



Ongoing Monitoring Report, October 2024 – May 2025

Department of Defence

Per and Polyfluoroalkyl Substance (PFAS) Ongoing Monitoring Program
(OMP) – Royal Australian Air Force (RAAF) Base Amberley

JBS&G 66133 | 169,836 Rev 0

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We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

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Abbreviations

Abbreviation / Acronym	Full Term
AFFF	Aqueous Film Forming Foam
AMO	Atlantic Multidecadal Oscillation
AHD	Australian Height Datum
AIR	Annual Interpretive Report
ANZECC	Australia New Zealand Environmental Conservation Council
ANZG	Australia and New Zealand Guidelines
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999 (As Amended 2013)
BoM	Bureau Of Meteorology
CPSA	Confirmed Primary Source Area
CSM	Conceptual Site Model
Defence	Department Of Defence
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DoH	Department Of Health
DP	Discharge Point
DQOs	Data Quality Objectives
DSI	Detailed Site Investigation
EC	Electrical Conductivity
Eh	Oxidation Reduction Potential
ERA	Ecological Risk Assessment
FTA	Fire Training Area
HEPA	Heads Of Environmental Protection Agencies
HHRA	Human Health Risk Assessment
LOR	Limit Of Reporting
NA	Not Applicable
NEMP	National Environmental Management Plan
NHMRC	National Health and Medical Research Council
OMP	Ongoing Monitoring Plan
OMR	Ongoing Monitoring Report
PFAS	Per- And Poly-Fluoroalkyl Substances
PFOS	Perfluorooctane sulfonate
PFHxS	Perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFBS	Perfluorobutane sulfonic acid
PMAP	PFAS Management Area Plan
QA/QC	Quality Assurance / Quality Control
RAAF	Royal Australian Air Force
RAP	Remediation Action Plan
SAQP	Sampling Analysis and Quality Plan
STP	Sewage Treatment Plant

Abbreviation / Acronym	Full Term
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UST	Underground Storage Tank

Per and Polyfluoroalkyl Substance (PFAS) Compounds and Chemical Abstract Service (CAS) Numbers

PFAS Group	Compound	CAS No.
Perfluoroalkyl Sulfonic Acids	Perfluorobutane sulfonic acid (PFBS)	375-73-5
	Perfluoropentane sulfonic acid (PFPeS)	2706-91-4
	Perfluorohexane sulfonic acid (PFHxS)	355-46-4
	Perfluoroheptane sulfonic acid (PFHpS)	375-92-8
	Perfluorooctane sulfonic acid (PFOS)	1763-23-1
	Perfluorodecane sulfonic acid (PFDS)	335-77-3
Perfluoroalkyl Carboxylic Acids	Perfluorobutanoic acid (PFBA)	375-22-4
	Perfluoropentanoic acid (PFPeA)	2706-90-3
	Perfluorohexanoic acid (PFHxA)	307-24-4
	Perfluoroheptanoic acid (PFHpA)	375-85-9
	Perfluorooctanoic acid (PFOA)	335-67-1
	Perfluorononanoic acid (PFNA)	375-95-1
	Perfluorodecanoic acid (PFDA)	335-76-2
	Perfluoroundecanoic acid (PFUnDA)	2058-94-8
	Perfluorododecanoic acid (PFDoDA)	307-55-1
	Perfluorotridecanoic acid (PFTrDA)	72629-94-8
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	
Perfluoroalkyl Sulfonamides	Perfluorooctane sulphonamide (FOSA)	754-91-6
	N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8
	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2
	N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	2448-09-7
	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2
	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	
(n:2) Fluorotelomer Sulfonic Acids	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4
	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4
	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0

Units

Abbreviation	Term	Abbreviation	Term
GWE	Groundwater Elevation	°C	Degrees Celsius
Kg	Kilogram	m AHD	Metres Australian Height Datum
km	Kilometre	m bTOC	Metres below Top of Casing
km ²	Kilometre squared	mg	Milligram
mV	Millivolt	mg/L	Milligram per litre
L	Litres	mbgl	Metres below ground level
m	Metre	µS/cm	Micro-Siemens per centimetre
mm	Millimetre	SWL	Standing Water Level
cm	Centimetre	µg	Microgram
Ha	Hectare	µg/L	Microgram per litre

Executive Summary

Introduction

JBS&G Australia Pty Ltd (JBS&G) has been engaged by the Department of Defence (Defence) to act as the Lead Consultant for the implementation of the RAAF Base Amberley, Per and Polyfluoroalkyl Substances (PFAS) Management Area Plan (the PMAP) (Defence, 2025a) and Ongoing Monitoring Plan (OMP) (Defence, 2025b). The location of the Base and Management Area are shown on **Figure 1**.

This Ongoing Monitoring Report (OMR) has been prepared in general accordance with the Defence (2024) *Ongoing Monitoring Program Reporting Guidance* and presents an assessment of monitoring completed in accordance with the OMP between October 2024 and May 2025 (the '2024-2025 monitoring period').

Objective

The objective of this OMR is to assess the following in consideration of the PMAP (Defence, 2025a), historical OMP data and other relevant information:

- Objective 1: The distribution (spatial and temporal) and transport of PFAS in the Management Area.
- Objective 2: Whether the current understanding of risks to human and ecological receptors require review.
- Objective 3: PMAP delivery and associated management actions, where relevant.

Monitoring Scope

The 2024-2025 monitoring period was conducted during a transitional phase in which the former OMP (Defence, 2020) was being updated. As a result, JBS&G completed the monitoring under two separate Sampling and Analysis Quality Plans (SAQPs): one reflecting the sampling design aligned with the previous OMP (Defence, 2020), and the other incorporating the revised requirements of the revised OMP (Defence, 2025b). The monitoring program comprised the following:

- Assessment of groundwater, surface water and sediment at the end of the dry season (October / November 2024). The program included assessment of additional groundwater monitoring wells installed as part of well replacement works during the previous 2023-2024 monitoring period.
- Assessment of groundwater and surface water at the end of the wet season (April / May 2025) in accordance with the revised OMP.

Interpretive Assessment

Surface Water and Sediment

Surface water and sediment samples were collected from on-Base drainage lines as well as Warrill Creek and the Bremer River. All on-Base drainage lines eventually discharge into either Warrill Creek or the Bremer River. Warrill Creek converges with Bremer River immediately east of the Base, with Bremer River then continuing east and then north throughout the Management Area. It is noted that the conceptual understanding of the discharge point from Catchment 8 changed during the 2024-2025 monitoring period, with a surface water feature (i.e. the Lagoon) now understood to be present between the discharge point and the Bremer River.

For sediment, 47 primary samples were collected during the October / November 2024 event. For surface water, 44 primary samples were collected during the October / November 2024 event, and 56 primary samples were collected during the April / May 2025 event. Sediment samples were collected during the October / November 2024 event only as a result of changes to the OMP.

PFAS concentrations detected in surface water samples were predominantly consistent with historical results, with a) no evidence of significant increasing trends¹ and b) new historical maximum concentrations detected at less than 10% of the sampling locations (less than 5% of sample locations were greater than an order of magnitude from previous historical maximum). The new historical maximums did not result in a change to the overall risk profile, with only one new maximum reporting a first-time exceedance of adopted screening criteria.

PFAS concentrations detected in sediment were predominantly consistent with historical results, with new historical maximum concentrations detected at less than 10% of the sampling locations (the majority of which were associated with first time detections). Due to the absence of established Commonwealth sediment screening values, the significance of PFAS detected in sediments is therefore assessed indirectly via surface water monitoring, which showed no change in the overall risk profile for the Management Area.

Groundwater

A groundwater aquifer is an underground layer of porous and permeable rock, gravel, sand or silt, which can contain or transmit groundwater. There are two groundwater aquifers that are monitored at Amberley, namely: Alluvium-Tertiary Formation and Walloon Coal Measures. The Walloon Coal Measures aquifer is present at surface along the western boundary of the Base and underlies the Alluvium-Tertiary Formation aquifer at other locations.

The groundwater flow direction in the shallow aquifer during the sampling events was similar. Groundwater flows in multiple directions from the central western portion of the Base, towards Bremer River and Warrill Creek flowing northeast, east and southeast. Groundwater flowing outwards in multiple directions from a single area where there is elevated groundwater is referred to as radial. The groundwater flow direction in the deeper aquifer during the sampling events were also similar, with groundwater flowing from west to east. This is consistent with previous investigations and monitoring rounds.

Bremer river has been confirmed to be a predominantly gaining stream and Warrill Creek a predominantly losing stream. As a result of drinking water changes during the current OMR period, the extent of PFAS contamination above drinking water criteria downgradient of wells located east and south of Bremer River and Warrill Creek is not delineated in some areas by the current OMP network (e.g. south of MW054S, east of MW057S, east of MW056I). The recommendations of this OMR have considered these findings.

Groundwater samples were collected from monitoring wells installed across the Base and areas within the Management Area adjacent to Warrill Creek and the Bremer River. A total of 44 primary groundwater samples were collected during October / November 2024 event and 45 primary samples were collected during the April / May 2025 event. PFAS concentrations detected in groundwater were consistent with historical results, noting a) evidence of both increasing and decreasing concentration trends in some wells, and b) identification of new historical maximum concentrations in less than 25% of the monitoring wells (less than 15% of monitoring wells were greater than an order of magnitude from previous historical maximum). The new historical maximums did not result in a change to the overall risk profile, with only two new maximums reporting a first-time exceedance of adopted screening criteria. The increasing trends are considered to be related to above average rainfall conditions and elevated groundwater levels, as noted in the previous OMR. Increasing trends observed in Catchment 6 may also be related to stockpile management activities associated with the new STP construction project. The next round of monitoring and associated OMR will continue to assess this and whether the results represent an increase in risk.

¹ **No evidence of significant increasing trends** indicates that, although a statistical test (such as the Mann–Kendall assessment) has recorded an increasing trend, this result is not considered to represent a true or meaningful increase when evaluated against the broader dataset and contextual factors (e.g. limits of reporting and the magnitude of increase)

Risk Summary

The conceptual site model was reviewed considering the new monitoring data collected over the monitoring period. No changes were identified to sources, pathways or receptors at the Base or within the Management Area to change the risk profile described in the PMAP based on available information. Recent updates to the drinking water criteria have not resulted in a change to the risk profile.

Conclusions

The overall conclusions can be summarised as follows:

- Objective 1: The distribution of PFAS in the Management Area has not changed significantly since the previous monitoring period. Bremer river has been confirmed to be a predominantly gaining stream and Warrill Creek a predominantly losing stream.
- Objective 2: The risk profile to human health and ecological receptors within the Management Area remains unchanged since the publication of the PMAP.
- Objective 3: Additional investigations have been progressed with the view to develop Remediation Action Plans for Catchments 3, 7 and 8. Key management actions undertaken during the monitoring period have included a) significant earthworks and hardstand construction works across PFAS source areas, b) ongoing operation of two water treatment plants which collect and treat water from fire training areas, and c) ongoing construction of a new Sewage Treatment Plant with PFAS treatment capability (refer to **Section 6.2**).

Recommendations

The following recommendations were made:

- The Ongoing Monitoring Program should be reviewed in consideration of the findings of this OMR, specifically including:
 - Inclusion of surface water sampling targeting the Lagoon.
 - The findings of ongoing investigations in relation to Catchments 3, 7 and 8 (e.g. installation of additional groundwater monitoring wells which require ongoing monitoring, surface water sampling targeted towards proposed remediation areas).
 - All future surface water and groundwater samples collected as part of the OMP are tested at a lower LOR to enable comparison with NHMRC (2025).

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) has been engaged by the Department of Defence (Defence) to act as the Lead Consultant for the implementation of the *Per- and Poly-fluoroalkyl Substances (PFAS) Management Area Plan* (the PMAP) (Defence, 2025a) for the Royal Australian Air Force (RAAF) Base in Amberley, Queensland (RAAF Base Amberley, Defence Property ID 0861, the Base). The location of the Base and Management Area have been illustrated on **Figure 1**.

An important requirement of the PMAP is to undertake ongoing monitoring of PFAS in the environment and to assess for changes in risks to human and ecological receptors from PFAS originating from the Base. The Ongoing Monitoring Plan (OMP) (Defence, 2025b) sets out the requirements for collection of adequate data to assess changes in the nature and extent of contamination across the Management Area. The information collected may be used to inform where new risk management actions may be required, or to support a determination that remediation has been completed so far as reasonably practicable.

This Ongoing Monitoring Report (OMR) has been prepared in general accordance with the *Ongoing Monitoring Program Reporting Guidance* (Defence, 2024) and presents an assessment of monitoring completed in accordance with the OMP between October 2024 and May 2025 (the 'monitoring period').

1.2 Objective

The objective of this OMR is to assess the following in consideration of the PFAS Management Area Plan (PMAP) (Defence, 2025a), historical OMP data and other relevant information:

- Objective 1: The distribution (spatial and temporal) and transport of PFAS in the Management Area.
- Objective 2: Whether the current understanding of risks to human and ecological receptors require review.
- Objective 3: PMAP delivery and associated management actions, where relevant.

1.3 Scope

The following scope of works were completed to satisfy the objective of this OMR:

- **Section 2:** Summary of Base setting inclusive of Base location, Management Area and environmental setting.
- **Section 3:** Summary of sampling and analysis completed over the monitoring period.
- **Section 4:** A review of the reliability of data collected over the monitoring period.
- **Section 5:** Summary of adopted PFAS screening criteria.
- **Section 6:** Summary of key events since preparation of the last OMR.
- **Section 7:** Factual summary of OMP data collected between October 2024 and May 2025.
- **Section 8:** Interpretive analysis of the current and historical OMP data.
- **Section 9:** Review of the Conceptual Site Model (CSM).
- **Section 10:** Review of the risk profile.
- **Section 11:** Provision of conclusions and recommendation.
- **Section 12:** Limitations.
- **Section 13:** References.

2. Base Setting

2.1 General

The following sections present a summary of the Base setting based upon historical investigation reports (as cited in the PMAP) and publicly available information. Consideration has also been given to information provided by the local community, including during a community engagement session held on 6 August 2024 as well as community engagement conducted between 21 February 2025 and 10 March 2025 in relation to a targeted aquatic biota sampling campaign from within and immediately east of the PMAP Management Area (see **Section 6.4**).

2.2 RAAF Base Amberley

The Base is located at Southern Amberley Road, Amberley, Queensland approximately 7 kilometres (km) west of Ipswich and 50 km southwest of Brisbane (see **Figure 1** and **Figure 2**). The facility is approximately 2,030 hectares (ha) in area and includes the Base itself as well as several parcels of Defence owned land to the east and south of the Base. The Base details are listed in **Table 2-1**.

Table 2-1: Base Identification

Aspect	Detail
Address	Southern Amberley Road, Amberley, Queensland
Coordinates	Northern boundary: 273608.92 S, 1524139.18 E Southern boundary: 273917.50 S, 1524257.17 E Eastern boundary: 273809.06 S, 1424353.04 E Western boundary: 273806.10 S, 1524049.85 E Southwestern point: 273905.38 S, 1524125.91 E Northwestern point: 273737.99 S, 1524007.07 E Northeastern point: 273659.71 S, 1524250.53 E Southeastern point: 273836.01 S, 1524351.63 E
Base ID	0861
Property Owner	Department of Defence
Lot and Plan	The Base consists of 716 property Lots
Current Property Use	Military Aircraft Base
Size	~2,030 ha, with ~1,600 ha currently being vacant green space. It is noted that although there are currently no leases for grazing/agricultural within Base property, there remains a future potential for these land uses to occur within the reserved green space on Base.
Local Government Area	Ipswich City Council

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Approximate RAAF Base Amberley Boundary
- Boundary



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Scale 1:48,000



Coord. Sys. GDA2020 MGA Zone 56

**RAAF Base Amberley,
Queensland**

SITE LOCATION

FIGURE 1



Name: 66133_RAAF_Amberley_OMR25_RevC/66133_01_SiteLoc
Reference: www.nearmap.com - Imagery Date: 03/06/2024

2.3 Land Use

2.3.1 Current and Previous Land Use

European settlement occurred around 1826, coinciding with the discovery of limestone in the area. Historical land use post-settlement included an aboriginal mission, some areas of cotton farming, and livestock rearing. The property was purchased by the Commonwealth between 1865 and 1938 and was developed as an airfield in 1940.

The current Base is an operational air force facility and operates two runways. The main runway runs approximately north to south, parallel to the eastern boundary. The second runway is shorter and runs southwest to northeast and is in the southern part of the Base. Parallel to the main runway is a taxiway that services both runways and provides access to the main hangars. Most of the operational areas, historical and current, are located to the west of the runways and taxiways. Operational areas where PFAS containing firefighting foams, including Aqueous Film Forming Foam (AFFF), has historically been used (see **Figure 5**) include:

- The main hangars for 1 Squadron, 6 Squadron and 38 Squadron which house fire suppression systems.
- The redeveloped fire training area pad and AFFF holding tank.
- The fire-fighter training school.
- Fuel facilities.
- Engine test facilities.
- Temporary stockpile facility for PFAS impacted soils.

At the time of this report, as per the 2023-2024 OMR report, JBS&G understands that PFAS containing firefighting foams have been phased out in mobile firefighting equipment and training areas, with PFAS containing firefighting foams to be phased out in fixed hangar systems in the near future.

2.3.2 Surrounding Land Use

Land to the north, south and west of the Base is surrounded largely by rural residential areas and several urban suburbs. Warrill Creek and Bremer River form part of the boundary of the Base to the south and north, respectively with Purga Creek to the southeast of the Base. The surrounding land is used for grazing, cropping, mining and small acreages / hobby farms. East of the Base, land use changes from rural to industrial and residential approaching the City of Ipswich. Residential development and parkland areas are present adjacent to the Bremer River, downstream of the Base. Kayaking, canoeing, fishing and swimming are popular recreational activities in the waterways east of the Base.

It is understood that Berry's Lagoon (also known as Berry's Weir or the Bremer River fishway), located immediately north of the Churchill's Abattoir in Yamanto, is a popular local recreational area. Berry's Lagoon is approximately 2.2km downstream of the confluence of Bremer River and Warrill Creek.

2.4 Base Environmental Setting

Key Base environmental setting details are summarised in **Table 2-2** below and illustrated on **Figure 3**, **Figure 4**, and **Figure 6**.

Table 2-2: Environmental Setting Details

Setting	Description
Regional Climate	The climate in the Amberley area is warm and temperate with annual average day-time temperatures ranging from 21°C in July to 31°C in January. There is a wet season from December through to March, with the months from April to November being relatively dry.

Setting	Description
Topography	<p>The Base is mostly located in the floodplains of the Bremer River, and Purga and Warrill Creeks. The runways, taxiways and hangars are located below the 30 m Australian Height Datum (m AHD) contour line, within the flood plains, where the topography is very flat (with surface gradients of 0.003 to 0.005), in the eastern portion of the Base.</p> <p>In the central west of the Base, the topography rises above the floodplain to topographical highs of 50 m AHD in the south (south of Frog’s Hollow Gully) and 60 m AHD in the west, at the Fire Fighting Training School. Most of the other operational areas and accommodation are located in the central western area, above the floodplains.</p>
Geology	<p>The following geological units are present at the Base:</p> <ul style="list-style-type: none"> • Quaternary Floodplain Alluvium, comprising silt, gravel, and clay in the eastern and lower elevation portions of the Base. • Tertiary Formation consisting of claystone, siltstone, sandstone, and basalt in the west-central at higher elevation portions of the Base and basalt, in the northwestern-central and southwestern-central portions of the Base. • Jurassic Walloon Coal Measures comprising shale, siltstone, sandstone, and coal seams, cropping out along the western Base boundary. • Quaternary (Holocene) Terrace Alluvium, lowest river terrace comprising gravel, sand, silt and clay along Bremer River and Warrill Creek at the northern, southern, and eastern boundaries, respectively. <p>The regional area has been subject to mining activity including the Jeebropilly coal mine located to the south-west of the base. The Ipswich City Plan Overlay - OV8 Mining Influence Areas (Ipswich City Council, 2025) maps a portion of Confirmed Primary Source Area (CPSA A) and the Hansen Farm Conservation Area as being underlain by mining influence areas, understood to be underground mining, mine shafts and associated buffer zone. The Detailed Site Investigation (DSI; CH2M Hill, 2018) reported the underground mine working were expected to be flooded where located beneath the water table.</p>
Acid Sulfate Soil	<p>A review of the Atlas of Australian Acid Sulphate Soils (Fitzpatrick et al., 2011) indicates that the riparian zones of the Bremer River and Warrill Creek adjacent to the base are mapped as having an ‘extremely low probability of occurrence (1-5%)’.</p>
Hydrogeology	<p>Aquifer units - The three main water-bearing units underlying the Base include the Quaternary Floodplain Alluvium, Tertiary Formation, and the Walloon Coal Measures. The Alluvium and Tertiary Formation are connected and are considered a single hydrogeological unit. The DSI (CH2M Hill, 2018) identified that there was hydraulic connection between the Alluvium-Tertiary Formation and underlying Walloon Coal Measures. The geological data indicated vertical and horizontal flow in the Walloon Coal Measures may be restricted by lower hydraulic conductivity zones between coal seams, which may mean flow in the Walloon Coal Measures is not continuous across the Base.</p> <p>Depths to groundwater - Groundwater at the Base has been encountered at depths typically between approximately 5.5 to 35 metres below top of casing.</p> <p>An ephemeral water body, Frog’s Hollow Gully, is present in the southwest portion of the Base and connects with Warrill Creek at the Base boundary. Based on the climatic conditions and groundwater recharge there is a rise of the groundwater table during the wet season. This increase in water table elevation has the potential to increase contaminant migration towards the surface water bodies during the wetter months.</p> <p>Groundwater Flow Direction - Groundwater flow in both the Quaternary-Tertiary Formation and the Walloon Coal Measures is predominantly from the higher elevation central-west areas of the Base north and east towards Bremer River and southeast towards Warrill Creek.</p>

Setting	Description
Registered bores and groundwater use	<p>A review of the Registered Bore database hosted by Queensland Government ² was completed in August 2025 and identified the following bores within 2 km of the Base:</p> <ul style="list-style-type: none"> • 19 water supply bores. Seven of the bores are located east of Bremer River/South of Warrill Creek, five of which are located within the Management Area. • 22 Sub-artesian monitoring bores.
Hydrology	<p>The Base and Management Area are located within the Bremer River sub-catchment. The Bremer River sub-catchment covers approximately 2,036 square kilometres (km²) and is a major sub-catchment of the Brisbane River catchment. The main watercourses in the Bremer River sub-catchment include the Bremer River, Purga Creek and Warrill Creek.</p> <p>The Base has historically been segregated into 11 surface water catchment areas which discharge to Bremer River or Warrill Creek at a number of discharge points. This is discussed in more detail in Section 6.1.</p> <p>Purga and Warrill Creeks run in a south-to-north direction and follow the southern boundary of the Base before joining the Bremer River to the east of the Base. Warrill Creek originates 50 km southwest of the Base, with a catchment area of 920 km². Flow into Warrill Creek is partly controlled by the Moogerah Dam on Reynolds Creek, a tributary of Warrill Creek.</p> <p>The Bremer River flows from west-to-east and borders the northwest, northern and eastern extents of the Base. The Bremer River enters the Brisbane River 8 km downstream and to the northeast of the Base.</p> <p>Based on groundwater and surface water elevations within and adjacent to the Bremer River and Warrill Creek, the DSI (CH2M Hill, 2018) identified that these watercourses were potentially both gaining and losing streams depending on the watercourse reach and season. Landowners who adjoin waterways have ‘riparian rights’ under the Water Act, that permit the owner of land adjoining a watercourse to take from that stream for stock watering or domestic purposes without a licence. The Water Use Survey (WuS) completed in 2017 identified properties that have access to water from the Bremer River, Warrill Creek or Purga Creek. The Human Health Risk Assessment (HHRA; EnRisks, 2019) identified a potentially elevated risk to human health from consumption of home-grown beef and offal where cattle have access to PFAS impacted waterways, including Warrill Creek.</p> <p>Three extraction licences exist downstream of the Base (one in Warrill Creek and two in the Bremer River) for the purposes of agriculture and irrigation (watering of crops used for domestically sold livestock). Due to the salinity concentrations ranging from 500 – 5,000 mg/L and data from a WuS completed in 2017 is considered unlikely that surface waters were used for potable purposes, which was substantiated by community feedback during the 2024 community engagement session. It was also identified that water from the Bremer River is used for industrial water supplies.</p>
Hydrogeology to Hydrology Relationship	<p>The relationship between groundwater and surface water systems is critical to understand when interpreting analytical data and attempting to understand contamination patterns and trends. The relationships between groundwater and surface water are typically thought of in terms of losing streams (i.e. surface water discharges into groundwater) and gaining streams (i.e. groundwater discharges into surface water). Surface water bodies can be losing, gaining or both losing/gaining. Surface water bodies which are both losing and gaining relate to spatial changes (e.g. geology changes over the length of a stream) and temporal changes (e.g. rainfall driven lowering or raising of the groundwater table).</p> <p>Historical reports have referred to:</p> <ul style="list-style-type: none"> • Bremer River as being both a losing and gaining stream. • Warrill Creek is a losing stream. <p>A survey of Bremer River and Warrill Creek was completed in January 2025, with relative levels for surface water and sediment recorded in m AHD at locations adjacent to boundary</p>

² <https://www.business.qld.gov.au/industries/mining-energy-water/water/bores-and-groundwater/bore-reports>

Setting	Description
	<p>groundwater monitoring wells. This survey data was compared to groundwater elevation data recorded between October 2023 and April 2025. This review corroborates historical findings in relations to the groundwater and surface water interaction.</p> <p>The survey and review has been interpreted within Section 8.2.</p>
Base Management Drainage	<p>There is an extensive stormwater drainage system across the Base originally constructed in the 1940s with various upgrades over time. The drainage system comprises open, lined, and unlined drains, covered lined drains, underground drainpipes and grated lined drains to direct water from operational areas to discharge points off-Base. Discharge points for the drainage system to Bremer River and Warrill Creek and catchments are shown on Figure 6.</p>

2.5 Management Area

The PFAS Management Area is divided into the following zones where potential risks have been identified that require management:

- The Base:** The Base is divided into 11 surface water catchment areas. The Base is currently an operating RAAF Base and is utilised for flying operations, bulk fuel storage, chemical and armaments storage, firefighting training, short-term accommodation, and support and maintenance activities. Some land is also used for residential and recreational / open space uses.
- Land adjacent to the Base and Warrill Creek:** This area comprises land adjacent to the southern boundary of the Base and Warrill Creek downstream to the confluence with the Bremer River. This area includes private properties adjacent to the Base along this stretch of the creek. Private properties that lie within this area are used for agriculture and rural residential purposes. *Note: this area represents what has previously been referred to as Area 1 in the DSI (CH2M Hill, 2018), HHRA (EnRisks, 2019) and Ecological Risk Assessment (ERA) (EnRisks, 2020) documents.*
- Land adjacent to the Base and Bremer River:** This area comprises the Bremer River adjacent to the western, northern and eastern boundaries of the Base and extends as far downstream as Cribb Park³. This area includes private properties adjacent to the stretch of river adjacent to the Base as far downstream as Woodend Road Reserve. Private properties within this area are used for agriculture and rural residential purposes. Bremer River is also used for recreational purposes including swimming and fishing. *Note: this represents what has previously been referred to as Area 2 and 3 in the DSI (CH2M Hill, 2018), HHRA (EnRisks, 2019) and ERA (EnRisks, 2020) documents.*

The Management Area does not include the following zones:

- Bremer River and adjacent properties to the northwest of the Base (upstream of the section of Bremer River referred to above), as well as Purga Creek to the south of the Base. *Note: these represent what has previously referred to as Area 4 and 5 respectively in the DSI (CH2M Hill, 2018), HHRA (EnRisks, 2019) and ERA (EnRisks, 2020) documents. There were no potential elevated risks relevant to these areas identified as part of the HHRA or ERA.*
- The Leichardt Residential Area (Area 6). A HHRA was completed by CH2M Hill (2020) which concluded the potential risks within the area are low and acceptable.

The Management Area boundary is presented on **Figure 1**.

This report considers the Management Area as described above but focuses upon surface water catchment areas.

³ Approximately 9.25km downstream of the Bremer River and Warrill Creek confluence.

2.6 PFAS Source Areas

In the PMAP (Defence, 2025a), a total of 31 PFAS source areas, referred to as Confirmed Primary Source Areas (CPSAs), were identified based on the findings of the DSI (CH2M Hill, 2018). The primary source areas are shown in **Figure 5** and summarised in the **Table 2-3** below.

It is noted that investigations in Catchment 3 remain ongoing to confirm the presence / absence of an additional PFAS source associated with a historical fire station, north of CPSA Z.

Table 2-3: Summary of Primary Source Areas

CPSA Type	CPSA	Description
Major	CPSA A	Former Topside Aviation Fire Training Area (FTA) and current FTA Pad
	CPSA B	Hangar 410 (Building 410) and Former Landfill
	CPSA C	Frogs Hollow Former Fire Training School Location
	CPSA D	Sewage Treatment Plant (STP)
	CPSA G	Former FTA and Operations Testing Area
	CPSA J	Former FTA and Operations Testing Area
	CPSA M	Former Fuel Farm 1 and Triple Interceptor Pit
	CPSA N	Fire Station, FTA training
	CPSA U	38 Squadron Hangar
	CPSA V	AFFF Wastewater Holding Tank ¹
	CPSA W	Fire Fighting Training School
	CPSA X	Former Structural and Open Pit FTA
	CPSA Y	Former Secondary FTA
Moderate	CPSA DD	HS748 Former FTA on Disused Runway
	CPSA E	Historic Containment Pond
	CPSA CC	Former Landfill
	CPSA FF	Buried PFAS impacted stockpile from CPSA A (stockpiled sourced from new FTA area)
Minor	CPSA S	AFFF Store / Truck Washdown at Fuel Farm 2/2A
	CPSA BB	Areas used for irrigation – former grassed runways
	CPSA F	Potential former FTA and Landfill
	CPSA Q	1 Squadron Hangar and 6 Squadron Hangar
Insignificant	CPSA Z	Fuel UST with AFFF listing
	CPSA H	Potential Former FTA and Landfill
	CPSA I	Potential Former FTA and Landfill
	CPSA L	Potential Former Fire Training and Operations Testing Area
	CPSA O	Potential location of F1-11 2006 incident
	CPSA P	Potential location of 1978 Skyhawk incident
	CPSA R	K Store- potential AFFF storage
Secondary Impact Area	CPSA T	Potential Location of Aircraft F-4E Incident
	CPSA AA	Triple interceptor pits at engine test cell facilities 1 and 2, which receive wastewaters from a variety of on-Base facilities.
	CPSA EE	Former sports ovals – potentially irrigated with PFAS contaminated wastewater.

1. Reclassified from moderate to major following a recommendation in CH2M Hill (2020)

2.7 Previous Ongoing Monitoring Report (OMR)

This OMR has considered the findings of the most recent OMR (October 2023 – July 2024), as documented in JBS&G (2025a). The overall conclusions of this report are reproduced below:

“• *Objective 1: The distribution (spatial and temporal) and transport of PFAS in the Management Area:*

○ *The distribution of PFAS in the Management Area has not changed significantly since the previous monitoring period, with the potential exception of:*

- *Localised evidence of both reducing and increasing concentration trends in groundwater and surface water; and*
- *Relatively widespread evidence of reducing surface water concentration trends in the Bremer River.*

○ *The significance of both localised and widespread PFAS concentration trends requires further consideration during the 2024-2025 OMR, noting that the concentration typically remain within the same order of magnitude as historical data.*

• *Objective 2: Whether the current understanding of risks to human and ecological receptors require review:*

○ *The risk profile to human health receptors within the Management Area remains unchanged since the publication of the HHRA (EnRisks, 2019); and*

○ *The current understanding of risks to human and ecological receptors is only considered to require review with respect to whether reducing surface water concentration trends in the Bremer River are also associated with reducing concentration trends in aquatic biota.*

• *Objective 3: PMAP delivery and associated management actions, where relevant:*

○ *The key management actions to date have comprised:*

- *Preparation of a mass flux study which identified that 99% of the PFAS migrating off-Base is via surface water;*
- *Significant earthworks and hardstand construction works across PFAS source areas;*
- *Establishment of two water treatment plants to capture and treat PFAS contaminated water generated during fire training activities (CPSA A, CPSA W); and*
- *Commencement of replacement of the old Sewage Treatment Plant (CPSA D), with the new Sewage Treatment Plant to provide PFAS treatment capability.*

○ *Reducing PFAS trends in the Bremer River indicate that initial PMAP delivery and associated management actions are potentially having a measurable impact.*

The Ongoing Monitoring Program should be reviewed in consideration of the findings of this OMR.”

Legend

- Watercourse**
- PMAP Management Area
 - Confirmed Primary Source Area
 - Approximate RAAF Base Amberley Boundary
- Detailed Geological Structure**
- approximate
 - Geological boundary inferred
 - Fault approximate
 - Fault concealed
 - Fault inferred
 - Fault inferred/concealed
 - Anticline approximate showing plunge
 - Anticline concealed showing plunge
 - Syncline approximate showing plunge
 - Syncline concealed showing plunge
- Detailed Surface Geology**
- Aberdare Conglomerate (Rbwa)
 - Blackstone Formation (Rlb)
 - Gatton Sandstone (Jbmg)
 - Koukandowie Formation (Jbmk)
 - Qa-QLD (Qa)
 - Qh/1-QLD (Qh/1)
 - Qh/1-QLD (Qh/2-QLD)
 - Qh/1-QLD (Qh/2)
 - Qh/2-QLD (Qh/2)
 - Qp/1-SEQ (Qp/1)
 - Reaview Formation (Rbwc)
 - Redbank Plains Formation (Tbr)
 - Ripley Road Sandstone (Rbwr)
 - Siltstone Formation/1 (Tbs/1)
 - Siltstone Formation/2 (Tbs/2)
 - Tivoli Formation (Rit)
 - Tb-QLD (Tb)
 - TbW-QLD (TbW)
 - Ts/1-SEQ (Ts/1)
 - Ts/1-SEQ (Ts/2)
 - Ts/1-SEQ (Ts/3)
 - Walloon Coal Measures (Jw)



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:48,000

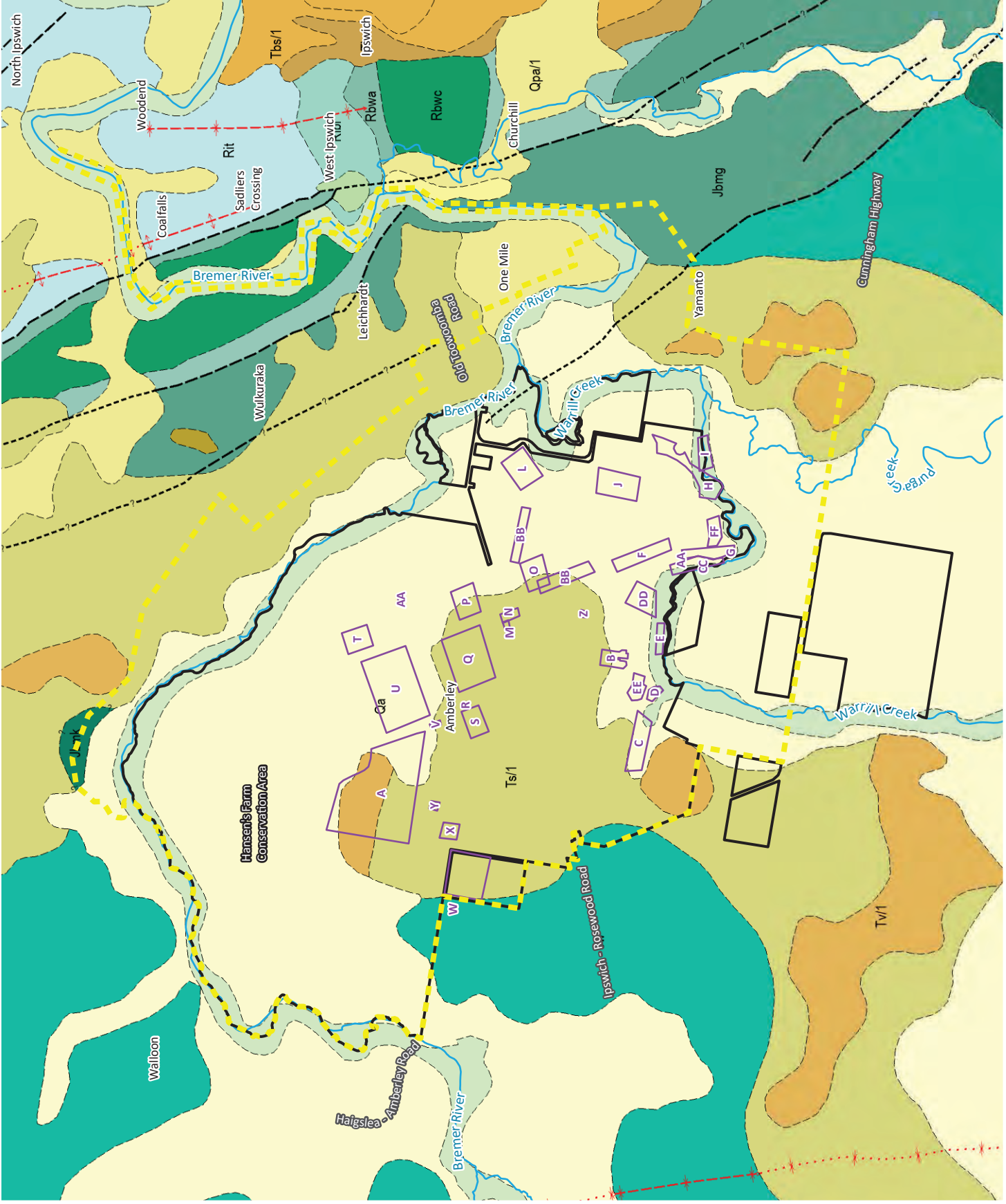


Coord. Sys. GDA2020 MGA Zone 56

**RAAF Base Amberley,
Queensland**

SURFACE GEOLOGY

FIGURE 3



- Legend**
- Watercourse / Drainage Line
 - PWAP Management Area
 - Confirmed Primary Source Area
 - Approximate RAAF Base Amberley Boundary
 - Mining Activity
 - Shaft
 - Tunnel
 - Area Affected by Underground Mining
 - Surface Disturbance
 - Mining Influence Constrained Area



