

Robertson Barracks PFAS Investigation

Robertson Barracks - Recommendation for PMAP Transition

Department of Defence



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This report and conclusions must be read in the context of the limitations described in "Important information about your Tetra Tech Coffey Environmental Report" in Appendix E.

EXECUTIVE SUMMARY

The Department of Defence (Defence) engaged Tetra Tech Coffey Pty Ltd (Tetra Tech Coffey) to re-assess per- and poly-fluoroalkyl substances (PFAS) at Robertson Barracks (the base), located at Thorngate Road, Darwin, Northern Territory (NT). This reassessment follows previous investigations and the implementation of a PFAS Management Area Plan (PMAP) in 2018 and was conducted to support a recommendation for transition from active PFAS management to ongoing monitoring under the Defence Remediation SFARP Guidance (Defence, 2024).

The objective of this reassessment was to evaluate whether PFAS risks at the base remain low and acceptable, confirm that all PMAP actions have been completed or remain effective, and assess whether active remediation is warranted. The recommendation to transition the site to a long-term monitoring program is based on multiple lines of evidence including data collected from soil, groundwater and surface water.

The reassessment focused on three PFAS source areas, namely:

- **Source Area 1** – Former Emergency Response Squadron (ERS) compound, where legacy aqueous film forming foam (AFFF) was stored and used.
- **Source Area 2** – Combat Service Support building, previously associated with vehicle maintenance.
- **Source Area 3** – Washdown bays and refuelling compound, also associated with AFFF use.

The reassessment also considered long-term monitoring data, updated risk assessments, and statistical trend analysis to understand the stability of PFAS concentrations and the potential for exposure.

The updated conceptual site model identified the following:

Primary Sources: No new PFAS sources were identified. Source Areas 1, 2 and 3 are the main PFAS sources at the base.

Secondary Sources: Secondary sources contributing to PFAS migration were found to include the following:

- PFAS-impacted soils were identified beneath interlocking pavers at Source Area 1, with sum of PFOS+PFHxS concentrations up to 0.532 mg/kg. However, these soils are located beneath hardstand surfaces and are considered inaccessible to receptors.
- Concrete pavements at Source Areas 1 and 3 were confirmed to contribute PFAS to surface water runoff, with an estimated annual mass discharge of ~28 grams and ~0.7 grams of PFOS and PFHxS, respectively.
- Sediments in drainage networks reported low levels of PFAS but are not considered a significant ongoing source under current conditions.

Pathways: Surface water runoff is the primary migration pathway for PFAS at the base. A strong hydraulic connectivity between surface water and groundwater is observed during the wet season, with the aquifer being recharged through infiltration, surface water/river leakage. In the wet season, groundwater rises to the surface in the south-eastern corner of the base and likely discharges to surface water, although recharge and discharge patterns vary between seasons. Groundwater contributes a negligible proportion to the overall discharge of PFAS from the base flux.

Receptors: Human health and ecological risks are considered low. Defence has restricted access to key areas such as the Close Training Area (CTA), and no potable or recreational use of groundwater or surface water occurs in impacted areas. Risks to ecological receptors in Milners Creek were evaluated using a conservative food-web model adapted from RAAF Base Darwin. Results indicated that PFAS concentrations are one to two orders of magnitude lower than those observed at RAAF Darwin, and risks to higher trophic species were therefore considered low and acceptable.

Key findings supporting transition to long-term monitoring include:

- All PMAP actions from 2018 have been completed or are ongoing.
- PFAS concentrations in soil, groundwater and surface water are stable or declining.
- No evidence of risks from off-site PFAS migration have been identified.
- PFAS concentrations are below human health guidelines, and ecological risks are low under current land use.
- The limited PFAS mass flux, impracticality of further remediation, and ongoing controls meet Defence's SFARP transition criteria.

Based on the above, it is recommended that active PFAS management at Robertson Barracks transition to "business as usual" monitoring in accordance with the current Ongoing Monitoring Plan (OMP). The OMP should continue to be implemented and reviewed, with integration into Defence's Regional Water Quality Monitoring Program. Opportunistic remediation may be considered during future redevelopment of impacted source areas, particularly Source Area 1.

This executive summary should be read in conjunction with the entirety of this report.

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ACRONYMS/ABBREVIATIONS

Per- and poly-fluoroalkyl substances (PFAS) and their acronyms

Perfluoroalkane sulfonic acids (PFSA)s

PFBS	Perfluorobutane sulfonic acid
PFPeS	Perfluoropentane sulfonic acid
PFHxS	Perfluorohexane sulfonic acid
PFHpS	Perfluoroheptane sulfonic acid
PFOS	Perfluorooctane sulfonic acid
PFDS	Perfluorodecane sulfonic acid

Perfluoroalkyl carboxylic acids (PFCAs)

PFBA	Perfluorobutanoic acid
PFPeA	Perfluoropentanoic acid
PFHxA	Perfluorohexanoic acid
PFHpA	Perfluoroheptanoic acid
PFOA	Perfluorooctanoic acid
PFNA	Perfluorononanoic acid
PFDA	Perfluorodecanoic acid
PFUnDA	Perfluoroundecanoic acid
PFDoDA	Perfluorododecanoic acid
PFTTrDA	Perfluorotridecanoic acid
PFTeDA	Perfluorotetradecanoic acid

Perfluoroalkyl sulfonamides

FOSA	Perfluorooctane sulfonamide
MeFOSA	N-Methyl perfluorooctane sulfonamide
EtFOSA	N-Ethyl perfluorooctane sulfonamide
MeFOSE	N-Methyl perfluorooctane sulfonamidoethanol
EtFOSE	N-Ethyl perfluorooctane sulfonamidoethanol
MeFOSAA	N-Methyl perfluorooctane sulfonamidoacetic acid
EtFOSAA	N-Ethyl perfluorooctane sulfonamidoacetic acid

(n:2) Fluorotelomer sulfonic acids

4:2 FTS	4:2 Fluorotelomer sulfonic acid
6:2 FTS	6:2 Fluorotelomer sulfonic acid
8:2 FTS	8:2 Fluorotelomer sulfonic acid
10:2 FTS	10:2 Fluorotelomer sulfonic acid

Acronyms/Abbreviations	Definition
AFFF	Aqueous film forming foam
CMF	Construction and Maintenance Framework
COV	Coefficient of Variation
CSR	Contaminated Sites Register
CTA	Close Training Area
Defence	Department of Defence
DCMM	Defence Contamination Management Manual
DoEE	Department of Environment and Energy
DSI	Detailed Site Investigation
ERA	Ecological Risk Assessment
ERS	Emergency Response Squadron
HEPA	Heads of Environment Protection Authority Australia and New Zealand
HHERA	Human Health and Ecological Risk Assessment
HIL D	Human Health Investigation Level D
LOR	Limit of reporting
MTR	Marksmanship Training Range
NEMP	PFAS National Environmental Management Plan
NT	Northern Territory
OH&S	Occupational health and safety
OMP	Ongoing Monitoring Plan
PMAP	PFAS Management Area Plan
PPMM	Pollution Prevention Management Manual
RAAF	Royal Australian Air Force
RAP	Remediation Action Plan
S	Mann-Kendall statistic
SBRS	Shoal Bay Receiving Station
SFARP	So Far As Reasonably Practicable
TDI	Tolerable daily intake
Tetra Tech Coffey	Tetra Tech Coffey Pty Ltd
UCL	Upper confidence limit
US EPA	United States Environmental Protection Agency

UNITS OF MEASUREMENT

Acronyms/Abbreviations	Definition
°C	degrees Celsius
µg/kg	micrograms per kilogram
L	litre(s)
m	metre(s)
m/year	metres per year
mm	Millimetre(s)
mg/L	milligrams per litre
mg/kg	milligrams per kilogram
m bgl	metres below ground level
mV	Millivolt(s)
µg	microgram(s)
µg/L	micrograms per litre
µS/cm	micro Siemens per centimetre

1. INTRODUCTION

Department of Defence (Defence) operate Robertson Barracks (the base) in Darwin, Northern Territory (NT). Defence engaged Tetra Tech Coffey Pty Ltd (Tetra Tech Coffey) to re-assess the nature and extent of per- and polyfluoroalkyl substances (PFAS) at and leaving Robertson Barracks.

The purpose of this letter is to provide a summary of this re-assessment, as well as Tetra Tech Coffey's recommendation active PFAS management at Robertson Barracks transition to "business as usual" ongoing monitoring in accordance with the Ongoing Monitoring Plan (OMP).

1.1 Background and purpose

A supplementary investigation (Tetra Tech Coffey, 2025a) was undertaken at Robertson Barracks in 2025 to address data gaps related to the nature and extent of PFAS contamination and refine an understanding of the risks on base, following a Site Review Assessment completed in 2024 (Tetra Tech Coffey, 2024). These additional works were designed to further characterise PFAS distribution at the base and assess whether remediation actions were warranted. Where risks to receptors are deemed low and acceptable, management of PFAS at the site will transition to "business as usual" monitoring and management, consistent with the approach used for other contaminants. This includes continued implementation of relevant actions in the PFAS Management Area Plan (PMAP), supported by institutional controls such as the PFAS Construction and Maintenance Framework (CMF) (Defence, 2025), Pollution Prevention Management Manual (PPMM) (Defence, 2023), and Defence Contamination Management Manual (DCMM) (Defence, 2021). A summary of previous investigations and management actions is provided in Table 1-1 below.

Table 1-1 Summary of previous investigation and management actions

Year	Description / Outcome
2018	A Detailed Site Investigation (DSI) was undertaken at Robertson Barracks in 2018 (Senversa, 2018a). Concentrations of perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS) were detected in soil, sediment, surface water and groundwater at concentrations exceeding PFAS National Environmental Management Plan (NEMP) 1.0 (2018) screening criteria. Exceedances were identified for indirect ecological receptors (soil), and for drinking and ecological receptors (surface water and groundwater). Tetra Tech Coffey note that NEMP 1.0 (2018) was the valid guideline at the time of this investigation. A review of the data confirms the same conclusions are drawn when comparing to the, updated, PFAS NEMP 3.0 (2025).
2018	In response to the DSI findings, a Human Health and Ecological Risk Assessment (HHERA) was undertaken (Senversa, 2018b). The HHERA concluded that PFAS levels in soil, sediment and groundwater were generally low and acceptable for site workers and terrestrial receptors. However, the HHERA identified potential risks for human consumers of finfish or crustaceans collected from the Southern Drainage Channel (immediately south of the base) and Milners Creek in the Close Training Area (CTA) (east of Thorngate Road). The HHERA also concluded that PFAS concentrations in surface water within Milners Creek could lead to biomagnification in the food chain in aquatic biota.
2018	Based on the findings of the DSI and HHERA, Defence implemented a PFAS Management Area Plan (PMAP) (Defence, 2018) outlining management strategies and monitoring requirements.
Post-2018	Since the implementation of the PMAP, Defence have conducted biannual monitoring of PFAS in surface water, groundwater and (until 2023) sediment undertaken at key locations as part of the Ongoing Monitoring Plan (OMP) for the base.

1.2 OBJECTIVES

The objective of this PMAP Transition report is to review the nature and extent of PFAS at the base to assess whether actions recommended under the PMAP have been completed so far as reasonably practicable and to assess whether further active management of PFAS at the base is warranted.

1.3 PMAP TRANSITION

In 2024, Defence developed the Defence PFAS Investigation and Management Program (PFASIM) Remediation So Far As Reasonably Practicable (SFARP) Guidance (Defence Remediation SFARP) (Defence, 2024), which outlines Defence's objectives for managing PFAS across the Defence estate. This guideline recognises that complete removal or treatment of all PFAS in the environment is neither technically feasible nor practicable. It sets out Defence's approach to determining what is considered "reasonably practicable" in the context of PFAS remediation and management and provides a framework for making SFARP determinations as to when further active management of PFAS at a base is no longer justified.

1.3.1 SFARP approach

The approach to determining whether remediation has been completed to SFARP involves drawing on multiple lines of evidence to demonstrate that undertaking active remediation – or continuing with further remediation – is not practicable or proportionate to the level of risk posed by PFAS contamination. An SFARP assessment should consider a range of specific factors, including:

- nature and extent of PFAS contamination
- level of risk to human and ecological receptors
- the site's hydrogeological and soil profiles
- surface water dynamics, including hydraulic behaviour and contaminant mass flux
- the stability and mass flux of any groundwater plume
- the availability and suitability of proven remediation technologies for the site
- logistical and operational constraints
- financial and sustainability considerations of remedial technologies

The Defence Remediation SFARP Guidance (Defence, 2024) outlines a stepwise approach for demonstrating that SFARP has been met and defines two pathways for transitioning to long-term management and monitoring. The first pathway applies where active remediation has been, or is being, implemented, and requires the preparation of a remediation options assessment, a remediation action plan (RAP), and a remediation completion report.

The second pathway applies where PFAS-related risks at a site are already considered low and acceptable in the absence of active remediation. In such cases, the PMAP may be transitioned to a "business as usual" ongoing monitoring approach *PMAP Transition Recommendation*. This recommendation must demonstrate that site conditions and associated risks are low and acceptable and be supported by evidence of the stability of PFAS contamination (including mass flux considerations) and the viability of managing any residual impacts.

The decision as to whether SFARP has been achieved at a site is determined by Defence's independent Technical Advisor.

1.3.2 Transition requirements

The Defence Remediation SFARP Guidance (Defence, 2024) outlines the process for transitioning site management from a PMAP to a “business as usual” ongoing monitoring approach, as well as information and lines of evidence required to demonstrate that SFARP has been achieved. As part of a PMAP transition recommendation, the lead consultant must demonstrate that all relevant actions identified in the PMAP have been completed or are no longer applicable. This must be supported by appropriate lines of evidence, such as ongoing monitoring data, remediation completion reports, and any additional human health or ecological risk assessments.

At Robertson Barracks, the PMAP developed by Defence in 2018 outlined specific response actions to manage and monitor PFAS as summarised, in Table 1-2.

Table 1-2 PMAP (2018) response actions

Action	Comments
Discontinue use of legacy aqueous film forming foam (AFFF) containing PFAS (3M Lightwater™ formulation) at the base	This action was confirmed as complete in 2018 (Defence, 2018)
Manage use of AFFF containing other PFAS (such as Ansilite formulation) for emergency response	This action was confirmed as complete in 2018 (Defence, 2018), with the use of PFAS-containing AFFF discontinued at the base.
Occupational health and safety (OH&S) measures for intrusive maintenance or construction workers to reduce potential exposure	This measure has been implemented in identified source areas. Given the low risks of PFAS exposure to construction and maintenance workers, additional controls beyond standard occupational hygiene practices are not considered necessary.
Restriction on groundwater abstraction within Robertson Barracks, CTA, and the southern drainage channel	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.
Implement OMP	The OMP has been implemented at the base since 2018.
Avoid accidental damage or destruction of groundwater monitoring wells included in the OMP	This is being undertaken through data management and Base Estate Management and Planning procedures.
Continue to implement construction management procedures	This action aligns with existing occupational health and safety measures that are routinely required on Defence projects as detailed in the PFAS CMF (Defence, 2025) and DCMM (Defence, 2021).
Reduce access to Milners Creek	Access restrictions to Milners Creek were implemented in 2019 through permanent fencing of the CTA.

All the actions outlined in the 2018 PMAP have either been completed, are no longer required, or continue to be implemented at the base. Notably, the PMAP did not include actions aimed at reducing the potential off-site migration of PFAS to reduce potential risks to human or ecological receptors. While the PMAP acknowledged potential for source control and pathway management, it concluded that such measures were unlikely to result in risk reduction and therefore were not considered further.

As a part of this PMAP transition recommendation, we have considered the practicability of source removal and pathway interception to reduce the mass of PFAS leaving the base, as well as re-evaluating the potential risks to relevant receptors.

1.4 Supporting information

In preparing this PMAP Transition Recommendation we have reviewed and assessed data included in the following reports:

- Coffey (2018) RAAF Darwin Ecological Risk Assessment
- Senversa (2018a) Detailed Site Investigation, Robertson Barracks.
- Senversa (2018b) Human Health and Ecological Risk Assessment, Robertson Barracks, Per- and Poly-fluoroalkyl Substances (PFAS) Investigations.
- Department of Defence (2018) Robertson Barracks PFAS Management Area Plan.
- AECOM (2021a) Interpretive Report 2020, PFAS OMP, Robertson Barracks.
- AECOM (2021b) Sampling Event Factual Report, November and December 2020, PFAS OMP, Robertson Barracks.
- AECOM (2021c) Sampling Event Factual Report, April 2021, PFAS OMP, Robertson Barracks.
- AECOM (2023) Sampling Event Factual Report, Dry Season 2023, PFAS OMP, Robertson Barracks.
- AECOM (2024) Ongoing Monitoring Report (November 2021 – March 2023), PFAS OMP, Robertson Barracks.
- Tetra Tech Coffey (2024) Robertson Barracks Site Review Assessment Report.
- Tetra Tech Coffey (2025a) Robertson Barracks, 2024 Supplementary Detailed Site Investigation.
- Tetra Tech Coffey (2025b) Robertson Barracks – Ongoing Monitoring Report.

2. SITE DESCRIPTION AND MANAGEMENT AREA

2.1 Site description

Robertson Barracks is located approximately 17 km east of Darwin central business district. The base comprises several distinct sub-areas, and nearby features of relevance, including:

- **Main Barracks Area** – This area includes residential accommodation areas, infrastructure, and buildings that support Defence units. A helicopter support facility is in the northern section of this area.
- **Close Training Area (CTA)** – Located east of Thorngate Road and the Main Barracks area, the CTA consists of open scrubland, several partially water-filled former quarries, Milners Creek, and various vehicle and other training infrastructure. The CTA is securely fenced, with access restricted to Defence personnel.
- **Marksmanship Training Range (MTR)** – Situated to the north of the Main Barracks, the MTR comprises open bushland and a designated shooting range. The MTR is securely fenced, and accessible only to Defence personnel.
- **Shoal Bay Receiving Station (SBRS)** – Approximately 4.5 km north of the base, the SBRS is not associated with the base but does extract groundwater for drinking water purposes.

The Management Area defined in the PMAP (Defence, 2018) covers approximately 615 hectares and includes both the Main Barracks and western portion of the CTA, as shown in Figures 1-3, Appendix A.

The Management Area is located within the monsoonal tropics of northern Australia, characterised by two distinct seasons: a warm, dry season from approximately May to September, and a hot, wet season from approximately October to April, during which most rainfall occurs, often accompanied by monsoonal activity and tropical cyclones.

To the north and northeast of the base lie Milners Swamp and Noogoo Swamp – permanent, freshwater systems that support significant breeding populations of waterbirds. Portions of these swamps may dry out and become discontinuous during the dry season.

Land surrounding the base is predominantly Commonwealth-owned, with no privately owned rural residential homes within a one-kilometre radius.

2.2 Geology

The area is underlain by Bathurst Island Formation which in turn overlies the Wildman Siltstone Formation. An outcrop of the Acacia Gap Quartzite Member is also present within the CTA.

Overlying the Bathurst Island Formation are Quaternary and Tertiary aged colluvial and alluvial deposits, comprising claystones, sandstones, and basal conglomerate, with thicknesses of up to 50 metres.

The Wildman Siltstone Formation comprises siltstone and sandstone with minor quartzite and is inferred to occur at depths ranging from approximately 50 metres to over 1,000 metres below ground level (m bgl).

The Acacia Gap Quartzite Member comprises quartzite and is limited to the CTA. Quarrying/mining areas within the CTA largely coincide with the Acacia Gap Quartzite deposits.

2.3 Surface water and groundwater

Robertson Barracks is in the Kings Creek Catchment, which drains northward into Shoal Bay, situated northeast of Darwin Harbour. Part of the base is located on a wetland area which extends west of the Main Barracks. The wetland drains south along the western boundary into the southern drainage channel, which discharges into the southern tributary of Milners Creek, located east of the base within the CTA.

Within the Main Barracks, multiple lined and unlined drainage lines follow local topography, diverting surface runoff through and off the base into perimeter drainage channels. These drainage lines discharge into one of two tributaries of the Milners Creek system. The tributaries converge within the CTA, and Milners Creek flows northeast into Milners Swamp. These tributaries are ephemeral in places dependent on recent rainfall events and groundwater levels. Flow from Milners Swamp continues into Kings Creek, which partially transitions through Noogoo Swamp before discharging into Shoal Bay.

Groundwater beneath the base is contained with the Bathurst Island Formation, consisting primarily of alluvial deposits. Groundwater levels range from approximately 10 m bgl during the dry season to near-surface levels in the latter parts of the wet season.

A strong hydraulic connection between groundwater and surface water is observed during the wet season, with the aquifer being recharged via infiltration from rainfall, flooding, water, and river leakage. In some areas, the upper aquifer discharges to nearby watercourses, with recharge and discharge patterns varying seasonally.

Monitoring wells have been installed in both upper and lower sections of the Bathurst Island Formation. In monitoring wells installed within the lower part of the aquifer (approximately 27 to 30 m bgl), groundwater levels ranged from 1.45 to 7.28 m bgl, indicating a semi-confined aquifer system. Review of hydraulic gradients of shallow and deep well pairs suggest hydraulic connectivity. Across the base, groundwater gradients are generally consistent, ranging between 0.0116 and 0.0138 m/m.

Groundwater flow direction in the northern and central portions of the base is inferred toward the east-northeast. In the southern portion, flow is inferred to the south-southeast, likely influenced by the southern drainage channel discharging into Milners Creek.

The average calculated seepage velocity for the upper Bathurst Island Formation aquifer ranges from approximately 46 m/year during the dry season to 77 m/year during the wet season. In contrast, seepage velocities in the lower, more competent siltstone layers of the aquifer are estimated at approximately 2 m/year.

2.4 PFAS Sources

Five potential PFAS source areas were initially identified during the 2018 DSI investigation; however, two of these were later discounted due to lack of significant PFAS impacts. The primary source of PFAS at the base was associated with historical use of PFAS-containing AFFF. Senversa (2018a) concluded that the most significant PFAS impacts were associated with areas where legacy AFFF was used, including areas of historical firefighting foam testing, repeated refilling points, and storage areas used for legacy foam solutions.

Key PFAS sources areas identified in the DSI (Senvorsa, 2018a) and confirmed in the Supplementary DSI (Tetra Tech Coffey, 2025) include:

- **Source Area 1:** Former Emergency Response Squadron (ERS) compound (Building 137)
- **Source Area 2:** Combat Service Support Building
- **Source Area 3:** Wash down bays and refuelling compound

Two areas initially identified but subsequently ruled out as significant sources were:

- The current ERS compound, located in the south-west corner of the Main Barracks, where AFFF foam concentration was stored
- The Aviation helipad area, where AFFF extinguishers were located for emergency use

Soil, groundwater surface water and sediment testing conducted in these two areas reported negligible PFAS impacts.

2.5 Pathways for PFAS migration

The following pathways for PFAS migration have been identified at the base:

- Leaching from soils and concrete pavements in source areas, with subsequent migration via surface water runoff
- Leaching from soils and concrete into groundwater, followed by horizontal transport with the direction of groundwater flow

Shallow (less than 1 m deep), perched groundwater flow is likely to occur during latter parts of the wet season, where groundwater preferentially moves through the laterised upper portion of the soil profile (within Bathurst Island Formation) and discharges into drainage lines where the drain is incised into the laterite. However, this pathway is considered to contribute only a limited PFAS mass flux. The predominant mechanism for PFAS migration from source areas is via surface water runoff directly to nearby drains.

This conclusion is supported by several factors: the short flow distances from the source areas to surface water drains (less than 10 metres), the presence of pavement across most of the source areas which limits infiltration, and the relatively low PFAS concentrations seeping from the laterite compared to those detected in adjacent surface water drains (Tetra Tech Coffey, 2025). As a result, perched groundwater flow path has been excluded as a significant pathway for PFAS migration.

2.6 Receptors

Potential receptors of PFAS contamination have been identified in the HHERA based on the site's setting and the current land use. The following human and ecological receptors are considered relevant at the base:

- Current and future 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 are no longer considered relevant.

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

2.7 Screening Criteria

The assessment of risks to receptors has been undertaken by comparing soil, groundwater and surface water concentrations against Tier 1 screening criteria set out in the *PFAS NEMP 3.0* (Heads of Environment Protection Authority Australia and New Zealand (HEPA), 2025). A summary of screening criteria adopted for each media are provided below.

2.7.1 Soil and sediment

PFAS NEMP 3.0 (2025) *Human Health Investigation Level D (HIL D)* has been adopted given that the PFAS-impacted areas correspond to industrial-type land-use.

PFAS NEMP 3.0 (2025) *Ecological (direct exposure)* criteria has also been applied, as it specifically relates to the protection of organisms that live within, or in close contact with, soil. While *Ecological Indirect Exposure* criteria is available to assess potential bioaccumulation and biomagnification through the food chain, its application in this context is considered overly conservative. The majority of PFAS-impacted soils are located within paved or hardstand areas with little to no ecological value, and thus potential for food chain transfer to secondary consumers is considered minimal.

In accordance with PFAS NEMP 3.0 guidance, a higher-value screening criteria as been adopted for these source areas, where more than 80% of each impacted hectare is covered by hard surfaces (e.g., pavement, concrete or compacted hardstand). As a result, *Ecological Indirect Exposure* 0.14 mg/kg for PFOS has been adopted for the assessment of source area soils.

Although PFAS NEMP 3.0 (2025) does not provide specific screening criteria for sediments, *Ecological Indirect* criteria for soil has been adopted to appraise PFAS sediment concentrations. This is considered an appropriate and conservative approach, given that most sediments within drainage lines and sampling locations are dry for the majority of the year and not representative of persistent sub-aqueous conditions. Soil screening levels are summarised in Table 2-1 below.

Table 2-1 Soil screening levels

Analyte	Ecological (direct exposure) (mg/kg)	Ecological (indirect exposure – source areas) (mg/kg)	Ecological (indirect exposure) (mg/kg)	Human Health Commercial (Health Investigation Level (HIL D) – (mg/kg)
PFOS	1	0.14	0.003	20
PFHxS	-	-	-	
Sum of PFOS+PFHxS	-	-	-	
PFOA	10	0.14	0.003	50

Notes: “-“ No PFAS NEMP 3.0 criteria available and/or relevant.

