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PFAS INVESTIGATION AND MANAGEMENT PROGRAM

SERVICE
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INTEGRITY
EXCELLENCE

Lavarack Barracks

PFAS ONGOING MONITORING PLAN

May 2025

ACKNOWLEDGEMENT OF COUNTRY

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

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Rev0	30 July 2024	
Rev1	15 November 2024	This revision addresses Defence draft (Rev0) review comments
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RevC	3 March 2025	This revision addresses Defence draft (RevB) review comments
RevD	20 March 2025	Final Draft
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GLOSSARY

AFFF	Aqueous Film Forming Foam
AS	Australian Standard
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure, as amended 2013
Base	Lavarack Barracks
CSM	Conceptual Site Model
DQI	Data Quality Indicators
DQO	Data Quality Objectives
DSI	Detailed Site Investigation
EIL	Ecological Investigation Level
ERA	Ecological Risk Assessment
HHRA	Human Health Risk Assessment
LOR	Limit of Reporting
Management Area	The geographical area subject to Defence risk management actions. May include private or Defence owned detached properties beyond the boundaries of the base.
NATA	National Association of Testing Authorities
OCP	Organochlorine pesticides
Off-base	Outside Defence property
On-base	On Defence property
OMP	Ongoing Monitoring Plan
PFAS	Per- and polyfluoroalkyl Substances
PFAS NEMP	PFAS National Environmental Management Plan
PFHxS	Perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PMAP	PFAS Management Area Plan
PSC	Potential Sources of Contamination
QA	Quality Assurance
QC	Quality Control
Risk management actions	Remediation and management actions to address potential risks to receptors from PFAS contamination
RPD	Relative Percent Difference
SAQP	Sampling, Analysis and Quality Plan
SFARP	So Far As Reasonably Practicable
Source	A source can be primary or secondary and is the place or event from which the contamination originated. Primary sources are generally areas where AFFF was used or stored. Secondary sources may be an accumulation of contamination in the environment, such as in soil, sediments, groundwater, or surface water bodies.
TDI	Tolerable Daily Intake

1 INTRODUCTION

1.1 Background

In August 2020, Department of Defence prepared a per- and poly-fluoroalkyl substances (PFAS) Management Area Plan (PMAP) for managing risks to human health and the environment from PFAS contamination associated with Lavarack Barracks (the base) and surrounding areas. An important requirement of the PMAP is to undertake ongoing monitoring of PFAS in the on-base and off-base environment and to assess for changes in risks to human and ecological receptors from PFAS originating from the base.

This Ongoing Monitoring Plan (OMP) is a revision of the OMP, which was presented as an attachment (Attachment 1) of the 2020 PFAS Management Area Plan (PMAP; Department of Defence, 2020). With the current update and revision of the PMAP (Department of Defence, 2025), the OMP is now a standalone document.

1.2 Purpose

The OMP sets out requirements for 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, including remediation activities, at the base, as outlined in the current Department of Defence PMAP (2025), have had on PFAS in the environment;
- whether identified changes trigger an action and/or review, and
- whether the monitoring program (eg frequency/seasonality, locations, or media), based on measured data, needs to be modified.

The data collected may be used to inform where new risk management actions may be required, or to support a determination that remediation has been completed So Far As Reasonably Practicable (ie remediation SFARP).

1.3 Supporting information

Lavarack Barracks is a Department of Defence property subject to Commonwealth Government jurisdiction. This OMP has been prepared in general accordance with the current PMAP for the site:

- Department of Defence (2025), PFAS Management Area Plan (PMAP), Lavarack Barracks, Townsville.

In developing the OMP, reference has been made to the *PFAS National Environmental Management Plan Version 3.0, 2025* (the 'PFAS NEMP'), the *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013 (the ASC NEPM)* and Defence estate, environmental and PFAS-specific strategies and guidance, and other information as provided in the References section of this document.

1.4 Constraints and assumptions

This OMP has been prepared based on information available at the time of writing and relies on the findings of the detailed site assessments (DSI), risk assessments, mass flux assessments, remediation activities, ongoing monitoring program data, and management of risks documented in the PMAP (Department of Defence, 2025). Defence recognises that there may still be gaps in information, and if required, these will be progressively reviewed while impacted sites are being managed.

This document has been developed based on the following assumptions:

- There are currently limited proven technologies for the treatment and destruction of PFAS. The treatment techniques discussed in this OMP were current at the time of writing.
- There is currently limited Australian contractor capability to implement proven technologies for the treatment and destruction of PFAS, as well as restrictions on local landfill disposal of PFAS.
- The monitoring focus is limited to impacts associated with PFAS only.

Information collected under the following work scopes on-base and off-base has been relied upon for the development of this report. These reports are therefore subject to their own limitations and assumptions as outlined in those reports:

- Detailed Site Investigation (DSI) Rev 4, 3 December 2019 (RPS/Wood 2019a);
- Seasonal Monitoring Report (SME) Rev 1, 3 December 2019 (RPS/Wood 2019b);
- Human Health Risk Assessment (HHRA) Rev 3, 3 December 2019 (RPS/Wood 2019c);
- Lavarack Barracks PFAS Management Area Plan Rev 5, Townsville, August 2020, Department of Defence (2020);
- Seasonal Monitoring Report 2, Lavarack Barracks PFAS Investigation. Rev 2, 12 August 2020 (RPS/Wood 2020a);
- Ecological Risk Assessment (ERA) Rev 4, 18 August 2020 (RPS/Wood 2020b);
- Ongoing Monitoring Interpretive Report (October 2020 – March 2023), 24 October 2023 (AECOM 2023);
- PFAS Annual Mass Discharge Report, Lavarack Barracks PMAP Delivery Rev 1, 20 January 2023 (WSP Golder 2023a);
- Remediation Action Plan: Former Fire Stations (PSC-4) Lavarack Barracks Rev A, 16 February 2023 (WSP Golder 2023b);
- Soil and Groundwater Delineation Report, Former Fire Training Area (PSC-5) / Monocell (PSC-6) Lavarack Barracks, 30 October 2023 (WSP Golder 2023c);
- PFAS OMP Lavarack Barracks, Sampling and Analysis Quality Plan, 20 February 2024 (AECOM 2024); and
- Lavarack Barracks PFAS Management Area Plan, Townsville, Department of Defence (2025).

2 SITE SETTING

2.1 Base description

The base is located in Townsville, North Queensland and covers an area of approximately 740 hectares (ha). The base consists of a working, training, and accommodation facility, which houses the Australian Army 3rd and 11th Brigades and supporting organisations. Activities carried out at the base are mainly related to general Defence training activities, and vehicle maintenance works. Vehicle maintenance workshops include wash-down bays, interceptor pits, and battery storage areas. The base also contains numerous workshops and bulk fuel area/oil storage and distribution facilities, including a former Mobil Service Station (Department of Defence, 2025).

The base is located at the foot of Mount Stuart with regional topography influencing ground and surface water flows in a northerly and north-easterly direction towards Ross River. A dam is located at the central portion of the site and several creeks, which are tributaries of Ross River that flow through the base. Lavarack golf course and sporting fields are located along the northern boundary of the site. A site locality plan is provided in Figure 1, Appendix B and site features are provided in Figure 2, Appendix B.

2.2 Management area setting

The PFAS Management Area comprises 2,365 ha and is divided into ‘on-base’ and ‘off-base’ areas. The boundary of the Management Area is formed by Ross River to the north, the relevant sub-catchment boundaries to the east and west, and the southern base boundary to the south (refer to Figure 2, Appendix B).

The Management Area includes the base and the surrounding residential suburbs of Murray, Douglas, Annandale, Idalia, Oonoonba, and Wulguru (Department of Defence, 2025). The area north of the base mainly consists of low-density residential properties. In addition, schools, public recreational areas, commercial and light industrial properties are also located within the Management Area.

Risk characterisation for PFAS in the on-base and off-base areas in the Management Area focuses on ecological and human receptors per the Human Health Risk Assessment (RPS/Wood 2019c) and Ecological Risk Assessment (RPS/Wood 2020):

On-base

- There are no key ecological receptors identified within the on-base area.
- Residents of the base and workers/visitors to the base are key on-base human receptors.

Off-base

- Ross River and its tributaries are considered key ecological receptors within the off-base Management Area.
- The key off-base human receptors include:
    - Residents of the low-density residential properties and workers in the commercial/industrial properties in the vicinity of the base.
    - Users of groundwater and surface water for recreational activities (eg dermal contact and incidental ingestion).

- Users of groundwater for drinking water supply at private residences. Note, there are no surface water sources for public drinking water in the Management Area as none of the weirs in Ross River (especially Black Weir[1]) are identified as an emergency water supplies for Townsville. The Regional Water Supply Security Assessment, Townsville SoQ (2014) identifies three sources of water supply for Townsville: Paluma Dam / Crystal Creek, Ross River Dam (primary source), and the Burdekin Haughton Water Supply Scheme, which is the backup supply should drought conditions prevail and water levels in Ross River Dam decline to <10% capacity.
- Users of groundwater for the irrigation and consumption of home-grown primary produce.
- Users of surface water for harvesting and consumption of biota (eg fish).

The Management Area is located within the dry tropics of Queensland. Townsville's climate is dominated by a wet season (November to April) and dry season (May to October). The wet season is typically hot and humid, with a long-term maximum average temperature of 30.9 Degrees Celsius (°C) and a minimum average temperature of 23.2°C (BoM, 2024). Dry seasons are generally warm with a long-term maximum average temperature of 27°C and a minimum average temperature of 16.5°C (BoM, 2024). Townsville's average yearly rainfall is 1,129.4 millimetres (mm) with contrasting wet and dry season averages (wet season: 1,012.5 mm [89.6%]; dry season average: 119.3 mm [10.4%]), which falls on a total of 65 days per year (BoM, 2024). The intensity of the pronounced wet season has a substantial bearing on the shallow geology and hydrogeology as well as the surface water and groundwater flow regimes across the Management Area. Many of the watercourses (and drains) that flow through the on-base and off-base areas of the Management Area are ephemeral, with little to no water (ponded or flowing) present during the dry season. Surface water is generally limited to downstream water courses (ie lower tributaries to Ross River) and waterbodies in the on-base and off-base areas (eg on-base dams, lakes in the suburb of Idalia) and Ross River.

The topography of the Management Area is characterised by a hillslope profile descending from the Mount Stuart massif to the south towards the Ross River floodplain terraces. The Management Area is characterised by coastal floodplain sediments (in the northern Management Area) and colluvial hillslope soils (in the southern Management Area) over igneous granitic bedrock. The underlying bedrock consists predominantly of Carboniferous volcanics and Permian intrusions.

Shallow groundwater is present within the alluvial sediments of the Ross River floodplain and likely recharged by the network of inflowing freshwater tributaries, direct infiltration from rainfall in the catchment, and baseflow from rainfall on the surrounding granitic outcrop and associated colluvium.

A groundwater bore search (https://qldglobe.information.qld.gov.au/) was conducted in July 2024 for the Management Area and 108 registered existing groundwater bores were identified. These bores are registered for domestic (50), irrigation (6), monitoring (31), test (4), commercial school (1), lake top up (1), and unknown (15) purposes.

[1] Surface water monitoring location SW245 is in Black Weir, and SW244 is in Gleeson's Weir; these locations are upstream of potential downstream influences from Lavarack Barracks and are considered reference surface water locations in the OMP.

3 EXTENT OF PFAS CONTAMINATION

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

3.1 Source areas

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

The PFAS source areas that have been identified through previous investigations are presented in Table 3.1. These investigations include the detailed site investigation (RPS/Wood 2019), the annual mass discharge assessment (WSP Golder 2023a), and soil and groundwater delineation investigations for PSC-4 (WSP Golder 2023b), and PSC-5 and PSC-6 (WSP Golder 2023c). The information provided in the above listed reports is compiled in the 2025 PMAP (Department of Defence, 2025). A map showing the source areas is provided as Figure 2 in Appendix B.

3.2 PFAS transport pathways

PFAS can travel from a source to human or ecological receptors by surface water or groundwater. These are referred to as transport (or migration) pathways. The DSI identified that the dominant transport pathway for PFAS through and from Lavarack Barracks was via surface water migration. It was noted that whilst groundwater pathways do exist, they are limited due to the nature of the geology/hydrogeological setting, such as low hydraulic conductivity, as well as the intermitting and disconnected groundwater flow paths on-base. In general, there is likely limited groundwater-surface water connectivity due to the low permeability of the alluvial soils on-base, except around drains and creeks up-stream of the Lower Dam.

These migration pathways, and the potential mass of PFAS migrating off-base was further assessed as part of the PFAS Annual Mass Discharge Report (WSP Golder, 2023a). This report identifies the mass of PFAS migrating in both the surface water and groundwater transport pathways. The surface water migration was sub-divided into catchments based on the natural surface water flow to enable an understanding of the source areas (Table 3.1) that may be contributing to the PFAS mass in each catchment at the northern (downstream) boundary of the base. The surface water sub-catchments are presented in Figure 4. The groundwater was assessed along the north (down hydraulic gradient) boundary, along a flux plane, divided unto individual ‘faces’ connecting adjoining wells.

The annualised PFAS mass discharge indicates that surface water is the dominant transport pathway for PFAS, with 93% of the PFAS mass migrating via this pathway, with PFAS mass discharge via groundwater estimated to account for, at most, 7% of the annual PFAS mass migration. off-base PFAS mass discharge via surface water is dominated by discharge from Catchment G (Central), which contains the on-base series of dams and the priority source areas PSC-4, the former Fire Station, and PSC-6, the Former Fire Training Area.

The transport pathways identified at and surrounding the base are summarised in Table 3.2.

Table 3.1 Known source areas of PFAS, Lavarack Barracks (to 2024)

Potential Sources of Contamination (PSC)	Source Area	CSR Number	Extent of PFAS Contamination[1,2]
PSC-1	Soil Stockpile Area	CSR_QLD_000534	• Low concentrations of PFAS in soil, groundwater and surface water. • Further sampling required to characterise soil for ongoing training use.
PSC-2	Suspected AFFF Disposal Area	CSR_QLD_000535	• Low concentrations of PFAS in soil, groundwater and surface water. • No further action required.
PSC-3	Former Helicopter Squadron 2CAV Buried OCP Waste Material	CSR_QLD_000488 CSR_QLD_000055	• Low concentrations of PFAS in soil, groundwater and surface water. • Possible contribution of PFAS to Top Dam.
PSC-4	Former Fire Station	CSR_QLD_000536	• PFAS present in concrete and soil associated with the former Fire Station, estimated mass of PFAS was 55.6 kg (∑28 PFAS). • Migration via groundwater and surface water to Lower Dam, then off-base. • Remediation Action Plan prepared. • Further assessment under the Dental building to be undertaken in the future if land use changes. • **Remediation** to be undertaken.
PSC-5	Monocell	CSR_QLD_000315	• Delineation of soil and groundwater, with assessment of interactions with surface water, indicates no detectable PFAS. Water within Monocell had low concentrations of PFAS. • Surface water and groundwater flow direction toward Catchment G (north-west), with negligible contribution to Catchment J (north-east) and associated off-base receptors. • The Monocell not considered to be an ongoing source of PFAS that requires active management. • **No remediation action** is required for the Monocell.
PSC-6	Former Fire Training Area	CSR_QLD_000313	• Delineation of soil and groundwater indicates limited soil PFAS mass associated with one of the burn-pits. • Surface water and groundwater flow direction toward Catchment G (north-west), with negligible contribution to Catchment J (north-east) and associated off-base receptors.

Potential Sources of Contamination (PSC)	Source Area	CSR Number	Extent of PFAS Contamination[1,2]
			• Investigation limited to one of the two burn-pit areas due to Defence infrastructure; however, based on principles of remediation SFARP and incomplete PFAS mass migration, remediation of the former Fire Training Area is not warranted at this time. • **Ongoing monitoring** required and additional investigation under Defence infrastructure in the future land use changes.
PSC-7	Land 121 Project	CSR_QLD_000538	• Land121 area excavated as part of development and soil placed in stockpile. • **Remediation** of Land121 stockpile containing PFAS by off-site disposal was completed in 2024.
PSC-8	Former Helicopter Landing Area (Building 750)		• Low concentrations of PFAS in soil, groundwater and surface water. • No further action required.
PSC-9	Suspected Fire Training Area		• Low concentrations of PFAS in soil, groundwater and surface water. • No further action required.
PSC-10	Former Caribou Airfield		• Low concentrations of PFAS in soil, groundwater and surface water. • No further action required.
PSC-11	Former B Squadron	CSR_QLD_000540	• Low concentrations of PFAS in soil, groundwater and surface water. • No further action required.
PSC-12	Stockpile Designated Area 2	CSR_QLD_000314	• Low concentrations of PFAS in soil, groundwater and surface water. • No further action required. • Assessment to identify sources within Catchment K, which are contributing to Surface Water PFAS mass. • **Ongoing investigation** of Bulk Fuel Facility, Wash-down Bays, and Petroleum Platoon.
Secondary	Lavarack Golf Course Sporting Fields	CSR_QLD_000537	• Potential secondary source of PFAS due to irrigation practices at the base. Irrigation has ceased. • Low concentrations of PFAS in groundwater and surface water. • No further action required.

Potential Sources of Contamination (PSC)	Source Area	CSR Number	Extent of PFAS Contamination[1,2]
Secondary	On-base dams (Top, Middle, and Lower)	CSR_QLD_000539	• Secondary source of PFAS due to discharge either via groundwater or surface water from primary source areas within Catchment G. • Low concentrations of PFAS in groundwater and surface water. • No further action required.

