RAAF Base Williamtown

PFAS ONGOING MONITORING PLAN

November 2023

ACKNOWLEDGEMENT OF COUNTRY

We respectfully acknowledge and pay respects to past, present and emerging Elders of the Traditional Owners of Country and First Nations cultures and countries upon which we live and work in. We extend our respects to our Aboriginal and Torres Strait Islander colleagues who we are working with, engaging with and learning from throughout this program and beyond. We also pay respect to the Aboriginal and Torres Strait Islander men and women who have contributed to the defence of Australia in times of peace and war.

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GLOSSARY

AFFF	Aqueous film forming foam
AHD	Australian Height Datum
AS	Australian Standard
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 2013
ANZECC	Australian and New Zealand Environment and Conservation Council
Base	RAAF Base Williamtown
COC	Chain of Custody
CSM	Conceptual Site Model
DO	Dissolved Oxygen
DSI	Detailed Site Investigation
DQI	Data Quality Indicators
DQO	Data Quality Objectives
EC	Electrical Conductivity
EPA	Environment Protection Authority
ERA	Ecological Risk Assessment
HHERA	Human Health and Ecological Risk Assessment
HHRA	Human Health Risk Assessment
LGA	Local Government Area
LOR	Limit of Reporting
Management Area	The geographical area subject to Defence risk management actions. May include private or Defence owned detached properties beyond the boundaries of the base.
NATA	National Association of Testing Authorities
Off-site	Off-base
OMP	Ongoing Monitoring Plan
On-site	On-base
PFAS	Per- and polyfluoroalkyl Substances
PFAS NEMP	PFAS National Environmental Management Plan 2020 (as updated from time to time)
PFHxS	Perfluorohexane sulfonate (PFHxS)
PFOA	Perfluorooctanoic acid (PFOA)
PFOS	Perfluorooctane sulfonate (PFOS)
PMAP	PFAS Management Area Plan
QA	Quality Assurance

QC	Quality Control
Remediation Action Plan (RAP)	Defines the purpose and objectives of the remediation, evaluates and determines the remediation options, and sets out performance measures.
Risk management actions	Remediation and management actions to address potential risks to receptors from PFAS contamination
SAQP	Sampling and Analysis Quality Plan
SFARP	So far as reasonably practicable
Source	A source can be primary or secondary. Primary sources are generally areas where AFFF was used or stored. Secondary sources may be an accumulation of contamination in the environment, such as in soil, sediments, or surface water bodies.
SWL	Standing Water Level
TOC	Total Organic Carbon

1 INTRODUCTION

1.1 Background

In 2019 Defence prepared a PFAS Management Area Plan (2019 PMAP) for managing risks to human health and the environment from per- and poly-fluoroalkyl substances (PFAS) contamination associated with Royal Australian Air Force (RAAF) Base Williamtown ('the base') and surrounding areas. An important requirement of the PMAP is to undertake ongoing monitoring of PFAS in the environment at and surrounding the base, and to assess for changes in risks to human and ecological receptors from PFAS originating from the base. The monitoring requirements were initially documented in an Ongoing Monitoring Plan (OMP) that formed part of the 2019 PMAP.

The PMAP was subsequently updated in 2023 (2023 PMAP) to reflect the current status of PFAS contamination and risk management actions.

Concurrently the requirements set out in the OMP were reviewed, and a revised OMP prepared (this document).

1.2 Purpose

The OMP sets out requirements for collection of adequate data to identify and evaluate:

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

The data collected may be used to inform where new risk management actions may be required, or to support a determination that remediation has been completed so far as reasonably practicable.

1.3 Supporting information

In developing the OMP, reference has been made to the PFAS National Environmental Management Plan 2020 (NEMP), the National Environment Protection (Assessment of Site Contamination) Measure 2013 (ASC NEPM), Defence estate, environmental and PFAS-specific strategies and guidance, and other information as provided in Section 6.

1.4 Constraints and assumptions

This OMP has been prepared based on information available at the time of writing and relies on the findings of the Detailed Site Investigation (DSI), risk assessments, mass flux assessments, remediation activities, ongoing monitoring program data, and management of risks documented in the 2023 PMAP. Defence recognises that there may still be gaps in information, and if required these will be progressively addressed while impacted sites are being managed.

This document has been developed based on the following assumptions:

- The current government issued guidelines, advisories and policies may change, and as a result may trigger a review of the OMP.

- The monitoring locations were based on the data collected to date, and may be further refined as proposed management / remediation actions are implemented.
- Base infrastructure development and access constraints at the time of this report
- Access to off-base private properties will be granted, where required. It is noted that off-base access has not been granted in some key locations.

2 SITE SETTING

2.1 Base description

The base is located at Medowie Road, Williamtown, NSW, approximately 15 km north of the Newcastle NSW central business district (CBD) and is located in the Port Stephens local government area (LGA), as shown in Figure F1 in Appendix A.

2.2 Site and management area setting

The base has been an active Defence base since 1941 and serves as the headquarters to both the Air Combat Group and the Surveillance and Response Group. In 2014, it was designated as the home base for Australia's F-35 Joint Strike Fighters. The southern side of the base is leased to Newcastle Airport Pty Limited, which operates the commercial Newcastle Airport.

The surrounding land uses comprise rural and semi-rural, settlements at Fullerton Cove and Salt Ash, small commercial properties and the Salt Ash Primary School. Tilligerry State Conservation area, managed by National Parks and Wildlife Service (NPSW), immediately borders the base to the west, north and east.

Hunter Water Corporation (HWC) pumping stations and groundwater extraction bore fields are located to the west, north and east of the base.

A summary of the environmental setting of the Management Area is as follows:

- The area experiences average low temperatures around 6°C in July and maximum average temperatures of around 28°C in January.
- The highest monthly rainfall generally occurs between January and June (averaging >100 mm per month), with the lowest rainfall in July to December (averaging 74 mm per month).
- Low lying area associated with the Lower Hunter River. The region is characterised by low sand dunes, sand sheets and estuarine mud flats.
- Relatively flat topography with ground elevation ranging approximately 10 metres Australian Height Datum (m AHD) to low lying areas between Fullerton Cove and Tilligerry Creek with elevations between 1 and 3 m AHD.
- The geology of the base and Management Area comprises unconsolidated sands (Tomago Sand Beds and Stockton Sand Beds) underlain by estuarine sediments (Tilligerry Mud Member).
- The base is surrounded by an interconnected network of drains, rivers, estuaries, reservoirs and coastal waterbodies within the catchment areas of both the Hunter River and Port Stephens estuary. The major elements of the regional surface water drainage network include:
    - Dawsons Drain, the Fourteen Foot Drain and the Ten Foot Drain, which are located to the south of the base and drain into Fullerton Cove.
    - Moors Drain and Tilligerry Creek, which are located to the east and south-east of the base and drain to the north east into the Tilligerry Creek arm of Port Stephens.
- The hydrogeology of the area is characterised by two unconfined sand aquifers:
    - Tomago Sand Beds aquifer located northwest of Tilligerry Creek.
    - Stockton Sand Beds aquifer located between Tilligerry Creek and the Newcastle Bight.

