Insecta	Hylaeus	Plasterer Bee
Acaena novae-zelandiae	Equisetopsida	Acaena	Bidgee-widgee
Ogyris amaryllis	Insecta	Ogyris	Amaryllis Azure
Arocatus rusticus	Insecta	Arocatus	Bug
Nocar	Insecta	Nocar	
Capua intractana	Insecta	Capua	
Tephritini	Insecta		
Ailanthus altissima	Equisetopsida	Ailanthus	Tree Of Heaven
Gleditsia triacanthos	Equisetopsida	Gleditsia	Honey Locust
Anthomyia	Insecta	Anthomyia	
Botrytis cinerea	Leotiomycetes	Botrytis	
Monomorium pharaonis	Insecta	Monomorium	Pharaoh Ant
Cynara	Equisetopsida	Cynara	
Ipheion uniflorum	Equisetopsida	Ipheion	Spring Star-flower
HELMINTHOMORPHA	Diplopoda		
Trichocera (Trichocera) annulata	Insecta	Trichocera	Winter Crane Fly
Culex (Culex) quinquefasciatus	Insecta	Culex	House Mosquito
Theclinesthes serpentatus	Insecta	Theclinesthes	Salt-bush Blue
Hylaeus (Rhodohylaeus)	Insecta	Hylaeus	
Acer negundo	Equisetopsida	Acer	Box-elder Maple
Heliothinae	Insecta		
Lithobius	Chilopoda	Lithobius	
Tropidoderus rhodomus	Insecta	Tropidoderus	Red-shouldered Stick-insect
Radumeris tasmaniensis	Insecta	Radumeris	Parasitoid Wasp
Ocimum	Equisetopsida	Ocimum	Basil
TRICHOPTERA	Insecta		Caddisflies
Omphalotus nidiformis	Agaricomycetes	Omphalotus	
Vespula	Insecta	Vespula	
Phasia	Insecta	Phasia	
Zygophyllales	Equisetopsida		
Culex	Insecta	Culex	
Balanus trigonus	Maxillopoda	Balanus	
Colocasia esculenta	Equisetopsida	Colocasia	Taro
DOLICHOPODIDAE	Insecta		
Hermetia illucens	Insecta	Hermetia	
Chrysomya rufifacies	Insecta	Chrysomya	Hairy Maggot Blowfly
Xantholinini	Insecta		
Nabis (Tropiconabis) kinbergii	Insecta	Nabis	Pacific Damsel Bug
Arecales	Equisetopsida		
Torbia viridissima	Insecta	Torbia	Gum Leaf Katydid
Hadronyche adelaidensis	Arachnida	Hadronyche	
Cylindromyia	Insecta	Cylindromyia	
Heliotropium	Equisetopsida	Heliotropium	Heliotrope
Syzygium paniculatum	Equisetopsida	Syzygium	Magenta Lilly Pilly
Linepithema humile	Insecta	Linepithema	Argentine Ant
Cortinarius	Agaricomycetes	Cortinarius	
Mentha spicata	Equisetopsida	Mentha	Spearmint
Macrosiphum (Macrosiphum) rosae	Insecta	Macrosiphum	Rose Aphid
Eragrostis barrelieri	Equisetopsida	Eragrostis	Pitted Love-grass
Cryptes baccatus	Insecta	Cryptes	Wattle Tick Scale
CICADOMORPHA	Insecta		
Pentodontini	Insecta		
Geastrum fornicatum	Agaricomycetes	Geastrum	
Phaeoceros	Anthocerotopsida	Phaeoceros	
Platyzosteria	Insecta	Platyzosteria	
LIBELLULIDAE	Insecta		Skimmers
SCINCIDAE	Reptilia		
Penicillium	Eurotiomycetes	Penicillium	
Scaevola albida	Equisetopsida	Scaevola	Pale Fanflower
Podiceps cristatus australis	Aves	Podiceps	Australian Great Crested Grebe
Melithreptus (Melithreptus) lunatus	Aves	Melithreptus	White-naped Honeyeater
Laccotrephes (Laccotrephes) tristis	Insecta	Laccotrephes	Water Scorpion
Geastrum triplex	Agaricomycetes	Geastrum	
Epilobium hirtigerum	Equisetopsida	Epilobium	Hairy Willow-herb
Chortoicetes	Insecta	Chortoicetes	
Eucalyptus leucoxylon subsp. leucoxylon	Equisetopsida	Eucalyptus	Yellow Gum
Thaumastocoris peregrinus	Insecta	Thaumastocoris	
Hylaeus (Gnathoprosopis) euxanthus	Insecta	Hylaeus	Plasterer Bee
Pachyprosopis (Pachyprosopis) haematostoma	Insecta	Pachyprosopis	Plasterer Bee

Seira	Collembola	Seira	
Heoclisis	Insecta	Heoclisis	
Correa alba	Equisetopsida	Correa	White Correa
Belenois java teutonia	Insecta	Belenois	Caper White
Ardea	Aves	Ardea	
Naupactus leucoloma	Insecta	Naupactus	White-fringed Weevil
Westringia	Equisetopsida	Westringia	
Casuarinaceae	Equisetopsida		Sheoak
Periplaneta australasiae	Insecta	Periplaneta	Australian Cockroach
Maratus vespertilio	Arachnida	Maratus	Species Of Peacock Spider
ZYGOPTERA	Insecta		
Homoneura (Homoneura) binotata	Insecta	Homoneura	
Austrostipa multispiculis	Equisetopsida	Austrostipa	Many-flowered Spear-grass
ONYCHIURIDAE	Collembola		
Digitaria sanguinalis	Equisetopsida	Digitaria	Summer Grass
Hyparrhenia hirta	Equisetopsida	Hyparrhenia	Tambookie Grass
Prostanthera behriana	Equisetopsida	Prostanthera	Downy Mintbush
Brassica oleracea	Equisetopsida	Brassica	Cabbage
Hellula hydralis	Insecta	Hellula	Grass Moth
Dieuches maculicollis	Insecta	Dieuches	Seed Bug
Sympycninae	Insecta		
Epilobium ciliatum	Equisetopsida	Epilobium	Glandular Willow-herb
Ixia polystachya	Equisetopsida	Ixia	Variable Ixia
Phylloporus	Agaricomycetes	Phylloporus	
Pinus	Equisetopsida	Pinus	Pine
Casuarina	Equisetopsida	Casuarina	Oaks
Tubaria	Agaricomycetes	Tubaria	
Panaeolus	Agaricomycetes	Panaeolus	
Correa glabra	Equisetopsida	Correa	Rock Correa
Inopus	Insecta	Inopus	
Lactarius deliciosus	Agaricomycetes	Lactarius	
NOTONECTINI	Insecta		
Idolothripinae	Insecta		
Lepisma saccharina	Insecta	Lepisma	Silverfish
Acacia euthycarpa	Equisetopsida	Acacia	Wallowa
Correa reflexa	Equisetopsida	Correa	Basalt Correa
Amyema miquelii	Equisetopsida	Amyema	Box Mistletoe
THYSANOPTERA	Insecta		Thrips
Geranium	Equisetopsida	Geranium	Crane's-bill
Anthomyia vicarians	Insecta	Anthomyia	
Xanthocryptus	Insecta	Xanthocryptus	
EPHEMEROPTERA	Insecta		Mayflies
Myrmecia urens	Insecta	Myrmecia	Baby Bull Ant
Halotydeus destructor	Arachnida	Halotydeus	Redlegged Earth Mite
Trifolium arvense	Equisetopsida	Trifolium	Haresfoot Clover
Cloeon fluviatile	Insecta	Cloeon	Mayfly
TRIOZIDAE	Insecta		
Acacia baileyana	Equisetopsida	Acacia	Cootamundra Wattle
Calvatia	Agaricomycetes	Calvatia	
Geomitridae	Gastropoda		
Podolepis rugata	Equisetopsida	Podolepis	Pleated Podolepis
PHYCITINAE	Insecta		
Fomitopsis lilacinogilva	Agaricomycetes	Fomitopsis	
Vittadinia cuneata	Equisetopsida	Vittadinia	Fuzzy New Holland Daisy
CRINOCHETA	Malacostraca		
REPTILIA	Reptilia		
Xanthium	Equisetopsida	Xanthium	Burr
Cardamine hirsuta	Equisetopsida	Cardamine	Common Bitter-cress
Phereoeca	Insecta	Phereoeca	
Cermatulus nasalis	Insecta	Cermatulus	Predatory Shield Bug
Myrmeleon	Insecta	Myrmeleon	
Chenopodium curvispicatum	Equisetopsida	Chenopodium	Cottony Saltbush
Chrysolarentia	Insecta	Chrysolarentia	
Xanthorrhoea semiplana	Equisetopsida	Xanthorrhoea	
Prunus	Equisetopsida	Prunus	Plum
Crassula decumbens	Equisetopsida	Crassula	Rufous Stonecrop
Machaerina	Equisetopsida	Machaerina	
Geocorinae	Insecta		
Tremella mesenterica	Tremellomycetes	Tremella	
PYROGLYPHIDAE	Arachnida		
Geraniaceae	Equisetopsida		Geranium
HALTERIIDAE	Spirotrichea		
Pediculus humanus	Insecta	Pediculus	
Leptocybe invasa	Insecta	Leptocybe	
Hortophora transmarina	Arachnida	Hortophora	
Apertochrysa edwardsi	Insecta	Apertochrysa	
Podalonia tydei suspiciosa	Insecta	Podalonia	Wasp
Briza maxima	Equisetopsida	Briza	Large Quaking-grass
Myrmecia forficata	Insecta	Myrmecia	Inchman Bulldog Ant
Lepidogryllus	Insecta	Lepidogryllus	
Aphis (Aphis) craccivora	Insecta	Aphis	Cowpea Aphid
Syllitus	Insecta	Syllitus	
Clavulina vinaceocervina	Agaricomycetes	Clavulina	
Polycauliona	Lecanoromycetes	Polycauliona	
Sisymbrium irio	Equisetopsida	Sisymbrium	London Rocket
Sporobolus virginicus	Equisetopsida	Sporobolus	Marine Couch
Thinopyrum obtusiflorum	Equisetopsida	Thinopyrum	Tall Wheat Grass
Oudemansiella	Agaricomycetes	Oudemansiella	
Rickenella fibula	Agaricomycetes	Rickenella	
CHALCIDOIDEA	Insecta		
Grevillea robusta	Equisetopsida	Grevillea	Silky Oak
Tapeigaster brunneifrons	Insecta	Tapeigaster	Fly
Geotomini	Insecta		
Dysdera crocota	Arachnida	Dysdera	European Garden Spider
Todiramphus (Todiramphus) sanctus	Aves	Todiramphus	Sacred Kingfisher
Lissopimpla excelsa	Insecta	Lissopimpla	Dusky Winged Ichneumonid (orchid Dupe Wasp)
Mentha pulegium	Equisetopsida	Mentha	Pennyroyal
Scolopendra laeta	Chilopoda	Scolopendra	
Agonis flexuosa	Equisetopsida	Agonis	Willow Myrtle
Gastrimargus musicus	Insecta	Gastrimargus	Yellow-winged Locust
CYDNIDAE	Insecta		
Coniophora puteana	Agaricomycetes	Coniophora	
Agaricus bernardii	Agaricomycetes	Agaricus	
TETRAGNATHIDAE	Arachnida		
PSOCODEA	Insecta		
Lepraria finkii	Lecanoromycetes	Lepraria	
Delta	Insecta	Delta	
Hypoestes	Equisetopsida	Hypoestes	
LYGAEIDAE	Insecta		
Tenebrio	Insecta	Tenebrio	
Chiromyzinae	Insecta		
Gryllotalpinae	Insecta		
Opsius stactogalus	Insecta	Opsius	Tamarix Leafhopper
Amaranthus	Equisetopsida	Amaranthus	Amaranth
Capsella bursa-pastoris	Equisetopsida	Capsella	Shepherd's Purse
Festuca	Equisetopsida	Festuca	Fescues
Lupinus cosentinii	Equisetopsida	Lupinus	Sandplain Lupin
Chrysis	Insecta	Chrysis	
Phyla nodiflora	Equisetopsida	Phyla	Carpetweed
Ardices	Insecta	Ardices	
Ailanthus	Equisetopsida	Ailanthus	
Ornithogalum thyrsoides	Equisetopsida	Ornithogalum	Chincherinchee
Hypericum	Equisetopsida	Hypericum	St John's Wort
Schoenoplectus tabernaemontani	Equisetopsida	Schoenoplectus	River Club-rush
Nesidiocoris	Insecta	Nesidiocoris	
Echinochloa crus-galli	Equisetopsida	Echinochloa	Barnyard Grass
Laxta granicollis	Insecta	Laxta	Bark Cockroach
Parasola plicatilis	Agaricomycetes	Parasola	Ink Cap Mushroom
Grevillea rosmarinifolia	Equisetopsida	Grevillea	Rosemary Grevillea
SENTICAUDATA	Malacostraca		
PORCELLIONIDAE	Malacostraca		
Tropidoderini	Insecta		
Paraspathulina eremostigma	Insecta	Paraspathulina	Primitive Crane Fly
Thyreocephalus	Insecta	Thyreocephalus	
Holocnemus pluchii	Arachnida	Holocnemus	Cellar Spider
Phoracantha tricuspis	Insecta	Phoracantha	
Limonium companyonis	Equisetopsida	Limonium	Sea-lavender
Laetiporus portentosus	Agaricomycetes	Laetiporus	Polypore Fungi

Eryciini	Insecta		
Lagriina	Insecta		
Euphorbia terracina	Equisetopsida	Euphorbia	False Caper
Callitris	Equisetopsida	Callitris	Cypress-pine
LEUCOPHOROPTERINI	Insecta		
Cichorium	Equisetopsida	Cichorium	Chicory
Psaltoda moerens	Insecta	Psaltoda	Red Eye Cicada
Mogoplistinae	Insecta		
Laccaria laccata	Agaricomycetes	Laccaria	
Isopeda leishmanni	Arachnida	Isopeda	Huntsman Spider
Conocephalus (Chloroxiphidion) albescens	Insecta	Conocephalus	
Romulea rosea	Equisetopsida	Romulea	Onion Grass
Goodenia albiflora	Equisetopsida	Goodenia	White Goodenia
SCATOPSINAE	Insecta		
Nemobiinae	Insecta		
Cetratus	Arachnida	Cetratus	
Eucalyptus gomphocephala	Equisetopsida	Eucalyptus	Tuart
DICYRTOMIDAE	Collembola		
Crepis capillaris	Equisetopsida	Crepis	Smooth Hawksbeard
Monteithiella humeralis	Insecta	Monteithiella	Shield Bug
Crassula multicava	Equisetopsida	Crassula	
Osphranter robustus	Mammalia	Osphranter	Common Wallaroo
Rumex tenax	Equisetopsida	Rumex	Shiny Dock
Taylorilygus apicalis	Insecta	Taylorilygus	Brokenbacked Bug
Arsipoda chrysis	Insecta	Arsipoda	
Monocrepidus	Insecta	Monocrepidus	
Limnodynastes peronii	Amphibia	Limnodynastes	Striped Marsh Frog
Phyllanthus saxosus	Equisetopsida	Phyllanthus	Blister Spurge
Pultenaea acerosa	Equisetopsida	Pultenaea	Bristly Bush-pea
Eucalyptus viminalis subsp. cygnetensis	Equisetopsida	Eucalyptus	Rough-barked Manna-gum
Hibbertia stricta	Equisetopsida	Hibbertia	Upright Guinea-flower
Allium vineale	Equisetopsida	Allium	Crow Garlic
Salsola tragus	Equisetopsida	Salsola	Saltwort
Panicum hillmanii	Equisetopsida	Panicum	Witch-grass
Goodenia blackiana	Equisetopsida	Goodenia	Native Primrose
Ixodia achillaeoides subsp. alata	Equisetopsida	Ixodia	Ixodia
Eucalyptus microcarpa	Equisetopsida	Eucalyptus	Grey Box Intergrade
Solanum chrysotrichum	Equisetopsida	Solanum	Devil`s Fig
Eucalyptus phenax subsp. phenax	Equisetopsida	Eucalyptus	Green-leaf Mallee
Myrtus communis	Equisetopsida	Myrtus	Common Myrtle
Eutaxia diffusa	Equisetopsida	Eutaxia	Large-leaf Eutaxia
Eucalyptus socialis subsp. viridans	Equisetopsida	Eucalyptus	Grey Mallee
Polytrichum juniperinum	Polytrichopsida	Polytrichum	Juniper Haircap
Lepidium didymum	Equisetopsida	Lepidium	Lesser Swine's-cress
Acacia papyrocarpa	Equisetopsida	Acacia	Western Myall
Corymbia calophylla	Equisetopsida	Corymbia	Marri
Nitella	Charophyceae	Nitella	
Lomandra collina	Equisetopsida	Lomandra	Sand Mat-rush
Campylopus torquatus	Bryopsida	Campylopus	
Tordylium apulum	Equisetopsida	Tordylium	Hartwort
Gonocarpus mezianus x Gonocarpus elatus	Equisetopsida	Gonocarpus	
Eucalyptus odorata	Equisetopsida	Eucalyptus	Peppermint Box
Calytrix tetragona	Equisetopsida	Calytrix	Grampians Fringe-myrtle
Fissidens megalotis	Bryopsida	Fissidens	Curly Pocket-moss
Funaria	Bryopsida	Funaria	
Austrostipa scabra subsp. falcata	Equisetopsida	Austrostipa	Rough Spear-grass
Eucalyptus rugosa	Equisetopsida	Eucalyptus	Coastal White Mallee
Trymalium wayi	Equisetopsida	Trymalium	Grey Trymalium
Eucalyptus dumosa	Equisetopsida	Eucalyptus	White Mallee
Viola odorata	Equisetopsida	Viola	Common Violet
Gonocarpus elatus	Equisetopsida	Gonocarpus	Hill Raspwort
Lepidium draba	Equisetopsida	Lepidium	Lepidium
Campylopus	Bryopsida	Campylopus	
Veronica arvensis	Equisetopsida	Veronica	Wall Speedwell
Austrostipa tenuifolia	Equisetopsida	Austrostipa	Long-awn Spear-grass
Acacia nematophylla	Equisetopsida	Acacia	Coast Wallowa
Austrostipa nodosa	Equisetopsida	Austrostipa	Knotty Spear-grass
Conospermum patens	Equisetopsida	Conospermum	Slender Smoke-bush
Paspalidium constrictum	Equisetopsida	Paspalidium	Knottybutt Grass
Cladophora glomerata	Ulotrichophyceae	Cladophora	Green Algae
Acacia continua	Equisetopsida	Acacia	Thorn Wattle
Triglochin nana	Equisetopsida	Triglochin	Dwarf Arrowgrass
Daviesia brevifolia	Equisetopsida	Daviesia	Leafless Bitter-pea
Compsopogon caeruleus	Compsopogonophyceae	Compsopogon	
Acacia spinescens	Equisetopsida	Acacia	Spiny Wattle
Oedogonium	Ulotrichophyceae	Oedogonium	
Dillwynia hispida	Equisetopsida	Dillwynia	Red Parrot-pea
Pimelea flava subsp. dichotoma	Equisetopsida	Pimelea	Yellow Rice-flower
Austrostipa macalpinei	Equisetopsida	Austrostipa	Annual Spear-grass
Pimelea octophylla	Equisetopsida	Pimelea	Woolly Riceflower
Lepidium coronopus	Equisetopsida	Lepidium	Flat Swine's Cress
Daviesia ulicifolia subsp. ulicifolia	Equisetopsida	Daviesia	Gorse Bitter-pea
Daviesia leptophylla	Equisetopsida	Daviesia	Narrow-leaf Bitter-pea
Trifolium arvense var. arvense	Equisetopsida	Trifolium	Hare's-foot Clover
Epilobium ciliatum subsp. ciliatum	Equisetopsida	Epilobium	Glandular Willow-herb
Austrostipa setacea	Equisetopsida	Austrostipa	Corkscrew Spear-grass
Eragrostis dielsii	Equisetopsida	Eragrostis	Lovegrass
Leuzea repens	Equisetopsida	Leuzea	Creeping Knapweed
Ehrharta longiflora	Equisetopsida	Ehrharta	Annual Veldt-grass
Lamarckia aurea	Equisetopsida	Lamarckia	Toothbrush Grass
Sonchus asper	Equisetopsida	Sonchus	Rough Sow-thistle
Polypogon viridis	Equisetopsida	Polypogon	Water Bent
Vittadinia blackii	Equisetopsida	Vittadinia	Narrow-leaf New Holland Daisy
Abutilon theophrasti	Equisetopsida	Abutilon	Chingma Lantern
Epilobium pallidiflorum	Equisetopsida	Epilobium	Showy Willow-herb
Chenopodium nitrariaceum	Equisetopsida	Chenopodium	Nitre Goosefoot
Eriobotrya japonica	Equisetopsida	Eriobotrya	Loquat
Thysanotus baueri	Equisetopsida	Thysanotus	Mallee Fringe-lily
Galium divaricatum	Equisetopsida	Galium	Slender Bedstraw
Poa poiformis var. poiformis	Equisetopsida	Poa	Coast Tussock-grass
Goodenia willisiana	Equisetopsida	Goodenia	Silver Goodenia
Lythrum hyssopifolia	Equisetopsida	Lythrum	Lesser Loosestrife
Dichanthium sericeum subsp. sericeum	Equisetopsida	Dichanthium	Silky Blue-grass
Elytrigia repens	Equisetopsida	Elytrigia	English Couch
Austrostipa blackii	Equisetopsida	Austrostipa	Crested Spear-grass
Rhagodia candolleana subsp. candolleana	Equisetopsida	Rhagodia	Seaberry Saltbush
Landoltia punctata	Equisetopsida	Landoltia	Thin Duckweed
Drosera auriculata	Equisetopsida	Drosera	Tall Sundew
Digitaria brownii	Equisetopsida	Digitaria	Cotton Panic-grass
Millotia myosotidifolia	Equisetopsida	Millotia	Broad-leaf Millotia
Eragrostis parviflora	Equisetopsida	Eragrostis	Lovegrass
Juncus planifolius	Equisetopsida	Juncus	Broad-leaf Rush
Epilobium billardiereanum subsp. cinereum	Equisetopsida	Epilobium	Grey Willow-herb
Schoenus breviculmis	Equisetopsida	Schoenus	Matted Bog-rush
Amaranthus albus	Equisetopsida	Amaranthus	Stiff Tumbleweed
Galinsoga parviflora	Equisetopsida	Galinsoga	Yellow Weed
Austrostipa drummondii	Equisetopsida	Austrostipa	Cottony Spear-grass
Pimelea glauca	Equisetopsida	Pimelea	Smooth Riceflower
Lotus australis	Equisetopsida	Lotus	Austral Trefoil
Lysiana exocarpi subsp. exocarpi	Equisetopsida	Lysiana	Mistletoe
Maireana aphylla	Equisetopsida	Maireana	Leafless Bluebush
Erodium botrys	Equisetopsida	Erodium	Big Herons-bill
Pimelea micrantha	Equisetopsida	Pimelea	Silky Riceflower
Vicia sativa subsp. sativa	Equisetopsida	Vicia	Common Vetch
Coriandrum sativum	Equisetopsida	Coriandrum	Coriander
Medicago lupulina	Equisetopsida	Medicago	Black Medic
Geranium solanderi var. solanderi	Equisetopsida	Geranium	Austral Crane's-bill
Salpichroa origanifolia	Equisetopsida	Salpichroa	Pampas Lily-of-the-valley
Stachys arvensis	Equisetopsida	Stachys	Stagger Weed
Paspalidium jubiflorum	Equisetopsida	Paspalidium	Warrego Grass
Austrostipa platychaeta	Equisetopsida	Austrostipa	Flat-awned Spear-grass
Rumex conglomeratus	Equisetopsida	Rumex	Clustered Dock
Opercularia turpis	Equisetopsida	Opercularia	Twiggy Stinkweed
Hibiscus tridactylites	Equisetopsida	Hibiscus	Bladder Ketmia
Velleia paradoxa	Equisetopsida	Velleia	Spur Velleia
Leucopogon cordifolius	Equisetopsida	Leucopogon	Heart-leaf Beard-heath
Actinobole uliginosum	Equisetopsida	Actinobole	Flannel Cudweed
Allocasuarina muelleriana subsp. muelleriana	Equisetopsida	Allocasuarina	Slaty Sheoak