[1] – Sources of extent of PFAS contamination at Lavarack Barracks include RPS/Wood (2019a), Department of Defence (2025), WSP Golder (2023a); WSP Golder 2023b); WSP Golder (2023c).

[2] – Where reference is made to future actions (ie remediation/further sampling/no further action), these actions will be subject to the site re-evaluation currently being undertaken.

PSC = potential source area; AFFF = aqueous film forming foam; SFARP = so far as reasonably practicable; OCP = organochlorine pesticides.

Table 3.2 PFAS transport pathways, Lavarack Barracks Management Area

Transport Mechanisms	Catchment / Well ID	Source Areas within the Catchment
Surface Water	A-2	None Identified.
	B	None Identified.
	C	None Identified.
	D	PSC-1 (soil stockpile area).
	E	Secondary PSC-13 (golf course).
	F	Secondary PSC-13 (golf course).
	G	PSC 2 (suspected AFFF disposal area), PSC-3 (former helicopter squadron), PSC-4 (former fire station), PSC-5 (Monocell), and PSC 6 (former fire training area).
	H	Secondary PSC-14 (sporting fields – western portion).
	I	Secondary PSC-14 (sporting fields – eastern portion).
	J	PSC-12 (stockpile designated area 2) and part of PSC-11 (former B Squadron).
	K	PSC-7 (Land 121 Project), PSC-8 (former helicopter landing area), PSC-9 (suspected fire training area), PSC-10 (former Caribou airfield) and PSC-11 (former B Squadron), and potential new sources Bulk Fuel Facility and Petroleum Platoon.
	L	None Identified.
Groundwater (wells represent off-base migration routes along the downgradient boundary)	MW125S	
	MW124	
	MW123S	PSC-4 (former fire station).
	MW121	
	MW120	
	MW002	PSC-8 (former helicopter landing area), PSC-10 (former Caribou airfield) and PSC-11 (former B Squadron).
	MW116	

Transport Mechanisms	Catchment / Well ID	Source Areas within the Catchment
	MW139	

PSC 5 (Monocell) and PSC 6 (former fire training area) were originally considered to be within Catchment J; however, subsequent investigation that flow from these areas were into Catchment G (WSP Golder, 2023b).

PSC = potential source area; AFFF = aqueous film forming foam.

3.3 Receptors and risks

The evaluation of risk to a set of identified human and ecological receptors via the above exposure pathways has been undertaken in the HHRA and the ERA. A summary of the risks to human and ecological receptors is provided in Section 3.3.1 and Section 3.3.2, respectively.

3.3.1 Human health receptors

A Human Health Risk Assessment (HHRA) (RPS/Wood, 2019c) was undertaken to quantitatively assess potential risk to human health associated with exposure to PFAS in soil, sediment, surface water and groundwater within the Management Area. The HHRA also considered potential human health risks from the consumption of home-grown fruit, vegetables, chicken eggs, and seafood within Ross River and associated tributaries. A complete exposure pathway must exist for a person to be exposed to PFAS. If the exposure pathway is not complete, then no PFAS exposure will occur and, as a result, no risk to health exists.

The HHRA process included a comparison of on-base PFAS concentrations within the different media (e.g. soil, surface water) to health-based investigation levels (HIL) or guideline values published by Australian regulators; this is a Tier 1 or screening level assessment. These criteria and guideline values are highly conservative, deliberately set at concentrations well below levels where adverse health effects are expected to occur in the general population.

Concentrations of PFAS in the tissue of some fish species were found to be above Tier 1 screening values. This triggered a Tier 2 assessment that considered a more detailed evaluation of the potential exposure from eating locally caught fish. Samples of water from one on-base dam used to irrigate the golf course were found to exceed Tier 1 screening values for recreational use. Although the dam was not used for swimming or other recreational activities, the potential for exposure to PFAS in water to irrigate the golf course was further considered in the Tier 2 assessment. Additionally, because there are no applicable Tier 1 criteria to evaluate produce consumption following irrigation, this pathway was also carried into the Tier 2 assessment.

The HHRA concluded that the potential risk from exposure to PFAS impacted media from the base was low and acceptable. A summary of the key human receptors is presented in Table 3.3.

Table 3.3 PFAS receptors and risk – human health (based on HHRA, [RPS/Wood 2019c])

Who? (Receptor Populations)	Where? (Source Location)	How? (Exposure Pathway)	What? (Risk to Health)	Why? (Reason for Risk)	More Details (Discussion)
Local residents	Off-base Soil in yards	Accidental ingestion (swallowing) of soil Inhalation of soil and dust (soil-derived)	Very low to negligible	Low concentrations in residential and public soil	PFAS measured within off-base **soil** from private residential land were below health-based investigation levels set for residential soil. Two samples taken from public walkways were below health-based guideline values for recreational areas. Concentrations below Tier 1 criteria for surface water, soil and sediment, as well as groundwater for non-potable use for ingestion, dermal contact and inhalation.
Local residents	Off-base Groundwater	Drinking the water extracted from groundwater	Very low	Limited use of groundwater for consumption	The Water Use Survey (204 respondents) indicated that 25% of residents had either a groundwater bore or surface water on their property. No respondent indicated bore (groundwater) water or surface water used as a primary source of drinking water. The Management Area is served by Townsville City-supplied water. Two residents, in areas with PFAS concentrations below current health advisory levels, indicated using bore (groundwater) water as a secondary source for drinking. As use of groundwater has been identified as a source of drinking water to a limited number of residents, this indicates a potentially complete exposure pathway to human health risk. It is recognised that this exposure pathway is limited to a small proportion of residents.
Local residents	Off-base Garden produce	Eating fruit, vegetables, and poultry eggs irrigated with groundwater and grown/collected at home	Very low	Concentrations of PFAS in home grown produce are low Consumption of 10% of food consumed daily is home grown	PFAS concentrations in home-grown produce, due to bioaccumulation from groundwater used for irrigation, below guideline levels for ingestion based on the assumption that 10% of total fruits, vegetables and poultry eggs eaten daily was home-grown (i.e. not from outside sources). It was also noted that the home grown produce, vegetables, fruit and poultry do not appear to be widely grown within the Management Area.
Recreational users of the Ross River, tributaries, and local lakes	Off-base Surface water and sediment	Accidental ingestion and inhalation of water during swimming, boating, and	Very low to negligible	Low concentrations in surface water and sediments	PFAS measured in surface water and sediments of local rivers, creeks, lakes, and tributaries below the health-based recreational screening criteria considering incidental ingestion and dermal exposures.

Who? (Receptor Populations)	Where? (Source Location)	How? (Exposure Pathway)	What? (Risk to Health)	Why? (Reason for Risk)	More Details (Discussion)
		other water activities			
Recreational Anglers	Off-base Ross River and its tributaries (estuarine and freshwater)	Eating locally caught seafood	Low	Considering a combination of: Generally low PFAS concentrations in fish and the specific species Number of local fish meals per week Includes various locations - Ross River, Northview Lake, and Fairfield Lake	Measured PFAS concentrations within milkfish suggest consumption of two meals per week caught from within Fairfield Lake (within the suburb of Idalia) will not result in levels of PFAS above TDI. Precautionary advice has been issued by Queensland Health for recreational fishing and the consumption of fish from the lakes within Idalia and Gordon Creek. Signage providing this precautionary advice has been erected around the lakes within Idalia, as well as existing signage at Alpin's Weir.
Recreational Shellfish Harvesters	Off-base Ross River and its tributaries (estuarine and freshwater)	Eating locally harvested shellfish	Very low to negligible	Low concentrations of PFAS in shellfish	Recreational shellfish harvesting considered a negligible risk based on PFAS concentrations in blue swimmer crab and mud crab being below screening levels.
Defence personnel, contractors, and visitors	On-base Soil	Accidental ingestion of soil Inhalation of soil and dust (soil-derived)	Very low to negligible	Low concentrations in soil	PFAS within on-base **soil** were generally 10 to 1,000 times lower than nationally agreed health-based investigation levels for industrial and commercial worker scenarios. This includes maintenance workers working in trenches and pits within the soil. PFOS + PFHxS concentrations were found to exceed the investigation levels in 6 soil samples in the Former Fire Station where remediation is scheduled to be completed. One concrete sample was also found to have PFOS + PFHxS concentrations that exceeded the investigation levels. This is considered outliers within a small area, and people would not commonly access that location, resulting in minor, irregular exposure.

Who? (Receptor Populations)	Where? (Source Location)	How? (Exposure Pathway)	What? (Risk to Health)	Why? (Reason for Risk)	More Details (Discussion)
Defence personnel, contractors, and visitors	On-base Groundwater	Drinking the water extracted from groundwater	Extremely low to negligible	No exposure pathway to groundwater	On-base **groundwater** is not extracted for use as a drinking water or irrigation supply; therefore, this exposure pathway is incomplete. Groundwater is found greater than 3 m below ground level; therefore, construction or services workers are unlikely to come into contact with groundwater during on-base excavation activities. If groundwater is to be encountered during excavation, exposure can be controlled through Work Health Safety protocols. As such, people are not exposed to PFAS in groundwater.
Defence personnel, contractors, and visitors	On-base Surface water Sediments	Direct contact with surface water and sediments	Extremely low to negligible	No exposure pathway to surface water and sediments	On-base **surface water** bodies, such as Top, Middle and Lower Dams, are not used for recreation. Base personnel do not enter these water bodies to swim or boat. Therefore, no complete exposure pathways exist.
Defence personnel, contractors, and visitors. Adults and children utilising the golf course	On-base Golf course irrigated with water from the Lower Dam	Direct contact with surface water used to irrigate the golf course	Very low	Limited exposure	The potential for exposure to PFAS in surface water used to irrigate the golf course is limited. This is based on the intermittent frequency of use of the golf course, the duration of time spent on irrigated areas, and the limited exposure pathway to the water once it has been used to irrigate the golf course areas. The golf course has subsequently been closed and as such irrigation has ceased.

TDI = tolerable daily intake.

3.3.2 Ecological receptors

An Ecological Risk Assessment (ERA) (RPS/Wood, 2020) was undertaken to assess potential risk to environment. Exposure pathways for terrestrial plants and invertebrates, including herbivorous and predatory wildlife, were considered as either not complete or not significant based on PFAS concentrations and current/future land use. Aquatic plants, aquatic invertebrates (e.g. crabs, water bugs, leeches etc.) and fish, as well as herbivorous (plant-eating), piscivorous (fish-eating) and predatory (meat-eating) wildlife, were considered to have potential complete exposure pathways associated with PFAS in surface water, sediment, and sediment pore water within the Management Area.

Key conclusions from the ERA are:

- Risks from PFAS to the aquatic environment are likely elevated, with surface water from the central drainage (Catchments G and R) and eastern drainage (Catchments J, K, and L) categorised as high risk;
- Risks from PFAS to the aquatic environment within the lakes in the suburb of Idalia are low to moderate risk; and
- PFOS was noted to be accumulating in on-base and off-base biota, most likely to accumulate in fish tissue, and less likely to accumulate in aquatic plants.

A summary of the key ecological receptors is presented in Table 3.4.

Table 3.4 PFAS receptors – ecological (based on ERA [RPS/Wood, 2020])

Who? (Receptor populations)	Where? (Source Area)	How? (Exposure Pathway)	What? (Assessment of Risk)	Why? (Reason for Risk)	More Details (Discussion)
Piscivorous, invertivores and herbivore wildlife	Central Drainage	Based on the bird and mammal diet	High	Elevated concentrations of PFOS+PFHxS in tissue samples	PFOS is accumulating in biota both on- and off-base. PFOS least likely to accumulate in aquatic plant tissue and most likely to accumulate in fish tissue.
	Eastern Drainage		High		
	Idalia Suburb Lakes		Low to Moderate		
Aquatic plants, aquatic macroinvertebrates, fish	Central Drainage	Direct contact exposure	Low	Elevated concentrations of PFOS	Maximum and average PFOS concentrations in surface water above the screening value protective of direct contact exposure.
	Eastern Drainage		Low		
	Idalia Suburb Lakes		Low		
Aquatic plants, aquatic macroinvertebrates, fish. Piscivorous, invertivores and herbivore wildlife.	Catchment A	Assessment of all exposure pathways	Negligible	Low concentrations in all media	PFAS concentrations in surface water, pore water, aquatic plants, aquatic invertebrates, and fish all below EILs.
	Catchment C		Negligible		
	Gordon Creek		Negligible		
	Ross River		Negligible		

EIL = ecological investigation level.

4 ONGOING MONITORING PLAN

This section sets out the data quality objectives, monitoring scope, and assessment requirements for the OMP field work. Changes made to the OMP, included in the Lavarack Barracks PFAS Management Area Plan (Department of Defence, 2025), are summarised in the following sections, and supporting rationale is provided in Appendix D.

4.1 Sampling, analysis, and quality plan

A SAQP will be developed prior to implementation of the OMP. The SAQP provides information on data quality assurance procedures and measures including data quality indicators (DQI), and sampling and analytical methods. The SAQP will be updated as required.

4.2 Data quality objectives

The Data Quality Objective (DQO) process is an iterative planning approach used to define the type, quantity, and quality of data that are 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; and
- 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	The site has historically been used as a Defence base including a fire station and a fire training centre, which is understood to have included the use of AFFF during training activities. PFAS has historically been identified in soil, surface water, sediment and groundwater at the site and the surroundings.
Step 2: Identify the goal of the study	The goals of the assessment are to: • Evaluate the nature and extent (spatial and temporal) of PFAS impact in groundwater and surface water pathways associated with site sources of PFAS derived from AFFF. • Monitor the migration of PFAS in groundwater and surface water from the site. • Provide confirmation of the current understanding of risk. • Provide supporting data for assessment of management actions originating from the PMAP.
Step 3: Identify the information inputs	The inputs required to achieve the goals of the assessment are: • Available geological and hydrogeological data. • Available previous investigation results, site information, and information from publicly available databases and government websites. • Field observations. • Laboratory analytical data for contaminants of potential concern in groundwater, surface water and sediment collected at the site.

Process	Description
	• Site assessment criteria for the media assessed.
Step 4: Define the boundaries of the study	The PFAS Management Area considered in this OMP includes the base and the surrounding residential suburbs as described in the PMAP for the site (refer to Figure 2, Appendix B for the boundaries). The vertical limits of the OMP will extend to the maximum depth of groundwater monitoring wells. The temporal boundaries will be from the date of the available historical data to the final sampling date for the assessment. The analytical detection limits (ie LOR by the analytical laboratory, Section 4.8) define a data boundary for which PFAS concentrations will be detected as part of the monitoring.
Step 5: Develop the analytical approach / decision rules	The purpose of this step is to define the parameters of interest, specify the action levels, and combine the outputs of the previous DQO steps into an 'if…then…' decision rule that defines the conditions that would cause the decision maker to choose alternative actions. The decision rules for the assessment (defined as screening triggers) are: • If PFAS concentrations are not detectable (<LOR) or measured below the screening criteria applicable to the monitoring location (eg on-base, off-base), it will be considered whether monitoring is to be continued or reduced – *Negligible potential to result in a risk profile change (Trigger 0)*. • If PFAS concentrations are detectable, above the adopted screening criteria applicable to the monitoring location (eg on-base, off-base), and have the potential to affect the risk profile for that location, further assessment and response required. • If PFAS is reported at a concentration that is greater than the 85th percentile of the existing data for the monitoring location and shows a visually increasing trend[2] for the previous three (3) wet seasons, then data verification will be undertaken. If verified, further assessment and mitigation responses will be required – *High potential to result in a risk profile change (Trigger 3)*. • If PFAS is reported at a concentration that is greater than the 65th percentile of the existing data for the monitoring location and shows a visually increasing trend for the previous three (3) wet seasons, then further assessment may be considered – *Elevated potential to result in a risk profile change (Trigger 2)*. • If PFAS is reported at a concentration that is less than the 65th percentile of the existing data for the monitoring location and does not show a visually increasing trend for the previous three (3) wet seasons, monitoring will be continued – *Low potential to result in a risk profile change (Trigger 1)*. Further information on the trigger screening process and potential response actions is provided in Section 7.
Step 6: Specify performance or acceptance criteria	The acceptable limits on decision errors to be applied in the investigation and the manner of addressing possible decision errors have been developed based on the DQIs of precision, accuracy, representativeness, comparability, and completeness and are presented in Table 4.2 and Table 4.3.
Step 7: Optimise the plan for obtaining data	The purpose of this step is to identify a resource-effective data collection design for generating data that satisfies the DQOs. This OMP has been designed considering the information and data obtained during the review of available site information and PMAP. The resource effective data collection design that is expected to satisfy the DQOs is described in detail in the following sections. To ensure the design satisfies the DQOs, DQIs (for accuracy, comparability, completeness, precision and reproducibility) have been established to set

[2] At each monitoring location for groundwater, surface water, and sediment components, PFAS data (ie PFOS, PFOA, ∑PFOS and PFHxS, and ∑PFAS) will be plotted on time series plots and visually evaluated to identify increasing trends.

Process	Description
	acceptance limits on field methods and laboratory data collected and are presented in Table 4.2 and Table 4.3.

4.3 Data quality indicators

The following DQIs have been established to set the QA/QC acceptance limits on field and laboratory data.