3 EXTENT OF PFAS CONTAMINATION

This section provides a description of the PFAS sources on the base, the ways in which PFAS has moved in the environment (migration pathways), and the extent of PFAS in the environment outside the base. It also provides a summary of the potential human and ecological receptors that may be exposed to PFAS. This information is referred to as the Conceptual Site Model (CSM).

3.1 Source areas

Source areas can be primary or secondary. Primary sources are generally areas of PFAS contamination where aqueous foam forming film (AFFF) was used or stored, for example a fire training area. Secondary sources are areas where PFAS accumulates and then continues to feed into the environment.

In the 2019 PMAP, a total of 14 PFAS source areas were prioritised for risk management based on the amount of PFAS they contained. Additional monitoring and investigation has subsequently been undertaken at the base to improve understanding of these source areas to inform the management requirements. The 2023 PMAP provides an update on the current status of source areas.

3.2 Transport pathways

PFAS can be transported from a source to human or environmental receptors by surface water and groundwater. These are referred to as “migration pathways”. The Groundwater Strategy Review (2022) categorised the PFAS migration pathways based on the natural catchments across the base and Management Area:

- **Western Region** - characterised by the former Fire Training Area (FFTA) source that is now remediated, and a PFAS groundwater plume extending south away from the source.
- **Central Region** - characterised by ongoing sources at the Former Fire Training Pad / Current Fire Station (Facility 165) and the Sewage Treatment Plant (Facility 410); with PFAS groundwater plumes extending south across the base boundary. The concentrations of PFAS south of the base and north of Cabbage Tree Rd were likely sourced from Lake Cochran, which was impacted when AFF foams were still in use at the base. However, Lake Cochran is no longer considered a significant ongoing PFAS source to groundwater. PFAS in the central southern plume discharges into Leary’s and Dawsons Drain.

- **Eastern Region** - characterised by likely sources at the Trade Waste Treatment Plant (Facility 480) and a Former Fuelling Area, with PFAS groundwater plumes extending east across the base boundary, and PFAS impacted surface water discharges to Moors Drain.

3.3 Distribution of PFAS

PFAS has migrated away from source areas on the base via the surface water and groundwater pathways described above. In doing so it has spread throughout (and has been used to define) the Management Area. Apart from some areas where the PFAS is concentrated off-base, such as south of the base, the majority of the Management Area is impacted with low levels of PFAS.

3.4 Receptors and risks

3.4.1 Human receptors

More than 50 potential pathways through which humans could be exposed to PFAS from the base were assessed in the Human Health and Ecological Risk Assessment (HHERA). These pathways included exposure to elevated PFAS in soil, groundwater, surface water, sediment, land animals and seafood within the Management Area.

The HHRA concluded that unrestricted exposure to PFAS across the Williamtown Management Area may result in an exceedance of the tolerable daily intake (TDI). The TDI is a limit of consumption, under which no adverse health impacts are likely. The NSW Government subsequently issued precautionary advice in April 2017 (Williamtown-precautionary-advice (nsw.gov.au) on how people within the Williamtown Management Area can reduce their exposure to PFAS. If this advice is followed then individual exposure to PFAS is very unlikely to exceed the TDI.

Potential risks that were identified as elevated or unacceptable in the HHERA are listed in Table 1 with corresponding exposure management advice from the NSW EPA (Williamtown-precautionary-advice (nsw.gov.au). To address these risks Defence is continuing to implement risk management actions to reduce PFAS leaving the base.

Table 1 Potential Human Health Risks

Process	NSW Government Precautionary Advice
R01 – Ingesting Groundwater Drinking groundwater with PFAS concentrations above drinking water guidelines (or use in cooking). Applies to NSW EPA Williamtown Management Area.	**NSW Government**: • Precautionary advice to minimise exposure by not using groundwater for drinking or cooking, • Avoid swallowing groundwater when bathing, showering, swimming and paddling in the NSW EPA Williamtown Secondary and Broader Management Zones. • Groundwater and bore water should not be used for any purpose in the NSW EPA Williamtown Primary Management Zone.
R02 – Ingesting Groundwater Incidental ingestion of shallow groundwater (where PFAS concentrations are above drinking water guidelines) from indoor use, including showering, bathing, food preparation using extracted groundwater. Applies to NSW EPA Williamtown Primary Management Zone.	**NSW Government**: • Precautionary advice to minimise exposure by not using groundwater and bore water for any purpose in the NSW EPA Williamtown Primary Management Zone.

Process	NSW Government Precautionary Advice
R03 – Ingesting Groundwater Incidental ingestion of shallow groundwater where PFAS concentrations are above drinking water guidelines, as a result of outdoor use (including swimming pools, sprinkler play, domestic irrigation). Applies to NSW EPA Williamtown Primary Management and Secondary Management Zones	**NSW Government**: • Precautionary advice to minimise exposure by not using groundwater for any purpose in the NSW EPA Williamtown Primary Management Zone.
R04 – Eating Home Produced Eggs Eating eggs from home grown backyard poultry that are exposed to groundwater or surface water as their primary drinking water supply and/or consumed soil or plants that have accumulated PFAS from irrigation water. Applies to the NSW EPA Williamtown Management Area.	**NSW Government**: • Precautionary advice to minimise exposure by not consuming home-grown foods produced, including eggs in the NSW EPA Williamtown Primary Management Zone, • Avoid eating eggs from the NSW EPA Williamtown Secondary and Broader Management Zones.
R05 – Eating Home-grown Vegetables Eating vegetables that have been irrigated with surface water or groundwater containing detectable PFAS concentrations and/or have been grown in soil that has been irrigated or flooded with water containing detectable PFAS concentrations. Applies to the NSW EPA Williamtown Management Area.	**NSW Government**: • Precautionary advice to minimise exposure by not consuming home-grown foods produced in the NSW EPA Williamtown Primary Management Zone, • Avoid eating vegetables produced in the NSW EPA Williamtown Secondary and Broader Management Zones.
R06- Ingesting Groundwater Incidentally ingesting surface water through swimming/ outdoor recreational use (drains/creeks). Applies to the NSW EPA Williamtown Management Area.	**NSW Government** • Surface water should not be used for any purpose in the NSW EPA Williamtown Primary Management Zone. • Avoid swallowing groundwater or surface water when bathing, showering, swimming and paddling (including in creeks and drains) in the Secondary and Broader Management Zones. • Groundwater should not be used for swimming or paddling pools in the Secondary and Broader Management Zones.
R07 – Eating Locally Sourced Cattle Eating locally grown cattle, which are exposed to surface water or groundwater as their primary drinking water supply and/or have consumed soil or plants that	**NSW Government**: • Precautionary advice to minimise exposure by not consuming home-grown foods produced, including home-slaughtered meat in the NSW EPA Williamtown Primary Management Zone.