Thymelaea passerina	Equisetopsida	Thymelaea	Thymelaea
Valerianella muricata	Equisetopsida	Valerianella	Narrow-fruit Cornsalad
Wurmbea dioica subsp. brevifolia	Equisetopsida	Wurmbea	Inland Early Nancy
Sisymbrium orientale	Equisetopsida	Sisymbrium	Indian Hedge Mustard
Adriana quadripartita	Equisetopsida	Adriana	Rare Bitter-bush
Raphanus raphanistrum	Equisetopsida	Raphanus	Wild Radish
Eucalyptus socialis subsp. socialis	Equisetopsida	Eucalyptus	Red Mallee
Datura ferox	Equisetopsida	Datura	Long-spine Thorn-apple
Walwhalleya proluta	Equisetopsida	Walwhalleya	Rigid Panic
Helichrysum leucopsideum	Equisetopsida	Helichrysum	Satin Everlasting
Rhodanthe pygmaea	Equisetopsida	Rhodanthe	Pigmy Daisy
Lepidosperma carphoides	Equisetopsida	Lepidosperma	Black Rapier-sedge
Carex bichenoviana	Equisetopsida	Carex	Plains Sedge
Teucrium racemosum	Equisetopsida	Teucrium	Grey Germander
Hakea carinata	Equisetopsida	Hakea	Erect Hakea
Trifolium resupinatum var. majus	Equisetopsida	Trifolium	Shaftal Clover
Spergularia marina	Equisetopsida	Spergularia	Salt Sand-spurrey
Juncus caespiticius	Equisetopsida	Juncus	Grassy Rush
Cotula coronopifolia	Equisetopsida	Cotula	Water Buttons
Daucus glochidiatus	Equisetopsida	Daucus	Native Carrot
Isolepis cernua	Equisetopsida	Isolepis	Nodding Club Rush
Laxmannia orientalis	Equisetopsida	Laxmannia	Dwarf Wire-lily
Goodenia geniculata	Equisetopsida	Goodenia	Bent Goodenia
Vittadinia cuneata var. cuneata	Equisetopsida	Vittadinia	Fuzzy New Holland Daisy
Chenopodium murale	Equisetopsida	Chenopodium	Sowbane
Lepidosperma canescens	Equisetopsida	Lepidosperma	Hoary Rapier-sedge
Lomandra nana	Equisetopsida	Lomandra	Small Mat-rush
Hibbertia crinita	Equisetopsida	Hibbertia	Velvet-leaf Guinea-flower
Rytidosperma caespitosum	Equisetopsida	Rytidosperma	Common Wallaby-grass
Eriochloa australiensis	Equisetopsida	Eriochloa	Australian Cupgrass
Acaena echinata	Equisetopsida	Acaena	Sheep's Burr
Agrostis capillaris	Equisetopsida	Agrostis	Brown-top Bent
Vulpia myuros f. myuros	Equisetopsida	Vulpia	Rat's-tail Fescue
Pimelea humilis	Equisetopsida	Pimelea	Low Riceflower
Centipeda cunninghamii	Equisetopsida	Centipeda	Common Sneezeweed
Mauranthemum paludosum	Equisetopsida	Mauranthemum	Ox-eye Daisy
Imperata cylindrica	Equisetopsida	Imperata	Blady Grass
Eleocharis acuta	Equisetopsida	Eleocharis	Common Spike-sedge
Solanum	Equisetopsida	Solanum	Nightshades
Gahnia trifida	Equisetopsida	Gahnia	Cutting Grass
Bolboschoenus caldwellii	Equisetopsida	Bolboschoenus	Salt Club-sedge
Hybanthus floribundus subsp. floribundus	Equisetopsida	Hybanthus	Shrub Violet
Marrubium vulgare	Equisetopsida	Marrubium	Horehound
Eleusine indica	Equisetopsida	Eleusine	Crowsfoot Grass
Rumex hypogaeus	Equisetopsida	Rumex	Spiny Emex
Rostraria pumila	Equisetopsida	Rostraria	Tiny Bristle-grass
Daviesia ulicifolia subsp. incarnata	Equisetopsida	Daviesia	
Exocarpos sparteus	Equisetopsida	Exocarpos	Broombush
Drosera peltata	Equisetopsida	Drosera	Swamp Sundew
Microlaena stipoides var. stipoides	Equisetopsida	Microlaena	Weeping Rice-grass
Hydrocotyle callicarpa	Equisetopsida	Hydrocotyle	Tiny Pennywort
Acaena x ovina	Equisetopsida	Acaena	Hairy Sheep's Burr
Malva arborea	Equisetopsida	Malva	Tree Mallow
Melaleuca brevifolia	Equisetopsida	Melaleuca	Short-leaf Honey-myrtle
Isolepis inundata	Equisetopsida	Isolepis	Swamp Club-rush
Urochloa panicoides var. panicoides	Equisetopsida	Urochloa	
Crassula decumbens var. decumbens	Equisetopsida	Crassula	Spreading Stonecrop
Cryptandra tomentosa	Equisetopsida	Cryptandra	Prickly Cryptandra
Myriophyllum verrucosum	Equisetopsida	Myriophyllum	Red Water-milfoil
Setaria italica	Equisetopsida	Setaria	Setaria
Symphyotrichum subulatum	Equisetopsida	Symphyotrichum	Wild Aster
Gamochaeta coarctata	Equisetopsida	Gamochaeta	Spiked Cudweed
Hordeum leporinum	Equisetopsida	Hordeum	Barley Grass
Scorzonera laciniata var. laciniata	Equisetopsida	Scorzonera	Scorzonera
Trachymene cyanopetala	Equisetopsida	Trachymene	Purple Trachymene
Rumex obtusifolius	Equisetopsida	Rumex	Broad-leaf Dock
Juncus radula	Equisetopsida	Juncus	Hoary Rush
Cheiranthera alternifolia	Equisetopsida	Cheiranthera	Clustered Finger-flower
Epilobium billardiereanum subsp. billardiereanum	Equisetopsida	Epilobium	Smooth Willow-herb
Senecio angulatus	Equisetopsida	Senecio	Cape Ivy
Disa bracteata	Equisetopsida	Disa	South African Orchid
Rytidosperma fulvum	Equisetopsida	Rytidosperma	Leafy Wallaby-grass
Puccinellia fasciculata	Equisetopsida	Puccinellia	Borrer's Saltmarsh-grass
Kickxia spuria subsp. integrifolia	Equisetopsida	Kickxia	Round-leaved Toadflax
Austrostipa hemipogon	Equisetopsida	Austrostipa	Half-bearded Spear-grass
Galium tricornutum	Equisetopsida	Galium	Three-horned Bedstraw
Cyperus gymnocaulos	Equisetopsida	Cyperus	Spiny Flat-sedge
Senecio behrianus	Equisetopsida	Senecio	Behr's Groundsel
Medicago truncatula	Equisetopsida	Medicago	Barrel Medic
Panicum capillare	Equisetopsida	Panicum	Common Millet
Chenopodium glaucum	Equisetopsida	Chenopodium	Glaucous Goosefoot
Crupina	Equisetopsida	Crupina	
Sorghum bicolor	Equisetopsida	Sorghum	Grain Sorghum
Potamogeton crispus	Equisetopsida	Potamogeton	Curly Pondweed
Eriochloa pseudoacrotricha	Equisetopsida	Eriochloa	Early Spring Grass
Puccinellia stricta	Equisetopsida	Puccinellia	Australian Saltmarsh-grass
Pentameris pallida	Equisetopsida	Pentameris	Pussy Tail
Callitriche stagnalis	Equisetopsida	Callitriche	Common Water-starwort
Malva nicaeensis	Equisetopsida	Malva	Mallow Of Nice
Cressa australis	Equisetopsida	Cressa	Rosinweed
Sclerolaena diacantha	Equisetopsida	Sclerolaena	Grey Copperburr
Gratiola peruviana	Equisetopsida	Gratiola	Austral Brooklime
Medicago orbicularis	Equisetopsida	Medicago	Button Medic
Leptospermum continentale	Equisetopsida	Leptospermum	Prickly Tea-tree
Logfia gallica	Equisetopsida	Logfia	Narrow Cudweed
Vittadinia australasica var. australasica	Equisetopsida	Vittadinia	Sticky New Holland Daisy
Dianella revoluta var. revoluta	Equisetopsida	Dianella	Snow-gum Flax-lily
Sinapis arvensis	Equisetopsida	Sinapis	Charlock
Fumaria densiflora	Equisetopsida	Fumaria	Fumitory
Leucopogon virgatus var. virgatus	Equisetopsida	Leucopogon	Common Beard-heath
Schoenoplectus pungens	Equisetopsida	Schoenoplectus	Spiky Club-rush
Rorippa nasturtium-aquaticum	Equisetopsida	Rorippa	Watercress
Caesia calliantha	Equisetopsida	Caesia	Blue Grass-lily
Atriplex prostrata	Equisetopsida	Atriplex	Hastate Orache
Erodium crinitum	Equisetopsida	Erodium	Native Crowfoot
Amaranthus caudatus	Equisetopsida	Amaranthus	Love-lies Bleeding
Nothoscordum borbonicum	Equisetopsida	Nothoscordum	Onion Weed
Atriplex paludosa subsp. cordata	Equisetopsida	Atriplex	
Myoporum platycarpum	Equisetopsida	Myoporum	Sugarwood
Hydrocleys nymphoides	Equisetopsida	Hydrocleys	Water Poppy
Pimelea curviflora var. gracilis	Equisetopsida	Pimelea	Curved Rice-flower
Aponogeton tofus	Equisetopsida	Aponogeton	Aponogeton
Myoporum platycarpum subsp. perbellum	Equisetopsida	Myoporum	Sugarwood
Pauridia glabella var. glabella	Equisetopsida	Hypoxis	Tiny Star
Papaver rhoeas	Equisetopsida	Papaver	Field Poppy
Goodia medicaginea	Equisetopsida	Goodia	Western Golden-tip
Nicotiana maritima	Equisetopsida	Nicotiana	Coast Tobacco
Minuria leptophylla	Equisetopsida	Minuria	Minnie Daisy
Euphorbia segetalis	Equisetopsida	Euphorbia	Short-stem Carnation Weed
Rytidosperma racemosum var. racemosum	Equisetopsida	Rytidosperma	Slender Wallaby-grass
Trifolium cherleri	Equisetopsida	Trifolium	Cupped Clover
Eucomis comosa	Equisetopsida	Eucomis	Pineapple Lily
Amaranthus muricatus	Equisetopsida	Amaranthus	Rough-fruit Amaranth
Bupleurum semicompositum	Equisetopsida	Bupleurum	Hare's Ear
Brachyscome debilis	Equisetopsida	Brachyscome	Weak Daisy
Austrostipa curticoma	Equisetopsida	Austrostipa	Short-crown Spear-grass
Limosella australis	Equisetopsida	Limosella	Australian Mudwort
Isolepis marginata	Equisetopsida	Isolepis	Little Club-rush
Lolium multiflorum	Equisetopsida	Lolium	Italian Ryegrass
Neurachne alopecuroidea	Equisetopsida	Neurachne	Fox-tail Mulga-grass
Rytidosperma auriculatum	Equisetopsida	Rytidosperma	Lobed Wallaby-grass
Erodium moschatum	Equisetopsida	Erodium	Musky Herons-bill
Polygonum plebeium	Equisetopsida	Polygonum	Small Knotweed
Triglochin striata	Equisetopsida	Triglochin	Streaked Arrowgrass
Thyridia repens	Equisetopsida	Thyridia	Creeping Monkey Flower
Sclerolaena muricata var. muricata	Equisetopsida	Sclerolaena	Sclerolaena
Pyrorchis nigricans	Equisetopsida	Pyrorchis	Black Fire-orchid
Echinochloa esculenta	Equisetopsida	Echinochloa	Japanese Millet

Sclerolaena muricata var. villosa	Equisetopsida	Sclerolaena	Five-spine Bindyi
Pultenaea canaliculata	Equisetopsida	Pultenaea	Soft Bush-pea
Bursaria spinosa subsp. spinosa	Equisetopsida	Bursaria	Sweet Bursaria
Xanthorrhoea semiplana subsp. semiplana	Equisetopsida	Xanthorrhoea	Yacca
Podotheca angustifolia	Equisetopsida	Podotheca	Sticky Long-heads
Xanthosia huegelii	Equisetopsida	Xanthosia	Hairy Xanthosia
Vicia sativa subsp. cordata	Equisetopsida	Vicia	Common Vetch
Ophioglossum lusitanicum	Equisetopsida	Ophioglossum	Austral Adders Tongue
Euphorbia dallachyana	Equisetopsida	Euphorbia	Caustic Weed
Bulbine bulbosa	Equisetopsida	Bulbine	Bulbine Lily
Lomandra sororia	Equisetopsida	Lomandra	Sword Mat-rush
Lomandra densiflora	Equisetopsida	Lomandra	Soft Tussock Mat-rush
Tagetes erecta	Equisetopsida	Tagetes	French Marigold
Hibbertia australis	Equisetopsida	Hibbertia	Stalked Guinea-flower
Centrolepis aristata	Equisetopsida	Centrolepis	Pointed Centrolepis
Bossiaea prostrata	Equisetopsida	Bossiaea	Creeping Bossiaea
Amaranthus deflexus	Equisetopsida	Amaranthus	Spreading Amaranth
Salvia reflexa	Equisetopsida	Salvia	Mintweed
Centaurea paniculata	Equisetopsida	Centaurea	Panicled Knapweed
Fumaria parviflora	Equisetopsida	Fumaria	Fumitory
Polygonum arenastrum	Equisetopsida	Polygonum	Wireweed
Trifolium pratense	Equisetopsida	Trifolium	Red Clover
Isolepis trachysperma	Equisetopsida	Isolepis	Grassy Club-rush
Cuscuta campestris	Equisetopsida	Cuscuta	Golden Dodder
Paspalidium clementii	Equisetopsida	Paspalidium	Clement's Paspalidium
Hypolaena fastigiata	Equisetopsida	Hypolaena	Tassel Rope Rush
Rumex dumosus	Equisetopsida	Rumex	Wiry Dock
Diplachne fusca subsp. fusca	Equisetopsida	Diplachne	Brown Beetle-grass
Dampiera dysantha	Equisetopsida	Dampiera	Shrubby Dampiera
Lomandra juncea	Equisetopsida	Lomandra	Desert Mat-rush
Haloragis aspera	Equisetopsida	Haloragis	Rough Raspwort
Frankenia pauciflora	Equisetopsida	Frankenia	Southern Sea-heath
Acacia dodonaeifolia	Equisetopsida	Acacia	Hop-bush Wattle
Carex gaudichaudiana	Equisetopsida	Carex	Fen Sedge
Crassula colorata var. acuminata	Equisetopsida	Crassula	Dense Stonecrop
Acrotriche serrulata	Equisetopsida	Acrotriche	Honeypots
Oxalis compressa	Equisetopsida	Oxalis	Winged Wood-sorrel
Solanum styleanum	Equisetopsida	Solanum	Cherry Nightshade
Enchylaena tomentosa var. tomentosa	Equisetopsida	Enchylaena	Ruby Saltbush
Achillea tomentosa	Equisetopsida	Achillea	Woolly Yarrow
Frankenia pulverulenta	Equisetopsida	Frankenia	Mediterranean Sea-heath
Panicum decompositum	Equisetopsida	Panicum	Stargrass
Rorippa microphylla	Equisetopsida	Rorippa	Brown Watercress
Trifolium scabrum	Equisetopsida	Trifolium	Rough Clover
Solanum lycopersicum	Equisetopsida	Solanum	Lycopersicon
Acacia victoriae subsp. victoriae	Equisetopsida	Acacia	Bramble Wattle
Pelargonium littorale	Equisetopsida	Pelargonium	Native Pelargonium
Cymbopogon obtectus	Equisetopsida	Cymbopogon	Silky-heads
Beta vulgaris subsp. maritima	Equisetopsida	Beta	Sea Beet
Scaevola linearis subsp. confertifolia	Equisetopsida	Scaevola	
Leptorhynchos tetrachaetus	Equisetopsida	Leptorhynchos	Little Buttons
Thelymitra antennifera	Equisetopsida	Thelymitra	Lemon Sun-orchid
Avena sativa	Equisetopsida	Avena	Oats
Grevillea lavandulacea subsp. lavandulacea	Equisetopsida	Grevillea	Lavender Grevillea
Geranium retrorsum	Equisetopsida	Geranium	Grassland Crane's-bill
Hainardia cylindrica	Equisetopsida	Hainardia	Common Barb-grass
Inocybe exigua	Agaricomycetes	Inocybe	
Siloxerus multiflorus	Equisetopsida	Siloxerus	Small Wrinklewort
Machaerina arthrophylla	Equisetopsida	Machaerina	Baumea
Kunzea pomifera	Equisetopsida	Kunzea	Muntries
Delairea odorata	Equisetopsida	Delairea	Cape Ivy
Tamarix ramosissima	Equisetopsida	Tamarix	Tamarisk
Brassica napus	Equisetopsida	Brassica	Canola
Ferraria crispa subsp. crispa	Equisetopsida	Ferraria	Black Flag
Pultenaea daphnoides	Equisetopsida	Pultenaea	Large-leaf Bush Pea
Exocarpos cupressiformis	Equisetopsida	Exocarpos	Native Cherry
Euphorbia cyparissias	Equisetopsida	Euphorbia	Cypress Spurge
Brachyscome lineariloba	Equisetopsida	Brachyscome	Hard-headed Daisy
Cyperus gunnii subsp. gunnii	Equisetopsida	Cyperus	Flecked Flat-sedge
Euphorbia helioscopia	Equisetopsida	Euphorbia	Sun Spurge
Phalaris aquatica	Equisetopsida	Phalaris	Phalaris
Glaucium flavum	Equisetopsida	Glaucium	Horned Poppy
Podolepis canescens	Equisetopsida	Podolepis	Grey Podolepis
Trifolium incarnatum var. incarnatum	Equisetopsida	Trifolium	Crimson Clover
Triglochin mucronata	Equisetopsida	Triglochin	Prickly Arrowgrass
Salsola kali	Equisetopsida	Salsola	
Vicia hirsuta	Equisetopsida	Vicia	Hairy Vetch
Acacia cupularis	Equisetopsida	Acacia	Cup Wattle
Rumex vesicarius	Equisetopsida	Rumex	Bladder Dock
Juncus articulatus	Equisetopsida	Juncus	Jointed Rush
Reseda luteola	Equisetopsida	Reseda	Wild Mignonette
Ranunculus sessiliflorus var. sessiliflorus	Equisetopsida	Ranunculus	Annual Buttercup
Lepidosperma curtisiae	Equisetopsida	Lepidosperma	Little Sword-sedge
Datura stramonium	Equisetopsida	Datura	Common Thorn-apple
Eremophila longifolia	Equisetopsida	Eremophila	Dogwood
Persicaria orientalis	Equisetopsida	Persicaria	Persicaria
Lepidium latifolium	Equisetopsida	Lepidium	Perennial Peppercress
Crassula helmsii	Equisetopsida	Crassula	Swamp Stonecrop
Soliva sessilis	Equisetopsida	Soliva	Jo-jo
Rytidosperma robertsoniae	Equisetopsida	Rytidosperma	Robertson Wallaby-grass
Chrysocephalum semipapposum	Equisetopsida	Chrysocephalum	Clustered Everlasting
Malva pseudolavatera	Equisetopsida	Malva	Cretan Hollyhock
Gamochaeta americana	Equisetopsida	Gamochaeta	Spiked Cudweed
Bromus arenarius	Equisetopsida	Bromus	Sand Brome
Vallisneria nana	Equisetopsida	Vallisneria	Vallisneria
Cladium procerum	Equisetopsida	Cladium	Leafy Twig-rush
Craspedia variabilis	Equisetopsida	Craspedia	Common Billy-buttons
Austrostipa flavescens	Equisetopsida	Austrostipa	Coast Spear-grass
Sida intricata	Equisetopsida	Sida	Twiggy Sida
Acacia falciformis	Equisetopsida	Acacia	Broad-leaved Hickory
Nassella neesiana	Equisetopsida	Nassella	Chilean Needle Grass
Tricoryne tenella	Equisetopsida	Tricoryne	Tufted Yellow Rush-lily
Eclipta platyglossa	Equisetopsida	Eclipta	Yellow Twin-heads
Salicornia quinqueflora	Equisetopsida	Salicornia	Beaded Glasswort
Rumex pulcher	Equisetopsida	Rumex	Fiddle Dock
Opercularia scabrida	Equisetopsida	Opercularia	Stalked Stinkweed
Hydrocotyle laxiflora	Equisetopsida	Hydrocotyle	Stinking Pennywort
Hypericum triquetrifolium	Equisetopsida	Hypericum	Tangled Hypericum
Pyrus calleryana	Equisetopsida	Pyrus	Callery Pear
Medicago sativa	Equisetopsida	Medicago	Lucerne
Sisymbrium officinale	Equisetopsida	Sisymbrium	Hedge Mustard
Caladenia leptochila	Equisetopsida	Caladenia	Narrow-lip Spider Orchid
Rubus anglocandicans	Equisetopsida	Rubus	Blackberry
Lomandra multiflora subsp. dura	Equisetopsida	Lomandra	
Lomandra fibrata	Equisetopsida	Lomandra	Mount Lofty Mat-rush
Poa crassicaudex	Equisetopsida	Poa	Thick-stem Tussock-grass
Gonocarpus tetragynus	Equisetopsida	Gonocarpus	Small-leaf Raspwort
Erica arborea	Equisetopsida	Erica	Tree Heath
Blennospora drummondii	Equisetopsida	Blennospora	Dwarf Beauty-heads
Juncus sarophorus	Equisetopsida	Juncus	Broom Rush
Atriplex rhagodioides	Equisetopsida	Atriplex	Silver Saltbush
Solanum triflorum	Equisetopsida	Solanum	Three-flower Nightshade
Solanum chenopodioides	Equisetopsida	Solanum	Whitetip Nightshade
Silene gallica var. gallica	Equisetopsida	Silene	French Catchfly
Crassula natans var. minus	Equisetopsida	Crassula	Water Crassula
Stackhousia aspericocca subsp. Cylindrical inflorescence (W.R.Barker 1418)	Equisetopsida	Stackhousia	Rough-nut Stackhousia
Solanum linnaeanum	Equisetopsida	Solanum	Apple Of Sodom
Eragrostis mexicana	Equisetopsida	Eragrostis	Mexican Love-grass
Calocephalus citreus	Equisetopsida	Calocephalus	Lemon Beauty-heads
Persicaria prostrata	Equisetopsida	Persicaria	Creeping Knotweed
Rubus rubritinctus	Equisetopsida	Rubus	Blackberry
Euphorbia falcata	Equisetopsida	Euphorbia	Sickle-leaf Spurge
Leontodon rhagadioloides	Equisetopsida	Leontodon	Hedypnois
Austrostipa semibarbata	Equisetopsida	Austrostipa	Fibrous Spear-grass
Lemna disperma	Equisetopsida	Lemna	Common Duckweed
Chloris gayana	Equisetopsida	Chloris	Rhodes Grass
Sagina maritima	Equisetopsida	Sagina	Sea Pearlwort
Rosa canina	Equisetopsida	Rosa	Dog Rose

