RAAF BASE EAST SALE

PFAS MANAGEMENT AREA PLAN REVISION 1

April 2026

EXECUTIVE SUMMARY

In 2018, Defence published the RAAF Base East Sale PFAS Management Area Plan (2018 PMAP) for managing risks to human health and the environment from per- and poly-fluoroalkyl substances (PFAS) contamination associated with RAAF Base East Sale (the base) and surrounding areas.

Since development of the 2018 PMAP, Defence has implemented a number of actions set out in the plan and reassessed what is now needed to best manage these contamination risks. This PMAP revision sets out the updated plan to manage risks to human health and the environment from exposure to PFAS contamination at and from the base.

In managing PFAS contamination to reduce risks to human health and the environment, Defence prioritises:

- minimising exposure to PFAS
- preventing or minimising migration of PFAS
- keeping the community informed.

The PFAS Management Area as covered by this PMAP comprises RAAF Base East Sale and surrounding areas. The Management Area is the primary region throughout which risk management actions or ongoing monitoring are being applied, divided into three sub-areas, as follows:

- On-base, including
    - Active RAAF base
    - Leased Defence land for grazing
- Off-base monitoring area to the south and east (seven private properties)
- Off-base monitoring area within the Heart Morass (six private properties and the publicly managed wetlands).

The primary sources of PFAS contamination are areas where aqueous film forming foam (AFFF) was used or stored, like a fire fighting training area. There are also secondary source areas where an accumulation of PFAS contamination is present in the environment, like sediments in a wetland.

A conceptual site model (CSM) describes the ways that PFAS contamination can accumulate in source areas, and then move through the environment such as via storm-water, surface water in creeks and groundwater flow. The CSM also describes how people, plants and animals (refer to as ‘receptors’) are potentially exposed to the PFAS contamination, for example by eating contaminated fish.

The PFAS CSM for the base is summarised as follows:

- **Key source areas**: Airfield operations, firefighting foam storage and mechanical equipment operations maintenance section (MEOMS) operations involving the historic release and accumulation of aqueous film forming foams (AFFF) in the soil, concrete and asphalt
- **Transport mechanisms**: Migration of PFAS away from the source areas through surface water flow into drains, infiltration to groundwater and subsequent discharge into surface water bodies i.e. the Heart Morass
- **Potential receptors**:
    - On-base: people working in excavations (intrusive maintenance workers), plants and animals living in the creeks and drains (aquatic flora and fauna), and people eating produce from the leased land (such as home consumption of cattle)

- Off-base: Aquatic plants and animals, and people eating fish, eels, and water fowl (such as ducks).

Since the development of the 2018 PMAP, a new potential PFAS source area has been identified on the base, where accidental release of Ansulite C6 foam from a hanger firefighting system within Building A0842 occurred in 2021, 2022 and 2023. The spills were contained on-base, however because the C6 foam contains PFAS, residual contamination potentially remains in the soils and concrete surrounding the building.

The 2018 PMAP strategy included ceasing the use of AFFF on the base, targeted on-base drainage improvement, and implementing precautionary advice (including advice to the public on eating fish, eels and water fowl) with EPA Victoria. The PFAS ongoing monitoring plan (OMP), was also established in 2018 and included routine testing of sediment, surface water and groundwater samples.

To progress the management of the PFAS contamination as a part of this PMAP, the following strategies have been proposed alongside the ongoing actions from the 2018 PMAP:

- Preparation of remediation actions plans (RAPs) for SA06 (Current Fire Station) and SA16 (Grassed area near runway), where the highest PFAS contaminations are found on the base, and are therefore a high priority for remediation
- Refinement of the on-base drainage studies to further understand source area contribution, and implementation of a passive surface water treatment trial
- Implementation of a site investigation strategy to prioritise source areas and develop a base-wide remedial strategy that can be implemented in a staged approach
- Continue implementation of the OMP, and monitor the performance of each remedial stage.

These proposed actions will build on the works competed to date to remediate PFAS mass on-base so as to further reduce the amount of PFAS leaving the base, and over time will contribute to the long-term reduction of PFAS in the off-base environment.

Defence will provide regular updates to the local community. Factsheets and reports are available on the Defence website.

CONTENTS

GLOSSARY

AFFF	Aqueous Film Forming Foam
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure, as amended 2013
Base	RAAF Base East Sale
CD	Central Drain
CSM	Conceptual Site Model
Defence	Department of Defence
DSI	Detailed Site Investigation
EMD	Eastern Main Drain
HHA	Haunted Hills Aquifer
HHERA	Human Health and Ecological Risk Assessment
LAA	Lower Alluvial Aquifer
Management Area	The geographical area subject to Defence risk management actions. May include private or Defence owned detached properties beyond the boundaries of the base
MAD	Main Airfield Drain
NEMP	PFAS National Environment Management Plan
NAD	North Airfield Drain
NMD	Northwestern Drain
Off-base	Off-base (or other Defence property)
OMP	Ongoing Monitoring Plan
On-base	On-base (or other Defence property)
PFAS	Per- and poly-fluoroalkyl substances
PFAS NEMP	PFAS National Environmental Management Plan
PFHxS	Perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PMAP	PFAS Management Area Plan
RAAF	Royal Australian Air Force
RAP	Remediation Action Plan
Risk management actions	Remediation and management actions to address potential risks to receptors from PFAS contamination.
ROA	Remediation Options Assessment
SFARP	So Far as Reasonably Practicable
Source	A source can be primary or secondary. Primary sources are areas where AFFF was used or stored. Secondary sources may be an

	accumulation of contamination in the environment, such as in soil, sediments, or surface water bodies.
UAA	Upper Alluvial Aquifer
VFA	Victorian Fisheries Authority
VIC EPA	Victorian Environmental Protection Authority
WMD	Western Main Drain

Unless otherwise defined in this document, definitions provided in the *PFAS National Environmental Management Plan* (NEMP V3.0 [2025]) or the *National Environment Protection (Assessment of Site Contamination) Measure, as amended 2013* (ASC NEPM) apply.

1 INTRODUCTION

The Department of Defence (Defence) acknowledges the Traditional Custodians of Country throughout Australia. Defence recognises their continuing connection to traditional lands and waters and would like to pay respect to their Elders both past and present. Defence would also like to pay respect to the Aboriginal and Torres Strait Islander peoples who have contributed to the defence of Australia in times of peace and war.

1.1 Background and purpose

In August 2018, Defence published the PFAS Management Area Plan (2018 PMAP) for managing risks to human health and the environment from per- and poly-fluoroalkyl substances (PFAS) contamination associated with Royal Australian Air Force (RAAF) Base East Sale (the base) and surrounding areas.

Since the 2018 PMAP was developed, Defence has implemented parts of the plan and reassessed what is now needed to best manage risks from PFAS contamination.

This assessment considered:

- progress made in the implementation of the 2018 PMAP
- data collected through the Ongoing Monitoring Plan (OMP) and PFAS mass flux assessments including surface water sampling, groundwater flow and drainage assessments
- whether potential risks to human health or the environment from PFAS contamination have changed.

This PMAP revision sets out the updated plan to manage risks to human health and the environment from exposure to PFAS contamination from RAAF Base East Sale.

The PMAP revision has been developed in accordance with the PFAS National Environmental Management Plan (NEMP) (Heads of EPA [HEPA], 2025), which provides nationally consistent environmental guidance and standards for managing PFAS contamination. It is also consistent with Defence estate, environmental, and PFAS-specific strategies and guidance.

PMAPs are reviewed and updated periodically to account for changes in circumstances, such as progress in management and remediation, new data, changes in legislation, guidelines and policy, and advances in scientific information.

1.2 Management priorities

In managing PFAS contamination to reduce risks to human health and the environment, Defence prioritises:

- minimising exposure to PFAS
- preventing or minimising migration of PFAS
- keeping the community informed.

