Final Site Condition Robertson Barracks

PFAS Investigation and Management Program

Defence

21 April 2026

→ **The Power of Commitment**

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The Power of Commitment

Executive summary

Department of Defence (Defence) is undertaking a national program to investigate, manage and mitigate impacts of per- and poly-fluoroalkyl substances (PFAS) on, and in the vicinity of its bases around Australia. As part of this program, Defence has engaged Dr. Peter Beck of GHD as the Technical Advisor (TA) for the program implementation at Robertson Barracks, Holtze Northern Territory 0829 (the base).

The program is guided by information presented in the current PFAS Management Area Plan (PMAP) published for the base in November 2018. The PMAP developed for the base was based on the findings of site investigation and characterisation work to identify and assess:

- Sources of PFAS on the base.
- Contamination migration mechanisms and pathways by which PFAS mass may be discharged to the environment from the identified sources.
- Receptors (both human and ecological) which may be impacted by PFAS emanating from the site via the identified migration pathways.
- The level of risk posed to those receptors by PFAS.

The role of the TA is to conduct a critical and independent review of the investigation works and the management and mitigation measures implemented as part of ongoing investigations and monitoring, as well as provide independent input to the program at the base. This report summarises the TA's independent review of the data and information provided for review, as prepared by Defence's consultants for the base, including:

- A summary of the TA's opinion in relation to the level of risk posed by residual PFAS contamination with respect to known contaminant transport pathways and receptor exposure.
- A summary of the TA's opinion on how residual PFAS contamination is being managed at the base.
- The TA's opinion on how the PMAP actions have been addressed.

The investigation and characterisation work concluded that:

- PFAS detections in soil corresponded to identified source areas with respect to the onsite surface drainage network. A spatial relationship between PFAS sources and PFAS distribution was subsequently identified.
- PFAS were detected in groundwater samples collected from and down gradient of the identified source areas.
- A human health and ecological risk assessment (HHERA) was undertaken with respect to the results of investigation work. The majority of exposure pathways relating to PFAS originating from Robertson Barracks to human and ecological receptors were considered low and acceptable. Potentially elevated contamination exposure scenarios were identified in the HHERA, as follows:
  - Consumption of fish and molluscs caught from Milners Creek and the southern drainage channel.
  - Potential for PFAS exposure by aquatic ecosystems in the key habitat area (Milners Creek and Milner Swamp) cannot be excluded given the habitat value of this area and the known presence of PFAS.

The PMAP was developed by Defence to manage exposure regarding the presence of PFAS contamination on and emanating from the base. The mechanisms used to manage PFAS exposure included:

- Ongoing monitoring of surface water, sediment and groundwater
- Completion of further investigation works
- Continued implementation of exposure/receptor controls

The TA has undertaken an assessment of the robustness and defensibility of the data generated by the management and mitigation measures undertaken as part of PMAP implementation. Based on the critical and independent assessment documented in this report, and with respect to PMAP requirements, the TA's opinion is that sufficient data has been collected to understand the distribution and extent of PFAS contamination originating from the base to inform an assessment of risk to human health and the environment at the base. All PMAP actions outlined in the following table are considered to have been addressed.

PMAP Response Action	Status of action & TA's opinion on closure
1. Discontinue use of legacy AFFF containing PFAS (3M LightWater™ formulation) at the Site (Eliminate Primary Source)	The TA understands this action was completed prior to the commencement of PMAP implementation, based on information presented in Section 7.1 of the PMAP.
2. Manage use of AFFF containing other PFAS (such as Ansulite™ formulation) for emergency response (Engineering Controls	The TA understands this action was completed prior to the commencement of PMAP implementation, based on information presented in Section 7.1 of the PMAP.
3. OH&S measures for intrusive maintenance or construction workers to reduce potential exposure (Administrative Controls) – this includes appropriate PPE which should be documented in a HSEP for any intrusive works that may be required in source areas and drainage lines within Robertson Barracks, Milners Creek and the southern drainage channel. Whilst risks are assessed to be low and acceptable for intrusive maintenance workers, pragmatic steps to minimise exposure in source areas would reduce potential exposure via all pathways.	The TA understands Defence has implemented processes to this Response Action (Tetra Tech Coffey, 2025d) and that these will be maintained into the future following the PMAP transition, notwithstanding the low exposure risk to intrusive maintenance workers.
4. Restriction on groundwater abstraction within Robertson Barracks, CTA and the southern drainage channel (Administration Controls) – groundwater abstraction from the Bathurst Island Formation is not currently being undertaken. Defence should continue to ensure that no groundwater abstraction occurs within the PMAP Monitoring Area from the Bathurst Island Formation apart from the existing groundwater abstraction bores at the MTR, CTA and SBRS installed within the Wildman Siltstone Formation. The NT Government currently owns the land to the south of Robertson Barracks where the southern drainage channel is located who should be notified that groundwater abstraction should be restricted within the northern portion of this tenure (southern drainage channel and to the immediate north).	The TA understands no groundwater abstraction bores used for water supply are located within the base or impacted area of CTA. This potential exposure route may be managed via standard Defence Contaminated Sites Register (CSR) controls (Tetra Tech Coffey, 2025d). On this basis, the TA considers Defence to have implemented processes to this Response Action and that these should be maintained into the future following PMAP transition.
5. Implement ongoing monitoring plan (OMP) (Administration Controls) - to assess the effectiveness of ceasing the use of AFFF. The monitoring works will provide trend data for groundwater, surface water and sediment concentrations within the PMAP Monitoring Area to assess trends in PFAS concentrations of PFAS including the effectiveness of ceasing the use of AFFF and other management measures.	An OMP was prepared and implemented as part of the PMAP for the base (Tetra Tech Coffey, 2025d). The TA understands Defence processes implemented with respect to this Response Action will be maintained into the future following PMAP transition as part of a long-term environmental management strategy.
6. Avoid accidental damage or destruction of groundwater monitoring wells included in the OMP, particularly during construction work for the development of the CTA (Administration Controls). Should monitoring wells be identified that may impact on proposed construction works, this should be discussed with Defence prior to destruction of monitoring wells where possible. Decommissioning of monitoring wells should be undertaken in accordance with the National Uniform Driller Licensing Committee (NUDLC) (2012) Minimum Construction Requirements for Water Bores and installation of additional groundwater monitoring wells may be required as replacements.	The TA understands Defence processes implemented with respect to this Response Action will be maintained into the future following PMAP transition as part of a long-term environmental management strategy.
7. Continue to implement construction management procedures (Administration Controls).	The TA understands this action aligns with existing occupational health and safety measures that are routinely required on Defence projects as detailed in the PFAS Construction Management Framework and Defence Contamination Management Manual (Tetra Tech Coffey, 2025d).
8. Reduce access to Milners Creek (Engineering Controls) – Initial design plans for perimeter fencing around the CTA are currently being developed to facilitate the use of the CTA for active military training. This will also have the benefit of reducing access to Milners Creek by the public for recreational fishing.	The TA understands Defence have implemented processes to this Response Action by restricting access to Milners Creek through permanent fencing of the CTA in 2019 (Tetra Tech Coffey, 2025d). The TA understands the fencing will be maintained into the future following PMAP transition as part of a long-term environmental management strategy.

The TA understands that PFAS will continue to be monitored and managed at the base in alignment with PMAP actions which are 'ongoing' in nature. This includes continuation of the OMP and implementation of administrative controls such as the PFAS Construction and Maintenance Framework.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.4 and the assumptions and qualifications contained throughout the report.

Contents

Table index

Appendices

1. Introduction

Department of Defence (Defence) is undertaking a national program to investigate, manage and mitigate impacts of per- and poly-fluoroalkyl substances (PFAS) on, and in the vicinity of its bases around Australia. The goal of the program is to support affected communities and Defence capability by managing PFAS contamination through the adoption of best available science and practicable remedial/management approaches to restore or reduce impacts to Environmental Values.

1.1 Background

The approach taken to manage PFAS contamination at each base is outlined in a PFAS Management Area Plan (PMAP). Each PMAP is developed with respect to base-specific information and details the approach adopted by Defence to manage the risk of harm to human health and the environment and impacts to Environmental Values from PFAS contamination associated with the base.

A tailored approach is taken for each base due to the bespoke nature of PFAS contamination with respect to potential sources, transport/migration pathways and receptors and the resultant risks and impacts to Environmental Values.

In 2018, a PMAP (Defence 2018) was developed for Robertson Barracks which incorporated the base and a portion of the Closed Training Area (to the east of the base), collectively defined as the 'PMAP Monitoring Area'. The PMAP is titled Robertson Barracks, PFAS Area Management Plan, November 2018 (the PMAP) and can be found on the Defence website (**https://www.defence.gov.au/about/locations-property/pfas/pfas-management-sites/robertson-barracks**).

The PMAP was informed by the outcomes of detailed site investigations and reflects the low risk identified. The PMAP recommended that monitoring of PFAS be undertaken on and around Robertson Barracks through sampling of surface water, groundwater and sediment biannually. Treating or removing PFAS from the area was not a recommendation of the PMAP due to the low risk profile.

For each site, Defence engages a Technical Advisor (TA) whose role is to provide independent input on the management and mitigation measures to be implemented through the PMAP and to critically and independently review work undertaken by Defence's consultants and contractors.

Where risks to human health and the environment are low and acceptable and Environmental Values are not adversely impacted by defined PFAS contamination (i.e., in the case of Robertson Barracks), the TA is requested to provide an opinion on the final condition of the PMAP Monitoring Area in relation to the objective of the work undertaken as part of the PMAP.

This report provides the TA's opinion on the final condition of the PMAP Monitoring Area in relation to the activities completed as part of addressing specific PMAP actions (presented in Section 7.1 of the PMAP).

1.2 Report purpose

This report has been prepared with respect to the investigation work undertaken to assess the nature and extent of PFAS contamination at Robertson Barracks, accessed from Thorngate Road, Holtze Northern Territory 0829 (further referred to as the 'base'). The purpose of this report is to provide a summary of the TA's independent review of the reports and information provided for review, as prepared by Defence's consultants for the base, including:

- A summary of the TA's opinion on the final condition of the PMAP Monitoring Area in relation to the level of risk posed by residual PFAS contamination with respect to known contaminant transport pathways and receptor exposure.
- A summary of the TA's opinion on how residual PFAS contamination is being managed on the PMAP Monitoring Area.
- The TA's opinion on how the PMAP actions have been addressed.

1.3 Report objectives

The objectives of this report are for the TA to provide an opinion as to whether:

- Sufficient robust and reliable data was collected to inform a defensible conceptual site model (CSM), identify any complete source, pathway and receptor linkages, establish applicable Environmental Values and support an assessment of risk to human health and the environment.
- The assessment of risk to human health and the environment and impacts to Environmental Values is robust and defensible enough to identify any elevated risks to human health and the environment and impacts to Environmental Values. Where risks were identified as low and acceptable and no detrimental impacts to Environmental Values were identified, assess whether sufficient information was available to support the decision to not undertake any active remediation to reduce that risk.
- Management and mitigation measures (i.e. ongoing monitoring) demonstrate that PFAS concentrations are stable and that no further work is required to characterise the potential presence of other source areas.
- Empirical evidence that the PFAS mass discharge from the base to the surrounding environment is stable or declining with respect to the management and mitigation measures undertaken.
- Risks posed by residual PFAS impacts that remain on-base are low and acceptable or should further reduce over time.
- Passive ongoing management and mitigation measures are suitable to continue to prevent or minimise exposure to residual PFAS contamination.
- PMAP actions have been adequately addressed to transition the PMAP to an ongoing monitoring program.

1.4 Limitations

This report: Final site condition HMAS Robertson Barracks – PFAS Investigation and Management has been prepared by GHD for Defence and may only be used and relied on by Defence for the purpose agreed between GHD and Defence as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Defence arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Sections 5, 6, and 8.2 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report based on information provided by Defence and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD recognises that some documentation that contained information requiring the TA's verification was not available for review. GHD does not accept liability in connection with such unverified information and all opinions and conclusions in this report are made with the omission of this information.

2. Terms and definitions adopted

Terms and their definitions used in the preparation of this report are listed Table 1, below.

Table 1 Terms and definitions

Term	Definition of each term
Accredited or Appointed Environmental Auditor	An accredited or appointed auditor under State or Territory legislation.
Adopted Mass Estimate	The mass of PFAS compounds present in environmental media.
AFFF	Aqueous film forming foam
AS 18504-2022	AS 18504-2022 Sustainable Remediation
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)
base	A defined physical locality or geographical area from which Defence-related activities, operations, training or force preparations are managed, conducted, commanded or controlled. In this document, 'base' refers to Robertson Barracks.
CFI	Capital Facilities and Infrastructure Branch
Clean-Up	Active management and mitigation actions undertaken in response to addressing source-pathway-receptor linkages to decrease the impacts of PFAS on the environment. The objective of these actions is to either contribute to achieving the overall remediation goal for the base or where there is no driver for remediation to decrease the discharge of PFAS to the environment.
CSM	A Conceptual Site Model (CSM) is a representation and evaluation of contamination sources, the pathways by which contaminants can migrate, and the receptors (human health and/or ecosystems) that could be exposed to the contaminants. This information is used to identify the potential risks to human health and ecosystems.
Defence National PFAS Investigation and Management Program	The national program Defence is undertaking to investigate, remediate and manage impacts of per- and poly-fluoroalkyl substances (PFAS) on, and in the vicinity of its bases around Australia.
Detailed Site Investigation (DSI)	Detailed Site Investigation included investigation works that sample the environmental media, fauna and flora as necessary to identify and characterise the nature and extent of PFAS impacts in that environmental media.
EMOS	Estate Maintenance and Operations Services
Environmental Regulator	A State/Territory environmental regulator. May be named Environment Protection Authority or by a departmental name where those functions are embedded in a department.
Environmental Values	The uses, attributes and functions of the environment that people value.
Goal	The end point that active management and mitigation actions need to ultimately achieve (such as decreases risks to human health and the environment to low and acceptable levels and/or restoration of Environmental Values).
Human Health and Environmental Risk Assessment (HHERA)	Human Health and Environmental Risk Assessment, including consideration of human, flora and fauna receptors present in terrestrial and aquatic environments on and off-site. This assessment will identify the level of risk posed to receptors by PFAS presence in the environmental media to which the receptors are exposed.
Mass Discharge (MD)	The mass of PFAS that is discharged from a source (primary (AFFF) and secondary (soil)) or within a pathway of migration (sediment, surface water and groundwater). The MD can be expressed in terms of mass (kg) per unit time (year) (kg/year).
Mass Flux (MF)	The quantity of mass of PFAS moving through a unit area of an aquifer or stream. MF is expressed either in terms of mass per unit area per unit time (e.g. $kg/m^2/year$) or mass per unit volume per unit time (e.g. $kg/m^3/year$).
NEMP	PFAS National Environmental Management Plan (Version 2.0) (HEPA 2020). Please note, NEMP 3.0 was released in March 2025. This was after all assessment and cleanup works were completed. Therefore, the NEMP 2.0 document is relevant to this assessment.

Term	Definition of each term
NRF	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE), National Remediation Framework (NRF), August 2019.
Objective	The point at which active management and mitigation measures can cease as no further net environmental benefit can be achieved by continuing an action. Objectives typically aim to reduce MF and MD to a specified level.
OMP	Ongoing Monitoring Plan/Program
Pathway Mass Discharge (PMD)	The mass of PFAS that moves along a particular pathway, at a particular location over time. This occurs primarily through the movement of sorbed phase in sediments and dissolved phase in water. The PMD represents the mass of PFAS that moves along a pathway to assist in prioritising management and mitigation actions towards meeting the remediation goal. The PMD can be expressed in terms of mass (kg) per unit time (year) (kg/year).
Pathway Mass Flux (PMF)	The mass of PFAS that moves across a unit area or volume of media along a pathway over time. This occurs primarily through the movement of sorbed phase in sediments and dissolved phase in water. The PMF can be measured over a planar area that sits across or the volume that moves within a migration pathway (primarily surface water and groundwater). PMF is expressed either in terms of mass per unit volume per unit time (e.g. $kg/m^3/year$) or mass per unit area per unit time (e.g. $kg/m^2/year$).
PFAS	Per- and poly-fluoroalkyl substances
PFAS mass in environmental media	The amount of PFAS expressed in unit weight (kg) that resides in an environmental media, such as soil, sediment, groundwater, surface water. PFAS mass provides an indicator of where the contaminant mass resides and assists in planning active and passive management and mitigation actions.
PFHxS	Perfluoro-hexane sulfonate
PFOA	Perfluoro-octanoic acid
PFOS	Perfluoro-octane sulfonate
PMAP	PFAS Management Area Plan (and revisions)
Practicable Remediation Solution	A feasible and effective method for cleaning up contaminated sites, considering technical, economic and regulatory factors.
Primary Contamination Mechanism	The initial process by which contaminants are introduced into an environment, system or product.
Primary Contaminant Migration Processes	The ways in which contaminants move through different environmental media after initial release. For example, advection, diffusion, mechanical dispersion, sorption, biodegradation, volatilisation.
Preliminary Site Investigation (PSI)	Preliminary Site Investigation, including review of the activities that may have included use of PFAS containing products, identify where these products may have been used and establish whether any past works and infrastructure may have moved PFAS impacted media around the site.
Remediation	Active management and mitigation action undertaken in response to risks to human health and the environment and/or impacts to Environmental Values. These actions can include one or more clean-up actions that are undertaken on and off base to reduce risks to acceptable levels and restore Environmental Values. The remediation goal is to decrease risk to human health and the environment to low and acceptable levels and/or restore Environmental Values.
SFARP	So far as reasonably practicable
Site	In this document, a reference to 'Site' refers to the Robertson Barracks.

Term	Definition of each term
Source and source area	The source of PFAS at this base is from AFFF. A PFAS source area can be defined as primary or secondary. Primary source areas are where AFFF was used or stored, secondary source areas are where contaminants may have accumulated in the environment.
Source Mass Discharge (SMD)	The mass of PFAS discharged by a source into the environment, primarily through leaching and migration along pathways (sediment, surface water, groundwater etc.) The emissions can be expressed in terms of mass (kg) per unit time (year) (kg/year). The SMD applies to each source present on a base and assists in identifying the priority for management and mitigation actions to address PFAS mass discharge.
SPR	Source Pathway Receptor
TA	Technical Advisor
Total mass discharge (TMD)	The total mass of PFAS that discharges from the site into the environment and is a combination of SMD and PMD. Understanding TMD sets a baseline prior to undertaking any management and mitigation actions and using TMD as a measurement of their success after implementation.

3. Decision-making framework

3.1 TA considerations regarding PFAS movement

When conducting the critical and independent review of the site characterisation, risk assessment, remediation, management and monitoring documentation for a site that emits PFAS to the environment, the TA considers:

– how PFAS moves from the source to the receptor, with respect to the movement of PFAS mass.
– the speed at which the mass moves; and
– the amount of mass that moves.

In the context of the source, pathway and receptor (SPR) linkages, PFAS mass movement can be divided into the following key flux and discharge components, as set out in (Diagram 1):

– Source Mass Discharge (SMD): Emission of PFAS from primary and secondary sources lead to PFAS entering the environment. Primary SMD occurred when PFAS containing products, such as AFFF foam used during training and active firefighting, discharge onto infrastructure and soils, which then becomes PFAS containing secondary sources. Secondary SMD occurs when PFAS is emitted from impacted infrastructure and soils etc. into the environment.
– Therefore, understanding where on a site SMD occurs is a critical step in managing and mitigating PFAS discharge into the environment. Management and mitigation of SMD can be divided into:
  - Monitor source(s), as active management and mitigation is not practicable due to the requirement for maintaining capability and capacity of the infrastructure on the site.
  - Manage source(s), through treatment of source materials to decrease SMD. SMD management typically involves containing the source (e.g., covering or encapsulating) or stabilising the source (e.g., activated carbon addition, etc.).
  - Mitigate source(s), through removal of source material to decrease SMD. SMD mitigation typically involves removal of the source material either through excavation and disposal at a suitable facility or excavation and treatment (e.g., thermal destruction, soil washing, etc.), followed by either disposal or reuse of the treatment material.
– Pathway Mass Flux (PMF): Movement of PFAS occurs along pathways that transmit PFAS from the source into the environment. Common pathways include sediment transport, surface water flow and groundwater movement. Understanding the circumstances regarding PFAS movement along a pathway is an important consideration when assessing risks regarding PFAS mass discharge to the environment. For this site, surface water flow is the primary PMF.
– Pathway Mass Discharge (PMD): PMF along pathways leads to PFAS mass discharge from the source into the environment. Understanding the PFAS PMD is an important consideration when assessing risks regarding PFAS mass discharge to the environment.
– Total Mass Discharge (TMD): TMD is the total mass of PFAS that discharges from the site into the environment and is a combination of SMD and PMD. Understanding TMD sets a baseline prior to undertaking any management and mitigation actions (i.e. such as remediation activities, if required) and using TMD as a measurement of their success after implementation.

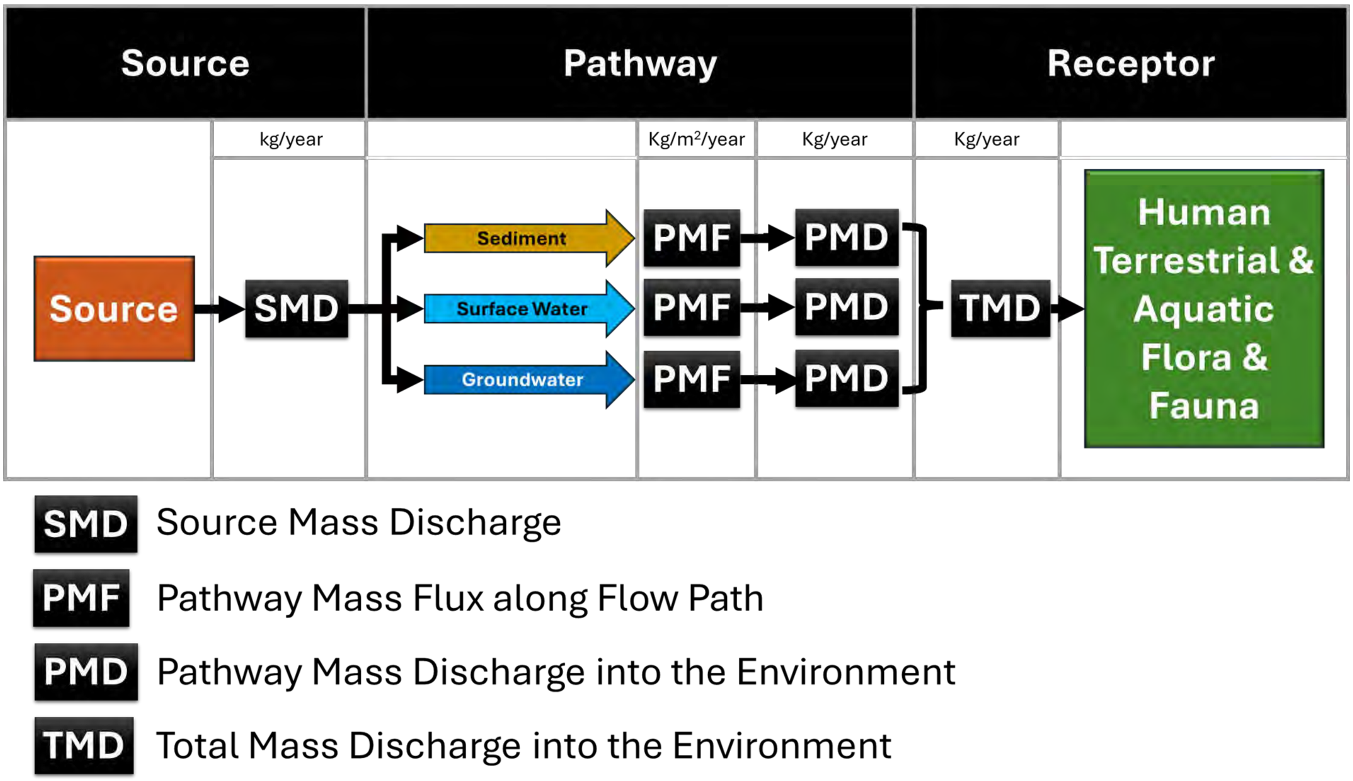

Diagram 1 Conceptualisation of mass flux and mass discharge in the context of the source, pathway and receptors linkage

3.2 TA workflow and decision process

To conduct an efficient and effective, critical and independent review of the investigation, management and mitigation actions, the TA mapped the general workflow and decision process. This mapping was done to identify the key gateway and decision points. At these points, the TA was requested to provide interim advice on whether the workflow can move forward.

The workflow and decision process set out in Diagram 2 and further explained in Table 2, provides the main work phases and decision points considered necessary to progress a site with suspected PFAS impacts to a reasonable and practicable endpoint.

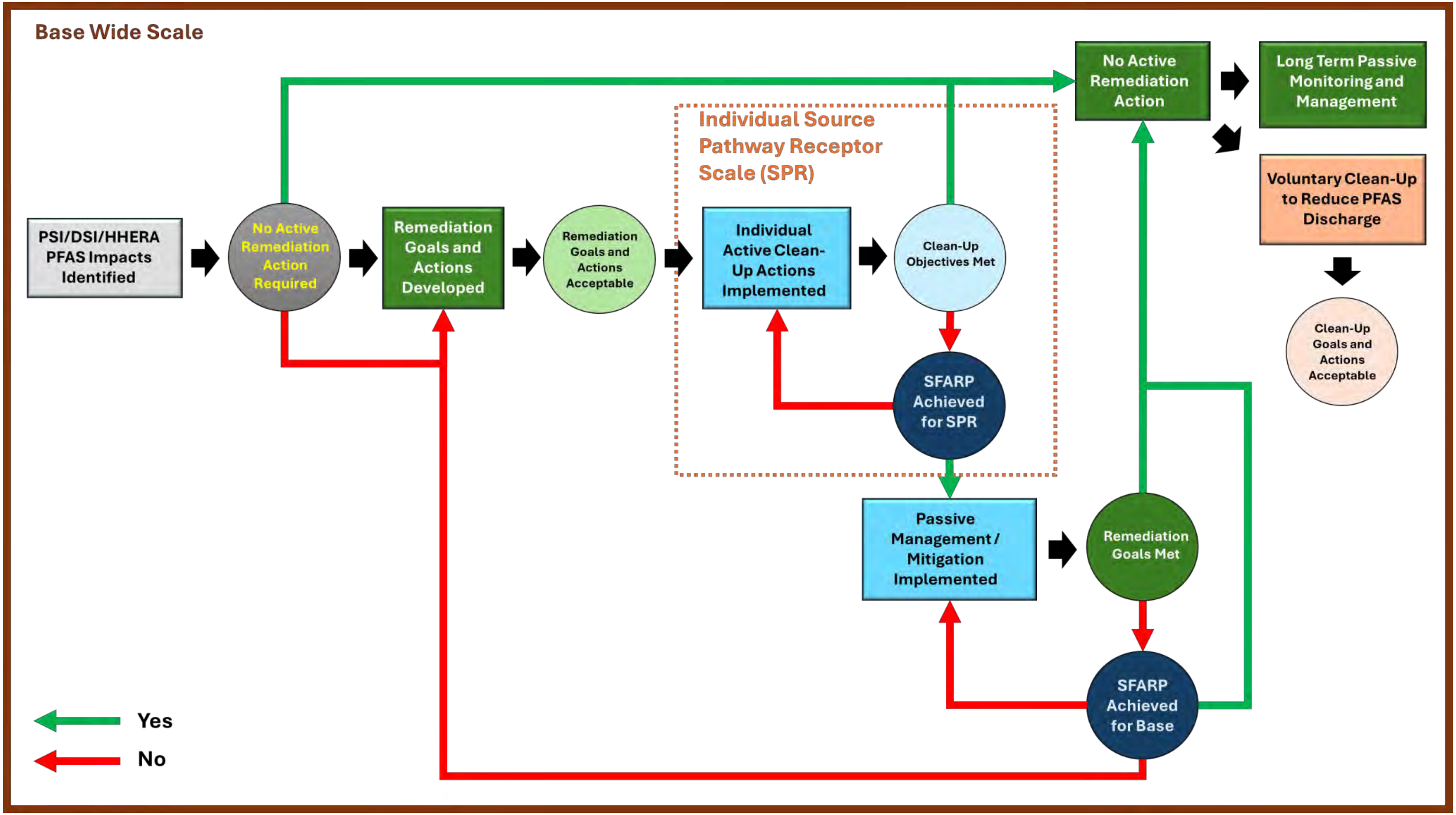

Diagram 2 Conceptualisation of workflow and decision process

Table 2 Breakdown of workflow and decision process

Phases and decision points	Description
Site Characterisation Phase PSI/DSI/HHERA PFAS Impacts Identified	Characterisation and assessment of risk related to historical use of PFAS containing products at the site. The work tasks commonly associated with this work phase include completion of a PSI, DSI and HHERA. The information from this work phase will inform a decision on whether active remediation actions are required to manage and mitigate impacts associated with PFAS impacts.
Further Action Decision Point No Active Remediation Action Required	The first key decision point in the workflow is whether active remediation actions are required to decrease risks to low and acceptable levels and /or restore Environmental Values. The details of the process adopted by the TA to support this decision are set out in Table 3.
Remediation Goals Setting and Action Planning Phase Remediation Goals and Actions Developed	Once the decision that active remediation actions are required to decrease risk and /or restore Environmental Values is made, the next work phase involves: – Development of remediation goals that focus on decreasing risks to low and acceptable levels and restores Environmental Values. – Identify, develop and plan feasible active remediation actions that provide the most practicable and effective means to meet the remediation goal.
Remediation goal and action Decision Point Remediation Goals and Actions Acceptable	After completion of the remediation goal setting and action planning the next key decision point is whether the remediation goals set, and actions planned are appropriate and practicable. The details of the process adopted by the TA to support this decision are set out in Table 3.
Implementation of Individual Active Clean-up Action Phase Individual Active Clean-Up Actions Implemented	Remediation typically comprises one or more distinct cleanup actions that need to be implemented in order to achieve the overall goals of the remediation. Each individual cleanup action aims to achieve a specific objective and represents a distinct part of the overall remediation strategy implemented at the site.
Clean-up Objectives met Decision Point Clean-Up Objectives Met	After implementation and completion of the clean-up action(s), the next key decision point is whether the set cleanup objectives have been met. The details of the process adopted by the TA to support this decision are set out in Table 3.
Clean-up Action SFARP Decision Point SFARP Achieved for SPR	Where the objectives set for the cleanup actions are not achieved within reasonable technical, logistical and financial effort and sustainability considerations, the next key decision point is whether the clean-up has achieved a practicable end point, and no net environmental benefit would result from continuing the clean-up action. The details of the process adopted by the TA to support this decision are set out in Table 3.
Implementation of Individual Passive Clean-up Action Phase Passive Management/ Mitigation Implemented	Once active cleanup actions have either met the clean-up objectives or have been implemented SFARP, passive cleanup actions must be implemented to deal with any residual PFAS impacts. The aim of the passive cleanup actions is to minimise risks to human health, the environment and Environmental Values SFARP into the future.

