Appendix B SAQP

RAAF Base Amberley Ongoing Monitoring Plan (OMP), Sampling and Analysis Quality Plan (SAQP)

Department of Defence

Report

JBS&G | 66133 | 166,079

20 May 2025

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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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 RAAF Base Amberley, Per and Polyfluoroalkyl Substances (PFAS) Management Area Plan (the PMAP; Defence, 2025a). The overall objective is to remediate PFAS contamination at the Base in accordance with the PMAP, adopting a 'so far as reasonably practicable' (SFARP) approach to the remediation of PFAS. The location of the Base and Management Area is shown on **Figure 1.**

The RAAF Base Amberley, Per and Polyfluoroalkyl Substances (PFAS) Ongoing Monitoring Plan (the OMP; Defence, 2025b) outlines the rationale and scope for the monitoring PFAS in surface water and groundwater within the Management Area. The OMP has been implemented at RAAF Base Amberley since 2020 and data collected as part of implementing the OMP is used to assess changes to the nature and extent of PFAS and assess for changes in risks to human and ecological receptors within the Management Area, including updates and revisions to the PMAP. This assessment is completed at the end of the monitoring period within an interpretive Ongoing Monitoring Report (OMR). It is noted OMP was revised in 2025, with the following key changes implemented:

- Groundwater sampling was reduced in frequency from bi-annually to annually; and
- Sediment sampling was discontinued.

This Sampling and Analysis Quality Plan (SAQP) has been prepared to support the implementation of the OMP. The SAQP has been developed with reference to guidelines and background documents detailed in **Section 9**, inclusive of key guidance noted in **Section 1.4**.

1.2 Objectives

The objectives of the OMP includes the collection of adequate data to identify and evaluate:

- Spatial, and temporal (including seasonal) variability of PFAS in the environment.
- Changes to sources, transport pathways and/or receptors, described as a conceptual site model (CSM) for the Base.
- Whether risks to human and ecological receptors require review.
- The influence that risk management activities at the Base, as outlined in the PMAP have had on PFAS in the environment.
- Whether the identified changes trigger an action and/or review.

The objective of this SAQP is to document the working CSM, data quality objectives (DQO) and investigation design required to ensure data collected is representative and provides a robust basis for decision making.

1.3 Scope

The scope of works associated with developed of this SAQP comprise the following:

- Summary of the Base and Management Area setting (**Section 2**).
- Summary of the CSM (**Section 3**).
- Summary of the DQOs (**Section 4**).
- Development of the sampling schedule and methodology (**Section 5**).

- Summary of applicable assessment criteria (**Section 6**).
- Outline of reporting requirements (**Section 7**).
- Summary of stakeholder engagement activities (**Section 8**).

1.4 Key Guidance

In developing this SAQP, reference has been made to the Defence Contamination Management Manual (the DCMM, Defence 2019), Schedule B2 of the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in 2013) (the ASC NEPM; NEPC, 2011) and Heads of EPAs Australia and New Zealand (HEPA), PFAS National Environmental Management Plan – Version 2; January 2020 (the PFAS NEMP; HEPA 2020). It is noted that at the time of this report:

- Version 3.0 of the PFAS NEMP has been issued (HEPA, 2025).
- JBS&G has requested clarification from DETSI as to whether Version 3.0 will be formally endorsed.

On the basis of the above, JBS&G has referred to Version 2.0 in this report. JBS&G notes that Version 3.0 is not considered to have significant changes which may impact upon the overall outcomes of the OMP.

2. Base and Management Area Setting

2.1 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**). 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 as presented in the 2025 Ongoing Monitoring Report (the OMR, JBS&G 2025) 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 South western point: 273905.38 S, 1524125.91 E North western point: 273737.99 S, 1524007.07 E North eastern point: 273659.71 S, 1524250.53 E South eastern 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

2.2 Management Area

The PFAS Management Area comprises the Base and portions of the surrounding area, as shown on **Figure 1**. The area is the primary area throughout which risk management actions and ongoing monitoring has been completed to date.

The PFAS Management Area, as detailed in the OMP, encompasses:

- **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 maintenance activities. Some land is also used for residential and recreational / open space uses;
- **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 Park. 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, noting that Queensland Health has advised the public to not consume fish caught in the Bremer River adjacent to RAAF Base Amberley and downstream to Cribb Park (i.e. catch and release only); and
- **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. Warrill Creek is also used for recreational purposes including swimming and fishing, noting that Queensland Health has advised the public to not consume fish caught in Warrill Creek adjacent to RAAF Base Amberley (i.e. catch and release only).

2.3 Land Use

2.3.1 Overview

The following sections provide a summary of land use at the Base and surrounding area, as presented by the OMR.

2.3.2 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 and 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 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.

Defence is no longer using AFFF and is in the process of phasing out PFAS containing firefighting foams at the Base. At the time of this report, 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.

It is noted that in March 2025, JBS&G identified potential evidence of an additional PFAS source (i.e. the original Base fire station, within Catchment 3) which has not been investigated as part of previous investigations. Based on anecdotal information obtained[1], an original Base fire station was located in the footprint of former Building 246, located in the southwest portion of Catchment 3 (to the north of CPSA Z). The original fire station is understood to have been operational from the early to late 1970's, with further information provided in correspondence from the Base Warrant Officer for Aircraft Rescue and Firefighting (WOFF ARFF). This indicated that the first fleet of firefighting vehicles were equipped with 3M Lightwater© AFFF concentrate from 1974-75. However, it was unknown precisely where the AFFF concentrate was stored or where vehicle replenishment was conducted.

2.3.3 Surrounding Land Use

The surrounding land immediately adjacent to the Base is used for grazing, cropping, mining and small acreages/hobby farms. Surrounding land uses located further to the north, south and west of the Base is predominantly characterised by rural residential areas and several urban suburbs. East of the Base, land use changes from rural to low density residential land uses, industrial estates and landfill approaching the City of Ipswich. Residential development and parkland areas are present adjacent to the Bremer River, downstream of the Base.

It is understood that Berry's Lagoon (also known as Berry's Weir or the Bremer River fishway), located downstream of the Base and situated immediately north of the abattoir in Yamanto, is a popular local recreational area. Berry's Lagoon is approximately 2.2 km downstream of the confluence of Bremer River and Warrill Creek. Kayaking, canoeing, fishing and swimming are popular recreational activities in the waterways east of the Base.

2.4 Environmental Setting

Key Base environmental setting details as presented in the OMR, are summarised in **Table 2-2** below.

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.

[1] Pers comm Andrew Saunders, Estate Maintenance and Operations (EMOS) Project Support Manager, RAAF Base Amberley

Setting	Description
Topography	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 (metres 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. 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.
Geology	The following geological units are present at the Base: • 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. The regional area has been subject to mining activity including the Jeebropilly coal mine located to the south-west of the base. The Ipswich Planning Scheme (Ipswich City Council, 2017) 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 mine void and associated buffer zone. The Detailed Site Investigation (the DSI; CH2M Hill, 2018) reported the underground mine working were expected to be flooded where located beneath the water table.
Acid Sulfate Soil	A review of the Atlas of Australian Acid Sulphate Soils (Fitzpatrick, Powell & Marvanek, 2011), indicates that the riparian zones of the Bremer River and Warrill Creek adjacent to the base are a mapped as having a 'extremely low probability of occurrence (1-5%)'.
Hydrogeology	**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 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. **Depths to groundwater -** Groundwater at the Base has been encountered at depths between 5.5 to 35 metres below top of casing. 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. **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.

Setting	Description
	Groundwater flow in off-Base areas adjacent to the Base is anticipated to follow the alignments of Bremer River and Warrill Creek.
Hydrology	The Base and Management Area are located within the Bremer River sub-catchment. The Bremer River sub-catchment covers approximately 2,036 square kilometres (km^2) 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. 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. 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 km^2. Flow into Warrill Creek is partly controlled by the Moogerah Dam on Reynolds Creek, a tributary of Warrill Creek. 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. Based on groundwater and surface water elevations within and adjacent to the Bremer River and Warrill Creek, the DSI 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 (the 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. 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. It was identified that water from the Bremer River is also used for industrial water supplies.
Hydrogeology to Hydrology Relationship	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). Historical reports have referred to: • Bremer River as being both a losing and gaining stream. • Warrill Creek is a losing stream.
Base Management Drainage	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

Setting	Description
	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 1.**

3. Conceptual Site Model

3.1 Overview

Significant environmental investigation have been completed the Base and the Management Area which has developed the current CSM. The following key investigations and reports have assisted in developing the CSM, and which are relied upon for this OMP SAQP:

- CH2M Hill. (2018). RAAF Base Amberley PFAS Investigation—Detailed Site Investigation, Revision 6.
- EnRiskS. (2019). Human Health Risk Assessment for the RAAF Base Amberley PFAS Investigation.
- EnRiskS. (2020). Screening Level Ecological Risk Assessment for the RAAF Base Amberley Investigation, Revision F (CH2M/18/AMBR002).
- Senversa. (2023). SP3 – PFAS Mass Flux Interpretive Report, RAAF Base Amberley, Revision D.
- JBS&G (2024). RAAF Base Amberley – PMAP Delivery Lead Consultant (PFAS 2023/24 – 38237) – Site Review Assessment and Data Gap Assessment, Revision 1 (66133|159116), July 2024.
- JBS&G. (2025). Ongoing Monitoring Report, October 2023 – July 2024, Department of Defence, Per and Polyfluoroalkyl Substances (PFAS) Ongoing Monitoring Program (OMP) – Royal Australia Air Force (RAAF) Base Amberley, Revision F (66133|161501), March 2025.

Based on the information provided in these documents, a summary of the current CSM for the Base and Management Area has been presented in the sections below.

3.2 Source Areas

A total of 32 Confirmed Primary Source Areas (CPSAs) has been identified across the Base via previous investigations (see **Table 3-1**). Additional monitoring and investigations have subsequently been undertaken at the Base to improve understanding of these source areas and to inform the risk management requirements. These investigations identified three catchment areas (Catchment 3, 7 and 8) which include a number of PFAS source areas that represent approximately 87% of the PFAS mass which migrates from the Base.

A map showing these source and catchment areas is provided as **Figure 2.**

Table 3-1: Confirmed Primary Source Areas (CPSA)

Source Areas	CPSA	Details
Primary Source Areas	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 E	Historic Containment Pond
	CPSA F	Potential former FTA and Landfill
	CPSA G	Former FTA and Operations Testing Area
	CPSA H	Potential Former FTA and Landfill
	CPSA I	Potential Former FTA and Landfill
	CPSA J	Former FTA and Operations Testing Area
	CPSA L	Potential Former Fire Training and Operations Testing Area
	CPSA M	Former Fuel Farm 1 and Triple Interceptor Pit
	CPSA N	Fire Station, FTA training

Source Areas	CPSA	Details
	CPSA O	Potential location of F1-11 2006 incident
	CPSA P	Potential location of 1978 Skyhawk incident
	CPSA Q	1 Squadron Hangar and 6 Squadron Hangar
	CPSA R	K Store- potential AFFF storage
	CPSA S	AFFF Store / Truck Washdown at Fuel Farm 2/2A
	CPSA T	Potential Location of Aircraft F-4E Incident
	CPSA U	38 Squadron Hangar
	CPSA V	AFFF Wastewater Holding Tank1
	CPSA W	Fire Fighting Training School
	CPSA X	Former Structural and Open Pit FTA
	CPSA Y	Former Secondary FTA
	CPSA Z	Fuel UST with AFFF listing
	CPSA CC	Former Landfill
	CPSA BB	Areas used for irrigation – former grassed runways
	CPSA DD	HS748 Former FTA on Disused Runway
	CPSA FF	Buried PFAS impacted stockpile from CPSA A
Secondary Source Areas	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.

It is noted that in March 2025, JBS&G identified potential evidence of an additional PFAS source (i.e. the original Base fire station, within Catchment 3) which has not been investigated as part of previous investigations.

3.3 Migration Pathways

PFAS can travel from a source to human or environmental receptors via transport pathways, such as surface water, groundwater and stormwater. The transport pathways identified at, and surrounding RAAF Base Amberley were summarised in the DSI and are briefly described below.

The DSI identified that PFAS derived from the Base was migrating into the surface waters of Warrill Creek and the Bremer River. The extent of PFAS within the Bremer River which is associated with the Base is defined by the downstream extents of the PFAS Management Area. On the basis of the MFA surface water migration is considered to be the most important transport pathway for the movement of PFAS downstream of the Base (i.e. 99% of PFAS mass migrates from Base via surface water).

Leachate analysis conducted on sediment and soil samples recovered throughout the DSI and during subsequent investigations (e.g. the MFA) has demonstrated that the key analytes of interest, namely PFOS and PFHxS, were readily leached from the soil samples. The results confirm that, without management, impacted soil and sediment at the Base will present an ongoing source of contamination to on-Base stormwater drainage system, groundwater beneath the Base and off-Base surface water of the Bremer River and Warrill Creek.