Minimising PFAS movement from the base will, in the long term, contribute to the reduction of PFAS concentrations in the surrounding environment. However, the process will take time and therefore other measures will also be implemented to reduce risks to human health and the environment.

1.3 Supporting information

The PMAP revision is based on information from a range of different investigations, human health and ecological risk assessments, and remediation planning. Details of these reports are provided in Appendix A, including web links where available.

The reports identified a range of elevated risks to receptors from exposure to PFAS, which are the focus of the risk management actions outlined in this document.

1.4 Limitations and assumptions

This document has been developed based on the information available at the time of preparation, and the following limitations and assumptions:

- the current state of knowledge regarding PFAS distribution at the time of this PMAP revision (refer to Appendix A for the source documents)
- government issued guidance, advisories and policies
- proposed management and remediation options based on current proven technologies available at the time of writing this document, including
    - management and remedial technologies summarised in the NEMP
    - additional technologies based on successful trials by Defence and conducted by others within and outside of Australia (based on publicly available information)
- understanding and application of base infrastructure development and access constraints at the time of this document
- access to off-base private residential properties where consent for sampling has been provided.

The PMAP will be revised if new information (such as revised guidelines, regulatory requirements, site data or remedial technologies) becomes available and the characterisation of risk changes, requiring a revised management or remediation approach.

2 MANAGEMENT AREA AND BASE SETTING

2.1 Base description and setting

RAAF Base East Sale is located 5 kilometres (km) east of the center of the town of Sale in Gippsland, Victoria (approximately 220 km southeast of Melbourne) and is an active major RAAF base, airport and training center that supports a capacity of approximately 700 personnel.

The base covers an area of approximately 8 square km (km^2) and includes a range of land uses that are ancillary to the aerodrome and aircraft support areas, such as accommodation, childcare facilities, recreation areas and cleared open space. The eastern portion of the base is leased for grazing land.

The base is Commonwealth land located in the rural area of the Sale township, with all land surrounding the base zoned by the Willington Shire Council as 'Farming (FZ)'.

The base is located within a mixed land use setting, including:

- agricultural land use (pastoral, food production)
- recreational land use of the Heart Morass (privately owned wetland)
- recreational land use of the Heart Morass Wildlife Reserve and Dowd Morass Wildlife Reserve (publicly managed wetlands).

It is also noted the base is located in an environmentally sensitive area, close to wetlands of ecological significance, including the Heart Morass to the south, and the Gippsland Lakes Ramsar site at Lake Wellington to the east. Groundwater and surface water are important resources for the local community, noting the ecologically significant wetlands contribute to the overall recreation and cultural identity of the region.

Shallow groundwater is commonly extracted for stock watering and agricultural irrigation across off-base across properties to the north, southeast, south and west of the site for non-potable uses i.e. domestic non-potable supply (bathroom and laundry), outdoor domestic supply, dairy operations, irrigation of pasture, stock watering and abattoir operations. Deeper groundwater (Boisdale Formation) is extracted both on-base and off-base to supplement drinking water supplies, outdoor domestic supply, dairy operations, irrigation of pasture and stock watering.

2.2 Management Area setting

The PFAS Management Area comprises RAAF Base East Sale and surrounding areas (Figure 1 in Appendix B). The management area is the primary region throughout which risk management actions or ongoing monitoring are being applied. The management area is divided into three sub-areas, as follows:

- On-base, including
    - Active RAAF base
    - Leased Defence land for grazing
- Off-base monitoring area to the south and east (seven private properties)
- Off-base monitoring area within the Heart Morass (six private properties and the publicly managed wetlands).

The primary management area is on-base which is currently an operating RAAF base with legacy PFAS source areas. The management area also incorporates off-base private properties to the east

and southeast, defined as the 'off-base monitoring area', as there are currently low and acceptable risks to off-site land based private properties. Private properties incorporating the waters of the Heart Morass are included as an 'off-base monitoring area: Heart Morass' due to the potentially elevated risks for human consumption of fish, eels and water fowl in this area and to the ecosystems.

The extent of the management area was determined from investigations in the Detailed Site Investigation (DSI) (Senversa, 2017) and the Human Health and Ecological Risk Assessment (HHERA) (Senversa, 2018). The two sub-areas categorised for monitoring were established due to low and acceptable risks to off-site land based private properties (Senversa, 2018).

A review of the risk profile was conducted in 2024 and determined that the outcomes of the HHERA (2018) remained appropriate (Senversa, 2024).

Detailed information about the management area environmental setting, such as climate, topography, geology, hydrology and various other aspects are provided in the DSI (Senversa, 2017).

The geology underlying the base includes the sands, silts and gravels of the Haunted Hills Formation, and quaternary alluvial silts and clay deposits associated with the wetlands and the Latrobe River. Groundwater is encountered below the base and surrounding areas in the following geological units, and the flow of groundwater in all water bearing units is generally to the south-east towards the Heart Morass:

- Upper Alluvium Aquifer (UAA) between 0-6 m below ground level (bgl)
- Lower Alluvium Aquifer (LAA) between 5-12 m bgl
- Haunted Hills Formation Aquifer (HHA) between 10-26 m bgl
- Nuntin Clay and underlying Wurruk Sand (Boisdale Formation) greater than 36 m bgl. The Boisdale Formation aquifer is an important regional water resource.

The base and surroundings are low lying and very flat, with general topographic gradients across the base of less than 0.5%. The stormwater and surface water on the base is managed through are closed, concrete lined stormwater drains which become open, unlined drainage channels in the lower reaches of the network (refer to Figure F2 in Appendix B). These networks generally follow the topography of the base and divert generated surface water runoff off-base to the north, south and east. To the north of the runways, stormwater drainage flows into the Northwestern Drain (NWD) and discharges off-base along Cobains Road, travelling towards low lying areas east of the base and ultimately to Lake Wellington. The remaining three drains, the Eastern Main Drain (EMD), Central Drain (CD) and Western Main Drain (WMD) all discharge off-base via the EMD which ultimately discharges into the Heart Morass.

Further information regarding the four main on-base drainage lines are summarised in Table 1.

Table 1. Drainage network

Network	Summary
Eastern Main Drain (EMD)	The EMD is an open swale drain running north-south down the eastern boundary of the base. Flow in the EMD is intermittent, and base of the channel gradually deepens from shallow to 4 to 5 m deep towards its discharge point in the southeastern corner of the base. This drain in unlined and fed by the Western Main Drain at the

Network	Summary
	most southeastern point of the base and the Main Airfield Drain from midway along the runways.
Northwest Drain (NWD)	The NWD is an open swale that runs south to north along the northwestern boundary of the base and then doglegs towards the east along the northern boundary of the base. Flow in the NWD is intermittent and is generated by surface water flow from across the Mechanical Equipment Operations Maintenance Section (MEOMS) area in the northwestern corner of the base. The NWD discharges off-base to a drain at Cobains Road, then ultimately travels east towards Lake Wellington.
Western Main Drain (WMD)	The WMD is an open swale drain running from the northwest of the base towards the southern boundary with intermittent flow. The drain culminates in a retention pond on the southern boundary that is then linked by the Southern Drain to the EMD and subsequently discharges off-base.
Central Drain (CD)	The CD is in the southern portion of the base, south of the airfield. This unlined drain discharges to the WMD and subsequently the EMD off-base discharge point.

3 EXTENT OF PFAS CONTAMINATION

This section provides an outline of the PFAS sources, transport pathways for migration of PFAS from a source area, and potential receptors such as humans and ecosystems (plants and animals) that may be exposed to PFAS from the base.