Process	NSW Government Precautionary Advice
have accumulated PFAS from irrigation water. Applies to the NSW EPA Williamtown Management Area.	• Avoid eating home-slaughtered meat in the NSW EPA Williamtown Secondary and Broader Management Zones.
R08 – Drinking Locally Sourced Milk Drinking milk from locally grown cattle, which are exposed to surface or groundwater as their primary source of drinking water and/or consumed soil or plants that have accumulated PFAS from irrigation water. Applies to the NSW EPA Williamtown Management Area.	**NSW Government**: • Precautionary advice to minimise exposure by not consuming home-grown foods produced, including milk in the NSW EPA Williamtown Primary Management Zone. • Avoid drinking milk produced in the NSW EPA Williamtown Secondary and Broader Management Zones.
R09 – Eating Locally Caught Fish Eating high quantities of locally sourced finfish from the marine environment. Applies to Hunter River Estuary, Fullerton Cove and Tilligerry Creek.	**NSW Government**: • People who personally source and eat fish and seafood from the Hunter River Estuary, Fullerton Cove and Tilligerry Creek should limit the number of servings of individual species. • Sourcing seafood from a variety of locations including the ocean and waterways outside these areas will assist in minimising exposure. • The NSW government also provide the recommended maximum intake based on eating a single species caught from the Hunter River Estuary, Fullerton Cove and Tilligerry Creek.

3.4.2 Ecological Risks

Potential risks to ecological receptors that were identified as elevated or unacceptable in the ERA (AECOM, 2018a) are listed in Table 2**.** To minimise these risks Defence continues to implement risk management actions to reduce PFAS leaving the base.

Table 2 Elevated Ecological Risks

Risk ID	Description
R10	Toxicity to terrestrial and aquatic organisms from direct exposure to PFAS in soil, sediment or surface water. Applies to drains in Management Area, including Dawsons Drain and Moors Drain.
R11	Consumption of organisms that have been exposed to PFAS where bioaccumulation is occurring.

4 ONGOING MONITORING PLAN

This section sets out the data quality objectives, monitoring scope and assessment requirements. Changes made to the 2019 OMP are summarised in the following sections, and supporting rationale is provided in Appendix C.

4.1 Sampling and Analysis Quality Plan

The current Sampling and Analysis Quality Plan (SAQP) will be updated prior to implementation of this OMP. The SAQP provides information on data quality assurance procedures and measures including data quality indicators (DQI), sampling methodologies and analytical methods. The SAQP will continue to be updated as required.

4.2 Data Quality Objectives

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

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

The DQOs for monitoring are presented in Table 3. They have been prepared in line with the DQO process outlined in the ASC NEPM (Schedule B2).

Table 3. Data Quality Objectives

Process	Description
Step 1: State the problem	Defence and State agencies require up-to-date data to enable informed risk management decisions to protect human health and the environment, given that elevated concentrations of PFAS have been identified in environmental media. Defence requires an understanding of the holistic effect of PFAS management response activities that have and will be implemented. The data collected by implementing this OMP will provide a detailed dataset that can be used to assist with assessment of temporal changes in PFAS concentrations in groundwater, surface water and sediment on- and off-base, and biota (sentinel species) in Fullerton Cove. This will facilitate refinement of the CSM, allow update of the human health and ecological risk assessment and inform management decisions by Defence and NSW EPA, and possibly other government agencies, if required. Additionally, the temporal monitoring of PFAS concentrations in selected biota aims to provide data necessary to support and/or update the ongoing advice relating to minimising exposure (e.g. consumption of seafood)

Process	Description
Step 2: Identify the decision / goal of the study	The goal of the study is to establish a systematic routine groundwater, surface water, sediment and biota sampling and analysis program to provide current and on-going information on the distribution of PFAS contaminants of potential concern in groundwater, surface water, sediment and biota. The information can be utilised by Defence and State agencies. The key issues are: 1. What is the optimum monitoring well network, surface water / sediment and biota locations that can be sampled to meet the objectives of the OMP? 2. What is analytical suite for each monitoring well / sampling point? 3. What frequency of sampling required? 4. Are the laboratory Limits of Reporting (LOR) appropriate for the objectives of the OMP? 5. Are the reported concentrations similar, greater than or less than those previously reported? 6. Are the concentration trends increasing, decreasing or stable? 7. If the concentrations of contaminants are found to be outside of an acceptable range, what actions should be implemented? 8. If the concentrations of contaminants are found to be inside a trigger value or acceptable range, what actions should be implemented? 9. Are the data reliable and adequate to enable informed decisions to be made by Defence / State agencies? 10. Is the approach scientifically suitable and defensible?
Step 3: Identify the information inputs	To allow assessment of the data against the study goal listed in Step 2 above, the following inputs will be considered: • PFAS results from previous environmental investigations. • Previous and new data collected during the residential sampling program, where permission to use the data has been granted by landowners. • Groundwater, surface water, sediment and biota data collected and analysed for PFAS, as part of this OMP. • Advances in laboratory analytical approaches and changes in regulatory requirements.
Step 4: Define the boundaries of the study	The spatial and temporal boundaries that apply for data collection are detailed below and will influence the decision-making process for ongoing monitoring: • The spatial boundary for data collection is the base and Management Area • The sampling completed as part of the OMP will be limited to groundwater, surface water, sediment and biota, at the frequencies defined in Section 4.3. • The monitoring will be long term (beyond 3 years) and ongoing.

Process	Description
	The OMP has covered the primary implementation period of the PMAP and will continue after the remediation / management actions have ended. This is the timeframe over which PMAP remediation actions (or other short-medium term actions) have been completed, and the monitoring following this period will be assessed with advice from NSW Government. The OMP will also cover the extended implementation period to the extent required by specific characteristics of the base and surrounds and behaviour of the plume, measured against specified data trends.
Step 5: Develop the analytical approach/decision rules	The decision rules can be defined as: • Analytical selection; all samples will be analysed for PFAS standard analytical suite at the standard LOR. • Analytical method selection for PFAS is based on achieving appropriate laboratory LOR in the various media to be analysed. • Sample locations have been selected with the objective of monitoring PFAS trends (temporal and seasonal), providing early warning of changes in the migration of PFAS in surface water and groundwater. • If the laboratory quality assurance / quality control data are within the acceptable ranges, the data will be considered suitable for use. • If PFAS concentrations are reported above the laboratory LOR, where it was previously <LOR, then it will be considered whether further assessment of the data will be required (refer to Table 10). • If the PFAS is reported at a concentration that is above drinking water guideline in groundwater, then it will be considered that further assessment is required and / or notification (refer to Table 10). • If the PFAS is reported at a concentration that is inside a trigger value or acceptable range, then it will be considered whether monitoring is continued or reduced, this assessment will be undertaken after two years of monitoring (refer to Table 10). The decision on the acceptance of the analytical data should be made on the basis of the Data Quality Indicators (DQIs) as follows: • **Precision:** A quantitative measure of the variability (or reproducibility) of data. • **Accuracy**: A quantitative measure of the closeness of reported data to the “true” value. • **Representativeness**: The confidence (expressed qualitatively) that data are representative of each media present on base. • **Completeness**: A measure of the amount of useable data from a data collection activity. • **Comparability**: The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.