Cyclospermum leptophyllum	Equisetopsida	Cyclospermum	Slender Celery
Tecticornia halocnemoides	Equisetopsida	Tecticornia	Red Glasswort
Setaria pumila	Equisetopsida	Setaria	Setaria
Deschampsia cespitosa	Equisetopsida	Deschampsia	Tufted Hair-grass
Matricaria chamomilla	Equisetopsida	Matricaria	Wild Chamomile
Stenanthera conostephioides	Equisetopsida	Stenanthera	Flame Heath
Microtis	Equisetopsida	Microtis	Onion Orchids
Hydrilla verticillata	Equisetopsida	Hydrilla	Hydrilla
Matricaria discoidea	Equisetopsida	Matricaria	Rounded Chamomile
Kickxia elatine subsp. crinita	Equisetopsida	Kickxia	Pointed Toadflax
Thelymitra grandiflora	Equisetopsida	Thelymitra	Great Sun-orchid
Lomandra micrantha subsp. micrantha	Equisetopsida	Lomandra	Small-flower Mat-rush
Prasophyllum odoratum	Equisetopsida	Prasophyllum	Scented Leek-orchid
Solanum aviculare	Equisetopsida	Solanum	Kangaroo Apple
Phyllangium divergens	Equisetopsida	Phyllangium	Wiry Mitrewort
Correa glabra var. turnbullii	Equisetopsida	Correa	Smooth Correa
Centaurea solstitialis	Equisetopsida	Centaurea	St Barnaby's Thistle
Onopordum acaulon	Equisetopsida	Onopordum	Horse Thistle
Poa pratensis	Equisetopsida	Poa	Kentucky Bluegrass
Bangia		Bangia	
Egeria densa	Equisetopsida	Egeria	Dense Waterweed
Potamogeton ochreatus	Equisetopsida	Potamogeton	Blunt Pondweed
Allium neapolitanum	Equisetopsida	Allium	Naples Onion
Acacia verniciflua	Equisetopsida	Acacia	Varnish Wattle
Eutaxia microphylla	Equisetopsida	Eutaxia	Common Eutaxia
Brachyscome ciliaris	Equisetopsida	Brachyscome	Variable Daisy
Brachyloma ericoides subsp. ericoides	Equisetopsida	Brachyloma	Brush Heath
Centaurea melitensis	Equisetopsida	Centaurea	Maltese Cockspur
Millotia tenuifolia var. tenuifolia	Equisetopsida	Millotia	Soft Millotia
Cotula bipinnata	Equisetopsida	Cotula	Ferny Cotula
Brachypodium distachyon	Equisetopsida	Brachypodium	False Brome
Acrotriche fasciculiflora	Equisetopsida	Acrotriche	Mount Lofty Ground-berry
Bromus madritensis	Equisetopsida	Bromus	Madrid Brome
Ceramium cliftonianum	Florideophyceae	Ceramium	
Levenhookia pusilla	Equisetopsida	Levenhookia	Tiny Stylewort
Potamogeton sulcatus	Equisetopsida	Potamogeton	Furrowed Pondweed
Vulpia myuros f. megalura	Equisetopsida	Vulpia	Fox-tail Fescue
Eleocharis pusilla	Equisetopsida	Eleocharis	Small Spike-rush
Reseda lutea	Equisetopsida	Reseda	Cut-leaf Mignonette
Orobanche minor	Equisetopsida	Orobanche	Lesser Broomrape
Thelymitra luteocilium	Equisetopsida	Thelymitra	Yellow-tuft Sun Orchid
Caladenia cardiochila	Equisetopsida	Caladenia	Heart-lip Spider-orchid
Isolepis levynsiana	Equisetopsida	Isolepis	Tiny Flat-sedge
Sanguisorba minor	Equisetopsida	Sanguisorba	Sheep's Burnet
Schoenus nitens	Equisetopsida	Schoenus	Shiny Bogrush
Caladenia tentaculata	Equisetopsida	Caladenia	Fringed Spider Orchid
Leptospermum myrsinoides	Equisetopsida	Leptospermum	Heath Tea-tree
Caladenia latifolia	Equisetopsida	Caladenia	Pink Fairies
Carex breviculmis	Equisetopsida	Carex	Common Grass-sedge
Spergularia diandra	Equisetopsida	Spergularia	
Stackhousia subterranea	Equisetopsida	Stackhousia	Creamy Candles
Opuntia monacantha	Equisetopsida	Opuntia	Drooping Prickly Pear
Scandix pecten-veneris	Equisetopsida	Scandix	Shepherd's Needle
Asperula conferta	Equisetopsida	Asperula	Common Woodruff
Lobelia rhombifolia	Equisetopsida	Lobelia	Tufted Lobelia
Aristida holathera var. holathera	Equisetopsida	Aristida	Tall Kerosene Grass
Epacris impressa	Equisetopsida	Epacris	Common Heath
Chara vulgaris	Charophyceae	Chara	Green Algae
Trifolium ornithopodioides	Equisetopsida	Trifolium	Bird's-foot Trefoil
Stylidium calcaratum	Equisetopsida	Stylidium	Spurred Trigger-plant
Tetratheca pilosa subsp. pilosa	Equisetopsida	Tetratheca	Hairy Pink-bells
Dianella longifolia var. grandis	Equisetopsida	Dianella	Pale Flax-lily
Talinum paniculatum	Equisetopsida	Talinum	Talinum
Austrostipa scabra subsp. scabra	Equisetopsida	Austrostipa	Rough Spear-grass
Serapias lingua	Equisetopsida	Serapias	
Diplachne fusca subsp. uninervia	Equisetopsida	Diplachne	Beetle Grass
Reichardia tingitana	Equisetopsida	Reichardia	False Sowthistle
Hibbertia virgata	Equisetopsida	Hibbertia	Twiggy Guinea-flower
Centaurea calcitrapa	Equisetopsida	Centaurea	Star Thistle
Cheilanthes austrotenuifolia	Equisetopsida	Cheilanthes	Green Rock-fern
Dysphania cristata	Equisetopsida	Dysphania	Crested Goosefoot
Prasophyllum occidentale	Equisetopsida	Prasophyllum	Plains Leek-orchid
Daviesia ulicifolia	Equisetopsida	Daviesia	Gorse Bitter-pea
Brassica fruticulosa	Equisetopsida	Brassica	Twiggy Turnip
Misopates orontium	Equisetopsida	Misopates	Lesser Snapdragon
Machaerina juncea	Equisetopsida	Machaerina	Bare Twig-rush
Malus domestica	Equisetopsida	Malus	Apple
Lathyrus odoratus	Equisetopsida	Lathyrus	Sweet Pea
Fumaria muralis subsp. muralis	Equisetopsida	Fumaria	Wall Fumitory
Juncus capitatus	Equisetopsida	Juncus	Dwarf Rush
Lycopus australis	Equisetopsida	Lycopus	Australian Gipsywort
Carthamus tinctorius	Equisetopsida	Carthamus	Safflower
Limnobium laevigatum	Equisetopsida	Limnobium	Amazon Frogbit
Oenothera speciosa	Equisetopsida	Oenothera	Rose Evening Primrose
Setaria viridis	Equisetopsida	Setaria	Green Pigeon-grass
Platanus	Equisetopsida	Platanus	
Epilobium billardiereanum subsp. intermedium	Equisetopsida	Epilobium	Variable Willow-herb
Lagenophora huegelii	Equisetopsida	Lagenophora	Coarse Bottle-daisy
Tecticornia pergranulata	Equisetopsida	Tecticornia	Samphire
Trifolium alexandrinum	Equisetopsida	Trifolium	Berseem Clover
Valerianella discoidea	Equisetopsida	Valerianella	Lesser Corn-salad
Pultenaea largiflorens	Equisetopsida	Pultenaea	Twiggy Bush-pea
Oenothera lindheimeri	Equisetopsida	Oenothera	Clock Weed
Eleusine tristachya	Equisetopsida	Eleusine	American Crows-foot Grass
Linum marginale	Equisetopsida	Linum	Native Flax
Brassica juncea	Equisetopsida	Brassica	
Lactuca saligna	Equisetopsida	Lactuca	Willow-leaf Lettuce
Eclipta platyglossa subsp. platyglossa	Equisetopsida	Eclipta	Yellow Twin-heads
Nitraria billardierei	Equisetopsida	Nitraria	Nitraria
Malva preissiana	Equisetopsida	Malva	Australian Hollyhock
Schoenoplectus subulatus	Equisetopsida	Schoenoplectus	Shore Club-rush
Vulpia bromoides	Equisetopsida	Vulpia	Squirrel-tail Fescue
Prostanthera chlorantha	Equisetopsida	Prostanthera	Green Mintbush
Lachnagrostis aemula	Equisetopsida	Lachnagrostis	Leafy Blown-grass
Crassula colligata subsp. lamprosperma	Equisetopsida	Crassula	Slender Stonecrop
Pimelea curviflora	Equisetopsida	Pimelea	Rice Flower
Caladenia reticulata	Equisetopsida	Caladenia	Veined Spider-orchid
Tricoryne elatior	Equisetopsida	Tricoryne	Yellow Rush Lily
Diplotaxis muralis	Equisetopsida	Diplotaxis	Wall Rocket
Pterostylis robusta	Equisetopsida	Pterostylis	Large Striped Greenhood
Poa labillardierei var. labillardierei	Equisetopsida	Poa	Tussock Grass
Rytidosperma clelandii	Equisetopsida	Rytidosperma	Cleland's Wallaby-grass
Hakea rugosa	Equisetopsida	Hakea	Dwarf Hakea
Lantana camara	Equisetopsida	Lantana	Lantana
Dodonaea viscosa subsp. angustissima - Dodonaea viscosa subsp. spatulata	Equisetopsida	Dodonaea	
Nitella subtilissima	Charophyceae	Nitella	Green Algae
Lactuca serriola f. serriola	Equisetopsida	Lactuca	Prickly Lettuce
Oxalis hirta	Equisetopsida	Oxalis	Hairy Wood-sorrel
Spergularia bocconei	Equisetopsida	Spergularia	Red Sand-spurrey
Poa bulbosa	Equisetopsida	Poa	Bulbous Meadow-grass
Centella asiatica	Equisetopsida	Centella	Indian Pennywort
Petrorhagia dubia	Equisetopsida	Petrorhagia	Velvet Pink
Crataegus azarolus	Equisetopsida	Crataegus	Azarola Thorn
Ageratina adenophora	Equisetopsida	Ageratina	Crofton Weed
Wahlenbergia luteola	Equisetopsida	Wahlenbergia	Yellow-wash Bluebell
Rapistrum rugosum subsp. rugosum	Equisetopsida	Rapistrum	Turnip Weed
Phalaris minor	Equisetopsida	Phalaris	Lesser Canary-grass
Pelargonium peltatum	Equisetopsida	Pelargonium	Ivy-leaf Pelargonium
Rytidosperma geniculatum	Equisetopsida	Rytidosperma	Kneed Wallaby-grass
Prunus domestica subsp. domestica	Equisetopsida	Prunus	Plum
Rhodanthe laevis	Equisetopsida	Rhodanthe	Smooth Sunray
Ammi majus	Equisetopsida	Ammi	Bishop's Weed
Pterostylis mutica	Equisetopsida	Pterostylis	Midget Greenhood
Wilsonia rotundifolia	Equisetopsida	Wilsonia	Round-leaf Wilsonia
Centrolepis strigosa subsp. strigosa	Equisetopsida	Centrolepis	Hairy Centrolepis
Cydonia oblonga	Equisetopsida	Cydonia	Quince
Olea europaea subsp. europaea	Equisetopsida	Olea	Olive
Crataegus monogyna	Equisetopsida	Crataegus	Hawthorn

Brachyscome perpusilla	Equisetopsida	Brachyscome	Rayless Daisy
Daucus carota	Equisetopsida	Daucus	Carrot
Xanthium spinosum	Equisetopsida	Xanthium	Bathurst Burr
Leptorhynchos squamatus subsp. squamatus	Equisetopsida	Leptorhynchos	Scaly Buttons
Eucalyptus cosmophylla	Equisetopsida	Eucalyptus	Cup Gum
Gomphocarpus fruticosus	Equisetopsida	Gomphocarpus	Narrow-leaved Cotton Bush
Galium gaudichaudii subsp. gaudichaudii	Equisetopsida	Galium	Rough Bedstraw
Thelymitra pauciflora	Equisetopsida	Thelymitra	Slender Sun Orchid
Lomandra leucocephala subsp. robusta	Equisetopsida	Lomandra	Woolly Mat-rush
Sonchus hydrophilus	Equisetopsida	Sonchus	Native Sow-thistle
Ptilotus spathulatus	Equisetopsida	Ptilotus	Pussy-tails
Veronica peregrina subsp. xalapensis	Equisetopsida	Veronica	Wandering Speedwell
Galium migrans subsp. migrans	Equisetopsida	Galium	
Burchardia umbellata	Equisetopsida	Burchardia	Milkmaids
Bifora testiculata	Equisetopsida	Bifora	Bifora
Senecio runcinifolius	Equisetopsida	Senecio	Thistle-leaf Groundsel
Parapholis incurva	Equisetopsida	Parapholis	Curly Ryegrass
Erica cruenta	Equisetopsida	Erica	Bloody Heath
Brachychiton populneus subsp. populneus	Equisetopsida	Brachychiton	Kurrajong
Mentha x piperita var. piperita	Equisetopsida	Mentha	Peppermint
Zaluzianskya divaricata	Equisetopsida	Zaluzianskya	Spreading Night-phlox
Brassica rapa	Equisetopsida	Brassica	Turnip
Lolium x hubbardii	Equisetopsida	Lolium	A Ryegrass
Linum trigynum	Equisetopsida	Linum	French Flax
Astragalus hamosus	Equisetopsida	Astragalus	Yellow Milk-vetch
Acaena x anserovina	Equisetopsida	Acaena	Hybrid Burr
Cynodon dactylon var. dactylon	Equisetopsida	Cynodon	Couch
Oxalis flava	Equisetopsida	Oxalis	Finger-leaf Oxalis
Cannabis sativa	Equisetopsida	Cannabis	Indian Hemp
Blyxa	Equisetopsida	Blyxa	
Euphorbia serpens	Equisetopsida	Euphorbia	Matted Sandmat
Trifolium tomentosum	Equisetopsida	Trifolium	Woolly Clover
Hakea rostrata	Equisetopsida	Hakea	Beaked Hakea
Cullen parvum	Equisetopsida	Cullen	Small Scurf-pea
Daviesia arenaria	Equisetopsida	Daviesia	Mallee Bitter-pea
Leiocarpa websteri	Equisetopsida	Leiocarpa	Narrow Plover-daisy
Wahlenbergia stricta subsp. stricta	Equisetopsida	Wahlenbergia	Tall Bluebell
Juncus aridicola	Equisetopsida	Juncus	Tussock Rush
Eragrostis brownii	Equisetopsida	Eragrostis	Bentham's Love-grass
Euphrasia collina subsp. osbornii	Equisetopsida	Euphrasia	Osborn's Eyebright
Hemarthria uncinata var. uncinata	Equisetopsida	Hemarthria	Mat Grass
Hackelia suaveolens	Equisetopsida	Hackelia	Sweet Hound's-tongue
Cassytha pubescens	Equisetopsida	Cassytha	Downy Dodder-laurel
Romulea rosea var. australis	Equisetopsida	Romulea	Guilford Grass
Melilotus indicus	Equisetopsida	Melilotus	Sweet Melilot
Dodonaea viscosa subsp. angustissima	Equisetopsida	Dodonaea	Slender Hop-bush
Aristida australis	Equisetopsida	Aristida	
Verbena officinalis var. officinalis	Equisetopsida	Verbena	Verbena
Amphipogon caricinus	Equisetopsida	Amphipogon	Grey-beard Grass
Silene gallica var. quinquevulnera	Equisetopsida	Silene	French Catchfly
Leionema hillebrandii	Equisetopsida	Leionema	Mount Lofty Phebalium
Podolepis rugata subsp. glabrata	Equisetopsida	Podolepis	Pleated Podolepis
Microtis arenaria	Equisetopsida	Microtis	Notched Onion-orchid
Cedrus atlantica	Equisetopsida	Cedrus	Blue Atlas Cedar
Trichoglossus haematodus	Aves	Trichoglossus	Rainbow Lorikeet
CORVIDAE	Aves		Eurasian Magpie
Platycercus (Platycercus) elegans subadelaidae	Aves	Platycercus	Flinders Adelaide Rosella
Streptopelia	Aves	Streptopelia	
Cygnus (Chenopis) atratus	Aves	Cygnus	Black Swan
Porphyrio (Porphyrio) porphyrio	Aves	Porphyrio	Purple Swamphen
Anas (Nettion) gracilis	Aves	Anas	Grey Teal
Larinae	Aves		
PARDALOTIDAE	Aves		
Himantopus himantopus	Aves	Himantopus	Black-winged Stilt
Corvus coronoides	Aves	Corvus	Australian Raven
Acrocephalus	Aves	Acrocephalus	
Acanthiza (Acanthiza) pusilla	Aves	Acanthiza	Brown Thornbill
Spatula rhynchotis	Aves	Spatula	Australasian Shoveler
PSITTACIDAE	Aves		
Nerita (Lisanerita) atramentosa	Gastropoda	Nerita	Black Crow
ACROCEPHALIDAE	Aves		
Hirundo (Hirundo) tahitica	Aves	Hirundo	Pacific Swallow
Hirundo (Hirundo) neoxena neoxena	Aves	Hirundo	Eastern Welcome Swallow
Thelymitra	Equisetopsida	Thelymitra	Sun Orchids
Dacelo	Aves	Dacelo	
Acanthagenys rufogularis	Aves	Acanthagenys	Spiny-cheeked Honeyeater
Spilopelia	Aves	Spilopelia	
Acanthiza (Geobasileus) uropygialis	Aves	Acanthiza	Chestnut-rumped Thornbill
Acrocephalus stentoreus	Aves	Acrocephalus	Clamorous Reed-warbler
Eudynamys orientalis	Aves	Eudynamys	Eastern Koel
Falco (Ieracidea) berigora	Aves	Falco	Brown Falcon
Acanthiza (Geobasileus) reguloides	Aves	Acanthiza	Buff-rumped Thornbill
Melanodryas (Melanodryas) cucullata	Aves	Melanodryas	Hooded Robin
Amphibromus nervosus	Equisetopsida	Amphibromus	Swamp Wallaby Grass
Eleocharis acutangula	Equisetopsida	Eleocharis	Eleocharis
Isolepis platycarpa	Equisetopsida	Isolepis	Flat-fruit Club-rush
Campylium	Bryopsida	Campylium	
Eragrostis infecunda	Equisetopsida	Eragrostis	Barren Cane-grass
Crassula natans	Equisetopsida	Crassula	Swamp Stonecrop
Puccinia myrsiphylli	Pucciniomycetes	Puccinia	
Eolophus roseicapilla roseicapilla	Aves	Eolophus	Western Galah
Tetragnatha	Arachnida	Tetragnatha	
PELECANIFORMES	Aves		
Anthrax	Insecta	Anthrax	
Sphenarches	Insecta	Sphenarches	
ANSERIFORMES	Aves		Ducks
Malvaceae	Equisetopsida		Mallow Family
Lalage (Lalage) tricolor	Aves	Lalage	White-winged Triller
Anthrenus (Nathrenus) verbasci	Insecta	Anthrenus	Varied Carpet Beetle
Swainsona formosa	Equisetopsida	Swainsona	Sturt Pea
Artoria cingulipes	Arachnida	Artoria	
Rosales	Equisetopsida		
Isopedella cerussata	Arachnida	Isopedella	Huntsman Spider
Isoodon obesulus	Mammalia	Isoodon	Southern Brown Bandicoot
Oxalidales	Equisetopsida		
GRYLLIDAE	Insecta		
Artoriopsis expolita	Arachnida	Artoriopsis	Wolf Spider
Erodium cicutarium	Equisetopsida	Erodium	Common Herons-bill
Phoracantha	Insecta	Phoracantha	
COCCINELLIDAE	Insecta		
SCOLIIDAE	Insecta		
Nephila edulis	Arachnida	Nephila	Australian Golden Orb-weaving Spider
Fabales	Equisetopsida		
GRUIFORMES	Aves		
Solanales	Equisetopsida		
Phoracantha recurva	Insecta	Phoracantha	
Psittacula krameri	Aves	Psittacula	Ring-necked Parakeet
ARHYNCHOBDELLIDA	Hirudinida		
Magnoliophyta			
PASSERIFORMES	Aves		Yellowhammer
FLATIDAE	Insecta		
Tachynomyia	Insecta	Tachynomyia	
Magnoliales	Equisetopsida		
Trichoglossus haematodus moluccanus	Aves	Trichoglossus	
Gryllodes	Insecta	Gryllodes	
Leptotarsus	Insecta	Leptotarsus	
LIMONIIDAE	Insecta		
Eucalyptus erythrocorys	Equisetopsida	Eucalyptus	Red-capped Gum
LUMBRICIDAE	Oligochaeta		
Moraea	Equisetopsida	Moraea	Cape Tulip
RODENTIA	Mammalia		
SQUAMATA	Reptilia		
Tetralycosa oraria	Arachnida	Tetralycosa	Wolf Spider
LYCAENIDAE	Insecta		Blues
Araneus acuminatus	Arachnida	Araneus	
Neophema (Neophema) pulchella	Aves	Neophema	Turquoise Parrot
Cacatua	Aves	Cacatua	
Numida meleagris	Aves	Numida	Helmeted Guineafowl

Christinus	Reptilia	Christinus	
Pogona	Reptilia	Pogona	
PTEROPODIDAE	Mammalia		
Oecobius navus	Arachnida	Oecobius	Wall Spider
Acrossidius tasmaniae	Insecta	Acrossidius	Blackheaded Pasture Cockchafer
Drosophila	Insecta	Drosophila	
COLUMBIDAE	Aves		Eastern Red Collared-dove
DIPROTODONTIA	Mammalia		
Isopeda	Arachnida	Isopeda	
ANNELIDA			Segmented Worms
Arctiinae	Insecta		
Gotra	Insecta	Gotra	
Hapalochlaena maculosa	Cephalopoda	Hapalochlaena	Southern Blue-ringed Octopus
PODICIPEDIFORMES	Aves		
BDELLIDAE	Arachnida		
Dictyotus	Insecta	Dictyotus	
COSSIDAE	Insecta		
Heteropsilopus	Insecta	Heteropsilopus	
Chroicocephalus novaehollandiae novaehollandiae	Aves	Chroicocephalus	Silver Gull
Taraxacum sp. Group 1 Fl. Victoria (A.C.Beauglehole 67529)	Equisetopsida	Taraxacum	
Arecaceae	Equisetopsida		Palm Family
ZYGENTOMA	Insecta		Silverfish
Aizoaceae	Equisetopsida		Pigface
Pogona barbata	Reptilia	Pogona	Common Bearded Dragon
Ocrisiona leucocomis	Arachnida	Ocrisiona	Jumping Spider
Isopedella victorialis	Arachnida	Isopedella	Huntsman Spider
Melanerythrus	Insecta	Melanerythrus	
Diphyrrhynchus (Neoabantis)	Insecta	Diphyrrhynchus	
ODONATA	Insecta		Dragonflies
Venatrix pseudospeciosa	Arachnida	Venatrix	Wolf Spider
Lampropholis	Reptilia	Lampropholis	
Freesia	Equisetopsida	Freesia	Freesia
Ascomycota			
Hemiergis	Reptilia	Hemiergis	
SCOLOPENDROMORPHA	Chilopoda		
Catopsilia	Insecta	Catopsilia	
Myrtales	Equisetopsida		
Flavoparmelia rutidota	Lecanoromycetes	Flavoparmelia	Common Biscuit Lichen
Latrodectus geometricus	Arachnida	Latrodectus	Brown Widow Spider
GYRINIDAE	Insecta		
Clynotis severus	Arachnida	Clynotis	Jumping Spider
Cornu	Gastropoda	Cornu	
VALVATIDA	Asteroidea		
CLITELLATA			
Gentianales	Equisetopsida		
Physarum cinereum	Myxogastrea	Physarum	
Loxosceles rufescens	Arachnida	Loxosceles	
Euproctis	Insecta	Euproctis	
AGAMIDAE	Reptilia		
Nephrolepis cordifolia	Equisetopsida	Nephrolepis	Fishbone Fern
Blepharotes coriarius	Insecta	Blepharotes	Giant Yellow Robber Fly
Recurvirostra novaehollandiae	Aves	Recurvirostra	Red-necked Avocet
Simosyrphus	Insecta	Simosyrphus	
Struthio camelus	Aves	Struthio	Ostrich
Assara	Insecta	Assara	
Ipomoea	Equisetopsida	Ipomoea	Morning Glory
FORFICULIDAE	Insecta		
Aeolothynnus	Insecta	Aeolothynnus	
CRYPTOPIDAE	Chilopoda		
Malpighiales	Equisetopsida		
Gymnorhina	Aves	Gymnorhina	
Turdus merula merula	Aves	Turdus	European Common Blackbird
Geraniales	Equisetopsida		
Sceliphron	Insecta	Sceliphron	
SCOLOPENDRIDAE	Chilopoda		
CASSIDAE	Gastropoda		
NEUROPTERA	Insecta		Ant-lions
Xanthorrhoea	Equisetopsida	Xanthorrhoea	Grasstree
Persicaria dichotoma	Equisetopsida	Persicaria	Persicaria
Cephrenes	Insecta	Cephrenes	
PALAEMONIDAE	Malacostraca		
Haematopus longirostris	Aves	Haematopus	Australian Pied Oystercatcher
Teleogryllus	Insecta	Teleogryllus	
Gallus gallus	Aves	Gallus	Red Junglefowl
CHARADRIIFORMES	Aves		
Charadrius (Charadrius) ruficapillus	Aves	Charadrius	Red-capped Plover
Tringa (Rhyacophilus) stagnatilis	Aves	Tringa	Marsh Sandpiper
Cracticus torquatus	Aves	Cracticus	Grey Butcherbird
Acanthiza (Geobasileus) chrysorrhoa	Aves	Acanthiza	Yellow-rumped Thornbill
Calidris (Erolia) melanotos	Aves	Calidris	Pectoral Sandpiper
Calidris pugnax	Aves	Calidris	Ruff
Petroica (Petroica) goodenovii	Aves	Petroica	Red-capped Robin
Milvus migrans	Aves	Milvus	Black Kite
Heteroscenes pallidus	Aves	Heteroscenes	Pallid Cuckoo
Apus (Apus) pacificus	Aves	Apus	Fork-tailed Swift
Synoicus ypsilophora	Aves	Synoicus	Brown Quail
Artamus (Campbellornis) superciliosus	Aves	Artamus	White-browed Woodswallow
Chalcites osculans	Aves	Chalcites	Black-eared Cuckoo
Aquila (Uroaetus) audax	Aves	Aquila	Wedge-tailed Eagle
Calidris (Ereunetes) ruficollis	Aves	Calidris	Red-necked Stint
Smicrornis brevirostris	Aves	Smicrornis	Weebill
Calidris (Ereunetes) subminuta	Aves	Calidris	Long-toed Stint
Thalasseus bergii	Aves	Thalasseus	Crested Tern
Ardea intermedia	Aves	Ardea	Intermediate Egret
Zapornia tabuensis	Aves	Zapornia	Spotless Crake
Cacomantis (Vidgenia) flabelliformis	Aves	Cacomantis	Fan-tailed Cuckoo
Taeniopygia guttata	Aves	Taeniopygia	Zebra Finch
Cereopsis novaehollandiae	Aves	Cereopsis	Cape Barren Goose
Circus assimilis	Aves	Circus	Spotted Harrier
Pachycephala (Alisternornis) rufiventris	Aves	Pachycephala	Rufous Whistler
Sericornis (Sericornis) frontalis maculatus	Aves	Sericornis	South-western Spotted Scrubwren
Xenus cinereus	Aves	Xenus	Terek Sandpiper
Falco (Hierofalco) subniger	Aves	Falco	Black Falcon
Alauda arvensis	Aves	Alauda	Eurasian Skylark
Botaurus poiciloptilus	Aves	Botaurus	Australasian Bittern
Rostratula australis	Aves	Rostratula	Australian Painted Snipe
Geopelia placida	Aves	Geopelia	Peaceful Dove
Calidris (Erolia) ferruginea	Aves	Calidris	Curlew Sandpiper
Cincloramphus (Cincloramphus) cruralis	Aves	Cincloramphus	Brown Songlark
Limosa limosa	Aves	Limosa	Black-tailed Godwit
Cincloramphus (Maclennania) mathewsi	Aves	Cincloramphus	Rufous Songlark
Artamus (Campbellornis) personatus	Aves	Artamus	Masked Woodswallow
Ardenna tenuirostris	Aves	Ardenna	Short-tailed Shearwater
Hieraaetus (Hieraaetus) morphnoides	Aves	Hieraaetus	Little Eagle
Neophema (Neonanodes) elegans	Aves	Neophema	Elegant Parrot
Turnix (Alphaturnia) velox	Aves	Turnix	Little Button-quail
Sericornis (Sericornis) frontalis	Aves	Sericornis	White-browed Scrubwren
Tyto	Aves	Tyto	Barn Owl
Acanthiza (Subacanthiza) lineata	Aves	Acanthiza	Striated Thornbill
Merops (Merops) ornatus	Aves	Merops	Rainbow Bee-eater
Zoothera (Zoothera) lunulata	Aves	Zoothera	Bassian Thrush
Juncus ambiguus	Equisetopsida	Juncus	
Drosophila (Drosophila) buzzatii	Insecta	Drosophila	Fruit Fly
Opuntia ficus-indica	Equisetopsida	Opuntia	Indian Fig
Tribolium castaneum	Insecta	Tribolium	Red Flour Beetle
Uromyces striatus var. loti	Pucciniomycetes	Uromyces	
Ustilago tritici	Ustilaginomycetes	Ustilago	
Stagonospora	Dothideomycetes	Stagonospora	
Hyaloperonospora parasitica	Oomycetes	Hyaloperonospora	
Uromyces anthyllidis	Pucciniomycetes	Uromyces	
Leptotrochila medicaginis	Leotiomycetes	Leptotrochila	
Closterovirus		Closterovirus	
Cymadothea trifolii	Dothideomycetes	Cymadothea	
Cercospora zonata	Dothideomycetes	Cercospora	
Pseudopeziza trifolii	Leotiomycetes	Pseudopeziza	
Thielaviopsis basicola	Sordariomycetes	Thielaviopsis	
Phoma	Dothideomycetes	Phoma	
Plectosphaerella cucumerina (Lindf.) W.Gams	Sordariomycetes	Plectosphaerella	