Phases and decision points	Description
Remediation Goals Met Decision Point Remediation Goals Met	After implementation and completion of the remediation, the next key decision point is whether the remediation goals set, and actions undertaken, have been met. Details of the process adopted by the TA to support this decision are described in Table 3.
Remediation Action SFARP Decision Point SFARP Achieved for Base	Where the remediation goals are not achieved within reasonable technical, logistical and financial effort and sustainability considerations, the next key decision point is whether the remediation has achieved a practicable end point, and no net environmental benefit would result from continuing the remediation. The details of the process adopted by the TA to support this decision are set out in Table 3.
No Further Active Remediation Action Phase (Passive Management Phase) No Active Remediation Action	When no active remediation actions are needed to reduce risk or restore Environmental Values, or when the remediation goals have been achieved, the project will transition to long-term management and monitoring to address any remaining PFAS impacts.
Long Term Passive Monitoring and Management Phase Long Term Passive Monitoring and Management	Once active remediation has ended the site can transition to long-term environmental management that deals with any residual PFAS impact that remain after completion of remediation.
Voluntary Clean-up Action Phase Voluntary Clean-Up to Reduce PFAS Discharge	In situations where no further active remediation is required, either due to risks being low and acceptable, Environmental Values having been restored or remediation goals having been met SFARP, some clean-up actions may still be implemented on a voluntary basis to further decrease mass discharge of PFAS into the environment.
Voluntary Clean-up Objectives and Action Acceptable Decision Clean-Up Goals and Actions Acceptable	After completion of the Site Characterisation Phase or when No Further Active Remediation Action is required, further cleanup action may be undertaken to achieve goals on a voluntary basis using actions to achieve those goals. Therefore, the next key decision point is whether the cleanup goals set, and actions planned are appropriate and practicable. The details of the process adopted by the TA to support this decision are set out in Table 3.

3.3 Data quality objectives

To facilitate a structured and consistent approach to the TA review process, the Data Quality Objectives (DQO) set out in Table 3 were adopted. The DQO Process involves logical steps that guide the TA's review. This ensures a resource-effective approach to conduct an independent advisory role for completing PMAP implementation and transitioning to long-term management. The DQO Process is both flexible and iterative, and applies to both decision-making (e.g., compliance/non-compliance with a standard) and estimation (e.g., ascertaining the mean concentration level of a contaminant, assessment of risk, impact to Environmental Values, effective management and mitigation measurements).

The DQO Process is used to establish performance and acceptance criteria, which serve as the basis to independently support robust and defensible decision making for implementation of the PMAP and process for transition from PMAP to long-term management. Use of the DQO Process leads to:

- Efficient and effective expenditure of resources.
- A consensus on the type, quality, and quantity of data needed to meet the project goal.
- Full, clear and transparent documentation of actions taken during the development of the project.

Table 3 Data Quality Objectives Process

<table>
<tr><th>Step</th><th colspan="2">Description</th></tr>
<tr><td>Step 1. State the Problem</td><td colspan="2">Has the historical use of PFAS containing products resulted in impacts to Environmental Values on and off base? Do these impacts warrant remediation (i.e., active management and mitigation actions) to reduce risk to Human Health and the Environment to acceptable levels? Where required, have these active actions restored Environmental Values and decreased risks to low and acceptable levels?</td></tr>
<tr><td rowspan="8">Step 2. Identify to the Decision of the Assessment</td><td colspan="2">As part of the review of the PMAP process with respect to the problem statement (Step 1) requires the following decisions by the TA:</td></tr>
<tr><td>No Active Action Required</td><td>Do the results from assessment and monitoring work completed to date demonstrate that PFAS emissions from one of more sources do not impact Environmental Values, and risks to current and potential future receptors on and off base are low and acceptable?</td></tr>
<tr><td>Remediation Goals and Actions Acceptable</td><td>Are the remediation goals and remediation methods of active management and mitigation actions reasonable and, the actions proposed, able to reduce risks to human health and the environment to low and acceptable levels and restore Environmental Values?</td></tr>
<tr><td>Clean-Up Objectives Met</td><td>Have the objectives of the active cleanup management and mitigation measures undertaken with respect to the source(s), pathway and receptor linkages reduced PFAS discharge into the environment and reduced exposure?</td></tr>
<tr><td>SFARP Achieved for SPR</td><td>Where the active management and mitigation measures have not been able to reduce risk to human health and the environment to low and acceptable levels and /or restore Environmental Values, have actions undertaken been able to meet the objectives of SFARP with respect to SPR linkages?</td></tr>
<tr><td>Remediation Goals Met</td><td>Have the goals of the remediation undertaken with respect to the base and surrounding environment been met?</td></tr>
<tr><td>SFARP Achieved for Base</td><td>Where the remediation has not been able to ultimately meet the objectives, have actions undertaken been able to meet the objectives SFARP with respect to the base and surrounding environment?</td></tr>
<tr><td>Clean-Up Goals and Actions Acceptable</td><td>Have the objectives of the active clean-up management and mitigation measures undertaken with respect to the source(s), pathway and receptor linkages reduced PFAS discharge into the environment and reduced exposure?</td></tr>
<tr><td>Step 3. Identify Information Inputs to support Decisions</td><td colspan="2">The key information required by the TA to support the decisions made as part of the review process are:
– Information on where and when PFAS containing products, particularly with respect to use of AFFF, occurred on the base.
– Site Investigation Data that characterises the following as far as reasonably practicable:
• Geomorphological setting of the base and surround (geology, hydrology, hydrogeology, geochemistry and hydrochemistry, etc.).
• Sources (primary, secondary and tertiary) where PFAS is present and where emissions occur from the base into the environment.
• Pathways (Air, Soil, Sediment, Surface Water, Groundwater) by which PFAS emission from source areas migrate into the environment and expose receptors.
– Receptors (human, terrestrial and aquatic flora and fauna) that may be exposed currently or in the future to PFAS emissions from the source areas on the base.
– Human Health and Environmental Risk Assessment that characterises the nature, scale and acceptability of risks arising from PFAS exposure to human, terrestrial and aquatic flora and fauna receptors.
– Remediation Action Plan (RAP) that sets out the objective of the active management and mitigation measures selected as suitable and effective to be implemented with respect to the SPRs to achieve the goals set for the remediation of the base.</td></tr>
</table>

Step	Description
	– Management and Mitigation Action Validation Report(s) that provide robust and defensible data for multiple lines of evidence that demonstrate that the actions undertaken have achieved the objectives. Where the objectives were not met, a sound and robust multiple lines of evidence case is required to demonstrate that the active management and mitigation measures have progressed towards achieving the objectives SFARP. – Ongoing Monitoring Plan (OMP) that monitors the emissions of PFAS into the environment and provides data with respect to the performance of the active and passive management and mitigation measures with respect to progress towards achieving the remediation goals. – Remediation Validation Report (RVR) that provides robust and defensible data for multiple lines of evidence, that demonstrate that the actions undertaken have achieved the remediation goals. Where the remediation goals were not met, a sound and robust multiple lines of evidence case is required to demonstrate that the active and passive actions have progressed towards achieving the remediation goals SFARP. – Long-term environment management plan that sets out the monitoring, management and contingency measures to be implemented over the long term after active management and mitigation of PFAS impacts cease.
Step 4. Define the Boundaries of the Assessment	The boundaries of the assessment area are defined in the PMAP.
Step 5. Develop the Analytical Approach	The following analytical approach was adopted for the review of the PMAP implementation process with respect to subsequent ongoing monitoring: – The source of all public database and anecdotal information supplied is clearly identified and verified. – All sampling and analytical analysis undertaken as part of all investigation and monitoring works was collected using robust and defensible methods. – All analytical data was of suitable accuracy and precision, thereby demonstrating suitable reliability to support defensible risk assessment and decision making. – Risk assessments with respect to human, terrestrial and aquatic flora and fauna receptors was undertaken using robust and defensible methods that relied on robust and verified data. – Management and Mitigation methods adopted to address impacts to Environmental Values, including risks to human health and the environmental receptors are robust, defensible. – Ongoing monitoring has been undertaken in a robust and defensible manner to assess the status and potential exposure risks associated with residual PFAS impacts. – Long-term monitoring and management actions are reasonable and effective at managing any residual PFAS impacts on site and any associated residual emissions to the environment are stable or preferably declining over the long term.
Step 6. Specify Performance or Acceptance Criteria	To support robust and defensible decision making over the course of the review process, the following performance criteria were adopted:
	No Active Action Required The specified performance or acceptance criteria for this decision point are: – The robustness and defensibility of the data used to support decision making meets the relevant Quality Assurance (QA) and Control Data Quality Indicators (DQI). – PFAS exposure concentration for relevant receptors are demonstrated to be below the Tier 1 risk screening criteria at the 95% confidence level. Or where this is not the case – risks posed to receptors by PFAS are low and acceptable as demonstrated through a robust and defensible HHERA.
	Remediation Goals and Actions Acceptable The specified performance or acceptance criteria for this decision point are: – The robustness and defensibility of the data used to support decision making meets the relevant QA and DQIs. – The sources, pathways and receptors, including the linkages between them have been adequately characterised to inform development of defensible remediation goals. – The remediation goals set for the base are clearly stated and meet the spirit and intent of Commonwealth and State legislation. The remediation management and mitigation actions (comprised of one or more clean-up actions) provide the most appropriate means of achieving the remediation goals for the site, having considered: – Technical feasibility and performance of remediation measures is demonstrated through appropriate research, laboratory trials and field trials.

Step	Description	
		– Logistical requirements for implementation of the remediation measures are commensurate to the risk to human health and the environment, impact to Environmental Values and maintain capability and operations of the site. – Financial investment for implementation of the remediation measures are commensurate to the risk to human health and the environment, impact to Environmental Values and demonstrate prudent expenditure of public funds. – The remediation goals and actions aim to achieve a net environmental benefit.
	Clean-Up Objectives Met	The specified performance or acceptance criteria for this decision point are: – The robustness and defensibility of the data used to support decision making regarding the clean-up actions meets the relevant QA and DQIs. – The sources, pathways and receptors associated with the risks to human health and the environment and /or impacts to Environmental Values have been adequately characterised to inform development of defensible clean-up objectives for the individual clean-up actions that contribute to achieving the remediation goals for the site. The cleanup actions provide the most appropriate means of achieving the remediation goals for the site, having considered: – Technical feasibility and performance of each cleanup action is demonstrated through appropriate research, laboratory trials and field trials. – Logistical requirements for implementation of each cleanup action are commensurate to the risk to human health and the environment, impact to Environmental Values and maintain capability and operations of the site. – Financial investment for implementation of each cleanup action is commensurate to the risk to human health and the environment, impact to Environmental Values and demonstrate prudent expenditure of public funds.
	SFARP Achieved for SPR	The specified performance or acceptance criteria for this decision point are: – The robustness and defensibility of the data used to support decision making meets the relevant QA and DQIs. – The clean-up action, while not meeting the clean-up objective, has resulted in: • A decrease in TMD and /or PMD and PMF. The cleanup actions were implemented within the: – Technical specifications and have achieved a practicable end point with respect to progress towards achieving the clean-up action objective. – Logistical constrains and capabilities of the clean-up action undertaken but continuance of the action would result in an interference with capability and operations of the site. – Financial expenditure has been commensurate with the scale, extent and magnitude of the cleanup objectives towards achieving the clean-up goals and further implementation of the cleanup action(s) results in a diminishing return on investment.
	Remediation Goals Met	The specified performance or acceptance criteria for this decision point are: – The robustness and defensibility of the data used to support decision making meets the relevant QA and DQIs. – Remediation actions undertaken have achieved the remediation goal(s) set for the site.
	SFARP Achieved for Base	The specified performance or acceptance criteria for this decision point are: – The robustness and defensibility of the data used to support decision making meets the relevant QA and DQIs. – The remediation actions, while not meeting the remediation goal, has resulted in a decrease in TMD from the site. – The TMD from the site shows a decreasing trend at an acceptable level of statistical confidence. The remediation actions were implemented within the: – Technical specifications for the remediation method(s) and have achieved a practicable end point with respect to progress towards achieving the remediation goal.

Step	Description	
		– Logistical constraints and capabilities of the remediation actions undertaken and have reached a point where continuance of the action would result in an interference with capability and operations of the site. – Financial expenditure, commensurate with the scale, extent and magnitude of the remediation actions towards achieving the remediation goals and further implementation of the remediation action(s) would result in a diminishing return on investment.
	Clean-Up Goals and Actions Acceptable	The specified performance or acceptance criteria for this decision point are: – The robustness and defensibility of the data used to support decision making in regard to the clean-up actions meets the relevant Quality Assurance and Control DQIs. – The sources, pathways and receptors associated with the TMD to the environment have been adequately characterised to inform development of defensible clean-up objectives for the individual clean-up actions intended to reduce TMD to the environment. The clean-up actions provide the most appropriate means of achieving the clean-up objectives, having considered: – Technical feasibility and performance of each clean-up action is demonstrated through appropriate research, laboratory and field trials. – Logistical requirements for implementation of each clean-up action are commensurate to the TMD from the site and maintain capability and operations of the site. – Financial investment for implementation of each clean-up action is commensurate to the TMD decrease and demonstrate prudent expenditure of public funds.
Step 7. Develop the Plan for Obtaining the Data to Support the Assessment	To complete the TA role for the site, the following plan was developed to deliver the critical and independent review of documentation and complete advice to support transition of the PMAP for the site: – Establish clear and concise DQIs for assessment of data generated to support site characterization and remediation decisions. – Provide clear and concise feedback and comments on documents that are critically and independently reviewed by the TA and his team. – Review and approve clear and concise remediation goals that consider the risk to human health and the environment, impacts to Environmental Values, Commonwealth environmental legislation and compliance with the spirit and intent of State environmental legislation. – Review and approve clear and concise clean-up objectives for the clean-up actions to be implemented as part of the overall remediation approach for the site. – Achieving the remediation goal is demonstrated using multiple lines of evidence, supported by robust and defensible data that is presented in a clear and concise Remediation Validation Report (RVR). – Achieving the clean-up objectives is demonstrated using multiple lines of evidence, supported by robust and defensible data that is presented in a clear and concise Clean-up action close out report (CCR). – Demonstrate that Remediation SFARP has been achieved for the site based on technical, financial, logistical and sustainability considerations and no net environmental benefit would be achieved by further active remediation actions. – Demonstrate that Clean-Up SFARP has been achieved for the source, pathway and/or receptor based on technical, financial, logistical and sustainability considerations.	

3.4 Assessment of Environmental Values

The Northern Territory Environment Protection Authority (NT EPA) administers the *Waste Management and Pollution Control Act 1998* (WMPC Act). Whilst the TA has not been engaged by Defence to undertake an environmental audit with respect to the meanings provided in the WMPC Act, we understand Defence has a policy of considering State/Territory legislation in both spirit and intent. As such, the process required by the WMPC Act was considered by the TA. In this way, the TA has adopted jurisdictional requirements administered by EPA Victoria for the purpose of this report, including:

- Environment Protection Act, 2017 (the ‘Act’)
- Environment Protection Regulations, 2021 (the ‘Regulations’)
- Environment Reference Standard, 2021 (the ‘ERS’)

The adoption of these jurisdictional requirements is considered reasonable noting both NT EPA and EPA Victoria implement a risk-based approach for the assessment of contaminated land to ensure the protection of human health and the environment, as follows:

- In Victoria, there is a legislated general environmental duty (GED) requiring each Victorian and all businesses to manage activities to reduce the risk of harm to human health and the environment from pollution or waste. This includes the ‘Duty to Manage’ and ‘Duty to Notify’ contamination, which include identifying and assessing contamination, implementing measures to minimise risks, and providing relevant information to parties that might be affected (including notification to EPA Victoria if certain thresholds are met).
- In NT under the Waste Management and Pollution Control Act (WMPC Act) 1998, known or suspected contamination must be reported to the NT EPA. The NT EPA can then require assessment, and if necessary, remediation, to treat, contain, remove or manage the contamination.

The risk-based approach adopted by NT EPA and EPA Victoria aligns to the requirements of the *National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended in 2013)* (ASC NEPM). The ASC NEPM was developed by the National Environment Protection Council (NEPC) under the National Environment Protection Council Act 1994 to be a nationally consistent framework to assess contaminated land and the risk it poses to human health and the environment.

The ERS, which forms part of subordinate legislation of the Act, defines the Environmental Values. The Environmental Values concept describes the uses, attributes and functions of the environment that people value. This includes elements associated with the land environment, surface water, groundwater, ambient air, ambient sound and sediments. The ERS sets the objectives for supporting different uses of the environment, and indicators that can be measured to establish whether those objectives are being met. The indicators and objectives provide a basis for assessment and reporting on environmental conditions with respect to the ASC NEPM.

Restoration and/or maintenance of Environmental Values can be achieved through prevention, management and/or mitigation of unacceptable/elevated risks posed to the Environmental Values.

It is recognised that all or some Environmental Values may not be able to be restored within a foreseeable timeframe even with active intervention. In such cases the legislated standards cannot be met due to impracticalities posed by one or more site characteristics, such as technical, logistical, financial and also sustainability considerations. However, efforts should be made to restore the Environmental Values to the extent practical. Risk of harm to Environmental Values is the primary driver for active remediation. If there is no unacceptable risk of harm posed to Environmental Values, then no remediation is required.

In the case of Robertson Barracks, the DSI (Senversa, 2018a) and HHERA (Senversa, 2018b) did not identify any elevated risks to Environmental Values posed by PFAS contamination on the base. Robertson Barracks operates on Commonwealth land, therefore State and Territory legislation is not enforceable on the base. Nevertheless, Defence has an obligation to all personnel and communities to manage and reduce risks of harm to human health and the environment where practical. So, although active remediation was not required, Defence implemented a proactive management and mitigation program through the PMAP and associated ongoing monitoring requirements to confirm the ongoing risk of harm to be low and acceptable with respect to the findings of the DSI and HHERA.

4. Site setting

4.1 Site description

Robertson Barracks is located approximately 17 km east of the Darwin city centre. The area surrounding Robertson Barracks contains predominately semi-rural residential land uses, with open wetland and swamp areas as well as multiple historical quarrying areas including within the Closed Training Area (CTA) located to the east of Robertson Barracks. Site location plans prepared by the LC (Tetra Tech Coffey, 2025d) are shown as Figure 1, Figure 2A and Figure 2B in Appendix A.

The PMAP Monitoring Area comprises Robertson Barracks and the southern drainage channel running along the southern boundary of the Barracks which discharges to Milners Creek. The Site also includes a portion of the CTA to monitor potential lateral migration of PFAS impacted groundwater from Robertson Barracks and PFAS impacted surface water and sediment within Milners Creek and Milners Swamp within the CTA.

Whilst not technically ‘on Site’, two groundwater abstraction bores to the far north of the Site which are used for potable purposes at the Shoal Bay Receiving Station (SBRS) have been included as part of ongoing monitoring, despite no previous detections of PFAS above the adopted laboratory limit of detection. Site identification details are summarised in Table 4.

Table 4 Site Details

Item	Discussion
Address	Robertson Barracks, Thorngate Road, Darwin, NT, 0829 plus the southern drainage channel that runs parallel to the southern boundary and part of the CTA.
Spatial Area	181.3 Ha (1.81 km^2)
Traditional Owner	The Larrakia people are the traditional owners of the Darwin region identifying an area from Cox Peninsula in the west to Gunn Point in the north, Adelaide River in the east and Manton Dam in the south.
Current Owner	The Commonwealth of Australia
Land Parcels	Robertson Barracks: Tenure 805/990
Municipality	The Commonwealth of Australia
Current Land Use Zoning	Commonwealth Land (CA)
Current Occupier	Defence
Current Uses	Over 2,600 staff work daily on Robertson Barracks, which is also the home of Australia’s 1st Brigade. Key features include: – Helicopter airfield and infrastructure in the northern portion of Robertson Barracks, including hangars, vehicle and aircraft maintenance areas, and fuel supply infrastructure. – Commercial/office buildings across Robertson Barracks. – Residential housing for personnel, sports and recreational facilities and a child care centre (used four days a week as a minimum by mothers and toddlers) in the central eastern section of Robertson Barracks. – Four main catering kitchens and recreational facilities, including gyms, swimming pools, children’s play parks, cafes and a chapel. – Wash bay, refuelling areas, dangerous goods stores and mechanic areas within various compounds across Robertson Barracks. – Training areas, including shooting ranges and revetments in the cleared open space to the north of Robertson Barracks known as the MTR. – The CTA which is a former quarry area to the east of Robertson Barracks has also recently been acquired by Defence which is currently being developed for the use of live fire range field training. As part of the proposed development of the CTA, fencing and gated access will be installed around the perimeter of the CTA to restrict access to the general public who can currently access some areas of the CTA. – Sports fields, ovals and activity areas located along the south eastern section of Robertson Barracks.

The TA considered that the reports prepared for the Site provided adequate information to clearly and unambiguously identify the Base, its location and ownership. The primary uses of the land occupied by the base were considered to have been adequately identified and described.

4.2 Topographical setting

The PMAP Monitoring Area is slightly undulating and low lying, with wetlands and swamps sloping towards the east. The PMAP Monitoring Area elevation ranges between approximately 37 metres above Australian Height Datum (m AHD) in the northwest and 19 m AHD in the northeast. The surrounding area slopes to the northeast towards Shoal Bay.

The TA considered that the topography of the base and surrounding area was adequately described.

4.3 Climate

The PMAP Monitoring Area is within the monsoonal tropic area of northern Australia. The area experiences two distinct seasons, a warm, Dry season from approximately May to September and a hot, monsoon and tropical cyclone Wet season from approximately October to April with rainfall predominantly falling during the Wet season. Significant monsoon and tropical cyclone events during January to March are relatively common, occurring throughout the Wet season and are likely to cause localised flooding.

The TA considered that the climatic conditions that prevail on and around the base was adequately described.

4.4 Hydrology

Robertson Barracks is situated adjacent to and resides on part of a wetland area within the Kings Creek Catchment. Generally, surface water diverts around the perimeter of Robertson Barracks in open drainage channels (both lined and unlined) before discharging along points on the eastern, western and southern boundaries. The drainage channels follow the local topographic low areas and divert surface runoff through and off Robertson Barracks, as follows:

- The drainage lines in the central portion of Robertson Barracks discharge to a drain that runs underneath Thorngate Road to the east and into the western tributary of Milners Creek.
- The drainage lines in the western and southern portion of Robertson Barracks drain along the western base boundary and discharge into the southern drainage channel, which is an unlined drain located outside of Robertson Barracks that runs parallel to the southern base boundary. The southern drainage channel discharges into the southern tributary of Milners Creek which flows northwards through the CTA.

In addition to the drainage channel network, two surface water features are present in low lying areas in the northeastern and western portions of Robertson Barracks that likely collect surface water run-off during high rainfall events. These features are likely to be associated with former water courses such as creeks and swamp systems. The swamp area along the western portion of Robertson Barracks is predominantly inundated year-round, while the northeastern area only becomes inundated during high rainfall events. The TA understands the water from these lakes is not used for any purpose by Defence, however, note the water may be used by ecological receptors (particularly birds).

The tributaries of the Milners Creek flow system converge within the CTA to the east, with Milners Creek then flowing to the northeast and into the area known as Milners Swamp. Milners Creek and the tributaries are ephemeral, with surface water flows largely dependent on rainfall events and groundwater levels.

Surface water from Milners Swamp then flows into Kings Creek which, in part, transitions through the Noogoo Swamp before entering Shoal Bay. Milners Swamp and Noogoo Swamp to the north and northeast are permanent, freshwater swamps (although portions of these swamps are dry and therefore discontinuous during the Dry season). These swamps are reported to support significant breeding populations of waterbirds, which may include Rajah Shelducks, Magpie Geese, Brolga and other species that are regionally important. However, no regular, significant waterbird breeding colonies have been identified in this area of NT (Chatto, 2006).

Kings Creek ultimately flows to the far north of the PMAP Monitoring Area and discharges into Shoal Bay, northeast of Darwin Harbour. The Shoal Bay area is listed as being of 'International Significance' according to the Northern Territory Government Department of Environment and Natural Resources (DENR, 2017) with the area predominantly comprising conservation reserves and protected areas, consisting of extensive mud and sand flats with much of the area exposed during low tide. The tidal flats provide an important roosting area for up to 5,000 migratory waterbirds which aggregate on small freshwater wetlands within inland areas, and more broadly the area of conservation significance contains approximately 14 threatened species with international significance.

The TA considers that sufficient effort has been made to understand characterise the hydrological setting and associated surface water flow in the area to support robust and defensible data collection for this migration pathway in the context of assessing the fate and transport of PFAS contamination emanating from the base.

4.5 Geology and groundwater

The PMAP Monitoring Area is underlain by various geological formations, summarised below:

- **Bathurst Island Formation**: typically comprises radiolarian claystone, sandy claystone, clayey sandstone, quartz sandstone, glauconitic sandstone and basal conglomerate up to 50 m in thickness.
- **Wildman Siltstone Formation**: comprises siltstone, silty sandstone and minor quartzite encountered between 50 m to over 1,000 metres below ground level (m bgl).
- **Acacia Gap Quartzite Member**: comprises quartzite, commonly pyritic sandstone with interbedded siltstone.

The upper water table aquifers of the Bathurst Island Formation are discontinuous and unconfined, occurring as localised aquifers within the surface fluvial sand, silts and gravel beds of this predominantly fine sediment dominated units. Groundwater levels in the upper water table vary considerably between the Wet season and Dry season, with measurements ranging from being recorded at ground level to over 10 m below ground level (m bgl).

The upper water table aquifer is recharged during the Wet season by infiltration of rain and flood water and river leakage and bank storage with significant seasonal variations reported between the Dry and Wet seasons. In some areas, it is likely that the upper aquifer discharges to the on-base drainage network and nearby creeks/rivers, with the pattern of recharge and discharge relationships between the upper aquifers and rivers is seasonal in many areas. This likely has implications with respect to contamination fate and transport, particularly the potential movement of contamination between groundwater and surface water environments.

Groundwater monitoring wells were installed within deeper portions of the Bathurst Island Formation at depths between 27 and 30 m bgl. Measured depths to groundwater in the deeper portion of the aquifer were also variable; but less so when compared to wells installed at shallower depths.

The vertical hydraulic gradient was calculated with respect to the measured depth to groundwater to estimate the vertical flow component between the 'shallow' and 'deeper' portions of the water table aquifer within the Bathurst Island Formation. It was concluded that there was likely a downward vertical flow component between the shallow and deeper portions of the water table aquifer; notwithstanding that the deeper portions were likely semi-confined due to the presence of discontinuous layers of predominantly cohesive soils at depth.

Groundwater flow direction in the northern and central portions of Robertson Barracks is inferred to the east-northeast. Groundwater flow direction in the southern portion of Robertson Barracks is inferred to the south-southeast which is likely to be influenced by the southern drainage channel leading into the Milners Creek. Figure 8 (Appendix A) prepared by the LC (Tetra Tech Coffey, 2025d) presents the inferred groundwater flow direction, measured in April 2025.

Groundwater hydraulic gradients across the PMAP Monitoring Area were generally consistent ranging between 0.0116 m/m and 0.0138 m/m. Apart from some minor spatial and temporal variations, the hydraulic gradients reported for the Wet season compared to the Dry season were relatively similar. This suggests that groundwater recharge to the underlying aquifers is relatively uniform across the study area with no evidence of preferential recharge zones. The average calculated seepage velocities vary by an order of magnitude between the upper (silt) aquifer (from 46 m/year in the Dry season to 77 m/year in the Wet season) and the lower (siltstone) aquifer (approximately 2 m/year).