Process	Description
Step 6: Specify performance or acceptance criteria	Specific limits for the works included in the OMP are in accordance with the appropriate guidance made or endorsed by state and national regulations, appropriate indicators of data quality, and standard procedures for field sampling and handling. This step also examines the certainty of conclusive statements based on the available new data collected. This should include the following points to quantify tolerable limits: • A decision can be made based on a certainty assumption of 95% confidence in any given data set. A limit on the decision error will be 5% that a conclusive statement may be a false positive or false negative. • A decision error in the context of the decision rule presented above would lead to either underestimation or overestimation of the risk level associated with a particular sampling area. • Sampling errors may occur when the sampling program does not adequately detect the variability of a contaminant from point to point across the base. To address this, the OMP outlines minimum numbers of samples proposed to be collected from each media. • As such, there may be limitations in the data if aspects of the OMP cannot be implemented. Some examples of this scenario include but are not limited to: - Proposed surface water sample locations may be dry at the time of sampling - Proposed groundwater well locations are damaged or destroyed and therefore cannot be sampled - Proposed samples are not collected due to access being restricted to a given location. • Limitations in ability to acquire useful and representative information from the data collected. The data are proposed to be collected from multiple locations and sample media. An example of this scenario includes: - Some of the data are proposed to be collected from landholder bores, which are not purpose-built for groundwater monitoring. In some cases, there is limited information on the bore construction, and the likely presence of dedicated pumps may prevent groundwater depths being accurately recorded while also preventing groundwater being sampled using Hydrasleeves™ . • Measurement errors can occur during sample collection, handling, preparation, analysis and data reduction. To address this the following measures are proposed: - Collection of sufficient sample mass to facilitate analysis reported to standard laboratory detections limits. Collection of insufficient sample mass may result in raised detection limits. - Field staff to follow a standard procedure when collecting samples, including decontamination of tools, and use of appropriate sample containers and preservation methods. - Laboratories to follow a standard procedure when preparing samples for analysis and undertaking analysis. - Laboratories to report quality assurance/ quality control data for comparison with the DQIs established for the OMP.

Process	Description
Step 7: Develop the plan for obtaining data	The methodology presented in this OMP is designed to meet the objectives described in Section 1.2 to achieve the nominated DQOs. Optimisation of the data collection process will be achieved by: • Working closely with the analytical laboratories and sampling equipment suppliers to ensure that appropriate procedures and processes are developed and implemented prior to and during the fieldwork, to ensure that sample handling, and transport to and processing by the analytical laboratories is appropriate • Conducting sampling according to Australian Standards for the type of sampling being conducted (i.e. groundwater monitoring well sampling versus landholder bore water sampling). This standard is: Standards Australia (AS/NZS5667.11–1998) *Water Quality – Sampling, part 11: Guidance on sampling of groundwater.* • Basing the sampling upon a CSM developed using the information available at the implementation of the OMP. Updating the CSM as new data becomes available in the course of the implementation of the OMP, as required. If the objectives of the OMP are not being met, the sampling design and approach will be reviewed and amended, as required.

4.3 Proposed monitoring intervals

The key element of the OMP is six monthly groundwater, surface water and sediment sampling on and off-base, and biota sampling biennially. This includes:

- An **autumn** comprehensive sampling and analysis event for the first of the biannual groundwater, surface water and sediment sampling events timed to occur in March / April.
- A **spring** targeted sampling and analysis event for the second of the biannual groundwater, surface water and sediment sampling events timed to occur in September / October to target key monitoring wells.
- Biota sampling for sentinel species in Fullerton Cover to occur every second year.

The rationale for these elements are summarised below:

- The six-monthly monitoring to occur:
    - **Autumn** (March / April), during high average rainfall period (128 mm for March and 109 mm for April) based on Bureau of Meteorology (BoM) Williamtown RAAF weather station (number 061078); and
    - **Spring** (September / October), during low average rainfall period (60 mm for September and 76 mm for October) based on BoM.

      It is considered that relatively higher contamination concentrations may occur in groundwater and surface water systems during the high average rainfall periods due to the effects of higher infiltration rates through the unsaturated zone which may mobilise contaminants.
- The monitoring event targeting low average rainfall period will increase the understanding of groundwater changes at discrete locations considered to be of importance for understanding trends (for example bores close to source areas, base boundaries and creek systems), or

locations with higher sensitivity (groundwater sample locations with concentrations close to screening criteria, areas with fewer monitoring locations).

4.4 Monitoring locations

4.4.1 Rationale for groundwater sample locations

Groundwater monitoring will be undertaken on selected monitoring wells, Hunter Water bores and residential bores. The OMP will monitor water quality in the shallow and deep portions of the Tomago Sand Beds aquifer. The current understanding of the conceptual site model is that PFAS concentrations in the intermediate groundwater (approximate depth of 12 m bgs) are similar to that of the deeper portions (approximate depth of 20 m bgs) of the aquifer, and hence will not be targeted.

The rationale for monitoring well selection for each area is summarised in Table 4 below.

The groundwater monitoring well sampling methodology will be presented in the SAQP. The locations to be monitored on a six-monthly basis ('Autumn' comprehensive and 'Spring' targeted) are provided in Appendix B and shown on Figure F2-0 to Figure F2-3 in Appendix A.

Table 4. Rationale for groundwater monitoring

Area	Rationale
On-Base	• Monitor spatial and temporal variations in PFAS concentrations in groundwater concentrations up, down and gross-gradient of source areas • Assess if PFAS concentrations in groundwater within and downgradient of the source areas change in response to management measures over time • Monitoring of HWC assets that are in close proximity to the PFAS plume to inform risk to a potential drinking water supply • Monitoring of sentinel wells for Pump Station 7 located on-base • Monitor PFAS concentrations in groundwater within the on-base Moors Drain Catchment to target elevated PFAS concentrations detected during PFAS characterisation studies and support the Moors Drain Catchment data gap assessment and improve understanding of the interaction between groundwater and surface water • Continue to monitor groundwater wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations • Monitor groundwater on transects parallel and perpendicular to plume, and at shallow and deep portions of the aquifer to assist with understanding concentrations changes in the nominated transect alignments.
East of Base	• Monitor spatial and temporal variation in PFAS concentration in groundwater up and down hydraulic gradient of HWC asset Pumping Station 9 • Continue to monitor groundwater wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations • Monitor potential changes in PFAS concentrations at the plume margins to refine model predictions and provide an indication of additional management of PFAS to groundwater users outside the current plume • Monitor groundwater adjacent to Moors Drain to assess PFAS migrating from the drain to groundwater

Area	Rationale
	• Monitor groundwater on transects parallel and perpendicular to the plume, and at shallow and deep portions of the aquifer to assist with understanding concentration changes in the nominated transect alignments.
West of Base	• Monitor the western edge of the plume in relation to HWC asset Pumping Station 5 at sentinel locations • Monitor the movement of PFAS from the FFTA towards southern boundary (within the DEMS Area). • Monitor groundwater wells on transects parallel and perpendicular to plume, and at shallow and deep portions of the aquifer to assist with understanding concentrations changes in the nominated transect alignments.
Southern Area	• Monitor potential changes in PFAS concentrations at the plume margins in the Southern Area (Primary Management Zone) to refine model predictions • Continue to monitor groundwater wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations • Monitor groundwater on transects parallel and perpendicular to plume, and at shallow and deep portions of the aquifer to assist with understanding concentrations changes in the nominated transect alignments.
Cabbage Tree Road	• Monitor potential changes in PFAS concentrations to refine model predictions and provide an indication of additional management of PFAS to groundwater users outside the current plume • Monitor the isolated detections of PFAS in groundwater that have been considered to be associated with unconfirmed mechanisms. This may include transport of PFAS via surface water, flooding or an unidentified source • Continue to monitor wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations • Monitor groundwater on transects parallel and perpendicular to plume, and at shallow and deep portions of the aquifer to assist with understanding concentrations changes in the nominated transect alignments.
Lavis Lane	• Monitor the plume to the south east of the base and in the Lavis Lane area • Monitor groundwater adjacent to Fourteen Foot Drain • Monitor potential changes in PFAS concentrations at the plume margins to refine model predictions and provide an indication of additional management of PFAS to groundwater users outside the current plume • Continue to monitor wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations. • Monitor groundwater on transects parallel and perpendicular to plume, and at shallow and deep portions of the aquifer to assist with understanding concentrations changes in the nominated transect alignments.
Salt Ash	• Monitor the isolated detections of PFAS in groundwater in Salt Ash that have been considered to be associated with unconfirmed mechanisms. This may include transport of PFAS via surface water, flooding or an unidentified source