- **Representativeness** – The confidence (expressed qualitatively) that data are representative of each media present.
- **Comparability** – The confidence (expressed qualitatively) that data may be considered equivalent for each sampling and analytical event.
- **Accuracy** – A measure of the closeness of the results to the actual results. Accuracy is assessed through the comparison of results produced by the primary and secondary laboratories for the same sample and by measuring the extent to which an analytical result reflects the known concentration as measured by the recovery obtained from internal laboratory spikes.
- **Precision** – A measure of the repeatability of results by the laboratory. This is assessed through the analysis of a sample, and it's duplicate (ie collected during field sampling and as part of the laboratory internal QA/QC processes) and is calculated by using relative percentage differences (RPDs).
- **Completeness** – The percentage of acceptable data obtained compared to the amount of data needed to achieve a particular level of confidence in the results.

The quantitative and qualitative measures/criteria employed to enable application of the DQI parameters are described in Table 4.2, below.

Table 4.2 Summary of data quality indicators

DQI	Field & Laboratory DQI Considerations
Representativeness	Appropriate media sampled according to the OMP, and all media identified in the OMP sampled and analysed. Samples analysed using same laboratory procedures and within appropriate holding times. Appropriate collection, handling, storage, and preservation used. Potential for change in sample before analysis may decrease representativeness.
Comparability	Same approach to sampling by use of standard procedures on each occasion, use of qualified samplers, same types of sampling equipment used, same types of samples collected, same analytical methods used, same sample LORs, same laboratories, same units, same laboratory methods, and appropriate sample integrity. The laboratories used are required to be National Association of Testing Authority (NATA) registered and the methods used are required to be NATA endorsed for all the analyses undertaken.
Accuracy	This is assessed through compliance with standard procedures and analysis of field blanks, rinsates, reagent blanks, method blanks, surrogate spikes, reference materials, laboratory control samples, and laboratory-prepared spiked control samples. Different matrix effects can affect the recoveries of some analytes and therefore recoveries that fall outside this range may still be acceptable. Accuracy is assessed through the comparison of results produced by the primary and secondary laboratories for the same sample and by measuring the extent to which an analytical result reflects the known concentration as measured by the recovery obtained from internal laboratory spikes.
Precision	This is assessed through compliance with standard procedures by collection of field duplicates, analysis of primary and secondary laboratory field duplicates, analysis of laboratory duplicates.

DQI	Field & Laboratory DQI Considerations
Completeness	All critical locations sampled, all samples collected (from grid and depth); appropriate standard procedures used and complied with, use of experienced samplers, and documentation correct. All critical samples and analytes analysed according to OMP, use of appropriate laboratory methods and LORs, sample documentation complete, sample holding times in compliance. Acceptable data are obtained when samples are collected and analysed in accordance with the quality control procedures and the DQIs.

NATA = National Association of Testing Authority.

Acceptance limits set to quantitatively assess DQIs are in accordance with the ASC NEPM and Standards Australia (AS/NZS 5567.1-1998) as outlined in Table 4.3.

Table 4.3 Summary of project quality acceptance limits

DQI	DQI Indicator	Acceptance Limit
Representativeness	-	Generally, there is no quantifiable acceptance limit for representativeness.
Comparability	LORs	LORs equivalent within each sampling / analytical event for each media, and between sampling events.
Accuracy	Field Method Blanks	Field method blanks will be collected of laboratory-supplied deionised water at rate of 1 per batch of deionised water to confirm the water being used is PFAS-free. Results should be below LORs.
	Rinsate Blanks	For PFAS samples, rinsates will be collected at a rate of at least one for every 10 primary samples but analysed at rate of 1 per day. If PFAS contamination is detected, additional rinsates samples will be submitted for analysis. Where dedicated sampling equipment is used (eg groundwater pumps which remain in bores or disposable bailers), no rinsate samples will be collected. Results should be below LORs.
	Trip Blanks	Submitted with each shipment of water samples to the laboratory and analysed as considered required. Trip blanks should be supplied by the laboratory (PFAS-free water in the same container used for the samples). Trip blanks are ordered from the laboratory and accompany the bottle order to site and the sample shipment from site. The trip blank remains in the cooler in the field for the duration of the sampling program. Results should be below LORs.
	Laboratory Method Blanks	Results should be below LORs.
	Laboratory Control Sample Spikes (LCS)	Analysed at a frequency of 10% of total samples analysed by the laboratory. Recoveries for most analytes should generally be within the range of 70% to 130%. This spike refers to a certified reference material or an independently prepared interference free matrix spiked with target analytes. Organic LCS' are almost exclusively blank water spiked with target analytes.
	Matrix Spikes	Analysed at a frequency of 10% of total samples analysed by the laboratory. Recoveries for most analytes should generally be within the range of 70% to 130%. Different matrix effects can affect the recoveries of some analytes and therefore recoveries that fall outside this range may still be acceptable. Matrix spikes refer to an intra-laboratory split sample, spiked

DQI	DQI Indicator	Acceptance Limit
		with a representative set of target analytes. This spike monitors potential matrix effects on analyte recoveries.
	Surrogates	Surrogates are added or analysed with each batch of samples and recoveries should be within acceptable laboratory limits.
Precision	Field Duplicates (Inter-laboratory duplicates)	Duplicates will be collected at a rate of 1 in 10 (ie 1 sample in 10 is analysed by the primary laboratory and 1 sample in 10 is analysed by the second laboratory. Refer to Section 4.3.1 for RPD calculations and acceptance limits.
	Field Duplicates (Intra-laboratory duplicates) (Blind duplicates)	Duplicates to be analysed at a rate of 1 in 10 samples will be a blind field duplicate analysed by the primary laboratory. Refer to Section 4.3.1 for RPD calculations and acceptance limits.
Completeness	Overall Completeness	95% of usable data are achieved from a data collection activity.

RPD = relative percent difference; LOR = limit of reporting.

If anomalous data are identified from data collected in the field or during review of the field with respect to DQIs, the potential cause for the anomalous results will be evaluated (eg change in analytical resolution, field or laboratory contamination, incorrect station location or transcription error). Anomalous data identified during this QA/QC analyses and confirmed by follow-up actions (eg review of field notes, re-analysis by laboratory) will be:

- flagged with recommendation for follow-up monitoring (ie for monitoring locations identified as critical for decision making [high risk profile locations]);
- flagged with consideration of the uncertainty during data interpretation; or
- excluded from the assessment.

Anomalous data and follow-up will be identified in the Sampling Event Report (SER).

4.3.1 Relative percent difference calculations

The Primary (intra-laboratory) and Secondary (inter-laboratory) duplicates are duplicate samples of the primary sample collected during sampling. The primary duplicates are labelled differently to the primary sample, and both primary duplicates are submitted to the primary laboratory for analysis (NATA accredited for the analysis required). The secondary duplicate is sent to the quality control laboratory (secondary laboratory; which will also be NATA accredited for the analyses required) for analysis to compare the results obtained between the two laboratories.

The primary and secondary duplicate results are compared with primary sample results using RPDs. RPDs are calculated according to the following formula:

$$\mathrm{RPD} = \left|\frac{A - B}{A + B}\right| \times 200$$

Where A is the concentration of the primary laboratory result per analyte and B is the corresponding duplicate result.

RPD values can range from 0% (indicating perfect correlation between results) to 200% (indicating complete divergence in results). In calculating RPD values, the following protocol types will be adopted according to the circumstance:

- **Type 1:** Where the two laboratories have reported levels below their LORs, a RPD of <50% will be assigned in the table.

- **Type 2A:** Where one laboratory has reported a value below a LOR and the other has identified detectable contaminant concentrations, a RPD will be calculated. This will be achieved using the LOR for the undetected sample, and comparing that to the concentration of the detected sample.
- **Type 2B:** Similar to Type 2A RPDs, except that the primary and secondary laboratories have different LORs and a reported value from one laboratory may be below a LOR from the other and may result in an elevated RPD.
- **Type 3:** Where both laboratories report detectable amounts of contaminant, a RPD will be calculated.

4.4 Proposed monitoring intervals

The complete groundwater, surface water, and sediment sampling across the Management Area will mostly be performed annually during the wet season, which will be timed to occur in March/April. Dry season sampling for surface water quality will be limited to a subset of the annual wet season monitoring locations and include eight (8) permanent waterbodies (ie on-base dams, lakes in the suburb of Idalia, and Ross River). Dry season sampling will be timed to occur in September/October.

The seasonality and frequency of sampling events will be reviewed after every sampling event and updated/changed where necessary based on the value addition of data produced to the OMP objectives. The OMP, per this update, will be undertaken for an initial period of two years (or as instructed by Defence), with the initial sampling event to be completed in September/October 2024. The proposed schedule of fieldwork across the initial two-year period is presented in Table 4.4 below.

Table 4.4 Proposed fieldwork schedule

Sampling Round	Description of Work	Proposed Schedule
Round 1	Dry season groundwater, surface water quality, and sediment sampling per the previous OMP (AECOM, 2023), with minor modifications.	September/October 2024
Round 2	Wet season groundwater, surface water and sediment sampling.	March/April 2025
Round 3	Dry season surface water sampling at on-base dams, lakes in the suburb of Idalia, and Ross River.	September/October 2025

4.5 Groundwater sampling locations

There are 45 groundwater monitoring wells currently identified for sampling, recognising the existing monitoring well (MW128) will be destroyed as part of planned remediation and not re-instated per the RAP. It is assumed MW128 will be replaced by MW126, which is part of post-remediation monitoring. The number of groundwater monitoring wells included in the OMP will be reviewed after every sampling event and will be updated/changed based on the value addition of data produced to the OMP objectives.

Groundwater monitoring wells currently used in the OMP are located across the base, base boundary, Townsville City Council controlled public spaces, and one location on a private property (ie MW226). Permission to access some sampling locations at the base boundary and on private property for the OMP is required:

- Stakeholder permission is required to access the private property and sample MW226.
- Stakeholder access permission in the form of a Training Area Safety and Management Information System booking with Mount Stuart Training Area Range Control is required for access to MW124, MW125I, and MW125S. No formal permits are required for collection of environmental samples under this OMP.

The rationale for monitoring well selection for each area is summarised in Table 4.5.

Table 4.5 Rationale for groundwater monitoring locations

Management Area	Rationale
On-base	Sampling points have been selected both within and down-gradient of the identified source areas on the base, to monitor the change in PFAS concentrations at each source area and confirm the level of risk identified in the DSI.
Base Boundary	The base boundary sampling points act as 'sentinels' for potential changes in PFAS concentrations in groundwater in the off-base Management Area. These points are considered critical to the understanding of risk to sensitive receptors in the off-base Management Area.
Off-base	Sampling locations within the off-base Management Area have been selected to assess the key PFAS migration pathways and to confirm the understanding of off-base risk and provide additional data points for use in determining the seasonal and longer-term trends in PFAS migration via pathways identified during the DSI.

DSI = Detailed Site Investigation (RPS/Wood, 2019a).

The groundwater locations to be monitored as part of the wet season sampling event are provided in Table 4.6 and presented in Figure 3, Appendix B.

Table 4.6 Groundwater sampling locations

Management / Source Area	Well ID	Number of Wells
Eastern PFAS Contamination Area	MW018, MW114, MW115, MW116, MW139	5
Former B Squadron	MW135	1
Former Fire Station	MW104, MW105, MW128[1], MW126, MW339, MW340, MW346, MW347	8
Former Fire Training Area	MW131	1
Former Helicopter Squadron	MW102	1
Lavarack Golf Course & Sporting Field	MW065, MW120, MW121, MW122, MW123I, MW123S	6
Monocell	MW014A, MW072, MW074, MW106	4
Stockpile Designated Area 2	MW141	1
Suspected AFFF Disposal Area	MW101	1
On-base dams (Top, Middle and Lower)	MW138	1
Base Boundary	MW002, MW003, MW118, MW119, MW124, MW125I, MW125S	7
Off-base	MW205S, MW212, MW217, MW220S, MW226[2], MW232, MW233, MW235S, MW236S	9
Total		**45**

[1] – The existing monitoring well (MW128) will be destroyed as part of planned remediation and not re-instated per the RAP. It is assumed MW128 will be changed to MW126, which is part of post-remediation monitoring; as a result, MW126 has been included herein.

[2] - MW226 is not shown on the attached Figure 3 due to privacy concerns.

4.6 Surface water sampling locations

The surface water sampling locations for the wet and dry season sampling events are provided in Table 4.7, Table 4.8 and presented in Figure 4, Appendix B. There are fewer surface water sampling locations to be monitored in the dry season because many of the sampling points are located in

surface water drains in the on-base and off-base area. These drains are ephemeral meaning that they are typically dry in the dry season. However, several of the downstream tributary watercourses to Ross River and the water bodies (ie the on-base dams, lakes in the suburb of Idalia and the impounded upstream regions of Ross River (by weirs) have permanent water. During the dry season sampling event, the tributary locations (where water flow is observed) and the permanent water bodies will be sampled.

Stakeholder access permission is required to access two sampling locations that are located on private property in the off-base area (ie SW/SD211 and SW/SD212). These locations have been selected to maintain consistency with the recent monitoring completed within the Management Area. Surface water locations are co-located with sediment sampling locations, and surface water will be collected at these locations where present.

Table 4.7 Surface water sampling locations – wet season

Management / Source Area	Location ID	Number of Locations
Eastern PFAS Contamination Area	SW119, SW121	2
Former Fire Station	SW109, SW110, SW138	3
Lavarack Golf Course & Sporting Field	SW129, SW130	2
On-base dams (Top, Middle and Lower)	SW139, SW140, SW144	3
On-base Balance	SW113, SW120	2
Base Boundary	SW126, SW128, SW132, SW133, SW134, SW135, SW136	7
Off-base	SW203, SW205, SW211, SW212, SW217, SW220, SW227, SW232, SW233, SW242, SW243, SW244, SW245	13
Total		**32**

Table 4.8 Surface water sampling locations – dry season

Management / Source Area	Location ID	Wet Season Number of Locations
On-base dams (Top, Middle and Lower)	SW139, SW140, SW144	3
Off-base	SW203[1], SW205[1], SW217[1], SW220[1], SW227, SW232[1], SW242[1], SW243, SW244, SW245	10
Total		**13**

[1] – surface water samples will only be collected if the creek/watercourse is flowing.

4.7 Sediment sampling locations

The sediment sampling locations for the wet season sampling event are provided in Table 4.7 and presented in Figure 4, Appendix B. As noted for surface water as the sediment sampling locations are co-located with surface water, stakeholder access permission is required to access and sample SW/SD211 and SW/SD212, which are located on private property. These locations have been maintained in conjunction with the surface water sampling locations to continue to monitor sediment concentrations as sediment represents a secondary pathway for PFAS transport within the Management Area.

Table 4.9 Sediment sampling locations

Management / Source Area	Location ID	Number of Locations
Eastern PFAS Contamination Area	SD119, SD121	2
Former Fire Station	SD109, SD110, SW138	3
Lavarack Golf Course & Sporting Field	SD129, SD130	2
On-base dams (Top, Middle and Lower)	SD139, SD140, SD144	3
On-base Balance	SD113, SD120	2
Base Boundary	SD126, SD128, SD132, SD133, SD134, SD135, SD136	7
Off-base	SD203, SD205, SD211, SD212, SD217, SD220, SD227, SD232, SD233, SD242, SD243, SD244, SD245	13
Total		**32**

4.8 Sample analysis

Samples will be analysed by a NATA accredited laboratory for a suite of PFAS compounds as outlined in Tables E.1 and E.2, Appendix E, using NATA accredited procedures. Given that the guidelines currently adopted for this OMP are all above the standard LORs (refer to Section 6), standard LORs are currently considered sufficient for the OMP.

Defence recognises potential changes to drinking water PFAS guidelines proposed by National Health and Medical Research Council (NHMRC, 2024) (see Section 6 for added information), which if approved will come into effect in 2025. As described in Section 6.1, Defence will adopt lower laboratory LOR for drinking water at select monitoring locations for the analysis of groundwater and surface water samples from base boundary and off-base monitoring locations that have consistently reported PFAS measurements at or below the standard LOR. This will be implemented as a pre-emptive step in the OMP to characterise and assess the exposure risk to human health for the consumption of water should the new drinking water guidelines be adopted.

Standard and low-level LORs are provided in Tables E.1 and E.2, Appendix E, respectively.

The suite of PFAS compounds analysed for the OMP may be revised if required to meet the OMP objective based on changes to screening criteria requirements or updates to the human and ecological risk profiles.

5 OTHER ASPECTS

Defence bases are dynamic in their operation, which includes ongoing infrastructure upgrades and re-development activities. With legacy PFAS contamination recognised at bases in Australia (eg Lavarack Barracks), these activities, which are conducted under the oversight of management and development plans and corresponding monitoring programs, provide information that furthers the understanding of the extent of contamination at the bases and the key pathways to off-site migration and risk. For Lavarack Barracks, some of the specific activities include remediation works across the base and at select legacy sites and Defence infrastructure projects (eg civil works, remediation projects). Project works under the PMAP and base infrastructure that have been completed or are scheduled to be undertaken are described in Section 5.1 and Section 5.2, respectively. These works need to be considered as part of the OMP implementation and/or interpretation of the sampling event monitoring data.

There is information that will be gathered from activities (eg public surveys) other than the monitoring data collected under the OMP that may affect the CSM for the Lavarack Barracks PFAS Remediation Project. This supplemental information will be used to continue to evaluate the potential or complete source-pathway-receptor linkages in the Management Area and includes identification of changes in local consumption habits or water uses, which may result in a change to a source-pathway-receptor linkage or pathway (eg a linkage changes from potential to complete) (Section 5.3).

5.1 PMAP investigation / remediation

PMAP delivery works commenced at the base are listed in Table 5.1.