As a result of the difference in surface topography between Roberson Barracks and the CTA, groundwater is generally encountered at more shallow depths within the CTA. In some areas of Milners Creeks, including in the south of the CTA and immediately adjacent to the east of Robertson Barracks, the creek channel is shallow and not likely to be in hydraulic continuity with groundwater during the Dry season until further down gradient closer to Milners Swamp. During the Wet season, however, groundwater levels rise almost to the ground surface within the CTA in proximity of Milners Creek as well as above the drainage lines in some areas within Robertson Barracks with groundwater and surface water both contributing to areas of high-water flow and/or areas of inundation.

The TA considered the hydrogeological regime that prevails on the Base and surrounding area to represent a key transport and migration pathway for PFAS. Sufficient effort was considered to have been made to understand the geological conditions and associated groundwater movement of the area to support robust and defensible data collection for this pathway.

5. Summary of PFAS characterisation and management response

5.1 Historical investigations

Defence commenced site investigation works at the base in June 2017 to identify the nature and extent of PFAS on, and in the vicinity of, the base as a result of the historical use of legacy Aqueous Film Forming Foams (AFFF). A PMAP was subsequently developed based on the outcomes of historical investigation works. The following reports are the principal reference documents regarding historical investigation methodologies and outcomes:

- Detailed Site Investigation, Robertson Barracks, prepared by Senversa Pty Ltd for Defence (31 May 2018)
- Human Health and Ecological Risk Assessment, Robertson Barracks – Per- and Polyfluoroalkyl Substances (PFAS) Investigations, prepared by Senversa Pty Ltd for Defence (30 August 2018) Revision 3
- Site Audit Close Out Report, Robertson Barracks – Per- and Poly-fluoroalkyl Substances (PFAS) Investigations, prepared by AECOM Australia Pty Ltd for Defence (28 November 2018) Revision R01 (Ref: 60547196)
- PFAS Management Area Plan – Robertson Barracks, prepared by Defence, November 2018

Senversa reported the DSI was based on the findings of a PSI, which involved reviewing historical contamination sources and potentially contaminating activities at the base. A Sampling Analysis and Quality Plan (SAQP) was developed with respect to Areas of Potential Concern (AoPC) and site-specific DQOs for the collection of soil, sediment, surface water and groundwater samples. No potential AoPC or unacceptable risks to sensitive receptors were identified in off-base areas in the PSI, as such investigations were limited to Defence managed land.

The result of investigation works confirmed the coincident nature of identified impacts within the identified AoPC, indicating that legacy AFFF was unlikely to have been used across most of the base. PFAS was primarily detected within three AoPC[1] as follows:

- **AoPC 1**: the former Emergency Response Squadron (ERS) compound within Building 137 and immediate surrounds (Contaminated sites register (CSR) number – CSR_NT_000162)
- **AoPC 2**: 17 Combat Service Support BDE Elements where the ERS parked their trucks prior to moving to Building 137 (CSR number – CSR_NT_000133, CSR_NT_000165 and CSR_NT_000245).
- **AoPC 3**: Wash down bays and refuelling areas within the southern portion of Robertson Barracks. The drainage network also culminates in this area of Robertson Barracks (CSR number – CSR_NT_000241 and CSR_NT_000108).

The location of each AoPC is shown on, prepared by the LC (Tetra Tech Coffey, 2025d) in Appendix A.

The nature and extent of PFAS contamination at the base was assessed with respect to the development of a CSM which identified contamination transport, migration, and receptor exposure pathways with respect to each AoPC. This SPR approach to preparing the CSM is further discussed in Section 6 and the following dot points provide a high-level summary of PFAS occurrence in soil, groundwater and sediment at the base:

- **Soil**: PFAS detections in soil were mostly associated with AoPC 1 and AoPC 2 & AoPC 3. Where detected outside of these AoPC, PFAS detections in soil were noted to correlate to areas in proximity to the drainage network, or areas subject to inundation during the Wet Season. This was suggestive of a spatial relationship between PFAS sources and subsequent distribution as a result of contaminant transport and migration by surface water flow/runoff.

[1] The TA notes that a total of five (5) AoPC were identified in the DSI however only those presented in the PMAP have been considered for the purpose of this report. The TA has therefore adopted the AoPC naming convention presented in the PMAP for the purpose of this report, noting that AoPC 3 within the PMAP (Defence, 2018) corresponds to AoPC 5 within the DSI (Senversa, 2018).

- **Groundwater**: PFAS were detected in groundwater samples collected from and down gradient of AoPC 1 and AoPC 2 & AoPC 3. Assessment of the occurrence and distribution of PFAS groundwater contamination was in general alignment with the conceptual understanding of historical use and storage of AFFF. Sampling of groundwater abstraction bores within and outside of the investigation area indicated that PFAS migration had not occurred in the water bearing zones where these private bores are located with no PFAS detected above laboratory limit of reporting (LOR).
- **Sediment and Surface-water**: Analytical results from sediment and surface water indicated that PFAS concentrations were distributed in areas coincident with, or likely to be receiving drainage from or interacting with groundwater from, the main source areas where soil and groundwater impacts have also been identified (AoPC 1 and AoPC 2 & AoPC 3). PFAS concentrations in sediments were mostly reported below laboratory LOR and/or the adopted screening criteria, except from locations immediately down gradient of AoPC 1, and along the southern base boundary and southern drainage channel. Access restrictions precluded the ability to delineate PFAS in these areas. Notwithstanding, sediment and surface water concentrations at locations further downgradient of AoPC 1, southern base boundary and southern drainage channel were not reported above laboratory LOR.

A human health and ecological risk assessment (HHERA) was undertaken with respect to the results of investigation work. The majority of exposure pathways relating to PFAS originating from Robertson Barracks to human and ecological receptors were considered low and acceptable. Potentially elevated contamination exposure scenarios were identified in the HHERA, as follows:

- Consumption of fish and molluscs caught from Milners Creek and the southern drainage channel.
- Potential for PFAS exposure by aquatic ecosystems in the key habitat area (Milners Creek and Milner Swamp) cannot be excluded given the habitat value of this area and the known presence of PFAS.

A summary of maximum PFAS concentrations (as PFOS+PFHxS) at Roberston Barracks is provided in Table 5.

Table 5 Maximum PFOS + PFHxS Concentrations

Source Location / Area	Approx. Spatial Area (m^2)	Surface Water (µg/L)	Sediment (mg/kg)	Soil (mg/kg)	Shallow Groundwater (µg/L)	Deeper Groundwater (µg/L)
		Maximum PFOS + PFHxS				
AoPC 1	106,000	0.67	0.0319	0.0755	1.71	<LOR
AoPC 2 & AoPC 3	218,000	0.09	0.0072	0.0139	0.42	<LOR
All Surface Water Drains (on base but outside AoPC)	N/A	0.18	0.0101	N/A	N/A	N/A
Milners Creek	140,000	0.54	0.0072	0.008	<LOR	0.02
Southern Drainage Channel	36,000	0.45	0.0119	0.0076	0.14	N/A
Notes: LOR = Limit of reporting N/A = Not applicable						

Contextual review of the DSI was undertaken to clarify the background and basis for PMAP implementation and ongoing monitoring requirements. The TA considered the hydrogeological regime that prevails on the base and surrounding area to represent a key transport and migration pathway for PFAS. Sufficient effort was considered to have been made to understand the geological conditions and associated groundwater movement of the area to support robust and defensible data collection for this pathway.

5.2 Site-specific risk mitigation approach

At the completion of historical investigations, PMAP development was undertaken to provide a broad roadmap for response management by Defence regarding the potential risks arising from PFAS contamination at the base and impacting the surrounding areas.

In essence, the PMAP set out a plan for Defence to manage elevated contamination exposure scenarios regarding the presence of PFAS contamination on and emanating from the base with respect to the findings of the historical investigation work, notably, the HHERA with respect to:

– Consumption of fish and molluscs caught from Milners Creek and the southern drainage channel.
– Potential for PFAS exposure by aquatic ecosystems in the key habitat area (Milners Creek and Milner Swamp) cannot be excluded given the high habitat value of this area and the known presence of PFAS.

The PMAP noted that the presence of potentially elevated exposure scenarios did not necessarily mean that adverse effects were unavoidable; rather, that management of risks and/or further work to investigate and assess the risk may be required. The PMAP was prepared with respect to the requirements of the PFAS National Environmental Management Plan[2] (NEMP). Defence consulted with NT EPA through the PMAP development process, which incorporated a comparative analysis process to consider three main management options to minimise potential exposure to PFAS contamination, including:

– **Source control** may include management of soil and/or sediment that are impacted by PFAS to remove or contain on-going sources of PFAS to the environment.
– **Pathway management** may include treatment of groundwater and/or surface water to reduce the movement of PFAS though the environment.
– **Exposure/receptor control** can include measures to minimise the exposure of receptors to PFAS such as restricting access to impacted areas, implementation of occupational health and safety (OH&S) measures or advisory consumption notice.

Based on consideration of the technical applicability, logistical requirements, Defence/Stakeholder considerations and the relative risk reduction benefits, the continued implementation of exposure/receptor controls was the management option considered most likely to provide the most significant environmental benefits to manage any elevated exposure scenarios.

An Ongoing Monitoring Plan (OMP) was subsequently incorporated into the PMAP to provide:

– Information on changes in PFAS contamination originating from a Defence base to inform risk management decisions by Defence and State/Territory agencies to protect human health and the environment.
– Data on changes in the distribution, concentration, transport (pathways and flow rates) and transformation of the contaminants and assessment against appropriate guideline values. The monitoring works will provide trend data for groundwater, surface water and sediment concentrations to assess trends in PFAS concentrations, including the effectiveness of ceasing the use of AFFF and other management measures.

The TA considered that risks to human health and the environment were sufficiently characterised and understood to inform adoption of robust and defensible management and mitigation strategies to maintain risk at sufficiently low and acceptable levels under current conditions and guidance, without the need for active clean-up actions.

5.3 PMAP OMP

An OMP was prepared and included as Attachment 1 to the PMAP. The following sections summarise the sampling requirements specified within the OMP, the investigation works completed, and a high-level assessment of data quality and completeness with regard to the PMAP requirements.

Whilst the TA was not required to endorse the OMP, contextual review was undertaken to understand the basis for how the monitoring requirements were developed. The TA considered that the PMAP OMP provided an appropriate means to guide collection of monitoring data with respect to the objectives of the PMAP as they relate to risks to human health and the environment.

[2] Noting that the 2018 version of the NEMP was relevant at the time of PMAP development.

5.3.1 Monitoring requirements

The OMP was prepared following completion of the DSI and set out the technical basis as to why ongoing monitoring was required to be undertaken with respect to the need to collect additional data from the nominated sediment, surface water and groundwater locations to inform ongoing assessment of the management response with regards to base derived PFAS contamination.

Whilst the OMP specifies technical requirements, it relied on additional documentation to assess the feasibility of ongoing monitoring. This approach was adopted to build in flexibility to the management response with respect to the potential need to undertake further investigations to understand the risks (such as investigating in areas which may not have been historically affected by PFAS or adjust sampling requirements with respect to monitoring results). Table 6 summarises the TA understanding of the monitoring rationale for each AoPC with respect to the following documents which outlined the PMAP monitoring and sampling requirements:

- Ongoing Monitoring Plan, PFAS Management Area Plan – Robertson Barracks, prepared by Senversa Pty Ltd for Defence (November 2018) (included as Attachment 1 to the PMAP)
- Sampling Analysis and Quality Plan, PFAS OMP – Roberston Barracks, prepared by AECOM Australia Pty Ltd for Defence, (Revisions incl. Rev0 dated 21 January 2020; Rev1 dated 8 October 2021; Rev2 dated 14 September 2022; Rev3 dated 25 September 2023)
- Robertson Barracks – PFAS Investigation, Ongoing Monitoring Plan 2025 Sampling and Analysis Quality Plan (SAQP), prepared by Tetra Tech Coffey for Defence (April 2025).

Notes are included in Table 6 summarising location nomenclature and sample scheduling adjustments.

Table 6 Summary of OMP monitoring and sampling rationale

Site Area	Sample Type	Sample Location	Sampling Rationale
AoPC 1 (incl. the CTA, Northern Drainage Channel and Milners Creek to the east)	Sediment	SD023[7]	Surface water samples to be collected biannually from each location, with monitoring events to establish potential seasonal variability by targeting periods of higher flow (i.e. Wet season) and lower flow (i.e. Dry season). The purpose of monitoring these locations is: – To target AoPC 1 PFAS contributions to the drainage system with respect to spatial extent and historical PFAS concentrations. – To understand migration into the CTA via the Northern Drainage Channel and Milners Creek. Sediment samples recommended to be collected during the Wet season to further contextualise PFAS extent/distribution and to understand potential migration pattern with respect to high surface water flow.
		SD059[7]	
		SD123[7]	
		SD091[7]	
	Surface water	SW023[7]	
		SW059	
		SW123	
		SW091	
	Groundwater	MW012/MW012D	Samples to be collected biannually from each monitoring location, which have been positioned up, across and down hydraulic gradient of AoPC 1 to: – Provide an indication of PFAS concentrations – Monitor potential changes in PFAS extent, including within the CTA to the east of AoPC 1 so as to understand if PFAS may be migrating off-base.
		ROBMW01[1]	
		MW032	
		MW066[2]	
		MW021[6]/MW021D	
		MW023[7]	
AoPC 2 & AoPC 3 (incl. the Southern Drainage Channel and the CTA and Milners Creek to the east)	Sediment	SD028[7]	Surface water samples to be collected biannually from each location, with monitoring events to establish potential seasonal variability by targeting periods of higher flow (i.e. Wet season) and lower flow (i.e. Dry season). The purpose of monitoring these locations is: – To target AoPC 2 & AoPC 3 PFAS contributions to the drainage system, particularly the Southern Drainage Channel, with respect to spatial extent and historical PFAS concentrations. – To understand migration into CTA via the Southern Drainage Channel and Milners Creek.
		SD007[7]	
		SD001[7]	
		SD075[7]	
		SD086[7]	
	Surface water	SW028[7]	
		SW007[7]	
		SW001[7]	

Site Area	Sample Type	Sample Location	Sampling Rationale
		SW075	Sediment samples recommended to be collected during the Wet season to further contextualise PFAS extent/distribution and to understand potential migration pattern with respect to high surface water flow.
		SW086[7]	
	Groundwater	MW004/MW004D	Samples to be collected biannually from each monitoring location, which have been positioned up, across and down hydraulic gradient of AoPC 2 & and AoPC 3 to: – Provide an indication of PFAS concentrations – Monitor potential changes in PFAS extent, including: • Potential interactions with the Southern Drainage Channel • Within the CTA to the east to understand if PFAS may be migrating off-base.
		ROBMW07[3]	
		MW029[7]	
		MW001[4]	
		MW031	
		MW018[7]	
SBRS	Groundwater	MW112[5]	Identified as a 'point of use' due to the abstraction of groundwater from these locations for potable purposes.
		MW113[6]	

Notes:

1. Location ID in TTC 2025 SAQP is "MW034"
2. Location ID in PMAP OMP is "103MW02"
3. Location ID in TTC 2025 SAQP is "MW080"
4. Location ID in TTC 2025 SAQP is "MW030"
5. Location ID in PMAP OMP is "SBRS 1"
6. Location ID in PMAP OMP is "SBRS 2"
7. Not scheduled for sampling under 2025 OMP SAQP.

Presenting a detailed technical assessment of the OMP content with respect to the various SAQP iterations is outside the scope of this document. A high-level review of the data collected with respect to OMP and SAQP is presented in Section 5.3.3.

The TA considered the OMP and associated documents were consistent with industry practice and were regarded as being reasonable with respect to the requirements of the PMAP, unless otherwise stated in this report.

5.3.2 Ongoing monitoring summary

With respect to the requirements of the PMAP, ongoing monitoring of surface water, sediment and groundwater was undertaken in accordance with a SAQP. Table 7 summarises the data collected for the reports that were reviewed by the TA with respect to OMP investigations completed with respect to PMAP requirements. A summary of sampling deviations with respect to the are provided in the respective reports.

Table 7 Monitoring event summary

Report	Media sampled[1]			
	Round	Sediment	Surface water	Groundwater
Interpretative Report 2020, PFAS OMP – Robertson Barracks, prepared by AECOM Australia Pty Ltd for Defence (28 January 2021)	Nov-2018	No	Yes	Yes
	Apr/May-2019	Yes	Yes	Yes
	Dec/Jan-2019	No	Yes	Yes
	Apr-2020	Yes	Yes	Yes
Annual Interpretative Report 2021, PFAS OMP – Robertson Barracks, prepared by AECOM Australia Pty Ltd for Defence (19 October 2022)	Nov/Dec-2020	Yes	Yes	Yes
	Apr/May-2021	Yes	Yes	Yes
Ongoing Monitoring Report (November 2021 – March 2023), PFAS OMP – Robertson Barracks, prepared by AECOM Australia Pty Ltd for Defence (28 February 2024)	Nov/Jan-2021	No	Yes	Yes
	Apr/May-2022	Yes	Yes	Yes
	Sep/Nov-2022	No	Yes	Yes

Report	Media sampled[1]			
	Round	Sediment	Surface water	Groundwater
	Mar-2023	No	Yes	Yes
Sampling Event Factual Report, Dry Season 2023, PFAS OMP Robertson Barracks, prepared by AECOM Australia Pty Ltd for Defence (21 March 2024)	Oct-2023	NIS[2]	No	Yes
Robertson Barracks PFAS Investigation, OMP End of Dry Season and Start of Wet Season Sampling Events Factual Report 2024, prepared by Tetra Tech Coffey Pty Ltd for Defence (24 March 2025)	Sep-2024	NIS[2]	No	Yes
	Jan-2024	NIS[2]	Yes	No
Ongoing Monitoring Report, October 2023 – March 2024, Robertson Barracks, prepared by Tetra Tech Coffey Pty Ltd for Defence (2 May 2025)	Nov/Dec-2023	NIS[2]	Yes	Yes
	Mar-2024	NIS[2]	Yes	Yes
Robertson Barracks PFAS Investigation, OMP End of Dry Season and Start of Wet Season Sampling Events Factual Report 2024, prepared by Tetra Tech Coffey Pty Ltd for Defence (23 June 2025)	Sep-2024 & Jan-2025	NIS[2]	Yes	Yes
Robertson Barracks PFAS Investigation, OMP Wet Season Sampling Event Factual Report 2025, prepared by Tetra Tech Coffey Pty Ltd for Defence (7 July 2025)	Apr-2025 & Jun-2025	NIS[2]	Yes	Yes

Notes:

1. It is noted that sampling deviations are summarised in relevant report with respect to presence/absence of sediment and surface water, impacted monitoring infrastructure, site access challenges, etc.
2. No longer in scope and therefore sampling not undertaken.

The TA considered that the ongoing monitoring, despite some gaps as shown in Table 7, provided sufficient monitoring data to allow assessment with respect to the PMAP and OMP objectives. Therefore, the TA considers that further monitoring data would not materially benefit or improve the conceptual understanding PFAS contamination at the Base with respect to identified source, pathway and receptor linkages and the resultant risk to human health and the environment.

5.3.3 Data quality and completeness

Data collection processes require quality assurance and quality control (QAQC) procedures to be adopted so that it can be demonstrated that methodologies used provide consistent, reliable, and reproducible results upon which accurate conclusions, and therefore decisions, can be made.

QAQC procedures were developed within the OMP, and these were considered and adapted for the purpose of each SAQP with respect to the seven-step process described within the ASC NEPM. Various QAQC elements (DQIs) were implemented during the investigation work to provide confidence that the data collected would meet DQO and DQI requirements.

Table 8 summarises the findings of the TA's high-level review of various QAQC elements implemented to demonstrate compliance with the DQOs and DQIs specified in the OMP and SAQP (noting that a detailed appraisal of all historical reports with respect to the procedures implemented during monitoring was not in the scope of this report). Table 9 summarises the TA's high-level opinion of monitoring data completeness with respect to purpose of this report.

Table 8 Review of QAQC elements implemented during monitoring

QAQC element	TA comment
Use of analytical laboratories whose testing methods are accredited by the National Association of Testing Authorities (NATA) for PFAS.	Analytical laboratories used for the analysis of samples included: – Eurofins Environment Testing Australia Pty Ltd (Eurofins) – Australian Laboratory Services Pty Ltd (ALS) – National Measurement Institute (NMI) Each laboratory was accredited by the NATA for their respective PFAS analytical methods.
Collection and presentation of field record sheets.	Field records were attached to relevant reports, either as: – Copies of scanned, handwritten field logs – Digitally generated/formatted records. Where field records were absent, relevant field data was tabulated and presented either as an in-text summary table or an appendix.
Use of calibrated sampling equipment.	Calibration certificates prepared by the equipment supplier or records of calibration checks undertaken during the sampling field work were attached to relevant reports.
Suitable decontamination procedure implemented for reuseable sampling equipment (including use of PFAS free materials/equipment).	Decontamination procedures were reportedly used. Where specified, the procedure included: – Cleaning using a three-step process, comprising an initial wash in tap water mixed with PFAS free detergent, followed by a tap water rinse and a final rinse using deionised water. – The use of PFAS free equipment However, the precise methodology implemented was not always clearly reported. Review of associated blank samples (i.e. rinse blanks, field blanks) indicated the potential occurrence of cross contamination during sampling to be low, suggesting suitable decontamination procedures were likely implemented.
Collection and analysis of sufficient QAQC samples (including type and frequency) with reported results within acceptable limits.	A range of QAQC samples were collected, comprising: – Field duplicates and splits – Rinsate blanks – Field blanks – Trip blanks Non-conformances were variably reported, such as: – Duplicate sampling frequency did not meet the 1:10 requirement – RPD exceedances not meeting the specified reporting limits – Detectable concentrations of PFAS in blank samples – The absence of some sample types Whilst some non-conformances were noted, the degree to which the identified discrepancies impacted the validity of the dataset was considered to be low. Reasonable justification as to why the non-conformances occurred was provided with respective reports. This suggests systematic errors associated with the adopted sampling methodologies and data reporting to be low.
Collection and submission of samples for analysis used appropriate preservation, storage and transport under chain-of-custody procedures and within acceptable holding times.	Samples were collected into laboratory supplied containers suitable for PFAS analysis (i.e. HPDE containers without Teflon lined lids, etc.). They were stored in ice-cooled containers during field work prior to dispatch to the analytical laboratory under chain-of-custody procedures. The location of the base, relative to the respective analytical laboratory meant that holding time exceedances were unavoidable for some analytes, such as pH, which have relatively short holding times. Notwithstanding, where holding time exceedances were reported they were mostly for analytes that were not PFAS and so potential impacts associated data accuracy and/or validity were likely to be low.
Laboratory methods and quality control procedures reviewed and considered acceptable.	The analytical laboratories adopted various QAQC methodologies to check the accuracy and precision of the analysis undertaken. This included analysis of: – Laboratory duplicates – Laboratory control samples – Matrix spikes – Method blanks – Surrogates

QAQC element	TA comment
	Attached to each report was an assessment of laboratory which summarised the results of analysis for the above listed samples, with respect to the adopted acceptability/recovery limits. Where non-conformances with the laboratory determined limits was identified, reasonable justification was provided as to how the non-conformances did not impact the validity and/or accuracy of the dataset. This suggested the analytical methods were suitable for the scheduled testing.
Laboratory limits of reporting with respect to investigation criteria	Laboratory limits of reporting (LOR) were not always less than the adopted screening criteria for the various PFAS compounds targeted during OMP sediment, surface water and groundwater monitoring. For example, the PFOS LOR of 0.01 µg/L which was higher than the 99% Freshwater ecological criteria of 0.00023 µg/L. This meant that wherever PFOS was detected above the laboratory LOR in relevant water samples, that a criteria exceedance was also identified. Whilst this challenge is not unusual in the context of PFAS assessment, the introduction of uncertainty when considering the potential spatial distribution of PFOS. The TA notes that a 'detect threshold' was adopted within relevant interpretative reports as being indicative of the presence/absence of PFOS at a location. A similar approach has been implemented by the TA for the purpose of this report when considering the potential risk to Environmental Values as a result of residual PFOS contamination emanating from the base.

Table 9 High-level data completeness

Completeness Item	TA comment
Has Defence implemented a systematic, routine sediment, surface water and groundwater monitoring program with respect to PMAP requirements?	Yes, based on the high-level review of the monitoring work undertaken, the TA believes Defence has implemented a systematic, routine monitoring program with respect to PMAP requirements.
Is the data collected by Defence throughout the monitoring program reliable to assess PFAS concentration trends over time with respect to the distribution in sediment, surface water and groundwater?	Yes, the data collected by Defence is considered reliable to understand PFAS concentration trends over time and spatial distribution.
Has Defence collected sufficient data to enable assessment of PFAS concentration trends in sediment, surface water and groundwater?	Whilst some gaps exist with respect to practical limitations inherent to undertaking field works, there is sufficient data available to assess PFAS trends in sediment, surface water and groundwater for the purpose of this report.
Will Defence need to undertake further management and/or monitoring to assess potential risks to Environmental Values, particularly elevated exposure scenarios associated with off-base ecological receptors?	Yes, ongoing monitoring will need to be undertaken by Defence. Further discussion regarding ongoing monitoring requirements is presented in Section 7 of this report.

The TA did not conduct a critical and independent review of the data quality at the time of preparation of all the reports prepared with respect to OMP requirements. However, as part of supporting the PMAP transition, the TA conducted a high-level review of the DQI compliance to be satisfied that the monitoring data generated by the OMP was sufficiently robust and defensible to support the PMAP transition. On completion of the high level review the TA considered that, despite some minor DQI non-conformances, the overall data collected was of an adequate quality standard to support the PMAP transition decision.

5.4 Data gap assessment and investigations

The following reports are relevant with respect to the completion of additional investigations undertaken:

– PFAS Investigation and Management Robertson Barracks, Site Review Assessment Report, prepared by Tetra Tech Coffey (2024).

– PFAS Investigation and Management – Robertson Barracks, Robertson Barracks Supplementary Detailed Site Investigation Report 2024, prepared by Tetra Tech Coffey (2025a).

The Site Review Assessment (SRA) report prepared by Tetra Tech Coffey in July 2024 aimed to consolidate available data in relation to PFAS occurrence and distribution. Identifying data gaps was an objective of the SRA in the context of understanding if changes made to legislation and guidelines associated with the assessment and management of PFAS contamination could alter the understanding of the contamination status of the base since completion of the DSI and HHERA. Identified data gaps were then considered with respect to the implementation of the PMAP OMP was the most appropriate tool to manage potential receptor exposure risks in comparison to a more active approach (i.e. remediation). Data gaps were identified in the SRA report, and these are summarised in Table 10.

Table 10 Data gap summary within SRA

Data Gap	Summary
Data Gap 1 – Laterised soils	Understanding the potential presence and extent of an iron-cemented soil horizon (i.e. a lateritic unit) could help to contextualise PFAS migration and transport during the Wet season and subsequent persistence in surface water down-stream of AoPC 1. This data gap was contextualised following a review of existing photographs and borehole logs with respect to investigation experience at a nearby Defence base where similarly transmissive lateritic units were identified. It was suggested that a high-level review of shallow groundwater, presence/absence of laterite at AoPC 1 and PFAS migration pathways be considered during PMAP review.
Data Gap 2 – PFAS beneath concrete pavements	Little data was present regarding soil quality beneath concrete pavers in the source areas to facilitate PFAS mass calculations. Whilst the gap was acknowledged, the potential benefits from undertaking further testing were considered unlikely to better inform or change how PFAS is managed.
Data Gap 3 – Vertical delineation of PFAS in soils	Refusal on hard soils/siltstone was encountered during previous investigations which limited the ability for PFAS samples to be collected at depth, thereby not allowing for PFAS contamination in soil to be vertically delineated, particularly at AoPC 1. The potential benefits of undertaking further investigation were considered unlikely to better inform or change the conceptual understanding of PFAS distribution and extent at AoPC 1.
Data Gap 4 – PFAS in pavement surface water runoff	No surface water runoff testing data was identified with respect to the areas where PFAS spills may have occurred. The provision of such data could clarify potential management measures to apply (i.e. surface coatings) and would likely provide an additional line of evidence in the context of future PMAP transition.
Data Gap 5 – Management of sediment in drainage network	The degree to which routine maintenance works are undertaken to remove sediment from the drainage network was not known. Understanding processes associated with this activity could provide a line of evidence as to how the contribution of potential ongoing sources of PFAS to surface water impacts may change over time.
Data Gap 6 – Surface water mass flux	As the mass flux of PFAS in surface water was prepared using a number of general assumptions, some uncertainty was identified with respect to the overall catchment extents and relative contributions of various source areas to the overall flux of PFAS in surface water. Providing a more robust assessment of the PFAS mass flux in surface water would better inform assessment of risk to sensitive receptors.
Data Gap 7 – Biota sampling	Potential ecological risks were identified during preparation of the HHERA (Senversa, 2018). Challenges were identified with respect to the design and implementation of a technically robust biota sampling program due to site access constraints inherent to Milners Creek/Swamp. The identified constraints were likely to hinder sampling of sufficient trophic levels, thereby limiting the outcomes of such a study as potential risks to ecological receptors could therefore not be ruled out. Consequently, whilst the concentrations of PFAS in biota in the receiving environment are not well understood, collecting additional data was unlikely to affect how PFAS is managed at the base when considering the relatively low concentrations and mass of PFAS migrating from the base. It was concluded that this data gap would be better managed via ongoing monitoring and opportunistic remediation of PFAS impacts in soils on the base (if required) rather than through completion of additional biota sampling.