Area	Rationale
	• Monitor potential changes in PFAS concentrations at the plume margins to refine model predictions and provide an indication of additional management of PFAS to groundwater users outside the current plume • Continue to monitor wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations • Monitor groundwater on transects perpendicular to the plume, and at shallow and deep portions of the aquifer to assist with understanding concentrations changes in the nominated transect alignments.
Fullerton Cove	• Monitor the isolated detections of PFAS in groundwater that have been considered to be associated with unconfirmed mechanisms. This may include transport of PFAS via surface water, flooding or an unidentified source • Monitor potential changes in PFAS concentrations to refine model predictions • Continue to monitor wells with existing temporal datasets to assist with better understanding of temporal patterns in PFAS concentrations.

Off-base monitoring locations requiring access to private properties will require the agreement of the landowners prior to access.

4.4.2 Rationale for groundwater gauging locations

In addition to the measurement of depth to groundwater in each monitoring well prior to collection of groundwater samples, a targeted gauging round at selected groundwater locations shall be undertaken prior to a sampling event, given that it is not necessary to gauge all monitoring well locations to determine regional groundwater flow directions.

The selected locations for the targeted gauging event are as follows:

- Shallow wells: MW106S, MW122, MW123, MW124, MW125S, MW126S, MW146S, MW158S, MW162S, MW188S, MW202S, MW232S, MW247S, MW256S, MW257S, MW260S, MW268S and MW897S.
- Deep monitoring wells: MW106D, MW125D, MW126D, MW146AD, MW158D, MW162D, MW202D, MW232D, MW247D, MW256D, MW257D, MW260D, MW268D and MW897D.

4.4.3 Rationale for surface water sample locations

The surface water monitoring locations have been selected to maintain consistency with the monitoring completed under the DSI and 2019 OMP, and address the requirements of the NSW Government.

The locations have been previously sampled several times, and continued monitoring will provide additional data to assess temporal variability.

The existing surface water sampling locations have been complimented by four additional locations which have been included due to the following:

- Improve understanding of the interaction between groundwater and surface water drainage pathways for elevated PFAS concentrations in the Moors Drain Catchment. The locations are downgradient of the Trade Waste Treatment Plant and MEOMS Building source areas, and on the eastern base boundary, prior to discharge to Moors Drain.
- Gain access to off-base drains that were not able to be sampled as access to private property could not be achieved.

- Improve understanding of the concentrations along Dawsons Drain to the south of the base, which will aim to monitor the area where the groundwater model has predicted that groundwater from the base (originating from the FFTA) upwells.

Off-base monitoring locations requiring access to private properties will require the agreement of the landowners prior to access.

4.4.4 Rationale for sediment sample locations

The sediment monitoring locations have been selected to maintain consistency with the monitoring completed under the DSI and 2019 OMP and address the requirements of the NSW Government.

The locations have been previously sampled several times, and continued monitoring will provide additional data to assess temporal variability.

The existing sediment sampling locations have been complimented by two additional locations which have been included due to the following:

- Gain access to off-base drains that were not able to be sampled as access to private property could not be achieved.
- Improve understanding of the concentrations along Dawsons Drain to the south of the base, which will aim to monitor the area where the groundwater model has predicted that groundwater from the base (originating from the FFTA) upwells.

Six monthly sediment monitoring will be undertaken at the selected locations.

Off-base monitoring locations requiring access to private properties will require the agreement of the landowners prior to access.

4.4.5 Rationale for biota sample locations

The aquatic biota monitoring locations have been selected to maintain consistency with the monitoring completed under the 2019 OMP and address the requirements of the NSW Government.

Biota sampling will be undertaken in publicly accessible areas under applicable licences and ethics approvals. NSW government had previously requested that temporal variation of PFAS concentrations in selected sentinel species need to be monitored through the collection of additional samples.

As per the 2019 OMP, the locations will be focused in Fullerton Cove only, refer to Figure F3 (in Appendix A).

Sampling will target sentinel species that has been identified by the former Risk Assessment Working Group (RAWG) (previously appointed by NSW government) that appear to accumulate elevated concentrations of PFAS relative to other species, namely:

- Dusky Flathead (*Platycephalus fuscus*)
- Luderick (*Girella tricuspidata*)
- School Prawn (*Metapenaeus macleayi*).

A description of these species is provided in Table 5.

Table 5. Aquatic Biota Description

Species	Description
Finfish	
Dusky Flathead (Platycephalus fuscus)	• Dusky Flathead PFAS levels in the Hunter River were considered to be elevated relative to other species, variable and did not follow spatial patterns evident in the other species • Dusky Flathead is a target recreational and commercial species.

Species	Description
Luderick (Girella tricuspidata)	• Found primarily in estuaries and around nearshore rocky reefs. • Spawning occurs in surf zones near estuary entrances during winter, the larvae then enter estuaries and small juveniles live in sheltered shallow water habitats. Adults are mainly found in association with weedy habitats such as seagrass and rocky reefs. Adults migrate to near-coastal waters prior to spawning and may then return to estuaries • Mainly herbivorous, feeding on seagrass and green algae, and sometimes small invertebrates • Mature around 25 cm. Minimum legal length is 27 cm • Important recreational species, minor commercial species.
Crustacea	
School Prawn (Metapenaeus macleayi)	• Inhabit estuaries and inshore ocean waters • Spawn in near shore ocean waters between December and May. Post-larval prawns enter estuaries and move upstream. Following spring the adolescent prawns return down-stream and migrate to sea to mature and spawn • Prefer soft muddy substrates and areas of seagrass • Eat a variety of small invertebrates and detritus • Maximum length 16 cm • Important domestic market.

It is noted that not all species above may be present at Fullerton Cove during the sampling events.

4.5 Sample analysis

Samples will be analysed by a NATA accredited laboratory for a suite of PFAS as outlined in Appendix D, using NATA accredited methods.

Laboratory levels of reporting (LORs) must be selected to achieve the OMP objectives (Section 1.2) and the DQO's. The rationale for selecting LORs below the standard LOR must be provided.

Quality control and quality assurance measures will be outlined within the SAQP.

In addition to PFAS, field measurement of water quality parameters such as pH, electrical conductivity, redox potential, dissolved oxygen, temperature, total dissolved solids, salinity, and turbidity (where feasible) will be undertaken on all surface and groundwater samples.