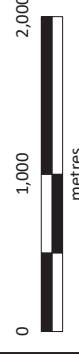
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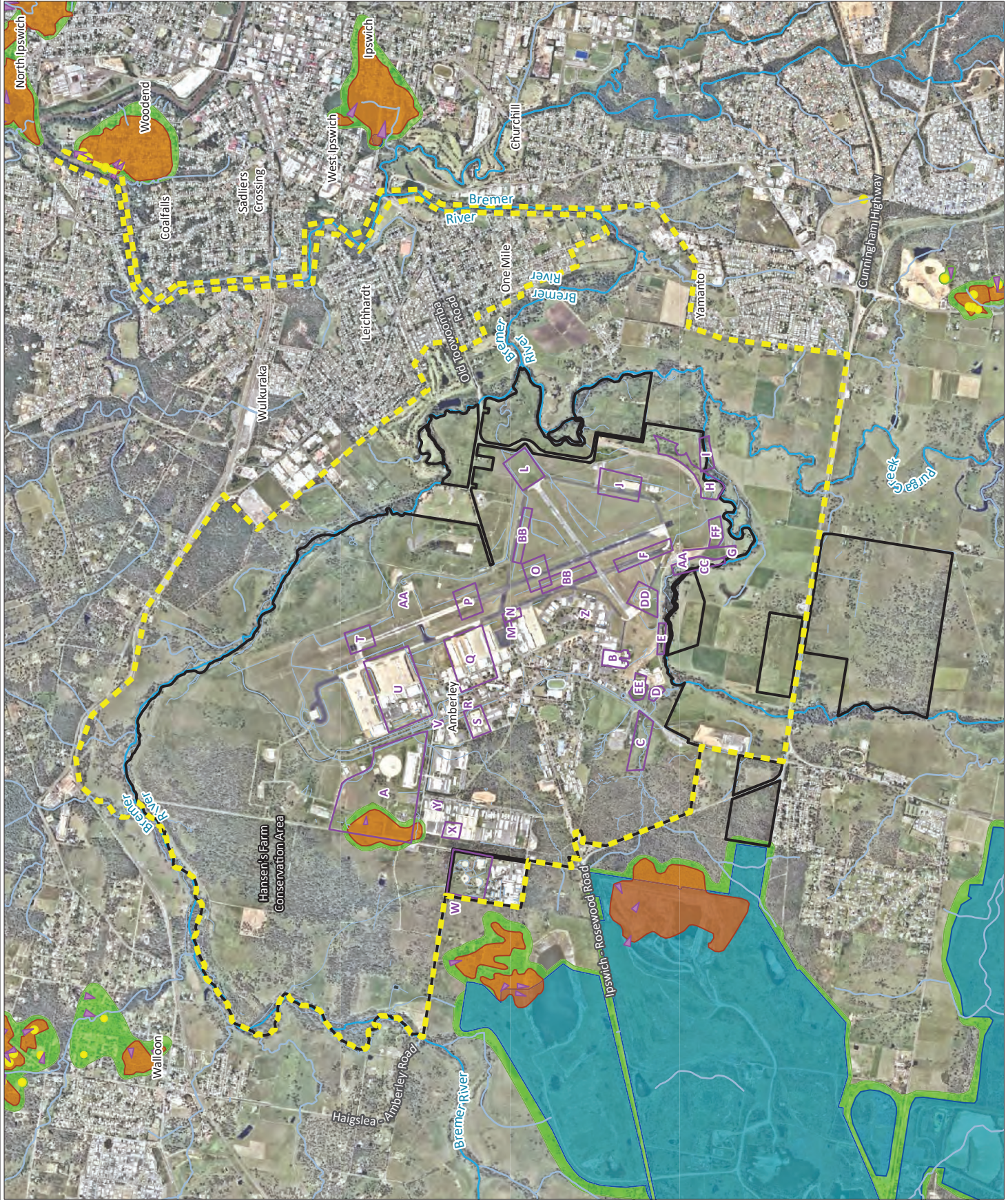


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

MINING BUFFERS

FIGURE 4



Name: 66133_RAAF Amberley_OMR25_RevC/66133_04_Mining
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Approximate RAAF Base Amberley Boundary
- Confirmed Primary Source Area Type
 - Major
 - Moderate
 - Minor
 - Secondary Impact Area
 - Insignificant



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:25,000



Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

CONFIRMED PRIMARY SOURCE AREAS

FIGURE 5



PSA Type	PSA	Description
Major	A	Former Topside Aviation Fire Training Area (FTA) and current FTA Pad
	B	Hangar 410 (Building 410) and Former Landfill
	C	Frogs Hollow Former Fire Training School Location
	D	Sewage Treatment Plant (STP)
	G	Former FTA and Operations Testing Area
	J	Former FTA and Operations Testing Area
	M	Former Fuel Farm 1 and Triple Interceptor Pit
	N	Fire Station, FTA training
	U	38 Squadron Hangar
	V	AFFF Wastewater Holding Tank
	W	Fire Fighting Training School
	X	Former Structural and Open Pit FTA
	Y	Former Secondary FTA
	DD	H5748 Former FTA on Disused Runway
	E	Historic Containment Pond
	CC	Former Landfill
	FF	Buried PPAS impacted stockpile from CPSSA A
S	AFFF Store / Truck Washdown at Fuel Farm 2/2A	
Moderate	BB	Areas used for irrigation - former grassed runways
	F	Potential former FTA and Landfill
	Q	1 Squadron Hangar and 6 Squadron Hangar
	Z	Fuel LUST with AFFF listing
Minor	H	Potential Former FTA and Landfill
	I	Potential Former FTA and Landfill
	L	Potential Former Fire Training and Operations Testing Area
Insignificant	O	Potential location of F1-11 2006 incident
	P	Potential location of 1978 Skyhawk incident
	R	K Store- potential AFFF storage
	T	Potential Location of Aircraft F-4E Incident
Secondary Impact Area	AA	Triple interceptor pits at engine test cell facilities 1 and 2
	EE	Former sports ovals

Name: 66133_RAAF Amberley_OMR25_RevC/66133_05_ConfirmedPrimarySourceAreas
Reference: www.nearmap.com - Imagery Date: 02/03/2024

Legend

- ★ Major Discharge Point
- ★ Minor Discharge Point
- Watercourse / Drainage Line
- ▭ PMAP Management Area
- ▭ Confirmed Primary Source Area
- ▭ RAAF Amberley Approximate Site Boundary

Catchment Areas

- 1 Catchment 1
- 2 Catchment 2
- 3 Catchment 3
- 4 Catchment 4
- 5 Catchment 5
- 6 Catchment 6
- 7 Catchment 7
- 8 Catchment 8
- 9 Catchment 9
- 10 Catchment 10
- 11 Catchment 11



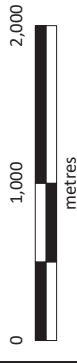
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Version: RevC

Date: 14-Oct-2025

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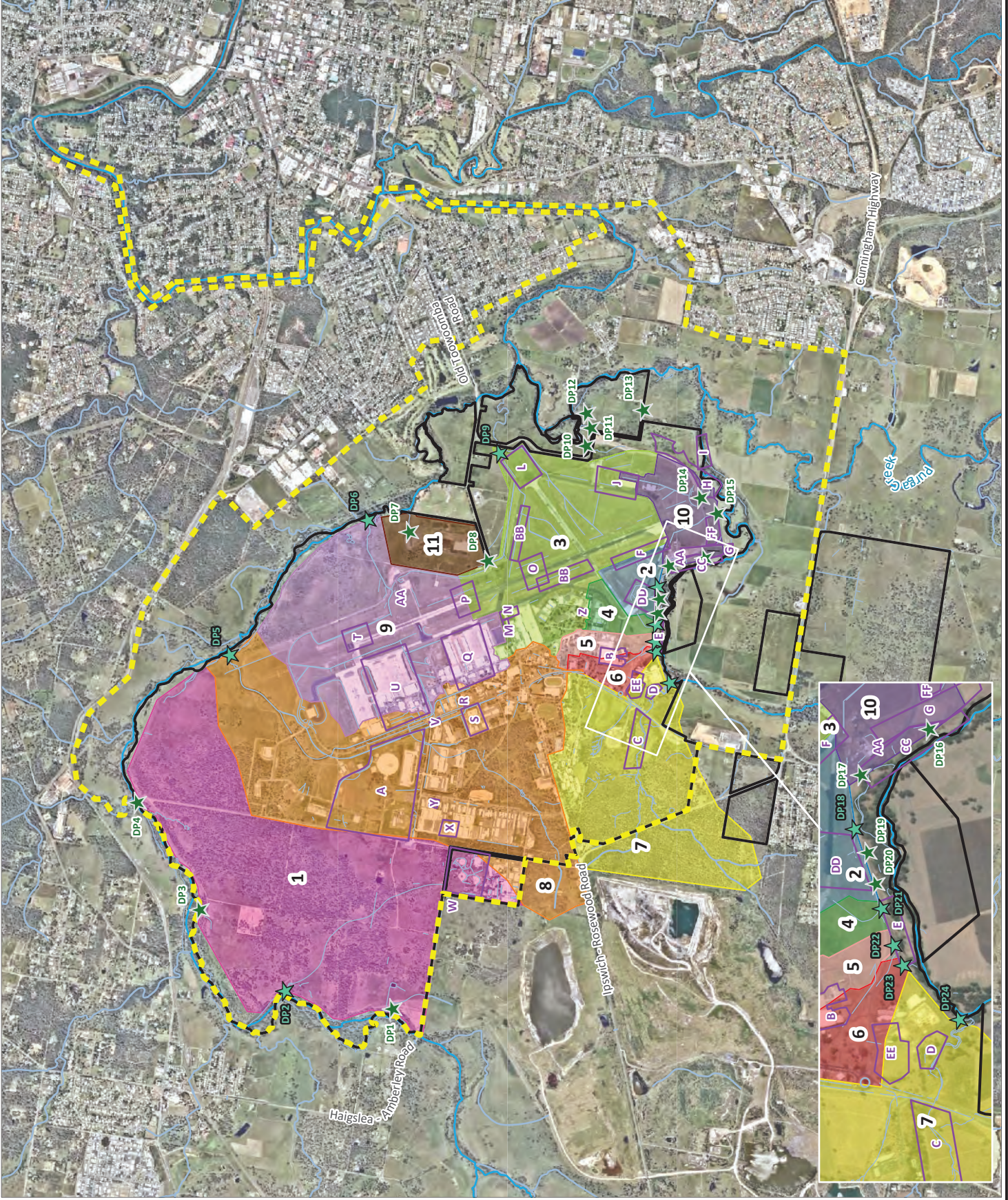


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

SURFACE WATER CATCHMENTS

FIGURE 6



Name: 66133_RAAF Amberley_OMR25_RevC/66133_06_Catchments
Reference: www.nearmap.com - Imagery Date: 03/06/2024

3. Sampling and Analytical Methodology

3.1 Sampling and Analysis Quality Plan

3.1.1 General

In May 2025, Defence published a revised OMP for RAAF Base Amberley following consultation with its technical advisor and DETSI. The key changes to the OMP included:

- The frequency of groundwater monitoring was reduced from bi-annually to annually, targeting an autumn monitoring event conducted during April to capture post wet season conditions. This was considered to be appropriate on the basis of the following:
 - Groundwater migration rates are relatively slow, and it is anticipated that groundwater concentrations will not change significantly over a 12-month period, consistent with historical trends.
 - Conceptually the October (post dry season) event is designed to capture lower rainfall conditions and lower standing water levels, whereas the April (post wet season) event is designed to capture higher rainfall conditions and higher standing water levels. A comparison of average April vs October concentrations in wells containing the highest PFAS concentrations predominantly shows a lack of statistically significant seasonal influence.
 - The 2023 mass flux study (Senversa, 2023) demonstrates that groundwater is a secondary concern with respect to off-Base PFAS migration (i.e. 1% via groundwater, 99% via stormwater). As such, future remediation work will focus upon reducing PFAS concentrations in surface water and there may be relatively short-term changes in PFAS concentrations in surface water (i.e. which warrants biannual monitoring). In contrast, PFAS concentrations in groundwater are not expected to change significantly in the short term and biannual monitoring is not critical.
- Additional surface water monitoring locations were nominated at the source area, mid-point and discharge locations. The additional locations have been included to ensure representative data is collected from the surface water catchments located across the Base, on the basis that surface water / stormwater runoff from the Base represents the primary PFAS transport pathway (Senversa, 2023).
- Cessation of sediment monitoring on the following basis:
 - There is no current Commonwealth sediment criteria for which to assess the biannual sediment data against.
 - There is poor correlation between co-located sediment and surface water data. This is consistent with what may reasonably be expected as sediment samples represent PFAS contamination within a very localised area (<50mm sample diameter) whereas surface water samples represent PFAS contamination across a much larger area (i.e. runoff from various Base areas and in contact with sediment over hundreds of m²).
 - Based on current Commonwealth guidance, the primary use of sediment data is to inform bioconcentration modelling (e.g. to predict PFAS concentration in benthic invertebrates). Targeted event-based sediment sampling can be completed to inform future modelling as required.

As a result of the above, the 2024-2025 monitoring period was conducted during a transitional phase in which the OMP was being updated. As a result, the monitoring program was carried out under two separate Sampling and Analysis Quality Plans (SAQPs): one reflecting the sampling design aligned with the previous OMP (Defence, 2020), and the other incorporating the revised requirements of the updated OMP (Defence, 2025b):

- October / November 2024 monitoring event: AECOM. (2024a). *PFAS OMP-RAAF Base Amberley Sampling and Analysis Quality Plan*.
- April / May 2025 monitoring event: JBS&G. (2025b). *RAAF Base Amberley Ongoing Monitoring Plan, Sampling and Analysis Quality Plan*. JBS&G Australia Pty Ltd, 66133 | 166079 Revision B.

The SAQPs presented the sampling and analytical approach for the acquisition of environmental monitoring data based on the seven step Data Quality Objectives (DQO) process outlined in the ASC NEPM. The SAQPs have been provided as **Appendix B** and are collectively referred herein as the ‘SAQP’.

A summary of the monitoring events completed in comparison to the SAQP requirements has been provided in **Table 3-1**. Deviations from the SAQP requirements are discussed in **Section 3.2**. The corresponding factual reports, as cited in the table below, for the monitoring events have been provided as **Appendix C**.

Table 3-1: Summary of Monitoring Scope

Monitoring Event	Environmental Media / Aspects	SAQP Scope	Primary Samples Collected	Analysis
Sampling Event Report, October / November 2024 (JBS&G, 2025c)	Groundwater	45 Samples	44	PFAS Suite
	Surface Water	49 Samples	44	
	Sediment	49 samples	47	
	Groundwater Level Data Loggers	7 downloads	NA	NA
Sampling Event Report, April 2025 (JBS&G, 2025d)	Groundwater	45 Samples	45	PFAS Suite
	Surface Water	61 Samples	56	

3.1.2 Groundwater Monitoring Network

The following table presents the OMP groundwater monitoring network across the Management Area, including a description of proximity to potential PFAS sources referred to as CPSAs detailed in the PMAP. The groundwater monitoring locations are illustrated on **Figure 7**.

Table 3-2: OMP Groundwater Monitoring Network

Approximate Target Source Area	Monitoring Well ID	Screened Aquifer
Major - CPSA A Former Topside Aviation FTA and current FTA Fire Pad	MW002	Walloon Coal Measures
	MW033	Walloon Coal Measures
	MW535*	Alluvium
	MW536*	Alluvium
	MW539*	Alluvium
Major - CPSA B Hangar 410 and Former Landfill	MW047	Tertiary Formation
Major - CPSA C Frogs Hollow Former Fire Training School Location	MW037	Alluvium
Major - CPSA D Sewage Treatment Plant	MW021	Alluvium
	MW032	Alluvium
Moderate - CPSA E Historical Containment Pond	MW048	Alluvium
Major - CPSA G	MW050	Alluvium

Approximate Target Source Area	Monitoring Well ID	Screened Aquifer
Former FTA and Operational Testing Area		
Major - CPSA J Former FTA and Operational Testing Area	MW005	Alluvium
Major - CPSA M Former Fuel Farm 1 and Triple Interceptor Pit and Major - CPSA N Fire Station	MW006	Alluvium
	MW023	Alluvium
	MW028	Alluvium
	MW029	Alluvium
	MW036	Alluvium
	MW309	Tertiary Formation
Insignificant - CPSA P Potential location of 1978 Skyhawk incident	MW538*	Alluvium
Minor - CPSA V AFFF Wastewater Holding Tank	MW046	Tertiary Formation
Major - CPSA W Fire Fighting Training School	MW026	Tertiary Formation
	MW030	Walloon Coal Measures
	MW031	Tertiary Formation
	MW042	Walloon Coal Measures
	MW043	Walloon Coal Measures
Major - CPSA X Former Structural and Open Pit FTA	MW041	Walloon Coal Measures
Major - CPSA Y Former Secondary FTA	MW537*	Tertiary Formation
Minor - CPSA Z Fuel underground storage tank (UST) with AFFF listing	MW020	Tertiary Formation
Moderate - CPSA AA Triple Interceptor Pits at Engine Test Cell Facilities 1 and 2	MW007	Alluvium
Minor - CPSA BB Areas used for irrigation- former grassed runways	MW012	Tertiary Formation
Moderate – CPSA CC Former Landfill	MW022	Alluvium
Major - CPSA DD HS748 Former FTA on Disused Runway	MW049	Alluvium
Off-Base Warrill Creek. These locations are down-gradient of multiple source areas.	MW054S	Alluvium
	MW054D	Walloon Coal Measures
	MW057S	Alluvium
	MW057I	Tertiary Formation
On-Base Bremer River. These locations are down-gradient of multiple source areas.	MW024	Alluvium
	MW025	Alluvium
	MW034	Alluvium

Approximate Target Source Area	Monitoring Well ID	Screened Aquifer
	MW035	Alluvium
	MW044	Alluvium
	MW055S	Alluvium
	MW055D	Walloon Coal Measures
Off-Base Bremer River.	MW056S	Alluvium
These locations are down-gradient of multiple source areas	MW056I	Tertiary Formation

Notes:

* Indicates additional monitoring location included in revised OMP.

Suffix 'S', 'D' or 'I' represents the following S= Shallow I= Intermediate and D= Deep

3.1.3 Surface Water Monitoring Locations

The following table presents the OMP surface water monitoring locations across the Management Area, including a description of location from which the body of water was sampled. The surface water and sediment locations are illustrated on **Figure 8**.

Table 3-3: OMP Surface Water Monitoring Locations

Location	Surface Water Monitoring Locations	Number of Locations
On-Base Drains	SW002, SW003, SW008, SW011, SW021, SW027, SW028, SW030, SW033, SW037, SW038, SW041, SW048, SW049, SW053, SW056, SW059, SW064, SW067, SW076, SW079, SW080, SW530*, SW658*, SW661*, SW662*	26
Warrill Creek	SW004, SW005, SW009, SW015, SW016, SW018, SW020, SW022*, SW023*, SW026, SW032*, SW034, SW043, SW099, SW100, SW657*, SW659*, SW660*	18
Bremer River	SW025, SW036, SW039, SW040, SW045, SW047, SW050, SW051, SW052, SW088, SW089, SW090, SW091, SW094, SW096*, SW098, SW656*	17

Note:

* Indicates additional monitoring location included in revised OMP.

3.1.4 Sediment Monitoring Locations

The following table presents the superseded OMP sediment monitoring locations across the Management Area, including a description of location from which the body of water was sampled.

Table 3-4: Sediment Monitoring Network

Area	Sample Locations	Number of Locations
On-Base Drains	SD002, SD003, SD008, SD011, SD021, SD027, SD028, SD030, SD033, SD037, SD038, SD041, SD048, SD049, SD053, SD056, SD059, SD064, SD067, SD076, SD079, SD080	22
Warrill Creek	SD004, SD005, SD009, SD015, SD016, SD018, SD020, SD026, SD034, SD043, SD099, SD100	12
Bremer River	SD025, SD036, SD039, SD040, SD045, SD047, SD050, SD051, SD052, SD088, SD089, SD090, SD091, SD094, SD098	15

3.2 Deviations from SAQP

The scope of works completed during the monitoring period complied with the SAQP, with the exceptions detailed in **Table 3-5**.

Table 3-5: Deviations from SAQP - October 2024 to May 2025

Monitoring Event	Location(s)	Deviation	Comment	Impact
Groundwater				
October / November 2024	MW535, MW536, MW537, MW538, MW539	Additional monitoring locations	Newly installed replacement wells monitored.	Not significant – The monitoring of newly installed replacement groundwater wells does not negatively impact the existing monitoring well network but rather increases the spatial coverage.
October / November 2024	MW309	Not sampled	Well damaged.	Not significant – This deviation reduces the spatial coverage of the groundwater monitoring well network within the central portion of the Base but doesn't impact monitoring along the boundaries of the Base where groundwater may discharge into surface water. Groundwater monitoring wells are located downgradient of the target source area.
October / November 2024	MW025, MW028, MW032, MW055S, MW055D, MW056S, MW056I	Retrieval of data logger not completed	Data loggers were removed from the monitoring wells prior to the October / November 2024 sampling event.	Not significant – the changes in groundwater elevations at these monitoring wells are well understood through data collected since 2019. Survey of Bremer River and Warrill Creek completed in January 2025 to assess groundwater-surface water interactions more broadly across the base.
April / May 2025	MW006, MW007, MW023	HydraSleeve™ sampled prior to 24-hour residence time	These sample locations are within the airside area. Due to access constraints, the HydraSleeve™ residence time was shortened to 5 hours.	Not significant – Deployment targeted high conductivity screen intervals to compensate for the reduced residence time. In addition, there is extensive historical data available to assess whether PFAS concentrations are consistent with what may reasonably be expected.
Surface Water				
October / November 2024	SW003, SW030, SW064 and SW067	Not sampled	Sample locations were recorded as being dry at the time of monitoring.	Not significant – upstream and downstream locations were sampled during this monitoring event.
October / November 2024	SW033	Not sampled	Sample locations were inaccessible due to Base operations.	Not significant – downstream locations were sampled during this monitoring event.

Monitoring Event	Location(s)	Deviation	Comment	Impact
April / May 2025	SW038, SW657, SW659, SW660, SW662	Not sampled	Sample locations were recorded as being dry at the time of monitoring.	Not significant – upstream and downstream locations were sampled during this monitoring event.
Sediment				
October / November 2024	SD033	Not sampled	Sample locations were inaccessible due to Base operations.	Not significant – downstream locations were sampled during this monitoring event.
October / November 2024	SD040	Not sampled	Sample locations were inaccessible due to unsafe access conditions.	Not significant – sufficient sediment data has been collected at the monitoring locations.

Legend

- Tertiary Formation / Alluvium
- Walloon Coal Measures
- Destroyed
- Watercourse
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary
- Boundary
- Catchment Areas**
- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:48,000

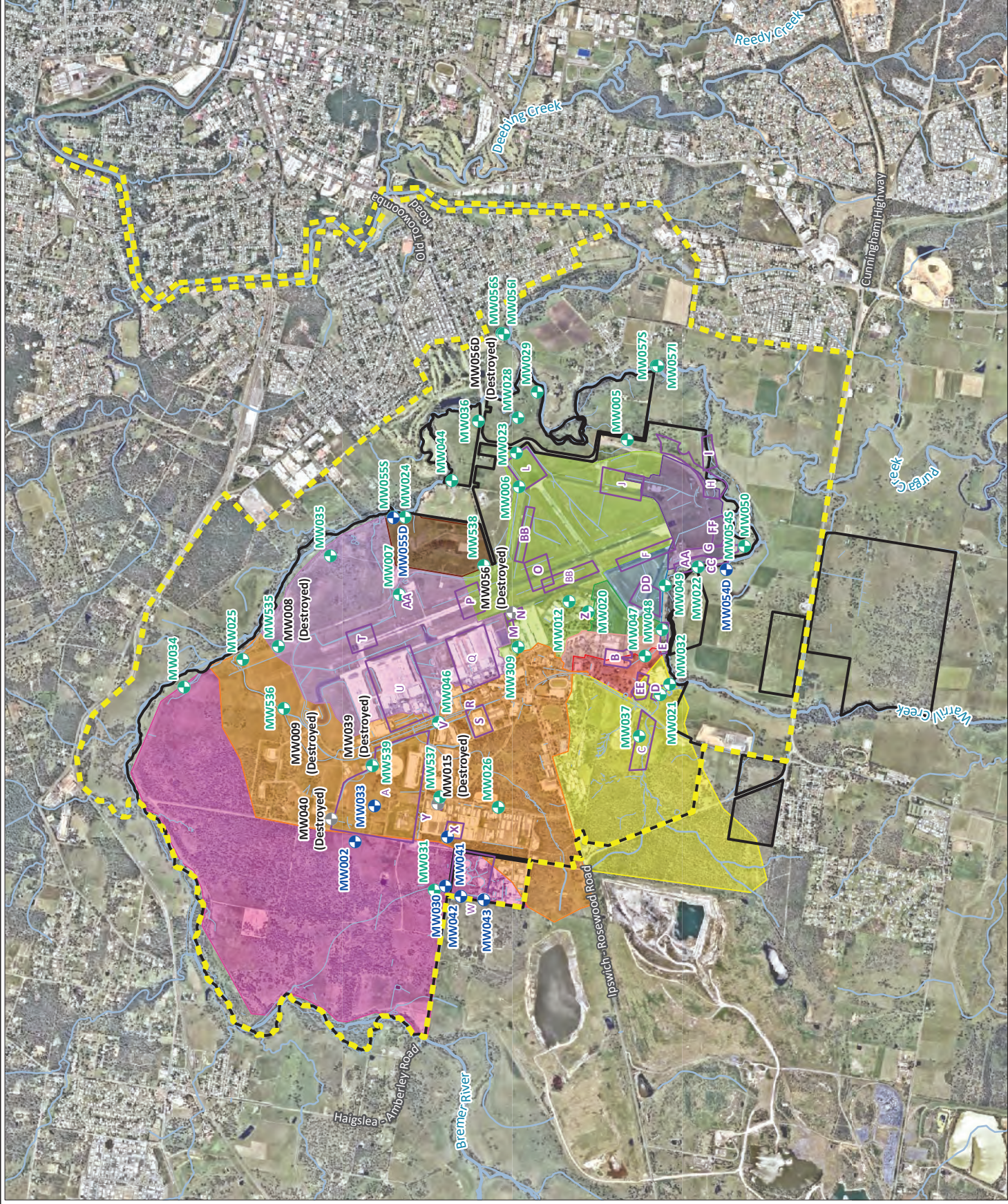


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

GROUNDWATER MONITORING
WELL LOCATIONS

FIGURE 7



Name: 66133_RAAF Amberley_OMR25_RevC/66133_07_GWLocs
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Surface Water Sample Location
 - Major Discharge Point
 - Minor Discharge Point
 - Watercourse of Interest
 - Watercourse / Drainage Line
 - PMPAP Management Area
 - Confirmed Primary Source Area
 - RAAF Amberley Approximate Site Boundary
- Catchment Areas**
- Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

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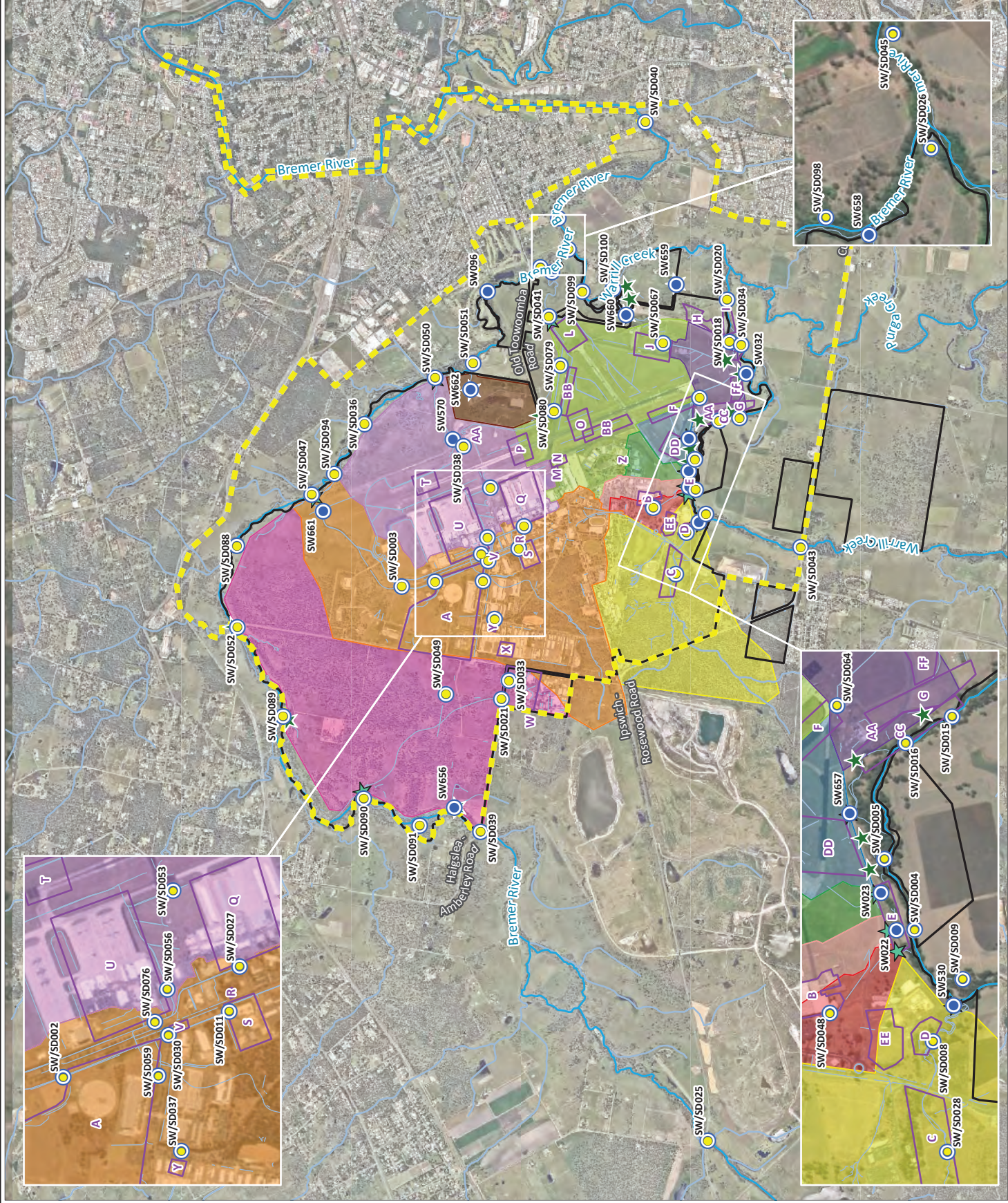


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

**SURFACE WATER AND SEDIMENT
SAMPLE LOCATIONS**

FIGURE 8



Name: 66133_RAAF Amberley_CMR25_RevC/66133_08_SWSLocations
Reference: www.nearmap.com - Imagery Date: 03/06/2024

4. Quality Assurance and Quality Control

4.1 Data Reliability Process

An assessment of data reliability is critical to inform the use and interpretation of the data collected as part of the OMP. Data Quality Indicators (DQIs) are presented within the SAQP (AECOM, 2024; JBS&G, 2025b) and include assessment of the following:

- Documentation and data completeness.
- Data Quality – comparability, representativeness, precision, and accuracy of the analytical data.

The project target for data reliability is 95% compliance with the DQIs.

4.2 Data Reliability Summary

Data reliability assessment pertaining the OMP data collected over the monitoring period has previously been completed and discussed within, JBS&G (2025c) and JBS&G (2025d) (see **Appendix C**).

The data reliability assessments completed have concluded that there are no significant errors associated with data collected of laboratory analysis of the samples. As such, the analytical results reports are considered to be representative of Base conditions, and the data set is adequately reliable for the objective of this OMR.

5. Assessment Criteria

5.1 Groundwater and Surface Water

Assessment criteria adopted for groundwater and surface water are summarised in **Table 5-1** below. The assessment criteria were adopted in consideration of the following guidance:

- HEPA, (2025). PFAS National Environmental Management Plan Version 3.0. Heads of EPA Australia and New Zealand, Commonwealth of Australia, Canberra.
- NHMRC, (2025). *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra (as updated June 2025).

The adopted assessment criteria are in accordance with the PFAS screening criteria nominated in the PMAP (Defence, 2025a). It is noted that National Health and Medical Research Council (NHMRC) has revised the drinking water guidelines in June 2025, including a) not treating PFOS and PFHxS as a group, and b) providing a guideline for PFBS. Consequently, the revised guideline was considered as part of the April / May 2025 sampling event report (JBS&G 2025d) but not the October / November sampling event report (JBS&G 2025c).

Notwithstanding, the PFOS limit of reporting adopted by the OMP is not low enough to enable comparison with the lower guideline value. It is recommended all future samples collected as part of the OMP are tested at a lower limit of reporting (LOR) to ensure comparison.

Table 5-1: Groundwater and Surface Water Assessment Criteria

Exposure Scenario	Adopted Assessment Criteria (µg/L)					Guidance
	PFHxS	PFOS	Sum of PFHxS and PFOS	PFOA	PFBS	
Human Health Receptors						
Drinking Water	0.03	0.008		0.2	1	NHMRC (2025)
Recreational Use			2	10		HEPA (2025) ¹
Ecological Receptors						
Groundwater and Surface Water	Freshwater (95 % species protection)	0.13		220		HEPA (2025)
Groundwater and Surface Water	Freshwater (99% species protection)	0.00023		19		HEPA (2025)

Notes:

1. Based on NHMRC, (2019). *Guidance on PFAS in Recreational Water*. National Health and Medical Research Council (NHMRC), National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

5.2 Sediment

At the time of this report, there are currently no nationally endorsed criteria for screening of risk posed to human health or the environment by PFAS in sediment.

6. Context and Ancillary Information

6.1 Mass Flux Assessment

A mass flux study was conducted in 2023 (Senversa, 2023). A mass flux study is a technical investigation which identifies how PFAS is migrating across an area and is critical for informing PFAS management approaches. The mass flux study can be summarised as follows:

- The Base was divided into 11 surface water catchments, consistent with historical investigations across the base dating back to 2018 (CH2M Hill, 2018).
- Field investigations were conducted to further investigate the nature and extent of PFAS contamination across the base, inclusive of topographical survey, mapping of stormwater infrastructure and sampling / analysis.
- Mass flux calculations were conducted to determine the total mass⁴ of contaminants migrating from different areas of the base in surface water and groundwater. These calculations consider point in time concentration data but also consider other factors (e.g. flow rate) to allow for the identification of areas which require remediation or management.
- The mass flux calculations identified that:
 - 99 % of the PFAS mass flux from the base is via surface water, with the remaining 1 % via groundwater.
 - Of the PFAS mass flux via surface water:
 - 56 % originates from Catchment 3 (inclusive of CPSA N).
 - 24 % originates from Catchment 8 (inclusive of CPSA A and CPSA V).
 - 6.6 % originates from Catchment 7 (inclusive of CPSA D).

The findings of the mass flux study align with what may reasonably be expected, with the largest areas of the base where significant firefighting foam related activities have been undertaken (i.e. training, fire suppression systems) representing the most significant PFAS mass flux sources.

The mass flux study recommended that remediation focuses upon the key catchment areas noted above.

6.2 Remediation Projects

6.2.1 General

Works were undertaken to address PMAP recommendations during 2024-2025, inclusive of:

- Operation of PFAS treatment plants at fire training pads.
- Ongoing construction of a new Sewage Treatment Plant (STP) with PFAS treatment capability.
- Additional investigations and remediation planning with respect to Catchments 3, 7 and 8.

6.2.2 Additional Investigations and Remediation planning

During the monitoring period additional investigations were progressed in relation to Catchments 3, 7 and 8 with view to developed remediation plans. These investigations have predominantly focused upon near surface soils and surface water with the overall goal of refining remediation areas. The investigations of interest to this report are briefly summarised below:

⁴ Total mass includes the sum of up to 30 PFAS compounds.

- Investigations related to Catchment 3 have identified the potential for a previously unidentified former fire station to be located south of the previously identified former fire station and north of CPSA Z (JBS&G, 2025g). Investigations are ongoing to determine whether there is evidence of significant PFAS contamination in this area.
- Catchment 7 additional investigations were completed in September and October 2025, focusing upon CPSA C. The results of this investigation are being interpreted at the time of this report.
- Investigations related to Catchment 8 (JBS&G, 2025h) have identified that:
 - Discharge to Bremer River via Catchment 8 occurs between SW047 and SW094 via a semi-permanent surface water feature identified as the Lagoon. The Lagoon is located approximately 50 m downgradient of DP5 and is located beside a stockpile colloquially known as the 'Growler stockpile' on account of its origin (i.e. Growler hangars in the southern portion of Catchment 9). The Lagoon has been identified to contain relatively elevated PFAS concentrations in surface water (i.e. Sum PFAS 2.6 µg/L). It is noted that the Growler stockpile was assessed as having a negligible contribution to PFAS concentrations in surface water.
 - On the basis of the above, it is likely that the historical OMP sampling point for SW047 was moved during historical monitoring events, with results significantly changing between 2020 and 2021 (i.e. results above assessment criteria reducing to below limit of reporting). It is considered that the location was most likely moved from an area downstream of the DP5 discharge point (which is within Catchment 8 and reports to a drain within Catchment 8) to a portion of Bremer River immediately east of this area which upstream of the actual point of discharge of Catchment 8 stormwater into Bremer River (SW094).
 - Catchment 8 additional investigations were completed in September and October, focusing upon CPSA X and CPSA Y. The results of this investigation are being interpreted at the time of this report.
- Investigations related to the relationship between groundwater and Bremer River / Warrill Creek (including targeted professional survey) (JBS&G, 2025I) have confirmed that:
 - Bremer River is predominantly a gaining stream, with the exception of areas near the Bremer River and Warrill Creek confluence (losing stream approximately 1.5-2 km between SW051 and SW098, adjacent to Catchments 3 and 11).
 - Warrill Creek is predominantly a losing stream, with the exception of areas near the Bremer River and Warrill Creek confluence (gaining stream approximately 1-1.5km from SW100 downstream, adjacent to Catchment 3).

6.2.3 PFAS Treatment Plants

PFAS treatment plants were established to capture and treat wastewater generated from firefighting training activities on the pads in Catchment 7 (CPSA A) and Catchment 1 (CPSA W). The CPSA A plant was commissioned in November 2022 and operated throughout the 2024-2025 monitoring period. The CPSA W plant was established in December 2023 and operated for the remainder of the 2024-2025 OMR period. The treatment plants are understood to be a temporary measure to be employed until a permanent solution is in effect. The operation of the PFAS treatment plants is understood to have transitioned from Veolia to Cleanaway during the 2024-2025 monitoring period.

6.2.4 New Sewage Treatment Plant

Construction of a new STP commenced during late 2022 and has continued throughout 2024-2025 monitoring period. The new STP is being constructed to the northeast of the existing STP. The new STP has been designed with PFAS treatment capability and is anticipated to be commissioned during late 2026. The STP will receive and treat PFAS impacted wastewater overflows from Base. The construction works include management of

PFAS contaminated stockpiles generated from nearby construction projects. At the time of this report, stockpiles straddle the Catchment 6 and Catchment 7 boundary.

6.2.5 Runway Reprofiling

Runway reprofiling work was conducted within Catchment 3 during the 2024-2025 monitoring period. JBS&G is awaiting information from Defence in this regard. Anecdotally, this work is understood to have resulted in approximately 40,000m³ of surplus materials being used to form a pad within the southeastern portion of Catchment 3.

6.3 Infrastructure Projects

Any infrastructure works involving soil disturbance and reuse, movement and stockpiling of soil on-Base are managed as per Defence environmental guidelines including the Defence PFAS Construction and Maintenance Framework (Defence, 2025c), the Defence Contamination Management Manual (Defence, 2018 amended 2021) (in particular Annex K which details the management, reuse and stockpiling of PFAS impacted soil) and the Pollution Prevention Management Manual (Defence, 2017).

No major infrastructure works relevant to PFAS remediation or management were conducted during the 2024-2025 monitoring period with the exception of PFAS treatment plant operation (see **Section 6.2.2**), new STP construction works (see **Section 6.2.4**) and runway reprofiling works (see **Section 6.2.5**). A summary of historical infrastructure projects is provided as **Appendix D**. It is noted that as detailed in the PMAP, historical infrastructure activities associated with the Battlefield Airlifter (BFA) project and Growler Project included significant excavation of PFAS contaminated soils from Catchment 3. These soils were either disposed of offsite or stockpiled onsite, with the most contaminated materials transferred to Catchment 8 in an area referred to as the Temporary Storage Facility (TSF).

6.4 Biota Sampling Program

During early 2025, JBS&G was engaged to assist Defence with a joint project involving:

- Defence.
- Queensland Government:
 - Department of Environment, Tourism, Science and Innovation (DETSI).
 - Queensland Health (QH).

The joint project related to assessing PFAS concentrations in aquatic biota across the Management Area defined in the PMAP, as well as an area related to the Bundamba Creek catchment to the east of the Management Area. The following scope of works was completed as part of the joint project:

- HHRA Review: JBS&G completed a detailed review of the HHRA (EnRisks, 2019) and a biota sampling program developed by the Queensland Government.
- Community Consultation: JBS&G and Defence conducted community consultation between 21 February 2025 and 10 March 2025 to obtain information pertaining to fishing practices within the Investigation Area. A stakeholder survey was developed to obtain details concerning the location, timing, number and species being caught and actions typically undertaken (i.e. catch and release, destroy, or cooking for consumption).
- Biota SAQP: A biota monitoring SAQP was developed by JBS&G in consultation with Defence and the Queensland Government (JBS&G, 2025e). The SAQP was developed in consideration of the HHRA review, community consultation as well as specialist ecologist advice.
- Biota Monitoring and Factual Report: Biota monitoring was undertaken during May 2025, with the scope and findings reported in JBS&G (2025f).

Based on review of the results, the biota concentrations were found to be generally comparable to the concentrations identified in 2019 based on comparison of concentrations between sample type (i.e. predatory fish, pelagic invertebrates and benthic invertebrates as opposed to species specific concentrations).