Data Gap	Summary
Data Gap 8 – Additional sources of PFAS	Some limitations were identified through review of previous reports, notably the DSI (Senversa, 2018), which noted that due to time constraints not all chemical stores and fire extinguishers on the base were inspected and that additional potential sources of PFAS could be present. Further inspection of, and engagement with the base, was suggested to close this data gap.

Investigations were subsequently undertaken, and the findings of these investigations are summarised in the Supplementary Detailed Site Investigation (Supp DSI) report prepared by Tetra Tech Coffey (2025a). The aim of the Supp DSI was to collect additional data to close data gaps presented in the SRA Report and to identify if additional management or remediation measures were required to mitigate the movement of PFAS off-base and/or to reduce the potential risks of PFAS exposure to sensitive receptors as part of the PMAP response. Additional investigations undertaken included:

– Lysimeter installation at two locations at depths of 1.0 m and 1.5 m below ground level (bgl) within AoPC 1 within laterised soils. Attempts were made to collect samples were collected from the lysimeters following simulated rainfall events to understand the potential presence of PFAS within pore water of the lateritic soils.
– Advancement and logging of 13 soil bores in AoPC 1 to investigate the presence of a laterised soil horizon and to enable collection of soil samples to vertically delineate PFAS contamination.
– Surface water runoff was collected off the interlocking pavers within AoPC 1 across four simulated rain events. At AoPC 3[3] two simulated rainfall events were conducted, and surface water samples were taken from the nearby drainage and treatment basin.
– Interviews were carried out with base management and three staff members to further understand the potential presence of unidentified PFAS sources.

The TA undertook a review the Supplementary DSI from a technical and quality perspective and note that each of the issues raised were addressed. The findings of the Supp DSI with respect to the data gaps presented in the SRA are summarised in Table 11.

Table 11 Supplementary DSI findings

Data Gap	Data gap closure discussion	TA's opinion
Data Gap 1 – Laterised soils	Laterised soils were observed during borehole drilling within the northern portion of AoPC 1 at varying depths. The lateritic soil layer was in the order of 2 to 3 metres thick. The results from sampling of the two lysimeters were variable, as follows: – SL001: Positioned at the north-eastern corner of AoPC 1, no sample was able to be obtained from this location due to dry soils. – SL002: Positioned along the northern boundary of AoPC 1, approximately ~30 m west of SL001. A sample was obtained from this lysimeter. Whilst analytical results suggest the presence of PFAS at this location, concentrations were an order of magnitude below nearby surface water results. The conclusion reached following assessment of the results indicated that whilst the lateritic unit could be a preferential subsurface flow pathway, the laterite does not contain a significant mass of PFAS. It was therefore considered unlikely to be a significant secondary source or critical pathway for the transport and migration of PFAS contamination. The data gap was considered to be closed.	These further investigations of the nature, extent and characteristics of the Lateritic Soils in the AoPC 1 area provided robust and defensible data to further understand the Laterites and any role they play in acting as a preferential flow path for PFAS. The TA considered the scope of work to address this data gap to be adequate and concurred with the conclusions reached based on the data collected during the investigation.
Data Gap 2 – PFAS beneath concrete pavements	Review of analytical results from samples collected during soil bore drilling indicated the following:	These further investigations of the nature, extent and characteristics of PFAS impacts beneath the pavements provided robust and defensible data to further

[3] The TA notes that within the Supp. DSI report reference was made to AoPC 5 which is consistent to that presented in the DSI prepared by Senversa (2018). However, for the purpose of this report the adopted AoPC nomenclature is consistent with the PMAP. As such, we've referred to the results as being relevant to AoPC 3.

Data Gap	Data gap closure discussion	TA's opinion
	– PFAS distribution was primarily in shallow soils between 0.0 m to 0.5 m bgl. – The highest PFAS concentrations were within the top 0.3 m of soil and generally decreased with depth. – The highest concentration of PFAS was reported at location BH254, positioned within AoPC 1 where vehicle washdown activities were undertaken. The data gap was considered to be closed.	understand the nature and extent of PFAS impacts. The TA considered the scope of work to address this data gap to be adequate and concurred with the conclusions reached based on the data collected during the investigation.
Data Gap 3 – Vertical delineation of PFAS in soils	Review of analytical results from samples collected during soil bore drilling indicated the following: – PFAS concentrations were vertically delineated within the top 0.5 m of the soil profile. – PFAS was detected at depths between 2 m and 4.25 m bgl at two locations in at AoPC 1 (BH247 at 2.25 m and BH248 at 3.25 m and 4.25 m). – When considering the dataset as a whole, this data gap was considered to be closed, noting: • The highest concentrations of PFAS were reported in near surface samples (i.e. the top 0.3 m of soil) and not with the lateritic soils • PFAS concentrations generally reduced with depth.	This further review of the nature, extent and characteristics of PFAS impacts beneath the pavements provided robust and defensible data to further understand the nature and extent of PFAS impacts. The TA considered the scope of work to address this data gap to be adequate and concurred with the conclusions reached based on the data collected during the investigation.
Data Gap 4 – PFAS in pavement surface water runoff	Samples of surface water runoff indicated that surface infrastructure in AoPC 1 and AoPC 3 contained PFAS sorbed to the concrete pavements and that this may continue to act a source of PFAS migration to the surrounding water bodies and drainage network. The data gap was considered to be closed.	These further investigations of runoff from AoPC 1 and AoPC 3 confirmed PFAS was sorbed onto and is released from pavements in these areas. The TA considered the scope of work to address this data gap to be adequate and concurred with the conclusions reached based on the data collected during the investigation.
Data Gap 5 – Management of sediment in drainage network	During the field investigations, interviews were conducted with various base personnel. The following was noted: – No drain sediment removal was known to have taken place within AoPC 1 within the last three years, except for some surficial scraping around fence edges to minimise dust and soil creep into the Building 137 compound. – The base manager and Estate Management and Operations Services contractor confirmed that drainage sediment removal had not occurred within the last 10 years. based on this information it was concluded that the sediments within the drainage network may act as an ongoing source of PFAS in surface water. The data gap was considered to be closed.	These further investigations of the nature, extent and characteristics of PFAS impacts in sediments within the drains near AoPC 1 provided robust and defensible data to further understand the nature and extent of PFAS impacts within the drain network. The TA considered the scope of work to address this data gap to be adequate and concurred with the conclusions reached based on the data collected during the investigation.
Data Gap 6 – Surface water mass flux	No calculations of surface water mass flux were presented in the Supp DSI Report. Closure of this data gap was proposed to occur following the collection of 2024/25 wet season monitoring data, where the overall mass flux of PFAS in surface water would be calculated. Closure of this gap was not considered necessary for the purpose of this report with respect to the availability of historically reported approximations of PFAS mass flux.	The TA concurs that this data gap can be addressed as part of a long-term management approach once sufficient robust and defensible data is available to calculate a reliable mass flux and establish a trend at an acceptable confidence level.
Data Gap 7 – Biota sampling	No Biota sampling was undertaken as access to Milners Creek and Swamp was constrained due to limited roads in the area and dense vegetation. The	While the TA understands the reasons for not including biota sampling at this time, given the low risk profile consideration

Data Gap	Data gap closure discussion	TA's opinion
	constraints were considered likely to hinder the collection of sufficient biota samples from different trophic levels which would limit the development of a food-web model for the purpose of revised ecological risk assessment. It was also considered that even if a biota sampling program was undertaken that characterised PFAS from different trophic levels, that the results may still not rule out potential exposure risks to relevant ecological receptors. Consequently, given that human exposure to PFAS impacted biota was being managed by Defence by limiting access to the Milners Creek area in the CTA, additional biota sampling was not considered necessary. Results of other investigations concluded that PFAS impacts were present at the base, but were largely localised to the identified source areas, and that surface water was the primary pathway by which PFAS moved from the base. The investigation also identified that PFAS leaching from the pavement at AoPC 1 into surface water run-off is contributing the largest proportion of PFAS to the surface water system leaving this area of the base.	should be given to biota sampling in the event that mass flux trends do not provide sufficient and robust lines of evidence to support that management measures in regard to PFAS source discharge are adequate.
Data Gap 8 – Additional sources of PFAS	No additional chemical stores, foam fire extinguishers or sources of PFAS were identified as a result of interviews conducted with base management and site personnel. The data gap was considered to be closed.	The TA considers that the additional investigations provided sufficient information to support that this data gap was adequately addressed.

The TA considered that all data gaps, except Data Gap 6 and Data Gap 7, were addressed through further investigations. Data Gap 6 relates to mass flux quantum and trend. The TA agrees with the LC that this data gap can be most effectively and efficiently addressed as part of long-term management of the Site as more monitoring data becomes available. Data Gap 7 refers to undertaking biota sampling to provide an additional line of evidence to assess potential ecological exposure risks. The TA concurs with the LC that not closing this data gap should not prevent PMAP transition. Completion of biota sampling should be considered as an opportunity as part of ongoing monitoring to be completed in the future as a potential line of evidence to support long term management decisions, should this be necessary.

5.5 PMAP transition reporting

Tetra Tech Coffey prepared the following report to assess whether sufficient data was available to support the decision to recommend the transition from active PFAS management as set out in the PMAP to ongoing long-term monitoring under Defence's approach to manage and mitigate PFAS discharge from their bases *'So Far as Reasonably Practicable'*:

– Robertson Barracks PFAS Investigation, Robertson Barracks – Recommendation for PMAP Transition, prepared by Tetra Tech Coffey (2025d).

The objective of the PMAP Transition Report was to evaluate:

– If PFAS risks at the base remain low and acceptable, allowing for long term passive manageable
– Confirm that all PMAP actions have been completed or remain effective so far as reasonably practicable in the context of the base PFAS risk profile.
– If further active remediation is warranted to further decrease risk resulting from PFAS discharge form the on base sources and pathways to receptors.

The assessment primarily focused on the three PFAS source areas identified in the PMAP (i.e. AoPC 1 and AoPC 2 & AoPC 3) with regards to:

– Available long term monitoring data
– Statistical analysis to understand PFAS concentration trend over time

– Consideration of the findings of the Supp DSI in the context of an updated risk assessment with respect to the following secondary contamination sources identified as follows:
  - PFAS-impacted soils were identified beneath interlocking pavers at AoPC 1, with PFOS+PFHxS concentrations up to 0.532 mg/kg. However, as these soils were located beneath hardstand surfaces, they were considered to be practically inaccessible to Human and Terrestrial flora and fauna receptors, apart from soil dwelling organisms that may be present beneath the pavement.
  - Concrete pavements at AoPC 1 and AoPC 3 were confirmed to contribute PFAS to surface water runoff, with an estimated annual mass discharge of ~28 grams and ~0.7 grams PFOS+PFHxS, respectively.
  - Sediments in drainage networks contain low levels of PFAS but were not considered a significant ongoing source, based on the conditions at the time of the assessment.

The primary contamination transport mechanism for PFAS migration at the base was via surface water runoff. Although also contaminated with PFAS, groundwater was considered to be largely disconnected from surface water systems (except in isolated areas during the Wet season) and therefore offered a minor contribution to PFAS mass-flux to surface water environments. This conclusion was based on:

– The short flow distances from the source areas to surface water drains (i.e. which are in the order of <10 metres).
– The presence of pavement across most of the source areas which limits direct infiltration into the soil.
– The shallow near surface impacts of PFAS in the soil.
– The relatively low PFAS concentrations seeping from the laterite (based on results of lysimeter testing, reported in the Supp DSI) compared to that detected in water samples collected from nearby drains.

Receptors considered relevant included:

– Current and future Defence personnel, contractors, employees and residents stationed or living at the base
– Construction or maintenance workers who may encounter contaminated soil, groundwater or surface water during ground disturbance, infrastructure works, or other site activities
– Ecological receptors (both aquatic and terrestrial), which may be exposed to PFAS directly or indirectly through bioaccumulation and biomagnification, particularly higher-order predators such as fish-eating birds inhabiting surface water bodies including Milners Creek and Milners Swamp

Recreational users and consumers of fish or crustaceans from the CTA or Southern Drainage Channel were previously identified as potential receptors. However, due to restricted access to the CTA, and the limited presence of surface water in the Southern Drainage Channel, it is unlikely that these areas support significant aquatic biota to sustain fishing activities. As such, these receptors were not considered relevant.

Groundwater users were a potential receptor that may be exposed to PFAS. However, there are no groundwater abstraction bores within the PFAS plume within the PMAP Management Area, and groundwater users were not considered to be a relevant receptor.

The TA considered that the documentation provided to support the PMAP transition recommendation was sufficient to allow for critical and independent review of the information and data that underpins the transition decision. The TA considered that the transition decision was supported by sufficient data to assess the risk associated with identified Source, Pathway, and Receptor (SPR) linkages and to demonstrate with an acceptable level of confidence that the risks associated with these SPR linkages are understood.

5.6 Screening criteria and results summary

5.6.1 Summary of PFAS criteria

Based on review of the supplied monitoring data, PFOS is considered to be the primary PFAS compound of interest for it was consistently reported above the laboratory limit of reporting (LOR) and adopted screening criteria across multiple sampling events. Detections of PFHxS are noted; however, in comparison to PFOS it was not consistently detected between monitoring events, and when detected it was at relatively lower levels and below the adopted screening criteria. PFOA was mostly reported below the laboratory LOR.

The reported concentrations of PFOS in various contaminated media at the site (i.e. soil, sediment, surface water and groundwater) are therefore considered the primary risk driver with respect to potential impacts to ecological and human health receptors for the purpose of this report. The PFOS screening criteria adopted for the purpose of the PMAP transition support decision are summarised in Table 12.

Table 12 Adopted PFOS Screening Criteria

Environmental Value	Media	Criteria reference	Criteria
Human Health	Soil & Sediment	PFAS NEMP 3.0 – Commercial land use[1]	20 mg/kg
	Surface water & Groundwater	PFAS NEMP 3.0 – Drinking water[2]	0.07 µg/L
		PFAS NEMP 3.0 – Recreational water[2]	2 µg/L
Ecological	Soil & Sediment	PFAS NEMP 3.0 – Commercial land use	0.003 mg/kg[3] 1 mg/kg[4]
	Surface water & Groundwater	PFAS NEMP 3.0 – Freshwater ecosystems 99% level of protection[5]	0.00023 µg/L

Notes:

1. It is noted that the base includes residential accommodation areas, however, the use of the land at each AoPC aligns more closely to a commercial/industrial land use scenario in accordance with the ASC NEPM and has therefore been adopted for the purpose of this report.
2. Criteria adopted is that for PFOS+PFHxS with respect to Note 'a' beneath Table 4 within the PFAS NEMP 3.0 which states: *"Where the criteria refer to the sum of PFOS and PFHxS, this means concentrations of PFOS only, PFHxS only, and the sum of the two."*
3. This is the *Interim ecological indirect exposure – all land uses* criterion presented in Table 6 of the PFAS NEMP 3.0 which is based on dietary PFAS exposure to secondary and tertiary consumers. For sites where no secondary consumers and minimal potential for indirect exposure scenarios to exist, a higher criterion of 0.14 mg/kg can be considered with respect to guidance presented in Section 8.7.1 of the PFAS NEMP 3.0.
4. This is the *Ecological direct exposure – all land uses* criterion presented in Table 6 of the PFAS NEMP 3.0.
5. Receiving water bodies at the base are likely to be representative of either highly modified and/or slightly modified ecosystems which would result in the adoption of either a 90% or 95% level of protection. However, to account for the bioaccumulative potential of PFAS, a 99% level of protection has been adopted for the purpose of this report.

Further to that detailed in the table above, the TA notes that in June 2025 the NHMRC (2025) released revised health-based drinking water guidelines (DWG) for various PFAS compounds, including PFOS, PFOA, PFHxS and PFBS. The revised health-based DWG are lower than historical criterion, as illustrated in Table 13.

Table 13 Revised NHMRC Drinking Water Guidelines

Compound	Drinking Water Guideline (µg/L)	
	Historical	Current (2025)
PFOS	0.07	0.008
PFHxS		0.03
PFOA	0.56	0.2
PFBS	-	1

The PFAS DWG were derived using a threshold approach with respect to revised health-based guideline values (HBGVs) for each of these compounds. The HBGV represent the level of exposure (dose) below which no appreciable health risk to humans is expected across a lifetime of repeated exposure at the rate of water ingestion assumed (generally 2L per day). HBGVs are derived from toxicological studies, with various safety factors applied.

The NHMRC (2025) DWG are not mandatory or legally enforceable. Their adoption, implementation and integration into legislative frameworks are at the discretion of each state and territory. Notwithstanding, the enHealth (2012) *Environmental Health Risk Assessment Guidelines* designates the NHMRC as a Level 1 source of toxicological data and state that it should be given preference in the environmental health risk assessment process.

From a toxicological perspective, all relevant sources of exposure should be considered when evaluating the extent to which a HBGV is reached or exceeded. HBGVs form the basis of the health-based guideline values that are used in the Tier 1 screening assessment process of samples collected during contaminated site assessments (as presented in the PFAS NEMP 3.0) and to support detailed (Tier 2/Tier 3) human health risk assessments (HHRA) and resultant public health advisories. The establishment of revised HBGVs by the NHMRC (2024) therefore has significant potential implications for PFAS investigation and risk assessment projects in general, the nature and extent of which are not yet clear.

Whilst the TA acknowledges the presence of the updated DWG presented within NHMRC (2025), the adoption of these for the purpose of the PMAP transition decision is not considered necessary, noting:

– Drinking water is not an exposure pathway of concern for the base and therefore revised DWG are not directly applicable in this context. This is discussed further in subsequent sections of this report.
– Ongoing controls to manage potential exposure pathways are still required (including to ecological receptors), notwithstanding the objective of this report with respect to transitioning the base from PMAP to a long-term management program. Concluding remarks have been made in this regard in Section 8.2 of this report, noting that the risk profile for PFAS discharges from the base into downstream receiving environments should be reassessed once guidance has been provided from NT EPA regarding how the revised HBGVs should be considered as part of an ongoing long-term management program.

The TA considers that in the context of the Source, Pathway and Receptor (SPR) linkages and associated risks an appropriate set of Tier 1 risk screening criteria was adopted to support the PMAP transition decision. While NHMRC have recently (June 2025) updated the Australian Drinking Water criteria for key PFAS compounds, the drinking water ingestion route was not considered a relevant SPR linkage. On that basis, the TA considers the updated drinking water criteria as not relevant at the time of the PMAP transition decision. However, should there be any changes to Tier 1 risk screening criteria adopted for relevant SPR linkages there is the potential for further clean-up action becoming necessary at some point in the future. This potential must be considered in the context of the long-term management strategy and any triggers for active clean-up action adjusted accordingly.

5.6.2 Summary of sampling results

A high-level summary of the reported analytical results is presented in Table 14 with respect to Figure 3A, Figure 3B, Figure 3C, Figure 3D, Figure 4A, Figure 4B, Figure 5, Figure 6 and Figure 7 which were prepared by the LC (Tetra Tech Coffey, 2025d) and are shown in Appendix A.

The TA notes criteria exceedances for groundwater and surface water samples with respect to the *PFAS NEMP 3.0 – Freshwater ecosystems 99% level of protection* criterion of 0.00023 ug/L. Due to the laboratory LOR being higher than the criteria, PFOS may theoretically exist at a concentration below the laboratory LOR but above the criterion. To manage uncertainty with respect to the presence of PFOS at such low concentrations, a detect based approach was adopted in accordance with note 'c' beneath Table 8 of the PFAS NEMP 3.0.

Table 14 Summary of PFAS Concentrations (PMAP OMP Locations)

Site Area	Sample Type	Sample Location	PFOS		
			Min.	Max.	95% UCL[1]
AoPC 1 (incl. the CTA, Northern Drainage Channel and Milners Creek to the east)	Soil and sediment (AoPC 1)	BH041 to BH061, BH246, SD051, SD052, SD054, SD055	<0.0002 mg/kg	0.54 mg/kg	0.0111 mg/kg
	Soil and sediment (CTA)	MW019, MW020, MW022 to MW024, SD086 to SD091, SD124 to SD126	<0.0002 mg/kg	0.0045 mg/kg	0.0009 mg/kg
	Surface water	SW023, SW059, SW123, SW091	<0.01[2] µg/L	0.38[5] µg/L	NA[3]
	Groundwater	MW012, MW012D, ROBMW01, MW032, MW066, MW021, MW021D, MW023	<0.01[2] µg/L	1.04 µg/L	NA[3]
AoPC 2 & AoPC 3 (incl. the Southern Drainage Channel and the CTA and Milners Creek to the east)	Soil and Sediment	BH077 to BH093, MW001, MW003, SD007 to SD011, SD075 to SD081, SD093 to SD097, SD202, SD203	<0.0002 mg/kg	0.0111 mg/kg	0.00189 mg/kg
	Surface water	SW028, SW007, SW001, SW075, SW086	<0.01[2] µg/L	0.09 µg/L	NA[3]
	Groundwater	MW004, MW004D, ROBMW07, MW029, MW001, MW030, MW031, MW018	<0.01[2] µg/L	0.32 µg/L	NA[3]
	Groundwater	MW112, MW113	<0.01[2] µg/L	<0.01[2] µg/L	NA[3,4]
SBRS	Groundwater	MW112, MW113	<0.01[2] µg/L	<0.01[2] µg/L	NA[3,4]

Notes:

1. Adopted 95% $UCL_{AVERAGE}$ value is that from Tetra Tech Coffey (2025d)
2. Laboratory LOR is greater than adopted ecological screening criteria of 0.00023 µg/L
3. Not applicable for water samples
4. Not calculated as no detections above laboratory LOR
5. Maximum concentration was recorded on base. All of base samples were an order of magnitude lower and all off-base measured concentrations were below the relevant criteria.

Given the absence of active remediation at the Site, the TA determined that all available data could be considered in support of the PMAP transition decision. PFAS compounds are persistent in the environment and given the relatively short duration of the monitoring program in this context and the absence of/need for active clean-up, the TA agrees that an appropriate data set was used to inform the PMAP transition decision.

6. Conceptual site model

A CSM is an analytical tool which identifies contamination sources, transport mechanisms, exposure pathways and receptors and the linkages between these aspects with respect to risk. The development of a CSM is an essential part of all contamination site assessments and provides the framework for identifying how a site became contaminated and how potential receptors may be exposed to contamination, either in the present or the future.

In preparation of the CSM to support the PMAP transition decision and using the PMAP as the principal guidance document for PFAS management at the base, it is important to note for a risk to be present, there must be a complete SPR linkage as shown in Diagram 3 below. If any one element (source, pathway or receptor) is missing then the linkage is incomplete and therefore no risk can materialise. In that context, if a source of contamination is identified along with a potential receptor, but there is no transport mechanism or exposure pathway connecting them, then a complete SPR linkage doesn't exist and therefore there is unlikely to be a risk.

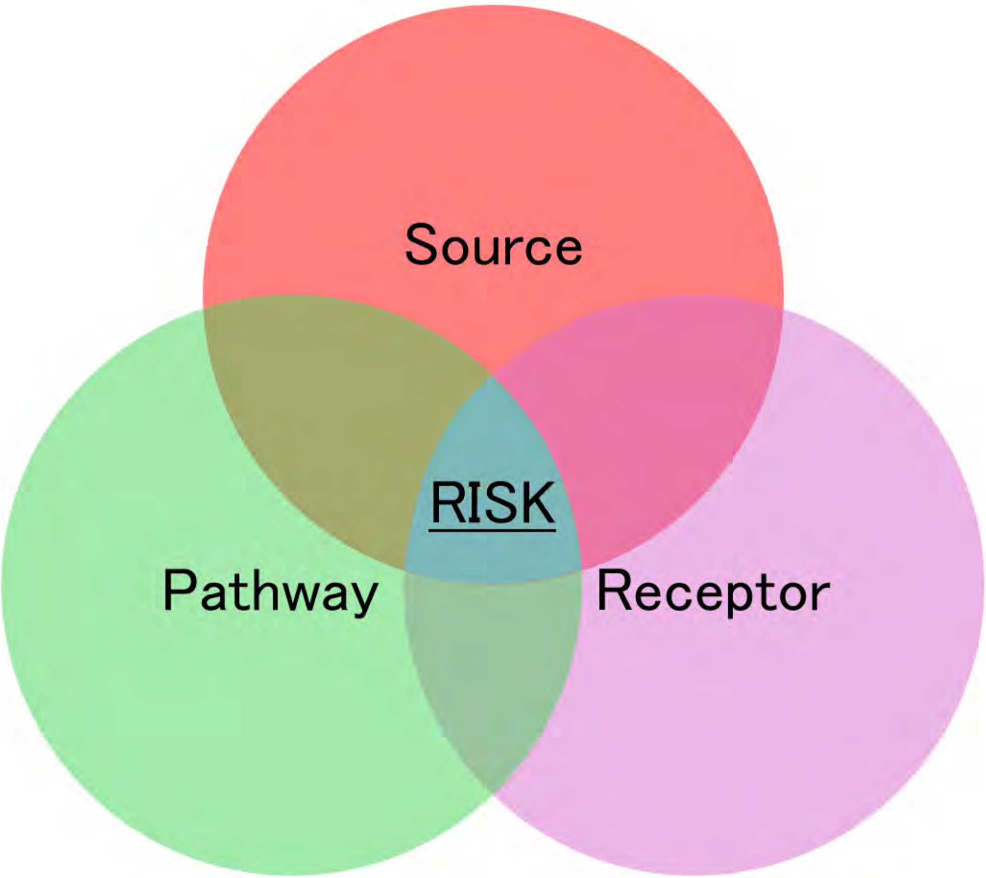

Diagram 3 Source-Pathway-Receptor linkage model

Review of various documents indicates numerous CSMs have been developed and iterated upon with respect to the findings of investigation works carried out to assess the presence and distribution of PFAS contamination. The acquisition and integration of data obtained throughout the assessment has refined the conceptual understanding of PFAS occurrence at the base using a multiple-lines-of-evidence approach (as appropriate). In this way, the TA acknowledges the CSM as being a dynamic and evolving analytical tool in the context of understanding potential risks associated site-derived contamination.

Using the CSM in this way allows for it to provide a platform to inform decision making on whether further investigation or management is necessary in the context of a risk-based approach. In this way, with respect to the assessment and decision-making flow chart, the CSM assists to demonstrate that there were no drivers for active remediation to decrease risk to human health and the environment, or for the restoration of Environmental Values. The first key decision point (No Active Remediation Action Required) outcome was 'yes', as shown in Diagram 4. As no voluntary clean-up has been undertaken, based on the absence of a complete SPR linkage on-base with an unacceptable level of risk, the base can therefore transition to long-term management and monitoring. Any potential clean-up actions required in the future will be on a voluntary basis with respect to the findings of future investigations and will aim to further reduce PFAS mass discharge into the environment, rather than to manage and mitigate risks and/or restore impacted Environmental Values.

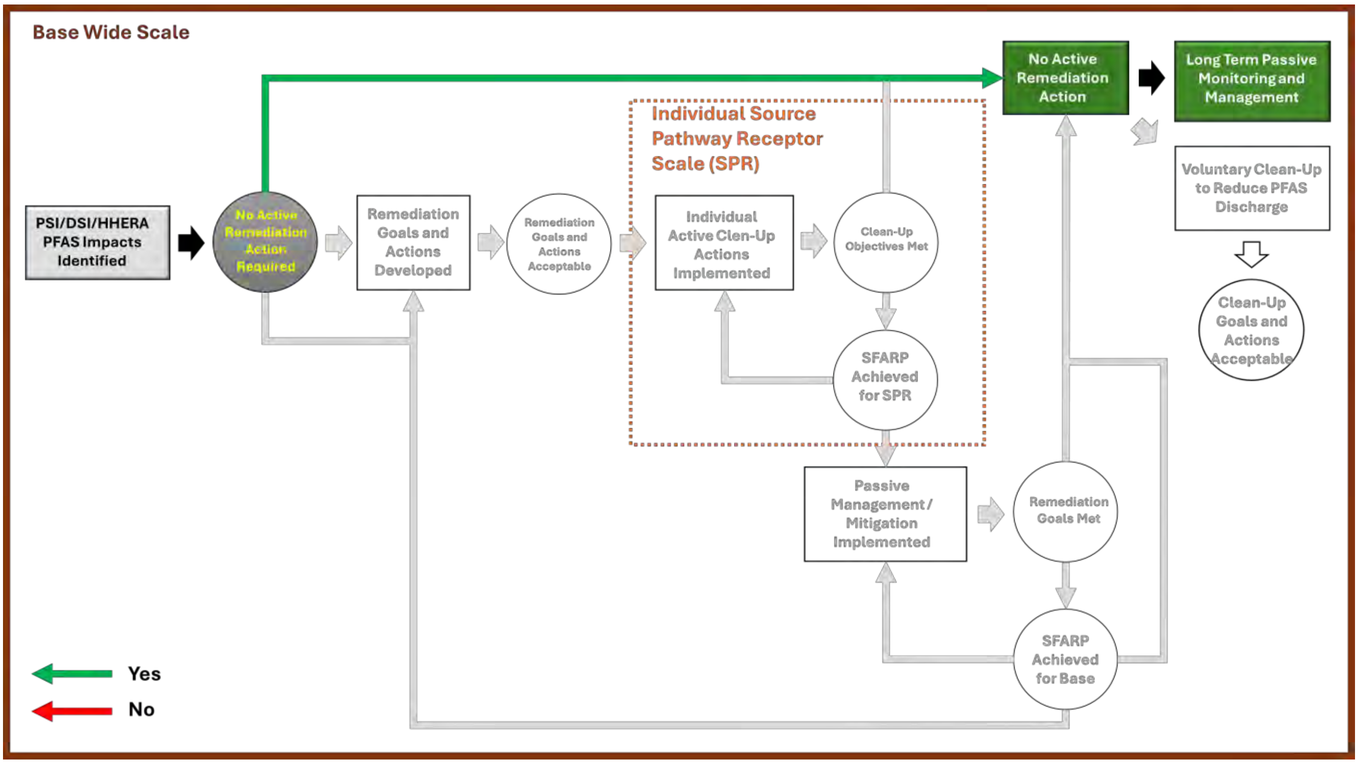

Diagram 4 Conceptualisation of assessment and decision process for this Site

The CSM developed to support the PMAP transition decision is presented in Table 15 with respect to base-derived PFAS contamination and is to be read in conjunction with the subsequent discussion presented in Section 7.