Table 5.1 PMAP project works

Area of the Base	Works Completed	Scheduled Works	Consideration for OMP
Former Fire Station (PSC-4)	Investigation Development of RAP	Remediation in dry season 2025	Post-remediation monitoring to be incorporated into the OMP, replacement wells to be installed. Changes in OMP monitoring data as a result of remediation works.
Whole of base	Mass Discharge Assessment (baseline)	Implementation of mass discharge assessment for two wet seasons post remediation	Results from the Mass Discharge assessment to be considered in the interpretation of OMP.
LAND121 Stockpiled	Off-site disposal of PFAS contaminated soils	Validation sampling	Results of OMP monitoring in Catchment K to be considered based on LAND121 Stockpile removal.

5.2 On-base infrastructure projects

Construction projects implemented since the implementation of the OMP that may influence interpretation of the OMP data are listed in Table 5.2.

Table 5.2 Infrastructure project works

Area of the Base	Works Completed	Scheduled Works	Consideration for OMP
Eastern Catchment - Land 121	Civil works and construction included significant alterations and reworking of soils and	Completed 2016 to 2019, prior to the commencement of the OMP.	Results of OMP monitoring in Catchment K to be considered.

Area of the Base	Works Completed	Scheduled Works	Consideration for OMP
project (PSC-7)	infrastructure over a large area, on the eastern side of the base, resulting in a potentially large, diffuse source of PFAS.		based on earthworks completed.
Former B Squadron (PSC-11)	Redevelopment works have occurred as part of the Land 400 project, with a building constructed in this area.	Completed, prior to the commencement of the OMP.	Results of OMP monitoring in Catchment K to be considered based on earthworks completed.
Eastern Boundary	Sewer upgrade works were conducted along the eastern boundary and off-base to the northeast commencing in early 2022.	Completed.	Ground disturbance associated with these redevelopments has the potential to impact the nature and extent of PFAS in this area of the base including surface water flow and mobilisation of PFAS from disturbed areas.
Lavarack Golf Course (secondary source)	Lavarack golf course closed as a recreational area in late 2021 with irrigation ceased.	Irrigation ceased in 2022.	Consideration of OMP data based on changes of potential migration pathways for surface water and groundwater.

5.3 Conceptual site model considerations

The following are key aspects of the Human Health and Ecological CSMs that are to be considered in combination with the review of the monitoring data, as changes in PFAS concentrations in groundwater, surface water, or sediment may increase the potential risk to sensitive receptors.

5.3.1 Human health CSM

- Change in human exposure to soils and groundwater via direct contact pathways either on-base or off-base.
- Changes in the consumption habits of home grown produce to greater than 10% and presence of PFAS within home grown produce.
- Consumption of biota from the lakes in the suburb of Idalia (noting public advisories cautioning the consumption of aquatic biota collected from the lakes were posted at the lakes circa 2020).
- Recreational activities in on-base surface water bodies (surface water and sediment) (eg on-base dams).

5.3.2 Ecological CSM

- Changes to biota tissue PFAS concentrations in fish, crustaceans, and molluscs collected off-base, which may increase potential risk for toxicity to mammals and predatory birds who rely on these aquatic biota for sustenance.
- Increases in concentrations of PFAS within the biota due to the bioaccumulation potential of PFOS through the food web for terrestrial and semi-terrestrial mammals, herbivorous birds, invertivorous and omnivorous birds, and predatory birds.

Understanding changes in consumption habits or use of surface water bodies could be through anecdotal evidence or via conducting a local community survey (eg repeating the Water Use Survey). Obtaining additional data in support of updating the CSM is not part of the OMP; however, if information is acquired through the OMP that suggests a change in consumption habits or water use

(eg consumption of home-grown poultry/eggs), the resultant change in the Risk Profile will be assessed. Monitoring changes in PFAS concentrations within ecological receptors is not part of the OMP; however, if notable increases in surface water or sediment are observed during the OMP monitoring, this may lead to further assessment of PFAS concentrations within biota.

6 PFAS SCREENING CRITERIA

PFAS screening criteria for perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorohexane sulfonate (PFHxS) were derived in the PFAS NEMP (HEPA, 2025) using methods consistent with assumptions set out in the ASC NEPM (1999, as amended 2013). The criteria to be adopted for the OMP are outlined in Table 6.1.

Table 6.1 PFAS screening criteria

Pathway	Compound[1]	Criteria	Comments
Human Health Receptors			
Drinking water	PFOS + PFHxS	0.07 µg/L	The values are from the PFAS NEMP (HEPA, 2025). Base boundary and off-base groundwater and surface water data will be compared to these criteria.
	PFOA	0.56 µg/L	
Recreational use	PFOS + PFHxS	2 µg/L	The values are from the PFAS NEMP (HEPA, 2025). On-base and off-base surface water and groundwater data will be compared to these criteria.
	PFOA	10 µg/L	
Ecological Receptors			
Freshwater and marine water (95% species protection values)	PFOS	0.13 µg/L	The values are from the PFAS NEMP (HEPA, 2025). Off-Base surface water data and on-base dam data will be compared to these criteria.
	PFOA	220 µg/L	

[1] - Per the PFAS NEMP (HEPA, 2025), where the guideline values refer to the sum of PFOS and PFHxS, this includes PFOS only, PFHxS only, and the sum of the two.

It is noted that at the time this report was prepared no PFAS NEMP (HEPA, 2025) endorsed criteria were available for PFAS in sediments. However, guideline criteria will be reviewed annually and updated based on the HEPA endorsed criteria at the time.

It is also noted that if PFAS are detected in groundwater and surface water samples, comparison to the PFAS screening criteria presented in Table 6.1 represents the initial screening trigger for the OMP. If these screening criteria are exceeded, the consequent screening process is to determine if the data indicate the potential for a change in the risk profile to the sensitive receptors at that monitoring location or to downstream receptors. This is then followed by screening triggers that consider magnitude of PFAS relative to previously collected data and recent data trends, using a weight of evidence approach. The triggers and screening approach are described in Section 7.

6.1 Draft changes to Australian Drinking Water Guidelines (October 2024)

In October 2024, the National Health and Medical Research Council (NHRMC) released draft health-based drinking water guideline values for public consultation (NHMRC 2024). Defence is considering how the draft guidelines, if adopted, may affect its PFAS Investigation and Management Program, and communities surrounding the Defence Estate. An initial step to this is the adoption of a lower laboratory LORs at select locations to understand any future implications; these select locations would comprise groundwater and surface locations that consistently report PFAS measurements at or below the standard LOR (eg base boundary groundwater monitoring wells MW003, MW118, and MW124, and off-base wells MW205S, MW212, MW217, MW233, and MW235S, and base boundary surface water locations SW126, SW128, SW129, SW130, SW133, SW134, and SW136, and off-base surface water locations SW205, SW211, SW212, SW217, SW227, SW232, SW243, SW244, and

SW245). Until the revised PFAS guideline values are finalised and published, the current Australian Drinking Water Guidelines, as they are applied for screening in the OMP, will remain in effect.

7 TRIGGERS FOR ACTION AND/OR REVIEW

PFAS compounds (ie PFOS, PFOA, and ∑PFOS and PFHxS) are detected at most on-base and off-base monitoring locations (excluding upstream reference locations). Identifying and implementing appropriate screening triggers is a critical component of Defence's approach to identifying and managing risks to sensitive receptors from PFAS contamination. The following data screening triggers and the associated responses will be considered during this OMP:

- If PFAS concentrations are not detectable (<LOR) or measured below the screening criteria applicable to the monitoring location (eg on-base, off-base), monitoring may be continued, reduced, or ceased – ***Negligible potential to result in a risk profile change (Trigger 0)***.
- If PFAS concentrations are detectable, above the adopted screening criteria applicable to the monitoring location (eg on-base, off-base), and have the potential to affect the risk profile for that location, further assessment and response will be required.
- If PFAS is reported at a concentration greater than the 85th percentile of the existing data for the monitoring location and shows a visually increasing trend[3] for the previous three (3) wet seasons, then data verification will be undertaken. If verified, further assessment and mitigation responses will be required – ***High potential to result in a risk profile change (Trigger 3)***.
- If PFAS is reported at a concentration greater than the 65th percentile of the existing data for the monitoring location and shows a visually increasing trend for the previous three (3) wet seasons, then further assessment may be considered – ***Elevated potential to result in a risk profile change (Trigger 2)***.
- If PFAS is reported at a concentration that is less than the 65th percentile of the existing data for the monitoring location and does not show a visual increasing trend for the previous three (3) wet seasons, monitoring will be continued – ***Low potential to result in a risk profile change (Trigger 1)***.

For this OMP, the screening trigger process will focus on groundwater data and surface water quality. Screening will not apply to the sediment quality data unless it is a response action to an elevated risk or high-risk trigger. The evaluation of a change to risk profile at a monitoring location based on sediment PFAS concentrations is subject to uncertainty because:

- sediment PFAS concentrations cannot be screened against guidelines; there are no current sediment guidelines or environmental investigation levels for sediment in the NEMP (HEPA, 2025) or from other national environmental agencies; and
- there are uncertainties in sediment PFAS concentrations sources (eg PFAS bound to sediment, PFAS in porewater), the representativeness of concentrations based on site (water body, creek course, drain), sampling technique and repeatability, equilibrium between the sediment and porewater, and season, and linkage to risk profile for human health and/or ecological risk.

For groundwater and surface water quality, a weight of evidence approach for the Management Area based on PFAS concentration, concentration trends, and potential for change in risk profile is to be adopted for an evaluation of risk and response. The screening process applicable to the OMP is illustrated in Figure 7.1.

In the screening trigger process for groundwater and surface water quality, reference is made to comparing measured PFAS concentrations to applicable screening criteria, which are listed in

[3] At each monitoring location for groundwater and surface water components, wet season PFAS data (ie PFOS, PFOA, ∑PFOS and PFHxS, and ∑PFAS) will be plotted on time series plots (or similarly displayed) and visually evaluated to identify increasing trends over the past three wet seasons.

Table 6.1. These screening criteria will not be applied to all collected data. Instead, the screening criteria will be applicable to the monitoring location within the monitoring area (Table 7.1). For example, groundwater and surface water quality PFAS concentrations within the on-base area, excluding on-base dams, will be limited to screening against NHMRC (2019) and HEPA (2025) PFAS Recreational Water guidelines. This is because the risk profile for on-base is limited to the potential for body contact and exposure of groundwater and surface water; the primary pathway is potential for contact and exposure to workers from surface water/groundwater exposure during irrigation or during construction and excavation activities. There is no potable use of the water sources, including the on-base dams, or cultivation of produce for consumption on-base. Due to the aquatic habitat associated with the on-base dams for fish and other water-borne biota, including aquatic birds that visit the dams, and because aquatic life has been shown to bioaccumulate PFAS, measured PFAS in surface water samples from the dams (SW144, SW139, and SW140) will also be compared to ecological guidelines.

Table 7.1 Monitoring guidelines used for comparison to site-specific and media specific data

Monitoring Area	Monitoring Component	Applicable Guideline	Rationale and Risk Potential
On-base	Groundwater	PFAS NEMP 3.0 (2025) Recreational Water	Dermal contact and incidental ingestion – very low risk
		PFAS NEMP 3.0 (2025) Drinking Water (base boundary monitoring locations only)	Water consumption from residential bores and eating produce irrigated with groundwater – very low risk
	Surface Water	PFAS NEMP 3.0 (2025) Recreational Water	Dermal contact and incidental ingestion – very low risk
		PFAS NEMP 3.0 (2025) Drinking Water (base boundary monitoring locations only)	Water consumption – very low risk
		PFAS NEMP 3.0 (2025) 95% Eco Marine Water (on-base dams only)	Protection of aquatic life from exposure and bioaccumulation – elevated risk
Off-base	Groundwater	PFAS NEMP 3.0 (2025) Recreational Water	Dermal contact and incidental ingestion – very low risk
		PFAS NEMP 3.0 (2025) Drinking Water	Water consumption from residential bores and eating produce irrigated with groundwater – very low risk
	Surface Water	PFAS NEMP 3.0 (2025) Recreational Water	Dermal contact and incidental ingestion – very low risk
		PFAS NEMP 3.0 (2025) Drinking Water	Water consumption – very low risk
		PFAS NEMP 3.0 (2025) 95% Eco Marine Water	Wildlife and aquatic life – negligible to high risk

Off-base and base boundary groundwater and surface water monitoring data will be compared the guidelines that represent the greater potential for risk exposure. For example:

- Groundwater – guideline references for groundwater include NHMRC (2019) Recreational Water and NEMP Drinking Water (HEPA, 2025), as groundwater sources have the potential for body contact (dermal) and incidental ingestion exposure and as a potential supply for irrigation (lawns, home grown produce [fruits and vegetables] that would be consumed) and drinking water consumption. Although use of groundwater as a drinking water supply for off-base locations was identified as an incomplete pathway in the HHRA for the Lavarack Barracks management area (RPS/Wood, 2019c), it is acknowledged that PFAS has a low-risk potential to be inadvertently

ingested through recreational contact and from direct consumption of home grown produce where PFAS is present in groundwater sourced for irrigation water.

- Surface Water – guidelines for surface water include NHMRC (2019) Recreational Water and NEMP Interim Freshwater and Marine 95% (HEPA, 2025) guidelines, as surface water draining from the base has the potential for recreational body contact (dermal) and incidental ingestion exposure in the drains, creeks, or public area irrigation. Additionally, there is potential for wildlife, freshwater and marine aquatic biota exposure (eg uptake, ingestion, and assimilation) and human exposure (eg consumption of local biota).

Measured PFAS data for each groundwater and surface water monitoring location will be screened against 65th and 85th percentile concentrations derived from the location dataset. The use of 65th and 85th percentiles in the trigger screening is currently based on the general sample count per monitoring location (eg ~12 data points). These screening thresholds identify triggers that represent reasonable upper bound concentrations that can assist in flagging potential for changes to risk profile, without being too conservative or not conservative enough in the screening process; the objective of the screening of the measured concentrations is to flag PFAS levels from the sampling event that represent upper bound concentrations. With the limited amount of data, these screening percentiles are considered reasonable thresholds. As more data are collected in future OMP sampling events, these percentile thresholds can be modified to reflect the larger dataset. Although not identified in the screening trigger framework, the screening process also considers if the measured concentration represents the highest concentration measured at a monitoring location over the period of the OMP (this query is a requirement of the sampling event data review).

The final data screening trigger is to determine if the monitoring data at a monitoring location indicate an increasing trend. For the OMP, the analysis of an increasing trend is limited to a visual assessment of increasing trends instead of using a statistical method. The use of a graphical display (plots or conditional array settings in the dataset [eg Excel tools]) to discern increasing PFAS trends over time is a reasonable and effective approach in the trigger screening process. With the transition of the OMP to focus on wet season sampling, the trend analysis focuses on wet season data, particularly the prior three wet seasons as available. The trigger for further evaluation is that there are consecutive increases in concentration over three wet season sampling events, regardless of measured concentration. The use of a visual assessment is because the current dataset (commencing in 2018 for many of the OMP monitoring locations) is small (an approximate maximum of 12 samples), which is further reduced by focusing on wet season data and therefore challenging to apply a statistical trend analysis with an adequate confidence level. Further, there is some conjecture regarding a trend analysis that could be meaningfully applied to these data for determine significant trends; the commonly applied Mann-Kendall or similar is not considered appropriate because of the low data count and because of the variable conditions and timing of sample collection at the monitoring locations between seasons. As data increase from future OMP sampling events, application of a statistical trend analysis for the OMP and data evaluation through the screening trigger framework will continue to be investigated.

For the On-going Monitoring Report (OMR), a visual trend analysis will be used to also evaluate whether PFAS concentrations trends are decreasing, especially for known sources areas on-base under remediation. A decreasing trends evaluation will be used to inform the progress of remediation with reduction in PFAS contribution from the source area and to the determination of remediation So Far As Reasonably Practicable.

At the onset of the data review at the conclusion of the screening process, there is provision to subjectively evaluate the measured data and the screening where an elevated or high potential for risk profile change is identified. These include considering the following questions:

- Are the data verified? (ie data validation completed and data valid, consideration of site-specific conditions at the time of sampling that may provide added context the result [eg a high result because the sample was collected from a stagnant pond]).
- Are the data consistent with the CSM for the site? (ie the data are expected in that range, the data are representative of a location in a source catchment or down-gradient of known sources where remediation/investigation is planned or underway).
- Are the data consistent with the identified Risk to Receptors implying there is no change to the Risk Profile (ie the risk to receptors identified in section 3 has not changed based on the measured result).

If the answer to all questions is “Yes”, the screening result can be downgraded with a supporting statement provided in the screening table and a note that no further response is required. If the answer to any of these questions is “No”, the screening outcome as derived remains and the response action identified in the screening table.

For surface water, note that screening triggers would not apply to the Ross River monitoring locations (ie SW227, SW224, and SW245) or the upstream lake in Idalia (ie SW243) as these waterbodies are characterised as reference locations. These locations occur upstream of potential base sources and their drainage catchments. Instead, they provide another reference data source to compare off-base surface water quality monitoring data.

Response Actions to triggers will be site specific and thus dependent on risk profile. Examples of the response actions for each of the screening triggers are provided below.

Trigger 0 *(negligible potential for risk profile to change at the monitoring location or down-gradient from the monitoring location):*

- Consider if monitoring location should be removed from OMP (based on consistency of non-detected data).
- Continue monitoring at that location.

Trigger 1 *(low potential for risk profile to change at the monitoring location or down-gradient from the monitoring location):*

- On-base and off-base advisories, if applicable and where necessary (OMP reporting, Defence notifications).
- Continue OMP monitoring at that location.