This information is described as a Conceptual Site Model (CSM), which is provided in Appendix C. As part of this PMAP revision, the CSM for the base and surrounding area was reviewed for currency and updated. One potential new source area that has not been fully characterised has been identified, and investigations are planned to confirm its significance. No new pathways or receptors have been identified.

The current CSM presented in this PMAP identifies:

- sources of PFAS on-base and their current characterisation
- PFAS transport pathways and the significance in PFAS discharging off-base, and
- receptors (human and ecological) that might be exposed to PFAS and the measures in place to manage associated risks.

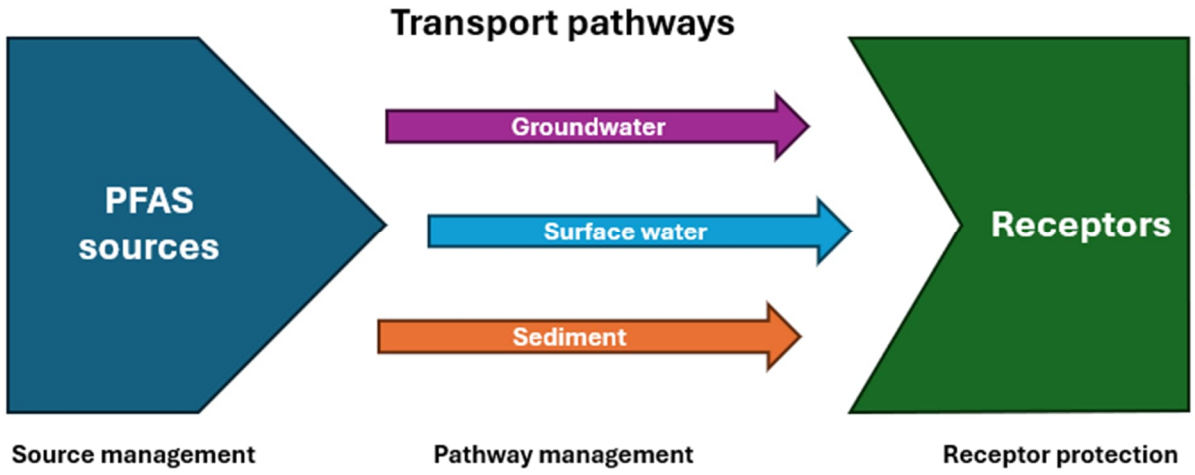


Figure 1 – Sources / Pathways / Receptors

For more detailed information informing the CSM, refer to the reports listed in Appendix A.

3.1 Source areas

Source areas can be primary or secondary. Primary sources are areas of PFAS contamination where aqueous film forming foam (AFFF) was used or stored, for example, a fire training area. Secondary source areas contain an accumulation of PFAS contamination in the environment, such as in soil or sediment, which has migrated from a primary source area through groundwater or surface water bodies.

The PFAS source areas that have been identified through previous investigations (Appendix A) are summarised in Table 2. A map showing these source areas is provided as Figure 3 in Appendix B.

Based on the data collected during the DSI (Senversa, 2017) and the assessment of PFAS migration through surface water and groundwater from the base (Senversa, 2023), source areas were assessed

for their significance of contribution to PFAS discharge from the base. Source areas where high PFAS concentrations and/or mass was reported in soil, groundwater and surface water typically have a greater contribution to PFAS movement from the base. During a review of site assessments completed to date, the source areas identified as key contributors (AECOM, 2025) were:

- SA01 (Mechanical Equipment Operations Maintenance Section [MEOMS] waste disposal)
- SA03 (MEOMS fire truck hose testing)
- SA06 (current fire station)
- SA11 (former AFFF testing area)
- SA14 (grassed area near MEOMS)
- SA16 (grassed area near runway).

Additionally, due to accidental AFFF releases at Building 0842, the unquantified nature of potential PFAS contamination at SA27 has been recently included as a potential key source area. The remaining source areas, which are summarised in Table 2, were categorised as either moderate or minor contributors to PFAS movement from the base.

The DSI provided enough data to identify the source areas and their significance, however, further data collection is required at key source areas to design practicable remediation actions. Presently, no further action is proposed for the sources area designated as moderate or minor contributors.

Table 2. Known source areas of PFAS

Source area	Description	Contribution to PFAS off-base migration	Current status
Northwestern Area			
SA01	MEOMS waste disposal	Key contributor	High concentrations of PFAS were reported in groundwater where SA01, SA03 and SA14 are located on the western boundary. These source areas are next to the NWD that leaves the base to the north along Cobains Road.
SA03	MEOMS fire truck hose testing	Key contributor	
SA14	Grassed area near MEOMS	Key contributor	
SA02	MEOMS operational area	Minor contributor	PFAS concentrations reported localised contamination around SA04, SA05 and SA15 in soil, with some PFAS contamination extending into groundwater. These source areas are not located near the surface water drainage network.
SA04	Former fire station	Minor contributor	
SA05	Chemical storage area	Minor contributor	
SA15	Grassed area near fire station	Moderate contributor	
Central Area			
SA06	Current fire station	Key contributor	SA06 and SA16 reported the highest concentrations of PFAS in soil and groundwater, and both source areas are directly connected to the surface water drainage network. PFAS concentrations in the surface water drainage network were the highest for the base. Groundwater data was collected from one groundwater well in each source area and the nearest groundwater well exists 1 km to the southeast. SA11 reported low concentrations of PFAS in the soil but higher concentrations in groundwater. Further investigation is required to determine the source of PFAS impacted groundwater in the area. SA27 includes known AFFF releases at Building A0842, however, the PFAS contamination is unquantified.
SA11	Former AFFF testing area	Key contributor	
SA16	Grassed area near runways	Key contributor	
SA19	Former refuelling area	Minor contributor	SA19 reported low PFAS concentrations in soil and groundwater, considered representative of diffuse

Source area	Description	Contribution to PFAS off-base migration	Current status
			concentrations across the base. There are no plans to undertake further management actions.
SA27	Accidental AFFF releases at Building A0842	Has not been quantified yet	Accidental AFFF releases have been reported at Building A0842, however, the PFAS contamination is unquantified, and further investigation is required to evaluate the presence and significance of PFAS contamination.
South Eastern Area			
SA07	Former waste burial area	Moderate contributor	PFAS concentrations in soil are low across all the source areas in the southeast, with some localised high concentrations within SA07, SA08 and SA09. PFAS in groundwater reported moderate concentrations in the area, mostly across SA07, SA08, SA09 and SA13. These source areas are connected to the surface water drainage network that drains from the base. The significance of contribution from these source areas is being monitoring under the OMP, and there no plans to undertake further management actions.
SA08	Former fire training area	Moderate contributor	
SA09	Former fire training area	Moderate contributor	
SA10	Former fire training area	Minor contributor	
SA12	4WD training track	Minor contributor	
SA13	Former sewage treatment plant and fire training	Moderate contributor	
SA18	Revetments	Minor contributor	
Diffuse sources			
SA17	Stormwater drains	Minor contributor	SA17 and SA20 – SA26 reported concentrations in soil and groundwater consistent with low level diffuse PFAS impact across the base. The contribution from these source areas is being monitoring under the OMP, and there no plans to undertake further management actions.
SA20	Runways	Minor contributor	
SA21	Football club	Minor contributor	
SA22	Oval	Minor contributor	
SA23	Mirage crash	Minor contributor	
SA24	Former waste burial area (southeast)	Minor contributor	
SA25	Lake Edward	Minor contributor	

Source area	Description	Contribution to PFAS off-base migration	Current status
SA26	Concrete and rubble stockpile	Minor contributor	

3.2 Transport pathways

PFAS can travel from a source to human and/or environmental receptors via transport pathways, such as surface water, groundwater, sediment and stormwater. The transport pathways identified at and surrounding the base are summarised in Table 3.