Table 15 Summary of potential sources, pathways and receptors for base derived PFAS contamination

Source Area	Potentially contaminating activities	Potentially affected media	Potential migration and exposure pathways	Potential receptors	Potential SPR Linkage		TA discussion
					On-Base	Off-Base	
AoPC 1	AFFF concentrate storage, maintenance, refilling and testing activities for the former location of the ERS unit within the Building 137 compound in the northeast of Robertson Barracks prior to its relocation (CSR_NT_000162)	Soil/sediment	Inhalation (including dust), ingestion and/or dermal contact	Employees/residents/ worker (including intrusive maintenance workers)	Yes	No	Potential exists for on-base exposure to PFAS compounds as a result of near surface impacts in shallow soils. Comparison of the results to Tier 1 screening criteria from the PFAS NEMP for a commercial/industrial land use suggests the exposure risk is likely to be low given the absence of any criteria exceedances. Further discussion regarding the potential risks to human receptors is provided in Section 7.
				Higher trophic level organisms (i.e. predatory birds and reptiles) consuming aquatic species.	No	Yes	Ecological criteria exceedances were reported with respect to soil, sediment, and surface water sampling results which indicates potential exposure risks as a result of site-derived PFAS contamination. It is noted that comparison of the reported soil results to ecological direct exposure criteria within the PFAS NEMP indicates all results to be less than the criteria. As such, exposure risks were considered to predominantly relate to indirect ecological exposure, particularly those off-base and downgradient of the base. This is supported by the assessment undertaken by Tetra Tech Coffey (2025d) which indicated ecological receptors (both aquatic and terrestrial) may be exposed to PFAS through bioaccumulation and biomagnification, particularly higher-order predators such as fish-eating birds inhabiting surface water bodies including Milners Creek and Milners Swamp. This is because: – Whilst ecological criteria exceedances were identified on-base, there were unlikely to be any on-base receptors that could be exposed to the PFAS contamination (i.e. the SPR linkage was likely incomplete due to the absence of a receptor), or – Reported results were below the adopted Tier 1 screening criteria associated with human receptors, suggesting potential exposure risks to employees, workers and recreational users to be low/negligible. The apparent lack of higher trophic organisms and/or extensively inhabited on-base terrestrial ecosystems which may be exposed to site-sourced PFAS suggests on-base exposure and bioaccumulation potential is likely to be low. The main risk-based driver/receptor exposure linkage regarding site-derived contamination in soil/sediment is therefore likely to be leaching of PFAS into solution and subsequent migration via the onsite drainage network and into off-base streams/creeks. Further discussion regarding the potential receptor exposure risks, including both on-base and off-base aquatic and terrestrial ecosystems and recreational water users, to site-derived PFAS contamination is provided in Section 7.
AoPC 2	Former 2 Cav Regt where anecdotal evidence suggested historical firefighting trucks were parked in the southeast of the compound before ERS moved to Building 137 (CSR_NT_000133, CSR_NT_000165 and CSR_NT_000245)		Leaching of impacts to surface water and/or groundwater	Aquatic ecological receptors	Yes	Yes	
				Terrestrial ecological receptors	Yes	Yes	
				Recreational users of surrounding wetlands and creeks	No	Yes	
		Surface water	Leaching of impacts through interaction with contaminated soil and surfaces (i.e. concrete, pavements, etc.)	Employees/residents/worker (including intrusive maintenance workers)	Yes	No	
AoPC 3	UST refuelling area and wash down bays which may have been utilised for firefighting tankers for wash down purposes following the use of legacy AFFF foams (CSR_NT_000241 and CSR_NT_000108).			Recreational users of surrounding wetlands and creeks	No	Yes	
				Aquatic ecological receptors	Yes	Yes	
				Higher trophic level organisms (i.e. predatory birds and reptiles) consuming aquatic species.	No	Yes	
		Groundwater	Incidental ingestion and/or direct contact	Employees/residents/worker (including intrusive maintenance workers)	Yes	No	Results from groundwater samples obtained from groundwater supply bores to the far north of the PMAP Monitoring Area within the SBRS did not report the presence of any PFAS compounds above the laboratory LOR of 0.01 ug/L and therefore below the adopted drinking water criteria from the PFAS NEMP. It is acknowledged that the laboratory LOR for PFOS was higher than the revised HBGV developed by NHMRC (2025). Nevertheless, the potential for site- derived PFAS to impact these receptors has not been considered any further in this report as they are not considered to be relevant because there are no known uses for groundwater, or groundwater users, at the base or within the PFAS plume within the area covered by the OMP. Comments regarding the laboratory LOR to be adopted during future investigation and reporting requirements are presented in Section 8.
			Abstractive use, i.e. for human consumption/ agricultural/irrigation	Employees/workers (including intrusive maintenance workers)	No	No	
				Groundwater users	No	No	
			Lateral migration and discharge into receiving environment	Drainage network, nearby Creeks and Wetlands	Yes	Yes	Significant variation in groundwater level can be observed when comparing data collected between the start of the Wet season (i.e. September/October each yeah) and the end of the Wet season (i.e. March/April each year). The variation relates to significant rainfall recharge during the Wet season that results in an increase in groundwater elevation to the extent that groundwater will discharge directly into low-lying surface features, such as the on-base drainage network and down gradient streams and creeks. The groundwater elevation then recedes during the Dry season as rainfall and groundwater recharge decreases. The TA notes that the comparison made between PFOS concentrations in groundwater between the start/end of the Wet seasons indicates no significant difference, suggesting a low potential for contaminants to become dilute as a result of increased recharge. As such, this interaction between groundwater and surface water suggests the potential for contaminant migration pathways, such as: – Rainfall recharge interacting with contaminated soil/sediment at the near surface – Contaminated groundwater discharging into surface water following significant recharge, and – From surface water/sediment into groundwater, upon recession of groundwater levels below the invert level of the drainage/surface water feature during the Dry season. Noting the absence of extractive groundwater users and/or uses on the base and within the area covered by the OMP, the primary risk-based driver/receptor exposure linkage regarding site-derived PFAS contamination are drainage/surface water features which may receive contaminated groundwater at concentrations above relevant Tier 1 ecological screening criteria.
				Recreational users of surrounding wetlands and creeks	No	Yes	

The TA considered the use of the CSM was a tool to demonstrate that a robust and defensible assessment of the SPR linkages has been undertaken to inform an assessment of risk. On that basis the TA considers the CSM to support the PMAP transition decision.

7. PMAP final site condition

A summary of the final site condition at the point of the PMAP transition decision is provided in this section with respect to:

- Environmental Values relevant to human health and the environment
- The results of monitoring work carried out as part of the PMAP OMP
- The TA's conceptual understanding of PFAS contamination occurrence, fate and transport, and exposure pathways at the base based on review of available reports.

7.1 Contamination sources

At the time of the PMAP transition, the available data was deemed sufficient, having been appropriately compiled to characterise historical AFFF use, storage and movement, along with drainage flows and soil/sediment transport, to identify PFAS impacts to soil, surface water and groundwater. The available data identified the sources of PFAS mass discharge into the environment at the base and were sufficiently characterised to inform future management and mitigation measures to address PFAS impacts.

The information with respect to the characterisation of the source areas at the time of this report included:

- PFAS has been detected in soils beneath paved areas within AoPC 1 with some minor detections in shallow soils beyond the compound area.
- The estimated PFAS mass within soils at AoPC 1 was:
  - Sum of PFOS + PFHxS: between 0.25 kg and 0.36 kg
  - Total PFAS: between 0.26 kg to 0.4 kg
- The estimated PFAS mass leaving AoPC 1 from the pavement in surface water was estimated to be:
  - Sum of PFOS + PFHxS: 0.028 kg/year
  - Total PFAS: 0.0488 kg/year
- The estimated PFAS mass leaving AoPC 2 & AoPC 3 from the pavement in surface water was estimated as:
  - Sum of PFOS + PFHxS: 0.0007 kg/year
  - Total PFAS: 0.01 kg/year
- In general, the majority of detections in soil/sediment were:
  - Below the adopted health investigation levels for a commercial/industrial land use
  - Below the ecological direct exposure criteria
  - Confined to identified source areas (AoPC 1 and AoPC 2/AoPC 3)
  - In areas typically located beneath pavement or hard stand, limiting the potential for direct contact exposure pathways to be realised
  - Within shallow soils which may become inundated during periods of high surface water flow.
  - The PFAS profile in surface water runoff from AoPC 3 differed from AoPC 1, with higher levels of perfluoroalkyl carboxylic acids (e.g., perfluoro butanoic acid (PFBA), perfluoro hexanoic acid (PFHxA)), suggesting a different AFFF product may have been used (e.g. Ansulite^{TM}) along with more recent usage
- Limited exceedances of the ecological indirect criteria were reported, including:
  - One PFOS exceedance was noted from location BH254 beneath intact pavement, where it is not accessible to identified receptors.
  - PFOS in AoPC 1, AoPC 2 / AoPC 3 and the CTA required calculation of the 95%UCL$_{AVERAGE}$.
    - Within AoPC 1, the 95%UCL$_{AVERAGE}$ concentration was indicated to be above ecological criteria.
    - Within AoPC 2 & AoPC 3 and the CTA the 95%UCL$_{AVERAGE}$ concentration was below ecological criteria.

- The presence of low-level PFOS in soil/sediment in AoPC 1, AoPC 2 & AoPC 3 (including the CTA) are considered likely to be an ongoing source of PFAS contamination to surface water and groundwater.
- The majority of surface water detections were:
  - Below the adopted recreational and drinking water guidelines from the PFAS NEMP (noting where limited exceedances were reported that potential exposure to receptors to which these criteria apply are likely low/negligible in context of the identified contaminant migration and transport pathways at the base).
  - Above the 99% level of protection criteria for freshwater ecosystems, noting that the laboratory LOR of <0.02 µg/L was above the criteria.
  - The occurrence of surface water contamination was most likely associated with:
    - Leaching of impacts from soil/sediment within AoPC 1 and AoPC 2 & AoPC 3, and
    - Interaction with groundwater during periods of high rainfall/recharge
- The majority of groundwater detections were:
  - Below the adopted recreational and drinking water guidelines. Exceedances of the criteria from some samples collected within the PMAP Management Area are acknowledged; however, in the context of the identified contaminant transport pathways and receptors are not considered to negatively impact exposure risks.
  - Above the 99% level of protection criteria for freshwater ecosystems, noting that the laboratory LOR of <0.02 µg/L was above the criteria.
  - The occurrence of groundwater contamination was associated with:
    - Leaching of impacts from soil/sediment within AoPC 1 and AoPC 2 & AoPC 3, and
    - Interaction with surface water during periods of high rainfall/recharge.

The TA considered that the investigation works conducted at the Site provided sufficient data and information to identify key PFAS sources and characterise the PFAS SMD and PMD to the environment. On that basis the TA considered that adequate robust and defensible data on SMD and PMD was available to inform migration and exposure risks with respect to the PMAP transition.

7.2 Migration and exposure pathways

The information collected with respect to the migration pathways for dissolved phase and sorbed sediment bound PFAS, primarily comprised of the drainage infrastructure, hydrology and hydrogeology that can impact surface water and groundwater was used to support the PMAP transition decision. The on-base drainage network and offsite steams/creeks provides the primary pathway for PFAS total mass discharge off-base. Groundwater is likely to be a lesser pathway noting that some of the PFAS mass in groundwater will likely enter the surface water pathway during periods of high rainfall/recharge during the Wet season. It is noted that groundwater is likely be discharging into Milners Swamp all year round, which is to the very far north-east of the base.

No active management and/or mitigation measures with respect to the surface water and groundwater PFAS pathways was undertaken as part of the PMAP OMP. The primary lines of evidence with respect to the key contamination migration and exposure pathways at the time of PMAP transition decision are:

- The presence of PFAS within shallow soils suggests potential exposure via inhalation (including dust), ingestion and/or dermal contact could occur, acknowledging that exposure impacts via this pathway are likely to be negligible given the absence of Tier 1 criteria exceedances for a commercial/industrial land use. Whilst potential exposure risks are negligible, adopting a precautionary approach is considered reasonable should interaction with the soil be required (i.e. intrusive maintenance).
- Leaching of PFAS from shallow soils/sediment and potential exposure to on-base terrestrial ecosystems. It is noted that the extent of on-base terrestrial ecosystems is low with respect to the presence of high trophic organisms to which the indirect ecological criteria apply. So, whilst the potential exposure to on-base terrestrial ecosystems via leaching of PFAS is noted, the likely absence of on-base receptors suggests the SPR linkage may not be complete which indicates the potential receptor exposure risk via this pathway to be low.

- Leaching of PFAS from shallow soil/sediment and potential exposure to aquatic ecosystems, such as that within the drain positioned along the southern boundary of the base, south of AoPC 2 / AoPC 3. It is noted that the drainage network would be classified as a highly modified ecosystem, suggesting criteria providing a 90% level of protection to be appropriate. To account for potential bioaccumulation however, the PFAS NEMP requires the level of protection to be increased by one level. As such the TA has considered the results with respect to a criterion of 0.13 µg/L which is congruent with a 95% level of species protection. Maximum surface water concentrations from monitoring locations selected to assess AoPC 2 / AoPC 3 were below this criterion suggesting potential exposure risks to receptors via this transport pathway are likely to be low.
- The migration of dissolved phase PFAS in surface water and groundwater into the drainage network, Milners Creek and Milners Swamp are likely to be the primary exposure pathway for off-base terrestrial and aquatic ecosystems. Potential exposure will likely be associated with bioaccumulation through potential uptake of PFAS impacted-surface water as a result of:
  - Rainfall recharge interacting with contaminated soil/sediment at the near surface of the base and flowing towards the north east towards Milners Creek and Milners Swamp.
  - Discharge of contaminated groundwater into surface water environments following periods of significant recharge during the Wet season.
  - From surface water/sediment into groundwater, upon recession of groundwater below the invert level of the drainage/surface water feature during the Dry season.

Recreational users and consumers of fish or crustaceans were previously identified as potential receptors. However, due to restricted access to the CTA, and the limited ephemeral presence of surface water, it was unlikely that significant aquatic biota could be present to sustain fishing activities. These receptors were therefore no longer considered relevant.

The TA considered that sufficient robust and defensible data with respect to the key pathways by which PFAS mass moves from the soil/sediment within each source area into surface water and groundwater beyond the boundary of the base and into the surrounding environment are sufficiently characterised to support the PMAP transition decision.

7.3 Receptors

Information was compiled to identify and characterise the key receptors that may be exposed to PFAS impacted media when a complete SPR linkage has been identified. Key receptors identified with respect to the potential presence of an elevated exposure risk with respect to the previously discussed sources (Section 7.1) and migration and transport pathways (Section 7.2) are summarised in Table 16.

Table 16 Summary of Receptor Exposure Risk

Base context	Receptor	Elevated exposure risk	TA opinion
On-base	Intrusive maintenance workers	No	Implement precautionary excavation management procedures to minimise exposure to low-level PFAS contaminated soil, sediment, surface water, and groundwater to intrusive maintenance workers.
	Base occupants (incl. visitors), residents	No	Does not require further consideration.
	Terrestrial flora (i.e. grass, trees, other vegetation)	No	Does not require further consideration.
	Terrestrial fauna (i.e. mammals, migratory birds, reptiles, insects, etc.)	No	Does not require further consideration.
	Aquatic and semi-aquatic fauna (i.e. worms, frogs, fish, crustaceans, etc.)	No	Does not require further consideration.
Off-base	Recreational water users (consumption of impacted water)	No	Does not require further consideration.

Base context	Receptor	Elevated exposure risk	TA opinion
	Recreational water users (consumption of impacted biota / fish)	No	Does not require further consideration.
	Abstractive groundwater users (incl. for human consumption)	No	Does not require further consideration.
	Terrestrial flora (i.e. grass, trees, other vegetation)	Yes	Further discussion presented in Section 7.4
	Terrestrial fauna (i.e. mammals, migratory birds, reptiles, insects, etc.)	Yes	Further discussion presented in Section 7.4
	Aquatic and semi-aquatic fauna (i.e. worms, frogs, fish, crustaceans, etc.)	Yes	Further discussion presented in Section 7.4

The TA considered that sufficient robust and defensible data was available to identify the key receptors that may be present within the PMAP Management Area and their potential to become exposed to PFAS. As such the TA considered that relevant receptors were identified so the risk associated with exposure to PFAS can be assessed and support the PMAP transition decision.

7.4 Off-Site receptor exposure risk

Concentrations of PFOS exceed the 99% level of species protection criteria for freshwater ecosystems which suggests a potential risk of harm to sensitive ecological receptors exists off-base and down gradient of the base. This was initially identified by Senversa as part of the DSI (2018) and HHERA (2018) with respect to the uncertainty associated with bioaccumulation and biomagnification of PFAS compounds within the Milners Creek and Milners Swamp areas.

Consideration was given to undertaking a bespoke biota sampling program within the Milners Creek and Milners Swamp areas, noting the data gap identified by Tetra Tech Coffey following completion of the SRA (Tetra Tech Coffey, 2024) and Supp DSI (2025b). Nevertheless, limitations associated with site access constraints were considered likely to technically inhibit completion of a robust assessment of different trophic levels within the Milners Creek and Milners Swamp ecosystems and hence was not undertaken. Further, the value of completing such an assessment was also considered in the context of how residual impacts associated with site-derived PFAS would be managed. It was concluded that obtaining additional data through completion of a biota sampling program was unlikely to affect how residual PFAS impacts emanating from the base would be managed.

To further contextualise the risk and reduce the uncertainty associated with potential ecological exposure/impacts within the Milners Creek and Milners Swamp areas, Tetra Tech Coffey undertook a semi-quantitative risk assessment using the food-web model they developed for the Ecological Risk Assessment (ERA) completed for the Royal Australian Air Force (RAAF) base Darwin (Tetra Tech Coffey, 2025d), which falls within the home range of species that may be exposed to PFAS in the Milners Creek and Milners Swamp areas. The applicability of the food-web model for the PMAP Monitoring Area was considered with respect to the similarities in habitat and species between the two sites, noting their close proximity to one another (RAAF base Darwin is approximately 8 km west of the base). The following ecological and environmental similarities supported the use of the RAAF base Darwin food-web model:

– The receiving water body at RAAF base Darwin (Rapid Creek) is a tropical freshwater stream with a monsoonal woodland ecosystem similar to Milners Creek.
– Overlap exists in the range of higher trophic species which likely exist at both sites, such as piscivorous birds and reptiles. Further, the desktop species list summarised in the DSI (Senversa, 2018) for Milners Creek was assessed to be similar to the list of species included in the RAAF base Darwin ERA and food-web model.
– Similar vegetation and hydrological regimes exist including seasonally influenced surface water flows.

Comparison was then made between PFOS concentrations from Robertson Barracks and RAAF base Darwin which indicated the following:

– At Robertson Barracks, PFOS concentrations in surface water and sediment were approximately ten times (an order of magnitude) lower than those at RAAF Darwin.

- PFOS concentrations in Milners Creek one to two orders of magnitude lower compared to those used to develop the food-web model for RAAF base Darwin.
- Comparison of surface water concentrations in Milners Creek against screening criteria for freshwater fish from the RAAF base Darwin ERA (Tetra Tech Coffey, 2025d) showed PFOS concentrations from the most downgradient location (SW091) were below both the adopted fish screening criteria of 0.3 µg/L and general ecological screening criterion of 0.13 µg/L. As a result, risk from potential impacts resulting from PFAS exposure for freshwater fish were considered low and acceptable.

A qualitative assessment of the risk to higher trophic species was undertaken using the RAAF base Darwin food-web model. This involved the application of a simplified order-of-magnitude reduction in PFOS concentrations (i.e. based on those from the base) to estimate the potential intake dosage for various species. Comparison of the revised intake dosage for the higher trophic species considered as part of the assessment indicated total daily intake (TDI) thresholds were unlikely to be exceeded, except for some carnivorous bird species. The presence of some TDI threshold exceedances for some species was not unexpected given the food-web model was not adjusted to discount exposure pathways that are not present at the base (i.e. soil PFAS exposure to terrestrial insects and reptiles was retained although this pathway is unlikely to be realised on-base).

The TA acknowledges the adopted approach is high-level and that uncertainties exist with respect to the simplified methodology applied to modify the RAAF Base Darwin food-web model for the purpose of contextualising potential ecosystem exposure risks to Milners Creek and Milners Swamp. Uncertainties include:

- The inclusion of additional exposure pathways which may not be realised suggests the model may not be appropriately calibrated to on-Site conditions.
- The absence of biota samples does not allow for the model to be validated with respect to actual exposure potential within the Milners Creek and Milners Swamp areas.
- The food-web model used international toxicological reference values in the development of TDS thresholds that may not reflect local species sensitivities to PFOS.

Notwithstanding the uncertainties, the TA considers the use of the RAAF Base Darwin food-web model reasonable at the Site because:

- PFOS concentrations at Robertsons Barracks are significantly lower than at RAAF Base Darwin.
- PFOS concentrations at the most downgradient surface water sampling location (SW091) are:
  - Generally reducing over time.
  - Below the fish screening criteria and general ecological screening criterion adopted within the RAAF Base Darwin ERA.
- The estimated PFOS intake doses for the majority of higher trophic species likely to be present were below revised, high level TDI thresholds.

Overall, the TA considered that the off-Site exposure risk assessment was sufficiently robust and defensible to support the PMAP transition decision.

7.5 Concentration trends and plume stability

An assessment of PFOS+PFHxS concentration trends at surface water and groundwater monitoring locations was undertaken by Tetra Tech Coffey (2025d) using data collected from February 2018 to March 2024. A combination of statistical methods was used to inform the trend assessments, including linear regression analysis and Mann-Kendall analysis, in conjunction with a qualitative/visual appraisal of graphs. The results of these trend analyses were used to support the PMAP transition decision

The TA identified a number of concerns in regard to the robustness and defensibility of the trend analysis as documented by Tetra Tech Coffey (2025d). As a result, the TA conducted an independent verification of the trend analysis using the available monitoring data.

Based on the TA review and independent verification of the of the trend assessment, the following was noted:

– Sufficient data was used to inform the trend assessment.

– Notwithstanding, the TA noted the trend assessment to be technically limiting with respect to how various metrics were interpreted. Therefore, the TA undertook independent analysis of the surface water data to clarify and confirm the outcome for the purpose of this report, noting that off-Site ecological exposure via surface water transport of PFAS was the primary transport and migration pathway driving risk at the Site.

– Based on the independent analysis of surface water data from locations relevant to source areas AoPC 1 and AoPC 2 & AoPC 3, the TA generally agrees with the outcome of the assessment work reviewed, which indicated PFOS + PFHxS concentrations to be either stable or decreasing over time with respect to data collected from surface water and groundwater monitoring locations relevant to source areas AoPC 1 and AoPC 2 & AoPC 3.

– The TA notes the following:

  - Throughout various reports reviewed, it was concluded that a seasonal correlation existed with PFAS concentrations in surface water. Review of the data by the TA did not identify a significant correlation between the reported concentration of PFOS + PFHxS in surface water with respect to the time sampling was undertaken. Further, it is noted that the interpretation of what constituted the start/end of the Wet season varied between reports. Clarity obtained by the TA indicated the start of the Wet season to relate to samples collected between October and January and the end of the wet season data related to samples collected between February and May.
  - The application and interpretation of various statistical methods was inconsistent between reports, and the statistical assessments did not distinguish between meaningful and non-meaningful differences in the dataset. For example, whilst linear regression analysis was undertaken, the distribution of the datasets was not considered to identify if potential data outliers could exist. As such, the presence and significance of minor variations was also not acknowledged in the context of the data, so, in instances where a non-favourable trend was identified or an erroneous result may have been present, there was no mechanism available to reasonably justify why this may or may not be problematic.

– On this basis, and with respect to future monitoring rounds, robust statistical assessment should be incorporated to enable trend analysis to better contextualise to potential off-Site ecological risks and impacts.

Nevertheless, based on the outcome of the statistical analysis undertaken with respect to concentration trends over time, the PFAS concentration discharged from the base is considered stable. In the context of the concentration trend and concentration stability, the TA considers that the extent of PFAS impacts associated with PFAS discharge from the Site is adequately understood.

On that basis the TA considers that sufficient robust and defensible trend analysis was available to support the PMAP transition decision.

7.6 Risks to human health and the environment

The available investigation, monitoring data, CSM and SPR linkage assessment were utilised to evaluate the risk to human health and terrestrial and aquatic flora and fauna associated with PFAS impacts and discharge from the base. The risk assessment found that exposure to PFAS for receptors where SPR linkages were complete represented a low and acceptable risk. On that basis the risk form PFAS impacts was considered such that PMAP transition to long term management can occur.

Based on the available information and risk assessment outcomes, the TA agrees that the risks associated with PFAS impacts to human health and the environment to be low and acceptable at the time of PMAP transition decision. Therefore, the TA believes that ongoing monitoring, administrative controls and contingency actions for the PFAS impacts will be sufficient to ensure the uninterrupted operation of Defence on the Site within the anticipated variance in environmental conditions. These monitoring, management and response actions can be documented in and implemented through a long-term management strategy for the base.

8. Closing

8.1 PMAP response action review

PMAP response actions were developed to address Defence's management of potentially elevated risks, through avoiding or minimising exposure to PFAS contamination from Defence property to human health and ecological receptors. Table 17 outlines the PMAP response actions and how they have been addressed through the works completed to date.

Table 17 PMAP actions and responses

PMAP Response Action	Status of action & TA's opinion on closure
1. Discontinue use of legacy AFFF containing PFAS (3M LightWater™ formulation) at the base (Eliminate Primary Source)	The TA understands this action was completed prior to the commencement of PMAP implementation, based on information presented in Section 7.1 of the PMAP.
2. Manage use of AFFF containing other PFAS (such as Ansulite™ formulation) for emergency response (Engineering Controls	The TA understands this action was completed prior to the commencement of PMAP implementation, based on information presented in Section 7.1 of the PMAP.
3. OH&S measures for intrusive maintenance or construction workers to reduce potential exposure (Administrative Controls) – this includes appropriate PPE which should be documented in a HSEP for any intrusive works that may be required in source areas and drainage lines within Robertson Barracks, Milners Creek and the southern drainage channel. Whilst risks are assessed to be low and acceptable for intrusive maintenance workers, pragmatic steps to minimise exposure in source areas would reduce potential exposure via all pathways.	The TA understands Defence has implemented processes to this Response Action (Tetra Tech Coffey, 2025d) and that these will be maintained into the future following the PMAP transition, notwithstanding the low exposure risk to intrusive maintenance workers.
4. Restriction on groundwater abstraction within Robertson Barracks, CTA and the southern drainage channel (Administration Controls) – groundwater abstraction from the Bathurst Island Formation is not currently being undertaken. Defence should continue to ensure that no groundwater abstraction occurs within the PMAP Monitoring Area from the Bathurst Island Formation apart from the existing groundwater abstraction bores at the MTR, CTA and SBRS installed within the Wildman Siltstone Formation. The NT Government currently owns the land to the south of Robertson Barracks where the southern drainage channel is located who should be notified that groundwater abstraction should be restricted within the northern portion of this tenure (southern drainage channel and to the immediate north).	The TA understands no groundwater abstraction bores used for water supply are located within the base or impacted area of CTA. This potential exposure route may be managed via standard Defence Contaminated Sites Register (CSR) controls (Tetra Tech Coffey, 2025d). On this basis, the TA considers Defence to have implemented processes to this Response Action and that these should be maintained into the future following PMAP transition.
5. Implement ongoing monitoring plan (OMP) (Administration Controls) - to assess the effectiveness of ceasing the use of AFFF. The monitoring works will provide trend data for groundwater, surface water and sediment concentrations within the PMAP Monitoring Area to assess trends in PFAS concentrations of PFAS including the effectiveness of ceasing the use of AFFF and other management measures.	An OMP was prepared and implemented as part of the PMAP for the base (Tetra Tech Coffey, 2025d). The TA understands Defence processes implemented with respect to this Response Action will be maintained into the future following PMAP transition as part of a long-term environmental management strategy.
6. Avoid accidental damage or destruction of groundwater monitoring wells included in the OMP, particularly during construction work for the development of the CTA (Administration Controls). Should monitoring wells be identified that may impact on proposed construction works, this should be discussed with Defence prior to destruction of monitoring wells where possible. Decommissioning of monitoring wells should be undertaken in accordance with the National Uniform Driller Licensing Committee (NUDLC) (2012) Minimum Construction Requirements for Water Bores and installation of additional groundwater monitoring wells may be required as replacements.	The TA understands Defence processes implemented with respect to this Response Action will be maintained into the future following PMAP transition as part of a long-term environmental management strategy.