Trigger 2 *(elevated potential for risk profile to change at the monitoring location or down-gradient from the monitoring location):*

- Review upstream PFAS source area activities.
- Review upstream and adjacent catchment data (all media).
- Follow-up monitoring, if required.
- Consider and implement mitigation and source control.

Trigger 3 *(high potential for risk profile to change at the monitoring location or down-gradient from the monitoring location):*

- Immediate follow-up monitoring for data verification.
- Review upstream PFAS source area activities.

- Review upstream and adjacent catchment data (all media), including consideration of data assessed as part of the human health and ecological risk assessments for the area / receptor group. For example, further review and/or consideration of biota PFAS concentrations may be warranted.
- Review remediation area / investigation study area activity or land disturbance.
- Consider addition of supplemental monitoring locations (groundwater wells, surface water stations).
- Implement mitigation and source control.

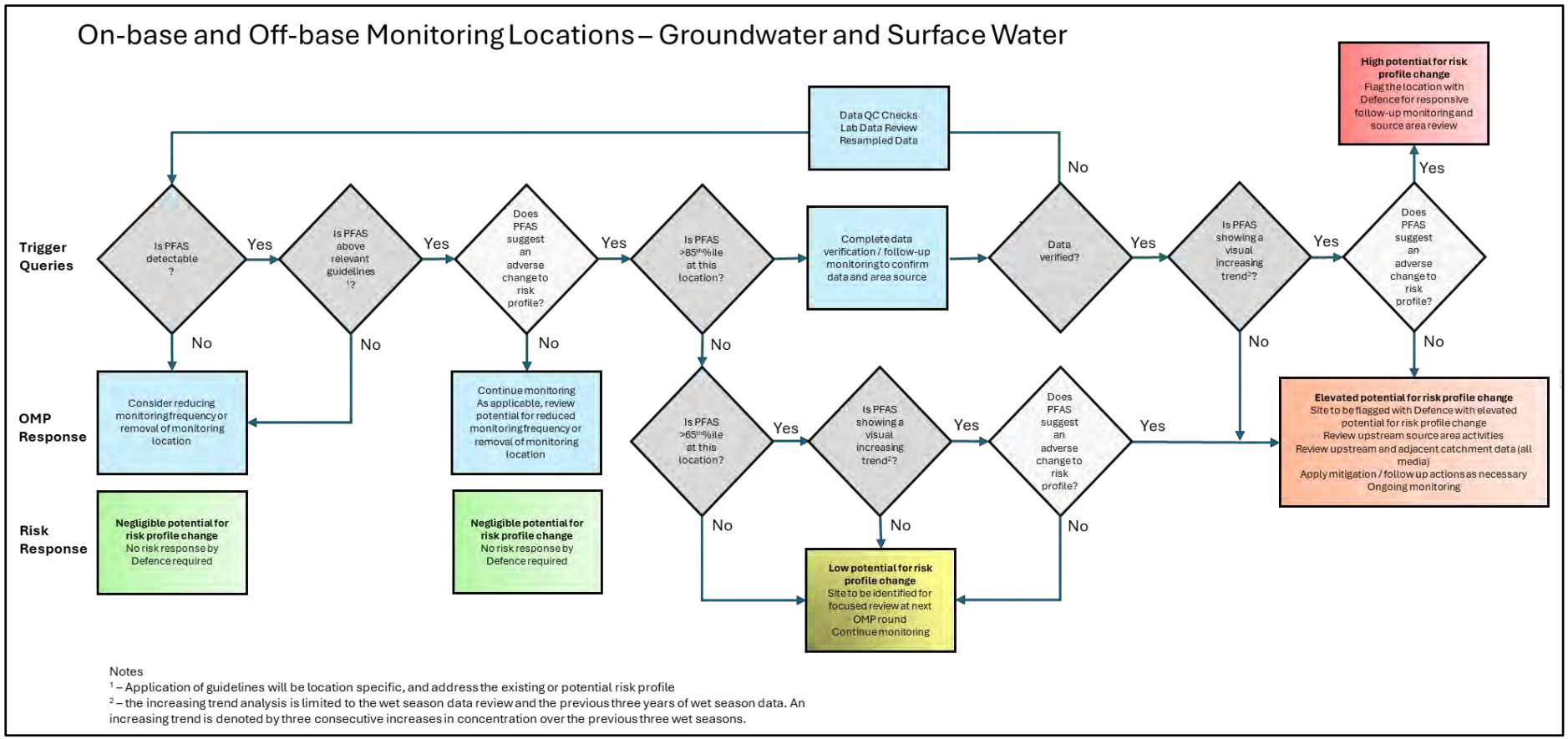


Figure 7.1: PFAS screening trigger framework, Lavarack Barracks

8 REPORTING REQUIREMENTS

8.1 Reporting

After each monitoring event, site information and observations, and field and laboratory data will be documented in the SER. At the end of a specified monitoring period (typically 12 months but this timeframe may vary) the whole data set (including the current and historic data) including the CSM will be reviewed, and an OMR prepared.

The SER will include a letter summarising the key observations and notable changes in the on-base and off-base concentrations including screening triggers that will inform if results indicate a potential change in risk profile at a monitoring location or catchment region within the Monitoring Area. The report will include an appendix including observations made during fieldwork, analytical result tables that includes comparisons with PFAS guidelines, laboratory analytical certificates and QA/QC reports, and the data screening results. In addition, it is planned that the SER will include a digital dashboard review of the data, which will be created and shared with Defence for easy interpretation of data.

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, per the CSM for the base, and if identified, update the CSM;
- potential for changes in risks to human and environmental receptors;
- the influence that risk management activities, including remediation activities, at the base, as outlined in the Department of Defence PMAP (2025), have had on PFAS in the environment;
- whether identified changes trigger a prescribed action and/or review; and
- whether the monitoring program, based on measured data, needs to be modified.

THE SER and OMR will be prepared in accordance with Defence guidance documentation.

8.2 Stakeholder engagement

Engagement with a range of stakeholders, such as Queensland government agencies, Local Councils, other agencies, and the community will be undertaken. A stakeholder engagement plan will be prepared and/or updated to manage the engagement process.

Where off-base monitoring is undertaken, a separate letter will be provided to the stakeholders presenting the results of the monitoring event.

The OMP will be published on the Defence website, along with the current version of the PMAP and OMR.

APPENDIX A REFERENCES

Lavarack Barracks is a Department of Defence property subject to Commonwealth Government jurisdiction. The collection and assessment of PFAS data for the OMP will be completed in accordance with the below outlined legislation, policy, standards, and guidance documents.

Commonwealth legislation

- Australian and New Zealand Governments (ANZG) 2018, Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- Environmental Protection and Biodiversity Conservation Act 1999.
- HEPA 2025, PFAS National Environmental Management Plan, Version 3.0.
- National Environment Protection Council (NEPC). National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999 (as amended 2013).
- National Health and Medical Research Council (NHMRC), National Resources Management Ministerial Council (NRMMC) 2011, (Version 3.8, updated September 2022) Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy.
- NHMRC 2019, Guidance on Per and Polyfluoroalkyl substances (PFAS) in Recreational Water.
- NHMRC 2024, NHMRC Statement: Per- and polyfluoroalkyl substances (PFAS) in drinking water. Available at: https://www.nhmrc.gov.au/health-advice/environmental-health/water/PFAS-review/NHMRC-statement-PFAS.
- Standards Australia 1998a, Water Quality—Sampling. Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples (AS/NZS 5667.1:1998).
- Standards Australia 1998b, Water Quality—Sampling. Part 4: Guidance on sampling from lakes, natural and man-made (AS/NZS 5667.4:1998).
- Standards Australia 1998c, Water Quality—Sampling. Part 11: Guidance on Sampling of Groundwaters (AS/NZS 5667.11:1998).
- Standards Australia 1998d. Water Quality—Sampling. Part 12: Guidance on Sampling of Bottom Sediments (AS/NZS 5667.12:1998).

Defence policy, standards, and guidance

- Defence Environmental Policy.
- Defence Estate Strategy 2016-2036.
- Defence Environmental Strategy 2016-2036.
- Defence Contamination Management Manual (2018, amended 2021).
- Defence PFAS Construction and Maintenance Framework Version 2.1 (2019).
- Lavarack Barracks, Townsville, PFAS Management Area Plan Revision 5 (2025).

State/Territory legislation and policy

The following state legislation and policy does not have jurisdiction on the base, although may be applied when potential environmental harm may occur to off-base environments and receptors:

- Environmental Protection Act 1994 (QLD).
- Environmental Protection Regulation 2019 (QLD).
- Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (QLD).

Other references not listed above

- AECOM (2023) Ongoing Monitoring Interpretive Report (October 2020 – March 2023), 24 October 2023.
- AECOM (2024) PFAS OMP Lavarack Barracks, Sampling and Analysis Quality Plan, 20 February 2024.
- BOM (2024) Climate statistics for Australian locations. Townsville AERO. http://www.bom.gov.au/climate/averages/tables/cw_032040_All.shtml.
- RPS/Wood (2019a) Detailed Site Investigation (DSI) Rev 4, 3 December 2019.
- RPS/Wood (2019b) Seasonal Monitoring Report (SME) Rev 1, 3 December 2019.
- RPS/Wood (2019c) Human Health Risk Assessment (HHRA) Rev 3, 3 December 2019.
- RPS/Wood (2020a) Seasonal Monitoring Report 2, Lavarack Barracks PFAS Investigation. Rev 2, 12 August 2020.
- RPS/Wood (2020b). Ecological Risk Assessment (ERA) Rev 4, 18 August 2020.
- WSP Golder (2023a) PFAS Annual Mass Discharge Report, Lavarack Barracks PMAP Delivery Rev 1, 20 January 2023.
- WSP Golder (2023b) Remediation Action Plan: Former Fire Stations (PSC-4) Lavarack Barracks. 16 February 2023.
- WSP Golder (2023c). Soil and Groundwater Delineation Report, former Fire Training Area (PSC-5) / Monocell (PSC-6) Lavarack Barracks. 30 October 2023.

APPENDIX B FIGURES

KEY MAP

LEGEND

- Management
- Lavarack Barracks Base Boundary
- RAAF Base Townsville
- Watercourse

0 1,000 2,000 3,000 4,000 5,000

1:75,000 METRES

NOTE(S)
1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)
1. AERIAL IMAGERY AND KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.
2. STATE REFERENCE DATA SOURCED FROM DATA.QLD.GOV.AU.

CLIENT
DEPARTMENT OF DEFENCE

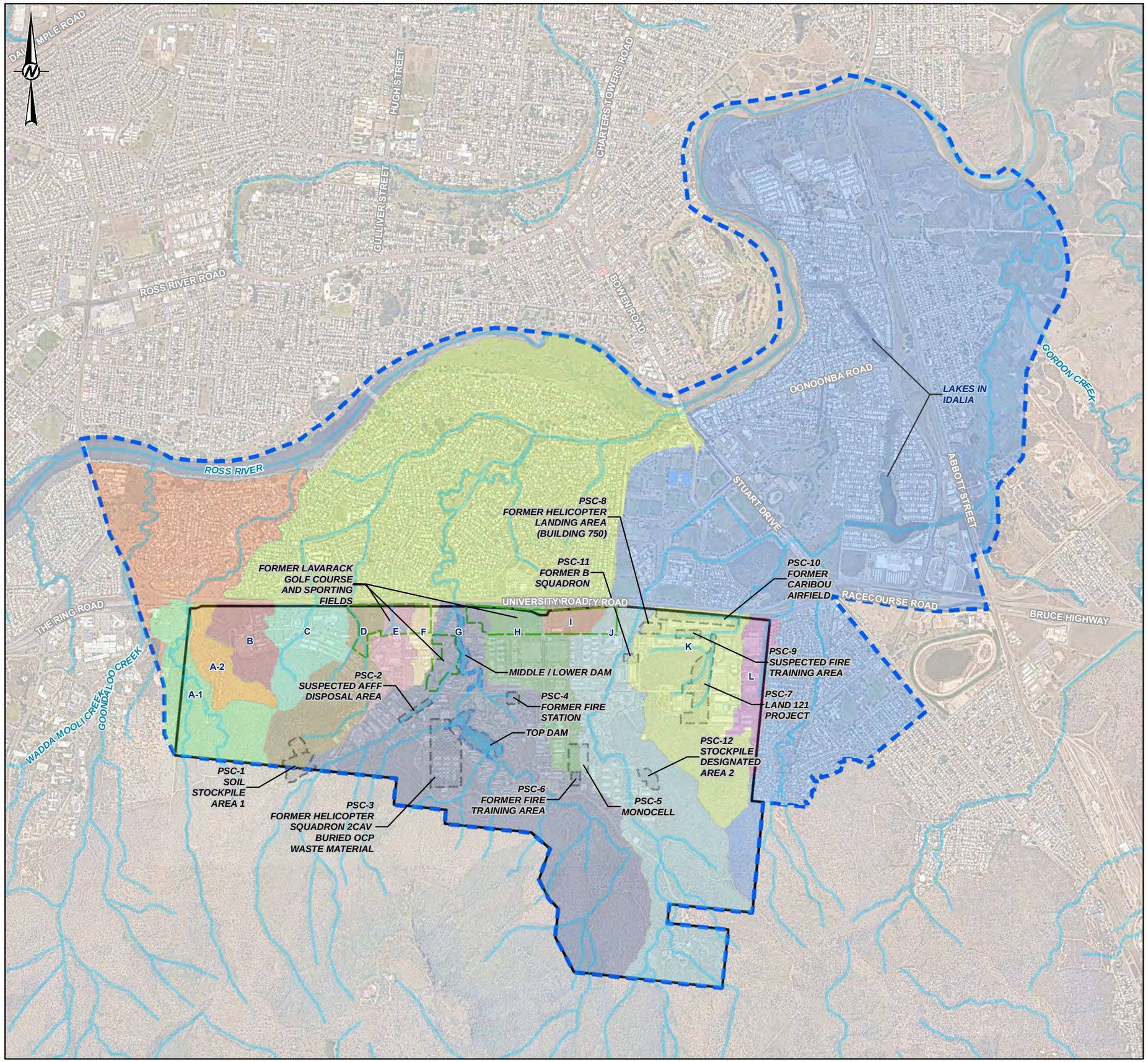
PROJECT
LAVARACK BARRACKS ONGOING MONITORING PROGRAM

TITLE
SITE LOCALITY

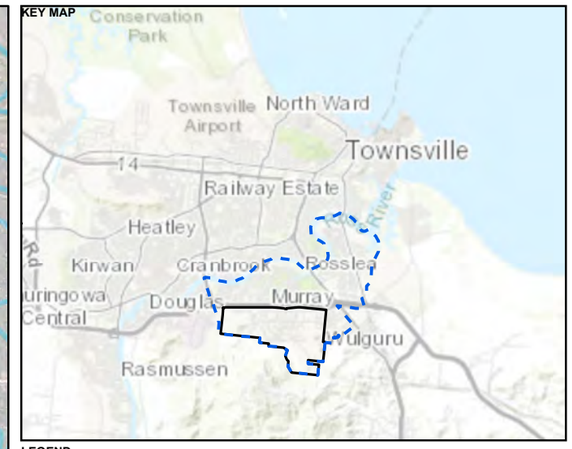
CONSULTANT
wsp

YYYY-MM-DD	2025-04-11
DESIGNED	-
PREPARED	MAH
REVIEWED	JF
APPROVED	AH

PROJECT NO.	CONTROL	REV.	FIGURE
PS129286	086-R	E	1



KEY MAP



LEGEND

- Management Area
- Base Boundary
- Watercourse
- Source Area

Secondary Source Areas

- Dam
- Outdoor Recreation Area

Approximate On-Base Sub-Catchments

A-1, A-2, B, C, D, E, F, G, H, I, J, K, L

Approximate Off-Base Sub-Catchments

- West
- Central
- East

0 500 1,000 1,500 2,000

1:27,500 METRES

NOTE(S)

1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)

1. AERIAL IMAGERY SOURCED FROM NEARMAP.COM. DATE OF CAPTURE 19/12/2024.
2. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.
3. SUB-CATCHMENTS AMENDED AFTER AECOM ONGOING MONITORING INTERPRETIVE REPORT FIGURE F2 DATED 15/08/2023.
4. STATE REFERENCE DATA SOURCED FROM DATA.QLD.GOV.AU.