Stormwater collected from across the Base is discharged off-Base through the stormwater drainage network. The Base drainage network is comprised of a mixture of unlined drains, lined open drains, and underground pipes within eleven main surface water catchments. A total of approximately 24 discharge points are located west, north and east of the Base along the Bremer River and south along Warrill Creek. As noted previously, the MFA identified that 99% of PFAS mass migrates from the Base via surface water with off-Base migration of PFAS for all surface water catchments. As previously noted, Catchments 3, 7 and 8 have been identified to be responsible for 87% of the PFAS discharge from the Base.

PFAS in soil, sediment and stormwater has the potential to migrate vertically into underlying groundwater. PFAS is present in groundwater throughout the Base, with the highest concentrations in groundwater correlating with CPSAs and unlined stormwater drainage lines. Discharge from groundwater to surface water is dependent on gaining or losing stream conditions, with previous studies indicating the Bremer River and Warrill Creek are both gaining and losing streams under different rainfall conditions. The MFA identified less than 1% of PFAS migrates from Base via groundwater.

3.4 Receptors and Risks

Potential current and future receptors on-site include Defence personnel, contractors, site operations workers, general attendees, and site visitors. Off-site, potential receptors include residents of neighbouring properties, consumers of home-grown produce, terrestrial and aquatic ecosystems, recreational users of surface water (such as recreational fishers), as well as land users and environments located down gradient of groundwater.

Table 3-2 below details each risk scenario and provides a current summary of the status of each risk, noting no change to the risk profile has occurred between 2020 and 2024. It is noted that at the time of this report, planning for 2025 aquatic biota investigations is underway and these works may result in revision of the risk listing and consequences noted below.

Table 3-2: Risk Listing and Consequences

Risk ID	Risk	Description	Nature of Risk	Relevant Risk Group	Risk Timescale
1	Incidental direct contact with PFAS in 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 safe work practices and 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 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 Investigation Area due to presence of PFAS.	Human health	Risk Group 3 – Warrill Creek Risk Group 5 – Bremer River	Current (although 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

Risk ID	Risk	Description	Nature of Risk	Relevant Risk Group	Risk Timescale
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
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 RAAF Base Amberley Management Area	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). 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	Concentrations of PFOS in surface water exceeded investigation criteria for ecological direct exposure (HEPA, 2020). As such, adverse effects on	Ecological risk	Risk Group 3 – Warrill Creek Risk Group 5 – Bremer River	Current

Risk ID	Risk	Description	Nature of Risk	Relevant Risk Group	Risk Timescale
	within aquatic ecosystems	ecological receptors cannot be excluded.			

4. Data Quality Objectives

4.1 Data Quality Objectives

The DQO process is an iterative planning approach used to define the type, quantity and quality of data that is needed to inform decisions relating to the environmental condition of a site. The seven-step DQO process:

- Clarifies the study objective.
- Defines the most appropriate collection of data as relevant to the study objective.
- Determines the conditions from which to collect data.
- Specifies tolerable limits on decision errors, which will be used as the basis for establishing the quantity and quality of data, needed to support the decision.

The DQOs for monitoring are presented in **Table 4-1**. They have been prepared in line with the DQO process outlined in the ASC NEPM (Schedule B2).

Table 4-1: Data Quality Objectives

Process	Description
Step 1: State the problem	Elevated concentrations of PFAS have been identified within environmental media, presenting potentially elevated risks to human health and the environment. Management response actions are being investigated and implemented to reduce PFAS mass migrating from the Base SFARP. On the basis of the above, ongoing monitoring is required to: • Assess the effectiveness of the response actions, and to enable informed risk management decisions to protect human health and the environment. • Refine the CSM to allow for an update of the human health and ecological risk assessment (if required).
Step 2: Identify the decision/goal of the study	The overall goal of the study is to continue a systematic routine monitoring program assessing PFAS in groundwater and surface water in order to assess: • Spatial, and temporal (including seasonal) variability of PFAS in the environment. • Changes to sources, transport pathways and/or receptors, described as a CSM for the Base. • Whether risks to human and ecological receptors require review. • The influence that risk management activities at the Base, as outlined in the PMAP have had on PFAS in the environment. • Whether the identified changes trigger an action and/or review.
Step 3: Identify the information inputs	To allow assessment of the data against the study goal listed in Step 2 above, the following inputs will be considered: • PFAS results from previous environmental investigations. • Meteorological data. • Data collected during implementation of the OMP. • Groundwater elevation data. • Surface water conditions at time of sampling of surface water.

Process	Description
	• Site status and land use scenarios and whether conditions and uses have changed. • Historical concentration trends. • Advances in laboratory analytical approaches and changes in regulatory requirements. Key inputs to the decisions also include field observations and measurements, sample collection, preservation, storage, transportation and documentation for each media of concern, analytical methods, and field and laboratory Quality Assurance/ Quality Control (QA/QC) data.
Step 4: Define the boundaries of the study	The spatial and temporal boundaries that apply for data collection are detailed below and will influence the decision-making process for ongoing monitoring: • The spatial boundary for data collection and decision-making is limited to the Management Area shown on **Figure 1**. • The sampling completed as part of the OMP will be limited to groundwater and surface water at the frequencies defined in **Section 5**. • The monitoring will occur for a further three-year period after which a review will be completed to assess ongoing monitoring requirements. Notwithstanding, the PMAP and OMP will be reviewed annually and revised as necessary in conjunction with the OMR.
Step 5: Develop the analytical approach/decision rules	Sample locations have been selected with the objective of monitoring PFAS trends (temporal and seasonal), providing early warning of changes in the migration of PFAS in surface water and groundwater. The decision rules can be defined as: • If the laboratory QA/QC data are within the acceptable ranges, the data will be considered suitable for use (**Section 5.7**). • If PFAS concentrations are reported above the laboratory LOR, where it was previously <LOR, then further assessment of the data may be required. Specific triggers and response actions are detailed in **Section 6.3**. • If the PFAS is reported at a concentration that is above drinking water guideline in groundwater, then further assessment may be required and / or notification (**Section 6.3**). Note, specific triggers for action and review of monitoring data and monitoring locations are detailed in **Section 6.3**, including triggers for resampling where PFAS is detected for the first time, or is detected above relevant guidance values. The decision on the acceptance of the analytical data should be made on the basis of the Data Quality Indicators (DQIs) as follows: • **Precision**: A quantitative measure of the variability (or reproducibility) of data. • **Accuracy:** A quantitative measure of the closeness of reported data to the true value. • **Representativeness:** The confidence (expressed qualitatively) that data are representative of each medium present on the site. • **Completeness**: A measure of the amount of useable data from a data collection activity. • **Comparability**: The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event. Detailed DQIs have been presented in **Section 4.2.**
Step 6: Specify performance or acceptance criteria	Specific limits for the OMP have been adopted in accordance with the appropriate guidance made or endorsed by state and national regulations, appropriate indicators of data quality, and standard procedures for field sampling and handling. This step also includes the following acceptable limits on decision making errors: • A decision can be made based on a 95% confidence limit in any given data set. A limit on the decision error will be 5% that a conclusive statement may be a false positive or false negative. • A decision error in the context of the decision rule presented above would lead to either underestimation or overestimation of the risk level associated with a particular sampling area. • Sampling errors may occur when the sampling program does not adequately detect the variability of a contaminant from point to point across the site. To address this, alternate locations may be sampled, or additional sampling events may be conducted.

Process	Description
	• There may be limitations in the data if aspects of the OMP cannot be implemented, such as: o Surface water locations may be dry at the time of sampling. o Groundwater monitoring wells are damaged or destroyed and therefore cannot be sampled. o Access to some sampling locations could be restricted due to operational activities or inaccessible due to weather. • Measurement errors can occur during sample collection, handling, preparation, analysis and data reduction. To address this the following measures are proposed: o Collection of sufficient sample mass to facilitate analysis reported to standard laboratory detections limits. Collection of insufficient sample mass may result in raised detection limits. o Field staff to follow a standard procedure when collecting samples, including decontamination of tools, and use of appropriate sample containers and preservation methods. o Laboratories to follow a standard procedure when preparing samples for analysis and undertaking analysis. o Laboratories to report QA/QC data for comparison with the DQIs established in this SAQP.
Step 7: Develop the plan for obtaining data	The scope and methodology for the assessment to gather data is defined within this SAQP.

4.2 Data Quality Indicators

The pre-determined DQIs established for the project are discussed below in relation to precision, accuracy, representativeness, comparability and completeness parameters, as summarised in **Table 4-2**.

Table 4-2: Summary of Quality Assurance / Quality Control Program

Data Quality Objectives	Frequency	Data Quality Indicator
	Precision	
Blind duplicates (intra laboratory)	1 / 10 samples	<30 RPD[a]
Blind duplicates (inter laboratory)	1 / 10 samples	<30 RPD[a]
Laboratory duplicates[b]	1 / 10 samples	<30 RPD[a]
	Accuracy	
Laboratory control samples	1 per lab batch	70-130% or as nominated in the laboratory's QC report
	Representativeness	
Sampling appropriate for media and analytes	-	-[c]
Samples extracted and analysed within holding times.	All samples	Samples analysed within 28 days (Eurofins and Envirolab) holding time for PFAS
Trip blank	1 per lab batch	<LOR
Rinsate blank	1 per day, where reusable equipment is used	<LOR
Field Blank	1 per day	<LOR
Laboratory blanks	1 per lab batch	<LOR
	Comparability	

Data Quality Objectives	Frequency	Data Quality Indicator
Standard operating procedures for sample collection and handling	All Samples	Samples collected in accordance with relevant procedure[c]
Standard analytical methods used for all analyses	All Samples	All samples analysed by a laboratory that is National Association of Testing Authorities (NATA) accredited for the analyses performed
Consistent field conditions, sampling staff and laboratory analysis	All Samples	-[c]
Limits of reporting appropriate and consistent	All Samples	Laboratory LOR is below adopted screening criteria, where practical and allows relevant comparability between results where more than one laboratory is used
Completeness		
Sample description and Chain of Custody (COC) completed and appropriate	All Samples	-[c]
Appropriate documentation	All Samples	-[c]
Satisfactory frequency and result for QC samples	All QA/QC samples	5% frequency is met, RPDs within acceptable range identified above
Data from critical samples is considered valid	-	Critical samples valid
Sensitivity		
Analytical methods and limits of recovery appropriate for media and adopted site screening criteria	All Samples	Laboratory LOR is below adopted screening criteria, where practical

Notes:

a. If the relative percent difference (RPD) between duplicates is greater than the pre-determined data quality indicator, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.

b. Duplicate sample analysis performed by the laboratory as part of their internal QA/QC program for the data.

c. A qualitative assessment of compliance with standard procedures and appropriate sample collection methods will be completed during the DQI compliance assessment.

5. Sampling Schedule and Methodology

5.1 OMP

The OMP provides an overview of the monitoring program (monitoring schedule and sample locations) to be implemented and provides the basis for the preparation of this sampling schedule. The scope of works presented in this SAQP is consistent with the OMP.

5.2 Monitoring Schedule

The OMP monitoring schedule is presented in the table below. The following sections detail the groundwater and surface water monitoring programs.

Table 5-1: OMP Monitoring Schedule

Sampling Round	Timing	Program
1	April 2025	Groundwater and surface water monitoring programs
2	October 2025	Surface water monitoring program
3	April 2026	Groundwater and surface water monitoring programs
4	October 2026	Surface water monitoring program
5	April 2027	Groundwater and surface water monitoring programs
6	October 2027	Surface water monitoring program

5.3 Prior to Sampling

Prior to the commencement of sampling activities, the field team will review the field sampling guides (**Appendix B** and **Appendix C**) and complete the checklist to ensure no prohibited items are brought to the investigation areas that may potentially contaminate or affect the integrity of the samples. Appropriate health and safety and environmental control documentation will be completed prior to the commencement of fieldworks. This documentation includes A Health, Safety and Environmental Management (HSEMP) including Safe Work Method Statement (SWMS) developed to encompass hazard management and risk mitigation. This site-specific safety plan will be reviewed, revised and understood by all field staff prior to the commencement of field works.

5.4 Groundwater Monitoring Program

5.4.1 Monitoring Locations

Groundwater monitoring will be undertaken on selected monitoring wells based on the following rationale:

- Monitor spatial and temporal variations in PFAS concentrations in groundwater concentrations up, down and cross gradient of source areas.
- Assess if PFAS concentrations in groundwater within and downgradient of the source areas change in response to management measures over time.
- Continue to monitor groundwater wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations.