PMAP Response Action	Status of action & TA's opinion on closure
7. Continue to implement construction management procedures (Administration Controls).	The TA understands this action aligns with existing occupational health and safety measures that are routinely required on Defence projects as detailed in the PFAS Construction Management Framework and Defence Contamination Management Manual (Tetra Tech Coffey, 2025d).
8. Reduce access to Milners Creek (Engineering Controls) – Initial design plans for perimeter fencing around the CTA are currently being developed to facilitate the use of the CTA for active military training. This will also have the benefit of reducing access to Milners Creek by the public for recreational fishing.	The TA understands Defence have implemented processes to this Response Action by restricting access to Milners Creek through permanent fencing of the CTA in 2019 (Tetra Tech Coffey, 2025d). The TA understands the fencing will be maintained into the future following PMAP transition as part of a long-term environmental management strategy.

8.2 Conclusions and recommendations

The TA draws the following conclusions based on the information reviewed and discussed in this document.

– With respect to PMAP requirements, sufficient data has been collected to understand the distribution and extent of PFAS contamination emanating from the base to inform an assessment of risk to human health and the environment at the base and receiving environments.

– All PMAP actions have been addressed and based on the characterisation, assessment and results of ongoing monitoring to date. The TA therefore considers it appropriate that the Robertson Barracks PMAP can be transitioned towards the implementation of existing institutional controls including PFAS CMF, OMP. Any future monitoring needs to incorporate ongoing monitoring requirements with respect to an SAQP.

– No calculations of surface water mass flux were presented in the Supplementary DSI Report (refer to Data Gap 6 within Table 11). It is recommended this data gap be addressed as part of a long-term management approach once sufficient robust and defensible data is available to calculate a reliable mass flux and establish a trend at an acceptable confidence level.

– No biota sampling was undertaken within Milners Creek and Swamp due to significant site access constraints and other technical limitations which would not allow for collection of suitable samples (refer to Data Gap 7 within Table 11). It is recommended that biota sampling be considered in the future in the event mass flux trends do not provide sufficient and robust lines of evidence to support long-term management decisions.

– Due to changing regulatory framework and guidelines, the PFOS laboratory LOR for existing data is now higher than some adopted screening criteria i.e PFOS may theoretically exist at a concentration below the current laboratory LOR but above the relevant screening criterion. For future sampling or monitoring events the adopted LOR by both primary and secondary laboratories for PFOS, PFHxS and PFOA analysis should be an order of magnitude below the adopted criteria if possible.

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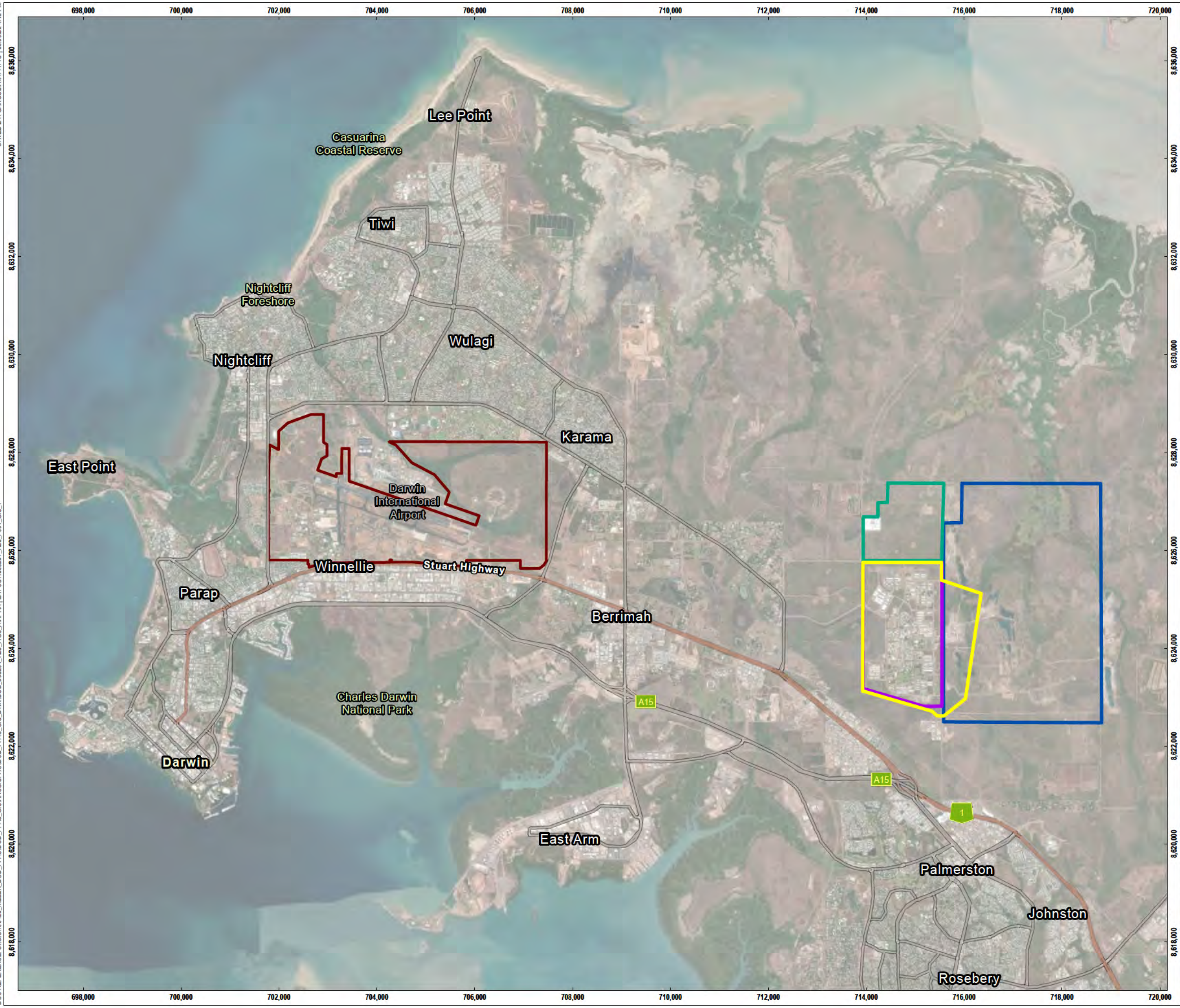
Appendices

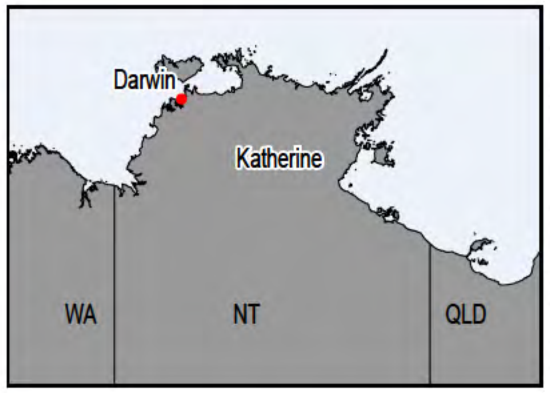
Appendix A

Supporting Figures



LEGEND

- Management Area
- Marksmanship Training Range (MTR)
- RAAF Base Darwin
- Close Training Area (CTA)
- Robertson Barracks



SOURCE
PFAS areas, Management area, MTR area and Site boundary (Indicative) from Tetra Tech Coffey
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

N

0 1 2 km

SCALE **1:75,000**
PAGE SIZE: **A3**
PROJECTION: **GDA 1994 MGA Zone 52**

DEPARTMENT OF DEFENCE

ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 1

Site location plan

TETRA TECH COFFEY

DATE: **04.09.25** PROJECT: **754-MELEN338204** FILE: **338204_R28_F001_GIS**

SAVED BY: GANGUL.ATAPATTU | 03.09.25 4:48 PM

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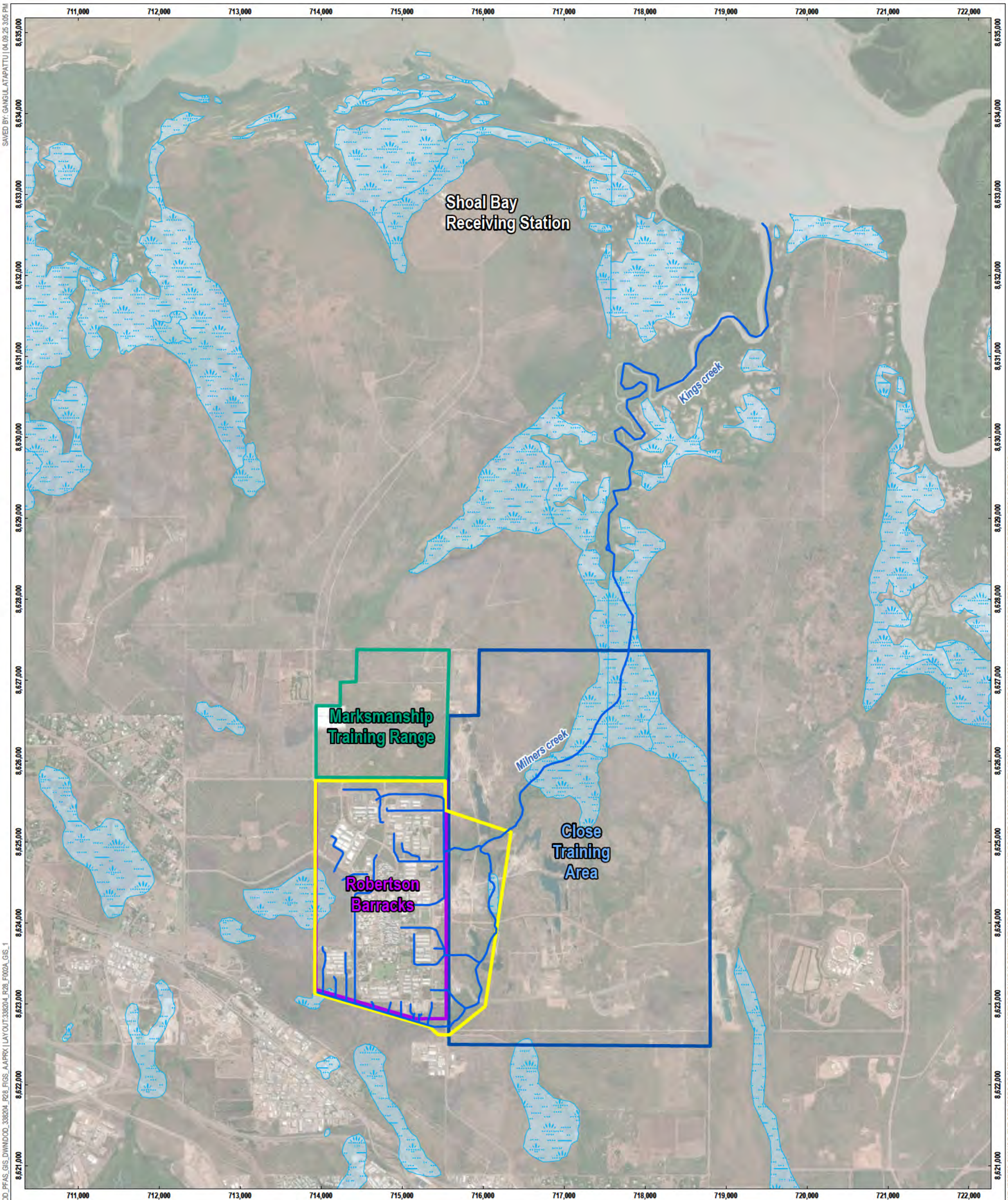

LEGEND

- Drainage and waterways
- Wetland
- Management Area
- Marksmanship Training Range (MTR)
- Close Training Area (CTA)
- Robertson Barracks

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SCALE 1:45,000

PAGE SIZE: A3

PROJECTION: GDA 1994 MGA Zone 52

SOURCE
PFAS areas, Management area, MTR area and Site boundary (Indicative) from Tetra Tech Coffey
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

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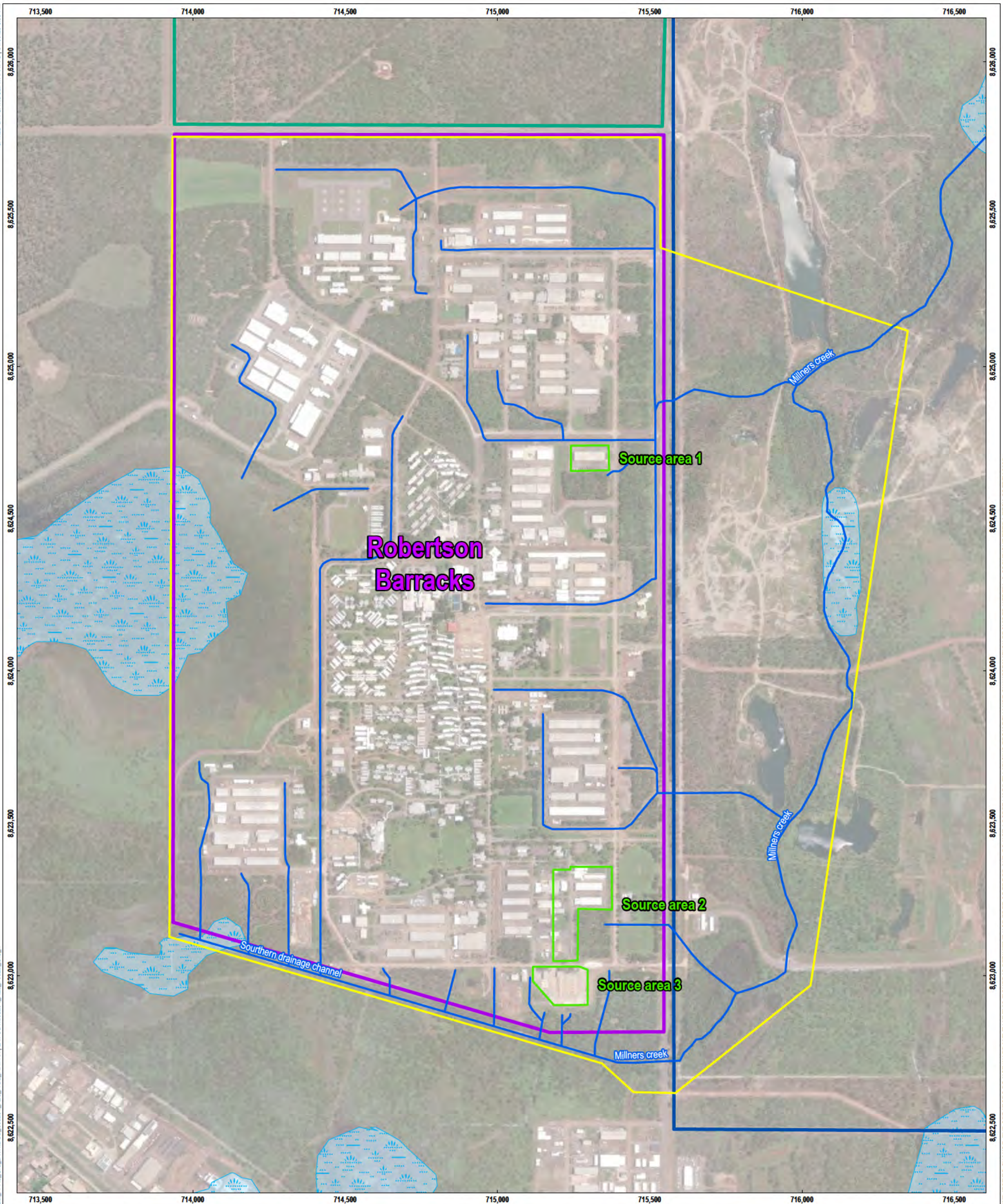
ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 2A

Regional site layout plan

TETRA TECH COFFEY

DATE: 04.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F002A_GIS



LEGEND

- Drainage and waterways
- Wetland
- Management area
- Marksmanship Training Range (MTR)
- PFAS source areas
- Close Training Area (CTA)
- Robertson Barracks

0 250 500 m

SCALE **1:12,000**

PAGE SIZE: **A3**

PROJECTION: **GDA 1994 MGA Zone 52**

SOURCE
PFAS areas, Management area, MTR area and Site boundary (Indicative) from Tetra Tech Coffey
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

DEPARTMENT OF DEFENCE

ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 2B

Site layout plan

TETRA TECH COFFEY

DATE: **04.09.25** PROJECT: **754-MELEN338204** FILE: **338204_R28_F002B_GIS**

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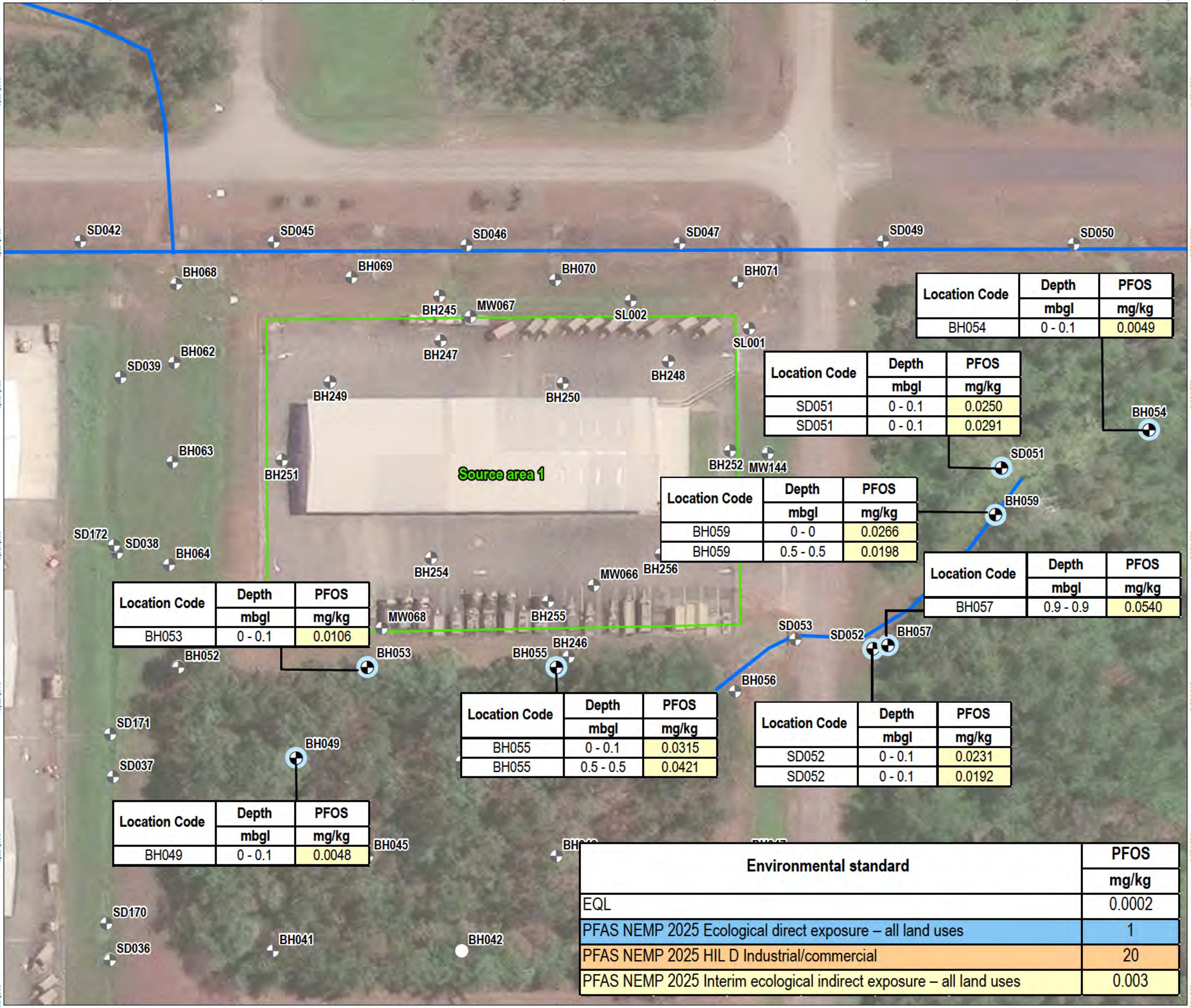


Location Code	Depth	PFOS
	mbgl	mg/kg
BH054	0 - 0.1	0.0049

Location Code	Depth	PFOS
	mbgl	mg/kg
SD051	0 - 0.1	0.0250
SD051	0 - 0.1	0.0291

Location Code	Depth	PFOS
	mbgl	mg/kg
BH059	0 - 0	0.0266
BH059	0.5 - 0.5	0.0198

Location Code	Depth	PFOS
	mbgl	mg/kg
BH057	0.9 - 0.9	0.0540

Location Code	Depth	PFOS
	mbgl	mg/kg
BH053	0 - 0.1	0.0106

Location Code	Depth	PFOS
	mbgl	mg/kg
BH055	0 - 0.1	0.0315
BH055	0.5 - 0.5	0.0421

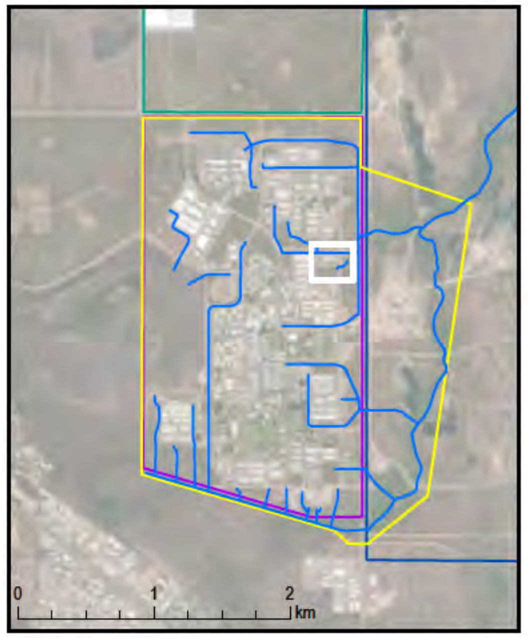
Location Code	Depth	PFOS
	mbgl	mg/kg
SD052	0 - 0.1	0.0231
SD052	0 - 0.1	0.0192

Location Code	Depth	PFOS
	mbgl	mg/kg
BH049	0 - 0.1	0.0048

Environmental standard	PFOS
	mg/kg
EQL	0.0002
PFAS NEMP 2025 Ecological direct exposure – all land uses	1
PFAS NEMP 2025 HIL D Industrial/commercial	20
PFAS NEMP 2025 Interim ecological indirect exposure – all land uses	0.003

LEGEND

- Soil sampling location exceeding PFAS criteria
- Soil sampling location
- Drainage and waterways
- PFAS source areas
- Close Training Area (CTA)
- Robertson Barracks
- Management Area



SOURCE
Areas of concern and Site boundary (indicative) from Tetra Tech Coffey.
Soil bore locations, results and NEMP exceedance criteria (from 2018 DSI) from DoD.
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

N

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SCALE **1:1,000**
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PROJECTION: **GDA 1994 MGA Zone 52**

DEPARTMENT OF DEFENCE

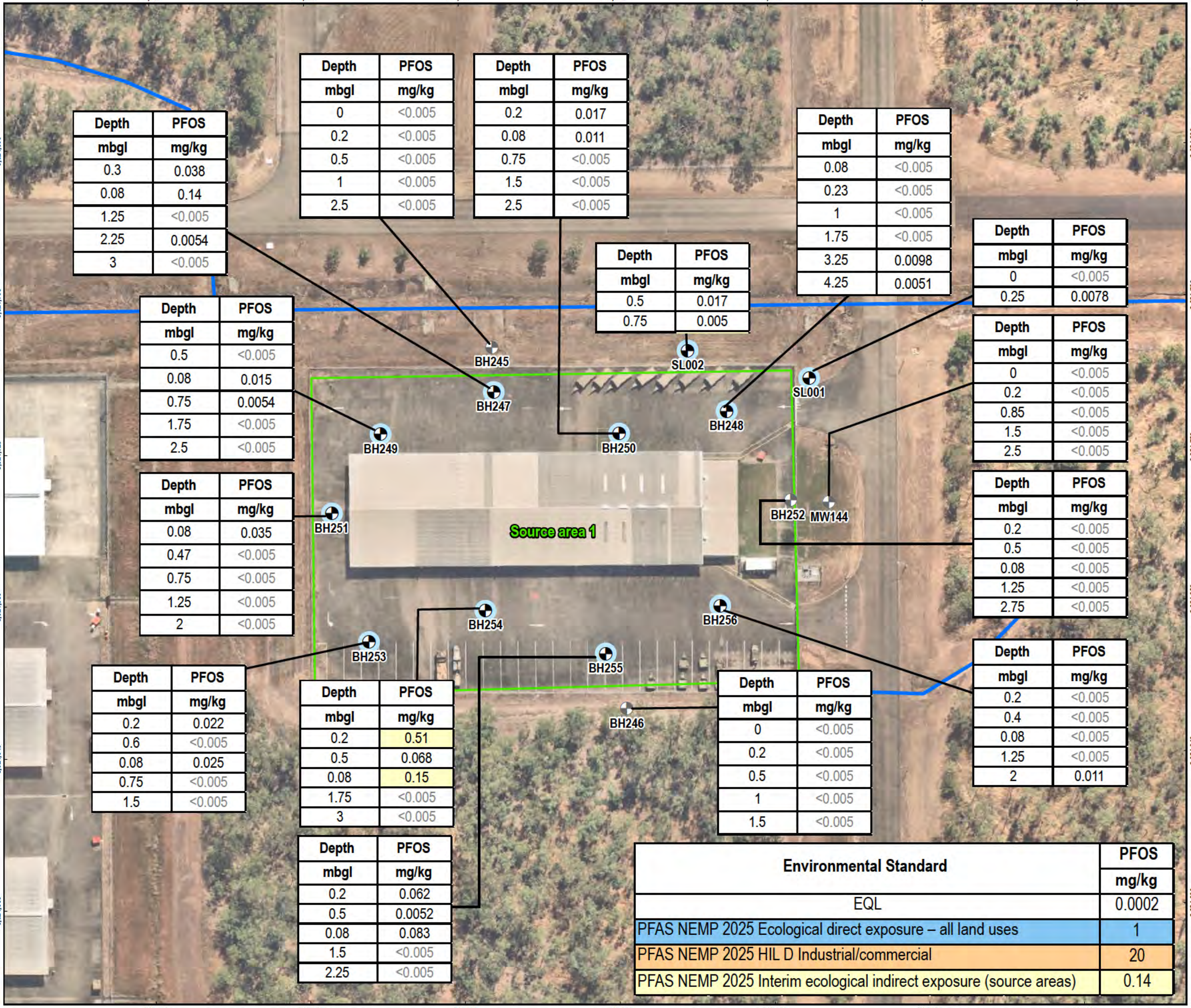
ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 3A

Source Area 1: PFOS concentrations in soil exceeding ecological criteria - indirect contact all land uses

TETRA TECH COFFEY

DATE: **04.09.25** PROJECT: **754-MELEN338204** FILE: **338204_R28_F003A_GIS**



Depth	PFOS
mbgl	mg/kg
0.3	0.038
0.08	0.14
1.25	<0.005
2.25	0.0054
3	<0.005

Depth	PFOS
mbgl	mg/kg
0	<0.005
0.2	<0.005
0.5	<0.005
1	<0.005
2.5	<0.005

Depth	PFOS
mbgl	mg/kg
0.2	0.017
0.08	0.011
0.75	<0.005
1.5	<0.005
2.5	<0.005

Depth	PFOS
mbgl	mg/kg
0.08	<0.005
0.23	<0.005
1	<0.005
1.75	<0.005
3.25	0.0098
4.25	0.0051

Depth	PFOS
mbgl	mg/kg
0.5	0.017
0.75	0.005

Depth	PFOS
mbgl	mg/kg
0	<0.005
0.25	0.0078

Depth	PFOS
mbgl	mg/kg
0.5	<0.005
0.08	0.015
0.75	0.0054
1.75	<0.005
2.5	<0.005

Depth	PFOS
mbgl	mg/kg
0	<0.005
0.2	<0.005
0.85	<0.005
1.5	<0.005
2.5	<0.005

Depth	PFOS
mbgl	mg/kg
0.08	0.035
0.47	<0.005
0.75	<0.005
1.25	<0.005
2	<0.005

Depth	PFOS
mbgl	mg/kg
0.2	<0.005
0.5	<0.005
0.08	<0.005
1.25	<0.005
2.75	<0.005

Depth	PFOS
mbgl	mg/kg
0.2	0.022
0.6	<0.005
0.08	0.025
0.75	<0.005
1.5	<0.005

Depth	PFOS
mbgl	mg/kg
0.2	0.51
0.5	0.068
0.08	0.15
1.75	<0.005
3	<0.005

Depth	PFOS
mbgl	mg/kg
0	<0.005
0.2	<0.005
0.5	<0.005
1	<0.005
1.5	<0.005

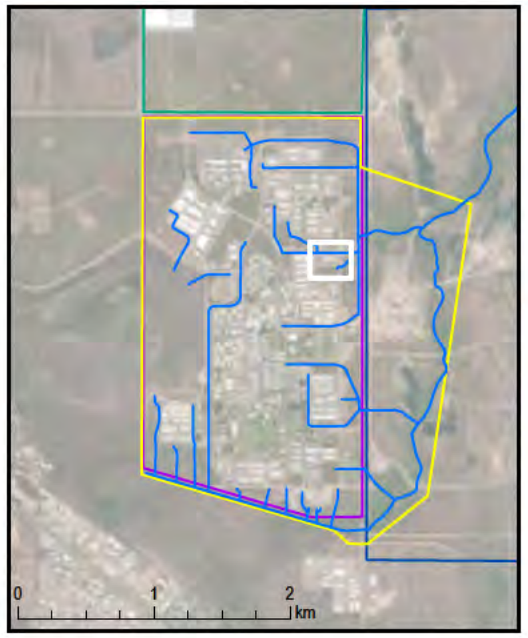
Depth	PFOS
mbgl	mg/kg
0.2	<0.005
0.4	<0.005
0.08	<0.005
1.25	<0.005
2	0.011

Depth	PFOS
mbgl	mg/kg
0.2	0.062
0.5	0.0052
0.08	0.083
1.5	<0.005
2.25	<0.005

Environmental Standard	PFOS
	mg/kg
EQL	0.0002
PFAS NEMP 2025 Ecological direct exposure – all land uses	1
PFAS NEMP 2025 HIL D Industrial/commercial	20
PFAS NEMP 2025 Interim ecological indirect exposure (source areas)	0.14

LEGEND

- Soil sampling location exceeding PFAS criteria
- Soil sampling location
- Drainage
- PFAS source areas



SOURCE
Areas of concern, drainage, sampling location and site boundary (Indicative) from Tetra Tech Coffey.
Imagery from Nearmap (04-05-2024).