5 OTHER ASPECTS

To achieve the OMP objectives (Section 1.2), inform the CSM and allow assessment of the site risk profile, a review of other aspects will also be undertaken, including (but not limited to) water use surveys, registered bore searches, change in land zoning, changes in land use on/off base, development works, remediation works, etc.

The aspects review requirements are included in Table 6.

Table 6. Other aspects review

Aspect	Review requirements
Information sources	The OMP will consider other sources of information, such as - Data obtained from works associated with PMAP implementation, namely remediation actions and further characterisation of source areas or areas of interest (i.e. catchments). - Changes may result from the specific or cumulative impact of remediation or containment actions, existing transportation trends, changes to hydrogeology. - Investigations associated with estate planning or works. - Other remediation works (non-PFAS) which may also result in changes to existing transportation trends, changes to hydrogeology.
Development works or changes in on-base land use	The OMP will consider development works and/or changes in on-base land use that may have the potential to impact the nature and/or extent of PFAS including: - Capture projects planned for the next 12-month monitoring period, particularly where works relate to a source areas. - A significant change of land use in source area may require review of OMP, and whether additional monitoring will be required (actions may include installing new monitoring wells or adding new surface water / sediment locations).
Development works or changes in off-base land use	The OMP will consider development works and/or changes in off-base land use that may have the potential to impact the nature and/or extent of PFAS including: - A significant change of land use within Management Area or adjoining land may require review of OMP, and whether additional monitoring will be required (actions may include installing new monitoring wells or adding new surface water / sediment locations). This includes the Special Activation Precinct (SAP).
Significant weather events	The significant weather events could include prolonged wet weather or long dry periods, where rainfall is significantly greater or lower than the monthly averages for the area. Review of these aspects will include: - Potential for variability on PFAS concentrations. - Potential for surface water or groundwater interaction with source areas could become a significant contributor.

Aspect	Review requirements
Water use surveys	The OMP will consider data collected through the completion of water use surveys to identify any changes in water use or land use activities which may impact the respective risk profiles.
Changes in NSW Government Precautionary Advice and/or geographical extent of current Management Zones	The OMP will consider any changes made by the NSW Government to the geographical extents of the existing management zones and/or associated Precautionary Advice.
Changes in nationally endorsed PFAS Screening Criteria	The OMP will consider any changes to the current human health and ecological screening criteria for PFAS as presented in the Heads of EPA (HEPA) PFAS National Environmental Management Plan 2.0 (PFAS NEMP, 2020)

6 PFAS SCREENING CRITERIA

The adopted screening criteria references the PFAS NEMP (2020), Defence estate and environmental strategies, and Defence PFAS-specific strategies and guidance. At the time of preparing this OMP, a number of guidance documents were available in Australia and referred to including:

- HEPA, 2020. PFAS NEMP Version 2.0. January 2020
- Department of Health (DoH), April 2017. Health Based Guidance Values for PFAS for use in site investigations in Australia. This document is based on the works undertaken by FSANZ in 2017 (FSANZ 2017)
- National Health and Medical Research Council (NHMRC), 2019. Guidance on Per and Polyfluoroalkyl Substances (PFAS) in Recreational Water. August 2019 (NHMRC 2019)
- National Environment Protection (Assessment of Site Contamination) Measure 1999, Schedule B1, as amended in 2013 (ASC NEPM 2013).

The adopted PFAS screening criteria to assess the data collected as part of the monitoring are presented in Table 7, Table 8, and Table 9.

Table 7. PFAS Water Criteria Summary – Human Health

Media	Pathway	Compound	Criteria	Comment / Reference
Water – Groundwater	Drinking water	PFOS+PFHxS	0.07 µg/L	The values presented in the PFAS NEMP, 2020 are from DoH 2017, which published final health-based guidance values for PFAS for use in site investigations in Australia. DoH utilised the TDI for PFOS and PFOA from FSANZ, 2017 and the methodology described in Chapter 6.3.3 of the National Health and Medical Research Council's (NHMRC) Australian Drinking Water Guidelines (ADWG), 2022 to determine drinking water values. For PFHxS, DoH 2017 noted that '*FSANZ concluded that there was not enough toxicological and epidemiological information to justify establishing a tolerable daily intake. However, as a precaution, and for the purposes of site investigations, the PFOS tolerable daily intake should apply to PFHxS. In practice, this means that the level of PFHxS exposure should be added to the level of PFOS exposure; and this combined level be compared to the tolerable daily intake for PFOS*'.
		PFOA	0.56 µg/L	

Media	Pathway	Compound	Criteria	Comment / Reference
Water – Surface Water and Groundwater	Recreational use	PFOS+PFHxS	2 µg/L	The previous values presented in the PFAS National Environmental Management Plan (NEMP), 2018 were from DoH 2017, which published final health-based guidance values for PFAS for use in site investigations in Australia. However, in 2019 the NHMRC's water quality advisory recommended an alternative methodology to calculate recreational guideline value. Instead of basing it on an ingestion rate of 0.2 L of water per day (as per the *Australian Drinking Water Guidelines* [ADWG] formula), NHMRC (2019) adjusted this rate with consideration of an event frequency (150 events / year) to calculate an annual ingestion rate of 30 L per year. These NHMRC (2019) values have since been adopted under Revision 2.0 of the PFAS NEMP (HEPA, 2020). Note: given that groundwater at the Base is extracted for irrigation purposes (post treatment), the recreational guidelines have been adopted to be protective of this water use activity.

Table 8. PFAS Water Criteria Summary – Ecological

Media	Pathway	Chemical	Criteria	Comment/Reference
Water – Groundwater and Surface Water	Freshwater	PFOS	0.00023 µg/L	The values are from the PFAS NEPM, 2020 (HEPA 2020) which endorsed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality – draft default guideline values. It is understood that these guidelines are currently being reviewed and will consider the appropriateness of considering any future revision. The 99% level of protection has been applied for slightly to moderately disturbed ecosystems. This approach is generally adopted for chemicals that bioaccumulate and biomagnify in wildlife. It is proposed that the laboratory LOR is adopted for the purposes of preliminary screening of analytical water results, rather than sole use of the criteria value.
		PFOA	19 µg/L	

Table 9. PFAS Screening Criteria Summary – Aquatic Biota

Media	Chemical	Criteria	Comment/Reference
Crustaceans, 2 – 6 years (all species)	PFOS	0.065 mg/kg	FSANZ (2017) *Perfluorinated chemicals in food.* Food Standards Australia New Zealand.
	PFOA	0.52 mg/kg	
	PFHxS	0.065 mg/kg	
Finfish, 2 – 6 years (all)	PFOS	0.0052 mg/kg	
	PFOA	0.041 mg/kg	
	PFHxS	0.0052 mg/kg	

It is noted that at the time this OMP was prepared no HEPA (2020) endorsed criteria was available for PFAS in sediments. Additionally, Defence has focussed on PFOA, PFOS and PFOS+PFHxS, the PFAS for which there is either human health and/or ecological assessment criteria available.

7 TRIGGERS FOR ACTION AND REVIEW

A critical step in establishing an effective monitoring program is to identify performance measures against which the environmental impact of PFAS can be assessed. Once these have been established, an action plan is necessary to describe the measures taken if pre-defined compliance levels are exceeded.