The surface water drainage network present on-base is detailed in Section 2.2 and the extent of the catchments are presented on Figure 3, Appendix B. It is understood that since the original mapping of the drainage network, redevelopment at the base has resulted in changes to the drainage network in the central area of the base. The main drainage channels remain unchanged and remain connected to one discharge point from the base, the EMD. In addition there is a minor drainage pathway off-site via the NWD associated to source areas SA01, SA03 and SA14, that leaves the base to the north along Cobains Road.

Infrastructure within the drainage network has localised impact on surface water drainage flow around some source areas. This infrastructure varies, such as redundant stormwater pits or overflow capture systems, and the degree of which this infrastructure impacts understanding of surface water drainage from nearby source areas is currently not well understood.

The primary pathway for the off-base migration of PFAS contamination is via surface water drainage features, and to a lesser extent, groundwater (Senversa, 2023). Surface water has been estimated to comprise approximately 90% of the total PFAS mass discharging from the base (1.27 kilograms [kg]/year). It was determined the Western Catchment contributes 42% of PFAS mass in surface water leaving the base, and the Eastern Catchment contributes 48% (Senversa, 2023). While sediment can transport PFAS through lateral movement when large amounts of surface water flow occur in the drainage network or overland during flooding events, sediment leaching and transport are not considered major pathways for PFAS discharge from the base (Senversa, 2023).

The highest concentrations of PFAS in groundwater were identified in the UAA, with decreasing concentrations in the LAA and then the HHA. Overall, groundwater was estimated to transport approximately 10% of PFAS mass identified from the base (0.14 kg/year).

Table 3. PFAS transport pathways

Environmental Media	PFAS transport mechanisms
Soil and hardstand material (concrete, asphalt)	Soil movements on-base, such as movement of stockpiles across base from redevelopment projects
	Leaching to surface water during rainfall events
	Vertical leaching to groundwater, through surface water infiltration
Sediment	Lateral movement with surface water during rainfall events
	Leaching PFAS to surface water bodies / drainage network
Surface water	Lateral movement overland through flooding and rainfall events
	Lateral movement through surface water drainage network
Groundwater	Vertical migration of PFAS in surface water to groundwater
	Lateral movement through groundwater towards off-base
	Interaction between groundwater discharging to surface water bodies / drainage network

Environmental Media	PFAS transport mechanisms
	Discharge of groundwater through extraction wells on- and off-base

3.3 Receptors and risks

Potential receptors that are considered to have elevated exposure risks associated with a complete transport pathways were identified by the HHERA (Senversa, 2018). These risks are summarised in Table 4 (on- and off-base human receptors) and Table 5 (on- and off-base ecological receptors).

Management actions are currently in place to reduce or mitigate human exposure, such as the Environmental Protection Authority Victoria (VIC EPA) consumption advice for duck, fish or eel caught from specific locations in the vicinity of the base. Precautionary advice signage was installed in 2021, and replaced in 2025 (locations of signage is shown on Figure 1 in Appendix B). The 2024 HHERA review confirmed that the risk profile for the Management Area had not changed since the 2017 assessment based on the available OMP data (Senversa, 2024).

The Victorian Government's response to PFAS is being coordinated by the VIC EPA with relevant Victorian Government Agencies. Further information can be found on their website, https://www.epa.vic.gov.au/and-polyfluoroalkyl-substances-pfas.

Table 4. Risks to on- and off-base human receptors

Location	Receptor	Environmental Media	Exposure Summary
On-base (active)	Intrusive workers	Surface water and shallow groundwater	Direct and incidental contact with impacted surface water and shallow groundwater. The potential risks to on-base intrusive workers can be effectively managed through the use of personnel protective equipment (PPE) and administrative controls employed by Defence (Work Health and Safety Strategy 2023-2028).
On-base (leased)	Human consumption	Meat, offal and milk raised on-base	In high consumption scenarios such as home consumption. There is currently no meat consumption by the grazier farming the on-base cattle or sheep. This is also a condition of the lease agreement (i.e., no home consumption of livestock raised on-base). No dairy cows are present in the on-base grazing areas.
Off-base	Human consumption	Duck tissue	Home consumption of duck caught from the Heart Morass even at low rates (i.e. 1 serve of duck a month). This exposure is currently managed via VIC EPA's consumption advice.

Location	Receptor	Environmental Media	Exposure Summary
		Fish	Home consumption of fish caught recreationally from the Heart Morass. Public consumption of commercial catch from the Heart Morass (around the EMD outlet only). Recreational consumption of fish is currently managed via VIC EPA's consumption advice. It is understood the Victorian Fisheries Authority (VFA) no longer issues commercial fishing licences in the Heart Morass.
		Eels and carp	Home consumption of eel and carp caught from the Lower Latrobe River bounded by the Heart Morass. This human exposure is managed via VIC EPA's consumption advice.

The HHERA assessed ecological risk by reviewing surface water PFAS concentrations in water bodies surrounding the base. Table 5 summarises the conclusions for direct and indirect exposure to ecological receptors.

Table 5. Risks to on-base and off-base ecological receptors

Location	Risk Type	Receptor	Environmental Media	Exposure Summary
Off-base	Direct ecological risk	Aquatic biota (flora and fauna)	Surface water	Potentially elevated risk was noted for the Heart Morass and the Dowd Morass. The risk evaluation for Sale Common, Latrobe River, Flooding Creek, Thomson River and Lake Wellington were assessed as low and acceptable.
	Bioaccumulation risk			Potentially elevated risk was noted for the Heart Morass, Sale Common, Dowd Morass, Latrobe River, Flooding Creek and Lake Wellington. The risk evaluation for Thomson River was assessed as low and acceptable.
	Indirect ecological risk	Higher order predators	Biota (flora and fauna)	Elevated risk from consumption of biota from the Heart Morass. Higher order predators may source only a portion of their diet within the Management Area, and the assessment of elevated risk

Location	Risk Type	Receptor	Environmental Media	Exposure Summary
				does not necessarily indicate adverse effects.
On-base	Direct ecological risk	Aquatic biota (flora and fauna)	Surface water	Potentially elevated risks were noted for on-base water bodies (ponds) for both direct exposure and bioaccumulation.
	Bioaccumulation risk			

Potential receptors where the risks were considered low and acceptable by the HHERA (Senversa 2018) include:

- public consumption of meat, milk or offal raised on-base
- home and public consumption of meat, milk or offal raised off-base
- public consumption of commercially caught fish from the Latrobe River at any rate, or eels and carp at low rates
- home consumption of fish caught recreationally in the Latrobe River
- incidental contact with groundwater or surface water in drains either on-base or off-base
- livestock health either on-base or off-base.

These receptors have been reviewed in the context of subsequent investigations, including the most recent OMP monitoring data (AECOM, 2026), and the risk profile was not considered to have changed since the HHERA was reviewed (Senversa, 2024).

4 RISK MANAGEMENT ACTIONS

This section outlines the actions that Defence will take to manage the risks associated with PFAS that are described in Section 3.

4.1 Background

In developing actions to address potential risks to receptors from PFAS contamination, Defence considers:

- whether a remediation option is proportional to risks
- the sustainability and longevity of an option (environmental, economic and social) in achieving an appropriate balance between benefits and effects
- views of the jurisdictional regulator and other stakeholders
- availability of best-practice management systems, treatments and technologies
- site specific issues (including transformation, cross-contamination, and remobilisation)
- logistical and operational constraints
- effectiveness and validation status of technology
- success measures for the treatment or remediation outcomes
- the need for ongoing operations, management, maintenance or monitoring
- the net environmental benefit.

Defence prioritises source and pathway management as preferable to receptor management in addressing the management priorities outlined in Section 1.2, however, these components may be progressed concurrently.