CLIENT
DEPARTMENT OF DEFENCE

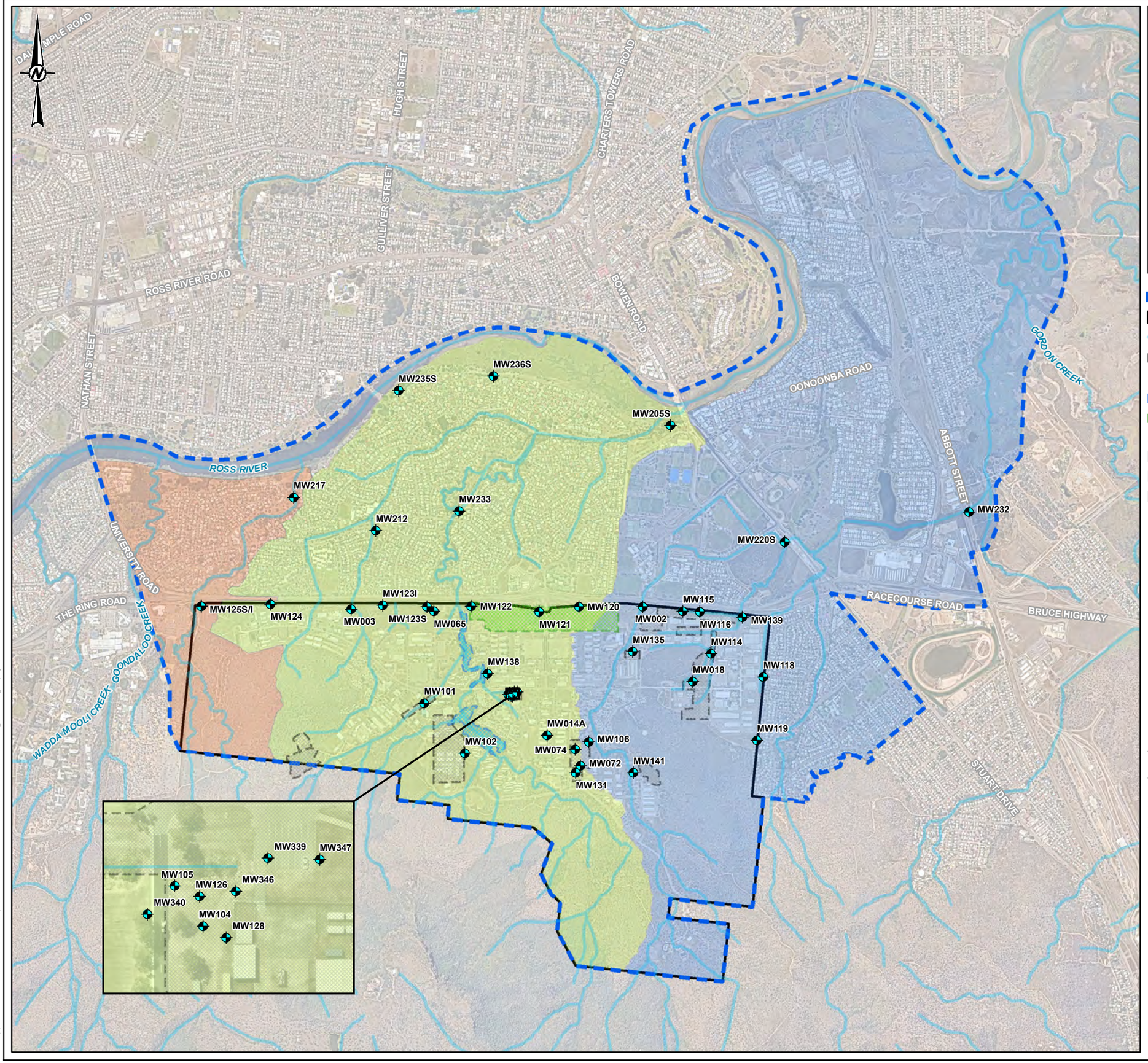
PROJECT
LAVARACK BARRACKS ONGOING MONITORING REPORT

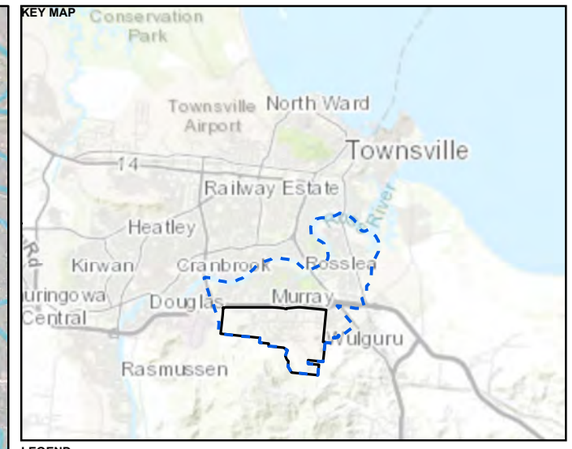
TITLE
MANAGEMENT AREA

CONSULTANT
wsp

YYYY-MM-DD	2025-04-11
DESIGNED	-
PREPARED	MAH
REVIEWED	JF
APPROVED	AH

PROJECT NO.	CONTROL	REV.	FIGURE
PS129286	086-R	E	2





LEGEND

- Management Area
- Base Boundary
- Watercourse
- Source Area

Secondary Source Areas

- Dam
- Outdoor Recreation Area

Approximate Sub-Catchments

- West
- Central
- East
- Groundwater Sampling Location

0 500 1,000 1,500 2,000

1:27,500 METRES

NOTE(S)

1. PROJECTION: GDA 1994 MGA ZONE 55.
2. MW226 LOCATED ON PRIVATE PROPERTY AND IS NOT DISPLAYED

REFERENCE(S)

1. AERIAL IMAGERY SOURCED FROM NEARMAP.COM. DATE OF CAPTURE 21/09/2021.
2. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.
3. SUB-CATCHMENTS AMENDED AFTER AECOM ONGOING MONITORING INTERPRETIVE REPORT FIGURE F2 DATED 15/08/2023.
4. STATE REFERENCE DATA SOURCED FROM DATA.QLD.GOV.AU.

CLIENT
DEPARTMENT OF DEFENCE

PROJECT
LAVARACK BARRACKS ONGOING MONITORING PROGRAM

TITLE
GROUNDWATER SAMPLING LOCATIONS

CONSULTANT
wsp

YYYY-MM-DD	2025-04-11
DESIGNED	-
PREPARED	MAH
REVIEWED	JF
APPROVED	AH

PROJECT NO.	CONTROL	REV.	FIGURE
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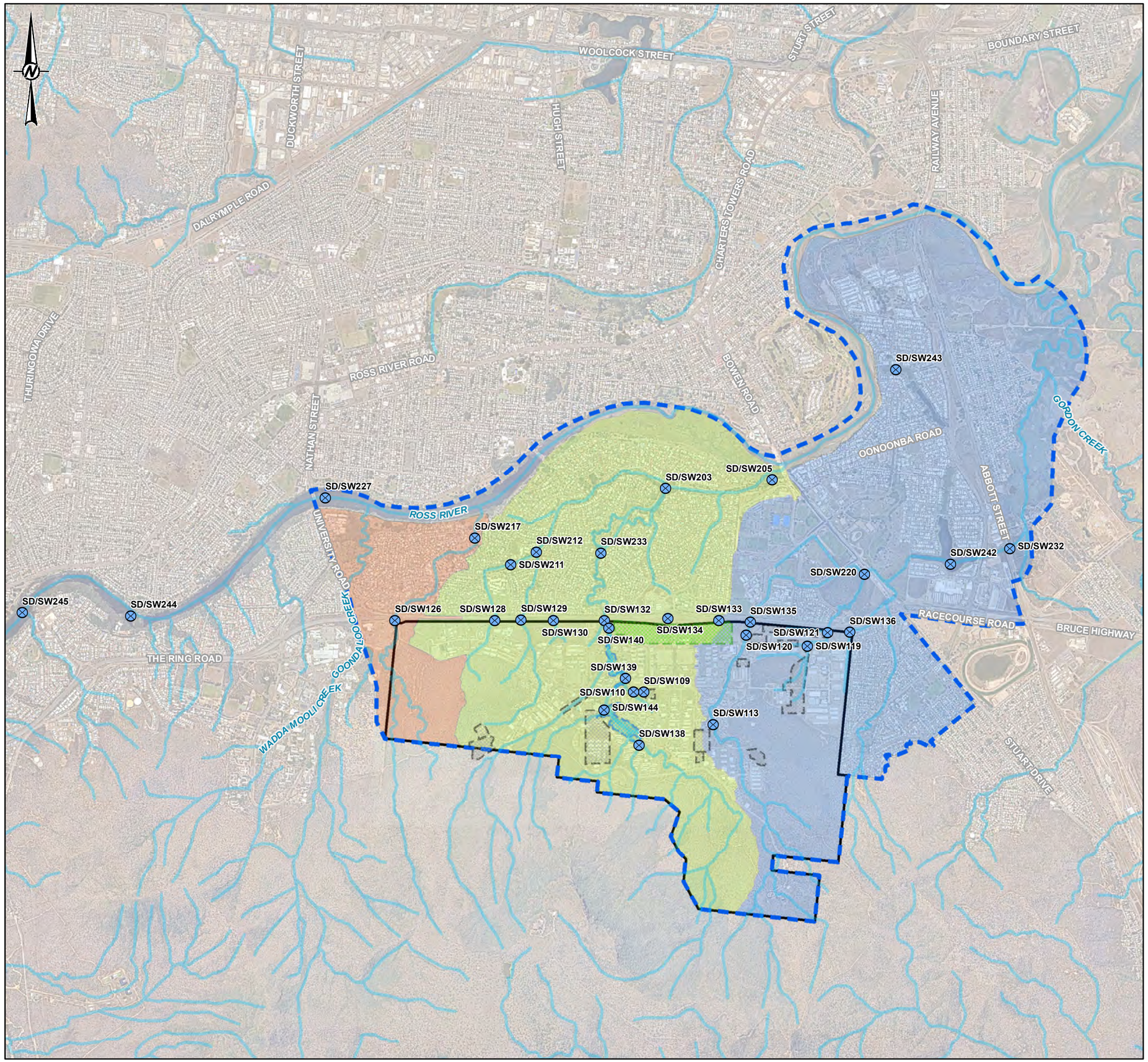

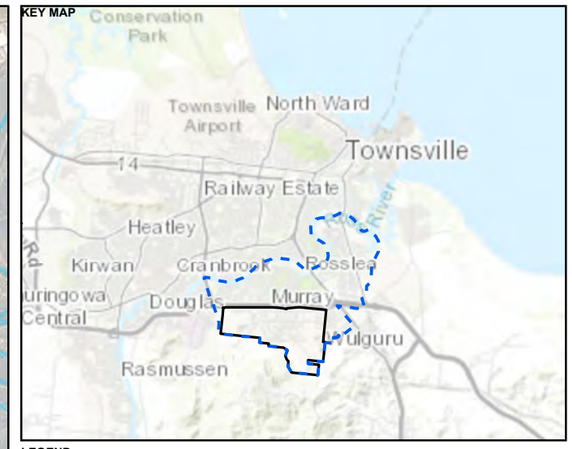

LEGEND

- Management Area
- Base Boundary
- Watercourse

Secondary Source Areas

- Dam
- Outdoor Recreation Area

Approximate Sub-Catchments

- West
- Central
- East
- Co-located Surface Water and Sediment Sampling Location

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1:35,000 METRES

NOTE(S)
1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)
1. AERIAL IMAGERY SOURCED FROM NEARMAP.COM. DATE OF CAPTURE 21/09/2021.
2. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.
3. SUB-CATCHMENTS AMENDED AFTER AECOM ONGOING MONITORING INTERPRETIVE REPORT FIGURE F2 DATED 15/08/2023.
4. STATE REFERENCE DATA SOURCED FROM DATA.QLD.GOV.AU.

CLIENT
DEPARTMENT OF DEFENCE

PROJECT
LAVARACK BARRACKS ONGOING MONITORING PROGRAM

TITLE
SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

CONSULTANT
wsp

YYYY-MM-DD	2025-04-11
DESIGNED	-
PREPARED	MAH
REVIEWED	JF
APPROVED	AH

PROJECT NO.	CONTROL	REV.	FIGURE
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APPENDIX C SAMPLE LOCATION INFORMATION

Table C.1 Groundwater monitoring well locations

Management / Source Area	Location Code	Easting	Northing
Eastern PFAS Contamination Area	MW018	479308.4	7863393.56
	MW114	479441.3	7863598.5
	MW115	479236.63	7863908.59
	MW116	479358.85	7863902.79
	MW139	479670.09	7863862.8
Former B Squadron	MW135	478868.84	7863614.47
Former Fire Station	MW104	477982.59	7863293.881
	MW105	477971.83	7863309.04
	MW128	477991.42	7863289.54
	MW126	477981.21	7863305.12
	MW339	478007.168	7863319.637
	MW340	477961.487	7863298.384
	MW346	477994.934	7863307.039
	MW347	478026.824	7863319.09
Former Fire Training Area	MW131	478453.24	7862728.27
Former Helicopter Squadron	MW102	477643.34	7862870.7
Lavarack Golf Course & Sporting Field	MW065	477418.13	7863907.77
	MW120	478477.7	7863940.96
	MW121	478186.12	7863903.66
	MW122	477691.43	7863943.29
	MW123I	477043.94	7863949.12
	MW123S	477367.06	7863942
Monocell	MW014A	478244.994	7862999.583
	MW072	478489.22	7862779.48
	MW074	478450.42	7862897.71
	MW106	478548.51	7862955.19
Stockpile Designated Area 2	MW141	478874.18	7862726.41
Suspected AFFF Disposal Area	MW101	477346.85	7863236.29
Top, Middle and Lower Dams	MW138	477810.88	7863452.65
Base Boundary	MW002	478944.02	7863941.25
	MW003	476815.59	7863923.12
	MW118	479823.19	7863426.78
	MW119	479776.41	7862965.06
	MW124	476226.28	7863960.04
	MW125I	475722.05	7863942.41
	MW125S	475718.89	7863942.39
Off-base	MW205S	479145.93	7865264.2

Management / Source Area	Location Code	Easting	Northing
	MW212	476993.23	7864497.33
	MW217	476395.18	7864738.17
	MW220S	479978.26	7864412.53
	MW226	-	-
	MW232	481325.84	7864633.73
	MW233	477601.28	7864637.7
	MW235S	477160.09	7865519.45
	MW236S	477853.16	7865624.42

Table C.2 Surface water and sediment monitoring locations

Management / Source Area	Location Code	Easting	Northing
Eastern PFAS Contamination Area	SD/SW119	479460.117	7863741.028
	SD/SW121	479646.971	7863865.792
Former Fire Station	SD/SW138	477909.346	7862829.651
	SD/SW109	477952.201	7863317.092
	SD/SW110	477858.514	7863315.971
Lavarack Golf Course & Sporting Field	SD/SW129	476821.71	7863979.589
	SD/SW130	477118.5	7863977.5
On-base Dams (Top, Middle, and Lower)	SD/SW139	477784.396	7863442.569
	SD/SW140	477632.037	7863905.72
	SD/SW144	477586.716	7863152.665
On-base Balance	SD/SW113	478591.209	7863016.381
	SD/SW120	478896.709	7863842.641
Base Boundary	SD/SW126	475661.149	7863978.928
	SD/SW128	476577.684	7863977.008
	SD/SW132	477590.868	7863973.5
	SD/SW133	478643.633	7863976.728
	SD/SW134	478175.091	7863996.09
	SD/SW135	478934.45	7863959.5
	SD/SW136	479850.245	7863867.022
Off-base	SD/SW203	478152.872	7865192.911
	SD/SW205	479134.096	7865270.728
	SD/SW211	476726.5191	7864491.379
	SD/SW212	476962.8418	7864606.611
	SD/SW217	476395.184	7864738.165
	SD/SW220	479985.153	7864400.269
	SD/SW227	475019.437	7865105.334
	SD/SW232	481323.787	7864639.575
	SD/SW233	477555.898	7864598.684
	SD/SW242	480776.638	7864493.587
	SD/SW243	480276.535	7866288.802
	SD/SW244	473226.026	7864018.233
	SD/SW245	472226.123	7864049.563

APPENDIX D OMP REVIEW

The following changes to the existing OMP are proposed at this time.