Alternaria solani	Dothideomycetes	Alternaria	
Cochliobolus cynodontis	Dothideomycetes	Cochliobolus	
Uromyces minor	Pucciniomycetes	Uromyces	
Phoma omnivora	Dothideomycetes	Phoma	
Tranzschelia discolor	Pucciniomycetes	Tranzschelia	
Placoasterella baileyi	Dothideomycetes	Placoasterella	
Puccinia wurmbeae	Pucciniomycetes	Puccinia	
Fusarium oxysporum	Sordariomycetes	Fusarium	
Hyperphyscia adglutinata	Lecanoromycetes	Hyperphyscia	
Deyeuxia densa	Equisetopsida	Deyeuxia	Heath Bent-grass
Hyperphyscia pruinosa	Lecanoromycetes	Hyperphyscia	
Physcia undulata	Lecanoromycetes	Physcia	
Bothriochloa ewartiana	Equisetopsida	Bothriochloa	Desert Bluegrass
Xanthium occidentale	Equisetopsida	Xanthium	Noogoora Burr
Emydura	Reptilia	Emydura	
Zonitoides arboreus	Gastropoda	Zonitoides	Orchid Snail
Austrosuccinea	Gastropoda	Austrosuccinea	
Potamopyrgus antipodarum	Gastropoda	Potamopyrgus	Mud Snail
Dichromodes explanata	Insecta	Dichromodes	Geometer Moth
Ogyris olane	Insecta	Ogyris	Olane Azure
Neobatrachus pictus	Amphibia	Neobatrachus	Painted Frog
Dichromodes anelictis	Insecta	Dichromodes	Geometer Moth
Isidorella	Gastropoda	Isidorella	
Glyptophysa	Gastropoda	Glyptophysa	
Jalmenus icilius	Insecta	Jalmenus	Amethyst Hairstreak
Corbicula (Corbiculina) australis	Bivalvia	Corbicula	Little Mussel
Potamopyrgus	Gastropoda	Potamopyrgus	
PLANORBIDAE	Gastropoda		
Species Inquirenda	Reptilia		
Physa	Gastropoda	Physa	
Galaxias olidus	Actinopterygii	Galaxias	Mountain Galaxias
Aprasia striolata	Reptilia	Aprasia	Striated Worm-lizard
Psephotellus chrysopterygius	Aves	Psephotellus	Golden-shouldered Parrot
Pachyptila salvini	Aves	Pachyptila	Salvin's Prion
Castiarina parallela	Insecta	Castiarina	
Eurymeloides punctata	Insecta	Eurymeloides	Leafhopper
Anzacia	Arachnida	Anzacia	
Artoria victoriensis	Arachnida	Artoria	Victorian Artoria
TATEIDAE	Gastropoda		
Physa acuta	Gastropoda	Physa	Acute Bladder Snail
Diphucrania minutissima	Insecta	Diphucrania	
Arion ater	Gastropoda	Arion	European Black Slug
OECOBIIDAE	Arachnida		Wall Spider
Pedionomus torquatus	Aves	Pedionomus	Plains Wanderer
Glyptophysa (Glyptophysa) novaehollandica	Gastropoda	Glyptophysa	Pouched Snail
Nysius vinitor	Insecta	Nysius	Rutherglen Bug
Dieuches scutellatus	Insecta	Dieuches	
Podargus strigoides brachypterus	Aves	Podargus	Western Tawny Frogmouth
Servaea narraweena	Arachnida	Servaea	Jumping Spider
Coturnix (Coturnix) pectoralis	Aves	Coturnix	Stubble Quail
Melophorus	Insecta	Melophorus	
Acridotheres tristis	Aves	Acridotheres	Common Myna
Trachyops australis	Insecta	Trachyops	Shield Bug
Ferrissia (Pettancylus) tasmanicus	Gastropoda	Ferrissia	Broad Freshwater Limpet
Chalinolobus gouldii	Mammalia	Chalinolobus	Gould's Wattled Bat
Sidymella lampei	Arachnida	Sidymella	
Notechis scutatus	Reptilia	Notechis	Tiger Snake
Austropyrgus	Gastropoda	Austropyrgus	
Megninia hologastra	Arachnida	Megninia	
Zosterops lateralis cornwalli	Aves	Zosterops	Eastern Silvereye
Onthophagus mniszechi	Insecta	Onthophagus	Threehorned Dung Beetle
Poecilometis apicalis	Insecta	Poecilometis	Shield Bug
Oncocephalus fuscicornis	Insecta	Oncocephalus	Assassin Bug
Castiarina decemmaculata	Insecta	Castiarina	Ten-spot Jewel Beetle
Trox (Trox) scaber	Insecta	Trox	
Dingosa simsoni	Arachnida	Dingosa	Grey Wolf Spider
Idiosoma subtriste	Arachnida	Idiosoma	
Trigonotylus tenuis	Insecta	Trigonotylus	Plant Bug
Isoodon obesulus obesulus	Mammalia	Isoodon	Southern Brown Bandicoot (eastern)
Mirafra (Mirafra) javanica	Aves	Mirafra	Horsfield's Bushlark
Macrocarenoides scutellatus	Insecta	Macrocarenoides	Shield Bug
Platynectes (Gueorguievtes) decempunctatus	Insecta	Platynectes	Diving Beetle
Lancetes lanceolatus	Insecta	Lancetes	Diving Beetle
FRINGILLIDAE	Aves		
Austronomus australis	Mammalia	Austronomus	White-striped Freetail-bat
Stenophyella macreta	Insecta	Stenophyella	Bug
Candalides heathi heathi	Insecta	Candalides	Rayed Blue
Mirafra (Mirafra) javanica secunda	Aves	Mirafra	South Australian Horsfield's Bushlark
Enochrus (Methydrus) elongatulus	Insecta	Enochrus	Water Scavenger Beetle
SPHAERIIDAE	Bivalvia		
Tyto javanica delicatula	Aves	Tyto	
Monomorium	Insecta	Monomorium	
Omorgus (Omorgus) euclensis	Insecta	Omorgus	
Gamasomorpha	Arachnida	Gamasomorpha	
Ferussacia (Ferussacia) folliculus	Gastropoda	Ferussacia	Husk Snail
Lampona cylindrata	Arachnida	Lampona	White-tailed Spider
Phaps (Phaps) elegans	Aves	Phaps	Brush Bronzewing
Pauropsalta	Insecta	Pauropsalta	
Backobourkia heroine	Arachnida	Backobourkia	
Falco (Falco) longipennis longipennis	Aves	Falco	Southern Australian Hobby
Pteropus	Mammalia	Pteropus	Nicobar Flying Fox
Yoyetta landsboroughi	Insecta	Yoyetta	Cicada
Bubulcus	Aves	Bubulcus	
Ceryerda	Arachnida	Ceryerda	
Tiliqua scincoides intermedia	Reptilia	Tiliqua	Northern Blue-tongued Skink
Ceyx azureus	Aves	Ceyx	Azure Kingfisher
Petroica (Petroica) boodang boodang	Aves	Petroica	Eastern Scarlet Robin
Stiltia isabella	Aves	Stiltia	Australian Pratincole
Stenolemus edwardsii	Insecta	Stenolemus	Assassin Bug
Idiosoma smeatoni	Arachnida	Idiosoma	
Brizocoris dimorphicus	Insecta	Brizocoris	Shield Bug
Ninox (Ninox) boobook boobook	Aves	Ninox	South-eastern Boobook
Rhinella marina	Amphibia	Rhinella	Cane Toad
Glyptophysa (Glyptophysa) aliciae	Gastropoda	Glyptophysa	Alices Pouch Snail
Amegilla (Zonamegilla) asserta	Insecta	Amegilla	Blue-banded Bee
Alcaeus hermannsburgi	Insecta	Alcaeus	
Ferrissia	Gastropoda	Ferrissia	
Battalus diadens	Arachnida	Battalus	
Remaudiereana inornata	Insecta	Remaudiereana	Seed Bug
Neochmia (Neochmia)	Aves	Neochmia	
Prietocella barbara	Gastropoda	Prietocella	Small Pointed Snail
Ctenotus spaldingi	Reptilia	Ctenotus	Spalding's Ctenotus
Falco (Tinnunculus) cenchroides cenchroides	Aves	Falco	Nankeen Kestrel
Niastama obscuritarsis	Insecta	Niastama	Plant Bug
Dictyotus caenosus	Insecta	Dictyotus	Brown Shield Bug
Velesunio ambiguus	Bivalvia	Velesunio	Southern Mussel
Melanacanthus scutellaris	Insecta	Melanacanthus	Podsucking Bug
Pachyptila desolata	Aves	Pachyptila	Antarctic Prion
Anthus (Anthus) novaeseelandiae novaeseelandiae	Aves	Anthus	
Candalides heathi	Insecta	Candalides	Rayed Blue
Falco (Ieracidea) berigora berigora	Aves	Falco	Eastern Brown Falcon
Nesidovelia peramoena	Insecta	Nesidovelia	Riffle Bug
Castiarina rufipennis	Insecta	Castiarina	
Lycosa	Arachnida	Lycosa	
Castiarina bicolor	Insecta	Castiarina	
Hogna senilis	Arachnida	Hogna	
Tamopsis raveni	Arachnida	Tamopsis	
Papyrius	Insecta	Papyrius	
Trochosa phyllis	Arachnida	Trochosa	
Lynceus tatei	Branchiopoda	Lynceus	
Lugensa	Aves	Lugensa	
Clubiona	Arachnida	Clubiona	
Bayardella cosmeta	Gastropoda	Bayardella	Ramshorn Snail
Pycnonotus (Pycnonotus) jocosus	Aves	Pycnonotus	Red-whiskered Bulbul
Onthophagus adelaidae	Insecta	Onthophagus	
Heteronympha merope merope	Insecta	Heteronympha	Common Brown
Rhantus suturalis	Insecta	Rhantus	Diving Beetle
Kalkadoona pallida	Insecta	Kalkadoona	Shield Bug

Musculium (Sphaerinova) tasmanicum tasmanicum	Bivalvia	Musculium	Pea Shell
Helochares tristis	Insecta	Helochares	Water Scavenger Beetle
Paratya australiensis	Malacostraca	Paratya	Australian Paratya
Austropeplea	Gastropoda	Austropeplea	
Robinsoniana speranda	Gastropoda	Robinsoniana	Adelaide Pinwheel Snail
Castiarina xanthopilosa	Insecta	Castiarina	
Geomela circumflava	Insecta	Geomela	
Piestolestes obscurus	Insecta	Piestolestes	Assassin Bug
Aulonogyrus strigosus	Insecta	Aulonogyrus	Whirligig Beetle
Amegilla (Zonamegilla) murrayensis	Insecta	Amegilla	Bee
Urodacus armatus	Arachnida	Urodacus	Yellow Sand Scorpion
PHASIANIDAE	Aves		
Onychohydrus scutellaris	Insecta	Onychohydrus	Diving Beetle
Onthophagus pentacanthus	Insecta	Onthophagus	Fivehorned Dung Beetle
Carepalxis	Arachnida	Carepalxis	
Melanacanthus margineguttatus	Insecta	Melanacanthus	
Myandra cambridgei	Arachnida	Myandra	Long-spinneret Ground Spider
Solaenodolichopus	Diplopoda	Solaenodolichopus	
Castiarina adelaidae	Insecta	Castiarina	
Crematogaster	Insecta	Crematogaster	
Pardalotus (Pardalotinus) striatus substriatus	Aves	Pardalotus	Western Striated Pardalote
Taeniopygia guttata castanotis	Aves	Taeniopygia	
Brentiscerus australis	Insecta	Brentiscerus	Seed Bug
Wandella murrayensis	Arachnida	Wandella	Crevice Weaver Spider
Theba pisana	Gastropoda	Theba	White Italian Snail
Ixobrychus dubius	Aves	Ixobrychus	Minute Bittern
Eretes australis	Insecta	Eretes	Diving Beetle
Anilios bicolor	Reptilia	Anilios	Dark-spined Blind Snake
Ochetellus	Insecta	Ochetellus	
Neophema (Neonanodes) chrysostoma	Aves	Neophema	Blue-winged Parrot
Longepi woodman	Arachnida	Longepi	White-tailed Spider
Australocleptes debilis	Insecta	Australocleptes	
Orchestina	Arachnida	Orchestina	
Vanellus (Lobivanellus) tricolor	Aves	Vanellus	Banded Lapwing
Novakiella	Arachnida	Novakiella	
Aname	Arachnida	Aname	
Austroaeschna unicornis	Insecta	Austroaeschna	Unicorn Darner
Thalassarche carteri	Aves	Thalassarche	Indian Yellow-nosed Albatross
Lehmannia nyctelia	Gastropoda	Lehmannia	Striped Field Slug
Berosus (Enoplurus) majusculus	Insecta	Berosus	Water Scavenger Beetle
Podomyrma	Insecta	Podomyrma	
Ozimops planiceps	Mammalia	Ozimops	South-eastern Free-tailed Bat
Holconia immanis	Arachnida	Holconia	Huntsman Spider
IDIOPIDAE	Arachnida		
Nyctophilus geoffroyi	Mammalia	Nyctophilus	Lesser Long-eared Bat
Manorina (Myzantha) flavigula	Aves	Manorina	Yellow-throated Miner
Ninox (Ninox) novaeseelandiae	Aves	Ninox	Southern Boobook
Lalage	Aves	Lalage	
Chalcites basalis	Aves	Chalcites	Horsfield's Bronze-cuckoo
Porzana	Aves	Porzana	
Pachycephala (Pachycephala) pectoralis	Aves	Pachycephala	Golden Whistler
Coturnix ypsilophora	Aves	Coturnix	
Phylidonyris (Phylidonyris) pyrrhopterus	Aves	Phylidonyris	Crescent Honeyeater
Lichenostomus	Aves	Lichenostomus	
Geopelia	Aves	Geopelia	
Malurus (Leggeornis) lamberti	Aves	Malurus	Variegated Fairy-wren
Sternula albifrons	Aves	Sternula	Little Tern
Melithreptus (Eidopsarus) brevirostris	Aves	Melithreptus	Brown-headed Honeyeater
Bubulcus ibis	Aves	Bubulcus	Cattle Egret
Petroica (Petroica) boodang	Aves	Petroica	Scarlet Robin
Anthus (Anthus) novaeseelandiae	Aves	Anthus	Australian Pipit
Daphoenositta (Neositta) chrysoptera	Aves	Daphoenositta	Varied Sittella
Cormobates leucophaea	Aves	Cormobates	White-throated Treecreeper
Gliciphila melanops	Aves	Gliciphila	Tawny-crowned Honeyeater
Tyto javanica	Aves	Tyto	Eastern Barn Owl
Anthela acuta	Insecta	Anthela	Lappet Moth
Delena gloriosa	Arachnida	Delena	
Eucalyptus chloroclada	Equisetopsida	Eucalyptus	Baradine Red Gum
Moina australiensis	Branchiopoda	Moina	Water Flea
Heoclisis fundata	Insecta	Heoclisis	Antlion
Aloe vera	Equisetopsida	Aloe	Aloe Vera
Odontomyia	Insecta	Odontomyia	
Antaresia childreni	Reptilia	Antaresia	Children's Python
Ficus rubiginosa f. glabrescens	Equisetopsida	Ficus	
Mustela	Mammalia	Mustela	
Lavandula	Equisetopsida	Lavandula	Lavender
Crassulaceae	Equisetopsida		
Sturnus (Sturnus) vulgaris vulgaris	Aves	Sturnus	European Common Starling
Carduelis carduelis britannica	Aves	Carduelis	European Goldfinch
Passer (Passer) domesticus domesticus	Aves	Passer	European House Sparrow
Ocyphaps lophotes lophotes	Aves	Ocyphaps	Eastern Crested Pigeon
Phylidonyris (Meliornis) novaehollandiae novaehollandiae	Aves	Phylidonyris	Eastern New Holland Honeyeater
Gymnorhina tibicen tyrannica	Aves	Gymnorhina	Southern Victoria Australian Magpie
Malurus (Malurus) cyaneus leggei	Aves	Malurus	South Australian Superb Fairy-wren
Coracina (Coracina) papuensis robusta	Aves	Coracina	South-eastern White-bellied Cuckoo-shrike
Philypnodon macrostomus	Actinopterygii	Philypnodon	Dwarf Flathead Gudgeon
Grallina cyanoleuca cyanoleuca	Aves	Grallina	Southern Magpie-lark
Philypnodon grandiceps	Actinopterygii	Philypnodon	Flathead Gudgeon
Threskiornis moluccus moluccus	Aves	Threskiornis	Australian White Ibis (nominate Subspecies)
Biziura lobata menziesi	Aves	Biziura	Eastern Musk Duck
Psephotus haematonotus haematonotus	Aves	Psephotus	South-eastern Red-rumped Parrot
Accipiter (Leucospiza) fasciatus fasciatus	Aves	Accipiter	Southern Brown Goshawk
Tachybaptus novaehollandiae novaehollandiae	Aves	Tachybaptus	Australian Grebe
Milvus migrans affinis	Aves	Milvus	Torresian Black Kite
Perca fluviatilis	Actinopterygii	Perca	Redfin
Dacelo (Dacelo) novaeguineae novaeguineae	Aves	Dacelo	Southern Laughing Kookaburra
Rhipidura (Sauloprocta) leucophrys leucophrys	Aves	Rhipidura	Southern Willie Wagtail
Anas (Nettion) gracilis gracilis	Aves	Anas	Grey Teal
Chlidonias (Pelodes) hybrida javanicus	Aves	Chlidonias	Eastern Whiskered Tern
Bubulcus ibis coromandus	Aves	Bubulcus	Eastern Cattle Egret
Alauda arvensis arvensis	Aves	Alauda	European Eurasian Skylark
Apus (Apus) pacificus pacificus	Aves	Apus	Eastern Fork-tailed Swift
Melithreptus (Eidopsarus) gularis	Aves	Melithreptus	Black-chinned Honeyeater
Anthochaera (Anellobia) chrysoptera chrysoptera	Aves	Anthochaera	South-eastern Little Wattlebird
Cacomantis (Vidgenia) flabelliformis flabelliformis	Aves	Cacomantis	Australian Fan-tailed Cuckoo
Accipiter (Paraspizias) cirrocephalus cirrocephalus	Aves	Accipiter	Australian Collared Sparrowhawk
Cereopsis novaehollandiae novaehollandiae	Aves	Cereopsis	Eastern Cape Barren Goose
Turdus philomelos	Aves	Turdus	Song Thrush
Platycercus (Violania) eximius eximius	Aves	Platycercus	South-east Eastern Rosella
Anthochaera (Anthochaera) carunculata woodwardi	Aves	Anthochaera	Western Red Wattlebird
Acrocephalus (Acrocephalus) australis australis	Aves	Acrocephalus	Eastern Australian Reed-warbler
Todiramphus (Todiramphus) sanctus sanctus	Aves	Todiramphus	Australian Sacred Kingfisher
Poodytes gramineus goulburni	Aves	Poodytes	Eastern Little Grassbird
Neochmia (Aegintha) temporalis temporalis	Aves	Neochmia	Southern Red-browed Finch
Falco (Falco) longipennis murchisonianus	Aves	Falco	Inland Australian Hobby
Acanthorhynchus tenuirostris halmaturinus	Aves	Acanthorhynchus	South Australian Eastern Spinebill
Dicaeum (Dicaeum) hirundinaceum hirundinaceum	Aves	Dicaeum	
Strepera (Neostrepera) versicolor melanoptera	Aves	Strepera	Black-winged Currawong
Phylidonyris (Phylidonyris) pyrrhopterus halmaturinus	Aves	Phylidonyris	South Australian Crescent Honeyeater
Acanthiza (Acanthiza) pusilla samueli	Aves	Acanthiza	Mount Lofty Ranges Brown Thornbill
Lonchura (Lonchura) punctulata	Aves	Lonchura	Nutmeg Munia
Pachycephala (Alisternornis) rufiventris rufiventris	Aves	Pachycephala	Southern Rufous Whistler
Caligavis chrysops samueli	Aves	Caligavis	Mount Lofty Ranges Yellow-faced Honeyeater
Geopelia placida placida	Aves	Geopelia	Eastern Peaceful Dove
Anhinga novaehollandiae novaehollandiae	Aves	Anhinga	Australasian Darter
Galaxias brevipinnis	Actinopterygii	Galaxias	Climbing Galaxias
Cacatua (Licmetis) sanguinea gymnopis	Aves	Cacatua	Eastern Little Corella
Melopsittacus undulatus	Aves	Melopsittacus	Budgerigar
Aquila (Uroaetus) audax audax	Aves	Aquila	Mainland Wedge-tailed Eagle
Eolophus roseicapilla albiceps	Aves	Eolophus	Eastern Galah
Zapornia pusilla palustris	Aves	Zapornia	Torresian Baillon's Crake
Nycticorax caledonicus australasiae	Aves	Nycticorax	Torresian Nankeen Night-heron
Hylacola pyrrhopygia parkeri	Aves	Hylacola	Mount Lofty Ranges Chestnut-rumped Heathwren
Pseudophryne bibronii	Amphibia	Pseudophryne	Brown Toadlet
Gavicalis virescens sonorus	Aves	Gavicalis	South-eastern Singing Honeyeater
Ardea intermedia plumifera	Aves	Ardea	Intermediate Egret
Phalacrocorax (Phalacrocorax) varius hypoleucos	Aves	Phalacrocorax	Australian Great Pied Cormorant
Vespadelus darlingtoni	Mammalia	Vespadelus	Large Forest Bat