4.2 Implementation

Defence takes a risk-based approach to implementing actions under this PMAP and considers value for money in the use of public resources. Defence engages consultants to implement the PMAP.

Key factors for progressing and prioritising PMAP actions include:

Mitigating PFAS migration and protecting human health	Implementation of practicable solutions to prevent or minimise the migration of PFAS beyond the Defence property boundary, and measures to protect the community from exposure to PFAS.
Higher risks	The relative level of risk being addressed, including changes in land use.
Outcomes of completed works	Outcomes from further studies, technology trials or validated remedial works may change the profile or priority of source areas or works.
Linked actions	Whether the implementation of one risk management action is dependent on the implementation of another risk management action.
Use of public resources	Application of the Commonwealth Procurement Rules (issued under the *Public Governance, Performance and Accountability Act 2013*) including the Defence Infrastructure Panel – Environment, Heritage and Estate Engineering Services 2020-2025, to achieve value for money in procurement and to use public money in an efficient, effective, economical and ethical manner. Cost-effectiveness may be facilitated through:

	• grouping the implementation of similar risk management actions within one or more Management Areas • aligning Defence infrastructure and maintenance plans with a PFAS response action.
Mandatory approvals	Timeframes for mandatory approvals and notification processes.
New legislation or policy	Development of relevant legislation, policy, guidelines and whole-of-government positioning.
Science and technology	The availability of new relevant science and technology.
Stakeholder input	Information from stakeholders that may impact a risk profile.

4.3 Status of 2018 PMAP recommended actions

A screening assessment of options to manage the risks presented in Section 3 was undertaken as part of the 2018 PMAP. Based on this assessment, the strategy adopted was to eliminate the source of PFAS (AFFF), target on-site drainage improvement and implement administrative controls via engagement with relevant State-based agencies.

The status of actions in the 2018 PMAP are detailed in Table 6 below.

Table 6. Status of 2018 PMAP recommended actions

Action	Description	Status	Reason / timeframe
Source Management	Discontinue use of legacy AFFF containing PFAS (3M lightwater formulation) at the base.	**Complete**	• From 2004, Defence commenced phasing out its use of legacy firefighting foams (including 3M lightwater) containing perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) as active ingredients. This program was completed with redundant stocks removed from all bases across the estate.
Source Management	Manage use of AFFF containing other PFAS (such as Ansulite formulation) for emergency response.	**Partially Complete**	• From 2004, Defence commenced transitioning away from PFOS dominated firefighting foams to a C6 based product called Ansulite. These replacement products contain PFAS. • Ongoing management and removal of legacy AFFF is being handled through Defence's Foam Transition Program with plans to replace all fluorinated AFFF at all bases across the Defence estate. All AFFF has been isolated from active fire protection systems at RAAF Base East Sale.
Pathway Management	**Drainage network study** Assessment of: • Drainage network flow conditions • Partitioning rate of PFAS from sediments to water • Modelling of PFAS transport pathways to increase understanding of mass transport to receiving environments (i.e. Heart Morass) and inform drainage improvement works	**Partially complete**	• A drainage network study was completed in 2024 as a part of the Interpretive PFAS Mass Flux Assessment (Senversa, 2023) and reviewed the contributions from surface water and groundwater transport pathways to PFAS mass leaving the base, inclusive of flow conditions. • Based on the conclusions of the assessment, Defence are planning to pilot pathway management options (passive surface water remediation) for short term implementation at the base as a part of the ongoing management actions in Section 4.4. • PFAS mass distribution and partitioning into the Heart Morass was unable to be fully characterised through the Interpretive PFAS Mass Flux Assessment (Senversa, 2023), however, it was acknowledged that PFAS transport in surface water was

Action	Description	Status	Reason / timeframe
	• Characterisation of PFAS mass distribution and partitioning in the Heart Morass • Modelling of shallow groundwater discharge to drains, in particular, where contributions may be significant from source areas.		the key source of mass discharge from the base towards the Heart Morass. • PFAS in sediments were not considered a significant mechanism for PFAS leaving the base, however, were considered to influence PFAS concentrations in sediment pore water (Senversa, 2023). • Refinement of the specific transport contributions from key source areas presented in Section 3.1 is planned to inform future PFAS remediation / management actions at key source areas and establish pre-remediation base line conditions.
Pathway Management	**Construction management procedures** Implement administration controls such as site-specific environmental management plans, Defence PFAS framework for construction and maintenance projects.	**Ongoing**	• Defence has implemented a national framework for the management of PFAS impacted soil and water in construction and upgrade projects (refer to Defence PFAS Construction and Maintenance Framework). This document was prepared in accordance with the PFAS NEMP (HEPA, 2025). Implementation is ongoing. • The need for a base-wide Spoil Management Plan will be considered should significant infrastructure upgrades / redevelopment be required at the base.
Exposure Management	**Ongoing Monitoring Plan**	**Ongoing**	• Implementation of the OMP is ongoing. Defence will continue to review and update the current understanding of the risk profile for the base based on ongoing monitoring data.
Exposure Management	**Precautionary advice** Continue to publicise regulator advisories.	**Completed & Ongoing**	• VIC EPA precautionary advice signage was installed in 2021 at four locations in the Heart and Dowd Morasses. These locations are presented on Figure 1 (Appendix B). • VIC EPA precautionary advice signage was replaced in 2025 at the above four locations in the Heart and Dowd Morasses. • Engagement with VIC EPA and other stakeholders to confirm the currency of precautionary advice and its implementation is ongoing.

4.4 Additional and ongoing risk management actions

The review of the 2018 PMAP management actions identified that refinement of ongoing risk management actions is required. These updated risk management actions are outlined in Table 7.

The strategy adopted in the review was to assess the actions outlined in the 2018 PMAP (Table 6) against the updated CSM and assess what other risk management actions may be required to progress the base towards remediation and site closure.

Table 7. PMAP recommended actions

Action	Description	Status	Management Activity
Source Management	**Source area remediation planning** Undertake a Remedial Options Assessment (ROA) and develop a Remediation Action Plan (RAP) for source areas SA06 and SA16.	**In progress**	• Conducted soil sampling to characterise the extent of PFAS mass in soil at source areas SA06 and SA16. • Conduct soil modelling to estimate the mass of PFAS in soil and therefore inform a remedial planning approach. • Complete an ROA for the base with source area specific considerations. • Develop soil RAPs for SA06 and SA16.
Pathway Management	**Groundwater and drainage network (surface water) characterisation study** Improve understanding of PFAS migration in groundwater and surface water from key source areas	**In progress**	• Review the surface water drainage network for currency. • Increase resolution of surface water and groundwater data to support understanding of pathways from source areas for future remediation planning. • Install groundwater wells off-base to characterise groundwater movement towards / seepage towards receptors.
Pathway Management	**Passive Surface Water Treatment**	**In progress**	• Further investigations undertaken to inform the potential effectiveness and design of a passive surface water treatment system within the drainage network which discharges into the Heart Morass. • Inclusion of the results of treatment system trial in remediation options assessments and potential inclusion in PFAS remediation management plan for pathway management.
Source & Pathway Management	**Source area remediation planning** Undertake an investigation strategy to prioritise source areas	**In progress**	• Develop a base-wide PFAS remediation strategy that considers both pathway and source management options. • Inclusion of short-, medium- and long-term goals for the source areas to be remediated and the broader base management.

Action	Description	Status	Management Activity
	and develop a base wide remedial strategy.		• Develop a prioritised remedial response, implemented in a staged approach informed by the OMP and remedial performance.