6.5 Significant Weather Events

Monthly rainfall measurements recorded at the Amberley Atlantic Multidecadal Oscillation (AMO) weather station (Station Number 040004) between October 2024 and May 2025 were obtained from the Bureau of Meteorology (BoM), as shown in **Figure 9**. The long term mean monthly rainfall (1941 to 2025) has also been illustrated, with the mean annual rainfall at the Amberley AMO weather station recorded to be 871.4 mm per year. In addition, the mean monthly discharge (ML/day) recorded for the Bremer River at Walloon (monitoring station 143107A) was obtained from Queensland Government Water Monitoring Information Portal.

In relation to the monitoring period, the following key observations are noted:

- Rainfall during November and December 2024 was two times greater the corresponding monthly mean. The above average rainfall recorded over November and December were generally associated with persistent showers and repeated thunderstorms resulting in record daily rainfall totals. The weather resulted in localised flash flooding within the Ipswich region.
- Rainfall during March 2025 was three times greater than the corresponding monthly mean. The above average rainfall was observed in March 2025 due to ex-Tropical Cyclone Alfred, which resulted in flooding of Ipswich waterways including Bremer River, Warrill Creek and Bundamba Creek. This is reflected in the above average mean monthly discharge (ML/Day).

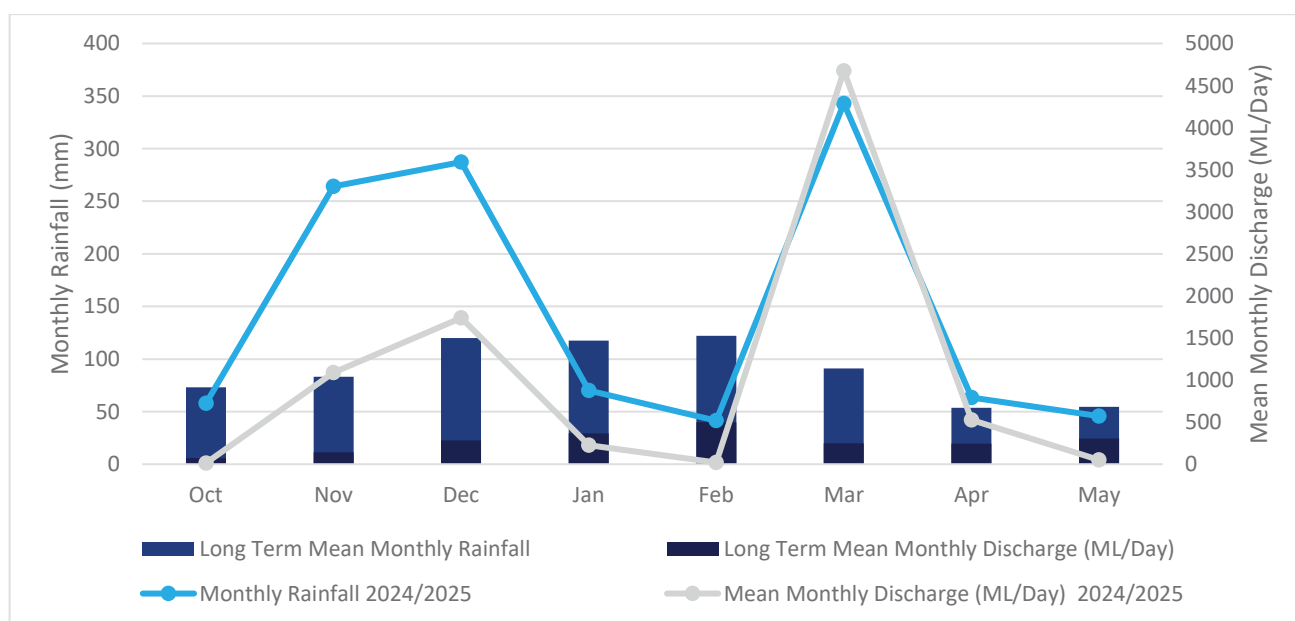


Figure 9: Monthly Rainfall at Amberley AMO (Station Number 040004) and Mean Monthly (ML/Day) Discharge at Bremer River at Walloon (143107A)

7. Monitoring Data Summary

7.1 Groundwater

7.1.1 Groundwater Physicochemical Field Parameters

Groundwater quality field parameters recorded during the monitoring period have been presented in **Table A1(a), Appendix A**. A summary of results has been presented in **Table 7-1**. Several pH and dissolved oxygen readings recorded across the monitoring network during the October / November 2024 monitoring event were anomalous compared to previous results (e.g. elevated dissolved oxygen readings and low pH readings). These anomalies were not generally observed during the April / May 2025 monitoring event, confirming their atypical nature. The anomalous results are considered to likely be a consequence of equipment malfunction (e.g. damage to sensor membrane, sensor fouling etc.).

Table 7-1: Summary of Groundwater Quality Parameters

Aquifer	Event	DO (mg/L)	EC ($\mu\text{s}/\text{cm}$)	pH	Eh (mV) ⁵	Temp ($^{\circ}\text{C}$)
Alluvium	Oct/Nov 2024	0.23 (MW021) – 8.6 (MW049) <i>Anaerobic to aerobic conditions</i>	113.5 (MW056S) – 15,780 (MW538) <i>Fresh to saline</i>	3.27 (MW056s) – 9.75 (MW021) <i>Acidic to alkaline</i>	173.8 (MW057S) – 425.2 (MW021) <i>Mildly to moderately oxidising</i>	21.3 (MW538) – 25.6 (MW056S)
	Apr/May 2025	1.35 (MW057S) – 7.41 (MW036) <i>Anaerobic to aerobic condition</i>	280.6 (MW048) – 8,012 (MW538) <i>Fresh to brackish</i>	6.49 (MW049) – 7.9 (MW006) <i>Near neutral</i>	101 (MW034) – 533.1 (MW007) <i>Mildly to strongly oxidising</i>	20.3 (MW055S) – 24.6 (MW029)
Tertiary Formation	Oct/Nov 2024	0.02 (MW057I) – 8.76 (MW020) <i>Anaerobic to aerobic condition</i>	384.6 (MW057I) – 27,740 (MW026) <i>Fresh to Saline</i>	4.03 (MW057I) – 10.06 (MW012) <i>Acidic to alkaline</i>	149 (MW057I) – 305.9 (MW020) <i>Mildly to moderately oxidising</i>	21.6 (MW047) – 25.5 (MW539)
	Apr/May 2025	0.92 (MW537I) – 7.19 (MW031) <i>Anaerobic to aerobic condition</i>	153.3 (MW539) – 25,528 (MW026) <i>Fresh to saline</i>	6.45 (MW537) – 7.17 (MW046) <i>Near neutral</i>	109.3 (MW057I) – 691.2 (MW309) <i>Mildly to strongly oxidising</i>	21.2 (MW047) – 24.9 (MW309)
Walloon Coal Measures	Oct/Nov 2024	0.02 (MW041) – 5.42 (MW042) <i>Anaerobic to aerobic condition</i>	499.7 (MW054D) – 21,876 (MW030) <i>Fresh to saline</i>	6.19 (MW002) – 7.07 (MW033) <i>Near neutral</i>	112 (MW054D) – 332.7 (MW030) <i>Mildly to moderately oxidising</i>	23 (MW053) – 25.2 (MW033)
	Apr/May 2025	1.29 (MW054D) – 7.94 (MW030) <i>Anaerobic to aerobic condition</i>	142.6 (MW033) – 12,581 (MW002) <i>Fresh to saline</i>	6.31 (MW002) – 7.53 (MW030) <i>Near neutral</i>	115.3 (MW054D) – 293.6 (MW002) <i>Mildly to moderately oxidising</i>	20.9 (MW055D) – 24.2 (MW042)

Note:

Table exclude anomalous results.

In summary, groundwater parameters recorded over the 2024-2025 monitoring period indicate the following:

- Alluvium / Tertiary formations – characterised by near neutral, fresh to saline, anaerobic to slightly aerobic conditions and reducing conditions. It is noted that the Eh readings were typically higher in April

⁵ Indicative ranges adopted are informed by the generalised Eh–pH stability fields presented in Hem (1985) *Study and Interpretation of the Chemical Characteristics of Natural Water* (U.S. Geological Survey Water-Supply Paper 2254).

/ May 2025 by comparison to October / November 2024 and was noted to vary significantly. Additionally, monitoring well MW026 has been reported to be screened within the tertiary formation; however, has been identified to be consistently more saline by comparison;

- Walloon Coal Measures – characterised by near neutral, brackish to saline, anerobic to slightly aerobic conditions and reducing conditions. Salinity varied significantly; however, is noted to be more saline in comparison to the Alluvium-Tertiary Formation. The EC results for MW030, MW033 and MW041 during the April 2024 event are considered uncharacteristic for groundwater within the Walloon Coal Measures (i.e. fresh).

7.1.2 Groundwater Elevation and Flow Direction

7.1.2.1 Depth to Groundwater

Standing water levels (SWLs) are measured in terms of metres below top of casing (mBTOC) and then converted into a relative water level (RWL) in order to determine groundwater flow directions (see **Section 7.1.2.2**). SWLs vary significantly across the Base and off-Base areas. The SWL within the Management Area which are located off-base in the alluvium adjacent to Bremer River and Warrill Creek can be summarised as follows (includes historical SWLs):

- Bremer River (MW056S): Ranges between 5 to 7.8 metres (16.4 – 25.4 feet) below top of casing.
- Warrill Creek (MW054S and MW057S): Typically, 3.9 to 7.3 metres (13.1 – 23.8 feet) below top of casing.

7.1.2.2 Groundwater Elevations and Flow Direction

Groundwater elevation data calculated from field gauging records has been presented in **Table A1(b)**, **Appendix A** and on **Figure 10 A-D**. Groundwater elevations within on-Base aquifers are consistent between monitoring rounds, indicating limited influence of wet and dry season climate conditions. The groundwater elevations are consistent with previous monitoring events.

Based on review of groundwater elevations:

- Alluvium-Tertiary Formation:
 - The Alluvium-Tertiary Formation forms part of a single hydrogeological unit, with groundwater flowing from the topographical high in western portion of the base where the Tertiary Formation is the upper aquifer material to the lower areas in the northeast, east and southeast where the Alluvium forms the upper portion of the aquifer.
 - The following groundwater wells have not been included in contours for the Alluvium-Tertiary System:
 - MW026 consistently reports higher groundwater elevation by comparison to other groundwater monitoring wells screened within the tertiary formation. Based on the higher salinity and relatively higher groundwater levels, groundwater within MW026 is considered to be relatively slow moving. As such, MW026 is unlikely to significantly contribute to off-Base groundwater flow. For this reason, MW026 has not been included contours for the Alluvium-Tertiary Formation.
 - Groundwater elevation data for monitoring wells located on the eastern side of Bremer River (MW056S/I) and southern side of Warrill Creek (MW054S/D, MW057S/I) were not used to model groundwater contours due to the influence of Bremer River and Warrill Creek (see **Section 8.2**).
 - Indicative groundwater flow directions have not been illustrated on the figures due to the complex and predominantly radial flow regime present at the site. Groundwater gradients vary locally and are influenced by subtle topographic and hydrogeological conditions, meaning that

simplified flow arrows may mischaracterise the hydraulic conditions. Groundwater flow patterns within the Alluvium-Tertiary formation are discussed in **Section 8.2**.

- No seasonal variation was observed with the exception of minor seasonal variation in MW057S and MW034.
- Walloon Coal Measures:
 - The Walloon Coal Measures represent a highly complex system which is recharged by leakage from upper formations. There is a potential for direct recharge of the Walloon Coal Measures via rock outcropping. The extent of outcropping in the vicinity of the Base has not been mapped as part of historical investigation work and as such the extent of outcropping and associated direct recharge is unclear.
 - There is significant variability of groundwater elevations for wells screened within the Walloon Coal Measures (e.g. 19 m head difference between MW042 and MW043). This indicates a complex system characterised by high (fractures and bedding planes) and low (rock mass) hydraulic conductivity zones. Considering this variability and the number of wells within the Walloon Coal Measures it is considered that preparation/presentation of groundwater contours is not justified.
 - No seasonal variation was observed.

Table 7-2: Summary of Groundwater RWLs October 2024 – May 2025

Sampling Event	Range in Groundwater RWL (mAHD) ⁶		
	Alluvium	Tertiary Formation	Walloon Coal Measures
Oct/Nov 2024	8.558 (MW056S) – 18.001 (MW037)	8.567 (MW056I) – 29.099 (MW026)	14.330 (MW055D) – 37.992 (MW043)
Apr/May 2025	10.857 (MW056S) – 18.413 (MW037)	10.212 (MW056I) – 29.174 (MW026)	14.755 (MW055D) – 37.732 (MW043)

7.1.3 Groundwater Analytical Results

Groundwater analytical results are presented in **Table A2, Appendix A**. A summary of the analytical results has been provided in **Table 7-3** and illustrated on **Figure 11 A-D, Figure 12A-D, Figure 13A-D** and **Figure 14A-D**. An interpretive assessment of data has been provided in **Section 8**. Deviations from the historical groundwater data set has been summarised in the **Table 7-4**.

Table 7-3: Summary of PFAS Concentrations in Groundwater

Compound	Sample Event	No. Samples (n)	Concentration Range (µg/L)	No. Sample with Conc. >LOR	No. Samples with Conc. > Drinking Water Criteria	No. Samples with Conc. > 99% Species Protection Criteria	No. Samples with Conc. > 95% Species Protection Criteria
Alluvium-Tertiary Formation							
PFBS	Oct/Nov 24	44	<LOR – 17	26	10	NA	NA
	Apr/May 25	45	<LOR – 9.6	29	5	NA	NA
PFHxS	Oct/Nov 24	44	<LOR – 120	35	29	NA	NA
	Apr/May 25	45	<LOR – 29	31	29	NA	NA
PFOS	Oct/Nov 24	44	<LOR – 240	35	35	35	23

⁶ metres Australian Height Datum

Compound	Sample Event	No. Samples (n)	Concentration Range (µg/L)	No. Sample with Conc. >LOR	No. Samples with Conc. > Drinking Water Criteria	No. Samples with Conc. > 99% Species Protection Criteria	No. Samples with Conc. > 95% Species Protection Criteria
	Apr/May 25	45	<LOR – 130	31	31	31	19
PFOA	Oct/Nov 24	44	<LOR – 23	23	8	1	0
	Apr/May 25	45	<LOR – 1.7	23	11	0	0
PFHxS+PFOS	Oct/Nov 24	44	<LOR – 360	37	NA	NA	NA
	Apr/May 25	45	<LOR – 146	32	NA	NA	NA
Walloon Coal Measures							
PFBS	Oct/Nov 24	10	<LOR – 5	4	1	NA	NA
	Apr/May 25	10	<LOR – 5.5	7	3	NA	NA
PFHxS	Oct/Nov 24	10	<LOR – 13	5	4	NA	NA
	Apr/May 25	10	<LOR – 21	8	7	NA	NA
PFOS	Oct/Nov 24	10	<LOR – 0.47	5	5	5	4
	Apr/May 25	10	<LOR – 0.6	7	7	7	4
PFOA	Oct/Nov 24	10	<LOR – 1.3	3	1	0	0
	Apr/May 25	10	<LOR – 2.7	6	3	0	0
PFHxS+PFOS	Oct/Nov 24	10	<LOR – 13.26	5	NA	NA	NA
	Apr/May 25	10	<LOR – 18.51	8	NA	NA	NA

Note:

No. samples includes quality assurance samples

NA = Not Applicable

Table 7-4: Summary of Deviation from Historical Groundwater Data

Aspect	PFBS	PFHxS	PFOS	PFOA	Sum PFHxS+PFOS
October / November 2024					
First-time Detection (<i>detection</i>)	MW005 (0.01)	MW034 (0.02)	MW538 (0.02)	MW034 (0.01) MW042 (0.02)	None
First-time Ecological Criteria Exceedance (<i>detection</i>)	None	None	MW538 (0.02)	none	None
First-time Human Health Exceedance (<i>detection</i>)	None	None	None	None	None
New Historical Minimum (<i>historical minimum / new minimum</i>)	MW020 (0.32 / 0.04) MW048 (0.12 / <LOR) MW049 (0.42 / 0.09)	MW020 (1.12 / 0.21) MW048 (0.74 / 0.06) MW049 (1.68 / 0.35)	MW020 (1.1 / 0.46) MW048 (1.5 / 0.75) MW049 (3.15 / 0.56)	MW020 (0.06 / 0.02) MW048 (0.03 / <LOR) MW049 (0.16 / 0.02)	MW020 (3.25 / 0.67) MW048 (2.34 / 0.81) MW049 (4.83 / 0.91)
	MW536 (0.10 / 0.09) MW537 (0.34 / 0.28) MW539 (3.73 / 2.9)	MW536 (0.62 / 0.48) MW537 (0.26 / 0.14) MW538 (0.05 / 0.01) MW539 (4.26 / 3.1)	MW536 (0.94 / 0.66) MW537 (0.18 / 0.07)	MW536 (0.08 / 0.06) MW537 (0.02 / 0.01) MW539 (0.04 / 0.02)	MW536 (1.56 / 1.14) MW537 (0.44 / 0.21) MW538 (0.05 / 0.03) MW539 (4.26 / 3.1)

Aspect	PFBS	PFHxS	PFOS	PFOA	Sum PFHxS+PFOS	
New Historical Maximum (historical maximum / new maximum)	MW042 (0.02 / 0.07)	MW042 (0.06 / 0.18)	MW036 (0.02 / 0.03) MW042 (0.15 / 0.17) MW538 (<LOR / 0.02) MW043 (0.40 / 0.47)	MW034 (<LOR / 0.01) MW037 (0.13 / 0.18) MW042 (<LOR / 0.02)	MW042 (0.21 / 0.35) MW043 (0.70 / 0.71)	
	April / May 2025					
	First-time Detection (detection)	MW054D (0.04)	MW056S (0.01)	MW535 (0.01)	MW054D (0.01)	None
	First-time Ecological Criteria Exceedance (detection)	None	None	MW535 (0.01)	None	None
First-time Human Health Exceedance (detection)	None	None	None	None	None	
New Historical Minimum (historical minimum / new minimum)	MW021 (0.66 / 0.49)	MW021 (12.7 / 9.0)	MW007 (4.69 / 4.6) MW021 (35 / 26) MW022 (0.071 / 0.04) MW046 (26.8 / 8.7)	MW021 (1.44 / 1.1) MW022 (0.018 / <LOR) MW046 (2.18 / 0.50)	MW021 (53.9 / 35) MW022 (1.54 / 0.26) MW046 (36.3 / 11.1) MW538 (0.03 / <LOR)	
	MW022 (0.61 / 0.03)	MW022 (1.42 / 0.22)				
	MW046 (1.29 / 0.42)	MW041 (0.16 / 0.29)				
	MW537 (0.28 / 0.2)	MW046 (9.48 / 2.4) MW538 (0.01 / <LOR)				

Aspect	PFBS	PFHxS	PFOS	PFOA	Sum PFHxS+PFOS
New Historical Maximum (<i>historical maximum / new maximum</i>)	MW005 (0.01 / 0.02)	MW005 (0.06 / 0.07)	MW030 (0.41 / 0.6)	MW030 (2.2 / 2.7)	MW023 (1.34 / 1.47)
	MW023 (0.14 / 0.43)	MW023 (0.84 / 1.3)	MW032 (27.9 / 37)	MW041 (0.01 / 0.03)	MW026 (0.03 / 0.04)
	MW025 (0.29 / 0.3)	MW024 (0.09 / 0.13)	MW047 (7.85 / 98)	MW054D (<LOR / 0.01)	MW030 (13.7 / 22)
	MW030 (5.49 / 5.5)	MW030 (13.5 / 17)	MW535 (<LOR / 0.01)	MW539 (0.04 / 0.07)	MW032 (37.4 / 45.8)
	MW047 (1.58 / 9.6)	MW047 (10.3 / 29)			MW041 (0.49 / 0.62)
	MW054D (<LOR / 0.04)	MW054D (0.02 / 0.1)			MW047 (71.1 / 127)
	MW536 (0.10 / 0.12)	MW056S (<LOR / 0.01)			MW054D (0.07 / 0.15)
	MW539 (3.73 / 5.8)	MW539 (4.26 / 5.1)			MW535 (<LOR / 0.01)
					MW539 (4.26 / 5.1)

Note:

Bold text indicates an order of magnitude difference.

- Legend**
- Watercourse of Interest
 - Watercourse / Drainage Line
 - Inferred Groundwater Contour (mAHD)
 - PMAP Management Area
 - RAAF Amberley Approximate Site Boundary
 - Groundwater Monitoring Location
 - RWL indicated (mAHD)
 - Not included in contours

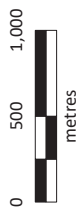


Job No: 66133

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Version: RevC

Scale 1:44,000

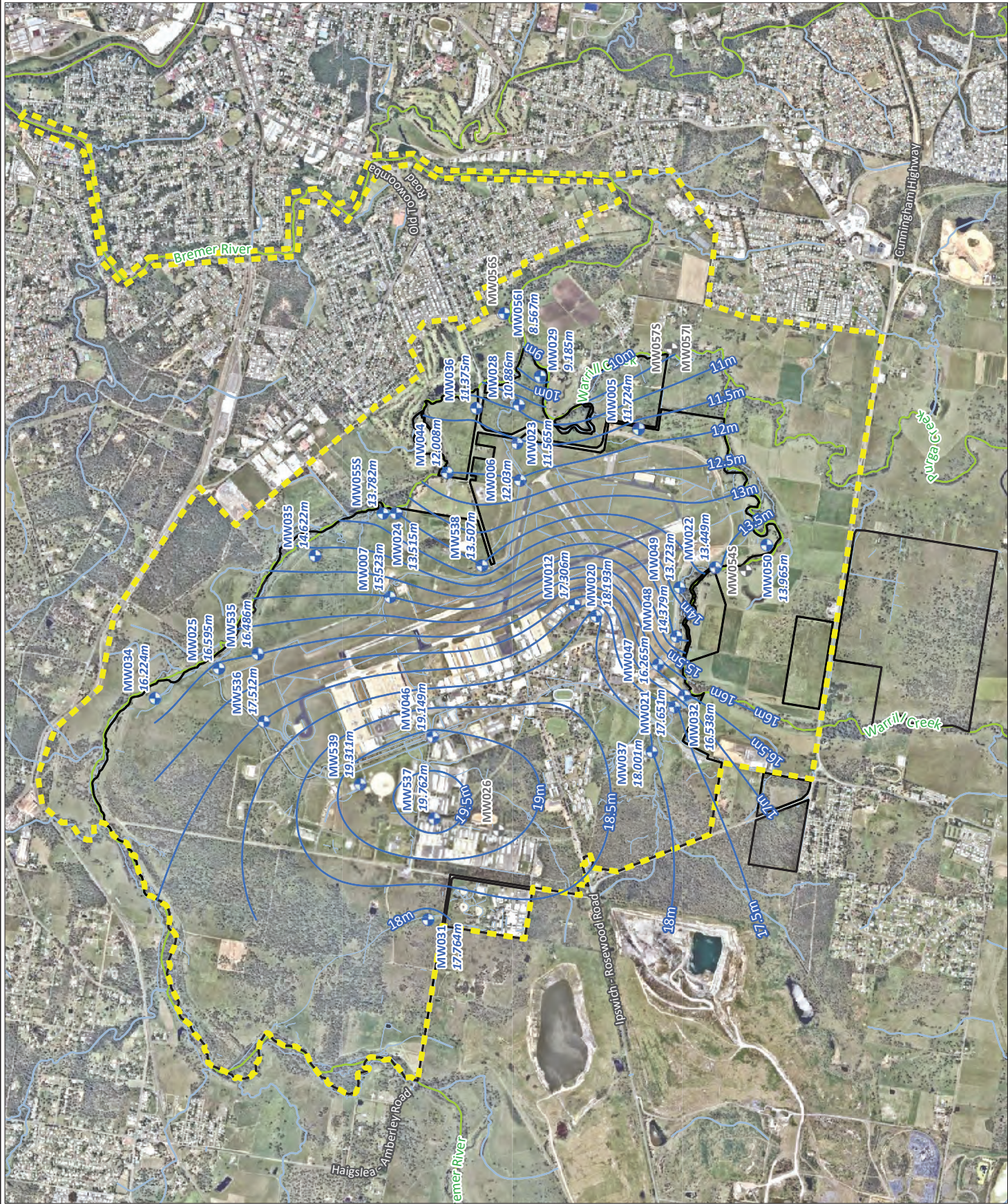


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

GROUNDWATER CONTOURS,
ALLUVIUM / TERTIARY FORMATION
(OCTOBER & NOVEMBER, 2024)

FIGURE 10A



- Legend**
- Watercourse of Interest
 - Watercourse / Drainage Line
 - Inferred Groundwater Contour (mAHD)
 - PMAP Management Area
 - RAAF Amberley Approximate Site Boundary
 - Groundwater Monitoring Location
 - RWL indicated (mAHD)
 - Not included in contours



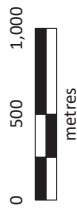
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000

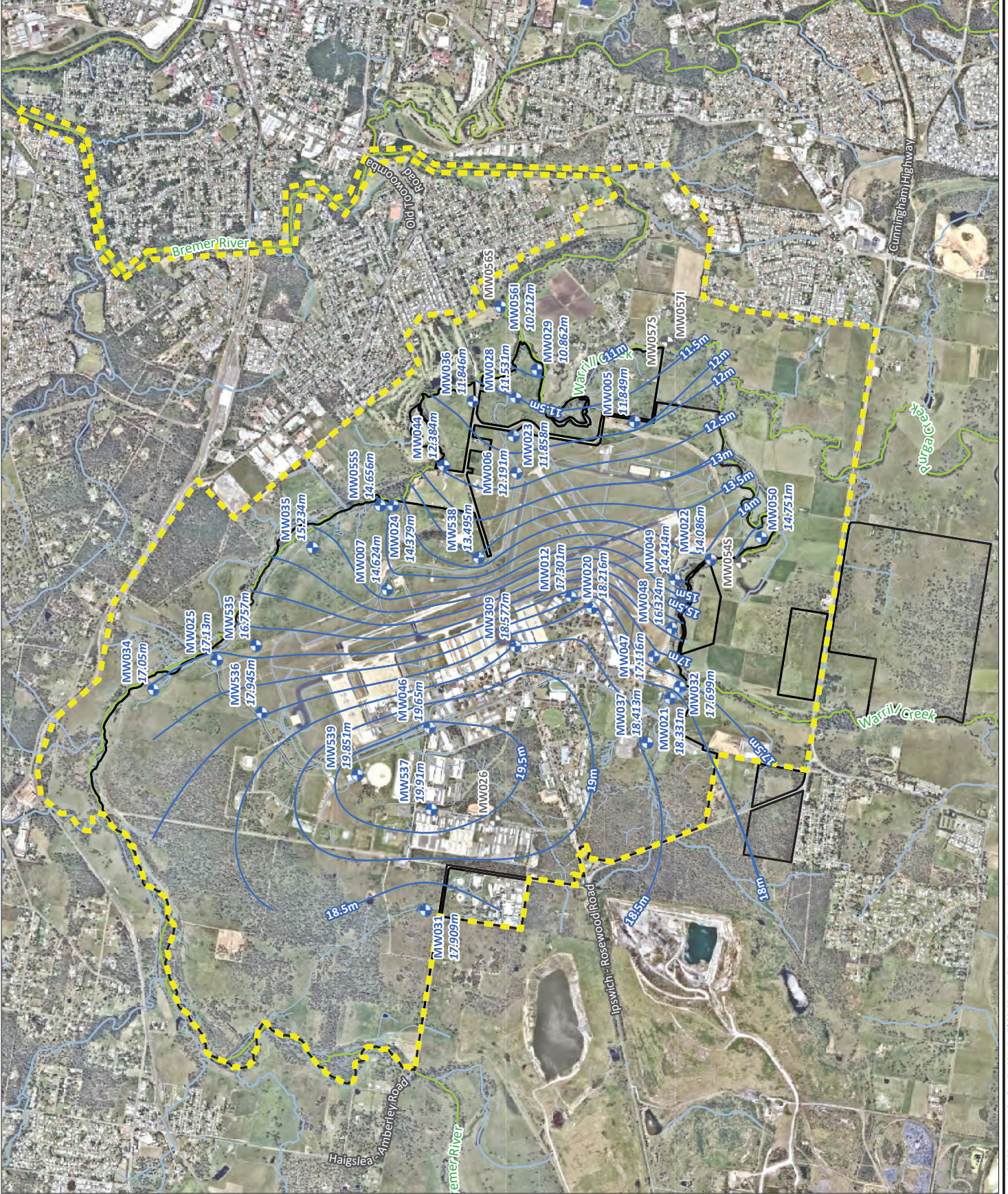


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland








**GROUNDWATER CONTOURS,
ALLUVIUM / TERTIARY FORMATION
(APRIL & MAY, 2025)**

FIGURE 10B



Name: 66133_RAAF_Amberley_OMR25_RevC/66133_10B_GWCContAlluviumAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

-  Watercourse of Interest
-  Watercourse / Drainage Line
-  PMAP Management Area
-  RAAF Amberley Approximate Site Boundary
-  Boundary
-  Groundwater Monitoring Location
-  RWL indicated (mAHD)



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000



0 500 1,000 metres



Coord. Sys. GDA2020 MGA Zone 56








RAAF Base Amberley,
Queensland

GROUNDWATER ELEVATION,
WALLOON COAL MEASURES
(OCTOBER & NOVEMBER, 2024)

FIGURE 10C



Legend

-  Watercourse of Interest
-  Watercourse / Drainage Line
-  P/MAP Management Area
-  RAAF Amberley Approving Site Boundary
-  Boundary
-  Groundwater Monitoring Location
-  RWL indicated (mAHD)



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000



0 500 1,000 metres



Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

GROUNDWATER ELEVATION,
WALLOON COAL MEASURES
(APRIL & MAY, 2025)

FIGURE 10D



Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMPAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

PFBS Concentration

- 10 - <50 µg/L
- 1 - <10 µg/L
- <1 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



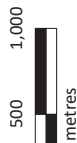
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000

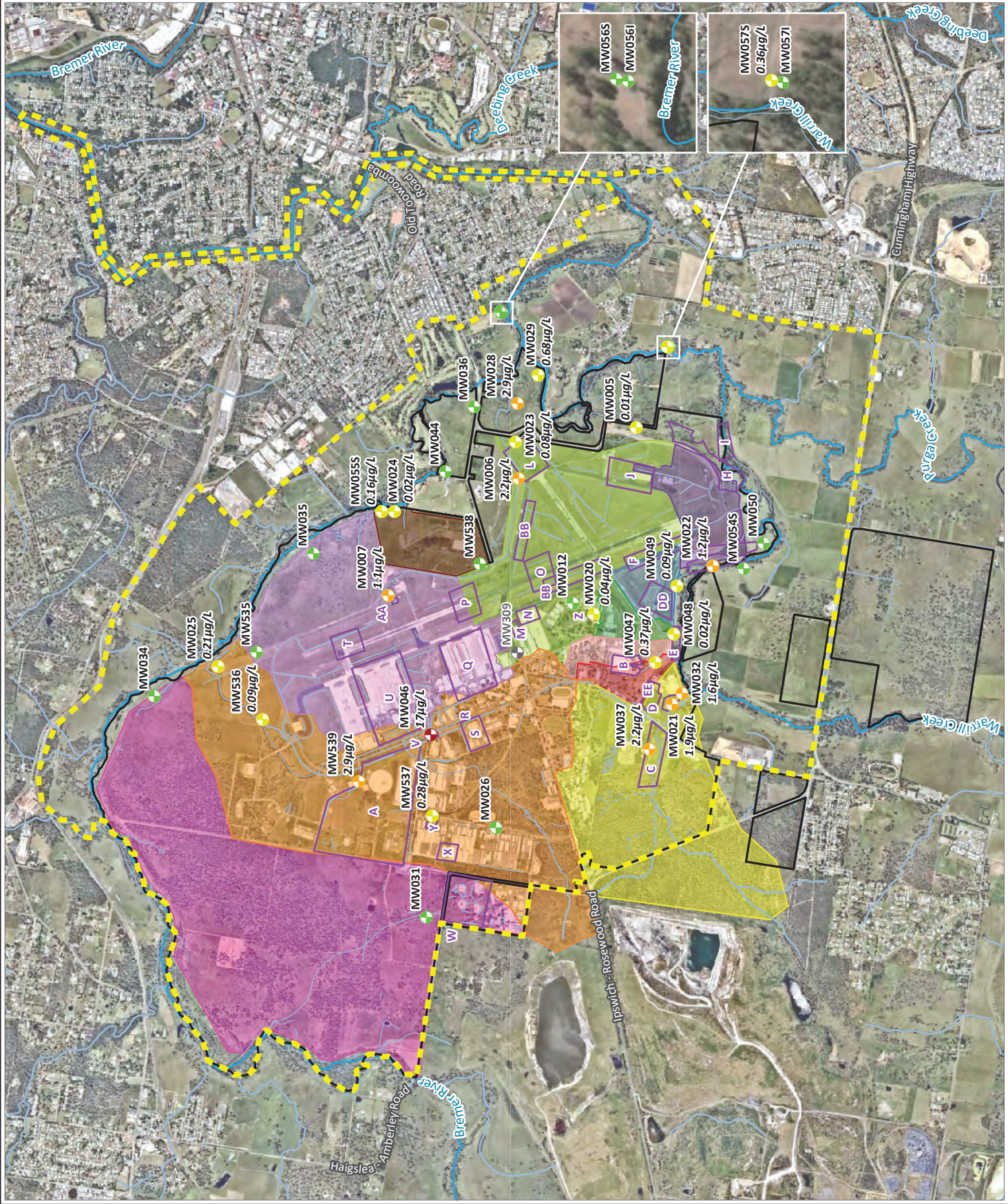


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFBS GROUNDWATER CONCENTRATION,
ALLUVIUM / TERTIARY FORMATION
(OCTOBER & NOVEMBER, 2024)

FIGURE 11A



Name: 66133_RAAF_Amberley_Oct25_RevC_66133_11A_PFBSSallinterOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

PFBS Concentration

- 10 - <50 µg/L
- 1 - <10 µg/L
- <1 µg/L
- Non-detect

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

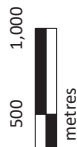
Client: Department of Defence

Version: RevC

Date: 14-Oct-2025



Scale 1:44,000

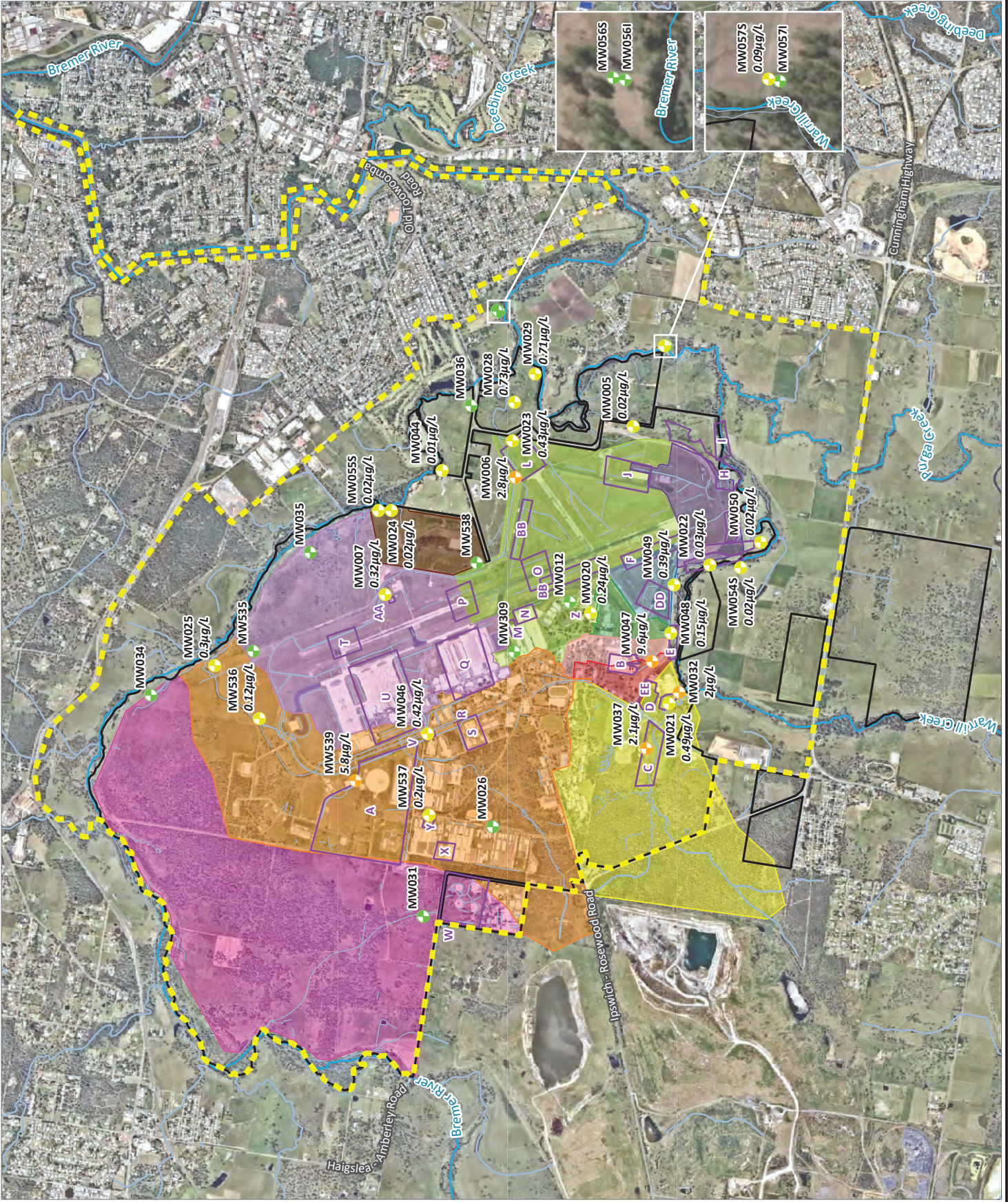


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFBS GROUNDWATER CONCENTRATION,
ALLUVIUM / TERTIARY FORMATION
(APRIL & MAY, 2025)

FIGURE 11B



Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMPAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

PFBS Concentration

- 10 - <50 µg/L
- 1 - <10 µg/L
- <1 µg/L
- Non-detect

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



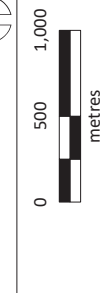
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000