2.7.2 Groundwater

Groundwater results at the base have been assessed against screening criteria adopted from *PFAS NEMP 3.0 (2025)* for protection of ecological receptors (99% species protection), as well as for recreational water uses and drinking water uses. It is noted, however, that groundwater in areas impacted by PFAS at the base is not currently used for recreational or potable water purposes. Groundwater screening levels are summarised in Table 2-2 below.

Table 2-2 Groundwater screening levels

Analyte	Maintenance of Ecosystems (Modified Ecosystems) Freshwater (µg/L)	Recreational Use (µg/L)	Drinking Water (µg/L)
PFOS	0.00023 (99%)	2	0.07
PFHxS	-		
Sum of PFOS+PFHxS	-		
PFOA	19 (99%)	10	0.56

Notes: "-" No PFAS NEMP 3.0 criteria available and/or relevant.

2.7.3 Surface water

Relevant screening criteria for recreational water quality and ecosystem protection have been sourced from *PFAS NEMP 3.0 (2025)*. Surface water at the site and at downstream discharge locations is considered part of the freshwater system connected to Milners Creek. Accordingly, surface water results have been assessed against freshwater ecosystem protection criteria.

The Southern Drainage Channel and man-made drainage lines within the base are constructed features and therefore considered highly disturbed systems. In line with PFAS NEMP 3.0 guidance, 90% species protection criterion has been applied to these drainage systems. Other surface water bodies at the site are considered slightly to moderately modified, for which 95% species protection level would typically apply. However, due to the bioaccumulative and biomagnifying properties of PFAS, 99% species protection level has been adopted in accordance with the precautionary approach recommended in PFAS NEMP 3.0.

Surface water screening levels are summarised in Table 2-3 below.

Table 2-3 Surface water screening levels

Analyte	Maintenance of Ecosystems (99% species protection) Freshwater (µg/L)	Maintenance of Ecosystems (90% species protection) Freshwater (µg/L)	Recreational Use (µg/L)
PFOS	0.00023	2	2
PFHxS	-	-	
Sum of PFOS+PFHxS	-	-	
PFOA	19	632	10

Notes: "-" No PFAS NEMP 3.0 criteria available and/or relevant.

3. RESIDUAL IMPACT

A review of PFAS concentrations in soil, groundwater, surface water and sediment collected during the 2018 DSI (Senversa, 2018a) and subsequent monitoring events (as detailed in Table 1-1, Section 1.1) was undertaken to summarise the nature and extent of PFAS at the base and to assess potential risks to receptors from residual contamination.

PFAS-impacted soil (those with concentrations exceeding adopted screening criteria) are largely confined to, or immediately surrounding, three identified source areas (refer Section 2.4). Impacts to surface water, sediment and groundwater are discussed for each source area individually; however, groundwater and surface water impacts extend downstream or down gradient and are discussed further in Section 3.2 and 3.3 respectively.

Historical tabulated analytical results are provided in Appendix B.

3.1 Source areas

3.1.1 Source Area 1 – Building 137

This source area comprises a fenced compound (approximately 1.1 hectares) formerly used by ERS. It includes a large open-sided shed with a concrete floor and is otherwise paved with interlocking concrete pavers. ERS activities here included maintenance of firefighting vehicles, involving draining and testing of equipment containing AFFF.

Soil:

PFAS has been detected in soils beneath paved areas, with minor detections in shallow soils outside the compound. The extent of PFAS concentrations reported in soils at Source Area 1 is presented on Figures 3a and 3b, Appendix A.

PFAS in soils is largely reported within the top 1 m of soils, which comprise a gravelly fill (0.2 m thick) overlying a lateritic iron-cemented clayey gravel that ranges in thickness between 0.5 to 2 m thick. Concentrations of the sum of PFOS+PFHxS in soils at Source Area 1 ranged between <0.0002 to 0.532 mg/kg.

The soil sampling results indicated that the majority of PFAS was present in the shallow fill immediately below the pavers on the site and generally was vertically delineated within 0.5 m of the surface. PFAS was identified in deeper soils at several locations and was not fully delineated vertically at two locations as presented in Figure 3b, Appendix A, and Table 3-1 below.

Table 3-1 Sum of PFOS+PFHxS at soil sampling locations with deeper PFAS detected

Depth (m)	BH248 (Sum of PFOS+PFHxS mg/kg)	BH256 (Sum of PFOS+PFHxS mg/kg)
0.08	<0.005	<0.005
0.23	<0.005	<0.005
0.4	NA	<0.005
1	<0.005	NS
1.25	NA	<0.005
1.75	<0.005	NA
2.0	NA	0.011 (end of hole)
3.25	0.0098	NS
4.25	0.0051	NS
4.45	NA	NS

Notes: "NA" – No sample was analysed at this depth, "NS" – No sample was collected at this depth.

The locations where PFAS was not delineated vertically were in the eastern half of the site and towards the base of the clay or at the top of the siltstone. Whilst vertical delineation of PFAS was not achieved at two locations at Source Area 1 (BH248 and BH256, as summarised in Table 3-1), the concentrations were low and generally decreasing with depth at all other locations, and do not suggest that significant PFAS is present at depths in the source area.

The extent of PFAS in soils at Source Area 1 is not delineated (to below the laboratory reporting limits of 0.005 mg/kg) to the west, and is partially delineated to the north, south and east – noting that PFAS was measured in soils to the east of the source area where surface water discharges (Senversa, 2018).

The concentrations of PFAS are below the adopted screening criteria for protection of human health in all soil samples at Source Area 1.

The lateral extent of PFAS has been delineated to below the adopted Ecological Indirect Source Area screening criteria. Only one location (BH254), situated beneath the southern paved area of the compound, reported PFOS concentrations above the adopted Ecological Indirect (source area) screening criteria at depths of 0.08 and 0.2 m bgl. As this location lies beneath intact pavement, it is considered inaccessible to sensitive ecological receptors. All other sampling locations reported concentrations of PFOS below Ecological Indirect (source area) screening criterion and all other applicable criteria.

The mass of PFAS in soils at source area is estimated to be between 0.25 to 0.36 kg sum of PFOS+PFHxS, and 0.26 to 0.4 kg Total PFAS (Tetra Tech Coffey, 2025).

Groundwater

Sum of PFOS+PFHxS concentrations in groundwater at Source Area 1 ranged from 0.33 to 1.64 µg/L in wells within the source area compound (MW066 and MW067). The concentrations of PFAS in wells MW066 and MW067 exceed the screening criteria for drinking water, and also above the adopted ecosystem protection (99% freshwater) screening criteria, but were below the recreational (primary contact) screening criteria. Groundwater is not used on the base for drinking water purposes.

The groundwater sum of PFOS + PFHxS impacts decrease to concentrations below or near the laboratory reporting limits (<0.01 to 0.03 µg/L) 300 m down-gradient (east-northeast) at wells MW021 and MW021D. Given the decrease in concentrations between the source area wells and the down-gradient wells, it is expected that the concentrations would further decrease to below the adopted screening criteria (via advection, dispersion, dilution and retardation effects along the groundwater flow path) prior to discharge to Milners Creek (approximately 750 m down-gradient of Source Area 1).

Surface Water

Surface water runoff testing collected from pavements within the compound reported sum of PFOS+PFHxS concentrations from 0.22 to 4 µg/L (Figure 4a, Appendix A).

The highest concentrations were at locations SW207 (4 µg/L), which is on the northern apron near the northern fence line, and SW209 in the south-western apron (1.78 µg/L). These two sampling points were located in areas where it appeared that fluids had drained across the site (as evidenced by lighter discoloration on the pavers). The other two sampling points (SW208 – north-eastern site apron, and SW210, south eastern apron) reported concentrations of sum of PFOS+PFHxS approximately an order of magnitude lower (0.22 and 0.31 µg/L respectively).

The surface water from SW207 flowed towards the north and where it didn't infiltrate into the gaps between the pavers, would flow off the pavement to the north, draining along a shallow swale drain to the east prior to discharging to the main swale drain to the north near the north-eastern corner of the compound.

The surface water from SW209 (which is near BH254, which reported the highest concentrations of sum of PFOS+PFHxS in soil) flowed to the south towards the southern fence line.

A small shallow swale drain (approximately 0.3 to 0.5 m wide and 0.3 m deep) was present immediately outside of the compound fence line and collected and directed surface water away from the compound. Any surface water discharging beyond the compound fence line would be collected in this drain and directed to either the northern swale drain, or the swale drain on the south-eastern corner of the area (which discharges into the adjacent treed area to the east).

In the adjacent drain (north of the compound), concentrations of sum of PFOS+PFHxS ranged from <0.01 to 0.14 µg/L. These were below both ecosystem protection criteria (for highly disturbed systems) and recreational water quality criteria; they exceed drinking water criteria, though surface water is not used for potable water supply.

The highest concentrations of sum of PFOS+PFHxS were recorded near the northern and southern fence lines, where pavement gradient causes water to accumulate. Surface water in the compound also infiltrates between the gaps in pavers and infiltrates into soils beneath the compound paving.

The concentration of sum of PFOS+PFHxS in the surface water runoff are approximately the same order of magnitude or an order of magnitude higher than the concentrations measured in the northern swale drain. It is considered that the sum of PFOS+PFHxS (and other PFAS compounds) measured in the runoff are contributing to the overall flux of PFAS discharging in surface water from the source area.

The estimated PFAS mass leaving the source area from the pavement in surface water was estimated to be approximately 28 grams per year (g/year) of sum of PFOS+PFHxS and 48.8 g/year Total PFAS (Tetra Tech Coffey, 2025).

Surface water from Source Area 1 enters a swale drain immediately to the north (10 m) of the ERS compound and flows to the east and crosses beneath Thorngate Road into the CTA before flowing into Milners Creek. Discussion on the results of additional samples collected further down-stream is provided in Section 3.3.

The surface water discharging from source area 1 contains concentrations of PFAS compounds that are below the ecological screening criteria relevant for the drainage line and not expected to impact on ecological receptors in the drain. The concentrations are also below the recreational water quality criteria and unlikely to impact on the health of site users. The concentrations of PFAS are above the drinking water criteria, but surface water is not used for potable water on the base.

Sediment

Concentrations of sum of PFOS in sediments in the drainage lines around Source Area 1 ranged between <0.0002 to 0.0319 mg/kg, with the highest concentrations measured at locations SD050, SD051 and SD052 located to the east of the source area. Concentrations of PFOS at these locations are below Ecological

Indirect (source area) soil screening criteria and considered unlikely to impact on ecological receptors. The concentrations are also below the human health screening criteria and unlikely to impact on the health of site users.

3.1.2 Source Areas 2 and 3

These adjacent source areas (located in the southern part of the base) were both associated with ERS vehicle storage and maintenance and have therefore been considered together.

Soil

At Source Area 2, PFAS (PFOS, PFHxS and Total PFAS) concentrations were below laboratory reporting limits (0.0002 mg/kg) in all but one surface sample (0.0003 mg/kg PFOS), which is below all screening criteria (human health and ecological direct and indirect).

At Source Area 3, concentrations of sum of PFOS+PFHxS ranged between 0.0008 to 0.0139 mg/kg in soils surrounding the paved area. No soil samples were collected from beneath the concrete pavement, which was observed to be in good condition with no noticeable cracking, damage, or other signs of degradation.

The concentrations of sum of PFOS+PFHxS were all below the adopted human health (HIL-D) screening criteria. The concentrations of PFOS were all below the adopted Ecological Direct Contact screening criteria (1 mg/kg).

Within the portion of Source Area 3 which comprises pavements and hardstands, the concentrations of PFOS were all below the *Ecological Indirect – Source Area* screening criteria (0.14 mg/kg). Outside of the pavement and hardstand areas, only one location (BH088, located in the south-eastern corner of the base, but outside of the security fence line) reported a concentration of PFOS above the *Ecological Indirect* screening criteria (0.003 mg/kg), with a concentration of 0.0072 mg/kg. All other sampling locations reported concentrations of PFOS below the *Ecological Indirect* screening criteria. Overall, the concentrations of PFAS in soils are not considered to impact on ecological or human receptors in this area of the base.

Due to low concentrations and sparse detections, PFAS mass in soil is considered negligible and has not been calculated.

Groundwater

At Source Area 2, concentrations of sum of PFOS+PFHxS ranged from <0.01 to 0.44 µg/L (MW004), declining to below laboratory reporting limit approximately 200 m downgradient (MW031). At Source Area 3, concentrations of sum of PFOS+PFHxS ranged from <0.01 to 0.4 µg/L (MW030 on the south-eastern boundary of the site).

The concentrations of PFOS in groundwater at Source Areas 2 and 3 exceeded the Ecological (99%) screening criterion (0.00023 µg/L). This criterion is relevant where groundwater emerges to a surface water body. Groundwater discharge to surface water is not expected across most of the base, except near wells MW001 and MW030 in the south-east, where groundwater levels rise to the base of the southern drainage channel at the end of the wet season. Concentrations of PFOS and sum of PFOS+PFHxS in groundwater at these wells exceed both the Ecological (99%) and drinking water criteria but remain below the Ecological (90%) and recreational water quality criteria. Given discharge is to the highly disturbed Southern Drainage Channel, application of the 90% species protection criterion (2 µg/L) is considered more appropriate for these locations, and consequently, the concentrations of PFAS in groundwater (that discharges to the Southern Drainage Channel) are below the adopted ecosystem protection criteria.

Overall the concentrations of PFAS in groundwater are not considered to impact on ecological or human receptors.

Surface water

Surface water sampling has not been conducted at Source Area 2 due to the absence of observable surface water (drainage is via underground pipes). Surface water from Source Area 2 is inferred to discharge to the southern drainage channel – combined with surface water from Source Area 3, or to Milners Creek to the east.

At Source Area 3, surface water sampling at washdown bays and the nearby stormwater detention pond (to the south) reported sum of PFOS+PFHxS concentrations of 0.04 to 0.17 µg/L. The highest concentration was reported in the washdown bay sump. Surface water runoff sampling from concrete reported sum of PFOS+PFHxS concentrations ranging of 0.02 to 0.03 µg/L (Figure 4b, Appendix A). Surface water from the concrete pavement discharges to the southern drainage channel, either via the stormwater detention basin to the south of the area, or via open swale drains to the east and west of the area.

Surface water monitoring in drains leading to the Southern Drainage Channel (SW001, SW002 and SW003) reported sum of PFOS+PFHxS concentrations ranging between 0.01 to 0.09 µg/L, with concentrations in the Southern Drainage Channel between 0.01 to 0.13 µg/L.

These concentrations were all below Ecological (90%) and Recreational criteria; they exceed drinking water criteria, though water is not used for this purpose.

PFAS mass discharging from Source Area 3 from pavement in surface water was estimated to be approximately 0.7 g/year of sum of PFOS+PFHxS and 10 g/year of Total PFAS (Tetra Tech Coffey, 2025).

The PFAS composition profile in surface water runoff from Source Area 3 differed to that from Source Area 1, with higher levels of perfluoroalkyl carboxylic acids (e.g., perfluoro butanoic acid (PFBA), perfluoro hexanoic acid (PFHxA)), suggesting a different AFFF product (e.g., Ansulite) and a more recent usage.

The surface water discharging from source areas 2 and 3 contains concentrations of PFAS compounds that are below the ecological screening criteria relevant for the drainage lines and are unlikely to impact on ecological receptors in the drains. The concentrations are also below the recreational water quality criteria and unlikely to impact on the health of site users. The concentrations of PFAS are above the drinking water criteria, but surface water is not used for potable water on the base.

Sediment

Concentrations of sum of PFOS+PFHxS in sediments in drainage lines around and down-stream from Source Area 3 ranged between <0.0002 to 0.0111 mg/kg as presented in Figure 3c, Appendix A. The concentrations of sum of PFOS+PFHxS in sediments were below the adopted human health screening criteria in all samples.

All sediment sampling locations reported concentrations of PFOS below the *Ecological Direct Contact* screening criteria (1 mg/kg).

All sediment sampling locations with the exception of SD094 (0.0111 mg/kg) and SD095 (0.0076 mg/kg), both of which are located to the south-east of Source Area 3 just prior to the discharge to the Southern Drainage Channel, reported concentrations of PFOS below the adopted *Ecological Indirect* screening criteria (0.003 mg/kg), and considered unlikely to impact on ecological receptors. The concentrations are also below the human health screening criteria and unlikely to impact on the health of site users.

3.2 Groundwater

PFAS in groundwater at the base is present within upper portions of the Bathurst Aquifer, within and down-gradient of the three source areas, as well as in two groundwater bores on the north-eastern boundary of the Main Barracks that are not associated with any known PFAS source area.

3.2.1 Groundwater flow directions

Groundwater at the base was initially reported as flowing to the northeast in the northern portion of the base with a southerly component in the far south (Senversa, 2018a). However, monitoring since the DSI has shown that groundwater consistently flows to the northeast across the base, with an easterly flow observed in the south-eastern corner. The most recent groundwater contour plans from 2025 (presented as Figure 8, Appendix A) confirm predominant east and northeast flow directions.

3.2.2 PFAS plume extent

PFAS (primarily PFOS and PFHxS) have been consistently detected in groundwater within and down-gradient of the three source areas, as well as in two groundwater wells (MW034 and MW032) located in the northern portion of the base on either side of Thorngate Road (refer to Figure 6, Appendix A). The PFAS plume is largely located in the eastern portion of the Main Barracks area and extends a short distance into the CTA, within the management area boundary. The lateral extent has been delineated to concentrations below laboratory reporting limits.

No PFAS has been detected in boundary wells along the western portion of Robertson Barracks, indicating that groundwater entering the base from up-hydraulic gradient is not impacted.

PFAS is primarily present in the upper portion of the Bathurst Island Aquifer. The deeper wells at Source Area 2 (MW004D) reported concentrations below reporting limits in all but one monitoring round (October 2023). Monitoring well MW21D (in the CTA) has occasionally reported PFOS at laboratory reporting limit (February 2018 and March 2024), although the initial sampling event in February 2018 may have been indicative of cross contamination introduced during drilling.

Based on this data, the vertical extent of PFAS is limited to the upper 10 m of the aquifer.

Groundwater samples from the SBRS bores have not reported PFAS above laboratory reporting limits. These wells are screened within the deeper Wildman Formation aquifer, approximately 4 km north of the base and at least 6 km north of the closest impacted well (MW034). The Wildman Formation Aquifer is not impacted by PFAS.

3.2.3 PFAS plume stability

PFAS concentrations in groundwater have remained stable or shown decreasing trends across the monitoring period (2017 to 2024) within source areas. Linear regression R^2 values are presented in the graphs included within this section, and Mann-Kendall outputs discussed are presented in Appendix C. Where a result is below the limit of reporting (LOR), half the LOR value has been used for the Mann-Kendall analysis.

3.2.3.1 Source Area 1

A graph showing sum of PFOS+PFHxS concentrations with linear regression analysis in Source Area 1 (MW066) is presented in Chart 3-1.

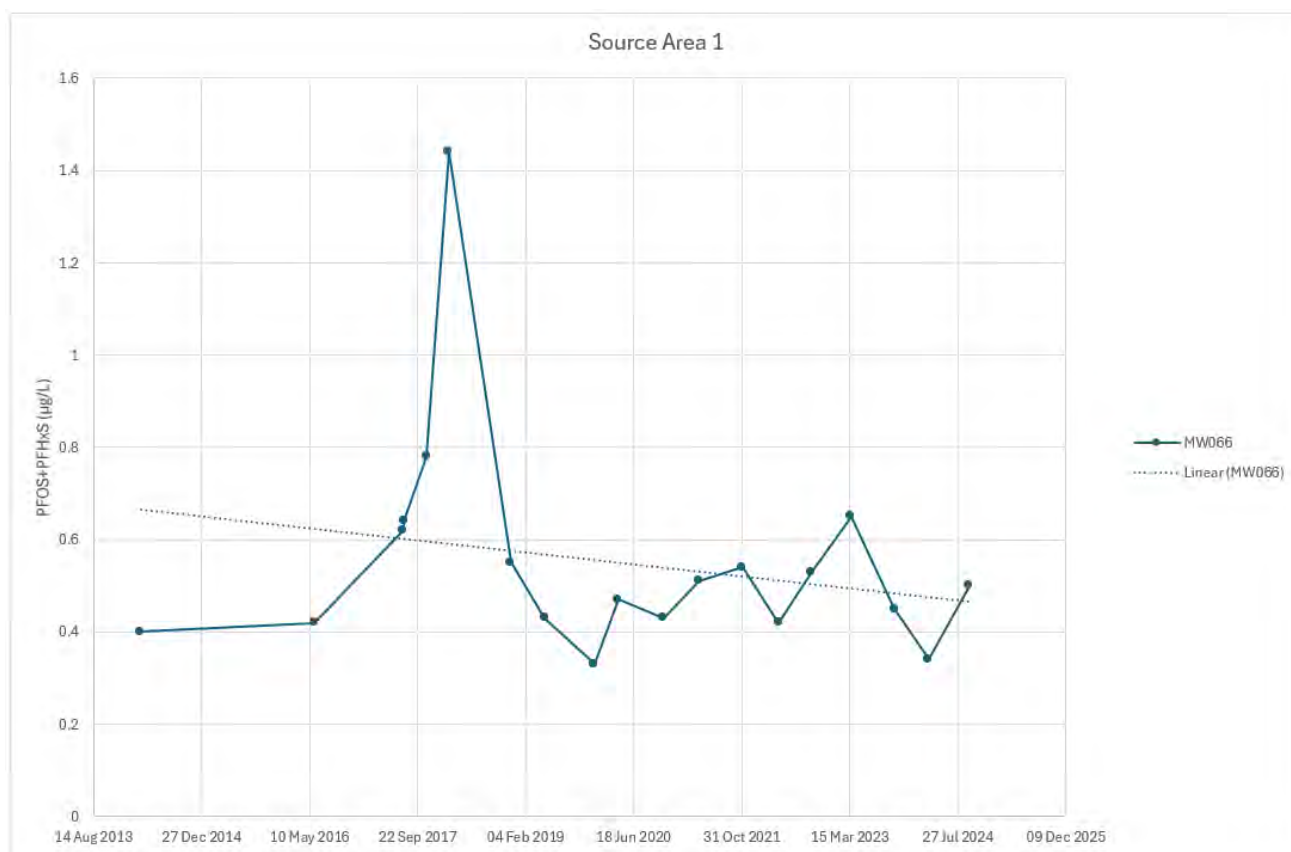


Chart 3-1 Sum of PFOS+PFHxS concentrations in groundwater at Source Area 1

Mann-Kendall analysis for MW066 returned a Mann-Kendall Statistic (S) of -13 and a Confidence Factor of 66.1%, with a Coefficient of Variation (COV) of 0.44. These results indicate a low level of variability in concentrations and a weak downward trend that does not meet the threshold for statistical significance, supporting a classification of 'Stable'. Complementary linear regression analysis of the same dataset shows a slightly negative slope with an R^2 of 0.0513, indicating that less than 6% of the variation in concentrations is explained by a linear trend. This low R^2 confirms that although concentrations have declined from a peak in 2018, the data do not exhibit a consistent or strong downward trend. Together, the statistical and graphical lines of evidence support the interpretation that sum of PFOS+PFHxS concentrations at MW066 have remained relatively stable over time, with no clear indication of a new or increasing source.

3.2.3.2 Source Areas 2 and 3

A graph showing sum of PFOS+PFHxS concentrations with linear regression analysis in Source Areas 2 and 3 (MW001, MW004, MW030 and MW060) is presented in Chart 3-2.

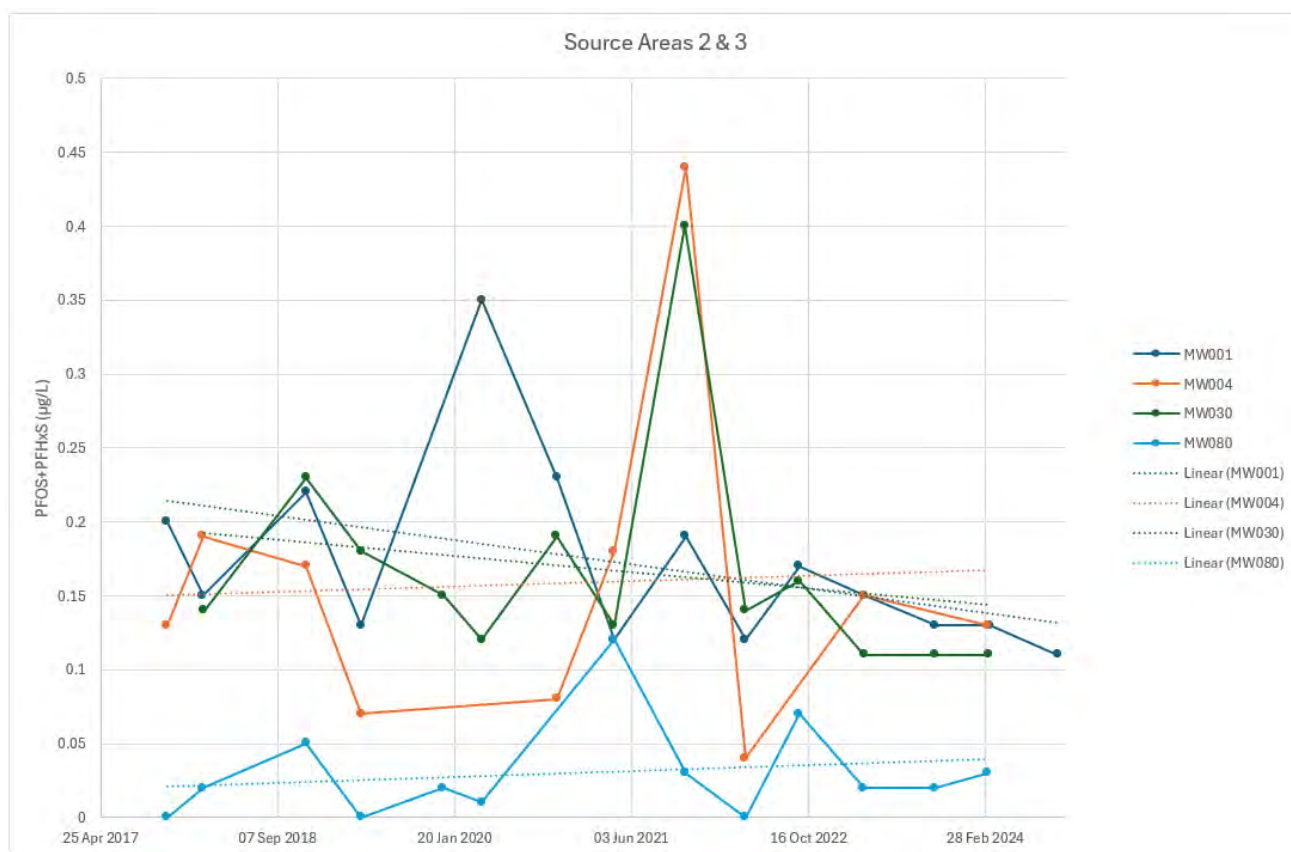


Chart 3-2 Sum of PFOS+PFHxS concentrations in groundwater – Source Areas 2 & 3

Trend analysis across four key wells shows a mix of statistically supported decreasing trends and wells with no meaningful directional change. MW001 exhibited the clearest declining trend, with a Mann-Kendall statistic (S) of -38 and a Confidence Factor of 97.9%, confirming a statistically significant decrease in sum of PFOS+PFHxS concentrations over time. The data show low variability (COV = 0.38), and linear regression returned a negative slope with an R^2 of 0.1758, indicating that approximately 17% of the variation in concentration is explained by the regression model. This provides two consistent lines of evidence supporting a sustained decline in PFAS concentrations at this location.