4.5 Completed PFAS management works

Outside of PMAP implementation, stockpile waste characterisation and assessment has been undertaken as part of on-base construction activity. During redevelopment works at the base, PFAS impacted soil was identified as a part of the waste management. At the time, PFAS impacted spoil was unable to be disposed of in Victoria and the spoil was stockpiled for future management. Since generation of the stockpiles, off-base disposal options have become available. The following has been completed with respect to management of the stockpiles, and no further action is warranted:

- In June 2023, approximately 5,000 tonnes of PFAS contaminated soil were transported to a licensed treatment facility for thermal destruction. The soils were initially removed from a source area on the base when construction occurred in 2016.
- Between August 2024 and April 2025, approximately 42,750 tonnes of PFAS impacted material was transported off-base for treatment via thermal destruction.
- Consolidation of remaining stockpiled material was undertaken in 2025, along with reinstatement of the staging area. The material will be reused on-base following assessment of risk, and in accordance with the Defence PFAS Construction and Maintenance Framework (CMF).

4.6 Ongoing monitoring and trigger levels

Defence continues to monitor PFAS concentrations in the environment at the base through an ongoing monitoring program. This allows for the timely identification and management of emerging risks and informs Defence's approach to the management of PFAS. Monitoring requirements are outlined in an Ongoing Monitoring Plan (OMP). The OMP is reviewed regularly and, if required, amended to ensure it continues to provide the data needed to monitor important changes in PFAS concentrations and distribution.

The results from the ongoing monitoring program are shared with VIC EPA and are provided in an Ongoing Monitoring Reports, which are made available on the Defence website. The Ongoing Monitoring Report provides the PFAS data, and an analysis of what important changes in concentrations may mean to the profile of PFAS contamination set out in the CSM, or potential changes to risks to humans or the environment.

The OMP outlines triggers and actions that Defence will undertake if certain results or trends are reported from the ongoing monitoring program. This includes actions to confirm the accuracy of results, notification to the VIC EPA and other agencies upon new PFAS detections or increasing trends. Additionally, it includes implementing further investigations and risk management actions if the monitoring data indicates changes to the current risk profile.

5 NEXT STEPS

Defence will carry out the risk management actions set out in this PMAP and continue to reassess its actions based on a range of factors, such as the outcomes of remediation, monitoring results, changes to government policy settings, base conditions, scientific methodologies and technologies.

Defence will review, and if required, revise the PMAP at regular intervals to ensure the PMAP remains current, relevant and prioritises the right actions to protect human health and the environment. Defence will continue to engage with the community, the Council, VIC EPA and other stakeholders to ensure information is available in an easily accessible form.

It is not possible to remove all PFAS from the environment. It is acknowledged that restoration of environmental values is an expectation for remediation under Victorian legislation, and where restoration is not possible, remediation so far as reasonably practicable is adopted. Remediation at RAAF Base East Sale will be undertaken so far as reasonably practicable, and unacceptable risks that may remain will be identified through monitoring and be appropriately managed.

In determining what is reasonably practicable, the flowing range of aspects will be considered:

- level of risk from PFAS to human and ecological receptors
- environmental site setting
- nature and extent of PFAS contamination
- availability of proven technologies suitable for the characteristics of the site
- logistical and operational constraints of the site
- financial and sustainability aspects of each technology.

At completion of remediation, an independent professional accredited as a site auditor by VIC EPA and engaged by Defence, will assess whether remediation has been conducted so far as reasonably practicable. The PMAP will then be updated to reflect a transition to ongoing monitoring, and long-term management of remaining risks.

APPENDIX A REFERENCES

Key documents

Department of Defence (2018), *RAAF Base East Sale PFAS Management Area Plan*, dated August 2018.

Senversa (2017), *Detailed Site Investigation, RAAF Base East Sale – Per- and Poly-fluoroalkyl Substances (PFAS) Investigations*, dated 07 June 2017.

Senversa (2018), *Human Health and Ecological Risk Assessment, RAAF Base East Sale – Per- and Poly-fluoroalkyl Substances (PFAS) Investigations*, dated 28 May 2018.

Senversa (2023), *Interpretive PFAS Mass Flux Assessment, RAAF Base East Sale (0937),* dated 13 October 2023.

Senversa (2024), *Technical Memorandum: RAAF Base East Sale 2018 HHERA Review,* dated 19 April 2024.

Stantec [formerly Cardno] (2024), *PFAS Ongoing Monitoring Report (2023), RAAF East Sale*, dated 24 July 2024.

Other references

AECOM (2025), *Site Review Assessment, RAAF Base East Sale*, dated February 2025.

AECOM (2026), *Ongoing Monitoring Report, 2025, RAAF Base East Sale*, DRAFT.

Department of Defence (2022), *Defence Contamination Management Manual*, dated March 2018, amended June 2022.

Department of the Environment, Water, Heritage and the Arts (DEWHA), 2010, *Gippsland Red Gum Grassy Woodland and Associated Native Grassland, A nationally threatened ecological community - Environment Protection and Biodiversity Conservation Act 1999 Policy, Statement 3.22,* dated April 2010.

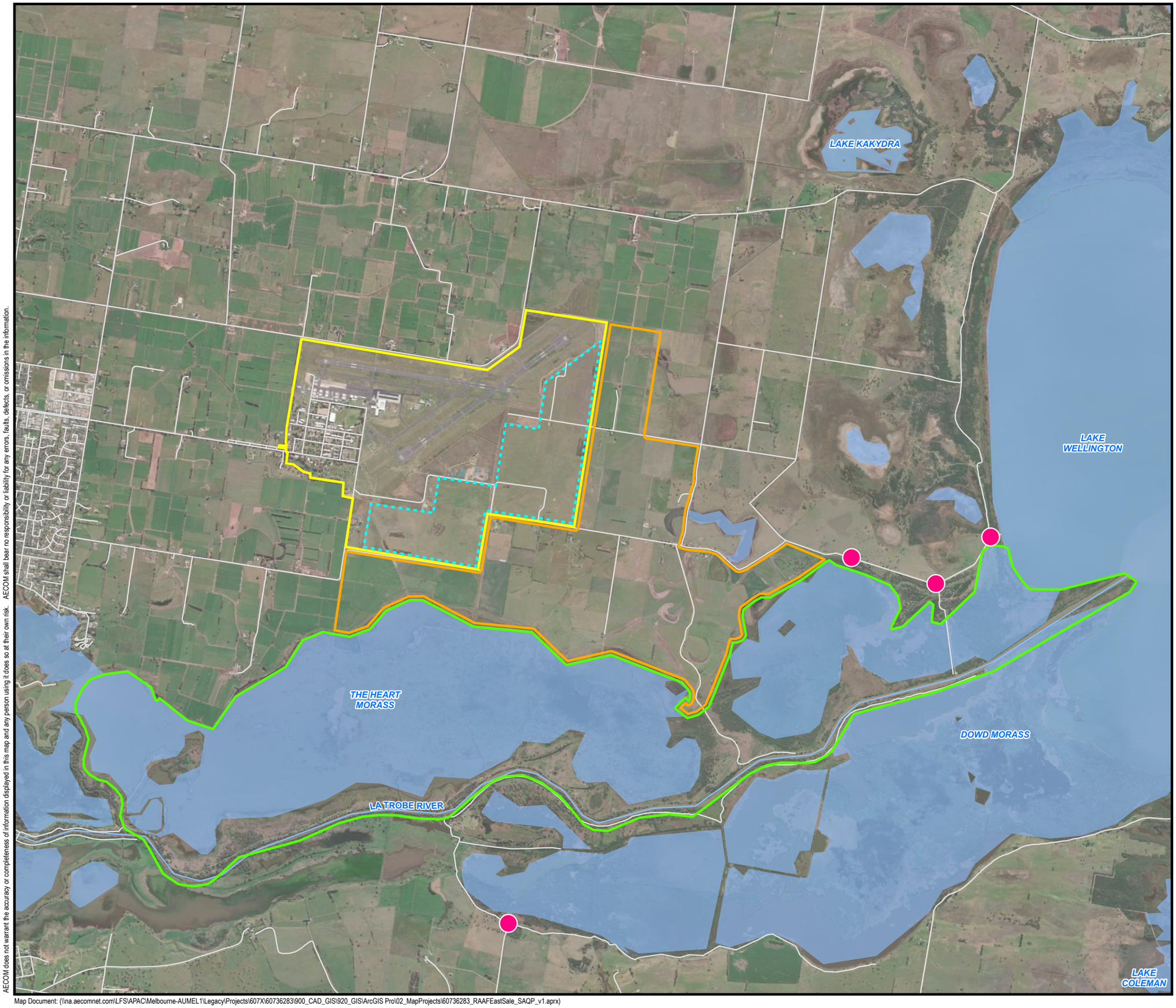
Heads of Environmental Protection Agencies (HEPA), 2025. Australian and New Zealand, 2018, PFAS National Environmental Management Plan (NEMP), version 3.0, March 2025.