A summary of the monitoring locations and the proximity to the PFAS sources has been presented in **Table 5-2** below. The well construction details are provided in **Appendix A** and locations shown on **Figure 3**.

Table 5-2: Groundwater monitoring locations

Approximate Target Source Area	Monitoring well ID	Screened Aquifer	Rationale
CPSA A Former Topside Aviation FTA and current FTA Fire Pad	MW002	Walloon Coal Measures	Downgradient of Temporary Storage Facility (TSF)
	MW033	Walloon Coal Measures	Downgradient of Temporary Storage Facility (TSF)
	MW535	Alluvium	Downgradient of Catchment 9
	MW536	Alluvium	Downgradient of Catchment 9
	MW539	Alluvium	Downgradient of Fire Training Area
CPSA B Hangar 410 and Former Landfill	MW047	Tertiary Formation	Downgradient of CPSA B
CPSA C Frogs Hollow Former Fire Training School Location	MW037	Alluvium	Within CPSA C
CPSA D Sewage Treatment Plant	MW021	Alluvium	Within CPSA D
	MW032	Alluvium	Downgradient of CPSA D
CPSA E Historical Containment Pond	MW048	Alluvium	Within CPSA E
CPSA G Former FTA and Operational Testing Area	MW050	Alluvium	Downgradient of CPSA G
CPSA J Former FTA and Operational Testing Area	MW005	Alluvium	Downgradient of CPSA J
CPSA M Former Fuel Farm 1 and Triple Interceptor Pit CPSA N Fire Station	MW006	Alluvium	Adjacent to CPSA L
	MW023	Alluvium	Downgradient of CPSA L at main discharge point for Catchment 3
	MW028	Alluvium	Downgradient of CPSA L
	MW029	Alluvium	Downgradient of CPSA L
	MW036	Alluvium	Downgradient of CPSA L
	MW309	Tertiary Formation	Upgradient of CPSA N
CPSA P Potential location of 1978 Skyhawk incident	MW538	Alluvium	Downgradient of CPSA P
CPSA V AFFF Wastewater Holding Tank	MW046	Tertiary Formation	Within CPSA V
CPSA W Fire Fighting Training School	MW026	Tertiary Formation	Upgradient of CPSA W (local area background well)
	MW030	Walloon Coal Measures	Downgradient of CPSA W (adjacent to drainage line)
	MW031	Tertiary Formation	Downgradient of CPSA W (adjacent to drainage line)
	MW042	Walloon Coal Measures	Downgradient boundary of CPSA W
	MW043	Walloon Coal Measures	Downgradient boundary of CPSA W

Approximate Target Source Area	Monitoring well ID	Screened Aquifer	Rationale
CPSA X Former Structural and Open Pit FTA	MW041	Walloon Coal Measures	Within CPSA X
CPSA Y Former Secondary FTA	MW537	Tertiary Formation	Adjacent to CPSA Y
CPSA Z Fuel underground storage tank (UST) with AFFF listing	MW020	Tertiary Formation	Within CPSA Z
CPSA AA Triple Interceptor Pits at Engine Test Cell Facilities 1 and 2	MW007	Alluvium	Downgradient of CPSA AA
CPSA BB Areas used for irrigation- former grassed runways	MW012	Tertiary Formation	Downgradient of CPSA Z and original Base fire station (not currently identified as a CPSAs)
CPSACC Former Landfill	MW022	Alluvium	Downgradient of CPSA CC
CPSA DD HS748 Former FTA on Disused Runway	MW049	Alluvium	Downgradient of CPSA DD
Off-Base Warrill Creek These locations are down-gradient of multiple source areas.	MW054S	Alluvium	Downgradient of CPSA G (across Warrill Creek)
	MW054D	Walloon Coal Measures	Downgradient of CPSA G (across Warrill Creek)
	MW057S	Alluvium	Downgradient of CPSA H and CPSA J (across Warrill Creek)
	MW057I	Tertiary Formation	Downgradient of CPSA H and CPSA J (across Warrill Creek)
On-Base Bremer River These locations are down-gradient of multiple source areas.	MW024	Alluvium	Downgradient of CPSA AA and CPSA P
	MW025	Alluvium	Base boundary well downgradient of CPSA A
	MW034	Alluvium	Base boundary well downgradient of CPSA A
	MW035	Alluvium	Base boundary well downgradient of CPSA AA
	MW044	Alluvium	Base boundary well downgradient of CPSA AA and CPSA P
	MW055S	Alluvium	Base boundary well downgradient of CPSA AA and CPSA P
	MW055D	Walloon Coal Measures	Base boundary well downgradient of CPSA AA and CPSA P
Off-Base Bremer River These locations are down-gradient of multiple source areas	MW056S	Alluvium	Downgradient of Bremer River and Warrill Creek confluence
	MW056I	Tertiary Formation	Downgradient of Bremer River and Warrill Creek confluence

5.4.2 Sampling Methodology

Groundwater wells have historically been sampled as part of the OMP program via HydraSleeve™, with select wells occasionally monitored via bailer due to sampling access constraints. The following hierarchy of groundwater sampling methodology will be adopted:

1. Passive sampling using a High-density polyethylene (HDPE) HydraSleeve™.
2. Sample collection by bailer.

HydraSleeve™ sampling methodology is considered an appropriate method for the collection of samples as part of this OMP and is the technique that has been used during previous OMPs sampling rounds. As such, maintaining the existing groundwater sampling methodology will enable direct comparison of results between current and historic sampling rounds and is therefore first preference for representativeness and consistency purposes. Sampling with a bailer is considered an appropriate back up methodology where Hydrasleeve™ sampling is not able to be completed.

The groundwater sampling methodology is presented in **Table 5-3** below.

Table 5-3: Groundwater Sampling Methodology

Aspect	Detail
Groundwater Gauging	Standing water levels (SWLs) will be measured in each monitoring well using an interface probe (IP) prior to the installation of HydraSleeve™. Gauging will be conducted in as short a time as possible; however, due to the number of wells and different requirements for accessing the monitoring well locations, the gauging may occur over multiple days.
HydraSleeve™ Deployment	A high-density polyethylene (HDPE) HydraSleeve™ will be installed within the screened interval of each well (based on a review of the well construction log) for a minimum of 24 hours prior to the sampling round (see **Appendix A**). The depth and date of HydraSleeve™ deployment will be recorded.
HydraSleeve™ Sample Retrieval	Groundwater samples will be collected from the monitoring wells via a continuous pull method, enabling water to pass through the HydraSleeve™ check valve. Samples will be collected immediately via the dedicated discharge tube (to minimise changes to chemistry).
Bailer Sample Retrieval	Should sample retrieval via HydraSleeve™ not be a viable sample option (e.g. insufficient sample volume), a bailer will be used to collect the sample. A new disposal bailer will be lowered into the well and into the available water column, with care taken not to strike the well base nor to stir up sediment. Additional deployments of the bailer will be made to collect sufficient sample.
Field Parameters	Groundwater field parameters will be obtained ex-situ, using water remaining in the HydraSleeve™ or bailer following sampling. Field parameters (i.e. pH, EC, oxidation reduction potential (ORP), DO, and temperature) will be recorded using a pre-calibrated water quality meter. The water quality meter will undergo daily bump tests and be re-calibrated as required. Field observations such as colour, turbidity, presence of suspended solids and odours, sheen, oily film, nuisance organisms, floating debris or froth and flow speed will be documented on field sampling sheets. The condition of the well, including any visible damage will also be recorded where applicable.
Shaker Test	A ‘shaker test’ will be undertaken on a small volume of the sample (approximately 10-25 mL). If foaming is noted within the sample, this will be documented on the sampling sheet.

Aspect	Detail
Decontamination	Before and between sampling at each location, all non-disposable equipment (e.g. interface probe, HydraSleeve™ weights) will be decontaminated to reduce the risks of cross-contamination using the following procedure: • Any debris will be removed from re-usable sampling equipment by scrubbing with a plastic brush followed by thorough rinsing with tap water then triple rinsing with laboratory supplied deionised water; • If required, suitable soaps (Alconox® and Liquinox®) may be used following the water only decontamination approach. Detergents or Decon 90® will not be used for decontamination; and • Rinsate blank samples collected from re-usable equipment following decontamination will be collected and analysed to assess the effectiveness of the decontamination procedures.
Sample Identification, Preservation and Transportation	Each sample will be labelled with project identification number, date, samplers initial and sample location, as discussed further in **Section 5.9.** Water samples will be placed directly into appropriately labelled, laboratory-supplied sample bottles and packed in chilled containers for delivery to the laboratory under chain of custody (COC) documentation.

5.5 Surface Water Monitoring Program

5.5.1 Monitoring Locations

Surface water monitoring will be undertaken at select locations based on the following rationale:

- Monitor spatial and temporal variations of PFAS concentrations at i) PFAS sources, ii) intermediate locations between sources and discharge points, and iii) the discharge point for each surface water catchment in consideration of the Base stormwater network (e.g. underground pipework and unlined drains).
- Monitor spatial and temporal variations of PFAS concentrations in the receiving environment (e.g. Bremer River and Warrill Creek).
- Assess if PFAS concentrations in surface water within and downgradient of the source areas change in response to management measures over time.
- Continue to monitor surface water at locations with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations.

A summary of the monitoring locations and the proximity to the PFAS sources has been presented in **Table 5-4** below. The sample location are shown on **Figure 4**.

Table 5-4: Surface water sample locations

Catchment	Monitoring Location	Source Area	Rationale
NA	SW025	-	Bremer River background, west of Catchment 1 and upstream of DP1
NA	SW043	-	Warrill Creek background, south of Catchment 7 and upstream of DP24
Catchment 1	SW033	CPSA W	On-Base, source area
	SW021	CPSA W	On-Base, downstream of source area

Catchment	Monitoring Location	Source Area	Rationale
	SW049	CPSA W, CPSA A	On-Base, dam downstream of source areas
	SW656	CPSA W, CPSA A	DP1, downstream of southern portion of Catchment 1 which receives runoff from CPSA W
Catchment 1 (Receiving Environment)	SW039	CPSA A	Bremer River, downstream background reference site (SW025)
	SW091	-	Bremer River, downstream of DP1
	SW090	-	Bremer River, downstream of DP2
	SW089	-	Bremer River, downstream of DP3
	SW052	-	Bremer River, adjacent to DP4
	SW088	-	Bremer River, downstream of DP4
Catchment 2	-	-	-
Catchment 2 (Receiving Environment)	SW005	CPSA DD	Warill Creek, adjacent to DP20
	SW657	CPSA DD	Warrill Creek, adjacent to DP18
Catchment 3	SW080	CPSA M, CPSA N, CPSA Z, CPSA BB, CPSA O	On-Base, downstream source areas
	SW079	CPSA M, CPSA N, CPSA Z, CPSA BB, CPSA O	On-Base, downstream source areas (downstream SW080)
	SW041	CPSA M, CPSA N, CPSA Z, CPSA BB, CPSA O	On-Base, downstream source areas (downstream SW079)
Catchment 3 (Receiving Environment)	**SW658**	CPSA M, CPSA N, CPSA Z, CPSA BB, CPSA O	On-Base, downstream source areas prior to discharge into Bremer River (downstream SW041)
	SW098	-	Bremer River, downstream DP7 (downstream SW096)
	SW659	CPSA J	Warrill Creek, at DP13
	SW100	CPSA J	Warrill Creek, downstream DP12
	SW660	CPSA J	Warrill Creek, at DP10
	SW099	-	Warrill Creek, downstream DP10
	SW026	-	Confluence of Bremer River and Warrill Creek, downstream of SW099 and SW098
Catchment 4	-	-	-
Catchment 4 (Receiving Environment)	**SW023**	-	Warrill Creek, at DP21
Catchment 5	-	-	-
Catchment 5 (Receiving Environment)	**SW022**	CPSA B	Warrill Creek, at DP22
Catchment 6	SW048	CPSA B	On-Base, adjacent source area
Catchment 6 (Receiving Environment)	SW004	-	Warrill Creek, Adjacent to discharge points DP22 (Catchment 6) and DP23 (Catchment 5)

Catchment	Monitoring Location	Source Area	Rationale
Catchment 7	SW028	CPSA C	On-Base, source area.
	SW008	CPSA D	On-Base, source area (STP discharge)
	SW530	CPSA C / CPSA D	On-Base, downstream source area (adjacent to DP24
Catchment 7 (Receiving Environment)	SW009	CPSA C / CPSA D	Warrill Creek, upstream of DP24.
Catchment 8	SW037	-	On-Base, upstream source area
	SW059	CPSA A	On-Base, downstream source area
	SW011	CPSA S	On-Base, downstream of source area
	SW030	CPSA V	On-Base, downstream of source area
	SW002	CPSA A	On-Base, downstream source area (downstream SW059 and SW030).
	SW027	CPSA Q	On-Base, adjacent to source area
	SW076	CPSA U	On-Base, adjacent to source area
	SW003	CPSA A	On-Base, downstream of source area (downstream SW002)
	SW661	-	On-Base DP5
Catchment 8 (Receiving Environment)	SW047	-	Bremer River, adjacent DP5
	SW094	-	Bremer River, downstream DP5
Catchment 9	SW038	CPSAA	On-Base, source area
	SW053	CPSA Q	On-Base, downstream source area
	SW056	CPSA U	On-Base, adjacent source area
Catchment 9 (Receiving Environment)	SW036	-	Bremer River, downstream DP5 (downstream SW094)
	SW050	-	Bremer River, adjacent to DP6
Catchment 10	SW067	CPSA J	On-Base, source area
	SW064	CPSA F	On-Base, downstream source area
Catchment 10 (Receiving Environment)	SW016	CPSA CC	Warill Creek, source area, downstream of DP17
	SW015	CPSA CC	Warrill Creek, downstream source area, downstream DP16
	SW032	CPSA FF	Warrill Creek, downstream source area, downstream of DP15
	SW034	CPSA H	Warrill Creek, source area, downstream of DP15
	SW018	CPSA H	Warrill Creek, source area, downstream of DP14
	SW020	CPSA H/I	Warrill Creek, downstream source area, downstream of DP14
Catchment 11	**SW662**	-	On-Base, adjacent to DP7
Catchment 11 (Receiving Environment)	SW051		Bremer River, downstream of DP7
	SW096	-	Bremer River, downstream of DP7
NA	SW045		Downstream of Bremer River and Warrill Creek confluence
NA	SW040		Approximately 2km downstream of SW/SD45, north of abattoir

Note: **Bold** indicates new OMP surface water sample location. 'NA' – not applicable

Off-site monitoring locations will require the agreement of the landholder/leaseholder.