MW080 similarly showed a statistically significant decreasing trend, with an S value of -30 and a Confidence Factor of 96.2%, also above the 95% threshold. While the Coefficient of Variation was moderate (COV = 0.47), the linear regression slope was again slightly negative, with an R^2 of 0.0353. Although this R^2 indicates that little of the variation is explained by a linear model, the Mann-Kendall result provides robust evidence of a downward trend, particularly in light of the early increases observed during the DSI phase.

In contrast, MW004 showed a Mann-Kendall S of -4 with a Confidence Factor of 60.3%, well below the threshold needed to support a clear trend. With a moderate COV of 0.7 and a low R^2 of 0.0027 from linear regression, the evidence points to a stable condition at this well. While a concentration spike occurred in 2021 - likely related to low groundwater levels - this does not appear to reflect a sustained trend, and concentrations have since returned to consistent levels.

MW030 also showed no statistically significant trend, with a Mann-Kendall S of 216 and Confidence Factor of 81.6%. The Coefficient of Variation was relatively high (COV = 1.05), and the linear regression trend line had a near-zero slope and R^2 of only 0.0386, indicating that the concentration variation is largely random. Together, these lines of evidence suggest that sum of PFOS+PFHxS concentrations at MW030 are likely due to natural variability or external factors, rather than a meaningful upward or downward trend.

3.2.3.3 Northern boundary wells

A graph showing sum of PFOS+PFHxS concentrations with linear regression analysis in the northern base boundary wells (MW032 and MW034) is presented in Chart 3-3.

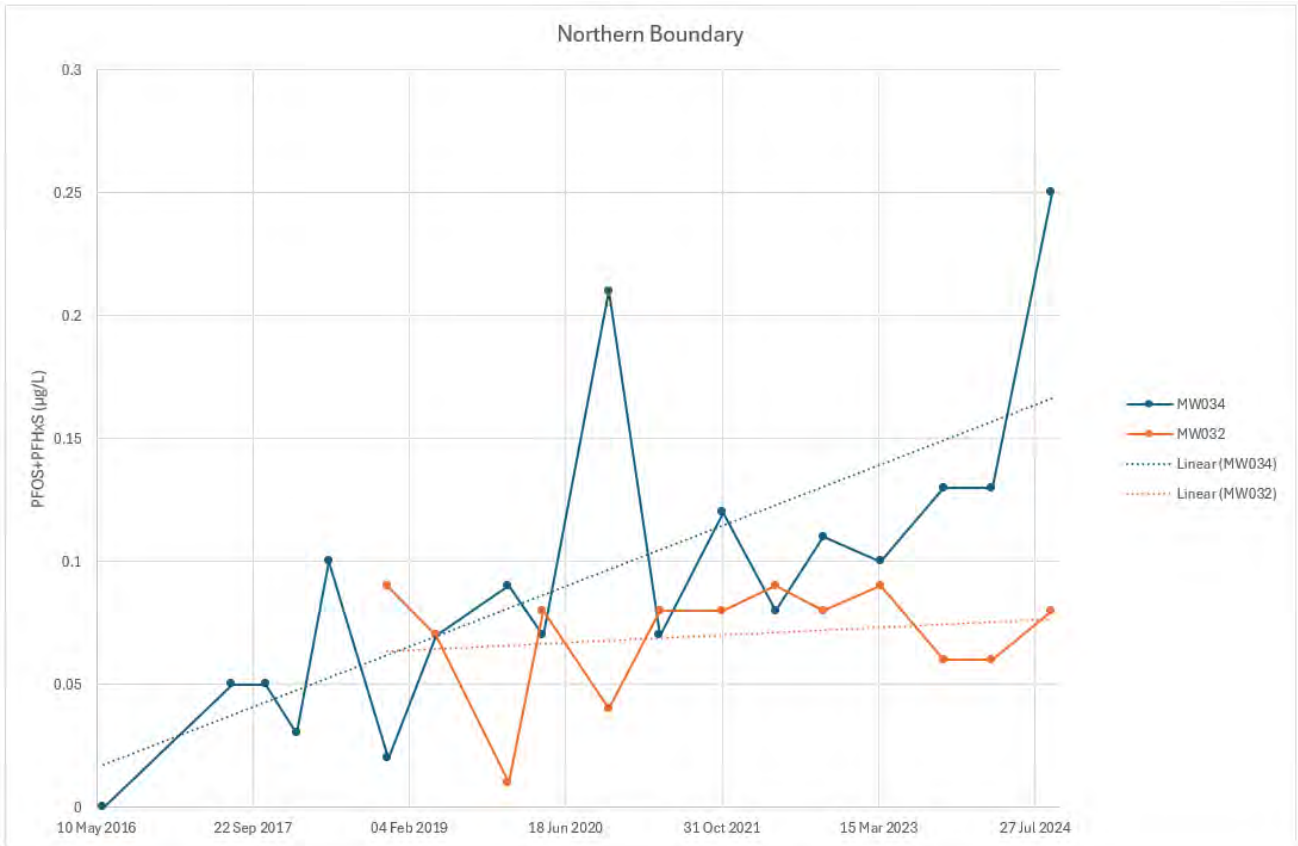


Chart 3-3 Sum of PFOS+PFHxS in northern boundary groundwater wells

In the northern portion of the base, PFAS has been detected in wells MW034 and MW032, which are located on either side of Thorngate Road. The source of contamination in this area is currently unclear. MW034 shows a clear increasing trend, supported by a Mann-Kendall statistic (S) of 80 and a Confidence Factor exceeding 99.9%, with a moderate COV of 0.6. Linear regression further reinforces this trend, with a positive slope and an R^2 of 0.5251, indicating that nearly half of the concentration variability over time is explained by the increasing trend. This strong statistical evidence suggests a consistent and ongoing rise in sum of PFOS+PFHxS concentrations at MW034, potentially due to an isolated source or localised instability in the plume. The direction and strength of the trend warrant continued monitoring to assess any future risk escalation. Further explanation on why remediation is not advised at this stage is provided in the following paragraph.

In contrast, MW032, located approximately 90 metres downgradient of MW034, shows no statistically significant trend. The Mann-Kendall statistic (S) is 4 with a Confidence Factor of 57.1%, and the COV is low at 0.33, indicating limited variability. Linear regression yields a very low R^2 of 0.0325, meaning that only approximately 3% of the variation is explained by time, and suggesting that concentration changes are minor and not directionally consistent. This supports the interpretation that PFAS has not significantly migrated downgradient from MW034. Further down-gradient wells MW023 and MW024 have not detected PFAS above the laboratory reporting limit (0.01 µg/L), reinforcing the interpretation that the increasing trend at MW034 is likely localised and not currently indicative of broader plume movement. Continued monitoring in this area remains important to track any potential changes in spatial extent or risk.

3.2.4 Groundwater mass flux

Senversa (2018a) estimated the mass discharges using flux-averaged concentrations of sum of PFOS+PFHxS in groundwater to be approximately 1 g/year. These values are lower than those observed in surface water at or near the source areas, indicating that groundwater transport represents a less significant pathway for PFAS migration at the base.

3.3 Surface water

During the DSI, Senversa (2018a) sampled surface water from 25 locations at the base, including within Milners Creek. PFAS concentrations were generally detected in surface water downstream of, or adjacent to, identified PFAS source areas. As outlined in Section 2.7.3, the Southern Drainage Channel and man-made drainage lines within the base are constructed features and therefore considered highly disturbed systems. In line with PFAS NEMP 3.0 guidance, 90% species protection criterion has been applied to these drainage systems. Other surface water bodies at the site are considered slightly to moderately modified, for which 95% species protection level would typically apply. However, due to the bioaccumulation and biomagnification properties of PFAS, 99% species protection level has been adopted in accordance with the precautionary approach recommended in PFAS NEMP 3.0.

For the purpose of assessing trends and comparing data, end-of-dry season data includes samples collected at the start of the wet season (i.e., October to January). This period captures first flush or early post-dry season conditions, which occur shortly after the dry season ends. End-of-wet season data refers to samples collected between February and May. This differs from the SRA report (Tetra Tech Coffey, 2024), which classified all data collected from November onward as wet season data.

Concentrations of sum of PFOS+PFHxS in surface water is shown in Figure 5, Appendix A. Mann-Kendall outputs discussed in this section are presented in Appendix C. Where a result is below LOR, half the LOR value has been used for the Mann-Kendall analysis.

3.3.1 Source Area 1 drainage line into Milners Creek

Concentrations of PFOS in surface water from the drainage line north of Source Area 1 leading into Milners Creek were consistently below adopted criteria for ecosystem protection (90% species protection) within the base, but exceeded adopted screening criteria for ecosystem protection (99% species protection) in Milners Creek. Sum of PFOS+PFHxS concentrations also exceeded adopted drinking water screening criteria at several locations downstream of Source Area 1 including within Milners Creek to the east of Source Area 1.

Surface water monitoring locations to the northeast of Source Area 1 (SW049, SW050, SW058, SW059, SW060 and SW122) indicated PFAS contributions primarily from leaching of soils and pavement, with subsequent discharge to surface water. Concentrations of sum of PFOS+PFHxS in this drainage line range from 0.14 µg/L at SW049 to 0.43 µg/L at SW058/SW059, near the Main Barracks boundary. Concentrations decreased further downstream within the CTA. A graph of concentrations along the drainage line with distance (sampled in February 2018) is presented in Chart 3-4 below.

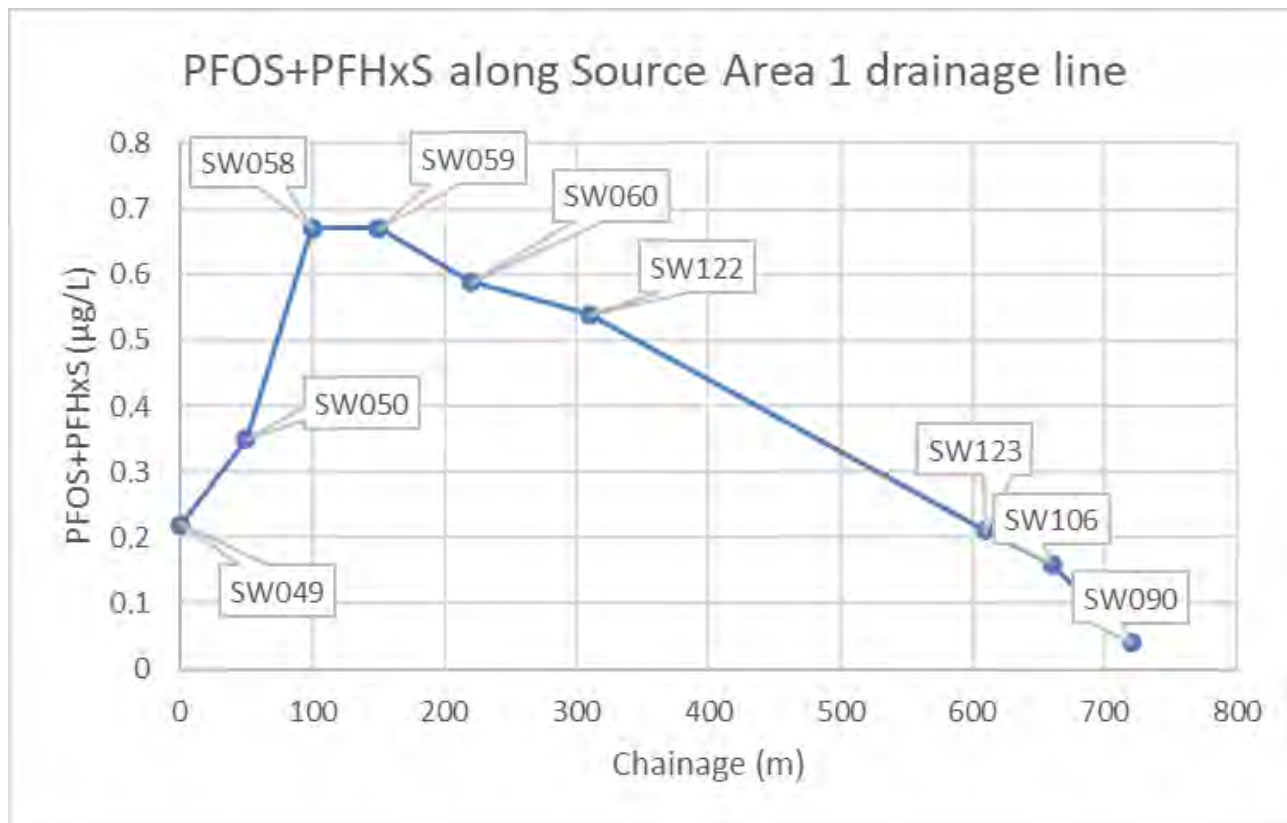


Chart 3-4 Concentrations of sum of PFOS+PFHxS from Source Area 1 drainage line (wet season 2018).

Surface water concentrations of sum of PFOS+PFHxS migrating along Source Area 1 drainage line into Milners Creek have fluctuated over time. Although greater fluctuations have been observed in the last three years, concentrations remain within the range of historical maximums recorded during the DSI. Location SW059, situated on the eastern boundary of the Main Barracks, consistently shows seasonal variation – with lower concentrations at the end of the dry season, and higher concentrations at the end of the wet season.

A graph of surface water sum of PFOS+PFHxS concentrations at three locations down stream of Source Area 1 – SW059 at the Main Barracks boundary, SW123 – at the confluence of the Source Area 1 drainage line and Milners Creek, and SW091 – approximately 400 m downstream from SW123, is presented in Chart 3-5 below.

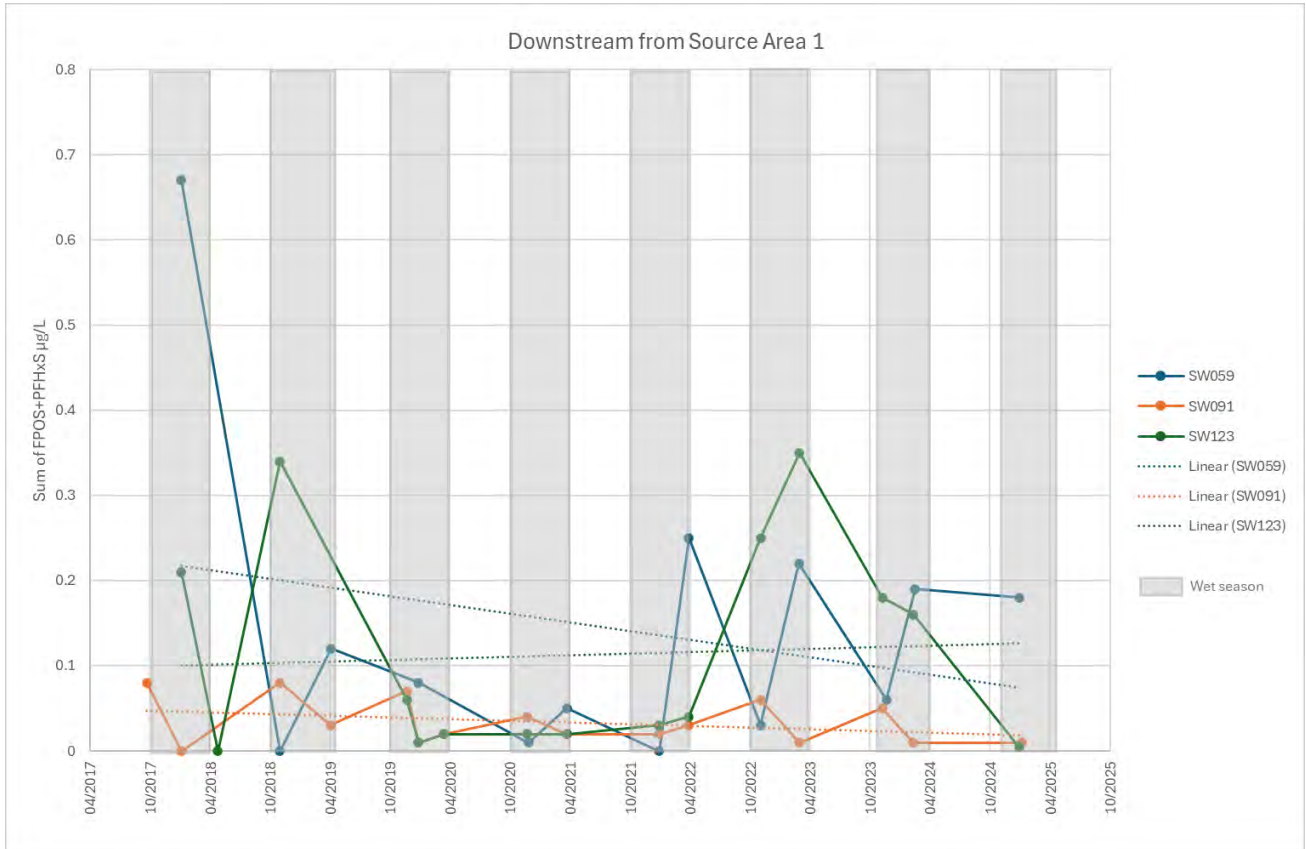


Chart 3-5 Surface water concentrations from Source Area 1 drainage line 2017-2025

Chart 3-5 illustrates the seasonal fluctuations at SW059 indicating concentrations are higher at the end of wet season. Statistical analysis for SW059, indicated the R² value was 0.0612, suggests a very weak linear relationship, Mann-Kendall analysis conducted also reported a “no trend” result (S = 5, confidence factor of 60.6%).

Mann-Kendall test result for SW123 (S = 2, confidence factor 52.2%) also indicated no statistically significant trend. The R² value was just 0.0036, also reflecting no meaningful linear relationship.

SW091 in Milners Creek shows a statistically significant decreasing trend with a confidence factor of 98%. The R² value is 0.1127, which reflects a weak linear correlation, but is consistent with the decreasing direction. Concentrations of PFAS appear generally lower at the end of wet season.

3.3.2 Source Areas 2 and 3 drainage line (into Milners Creek)

Concentrations of PFAS have also been reported in surface water drains to the south of Source Areas 2 and 3, though these concentrations are generally an order of magnitude lower than those reported in the Source Area 1 drains. Surface water PFAS concentrations in the Southern Drainage Channel have been monitored at SW075, located on the south-eastern corner of the base. Chart 3-6 presents the sum of PFOS+PFHxS concentrations recorded at SW075 over time. Concentrations at SW086, down-stream from SW075 in Milners Creek (within the CTA), were at or below laboratory reporting limits.

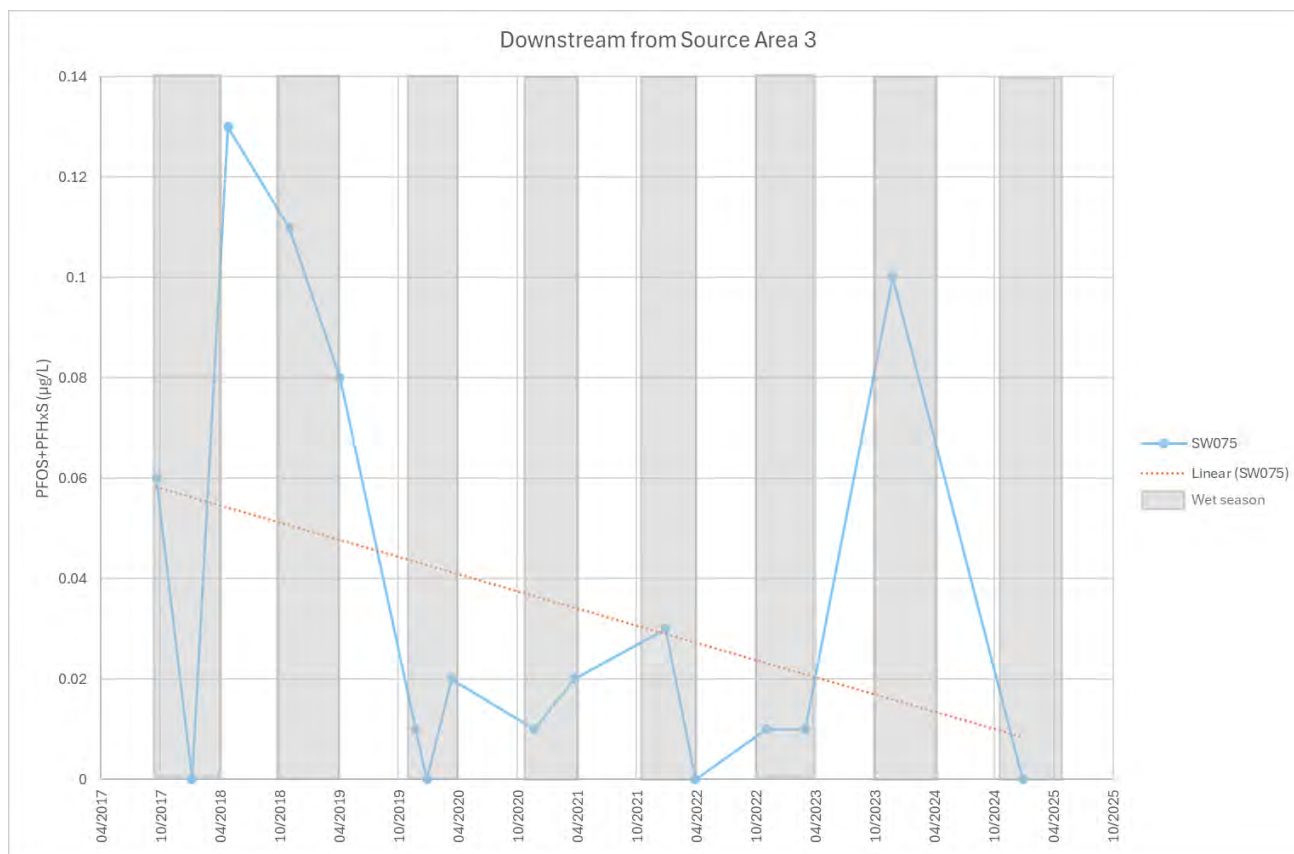


Chart 3-6 Surface water concentration for SW075 over time

The results at SW075 indicates no statistically significant trend with a confidence factor of 79.9%. The R^2 value of 0.1154 suggests a very weak linear relationship between concentration and time. While the slight downward direction in both the Mann-Kendall statistic and regression line may suggest some decline, the statistical evidence does not support a definitive trend. Overall, concentrations at SW075 are considered to be stable over time. Likely sources of PFAS at this location include surface water runoff from Source Areas 2 and 3, as well as potential groundwater discharge into the Southern Drainage Channel. Groundwater levels in nearby wells MW001 and MW030 rise to within 1 m of the ground surface and given that the drainage channel lies 1 to 2 m below the adjacent ground surface, it is inferred that PFAS-impacted groundwater discharges into the drainage channel at the end of wet season.

3.3.3 South of base (including Southern Drainage Channel)

Concentrations of sum of PFOS+PFHxS were below the adopted screening criteria for recreational water (2 µg/L) at all locations and periodically above the drinking water criteria (0.07 µg/L) in the southern area of the base at location SW075 (in the southern drainage channel). Surface water is not used for potable water supply in the area of the base.

Concentrations of PFOS in surface water south of the base (i.e., SW001 to SW008, SW075, SW076, SW077, SW079, SW081, SW093 to SW097, SW202 and SW203) were below the adopted criteria for ecosystem protection (90% species protection) within the Southern Drainage Channel and drains leading to the Southern Drainage Channel.

3.3.4 Summary

In summary, PFAS impact in surface water at Robertson Barracks primarily originates from drainage pathways associated with source areas, showing seasonal and spatial variability. Source Area 1 has the highest observed PFAS levels, decreasing downstream. PFAS concentrations from Source Areas 2 and 3 are considerably lower, exhibiting limited temporal variability. Groundwater interactions in the Southern Drainage Channel may contribute to PFAS concentrations, particularly after groundwater levels rise at the end of the wet season. The observed trends and spatial distribution align closely with the conceptual site model, reflecting historical PFAS use and known migration pathways.

3.4 Receptors and residual risks

Concentrations of sum of PFOS+PFHxS in soils, sediment, surface water and groundwater have been compared against adopted screening criteria to appraise potential risks to receptors.

3.4.1 Soil

Potential receptors at the base that have the potential to be exposed to PFAS in soils include:

- Onsite workers within source areas
- Construction or maintenance workers who may encounter contaminated soil during works
- Terrestrial ecological receptors (including flora and fauna) that may be exposed to PFAS impacted soils directly or indirectly through bioaccumulation or biomagnification

PFAS-impacted soils are generally limited to Source Areas 1, 2 and 3, with only a few isolated detections elsewhere on the base. Concentrations of PFAS in soils are below adopted screening criteria for protection of human receptors including onsite workers and construction and maintenance workers. PFOS concentrations in soils are also below direct (1 mg/kg) and indirect ecological (0.14 mg/kg) exposure criteria for source areas, except for one location beneath pavement in Source Area 1. Given this location is inaccessible to ecological receptors, it is not considered to present an ecological risk.