Saccolaimus flaviventris	Mammalia	Saccolaimus	Yellow-bellied Sheathtail-bat
Oriolus (Mimeta) sagittatus sagittatus	Aves	Oriolus	Eastern Olive-backed Oriole
Platycercus (Platycercus) elegans fleurieuensis	Aves	Platycercus	Fleurieu Adelaide Rosella
Petrochelidon (Hylochelidon) nigricans neglecta	Aves	Petrochelidon	Mainland Tree Martin
Falcunculus frontatus frontatus	Aves	Falcunculus	Eastern Shrike-tit
Neophema (Neonanodes) elegans elegans	Aves	Neophema	
Hirundapus caudacutus caudacutus	Aves	Hirundapus	Eastern White-throated Needletail
Epthianura (Aurepthianura) aurifrons	Aves	Epthianura	Orange Chat
Alisterus scapularis	Aves	Alisterus	Australian King-parrot
Acridotheres tristis tristis	Aves	Acridotheres	Indian Common Myna
Fraxinus angustifolia subsp. angustifolia	Equisetopsida	Fraxinus	Narrow-leaved Ash
Senecio pinnatifolius	Equisetopsida	Senecio	Variable Groundsel
Viburnum tinus	Equisetopsida	Viburnum	Laurestinus
Agapanthus praecox subsp. orientalis	Equisetopsida	Agapanthus	Agapanthus
Salix babylonica	Equisetopsida	Salix	Weeping Willow
Phoenix canariensis	Equisetopsida	Phoenix	Canary Island Palm
Gomphocarpus physocarpus	Equisetopsida	Gomphocarpus	Balloon Cotton-bush
Freesia leichtlinii	Equisetopsida	Freesia	Freesia
Prunus dulcis	Equisetopsida	Prunus	Almond
Salix x fragilis	Equisetopsida	Salix	Crack Willow
Hesperocyparis macrocarpa	Equisetopsida	Hesperocyparis	Monterey Cypress
Watsonia meriana var. bulbillifera	Equisetopsida	Watsonia	Bulbil Watsonia
Ranunculus repens	Equisetopsida	Ranunculus	Creeping Buttercup
Hedera helix	Equisetopsida	Hedera	English Ivy
Syzygium australe	Equisetopsida	Syzygium	Scrub Cherry
Genista monspessulana	Equisetopsida	Genista	Montpellier Broom
Rosa rubiginosa	Equisetopsida	Rosa	Sweet Briar
Coprosma repens	Equisetopsida	Coprosma	Mirror Bush
Euphorbia drummondii	Equisetopsida	Euphorbia	Mat Spurge
Glossodia major	Equisetopsida	Glossodia	Purple Cockatoo
Ceratonia siliqua	Equisetopsida	Ceratonia	Carob
Paraserianthes lophantha	Equisetopsida	Paraserianthes	Cape Leeuwin Wattle
Veronica hederifolia	Equisetopsida	Veronica	Ivy-leaf Speedwell
Nerium oleander	Equisetopsida	Nerium	Oleander
Thelymitra rubra	Equisetopsida	Thelymitra	Salmon Sun-orchid
Ehrharta calycina	Equisetopsida	Ehrharta	Perennial Veldt-grass
Schoenus apogon	Equisetopsida	Schoenus	Common Bog-rush
Prunus laurocerasus	Equisetopsida	Prunus	Cherry-laurel
Hibbertia sericea	Equisetopsida	Hibbertia	Silky Guinea-flower
Washingtonia filifera	Equisetopsida	Washingtonia	Cotton Palm
Asparagus plumosus	Equisetopsida	Asparagus	Ferny Climbing Asparagus Fern
Melaleuca armillaris subsp. armillaris	Equisetopsida	Melaleuca	Bracelet Honey-myrtle
Dactylis glomerata	Equisetopsida	Dactylis	Cocksfoot
Populus alba	Equisetopsida	Populus	White Fastigiate Poplar
Wurmbea dioica subsp. dioica	Equisetopsida	Wurmbea	Early Nancy
Myoporum viscosum	Equisetopsida	Myoporum	Sticky Boobialla
Arisarum vulgare	Equisetopsida	Arisarum	Monk's Hood
Salvia verbenaca var. verbenaca	Equisetopsida	Salvia	Wild Sage
Chrysanthemoides monilifera subsp. monilifera	Equisetopsida	Chrysanthemoides	African Boneseed
Crassula colligata subsp. colligata	Equisetopsida	Crassula	Slender Stonecrop
Amphipogon strictus	Equisetopsida	Amphipogon	Greybeard Grass
Yucca gloriosa	Equisetopsida	Yucca	Yucca
Medicago minima	Equisetopsida	Medicago	Medicago
Chamaescilla corymbosa var. corymbosa	Equisetopsida	Chamaescilla	Blue Stars
Aloe maculata	Equisetopsida	Aloe	Common Soap Aloe
Kniphofia uvaria	Equisetopsida	Kniphofia	Red Hot Poker
Stackhousia monogyna	Equisetopsida	Stackhousia	Creamy Candles
Rytidosperma pilosum	Equisetopsida	Rytidosperma	Large Velvet Wallaby-grass
Vittadinia megacephala	Equisetopsida	Vittadinia	Giant New Holland Daisy
Cordyline australis	Equisetopsida	Cordyline	New Zealand Cabbage-tree
Hirschfeldia incana	Equisetopsida	Hirschfeldia	Hoary Mustard
Cotoneaster simonsii	Equisetopsida	Cotoneaster	Himalayan Cotoneaster
Canna x generalis	Equisetopsida	Canna	Canna
Vittadinia cervicularis var. cervicularis	Equisetopsida	Vittadinia	Waisted New Holland Daisy
Lycium barbarum	Equisetopsida	Lycium	Chinese Boxthorn
Acacia cyclops	Equisetopsida	Acacia	Western Coastal Wattle
Lagenophora gunniana	Equisetopsida	Lagenophora	Coarse Bottle-daisy
Plantago coronopus subsp. coronopus	Equisetopsida	Plantago	Bucks-horn Plantain
Taraxacum khatoonae	Equisetopsida	Taraxacum	Dandelion
Pinus ponderosa	Equisetopsida	Pinus	Ponderosa Pine
Cortaderia selloana subsp. selloana	Equisetopsida	Cortaderia	Pampas Grass
Acacia longifolia subsp. longifolia	Equisetopsida	Acacia	Sallow Wattle
Geranium solanderi	Equisetopsida	Geranium	Austral Geranium
Dittrichia graveolens	Equisetopsida	Dittrichia	Stinkwort
Hakea laurina	Equisetopsida	Hakea	Pincushion Hakea
Sida corrugata	Equisetopsida	Sida	Variable Sida (peltate-hairy)
Asparagus aethiopicus	Equisetopsida	Asparagus	Asparagus Fern
Lilaeopsis polyantha	Equisetopsida	Lilaeopsis	Australian Lilaeopsis
Lolium perenne	Equisetopsida	Lolium	Perennial Rye-grass
Pinus radiata	Equisetopsida	Pinus	Radiata Pine
Oenothera stricta subsp. stricta	Equisetopsida	Oenothera	Common Evening Primrose
Austrostipa acrociliata	Equisetopsida	Austrostipa	Graceful Spear-grass
Moraea flaccida	Equisetopsida	Moraea	One-leaf Cape Tulip
Austrostipa scabra	Equisetopsida	Austrostipa	Rough Spear-grass
Chasmanthe floribunda	Equisetopsida	Chasmanthe	African Cornflag
Rosmarinus officinalis	Equisetopsida	Rosmarinus	Rosemary
Thinopyrum elongatum	Equisetopsida	Thinopyrum	Tall Wheat-grass
Dimorphotheca fruticosa	Equisetopsida	Dimorphotheca	Trailing African Daisy
Ixia cultivar	Equisetopsida	Ixia	Ixia
Narcissus pseudonarcissus	Equisetopsida	Narcissus	Common Daffodil
Eucalyptus cladocalyx subsp. cladocalyx	Equisetopsida	Eucalyptus	Bushy Sugar Gum
Juncus pauciflorus	Equisetopsida	Juncus	Loose-flower Rush
Drosera pygmaea	Equisetopsida	Drosera	Tiny Sundew
Solanum pseudocapsicum	Equisetopsida	Solanum	Jerusalem Cherry
Aloe arborescens	Equisetopsida	Aloe	Tree Aloe
Opercularia varia	Equisetopsida	Opercularia	Variable Stinkweed
Narcissus jonquilla	Equisetopsida	Narcissus	Jonquill
Rytidosperma tenuius	Equisetopsida	Rytidosperma	Short-awn Wallaby-grass
Haloragis acutangula	Equisetopsida	Haloragis	Smooth Raspwort
Gazania linearis	Equisetopsida	Gazania	Gazania
Hypericum perforatum subsp. veronense	Equisetopsida	Hypericum	St John's Wort
Callistemon rugulosus	Equisetopsida	Callistemon	Scarlet Bottlebrush
Alternanthera denticulata	Equisetopsida	Alternanthera	Lesser Joyweed
Pinus pinaster	Equisetopsida	Pinus	Maritime Pine
Senecio pinnatifolius var. lanceolatus	Equisetopsida	Senecio	Swamp Groundsel
Pterostylis pedunculata	Equisetopsida	Pterostylis	Maroon-hood
Lolium perenne x Lolium rigidum	Equisetopsida	Lolium	Hybrid Ryegrass
Opuntia elatior	Equisetopsida	Opuntia	Prickly Pear
Euchiton involucratus	Equisetopsida	Euchiton	Star Cudweed
Pteridium esculentum	Equisetopsida	Pteridium	Austral Bracken
Briza minor	Equisetopsida	Briza	Lesser Quaking-grass
Clematis decipiens	Equisetopsida	Clematis	Old Man's Beard
Erigeron bilbaoanus	Equisetopsida	Erigeron	Smooth Fleabane
Vulpia muralis	Equisetopsida	Vulpia	Wall Fescue
Holcus lanatus	Equisetopsida	Holcus	Yorkshire Fog
Pterostylis nana	Equisetopsida	Pterostylis	Dwarf Greenhood
Trifolium fragiferum var. fragiferum	Equisetopsida	Trifolium	Strawberry Clover
Leontodon saxatilis	Equisetopsida	Leontodon	Lesser Hawkbit
Cynosurus echinatus	Equisetopsida	Cynosurus	Rough Dog's Tail
Microtis unifolia	Equisetopsida	Microtis	Common Onion Orchid
Vicia monantha	Equisetopsida	Vicia	Spurred Vetch
Setaria pumila subsp. pumila	Equisetopsida	Setaria	Pale Pigeon-grass
Nymphaea alba	Equisetopsida	Nymphaea	White Water-lily
Thysanotus patersonii	Equisetopsida	Thysanotus	Twining Fringe-lily
Galium migrans	Equisetopsida	Galium	Wandering Bedstraw
Malva preissiana s.s. (white-flowered coastal form)	Equisetopsida	Malva	Coast Hollyhock
Paspalum distichum	Equisetopsida	Paspalum	Water Couch
Podolepis rugata subsp. rugata	Equisetopsida	Podolepis	Pleated Podolepis
Hibbertia sericea var. sericea	Equisetopsida	Hibbertia	Silky Guinea-flower
Convolvulus erubescens	Equisetopsida	Convolvulus	Blushing Bindweed
Pterostylis pusilla	Equisetopsida	Pterostylis	Small Rusty-hood
Brevipalpus californicus	Arachnida	Brevipalpus	
Lasioderma serricorne	Insecta	Lasioderma	Cigarette Beetle
Callosobruchus maculatus	Insecta	Callosobruchus	Cowpea Weevil
Aculus	Arachnida	Aculus	
Naupactus cervinus	Insecta	Naupactus	Fuller's Rose Weevil
Etiella behrii	Insecta	Etiella	Lucerne Seed Web Moth
Colobostoma	Insecta	Colobostoma	

Siphoninus phillyreae	Insecta	Siphoninus	Ash Whitefly
Bruchus pisorum	Insecta	Bruchus	
Hadrobregmus (Megabregmus) australiensis	Insecta	Hadrobregmus	Dampwood Borer
Melanagromyza apii	Insecta	Melanagromyza	
Dirioxa pornia	Insecta	Dirioxa	
Pyemotes herfsi	Arachnida	Pyemotes	
Dermestes (Dermestinus) maculatus	Insecta	Dermestes	Common Hide Beetle
Ethemaia sellata	Insecta	Ethemaia	Greybanded Leaf Weevil
Cosetacus camelliae	Arachnida	Cosetacus	
Phyllotocus rufipennis	Insecta	Phyllotocus	
Gibbium psylloides	Insecta	Gibbium	
Bactrocera (Bactrocera) tryoni	Insecta	Bactrocera	Queensland Fruit Fly
Sitotroga cerealella	Insecta	Sitotroga	Rice Moth
COCCIDAE	Insecta		
Sitophilus granarius	Insecta	Sitophilus	Granary Weevil
Pseudapion aemulum	Insecta	Pseudapion	
Ptinus fur	Insecta	Ptinus	
Steriphus caudatus	Insecta	Steriphus	Spinetailed Weevil
Tetranychus urticae	Arachnida	Tetranychus	
Mogulones larvatus	Insecta	Mogulones	Paterson's Curse Crown Weevil
Zermizinga	Insecta	Zermizinga	
Merophyas divulsana	Insecta	Merophyas	
Sitophilus oryzae	Insecta	Sitophilus	Rice Weevil
Liothrips vaneeckei	Insecta	Liothrips	
Orosius argentatus	Insecta	Orosius	Common Brown Leafhopper
Bruchidius	Insecta	Bruchidius	
Epiphyas postvittana	Insecta	Epiphyas	Light Brown Apple Moth
Steriphus diversipes	Insecta	Steriphus	Spotted Vegetable Weevil
Thrips tabaci	Insecta	Thrips	Onion Thrips
Heterocheira australis	Insecta	Heterocheira	
Aceria tulipae	Arachnida	Aceria	
Phenacoccus graminicola	Insecta	Phenacoccus	Ryegrass Mealybug
Sericesthis harti	Insecta	Sericesthis	Yellowheaded Cockchafer
GELECHIIDAE	Insecta		
Listroderes difficilis	Insecta	Listroderes	Vegetable Weevil
Coccus hesperidum	Insecta	Coccus	Brown Soft Scale
Liparetrus nigrinus	Insecta	Liparetrus	
Dasypodia	Insecta	Dasypodia	
Pseudococcus calceolariae	Insecta	Pseudococcus	Citrophilus Mealybug
Rhinoncus australis	Insecta	Rhinoncus	
Tetranychus ludeni	Arachnida	Tetranychus	
Lindingaspis rossi	Insecta	Lindingaspis	Araucaria Black Scale Insect
Chloroclystis	Insecta	Chloroclystis	
Sericesthis nigrolineata	Insecta	Sericesthis	Dusky Pasture Scarab
Acanthoscelides obtectus	Insecta	Acanthoscelides	Bean Weevil
Cacodacnus planicollis	Insecta	Cacodacnus	
Sternochetus mangiferae	Insecta	Sternochetus	Mango Seed Weevil
Plodia interpunctella	Insecta	Plodia	Snout Moth
Amitermes neogermanus	Insecta	Amitermes	Termite
Criconema (Criconema) mutabile	Chromadorea	Criconema	
Ancita fasciculata	Insecta	Ancita	
Ectomyelois ceratoniae	Insecta	Ectomyelois	
Stylogeocoris biroi	Insecta	Stylogeocoris	Big-eyed Bug
Euproctis edwardsii	Insecta	Euproctis	Mistletoe Browntail Moth
Pseudococcus	Insecta	Pseudococcus	
Haplonyx spencei	Insecta	Haplonyx	
Coptotermes acinaciformis	Insecta	Coptotermes	Subterranean Termite
Blaps polychresta	Insecta	Blaps	
Anilicus xanthomus	Insecta	Anilicus	
Stegobium paniceum	Insecta	Stegobium	Biscuit Beetle
Aculops lycopersici	Arachnida	Aculops	Tomato Russet Mite
Cadra cautella	Insecta	Cadra	Tropical Warehouse Moth
Rhopaea heterodactyla	Insecta	Rhopaea	
Blattisocius tarsalis	Arachnida	Blattisocius	
Thrips imaginis	Insecta	Thrips	Plague Thrips
DERMANYSSIDAE	Arachnida		
Decilaus	Insecta	Decilaus	
Heterotermes ferox	Insecta	Heterotermes	Termite
Corynophyllus	Insecta	Corynophyllus	
Orgyia anartoides	Insecta	Orgyia	Painted Apple Moth
Perapion antiquum	Insecta	Perapion	
Polyphagotarsonemus latus	Arachnida	Polyphagotarsonemus	
Ciampa arietaria	Insecta	Ciampa	Brown Pasture Looper Moth
Camponotus claripes	Insecta	Camponotus	Pale Legged Sugar Ant
Lixus mastersii	Insecta	Lixus	Weed Weevil
Ephestia elutella	Insecta	Ephestia	Tobacco Moth
Mezium affine	Insecta	Mezium	
Camponotus lownei	Insecta	Camponotus	Sugar Ant
Xerula	Agaricomycetes	Xerula	
Stereum hirsutum	Agaricomycetes	Stereum	
Geastrum minimum	Agaricomycetes	Geastrum	
Audouinella hermannii	Florideophyceae	Audouinella	
Waitzia acuminata var. acuminata	Equisetopsida	Waitzia	Orange Immortelle
Callitris preissii	Equisetopsida	Callitris	White Pine
Stenanthemum leucophractum	Equisetopsida	Stenanthemum	White Cryptandra
Xanthoria coomae	Lecanoromycetes	Xanthoria	
Lamprothamnium	Charophyceae	Lamprothamnium	
Crocosmia x crocosmiiflora	Equisetopsida	Crocosmia	Montbretia
Cenchrus macrourus	Equisetopsida	Cenchrus	African Feather Grass
Pimelea	Equisetopsida	Pimelea	Rice Flowers
Pterostylis sanguinea	Equisetopsida	Pterostylis	Blood Greenhood
Ramalina ovalis	Lecanoromycetes	Ramalina	
Dodonaea viscosa subsp. mucronata	Equisetopsida	Dodonaea	Hill Sticky Hopbush
Olearia lirata	Equisetopsida	Olearia	Snowy Daisy-bush
Opuntia leoglossa	Equisetopsida	Opuntia	Lion's Tongue
Gigaspermum repens	Bryopsida	Gigaspermum	Pineapple Moss
Calandrinia calyptrata	Equisetopsida	Calandrinia	Pink Purslane
Ajuga australis	Equisetopsida	Ajuga	Austral Bugle
Calocera guepinioides	Dacrymycetes	Calocera	
Conocybe sonderiana	Agaricomycetes	Conocybe	
Cladia muelleri	Lecanoromycetes	Cladia	
Cenchrus longispinus	Equisetopsida	Cenchrus	Spiny Burr-grass
Dichelachne rara	Equisetopsida	Dichelachne	Common Plume-grass
Lonchura (Munia) castaneothorax	Aves	Lonchura	Chestnut-breasted Munia
Hylacola pyrrhopygia	Aves	Hylacola	Chestnut-rumped Heathwren
Cinclosoma (Cinclosoma) punctatum	Aves	Cinclosoma	Spotted Quail-thrush
Turnix pyrrhothorax	Aves	Turnix	Red-chested Button-quail
Corvus orru	Aves	Corvus	Torresian Crow
Sugomel niger	Aves	Sugomel	Black Honeyeater
Burhinus (Burhinus) grallarius	Aves	Burhinus	Bush Stone-curlew
Geopelia cuneata	Aves	Geopelia	Diamond Dove
Myiagra (Seisura) inquieta	Aves	Myiagra	Restless Flycatcher
Gelochelidon nilotica	Aves	Gelochelidon	Gull-billed Tern
Petroica (Littlera) phoenicea	Aves	Petroica	Flame Robin
Batrachochytrium dendrobatidis	Chytridiomycetes	Batrachochytrium	Chytrid Fungus
Lepista nuda	Agaricomycetes	Lepista	
Stenoptilia zophodactylus	Insecta	Stenoptilia	Plume Moth
Platyptilia celidotus	Insecta	Platyptilia	Plume Moth
Anabaena circinalis	Cyanophyceae	Anabaena	Blue-green Alga
Dinotoperla evansi	Insecta	Dinotoperla	Stonefly
Lasioglossum (Chilalictus) opacicolle	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Ctenonomia) semipolitum	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) cognatum	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) gilesi	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) brunnesetum	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) vitripenne	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Parasphecodes) sulthicum	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) willsi	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) victoriellum	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) sculpturatum	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) repraesentans	Insecta	Lasioglossum	Sweat Bee
Lasioglossum (Chilalictus) pulvitectum	Insecta	Lasioglossum	Sweat Bee

NatureMaps Search Area

Map data is compiled from a variety of sources and hence its accuracy is variable.