0 10 20 m

SCALE 1:1,000
PAGE SIZE: A3
PROJECTION: GCS WGS 1984

DEPARTMENT OF DEFENCE

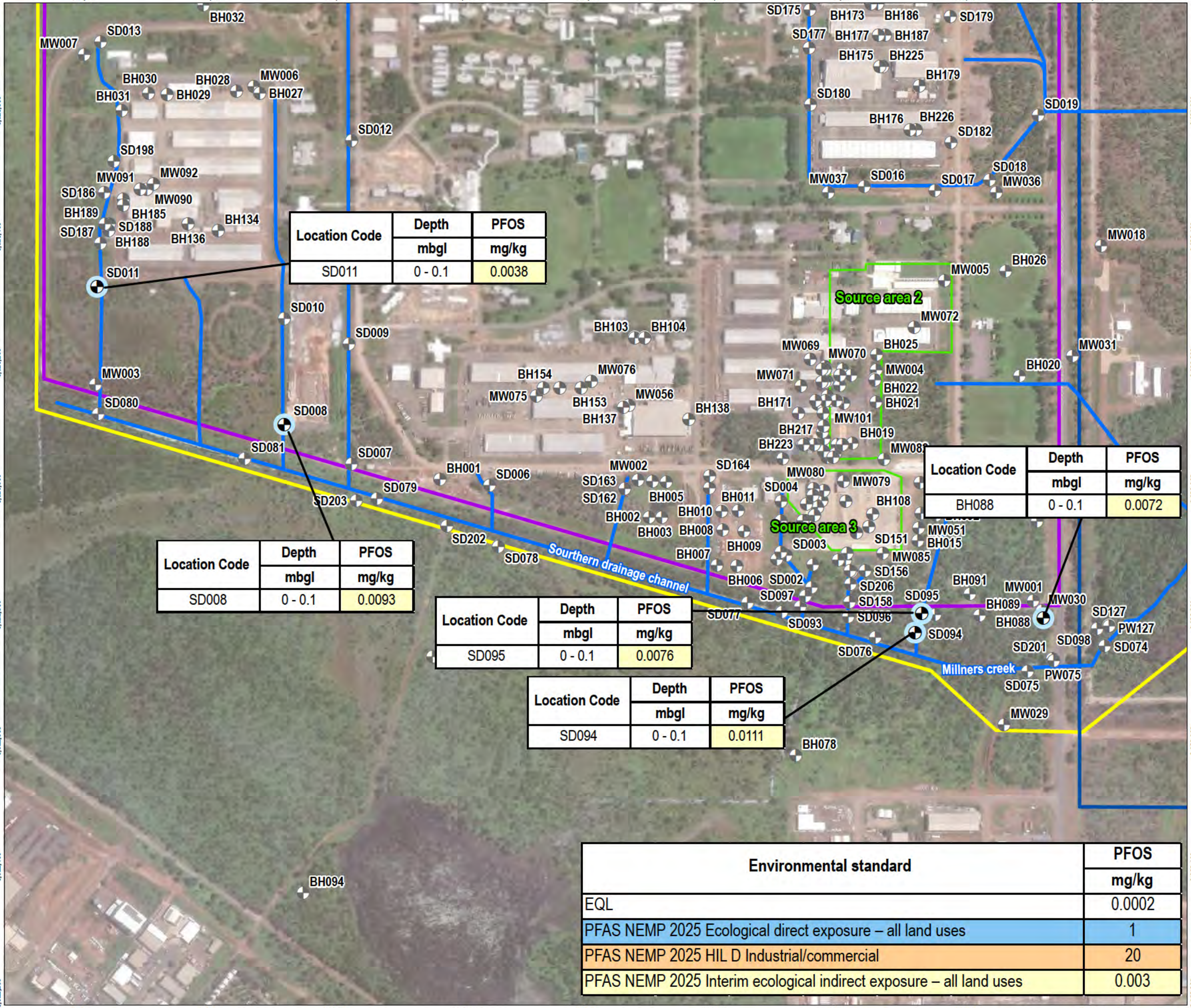
ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 3B

Source Area 1: PFOS concentrations in soil - vertical delineation results

TETRA TECH COFFEY

DATE: 04.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F003B_GIS



Location Code	Depth	PFOS
	mbgl	mg/kg
SD011	0 - 0.1	0.0038

Location Code	Depth	PFOS
	mbgl	mg/kg
SD008	0 - 0.1	0.0093

Location Code	Depth	PFOS
	mbgl	mg/kg
SD095	0 - 0.1	0.0076

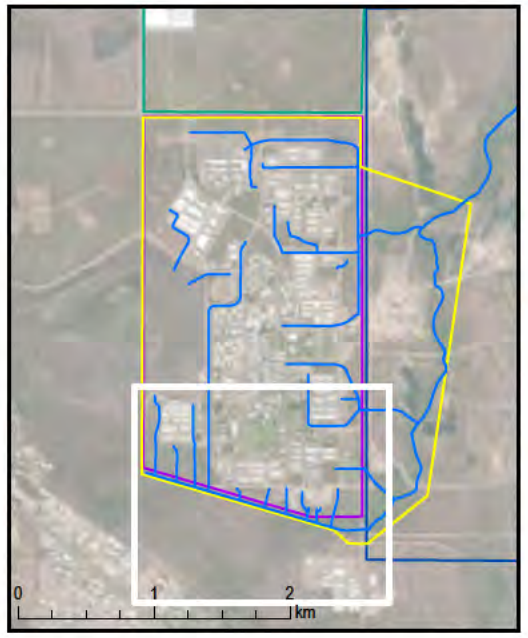
Location Code	Depth	PFOS
	mbgl	mg/kg
SD094	0 - 0.1	0.0111

Location Code	Depth	PFOS
	mbgl	mg/kg
BH088	0 - 0.1	0.0072

Environmental standard	PFOS
	mg/kg
EQL	0.0002
PFAS NEMP 2025 Ecological direct exposure – all land uses	1
PFAS NEMP 2025 HIL D Industrial/commercial	20
PFAS NEMP 2025 Interim ecological indirect exposure – all land uses	0.003

LEGEND

- Soil sampling location exceeding PFAS criteria
- Soil sampling location
- Drainage and waterways
- PFAS source areas
- Management Area
- Close Training Area (CTA)
- Robertson Barracks



SOURCE
Areas of concern and Site boundary (indicative) from Tetra Tech Coffey.
Soil bore locations, results and NEMP exceedance criteria (from 2018 DSI) from DoD.
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

0 100 200 m
SCALE 1:6,000
PAGE SIZE: A3
PROJECTION: GDA 1994 MGA Zone 52

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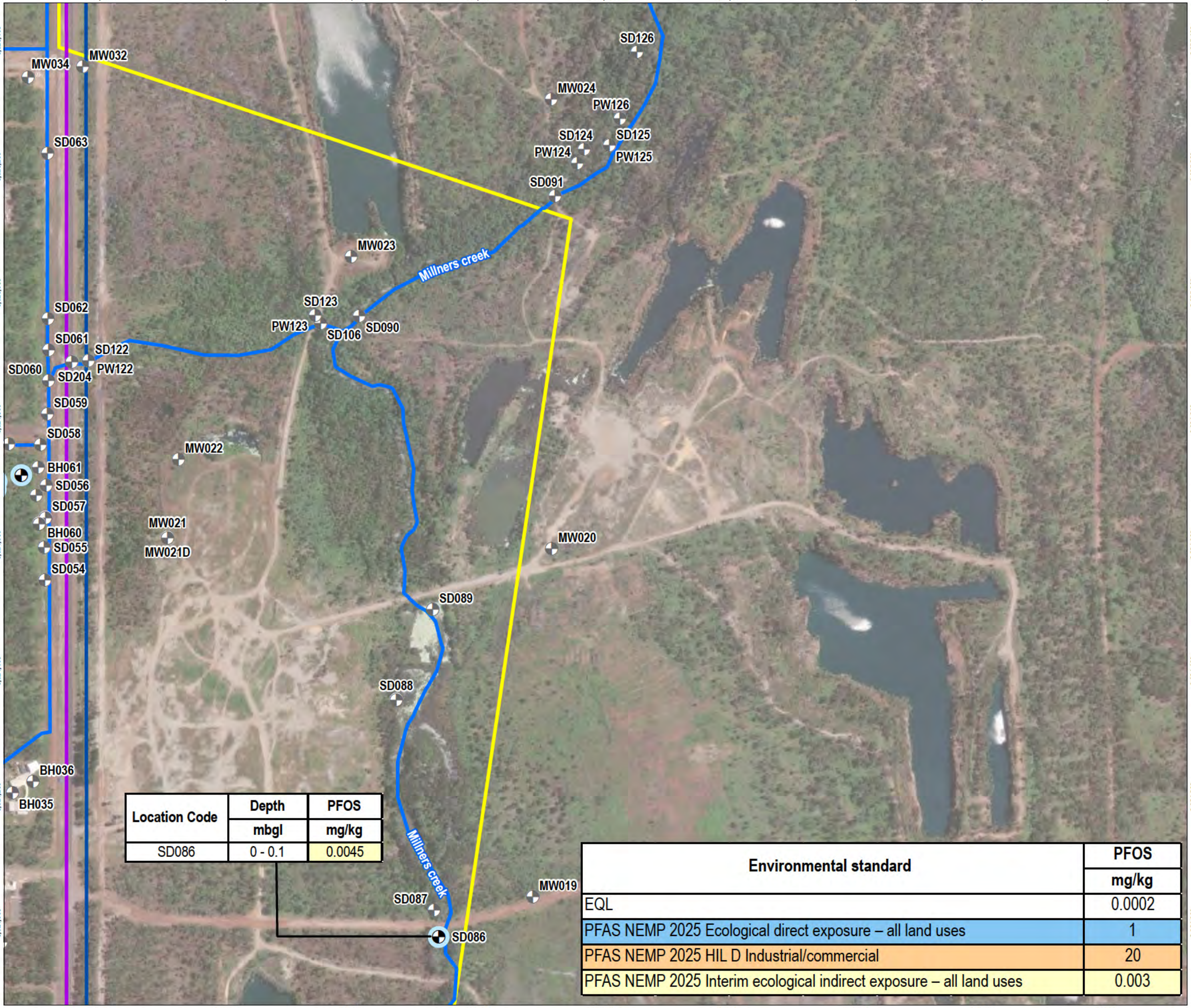
ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 3C

Source Areas 2 & 3: PFOS concentrations in soil exceeding criteria

TETRA TECH COFFEY

DATE: 04.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F003C_GIS

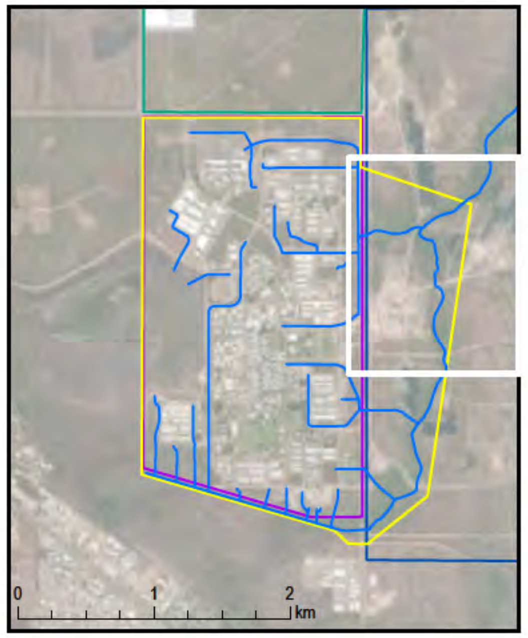


Location Code	Depth	PFOS
	mbgl	mg/kg
SD086	0 - 0.1	0.0045

Environmental standard	PFOS
	mg/kg
EQL	0.0002
PFAS NEMP 2025 Ecological direct exposure – all land uses	1
PFAS NEMP 2025 HIL D Industrial/commercial	20
PFAS NEMP 2025 Interim ecological indirect exposure – all land uses	0.003

LEGEND

- Soil sampling location exceeding PFAS criteria
- Soil sampling location
- Drainage and waterways
- PFAS source areas
- Close Training Area (CTA)
- Robertson Barracks



SOURCE
Areas of concern and Site boundary (indicative) from Tetra Tech Coffey.
Soil bore locations, results and NEMP exceedance criteria (from 2018 DSI) from DoD.
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

0 100 200 m

SCALE **1:6,000**
PAGE SIZE: **A3**
PROJECTION: **GDA 1994 MGA Zone 52**

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ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 3D

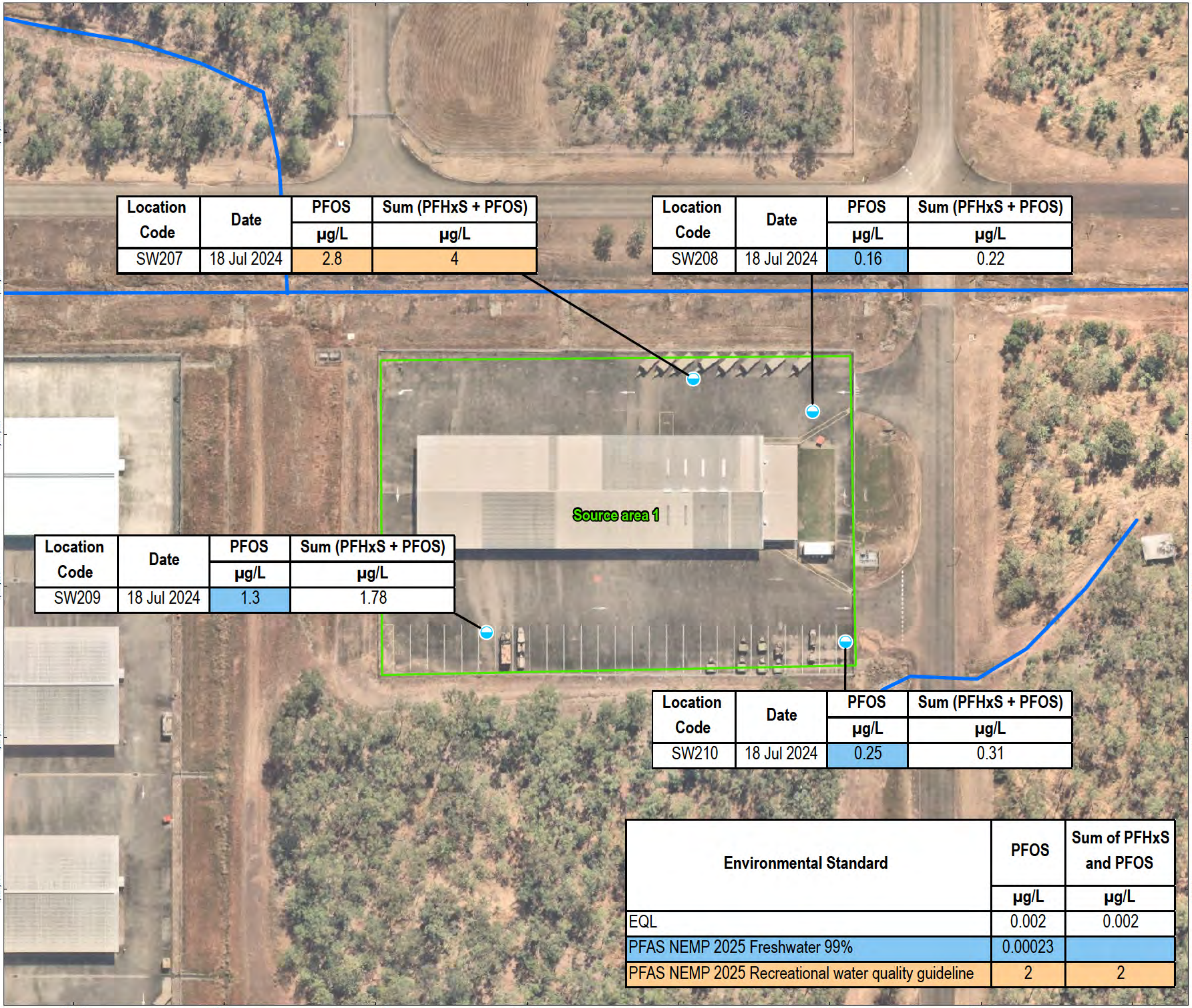
CTA: PFOS concentrations in soil exceeding criteria

TETRA TECH COFFEY

DATE: **04.09.25** PROJECT: **754-MELEN338204** FILE: **338204_R28_F003D_GIS**

SAVED BY: GANGULATAPATTU | 04.09.25 3:05 PM

DOC REFERENCE: S:\GIS\S199420_MELEN_DOD_PFAS\DOD_PFAS_GIS\ARCGIS\PRO\DOD_PFAS_GIS_DWN\DOD_338204_R28_FIGS_AAPRX | LAYOUT: 338204_R28_F003D_GIS_1



Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW207	18 Jul 2024	2.8	4

Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW208	18 Jul 2024	0.16	0.22

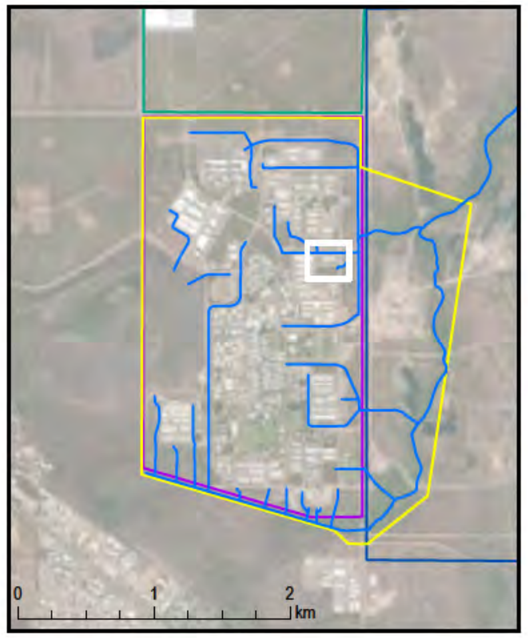
Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW209	18 Jul 2024	1.3	1.78

Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW210	18 Jul 2024	0.25	0.31

Environmental Standard	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
EQL	0.002	0.002
PFAS NEMP 2025 Freshwater 99%	0.00023	
PFAS NEMP 2025 Recreational water quality guideline	2	2

LEGEND

- Surface water runoff sampling location
- Drainage
- PFAS source areas



SOURCE
Areas of concern, drainage, sampling location and site boundary (Indicative) from Tetra Tech Coffey.
Imagery from Nearmap (04-05-2024).

0 10 20 m

SCALE 1:1,000
PAGE SIZE: A3
PROJECTION: GDA 1994 MGA Zone 52

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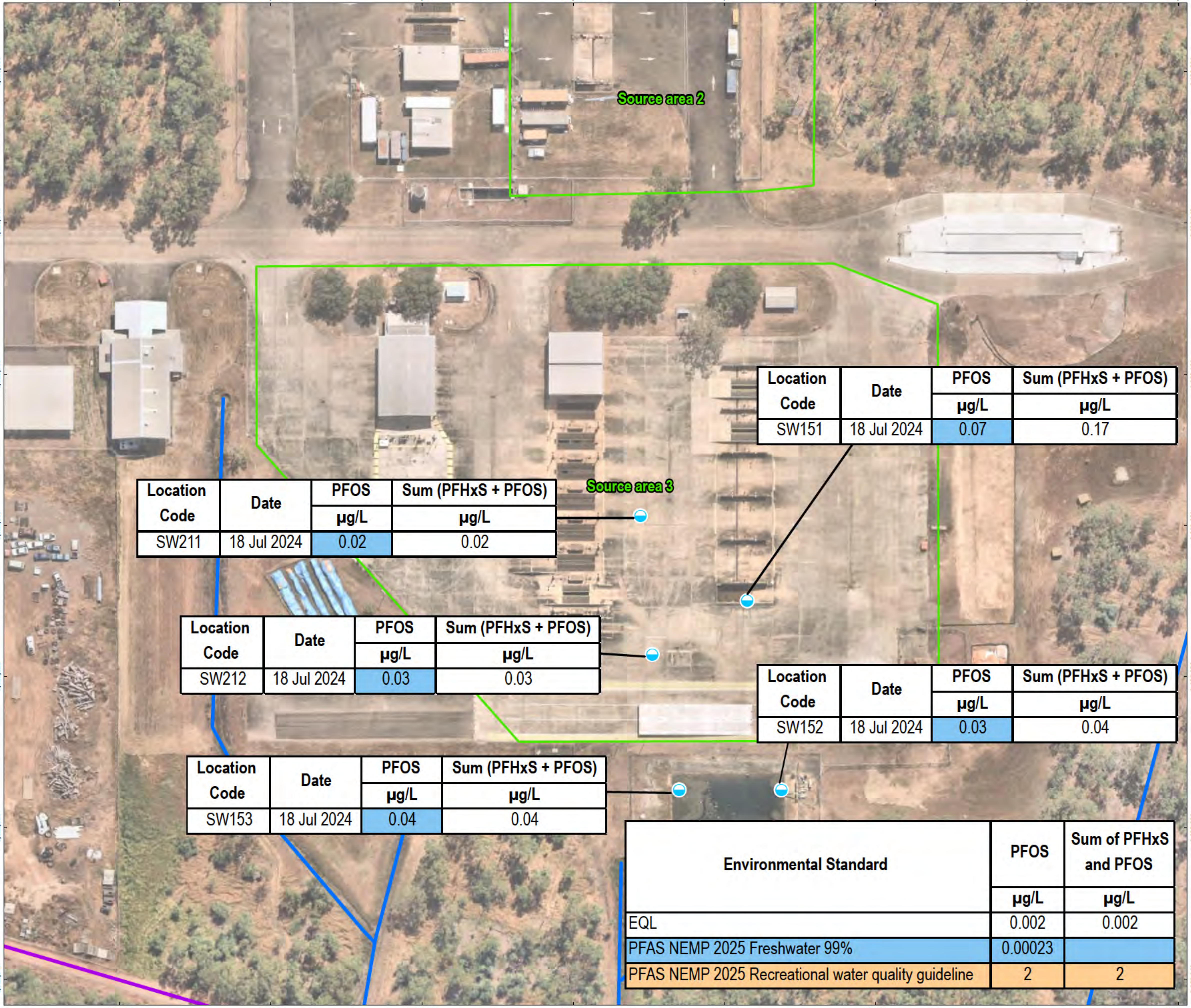
ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 4A

PFOS+PFHxS surface water runoff concentrations Source area 1

TETRA TECH COFFEY

DATE: 04.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F004A_GIS



Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW151	18 Jul 2024	0.07	0.17

Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW211	18 Jul 2024	0.02	0.02

Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW212	18 Jul 2024	0.03	0.03

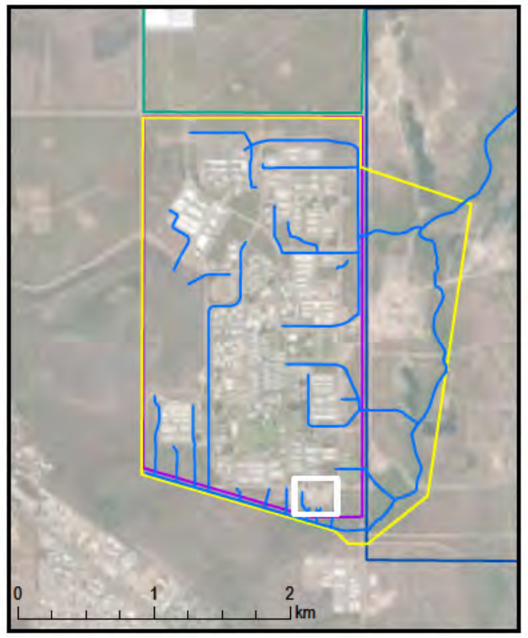
Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW152	18 Jul 2024	0.03	0.04

Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW153	18 Jul 2024	0.04	0.04

Environmental Standard	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
EQL	0.002	0.002
PFAS NEMP 2025 Freshwater 99%	0.00023	
PFAS NEMP 2025 Recreational water quality guideline	2	2

LEGEND

- Surface water runoff sampling location
- Drainage
- PFAS source areas
- Management Area
- Robertson Barracks



SOURCE
Areas of concern, sampling location and site boundary (Indicative) from Tetra Tech Coffey.
Roads from DoD.
Imagery from Nearmap (04-05-2024).