5.5.2 Sampling Methodology

The surface water sampling methodology is presented in **Table 5-5** below.

Table 5-5: Surface Water Sampling Methodology

Aspect	Detail
Sampling Methodology	Surface water samples will be collected directly into the laboratory supplied sample container. At each sample location a new sample container will be lowered into the water at least 10cm below the surface (where possible), with the opening facing down to avoid collection of surface films. The cap will be applied immediately once the sample container is full. Where surface water is difficult to access, the sample container will be attached to a telescopic pole, and lowered into the water body. The telescopic pole will be attached so that it is not in direct contact with the opening of the sample container.
Field Parameters	Surface water field parameters (i.e. pH, EC, oxidation reduction potential (ORP), DO, and temperature) will be recorded at the time of sampling using a pre-calibrated water quality meter. The water quality meter will undergo daily bump tested daily and re-calibrated as required. Field observations such as colour, turbidity, presence of suspended solids and odours, sheen, oily film, nuisance organisms, floating debris or froth will be documented on field sampling sheets. The condition of the water body, including its type (lake, stream etc.) and channel width, will also be recorded where applicable.
Shaker Test	A 'shaker test' will be undertaken on a small volume of the sample (approximately 10-25 mL). If foaming is noted within the sample, this will be documented on the sampling sheet.
Decontamination	All reusable monitoring equipment (i.e. telescopic pole) will be cleaned using PFAS-free detergent and PFAS-free deionised water supplied by the analytical laboratory.
Sample Identification, Preservation and Transportation	Each sample will be labelled with project identification number, date, samplers initial and sample location, as discussed further in **Section 5.9.** Water samples will be placed directly into appropriately labelled, laboratory-supplied sample bottles and packed in chilled containers for delivery to the laboratory under chain of custody (COC) documentation.

5.6 Analytical Suite and Laboratory Analysis Methods

5.6.1 Laboratory and NATA Accreditation Details

Groundwater and surface water samples will be submitted to the following NATA accredited laboratories for analysis in accordance with the analytical schedule.

- Eurofins Brisbane (NATA Accreditation Number 1261).
- Envirolab (NATA Accreditation Number 290).

5.6.2 Analytical Schedule

All media will be sampled for the extended PFAS suite with the laboratory limits of reporting for applicable environmental media detailed in **Table 5-6.**

Table 5-6: Sample Analytical Suite

Target analytes	Groundwater (µg/L)	Surface Water (µg/L)

Perfluoroalkane sulfonic acids			
PFBS	Perfluorobutane sulfonic acid	<0.01	<0.01
PFPeS	Perfluoropentane sulfonic acid	<0.01	<0.01
PFHxS	Perfluorohexane sulfonic acid	<0.01	<0.01
PFHpS	Perfluoroheptane sulfonic acid	<0.01	<0.01
PFOS	Perfluorooctane sulfonic acid	<0.01	<0.01
PFDS	Perfluorodecane sulfonic acid	<0.01	<0.01
Perfluoroalkyl carboxylic acids			
PFBA	Perfluorobutanoic acid	<0.05	<0.05
PFPeA	Perfluoropentanoic acid	<0.01	<0.01
PFHxA	Perfluorohexanoic acid	<0.01	<0.01
PFHpA	Perfluoroheptanoic acid	<0.01	<0.01
PFOA	Perfluorooctanoic acid	<0.01	<0.01
PFNA	Perfluorononanoic acid	<0.01	<0.01
PFDA	Perfluorodecanoic acid	<0.01	<0.01
PFUnDA	Perfluoroundecanoic acid	<0.01	<0.01
PFDoDA	Perfluorododecanoic acid	<0.01	<0.01
PFTrDA	Perfluorotridecanoic acid	<0.01	<0.01
PFTeDA	Perfluorotetradecanoic acid	<0.01	<0.01
Perfluoroalkyl sulfonamides			
FOSA	Perfluorooctane sulfonamide	<0.05	<0.05
MeFOSA	N-Methyl perfluorooctane sulfonamide	<0.05	<0.05
EtFOSA	N-Ethyl perfluorooctane sulfonamide	<0.05	<0.05
MeFOSE	N-Methyl perfluorooctane sulfonamidoethanol	<0.05	<0.05
EtFOSE	N-Ethyl perfluorooctane sulfonamidoethanol	<0.05	<0.05
MeFOSAA	N-Methyl perfluorooctane sulfonamidoacetic acid	<0.05	<0.05
EtFOSAA	N-Ethyl perfluorooctane sulfonamidoacetic acid	<0.05	<0.05
(n:2) Fluorotelomer sulfonic acids			
4:2 FTS	4:2 Fluorotelomer sulfonic acid	<0.01	<0.01
6:2 FTS	6:2 Fluorotelomer sulfonic acid	<0.05	<0.05
8:2 FTS	8:2 Fluorotelomer sulfonic acid	<0.01	<0.01
10:2 FTS	10:2 Fluorotelomer sulfonic acid	<0.01	<0.01

5.7 Quality Assurance / Quality Control

5.7.1 Overview

An overview of measures to be implemented to ensure that data collected is adequately reliable has been summarised in **Table 5-7.**

Table 5-7: Summary of QA/QC Measures

DQIs	Field	Laboratory
Precision	• Compliance with JBS&G's work instructions; • Compliance with groundwater sampling guidance such as field sampling methodologies, sample storage and preservation; • Investigation by suitably qualified and experienced personnel; and • Collection of blind duplicate and split samples.	• Use of NATA accredited laboratories; • Using NATA accredited testing methods for analysis of PFAS; • Analysis of blind duplicate and split samples at a frequency of 1 in every 10 primary samples; and • Laboratory internal duplicate samples.
Accuracy	• Compliance with JBS&G's work instructions; • Compliance with groundwater sampling guidance such as field sampling methodologies, sample storage and preservation; • Calibration of sampling equipment; • Investigation by suitably qualified and experienced personnel; and • Collection of quality control samples.	• Analysis of method blanks, matrix spike recoveries, surrogate spikes recoveries, laboratory control spike recoveries; • Compliance with sample holding times.
Representativeness	• Compliance with JBS&G's work instructions.	• Analysis of contaminants of concern; • Analysis within holding times; • Analysis of rinsate, trip and field blanks; and • Analysis of laboratory field blanks.
Comparability	• Compliance with JBS&G's work instructions.	• Use of NATA accredited laboratories; • Using NATA accredited testing methods for analysis of PFAS; • Analysis of split samples; • Comparison of analytical results against adopted screening criteria; and • Comparison of data against historic data where available.
Completeness	• All critical locations sampled	• All critical samples analysed.

5.7.2 Field QA/QC

Groundwater and surface water quality control samples are to be collected as follows, and analysed for the full PFAS analytical suite:

- Field duplicate (intra-laboratory) and field triplicate (inter-laboratory) samples are to be collected at a minimum frequency of 1 per 10 primary samples.
- Rinsate samples are to be collected at a rate of one sample per fieldwork day, by pouring laboratory supplied deionised water over the decontaminated reusable equipment (interface probe, telescopic pole).
- Field blank samples collected at a rate of one per day (groundwater and surface water) by filling sample containers with laboratory supplied deionised water in the field.

- Trip blank samples, supplied by the laboratory and placed in transport eskies, submitted at a rate of one per laboratory batch (groundwater and surface water).

5.8 Calibration

All field instruments (e.g. interface probes, water quality meters) will be calibrated by the equipment supplier. Calibration checks will be completed daily by field personnel prior to use during the monitoring event.

5.9 Sample Nomenclature

In order to meet Defence data management requirements, a consistent sample nomenclature has been adopted for the Program. All primary samples will be labelled using the following Defence Contamination Management Manual (DCCM) naming convention:

PPPP_XX000_ZZZ_YYMMDD
[property ID]_[type of sample][THREE DIGIT sample number]_[top of sample depth]_[yearmonthday]
e.g. 0861_MW001_191015

Location types and codes are prescribed by Defence and the Site’s investigation history.

Primary Sample Types/Location Codes relevant to this OMP include:

- MW = monitoring well.
- SW = surface water - no depth required.

QA/QC Samples will be labelled in accordance with the following convention:

- Blind Field Duplicate: PPP_QC1XX_YYMMDD.
- Blind Field Triplicate: PPP_QC2XX_YYMMDD.
- Rinsate: PPP_QC3XX_YYMMDD.
- Field Blank: PPP_QC4XX_YYMMDD.
- Trip Blank: PPP_QC5XX_YYMMDD.

5.10 Waste Management

Due to the proposed “no purge” sampling methodology, it is not anticipated that significant volumes of liquid waste would be generated that would require management or disposal.

All consumables (i.e. HydraSleeve™, filter cartridges, general rubbish) will be bagged and placed in on-site general waste bins for disposal.

5.11 Field Documentation

5.11.1 Sample Labels

Sample containers will be labelled with the sample ID with the following information:

- JBS&G project number.
- Name of sampler.
- Sample ID.
- Date of sample collection.

A ball point pen will be used for labelling, to ensure PFAS is not introduced to the samples from permanent markers.

5.11.2 Chain of Custody Forms

A CoC form will be completed, documenting the sample identification number and analytes. The CoC documents the chain of events from sample collection to delivery at the laboratory and provides a traceable account of sample handling. The CoC form will be signed by both the sample collector and the receiving laboratory. The CoC form will include the following information:

- Job number.
- Date of sample collection.
- Sample ID.
- Type of containers.
- Name of sampler.
- Laboratory to be used.
- Analyses required.
- Any comments.
- Signatures of the sampler and laboratory receiver.

In the event that additional samples are collected during the field investigations due to observations made by the Field Team, (i.e. samples not proposed in this SAQP), Defence will be provided the rationale for collection of those samples and proposed laboratory analyses. Defence approval will be sought to include these samples on the CoC and to dispatch these samples to the laboratory.

Upon receipt of the original documents accompanying the samples at the laboratory, the laboratory will provide a sample receipt document (noting the temperature of samples upon receipt, analyses required and any non-conformances) and return the signed CoC form to confirm analyses to be performed and the due date for the analytical results.

5.11.3 Sampling Documentation

Field sampling sheets will be completed for each location, and will include the following information:

- Name of sampler.
- Sample location.
- Date / time of monitoring / sampling.
- Sampling method.
- Observations of the sampled media.
- Calibration records.

Records of all equipment calibration will be included in the Sampling Event Factual Reports. Photographs of surface water sampling locations will be taken where permitted.

5.12 Data Management

All data collected as part of the monitoring program will be reviewed and managed in accordance with the requirements of Annex L of DCMM and uploaded into Defence's Environmental Data Management Software (EDMS). Data management will include the following:

- The Defence ESdat email address (DERP.LabReports@esdat.com.au) will be included on COCs as a laboratory report recipient.

- The laboratory Project ID and the laboratory provided ESdat files will be populated to match the Project ID setup in the Defence ESdat.
- The location code and sample naming conventions outlined in Annex L of the DCMM will be followed.
- Field data will be uploaded to Defence's EDMS.
- Laboratory data will be uploaded to Defence's EDMS, associated QA/QC data will be reconciled, and the laboratory data will be approved.