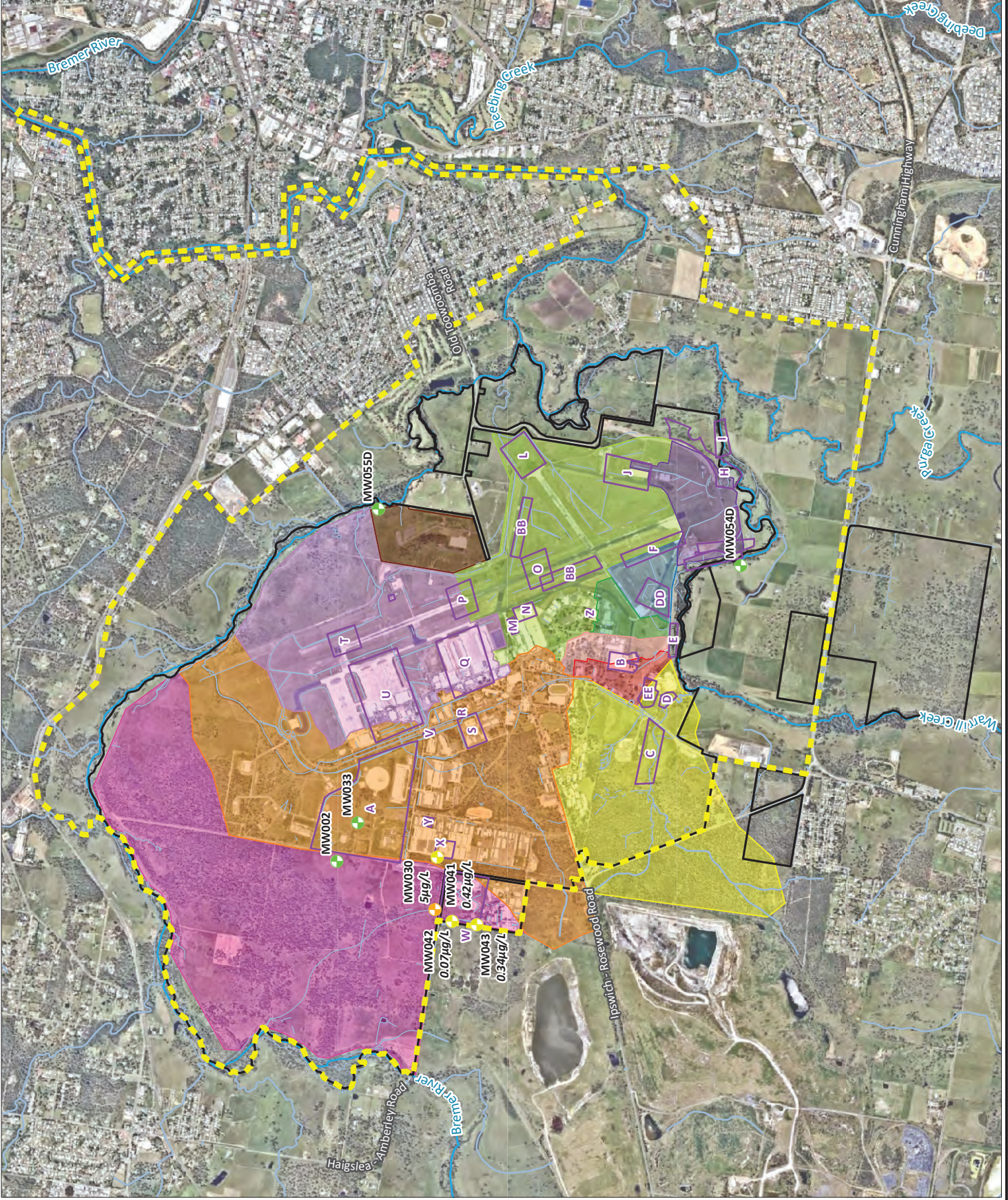


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFBS GROUNDWATER CONCENTRATIONS,
WALLOON COAL MEASURES
(OCTOBER & NOVEMBER, 2024)

FIGURE 11C



Name: 66133_RAAF Amberley_Oct25_RevC/66133_11C_PFBSWalloonOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

- PFBS Concentration**
- 10 - <50 µg/L
 - 1 - <10 µg/L
 - <1 µg/L
 - Non-detect

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



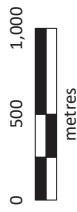
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

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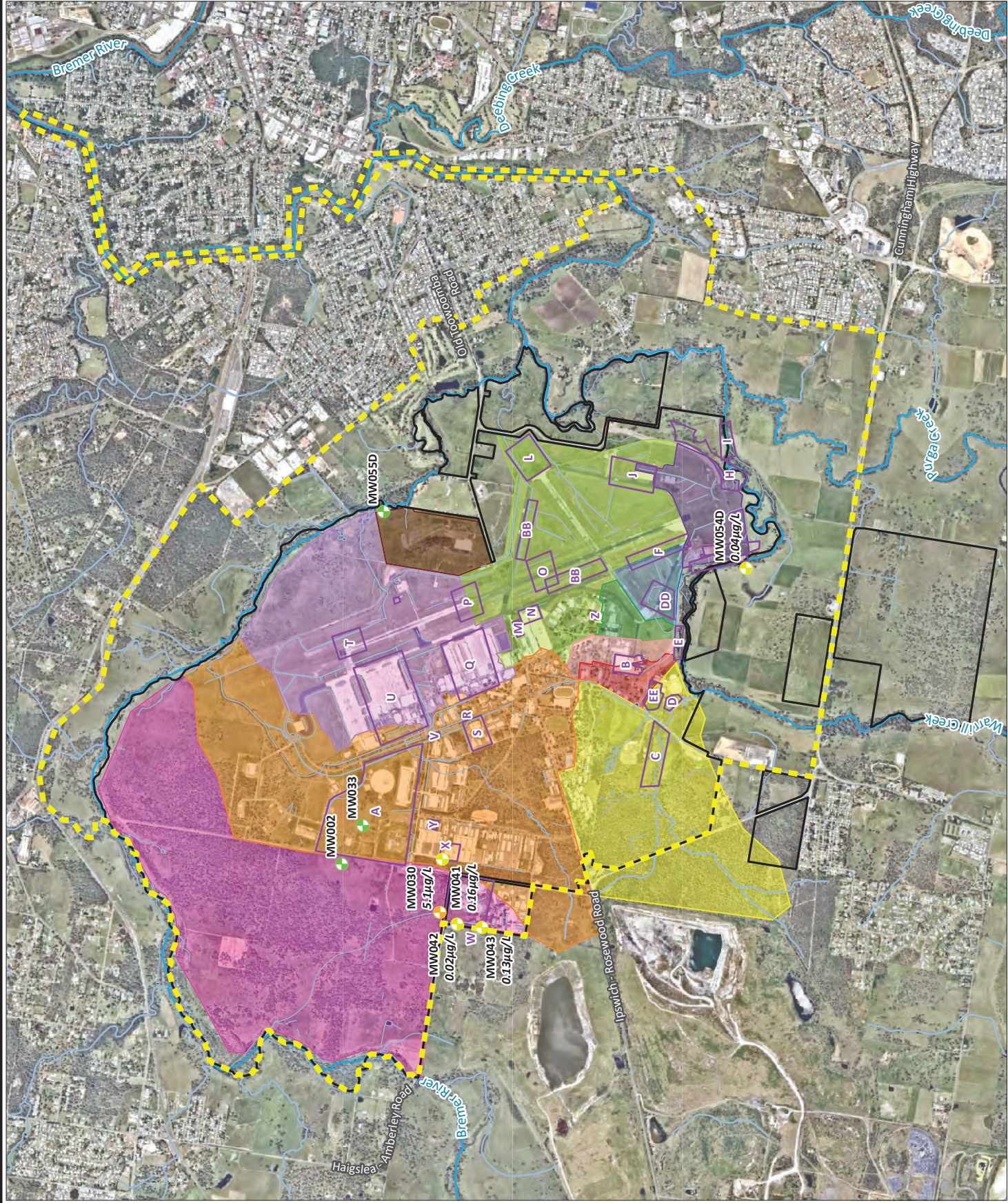


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

**PFBS GROUNDWATER CONCENTRATIONS,
WALLOON COAL MEASURES
(APRIL & MAY, 2025)**

FIGURE 11D



Name: 66133_RAAF Amberley_OMR25_RevC/66133_11D_PFBSSWalloonAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMPAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

PFOA Concentration

- 10 - <50 µg/L
- 0.2 - <10 µg/L
- <0.2 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



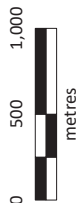
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000

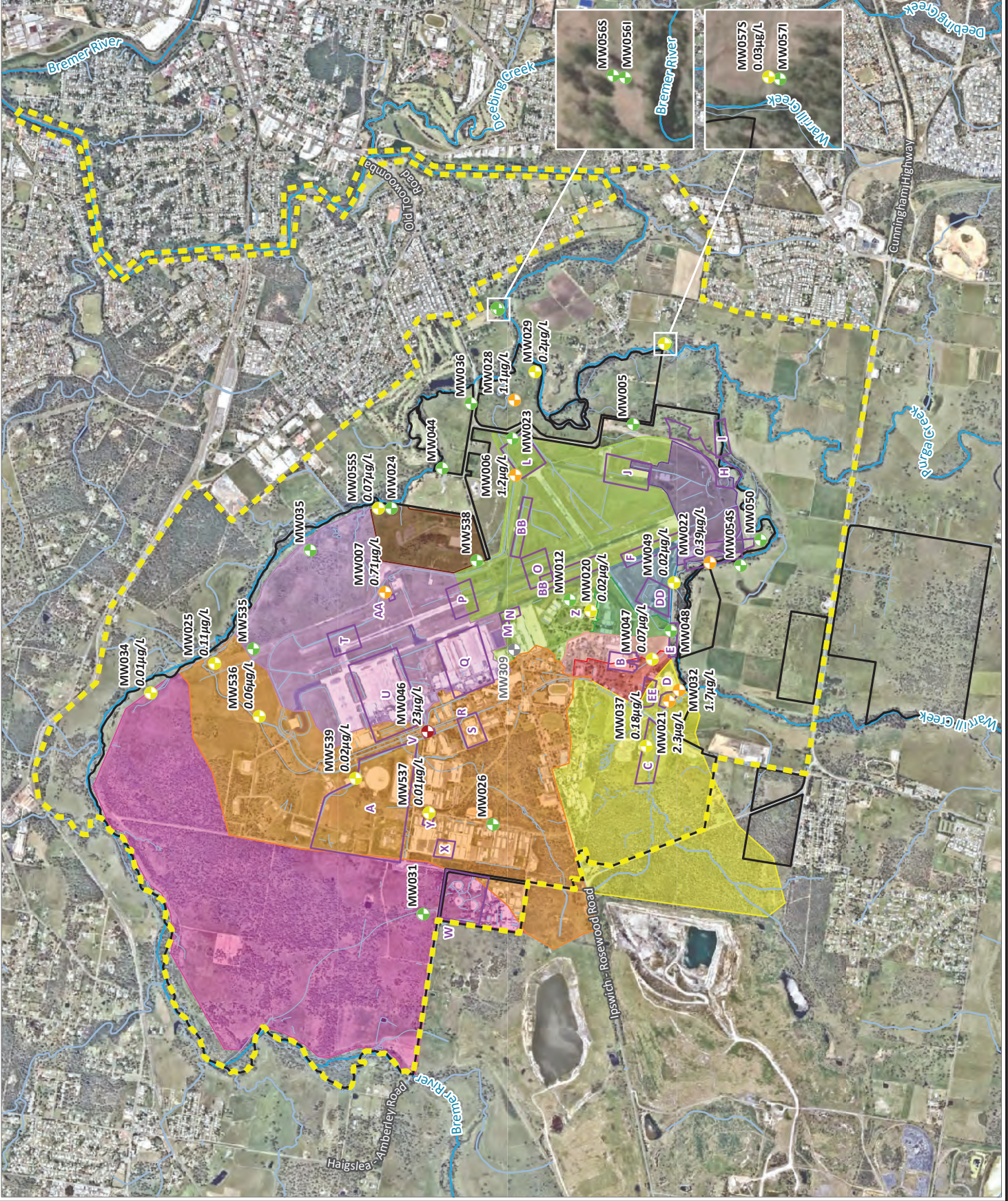


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFOA GROUNDWATER CONCENTRATIONS,
ALLUVIUM / TERTIARY FORMATION
(OCTOBER & NOVEMBER, 2024)

FIGURE 12A



Name: 66133_RAAF_Amberley_Oct24_RevC_66133_12A_PFOAAlluviumOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMPAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site
- Boundary

Groundwater Monitoring Location

PFOA Concentration

- 10 - <50 µg/L
- 0.2 - <10 µg/L
- <0.2 µg/L
- Non-detect

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



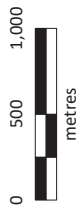
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000

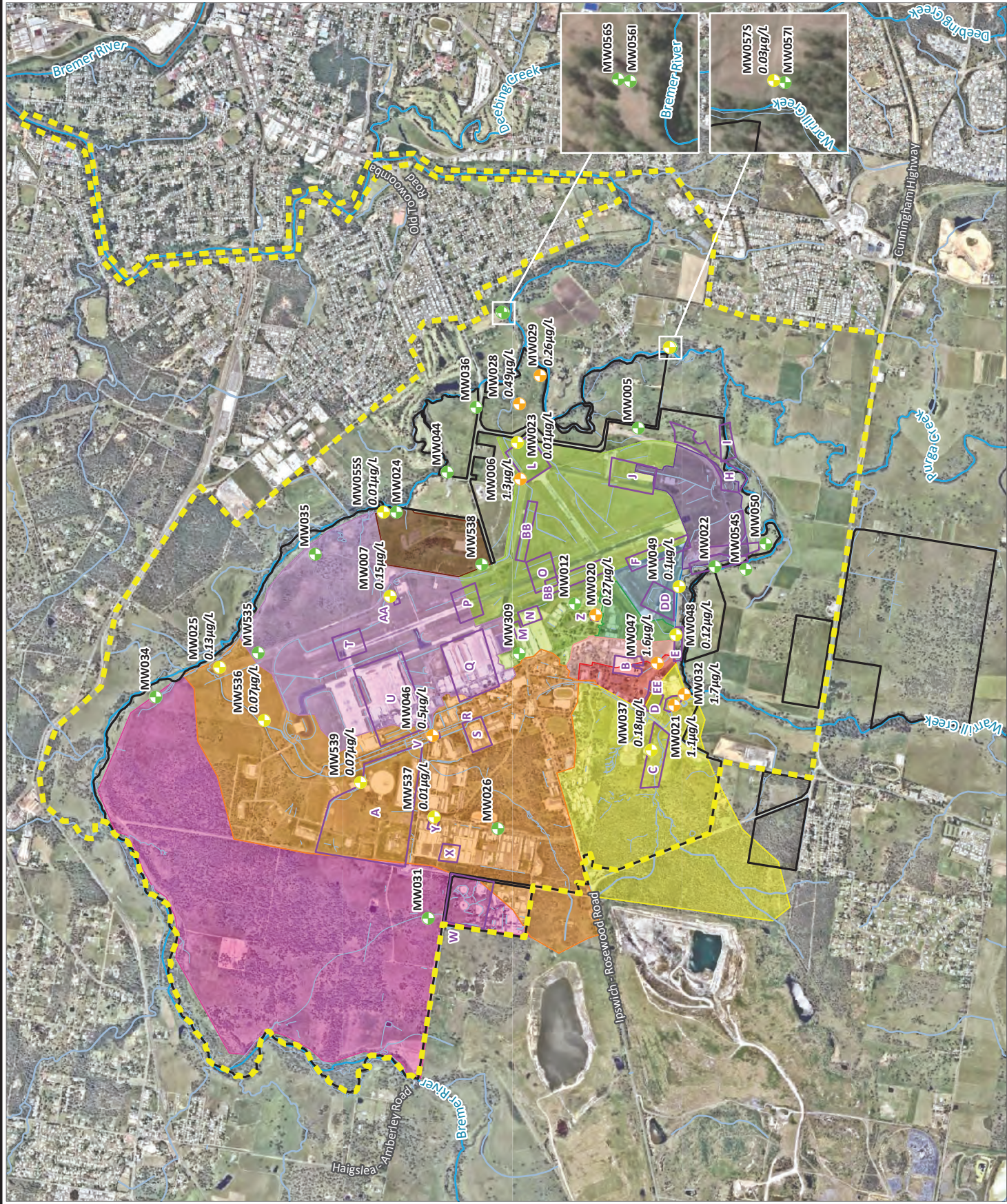


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFOA GROUNDWATER CONCENTRATIONS,
ALLUVIUM / TERTIARY FORMATION
(APRIL & MAY, 2025)

FIGURE 12B



Name: 66133_RAAF Amberley_OMR25_RevC/66133_12B_PFOAalluvAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

- PFOA Concentration**
- 10 - <50 µg/L
 - 0.2 - <10 µg/L
 - <0.2 µg/L
 - Non-detect

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025



Scale 1:44,000

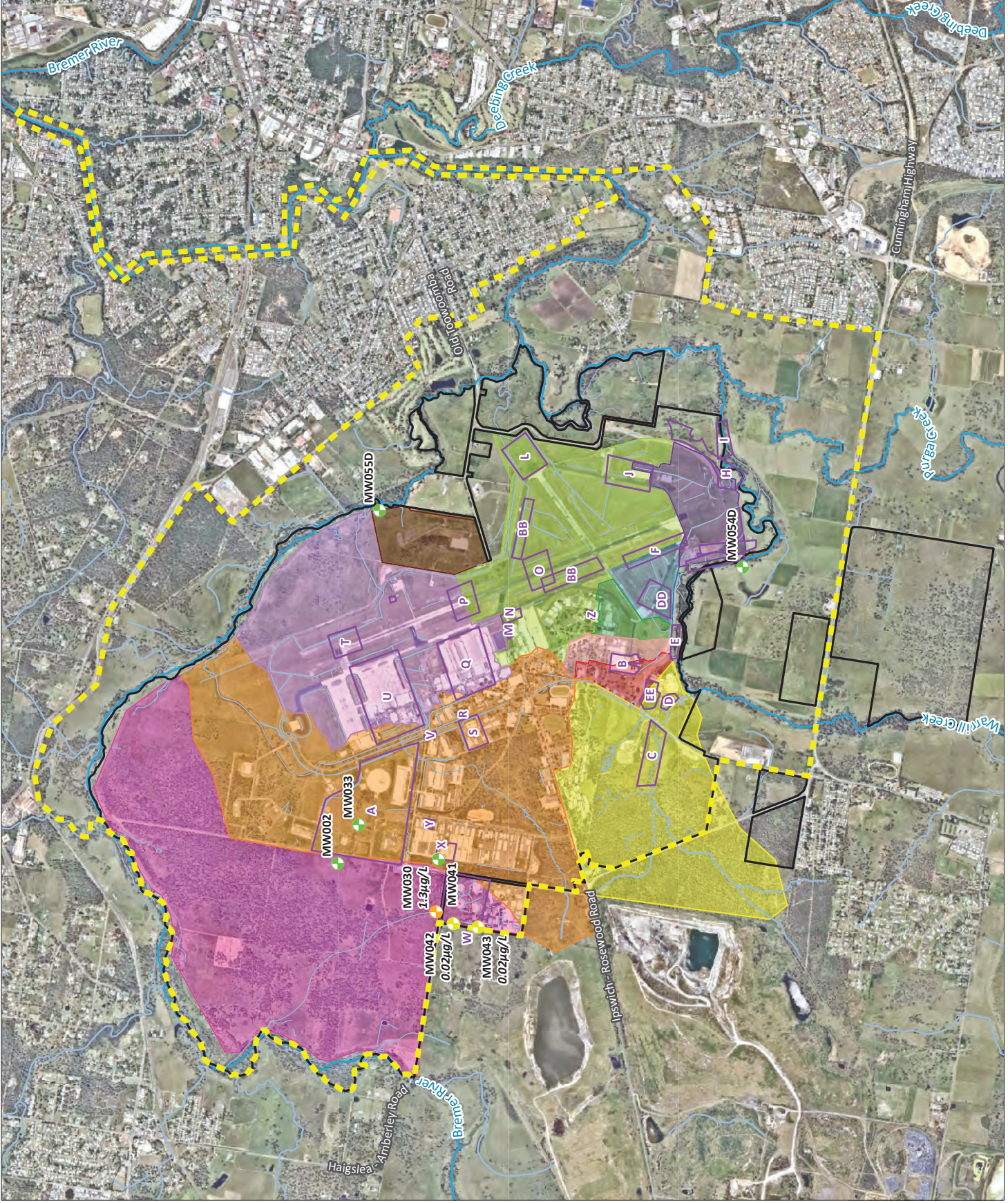


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

**PFOA GROUNDWATER CONCENTRATIONS,
WALLOON COAL MEASURES
(OCTOBER & NOVEMBER, 2024)**

FIGURE 12C



Name: 66133_RAAF_Amberley_OctNov24_RevC/66133_12C_PFOAWalloonOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

- PFOA Concentration
- 10 - <50 µg/L
- 0.2 - <10 µg/L
- <0.2 µg/L
- Non-detect

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevB

Date: 14-Oct-2025

Scale 1:44,000

0 500 1,000 metres

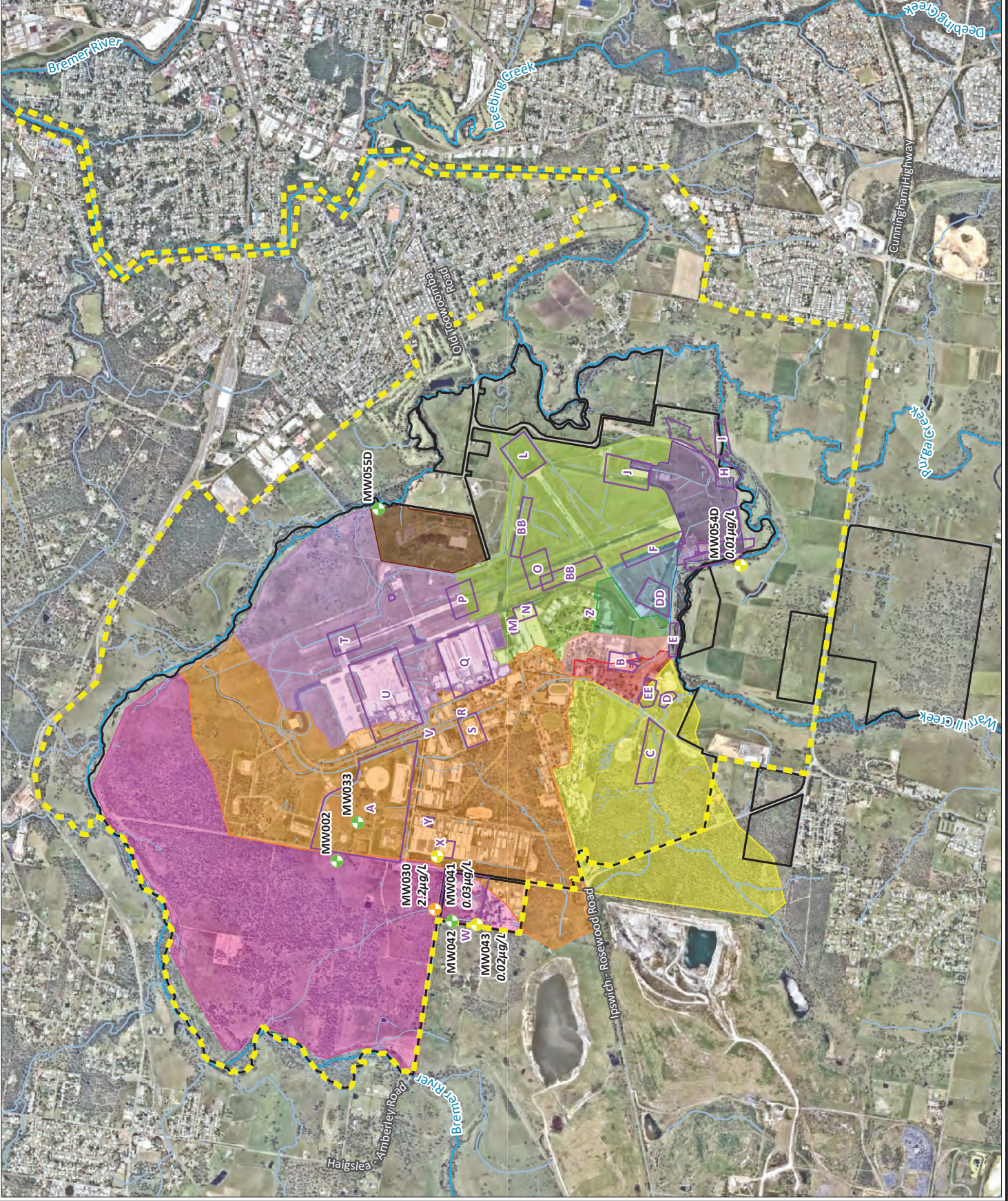


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFOA GROUNDWATER CONCENTRATIONS,
WALLOON COAL MEASURES
(APRIL & MAY, 2025)

FIGURE 12D



Name: 66133_RAAF Amberley_OMR25_RevC/66133_12D_PFOAWalloonAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMPAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

- PFOs Concentration
- >100 µg/L
- 10 - <100 µg/L
- 1 - <10 µg/L
- 0.1 - <1 µg/L
- 0.008 - <0.1 µg/L
- <0.008 µg/L
- Non-detect
- Not Sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC Date: 14-Oct-2025



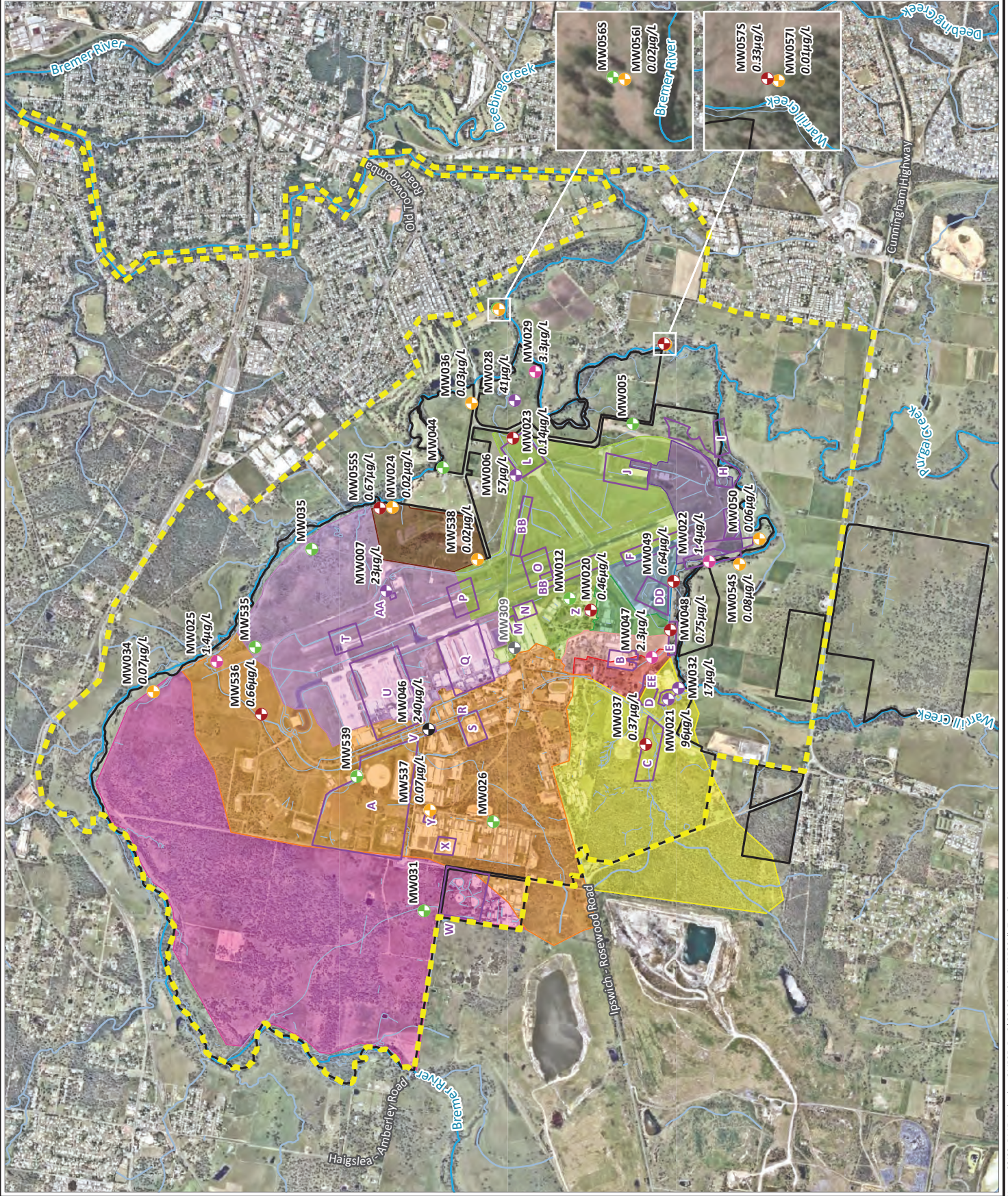
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Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley
 Queensland
 PFOS GROUNDWATER
 CONCENTRATIONS, ALLUVIUM /
 TERTIARY FORMATION (OCTOBER &
 NOVEMBER, 2024)

FIGURE 13A



Name: 66133_RAAF Amberley_Oct25_RevC/66133_13A_GWPFOSalluviumOct24
 Reference: www.nearmap.com - Imagery Date: 03/06/2024

- Legend**
- Watercourse of Interest
 - Watercourse / Drainage Line
 - PMPAP Management Area
 - Confirmed Primary Source Area
 - RAAF Amberley Approximate Site Boundary
- Groundwater Monitoring Location**
- PFOS Concentration**
- >100 µg/L
 - 10 - <100 µg/L
 - 1 - <10 µg/L
 - 0.1 - <1 µg/L
 - 0.008 - <0.1 µg/L
 - <0.008 µg/L
 - Non-detect
- Catchment Areas**
- Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11

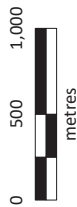


Job No: 66133

Client: Department of Defence

Version: RevC Date: 14-Oct-2025

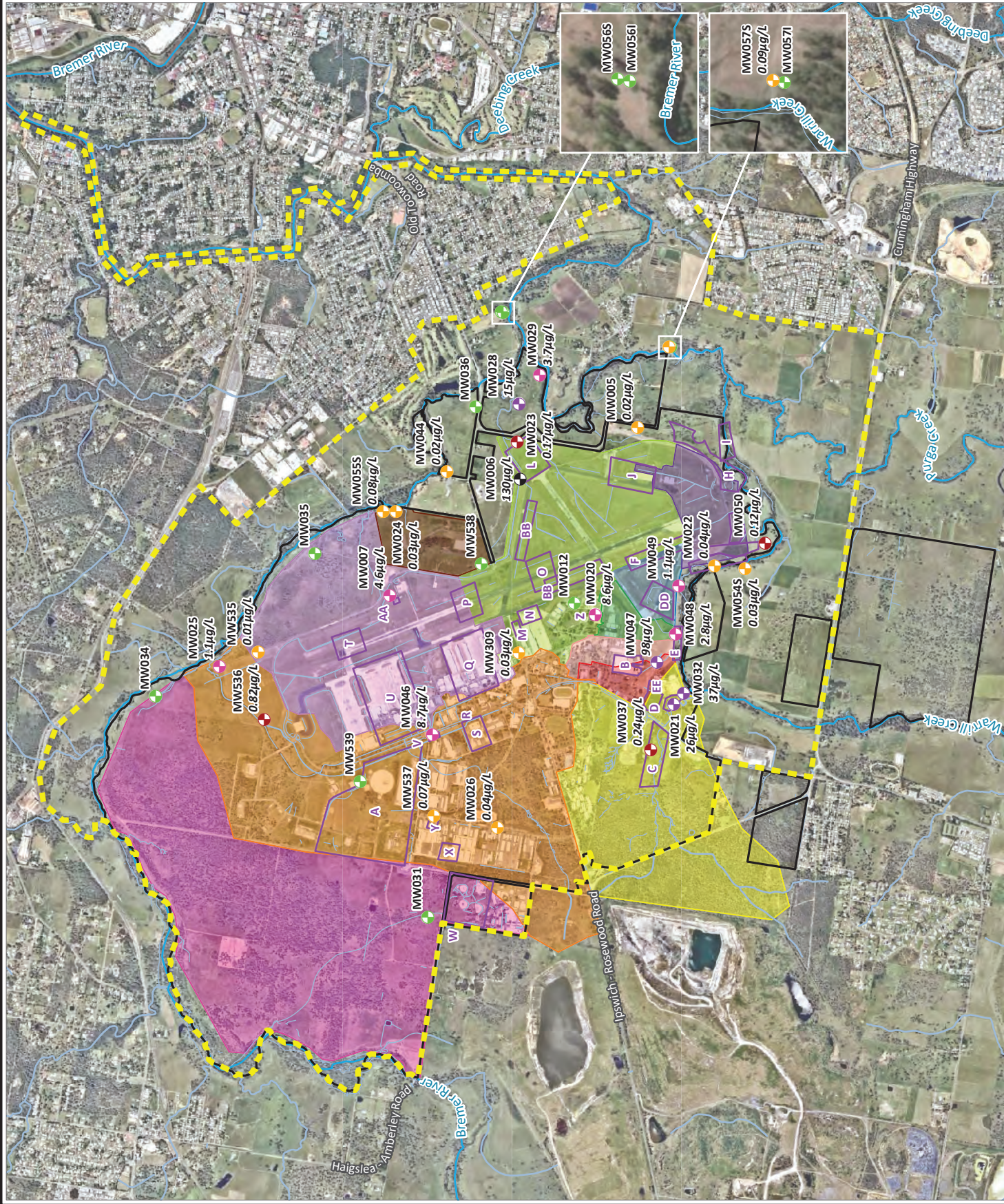
Scale 1:44,000



Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley
 Queensland
 PFOS GROUNDWATER
 CONCENTRATIONS, ALLUVIUM /
 TERTIARY FORMATION (APRIL &
 MAY 2025)

FIGURE 13B



- Legend**
- Watercourse of Interest
 - Watercourse / Drainage Line
 - PMPAP Management Area
 - Confirmed Primary Source Area
 - RAAF Amberley Approximate Site Boundary
 - Groundwater Monitoring Location
- PFOS Concentration**
- >100 µg/L
 - 10 - <100 µg/L
 - 1 - <10 µg/L
 - 0.1 - <1 µg/L
 - 0.008 - <0.1 µg/L
 - <0.008 µg/L
 - Non-detect
- Catchment Areas**
- Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:44,000

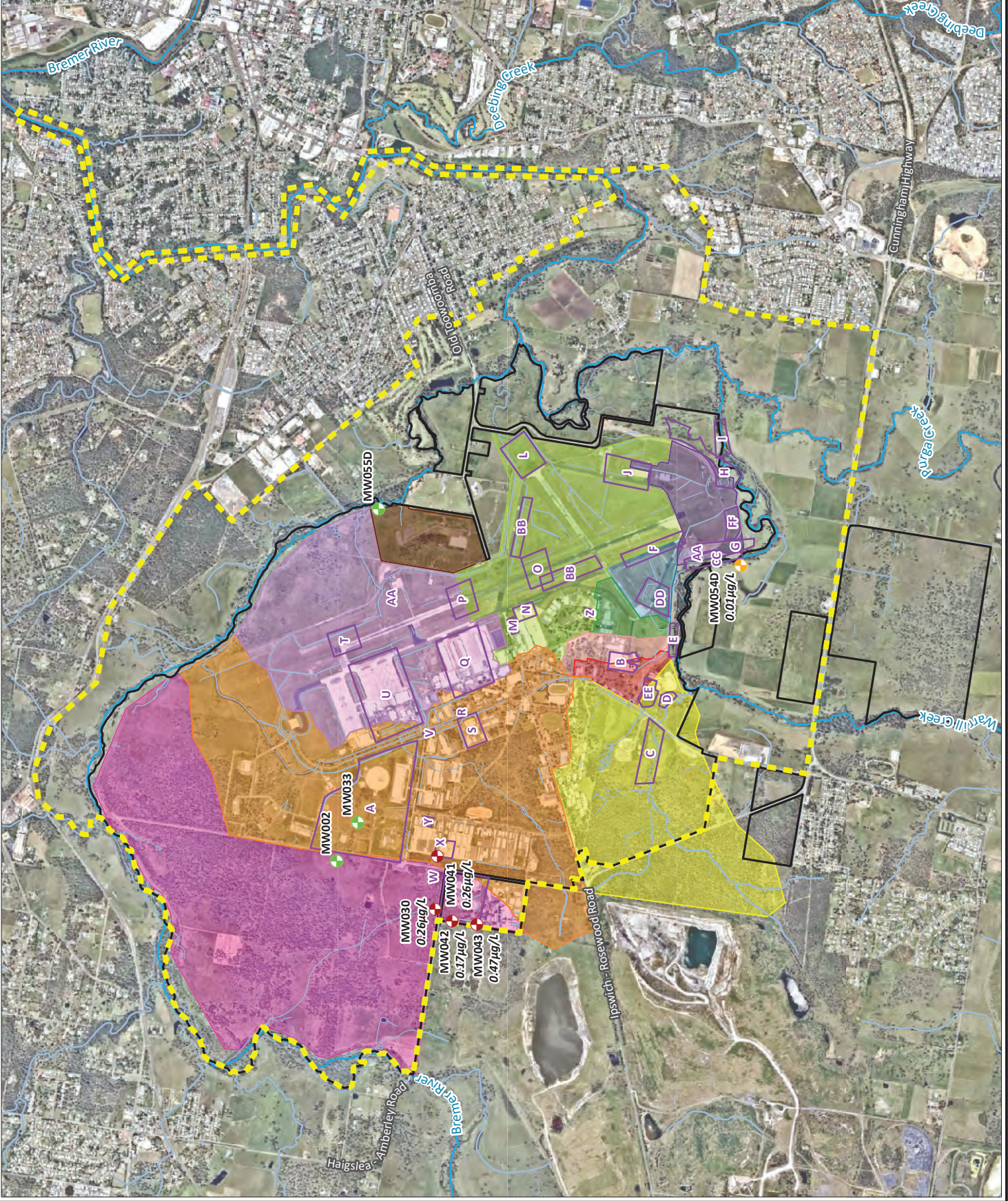
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Coord. Sys. GDA2020 MGA Zone 56

**RAAF Base Amberley,
Queensland
PFOS GROUNDWATER
CONCENTRATIONS, WALLOON COAL
MEASURES (OCTOBER &
NOVEMBER, 2024)**

FIGURE 13C



- Legend**
- Watercourse of Interest
 - Watercourse / Drainage Line
 - P/MAP Management Area
 - Confirmed Primary Source Area
 - RAAF Amberley Approximate Site Boundary
 - Groundwater Monitoring Location
- PFOS Concentration**
- >100 µg/L
 - 10 - <100 µg/L
 - 1 - <10 µg/L
 - 0.1 - <1 µg/L
 - 0.008 - <0.1 µg/L
 - <0.008 µg/L
 - Non-detect
- Catchment Areas**
- Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11

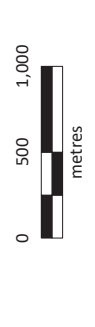


Job No: 66133

Client: Department of Defence

Version: RevC Date: 14-Oct-2025

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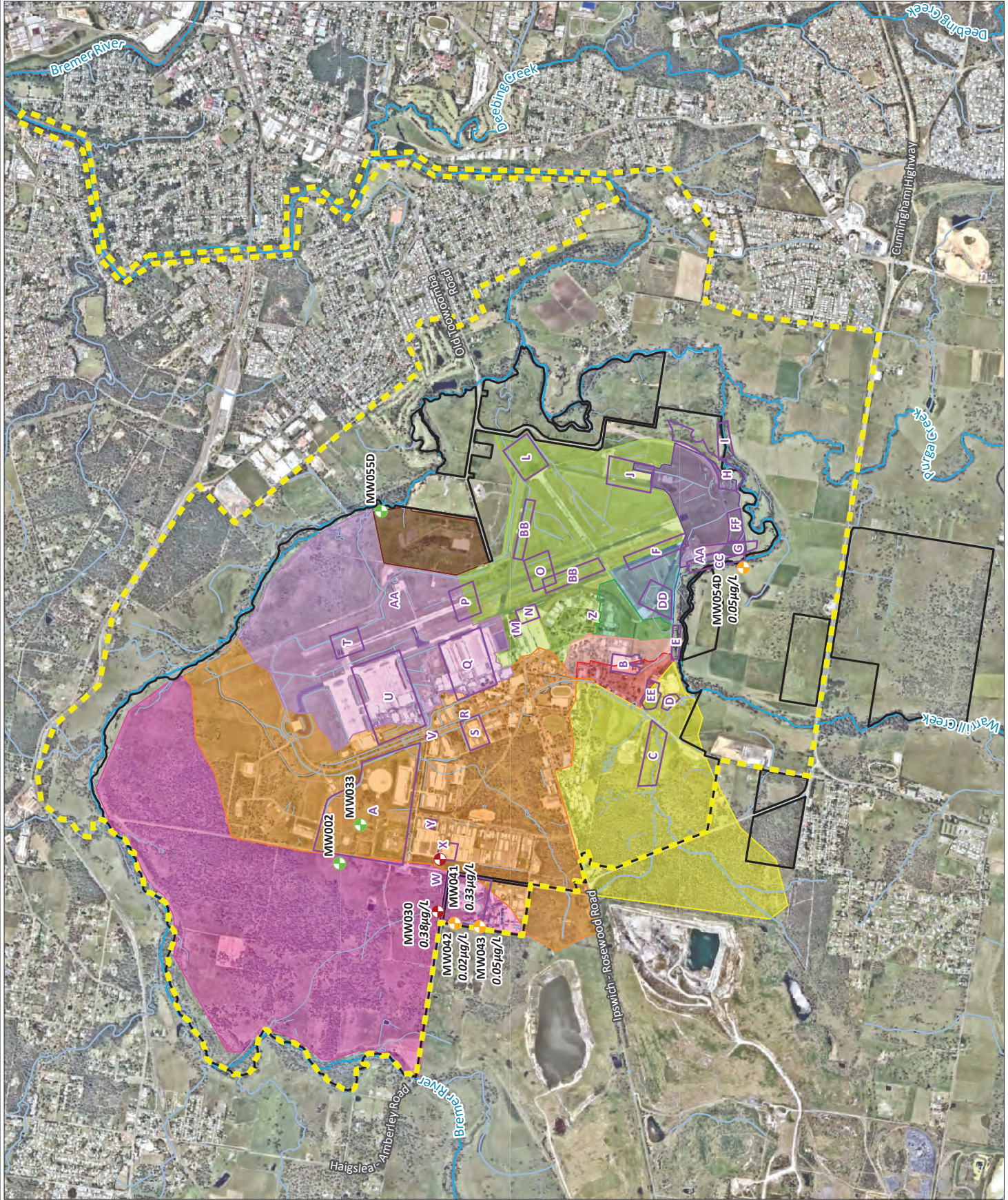