National Environmental Protection Council (2013), *National Environment Protection (Assessment of Site Contamination) Measure*, dated 22 December 1999, amended 11 April 2013.

West Gippsland Catchment Management Authority (WGCMA) 2008, *West Gippsland Native Vegetation Plan 2003,* dated June 2003, updated February 2008.

APPENDIX B FIGURES

List of Figures



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LEGEND

- Base Management Area
- Base Management Area: Leased Land
- Off-base Monitoring Area: Heart Morass
- Off-base Monitoring Area
- Water bodies
- Roads
- Rivers and Streams
- Precautionary Signage locations

Data sources:
Disclaimer:

SITE LOCATION AND MONITORING AREAS

PFAS Management Area Plan

0937 RAAF Base East Sale

Figure 1

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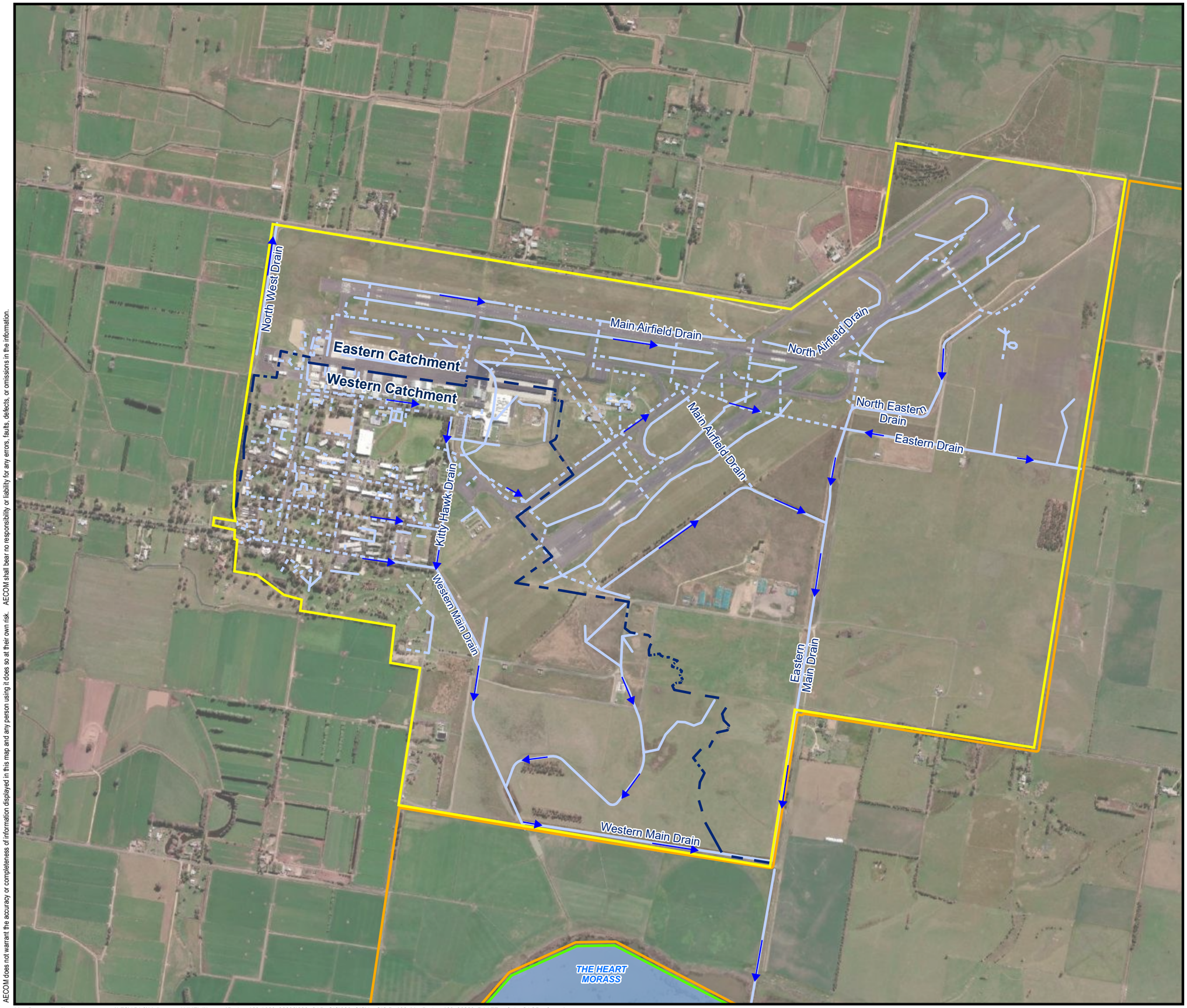

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LEGEND

- Base Management Area
- Off-base Monitoring Area: Heart Morass
- Off-base Monitoring Area
- Waterbodies
- Open Drain
- Closed Drain
- Catchment Boundary
- Inferred surface water flow direction

Data sources:
Disclaimer:

DRAINAGE CHANNELS AND CATCHMENTS

PFAS Management Area Plan

0937 RAAF Base East Sale

Figure
2

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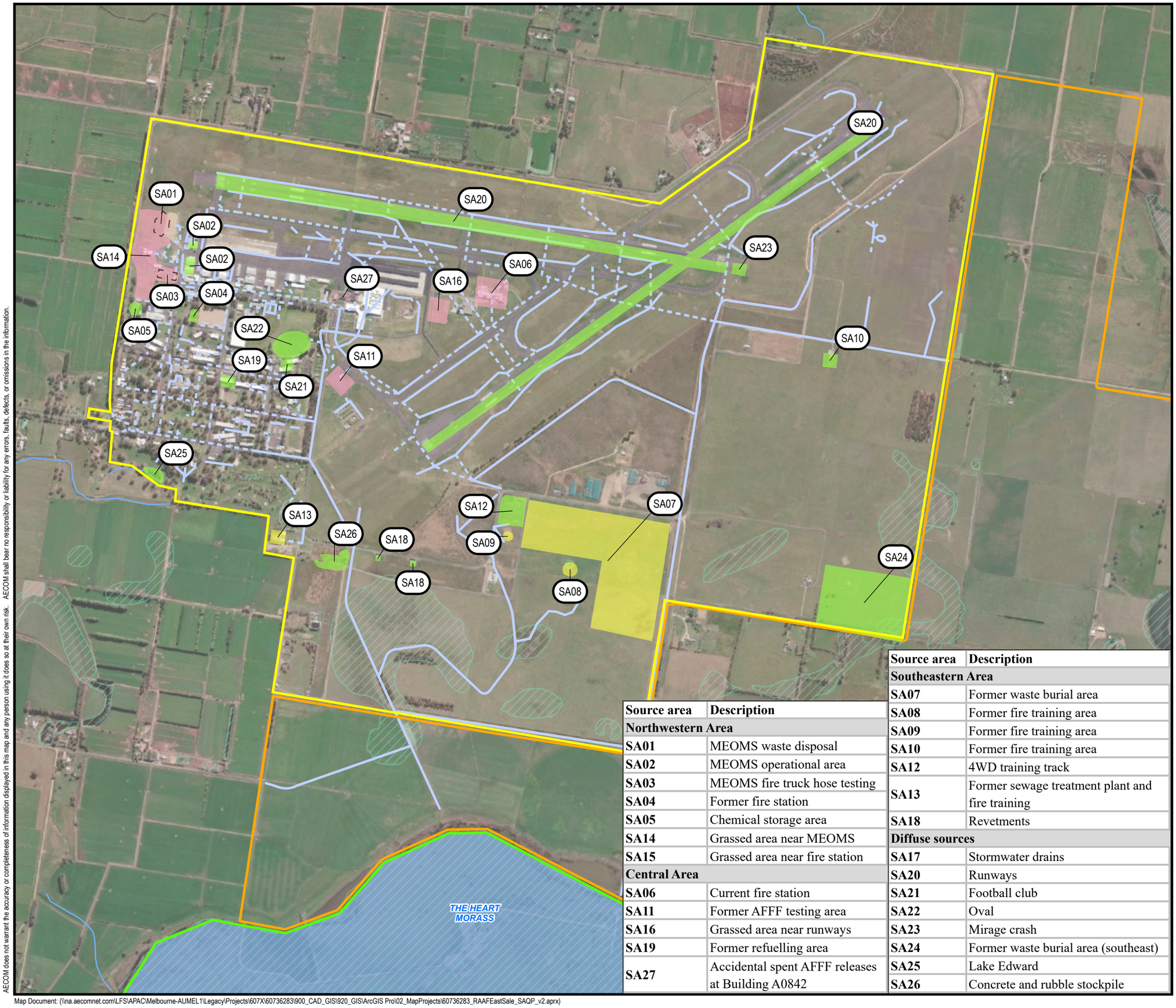

Source area	Description
Northwestern Area	
SA01	MEOMS waste disposal
SA02	MEOMS operational area
SA03	MEOMS fire truck hose testing
SA04	Former fire station
SA05	Chemical storage area
SA14	Grassed area near MEOMS
SA15	Grassed area near fire station
Central Area	
SA06	Current fire station
SA11	Former AFFF testing area
SA16	Grassed area near runways
SA19	Former refuelling area
SA27	Accidental spent AFFF releases at Building A0842

Source area	Description
Southeastern Area	
SA07	Former waste burial area
SA08	Former fire training area
SA09	Former fire training area
SA10	Former fire training area
SA12	4WD training track
SA13	Former sewage treatment plant and fire training
SA18	Revetments
Diffuse sources	
SA17	Stormwater drains
SA20	Runways
SA21	Football club
SA22	Oval
SA23	Mirage crash
SA24	Former waste burial area (southeast)
SA25	Lake Edward
SA26	Concrete and rubble stockpile

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LEGEND

- Base Management Area
- Off-base Monitoring Area: Heart Morass
- Off-base Monitoring Area
- Waterbodies
- Area Subject to Inundation
- Open Drain
- Closed Drain
- Watercourse

Contribution to PFAS off-base migration

- Key contributor
- Moderate contributor
- Minor contributor
- Has not been quantified yet

PFAS SOURCE AREAS

PFAS Management Area Plan

0937 RAAF Base East Sale

Figure 3

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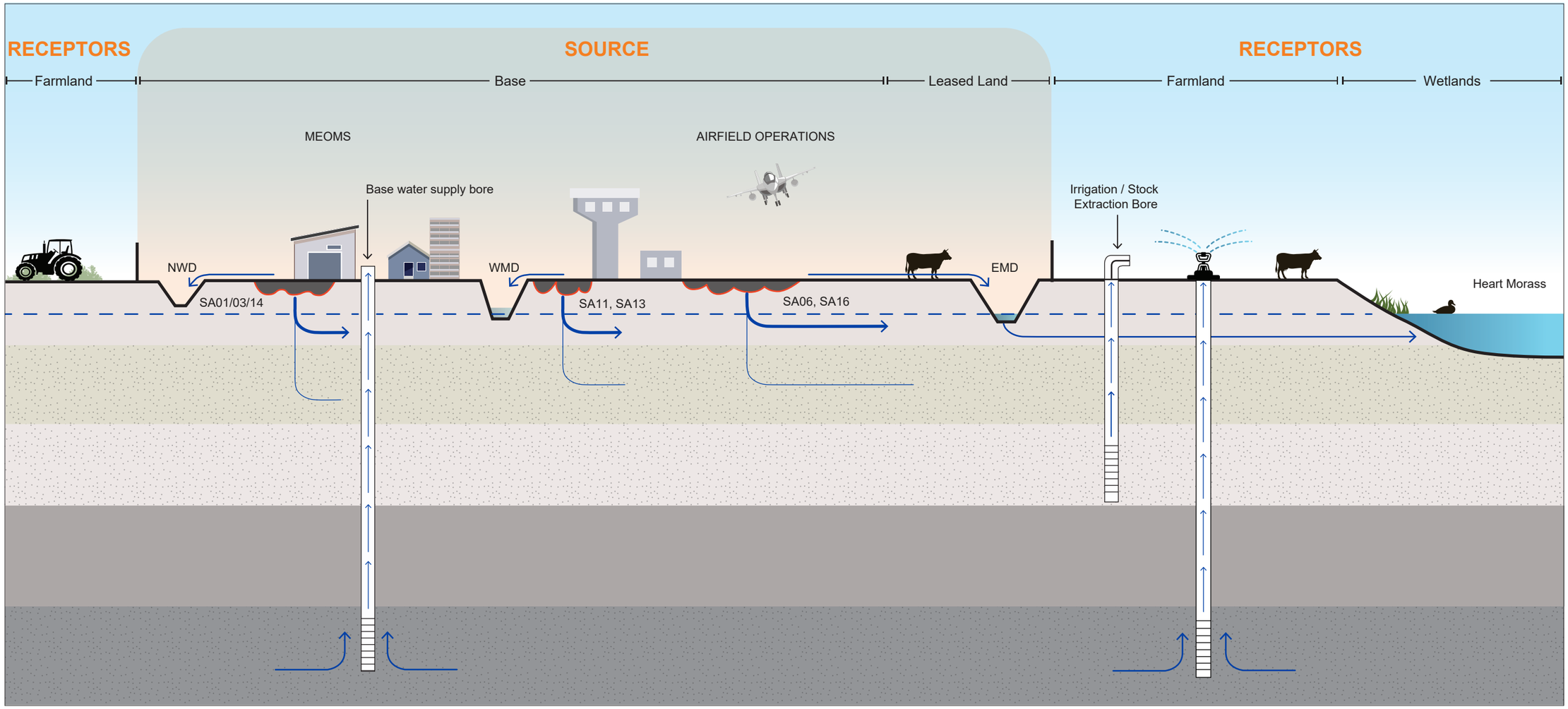
APPENDIX C CONCEPTUAL SITE MODEL

This Appendix provides visualisations of the source – pathway – receptor relationships in the form of a Conceptual Site Model.



Not to scale

LEGEND

- Upper Alluvial Aquifer
- Lower Alluvial Aquifer
- Haunted Hills Aquifer
- Nutin Clay Aquitard (Boisdale Formation)
- Wurruk Sand Aquifer (Boisdale Formation)
- Surface water
- Water table
- Groundwater flow
- Key source areas
- NWD Northwestern Drain
- EMD Eastern Main Drain
- WMD Western Main Drain
- MEOMS Mechanical Equipment Operations Maintenance Section
- Water infiltration

PFAS Conceptual Site Model

RAAF Base East Sale

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