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

- Assessment criteria: a water quality standard that is identified as being appropriate to a contaminant in a water body in order to assess the overall impact on water quality.
- Trigger level: a specific assessment criterion applied to a contaminant to assess whether there have been possible adverse trends in environmental monitoring data. A trigger level is used as a tool to alert stakeholders and Regulators of these changes. The trigger levels and responses are described in Table 10.

Table 10. Trigger levels and responses

Trigger	Response
First time detection of PFAS in groundwater / surface water	• Request the analytical laboratory to reanalyse the sample to verify detection • Consider increasing frequency of monitoring to include monitoring bore/point in the mid-year targeted sampling round.
First time exceedance of the drinking water guideline in groundwater	• Request the analytical laboratory to reanalyse the sample to verify exceedance • Calculate rolling average over a three year period for sample results from the same location and compare with the drinking water guideline • Consider increasing frequency of monitoring to include monitoring bore/point in the mid-year targeted sampling round.
First time exceedance in groundwater of the groundwater exposure point concentration (EPC) used in the 2017 HHRA for the relevant Risk Zone: **Risk Zone A** PFOS+PFHxS: 190.3 µg/L **Risk Zone B** PFOS+PFHxS: 5.67 µg/L **Risk Zone C & D** PFOS+PFHxS: 0.05 µg/L	• Request the analytical laboratory to re-analyse the sample to verify exceedance • If concentrations are confirmed and verified (as discussed above), undertake a site-specific review of potential exposure pathways to confirm whether pathways that may be subject to additional precautions are actually occurring • If concentrations exceed EPC and relevant additional pathways are complete, undertake a site-specific quantitative risk assessment to identify whether additional precautions would be suggested and/or consider a change to the boundary of the Risk Zone.

Trigger	Response
First time exceedance in surface water of the surface water EPC for 95th percentile used in the 2017 HHRA: **Marine Water** PFOS: 1.78 µg/L, PFHxS: 1.48 µg/L **Region 1** PFOS: 5.035 µg/L, PFHxS: 1.666 µg/L **Region 2** PFOS: 1.47 µg/L, PFHxS: 1.009 µg/L **Region 3** PFOS: 7.743 µg/L, PFHxS: 6.773 µg/L	• Request the analytical laboratory to re-analyse the sample to verify exceedance • If concentrations are confirmed and verified (as discussed above), undertake a site-specific review of potential exposure pathways to confirm whether pathways that may be subject to additional precautions are actually occurring • If concentrations exceed EPC and relevant additional pathways are complete, undertake a site-specific quantitative risk assessment to identify whether additional precautions would be suggested.
First time exceedance of the recreational water guideline in surface water	• Request the analytical laboratory to reanalyse the sample to verify exceedance • Calculate rolling average over the four most recent sample results from the same location and compare with the recreational water guideline.
Sediment PFAS concentration increase in two consecutive sampling events.	• Request the analytical laboratory to reanalyse the sample to verify increase.
Increasing PFAS trends	• Further assessment of the data to determine whether updates to the CSM and/or risk profile are required.
Decreasing PFAS trends	• Assess whether risks have been reduced.
No triggers or acceptable levels are exceeded	• Continue monitoring of the location as per the OMP. • Consider the following recommendations during the next OMP Review: o Decrease frequency of monitoring. o Cease monitoring and / or monitor nearby locations.

8 REPORTING REQUIREMENTS

8.1 Reporting

After each monitoring event, the information and laboratory data will be documented in a factual report.

At the end of a specified monitoring period (typically 12 months but may vary) the whole data set (including the current and historic data) will be reviewed, and an Ongoing Monitoring Interpretive Report prepared.

The Ongoing Monitoring Interpretive Report will report on the objectives of the OMP, which are to provide information to allow evaluation of:

- spatial, and temporal (including seasonal) variability of PFAS in the environment
- changes to sources, transport pathways or receptors, described as a CSM for the base
- changes in risks to human and environmental receptors
- the influence that risk management activities at the base, as outlined in the 2023 PMAP have had on PFAS in the environment
- whether the identified changes trigger a prescribed action and/or review (Section 3).

8.2 Stakeholder engagement

Engagement with a range of stakeholders, such as NSW EPA, Hunter Water Corporation, Councils, other agencies, and the community will be undertaken. A stakeholder engagement plan will be prepared and/or updated to manage the engagement process.

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

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

REFERENCES

PFAS OMP

AECOM, 2019a. PFAS Ongoing Monitoring Plan – May 2019, RAAF Base Williamtown, 27 May 2019.

AECOM, 2019b. Addendum OMP – Event Sampling, RAAF Base Williamtown, 27 May 2019.

AECOM, 2019c. Addendum OMP – Biota Sampling, RAAF Base Williamtown, 27 May 2019.

AECOM, 2023. OMP Review Report.. PFAS Ongoing Monitoring Plan – RAAF Base Williamtown. 4 July 2023.

SAQP

AECOM, 2021 Sampling, Analysis and Quality Plan – PFAS OMP, RAAF Base Williamtown (Revision J), 28 April 2023.

PMAP

Defence, 2019. PFAS Management Area Plan. RAAF Base Williamtown. Revision 1, 27 May 2019.

Defence, 2023. PFAS Management Area Plan. RAAF Base Williamtown. Revision 1 , September 2023

Groundwater Strategy Review

Geosyntec, 2022. Remedial Options Assessment, Royal Australian Airforce Base Williamtown. 16 September 2022.

Watershed Hydrogeo, 2022. Numerical Groundwater Model Update – September 2022. RAAF Base Williamtown GWSR. 12 September 2022.

Ongoing Monitoring Factual Reports

AECOM, 2020. Sampling Event Factual Report, November 2019, PFAS OMP - RAAF Base Williamtown. 13 May 2020.

AECOM, 2020. Sampling Event Factual Report, May 2020, PFAS OMP - RAAF Base Williamtown. AECOM. 28 August 2020.

AECOM, 2020. Flood Water Sampling Event Factual Report, July 2020. PFAS OMP - RAAF Base Williamtown. 30 October 2020.

AECOM, 2021. Sampling Event Factual Report, November 2020, PFAS OMP - RAAF Base Williamtown. 19 March 2021.

AECOM, 2021. Baseline Surface Water Discharge Sampling Event – December 2020, RAAF Base Williamtown, 15 October 2021.

AECOM, 2021. Surface Water Mass Discharge Sampling Event – December 2020, RAAF Base Williamtown, 16 August 2021.

AECOM, 2021. Surface Water Mass Discharge Sampling Event – January 2021, RAAF Base Williamtown, 14 October 2021.

AECOM, 2021. Surface Water Discharge Sampling Event – January 2021, RAAF Base Williamtown, 15 October 2021.

AECOM, 2021. Sampling Event Factual Report – Biota Sampling, February 2021. RAAF Base Williamtown, 4 May 2021.

AECOM, 2021. Surface Water Discharge Sampling Event – February 2021, RAAF Base Williamtown, 17 November 2021.

AECOM, 2021. Surface Water Discharge Sampling Event – March 2021, RAAF Base Williamtown, 17 November 2021.