Table D.1 OMP monitoring location and frequency review

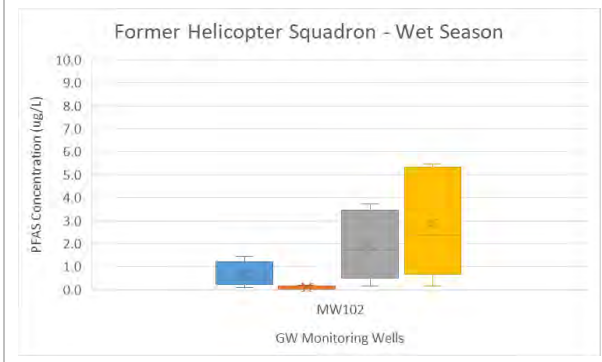
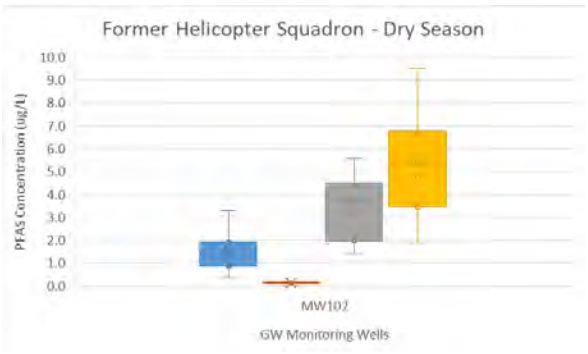
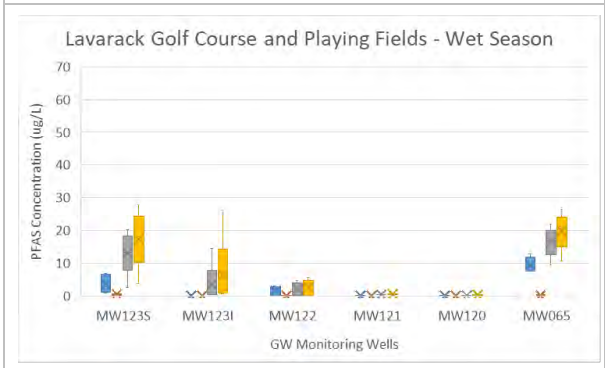
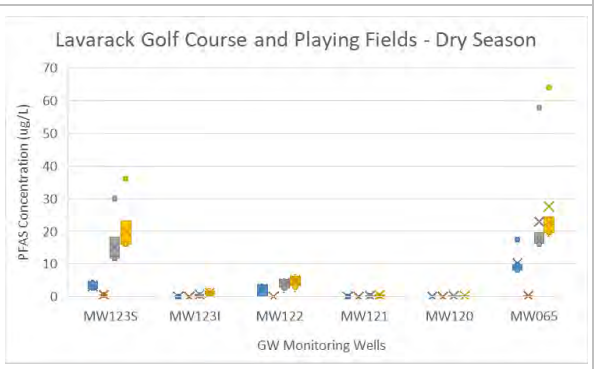
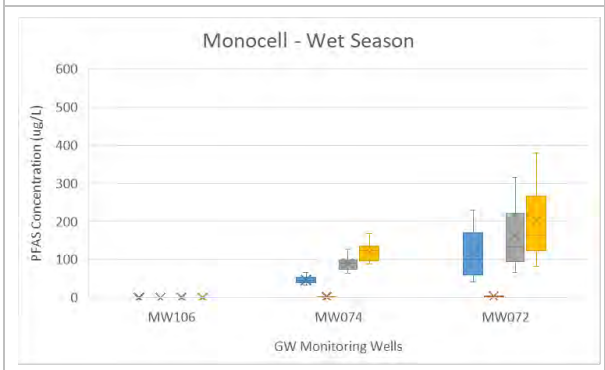
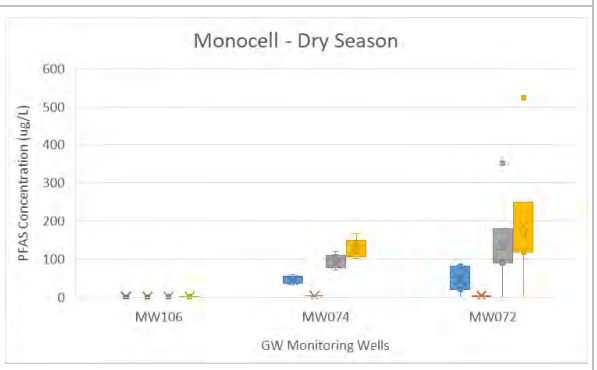
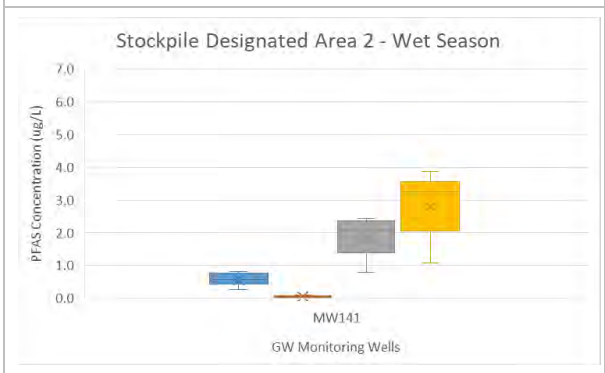
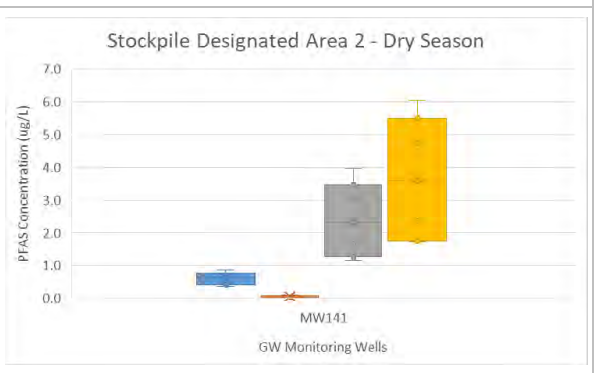
Location	Does the location inform the nature of PFAS at the site	Does the location inform the extent of PFAS at the site	Does the location inform the risk profile at the site	Does the sampling frequency inform the risk profile	OMP Review Outcome	Reason
All non-permanent surface waterbodies and groundwater well locations	*Yes*	*Yes*	*Yes*	*Yes – the reduced sampling frequency still informs risk profile*	*A reduction in seasonal (bi-annual) monitoring to wet season sampling only at groundwater and sediment quality sampling locations.* *For surface water quality monitoring, watercourses that possess flowing water in the dry season and permanent waterbodies (ie the on-base dams, lakes in the suburb of Idalia, and Ross River) will retain seasonal sampling events; all other watercourses will be limited to wet season sampling.*	*Previous studies at Lavarack Barracks (eg WSP Golder 2023a) show that surface water is the dominant PFAS migration pathway from the on-base source areas to the downstream receiving environment, particularly during the wet season. Also, water flow through the ephemeral on-base and off-base watersheds is generally limited to the wet season as shown in the OMP implementation. During the dry season, most of the on-base and downstream drainages are dry. The exceptions are those that are permanent waterbodies (eg on-base dams, Ross River, lakes in the suburb of Idalia) and the downstream reaches of the tributaries that flow directly into Ross River. As a result, annual monitoring during the wet season for surface watercourses/drains should be focused on periods when flow is occurring at the sampling locations and PFAS is being mobilised. The OMP has retained the permanent waterbodies in the dry season sampling event, and the downstream tributaries, which will be sampled in the dry season if tributary flow is evident.* *Groundwater and sediment represent secondary pathways for downstream PFAS*

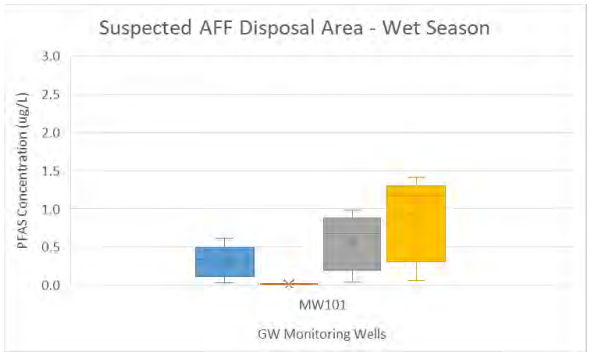
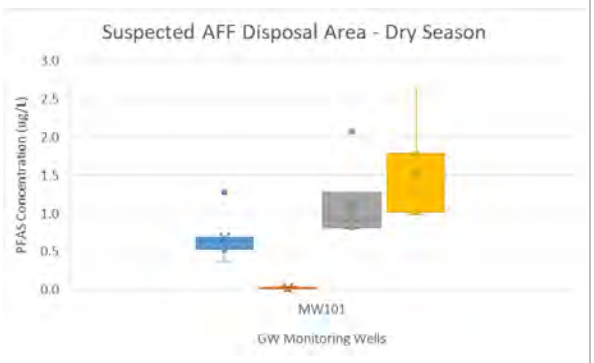
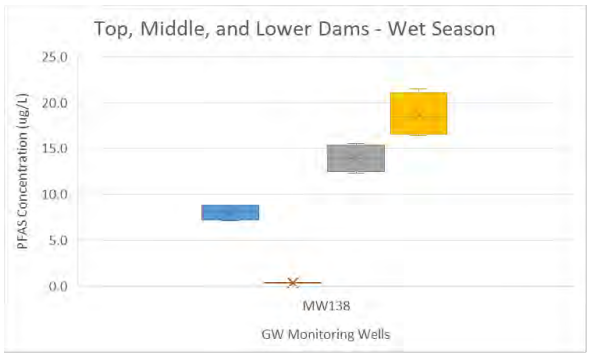
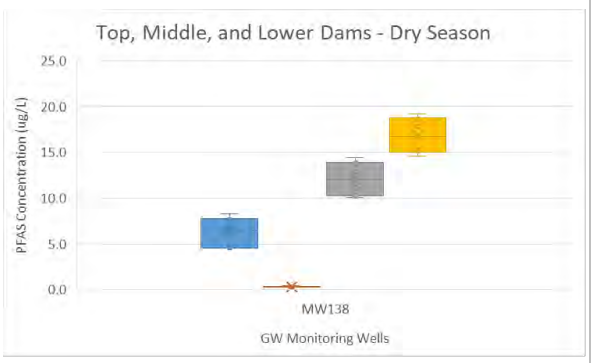
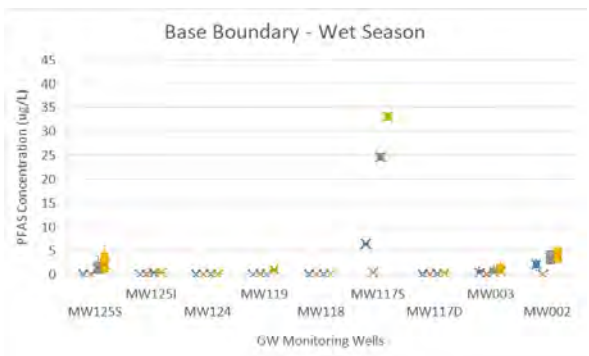
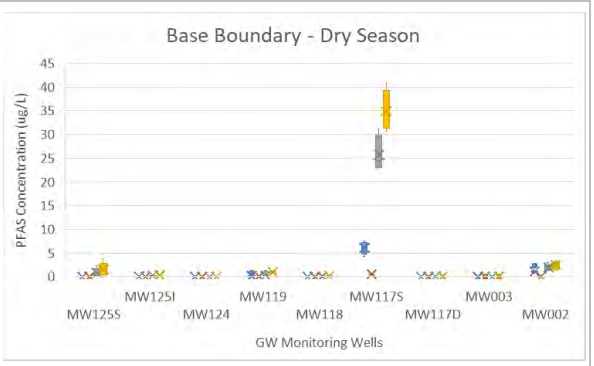
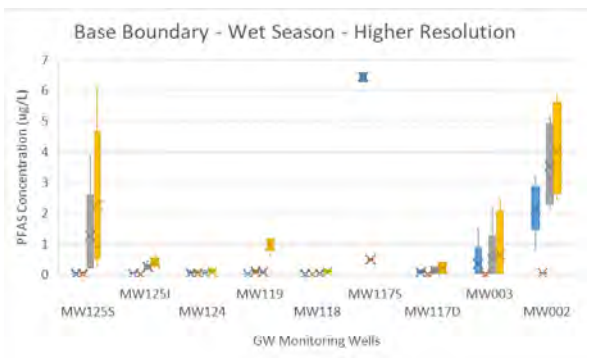
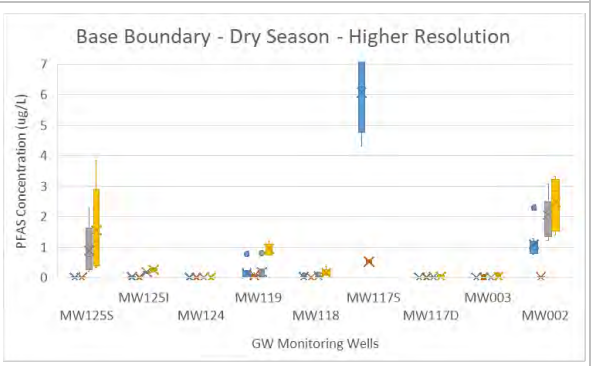
Location	Does the location inform the nature of PFAS at the site	Does the location inform the extent of PFAS at the site	Does the location inform the risk profile at the site	Does the sampling frequency inform the risk profile	OMP Review Outcome	Reason
						contribution from on-base source areas. With elevated potential for surface water interactions with groundwater (eg elevated groundwater levels) and sediment (eg sediment mobilisation and sediment/water interactions) during the wet season when PFAS has the greatest potential to mobilise to downstream receiving environments, sampling events will be limited to annual monitoring in the ephemeral watercourses and drains. *The annual sampling frequency reduction is supported by the evaluation of seasonal data collected to date over the period of the OMP (2017 to 2024) for groundwater, surface water, and sediment (Figures D.1, D.2, and D.3). The data illustrate the general consistency in PFAS concentrations between seasons and within monitoring areas for each of the sampled media. Where discernible differences occur between season (eg surface water where dry season concentrations are higher than wet season concentrations), the differences are small and explainable by seasonal condition (eg for dry season surface water concentrations, elevated concentrations are potentially attributable to ponded water subject to evapo-concentration factors).* *The reduction in sampling frequency will retain value in understanding on-base and off-base PFAS concentrations and generate data that can be expected to inform the risk profile, and changes in risk profile, in the receiving environment.*

Location	Does the location inform the nature of PFAS at the site	Does the location inform the extent of PFAS at the site	Does the location inform the risk profile at the site	Does the sampling frequency inform the risk profile	OMP Review Outcome	Reason
Sediment monitoring locations that are concrete drains (locations to be identified)	*Uncertain*	*Uncertain*	*Unlikely*	*Uncertain*	*Modify the sediment sampling location to areas downstream of the concrete drain to any natural/grassed areas if within 100 m of the sampling location. Otherwise, only collect a water sample and in situ water quality field data.*	*Concrete drains are designed for the efficient movement of stormwater through a catchment area (typically urbanised catchments so as to mitigate flood risk). As a result, the drains are not typically sediment deposition environments. Relocation of the sediment quality sampling location to an area downstream of the concrete drain to a depositional environment (as long as it's within an area in close vicinity to the sampling location) may retain some value of the location for the purpose of the OMP, and if that location is not readily identifiable, then the sediment sampling activity at the location is best removed. Changes to the location of a sediment sampling location will be recorded in the field notes and reported in the Sampling Event Report.*
Inclusion of MW104, MW339, MW340, MW346, and MW347 in the Former Fire Station source area	*Yes*	*Yes*	*Yes*	*Yes*	*Supplemental wells have been included in this source area for annual monitoring.*	*The inclusion of these supplemental monitoring wells to the former fire station source area is to inform the progression and effectiveness of remediation in this source area to reduce PFAS in the groundwater in this area.*
Inclusion of MW014A in the Former Fire Training source area	*Yes*	*Yes*	*Yes*	*Yes*	*The supplemental surface water and sediment monitoring location has been included in this source area for annual monitoring.*	*The inclusion of this supplemental monitoring well to the former fire training source area is to inform the progression and effectiveness of remediation in this source area to reduce PFAS in the groundwater in this area.*

Location	Does the location inform the nature of PFAS at the site	Does the location inform the extent of PFAS at the site	Does the location inform the risk profile at the site	Does the sampling frequency inform the risk profile	OMP Review Outcome	Reason
Addition of MW126	*Yes*	*No*	*Yes*	*Yes*	*The existing monitoring well, MW128, is anticipated to be destroyed as part of planned remediation activities and not re-instated as per the RAP. It is recommended that MW126 replace MW128 when it is destroyed.*	*MW126 is part of post-remediation monitoring and located in close proximity to MW128 to retain value in informing PFAS risk in this area of remediation. Monitoring of MW126 to commence immediately, and monitoring of MW128 to continue until it is decommissioned.*
Addition of SD/SW138 downstream of the Former Fire Training Area	*Yes*	*Yes*	*Yes*	*Yes*	*The supplemental surface water and sediment monitoring location has been included in this source area for annual monitoring.*	*The inclusion of this supplemental surface water and sediment monitoring location to the former fire training source area is to inform the progression and effectiveness of remediation in this source area to reduce PFAS in the groundwater in this area.*

Figure D.1 Seasonal groundwater PFAS concentrations in on-base and off-base locations in the Management Area (2017 to 2024)

Wet season	Dry season
	
	
	
	

Wet season	Dry season
	
	
	
	