Compiled:	22-Apr-2024
Generated at:	www.naturemaps.sa.gov.au
Datum:	Geocentric Datum of Australia, 2020
Projection:	Web Mercator (Auxiliary Sphere)

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0 1: 76,440 3,822 Kms

Government of South Australia
Department for Environment and Water

SPECIES	COMMON NAME	NATIVE	NATIONAL RATING	STATE RATING	NUMBER OF RECORDS
Agaricus xanthodermus		Y			1
Lepiota helveola		Y			1
Alternanthera denticulata	Lesser Joyweed	Y			1
Alternanthera denticulata (NC)	Lesser Joyweed	Y			1
Atriplex semibaccata	Berry Saltbush	Y			13
Atriplex suberecta	Lagoon Saltbush	Y			6
Chenopodium glaucum	Glaucous Goosefoot	?			2
Chenopodium nitrariaceum	Nitre Goosefoot	Y			1
Dysphania cristata	Crested Crumbweed	Y			1
Dysphania pumilio	Small Crumbweed	Y			11
Einadia nutans ssp. nutans	Climbing Saltbush	Y			10
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	Y			15
Maireana aphylla	Cotton-bush	Y			1
Maireana brevifolia	Short-leaf Bluebush	Y			11
Maireana enchylaenoides	Wingless Fissure-plant	Y			9
Ptilotus spathulatus	Pussy-tails	Y			1
Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush	Y			4
Rhagodia parabolica	Mealy Saltbush	Y			2
Salsola australis	Buckbush	Y			6
Sclerolaena muricata var. muricata	Five-spine Bindyi	Y			1
Sclerolaena muricata var. villosa	Five-spine Bindyi	Y		R	2
Suaeda australis	Austral Seablite	Y			1
Calostemma purpureum	Pink Garland-lily	Y			13
Centella asiatica	Asian Centella	Y			1
Lilaeopsis polyantha	Australian Lilaeopsis	Y			1
Lemna disperma	Common Duckweed	Y			1
Spirodela punctata	Thin Duckweed	Y			1
Hydrocotyle laxiflora	Stinking Pennywort	Y			3
Hydrocotyle sp.	Pennywort	Y			1
Hydrocotyle verticillata	Shield Pennywort	Y			3
Arthropodium fimbriatum	Nodding Vanilla-lily	Y			6
Arthropodium strictum	Common Vanilla-lily	Y			13
Laxmannia orientalis	Dwarf Wire-lily	Y			1
Lomandra collina	Sand Mat-rush	Y			2
Lomandra densiflora	Soft Tussock Mat-rush	Y			13
Lomandra effusa	Scented Mat-rush	Y			9
Lomandra fibrata	Mount Lofty Mat-rush	Y			1
Lomandra leucocephala ssp. robusta	Woolly Mat-rush	Y			1
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush	Y			5
Lomandra multiflora ssp. dura	Hard Mat-rush	Y			5
Lomandra nana	Small Mat-rush	Y			7
Lomandra sororia	Sword Mat-rush	Y			3
Thysanotus baueri	Mallee Fringe-lily	Y			7
Bulbine bulbosa	Bulbine-lily	Y			4
Caesia calliantha	Blue Grass-lily	Y			2
Dianella longifolia var. grandis	Pale Flax-lily	Y		R	2
Dianella revoluta var. revoluta	Black-anther Flax-lily	Y			16
Tricoryne tenella	Tufted Yellow Rush-lily	Y			1
Xanthorrhoea semiplana ssp. semiplana	Yacca	Y			1
Asplenium subglandulosum	Blanket Fern	Y			1
Actinobole uliginosum	Flannel Cudweed	Y			2
Blennospora drummondii	Dwarf Button-flower	Y			1
Brachyscome debilis	Weak Daisy	Y			1
Brachyscome lineariloba	Hard-head Daisy	Y			1
Centipeda cunninghamii	Common Sneezeweed	Y			3
Centipeda cunninghamii (NC)	Common Sneezeweed	Y			1
Chrysocephalum apiculatum (NC)	Common Everlasting	Y			2
Chrysocephalum semipapposum	Clustered Everlasting	Y			1
Cotula australis	Common Cotula	Y			3
Eclipta platyglossa ssp. platyglossa	Yellow Twin-heads	Y			2
Euchiton involucratus (NC)	Star Cudweed	Y			1
Helichrysum leucopsideum	Satin Everlasting	Y			3
Leiocarpa websteri	Narrow Plover-daisy	Y			1
Leptorhynchos tetrachaetus	Little Buttons	Y			1
Minuria leptophylla	Minnie Daisy	Y			1
Olearia ramulosa	Twiggy Daisy-bush	Y			9
Picris sp.	Picris	Y			1
Podolepis rugata ssp. glabrata	Pleated Podolepis	Y			1
Podolepis rugata var. rugata (NC)	Pleated Copper-wire Daisy	Y			1
Pseudognaphalium luteoalbum	Jersey Cudweed	?			5
Rhodanthe pygmaea	Pigmy Daisy	Y			1
Senecio behrianus	Behr's Groundsel	Y	EN	E	1
Senecio pinnatifolius (NC)	Variable Groundsel	Y			1
Senecio pinnatifolius var. lanceolatus	Variable Groundsel	Y			1
Senecio quadridentatus	Cotton Groundsel	Y			3
Senecio runcinifolius	Thistle-leaf Groundsel	Y			1
Senecio spanomerus	Native Groundsel	Y			1
Sigesbeckia orientalis	Oriental Sigesbeckia	Y			5
Sonchus hydrophilus	Native Sow-thistle	Y			2
Sonchus sp.	Sow-thistle	Y			6
Vittadinia australasica var. australasica	Sticky New Holland Daisy	Y			5
Vittadinia blackii	Narrow-leaf New Holland Daisy	Y			17

Vittadinia cervicularis var. cervicularis	Waisted New Holland Daisy	Y		3
Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy	Y		9
Vittadinia gracilis	Woolly New Holland Daisy	Y		10
Vittadinia megacephala	Giant New Holland Daisy	Y		1
Vittadinia sp.	New Holland Daisy	Y		2
Heliotropium europaeum	Common Heliotrope	?		8
Rorippa sp.	Watercress/Bitter-cress	Y		1
Lobelia anceps	Angled Lobelia	Y		3
Wahlenbergia luteola	Yellow-wash Bluebell	Y		1
Wahlenbergia stricta ssp. stricta	Tall Bluebell	Y		2
Spergularia marina	Salt Sand-spurrey	Y		3
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush	Y		2
Allocasuarina verticillata	Drooping Sheoak	Y		9
Casuarinaceae sp.	Sheoak Family	Y		10
Stackhousia monogyna	Creamy Candles	Y		1
Stackhousia subterranea	Creamy Candles	Y		1
Burchardia umbellata	Milkmaids	Y		1
Wurmbea dioica ssp. brevifolia	Early Nancy	Y		2
Wurmbea dioica ssp. dioica	Early Nancy	Y		1
Wurmbea dioica ssp. dioica (NC)	Early Nancy	Y		1
Calystegia sepium	Large Bindweed	Y		1
Calystegia sepium (NC)	Large Bindweed	Y		1
Convolvulus erubescens (NC)	Australian Bindweed	Y		1
Convolvulus remotus	Grassy Bindweed	Y		9
Cressa australis	Rosinweed	Y		3
Dichondra repens	Kidney Weed	Y		4
Crassula colligata ssp. lamprosperma		Y		1
Crassula colorata var. acuminata	Dense Crassula	Y		1
Crassula decumbens var. decumbens	Spreading Crassula	Y		1
Crassula helmsii	Swamp Crassula	Y		1
Crassula sieberiana	Sieber's Crassula	Y	E	1
Crassula sieberiana ssp. tetramera (NC)	Australian Stonecrop	Y		3
Callitris gracilis	Southern Cypress Pine	Y		12
Callitris sp.	Native Pine	Y		1
Bolboschoenus caldwellii	Salt Club-rush	Y		7
Carex appressa	Tall Sedge	Y		1
Carex bichenoviana	Notched Sedge	Y		9
Carex breviculmis	Short-stem Sedge	Y		2
Carex gaudichaudiana	Fen Sedge	Y		2
Cladium procerum	Leafy Twig-rush	Y	R	2
Cyperus gunnii ssp. gunnii	Flecked Flat-sedge	Y		3
Cyperus gymnocaulos	Spiny Flat-sedge	Y		7
Cyperus vaginatus	Stiff Flat-sedge	Y		13
Eleocharis acuta	Common Spike-rush	Y		3
Eleocharis pusilla	Small Spike-rush	Y		3
Ficinia nodosa	Knobby Club-rush	Y		2
Gahnia trifida	Cutting Grass	Y		3
Isolepis cernua	Nodding Club-rush	Y		5
Isolepis inundata	Swamp Club-rush	Y		1
Isolepis platycarpa	Flat-fruit Club-rush	Y		1
Isolepis trachysperma	Grassy Club-rush	?		3
Lepidosperma carphoides	Black Rapier-sedge	Y		2
Lepidosperma curtisiae	Little Sword-sedge	Y		7
Machaerina arthrophylla	Swamp Twig-rush	Y		2
Machaerina juncea	Bare Twig-rush	Y		1
Schoenoplectus pungens	Spiky Club-rush	Y		4
Schoenoplectus tabernaemontani	River Club-rush	Y		1
Schoenus apogon	Common Bog-rush	Y		3
Schoenus nitens	Shiny Bog-rush	Y		2
Pteridium esculentum ssp. esculentum	Bracken Fern	Y		1
Hibbertia australis	Stalked Guinea-flower	Y		2
Hibbertia australis (NC)	Stalked Guinea-flower	Y		1
Hibbertia sericea	Silky Guinea-flower	Y		2
Hibbertia sericea var. sericea (NC)	Silky Guinea-flower	Y		1
Drosera glanduligera	Scarlet Sundew	Y		2
Drosera peltata (NC)	Pale Sundew	Y		1
Drosera peltata s.str.	Swamp Sundew	Y		3
Drosera pygmaea	Tiny Sundew	Y		2
Acrotriche fasciculiflora	Mount Lofty Ground-berry	Y		1
Acrotriche serrulata	Cushion Ground-berry	Y		2
Epacris impressa	Common Heath	Y		1
Leucopogon virgatus var. virgatus	Common Beard-heath	Y		1
Styphelia humifusa	Cranberry Heath	Y		5
Adriana quadripartita	Coast Bitter-bush	Y		5
Chamaesyce drummondii (NC)	Caustic Weed	Y		4
Euphorbia dallachyana	Caustic Weed	Y		5
Acacia acinacea	Wreath Wattle	Y		22
Acacia cupularis	Cup Wattle	Y		2
Acacia cyclops	Western Coastal Wattle	Y		1
Acacia iteaphylla	Flinders Ranges Wattle	Y	R	5
Acacia ligulata	Umbrella Bush	Y		18
Acacia longifolia ssp.	Sallow Wattle	Y		7
Acacia melanoxylon	Blackwood	Y		2

Acacia paradoxa	Kangaroo Thorn	Y		12
Acacia pendula	Weeping Myall	Y	V	2
Acacia pycnantha	Golden Wattle	Y		17
Acacia salicina	Willow Wattle	Y		10
Acacia sp.	Wattle	Y		3
Acacia verniciflua	Varnish Wattle	Y		3
Acacia victoriae ssp. victoriae	Elegant Wattle	Y		1
Cullen australasicum	Tall Scurf-pea	Y		5
Cullen parvum	Small Scurf-pea	Y	V	5
Daviesia ulicifolia ssp. incarnata	Gorse Bitter-pea	Y		2
Dillwynia hispida	Red Parrot-pea	Y		2
Eutaxia microphylla	Common Eutaxia	Y		2
Goodia medicaginea	Western Golden-tip	Y		2
Hardenbergia violacea	Native Lilac	Y		7
Kennedia prostrata	Scarlet Runner	Y		4
Lotus australis	Austral Trefoil	Y		2
Paraserianthes lophantha	Cape Leeuwin Wattle	Y		1
Pultenaea daphnoides	Large-leaf Bush Pea	Y		1
Pultenaea largiflorens	Twiggy Bush-pea	Y		1
Senna artemisioides ssp. filifolia	Fine-leaf Desert Senna	Y		5
Senna artemisioides ssp. petiolaris		Y		2
Senna artemisioides ssp. petiolaris (NC)	Flat-stalk Senna	Y		1
Senna artemisioides ssp. X coriacea	Broad-leaf Desert Senna	Y		5
Unidentified sp.		Y		3
Erodium crinitum	Blue Heron's-bill	Y		4
Erodium sp.	Heron's-bill/Crowfoot	Y		12
Geranium retrorsum	Grassland Geranium	Y		3
Geranium solanderi	Austral Geranium	Y		1
Geranium sp.	Geranium	Y		7
Pelargonium littorale	Native Pelargonium	Y		1
Brunonia australis	Blue Pincushion	Y		1
Goodenia albiflora	White Goodenia	Y		4
Goodenia amplexans	Clasping Goodenia	Y		1
Goodenia pinnatifida	Cut-leaf Goodenia	Y		8
Goodenia willisiana	Silver Goodenia	Y		2
Scaevola albida	Pale Fanflower	Y		9
Gramineae sp.	Grass Family	Y		1
Gonocarpus elatus	Hill Raspwort	Y		6
Gonocarpus tetragynus	Small-leaf Raspwort	Y		6
Haloragis acutangula f.	Smooth Raspwort	Y		1
Haloragis aspera	Rough Raspwort	Y		13
Myriophyllum verrucosum	Red Milfoil	Y		7
Pauridia glabella var. glabella	Tiny Star	Y		1
Juncus aridicola	Inland Rush	Y		1
Juncus bufonius	Toad Rush	Y		4
Juncus caespiticius	Grassy Rush	Y		2
Juncus flavidus	Yellow Rush	Y		1
Juncus kraussii	Sea Rush	Y		8
Juncus pallidus	Pale Rush	Y		4
Juncus pauciflorus	Loose-flower Rush	Y		1
Juncus planifolius	Broad-leaf Rush	Y		2
Juncus radula	Hoary Rush	Y	V	1
Juncus sarophorus		Y		1
Juncus sp.	Rush	Y		1
Juncus subsecundus	Finger Rush	Y		6
Triglochin striata	Streaked Arrowgrass	Y		1
Lycopus australis	Australian Gipsywort	Y		1
Prostanthera behriana	Downy Mintbush	Y		1
Teucrium racemosum	Grey Germander	Y		5
Cassytha pubescens	Downy Dodder-laurel	Y		1
Linum marginale	Native Flax	Y		2
Phyllangium divergens	Wiry Mitrewort	Y		1
Amyema miquelii	Box Mistletoe	Y		3
Amyema preissii	Wire-leaf Mistletoe	Y		1
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe	Y		8
Lythrum hyssopifolia	Lesser Loosestrife	Y		8
Hibiscus sp.	Hibiscus	Y		1
Malva preissiana	Australian Hollyhock	Y		1
Malva preissiana (NC)	Australian Hollyhock	Y		1
Sida corrugata var. angustifolia	Grassland Sida	Y		4
Sida intricata	Twiggy Sida	Y		1
Marsilea drummondii (NC)	Common Nardoo	Y		1
Calandrinia eremaea	Dryland Purslane	Y		1
Callistemon rugulosus	Scarlet Bottlebrush	Y		2
Callistemon sieberi	River Bottlebrush	Y		7
Calytrix tetragona	Common Fringe-myrtle	Y		4
Eucalyptus camaldulensis ssp.	River Red Gum	Y		1
Eucalyptus camaldulensis ssp. camaldulensis	River Red Gum	Y		7
Eucalyptus camaldulensis var. camaldulensis (NC)	River Red Gum	Y		3
Eucalyptus cladocalyx ssp. cladocalyx	Sugar Gum	Y		4
Eucalyptus cosmophylla	Cup Gum	Y		1
Eucalyptus dumosa	White Mallee	Y		18
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum	Y		4

Eucalyptus microcarpa	Grey Box	Y		5
Eucalyptus odorata	Peppermint Box	Y		3
Eucalyptus odorata (NC)	Peppermint Box	Y		1
Eucalyptus porosa	Mallee Box	Y		22
Eucalyptus rugosa	Coastal White Mallee	Y		1
Eucalyptus socialis (NC)	Beaked Red Mallee	Y		2
Eucalyptus socialis ssp. socialis	Beaked Red Mallee	Y		13
Eucalyptus sp.		Y		6
Leptospermum continentale	Prickly Tea-tree	Y		1
Leptospermum myrsinoides	Heath Tea-tree	Y		1
Melaleuca brevifolia	Short-leaf Honey-myrtle	Y		3
Melaleuca lanceolata	Dryland Tea-tree	Y		1
Melaleuca sp.	Tea-tree	Y		2
Nitraria billardierei	Nitre-bush	Y		1
Boerhavia dominii	Tar-vine	Y		8
Boerhavia dominii (NC)	Tar-vine	Y		6
Epilobium billardierianum ssp. billardierianum	Robust Willow-herb	Y		5
Epilobium billardierianum ssp. cinereum	Variable Willow-herb	Y		3
Epilobium hirtigerum	Hairy Willow-herb	Y		4
Epilobium pallidiflorum	Showy Willow-herb	Y		1
Caladenia cardiochila	Heart-lip Spider-orchid	Y		2
Caladenia latifolia	Pink Caladenia	Y		1
Caladenia reticulata	Veined Spider-orchid	Y	R	1
Caladenia tentaculata	King Spider-orchid	Y		1
Glossodia major	Purple Cockatoo	Y		1
Microtis arenaria	Notched Onion-orchid	Y		1
Microtis unifolia complex	Onion-orchid	Y		1
Prasophyllum occidentale	Plains Leek-orchid	Y		1
Prasophyllum odoratum	Scented Leek-orchid	Y		2
Pterostylis mutica	Midget Greenhood	Y		1
Pterostylis robusta	Large Shell-orchid	Y		2
Thelymitra antennifera	Lemon Sun-orchid	Y		1
Thelymitra pauciflora	Slender Sun-orchid	Y		1
Thelymitra pauciflora (NC)	Slender Sun-orchid	Y		1
Oxalis perennans	Native Sorrel	Y		4
Oxalis perennans (NC)	Native Sorrel	Y		4
Oxalis perennans/exilis	Native Oxalis	Y		3
Bursaria spinosa ssp. spinosa	Sweet Bursaria	Y		12
Pittosporum angustifolium	Native Apricot	Y		18
Gratiola peruviana	Austral Brooklime	Y		2
Limosella australis	Australian Mudwort	Y		2
Agrostis avenacea var. avenacea (NC)	Common Blown-grass	Y		1
Aristida australis		Y	R	1
Aristida behriana	Brush Wire-grass	Y		19
Aristida holathera var. holathera	Tall Kerosene Grass	Y		2
Aristida strigosa	Rough Three-awn	Y		1
Austrostipa acrociliata	Graceful Spear-grass	Y		1
Austrostipa blackii	Crested Spear-grass	Y		7
Austrostipa curticoma	Short-crest Spear-grass	Y		10
Austrostipa drummondii	Cottony Spear-grass	Y		11
Austrostipa elegantissima	Feather Spear-grass	Y		14
Austrostipa eremophila	Rusty Spear-grass	Y		2
Austrostipa flavescens	Coast Spear-grass	Y		9
Austrostipa hemipogon	Half-beard Spear-grass	Y		1
Austrostipa mollis	Soft Spear-grass	Y		2
Austrostipa multispiculis	Many-flowered Spear-grass	Y	R	8
Austrostipa nitida	Balcarra Spear-grass	Y		4
Austrostipa nodosa	Tall Spear-grass	Y		27
Austrostipa platychaeta	Flat-awn Spear-grass	Y		9
Austrostipa scabra group	Falcate-awn Spear-grass	Y		1
Austrostipa scabra ssp. falcata	Slender Spear-grass	Y		5
Austrostipa scabra ssp. scabra	Rough Spear-grass	Y		1
Austrostipa semibarbata	Fibrous Spear-grass	Y		1
Austrostipa setacea	Corkscrew Spear-grass	Y		2
Austrostipa sp.	Spear-grass	Y		9
Bothriochloa macra	Red-leg Grass	Y	R	2
Bromus arenarius	Sand Brome	Y		1
Chloris truncata	Windmill Grass	Y		20
Cymbopogon ambiguus	Lemon-grass	Y		9
Deyeuxia densa	Heath Bent-grass	Y	R	1
Deyeuxia quadriseta	Reed Bent-grass	Y		1
Dichanthium sericeum ssp.	Silky Blue-grass	Y		1
Dichanthium sericeum ssp. sericeum	Silky Blue-grass	Y		13
Digitaria brownii	Cotton Panic-grass	Y		2
Elymus scaber var. scaber (NC)	Native Wheat-grass	Y		3
Enneapogon nigricans	Black-head Grass	Y		13
Eragrostis brownii	Bentham's Love-grass	Y		2
Eragrostis dielsii	Mulka	Y		1
Eragrostis parviflora	Weeping Love-grass	Y		3
Eriochloa australiensis	Australian Cupgrass	Y		2
Eriochloa pseudoacrotricha	Perennial Cupgrass	Y		4
Hemarthria uncinata var. uncinata	Mat Grass	Y		1
Imperata cylindrica	Blady Grass	Y		1

Lachnagrostis aemula	Blown-grass	Y		1
Lachnagrostis filiformis	Common Blown-grass	Y		2
Neurachne alopecuroidea	Fox-tail Mulga-grass	Y		2
Panicum effusum var. effusum	Hairy Panic	Y		5
Phragmites australis	Common Reed	Y		6
Poa crassicaudex	Thick-stem Tussock-grass	Y		2
Poa labillardieri var. labillardieri	Common Tussock-grass	Y		4
Poa poiformis var. poiformis	Coast Tussock-grass	Y		4
Poa sp.	Meadow-grass/Tussock-grass	Y		1
Puccinellia stricta	Australian Saltmarsh-grass	Y		2
Puccinellia stricta (NC)	Australian Saltmarsh-grass	Y		1
Rytidosperma caespitosum	Common Wallaby-grass	Y		4
Rytidosperma caespitosum (NC)	Common Wallaby-grass	Y		5
Rytidosperma fulvum	Leafy Wallaby-grass	Y		2
Rytidosperma geniculatum	Kneed Wallaby-grass	Y		1
Rytidosperma pilosum	Velvet Wallaby-grass	Y		1
Rytidosperma racemosum var. racemosum	Slender Wallaby-grass	Y		3
Rytidosperma setaceum	Small-flower Wallaby-grass	Y		1
Rytidosperma sp.	Wallaby-grass	Y		12
Rytidosperma tenuius	Short-awn Wallaby-grass	Y	R	1
Setaria constricta	Knotty-butt Paspalidium	Y		7
Setaria jubiflora	Warrego Summer-grass	Y		3
Themeda triandra	Kangaroo Grass	Y		10
Walwhalleya proluta	Rigid Panic	Y		10
Walwhalleya proluta (NC)	Rigid Panic	Y		1
Comesperma volubile	Love Creeper	Y		6
Duma florulenta	Lignum	Y		1
Persicaria decipiens	Slender Knotweed	Y		8
Persicaria decipiens (NC)	Slender Knotweed	Y		1
Persicaria prostrata	Creeping Knotweed	Y		2
Polygonum plebeium	Small Knotweed	Y		2
Rumex sp.	Dock	Y		1
Portulaca oleracea	Common Purslane	Y		1
Potamogeton crispus	Curly Pondweed	Y		2
Potamogeton ochreatus	Blunt Pondweed	Y	R	3
Samolus repens	Creeping Brookweed	Y		1
Banksia marginata	Silver Banksia	Y		1
Grevillea lavandulacea ssp. lavandulacea	Spider-flower	Y		4
Grevillea lavandulacea var. lavandulacea (NC)	Spider-flower	Y		1
Hakea carinata	Erect Hakea	Y		5
Cheilanthes austrotenuifolia	Annual Rock-fern	Y		2
Clematis microphylla	Old Man's Beard	Y		3
Clematis microphylla var. microphylla (NC)	Old Man's Beard	Y		3
Centrolepis aristata	Pointed Centrolepis	Y		2
Hypolaena fastigiata	Tassel Rope-rush	Y		1
Cryptandra tomentosa	Heath Cryptandra	Y		2
Spyridium parvifolium	Dusty Miller	Y		1
Trymalium wayi	Grey Trymalium	Y		1
Acaena echinata	Sheep's Burr	Y		5
Acaena ovina	Downy Sheep's Burr	Y		2
Asperula conferta	Common Woodruff	Y		1
Galium gaudichaudii ssp. gaudichaudii	Rough Bedstraw	Y		1
Galium migrans (NC)	Loose Bedstraw	Y		1
Galium migrans ssp. migrans	Loose Bedstraw	Y		1
Opercularia turpis	Twiggy Stinkweed	Y		2
Correa glabra var. turnbullii	Smooth Correa	Y		1
Leionema hillebrandii	Mount Lofty Phebalium	Y	R	1
Exocarpos cupressiformis	Native Cherry	Y		1
Exocarpos sparteus	Slender Cherry	Y		5
Dodonaea viscosa ssp. angustissima	Narrow-leaf Hop-bush	Y		1
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush	Y		19
Eremophila deserti	Turkey-bush	Y		21
Eremophila longifolia	Weeping Emubush	Y		2
Myoporum insulare	Common Boobialla	Y		2
Myoporum petiolatum	Sticky Boobialla	Y		5
Myoporum platycarpum ssp. perbellum	Mallee Sandalwood	Y		6
Myoporum platycarpum ssp. platycarpum	False Sandalwood	Y		2
Myoporum viscosum (NC)	Sticky Boobialla	Y		2
Anthocercis angustifolia	Narrow-leaf Ray-flower	Y	R	4
Nicotiana maritima	Coast Tobacco	Y		2
Pimelea flava ssp. dichotoma	Diosma Riceflower	Y		1
Pimelea glauca	Smooth Riceflower	Y		4
Pimelea humilis	Low Riceflower	Y		4
Pimelea micrantha	Silky Riceflower	Y		8
Pimelea stricta	Erect Riceflower	Y		1
Typha domingensis	Narrow-leaf Bulrush	Y		6