Isolated detections of PFOS in soils exceeding the Ecological Indirect criterion (0.003 mg/kg) outside of source areas were identified in five areas across the base. Table 3-2 summarises the locations exceeding this criterion. The 95% upper confidence limit (UCL) PFOS concentration was calculated for each area using United States Environmental Protection Agency (US EPA) software ProUCL® and outputs are provided in Appendix D, and a summary is included in Table 3-3.

Table 3-2 Summary of soil results above Ecological Indirect screening criteria outside of source areas

Area	Location ID	Date sampled	PFOS Concentration (mg/kg)	Depth (m bgl)
South and east of Source Area 1	BH049	05/10/2017	0.0048	0 – 0.1
	BH053	05/10/2017	0.0106	0 – 0.1
	BH054	05/10/2017	0.0049	0 – 0.1
	BH055	05/10/2017	0.0315	0 – 0.1
	BH055	05/10/2017	0.0421	0.5 – 0.6
	BH057	05/10/2017	0.0540	0.9 – 1.0
	BH059	05/10/2017	0.0266	0 – 0.1
		05/10/2017	0.0198	0.5 – 0.6
	SD051	05/10/2017	0.0250	0 – 0.1
		03/02/2018	0.0291	0 – 0.1
	SD052	05/10/2017	0.0231	0 – 0.1
03/02/2018		0.0192	0 – 0.1	
CTA	SD086	21/04/2022	0.0045	0 – 0.1
Southern portion and south of the base south of Source Areas 2 and 3	BH088	02/02/2018	0.0072	0 – 0.1
	SD008	02/02/2018	0.0093	0 – 0.1
	SD011	10/10/2017	0.0038	0 – 0.1
	SD094	02/02/2018	0.0111	0 – 0.1
	SD095	02/02/2018	0.0076	0 – 0.1

Table 3-3 95% UCL results for each area

Area	Locations included in 95% UCL calculation	95% UCL (mg/kg)	Statistical Method	Figure reference (Appendix A)
South and east of Source Area 1	BH041 to BH061, BH246, SD051, SD052, SD054, SD055	0.0111	95% KM (t) UCL	Figure 3a
CTA	MW019, MW020, MW022 to MW024, SD086 to SD091, SD124 to SD126	9.0262×10^{-4}	95% KM (t) UCL	Figure 3d
Southern portion and south of the base south of Source Areas 2 and 3	BH077 to BH093, MW001, MW003, SD007 to SD011, SD075 to SD081, SD093 to SD097, SD202, SD203	0.00189	95% KM (t) UCL	Figure 3c

Soil data were compared against the PFAS NEMP 3.0 Ecological Indirect Soil criteria outlined in Table 3-2. At least one exceedance of the criteria was identified in each of three areas of Robertson Barracks located outside known source areas including:

- to the south and east of Source Area 1
- within the CTA, and
- in the southern portion of the base (including areas south of Source Areas 2 and 3).

The 95% UCL concentrations calculated for the CTA and the southern portion of the base were below the ecological indirect soil criterion of 0.003 mg/kg. However, soils located to the east and south of Source Area 1 reported a 95% UCL exceeding the guideline value (refer Table 3-3), indicating a potential risk of bioaccumulation in accordance with the guidance provided in NEMP 3.0. The ecological indirect criteria are

designed to protect sensitive wildlife, such as small mammals and birds, from PFAS exposure through the food chain. Despite the exceedance, the risk to ecological receptors is considered low, as the area of impacts above the screening criteria are small in comparison to the broader area of ecosystem in which secondary and tertiary ecological receptors may forage.

The area of PFOS impacts in soils above the criterion is approximately 5,000 m² (which is based on half the distance to the nearest sampling point below the criterion, or the area of the drainage line multiplied by a factor of five to account for flooding). The area of the ecosystem in which secondary and tertiary receptors may be expected to forage (which excludes hardstands, paved areas and developed areas) is approximately 60,000 m² (and only includes the bushland areas surrounding the impacted area – refer to Figure 7, Appendix A, which shows the ecosystem areas and inferred PFOS impacted soils). Consequently, as the area of exposed soil is less than 10% of the localised ecosystem area, the impacted soils are considered too small to have any material impact on food chain transfer to secondary consumers (PFAS NEMP 3.0).

3.4.2 Groundwater

Potential receptors that may be exposed to PFAS in groundwater include:

- Construction or maintenance workers who may encounter shallow groundwater during works at the end of the wet season
- Aquatic ecological receptors where PFAS-impacted groundwater may discharge into surface water systems such as Milners Creek and Milners Swam

Groundwater at the base is not used for potable or recreational purposes. Surface water bodies are also inaccessible due to secure fencing around CTA. Groundwater PFAS concentrations are below recreational water criteria, which are considered protective for workers.

The groundwater PFAS plume at the base is not considered to discharge to surface water, except at a limited section of the Southern Drainage Channel in the south-east of the base at the end of the wet season. Given that this is a constructed channel, ecological screening criterion for highly modified ecosystems (90% protection – 2 µg/L for PFOS) is applied. PFOS concentrations in groundwater at discharge points are below this criterion.

Downstream surface water concentrations at location SW086 are below laboratory reporting limits, indicating that the contribution of PFAS from groundwater to Milners Creek is negligible. Accordingly, groundwater is not considered to pose an unacceptable risk to ecological receptors.

3.4.3 Surface water

Sum of PFOS+PFHxS concentrations in surface water across the base are below drinking water criteria, except at SW059. However, this location is within a small surface water drain not used for drinking water supply. All results are below the recreational water screening criteria.

Concentrations of PFOS in surface water on the base were all below the 90% species protection for highly disturbed systems and the risks to ecological receptors was considered low and acceptable.

Within Milners Creek, PFOS concentrations exceed 99% species protection criteria, suggesting a potential risk to ecological receptors via biomagnification and bioaccumulation. Senversa (2018b) undertook a HHERA and appraised potential risks to receptors in surface water, concluding that there was a potential risk to ecological receptors via biomagnification and bioaccumulation. However, this conclusion was based on conservative comparison of surface water results against published 99% screening criteria due to impracticality of biota sampling within the dense vegetation of Milners Creek and Milners Swamp. Site-specific or refined risk assessment approaches were not incorporated into this risk assessment.

To address this uncertainty, a semi-quantitative assessment was undertaken using the food-web model developed for the Ecological Risk Assessment (ERA) at Royal Australian Air Force (RAAF) Base Darwin (Coffey, 2018a). Given the similarities in habitat and species between the sites and their proximity (approximately 8 km apart), the RAAF Base Darwin model was considered an appropriate conservative screening tool for this assessment.

Key ecological and environmental similarities supporting the use of this model include:

- Both Milners Creek and Rapid Creek are freshwater tropical streams with similar monsoonal woodland ecosystems
- Overlap in the ranges of higher trophic species, including piscivorous birds and reptiles
- Similar vegetation and hydrological regimes, including seasonal surface water flows
- The desktop species list developed for Robertson Barracks (Senversa, 2018b) for Milners Creek and Swamp and surrounding woodland is materially similar to the species list included in the RAAF Darwin food-web and ecological risk assessment.

Table 3-4 compares PFOS concentrations in surface water and sediment at Milners Creek with those used in the RAAF Base Darwin model for Rapid Creek. The portions of Rapid Creek referred to in Table 3-4 relate to:

- **Upper:** The upper portion of Rapid Creek, including the northern and southern headwater tributaries, representing the section of the creek located south of the suburb of Marrara (referred to as Marrara Swamp).
- **Middle:** The middle portion of Rapid Creek, adjacent to the suburb of Marrara and extending downstream to Trower Road.
- **Lower:** The lower portion of Rapid Creek, located down-stream of Trower Road.

Table 3-4 Comparison of PFOS concentrations at RAAF Darwin and Robertson Barracks

	Average Concentration		Minimum Concentration		Maximum Concentration	
	Surface Water (µg/L)	Sediment (mg/kg)	Surface Water (µg/L)	Sediment (mg/kg)	Surface Water (µg/L)	Sediment (mg/kg)
Darwin - Rapid Creek						
Upper portion of Rapid Creek	0.13	0.015	0.09	<0.005	0.18	0.074
Middle portion of Rapid Creek	0.55	0.042	0.02	<0.005	2.46	0.39
Lower portion of Rapid Creek	0.245	0.01	<0.01	<0.005	0.8	0.019
Roberston Barracks – Milners Creek						
-	0.05	0.001	<0.01	<0.0002	0.11	0.0072

PFOS concentrations in Milners Creek are between 1 to 2 orders of magnitude lower than those used to develop the model for RAAF Darwin.

At RAAF Darwin, risk assessments for aquatic habitats in freshwater Rapid Creek identified potential risks due to direct toxicity to freshwater plants, aquatic invertebrates in the water column, amphibians, and fish, based on aqueous PFOS concentrations exceeding the general guideline value. However, further assessment found that risks to aquatic plants and water column invertebrates are negligible, as the maximum PFOS concentration was below specific toxicity thresholds for these groups. In contrast, moderate risks were identified for freshwater fish, with both average and maximum PFOS concentrations in Rapid Creek exceeding screening criteria, potentially affecting egg development and hatch rates in some species.

At Robertson Barracks, PFOS concentrations in surface water and sediment were approximately ten times lower than those at RAAF Darwin. As a result, using the RAAF Darwin food-web model, potential risks to aquatic plants and water column invertebrates at Robertson Barracks were considered negligible.

Comparison of surface water and sediment concentrations in Milners Creek against screening criteria for freshwater fish from the Darwin ERA (Coffey, 2018b) showed that all concentrations of PFOS were below both the fish screening criteria of 0.3 µg/L (DoEE, 2016), and general ecological screening criterion of 0.13 µg/L. As a result, potential impacts to freshwater fish are considered low and acceptable.

Risks to higher trophic species was qualitatively assessed using the ecological model developed for RAAF Darwin Species Ecosystem Area A, which includes headwaters of Rapid Creek and is most similar to Milners Creek and its surrounding environment. Applying a simplified order-of-magnitude reduction in input concentrations to the food web from surface water and sediment to the food web resulted in estimated intake doses for higher trophic species falling below tolerable daily intake (TDI) thresholds – with the potential exception of some carnivorous terrestrial birds. However, this assessment includes several conservative assumptions, particularly as the RAAF Darwin model included additional exposure pathways (e.g., soil PFAS exposures to terrestrial insects and reptiles) that are not present at Robertson Barracks.

While the application of the RAAF Base Darwin model introduces uncertainties, they are considered conservative in nature and include:

- Possible difference in actual species composition and abundance between the two areas
- No biota tissue data was collected from Milners Creek to validate the assessment
- Use of Rapid Creek PFAS concentrations as a base line (i.e., one to two orders of magnitude higher than those reported at Milners Creek), requiring a simplified magnitude-based adjustment
- Use of international toxicological reference values that may not precisely reflect local species sensitivities.

Despite these uncertainties, the significantly lower PFAS concentrations reported at Robertson Barracks, particularly at SW091, support the conclusion that risks to higher trophic species from PFOS in surface water and sediment in Milners Creek is low. PFOS concentrations in Milners Creek (notably at SW091) have shown a decreasing trend over time, and downstream locations (i.e., SW086) have recorded concentrations below laboratory reporting limits.

Using the RAAF Base Darwin model with adjusted PFOS concentrations suggests estimated intake doses for higher trophic species at Robertson Barracks fall below TDI thresholds. Based on this, and the decreasing PFOS trend, any uncertainty from the model is unlikely to result in an unacceptable risk.

4. FINAL PFAS MANAGEMENT AREA CONDITION SUMMARY

This section summarises the condition of Robertson Barracks PFAS Management Area with respect to PFAS contamination, drawing together multiple lines of evidence demonstrating why active remediation is not warranted.

4.1 SOIL

PFAS in soil has been assessed based on the data from the 2018 DSI (Senversa, 2018a), the supplementary investigation in 2024 (Tetra Tech Coffey, 2025a) and multiple ongoing monitoring events. For the purpose of this report, reference to soil also includes sediment. As detailed in Section 1.1.1, soil criteria has been adopted to appraise PFAS sediment concentrations. This was considered an appropriate and conservative approach, given that most sediments within drainage lines and sampling locations are dry for the majority of the year and not representative of persistent sub-aqueous conditions.

The majority of PFAS detections in soil are confined to identified source areas, which are mostly paved or hardstand surfaces. This significantly reduces the potential for ecological or human exposure. Outside of source areas, only isolated and low-level detections were reported, with no exceedances of relevant human health screening levels. The lines of evidence below summarise the key findings that support a low and manageable risk profile for soil:

- PFAS-impacted soils are primarily confined to three source areas (Section 3.1), with concentrations largely limited to the upper metre of soil.
- Impacted soil is typically located beneath pavement or hardstand, limiting ecological exposure (Section 3.1.1)
- All reported concentrations were below the Human Health (HIL-D) and Ecological Direct Exposure criteria (Section 3.4.1)
- One exceedance of Interim Ecological Indirect Exposure for modified ecosystems (in the source area) criteria was recorded beneath intact pavement (at BH254), where it is not accessible to receptors (Section 3.1.1)
- Exceedances of the Interim Ecological Indirect Exposure criterion were identified in three areas outside the source zones. A 95% UCL was calculated for each, with results below the guideline in all but the area directly east and south of Source Area 1. Despite this exceedance, the risk is still considered low due to the small extent of impact limiting the overall contribution to areas used for foraging by ecological receptors. (Section 3.4.1).

4.2 GROUNDWATER

Groundwater monitoring data from 2017 to 2024 indicates that PFAS impact remains confined to shallow portions of the aquifer, with no evidence of off-base migration. Groundwater is not used for potable or recreational purposes within the PFAS Management Area, and discharge to surface water is limited to a small area south of the base, in anthropogenic drains, at the end of the wet season. Statistical trend analysis shows stable or decreasing concentrations in the majority of monitoring wells, and estimated PFAS mass flux via groundwater remains low. These findings support the conclusion that PFAS in groundwater does not pose an unacceptable risk to human or ecological receptors based on the following lines of evidence:

- PFAS is restricted to the upper portion of the Bathurst Island Formation aquifer; deeper wells consistently return results below detection limits (Section 3.2.2)
- No PFAS was detected in boundary wells along the western side of the base, confirming no off-base migration (Section 3.2.2)

- Trend analysis indicates concentrations are either stable or decreasing, with statistically significant declines observed at MW001 and MW080 (Charts 3-1 to 3-3, Section 3.2.3)
- Groundwater is not used for drinking or recreational purposes, and access is controlled (Section 3.4.2)
- Groundwater discharge to surface water is limited to a short section of the Southern Drainage Channel, with PFAS concentrations below Ecological (90% protection) criteria, applicable to modified systems (Section 3.4.2).

4.3 SURFACE WATER

Surface water sampling has been undertaken at multiple locations across the base and within downstream receiving environments. PFAS concentrations in on-base drainage channels are below recreational and ecosystem protection criteria for highly modified ecosystems, where applicable. Although some exceedances of the 99% species ecosystem protection value for surface water are reported in Milners Creek, site-specific assessment using the RAAF Base Darwin food-web model (adjusted for lower PFAS exposure concentrations relevant to Robertson Barracks), indicates low ecological risk. Overall, surface water presents a low and acceptable risk based on reported PFAS concentrations under current base conditions and land use based on the following lines of evidence:

- The Southern Drainage Channel and man-made drainage lines within the base are constructed features and therefore highly disturbed surface water systems. In line with PFAS NEMP 3.0 guidance, the 90% species ecosystem protection criterion applies for these drainage systems. Milners Creek is a slightly to moderately disturbed surface water system, and in line with PFAS NEMP 3.0 guidance, the 99% species ecosystem protection criterion applies to this water body.
- Surface water concentrations of sum of PFOS+PFHxS are below Recreational Use and Ecological - 90% protection (for PFOS) criteria across the base (including off-base) (Section 3.3).
- Concentrations of PFOS and sum of PFOS+PFHxS at SW059 and SW123 have shown stable trends or no-trends since 2018, and downstream locations (e.g., SW086) report concentrations below laboratory reporting limits (Charts 3-5 and 3-6, Section 3.3).
- The application of the adjusted RAAF Base Darwin food-web model –indicates negligible risk to higher trophic species, including piscivorous birds and reptiles (Section 3.4.3).
- PFAS concentrations in surface water and sediment at Milners Creek are approximately 10 to 100 times lower than those observed at RAAF Darwin, where moderate ecological risks were previously identified (Table 3-4, Section 3.4.3). Application of the adjusted RAAF Darwin food-web model, using these lower concentrations relevant to Robertson Barracks, indicates negligible ecological risks within Milners Creek.

4.4 COMPLIANCE WITH PMAP AND DEFENCE REMEDIATION SFARP GUIDANCE

While active remediation has not been undertaken, a SFARP-based assessment concludes that such action would not be practicable or proportionate to the residual risks. The following lines of evidence support this conclusion include:

- All PMAP response actions have either been completed, are ongoing, or have been assessed as no longer necessary given current base conditions and exposure pathways (Table 1-2, Section 1.3.2).
- Residual PFAS concentrations are low and stable, with trend analysis indicating stable or declining concentrations across most groundwater and surface water monitoring locations (Sections 3.2.3 and 3.3).

- Remediation has been assessed as not warranted, based on the Defence Remediation SFARP Guidance (Defence, 2024), due to low risk, limited mass flux, the impracticality of source removal, and the availability of ongoing management controls (Sections 1.3.1 and 3.2.4).
- The OMP has been in place since 2018 for the purpose of ensuring that any future changes in risk are identified and managed (Section 1.1).

5. RECOMMENDATIONS FOR TRANSITION

As described in the above sections, concentrations of sum of PFOS + PFHxS at Robertson Barracks are either below adopted screening criteria, or present at a low and acceptable level of risk to receptors. The exception is the potential use of groundwater from within the PFAS plume or surface water from some drainage channels on the base for drinking water purposes. However, groundwater or surface water is not used for drinking water supply at the base in the vicinity of the PFAS plume so potential receptor exposure is unlikely.

On the basis that all PMAP actions have been undertaken, and that any ongoing actions continue to be implemented to safely manage potential risks associated with PFAS exposure at Robertson Barracks, remediation of PFAS at Robertson Barracks is not warranted to protect relevant ecological and human health receptors.

Ongoing management of potential risks can be effectively addressed through standard contaminated site protocols, as outlined in the DCMM (Defence, 2021) and PFAS CMF (Defence, 2025). This includes maintaining the base on the CSR and applying standard construction controls.

Where redevelopment of an identified PFAS source areas is proposed, potential exists for relevant ecological and health receptors to be exposed to PFAS contamination. It is therefore recommended that PFAS exposure pathways be reassessed with respect to any proposed redevelopment activity and opportunistic remediation of impacts (including pavements in Source Area 1) be undertaken (as required). This will reduce the need for future management of PFAS contamination.

Accordingly, it is recommended that active PFAS management at Robertson Barracks transition to a "business as usual" ongoing monitoring in accordance with the OMP. A regular review of the monitoring data (i.e., following each OMP monitoring event) against the OMP trigger values will remain, with annual review of the validity of the OMP to ensure it still adequately serves ongoing monitoring objectives.

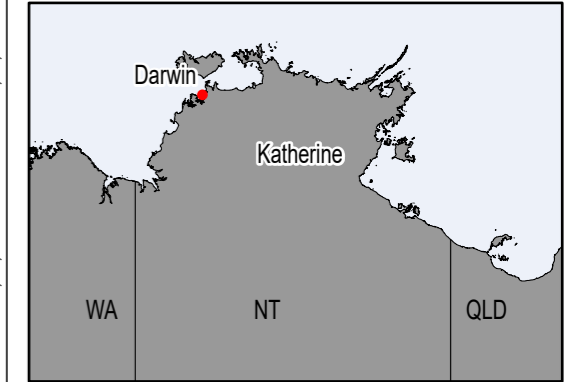
6. REFERENCES

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APPENDIX A 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).

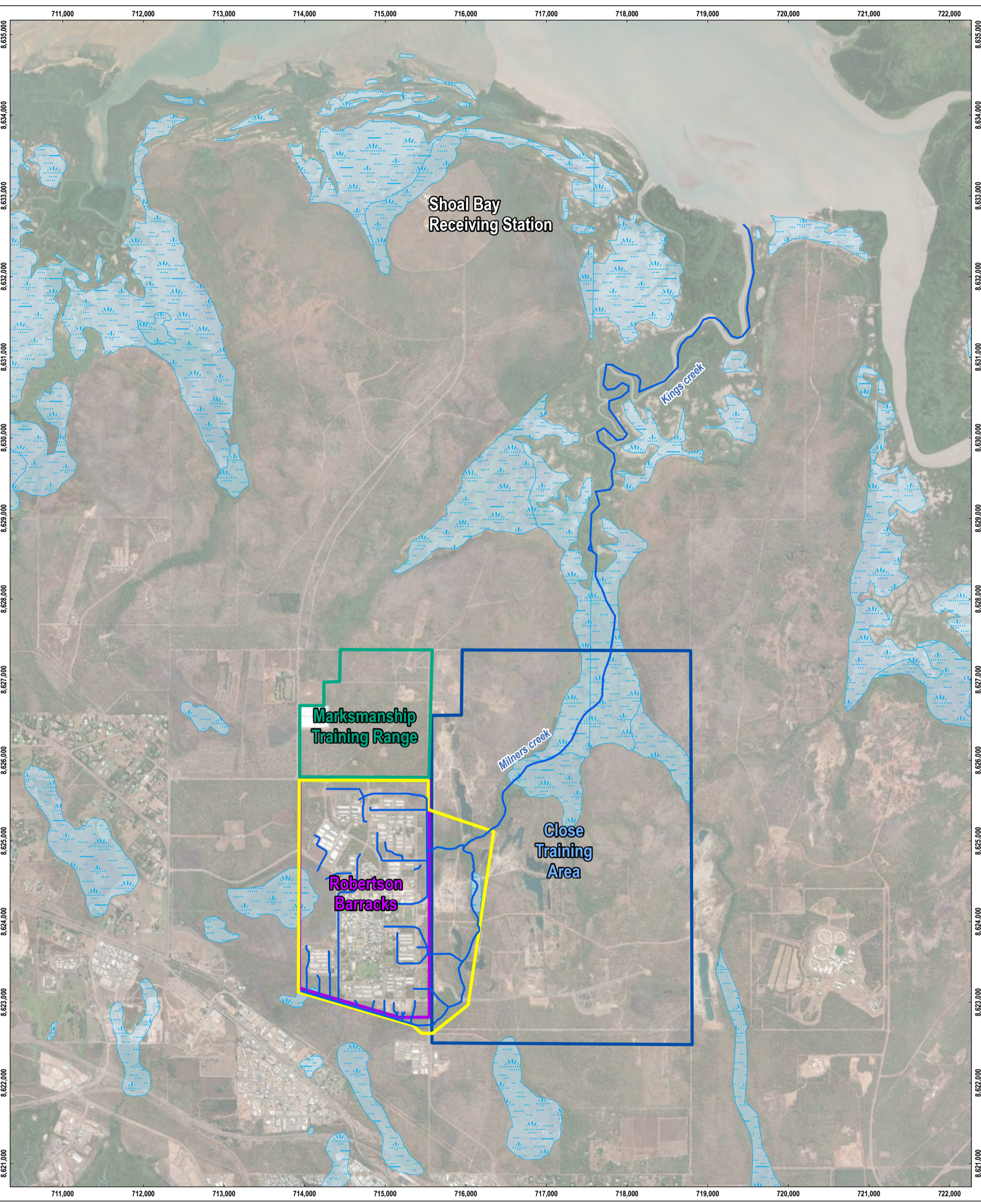
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DEPARTMENT OF DEFENCE
ROBERTSON BARRACKS PMAP TRANSITION
RECOMMENDATION REPORT

FIGURE 1
Site location plan



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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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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).

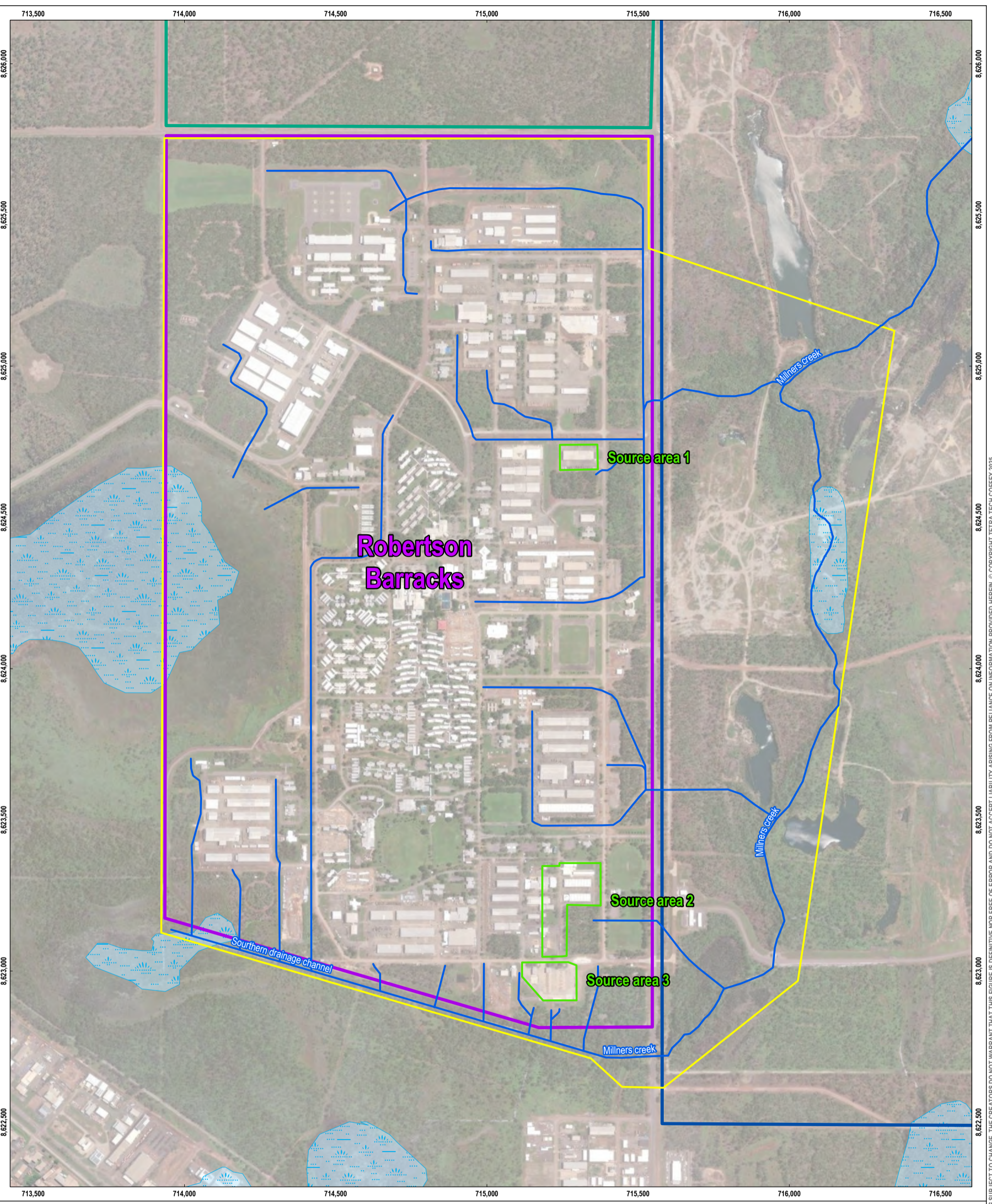
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FIGURE 2A
Regional site layout plan



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LEGEND

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



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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).