6. Screening Criteria and Trigger Levels

6.1 Overview

Performance measures designed to monitor the environmental impacts to groundwater and surface water have been assigned on the basis of the following definitions:

- **Screening criteria**: a water quality standard that is identified as being appropriate to a contaminant in a water body in order to assess the overall impact on water quality.
- **Trigger levels**: a specific assessment criterion applied to a contaminant to assess whether there have been possible adverse trends in environmental monitoring data. A trigger level is used as a tool to alert stakeholders and Regulators of these changes

6.2 Screening Criteria

The screening criteria were adopted in consideration of the ASC NEPM and the PFAS NEMP.

The adopted PFAS screening criteria to assess the data generated as part of the OMP are presented in **Table 6-1** below.

Table 6-1: Groundwater and Surface Water Assessment Criteria

Environmental Media	Exposure Scenario	Adopted Assessment Criteria (µg/L)			Guidance
		PFHxS + PFOS	PFOS	PFOA	
Human Health Receptors					
Groundwater and Surface Water	Drinking Water[1]	0.07		0.56	HEPA (2020)
Surface Water	Recreational Use	2		10	HEPA (2020)[2]
Ecological Receptors					
Groundwater and Surface Water	Freshwater (95 % species protection)		0.13	220	HEPA (2020)
Groundwater and Surface Water	Freshwater (99% species protection)		0.00023	19	HEPA (2020)

Notes:
1. Drinking water screening guidelines have been adopted for screened purposes for Industrial Water use, Stock Water use and Agriculture/Parks/Gardens water use.
2. Criteria sourced from National Health and Medical Research Council, 2019. Guidance on PFAS in Recreational Water, August 2019 (NHMRC, 2019).

6.3 Trigger Levels

The trigger levels and responses as presented in the OMP are described in **Table 6-2**.

Table 6-2: Trigger Levels and Responses

Trigger	Response
First time detection of PFOS, PFOS+PFHxS or PFOA in groundwater / surface water	**On-Base** • Request the analytical laboratory to reanalyse the sample to verify the detection. • Review risk profile for identified potential receptors including confirmation of exposure pathways. • Consider increasing frequency of monitoring. **Off-Base** • Request the analytical laboratory to reanalyse the sample to verify the detection.

Trigger	Response
	• Review risk profile for identified potential receptors including confirmation of exposure pathways. • Increasing frequency of monitoring (if required). • Notify relevant stakeholders (if required).
First time exceedance for PFOS+PFHxS or PFOA in groundwater above the drinking water guideline.	**On-Base** • Confirm groundwater in vicinity is not being utilised for drinking water purposes. • Re-sample to verify the exceedance. • Review concentration trends. • Notify relevant stakeholders (if required). **Off-Base** • Re-sample to verify the exceedance. • Review concentration trends. • Review risk profile for identified potential receptors including confirmation of exposure pathways. • Review potential for off-Base sources of PFAS to have contributed to identified impacts. • Issue Water Use Surveys to any licensed extractive groundwater users in vicinity of plume expansion (if not previously completed). • Notify relevant stakeholders (if required).
New maximum concentration for PFOS, PFOS+PFHxS or PFOA in surface water or groundwater which is less than an order of magnitude greater than the previous maximum.	**On-Base** • Review concentration trends. • Request the analytical laboratory to reanalyse the sample to verify the detection. • Review risk profile for identified potential receptors including confirmation of exposure pathways. **Off-Base** • Request the analytical laboratory to reanalyse the sample to verify the detection. • If initial result verified, re-sample to verify the exceedance. • Compare concentrations to HHRA assumptions to determine if review of risk profile is warranted. • Review concentration trends. • Review potential for off-Base sources of PFAS to have contributed to identified impacts. • Issue Water Use Surveys to any licensed extractive groundwater users in vicinity of plume expansion (if not previously completed) (if required). • Notify relevant stakeholders (if required).
New maximum concentration for PFOS, PFOS+PFHxS or PFOA in surface water or groundwater which is greater than an order of magnitude greater than the previous maximum.	• Re-sample within two weeks of receiving the results. • Review recent activities in vicinity of sampling location/s within two weeks. • Review risk profile, including confirmation of any potential exposure pathways. • Review management measures and amend (if required). • Notify relevant stakeholders (if required).
New minimum concentration for PFOS, PFOS+PFHxS or PFOA in surface water or groundwater.	**On-Base and Off-Base** • Review concentration trends. • Review risk profile for identified potential receptors including confirmation of exposure pathways. • Review requirement for ongoing monitoring.
First time exceedance of human health recreational	• Request the analytical laboratory to reanalyse the sample to verify the exceedance.

Trigger	Response
guidelines for PFOS+PFHxS or PFOA in surface water off Base (Bremer River, Warrill Creek).	• Resample location within four weeks of confirmation to verify detection (if water still present). • Review concentration trends. • Review risk profile, including confirmation of any potential exposure pathways. • Review management measures and amend if required. • Notify relevant stakeholders (if required).
Complete source pathway and receptor linkage identified based on Water Use Survey / change in land use.	• Review risk profile, including concentrations and exposure pathways. • Notify relevant stakeholders (if required). • Conduct further assessment and/or management (if required)
Statistically significant increasing trends for Sum of PFAS (assessed using statistical analysis such as Mann Kendall trend assessment)	• Further assessment of the data to determine whether updates to the CSM and/or risk profile are required. • Conduct further assessment and/or management, if required.
Statistically significant decreasing trends for Sum of PFAS trends (assessed using statistical analysis such as Mann Kendall trend assessment)	• Assess whether risks have been reduced, potential amendment to sampling program. • Review whether reduction is related to risk management actions implemented by Defence.
No triggers or acceptable levels are exceeded.	• Recommend the following actions during the next OMP Review: o Decrease frequency of monitoring. o Cease monitoring and / or monitor nearby locations.
Change in Commonwealth tolerable daily intake recommendations and/or tier 1 screening criteria.	• Review OMP within four weeks. • Revise OMP (if appropriate). • Revise human health risk assessment (if appropriate). • Revise ecological risk assessment (if appropriate). • Review the risk register (as appropriate). • Notify relevant stakeholders (if required).

7. Reporting

7.1 Sampling Event Report

A factual report will be prepared at the completion of each monitoring event, summarising the data and findings. The report will be prepared in accordance with guidance for OMP reporting (Defence, 2024) and will include the following information:

- Introduction.
- Scope of work completed during the monitoring event.
- Field activities undertaken and description of sampling methodologies used.
- Field observations (e.g. condition of monitoring wells, description of purged water) and water quality parameter measurements.
- Use of nomenclature of sampling locations as per DCMM Annex L.
- Summary of any changes to the monitoring network condition that may affect data integrity, including recommendations for repair, replacement of decommissioning of monitoring location.
- Evaluation of adopted screening criteria and trigger levels to ensure continued applicability.
- QA/QC evaluation to confirm the suitability of the data for assessment purposes
- Summary tables presenting gauged groundwater and surface water levels.
- Presentation of inferred groundwater contours.
- Summary tables of analytical results in comparison to adopted assessment criteria, managed within the Defence ESdat database.
- Figures showing results in accordance with OMP reporting guidance (Defence, 2024).
- Laboratory reports, COC documentation, field sampling records, data validation and QA/QC details, equipment calibration certificates and bump test records and other relevant documentation.
- Any deviations from the SAQP encountered during completion of the sampling event, the justification for the changes and any impacts of these changes on the data/program.

7.2 Ongoing Monitoring Report (OMR)

At the end each monitoring period (12 months) the whole data set (including the current and historic data) will be reviewed, and an interpretive OMR prepared.

The OMR will report on the objectives of the OMP which are to identify and evaluate:

- Spatial, and temporal (including seasonal) variability of PFAS in the environment.
- Changes to sources, transport pathways or receptors, described as a CSM for the Base
- Changes in risks to human and environmental receptors.
- The influence that risk management activities at the Base, as outlined in the PMAP have had on PFAS in the environment.
- Whether the identified changes trigger a prescribed action and/or review.

8. Stakeholder Engagement

Engagement with a range of stakeholders, such as Department of Environment, Tourism, Science, and Innovation (DETSI), Councils, other agencies, and the community will be undertaken. A stakeholder engagement plan has been prepared to manage the engagement process (Defence, 2024b).

Where off-Base monitoring is undertaken a separate letter will be provided to the stakeholder presenting the results of the monitoring event.

The OMP will be published on the Defence website, along with the current PMAP and Ongoing Monitoring Report.

9. References

PMAP and OMP

Defence. (2025a). PFAS Management Area Plan, RAAF Base Amberley, Australian Department of Defence, Revision 1.

Defence. (2025b). Ongoing Monitoring Plan, RAAF Base Amberley, Australian Department of Defence.

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AECOM. (2024). PFAS OMP- RAAF Base Amberley Sampling and Analysis Quality Plan. Doc No. 0612563_PL_006_8_240131

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EnRiskS. (2019). Human Health Risk Assessment for the RAAF Base Amberley PFAS Investigation.

EnRiskS. (2020). Screening Level Ecological Risk Assessment for the RAAF Base Amberley Investigation, Revision F (CH2M/18/AMBR002).

JBS&G. (2025). Ongoing Monitoring Report, October 2023 – July 2024, Department of Defence, Per and Polyfluoroalkyl Substances (PFAS) Ongoing Monitoring Program (OMP) – Royal Australia Air Force (RAAF) Base Amberley, Revision F (66133|161501), March 2025.

Senversa. (2023). SP3 – PFAS Mass Flux Interpretive Report, RAAF Base Amberley, Revision D.

Guidance Documents

Australian and New Zealand Governments (ANZG). (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Defence. (2016). Routine Environment Water Quality Monitoring Manual.

Defence. (2019). Contamination Management Manual (DCMM), amended 2021.

Defence. (2021). Defence PFAS Construction and Maintenance Framework, Guidance for managing risk of PFAS contamination for works on Defence estate, Version 3.0, August 2021.

Defence. (2023). PMAP and OMP Revision Process, PFAS Investigation and Management Program, Australian Government Department of Defence, Revision 0, 27 October 2023.

Defence. (2024a). Guidance, Ongoing Monitoring Program Reporting. February 2024.

Defence. (2024b). Stakeholder and Community Engagement Plan, RAAF Base Amberley, May 2024.

Department of Health (DoH). (2019). Health Based Guidance Values for PFAS for use in site investigations in Australia, Department of Health.

Environmental Protection (Water and Wetland Biodiversity) Policy 2019

Food Standards Australia and New Zealand (FSANZ). (2017). Hazard Assessment Report: Perfluorooctane sulfonate (PFOS), Perfluorooctanoic acid (PFOA) and Perfluorohexane sulfonate (PFHxS), April 2017.

Heads of EPAs Australia and New Zealand (HEPA). (2020). PFAS National Environmental Management Plan, Version 2.0 – January 2020.

Heads of EPAs Australia and New Zealand (HEPA). (2025). PFAS National Environmental Management Plan, Version 3.0 – March 2025.

National Environment Protection Council (NEPC). (2013). National Environment Protection (Assessment of Site Contamination) Measure, as amended in 2013.

National Health and Medical Research Council (NHMRC). (2019). Guidance on PFAS in Recreational Water.

Other References

Fitzpatrick, R., Powell, B., & Marvanek, S. (2011). Atlas of Australian Acid Sulphate Soils. v2. CSIRO. Data Collection. https://doi.org/10.4225/08/512E79A0BC589

Ipswich City Council. (2017). Ipswich Planning Scheme Overlay – OV3 Mining Influence Areas. https://data.gov.au/data/dataset/03baae2d-d64d-4c6b-b8d4-9750f571c055

10. 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.