SPECIES	COMMON NAME	NATIVE	NATIONAL RATING	STATE RATING	NUMBER OF RECORDS
Pseudophryne bibronii	Brown Toadlet	Y		R	6
Acanthiza lineata	Striated Thornbill	Y	ssp		10
Actitis hypoleucos	Common Sandpiper	Y		R	4
Anhinga novaehollandiae novaehollandiae	Australasian Darter	Y		R	28
Anthochaera chrysoptera	Little Wattlebird	Y	ssp		32
Anthochaera phrygia	Regent Honeyeater	Y	CR	E	3
Aphelocephala leucopsis leucopsis	Southern Whiteface	Y	sp		2
Ardea intermedia plumifera	Plumed Egret	Y		R	3
Biziura lobata menziesi	Musk Duck	Y		R	101
Botaurus poiciloptilus	Australasian Bittern	Y	EN	E	19
Bubulcus ibis coromandus	Eastern Cattle Egret	Y		R	31
Calidris acuminata	Sharp-tailed Sandpiper	Y	VU		23
Calidris ferruginea	Curlew Sandpiper	Y	CR	E	3
Calidris melanotos	Pectoral Sandpiper	Y		R	22
Calidris pugnax	Ruff	Y		R	3
Calidris subminuta	Long-toed Stint	Y		R	26
Cereopsis novaehollandiae novaehollandiae	Cape Barren Goose	Y		R	10
Cladorhynchus leucocephalus	Banded Stilt	Y		V	25
Climacteris affinis	White-browed Treecreeper	Y		R	1
Coracina papuensis robusta	White-bellied Cuckooshrike	Y		R	5
Corcorax melanorhamphos	White-winged Chough	Y		R	3
Corcorax melanorhamphos melanorhamphos	White-winged Chough (MM, SE)	Y		SP	1
Coturnix ypsilophora australis	Brown Quail	Y		V	3
Egretta garzetta nigripes	Little Egret	Y		R	48
Egretta sacra sacra	Pacific Reef Heron	Y		R	1
Falco hypoleucos	Grey Falcon	Y	VU	R	1
Falco peregrinus macropus	Peregrine Falcon	Y		R	58
Falco subniger	Black Falcon	Y		R	18
Falcunculus frontatus frontatus	Eastern Shriketit	Y		R	17
Gallinago hardwickii	Latham's Snipe	Y	VU	R	2
Gerygone olivacea olivacea	White-throated Gerygone	Y		R	3
Haematopus longirostris	Pied Oystercatcher	Y		R	1
Haliaeetus leucogaster	White-bellied Sea Eagle	Y		E	8
Hieraaetus morphnoides	Little Eagle	Y		V	11
Hirundapus caudacutus caudacutus	White-throated Needletail	Y	sp	V	14
Hylacola pyrrhopygia	Chestnut-rumped Heathwren	Y	ssp	ssp	17
Hylacola pyrrhopygia parkeri	Chestnut-rumped Heathwren (Mount Lofty Ranges)	Y	EN	E	112
Lewin pectoralis pectoralis	Lewin's Rail	Y		V	1
Limosa limosa melanuroides	Black-tailed Godwit	Y	sp	R	1
Lophochroa leadbeateri leadbeateri	Major Mitchell's Cockatoo (LNE, MM)	Y	EN	SP	2
Lophoictinia isura	Square-tailed Kite	Y		E	4
Manorina flavigula	Yellow-throated Miner	Y	ssp	ssp	3
Melanodryas cucullata cucullata	Hooded Robin (YP, MN, AP, MLR, MM, SE)	Y	EN	R	1
Melithreptus brevirostris	Brown-headed Honeyeater	Y	ssp		23
Melithreptus gularis	Black-chinned Honeyeater	Y		ssp	42
Microeca fascinans	Jacky Winter	Y		ssp	1
Myiagra inquieta	Restless Flycatcher	Y		R	9
Neophema chrysostoma	Blue-winged Parrot	Y	VU	V	1
Neophema elegans elegans	Elegant Parrot	Y		R	5
Northiella haematogaster (NC)	Bluebonnet (Eastern and Naretha)	Y		ssp	3
Oriolus sagittatus sagittatus	Olive-backed Oriole	Y		R	8
Oxyura australis	Blue-billed Duck	Y		R	6
Pachycephala inornata	Gilbert's Whistler	Y		R	4
Parvipsitta pusilla	Little Lorikeet	Y		E	3
Petroica boodang boodang	Scarlet Robin	Y		R	39
Petroica phoenicea	Flame Robin	Y		V	1
Platycercus elegans	Crimson Rosella	Y	ssp		1453
Plegadis falcinellus	Glossy Ibis	Y		R	10
Pluvialis fulva	Pacific Golden Plover	Y		R	1
Podiceps cristatus australis	Great Crested Grebe	Y		R	8
Rostratula australis	Australian Painted-snipe	Y	EN	E	12
Spatula rhynchotis	Australasian Shoveler	Y		R	35
Stagonopleura guttata	Diamond Firetail	Y	VU	V	2
Sternula nereis nereis	Fairy Tern	Y	VU	E	2
Stictonetta naevosa	Freckled Duck	Y		V	13
Strepera versicolor	Grey Currawong	Y		ssp	36
Tringa glareola	Wood Sandpiper	Y		R	13
Tringa nebularia	Common Greenshank	Y	EN		36
Turnix varius varius	Painted Buttonquail	Y		R	21
Xenus cinereus	Terek Sandpiper	Y	VU	R	1
Zanda funerea whiteae	Yellow-tailed Black Cockatoo	Y		V	288
Zapornia tabuensis	Spotless Crake	Y		R	9
Zoothera lunulata halmaturina	South Australian Bassian Thrush (southern FR, MLR, KI)	Y	EN	SP	5
Antechinus flavipes	Yellow-footed Antechinus	Y		V	6
Isoodon obesulus obesulus	Southern Brown Bandicoot (SA mainland and KI)	Y	EN	V	7
Phascogale calura	Red-tailed Phascogale	Y	VU	E	1
Pteropus poliocephalus	Grey-headed Flying-fox	Y	VU	R	9182
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat	Y		R	1
Tachyglossus aculeatus	Short-beaked Echidna	Y	ssp	ssp	18
Trichosurus vulpecula	Common Brushtail Possum	Y		R	21
Aprasia pseudopulchella	Flinders Worm-lizard	Y	VU		1
Egernia cunninghami	Cunningham's Skink	Y		E	48
Emydura macquarii	Macquarie River Turtle	Y		V	2
Eulamprus tympanum	Southern Water Skink	Y		R	2

SPECIES	COMMON NAME	NATIVE	NATIONAL RATING	STATE RATING	NUMBER OF RECORDS
Galaxias brevipinnis	Climbing Galaxias	Y			4
Galaxias maculatus	Common Galaxias	Y			4
Galaxias olidus (revised)	Mountain Galaxias	Y			10
Hypseleotris spp. (complex)	n/a	Y			2
Melanotaenia fluviatilis	Murray Rainbowfish	Y			2
Philypnodon grandiceps	Big-headed Gudgeon	Y			30
Philypnodon macrostomus	Dwarf Flathead Gudgeon	Y			22
Tandanus tandanus	Freshwater Catfish	Y			5
Crinia signifera	Common Froglet	Y			386
Limnodynastes dumerilii	Banjo Frog	Y			118
Limnodynastes tasmaniensis	Spotted Marsh Frog	Y			156
Litoria callicelis	South Australia Tree Frog	Y			30
Litoria peronii	Peron's Tree Frog	Y			5
Pseudophryne bibronii	Brown Toadlet	Y		R	3
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Y			1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Y			11
Acanthiza pusilla samueli	Brown Thornbill (MLR)	Y			2
Acanthorhynchus tenuirostris halmaturinus	Eastern Spinebill (KI, MLR, southern FR)	Y			27
Accipiter cirrocephalus cirrocephalus	Collared Sparrowhawk	Y			27
Accipiter fasciatus fasciatus	Brown Goshawk	Y			21
Acrocephalus australis australis	Australian Reed Warbler	Y			168
Alisterus scapularis	Australian King-Parrot	Y			1
Anas castanea	Chestnut Teal	Y			36
Anas gracilis gracilis	Grey Teal	Y			38
Anas superciliosa	Pacific Black Duck	Y			161
Anas superciliosa superciliosa	Pacific Black Duck	Y			5
Anas superciliosa x platyrhynchos	Pacific Black Duck x Mallard hybrid	Y			161
Anhinga novaehollandiae novaehollandiae	Australasian Darter	Y		R	2
Anthochaera carunculata	Red Wattlebird	Y			223
Anthochaera carunculata woodwardi	Red Wattlebird (MLR, AP, YP, EP, far west, Yellabinna)	Y			4
Anthochaera chrysoptera chrysoptera	Little Wattlebird (mainland SA)	Y			151
Anthus australis	Australian Pipit	Y			2
Aphrodroma brevirostris	Kerguelen Petrel	Y			1
Apus pacificus pacificus	Pacific Swift	Y			5
Aquila audax audax	Wedge-tailed Eagle	Y			1
Ardea alba modesta	Great Egret	Y			41
Ardea intermedia plumifera	Plumed Egret	Y		R	2
Ardea pacifica	White-necked Heron	Y			2
Ardenna tenuirostris	Short-tailed Shearwater	Y			2
Artamus cyanopterus	Dusky Woodswallow	Y			22
Aythya australis	Hardhead	Y			62
Biziura lobata menziesi	Musk Duck	Y		R	15
Botaurus poiciloptilus	Australasian Bittern	Y	EN	E	1
Bubulcus ibis coromandus	Eastern Cattle Egret	Y		R	2
Cacatua galerita	Sulphur-crested Cockatoo	Y			120
Cacatua sanguinea gymnopis	Little Corella	Y			22
Cacatua tenuirostris	Long-billed Corella	Y			12
Cacomantis flabelliformis flabelliformis	Fan-tailed Cuckoo	Y			26
Cacomantis pallidus	Pallid Cuckoo	Y			4
Caligavis chrysops samueli	Yellow-faced Honeyeater (MLR, southern FR)	Y			10
Cereopsis novaehollandiae novaehollandiae	Cape Barren Goose	Y		R	2
Chalcites basalis	Horsfield's Bronze Cuckoo	Y			18
Chenonetta jubata	Maned Duck	Y			115
Chlidonias hybrida javanicus	Whiskered Tern	Y			1
Chroicocephalus novaehollandiae novaehollandiae	Silver Gull	Y			90
Cincloramphus cruralis	Brown Songlark	Y			1
Cincloramphus mathewsi	Rufous Songlark	Y			2
Colluricincla harmonica	Grey Shrikethrush	Y			114
Coracina novaehollandiae	Black-faced Cuckooshrike	Y			176
Corvus mellori	Little Raven	Y			196
Coturnix pectoralis	Stubble Quail	Y			1
Cygnus atratus	Black Swan	Y			33
Dacelo novaeguineae novaeguineae	Laughing Kookaburra	Y			77
Dicaeum hirundinaceum hirundinaceum	Mistletoebird	Y			28
Egretta novaehollandiae	White-faced Heron	Y			192
Elanus axillaris	Black-shouldered Kite	Y			52
Elseyornis melanops	Black-fronted Dotterel	Y			5
Eolophus roseicapilla	Galah	Y			175
Eolophus roseicapilla albiceps	Galah (most of SA)	Y			3
Epthianura albifrons	White-fronted Chat	Y			1
Falco berigora berigora	Brown Falcon	Y			3
Falco cenchroides cenchroides	Nankeen Kestrel	Y			31
Falco longipennis murchisonianus	Australian Hobby	Y			27
Falco subniger	Black Falcon	Y		R	1
Falcunculus frontatus frontatus	Eastern Shriketit	Y		R	4
Fulica atra australis	Eurasian Coot	Y			102
Gallinula tenebrosa tenebrosa	Dusky Moorhen	Y			209
Gallirallus philippensis mellori	Buff-banded Rail	Y			13
Gavicalis virescens	Singing Honeyeater	Y			2
Geopelia placida placida	Peaceful Dove	Y			19
Glossopsitta concinna	Musk Lorikeet	Y			171
Grallina cyanoleuca cyanoleuca	Magpielark	Y			233
Gymnorhina tibicen	Australian Magpie	Y			218

Gymnorhina tibicen tyrannica	White-backed Magpie (SE)	Y			5
Haliastur sphenurus	Whistling Kite	Y			2
Hieraaetus morphnoides	Little Eagle	Y		V	2
Himantopus leucocephalus	Pied Stilt	Y			3
Hirundo neoxena neoxena	Welcome Swallow	Y			223
Hydroprogne caspia	Caspian Tern	Y			2
Hylacola pyrrhopygia parkeri	Chestnut-rumped Heathwren (Mount Lofty Ranges)	Y	EN	E	1
Lalage tricolor	White-winged Triller	Y			1
Malurus cyaneus leggei	Superb Fairywren (Mainland SA)	Y			95
Manorina melanocephala	Noisy Miner	Y			161
Melithreptus brevirostris	Brown-headed Honeyeater	Y	ssp		2
Melithreptus lunatus	White-naped Honeyeater	Y			4
Melopsittacus undulatus	Budgerigar	Y			2
Microcarbo melanoleucos melanoleucos	Little Pied Cormorant	Y			191
Neochmia temporalis temporalis	Red-browed Finch	Y			43
Ninox boobook	Australian Boobook	Y			5
Nycticorax caledonicus australasiae	Nankeen Night Heron	Y			14
Nymphicus hollandicus	Cockatiel	Y			4
Ocyphaps lophotes lophotes	Crested Pigeon	Y			202
Oriolus sagittatus sagittatus	Olive-backed Oriole	Y		R	2
Oxyura australis	Blue-billed Duck	Y		R	1
Pachycephala fuliginosa fuliginosa	Western Whistler	Y			7
Pachycephala rufiventris rufiventris	Rufous Whistler	Y			4
Pardalotus punctatus	Spotted Pardalote	Y			45
Pardalotus striatus substriatus	Striated Pardalote	Y			95
Parvipsitta porphyrocephala	Purple-crowned Lorikeet	Y			122
Pelecanus conspicillatus	Australian Pelican	Y			10
Petrochelidon ariel	Fairy Martin	Y			16
Petrochelidon nigricans	Tree Martin	Y			107
Petroica boodang boodang	Scarlet Robin	Y		R	1
Petroica goodenovii	Red-capped Robin	Y			1
Phalacrocorax carbo	Great Cormorant	Y			17
Phalacrocorax sulcirostris	Little Black Cormorant	Y			97
Phalacrocorax varius hypoleucos	Australian Pied Cormorant	Y			1
Phaps chalcoptera	Common Bronzewing	Y			20
Phylidonyris novaehollandiae novaehollandiae	New Holland Honeyeater (mainland SA)	Y			209
Phylidonyris pyrrhopterus halmaturinus	Crescent Honeyeater (KI and MLR)	Y			5
Platalea regia	Royal Spoonbill	Y			4
Platycercus elegans	Crimson Rosella	Y	ssp		146
Platycercus elegans fleurieuensis & elegans subadelaidae	Adelaide Rosella (MN, AP, MLR)	Y			2
Platycercus eximius eximius	Eastern Rosella	Y			86
Podargus strigoides	Tawny Frogmouth	Y			1
Podiceps cristatus australis	Great Crested Grebe	Y		R	1
Poliocephalus poliocephalus	Hoary-headed Grebe	Y			17
Poodytes gramineus goulburni	Little Grassbird	Y			142
Porphyrio melanotus melanotus	Australasian Swamphen	Y			140
Porzana fluminea	Australian Crake (Australian Spotted Crake)	Y			3
Psephotus haematonotus haematonotus	Red-rumped Parrot (eastern SA except NE)	Y			65
Ptilotula penicillata	White-plumed Honeyeater	Y			223
Ptilotula penicillata penicillata	White-plumed Honeyeater (northern YP, MN, AP, MLR, LNE, MM, SE)	Y			3
Rhipidura albiscapa	Grey Fantail	Y			52
Rhipidura leucophrys leucophrys	Willie Wagtail	Y			229
Rostratula australis	Australian Painted-snipe	Y	EN	E	1
Sericornis frontalis (NC)	White-browed Scrubwren	Y			72
Smicrornis brevirostris	Weebill	Y			54
Strepera versicolor melanoptera	Black-winged Currawong (MLR, MM, SE)	Y			25
Tachybaptus novaehollandiae novaehollandiae	Australasian Grebe	Y			106
Taeniopygia guttata castanotis	Zebra Finch	Y			50
Threskiornis molucca molucca	Australian White Ibis	Y			126
Threskiornis spinicollis	Straw-necked Ibis	Y			1
Todiramphus sanctus sanctus	Sacred Kingfisher	Y			19
Tribonyx ventralis	Black-tailed Nativehen	Y			18
Trichoglossus moluccanus moluccanus	Rainbow Lorikeet	Y			152
Tringa nebularia	Common Greenshank	Y	EN		1
Vanellus miles	Masked Lapwing	Y			47
Vanellus miles novaehollandiae	Spur-winged Plover	Y			2
Vanellus tricolor	Banded Lapwing	Y			1
Zapornia pusilla palustris	Baillon's Crake	Y			4
Zosterops lateralis	Silvereye	Y			133
Austronomus australis	White-striped Free-tailed Bat	Y			4
Chalinolobus gouldii	Gould's Wattled Bat	Y			6
Macropus fuliginosus	Western Grey Kangaroo	Y			2
Mormopterus planiceps	Southern Free-tailed Bat	Y			4
Nyctophilus geoffroyi	Lesser Long-eared Bat	Y			3
Phascolarctos cinereus	Koala	Y			2
Pteropus poliocephalus	Grey-headed Flying-fox	Y	VU	R	405
Trichosurus vulpecula	Common Brushtail Possum	Y		R	4
Vespadelus darlingtoni	Large Forest Bat	Y			3
Chelodina longicollis	Eastern Long-necked Turtle	Y			1
Eulamprus quoyii	Eastern Water Skink	Y			4
Tiliqua scincoides	Eastern Bluetongue	Y			1

SPECIES	COMMON NAME	NATIVE	NATIONAL RATING	STATE RATING	NUMBER OF RECORDS
Atriplex australasica		Y		R	1
Ptilotus erubescens	Hairy-tails	Y		R	15
Sclerolaena muricata var. villosa	Five-spine Bindyi	Y		R	9
Eryngium ovinum	Blue Devil	Y		V	1
Thysanotus tenellus	Grassy Fringe-lily	Y		R	2
Dianella longifolia var. grandis	Pale Flax-lily	Y		R	10
Brachyscome diversifolia	Tall Daisy	Y		E	1
Coronidium gunnianum	Pale Everlasting	Y		E	1
Lagenophora sublyrata	Slender Bottle-daisy	Y		V*	1
Olearia pannosa ssp. pannosa	Silver Daisy-bush	Y	VU	V	2
Olearia passerinoides ssp. glutescens	Sticky Daisy-bush	Y		R	2
Senecio behrianus	Behr's Groundsel	Y	EN	E	1
Senecio pinnatifolius var. pinnatifolius		Y		R	2
Blechnum nudum	Fishbone Water-fern	Y		R	3
Blechnum wattsii	Hard Water-fern	Y		R	1
Stellaria angustifolia ssp. tenella	Swamp Starwort	Y		R	3
Stackhousia annua	Annual Candles	Y	VU	V	1
Crassula sieberiana	Sieber's Crassula	Y		E	1
Carex gunniana	Mountain Sedge	Y		R	12
Cladium procerum	Leafy Twig-rush	Y		R	9
Acacia barattensis	Baratta Wattle	Y		R	2
Acacia dodonaeifolia	Hop-bush Wattle	Y		R	3
Acacia iteaphylla	Flinders Ranges Wattle	Y		R	38
Acacia pendula	Weeping Myall	Y		V	3
Cullen parvum	Small Scurf-pea	Y		V	17
Glycine latrobeana	Clover Glycine	Y	VU	V	1
Sphaerolobium minus	Leafless Globe-pea	Y		R	2
Swainsona behriana	Behr's Swainson-pea	Y		V	6
Isoetes drummondii ssp. drummondii	Plain Quillwort	Y		R	1
Juncus radula	Hoary Rush	Y		V	3
Mentha diemenica	Slender Mint	Y		R	1
Prostanthera chlorantha	Green Mintbush	Y		R	2
Logania saxatilis	Rock Logania	Y		R	38
Lycopodium deuterodensum	Bushy Clubmoss	Y		E	2
Lythrum salicaria	Purple Loosestrife	Y		R	1
Montia australasica	White Purslane	Y		R	1
Eucalyptus fasciculosa	Pink Gum	Y		R	117
Eucalyptus viminalis ssp. viminalis	Manna Gum	Y		R	17
Caladenia argocalla	White Beauty Spider-orchid	Y	EN	E	1
Caladenia behrii	Pink-lip Spider-orchid	Y	EN	E	2

Caladenia leptochila ssp. leptochila	Narrow-lip Spider-orchid	Y		R	8
Caladenia reticulata	Veined Spider-orchid	Y		R	18
Caladenia rigida	Stiff White Spider-orchid	Y	EN	E	6
Diuris behrii	Behr's Cowslip Orchid	Y		V	6
Prasophyllum constrictum	Tawny Leek-orchid	Y		R	1
Prasophyllum pallidum	Pale Leek-orchid	Y	VU	R	7
Prasophyllum pruinosum	Plum Leek-orchid	Y	EN	E	26
Pterostylis curta	Blunt Greenhood	Y		R	1
Pterostylis foliata	Slender Greenhood	Y		R	1
Thelymitra aristata	Great Sun-orchid	Y		E*	1
Thelymitra batesii		Y		R	1
Thelymitra carnea	Small Pink Sun-orchid	Y		R	1
Thelymitra flexuosa	Twisted Sun-orchid	Y		R	1
Thelymitra grandiflora	Great Sun-orchid	Y		R	8
Thelymitra latifolia	Blue Star Sun-orchid	Y		V	1
Thelymitra peniculata	Blue Star Sun-orchid	Y		V	1
Euphrasia collina ssp. osbornii	Osborn's Eyebright	Y	EN	E	1
Todea barbara	King Fern	Y		E	7
Aristida australis		Y		R	1
Austrostipa breviglumis	Cane Spear-grass	Y		R	3
Austrostipa densiflora	Fox-tail Spear-grass	Y		R	10
Austrostipa gibbosa	Swollen Spear-grass	Y		R	4
Austrostipa multispiculis	Many-flowered Spear-grass	Y		R	50
Austrostipa oligostachya	Fine-head Spear-grass	Y		E	1
Austrostipa tenuifolia		Y		R	4
Bothriochloa macra	Red-leg Grass	Y		R	7
Deyeuxia densa	Heath Bent-grass	Y		R	1
Echinopogon ovatus	Rough-beard Grass	Y		R	1
Poa umbricola	Shade Tussock-grass	Y		R	10
Rytidosperma laeve	Smooth Wallaby-grass	Y		R	1
Rytidosperma tenuius	Short-awn Wallaby-grass	Y		R	4
Rumex dumosus	Wiry Dock	Y		R	1
Potamogeton ochreatus	Blunt Pondweed	Y		R	7
Zannichellia palustris		Y		R	2
Grevillea anethifolia		Y		R	1
Adiantum capillus-veneris	Dainty Maiden-hair	Y		V	7
Anogramma leptophylla	Annual Fern	Y		R	5
Centrolepis glabra	Smooth Centrolepis	Y		R	1
Spyridium daphnoides	Spoon-leaved Spyridium	Y		R	20
Correa glabra var. leucoclada	Rock Correa	Y		R	13
Leionema hillebrandii	Mount Lofty Phebalium	Y		R	3
Philotheca angustifolia ssp. angustifolia	Narrow-leaf Wax-flower	Y		R	25
Zieria veronicea ssp. veronicea	Pink Zieria	Y		R	1
Anthocercis angustifolia	Narrow-leaf Ray-flower	Y		R	56

Appendix H

Ecotoxicity assessment

H-1 Introduction

This appendix details the toxicity reference values (TRV) used in the food chain modelling assessment to estimate PFOS+PFHxS exposure risk to koalas.

H-2 Derivation methodology

A TRV is the dose of a chemical (in mg/kg/day) that will not cause adverse effects to an ecological receptor group in association with chronic exposure. TRVs are derived from the endpoints identified in ecotoxicity studies based on lowest observed adverse effect levels (LOAELs) and no-observed adverse effect levels (NOAELs) values

Ideally, the ecotoxicity dataset used to establish TRVs should include a dose-response studies for variety of species, sensitive life stages (e.g., juvenile or reproductive stages) and chronic endpoints (e.g., reproduction, growth, and development). The US EPA (2007) provides a methodology for deriving TRV from an ecotoxicity dataset. The methodology focuses on chronic sub-lethal endpoints and oral exposures only. According to the US EPA (2007) methodology, the minimum ecotoxicity dataset required for deriving a TRV should include:

– Ecotoxicity data for at least three toxicity endpoints, including growth and reproduction
– Ecotoxicity data for at least two species.

If these conditions are met, US EPA (2007) recommends that the NOAEL from the dataset is adopted directly as the TRV to be protective of the entire class. For emerging and less well studied chemicals, such as PFAS, the US EPA (2007) recommends that the lowest of the range of NOAELs should be adopted as the TRV. A similar approach has also been more recently recommended by the TCEQ (2018) and has been adopted in this ERA. TRVs based on LOAELs have however been included in the ERA to provide an indication of the concentrations at which adverse effects are more likely to occur.