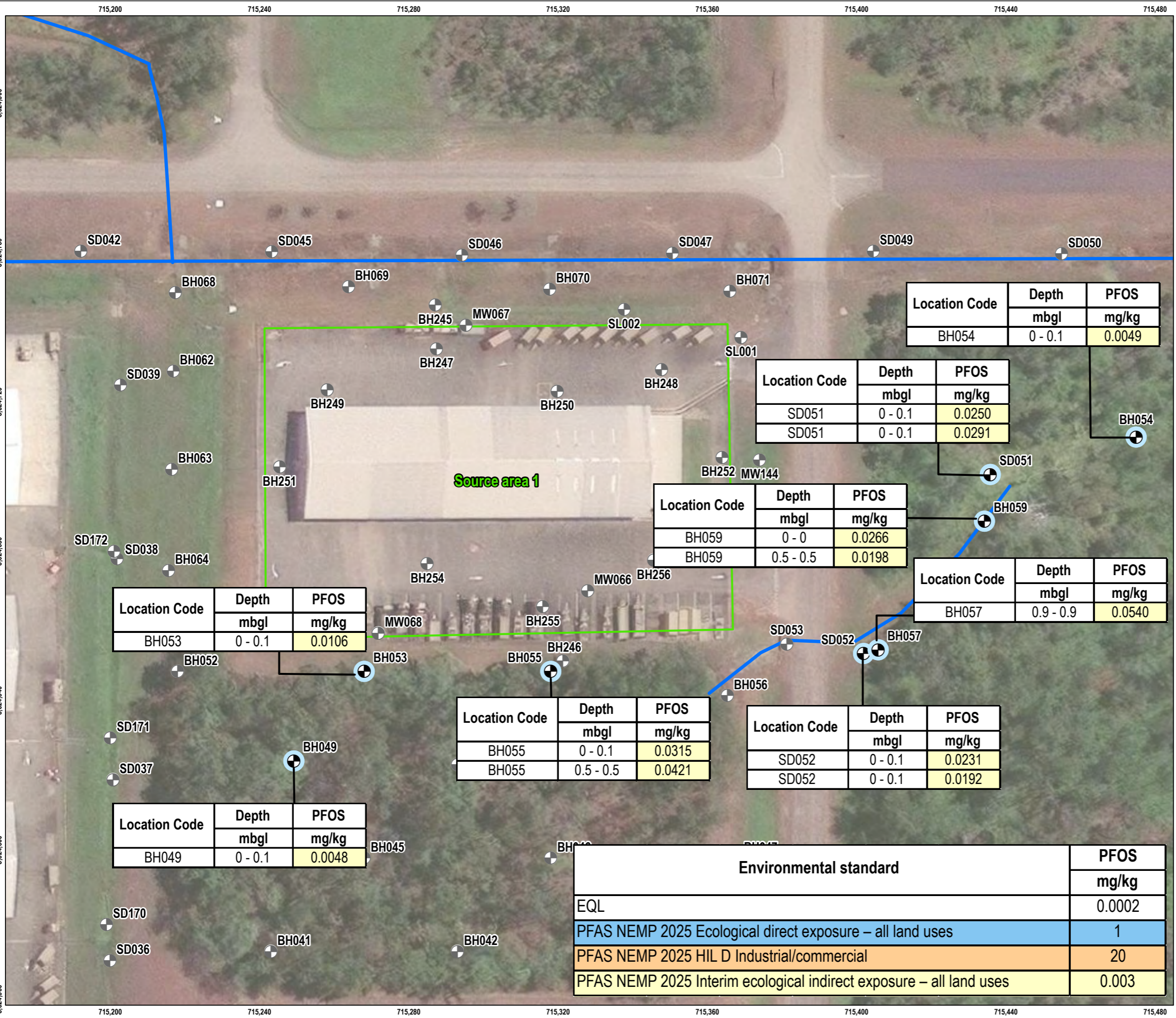
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FIGURE 2B
Site layout plan



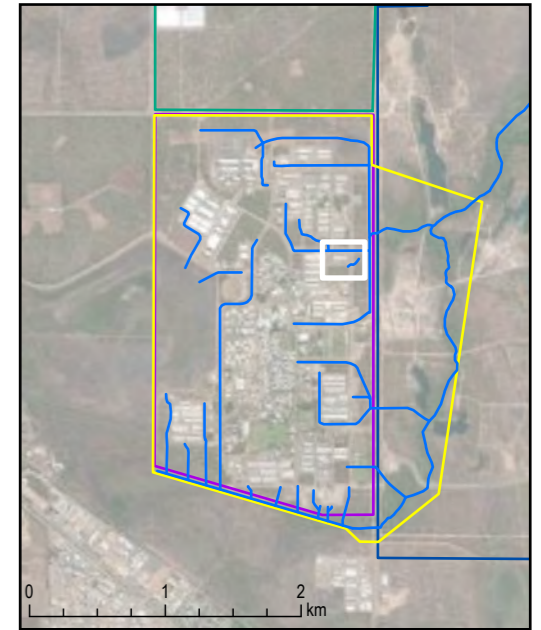
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LEGEND

- 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).

0 20 40 m
SCALE 1:1,000
 PAGE SIZE: A3
 PROJECTION: GDA 1994 MGA Zone 52

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FIGURE 3A
 Source Area 1: PFOS concentrations in soil exceeding ecological criteria - indirect contact all land uses



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

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

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

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

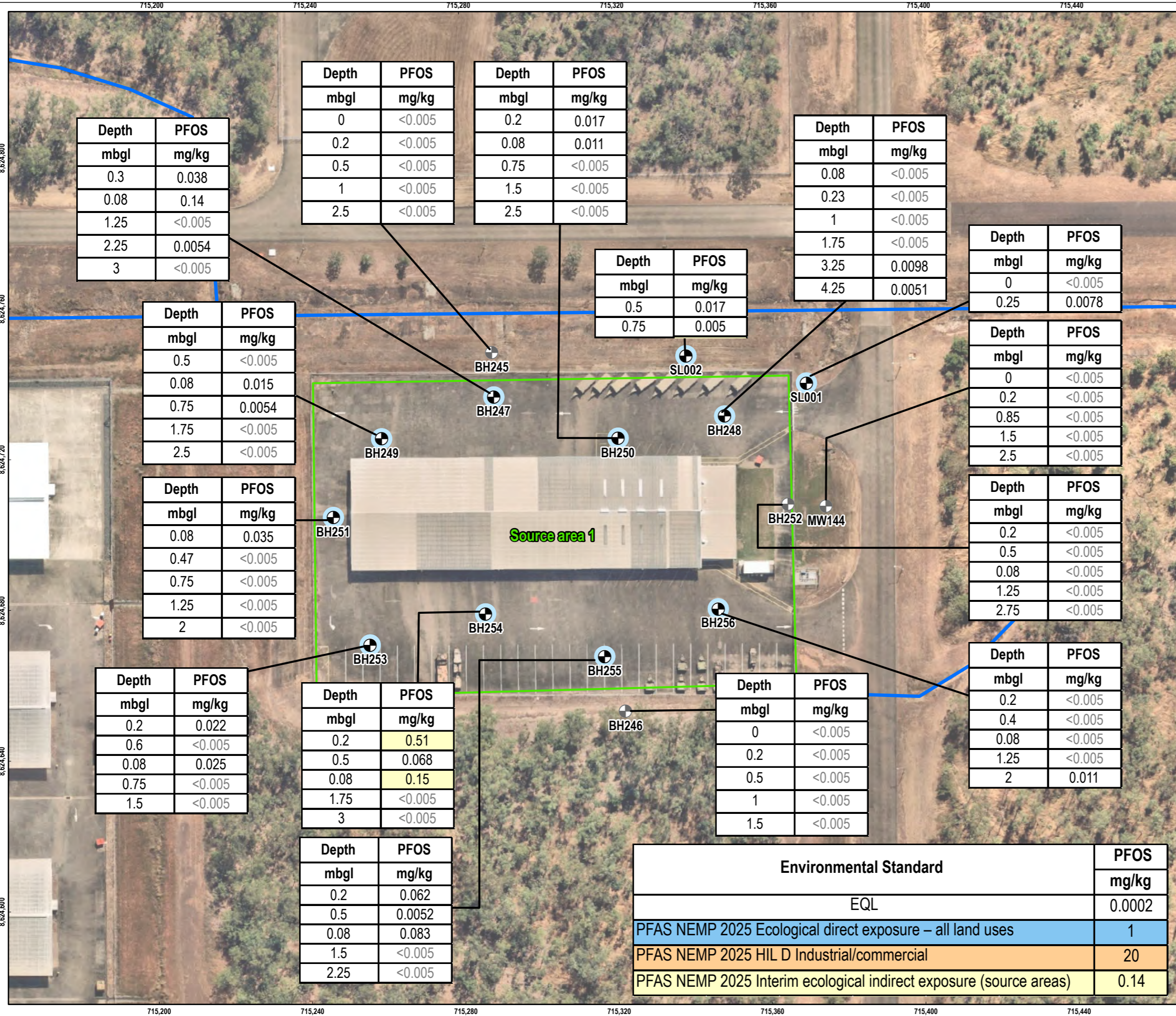
Location Code	Depth mbgl	PFOS mg/kg
BH059	0 - 0	0.0266
BH059	0.5 - 0.5	0.0198

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

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

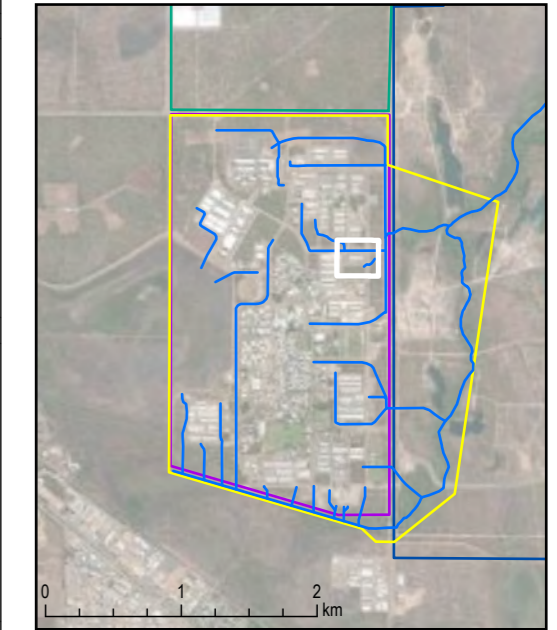
Location Code	Depth mbgl	PFOS mg/kg
BH057	0.9 - 0.9	0.0540

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

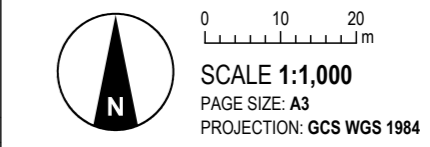


LEGEND

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



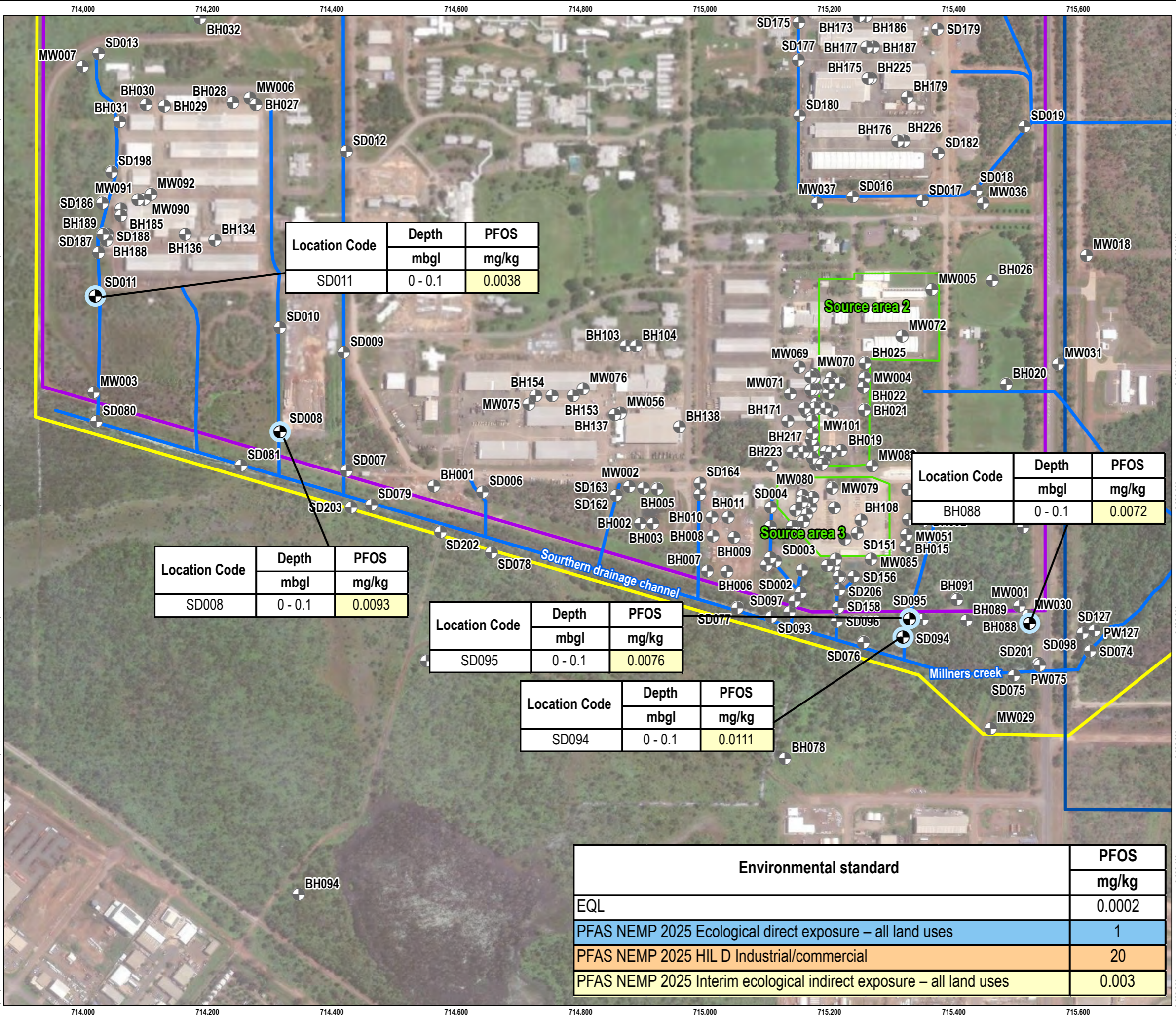
SOURCE
 Areas of concern, drainage, sampling location and site boundary (Indicative) from Tetra Tech Coffey.
 Imagery from Nearmap (04-05-2024).



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FIGURE 3B
 Source Area 1: PFOS concentrations in soil - vertical delineation results

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



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

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

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

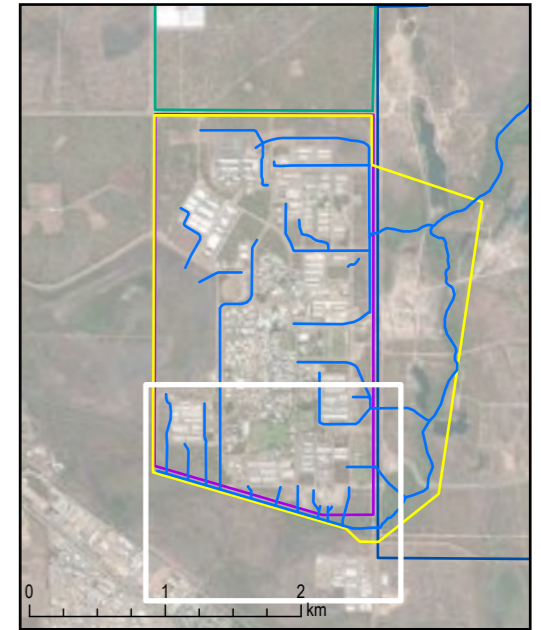
Location Code	Depth	PFOS
	mbgl	mg/kg
SD095	0 - 0.1	0.0076

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

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



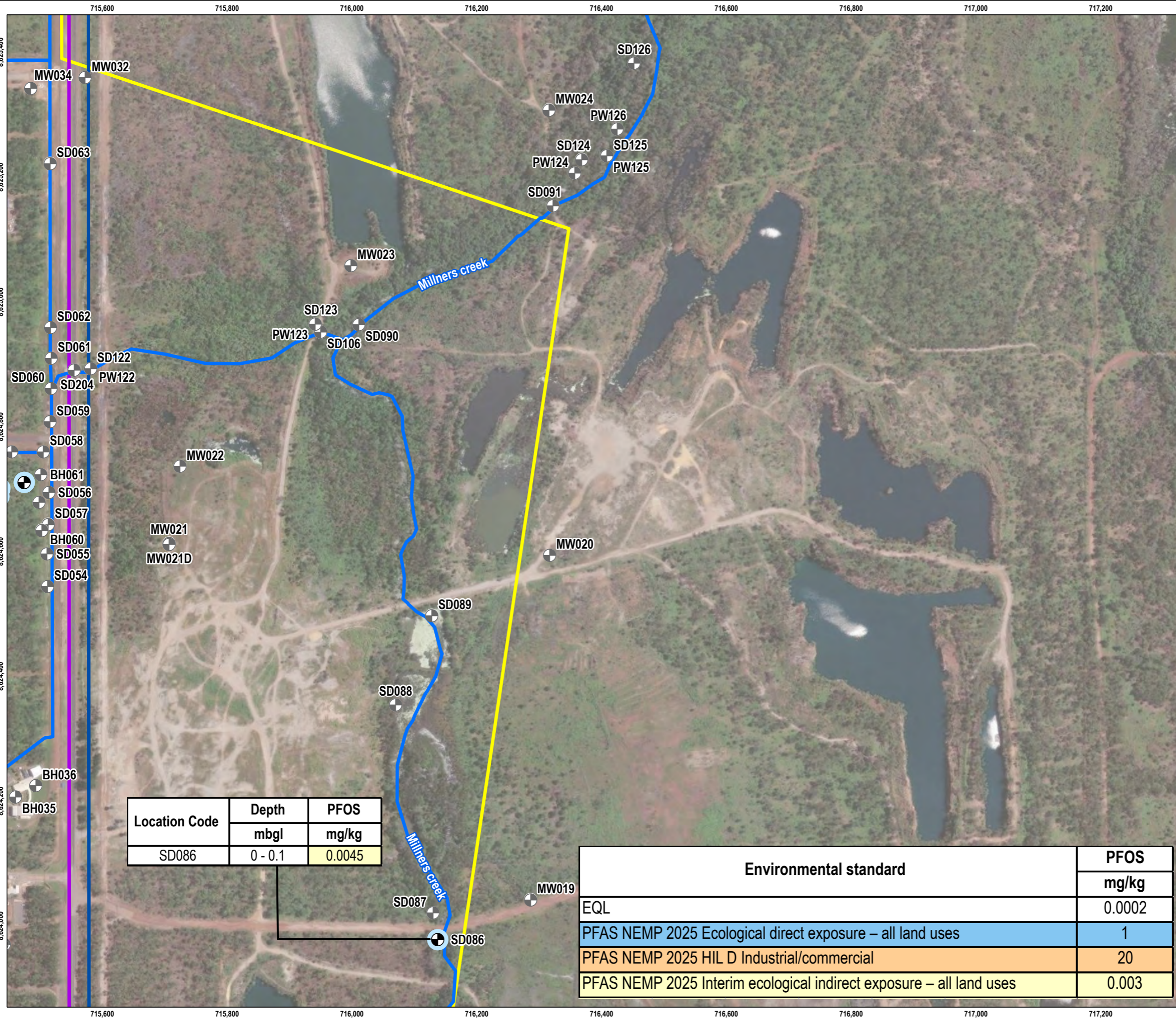
SOURCE
 Areas of concern and Site boundary (indicative) from Tetra Tech Coffey.
 Soil bore locations, results and NEMP exceedance criteria (from 2018 DSI) from DoD.
 Roads, tracks, and creeks from DoD.
 Imagery from Nearmap (06-06-2023).

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 PROJECTION: GDA 1994 MGA Zone 52

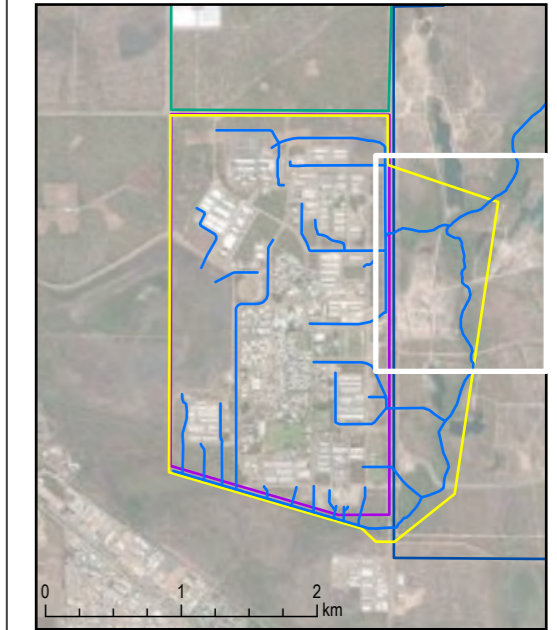
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FIGURE 3C
 Source Areas 2 & 3: PFOS concentrations in soil exceeding criteria


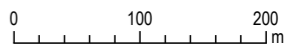




- LEGEND**
- Soil sampling location exceeding PFAS criteria
 - Soil sampling location
 - Drainage and waterways
 - PFAS source areas
 - Close Training Area (CTA)
 - Robertson Barracks



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).

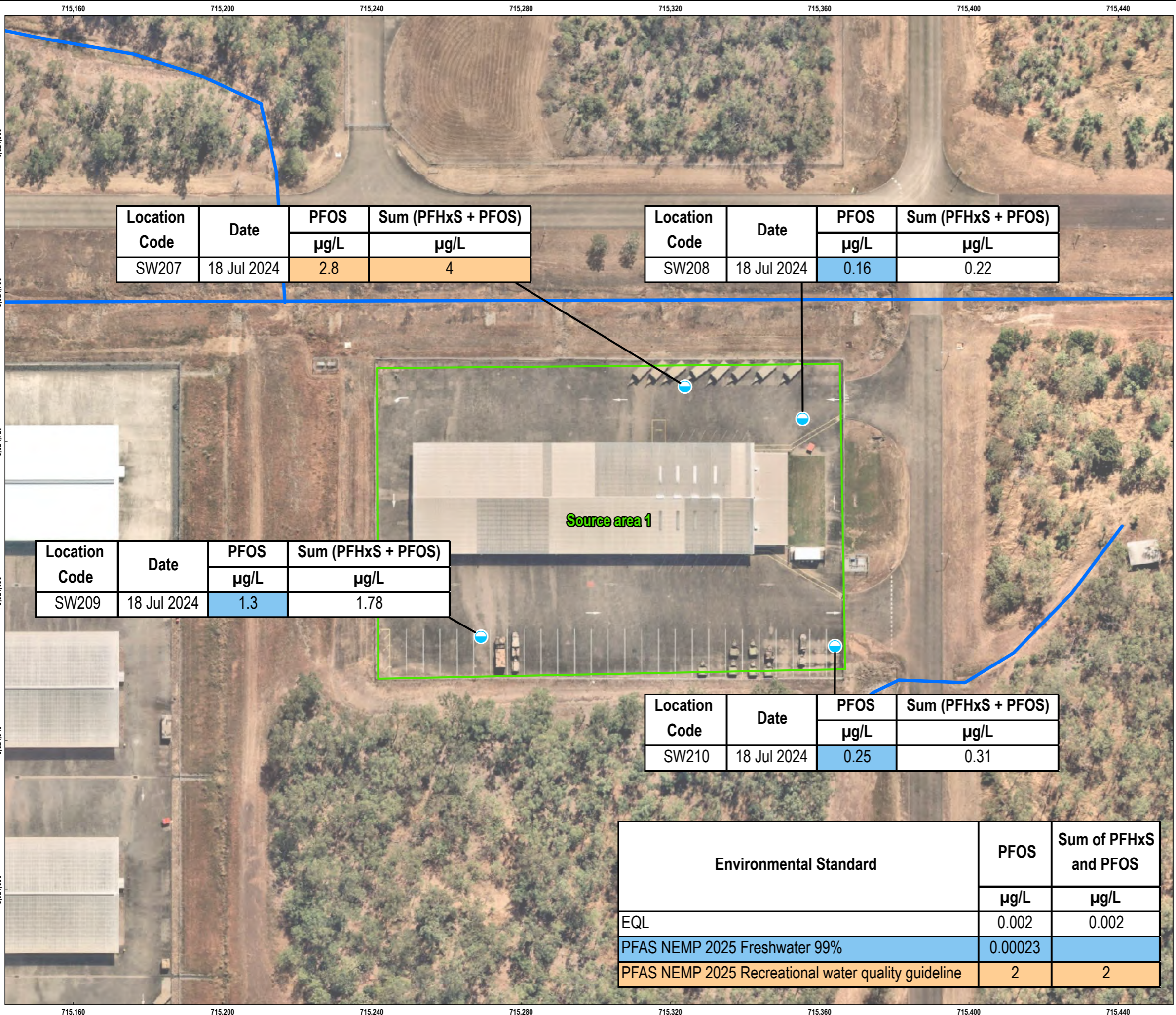


SCALE 1:6,000
 PAGE SIZE: A3
 PROJECTION: GDA 1994 MGA Zone 52

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FIGURE 3D
CTA: PFOS concentrations in soil exceeding criteria



DOC REFERENCE: S:\GIS\199420_MELLEN_DOD_PFA_SIDDOD_PFA_S_GISARCGISPRODDOD_PFA_S_GIS_DWINDOD_338204_R28_FIGS_A.APRX_LAYOUT\338204_R28_F004A_GIS_1
 SAVED BY: GANGULATAPATTU | 04.09.25 3:05 PM



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

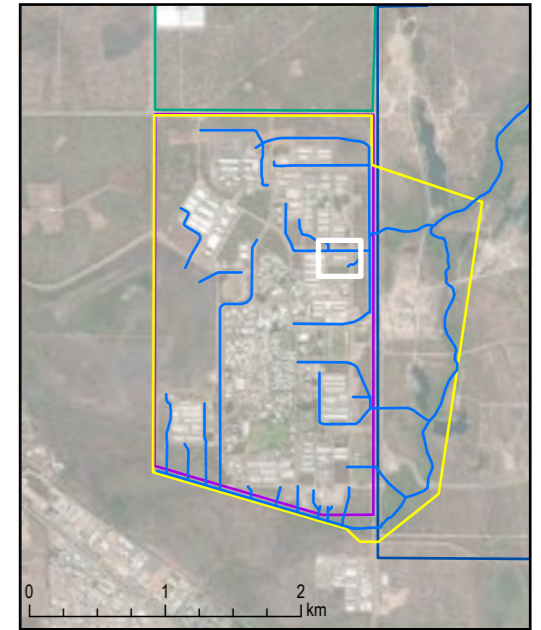
Location Code	Date	PFOS	Sum (PFHxS + PFOS)
		µg/L	µg/L
SW208	18 Jul 2024	0.16	0.22

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).