Figures

Legend

- Watercourse
- PFAS Management Area Plan Boundary
- Approximate RAAF Base Amberley Boundary

Job No: 66133

Client: Department of Defence

Version: v1

Date: 04-Dec-2024

Scale 1:48,000

0 500 1,000 metres

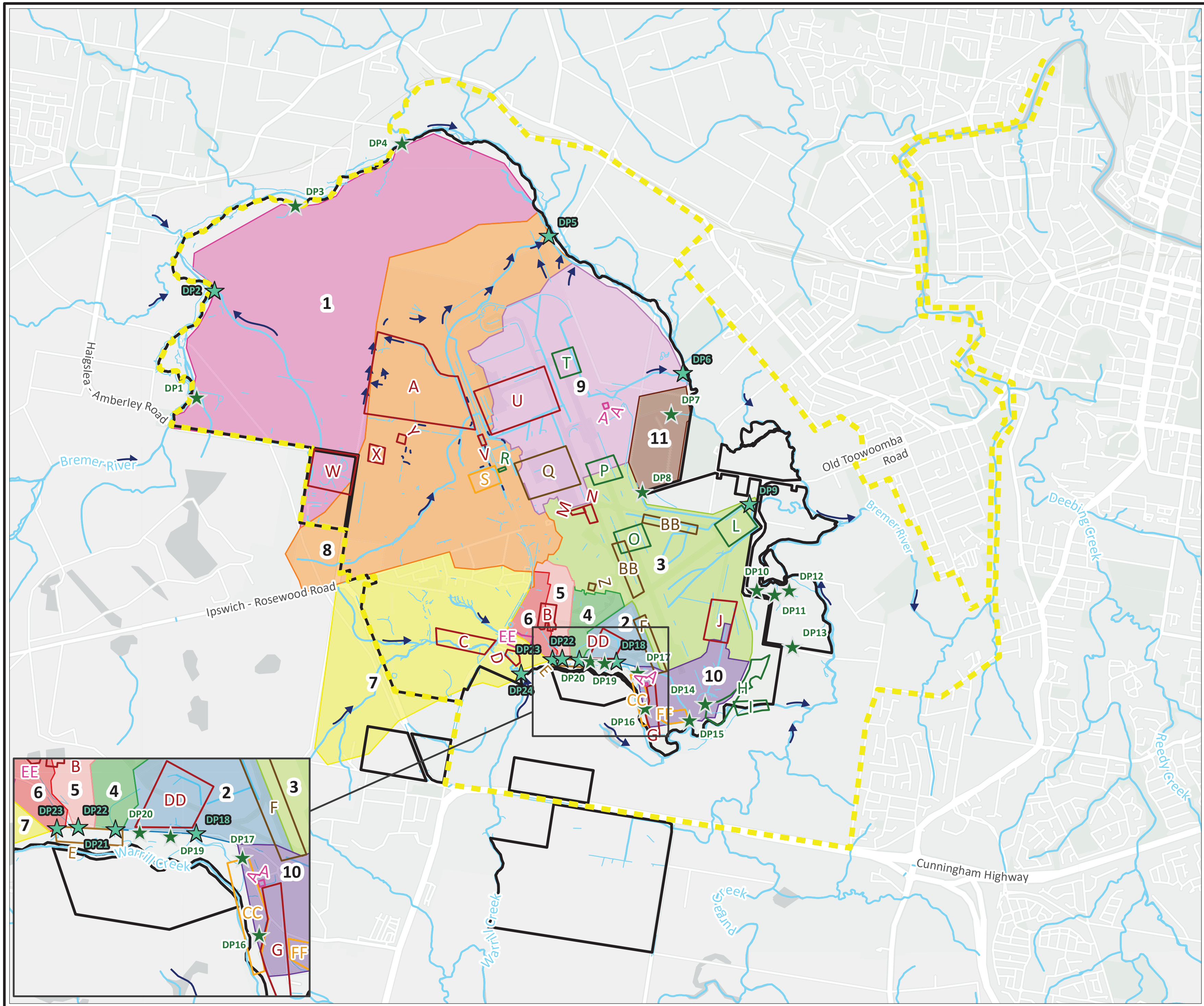
Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley, Queensland

SITE LOCATION AND MANAGEMENT AREA

FIGURE 1

Name: 66133_RAAF_Amberley_OMP24Review_v2/ 66133_01_SiteLoc
Reference: www.nearmap.com - Imagery Date: 02/03/2024



Job No: 66133

Client: Department of Defence

Version: v2

Date: 20-May-2025

Scale 1:48,000

0 500 1,000 metres

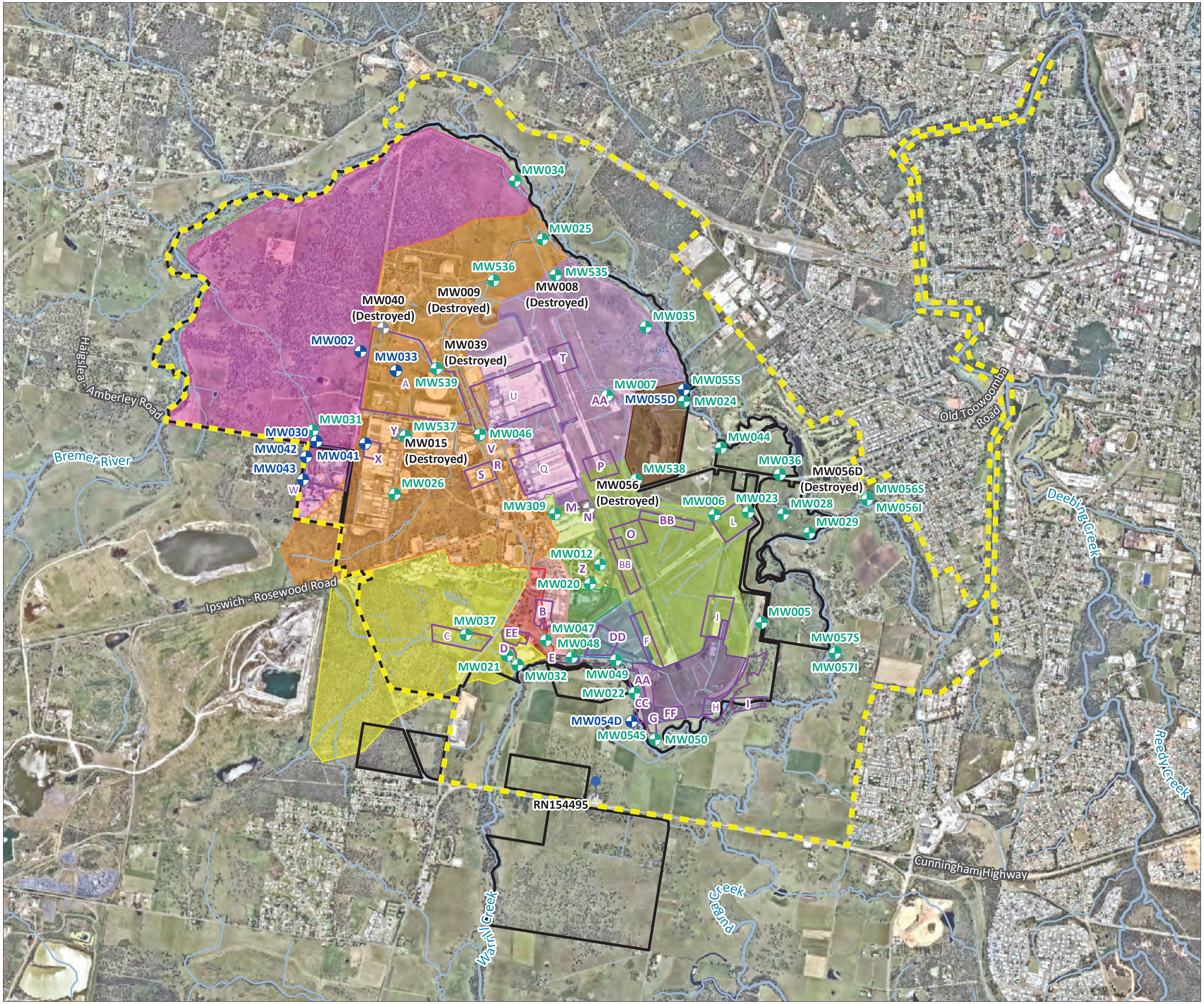
Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley, Queensland

CONFIRMED PRIMARY SOURCE AREAS AND SURFACE WATER CATCHMENTS

FIGURE 2

Name: 66133_RAAF_Amberley_OMP24Review_v2/ 66133_02_CPSAsAndCatchments



Legend

- Registered Groundwater Bore
- Tertiary Formation / Alluvium
- Walloon Coal Measures
- Destroyed
- Watercourse
- PFAS Management Area Plan Boundary
- 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

JBS&G

Job No: 66133

Client: Department of Defence

Version: v1 | Date: 04-Dec-2024

Scale 1:48,000

0 500 1,000 metres

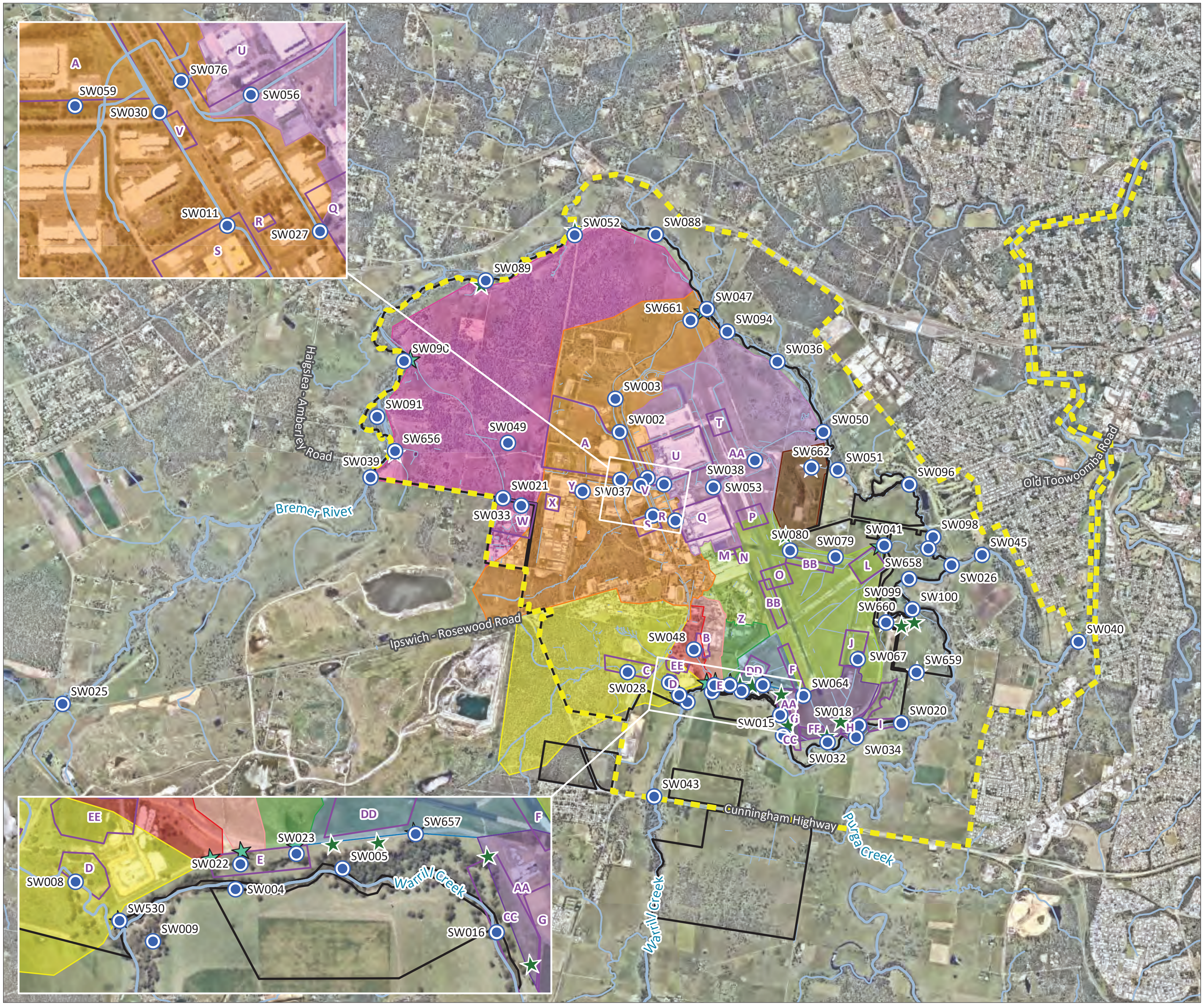
Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley, Queensland

GROUNDWATER MONITORING WELL LOCATIONS

FIGURE 3

Name: 66133_RAAF_Amberley_OMP24Review_v2/ 66133_03_GWLocs
Reference: www.nearmap.com - Imagery Date: 03/06/2024



JBS&G

Job No: 66133

Client: Department of Defence

Version: v1

Date: 19-Mar-2025

Scale 1:55,000

Coord. Sys. GDA2020 MGA Zone 56

RAAF Base Amberley, Queensland

SURFACE WATER SAMPLE LOCATIONS

FIGURE 4

Name: 66133_RAAF_Amberley_OMP24Review_v2/ 66133_04_SWLocs
Reference: www.nearmap.com - Imagery Date: 03/06/2024