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFOS GROUNDWATER
CONCENTRATIONS, WALLOON COAL
MEASURES (APRIL & MAY, 2025)

FIGURE 13D



Name: 66133_RAAF Amberley_OMR25_RevC/66133_13D_GWPFOSWalloonAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMPAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

PFHXS Concentration

- >100 µg/L
- 10 - <100 µg/L
- 1 - <10 µg/L
- 0.1 - <1 µg/L
- 0.03 - <0.1 µg/L
- <0.03 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11

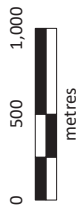


Job No: 66133

Client: Department of Defence

Version: RevC Date: 14-Oct-2025

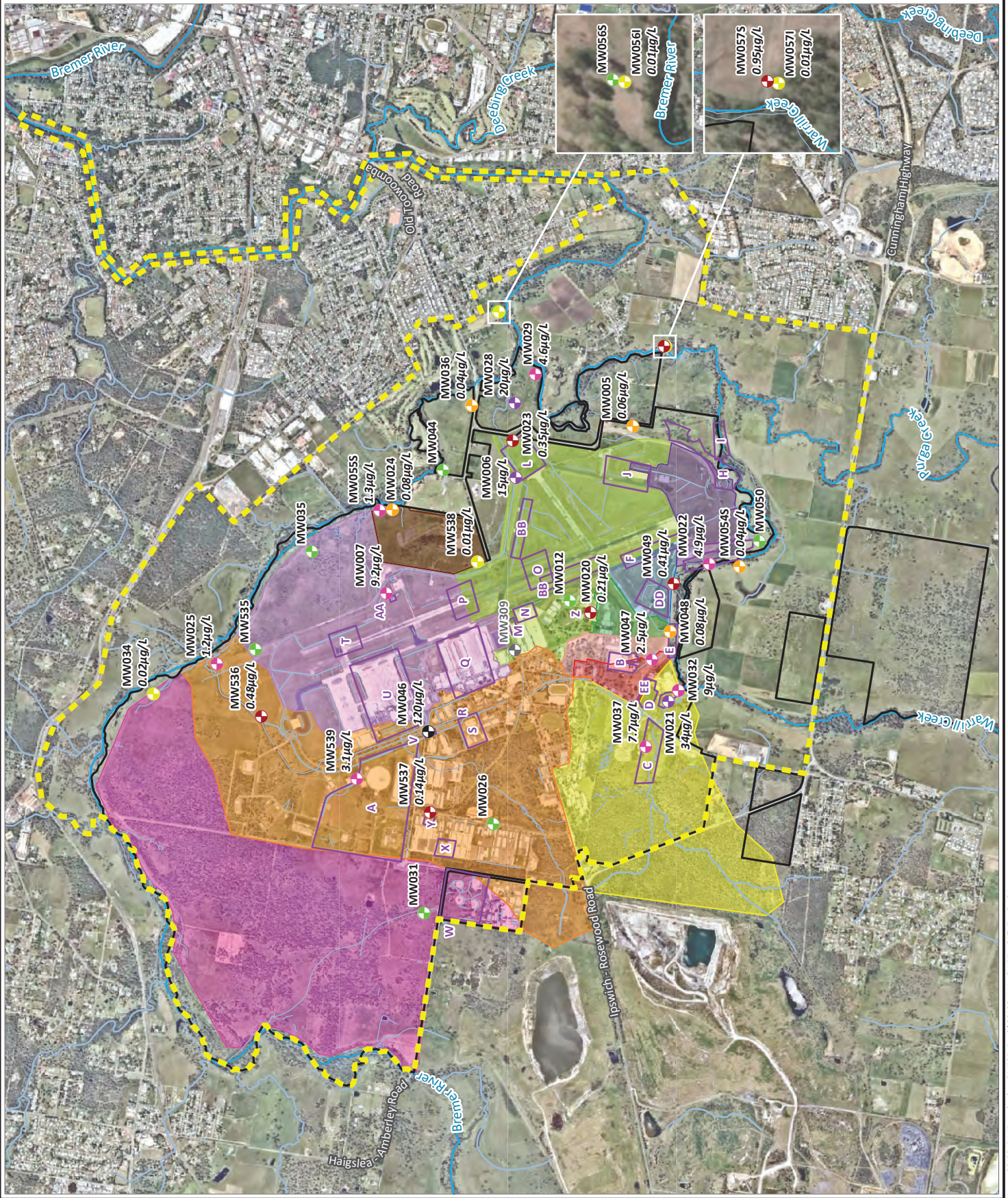
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Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley
Queensland
PFHXS GROUNDWATER
CONCENTRATIONS, ALLUVIUM /
TERTIARY FORMATION (OCTOBER &
NOVEMBER, 2024)

FIGURE 14A



Name: 66133_RAAF Amberley_Oct25_RevC/66133_14A_GWPFHXSAllTierOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

- Legend**
- Watercourse of Interest
 - Watercourse / Drainage Line
 - PMPAP Management Area
 - Confirmed Primary Source Area
 - RAAF Amberley Approximate Site Boundary
- Groundwater Monitoring Location**
- PFHXS Concentration**
- >100 µg/L
 - 0.03 - <0.1 µg/L
 - 1 - <10 µg/L
 - 0.1 - <1 µg/L
 - 0.03 - <0.1 µg/L
 - <0.03 µg/L
 - Non-detect
- Catchment Areas**
- Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC Date: 14-Oct-2025



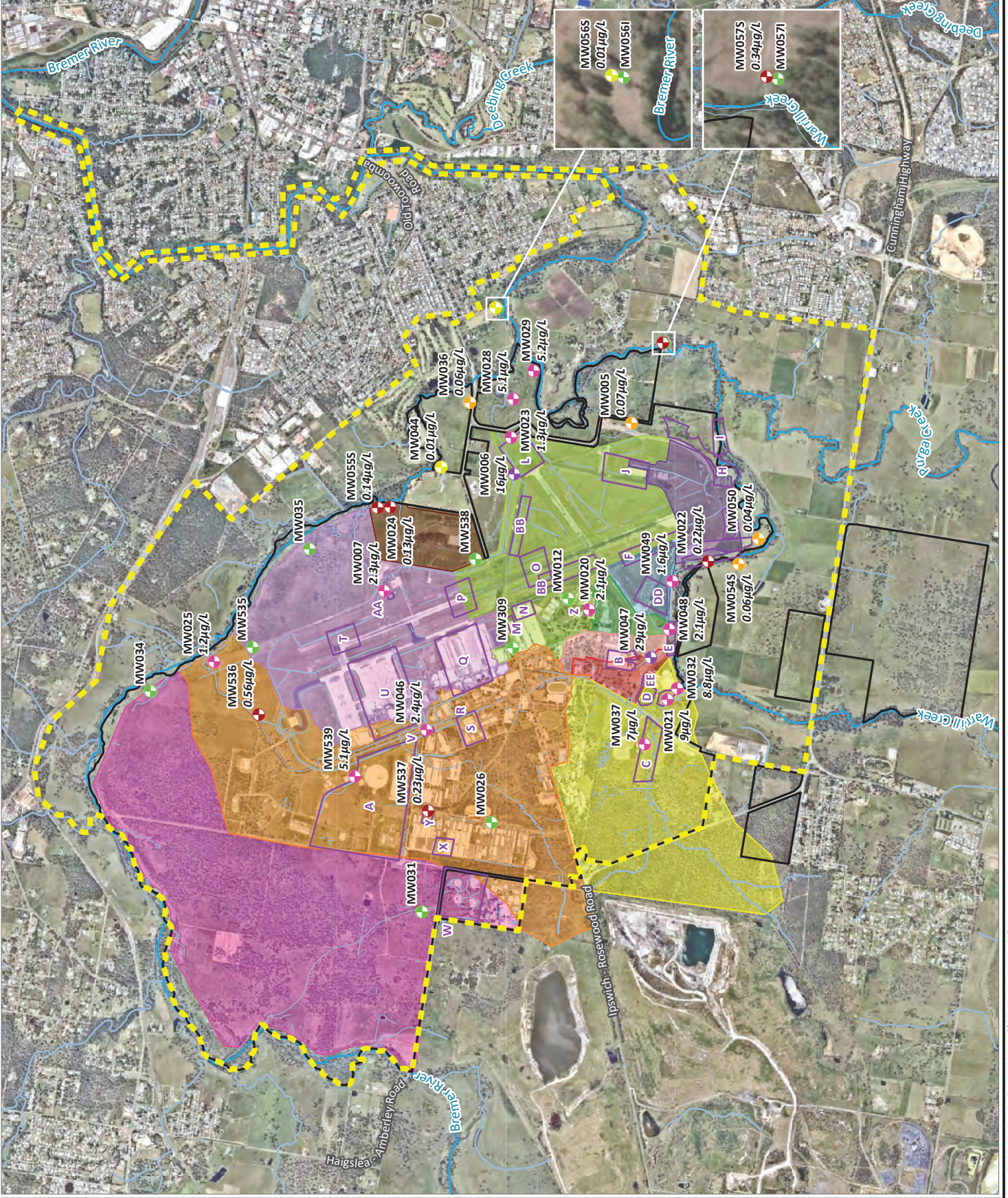
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Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley
 Queensland
 PFHXS GROUNDWATER
 CONCENTRATIONS, ALLUVIUM /
 TERTIARY FORMATION (APRIL &
 MAY 2025)

FIGURE 14B



Name: 66133_RAAF_Amberley_OMR25_RevC/66133_14B_GWPFHXSAlltertAprMay25
 Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Groundwater Monitoring Location

PFHxS Concentration

- >100 µg/L
- 10 - <100 µg/L
- 1 - <10 µg/L
- 0.1 - <1 µg/L
- 0.03 - <0.1 µg/L
- <0.03 µg/L
- Non-detect

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



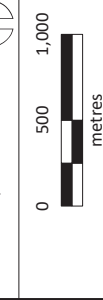
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

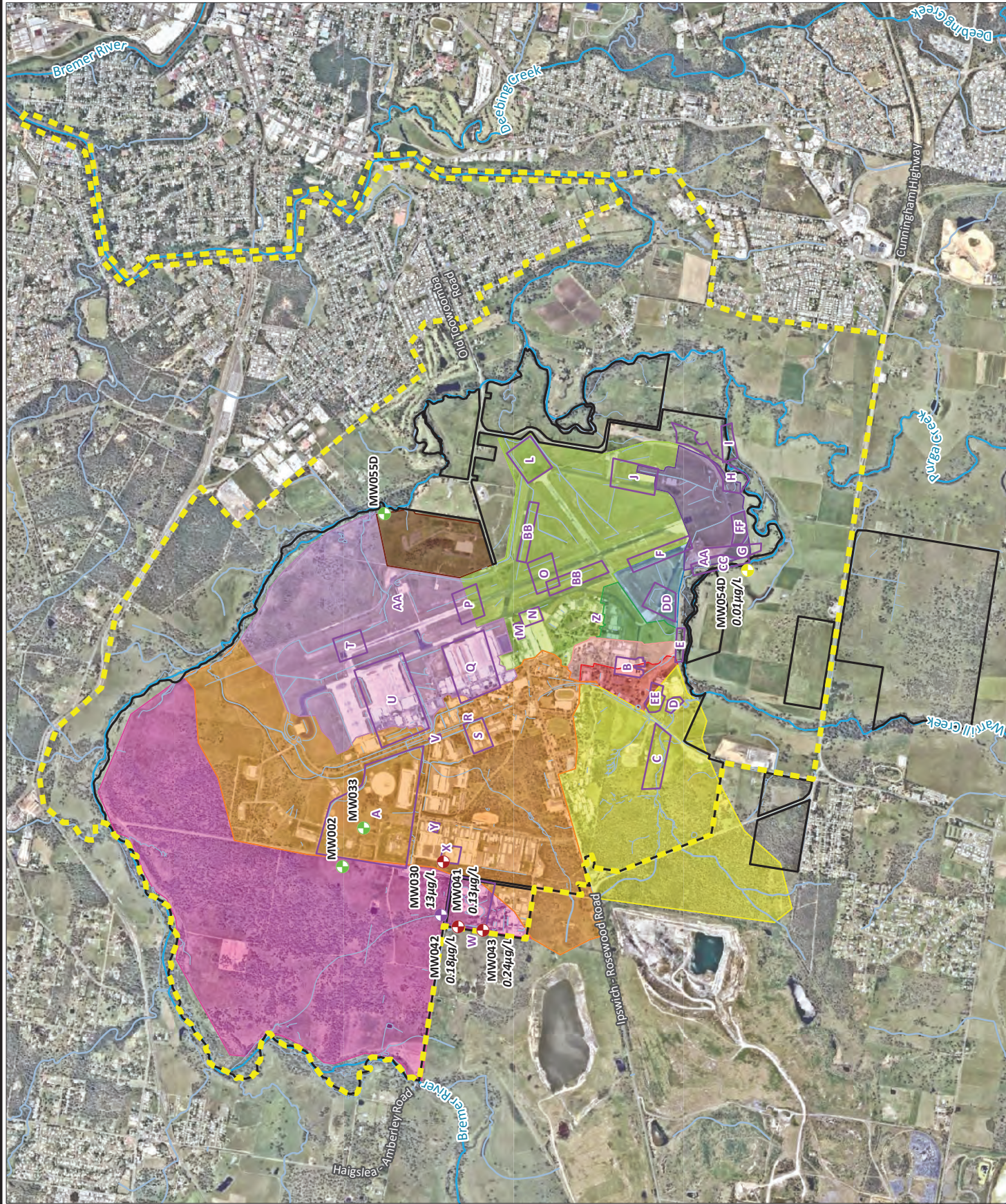
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Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland
PFHxS GROUNDWATER
CONCENTRATIONS, WALLOON COAL
MEASURES (OCTOBER &
NOVEMBER, 2024)

FIGURE 14C



- Legend**
- Watercourse of Interest
 - Watercourse / Drainage Line
 - P/MAP Management Area
 - Confirmed Primary Source Area
 - RAAF Amberley Approximate Site Boundary
 - Boundary
- Groundwater Monitoring Location**
- PFHXS Concentration**
- >100 µg/L
 - 10 - <100 µg/L
 - 1 - <10 µg/L
 - 0.1 - <1 µg/L
 - 0.03 - <0.1 µg/L
 - <0.03 µg/L
 - Non-detect
- Catchment Areas**
- Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11

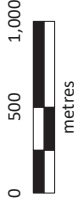


Job No: 66133

Client: Department of Defence

Version: RevC Date: 14-Oct-2025

Scale 1:44,000

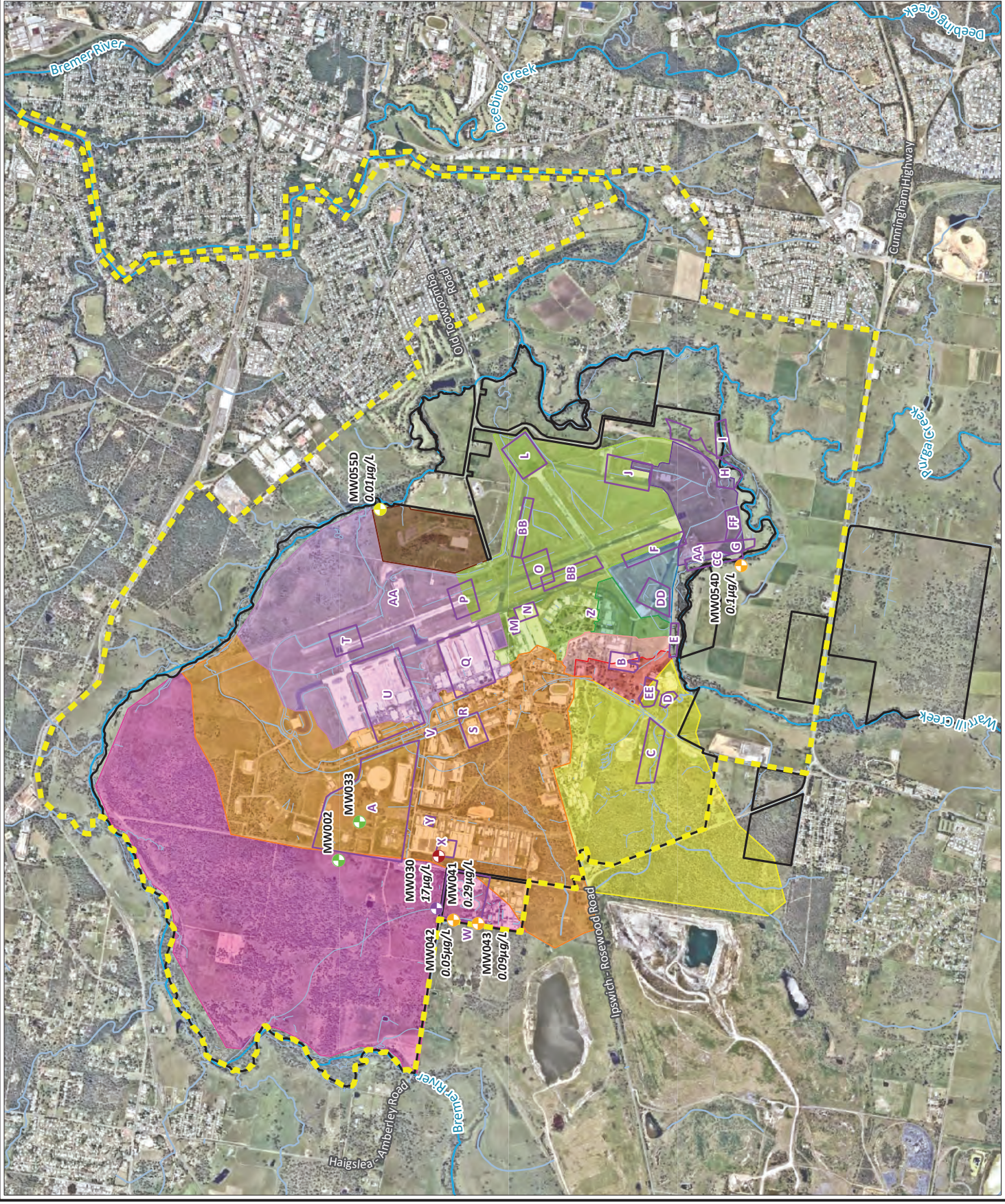


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFHXS GROUNDWATER
CONCENTRATIONS, WALLOON COAL
MEASURES (APRIL & MAY, 2025)

FIGURE 14D



Name: 66133_RAAF Amberley_OMR25_RevC/66133_14D_GWPFHXSWalloonAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

7.2 Surface Water

7.2.1 Surface Water Physiochemical Parameters

Surface water quality field parameters recorded during collection of surface water samples following stabilisation of parameters have been presented in **Table A3, Appendix A**. A summary of results has been presented in **Table 7-5**.

Several pH and dissolved oxygen readings recorded across the monitoring network during the October / November 2024 monitoring event were anomalous compared to previous results (e. g. elevated dissolved oxygen reading and low pH readings). These anomalies were not generally observed during the April / May 2025 monitoring event, confirming their atypical nature. The anomalous results are considered to likely be a consequence of equipment malfunction (e.g. damage to sensor membrane, sensor fouling etc.).

Table 7-5: Summary of Surface Water Quality Parameters

Water Body	Event	DO (mg/L)	EC (µs/cm)	pH	ORP (mV) ⁷	Temp (°C)
Bremer River	Oct/Nov 2024	0.03 (SW50) – 7.4 (SW094) <i>Anerobic to aerobic conditions</i>	3.5 (SW091) – 822 (SW050) <i>Fresh</i>	4.11 (SW040) – 7.95 (SW094) <i>Acidic to near neutral</i>	-43.0 (SW052) – 351.3 (SW098) <i>Mildly reducing to moderately oxidising</i>	23.0 (SW039) – 29.1 (SW094)
	Apr/May 2025	2.39 (SW656) – 8.28 (SW052) <i>Aerobic conditions</i>	117.8 (SW656) – 758 (SW025) <i>Fresh</i>	7.24 (SW656) – 7.95 (SW036) <i>Near neutral</i>	99.1 (SW656) – 300.3 (SW050) <i>Mildly reducing to moderately oxidising</i>	14.9 (SW656) – 22.8 (SW094)
Warrill Creek	Oct/Nov 2024	0.07 (SW016) – 5.90 (SW099) <i>Anerobic to aerobic conditions</i>	410.1 (SW043) – 855.0 (SW005) <i>Fresh</i>	2.13 (SW016) – 7.36 (SW0026) <i>Acidic to near neutral</i>	274.6 (SW015) – 437.2 (SW016) <i>Mildly to moderately oxidising</i>	24.4 (SW018) – 377.1 (SW026)
	Apr/May 2025	3.46 (SW022) – 9.6 (SW016) <i>Aerobic conditions</i>	300.9 (SW022) – 745 (SW020) <i>Fresh</i>	7.33 (SW100) – 8.23 (SW020) <i>Near neutral to alkaline</i>	177 (SW099) – 283.3 (SW009) <i>Mildly to moderately oxidising</i>	19.3 (SW009) – 22.5 (SW022)
On-base Drains	Oct/Nov 2024	0.46 (SW049) – 9.56 (SW021) <i>Anerobic to aerobic conditions</i>	144.7 (SW048) – 939 (SW008) <i>Fresh</i>	2.53 (SW027) – 7.32 (SW021) <i>Acidic to near neutral</i>	149.2 (SW059) – 516.2 (SW056) <i>Mildly to moderately oxidising</i>	20.4 (SW048) – 31.5 (SW002)
	Apr/May 2025	1.08 (SW037) – 6.95 (SW661) <i>Aerobic conditions</i>	30.6 (SW033) – 644 (SW059) <i>Fresh</i>	6.45 (SW067) – 9.2 (SW530) <i>Near neutral to alkaline</i>	136.6 (SW059) – 572.1 (SW064) <i>Mildly to moderately oxidising</i>	17.0 (SW079) – 27.6 (SW049)

Note:

Table exclude anomalous results.

⁷ Indicative ranges adopted are informed by the generalised Eh–pH stability fields presented in Hem (1985) *Study and Interpretation of the Chemical Characteristics of Natural Water* (U.S. Geological Survey Water-Supply Paper 2254).

In summary, surface water parameters recorded over the 2024-2025 monitoring period indicate the following:

- Bremer River – characterised by near neutral, fresh, aerobic conditions and mildly to moderately oxidising conditions. A solvent odour was noted at SW051 and organic odours at SW090 and SW050 during the October / November 2024 monitoring event and at SW045 during the April / May 2025 monitoring event.
- Warrill Creek – characterised by near neutral, fresh, aerobic conditions and mildly to moderately oxidising conditions. An organic odour was noted at SW016 during the October / November 2024 monitoring event.
- On-base Drains – characterised by near neutral to slightly alkaline, anerobic to aerobic conditions, mildly to moderately oxidising conditions. Sampling observations comprised the following:
 - Organic odours at SW001, SW037, SW038, SW041 and SW059 during the October / November 2024 monitoring event.
 - A solvent odour at SW027 during the October / November 2024 monitoring event.
 - Metallic odours at SW056 and SW076 during the October / November 2024 monitoring event.
 - Hydrocarbon odours at SW048 and SW053 during the October / November 2024 monitoring event.

7.2.2 Surface Water Analytical Results

Surface water analytical results are presented in **Table A4, Appendix A**. A Summary of the analytical results has been provided in **Table 7-6** and illustrated on **Figure 15 A-B, Figure 16A-B, Figure 17A-B, Figure 18A-B and Figure 19A-B**. An interpretive assessment of data has been provided in **Section 8**.

Deviations from the historical surface water data set has been summarised in **Table 7-7**.

Table 7-6: Summary of PFAS Concentrations in Surface Water

Compound	Sample Event	No. Samples (n)	Concentration Range (µg/L)	No. Sample with Conc. >LOR	No. Samples with Conc. > Drinking Water Criteria	No. Samples with Conc. > 99% Species Protection Criteria	No. Samples with Conc. > 95% Species Protection Criteria
PFBS	Oct/Nov 24	55	<LOR – 1.9	33	5	NA	NA
	Apr/May 25	69	< LOR – 2.6	31	5	NA	NA
PFHXS	Oct/Nov 24	55	<LOR – 14	38	34	NA	NA
	Apr/May 25	69	<LOR – 11	37	31	NA	NA
PFOS	Oct/Nov 24	55	<LOR – 14	41	41	41	31
	Apr/May 25	69	<LOR – 38	39	39	39	31
PFOA	Oct/Nov 24	55	<LOR – 0.74	24	8	0	0
	Apr/May 25	69	<LOR – 3.4	31	12	0	0
Sum PFHXS+PFOS	Oct/Nov 24	55	<LOR – 28	41	NA	12	NA
	Apr/May 25	69	<LOR – 60	39	NA	21	NA

Note:

No. Samples include quality assurance samples
 NA = Not Applicable

Table 7-7: Summary of Deviation from Historical Surface Water Data

Aspect	PFBS	PFHXS	PFOS	PFOA	Sum PFHXS+PFOS
October / November 2024					
First-time Detection (<i>detection</i>)			SW043 (0.03)	None	SW043 (0.04)

Aspect	PFBS	PFHxS	PFOS	PFOA	Sum PFHxS+PFOS
First-time Ecological Criteria Exceedance (<i>detection</i>)	None	None	SW043 (0.03)	None	None
First-time Human Health Exceedance (<i>detection</i>)	None	None	SW043 (0.03)	None	None
New Historical Minimum (<i>historical minimum / new minimum</i>)	SW021 (0.22 / 0.19) SW022 (0.23 / 0.08) SW023 (0.26 / 0.19)	SW056 (0.8 / 0.64)	None	SW021 (0.28 / 0.23) SW056 (0.08 / 0.05)	SW045 (0.01 / <LOR)
New Historical Maximum (<i>historical maximum / new maximum</i>)	SW020 (0.04 / 0.05) SW038 (0.05 / 0.11) SW056 (0.11 / 0.09)	SW018 (0.1 / 0.17) SW020 (0.09 / 0.25)	SW018 (0.12 / 0.34) SW020 (0.14 / 0.52) SW038 (0.62 / 0.98) SW043 (<LOR / 0.03) SW064 (1.43 / 1.44)	SW038 (0.05 / 0.07)	SW018 (0.22 / 0.51) SW020 (0.23 / 0.77) SW038 (0.97 / 1.56) SW043 (<LOR / 0.04)
April / May 2025					

Aspect	PFBS	PFHxS	PFOS	PFOA	Sum PFHxS+PFOS
First-time Detection (detection)	SW530 (0.14) SW570 (0.13) SW661 (0.02)	SW043 (0.01) SW096 (0.01) SW530 (0.94) SW570 (0.77) SW568 (0.02) SW661 (0.14)	SW658* (0.01) SW661* (0.43)	SW661 (0.02)	SW658* (0.03) SW661* (0.57)
First-time Ecological Criteria Exceedance (detection)	None	None	SW661* (0.43)	None	None
First-time Human Health Exceedance (detection)	None	None	SW658* (0.01) SW661* (0.43)	None	SW661* (0.57)
New Historical Minimum (historical minimum / new minimum)	SW022 (0.23 / 0.08) SW023 (0.26 / 0.19) SW032 (0.46 / <LOR) SW050 (0.06 / 0.09)	SW022 (1.66 / 0.66) SW032 (1.62 / <LOR)	SW022 (4.38 / 2.3) SW023 (4.81 / 3.7) SW051 (0.02 / <LOR) SW096 (0.02 / 0.01)	SW011 (0.01 / <LOR) SW022 (0.12 / 0.04) SW023 (0.11 / 0.07)	SW032 (3.3 / <LOR) SW051 (0.02 / <LOR)

Aspect	PFBS	PFHxS	PFOS	PFOA	Sum PFHxS+PFOS
New Historical	SW008 (0.15 / 0.58)	SW008 (1.72 / 2.0)	SW050 (0.72 / 0.73)	SW050 (0.04 / 0.081)	SW008 (4.19 / 4.7)
Maximum	SW570 (- / 0.13)	SW038 (0.35 / 0.58)	SW530* (0.66 / 1.5)		SW050 (1.1 / 1.4)
(historical	SW661 (- / 0.02)	SW050 (0.41 / 0.57)			
maximum / new		SW096 (<LOR / 0.01)			
maximum)		SW530 (0.57 / 0.94)			
		SW570 (- / 0.77)			
		SW568 (- / 0.02)			
		SW661 (- / 0.14)			

Note:

Bold text indicates an order of magnitude difference.

* New surface water sample location

Legend

- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Surface Water Location

- PFBS Concentration**
- >1 µg/L
 - 0.1 - <1 µg/L
 - <0.1 µg/L
 - Non-detect
 - Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

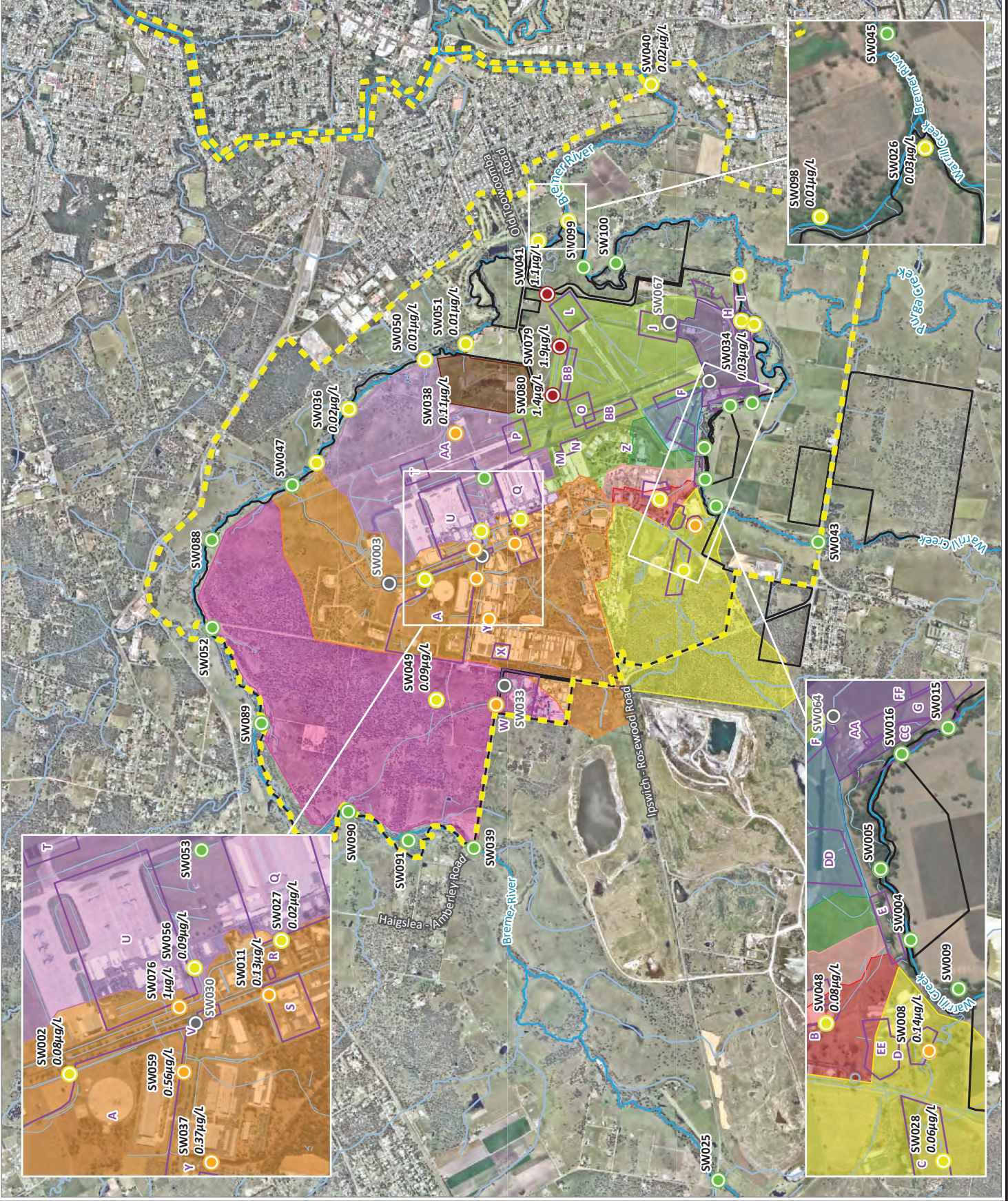


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFBS CONCENTRATIONS,
SURFACE WATER (OCTOBER &
NOVEMBER, 2024)

FIGURE 15A



Name: 66133_RAAF Amberley_Oct25_RevC/66133_15A_SWPFBSOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Surface Water Location

PFBS Concentration

- >1 µg/L
- 0.1 - <1 µg/L
- <0.1 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



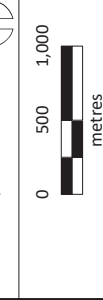
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

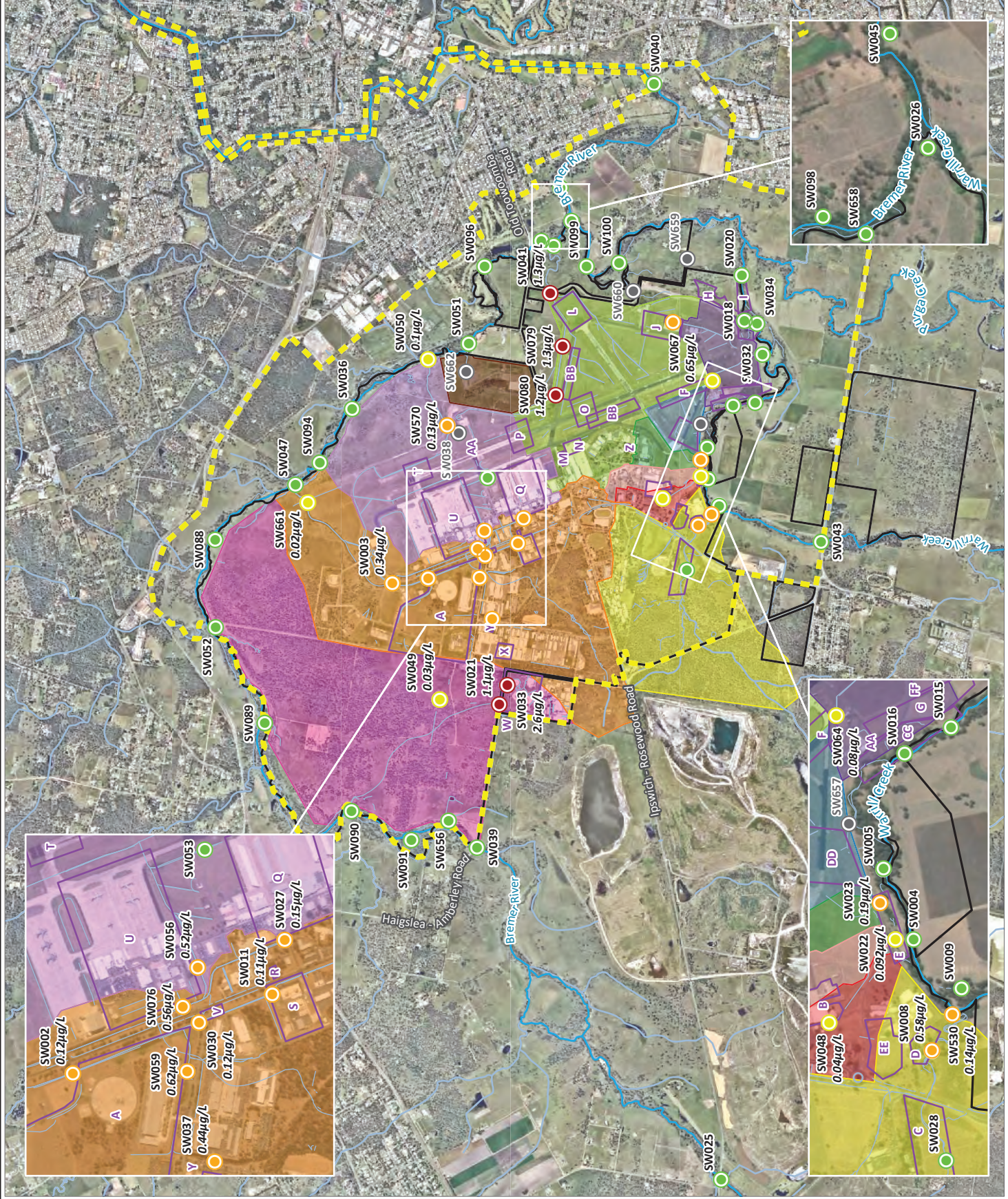


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFBS CONCENTRATIONS,
SURFACE WATER (APRIL & MAY, 2025)

FIGURE 15B



Name: 66133_RAAF Amberley_CMR25_RevC/66133_15B_SWPFBSAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary
- Surface Water Location
- PFOA Concentration**
 - 0.2 - <10 µg/L
 - <0.2 µg/L
 - Non-detect
 - Not sampled
- Catchment Areas**
 - Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

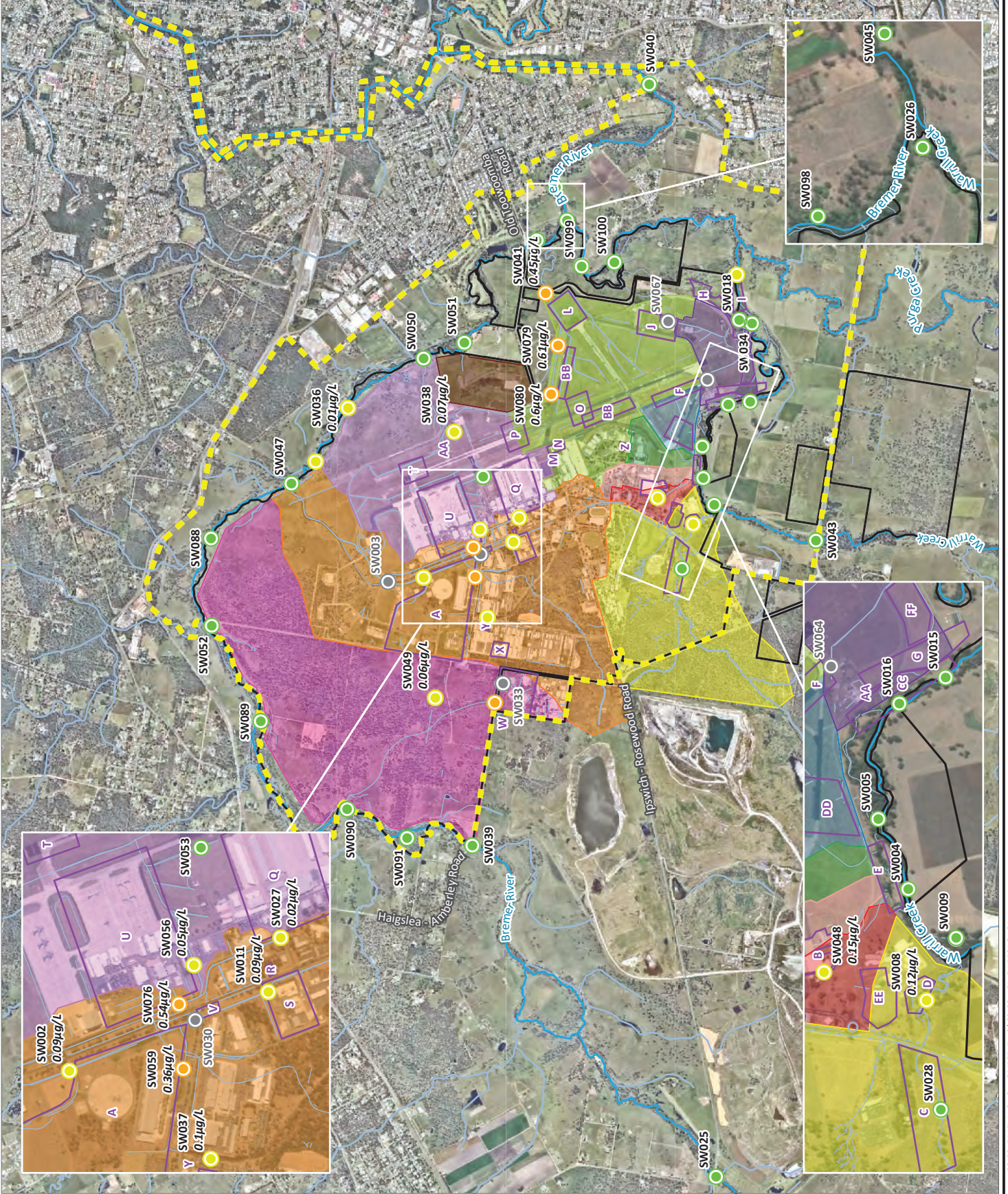


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley, Queensland

PFOA CONCENTRATIONS, SURFACE WATER (OCTOBER & NOVEMBER, 2024)