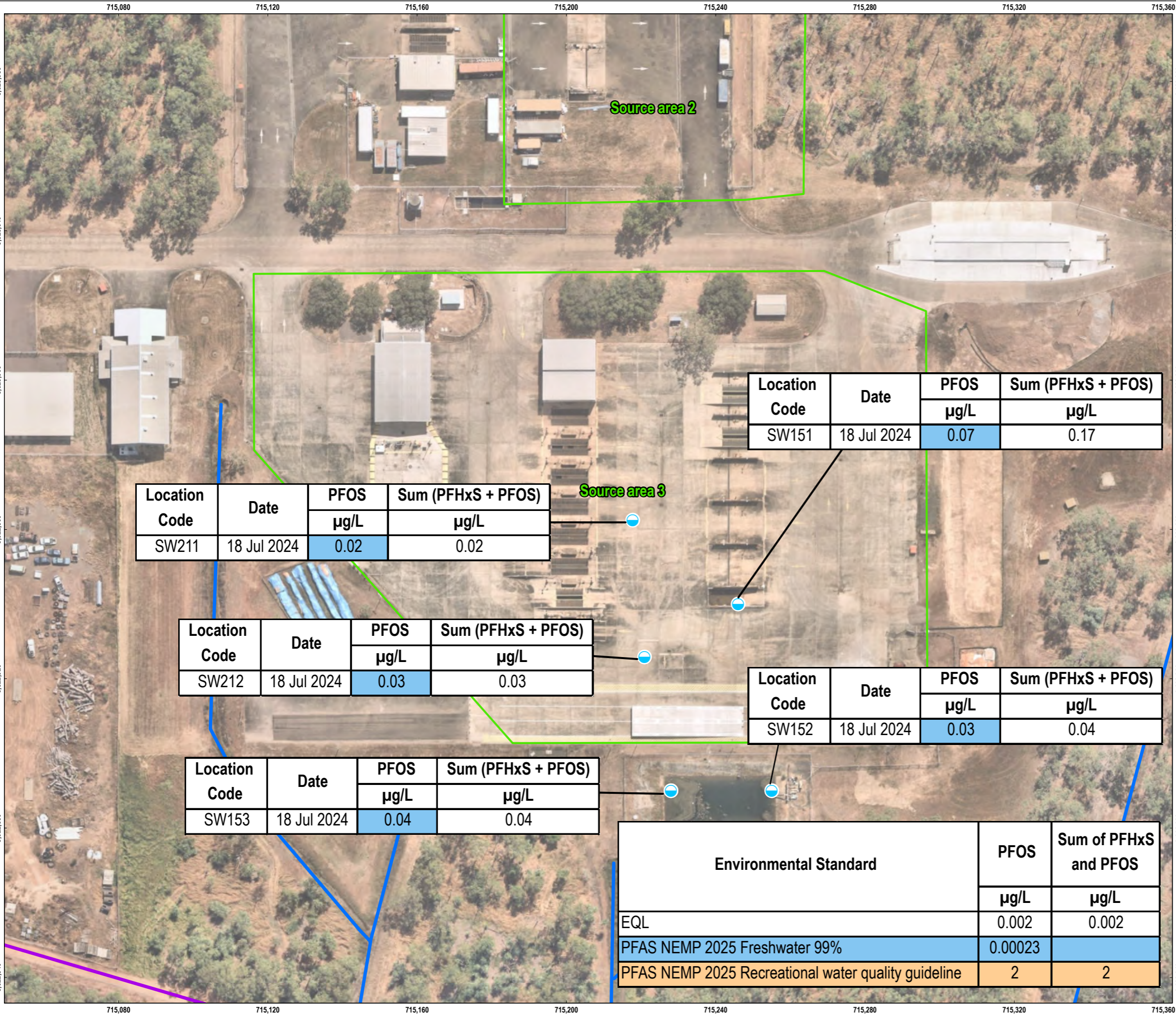
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 PAGE SIZE: A3
 PROJECTION: GDA 1994 MGA Zone 52

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FIGURE 4A
 PFOS+PFHxS surface water runoff
 concentrations Source area 1



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

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

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

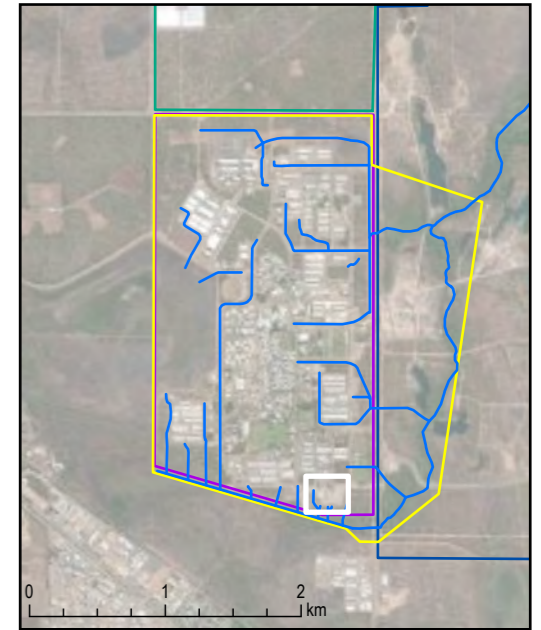
Location Code	Date	PFOS µg/L	Sum (PFHxS + PFOS) µg/L
SW151	18 Jul 2024	0.07	0.17

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

Environmental Standard	PFOS µg/L	Sum of PFHxS and PFOS 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



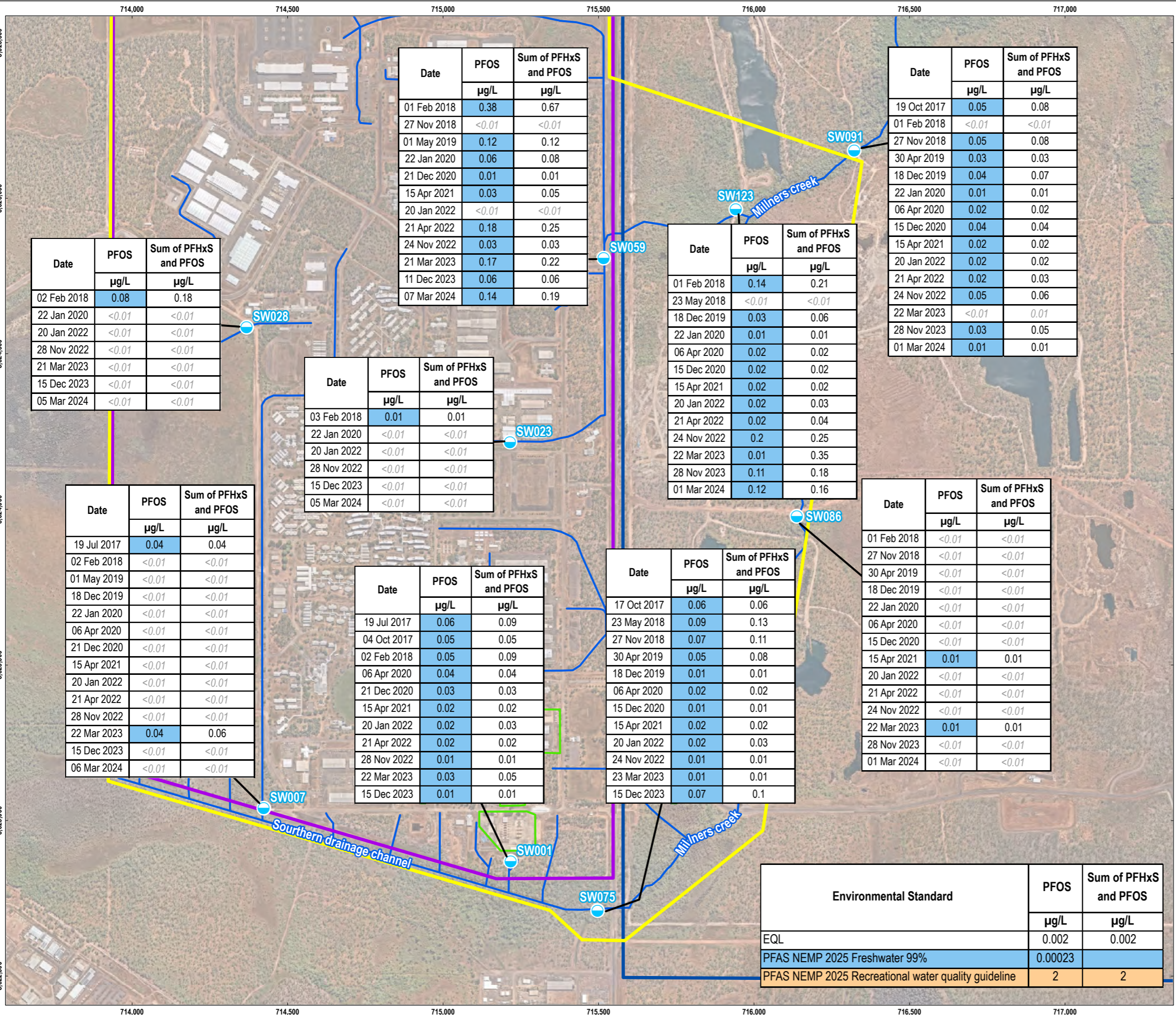
SOURCE
 Areas of concern, sampling location and site boundary (Indicative) from Tetra Tech Coffey.
 Roads from DoD.
 Imagery from Nearmap (04-05-2024).

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

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FIGURE 4B
 PFOS+PFHxS surface water runoff concentrations Source area 3





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

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

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

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

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

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

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

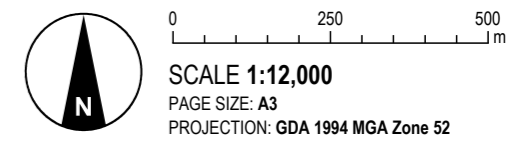
Date	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
19 Oct 2017	0.05	0.08
01 Feb 2018	<0.01	<0.01
27 Nov 2018	0.05	0.08
30 Apr 2019	0.03	0.03
18 Dec 2019	0.04	0.07
22 Jan 2020	0.01	0.01
06 Apr 2020	0.02	0.02
15 Dec 2020	0.04	0.04
15 Apr 2021	0.02	0.02
20 Jan 2022	0.02	0.02
21 Apr 2022	0.02	0.03
24 Nov 2022	0.05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

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

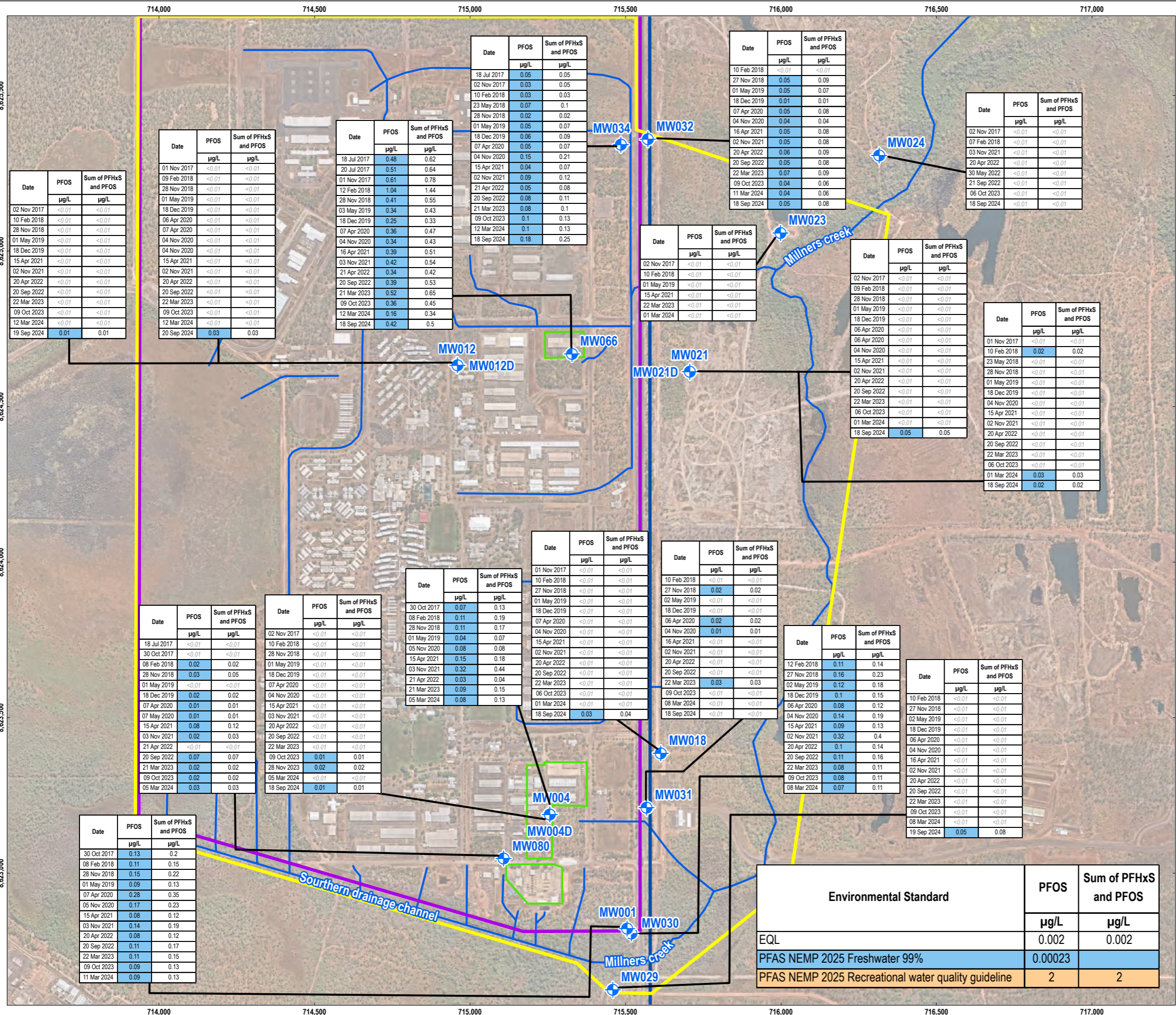
SOURCE
 Locations, PFAS areas, Management area, MTR area and Site boundary (Indicative) from Tetra Tech Coffey
 Roads, tracks, and drains from DoD.
 Imagery from Nearmap (06-06-2023).



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FIGURE 5
 PFOS+PFHxS concentrations in surface water





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).

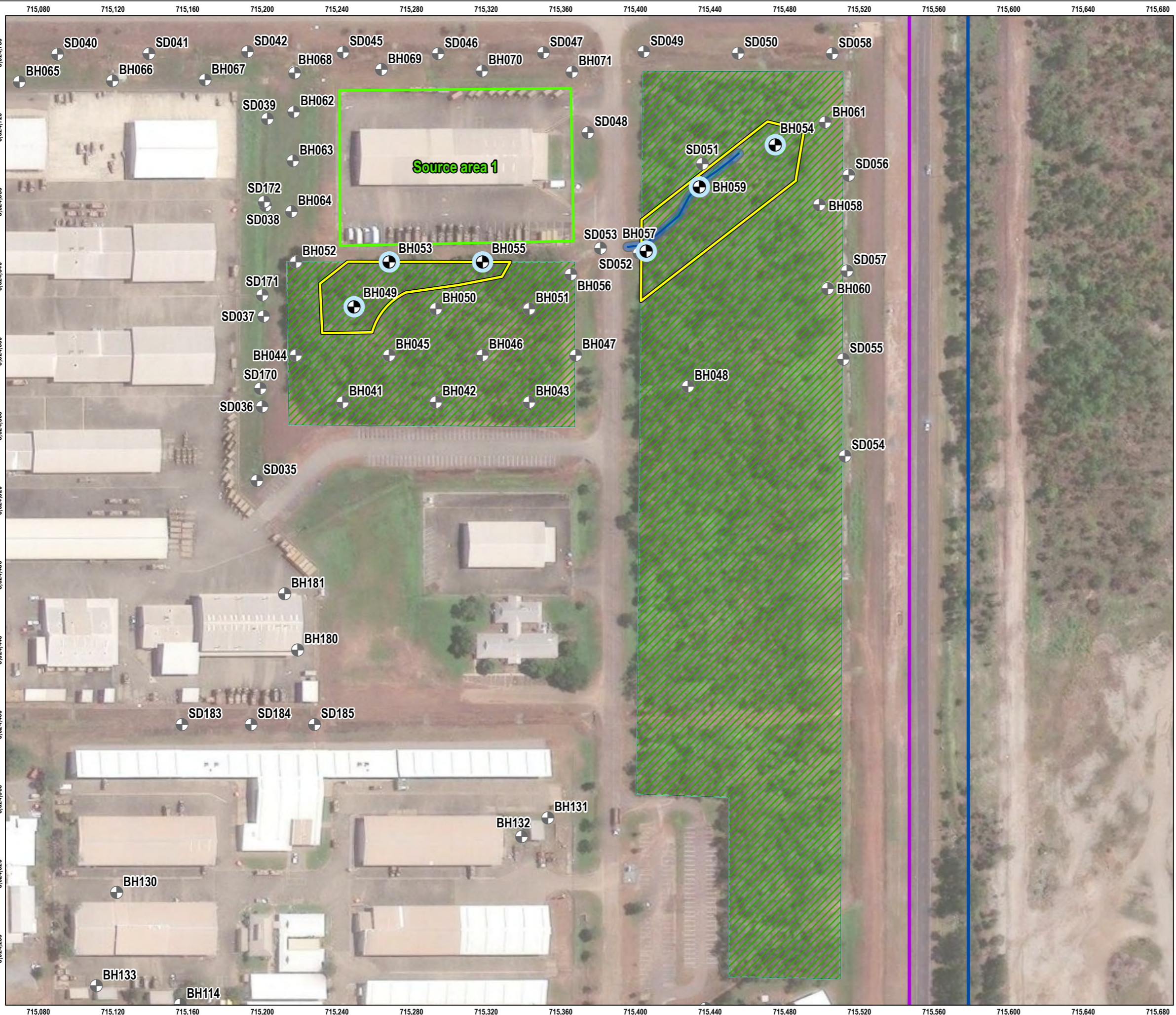
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FIGURE 6
PFOS+PFHxS concentrations in groundwater

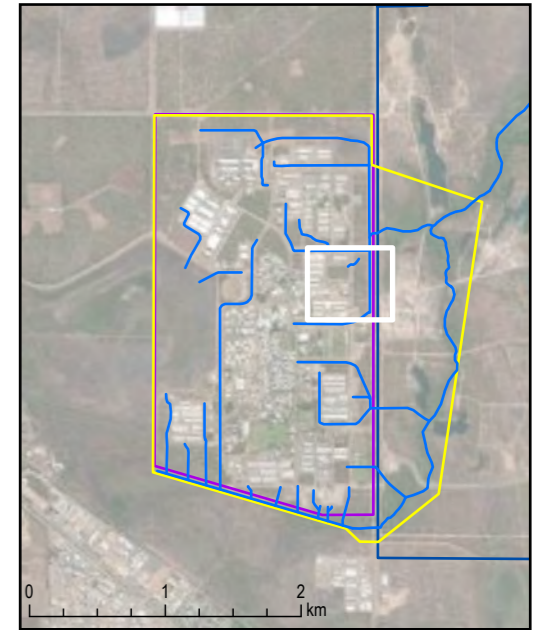
Environmental Standard	PFOS	Sum of PFHxS and PFOS
	µg/L	µg/L
EQL	0.002	0.002
PFAS NEMP 2025 Freshwater 99%	0.00023	
PFAS NEMP 2025 Recreational water quality guideline	2	2





LEGEND

- 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



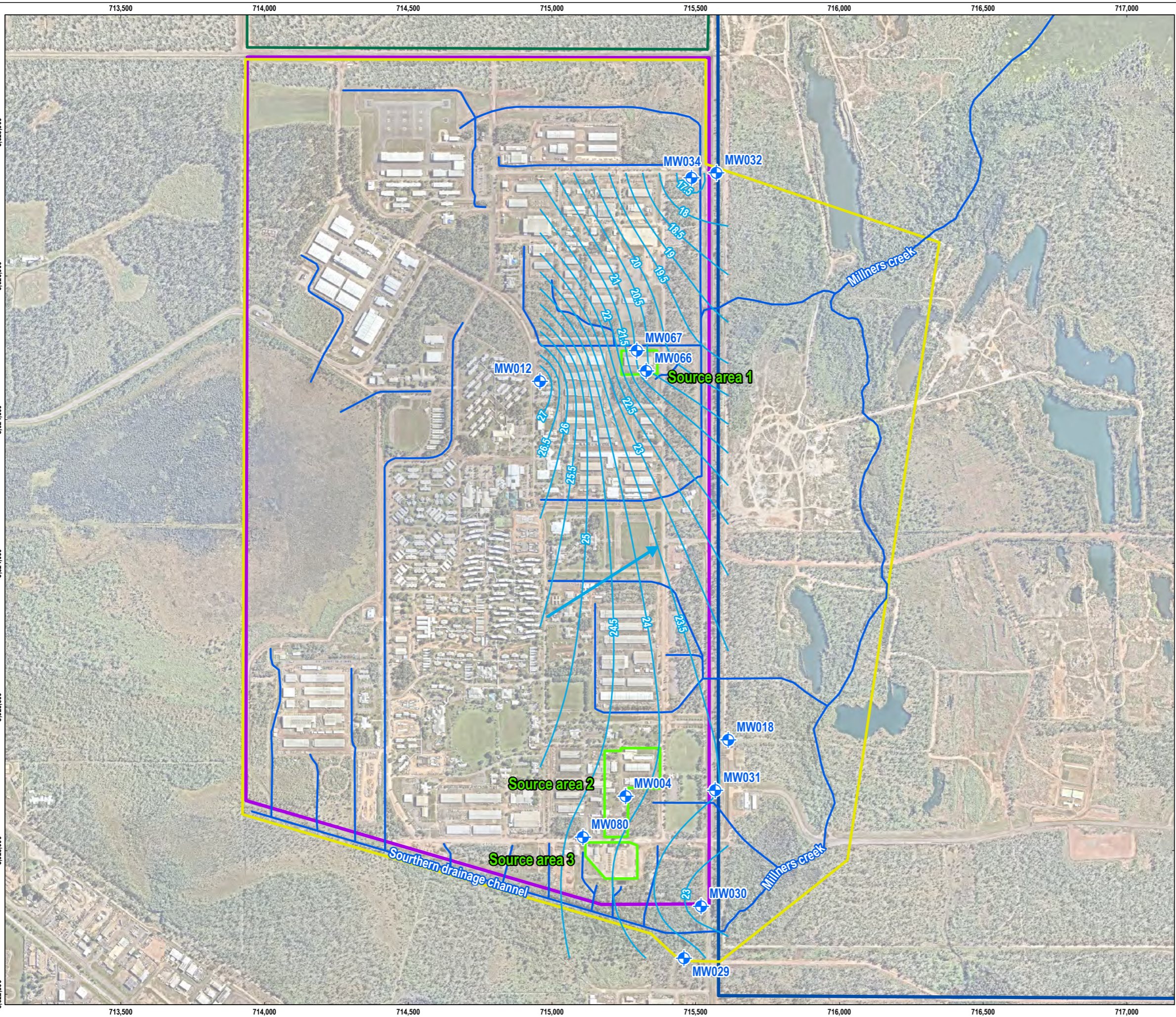
SOURCE
Areas of concern and Site boundary (indicative) from Tetra Tech Coffey.
Soil bore locations, results and NEMP exceedance criteria (from 2018 DSI) from DoD.
Roads, tracks, and creeks from DoD.
Imagery from Nearmap (06-06-2023).