Appendix A Monitoring Well Construction Details

Monitoring Well Construction Details

Property ID	Well ID	Aquifer	TOC Elevation (mAHD)	Top of screen (mAHD)	Bottom of screen (mAHD)	Target depth of Hydrasleeve™ (mbtoc)
0861	MW002	Walloon Coal Measures	-	16.70	23.70	22.50
0861	MW005	Alluvium	26.725	13.00	17.00	16.00
0861	MW006	Alluvium	21.937	10.30	14.30	12.50
0861	MW007	Alluvium	23.208	6.00	10.00	9.00
0861	MW012	Tertiary Formation	26.175	12.50	17.50	15.00
0861	MW020	Tertiary Formation	27.043	12.50	16.50	15.00
0861	MW021	Alluvium	20.72	2.50	6.00	4.50
0861	MW022	Alluvium	19.65	4.00	9.00	8.00
0861	MW023	Alluvium	20.51	7.80	11.80	11.00
0861	MW024	Alluvium	20.95	7.00	11.00	10.00
0861	MW025	Alluvium	25.42	7.40	11.40	10.50
0861	MW026	Tertiary Formation	40.24	14.50	17.50	16.00
0861	MW028	Alluvium	20.83	10.50	14.50	12.50
0861	MW029	Alluvium	18.23	7.00	10.00	9.00
0861	MW030	Walloon Coal Measures	35.84	17.00	21.00	19.50
0861	MW031	Tertiary Formation	33.45	14.50	20.50	16.50
0861	MW032	Alluvium	26.28	8.00	14.00	12.50
0861	MW033	Walloon Coal Measures	42.456	29.00	33.00	32.00
0861	MW034	Alluvium	24.305	5.00	10.00	8.50
0861	MW035	Alluvium	24.999	8.00	13.50	12.00
0861	MW036	Alluvium	24.04	10.20	15.20	13.00
0861	MW037	Alluvium	25.219	5.00	10.00	9.00
0861	MW041	Walloon Coal Measures	46.383	11.50	14.50	13.00
0861	MW042	Walloon Coal Measures	40.036	24.00	30.00	27.00
0861	MW043	Walloon Coal Measures	49.182	18.00	21.00	19.50
0861	MW044	Alluvium	20.311	8.00	11.00	9.50
0861	MW046	Tertiary Formation	26.001	8.20	11.20	9.50
0861	MW047	Tertiary Formation	26.265	110.50	13.50	11.50
0861	MW048	Alluvium	23.108	7.50	10.50	9.00
0861	MW049	Alluvium	22.044	7.50	10.50	9.00
0861	MW050	Alluvium	24.317	11.50	14.50	13.00
0861	MW054D	Walloon Coal Measures	24.317	18.00	21.00	19.50
0861	MW054S	Alluvium	24.317	4.00	7.00	6.00
0861	MW055D	Walloon Coal Measures	24.317	28.00	34.00	32.00

0861	MW055S	Alluvium	24.317	9.00	12.00	10.50
0861	MW056I	Tertiary Formation	14.762	12.50	15.50	14.50
0861	MW056S	Alluvium	15.078	6.50	9.50	8.50
0861	MW057I	Tertiary Formation	16.494	12.50	15.50	14.00
0861	MW057S	Alluvium	16.479	5.50	8.50	7.50
0861	MW309	Tertiary Formation	28.607	13.00	19.00	17.50
0861	MW535	Alluvium	25.331	8.50	13.50	12.00
0861	MW536	Alluvium	25.170	6.50	10.50	9.00
0861	MW537	Tertiary Formation	34.781	15.00	19.00	17.50
0861	MW538	Alluvium	25.218	13.50	17.00	15.50
0861	MW539	Alluvium	30.288	12.00	15.00	13.50

mbtoc - metres below top of casing, mAHD - metres above Australian Height Datum, TOC - top of casing, ‘-‘ no data

Appendix B PFAS Sampling Checklist

PFAS Sampling Checklist Part 1

Checklist for items prohibited at site during PFAS Investigations (adopted from WA DER 2017)		
Clothing and Food		**Y/N**
New clothing	Has all field clothing to be washed a minimum of six times after purchase before using at the site?	
Clothing, including boots, with stain-resistant, rain resistant, or waterproof coatings/treated fabric (e.g. GORE-TEX®)	Where sampling during rain was unaviodable, was polyethylene rain gear (e.g. disposable LDPE), vinyl, or polyvinyl chloride (PVC) waterproof clothing used?	
Tyvek® clothing	Have Tyvek clothes been removed from field bag and vehicle prior to mobilising to site?	
Fast food wrappers and containers, pre-wrapped foods and snacks (e.g. chocolate bars, energy bars, muesli bars, potato chips etc.)	Is all food being taken to site contained in rigid plastic containers or bags or stainless steel containers?	
Sampling Equipment and Containers		
Teflon®-containing or -coated field equipment (tubing, bailers, tape, plumbing paste, etc.)	Does all sampling equipment comprise High Density Polyethylene (HDPE), silicone tubing, and HDPE or polypropylene?	
Teflon®-lined lids on containers (e.g. sample containers, rinsate water storage containers)	Have specific sample containers provided by the laboratory confirmed to comprise either polypropylene or HDPE for sample containers?	
Other Products		
Aluminium foil	Has HDPE sheeting (commonly used as drop cloths for painting or home improvement) been sourced as a replacment for aluminium foil, if required?	
Self-sticking notes and similar office products (e.g. 3M Post-it notes)	Have these products been removed from site vehicles and field documentation?	
Waterproof paper, notebooks, and labels	Have all waterproof stationary been removed from site vehicles and field documentation and replaced with standard paper and paper labels? Aluminum clipboard to be used	
Markers (e.g. Sharpies)	Have ball point pens used for all labelling and note taking?	
Drilling fluid containing PFAS	If a drilling method requiring drilling fluid is to be used at the site has it been confirmed that drilling fluids to be used are PFAS-free?	
Detergents and decontamination solutions (e.g. Decon 90® Decontamination Solution)	Follow water-only decontamination approach. Is sufficient water avaliable on-site for removing all debris by scrubbing with a plastic brush followed by thorough rinsing with tap water and triple rinsing with distilled or deionised water?	
Reusable chemical or gel ice packs (e.g. BlueIce®)	Has all ice been contained by double bagging in plastic (polyethylene) bags?	
Many Sunscreens and Insect Repellents contain PFASs and should not be brough to site	Is one of the following or other acceptable products available for use at the site? Sunscreens - Alba Organics Natural Sunscreen, Yes to Cucumbers, Aubrey Organics, Jason Naturakl Sunblock, Kiss my face, and baby sunscreens that are PFAS free or "natural" Insect Repellants - Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect Repellent, Herbal Armor, California Baby Natural Bug Spray, BabyGanics Sunscreen and insect repellent - Avon Skin So Soft Bug Guard Plus - SPF 30 Lotion	

PFAS Sampling Checklist Part 2

Other Considerations when Sampling for PFAS	Y/N or N/A	Comments
Groundwater Well Drilling, Development and Sampling		
Detergents or Decon 90® NOT TO BE USED for decontamination - Alconox® and Liquinox® soap may be used, if required following water-only decontamination approach. Is sufficient water available on-site for removing all debris by scrubbing with a plastic brush followed by thoroughly rinsing with tap water and triple rinsing with distilled and deionised water (Grade 3 or Millipore water)?		
Where water has been used during the drilling process, has a sample of the water been collected for analysis?		
Following contact with bore water have hands been washed with soap and thoroughly rinsed prior to donning a clean, new pair of disposable nitrile gloves?		
Has a new pair of disposable gloves been donned between development/sampling of each new well?		
Has additional hand washing been undertaken prior to donning a new pair of gloves when the old pair was compromised or if ungloved hands touched items that may represent potential PFAS contamination?		
Has all development/purged water transported by a licensed waste disposal contractor for appropriate disposal at a facility licensed to receive PFAS-impacted materials?		
Has a peristaltic pump with disposable HDPE or silicone tubing or polypropylene HydraSleeves been used for groundwater sampling?		
Where depth to groundwater prevents the use of a peristaltic pump, then use of bladder pumps may be considered. Where a bladder is to used are all internal parts (bladders, check balls, O-rings, compression fittings) Teflon free?		
Are sufficient bladders and O-rings available for replacement at each sampling location?		
Where a bladder pump was used, were bladders and O-rings replaced prior to sampling at each location?		
Soil Drilling and Aquatic Sampling		
Detergents or Decon 90® NOT TO BE USED for decontamination - Alconox® and Liquinox® soap may be used, if required Follow water-only decontamination approach. Is sufficient water available on-site for removing all debris by scrubbing with a plastic brush followed by thoroughly rinsing with tap water and triple rinsing with distilled and deionised water (Grade 3 or Millipore water)?		
Is all equipment that will come in contact with sampling media free of Teflon?		
Are soil and/or sediment core samples being collected directly from single-use PVC liners?		
Prior to sample collection have hands been washed with soap and thoroughly rinsed prior to donning a clean, new pair of disposable nitrile gloves?		
Has a new pair of disposable gloves been donned between each sampling location?		
Has additional hand washing been undertaken prior to donning a new pair of gloves when the old pair was compromised or if ungloved hands touched items that may represent potential PFAS contamination?		
Where waders are being worn for sample collected are they constructed of fabric that has not been treated with waterproofing coatings?		
Have surface water samples been collected by inserting a capped sampling container (polypropylene or HDPE) with the opening pointing down to avoid the collection of surface films?		
Where practicable, at the time of container opening, was the container more than 10cm from the sediment bed and more than 10cm below the surface water level and as close to the centre of the channel as possible?		
During surface water sample collection was the container pointed upstream up so that gloved hands, sample container, and sampler were downstream of the sample?		

PFAS Sampling Checklist Part 2

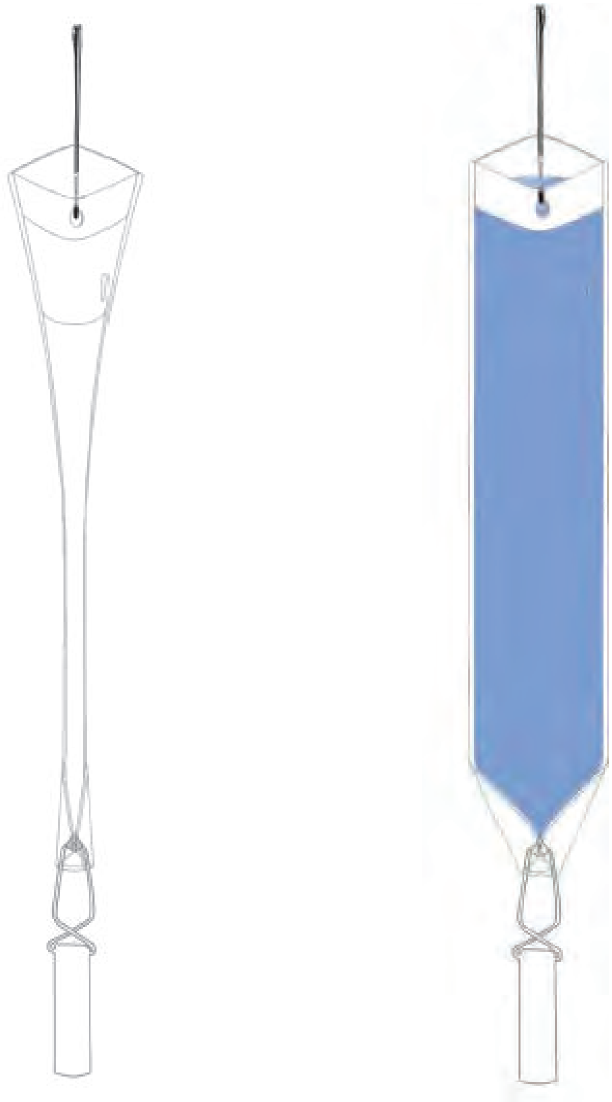
Other Considerations when Sampling for PFAS	Y/N or N/A	Comments
Has equipment rinsate water provided by the laboratory been confirmed to be free of PFAS and supplied in HDPE containers with polypropylene lids?		
Drinking Water Samples		
Has the analytical laboratory been consulted on the requirement for Trizma®, a buffering reagent that removes free chlorine from chlorinated drinking water, or similar sample additive, prior to collection of drinking water samples for analysis?		
Additional Considerations		
Has the exposure of samples to light during sample processing and storage been minmised?		
Carry our Shaker Test - A small portion of samples (~10-25 mL) should be shaken by the sample collector on-site. If foaming is noted within the sample, this should be documented when samples are submitted for analysis.		
It is noted that all support personnel that handle any equipment that directly contacts surface water or aquatic sediment, are within 2–3m of the borehole during soil sampling, or are within 2–3m of the collection and processing area on aquatic vessels during sediment or surface water sampling, are subject to the same restrictions related to precautionary measures for clothing and food, as applied to sampling personnel.		