FIGURE 16A



Name: 66133_RAAF Amberley_Oct24_RevC/66133_16A_SWPFOAOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary
- Surface Water Location
- PFOA Concentration
 - 0.2 - $10 \mu\text{g/L}$
 - <math><0.2 \mu\text{g/L}</math>
 - Non-detect
 - Not sampled
- Catchment Areas
 - Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11



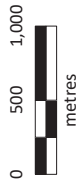
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

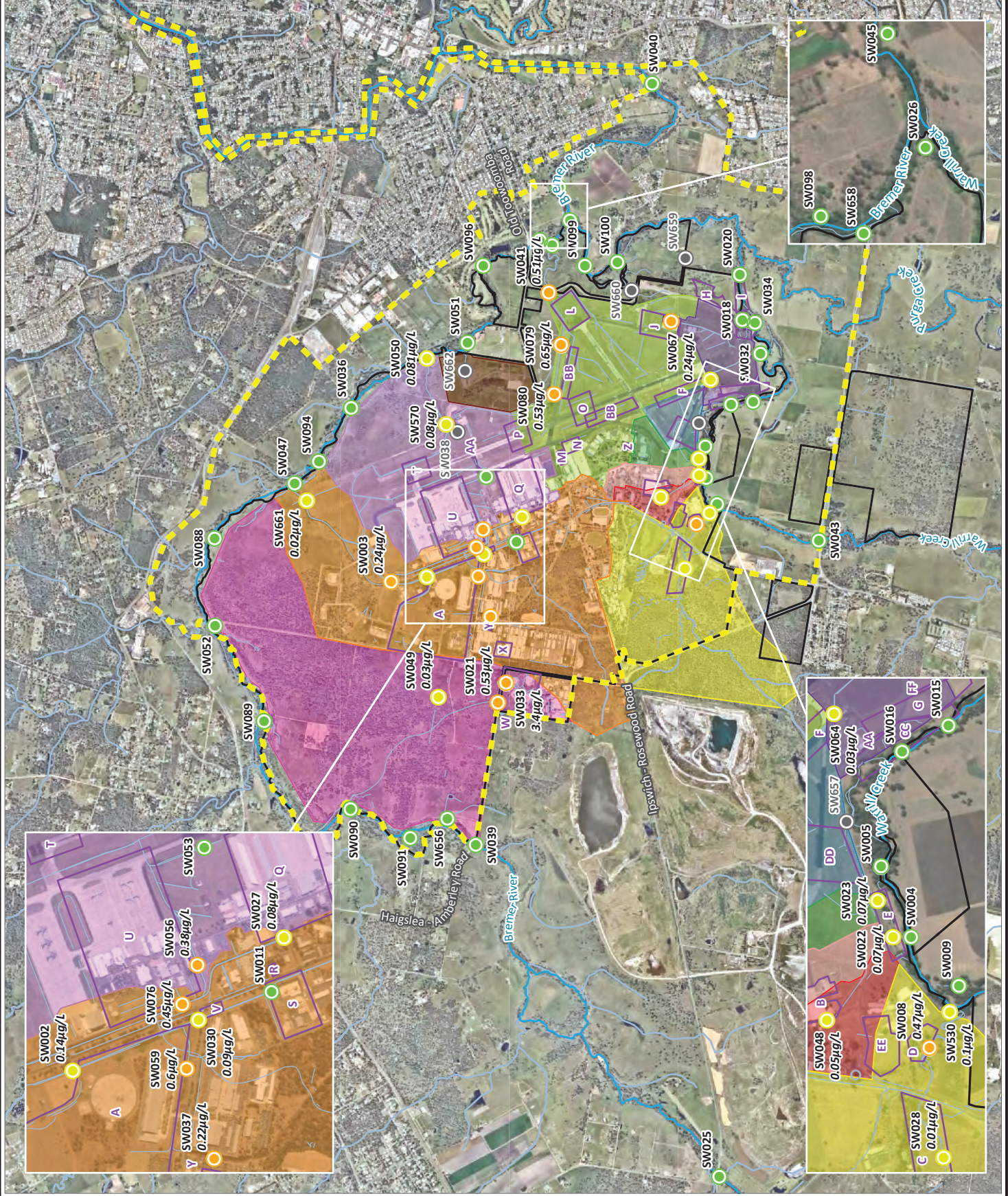


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFOA CONCENTRATIONS,
SURFACE WATER (APRIL & MAY, 2025)

FIGURE 16B



Name: 66133_RAAF Amberley_CMR25_RevC/66133_16B_SWPFOAAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary
- Surface Water Location
- PFOS Concentration
 - >10 µg/L
 - 1 - <10 µg/L
 - 0.1 - <1 µg/L
 - 0.008 - <0.1 µg/L
 - <0.008 µg/L
 - Non-detected
 - Not sampled
- Catchment Areas
 - Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11



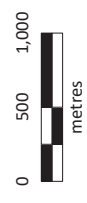
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

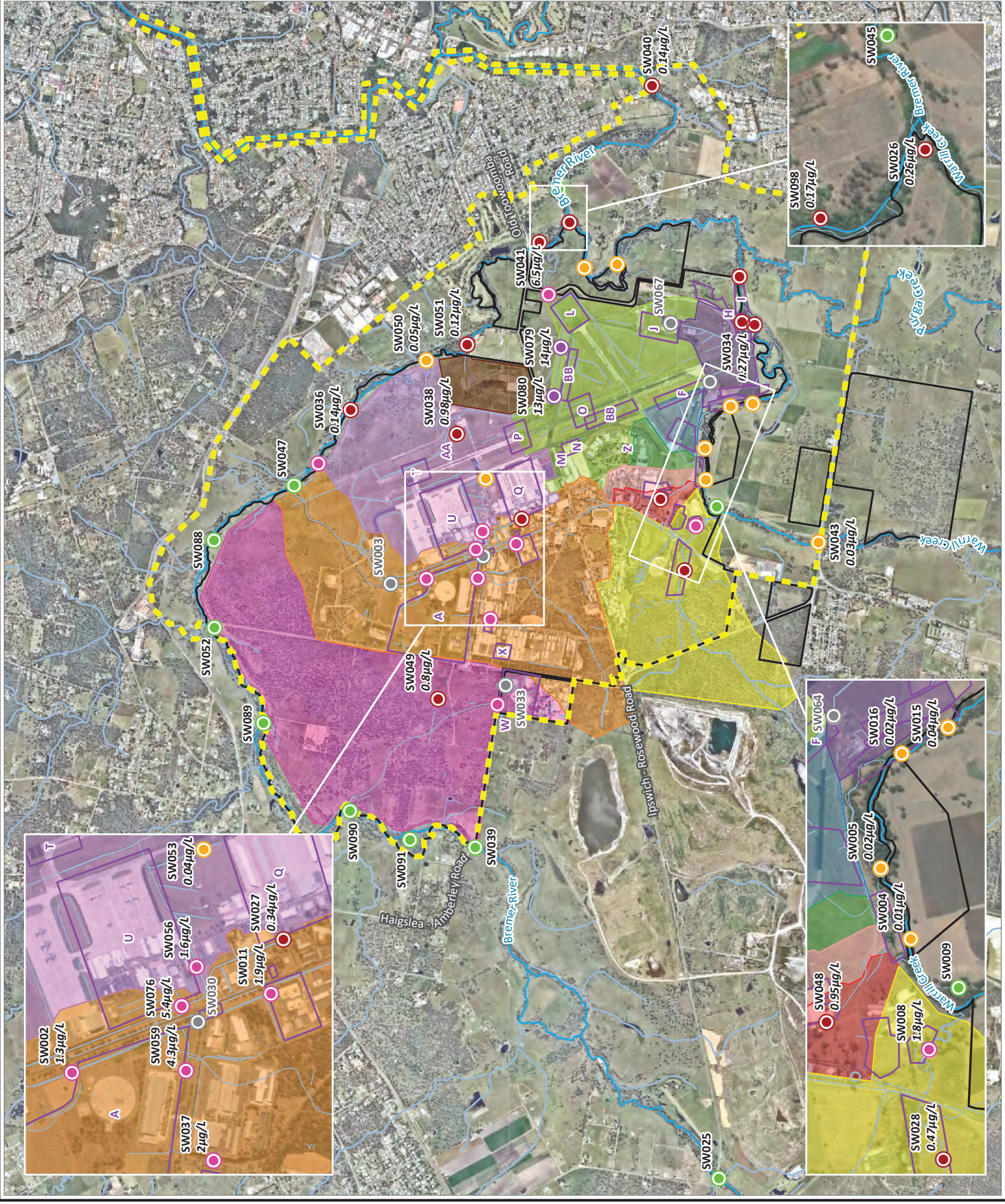


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley, Queensland

PFOS CONCENTRATIONS, SURFACE WATER (OCTOBER & NOVEMBER, 2024)

FIGURE 17A



Name: 66133_RAAF Amberley_Oct25_RevC/66133_17A_SWPFOSOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site
- Boundary

Surface Water Location

PFOS Concentration

- >10 µg/L
- 1 - <10 µg/L
- 0.1 - <1 µg/L
- 0.008 - <0.1 µg/L
- <0.008 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

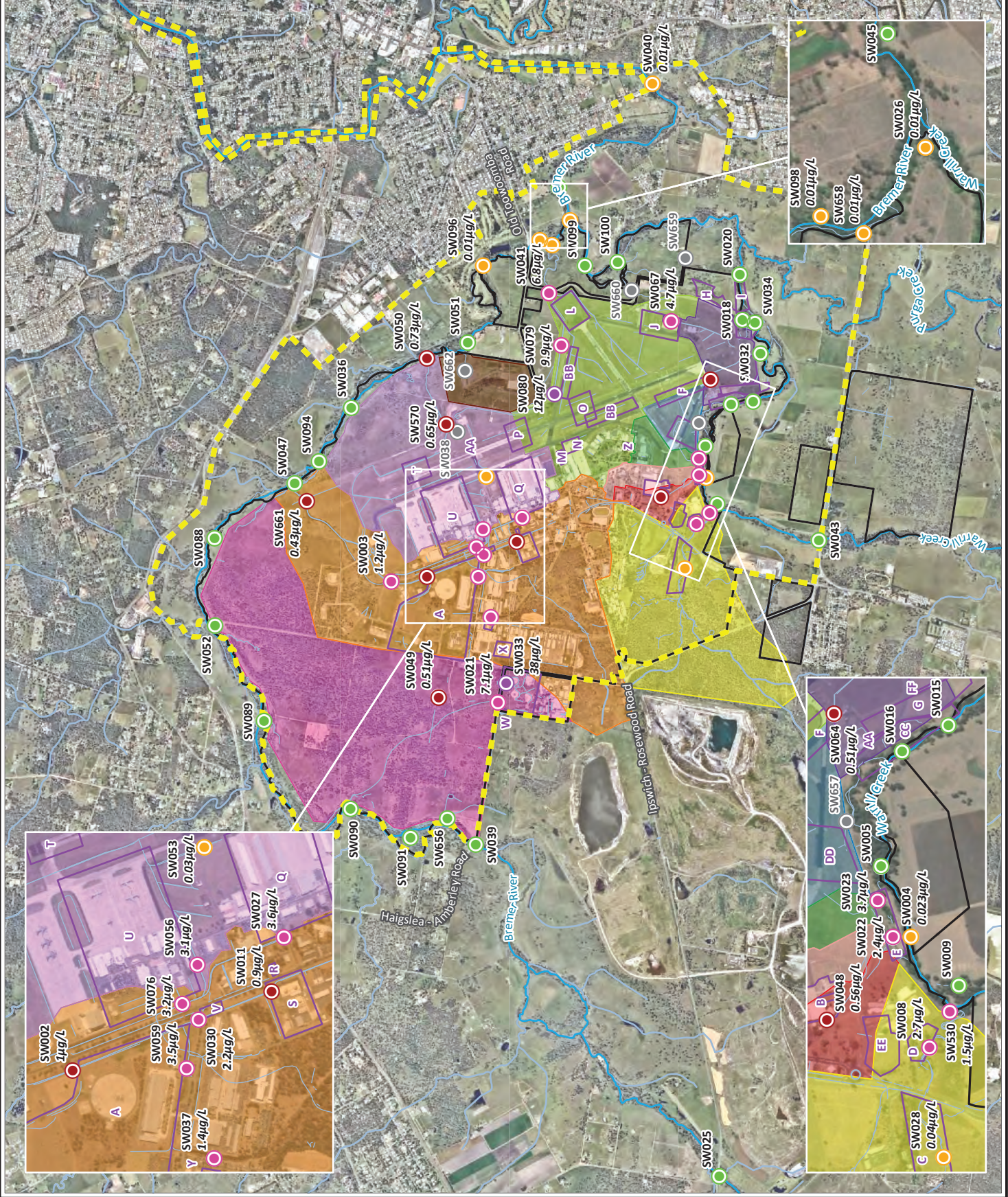


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFOS CONCENTRATIONS,
SURFACE WATER
(APRIL & MAY, 2025)

FIGURE 17B



Name: 66133_RAAF Amberley_OMR25_RevC/66133_17B_SWPFOSAprMay25
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Surface Water Location

PFHxS Concentration

- >10 µg/L
- 1 - <10 µg/L
- 0.1 - <1 µg/L
- 0.03 - <0.1 µg/L
- <0.03 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



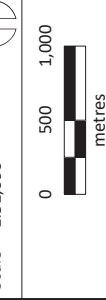
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

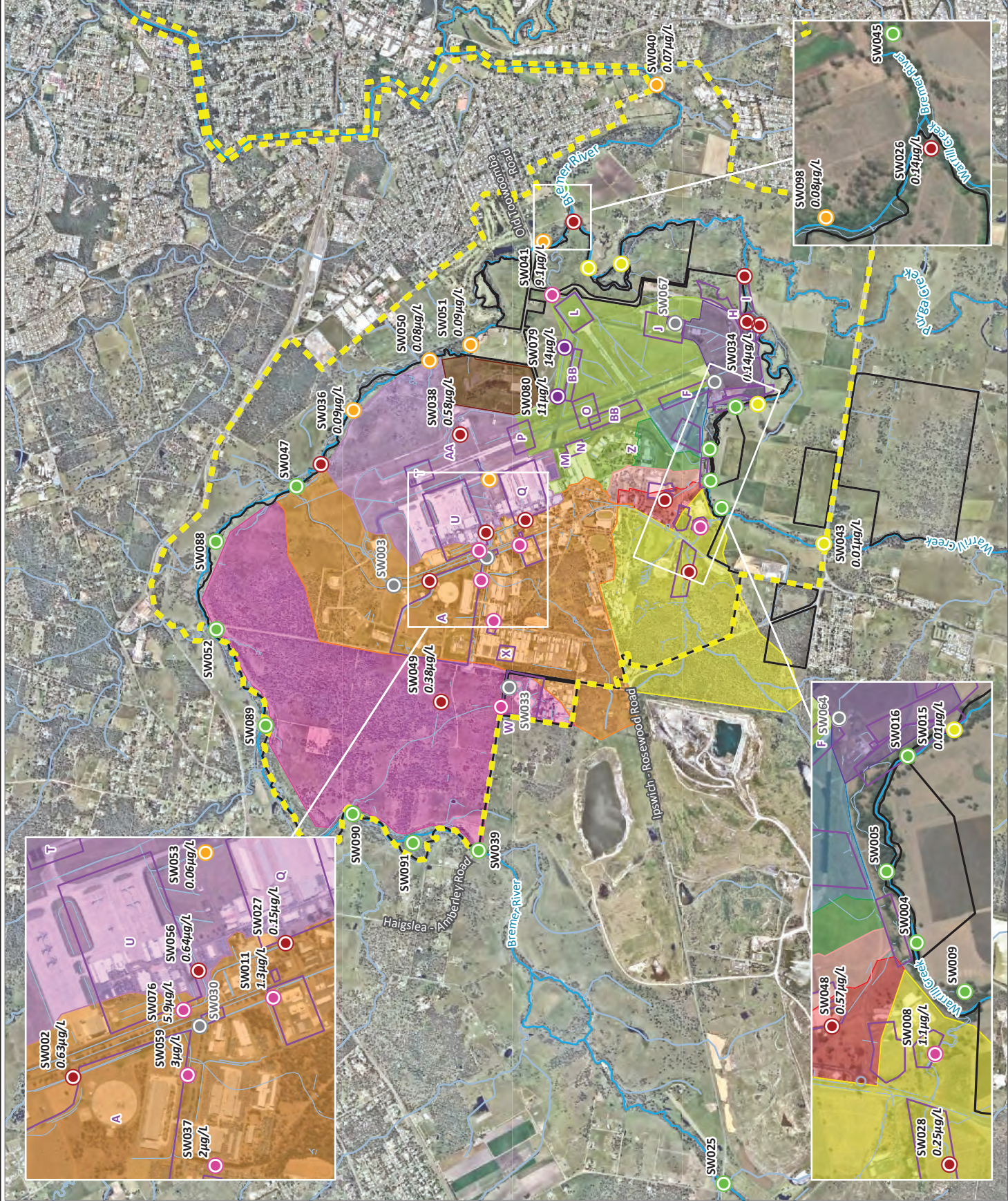


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFHxS CONCENTRATIONS,
SURFACE WATER
(OCTOBER & NOVEMBER, 2024)

FIGURE 18A



Name: 66133_RAAF Amberley_Oct25_RevC/66133_18A_SWPFHxS0424
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Surface Water Location

PFHxS Concentration

- >10 µg/L
- 1 - <10 µg/L
- 0.1 - <1 µg/L
- 0.03 - <0.1 µg/L
- <0.03 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

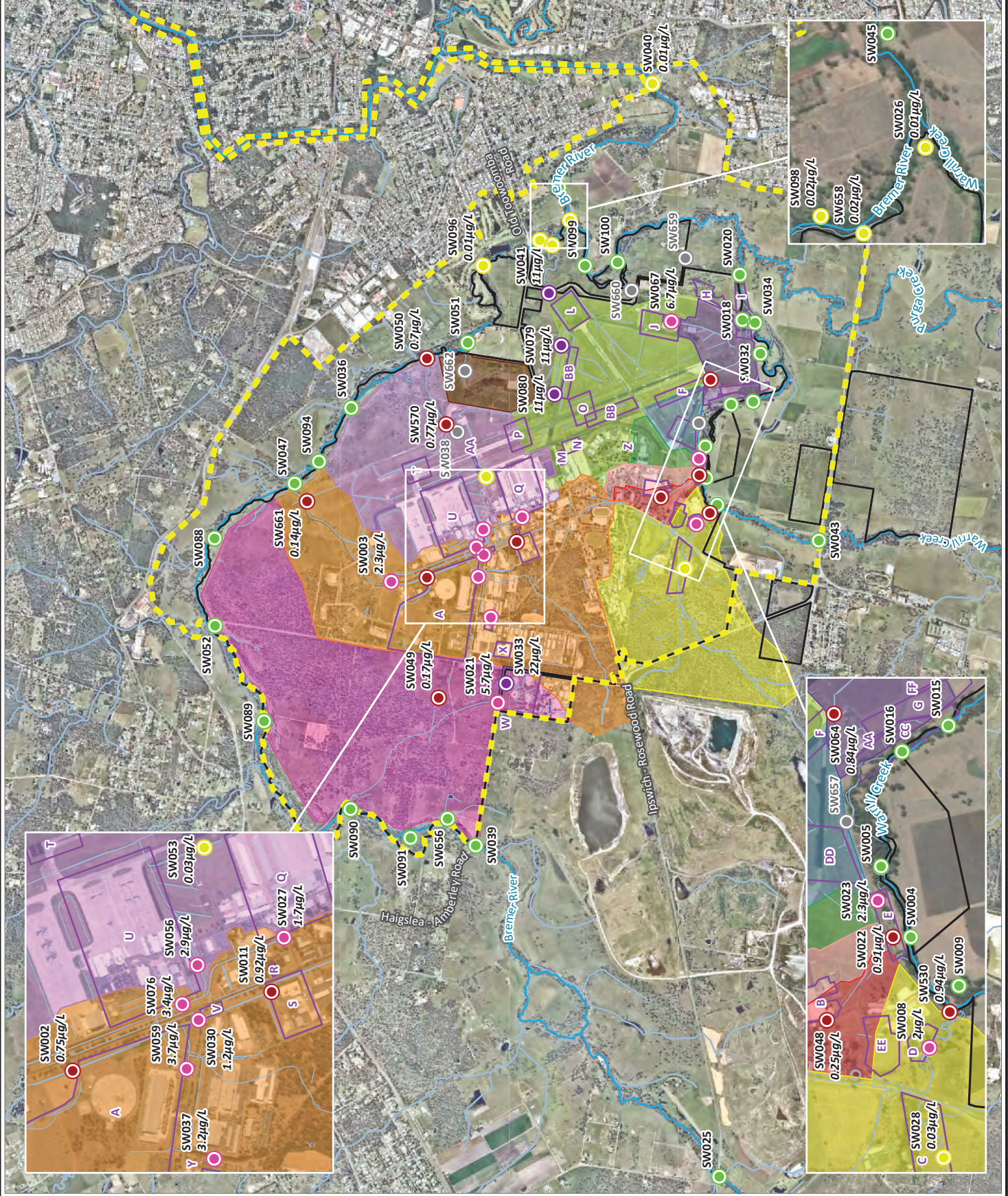


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFHxS CONCENTRATIONS,
SURFACE WATER
(APRIL & MAY, 2025)

FIGURE 18B



Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- PMAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Surface Water Location

Sum of PFHxS & PFOS Concentration

- >10 µg/L
- 2 - <10 µg/L
- 0.1 - <2 µg/L
- <0.1 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

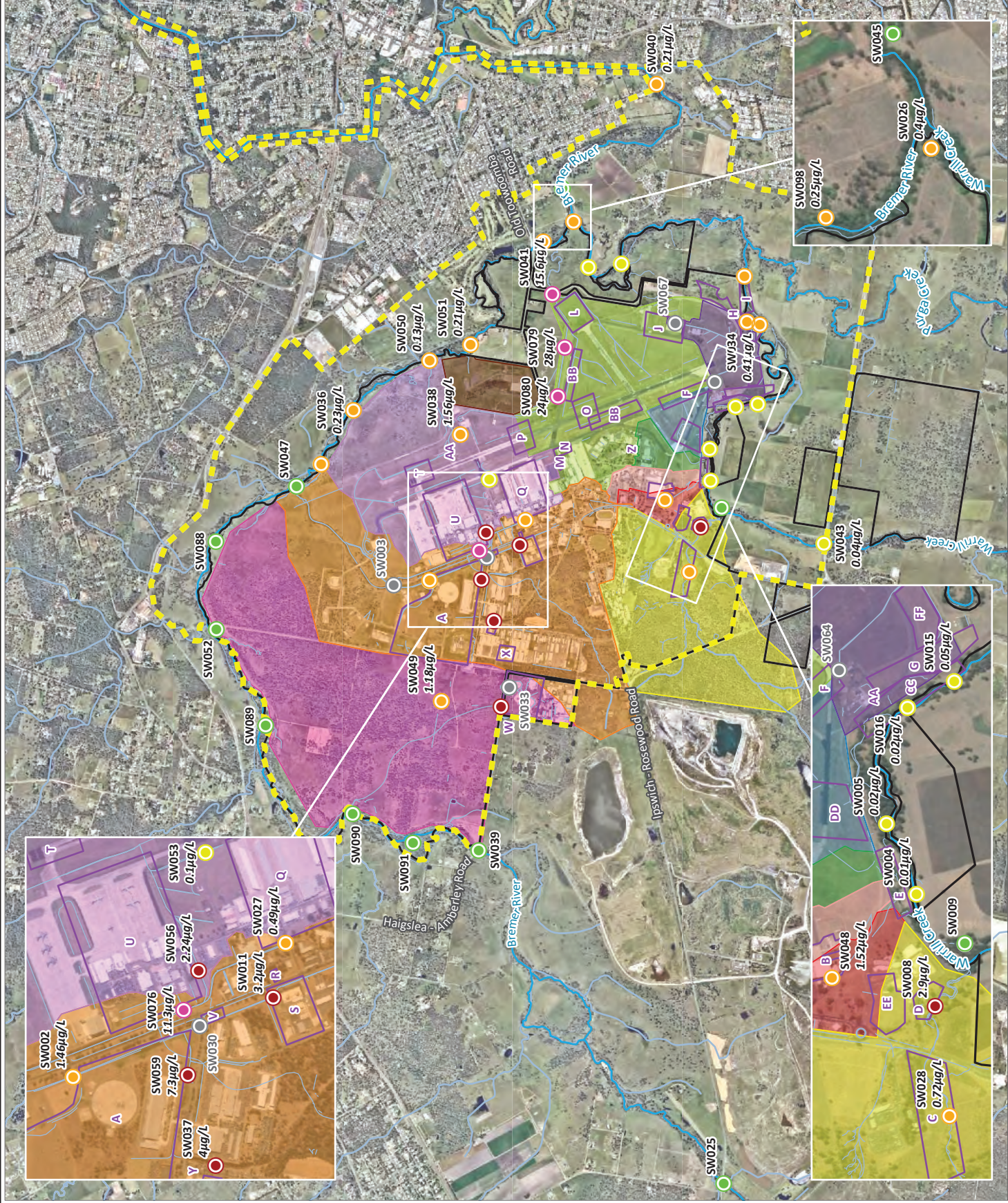


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

SUM OF PFHxS & PFOS
CONCENTRATIONS, SURFACE WATER
(OCTOBER & NOVEMBER, 2024)

FIGURE 19A



Name: 66133_RAAF Amberley_Oct25_RevC/66133_19A_SWPFHxS&PFOS024
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Surface Water Location

Sum of PFHxS & PFOS Concentration

- >10 µg/L
- 2 - <10 µg/L
- 0.1 - <2 µg/L
- <0.1 µg/L
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

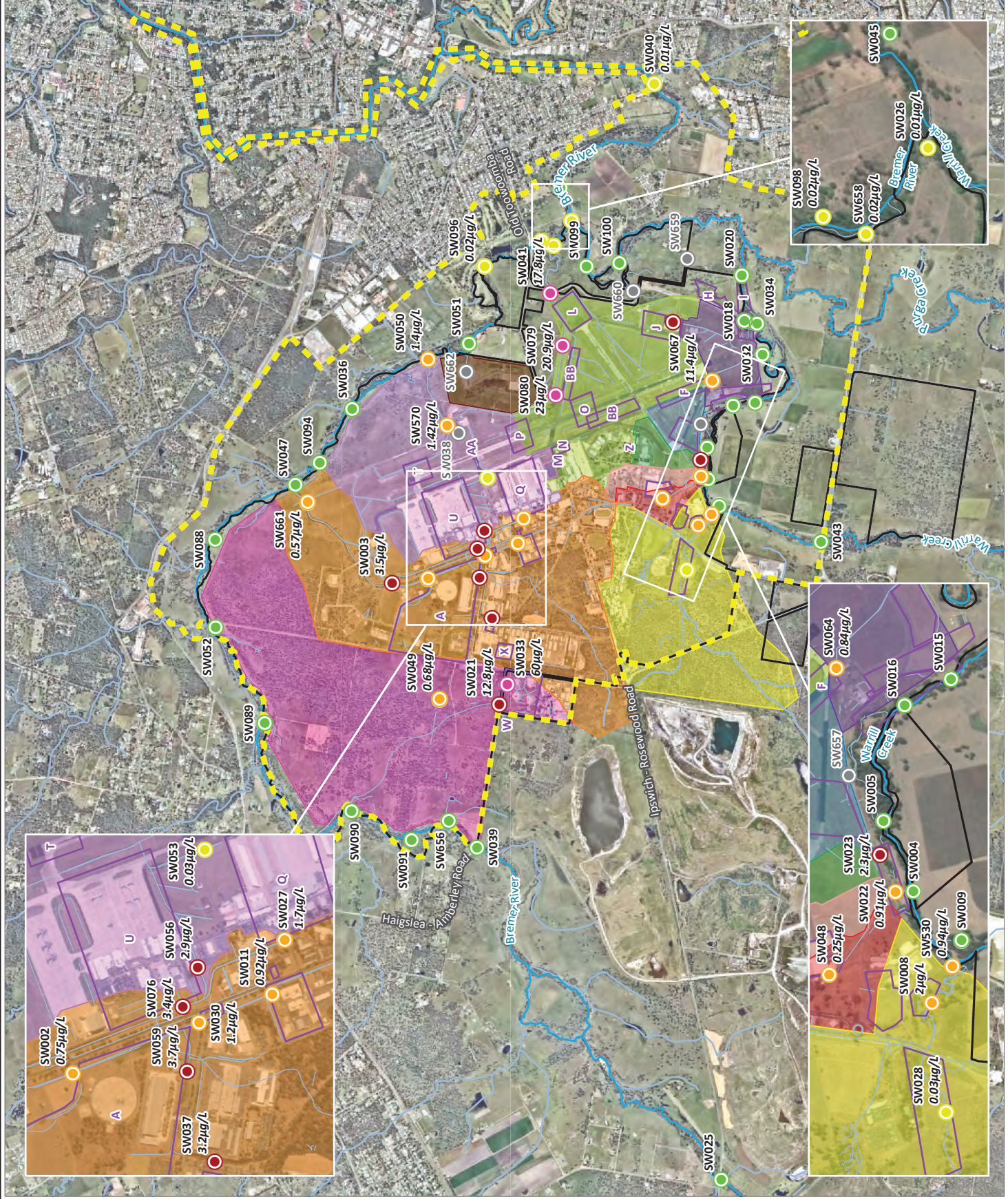


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

**SUM OF PFHxS & PFOS
CONCENTRATIONS, SURFACE WATER
(APRIL & MAY, 2025)**

FIGURE 19B



7.3 Sediment

7.3.1 Sediment Field Observations

Field observations made during the collection of sediment samples have been provided in **Table A5**, in **Appendix A**. The sediment samples were typically noted to comprise light to dark brown or light grey to grey silt, sand or clay of varying silty / sandy textures. Organic inclusions in the form of rootlets, algae and/or leaves were also noted.

7.3.2 Sediment Analytical Results

Analytical results for the co-located sediment samples are presented in **Table A6, Appendix A**. A Summary of the analytical results and deviation from the historical sediment data has been provided in **Table 7-8**. Results have been illustrated on **Figure 20, Figure 21, Figure 22** and **Figure 23**, and an interpretive assessment of data has been provided in **Section 8**.

Table 7-8: Summary of PFAS Concentrations in Sediment and Deviation from Historical Results

Compound	Unit	Sample event	No. of Samples	Concentration Range	No. Sample with Conc. >LOR	First-time Detection (Detection)	New Historical Maximum (Historical Maximum / New Maximum)						
PFBS	mg/kg	Oct/Nov 24	59	<LOR – 0.013	25	SD002 (0.0002)	SD002 (<LOR / 0.0002)						
						SD004 (0.0002)	SD004 (<LOR / 0.0002)						
						SD020 (0.0002)	SD020 (<LOR / 0.0002)						
						SD038 (0.0002)	SD038 (<LOR / 0.0002)						
							SD080 (0.0063 / 0.0068)						
PFHXS	mg/kg	Oct/Nov 24	59	<LOR – 0.18	43	None	SD004 (0.0011 / 0.0019) SD020 (0.0008 / 0.0012) SD038 (0.0032 / 0.0039)						
						PFOA	mg/kg	Oct/Nov 24	59	<LOR – 0.014	32	SD018 (0.0001)	SD018 (<LOR / 0.0001)
												SD100 (0.0001)	SD100 (<LOR / 0.0001)
PFOS	mg/kg	Oct/Nov 24	59	<LOR – 0.96	52	None	SD038 (0.0212 / 0.029) SD043 (0.0003 / 0.0005) SD053 (0.035 / 0.045)						
PFHXS + PFOS	mg/kg	Oct/Nov 24	59	<LOR – 1.14	52	None	SD038 (0.0229 / 0.0329) SD043 (0.0003 / 0.0005) SD053 (0.0403 / 0.0477)						

Note:

No. samples includes quality assurance samples
 NA = Not Applicable
Bold text indicates an order of magnitude difference.

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Sediment Sample Location

PFBS Concentration

- ▲ 0.01 - <0.1 mg/kg
- ▲ 0.001 - <0.01 mg/kg
- ▲ <0.001 mg/kg
- ▲ Non-detect
- ▲ Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



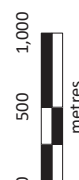
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

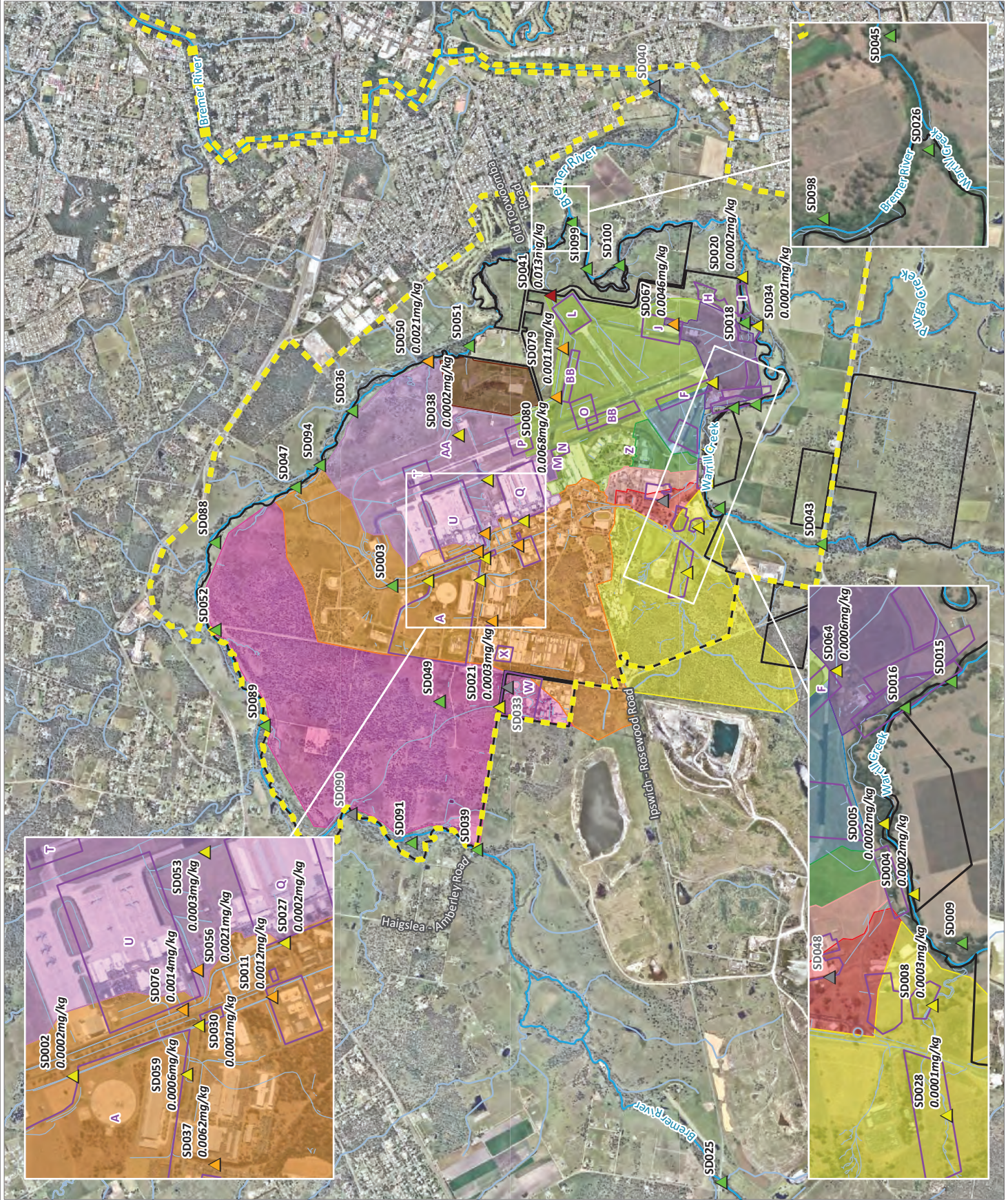


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFBS CONCENTRATIONS,
SEDIMENT (OCTOBER & NOVEMBER, 2024)

FIGURE 20



Name: 66133_RAAF Amberley_Oct24_RevC/66133_20_SDPFBSOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Sediment Sample Location

- PFOA Concentration
- >0.01 mg/kg
- 0.001 - <0.01 mg/kg
- <0.001 mg/kg
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000



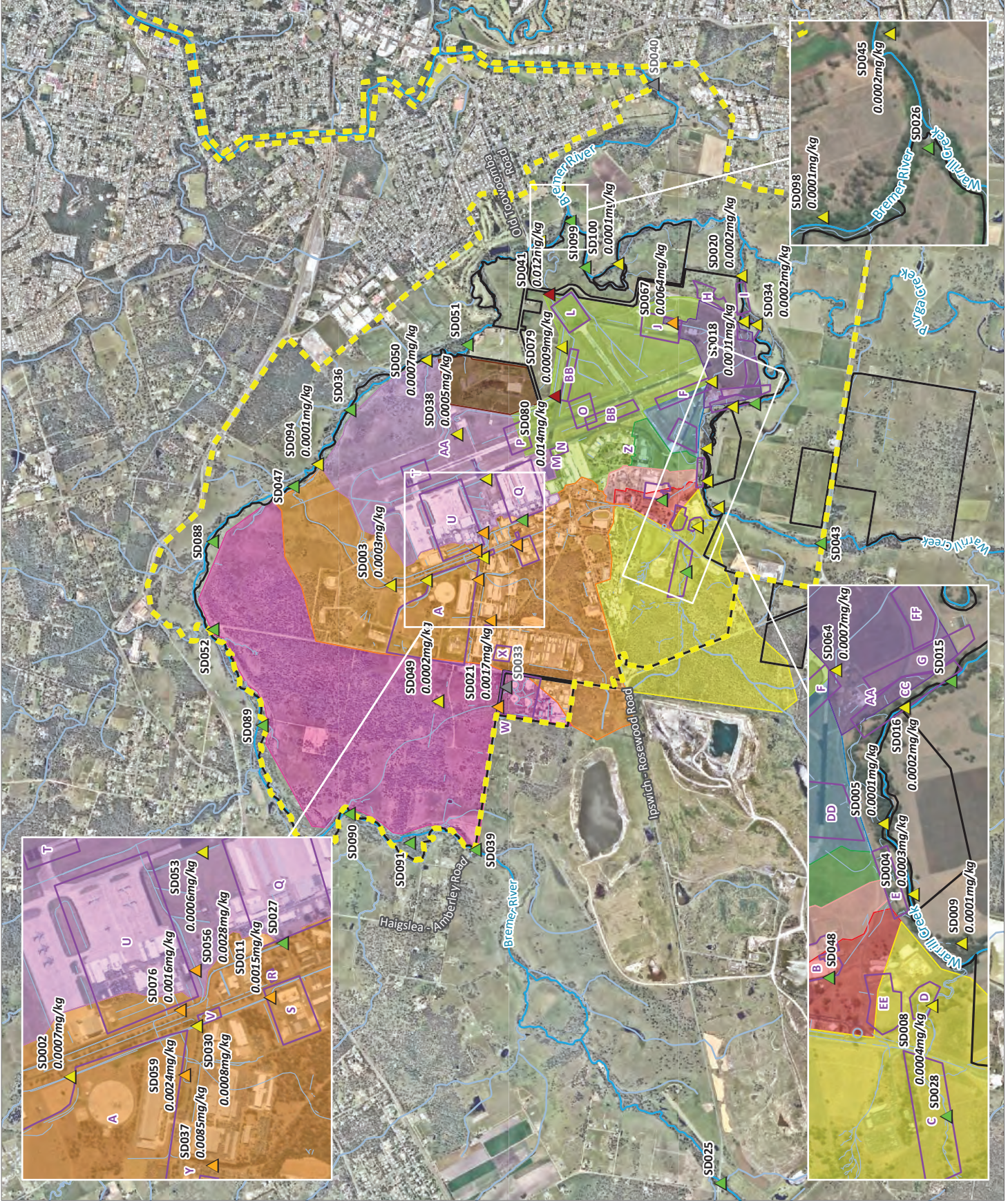
0 500 1,000 metres

Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley, Queensland

PFOA CONCENTRATIONS, SEDIMENT (OCTOBER & NOVEMBER, 2024)