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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





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
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



APPENDIX B TABULATED RESULTS



	PFAS - Perfluoroalkyl Sulfonic Acids						PFAS - Perfluoroalkyl Carboxylic Acids									
	Perfluorobutane sulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PFPeS)	Perfluorohexane sulfonic acid (PFHxS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorooctane sulfonic acid (PFOS)	Perfluorodecane sulfonic acid (PFDS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnDA)	Perfluorododecanoic acid (PFDoDA)	Perfluorotridecanoic acid (PFTriDA)
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
PFAS NEMP 2025 Ecological direct exposure – all land uses					1						10					
PFAS NEMP 2025 HIL D Industrial/commercial			20		20						50					
PFAS NEMP 2025 Interim ecological indirect exposure – all land uses					0.003						0.003					

Location Code	Field ID	Date	Matrix Type	Depth	Lab Report Number													
BH001	BH001_0.0	09 Oct 2017	Soil	0 - 0	ES1725354	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
% of Detects						1	2	13	2	36	3	1	4	7	2	6	0	
% of Non-Detects						99	98	87	98	64	97	99	96	93	98	94	100	98

Environmental Standards

- HEPA, March 2025, PFAS NEMP 2025 Ecological direct exposure – all land uses
- HEPA, March 2025, PFAS NEMP 2025 HIL A Residential with garden/accessible soil
- HEPA, March 2025, PFAS NEMP 2025 HIL D Industrial/commercial
- HEPA, March 2025, PFAS NEMP 2025 Interim ecological indirect exposure – all land uses



	PFAS - (n:2) Fluorotelomer Sulfonic Acids					PFAS - Perfluoroalkyl Sulfonamides								PFAS	
	Perfluorotetradecanoic acid (PFTeDA)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Perfluorooctane sulfonamide (FOSA)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	N-methyl perfluorooctane sulfonamidoethanol (MeFOSE)	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	Sum of PFHxS and PFOS	Sum of PFAS	
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
EQL	0.0005	0.0005	0.0005	0.0005	0.0005	0.0002	0.0005	0.0002	0.0005	0.0005	0.0002	0.0005	0.0002	0.0002	
PFAS NEMP 2025 Ecological direct exposure – all land uses															
PFAS NEMP 2025 HIL D Industrial/commercial													20		
PFAS NEMP 2025 Interim ecological indirect exposure – all land uses															

Location Code	Field ID	Date	Matrix Type	Depth	Lab Report Number														
BH001	BH001_0.0	09 Oct 2017	Soil	0 - 0	ES1725354	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005		
% of Detects						0	0	0	0	0	3	0	0	0	0	0	37	39	
% of Non-Detects						100	100	100	100	100	97	100	100	100	100	100	100	63	61

Environmental Standards

- HEPA, March 2025, PFAS NEMP 2025 Ecological direct exposure – all land uses
- HEPA, March 2025, PFAS NEMP 2025 HIL A Residential with garden/accessible soil
- HEPA, March 2025, PFAS NEMP 2025 HIL D Industrial/commercial
- HEPA, March 2025, PFAS NEMP 2025 Interim ecological indirect exposure – all land uses



Table B2 - Groundwater and Surface Water Analytical Results

	n:2) Fluorotelomer Sulfonic Acids			PFAS - Perfluoroalkyl Sulfonamides						PFAS		
	6:2 Fluorotelomer sulfonic acid (6:2 FTS) µg/L	8:2 Fluorotelomer sulfonic acid (8:2 FTS) µg/L	10:2 Fluorotelomer sulfonic acid (10:2 FTS) µg/L	Perfluorooctane sulfonamide (FOSA) µg/L	N-Methyl perfluorooctane sulfonamide (MeFOSA) µg/L	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA) µg/L	N-methyl perfluorooctane sulfonamidoethanol (MeFOSE) µg/L	N-Ethyl perfluorooctane sulfonamide (EtFOSA) µg/L	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA) µg/L	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE) µg/L	Sum of PFHxS and PFOS µg/L	Sum of PFAS µg/L
EQL	0.005	0.005	0.005	0.02	0.05	0.02	0.05	0.05	0.02	0.05	0.002	0.01
PFAS NEMP 2025 Drinking water quality guideline											0.07	
PFAS NEMP 2025 Freshwater 99%												
PFAS NEMP 2025 Freshwater 90%												
PFAS NEMP 2025 Recreational water quality guideline											2	

Location Code	Field ID	Date	Lab Report Number	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	SW086	30 Apr 2019	ES1913246	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_191218	18 Dec 2019	ES1942300	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_200122	22 Jan 2020	ES2002244	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_200406	06 Apr 2020	ES2012098	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_201215	15 Dec 2020	ES2045382	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_210415	15 Apr 2021	ES2114376	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.01	0.01
SW086	1200_SW086_220120	20 Jan 2022	ES2201970	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_220421	21 Apr 2022	ES2214158	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_221124	24 Nov 2022	ES2242809	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_230322	22 Mar 2023	ES2310005	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.01	0.01
SW086	1200_SW086_231128	28 Nov 2023	ES2341145	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW086	1200_SW086_240301	01 Mar 2024	ES2408291	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW087	SW087	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW088	SW088	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW089	SW089	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW090	SW090	19 Oct 2017	ES1726436	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.10	0.10
SW090	SW090	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.04	0.04
SW091	SW091	19 Oct 2017	ES1726436	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.08	0.08
SW091	SW091	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW091	SW091	27 Nov 2018	ES1835504	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.08	0.08
SW091	SW091	30 Apr 2019	ES1913246	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.03	0.03
SW091	1200_SW091_191219	18 Dec 2019	ES1942300	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.07	0.07
SW091	1200_SW091_200122	22 Jan 2020	ES2002244	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.01	0.01
SW091	1200_SW091_200406	06 Apr 2020	ES2012098	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW091	1200_SW091_201215	15 Dec 2020	ES2045382	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.04	0.04
SW091	1200_SW091_210415	15 Apr 2021	ES2114376	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW091	1200_SW091_220120	20 Jan 2022	ES2201970	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW091	1200_SW091_220421	21 Apr 2022	ES2214158	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.03	0.03
SW091	1200_SW091_221124	24 Nov 2022	ES2242809	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.06	0.06
SW091	1200_SW091_230322	22 Mar 2023	ES2310005	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.01	0.01
SW091	1200_SW091_231128	28 Nov 2023	ES2341145	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.05	0.05
SW091	1200_SW091_240301	01 Mar 2024	ES2408291	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.01	0.01
SW093	SW093	02 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW094	SW094	02 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.27	0.27
SW095	SW095	02 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.45	0.50
SW096	SW096	02 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.12	0.12
SW097	SW097	02 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.04	0.04
SW098	SW098	02 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW100	SW100	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW101	SW101	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW102	SW102	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW103	SW103	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW104	SW104	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW105	SW105	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW106	SW106	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.16	0.22
SW107	SW107	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW108	SW108	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW110	SW110	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW112	SW112	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW113	SW113	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW114	SW114	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW115	SW115	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW116	SW116	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW117	SW117	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW118	SW118	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW120	SW120	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01



	n:2) Fluorotelomer Sulfonic Acids			PFAS - Perfluoroalkyl Sulfonamides						PFAS		
	6:2 Fluorotelomer sulfonic acid (6:2 FTS) µg/L	8:2 Fluorotelomer sulfonic acid (8:2 FTS) µg/L	10:2 Fluorotelomer sulfonic acid (10:2 FTS) µg/L	Perfluorooctane sulfonamide (FOSA) µg/L	N-Methyl perfluorooctane sulfonamide (MeFOSA) µg/L	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA) µg/L	N-methyl perfluorooctane sulfonamidoethanol (MeFOSE) µg/L	N-Ethyl perfluorooctane sulfonamide (EtFOSA) µg/L	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA) µg/L	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE) µg/L	Sum of PFHxS and PFOS µg/L	Sum of PFAS µg/L
EQL	0.005	0.005	0.005	0.02	0.05	0.02	0.05	0.05	0.02	0.05	0.002	0.01
PFAS NEMP 2025 Drinking water quality guideline											0.07	
PFAS NEMP 2025 Freshwater 99%												
PFAS NEMP 2025 Freshwater 90%												
PFAS NEMP 2025 Recreational water quality guideline											2	

Location Code	Field ID	Date	Lab Report Number	6:2 FTS	8:2 FTS	10:2 FTS	FOSA	MeFOSA	MeFOSAA	MeFOSE	EtFOSA	EtFOSAA	EtFOSE	Sum of PFHxS and PFOS	Sum of PFAS
SW122	SW122	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.54	0.83
SW122	SW122	23 May 2018	ES1814996	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.09	0.19
SW123	SW123	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.21	0.23
SW123	SW123	23 May 2018	ES1814996	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW123	SW123	27 Nov 2018	ES1835504	0.06	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.34	0.40
SW123	1200_SW123_191218	18 Dec 2019	ES1942300	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.06	0.06
SW123	1200_SW123_200122	22 Jan 2020	ES2002244	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.01	0.01
SW123	1200_SW123_200406	06 Apr 2020	ES2012098	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW123	1200_SW123_201215	15 Dec 2020	ES2045382	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW123	1200_SW123_210415	15 Apr 2021	ES2114376	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW123	1200_SW123_220120	20 Jan 2022	ES2201970	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.03	0.03
SW123	1200_SW123_220421	21 Apr 2022	ES2214158	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.04	0.04
SW123	1200_SW123_221124	24 Nov 2022	ES2242809	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.25	0.28
SW123	1200_SW123_230322	22 Mar 2023	ES2310005	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.35	1.02
SW123	1200_SW123_231128	28 Nov 2023	ES2341145	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.18	0.18
SW123	1200_SW123_240301	01 Mar 2024	ES2408291	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.16	0.16
SW124	SW124	23 May 2018	ES1814996	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.03	0.09
SW125	SW125	23 May 2018	ES1814996	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.06	0.06
SW126	SW126	23 May 2018	ES1814996	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.06	0.06
SW127	SW127	24 May 2018	ES1814996	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.10	0.10
SW129	SW129	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW130	SW130	01 Feb 2018	ES1803862	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW151	1200_SW151_240718	18 Jul 2024	1119600	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.17	0.36
SW152	1200_SW152_240718	18 Jul 2024	1119600	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.04	<0.1
SW153	1200_SW153_240718	18 Jul 2024	1119600	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.04	<0.1
SW202	1200_SW202_201221	21 Dec 2020	ES2045524	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW202	1200_SW202_210430	30 May 2021	ES2120436	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	<0.01	<0.01
SW203	1200_SW203_210430	30 May 2021	ES2120436	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.04	0.06
SW204	1200_SW204_201221	21 Dec 2020	ES2045524	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW204	1200_SW204_210430	30 May 2021	ES2120436	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW204	1200_SW204_210601	01 Jun 2021	ES2121020	<0.05	<0.05	<0.05	<0.02	<0.05	<0.02	<0.05	<0.05	<0.02	<0.05	0.02	0.02
SW207	1200_SW207_240718	18 Jul 2024	1119600	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	4	6.75
SW208	1200_SW208_240718	18 Jul 2024	1119600	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.22	0.6
SW209	1200_SW209_240718	18 Jul 2024	1119600	<0.05	0.02	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.78	3.08
SW210	1200_SW210_240718	18 Jul 2024	1119600	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.31	0.6
SW211	1200_SW211_240718	18 Jul 2024	1119600	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.02	0.23
SW212	1200_SW212_240718	18 Jul 2024	1119600	0.08	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.03	0.52

Statistics													
% of Detects	2	0	0	0	0	0	0	0	0	0	0	43	43
% of Non-Detects	98	100	100	100	100	100	100	100	100	100	100	57	57

Environmental Standards
 HEPA, March 2025, PFAS NEMP 2025 Drinking water quality guideline
 HEPA, March 2025, PFAS NEMP 2025 Freshwater 99%
 HEPA, March 2025, PFAS NEMP 2025 Recreational water quality guideline

APPENDIX C MANN-KENDALL STATISTICAL ASSESSMENT

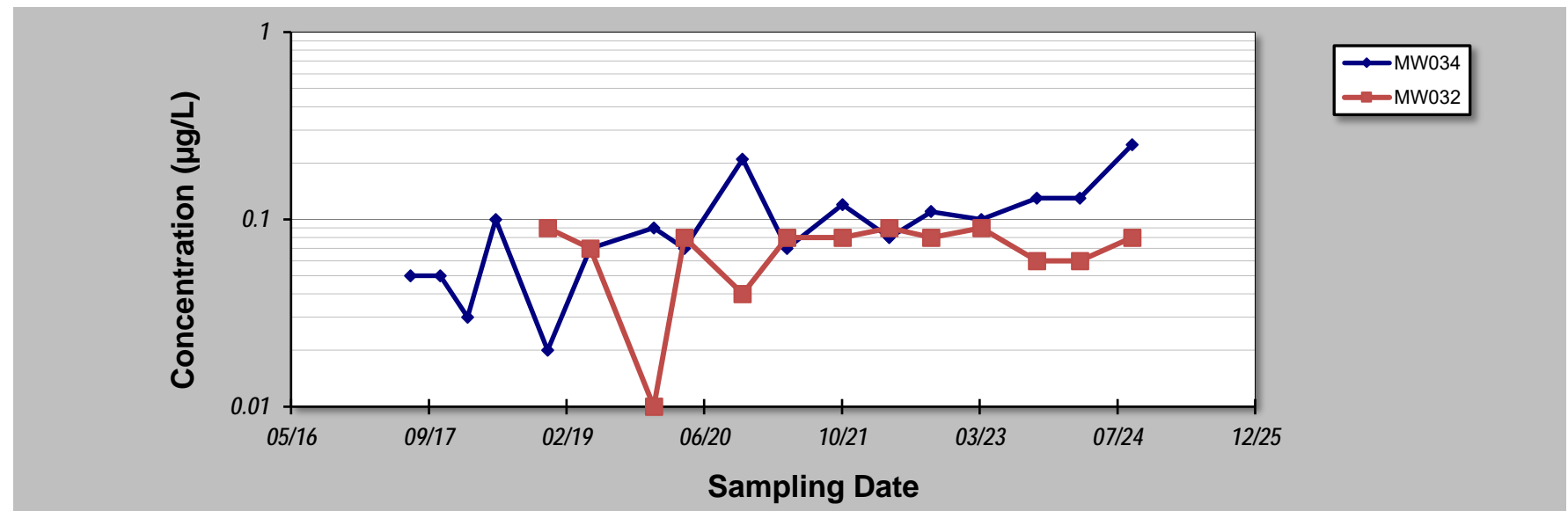
GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: **27-Mar-25**
 Facility Name: **Robertson Barracks**
 Conducted By: **Tetra Tech Coffey**

Job ID: **754-MELEN338204**
 Constituent: **Northern Bores - PFOS+PFHxS**
 Concentration Units: **µg/L**

Sampling Point ID: **MW034** **MW032**

Sampling Event	Sampling Date	NORTHERN BORES - PFOS+PFHXS CONCENTRATION (µg/L)					
1	18-Jul-17	0.05					
2	2-Nov-17	0.05					
3	10-Feb-18	0.03					
4	23-May-18	0.1					
5	28-Nov-18	0.02	0.09				
6	1-May-19	0.07	0.07				
7	18-Dec-19	0.09	0.01				
8	7-Apr-20	0.07	0.08				
9	4-Nov-20	0.21	0.04				
10	15-Apr-21	0.07	0.08				
11	2-Nov-21	0.12	0.08				
12	21-Apr-22	0.08	0.09				
13	20-Sep-22	0.11	0.08				
14	21-Mar-23	0.1	0.09				
15	9-Oct-23	0.13	0.06				
16	12-Mar-24	0.13	0.06				
17	18-Sep-24	0.25	0.08				
18							
19							
20							
Coefficient of Variation:		0.60	0.33				
Mann-Kendall Statistic (S):		80	4				
Confidence Factor:		>99.9%	57.1%				
Concentration Trend:		Increasing	No Trend				



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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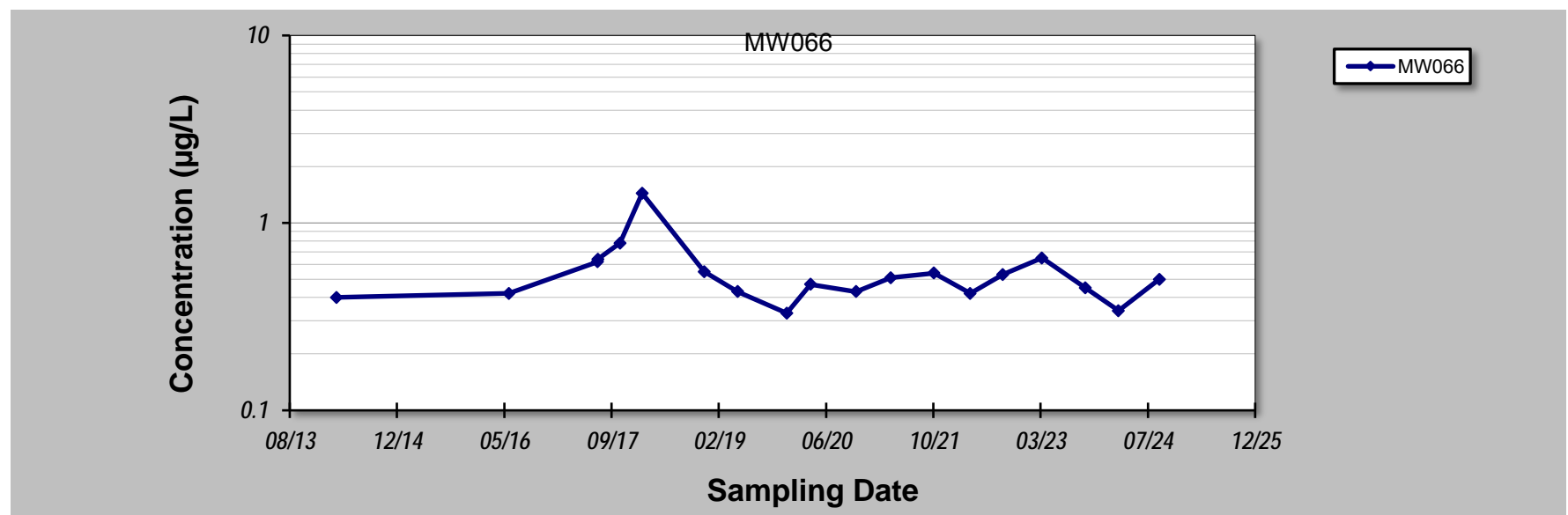
GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: **27-Mar-25**
 Facility Name: **Robertson Barracks**
 Conducted By: **Tetra Tech coffey**

Job ID: **754-MELEN338204**
 Constituent: **Source Area 1 and Northern bores - PFOS+PFHx**
 Concentration Units: **µg/L**

Sampling Point ID: **MW066**

Sampling Event	Sampling Date	SOURCE AREA 1 AND NORTHERN BORES - PFOS+PFHXS CONCENTRATION (µg/L)					
1	20-Mar-14	0.4					
2	1-Jun-16	0.42					
3	18-Jul-17	0.62					
4	20-Jul-17	0.64					
5	1-Nov-17	0.78					
6	12-Feb-18	1.44					
7	28-Nov-18	0.55					
8	3-May-19	0.43					
9	18-Dec-19	0.33					
10	7-Apr-20	0.47					
11	4-Nov-20	0.43					
12	16-Apr-21	0.51					
13	3-Nov-21	0.54					
14	21-Apr-22	0.42					
15	20-Sep-22	0.53					
16	21-Mar-23	0.65					
17	9-Oct-23	0.45					
18	12-Mar-24	0.34					
19	18-Sep-24	0.5					
20							
Coefficient of Variation:		0.44					
Mann-Kendall Statistic (S):		-13					
Confidence Factor:		66.1%					
Concentration Trend:		Stable					



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

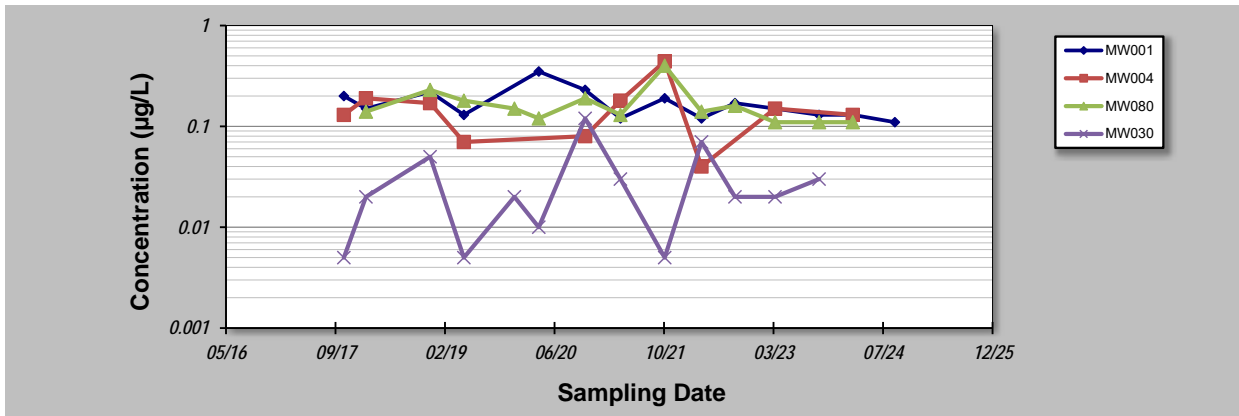
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GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 6-Jun-25	Job ID: 754-MELEN338204
Facility Name: Robertson Barracks	Constituent: Sum of PFOS+PFHxS
Conducted By: Tetra Tech Coffey	Concentration Units: µg/L

Sampling Point ID:		MW001	MW004	MW080	MW030			
Sampling Event	Sampling Date	SUM OF PFOS+PFHXS CONCENTRATION (µg/L)						
1	30-Oct-17	0.2	0.13		0.005			
2	8-Feb-18	0.15	0.19	0.14	0.02			
3	28-Nov-18	0.22	0.17	0.23	0.05			
4	1-May-19	0.13	0.07	0.18	0.005			
5	18-Dec-19			0.15	0.02			
6	7-Apr-20	0.35		0.12	0.01			
7	5-Nov-20	0.23	0.08	0.19	0.12			
8	15-Apr-21	0.12	0.18	0.13	0.03			
9	3-Nov-21	0.19	0.44	0.4	0.005			
10	20-Apr-22	0.12	0.04	0.14	0.07			
11	20-Sep-22	0.17		0.16	0.02			
12	22-Mar-23	0.15	0.15	0.11	0.02			
13	9-Oct-23	0.13		0.11	0.03			
14	11-Mar-24	0.13	0.13	0.11				
15	19-Sep-24	0.11						
16								
17								
18								
19								
20								
Coefficient of Variation:		0.38	0.70	0.47	1.05			
Mann-Kendall Statistic (S):		-38	-4	-30	16			
Confidence Factor:		97.9%	60.3%	96.2%	81.6%			
Concentration Trend:		Decreasing	Stable	Decreasing	No Trend			



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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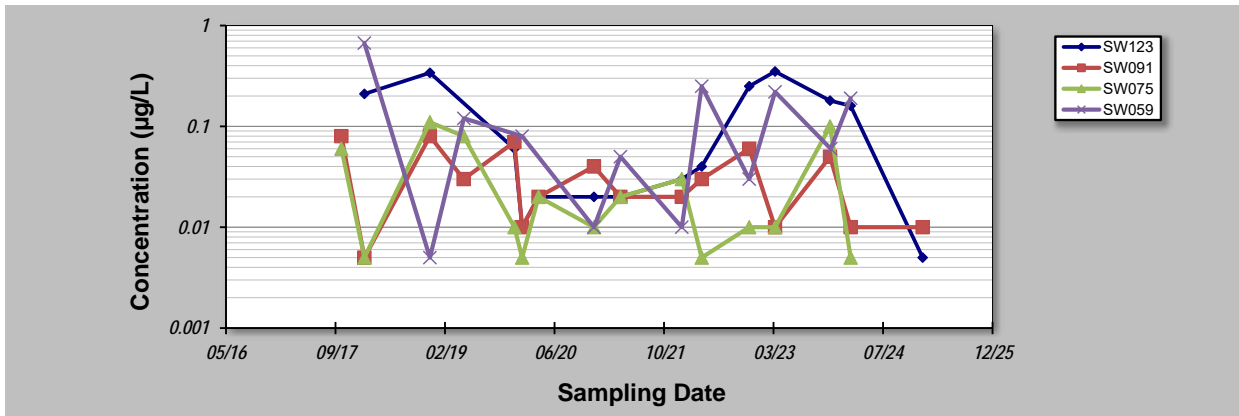
GSI MANN-KENDALL TOOLKIT for Constituent Trend Analysis

Evaluation Date: 27-Mar-25	Job ID: 754-MELEN338204
Facility Name: Robertson Barracks	Constituent: Surface water
Conducted By: Tetra Tech Coffey	Concentration Units: µg/L

Sampling Point ID:	SW123	SW091	SW075	SW059			
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Sampling Event	Sampling Date	SURFACE WATER CONCENTRATION (µg/L)			
1	Oct-17		0.08	0.06	
2	Feb-18	0.21	0.005	0.005	0.67
3	Nov-18	0.34	0.08	0.11	0.005
4	Apr-19		0.03	0.08	
5	May-19				0.12
6	Dec-19	0.06	0.07	0.01	
7	Jan-20	0.01	0.01	0.005	0.08
8	Apr-20	0.02	0.02	0.02	
9	Dec-20	0.02	0.04	0.01	0.01
10	Apr-21	0.02	0.02	0.02	0.05
11	Jan-22	0.03	0.02	0.03	0.01
12	Apr-22	0.04	0.03	0.005	0.25
13	Nov-22	0.25	0.06	0.01	0.03
14	Mar-23	0.35	0.01	0.01	0.22
15	Nov-23	0.18	0.05	0.1	
16	Dec-23				0.06
17	Mar-24	0.16	0.01	0.005	0.19
18	Jan-25	0.005	0.01		
19					
20					

Coefficient of Variation:	1.04	0.77	1.15	1.32
Mann-Kendall Statistic (S):	2	-29	-16	5
Confidence Factor:	52.2%	89.5%	76.7%	60.6%
Concentration Trend:	No Trend	Stable	No Trend	No Trend



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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APPENDIX D PROUCL® OUTPUTS