0 10 20 m

SCALE 1:1,000
PAGE SIZE: A3
PROJECTION: GDA 1994 MGA Zone 52

DEPARTMENT OF DEFENCE

ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

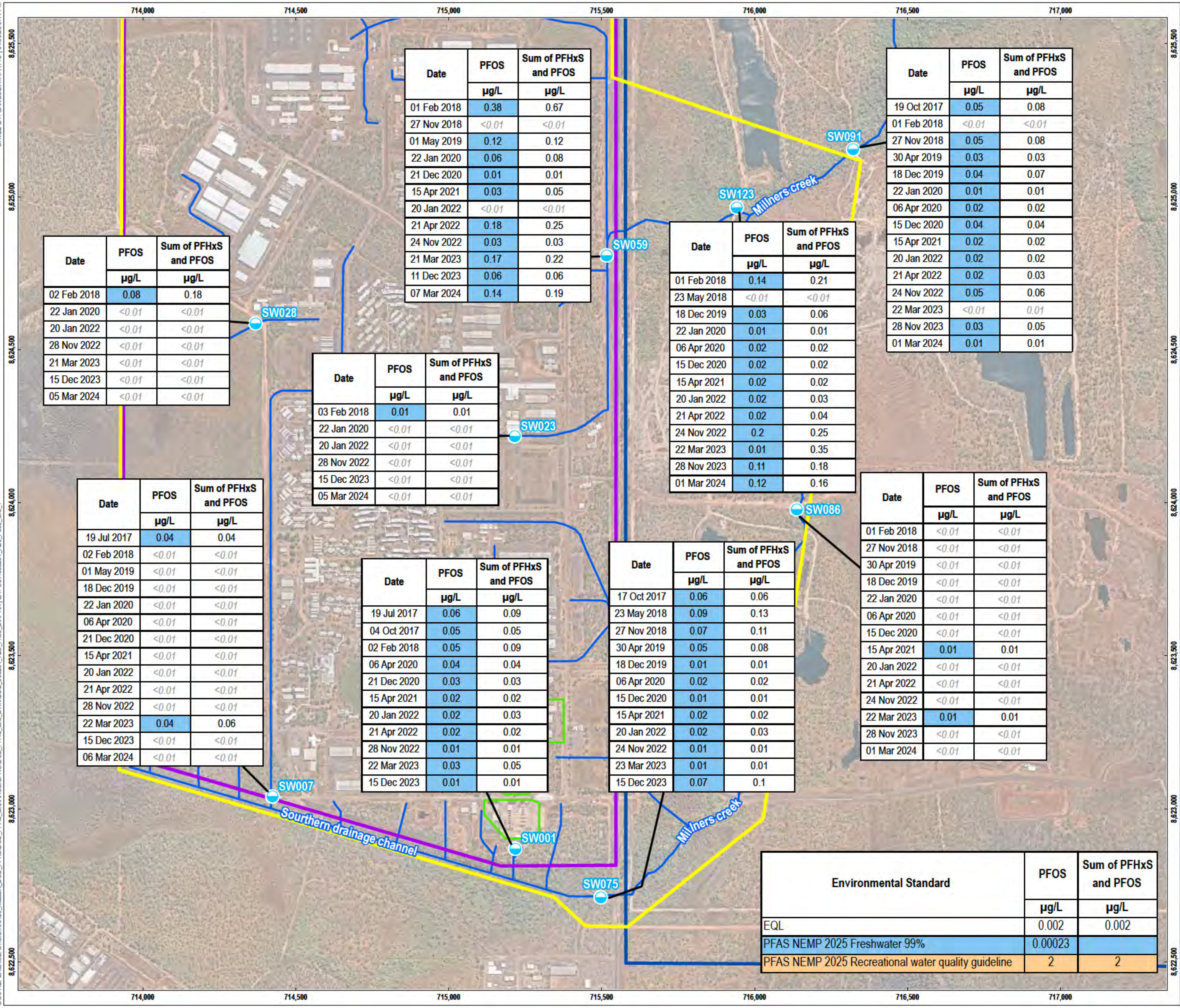
FIGURE 4B

PFOS+PFHxS surface water runoff concentrations Source area 3

TETRA TECH COFFEY

DATE: 04.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F004B_GIS

SAVED BY: GANGULATAPATU | 04.09.25 3:41 PM



SW028

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
02 Feb 2018	0.08	0.18
22 Jan 2020	<0.01	<0.01
20 Jan 2022	<0.01	<0.01
28 Nov 2022	<0.01	<0.01
21 Mar 2023	<0.01	<0.01
15 Dec 2023	<0.01	<0.01
05 Mar 2024	<0.01	<0.01

SW059

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
01 Feb 2018	0.38	0.67
27 Nov 2018	<0.01	<0.01
01 May 2019	0.12	0.12
22 Jan 2020	0.06	0.08
21 Dec 2020	0.01	0.01
15 Apr 2021	0.03	0.05
20 Jan 2022	<0.01	<0.01
21 Apr 2022	0.18	0.25
24 Nov 2022	0.03	0.03
21 Mar 2023	0.17	0.22
11 Dec 2023	0.06	0.06
07 Mar 2024	0.14	0.19

SW123

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
01 Feb 2018	0.14	0.21
23 May 2018	<0.01	<0.01
18 Dec 2019	0.03	0.06
22 Jan 2020	0.01	0.01
06 Apr 2020	0.02	0.02
15 Dec 2020	0.02	0.02
15 Apr 2021	0.02	0.02
20 Jan 2022	0.02	0.03
21 Apr 2022	0.02	0.04
24 Nov 2022	0.2	0.25
22 Mar 2023	0.01	0.35
28 Nov 2023	0.11	0.18
01 Mar 2024	0.12	0.16

SW091

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
19 Oct 2017	0.05	0.08
01 Feb 2018	<0.01	<0.01
27 Nov 2018	0.05	0.08
30 Apr 2019	0.03	0.03
18 Dec 2019	0.04	0.07
22 Jan 2020	0.01	0.01
06 Apr 2020	0.02	0.02
15 Dec 2020	0.04	0.04
15 Apr 2021	0.02	0.02
20 Jan 2022	0.02	0.02
21 Apr 2022	0.02	0.03
24 Nov 2022	0.05	0.06
22 Mar 2023	<0.01	0.01
28 Nov 2023	0.03	0.05
01 Mar 2024	0.01	0.01

SW023

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
03 Feb 2018	0.01	0.01
22 Jan 2020	<0.01	<0.01
20 Jan 2022	<0.01	<0.01
28 Nov 2022	<0.01	<0.01
15 Dec 2023	<0.01	<0.01
05 Mar 2024	<0.01	<0.01

SW007

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
19 Jul 2017	0.04	0.04
02 Feb 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
22 Jan 2020	<0.01	<0.01
06 Apr 2020	<0.01	<0.01
21 Dec 2020	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
20 Jan 2022	<0.01	<0.01
21 Apr 2022	<0.01	<0.01
28 Nov 2022	<0.01	<0.01
22 Mar 2023	0.04	0.06
15 Dec 2023	<0.01	<0.01
06 Mar 2024	<0.01	<0.01

SW001

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
19 Jul 2017	0.06	0.09
04 Oct 2017	0.05	0.05
02 Feb 2018	0.05	0.09
06 Apr 2020	0.04	0.04
21 Dec 2020	0.03	0.03
15 Apr 2021	0.02	0.02
20 Jan 2022	0.02	0.03
21 Apr 2022	0.02	0.02
28 Nov 2022	0.01	0.01
22 Mar 2023	0.03	0.05
15 Dec 2023	0.01	0.01

SW075

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
17 Oct 2017	0.06	0.06
23 May 2018	0.09	0.13
27 Nov 2018	0.07	0.11
30 Apr 2019	0.05	0.08
18 Dec 2019	0.01	0.01
06 Apr 2020	0.02	0.02
15 Dec 2020	0.01	0.01
15 Apr 2021	0.02	0.02
20 Jan 2022	0.02	0.03
24 Nov 2022	0.01	0.01
23 Mar 2023	0.01	0.01
15 Dec 2023	0.07	0.1

SW086

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
01 Feb 2018	<0.01	<0.01
27 Nov 2018	<0.01	<0.01
30 Apr 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
22 Jan 2020	<0.01	<0.01
06 Apr 2020	<0.01	<0.01
15 Dec 2020	<0.01	<0.01
15 Apr 2021	0.01	0.01
20 Jan 2022	<0.01	<0.01
21 Apr 2022	<0.01	<0.01
24 Nov 2022	<0.01	<0.01
22 Mar 2023	0.01	0.01
28 Nov 2023	<0.01	<0.01
01 Mar 2024	<0.01	<0.01

Environmental Standard	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
EQL	0.002	0.002
PFAS NEMP 2025 Freshwater 99%	0.00023	
PFAS NEMP 2025 Recreational water quality guideline	2	2

LEGEND

- Surface water sampling location
- Drainage and waterways
- Management Area
- PFAS source areas
- Close Training Area (CTA)
- Robertson Barracks

SOURCE
Locations, PFAS areas, Management area, MTR area and Site boundary (Indicative) from Tetra Tech Coffey
Roads, tracks, and drains from DoD.
Imagery from Nearmap (06-06-2023).

0 250 500 m
N

SCALE 1:12,000
PAGE SIZE: A3
PROJECTION: GDA 1994 MGA Zone 52

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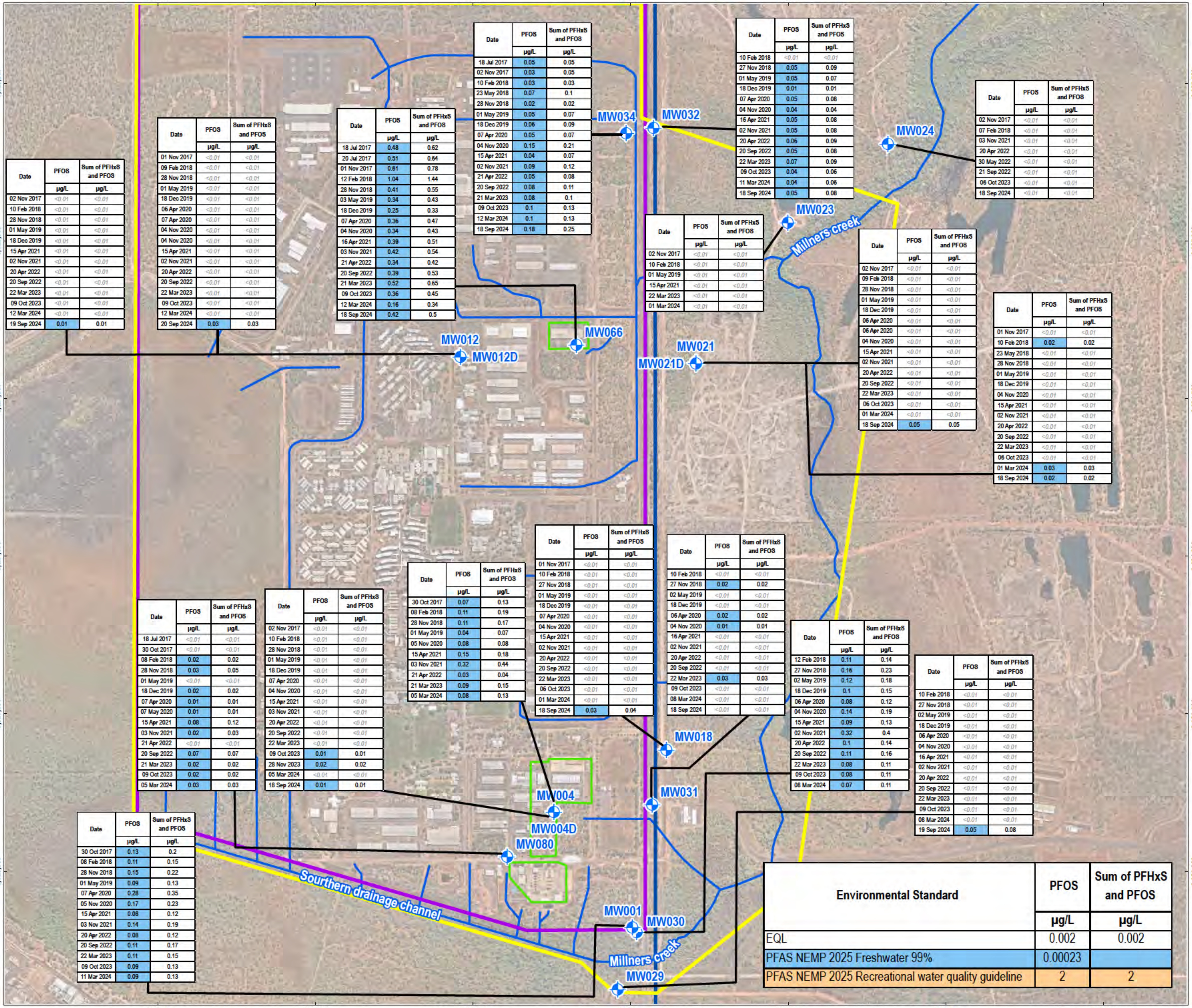
ROBERTSON BARRACKS PMAP TRANSITION RECOMMENDATION REPORT

FIGURE 5

PFOS+PFHxS concentrations in surface water

TETRA TECH COFFEY

DATE: 09.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F005_GIS



Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
02 Nov 2017	<0.01	<0.01
10 Feb 2018	<0.01	<0.01
28 Nov 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
02 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
09 Oct 2023	<0.01	<0.01
12 Mar 2024	<0.01	<0.01
19 Sep 2024	0.01	0.01

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
01 Nov 2017	<0.01	<0.01
09 Feb 2018	<0.01	<0.01
28 Nov 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
06 Apr 2020	<0.01	<0.01
07 Apr 2020	<0.01	<0.01
04 Nov 2020	<0.01	<0.01
04 Nov 2020	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
02 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
09 Oct 2023	<0.01	<0.01
12 Mar 2024	<0.01	<0.01
20 Sep 2024	0.03	0.03

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
18 Jul 2017	0.48	0.62
20 Jul 2017	0.51	0.64
01 Nov 2017	0.61	0.78
12 Feb 2018	1.04	1.44
28 Nov 2018	0.41	0.55
03 May 2019	0.34	0.43
18 Dec 2019	0.25	0.33
07 Apr 2020	0.36	0.47
04 Nov 2020	0.34	0.43
16 Apr 2021	0.39	0.51
03 Nov 2021	0.42	0.54
21 Apr 2022	0.34	0.42
20 Sep 2022	0.39	0.53
21 Mar 2023	0.52	0.65
09 Oct 2023	0.36	0.45
12 Mar 2024	0.16	0.34
18 Sep 2024	0.42	0.5

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
18 Jul 2017	0.05	0.05
02 Nov 2017	0.03	0.05
10 Feb 2018	0.03	0.03
23 May 2018	0.07	0.1
28 Nov 2018	0.02	0.02
01 May 2019	0.05	0.07
18 Dec 2019	0.06	0.09
07 Apr 2020	0.05	0.07
04 Nov 2020	0.15	0.21
15 Apr 2021	0.04	0.07
02 Nov 2021	0.09	0.12
21 Apr 2022	0.05	0.08
20 Sep 2022	0.08	0.11
21 Mar 2023	0.08	0.1
09 Oct 2023	0.1	0.13
12 Mar 2024	0.1	0.13
18 Sep 2024	0.18	0.25

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
10 Feb 2018	<0.01	<0.01
27 Nov 2018	0.05	0.09
01 May 2019	0.05	0.07
18 Dec 2019	0.01	0.01
07 Apr 2020	0.05	0.08
04 Nov 2020	0.04	0.04
16 Apr 2021	0.05	0.08
02 Nov 2021	0.05	0.08
20 Apr 2022	0.06	0.09
20 Sep 2022	0.05	0.08
22 Mar 2023	0.07	0.09
09 Oct 2023	0.04	0.06
11 Mar 2024	0.04	0.06
18 Sep 2024	0.05	0.08

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
02 Nov 2017	<0.01	<0.01
07 Feb 2018	<0.01	<0.01
03 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
30 May 2022	<0.01	<0.01
21 Sep 2022	<0.01	<0.01
06 Oct 2023	<0.01	<0.01
18 Sep 2024	<0.01	<0.01

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
02 Nov 2017	<0.01	<0.01
10 Feb 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
01 Mar 2024	<0.01	<0.01

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
02 Nov 2017	<0.01	<0.01
09 Feb 2018	<0.01	<0.01
28 Nov 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
06 Apr 2020	<0.01	<0.01
06 Apr 2020	<0.01	<0.01
04 Nov 2020	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
02 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
06 Oct 2023	<0.01	<0.01
01 Mar 2024	<0.01	<0.01
18 Sep 2024	0.05	0.05

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
01 Nov 2017	<0.01	<0.01
10 Feb 2018	0.02	0.02
23 May 2018	<0.01	<0.01
28 Nov 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
04 Nov 2020	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
02 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
06 Oct 2023	<0.01	<0.01
01 Mar 2024	0.03	0.03
18 Sep 2024	0.02	0.02

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
01 Nov 2017	<0.01	<0.01
10 Feb 2018	<0.01	<0.01
27 Nov 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
07 Apr 2020	<0.01	<0.01
04 Nov 2020	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
02 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
06 Oct 2023	<0.01	<0.01
01 Mar 2024	<0.01	<0.01
18 Sep 2024	0.03	0.04

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
10 Feb 2018	<0.01	<0.01
27 Nov 2018	0.02	0.02
02 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
06 Apr 2020	0.02	0.02
04 Nov 2020	0.01	0.01
16 Apr 2021	<0.01	<0.01
02 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	0.03	0.03
09 Oct 2023	<0.01	<0.01
08 Mar 2024	<0.01	<0.01
18 Sep 2024	<0.01	<0.01

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
30 Oct 2017	0.07	0.13
08 Feb 2018	0.11	0.19
28 Nov 2018	0.11	0.17
01 May 2019	0.04	0.07
05 Nov 2020	0.08	0.08
15 Apr 2021	0.15	0.18
03 Nov 2021	0.32	0.44
21 Apr 2022	0.03	0.04
21 Mar 2023	0.09	0.15
05 Mar 2024	0.08	0.13

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
02 Nov 2017	<0.01	<0.01
10 Feb 2018	<0.01	<0.01
28 Nov 2018	<0.01	<0.01
01 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
07 Apr 2020	<0.01	<0.01
04 Nov 2020	<0.01	<0.01
15 Apr 2021	<0.01	<0.01
03 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
09 Oct 2023	0.01	0.01
28 Nov 2023	0.02	0.02
05 Mar 2024	<0.01	<0.01
18 Sep 2024	0.01	0.01

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
18 Jul 2017	<0.01	<0.01
30 Oct 2017	<0.01	<0.01
08 Feb 2018	0.02	0.02
28 Nov 2018	0.03	0.05
01 May 2019	<0.01	<0.01
18 Dec 2019	0.02	0.02
07 Apr 2020	0.01	0.01
07 May 2020	0.01	0.01
15 Apr 2021	0.08	0.12
03 Nov 2021	0.02	0.03
21 Apr 2022	<0.01	<0.01
20 Sep 2022	0.07	0.07
21 Mar 2023	0.02	0.02
09 Oct 2023	0.02	0.02
05 Mar 2024	0.03	0.03

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
30 Oct 2017	0.13	0.2
08 Feb 2018	0.11	0.15
28 Nov 2018	0.15	0.22
01 May 2019	0.09	0.13
07 Apr 2020	0.28	0.35
05 Nov 2020	0.17	0.23
15 Apr 2021	0.08	0.12
03 Nov 2021	0.14	0.19
20 Apr 2022	0.08	0.12
20 Sep 2022	0.11	0.17
22 Mar 2023	0.11	0.15
09 Oct 2023	0.09	0.13
11 Mar 2024	0.09	0.13

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
12 Feb 2018	0.11	0.14
27 Nov 2018	0.16	0.23
02 May 2019	0.12	0.18
18 Dec 2019	0.1	0.15
06 Apr 2020	0.08	0.12
04 Nov 2020	0.14	0.19
15 Apr 2021	0.09	0.13
02 Nov 2021	0.32	0.4
20 Apr 2022	0.1	0.14
20 Sep 2022	0.11	0.16
22 Mar 2023	0.08	0.11
09 Oct 2023	0.08	0.11
08 Mar 2024	0.07	0.11

Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
10 Feb 2018	<0.01	<0.01
27 Nov 2018	<0.01	<0.01
02 May 2019	<0.01	<0.01
18 Dec 2019	<0.01	<0.01
06 Apr 2020	<0.01	<0.01
04 Nov 2020	<0.01	<0.01
16 Apr 2021	<0.01	<0.01
02 Nov 2021	<0.01	<0.01
20 Apr 2022	<0.01	<0.01
20 Sep 2022	<0.01	<0.01
22 Mar 2023	<0.01	<0.01
09 Oct 2023	<0.01	<0.01
08 Mar 2024	<0.01	<0.01
19 Sep 2024	0.05	0.08

Environmental Standard	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
EQL	0.002	0.002
PFAS NEMP 2025 Freshwater 99%	0.00023	
PFAS NEMP 2025 Recreational water quality guideline	2	2

LEGEND

- Groundwater sampling location
- Drainage and waterways
- Management Area
- PFAS source areas
- Close Training Area (CTA)
- Robertson Barracks

SOURCE
Locations, PFAS areas, Management area, MTR area and Site boundary (Indicative) from Tetra Tech Coffey
Roads, tracks, and drains from DoD.
Imagery from Nearmap (06-06-2023).

0 250 500 m

SCALE 1:12,000
PAGE SIZE: A3
PROJECTION: GDA 1994 MGA Zone 52

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FIGURE 6

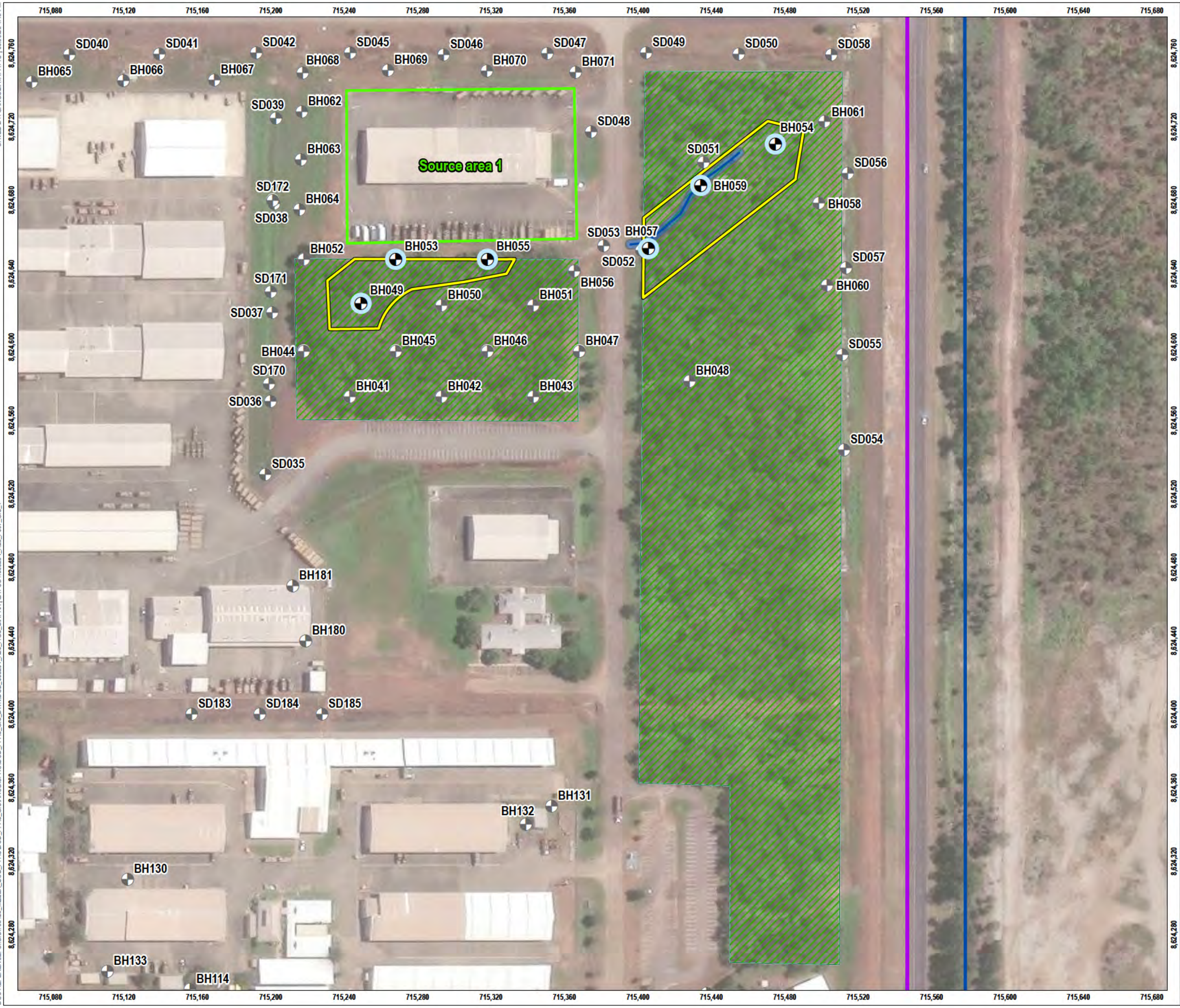
PFOS+PFHxS concentrations in groundwater

TETRA TECH COFFEY

DATE: 09.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F006_GIS

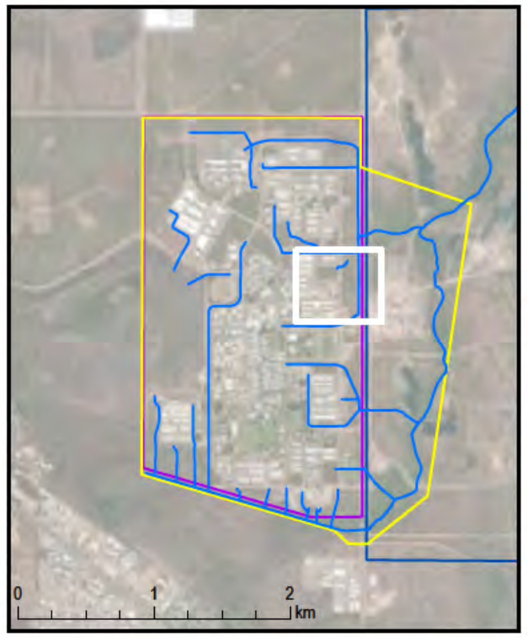
SAVED BY: GANGULATAPATTU | 04.09.25 3:41 PM

DOC REFERENCE: S:\GIS\199420_MELEN_DOD_PFAS\DOD_PFAS_GIS\ARCGIS\PRO\DOD_PFAS_GIS_DWN\DOD_338204_R28_FIGS_B.APRX | LAYOUT:338204_R28_F006_GIS_1



LEGEND

- Soil sampling location exceeding 99% ecological criteria for PFAS within potential ecological exposure area
- Soil sampling location
- Drainage and waterways
- Exceedance buffer
- Drainage buffer (5m)
- South and east of Source Area 1 – potential ecological exposure area
- PFAS source areas
- Close Training Area (CTA)
- Robertson Barracks



SOURCE
Areas of concern and Site boundary (indicative) from Tetra Tech Coffey.
Soil bore locations, results and NEMP exceedance criteria (from 2018 DSI) from DoD.
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

0 20 40 m

SCALE **1:2,000**
PAGE SIZE: **A3**
PROJECTION: **GDA 1994 MGA Zone 52**

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FIGURE 7

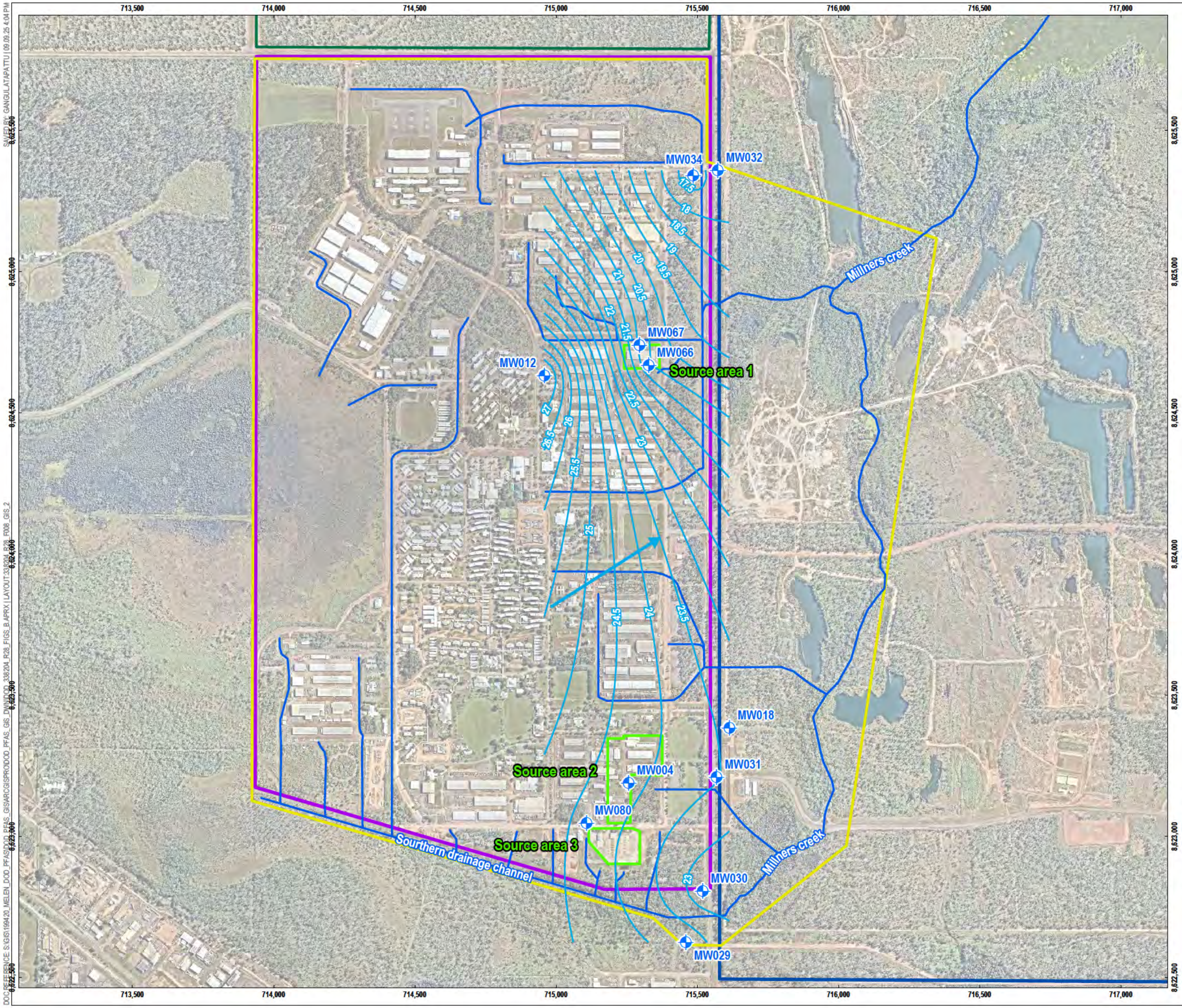
South and east of Source Area 1 Ecological exposure areas

TETRA TECH COFFEY

DATE: 04.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F007_GIS

SAVED BY: GANGULATAPATTU | 03.09.25 4:49 PM

DOC REFERENCE: S:\GIS\199420_MELEN_DOD_PFAS\DOD_PFAS_GIS\ARCGIS\PRO\DOD_PFAS_GIS_DWN\DOD_338204_R28_FIGS_BA.PRX | LAYOUT: 338204_R28_F007_GIS_1



LEGEND

- Groundwater Well
- Inferred Groundwater Flow Direction
- Groundwater Contours (mAHD)
- Drainage and waterways
- PFAS source area
- Management Area
- Close Training Area (CTA)
- Robertson Barracks
- Marksmanship Training Range (MTR)

SOURCE
Groundwater well, contour, PFAS area, management area, MTR area and site boundary (indicative) from Tetra Tech Coffey.
Road and drain from DoD.
Imagery from ESRI and Nearmap (02-05-2025).

0 250 500 m

N

SCALE 1:13,000
PAGE SIZE: A3
PROJECTION: GDA 1994 MGA Zone 52

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FIGURE 8

Inferred groundwater flow direction April 2025

TETRA TECH COFFEY

DATE: 10.09.25 PROJECT: 754-MELEN338204 FILE: 338204_R28_F008_GIS ghd.com

→ The Power of Commitment