Historically, uncertainty factors (UF) have been used when deriving TRV for interspecies extrapolations, but international regulatory agencies have recently moved away from this approach. This shift has been made on the basis that, although UF reduce the probability of underestimating ecological risk, the use of too many UF can substantially overestimate risk and reduce the relevance of the process. The only UF included in the US EPA (2007) TRV derivation process are values of up to 10 to convert a NOAEL to a LOAEL.

H-3 Adopted TRV

PFOS toxicity studies for several mammalian species including non-human primates, rats, mice and rabbits have been reviewed by FSANZ (2017). The lowest point of departure adopted by FSANZ (2017) in the derivation of the human health guideline for PFOS was a NOAEL of 0.1 mg/kg/day, derived on the basis of subchronic toxicity study in nonhuman primates (Seacat et al., 2002), a chronic toxicity and carcinogenicity study in rats (Butenhoff et al., 2012; Thomford, 2002) and a two generation reproductive toxicity study in rats (Luebker et al., 2005). The LOAEL identified in these studies ranged from 0.2 to 1.4 mg/kg/day. Consistent NOAEL values were also identified in the range of studies reviewed by FSANZ (2017) in experiments on rats, mice, monkeys and rabbits, and focused on endpoints including reproduction, development, growth and carcinogenicity. Several multigenerational studies were included in the dataset. Key studies identified by FSANZ (2017) are summarised in Table H.1.

Table H.1 PFOS TRVs for mammalian species

Species	Duration	Effect	Endpoint (mg/kg/day)		References
Rat	84 days	Growth	NOAEL	0.1	Luebker *et al.* (2005)
Rat	2 years	Hepatotoxicity (Liver lesion)	NOAEL	0.1	Thomford (2002)
Primates	182 days	Serum cholesterol and HDL	NOAEL	0.2	Seacat *et al* (2002)
Mice	60 days	Liver weight	NOAEL	0.1	Dong *et al.* (2009)

Given the high quality of the dataset, the NOAEL of 0.1 mg/kg/day identified by FSANZ (2017) has been adopted as the TRV for koalas in this ERA. Consistent with the approach used by FSANZ (2017), this TRV has been applied to the PFOS+PFHxS. A TRV of 0.1 mg/kg/day for koalas is consistent with the recommendations made by Conder *et al.* (2020) for ERAs conducted at US Department of Defence sites.

Lower LOAEL were identified by Pedens-Adams et al. (2008) and Dong *et al.* (2009) as the point of departure for the mammalian immunotoxicity of PFOS but these study was discounted FSANZ (2017), on the basis that modulation of the immune system was not a suitable endpoint for a quantitative risk assessment. Given the stringent protocols applied in studies aimed at the evaluation of human toxicity, the lowest endpoint adopted by FSANZ (2017) in the derivation of a human health tolerable daily intake (TDI) is also considered likely to be appropriately protective for most mammalian species.

CCME (2021) adopted a TRV of 0.001 mg/kg/day for mammals, based on the range of range of critical toxicity values identified in nine studies and a UF of 100. While the use of a UF of this order of magnitude is considered overly conservative, the sensitivity of the assessment outcomes to the mammalian TRV has been evaluated in Section 5.2 .

Appendix I

Ecological Risk Assessment modelling (Koalas)

PFOS+PFHxS intake estimates

The following equations have been used to estimate species-specific intake of PFOS+PFHxS from food, water and soil (Sample, et al., 1997; US EPA, 1993).

$$Intake = \left(\sum DIR \times EPC_{Diet} \times P_{Diet}\right) + (WIR \times EPC_{Water}) + (DIR \times EPC_{sediment} \times P_{Sediment})\, x\, AUF$$

Equation 1

Where:

DIR	=	Dietary ingestion rate (kg/kg body weight/day)
EPC	=	Concentration of contaminant in medium (mg/kg or mg/L)
P_{Diet}	=	Proportion of type of dietary medium consumed (unitless)
WIR	=	Water ingestion rate (L/kg body weight/day)
Intake	=	Total oral exposure to contaminant (mg/kg/day)
P_{soil}	=	Rate in incidental soil ingestion, proportion of the dietary ingestion rate (unitless)
AUF	=	Area use factor (unitless)

Food ingestion rates

Food ingestion rates for receptors have been estimated based on the following equation:

$$DIR = \frac{IngR}{BW}$$

Equation 2

Where:

DIR	=	Dietary ingestion rate (kg/kg body weight/day)
IngR	=	Ingestion rate of food (food source) (kg/day)
BW	=	Body weight of receptor (kg).

Where available, published data for indicator species or surrogates has been used to determine the dietary ingestion rate input parameters. In the absence of published data, the following general approaches, as recommended by Nagy (2001) have been adopted:

$$DIR = a \times BW^b$$ *Equation 3*

Where:

DIR	=	Dietary ingestion rate (g/day) (factor of 0.001 applied to convert to kg/day)
BW	=	Body weight (g)
a	=	Parameter dependant on the species and dietary type.
b	=	Parameter dependant of the type of species and dietary type.

Nagy (2001) presents values of parameters ‘a’ and ‘b’, both for birds and mammals as a group and for individual species groups. The values most closely representing the feeding habits of the indicator species have been selected to calculate food ingestion rates in this ERA.

Food ingestion rates have been calculated on both a wet and dry weight basis. The wet weight food ingestion rates have been input directly into the food chain model. The estimated percent of soil in diet has been input into the food chain model on a dry weight basis and has been obtained by multiplying dry weight food ingestion rates by an estimated soil percentage in the diet, either obtained from data presented by US EPA (1993) or via professional judgement.

Exposure Point Concentrations (EPC)

Area	0.50	hectares
	0.005	kilometres
Assessment Area	**Site and Development Area - Zones 1, 2, and 3**	

Constituent	*Medium*	*EPC*	*Units*	*Statistic*	*Source*
PFOS + PFHxS	Soil	0.11	mg/kg DW	Max	Maximum concentration measured in the site and Development Area (sample BH02_0-0.1)
	Plants	0.091	mg/kg WW	Max	Maximum concentration measured in the site and Development Area (sample BIO20_LEAVES located at the MFS site)

Inputs to food and water ingestion estimates

Food ingestion rates parameters "a" and "b" reported by Nagy (2001)

Species group	Parameters - to estimate [g Dry Matter Intake (DMI)/day]		Parameters - to estimate [g Fresh Matter Intake (FMI)/day]	
	a	b	a	b
Mammals				
All mammals	0.323	0.744	0.794	0.773
Marsupials	0.483	0.666	1.667	0.649
Diprotodont marsupials (herbivorous and omnivorous)	0.546	0.654	2.128	0.633
Chiroptera (Bats)	0.365	0.671	1.219	0.652
Rodentia (rats)	0.332	0.774	0.588	0.864
Carnivorous mammals	0.153	0.834	0.469	0.848
Herbivorous mammals	0.859	0.628	2.606	0.628
Insectivorous mammals	0.373	0.622	1.130	0.622
Birds				
All birds	0.638	0.685	2.065	0.689
Marine birds	0.880	0.658	3.221	0.658
Carnivorous birds	0.849	0.663	3.048	0.665
Insectivorous birds	0.540	0.705	1.633	0.705
Parrots	0.361	0.735	0.948	0.735
Omnivorous birds	0.670	0.627	2.094	0.627

Food ingestion rates parameters selected in the food web model

Species group	Nagy (2001) speciess group selected	Parameters - to estimate [g Dry Matter Intake (DMI)/day]		Parameters - to estimate [g Fresh Matter Intake (FMI)/day]	
		a	b	a	b
Koala	Diprotodont marsupials (herbivorous and omnivorous)	0.546	0.654	2.128	0.633

Water ingestion rates parameters "a" and "b" reported by US EPA (1993)

Species group	Parameters - to estimate [L/day]	
Water ingestion	**a**	**b**
Mammals	0.099	0.9
Birds	0.059	0.67

Exposure Parameters

Parameter	Acronym	Units	*Koala - Phascolarctos cinereus*	
			Mammal	
			Value	*Source*
BODY WEIGHT*	BW	grams	*7000*	*1*
INGESTION RATES				
Food	$DIR_{food-wet}$	g WW/day	*1000*	*1*
	$DIR_{food-wet}$	kg WW/kg BW /day	0.14	*2*
	$DIR_{food-dry}$	g DW/day	*179*	*3*
	$DIR_{food-dry}$	kg DW/kg BW/day	0.03	*2*
Soil	$DIR_{soil-dry}$	kg DW/kg BW/day	0.0026	*4*
Water	DIR_{water}	L/day	0.0	*1*
	DIR_{water}	L/kg BW/day	0.0	*1*
DIET				
%Diet Plant	PPlants	unitless	*1*	*1*
%Diet Soil	P_{soil}	unitless	*0.1*	*5*
AREA USE				
Home Range				
Area Use Factor	AUF	unitless	0.2	1

Sources	
1	DEW (2024), *Koala life – up close and personal.* Government of South Australia - Department of Environment and Water. - The lowest range of body weight for female koalas was selected. - The maximum food consumption was adopted as a conservative measure. - The AUF considered the extent of the vegetated area around he boundary of the site, relative to the reported home range of koalas
2	Calculated using Equation 2 and based on Nagy (2001) parameters and using a conversion factor of 1,000 to express the weight in kg
3	Calculated using Equation 3 and based on US EPA (1993) parameters
4	Calculated as $DIR_{food\ dry}$ * P_{soil}
5	The upper end of the range reported by the US EPA (1993) for mammals (in the absence of information specific to koalas

Species **KOALA**
Receptor group **Terrestrial primary consumer (mammal)**
Area **Site and Development Area - Zones 1 and 2**

Body Weight	7000	grams		
Food Ingestion Rate				
Wet Weight	0.143	kg ww/kg bw/day		
Dry Weight	0.026	kg dw/kg bw/day		
Soil Ingestion				
Proportion	0.10	unitless		
Rate	0.0026	kg dw/kg bw/day		
Water Ingestion Rate	0.00	L/kg bw-day	Area Use Factor	0.2

Constituent	EXPOSURE POINT CONCENTRATIONS				
	Abiotic Media		Biotic Media		
	Surface Water (mg/L)	*Soil (mg/kg DW)*	*Plants (mg/kg WW)*	*Invertebrates (mg/kg WW)#*	*Other (mg/kg WW)*
Proportion of Diet	*0.0*	*0.10*	*1*	*0.00*	*0.00*
PFOS + PFHxS	---	1.10E-01	9.10E-02	---	---

Constituent	PFAS INGESTION RATES (mg/kg/day)^				
	Abiotic Media		Biotic Media		
	Surface Water	*Soil*	*Plants*	*Invertebrates*	*Other*
PFOS + PFHxS	---	0.00006	0.00260	---	---

Proportion of total PFOS+PFHxS exposure (%)	---	2%	98%	---	---

Constituent	RISK CHARACTERIZATION				
	Total Ingestion	NOAEL	HI_{NOAEL}	LOAEL	HI_{LOAEL}
	mg/kg/day	*mg/kg/day*	*unitless*	*mg/kg/day*	*unitless*
PFOS + PFHxS	2.66E-03	0.10	0.027	0.20	0.01

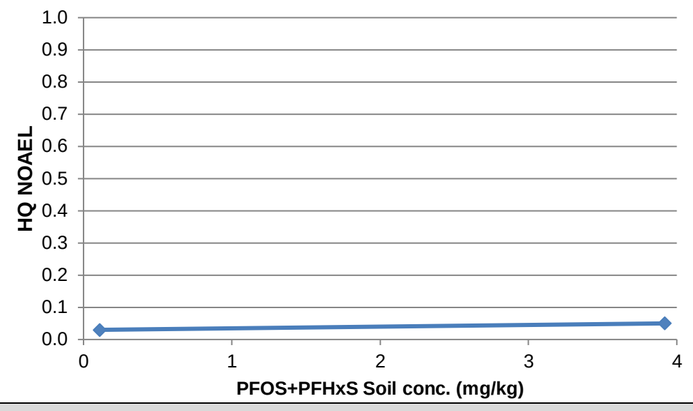
Notes:

DW - Dry Weight
LOAEL - Lowest Observed Adverse Effect Level
NOAEL - No Observed Adverse Effect Level
WW-Wet Weight
^ Calculated based on Equation 1 for each media.

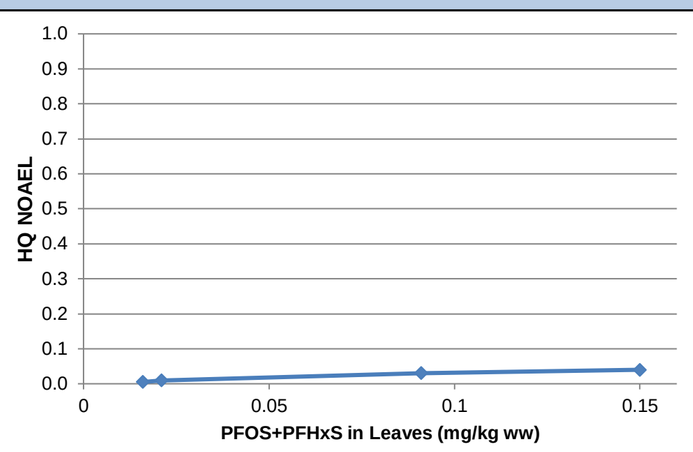
Appendix J

Ecological Risk Assessment Sensitivity Analysis calculations and outputs

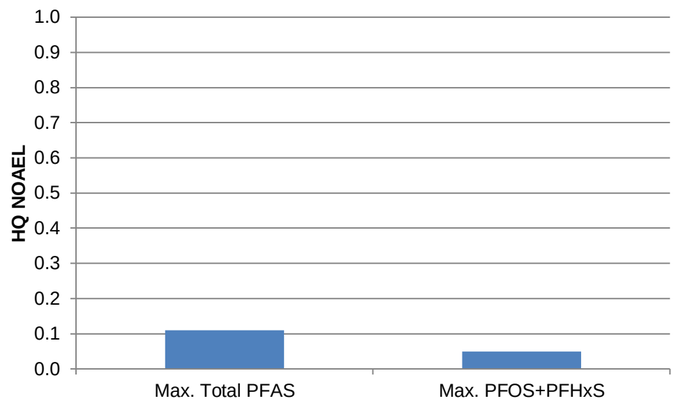
Influence of PFOS+PFHxS concentrations in soil on risks posed to Koalas

Soil PFOS+PFHxS conc. (mg/kg)	Input Selection	HI NOAEL	HI % Change	Graphical Representation	Relative Variable Sensitivity	Relative Variable Uncertainty in ERA
3.92	This is the maximum concentration detected in the Investigation Area, measured at the MFS site.	0.05	67%		Low: The concentration of PFOS+PFHxS in soil has a limited influence on the HI, which varies by up to 67% across a range of input values.	Low: The ERA adopted a reasonably conservative approach, and the sensitivity analysis shows that risks to koalas are low even if higher soil concentrations are adopted.
0.11	Soil concentration adopted. Maximum PFOS+PFHxS concentration measured in accessible soil of Zone 1, excluding sampling points SS01 and BH04	0.03	0%			

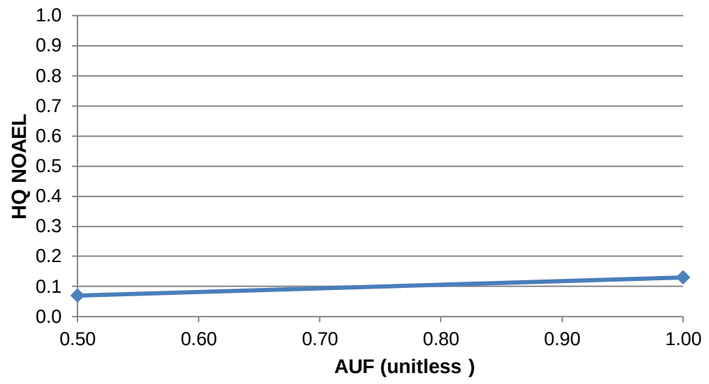
Influence of PFOS+PFHxS concentrations in leaves on risks posed to Koalas

Biota PFOS+PFHxS conc. (mg/kg ww)	Input Selection	HI NOAEL	HI % Change	Graphical Representation	Relative Variable Sensitivity	Relative Variable Uncertainty in ERA
0.15	This is the maximum PFOS+PFHxS concentration measured in biota samples collected across the site and development area (Zones 1, 2 and 3). It was detected in grass samples BIO4_GRASS. This concentration was excluded from the EPC because koalas do not feed on grass.	0.04	33%		Low: Similarly to soil, concentrations of PFOS+PFHxS in biota samples have a limited influence on the HI, which varies by up to 83% across a range of input values.	Low: Even if the highest concentration of PFOS+PFHxS found in a grass sample (not part of a koala's diet) is used as the EPC, the Hazard Index (HI) stays well below 1. This indicates that animals consuming only contaminated grass would face low risks.
0.091	Leaf concentration adopted. This is the maximum concentration detected in the Investigation Area, measured at the MFS site.	0.03	0%			
0.021	Average PFOS+PFHxS concentration measured in the Development Area (Zones 2 and 3), excluding BIO4_GRASS	0.01	-67%			
0.016	Maximum PFOS+PFHxS concentration measured in the Development Area (Zones 2 and 3), excluding BIO4_GRASS	0.005	-83%			

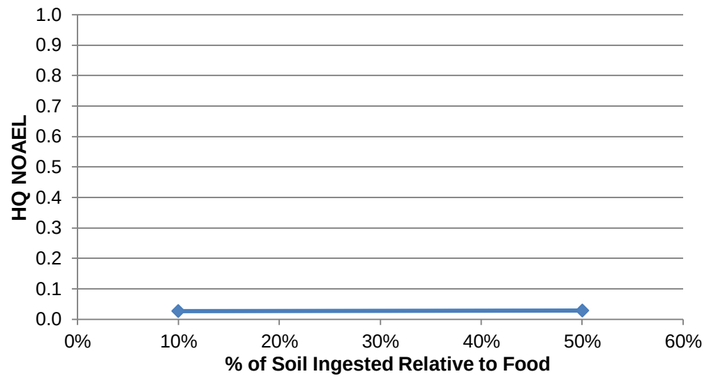
Influence of other PFAS on risk estimates for koalas

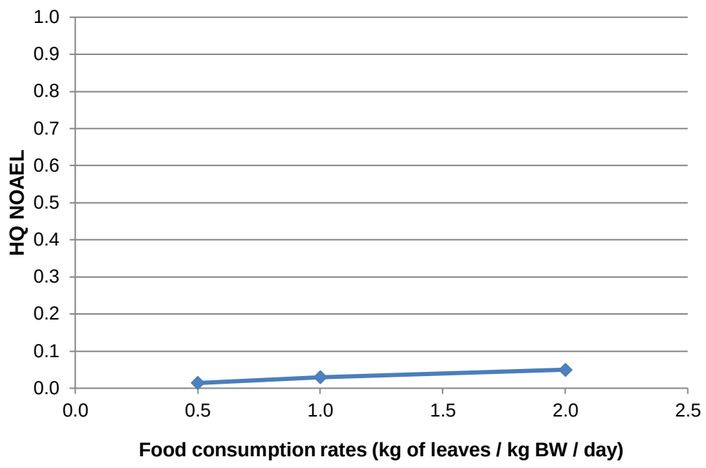
EPC	Input Selection	HI NOAEL	HI % Change	Graphical Representation	Relative Variable Sensitivity	Relative Variable Uncertainty in ERA
Max. Total PFAS	Maximum concentrations of total PFAS in soil and biota (excluding sampling points SS01, BH04, and BIO4_GRASS)	0.11	-		Low: When total concentrations of PFAS are considered instead of only PFOS+PFHxS, a minor increase in HI is observed. However, the toxicity of PFAS other than PFOS and PFHxS is unlikely to be greater than that of PFOS. Therefore, the presence of other PFAS is unlikely to significantly influence the ERA outcomes.	Low: The HI remains well below 1 even if maximum total PFAS concentrations are adopted.
Max. PFOS+PFHxS	Maximum concentrations of PFOS+PFHxS in soil and biota (excluding sampling points SS01, BH04, and BIO4_GRASS)	0.05	-			

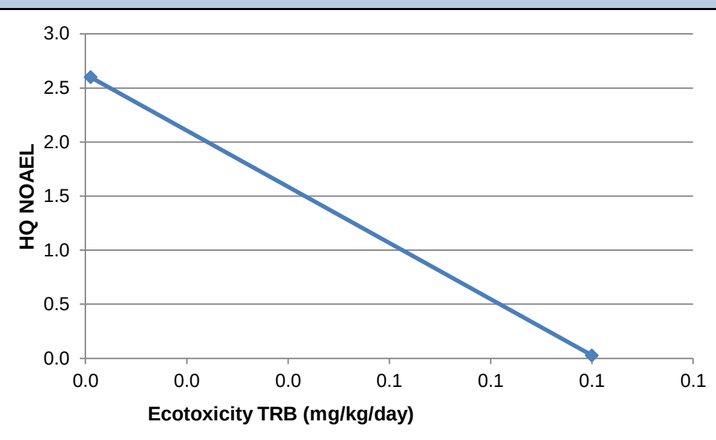
Influence of AUF on risk estimates for koalas

AUF (unitless)	Input Selection	HI NOAEL	HI % Change	Graphical Representation	Relative Variable Sensitivity	Relative Variable Uncertainty in ERA
1	It assumes that koalas spend all their time and life at the site and Development Area.	0.13	333%		Moderate: The HI varies up to 333% but remains below the threshold risk level of 1.	Low: Although the behaviour of koalas is not understood, risks associated with PFAS exposure at the site and in the Investigation Area remain low.
0.5	Koalas spend 50% of their time and life at the site and Development Area.	0.07	133%			
0.2	AUF adopted in the ERA.	0.03	0%			

Influence of soil ingestion rates on risk estimates for koalas

% of soil ingested relative to food	Input Selection	HI NOAEL	HI % Change	Graphical Representation	Relative Variable Sensitivity	Relative Variable Uncertainty in ERA
50%	It is assumed that soil ingestion equals 50% of the food ingestion rate. This is an overly conservative assumption.	0.03	7%		Low: The HI varies up to 7% and remains below the threshold risk level of 1.	Low: The soil ingestion rate of koalas at the site is unknown, but it is reasonable to assume that it is well below 50% of the food ingestion rate. This is because koalas spend most of their time and eat on trees. However, even when overly conservative soil ingestion rates are adopted, the risks associated with PFAS exposure at the site and in the Investigation Area remain low.
10%	The soil ingestion rate adopted in this ERA. The model assumes that soil ingestion equals 10% of the food ingestion rate.	0.03	0%			

Influence of food consumption rates on risk estimates for koalas						
Food consumption rates (kg of leaves / kg BW / day)	**Input Selection**	**HI NOAEL**	**HI % Change**	**Graphical Representation**	**Relative Variable Sensitivity**	**Relative Variable Uncertainty in ERA**
2.0	Twice the upper end of koala food consumption (based on DEW, 2024)	0.05	67%		Low: The HI varies up to 67% and remains below the threshold risk level of 1.	Low: The range of koala food ingestion rates is reliable given the data source (DEW, 2024). Even when the food ingestion rate is doubled, the risks associated with PFAS exposure at the site and in the Investigation Area remain low.
1.0	Value adopted in the ERA. The upper end of koala food consumption (based on DEW, 2024)	0.03	0%			
0.50	Lower end of koala food consumption (based on DEW, 2024)	0.01	-53%			

Influence of ecotoxicity inputs on risk estimates for koalas						
Ecotoxicity TRV (mg/kg/day)	**Input Selection**	**HI NOAEL**	**HI % Change**	**Graphical Representation**	**Relative Variable Sensitivity**	**Relative Variable Uncertainty in ERA**
0.001	TRV adopted by CCME (2021). This value was based on a range of critical toxicity values identified in nine studies and a UF of 100. This approach is considered overly conservative, associated with elevated uncertainty, and not considered by Australian regulators.	2.60	8567%		High: The HI varies up to >8,500% (85 times) and exceeds the threshold risk level of 1.	Moderate: The TRV for mammals adopted in the ERA is consistent with that used by Australian regulators, including by FSANZ (2017). This value is based on high quality data, in comparison to the one used by CCME (2021). If the CCME TRV is used, the resulting HI is marginally above the threshold value and below 10, indicating a scenario where the PFAS intakes estimated for koalas exceed that at which no adverse chronic effects have been measured. The magnitude of any adverse effects cannot be reliably estimated, and therefore, there is a moderate risk of chronic adverse effects on koalas.
0.1	Value adopted in the ERA. The upper end of koala food consumption (based on DEW, 2024)	0.03	0%			

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