	A	B	C	D	E	F	G	H	I	J	K
1	Field ID - South and east of SA1	South and east of SA1	D_South and east of SA1		Field ID - CTA	CTA	D_CTA		Field ID - Southern portion and south of the base	Southern portion and south of the base	D_Southern portion and south of the base
2	BH041_0.0	0.0002	0		MW019_0.0	0.0002	0		BH077	0.0007	1
3	BH042_0.0	0.0002	0		MW020_0.0	0.0002	0		BH077_0.0	0.0006	1
4	BH043_0.0	0.0002	0		MW022_0.0	0.0002	0		BH078_0.0	0.0002	0
5	BH044_0.0	0.0003	1		MW022_0.0	0.0002	0		BH079_0.0	0.0002	0
6	BH045_0.0	0.0002	0		MW023_0.0	0.0007	1		BH080_0.0	0.0002	0
7	BH046_0.0	0.0002	0		MW023_0.0	0.0002	0		BH088_0.0	0.0072	1
8	BH047_0.0	0.0002	0		MW024_0.0	0.0006	1		BH089_0.0	0.0003	1
9	BH048_0.0	0.0002	0		MW024_0.0	0.0002	0		BH090_0.0	0.0023	1
10	BH048_0.6	0.0002	0		1200_SD086_200406	0.0002	0		BH091_0.0	0.0002	0
11	BH049_0.0	0.0048	1		1200_SD086_210415	0.0002	0		BH092_0.0	0.0002	0
12	BH050_0.0	0.0007	1		1200_SD086_220421	0.0045	1		BH093_0.0	0.0005	1
13	BH051_0.0	0.0002	0		SD086	0.0008	1		MW001_0.0	0.0008	1
14	BH051_0.3	0.0002	0		SD086	0.0002	0		MW003_0.0	0.0004	1
15	BH052_0.0	0.0009	1		SD087	0.0007	1		1200_SD007_200406	0.0002	0
16	BH053_0.0	0.0106	1		SD087	0.0002	0		1200_SD007_210415	0.0002	0
17	BH053_0.3	0.0002	0		SD088	0.0013	1		1200_SD007_220421	0.0002	0
18	BH054_0.0	0.0049	1		SD088	0.0002	0		SD007	0.0002	0
19	BH055_0.0	0.0315	1		SD089	0.0014	1		SD007	0.0002	0
20	BH055_0.5	0.0421	1		SD089	0.0002	1		SD007	0.0002	0
21	BH056_0.0	0.0002	0		SD090	0.0008	1		SD008	0.0002	0
22	BH057_0.0	0.0007	1		SD090	0.0002	0		SD008	0.0093	1
23	BH057_0.9	0.054	1		1200_SD091_210415	0.0002	0		SD009	0.0002	0
24	BH058_0.0	0.0002	0		1200_SD091_220421	0.0002	0		SD009	0.0002	0
25	BH059_0.0	0.0266	1		SD091	0.001	1		SD010	0.0008	1
26	BH059_0.5	0.0198	1		SD091	0.0017	1		SD010	0.0002	0
27	BH060_0.0	0.0002	0		SD091	0.0002	1		SD011	0.0038	1
28	BH061_0.0	0.0002	0		SD124	0.0003	1		SD011	0.0002	0
29	1200_BH246_0.0_240718	0.0002	0		SD125	0.0004	1		1200_SD075_200406	0.0007	1
30	1200_BH246_0.2_240718	0.0002	0		SD126	0.0008	1		1200_SD075_210415	0.0002	0
31	1200_BH246_0.5_240718	0.0002	0						1200_SD075_220421	0.0013	1
32	1200_BH246_1.0_240718	0.0002	0						SD075	0.0014	1
33	1200_BH246_1.5_240718	0.0002	0						SD075	0.0003	1
34	SD051	0.025	1						SD075	0.0014	1
35	SD051	0.0291	1						SD075	0.0007	1
36	SD052	0.0231	1						SD076	0.0005	1
37	SD052	0.0192	1						SD077	0.0002	1
38	SD054	0.0002	0						SD077	0.001	1
39	SD054	0.0002	0						SD078	0.0003	1
40	SD055	0.0002	0						SD079	0.0002	0
41	SD055	0.0002	0						SD080	0.0002	0
42									SD081	0.0007	1
43									SD093	0.0023	1
44									SD094	0.0111	1
45									SD095	0.0076	1
46									SD096	0.0002	0
47									SD097	0.0003	1
48									1200_SD202_210601	0.0005	1
49									1200_SD203_210601	0.0012	1

A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects										
2											
3	User Selected Options										
4	Date/Time of Computation		ProUCL 5.2 4/06/2025 4:16:43 PM								
5	From File		WorkSheet.xls								
6	Full Precision		OFF								
7	Confidence Coefficient		95%								
8	Number of Bootstrap Operations		2000								
9											
10	South and east of Source Area 1										
11											
12	General Statistics										
13	Total Number of Observations			40		Number of Distinct Observations			16		
14	Number of Detects			16		Number of Non-Detects			24		
15	Number of Distinct Detects			15		Number of Distinct Non-Detects			1		
16	Minimum Detect			3.0000E-4		Minimum Non-Detect			2.0000E-4		
17	Maximum Detect			0.054		Maximum Non-Detect			2.0000E-4		
18	Variance Detects			2.6260E-4		Percent Non-Detects			60%		
19	Mean Detects			0.0183		SD Detects			0.0162		
20	Median Detects			0.0195		CV Detects			0.884		
21	Skewness Detects			0.642		Kurtosis Detects			-0.17		
22	Mean of Logged Detects			-4.806		SD of Logged Detects			1.701		
23											
24	Normal GOF Test on Detects Only										
25	Shapiro Wilk Test Statistic			0.912		Shapiro Wilk GOF Test					
26	1% Shapiro Wilk Critical Value			0.844		Detected Data appear Normal at 1% Significance Level					
27	Lilliefors Test Statistic			0.171		Lilliefors GOF Test					
28	1% Lilliefors Critical Value			0.248		Detected Data appear Normal at 1% Significance Level					
29	Detected Data appear Normal at 1% Significance Level										
30											
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs										
32	KM Mean		0.00745		KM Standard Error of Mean			0.00217			
33	90KM SD		0.0133		95% KM (BCA) UCL			0.011			
34	95% KM (t) UCL		0.0111		95% KM (Percentile Bootstrap) UCL			0.0111			
35	95% KM (z) UCL		0.011		95% KM Bootstrap t UCL			0.0123			
36	90% KM Chebyshev UCL		0.014		95% KM Chebyshev UCL			0.0169			
37	97.5% KM Chebyshev UCL		0.021		99% KM Chebyshev UCL			0.0291			
38											
39	Gamma GOF Tests on Detected Observations Only										
40	A-D Test Statistic		0.736		Anderson-Darling GOF Test						
41	5% A-D Critical Value		0.775		Detected data appear Gamma Distributed at 5% Significance Level						
42	K-S Test Statistic		0.229		Kolmogorov-Smirnov GOF						
43	5% K-S Critical Value		0.223		Detected Data Not Gamma Distributed at 5% Significance Level						
44	Detected data follow Appr. Gamma Distribution at 5% Significance Level										
45											
46	Gamma Statistics on Detected Data Only										
47	k hat (MLE)		0.743		k star (bias corrected MLE)			0.645			
48	Theta hat (MLE)		0.0247		Theta star (bias corrected MLE)			0.0284			
49	nu hat (MLE)		23.77		nu star (bias corrected)			20.65			
50	Mean (detects)		0.0183								
51											
52	Gamma ROS Statistics using Imputed Non-Detects										
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs										
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)										
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs										

A	B	C	D	E	F	G	H	I	J	K	L
56	This is especially true when the sample size is small.										
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates										
58	Minimum	3.0000E-4							Mean	0.0133	
59	Maximum	0.054							Median	0.01	
60	SD	0.0109							CV	0.815	
61	k hat (MLE)	1.504							k star (bias corrected MLE)	1.408	
62	Theta hat (MLE)	0.00887							Theta star (bias corrected MLE)	0.00947	
63	nu hat (MLE)	120.3							nu star (bias corrected)	112.6	
64	Adjusted Level of Significance (β)	0.044									
65	Approximate Chi Square Value (112.60, α)	89.11							Adjusted Chi Square Value (112.60, β)	88.32	
66	95% Gamma Approximate UCL	0.0168							95% Gamma Adjusted UCL	0.017	
67											
68	Estimates of Gamma Parameters using KM Estimates										
69	Mean (KM)	0.00745							SD (KM)	0.0133	
70	Variance (KM)	1.7737E-4							SE of Mean (KM)	0.00217	
71	k hat (KM)	0.313							k star (KM)	0.306	
72	nu hat (KM)	25.05							nu star (KM)	24.5	
73	theta hat (KM)	0.0238							theta star (KM)	0.0243	
74	80% gamma percentile (KM)	0.0115							90% gamma percentile (KM)	0.0219	
75	95% gamma percentile (KM)	0.0339							99% gamma percentile (KM)	0.0648	
76											
77	Gamma Kaplan-Meier (KM) Statistics										
78	Approximate Chi Square Value (24.50, α)	14.23							Adjusted Chi Square Value (24.50, β)	13.94	
79	95% KM Approximate Gamma UCL	0.0128							95% KM Adjusted Gamma UCL	0.0131	
80											
81	Lognormal GOF Test on Detected Observations Only										
82	Shapiro Wilk Test Statistic	0.848							Shapiro Wilk GOF Test		
83	10% Shapiro Wilk Critical Value	0.906							Detected Data Not Lognormal at 10% Significance Level		
84	Lilliefors Test Statistic	0.255							Lilliefors GOF Test		
85	10% Lilliefors Critical Value	0.196							Detected Data Not Lognormal at 10% Significance Level		
86	Detected Data Not Lognormal at 10% Significance Level										
87											
88	Lognormal ROS Statistics Using Imputed Non-Detects										
89	Mean in Original Scale	0.00746							Mean in Log Scale	-7.578	
90	SD in Original Scale	0.0135							SD in Log Scale	2.863	
91	95% t UCL (assumes normality of ROS data)	0.0111							95% Percentile Bootstrap UCL	0.0111	
92	95% BCA Bootstrap UCL	0.0115							95% Bootstrap t UCL	0.0122	
93	95% H-UCL (Log ROS)	0.321									
94											
95	Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution										
96	KM Mean (logged)	-7.033							KM Geo Mean	8.8249E-4	
97	KM SD (logged)	2.095							95% Critical H Value (KM-Log)	3.918	
98	KM Standard Error of Mean (logged)	0.342							95% H-UCL (KM -Log)	0.0295	
99	KM SD (logged)	2.095							95% Critical H Value (KM-Log)	3.918	
100	KM Standard Error of Mean (logged)	0.342									
101											
102	DL/2 Statistics										
103	DL/2 Normal					DL/2 Log-Transformed					
104	Mean in Original Scale	0.00739							Mean in Log Scale	-7.449	
105	SD in Original Scale	0.0135							SD in Log Scale	2.426	
106	95% t UCL (Assumes normality)	0.011							95% H-Stat UCL	0.0617	
107	DL/2 is not a recommended method, provided for comparisons and historical reasons										
108											
109	Nonparametric Distribution Free UCL Statistics										
110	Detected Data appear Normal Distributed at 1% Significance Level										
111											

	A	B	C	D	E	F	G	H	I	J	K	L
111												
112	Suggested UCL to Use											
113	95% KM (t) UCL				0.0111							
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
117	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
118												

A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects										
2											
3	User Selected Options										
4	Date/Time of Computation		ProUCL 5.2 4/06/2025 4:32:19 PM								
5	From File		WorkSheet.xls								
6	Full Precision		OFF								
7	Confidence Coefficient		95%								
8	Number of Bootstrap Operations		2000								
9											
10	CTA										
11											
12	General Statistics										
13	Total Number of Observations			29		Number of Distinct Observations			11		
14	Number of Detects			15		Number of Non-Detects			14		
15	Number of Distinct Detects			11		Number of Distinct Non-Detects			1		
16	Minimum Detect			2.0000E-4		Minimum Non-Detect			2.0000E-4		
17	Maximum Detect			0.0045		Maximum Non-Detect			2.0000E-4		
18	Variance Detects			1.1121E-6		Percent Non-Detects			48.28%		
19	Mean Detects			0.00103		SD Detects			0.00105		
20	Median Detects			8.0000E-4		CV Detects			1.027		
21	Skewness Detects			2.835		Kurtosis Detects			9.31		
22	Mean of Logged Detects			-7.214		SD of Logged Detects			0.822		
23											
24	Normal GOF Test on Detects Only										
25	Shapiro Wilk Test Statistic			0.666		Shapiro Wilk GOF Test					
26	1% Shapiro Wilk Critical Value			0.835		Detected Data Not Normal at 1% Significance Level					
27	Lilliefors Test Statistic			0.252		Lilliefors GOF Test					
28	1% Lilliefors Critical Value			0.255		Detected Data appear Normal at 1% Significance Level					
29	Detected Data appear Approximate Normal at 1% Significance Level										
30											
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs										
32	KM Mean			6.2759E-4		KM Standard Error of Mean			1.6168E-4		
33	90KM SD			8.4114E-4		95% KM (BCA) UCL			9.1034E-4		
34	95% KM (t) UCL			9.0262E-4		95% KM (Percentile Bootstrap) UCL			9.1034E-4		
35	95% KM (z) UCL			8.9352E-4		95% KM Bootstrap t UCL			0.00117		
36	90% KM Chebyshev UCL			0.00111		95% KM Chebyshev UCL			0.00133		
37	97.5% KM Chebyshev UCL			0.00164		99% KM Chebyshev UCL			0.00224		
38											
39	Gamma GOF Tests on Detected Observations Only										
40	A-D Test Statistic			0.494		Anderson-Darling GOF Test					
41	5% A-D Critical Value			0.752		Detected data appear Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic			0.183		Kolmogorov-Smirnov GOF					
43	5% K-S Critical Value			0.225		Detected data appear Gamma Distributed at 5% Significance Level					
44	Detected data appear Gamma Distributed at 5% Significance Level										
45											
46	Gamma Statistics on Detected Data Only										
47	k hat (MLE)			1.649		k star (bias corrected MLE)			1.363		
48	Theta hat (MLE)			6.2268E-4		Theta star (bias corrected MLE)			7.5298E-4		
49	nu hat (MLE)			49.46		nu star (bias corrected)			40.9		
50	Mean (detects)			0.00103							
51											
52	Gamma ROS Statistics using Imputed Non-Detects										
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs										
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)										
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs										

A	B	C	D	E	F	G	H	I	J	K	L
56	This is especially true when the sample size is small.										
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates										
58	Minimum	2.0000E-4							Mean	0.00536	
59	Maximum	0.01							Median	0.0045	
60	SD	0.00462							CV	0.863	
61	k hat (MLE)	0.816							k star (bias corrected MLE)	0.754	
62	Theta hat (MLE)	0.00657							Theta star (bias corrected MLE)	0.0071	
63	nu hat (MLE)	47.31							nu star (bias corrected)	43.75	
64	Adjusted Level of Significance (β)	0.0407									
65	Approximate Chi Square Value (43.75, α)	29.58							Adjusted Chi Square Value (43.75, β)	28.89	
66	95% Gamma Approximate UCL	0.00793							95% Gamma Adjusted UCL	0.00812	
67											
68	Estimates of Gamma Parameters using KM Estimates										
69	Mean (KM)	6.2759E-4							SD (KM)	8.4114E-4	
70	Variance (KM)	7.0751E-7							SE of Mean (KM)	1.6168E-4	
71	k hat (KM)	0.557							k star (KM)	0.522	
72	nu hat (KM)	32.29							nu star (KM)	30.28	
73	theta hat (KM)	0.00113							theta star (KM)	0.0012	
74	80% gamma percentile (KM)	0.00103							90% gamma percentile (KM)	0.00168	
75	95% gamma percentile (KM)	0.00237							99% gamma percentile (KM)	0.00407	
76											
77	Gamma Kaplan-Meier (KM) Statistics										
78	Approximate Chi Square Value (30.28, α)	18.71							Adjusted Chi Square Value (30.28, β)	18.17	
79	95% KM Approximate Gamma UCL	0.00102							95% KM Adjusted Gamma UCL	0.00105	
80											
81	Lognormal GOF Test on Detected Observations Only										
82	Shapiro Wilk Test Statistic	0.954							Shapiro Wilk GOF Test		
83	10% Shapiro Wilk Critical Value	0.901							Detected Data appear Lognormal at 10% Significance Level		
84	Lilliefors Test Statistic	0.142							Lilliefors GOF Test		
85	10% Lilliefors Critical Value	0.202							Detected Data appear Lognormal at 10% Significance Level		
86	Detected Data appear Lognormal at 10% Significance Level										
87											
88	Lognormal ROS Statistics Using Imputed Non-Detects										
89	Mean in Original Scale	5.7799E-4							Mean in Log Scale	-8.301	
90	SD in Original Scale	8.8381E-4							SD in Log Scale	1.384	
91	95% t UCL (assumes normality of ROS data)	8.5718E-4							95% Percentile Bootstrap UCL	8.5181E-4	
92	95% BCA Bootstrap UCL	9.5966E-4							95% Bootstrap t UCL	0.00112	
93	95% H-UCL (Log ROS)	0.00141									
94											
95	Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution										
96	KM Mean (logged)	-7.843							KM Geo Mean	3.9236E-4	
97	KM SD (logged)	0.866							95% Critical H Value (KM-Log)	2.306	
98	KM Standard Error of Mean (logged)	0.166							95% H-UCL (KM -Log)	8.3249E-4	
99	KM SD (logged)	0.866							95% Critical H Value (KM-Log)	2.306	
100	KM Standard Error of Mean (logged)	0.166									
101											
102	DL/2 Statistics										
103	DL/2 Normal					DL/2 Log-Transformed					
104	Mean in Original Scale	5.7931E-4							Mean in Log Scale	-8.178	
105	SD in Original Scale	8.8212E-4							SD in Log Scale	1.17	
106	95% t UCL (Assumes normality)	8.5796E-4							95% H-Stat UCL	0.00101	
107	DL/2 is not a recommended method, provided for comparisons and historical reasons										
108											
109	Nonparametric Distribution Free UCL Statistics										
110	Detected Data appear Approximate Normal Distributed at 1% Significance Level										
111											

	A	B	C	D	E	F	G	H	I	J	K	L
111												
112	Suggested UCL to Use											
113	95% KM (t) UCL 9.0262E-4											
114												
115	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.											
116	Please verify the data were collected from random locations.											
117	If the data were collected using judgmental or other non-random methods,											
118	then contact a statistician to correctly calculate UCLs.											
119												
120	When a data set follows an approximate distribution passing only one of the GOF tests,											
121	it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL											
122												
123	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
124	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
125	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
126												

A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects										
2											
3	User Selected Options										
4	Date/Time of Computation		ProUCL 5.2 4/06/2025 4:37:48 PM								
5	From File		WorkSheet.xls								
6	Full Precision		OFF								
7	Confidence Coefficient		95%								
8	Number of Bootstrap Operations		2000								
9											
10	Southern portion and south of the base										
11											
12	General Statistics										
13	Total Number of Observations			48		Number of Distinct Observations			17		
14	Number of Detects			28		Number of Non-Detects			20		
15	Number of Distinct Detects			17		Number of Distinct Non-Detects			1		
16	Minimum Detect			2.0000E-4		Minimum Non-Detect			2.0000E-4		
17	Maximum Detect			0.0111		Maximum Non-Detect			2.0000E-4		
18	Variance Detects			8.7521E-6		Percent Non-Detects			41.67%		
19	Mean Detects			0.00208		SD Detects			0.00296		
20	Median Detects			7.5000E-4		CV Detects			1.423		
21	Skewness Detects			2.083		Kurtosis Detects			3.325		
22	Mean of Logged Detects			-6.874		SD of Logged Detects			1.119		
23											
24	Normal GOF Test on Detects Only										
25	Shapiro Wilk Test Statistic			0.632		Shapiro Wilk GOF Test					
26	1% Shapiro Wilk Critical Value			0.896		Detected Data Not Normal at 1% Significance Level					
27	Lilliefors Test Statistic			0.341		Lilliefors GOF Test					
28	1% Lilliefors Critical Value			0.191		Detected Data Not Normal at 1% Significance Level					
29	Detected Data Not Normal at 1% Significance Level										
30											
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs										
32	KM Mean		0.0013		KM Standard Error of Mean			3.5340E-4			
33	90KM SD		0.0024		95% KM (BCA) UCL			0.0019			
34	95% KM (t) UCL		0.00189		95% KM (Percentile Bootstrap) UCL			0.00191			
35	95% KM (z) UCL		0.00188		95% KM Bootstrap t UCL			0.00232			
36	90% KM Chebyshev UCL		0.00236		95% KM Chebyshev UCL			0.00284			
37	97.5% KM Chebyshev UCL		0.0035		99% KM Chebyshev UCL			0.00481			
38											
39	Gamma GOF Tests on Detected Observations Only										
40	A-D Test Statistic		1.966		Anderson-Darling GOF Test						
41	5% A-D Critical Value		0.781		Detected Data Not Gamma Distributed at 5% Significance Level						
42	K-S Test Statistic		0.236		Kolmogorov-Smirnov GOF						
43	5% K-S Critical Value		0.171		Detected Data Not Gamma Distributed at 5% Significance Level						
44	Detected Data Not Gamma Distributed at 5% Significance Level										
45											
46	Gamma Statistics on Detected Data Only										
47	k hat (MLE)		0.845		k star (bias corrected MLE)			0.778			
48	Theta hat (MLE)		0.00246		Theta star (bias corrected MLE)			0.00267			
49	nu hat (MLE)		47.3		nu star (bias corrected)			43.57			
50	Mean (detects)		0.00208								
51											
52	Gamma ROS Statistics using Imputed Non-Detects										
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs										
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)										
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs										

A	B	C	D	E	F	G	H	I	J	K	L
56	This is especially true when the sample size is small.										
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates										
58	Minimum	2.0000E-4							Mean	0.00538	
59	Maximum	0.0111							Median	0.0055	
60	SD	0.00454							CV	0.844	
61	k hat (MLE)	0.839							k star (bias corrected MLE)	0.8	
62	Theta hat (MLE)	0.00641							Theta star (bias corrected MLE)	0.00672	
63	nu hat (MLE)	80.52							nu star (bias corrected)	76.82	
64	Adjusted Level of Significance (β)	0.045									
65	Approximate Chi Square Value (76.82, α)	57.63							Adjusted Chi Square Value (76.82, β)	57.11	
66	95% Gamma Approximate UCL	0.00717							95% Gamma Adjusted UCL	0.00723	
67											
68	Estimates of Gamma Parameters using KM Estimates										
69	Mean (KM)	0.0013							SD (KM)	0.0024	
70	Variance (KM)	5.7808E-6							SE of Mean (KM)	3.5340E-4	
71	k hat (KM)	0.29							k star (KM)	0.286	
72	nu hat (KM)	27.89							nu star (KM)	27.48	
73	theta hat (KM)	0.00446							theta star (KM)	0.00453	
74	80% gamma percentile (KM)	0.00196							90% gamma percentile (KM)	0.00384	
75	95% gamma percentile (KM)	0.00602							99% gamma percentile (KM)	0.0117	
76											
77	Gamma Kaplan-Meier (KM) Statistics										
78	Approximate Chi Square Value (27.48, α)	16.52							Adjusted Chi Square Value (27.48, β)	16.26	
79	95% KM Approximate Gamma UCL	0.00216							95% KM Adjusted Gamma UCL	0.00219	
80											
81	Lognormal GOF Test on Detected Observations Only										
82	Shapiro Wilk Test Statistic	0.913							Shapiro Wilk GOF Test		
83	10% Shapiro Wilk Critical Value	0.936							Detected Data Not Lognormal at 10% Significance Level		
84	Lilliefors Test Statistic	0.162							Lilliefors GOF Test		
85	10% Lilliefors Critical Value	0.151							Detected Data Not Lognormal at 10% Significance Level		
86	Detected Data Not Lognormal at 10% Significance Level										
87											
88	Lognormal ROS Statistics Using Imputed Non-Detects										
89	Mean in Original Scale	0.00125							Mean in Log Scale	-8.085	
90	SD in Original Scale	0.00245							SD in Log Scale	1.781	
91	95% t UCL (assumes normality of ROS data)	0.00184							95% Percentile Bootstrap UCL	0.00187	
92	95% BCA Bootstrap UCL	0.00199							95% Bootstrap t UCL	0.00216	
93	95% H-UCL (Log ROS)	0.00355									
94											
95	Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution										
96	KM Mean (logged)	-7.559							KM Geo Mean	5.2165E-4	
97	KM SD (logged)	1.166							95% Critical H Value (KM-Log)	2.52	
98	KM Standard Error of Mean (logged)	0.171							95% H-UCL (KM -Log)	0.00158	
99	KM SD (logged)	1.166							95% Critical H Value (KM-Log)	2.52	
100	KM Standard Error of Mean (logged)	0.171									
101											
102	DL/2 Statistics										
103	DL/2 Normal					DL/2 Log-Transformed					
104	Mean in Original Scale	0.00125							Mean in Log Scale	-7.847	
105	SD in Original Scale	0.00245							SD in Log Scale	1.44	
106	95% t UCL (Assumes normality)	0.00185							95% H-Stat UCL	0.00201	
107	DL/2 is not a recommended method, provided for comparisons and historical reasons										
108											
109	Nonparametric Distribution Free UCL Statistics										
110	Data do not follow a Discernible Distribution										
111											

	A	B	C	D	E	F	G	H	I	J	K	L
111												
112	Suggested UCL to Use											
113	95% KM (t) UCL				0.00189							
114												
115	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.											
116	Please verify the data were collected from random locations.											
117	If the data were collected using judgmental or other non-random methods,											
118	then contact a statistician to correctly calculate UCLs.											
119												
120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
121	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
122	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
123												

APPENDIX E LIMITATIONS

IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY ENVIRONMENTAL REPORT

Introduction

This report has been prepared by Tetra Tech Coffey for you, as Tetra Tech Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Tetra Tech Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Tetra Tech Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Tetra Tech Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Tetra Tech Coffey should be kept apprised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statutes and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Tetra Tech Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Tetra Tech Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Tetra Tech Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Tetra Tech Coffey prepared the report and has familiarity with the site, Tetra Tech Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Tetra Tech Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY ENVIRONMENTAL REPORT

Introduction

This report has been prepared by Tetra Tech Coffey for you, as Tetra Tech Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Tetra Tech Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Tetra Tech Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Tetra Tech Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Tetra Tech Coffey should be kept apprised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statutes and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Tetra Tech Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Tetra Tech Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Tetra Tech Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Tetra Tech Coffey prepared the report and has familiarity with the site, Tetra Tech Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Tetra Tech Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

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