Appendix C HydraSleeve™ Standard Operating Procedure

HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure: Sampling Groundwater with a HydraSleeve



This guide should be used in addition to field manuals and instructions appropriate to the chosen sampling device (i.e., HydraSleeve, SpeedBag or Super/Skinny Sleeve and W3 HybridSleeve).

Find the appropriate field manual and instructions on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact:
GeoInsight, P.O. Box 1266, Mesilla Park, NM 88047
800-996-2225, info@hydrasleeve.com.

Table of Contents

Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect groundwater samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only. It excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative groundwater samples depends on the natural movement of groundwater (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of groundwater for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1" inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can't be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

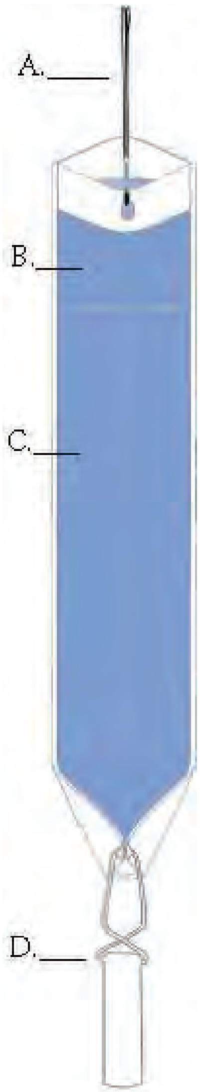
The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term groundwater monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

Description of the HydraSleeve

The basic HydraSleeve (Figure 1) consists of the following components*:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75” OD and are available in a variety of sizes. An optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.



*Other configurations such as top weighted assemblies, Super/SkinnySleeves, Speedbags, and W3 Hybrids are available.

> **Note:** The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

Table 1. Dimensions and Volumes of HydraSleeve Models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 600 mls HydraSleeve	~600mls	30”	2.5”	1.4”
Standard 1-liter HydraSleeve	~1 Liter	38”	3”	1.9”
Super/SkinnySleeve 1-liter	~1 Liter	38”	2.5"	1.5”*
Super/SkinnySleeve 1.5-liter	~1.5 Liters	52”	2.5”	1.5”*
Super/SkinnySleeve 2-liter	*~2Liters*	*66"*	*2.5"*	*1.5"**
4-Inch HydraSleeves				
Standard 2.5 liter	~2 Liters	38”	4”	2.7”

* outside diameter on the Heavy Duty Universal Super/SkinnySleeves is 1.5" however when using with schedule 40 hardware the O.D. of the assembly will be 1.9"

It's also recommended that you size the diameter of the HydraSleeve according to the diameter of the well (i.e. use 2-inch HydraSleeves in 2-inch wells). Using smaller sleeves in larger diameter wells (i.e. 2-inch HydraSleeves in 4-inch wells) will result in a longer fill rate and will require special retrieval instructions (explained later).

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

HydraSleeves can be custom-fabricated by GeoInsight in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied using a HydraSleeve.

HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen. It fills by pulling it up through the screen a distance equivalent to the length of the sampler when correctly sized to the well diameter. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2" ID PVC well, 50' total depth, 10' screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2" well (2.5" flat width/1.5" filled OD x 30" long, 600 ml volume), deploy the sampler so the weight (a 5 oz., 2.5" long weight with a 2" long clip) rests at the bottom of the well. The top of the sleeve is thus set at ~34" above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30" before it is filled; therefore, it is full (and the top check valve closes) at approximately 64" (5.3 feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

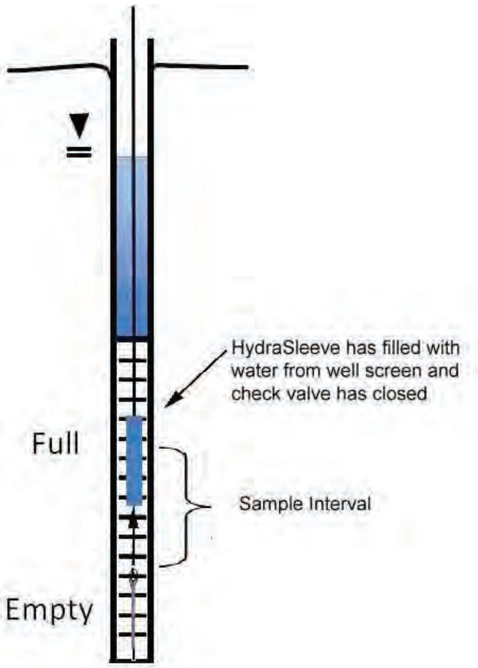


Figure 2. Correct Placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

<u>The solution?</u> Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 36" (3 feet) from the bottom of the well, or 2-feet before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

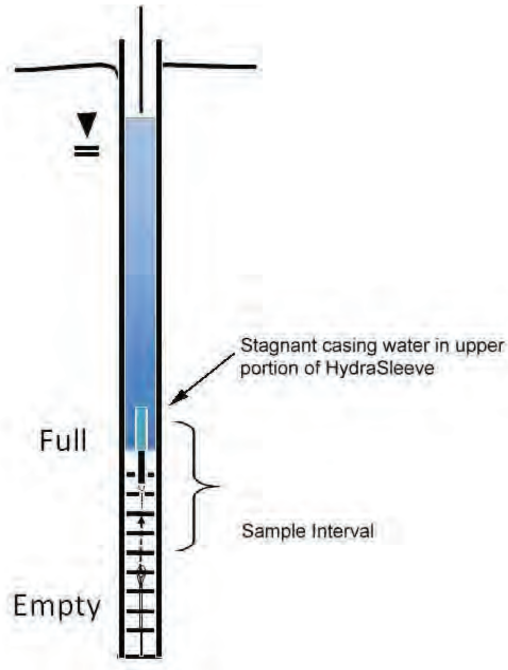


Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

NOTE: Using smaller diameter HydraSleeves (2-inch) in larger diameter wells (4-inch) causes a slower fill rate. Special retrieval methods are necessary if this is your set up (shown later in this document).

Procedures for Sampling with the HydraSleeve

Collecting a groundwater sample with a HydraSleeve is usually a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a groundwater contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve.

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the Basic HydraSleeve*

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.

2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.

3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.

4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, if spring clips are not being utilized, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together to align the holes and slide the weight clip through the holes.

6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

*See Super/SkinnySleeve assembly manual and HydraSleeve Field Manual for other assembly instructions.

II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

> **Note:** Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

> **Note:** Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The basic HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In some cases, like when useing the SpeedBags, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

  NOTE: If using top weights additional equilibration time is needed to allow the top weight time to compress the HydraSleeve into the bottom of the well.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event.

  In periodic (i.e., quarterly, semi-annual, or annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.
2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)
3. Measure the water level in the well.
4. Use one of the following 3 retrieval methods. In all 3 scenarios, when the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

   a. In one smooth motion, pull the tether up 30”-60" (the length of the sampler) at a rate of about 1 foot per second (or faster). The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1:1 ratio or the length of the HydraSleeve if the sleeve is sized to fit the well). This is analogous to coring the water column in the well from the bottom up.

   b. There are times it is recommended that the HydraSleeve be oscillated in the screen zone to ensure it is full before leaving the screen area. Pull up 1-3 feet, let the sleeve assembly drop back down and repeat 3-5 times before pulling the sleeve to the surface. The collection zone will be the oscillation zone. ***When in doubt use this retrieval method.***

   c. SpeedBags require check valve activation and oscillation during recovery: When retrieving the SpeedBag, pull up hard 1-2 feet to open the check valve; let the assembly drop back down to the starting point; REPEAT THIS PROCESS 4 TIMES; and then quickly recover the SpeedBag through the well sceen to the surface.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.
6. Discard the small volume of water trapped in the Hydrasleeve above the check valve by pinching it off at the top under the stiffeners (above the check valve).

V. Sample Discharge

NOTE: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

Be sure you have discarded the water sitting above the check valve – see step #6 above.

1. Remove the discharge tube from its sleeve.
2. Hold the HydraSleeve at the check valve
3. Puncture the HydraSleeve at least 3-4 inches below the reinforcement strips with the pointed end of the discharge tube. NOTE: For some contaminants (VOC's/sinkers) the best location for discharge is the middle to bottom of the sampler. This would be representative of the deeper portion of the well screen.
4. Discharge water from the HydraSleeve into your sample containers. Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.
5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column needs to be sampled, the HydraSleeve can be deployed with an optional top weight in addition to a bottom weight. The top weight will collapse the HydraSleeve to a very short (approximately 6" to 24") length, depending on the length and volume of the sampler. This allows the HydraSleeve to fill in a water column only 3' to 10' in height (again) depending on the sampler size. Note the SuperSleeves accomplish the same thing but provide greater sample volume at a lower per sample cost.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

1. It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
2. It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

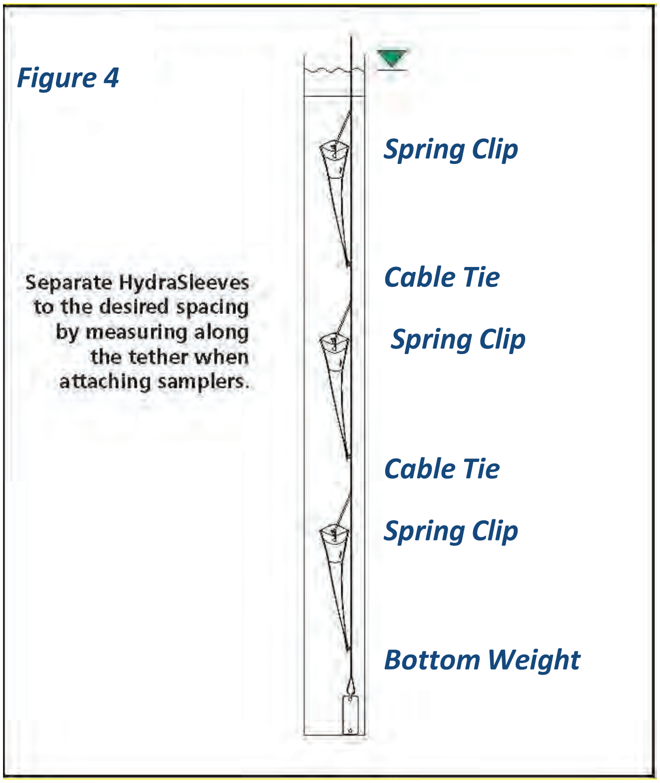


Figure 5. Multiple HydraSleeve deployment

If there is a need for only 2 samplers, they can be installed as follows. The first sampler can be attached to the tether as described above, a second attached to the bottom of the first using your desired length of tether between the two and the weight attached to the bottom of the second sampler (figure 6). This method can only be used with 2 samplers; 3 or more HydraSleeves in tandem need to be attached as described above.

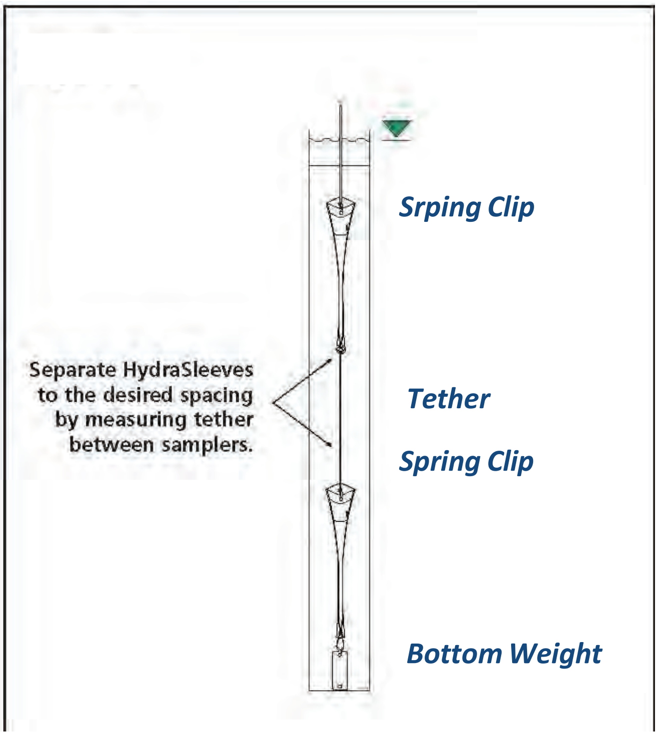


Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight will be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

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1.1.1.1 Document Distribution

Rev No.	Copies	Recipient	Date
A	1 x Electronic	Department of Defence	28 March 2025
B	1 x Electronic	Department of Defence	20 May 2025

1.1.1.2 Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Jenna Bligh / Mikayla Cover	Kane Mitchell	Kane Mitchell	Draft for review	28 March 2025
B	Jenna Bligh / Mikayla Cover	Kane Mitchell	Kane Mitchell	Draft for review	20 May 2025

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