FIGURE 21



Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Sediment Sample Location

PFOS Concentration

- >0.1 mg/kg
- 0.01 - <0.1 mg/kg
- 0.001 - <0.01 mg/kg
- <0.001 mg/kg
- Non-detect
- Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000



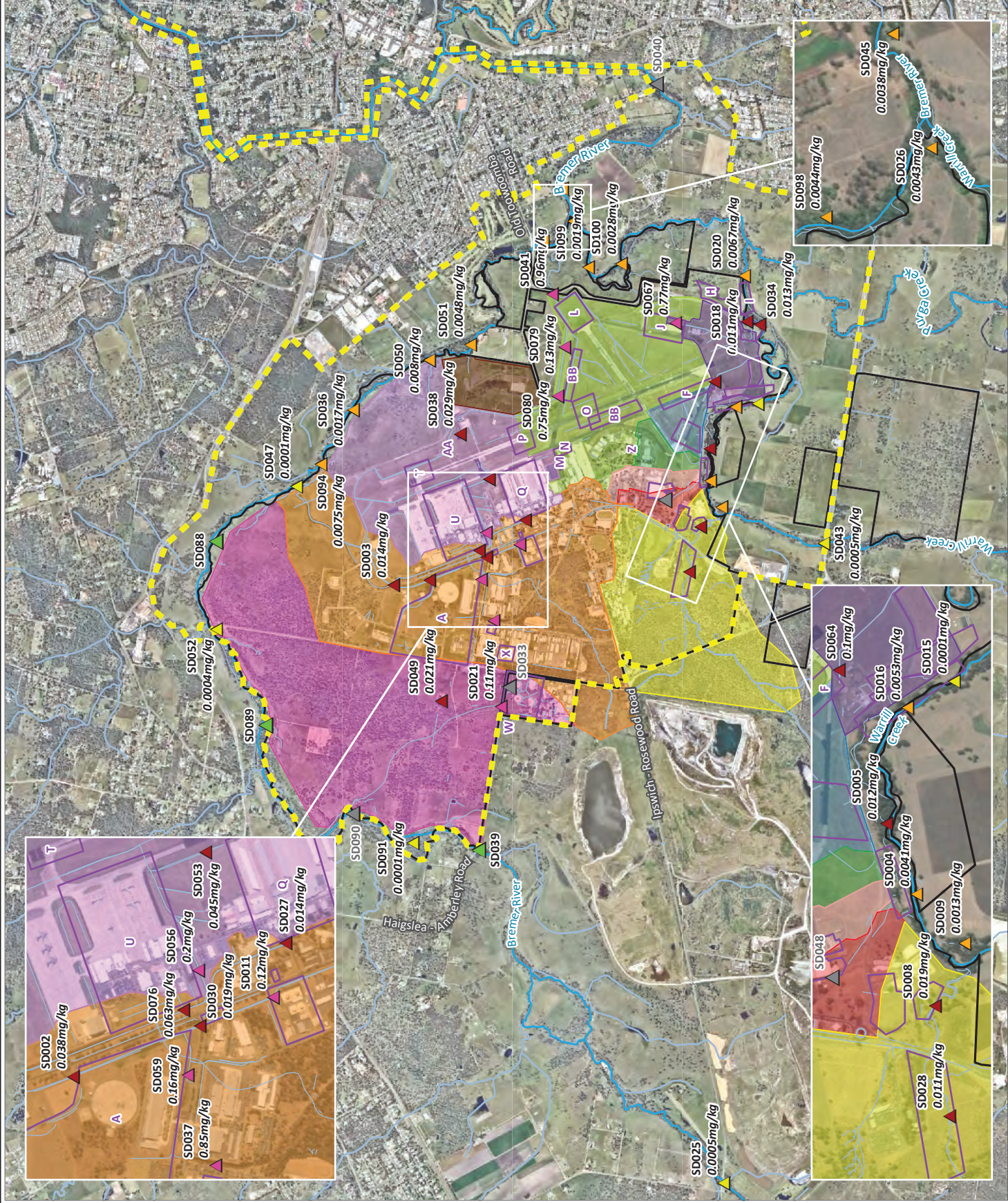
0 500 1,000 metres

Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFOS CONCENTRATIONS,
SEDIMENT (OCTOBER & NOVEMBER, 2024)

FIGURE 22



Name: 66133_RAAF Amberley_OMR25_RevC/66133_22_SDPFOS04r24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Sediment Sample Location

- PFHYS Concentration**
- >0.1 mg/kg
 - 0.01 - <0.1 mg/kg
 - 0.001 - <0.01 mg/kg
 - <0.001 mg/kg
 - Non-detect
 - Not sampled

Catchment Areas

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10
- Catchment 11



Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

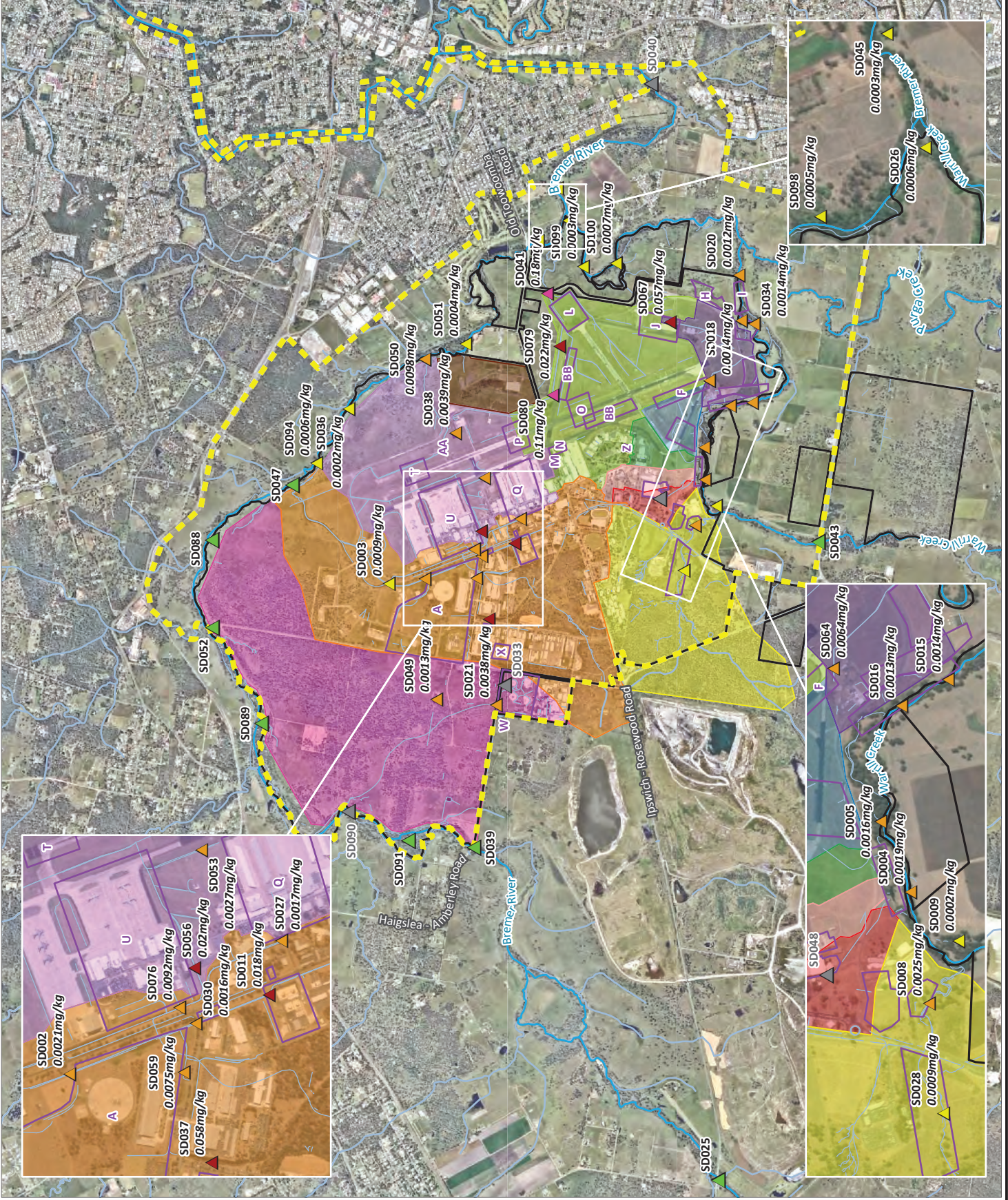


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

PFHYS CONCENTRATIONS,
SEDIMENT (OCTOBER & NOVEMBER, 2024)

FIGURE 23



Name: 66133_RAAF_Amberley_Oct24_RevC/66133_23_SDPFHYSOct24
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Legend

- Watercourse of Interest
- Watercourse / Drainage Line
- P/MAP Management Area
- Confirmed Primary Source Area
- RAAF Amberley Approximate Site Boundary

Sediment Sample Location

Sum of PFHxS & PFOS Concentration

- >1 mg/kg
 - 0.1 - <1 mg/kg
 - 0.01 - <0.1 mg/kg
 - 0.001 - <0.01 mg/kg
 - <0.001 mg/kg
 - Non-detect
 - Not sampled
- Catchment Areas**
- Catchment 1
 - Catchment 2
 - Catchment 3
 - Catchment 4
 - Catchment 5
 - Catchment 6
 - Catchment 7
 - Catchment 8
 - Catchment 9
 - Catchment 10
 - Catchment 11



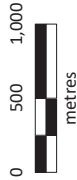
Job No: 66133

Client: Department of Defence

Version: RevC

Date: 14-Oct-2025

Scale 1:51,000

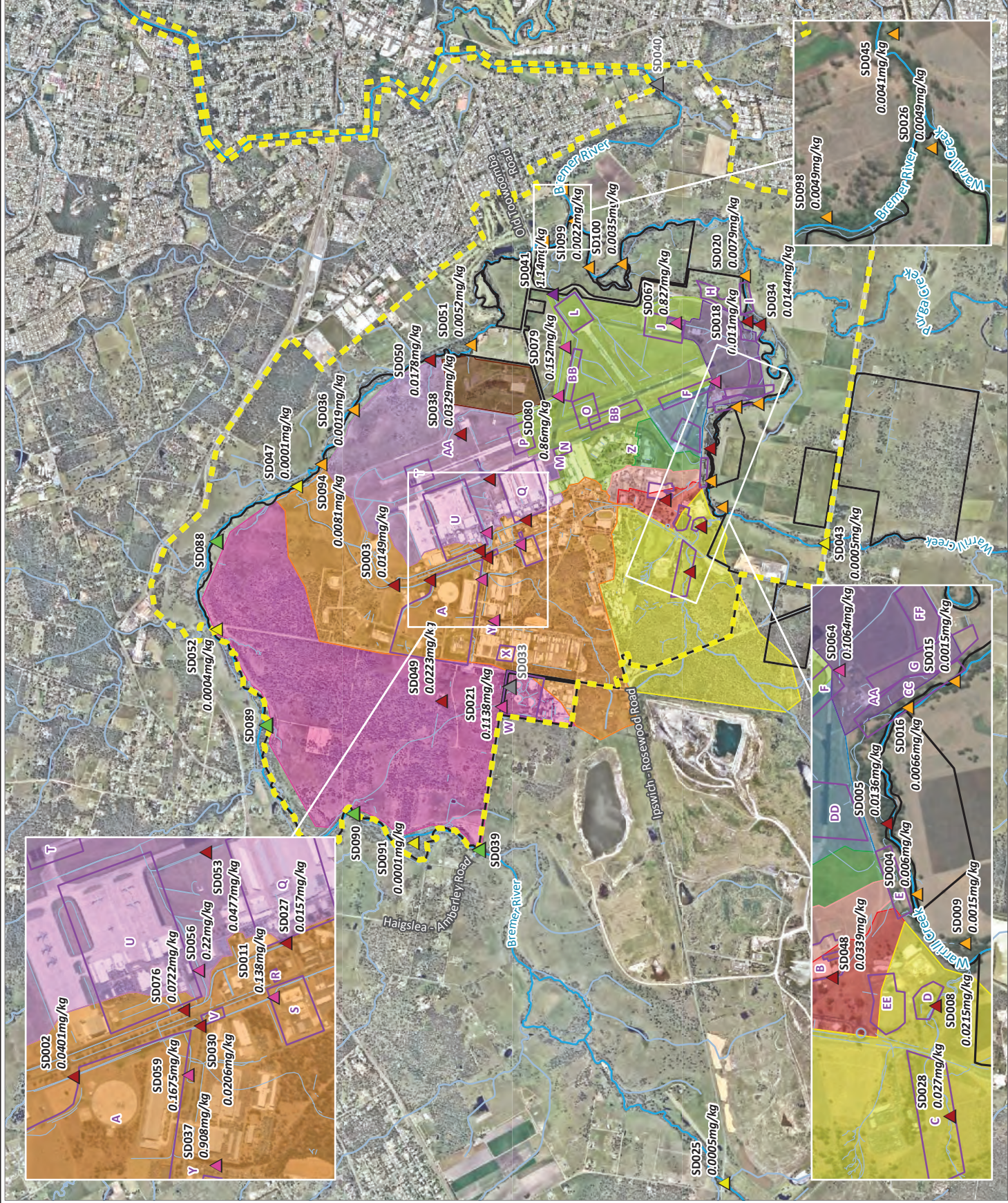


Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley,
Queensland

SUM OF PFHxS & PFOS
CONCENTRATIONS, SEDIMENT
(OCTOBER & NOVEMBER, 2024)

FIGURE 24



8. Interpretive Analysis

8.1 General

The data obtained during the 2024-2025 monitoring period has been interpreted in consideration of the 2023 mass flux study (Senversa, 2023). As such, Sum PFAS concentrations have been focused upon for consistency with the 2023 mass flux study, noting that there is no Commonwealth criteria for Sum PFAS. Consideration has also been given to PFOS, PFHxS, PFOA and PFBS as the PFAS compounds with Commonwealth criteria (where available for different human health or ecological exposure scenarios).

Relevant surface water, sediment and groundwater sampling locations have been assigned to one of the 11 surface water catchments as appropriate. For some areas, there is land between the outer boundaries of the 11 surface water catchments and either Bremer River, Warrill Creek and/or the perimeter fence of the Base. Relevant surface water, sediment and groundwater sampling locations for these areas have been assigned to either Bremer River or Warrill Creek for the purposes of data interpretation.

For relevant surface water and sediment sample locations undertaken directly from the Bremer River or Warrill Creek, these have been assigned to either Bremer River or Warrill Creek for the purposes of data interpretation.

The assessment of surface water concentration trends is more difficult than groundwater concentration trends given the seasonal factors which influence surface water concentrations (i.e. dilution following heavy rainfall, evapoconcentration during dry periods). One means of assessing this uncertainty is to differentiate the time series data by season and conduct trend assessments for different seasons (e.g. wet vs dry). At least 8-10 measurements are recommended for the purposes of assessing trends (state of Queensland, 2021). The current data set:

- Meets the 8-10 measurement requirements when considering the data as a whole.
- Predominantly does not meet the 8-10 measurement requirements if the data was to be split by season in order to prepare seasonal Mann-Kendall trends.

Mann-Kendall trend assessments completed for the groundwater and surface water data sets as a whole have been provided in **Appendix E**. It is recommended that seasonal Mann Kendall trends are considered for the 2025-2026 OMR. It is anticipated that by this time, the majority of monitoring locations will have sufficient data.

8.2 Groundwater Elevation and Flow

The inferred groundwater flow direction in the Alluvium-Tertiary Formation is consistent with previous reports, with groundwater flowing from the topographical high in the western portion of the Base where the Tertiary Formation is the upper aquifer material to the lower areas in the northeast, east and southeast where the Alluvium forms the upper portion of the aquifer (refer to **Figure 10A-D**). Localised variations in flow direction are likely to occur, particularly in proximity to surface water features and drainage lines, where hydraulic gradients may be locally influenced.

The Walloon Coal Measures is a complex system characterised by high (fractures and bedding planes) and low (rock mass) hydraulic conductivity zones which is recharged by leakage from upper formations. It is anticipated that groundwater flow in the Walloon Coal Measures is predominantly east towards the Bremer River and Warrill Creek confluence.

As noted earlier, a survey of Bremer River and Warrill Creek was completed in January 2025, with relative levels for surface water and sediment recorded in mAHD at locations adjacent to boundary groundwater monitoring wells to further assess the gaining/losing characteristics of these water ways. Based on review of this data:

- Bremer River appears to be predominantly gaining stream. On this basis, groundwater typically discharges to surface water and Bremer River functions as a hydraulic barrier limiting the lateral migration of PFAS in groundwater from the Base. The relative levels for groundwater being higher than the base of the Bremer River support the existing groundwater monitoring network (i.e. between base and river) when coupled with ongoing surface water monitoring. Where relative levels for groundwater are lower than the base of the Bremer River (function as a losing stream) consideration of monitoring network adequacy on the One Mile side of the Bremer River may be required, noting that the topography in this area suggests groundwater flow would be towards Bremer River.
- Warrill Creek appears to be a predominantly losing stream. On this basis, surface water typically infiltrates downward into the underlying aquifer and does not serve as a hydraulic barrier. As Warrill Creek does not typically serve as a hydraulic barrier, groundwater may migrate beneath the stream channel and beyond. It is noted that it is currently unclear whether groundwater may be discharging into Purga Creek.

Further discussion regarding the relationship between surface water and groundwater is provided in **Sections 8.4.1** and **8.5.1**.

8.3 Catchment Based Groundwater, Surface Water and Sediment

8.3.1 Catchment 1

8.3.1.1 Groundwater

Groundwater data collected from Catchment 1 as part of the OMP has been summarised in **Table 8-1**. In relation to the spatial trends, concentrations of PFAS are noted to be greater within the vicinity of the relevant CPSAs, with exception of MW030. Monitoring well MW030 reported the highest concentration of PFAS in this catchment and is located downgradient of CPSA W, adjacent to on-Base stormwater drain which receives discharge from CPSA W. Historical sum of PFAS concentrations from surface water sample location SW021, located within the stormwater drain have ranged between 10.2 – 84.6 µg/L.

The groundwater well located at the perimeter of the catchment and the Bremer River (MW034) did not report detectable concentrations of PFAS. It is noted that monitoring well is more representative of Catchment 7, as opposed to Catchment 1. There are no wells between the CPSA W boundary wells (MW043 and MW042) and the Bremer River (1.4km to river) despite a potential north-west groundwater flow direction within this portion of the base.

No trend for Sum PFAS was recorded for four out of six wells. Monitoring well MW030 reported new maximums for PFBS, PFHxS, PFOS, PFOA and Sum PFOS + PFHxS and an increasing trend with >99.9% confidence across the 2024-2025 monitoring period. The increase trend is considered to potentially be associated with ongoing infiltration of impacted surface water from the adjacent drainage line and/or an increase in groundwater elevation (18.41 mAHD in April 2020 to 20.858 mAHD in April 2025) mobilising PFAS within the vadose zone. A probably increasing trend was reported for MW043 with 97.9% confidence, consistent with the 2023-2024 monitoring period. An increase in groundwater elevation was also reported for this well from April 2020 (34.584 mAHD) to October 2024 (37.732 mAHD). It is noted that the trend is not consistent with what may reasonably be expected if the increasing trend was related to a true change in the CPSA W source when considering that a PFAS treatment plant was established in this area during the 2023-2024 monitoring period (see **Section 6.2.2**).

Table 8-1: Catchment 1 Groundwater Summary (October 2024 - May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS				
MW043 (Walloon Coal Measures)	CPSA W	0.34	0.24	0.47	0.02	0.71	1.58	Sum PFOS + PFHxS	None	Increasing (97.9%)	
MW042 (Walloon Coal Measures)	CPSA W	0.07	0.18	0.17	0.02	0.35	0.7	PFBS, PFHxS, PFOS, PFOA, Sum PFOS + PFHxS	None	No trend (71.5%)	
MW030 (Walloon Coal Measures)	CPSA W (down gradient)	5.1	17	0.38	2.2	17.38	47.76	PFBS, PFHxS, PFOS, PFOA, Sum PFOS + PFHxS	None	Increasing (>99.9%)	
MW031 (Tertiary Formation)	CPSA W (down gradient)	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	None	None	No trend (57.7%)	

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)						New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS			
MW002 (Walloon Coal Measures)	CPSA A (down gradient)	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	None	None	No trend (52.4%)
MW034 (Alluvium)	Northeast Catchment 1	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	None	None	No trend (87.0%)

Notes:

Summary table excludes quality assurance samples.

8.3.1.2 Surface Water and Sediment

Surface water and sediment data collected from Catchment 1 as part of the OMP represents a drainage line from within CPSA W leading to a dam within the Hansen Farm Conservation Area. The following table (**Table 8-2**) presents a summary of the data collected in order of upstream to downstream. PFAS concentrations detected are consistent with the conceptual understanding of PFAS in this area (i.e. PFAS migration from areas surrounding fire training area, reduction of PFAS concentrations with distance from primary source).

Trend assessments completed for Sum PFAS concentration have identified decreasing trends for SW021 (99.0%) and SW049 (99.3%), consistent with the 2023-2024 monitoring period. It is noted that there nearest sampling location to the Bremer River is >1.3km. The significance of the concentrations detected in this catchment is considered in more detail when reviewing the off-Base data (see **Section 8.4**).

Table 8-2: Catchment 1 Surface Water and Sediment Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Surface Water concentration (µg/L)						Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW / SD033	CPSA W	2.6	22	38	3.4	60	84.08	-	-	-	-	-	-
SW / SD021	CPSA W	1.1	5.7	7.1	0.53	12.8	19.5	0.0003	0.0038	0.11	0.0017	0.1138	0.1473
SW / SD049	Hansens Farm Dam	0.09	0.38	0.8	0.06	1.18	1.82	<LOR	0.0013	0.021	0.0002	0.0223	0.0239

Notes:

Summary table excludes quality assurance samples.

'-' = no data

8.3.2 Catchment 2

No groundwater or surface water data is collected from Catchment 2 as part of the OMP. The 2023 mass flux study confirmed this to be appropriate as <1% of the PFAS mass flux migrates from this area. The significance of potential PFAS migration from this catchment is considered when reviewing the data for Warrill Creek (see **Section 8.5**).

8.3.3 Catchment 3

8.3.3.1 Groundwater

Groundwater data collected from Catchment 3 as part of the OMP has been summarised in **Table 8-3**. Concentrations of PFAS are noted to be greater within the vicinity of relevant CPSAs; however, are also noted to be higher at monitoring wells located adjacent to surface water drainage features. The highest concentrations of PFAS in this catchment were recorded at MW006 and MW020. Monitoring well MW020 is located within CPSA Z (Fuel UST with AFFF listing) and MW006 is located downgradient of several CPSAs (approximately 1 km downgradient of CPSA M/N) and is immediately adjacent to the major stormwater drain for Catchment 3. Historical Sum PFAS concentrations in surface water recorded at nearby location SW079 ranged between 0.15 – 72.2 µg/L. There are no groundwater wells located between CPSA M and CPSA N and MW006. As such, there is uncertainty with respect to the extent of PFAS contamination in this area (i.e. whether there is a PFAS plume originating from CPSA M and CPSA N or whether the PFAS detected in MW006 is associated with vertical migration of stormwater from drainage lines). This uncertainty will be addressed during late 2025 and early 2026 as Catchment 3 investigations progress.

No trend, stable or decreasing trends for Sum PFAS was recorded for four out of the five wells, with an increasing trend identified for MW023 (immediately south of Catchment 3 discharge point and east of CPSA L, Potential Former Fire Training and Operations Testing Area). MW023 reported new historical maximums within an order of magnitude for PFBS, PFHxS and Sum PFHxS+PFOS during the April / May 2025 event. Monitoring well MW020 was noted to have reported an increasing trend in during the 2023-2024 monitoring period.

Table 8-3: Catchment 3 Groundwater Summary (October 2024 - May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	Sum PFAS			
MW309 (Tertiary Formation)	CPSA M (upgradient)	<LOR	<LOR	0.03	<LOR	0.03	<LOR	<0.1	None	None	No trend (68.4%)
MW012 (Tertiary Formation)	CPSA BB (upgradient)	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	None	None	No trend (86.7%)
MW020 (Tertiary Formation)	CPSA Z	0.24	2.1	8.6	0.27	10.7	13.36	None	PFBS, PFHxS, PFOS, PFOA, Sum of PFOS + PFHxS	None	No trend (86.5%)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	Sum PFAS			
MW006 (Alluvium)	CPSA M, N and BB (down gradient)	2.8	16	130	1.3	146	163.83	None	None	Stable (68.7%)	
MW023 (Alluvium)	CPSA L (down gradient)	0.43	1.3	0.17	0.01	1.47	2.52	PFBS, PFHxS, Sum PFOS + PFHxS	None	Increasing (99.9%)	

Notes:
Summary table excludes quality assurance samples.

8.3.3.2 Surface Water and Sediment

Surface water and sediment data collected from Catchment 3 as part of the OMP represents a northwest to east drainage line receiving stormwater discharge from all CPSAs within Catchment 3. The following table (**Table 8-4**) presents a summary of the data collected in order of upstream to downstream. PFAS concentrations detected are consistent with the conceptual understanding of PFAS in this area (i.e. PFAS migration from source areas, reduction of PFAS concentrations with distance).

Trend assessment completed for Sum PFAS concentrations have identified a stable trend for all locations. The significance of the concentrations detected in this catchment is considered in more detail when reviewing the data collected for Bremer River and Warrill Creek (see **Section 8.4** and **8.5**).

Table 8-4: Catchment 3 Surface Water and Sediment Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Surface Water Concentrations (µg/L)						Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW / SD080	CPSA M, CPSA N, CPSA Z, CPSA BB, CPSA O	1.4	11	13	0.6	24	32.09	0.0068	0.11	0.75	0.014	0.86	1.0556
SW / SD079	CPSA M, CPSA N, CPSA Z, CPSA BB, CPSA O	1.4	13	10	0.65	23	31.54	0.0011	0.015	0.077	0.0009	0.092	0.1028
SW / SD041	CPSA M, CPSA N, CPSA Z, CPSA BB, CPSA O	1.3	11	6.8	05.1	17.8	24.96	0.013	0.18	0.96	0.012	1.14	1.2872

Notes:

Summary table excludes quality assurance samples.

8.3.4 Catchment 4

No groundwater or surface water data is collected from Catchment 4 as part of the OMP. The 2023 mass flux study confirmed this to be appropriate as only 1.7% of the PFAS mass flux migrates from this area. The significance of potential PFAS migration from this catchment is considered when reviewing the data for Warrill Creek (see **Section 8.5**).

8.3.5 Catchment 5

No groundwater or surface water data is collected from Catchment 5 as part of the OMP. The 2023 mass flux study confirmed this to be appropriate as <1% of the PFAS mass flux migrates from this area. The significance of potential PFAS migration from this catchment is considered when reviewing the data for Warrill Creek (see **Section 8.5**).

8.3.6 Catchment 6

8.3.6.1 Groundwater

Groundwater data collected from Catchment 6 as part of the OMP has been summarised in **Table 8-5**.

Monitoring well MW047 is located cross gradient of CPSA B (Hangar 410 and Former Landfill); however, is installed adjacent to the on-Base stormwater drain which receives discharge from CPSA B. This monitoring well recorded new historical maximums for PFBS, PFHxS, PFOS and Sum PFOS + PFHxS across the 2024-2025 monitoring period and recorded an increasing trend with a 99.6% confidence factor, consistent with the 2023-2024 monitoring period. The trend is considered potentially associated with the mobilisation of PFAS as consequence of increased groundwater elevations (see **Table A1, Appendix A**) and may relate to stockpile management activities associated with the new STP construction project (see **Section 6.2.4**). Upstream surface water sample location SW048 reports historical Sum PFAS concentrations ranging between 0.79 – 25.8 µg/L.

Table 8-5: Catchment 6 Groundwater Summary (October 2024 - May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)						New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS			
MW047 (Tertiary Formation)	CPSA B (cross gradient)	9.6	29	98	1.6	127	163.69	PFBS, PFHxS, PFOS, Sum PFOS + PFHxS	None	Increasing (99.6%)

Notes:

Summary table excludes quality assurance samples.

8.3.6.2 Surface Water and Sediment

Surface water and sediment data collected from Catchment 6 as part of the OMP represents a drainage line receiving runoff from CPSA B (upstream of MW047). The following table presents a summary of the data collected. Based on review of the Base stormwater management infrastructure, the surface water from sample location SW048 is discharging to CPSA E. No trend has been identified for SW048. The significance of the concentration detected in this catchment is considered in more detail when reviewing the off-Base data for Warrill Creek (see **Section 8.5**).

Table 8-6: Catchment 6 Surface Water and Sediment Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Surface Water Concentration (µg/L)						Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW/SD048	CPSA B	0.08	0.57	0.95	0.15	1.52	3.37	-	-	-	-	-	-

Notes:

Summary table excludes quality assurance samples.

'-' = no data

8.3.7 Catchment 7

8.3.7.1 Groundwater

Groundwater data collected from Catchment 7 as part of the OMP has been summarised in **Table 8-7**. Higher concentration of PFAS occurs within the vicinity of CPSAs and surface water drainage features downstream of CPSAs.

The highest concentration within the catchment was recorded at monitoring well MW021, located within CPSA D (STP) which receives PFAS impacted wastewater and stormwater runoff from various Base operations. Consistent with the 2023-2024 monitoring period, monitoring wells MW021 and MW032 reported increasing trends with confidence factors of 94.2% and 97.7%, respectively. MW032 reported new historical maximums within an order of magnitude for PFOS and Sum of PFHxS+PFOS. Conversely, MW021 reported new historical minimums within an order of magnitude for PFBS, PFHxS, PFOS, PFOA and Sum of PFHxS+PFOS. The results indicate a potential ongoing contribution of PFAS associated with CPSA D, with increasing trends potentially influenced by increasing /decreasing groundwater elevations (see **Table A1, Appendix A**).

MW037 results are consistent with CPSA D (STP) being the primary source of contamination, but CPSA C also appears to be a relatively significant contamination source. This is consistent with the understanding of CPSA C (i.e. historical firefighting training). The significant of near surface soil contamination in CPSA C is to be investigated during 2025/2026.

Table 8-7: Catchment 7 Groundwater Summary (October 2024 - May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS				
MW037 (Alluvium)	CPSA C	2.1	7.7	0.37	0.18	8.07	16.7	PFOA	None	No trend (85.7%)	
MW021 (Alluvium)	CPSA D (STP)	1.9	34	96	2.3	130	145.96	None	PFBS, PFHxS, PFOS, PFOA, Sum PFHxS + PFOS	Probably increasing (94.2%)	
MW032 (Alluvium)	CPSA D (downgradient)	2.0	9	37	1.7	45.8	57.56	PFOS, Sum PFOS + PFHxS	None	Increasing (97.7%)	

Notes:

Summary table excludes quality assurance samples.

'-' = no data

8.3.7.2 Surface Water and Sediment

Surface water and sediment data collected from Catchment 7 as part of the OMP represents a north-west to east drainage line receiving stormwater discharge from CPSA C and CPSA D. The following table (**Table 8-8**) presents a summary of the data collected in order of upstream to downstream. PFAS concentrations detected are consistent with the conceptual understanding of PFAS in this area (i.e. PFAS migration from areas sewage treatment plant, reduction of PFAS concentrations with distance from primary source).

The concentrations detected indicate that CPSA C and CPSA D represent PFAS sources to surface water on the Base. A new maximum for PFBS and PFHxS was reported for SW008 in April / May 2025. No trend has been identified at this sample location.

The significance of the concentrations detected in this catchment is considered in more detail when reviewing the off-Base data for Warrill Creek (see **Section 8.5**). The surface water and sediment results are broadly consistent with the groundwater data (i.e. CPSA D as a more significant source than CPSA C).

Table 8-8: Catchment 7 Surface Water and Sediment Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Surface Water Concentration (µg/L)						Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW/SD028	CPSA C	0.06	0.25	0.47	0.01	0.72	0.92	0.0001	0.0009	0.011	<LOR	0.0119	0.0124
SW/SD008	CPSA D	0.58	2.0	2.7	0.47	4.7	7.1	0.0003	0.0025	0.019	0.0004	0.215	0.0272
SW530*	CPSA C / CPSA D (downgradient)	0.14	0.94	1.5	0.10	2.44	3.77	-	-	-	-	-	-

Notes:

Summary table excludes quality assurance samples.

'-' = no data

* revised OMP surface water monitoring location

8.3.8 Catchment 8

8.3.8.1 Groundwater

Groundwater data collected from Catchment 8 as part of the OMP has been summarised in **Table 8-9**. Higher concentrations of PFAS occurs within the vicinity of relevant CPSAs and surface water drainage features downstream of the CPSAs. The highest concentrations of PFAS in this catchment were recorded at monitoring well MW046, located in CPSA V (AFFF Wastewater Holding Tank). The holding tank is understood to have historically received AFFF wastewater which is later decanted and disposed to licenced off-Base facilities. The DSI (CH2M Hill, 2018) reported that cracks were identified in 2016 indicating potential containment breaches. The tank is understood to have been repaired and put back into service. New historical minimums and a decreasing trend was reported for MW046 with a confidence factor of 99.7%, consistent with the 2023-2024 monitoring period. As such, the results indicate the tank repairs were successful in reducing contaminant migration associated with containment breaches.

Increasing trends were identified for monitoring wells MW025 and MW033. Monitoring well MW025 is located east of Catchment 8, adjacent to the catchment's major surface water discharge point into Bremer River. MW025 reported new historical maximums within an order of magnitude for PFBS in April / May 2025. The increasing trend is considered likely to be associated with ongoing infiltration of PFAS impacted surface water originating in Catchment 8 and/or an increase in groundwater elevation over the 2022 monitoring period (see **Table A1, Appendix A**). The increasing trend identified for MW033 (CPSA A) is not considered to be significant on the basis of the small historical range (<0.01 to 0.19 µg/L) and a number of non-detects (11 non-detects out of 19 samples). No detectable concentrations were recorded during the monitoring period.

A probably increasing trend was identified for MW041, located within CPSA X (Former Structural and Open Pit FTA). MW041 reported new maximum concentrations within an order of magnitude for PFOA and Sum of PFHxS+PFOS in April / May 2025. The significance of this probable trend should be assessed in 2025/2026 as part of ongoing investigations in relation to CPSA X and CPSA Y.

Table 8-9: Catchment 8 Groundwater Summary (October 2024 - May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)						New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS			
MW026 (Tertiary Formation)	CPSA W (down gradient)	<LOR	<LOR	0.04	<LOR	0.04	<LOR	Sum PFOS + PFHxS	None	No trend (68.6%)
MW041 (Walloon Coal Measures)	CPSA X	0.42	0.29	0.33	0.03	0.62	1.61	Sum PFOS + PFHxS	PFHxS	Probably increasing (95.0%)
MW537 (Alluvium)	CPSA Y	0.28	0.14	0.07	0.01	0.3	1.37	None	PFBS, PFHxS, PFOS, PFOA, Sum PFHxS + PFOS	ID
MW046 (Tertiary Formation)	CPSA V	17	120	240	23	360	636.29	None	PFBS, PFHxS, PFOS, PFOA, Sum PFOS + PFHxS	Decreasing (99.7%)
MW033 (Walloon Coal Measures)	CPSA A	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	None	None	Increasing (98.0%)
MW539	CPSA A	5.8	5..1	<LOR	0.07	5.1	23.03	PFBS, PFHxS, PFOA, Sum PFOS + PFHxS	PFBS, PFHxS, PFOA, Sum PFOS + PFHxS	ID

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	ID			
(Alluvium)	(down gradient)										
MW536 (Alluvium)	CPSA A (down gradient)	0.12	0.56	0.82	0.07	1.38	2.34	PFBS	PFBS, PFHxS, PFOS, PFOA, Sum PFAS + PFHxS		
MW025 (Alluvium)	East of Catchment 8	0.3	1.2	1.1	0.13	2.3	4.36	PFBS	None	Increasing (99.7%)	

Notes:

Summary table excludes quality assurance samples.

'-' = no data

ID = insufficient data

8.3.8.2 Surface Water and Sediment

Surface water and sediment data collected from Catchment 8 as part of the OMP represents several stormwater drains which later converge at sample location SW/SD003. It is unclear if the catchment boundaries are entirely correct, as SW076 appears to receive discharge from Catchment 9 (CPSA U in particular). The following table presents a summary of the data collected in order of upstream to downstream.

The following is noted with respect to surface water in Catchment 8:

- The surface water data for SW0059 represents the highest PFAS concentrations in Catchment 8. Based on review of the stormwater infrastructure for the Base, this location receives drainage from the Fire Fighting Training School (CPSA W).
- Overall, the PFAS concentrations reduce by less than an order of magnitude between the upstream sample locations and the confluence at SW003 (predominantly within the 1-10µg/L range). Concentrations of Sum PFAS subsequently decrease an order of magnitude between SW003 and the discharge point to Bremer River (SW661), indicating the limited potential for significant unknown PFAS sources north of CPSA A.

Trend assessment completed for Sum PFAS concentrations have identified decreasing trends at SW037 (96.0%), SW011 (96.2%) and SW002 (95.7%).

The significance of the concentrations detected in this catchment is considered in more detail when reviewing the off-Base data for Bremer River (see **Section 8.4**).

Table 8-10: Catchment 8 Surface Water and Sediment Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Surface Water Concentration (µg/L)						Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW / SD037 (western drain)	CPSA Y	0.44	3.2	2.0	0.22	4.6	7.78	0.0062	0.058	0.85	0.0085	0.908	1.0032
SW / SD059 (western drain)	Down-stream of CPSA Y, CPSA A (fire training school)	0.62	3.7	4.3	0.6	7.3	12.62	0.0006	0.0075	0.16	0.0024	0.1675	0.2236
SW / SD011 (central drain)	CPSA S, CPSA R	0.13	1.3	1.9	0.09	3.2	4.36	0.0012	0.018	0.12	0.0015	0.138	0.1546
SW / SD030 (central drain)	Down-stream of CPSA V	0.1	1.1	1.9	0.07	3	4.07	0.0001	0.0016	0.019	0.0008	0.0206	0.0342
SW / SD002 (central drain)	Down-stream of fire training pad in CPSA A	0.12	0.75	1.0	0.14	1.75	3.22	0.0002	0.0021	0.038	0.0007	0.0401	0.0531
SW / SD027 (eastern drain)	CPSA Q	0.15	1.7	3.6	0.08	5.3	6.33	0.0002	0.0017	0.014	<LOR	0.0157	0.0173
SW / SD076 (eastern drain)	Down-stream of 27 (West of CPSA U)	1.0	5.9	5.4	0.54	11.3	18.68	0.0014	0.0092	0.063	0.0016	0.0722	0.0927

Location	Adjacent Feature	Maximum Surface Water Concentration (µg/L)							Sediment (mg/kg)						
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS		
SW / SD003 (at confluence of eastern and central drains)	Down-stream of SW/SD002	0.34	2.3	1.2	0.24	3.5	6.45	<LOR	0.0009	0.014	0.0003	0.0149	0.0185		
SW661* (discharge point)	Down-stream SW003	0.02	0.14	0.43	0.02	0.57	0.68	-	-	-	-	-	-		

Notes:

Summary table excludes quality assurance samples.