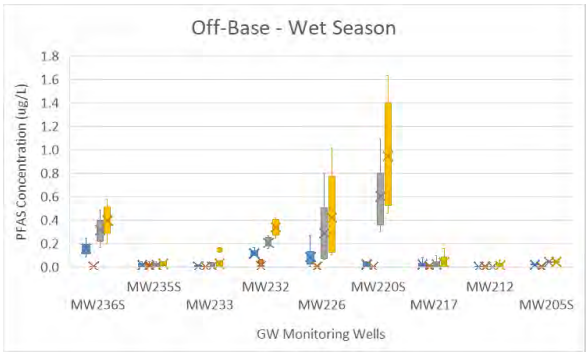
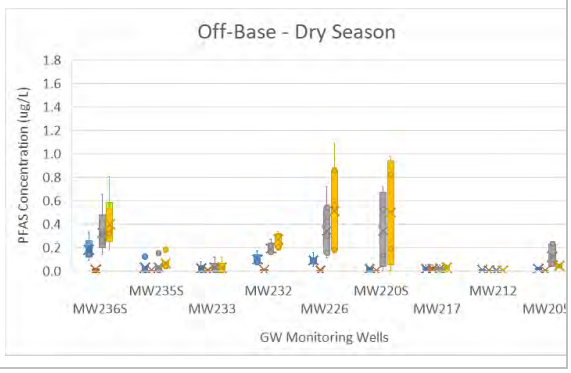
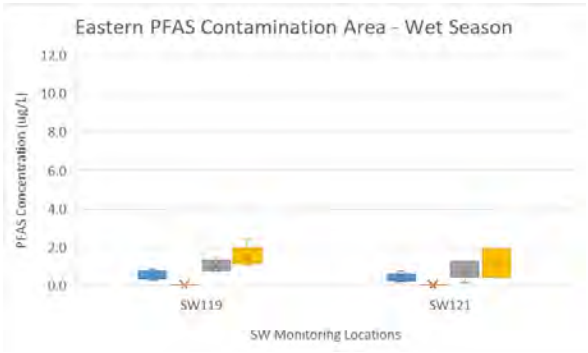
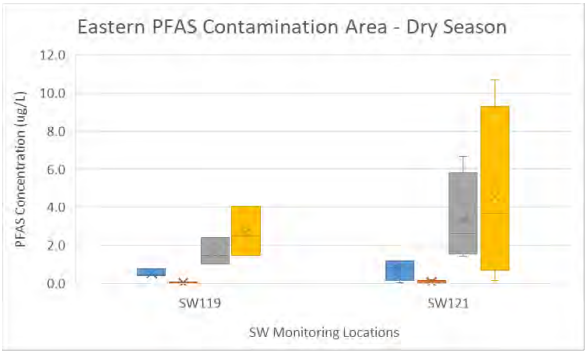
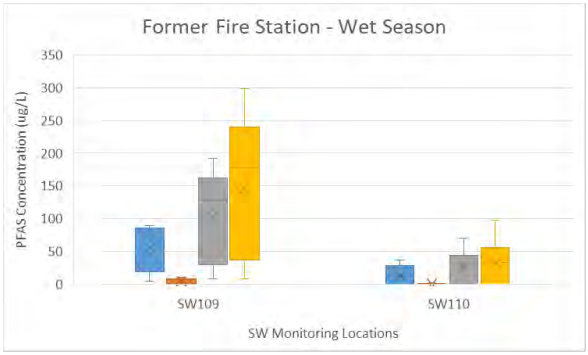
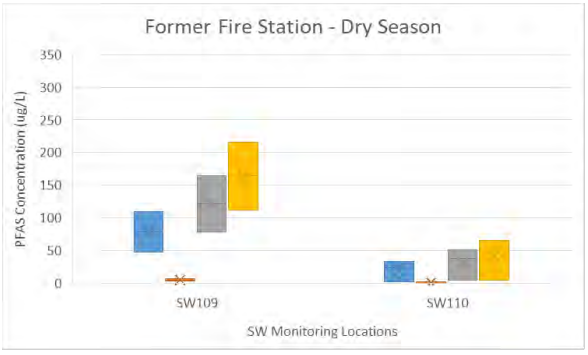
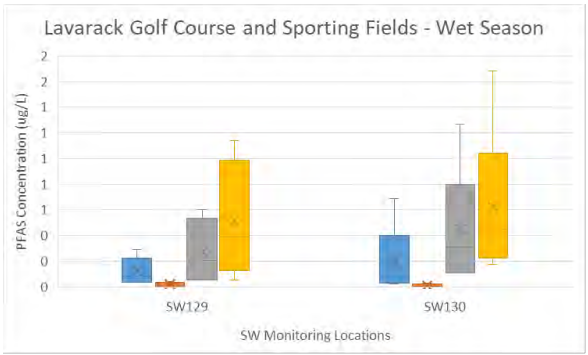
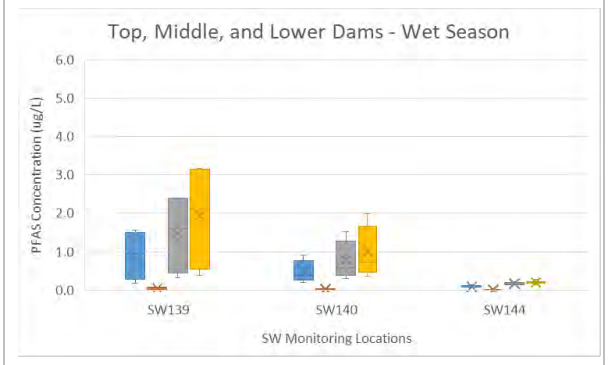
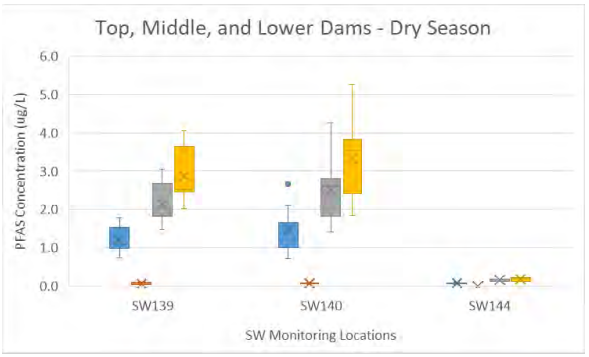
Wet season	Dry season
	

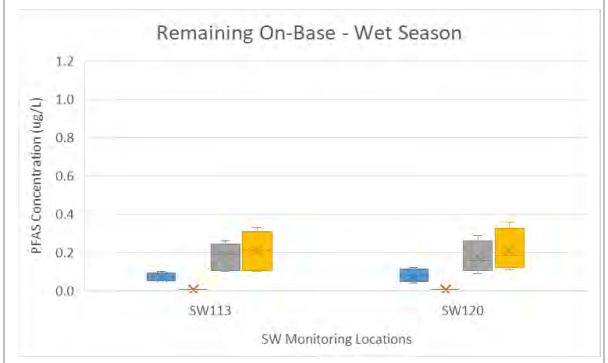
Figure D.2 Seasonal surface water PFAS concentrations in on-base and off-base locations in the Management Area (2017 to 2024)

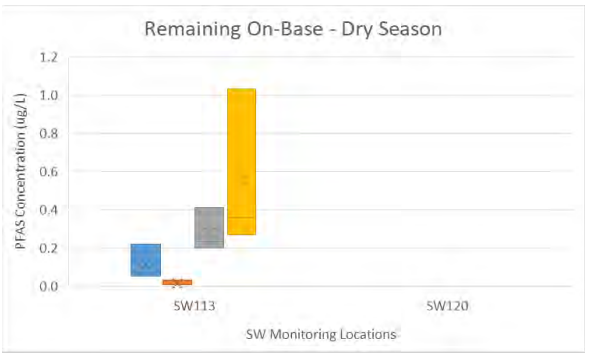
Wet season	Dry season
	
	
	No Dry Season Surface Water Quality Data

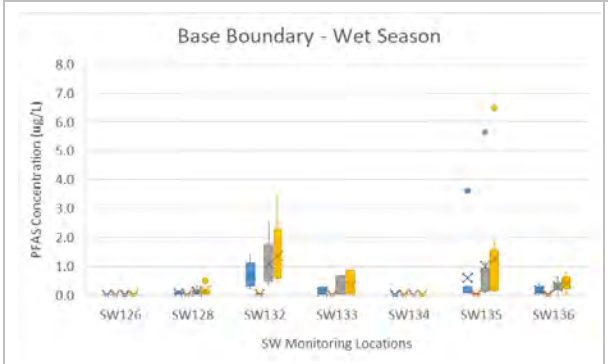
Wet season	Dry season

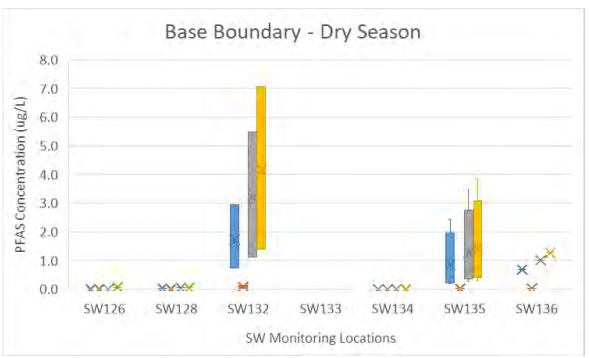


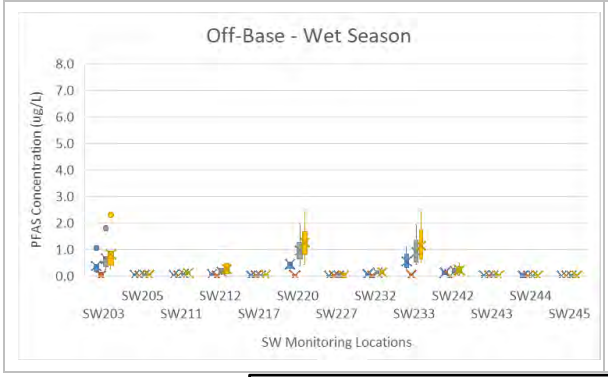












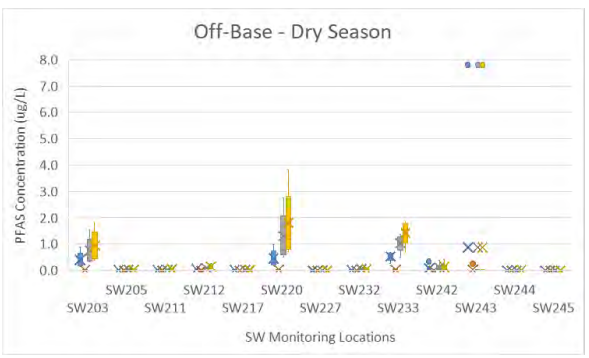
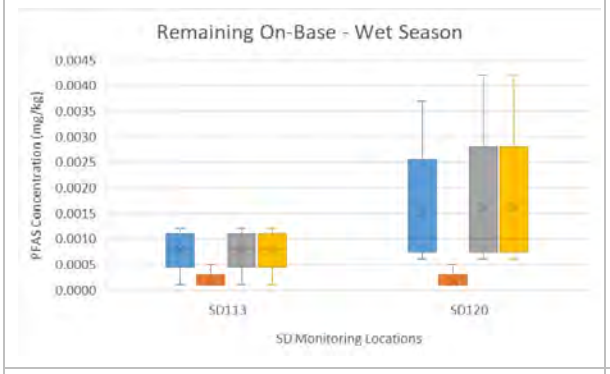
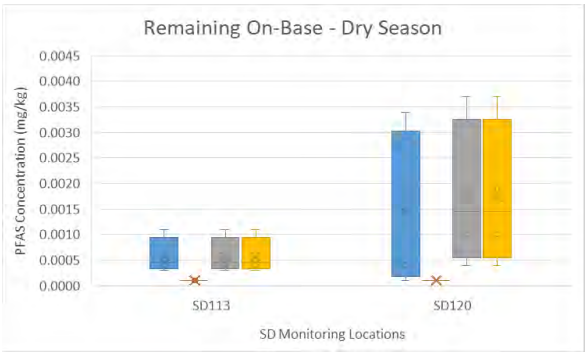
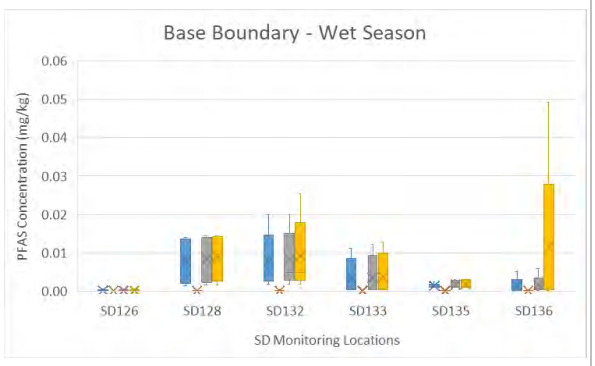
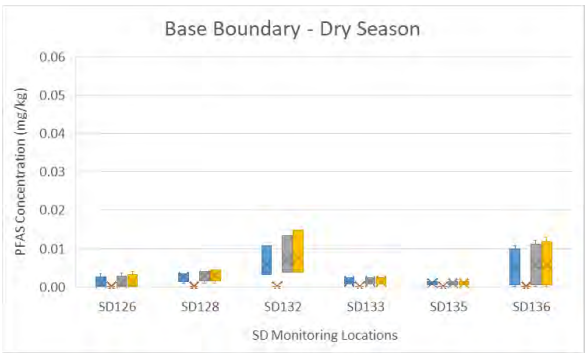
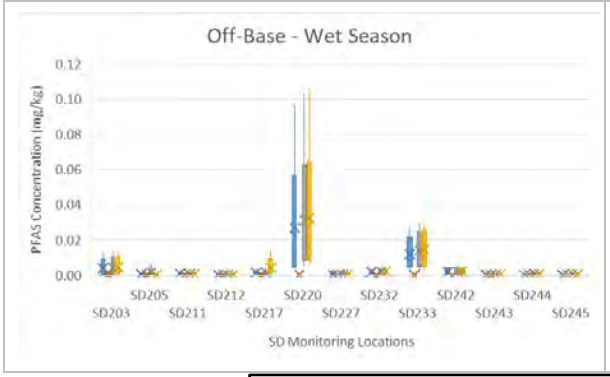
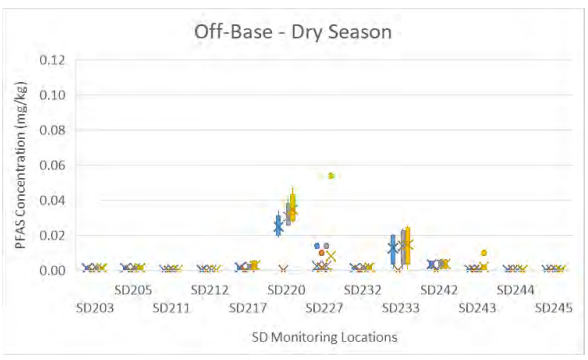


Figure D.3 Seasonal sediment PFAS concentrations in on-base and off-base locations in the Management Area (2017 to 2024)

Wet season	Dry season
	
	
	

APPENDIX E PFAS ANALYTICAL SUITE

Table E.1 – Limits of reporting for on-base groundwater and surface water, and all sediment samples				
Target PFAS analytes[1]	Groundwater and Surface Water		Sediment	
	Units	LOR	Units	LOR
Perfluoroalkyl Sulfonic Acids				
Perfluoropropane sulfonic acid (PFPrS)	µg/L	0.02	mg/kg	0.0005
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.02	mg/kg	0.0002
Perfluoropentane sulfonic acid (PFPeS)	µg/L	0.02	mg/kg	0.0002
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.01	mg/kg	0.0002
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	0.02	mg/kg	0.0002
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.01	mg/kg	0.0002
Perfluorononane sulfonic acid (PFNS)	µg/L	0.02	mg/kg	0.0002
Perfluorodecane sulfonic acid (PFDS)	µg/L	0.02	mg/kg	0.0002
Perfluoroalkyl Carboxylic Acids				
Perfluorobutanoic acid (PFBA)	µg/L	0.1	mg/kg	0.001
Perfluoropentanoic acid (PFPeA)	µg/L	0.02	mg/kg	0.0002
Perfluorohexanoic acid (PFHxA)	µg/L	0.02	mg/kg	0.0002
Perfluoroheptanoic acid (PFHpA)	µg/L	0.02	mg/kg	0.0002
Perfluorooctanoic acid (PFOA)	µg/L	0.01	mg/kg	0.0002
Perfluorononanoic acid (PFNA)	µg/L	0.02	mg/kg	0.0002
Perfluorodecanoic acid (PFDA)	µg/L	0.02	mg/kg	0.0002
Perfluoroundecanoic acid (PFUnDA)	µg/L	0.02	mg/kg	0.0002
Perfluorododecanoic acid (PFDoDA)	µg/L	0.02	mg/kg	0.0002
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.02	mg/kg	0.0002
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.05	mg/kg	0.0005
Perfluoroalkyl Sulfonamides				
Perfluorooctane sulfonamide (FOSA)	µg/L	0.02	mg/kg	0.0002
N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	0.05	mg/kg	0.0005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	0.05	mg/kg	0.0005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	µg/L	0.05	mg/kg	0.0005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	µg/L	0.05	mg/kg	0.0005
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	µg/L	0.02	mg/kg	0.0002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	µg/L	0.02	mg/kg	0.0002
(n:2) Fluorotelomer Sulfonic Acids				
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.05	mg/kg	0.0005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	µg/L	0.05	mg/kg	0.0005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.05	mg/kg	0.0005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.05	mg/kg	0.0005
PFAS Sums				
Sum of PFAS	µg/L	0.01	mg/kg	0.0002
Sum of PFHxS and PFOS	µg/L	0.01	mg/kg	0.0002
Sum of PFAS (WA DER List)	µg/L	0.01	mg/kg	0.0002

[1] - the suite of PFAS compounds analysed for the OMP may be revised if required to meet the OMP objective based on changes to screening criteria requirements or updates to the human and ecological risk profiles.

Table E.2 – Low-level limits of reporting for select off-base and base boundary groundwater and surface water samples		
Target PFAS analytes[1]	**Groundwater and Surface Water**	
	Units	**Low-level LOR**
Perfluoroalkyl Sulfonic Acids		
Perfluoropropane sulfonic acid (PFPrS)	µg/L	0.01
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.002
Perfluoropentane sulfonic acid (PFPeS)	µg/L	0.002
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.002
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	0.002
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.002
Perfluorodecane sulfonic acid (PFDS)	µg/L	0.002
Perfluoroalkyl Carboxylic Acids		
Perfluorobutanoic acid (PFBA)	µg/L	0.01
Perfluoropentanoic acid (PFPeA)	µg/L	0.002
Perfluorohexanoic acid (PFHxA)	µg/L	0.002
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002
Perfluorooctanoic acid (PFOA)	µg/L	0.002
Perfluorononanoic acid (PFNA)	µg/L	0.002
Perfluorodecanoic acid (PFDA)	µg/L	0.002
Perfluoroundecanoic acid (PFUnDA)	µg/L	0.002
Perfluorododecanoic acid (PFDoDA)	µg/L	0.002
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.002
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.005
Perfluoroalkyl Sulfonamides		
Perfluorooctane sulfonamide (FOSA)	µg/L	0.002
N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	0.005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	0.005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	µg/L	0.005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	µg/L	0.005
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	µg/L	0.002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	µg/L	0.002
(n:2) Fluorotelomer Sulfonic Acids		
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	µg/L	0.005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.005
PFAS Sums		
Sum of PFAS	µg/L	0.002
Sum of PFHxS and PFOS	µg/L	0.002
Sum of PFAS (WA DER List)	µg/L	0.002

[1] - the suite of PFAS compounds analysed for the OMP may be revised if required to meet the OMP objective based on changes to screening criteria requirements or updates to the human and ecological risk profiles.