'-' = no data

* Revised OMP surface water monitoring location

8.3.9 Catchment 9

8.3.9.1 Groundwater

Groundwater data collected from Catchment 9 as part of the OMP has been summarised in **Table 8-11**. The highest concentrations of PFAS in this catchment was recorded at monitoring well MW007, located adjacent to CPSA AA (triple interceptor pit at engine test cell facilities 1 and 2). The triple interceptor pit is considered to represent a diffuse source of PFAS as it potentially receives PFAS contaminated wastewater from a variety of Base facilities. This monitoring well is noted to report a decreasing trend for Sum PFAS, with a 99.9% confidence.

Table 8-11: Catchment 9 Groundwater Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	None			
MW007 (Alluvium)	CPSA AA (downgradient)	1.1	9.2	23	0.71	32.2	40.7	None	PFOS	Decreasing (99.9%)	
MW035 (Alluvium)	East of Catchment 9	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	None	None	No trend (89%)	
MW535 (Alluvium)	East of Catchment 9	<LOR	<LOR	0.01	<LOR	0.01	<LOR	PFOS, Sum PFOS + PFHxS	None	ID	

Notes:

Summary table excludes quality assurance samples.

'-' = no data

ID = insufficient data

8.3.9.2 Surface Water and Sediment

Surface water and sediment data collected from Catchment 9 as part of the OMP represents several stormwater drains receiving discharge from a number of CPSAs. Based on review of the Base stormwater infrastructure, the sample locations are not linear but are collected from drains which later converge. The following table presents a summary of the data collected. Based on review of the data, SW056 represents the highest PFAS concentration in Catchment 9. This location receives drainage from the 38 Squadron Hangars (CPSA U) and potentially drains into Catchment 8. No concentration trends were identified for monitoring locations within the catchment.

The significance of the concentrations detected in this catchment is considered in more detail when reviewing the off-base data for Bremer River (see **Section 8.4**).

Table 8-12: Catchment 9 Surface Water and Sediment Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Surface Water Concentration (µg/L)						Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW / SD038	CPSA AA	0.11	0.58	0.98	0.07	1.56	2.48	0.0002	0.0039	0.029	0.0005	0.0329	0.0494
SW / SD053	CPSA Q	<LOR	0.06	0.04	<LOR	0.1	0.13	0.0003	0.0027	0.045	0.0006	0.0477	0.0562
SW / SD056	CPSA U	0.52	2.9	3.1	0.38	6	9.95	0.0021	0.02	0.2	0.0028	0.22	0.2579

Notes:

Summary table excludes quality assurance samples.

8.3.10 Catchment 10

8.3.10.1 Groundwater

No groundwater data is collected from Catchment 10 as part of the OMP.

8.3.10.2 Surface Water and Sediment

Surface water and sediment data collected from Catchment 10 as part of the OMP represents two stormwater drains receiving discharge from CPSA J and CPSA F. Based on review of the Base stormwater infrastructure, the sample locations are not linear (e.g. upstream to downstream), nor do they later converge prior to discharge to Warrill Creek. The following table presents a summary of the data collected.

The following is noted with respect surface water in Catchment 10:

- The surface water data for SW067 represents the highest PFAS concentrations in Catchment 10. Based on review of the stormwater infrastructure for the Base, this location receives drainage from the former FTA and operations testing area (CPSA J).
- SW064 receives a runoff from a small portion of the Potential former FTA and Landfill (CPSA F).

The significance of the concentrations detected in this catchment is considered in more detail when reviewing the off-base data for Warrill Creek (see **Section 8.5**).

Table 8-13: Catchment 10 Surface Water and Sediment Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Surface Water Concentration (µg/L)						Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW / SD067	CPSA J	0.65	6.7	4.7	0.24	11.4	16.1	0.0046	0.057	0.77	0.0064	0.827	0.955
SW / SD064	CPSA F	0.08	0.84	0.51	0.03	1.35	1.7	0.0006	0.0064	0.1	0.0007	0.1064	0.114

Notes:

Summary table excludes quality assurance samples.

8.3.11 Catchment 11

8.3.11.1 Groundwater

Groundwater data collected from Catchment 11 as part of the OMP has been summarised in **Table 8-14**. There are no CPSAs in Catchment 11; however, it is noted to be hydraulically downgradient of Catchment 9 and in the vicinity of the major discharge feature for Catchment 9.

An increasing trend with a 99.9% confidence factor was reported for well MW024. MW024 reported new maximums within an order of magnitude for PFHxS in April / May 2025. The significance of this increasing trend should be assessed following the 2025-2026 monitoring period.

Table 8-14: Catchment 11 Groundwater Summary (October 2024 - May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	ID			
MW538 (Alluvium)	East of CPSA P	<LOR	0.01	0.02	<LOR	0.03	<LOR	PFOS	PFHxS, Sum PFOS + PFHxS		
MW024 (Alluvium)	East of Catchment 11	0.02	0.13	0.03	<LOR	0.16	0.2	PFHxS	None	Increasing (99.9%)	
MW055S (Alluvium)	East of Catchment 11	0.16	1.3	0.67	0.07	1.97	2.78	None	None	No trend (50.0%)	
MW055D (Tertiary Formation)	East of Catchment 11	<LOR	0.01	<LOR	<LOR	0.01	<LOR	None	None	No trend (52.0%)	

Notes:

Summary table excludes quality assurance samples.

'-' = no data

ID = insufficient data

8.3.11.2 Surface Water

Surface water data collected from Catchment 11 as part of the OMP represents a single monitoring location collected adjacent to the discharge point to the Bremer River. The monitoring location was reported to be dry at the time of sampling.

8.4 Bremer River

8.4.1 Groundwater

Groundwater data collected from monitoring wells adjacent to the Bremer River as part of the OMP have been summarised in **Table 8-15**. It noted that some groundwater monitoring wells adjacent to the Bremer River fall within the catchment boundaries and have had results previously summarised. These results have been replicated here for completeness.

Higher concentrations of PFAS in monitoring wells adjacent to the Bremer River are noted to be located within the vicinity of surface water drainage lines and major discharge points which receive the majority of surface water runoff from the catchments and CPSAs contained therein, namely:

- DP5 (Catchment 8) – MW025.
- DP6 (Catchment 9) – MW055S.
- DP9 (Catchment 3) – MW028 and MW029.

It is noted that MW056S and MW056I are located on the eastern side of Bremer River in the alluvium and Tertiary Formation, respectively. One Mile residences are located greater than 170 m east of the monitoring wells, with the Management Area boundary located 250m east. Both monitoring wells have historically recorded occasional exceedances of drinking water criteria for PFOS (maximum concentration of 0.02 µg/L). The concentrations of PFAS reported in this groundwater well are typically lower than those detected in adjacent surface water sample locations in Bremer River (SW026 and SW040). Bremer River is understood to behave as predominantly gaining stream (see **Section 8.2**), and therefore to some extent acts as a hydraulic barrier to the lateral migration of PFAS contamination from the Base. As such, groundwater migration beneath Bremer River and beyond is likely constrained at least some of the time.

Increasing trends were identified for MW024, MW025 and MW029, consistent with the 2023-2024 monitoring period. In relation to increasing trends reported for MW024 and MW025, please refer to **Sections 8.3.11.1** and **8.3.8.1**, respectively. No new maximums or minimums were reported in relation to MW029. The increasing trends are considered to be potentially associated with infiltration of PFAS impacted surface water from adjacent drainage features and/or increases in groundwater elevations associated with major rainfall and flooding events in early 2022 and 2025 (see **Table A1, Appendix A**).

Probably increasing trends were identified for MW036 and MW056I. The increasing trend for MW036 and MW056I are not considered to be significant based on the small historical range (<0.01 to 0.07 µg/L).

Table 8-15: Bremer River Groundwater Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS				
MW025 (Alluvium)	East of Catchment 8	0.3	1.2	1.1	0.13	2.3	4.36	PFBS	None	Increasing (99.7%)	
MW026 (Alluvium)	East of Catchment 9	<LOR	<LOR	0.04	<LOR	0.04	<LOR	Sum PFHxS + PFOS	None	No trend (68.6%)	
MW024 (Alluvium)	East of Catchment 11	0.02	0.13	0.03	<LOR	0.16	0.2	PFHxS	None	Increasing (99.9%)	
MW055S (Alluvium)	East of Catchment 11	0.16	1.3	0.67	0.07	1.97	2.78	None	None	Stable (50.0%)	
MW055D (Tertiary Formation)	East of Catchment 11	<LOR	0.01	<LOR	<LOR	0.01	<LOR	None	None	No trend (55.0%)	
MW044 (Alluvium)	East of Catchment 11	0.01	0.01	0.02	<LOR	0.03	<LOR	None	None	No trend (79.1%)	
MW036 (Alluvium)	East of Catchment 3 (CPSA L)	<LOR	0.06	0.02	<LOR	0.06	<LOR	PFOS	None	Probably increasing (94.7%)	
MW028 (Alluvium)	East of Catchment 3 (CPSA L)	2.9	20	41	1.1	61	78.02	None	None	Stable (68.7%)	

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS				
MW029 (Alluvium)	East of Catchment 3 (CPSA L)	0.71	5.2	3.7	0.26	8.9	12.73	None	None	Increasing (99.2%)	
MW056i (Tertiary Formation)	East of Catchment 3	<LOR	0.01	0.02	<LOR	0.03	0.1	None	None	Probably increasing (93.7%)	
MW056S (Alluvium)	East of Catchment 3	<LOR	0.01	<LOR	<LOR	0.01	<LOR	PFHxS	None	No trend (78.2%)	

Notes:

Summary table excludes quality assurance samples.

8.4.2 Surface Water and Sediment

Groundwater and surface water from catchments 1, 8, 9, 11 and 3 discharge into Bremer River. It is noted that Catchment 3 discharges into both Bremer River and Warrill Creek.

The following presents a summary of the surface water and sediment data for Bremer River, with the samples organised from upstream to downstream. The results are considered to be consistent with the 2023 mass flux study and the 2023-2024 monitoring period:

- Concentrations at locations upstream of Catchment 8 are below the LOR in surface water and predominantly below the LOR in sediment.
- Concentrations at locations downstream of Catchment 8 are elevated above upstream concentrations.
- Concentrations decrease slightly between discharge points from Catchment 8, 9, 11 and 3; however, remain relatively consistent indicating the potential for groundwater discharge to Bremer River.

Sample location SW047 records results which are lower than expected for a sampling location adjacent to the Catchment 8 discharge point, which recorded Sum PFAS of 0.68 µg/L (SW661). As noted earlier, the conceptual understanding of this area changed during the 2024-2025 monitoring period, including identification of a potential relocation of the SW047 monitoring point in previous OMR events and confirmation of the presence of elevated PFAS concentrations in the Lagoon.

SW/SD040 is located approximately 2km downstream of SW/SD045 and reported comparatively higher concentrations, indicating the potential influence of additional sources and/or contributions from diffuse pathways (e.g., stormwater inputs, surface runoff, or groundwater discharge) within the catchment area. This indicates that the Base may not be the only contributor to PFAS presence at downstream locations.

In relation to sum of PFAS concentration trends, several locations upgradient of the catchment 8 discharge point reported increase or potentially increasing trends (SW039, SW091, SW089 and SW052). The increasing trends are not considered to be significant on the basis of the small historical concentrations range and variation in limits of reporting.

Further, several locations downstream the catchment 8 discharge point have reported decreasing / potentially decreasing trends. The trends are generally associated with a reduction in concentrations reported from 2017 to 2019, which were an order of magnitude higher. A general reduction in contaminant concentrations as a consequence of reduced mass discharge is considered to be consistent with what may reasonably be expected given the scale of earthworks and capping activities conducted since 2017, inclusive of significant works within Catchment 3 (e.g. Battlefield Airlifter project, Growler projects) as well as establishment of water treatment plants in Catchment 1 and Catchment 7 (e.g. fire training water now captured and treated). Above average rainfall since 2020 would be expected to both mobilise additional PFAS and dilute PFAS concentrations during periods of high flows. It is currently unclear to what extent above average rainfall conditions could explain the apparent reducing trends and additional ongoing monitoring will be required to confirm.

Table 8-16: Summary of Bremer River Surface Water and Sediment (October 2024 – May 2025)

Location	Area	Maximum Surface Water Concentration (µg/L)					Surface Water Sum PFAS Trend (confidence factor)	Sediment (mg/kg)						
		PFBS	PFHxS (µg/L)	PFOS (µg/L)	PFOA (µg/L)	Sum PFOS + PFHxS		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	
SW / SD025	Background, west of Catchment 1 and upstream of DP1	<LOR	<LOR	<LOR	<LOR	<LOR	No trend (73.3%)	<LOR	<LOR	0.0002	<LOR	<LOR	0.0002	<LOR
SW / SD039	Background, west of Catchment 1 and upstream of DP1	<LOR	<LOR	<LOR	<LOR	<LOR	Increasing (96%)	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
SW656*	Background, west of Catchment 1 and adjacent of DP1	<LOR	<LOR	<LOR	<LOR	<LOR	-	-	-	-	-	-	-	-
SW / SD091	West of Catchment 1, downstream of DP1	<LOR	<LOR	<LOR	<LOR	<LOR	Probably increasing (90.7%)	<LOR	<LOR	0.0001	<LOR	<LOR	0.0001	<LOR
SW / SD090	West of Catchment 1, adjacent to DP2	<LOR	<LOR	<LOR	<LOR	<LOR	No trend (89.8%)	-	-	-	-	-	-	-
SW / SD089	North of Catchment 1, adjacent to DP3	<LOR	<LOR	<LOR	<LOR	<LOR	Probably increasing (90.2%)	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
SW / SD052	North of Catchment 1, adjacent to DP4	<LOR	<LOR	<LOR	<LOR	<LOR	Probably increasing (93.6%)	<LOR	<LOR	0.0004	<LOR	<LOR	0.0004	0.0008

Location	Area	Maximum Surface Water Concentration (µg/L)							Surface Water Sum PFAS Trend (confidence factor)	Sediment (mg/kg)						
		PFBS	PFHxS	PFOS (µg/L)	PFOA (µg/L)	Sum PFOS + PFHxS	Sum PFAS	PFBS		PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS		
SW / SD088	North of Catchment 1, downstream of DP4	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	No trend (82.8%)	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
SW / SD047	East Catchment 8, adjacent to DP5	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	Decreasing (96.0%)	<LOR	<LOR	0.0001	<LOR	0.0001	<LOR	<LOR
SW / SD094	East of Catchment 8, Downstream of DP5	0.09	0.45	1.1	0.06	1.55	2.24	2.24	Probably Decreasing (91.3%)	<LOR	0.0006	0.0075	0.0001	0.0081	0.0087	0.0087
SW / SD036	Northeast of Catchment 9, downstream of DP5	0.02	0.09	0.14	0.01	0.23	0.35	0.35	No trend (72.3%)	<LOR	0.0002	0.0017	<LOR	0.0019	0.0023	0.0023
SW / SD050	East of Catchment 9, adjacent to DP6	0.09	0.57	0.52	0.07	1.09	1.83	1.83	No trend (72.5%)	0.0021	0.0098	0.0080	0.0007	0.0178	0.0231	0.0231
SW / SD051	East of Catchment 11, downstream of DP7	0.01	0.09	0.12	<LOR	0.21	0.25	0.25	Decreasing (98.4%)	<LOR	0.0004	0.0048	<LOR	0.0052	0.0065	0.0065
SW096*	East of Catchment 11, downstream of DP7	<LOR	0.01	0.01	<LOR	0.02	<LOR	<LOR	-	-	-	-	-	-	-	-

Location	Area	Maximum Surface Water Concentration (µg/L)							Surface Water Sum PFAS Trend (confidence factor)	Sediment (mg/kg)					
		PFBS	PFHxS	PFOS (µg/L)	PFOA (µg/L)	Sum PFOS + PFHxS	Sum PFAS	PFBS		PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	
SW / SD098	East of Catchment 3, downstream DP7	0.01	0.08	0.17	<LOR	0.25	0.41	No trend (70.5%)	<LOR	0.0005	0.0044	0.0001	0.0049	0.0065	
SW658*	East of Catchment 3, downstream DP9	<LOR	0.02	0.01	<LOR	0.03	<LOR	-	-	-	-	-	-	-	
SW / SD045	Downstream of Bremer River and Warrill Creek confluence	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	Decreasing (98.9%)	<LOR	0.003	0.0038	0.0002	0.0041	0.0045	
SW / SD040	Approximately 2km downstream of SW/SD45, north of abattoir	0.02	0.07	0.14	<LOR	0.21	0.29	Probably decreasing (90.4%)	-	-	-	-	-	-	

Notes:

Summary table excludes quality assurance samples.

'-' = no data

* Revised OMP surface water monitoring location.

8.5 Warrill Creek

8.5.1 Groundwater

Groundwater data collected from monitoring wells adjacent to Warrill Creek as part of the OMP have been summarised in **Table 8-17**. It noted that some groundwater monitoring wells adjacent to Warrill Creek which fall within the catchment boundaries and have had results previously summarised. These results have been replicated here for completeness.

Monitoring wells adjacent to Warrill Creek with higher concentrations of PFAS are noted to be either located within the vicinity of surface water drainage lines and major discharge points which receive the majority of surface water runoff from the catchments and CPSAs contained therein and/or directly located within CPSAs. The highest concentration of PFAS is recorded within MW032, located downgradient of CPSA D (Sewage Treatment Plant) which receives PFAS impacted wastewater from across the operational Base. New historical maximum for PFOS and Sum PFOS + PFHxS and an increasing trend was identified for this location, consistent with the 2023-2024 monitoring period (see **Section 8.3.7.1**).

Increasing trends were also identified for MW054S and MW050. Monitoring well MW050 is located downgradient of CPSA G (Former FTA and Operations Testing Area), indicating potential migration of contamination. No new maximum concentrations were identified at this location over the 2024-2025 monitoring period. Monitoring well MW054S is located on the southern side of Warrill Creek, and no new maximum concentrations were reported at this location over the monitoring period.

A probably increasing trend was reported for MW005 located to the east of the Former FTA and Operations Testing Area (CPSA J). New maximums within an order of magnitude were reported for PFBS and PFHxS during the April / May 2025 event at this location. The significance of this probable trend should be assessed during 2026.

It is noted that MW054S (Alluvium) MW054D (Walloon Coal Measures) are located on the southern side of Warrill Creek and MW057S (Alluvium) and MW057I (Tertiary Formation) are located on the eastern side of Warrill Creek. Purga residences are located greater than 300m south of MW054S/D, with the Management Area boundary located 800 m south at its closest point. Conversely, Yamanto residences are located greater than 200 m east of M057S/I, with the Management Area boundary located 500 m southeast at its closest point. The monitoring wells have reported concentrations of PFAS above drinking water criteria at concentrations comparable to or an order of magnitude greater than those detected in adjacent surface water sample locations in Warrill Creek. Warrill Creek is understood to behave as a losing stream (see **Section 8.2**) and therefore does not serve as a hydraulic barrier to the lateral migration of PFAS contamination from the Base. As such, groundwater may continue to migrate beneath the creek and beyond. Furthermore, the extent of PFAS migration downgradient of these wells is not delineated by the current OMP and it is unclear whether Purga Creek may acting as a gaining stream.

Table 8-17: Warrill Creek Groundwater Summary (October 2024 – May 2025)

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS				
MW032 (Alluvium)	South of Catchment 7, CPSA D (downgradient)	2.0	8.8	37	1.7	45.8	57.56	PFOS, Sum PFOS + PFHxS	None	Increasing (97.7%)	
MW048 (Alluvium)	South of Catchment 4 (CPSA E)	0.15	2.1	2.8	0.12	4.9	6.07	None	PFBS, PFHxS, PFOS, PFOA, Sum PFOS + PFHxS	Decreasing (99.8%)	
MW049 (Alluvium)	South of Catchment 2 (CPSA DD)	0.39	1.6	1.1	0.1	2.7	4.56	None	PFBS, PFHxS, PFOS, PFOA, Sum PFHxS + PFHxS	Decreasing (>99.9%)	
MW022 (Alluvium)	West of Catchment 10 (CPSA CC)	1.2	4.9	1.4	0.39	6.3	11.21	None	PFBS, PFHxS, PFOS, PFOA, Sum PFOS + PFHxS	Decreasing (>99.9%)	
MW054S (Alluvium)	West of Catchment 10 (CPSA CC)	0.02	0.06	0.03	<LOR	0.12	0.13	None	None	Increasing (99.0%)	
MW054D (Walloon Coal Measures)	West of Catchment 10 (CPSA CC)	0.04	0.10	0.05	0.01	0.15	0.24	PFBS, PFHxS, PFOA, Sum PFOS + PFHxS	None	No trend (70.3%)	
MW050 (Alluvium)	South of Catchment 10 (CPSA G)	0.02	0.04	0.12	<LOR	0.16	0.2	None	None	Increasing (99.0%)	

Location	Adjacent Feature	Maximum Groundwater Concentration (µg/L)							New Historical Maximum	New Historical Minimum	Sum of PFAS Trend (confidence factor)
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS				
MW005 (Alluvium)	East of Catchment 3 (CPSA J)	0.02	0.07	0.02	<LOR	0.09	0.13	PFBS, PFHxS	None	Probably increasing (91.0%)	
MW057S (Alluvium)	East of Catchment 3 (CPSA J), eastern side of Warrill Creek	0.36	0.95	0.33	0.03	1.28	2.22	None	None	No trend (78.2%)	
MW057I (Tertiary Formation)	East of Catchment 3 (CPSA J), eastern side of Warrill Creek	<LOR	0.01	0.01	<LOR	0.02	0.14	None	None	No trend (84.7%)	

Notes:

Summary table excludes quality assurance samples.

8.5.2 Surface Water and Sediment

Surface water from Catchments 7, 6, 5, 4, 2, 10 and 3 discharge into Warrill Creek. It is noted that Catchment 3 discharges into both Bremer River and Warrill Creek. Warrill Creek typically reports lower concentrations of PFAS in surface water by comparison to Bremer River, despite proximity to numerous CPSAs, numerous discharge points and high concentration of PFAS within adjacent groundwater monitoring wells. The highest concentration of PFAS were recorded between Catchments 11, and 4-6 (SW530, SW022 and SW023).

In relation to Sum PFAS concentration trends, all sample locations in Warrill Creek were recorded as having no trend / stable trends. Decreasing / probably decreasing trends were recorded in Bremer River following the confluence of Warrill Creek (SW045 and SW040). The trends are considered to be associated with a reduction in concentrations reported from 2017 to 2019 or a small range in sum of PFAS concentrations.

Table 8-18: Summary of Warrill Creek Surface Water and Sediment (October 2024 – May 2025)

Location	Area	Maximum Surface Water Concentration (µg/L)						Surface Water Sum PFAS Trend (Confidence Factor)	Sediment (mg/kg)						
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	
SW / SD043	Upstream of base	<LOR	0.01	0.03	<LOR	<LOR	0.04	<LOR	<LOR	<LOR	0.0005	<LOR	<LOR	0.0005	0.0005
SW / SD009	Downstream of Catchment 7, adjacent to DP24	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	0.0002	0.0013	0.0001	0.0015	0.0021	
SW530*	Downstream Catchment 7, at DP24	0.14	0.94	1.5	0.1	2.44	3.77	-	-	-	-	-	-	-	
SW / SD004	South of Catchments 4-6, adjacent to DP22 and DP23	<LOR	<LOR	0.01	<LOR	0.01	<LOR	No trend (79.1%)	0.0002	0.0019	0.0041	0.0003	0.0006	0.0093	
SW022*	South of catchments 4-6, adjacent to DP22	0.08	0.66	2.3	0.04	2.96	3.68	-	-	-	-	-	-	-	
SW023*	South of catchments 4, adjacent to DP23	0.19	2.3	3.7	0.07	6	7.06	-	-	-	-	-	-	-	
SW / SD005	South of Catchment 2, adjacent to DP20 and DP21	<LOR	<LOR	0.02	<LOR	0.02	<LOR	No trend (79.1%)	0.0002	0.0016	0.012	0.0001	0.0136	0.0149	

Location	Area	Maximum Surface Water Concentration (µg/L)						Surface Water Sum PFAS Trend (Confidence Factor)	Sediment (mg/kg)					
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW / SD016	West of Catchment 10, downstream of DP 17-19	<LOR	<LOR	0.02	<LOR	0.02	<LOR	No trend (50.0%)	<LOR	0.0013	0.0053	0.0002	0.0066	0.0074
SW / SD015	West of Catchment 10, downstream of DP16	<LOR	0.01	0.04	<LOR	0.05	<LOR	No trend (75.8%)	<LOR	0.0014	0.0001	<LOR	0.0015	0.0028
SW032*	South of Catchment 10, Downstream of DP15	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	-	-	-	-	-	-	-
SW / SD034	South of Catchment 10, Downstream of DP15	0.03	0.14	0.27	<LOR	0.41	0.52	No trend (86.0%)	0.0001	0.0014	0.013	0.0002	0.0144	0.0154
SW / SD018	South of Catchment 10, Downstream of DP14	0.04	0.17	0.34	<LOR	0.51	0.63	No trend (54.8%)	<LOR	0.0014	0.0019	0.0001	0.0033	0.0047
SW / SD020	Southeast of Catchment 10	0.05	0.25	0.52	0.01	0.77	0.98	No trend (48.0%)	0.0002	0.0012	0.0067	0.0002	0.0079	0.0105
SW / SD100	East of Catchment 3, Downstream of DP12	<LOR	0.02	0.04	<LOR	0.06	<LOR	No trend (66.6%)	<LOR	0.0007	0.0028	0.0001	0.0035	0.0044

Location	Area	Maximum Surface Water Concentration (µg/L)							Surface Water Sum PFAS Trend (Confidence Factor)	Sediment (mg/kg)				
		PFBS	PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS	PFBS		PFHxS	PFOS	PFOA	Sum PFOS + PFHxS	Sum PFAS
SW / SD099	East of Catchment 3, Downstream of DP10 and DP11	<LOR	0.01	0.02	<LOR	0.03	<LOR	Stable (62.6%)	<LOR	0.0003	0.0019	<LOR	0.0022	0.0023
SW / SD026	East of Catchment 3, Downstream of DP10 and DP11 (near Bremer River and Warrill Creek confluence)	0.03	0.14	0.26	<LOR	0.4	0.51	No trend (58.4%)	<LOR	0.0006	0.0043	<LOR	0.0049	0.0057
SW / SD045	Downstream of Bremer River and Warrill Creek confluence	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	Decreasing (98.9%)	<LOR	0.003	0.0038	0.0002	0.0041	0.0045
SW / SD040	Approximately 2km downstream of SW/SD45, north of abattoir	0.02	0.07	0.14	<LOR	0.21	0.29	Probably decreasing (90.4%)	-	-	-	-	-	-

Notes:

Summary table excludes quality assurance samples.

'-' = no data

* Revised OMP surface water monitoring location.

9. Refined Conceptual Site Model

9.1 General

CH2M Hill (2018) developed the initial conceptual site model (CSM) for the Base and the CSM has subsequently been reviewed and revised as appropriate through subsequent works, including the current PMAP. The CSM has been reviewed in consideration of the current information and data available with respect to:

- PFAS source areas.
- PFAS transport pathways.
- Receptors.

9.2 PFAS Source Areas

A limited number of first-time detections have been recorded since the 2023-2024 OMR (JBS&G 2025a) and despite the new maximum and minimums / order of magnitude increases and decreases, no significant evidence of additional new PFAS source areas were identified based on the monitoring data.

The mass flux study (Senversa, 2023) identified the relatively higher estimates of PFAS mass discharge from Catchment 3 and Catchment 8 are likely attributed to the 'High' and 'Moderate' risk CPSAs within these areas, including CPSA A, CPSA N and CPSA V. Relative mass discharge estimates from Catchment 7 also suggest that CPSA D is contributing a significant amount to the Base's PFAS mass discharge, albeit to a lesser degree than Catchments 3 and 8.

The monitoring data indicates spatially inconsistent evidence of both decreasing and increasing concentration trends in surface water and groundwater within Catchments 1-11 and Bremer River. This observation may be related to above average rainfall during the 2020-2022 period (e.g. mobilisation of PFAS through raising groundwater levels) and reflects the complexity created by the scale of the Base, the ongoing investigations to further define primary PFAS source areas, the number of active earthworks projects and the spoil management activities (refer to **Section 6.2** and **6.3**).

A potential new historical source area was identified during the 2024-2025 monitoring period via completion of additional investigation works in Catchment 3 (i.e. not identified based on ongoing monitoring / notable change in PFAS concentrations). The new potential new source was an original fire station located south of the previously known former fire station and new fire station (north of CPSA Z). At the time of this draft, investigations are ongoing with respect to confirming the nature and extent of PFAS contamination in this area.

9.3 Transport Pathways

The mass flux study (Senversa, 2023) estimated that surface water comprises approximately 99% of the total PFAS mass discharging from the Base per year, with approximately 1% attributed to discharge via groundwater pathways. As such, surface water represents the primary transport pathway of concern.

9.4 Receptors

No new receptors and no change to existing receptors have been identified.

9.5 CSM Revision

No new sources, pathways or receptors were identified apart from confirmation that:

- The surface water feature between the Catchment 8 discharge point and Bremer River (i.e. the Lagoon) contains PFAS above adopted screening criteria, as identified by Catchment 8 investigation works (see **Section 6.2.2**).
- Bremer River is predominantly a gaining stream (losing stream adjacent to Catchment 3 and 11), and not a barrier to groundwater flow at all times in all areas adjacent to the Base.
- Warrill Creek is predominantly a losing stream and not a barrier to groundwater flow at all times in all areas adjacent to the Base. It is noted that it is currently unclear whether groundwater may be discharging into Purga Creek further east of Warrill Creek.

At the time of this report, investigations are ongoing with respect to Catchments 3, 7 and 8.

10. Risk Profile

Based on the data collected during the monitoring period, the risk profile to human health receptors within the Management Area remains unchanged since the publication of the HHRA (EnRisks, 2019). The risk profile has been presented in **Table 10-1**. However, there are a number of matters which require discussion in relation to the risk profile (see below).

Since the HHRA (EnRisks, 2019) was finalised, several guidelines have been updated in relation to PFAS regulation in Australia. The key guideline updates are summarised as follows:

- **Biota trigger points:** After initial publication in 2018 (i.e. prior to EnRisks 2019), the Heads of Environment Protection Authorities (HEPA) PFAS National Environmental Management Plan (PFAS NEMP) was updated in January 2020 (Version 2.0) and again in March 2025 (Version 3.0). The PFAS NEMPs in effect between 2019 and the present (i.e. Versions 1.0 to 3.0) each refer to FSANZ (2017) to identify the tolerable daily intakes (TDIs) adopted for PFAS exposure, but do not refer to the biota trigger points. EnRisks (2019) adopted biota trigger points for investigation and toxicity assumptions consistent with FSANZ (2017). At the time of this report, FSANZ (2017) remains in effect.
- **Recreational water quality criteria:** At the time the HHRA (EnRisks, 2019) was prepared, recreational water quality criteria risks were assessed based upon 2017 Department of Health advice (drinking water criteria multiplied by 10) reflected in Version 1.0 of the PFAS NEMP. In 2019 NHMRC issued revised guidance (NHMRC, 2019) which raised the recreational water by an order of magnitude and this guidance is reflected in Version 2.0 and Version 3.0 of the PFAS NEMP. At the time of this letter, NHMRC (2019) remains in effect.
- **Drinking water criteria:** The NHMRC (2025) Australian Drinking Water Guidelines have been updated several times since 2019, most notably in June 2025 (Version 4.0). The most recent revision includes revised drinking water criteria for PFAS (PFOS, PFHxS, PFBS and PFOA). The revised drinking water guidelines are based on updated toxicity reference values (TRVs) for each of the PFAS with new criteria. At the time of this letter, no changes have been made to FSANZ (2017), NHMRC (2019) or the PFAS NEMP on the basis of NHMRC (2025).

On the basis of the above and at the time of this OMR:

- The HHRA (EnRisks, 2019) was conservative with respect to recreational water quality related risks.
- The HHRA (EnRisks, 2019) was based upon biota trigger points and underlying toxicity assumptions which remain current.

The updated drinking water criteria (NHMRC, 2025) has implications with respect to drinking water scenarios. The DSI (CH2M Hill, 2018) and the HHRAs (EnRisks, 2019; EnRisks 2020) identified that use of groundwater for drinking water purposes was unlikely to be a significant exposure pathway within the Management Area. As such, application of the updated NHMRC (2025) guideline values is not considered to have a significant impact upon the overall risk profile detailed in the PMAP (2025).

The updated NHMRC (2025) guideline values do change:

- The number of groundwater monitoring wells with drinking water guideline value exceedances (i.e. increase).
- The manner in which the lateral extents of the groundwater PFAS impact extents are defined (i.e. typically defined as the leading edge of the groundwater where PFAS is below applicable drinking water guideline values).

Whilst drinking water was not identified as a likely exposure pathway in the previous HHRAs, the previous drinking water guidelines were used as a surrogate to undertake screening level assessments of unrelated exposure pathways (e.g. consumption of home-grown produce watered using bore water). The rationale for adoption of the previous guideline values for this purpose was not explained in the HHRAs.

Considering the time which has elapsed since the initial broad scale WUS water use survey and the limited scope of the 2025 WUS, it is considered that an updated WUS is appropriate to confirm that groundwater use within the Management Area has not changed (i.e. still not used for drinking water purposes).

Table 10-1: Risk Profile

ID	Risk	Description in the PMAP	Nature of risk	Relevant Risk Group	Risk Timescale
1	Incidental contact with soil and sediment	Soils within CPSA A and N contain elevated concentrations of PFAS which presents a risk to Base personnel and contractors who are involved in regular soil disturbance activities. Direct contact with soil and sediment on base is mitigated by implementation of the Defence PFAS Construction and Maintenance Framework	Human health	Risk Group 1 – CPSA A and N, located within the RAAF Base Amberley Management Area	Current
2	Human consumption of fish caught from local waterways	PFAS has historically been detected in fish and crustaceans collected from Warrill Creek and Bremer River. Current Queensland Health advice is not to consume fish caught in the Management Area due to presence of PFAS. Additional signage providing precautionary health advice for fishing was installed along Bremer River in July 2024.	Human health	Risk Group 3 – Warrill Creek Risk Group 5 – Bremer River	Current. Queensland Government has precautionary advice in place
3	Consumption of eggs by children	PFAS has been detected in soils on private properties and in water that has historically been used for irrigation. This exposure risk applies to properties where chickens have regular access to PFAS in soil or where water containing PFAS is used for irrigation.	Human health	Risk Group 4 – Properties adjacent to Warrill Creek	Current
4	Consumption of home-slaughtered beef meat	PFAS has been detected in soils on private properties and in water that has historically been used for irrigation. This exposure risk applies to properties where cattle have regular access to PFAS in soil / sediment / pasture, or where water containing PFAS is used for irrigation.	Human health	Risk Group 4 – Properties adjacent to Warrill Creek	Current
5	Consumption of home-slaughtered beef offal (liver and / or kidney)	PFAS has been detected in soils on private properties and in water that has historically been used for irrigation. This exposure risk applies to properties where cattle have regular access to PFAS in soil / sediment / pasture, or where water containing PFAS is used for irrigation.	Human health	Risk Group 4 – Properties adjacent to Warrill Creek	Current

ID	Risk	Description in the PMAP	Nature of risk	Relevant Risk Group	Risk Timescale
6	Multiple exposure pathways	Multiple exposure pathways that relate to the cumulative risks associated with the consumption of fish, eggs and beef products as identified in Risk ID 3-- 6 above and the incidental direct contact with water and swimming in the Bremer River and Warrill Creek.	Human health	Risk Group 3 – Warrill Creek Risk Group 4 – Properties adjacent to Warrill Creek Risk Group 5 – Bremer River Risk Group 6 – Properties adjacent to Bremer River	Current
7	Direct toxicity to terrestrial ecosystems	Concentrations of PFOS in soils, sediments and some grass samples on-Base exceeded investigation criteria for ecological direct exposure (HEPA, 2020). As such, adverse effects on ecological receptors cannot be excluded.	Ecological risk	Risk Group 2 – CPSA A, C, G, W, X, DD, located within	Current
8	Bioaccumulation and effects on higher order consumers within terrestrial ecosystems	Concentrations of PFOS in soils, sediments and some grass samples on- and off-Base exceeded investigation criteria for ecological direct exposure (95% species protection) (HEPA, 2020). As such, adverse effects on ecological receptors cannot be excluded.	Ecological risk	Risk Group 2 – CPSA A, C, G, W, X, DD, located within RAAF Base Amberley Management Area	Current
9	Direct toxicity to aquatic ecosystems	Concentrations of PFOS in surface water exceeded investigation criteria for ecological direct exposure (HEPA, 2020) during the monitoring period. As such, adverse effects on ecological receptors cannot be excluded.	Ecological risk	Risk Group 3 – Warrill Creek Risk Group 5 – Bremer River	Current
10	Bioaccumulation and effects on higher order consumers within aquatic ecosystems	Concentrations of PFOS in surface water exceeded investigation criteria for ecological direct exposure (HEPA, 2020) during the monitoring period. As such, adverse effects on ecological receptors cannot be excluded.	Ecological risk	Risk Group 3 – Warrill Creek Risk Group 5 – Bremer River	Current

11. Conclusions

The following conclusions are made with respect to the overall objectives of the OMR report:

- *Objective 1: The distribution (spatial and temporal) and transport of PFAS in the Management Area:*
 - The distribution of PFAS in the Management Area has not changed significantly since the previous monitoring period, with the potential exception of localised evidence of both reducing and increasing concentration trends in groundwater and surface water.
 - Bremer River has been confirmed to be predominantly gaining stream (losing stream adjacent to Catchment 3 and 11 and mostly serves as a hydraulic barrier for lateral groundwater migration. Conversely, Warrill Creek is a predominantly losing stream (apart from a relatively minor stretch near the confluence with Bremer River) and PFAS impacted groundwater may migrate beyond Warrill Creek. Evidence of drinking water criteria exceedances have been recorded south of Warrill Creek and east of Bremer River.
- *Objective 2: Whether the current understanding of risks to human and ecological receptors require review:*
 - The risk profile to human health receptors within the Management Area remains unchanged since the publication of the HHRA (EnRisks, 2019).
 - The risk profile to ecological receptors remains unchanged since the publication of the ERA (EnRisks, 2020).
- *Objective 3: PMAP delivery and associated management actions, where relevant:*
 - Additional investigations were progressed in relation to Catchments 3, 7 and 8 with view to developed remediation plans. These investigations have predominantly focused upon near surface soils and surface water with the overall goal of refining the scope of remediation.
 - The key management actions to date have comprised:
 - Significant earthworks and hardstand construction works across PFAS source areas (e.g. Battlefield Airlifter Project, Growler Project).
 - Ongoing operation of two water treatment plants to capture and treat PFAS contaminated water generated during fire training activities (CPSA A, CPSA W).
 - Ongoing construction of the new Sewage Treatment Plant to provide PFAS treatment capability.

On the basis of the above, the following recommendations are made:

- The Ongoing Monitoring Program should be reviewed in consideration of the findings of this OMR, specifically including:
 - Inclusion of surface water sampling targeting the Lagoon.
 - The findings of ongoing investigations in relation to Catchments 3, 7 and 8 (e.g. installation of additional groundwater monitoring wells which require ongoing monitoring, surface water sampling targeted towards proposed remediation areas)
 - All future surface water and groundwater samples collected as part of the OMP are tested at a lower LOR to enable comparison with NHMRC (2025).

12. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties. The report has been prepared specifically for the client for the purposes of the commission, and no warranties, express or implied, are offered to any third parties and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose. This report should not be amended in any way without prior approval by JBS&G, or reproduced other than in full including all attachments as originally provided to the client by JBS&G.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements or agreed scope of work.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

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