AECOM, 2021. Surface Water Discharge Sampling Event – April 2021, RAAF Base Williamtown, 24 December 2021.

AECOM, 2021. Sampling Event Factual Report, May 2021. PFAS OMP – RAAF Base Williamtown, 3 September 2021.

AECOM, 2021. Surface Water Discharge Sampling Event – May 2021, RAAF Base Williamtown, 24 December 2021.

AECOM, 2021. Surface Water Discharge Sampling Event – June 2021, RAAF Base Williamtown, 24 December 2021.

AECOM, 2022. Surface Water Discharge Sampling Event – July 2021, RAAF Base Williamtown, 4 March 2022.

AECOM, 2022. Surface Water Discharge Sampling Event – August 2021, RAAF Base Williamtown, 4 March 2022.

AECOM, 2022. Surface Water Discharge Sampling Event – September 2021, RAAF Base Williamtown, 10 March 2022.

AECOM, 2022. Surface Water Discharge Sampling Event – October 2021, RAAF Base Williamtown, 1 March 2022.

AECOM, 2022. Sampling Event Factual Report, November 2021, PFAS OMP - RAAF Base Williamtown. 15 March 2022.

AECOM, 2022. Sampling Event Factual Report – Biota Sampling, February 2022. RAAF Base Williamtown, 29 July 2022.

AECOM, 2022. Sampling Event Factual Report, May 2022, PFAS OMP - RAAF Base Williamtown. 25 November 2022.

Ongoing Monitoring Interpretive Reports

AECOM, 2021. Annual Interpretive Report – 2020 – PFAS OMP, RAAF Base Williamtown, 26 February 2021.

AECOM, 2022. Annual Interpretive Report – 2021 – PFAS OMP, RAAF Base Williamtown, 10 October 2022.

Guidance Document

Defence, 2021a. PFAS Ongoing Monitoring Plan Review Guidance. Directorate of PFAS Remediation Infrastructure Division, Version 1, dated October 2021

Defence, 2021b. PFAS OMP Factual Report Guidance. Directorate of PFAS Remediation Infrastructure Division Version 0.2 dated May 2021 (Defence, 2021b)

Defence, 2022a. Guidance Document E, Standard PFAS Analytical Suite. PFAS Investigation and Management. Revision 5, 29 June 2022.

Defence, 2022b. PFAS OMP Annual Interpretive Report Guidance. Directorate of PFAS Investigation and Remediation Infrastructure Division. Version 0.4, dated October 2022 (Defence, 2022b)

APPENDIX A FIGURES

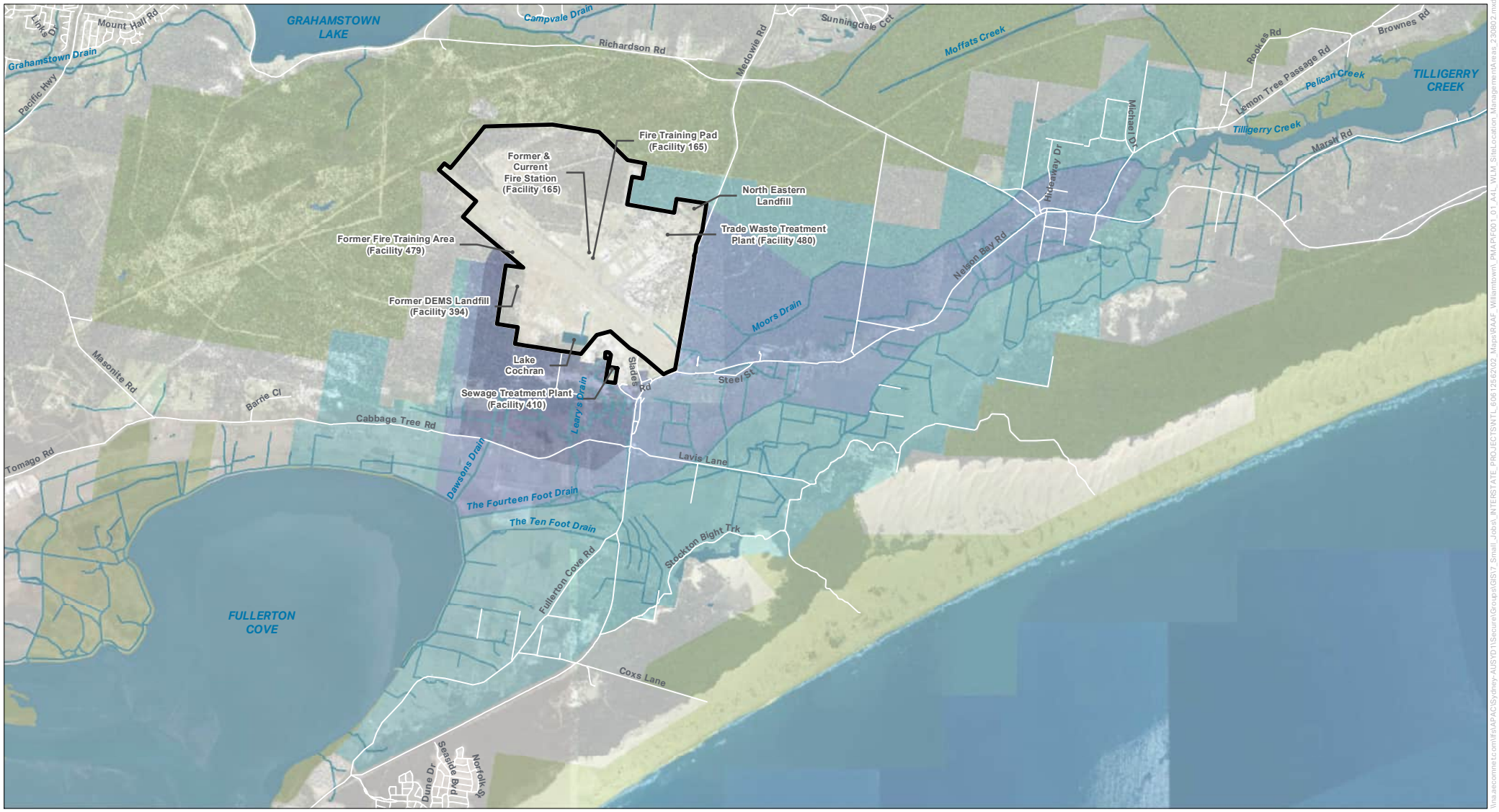
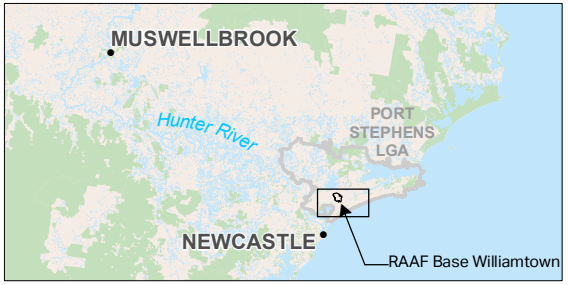


FIGURE F1: SITE LOCATION AND MANAGEMENT AREA

Legend

- RAAF Base Williamtown
- Primary Management Zone
- Secondary Management Zone
- Broader Management Zone



N

0 1 2 km

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PFAS OMP
RAAF BASE WILLIAMTOWN

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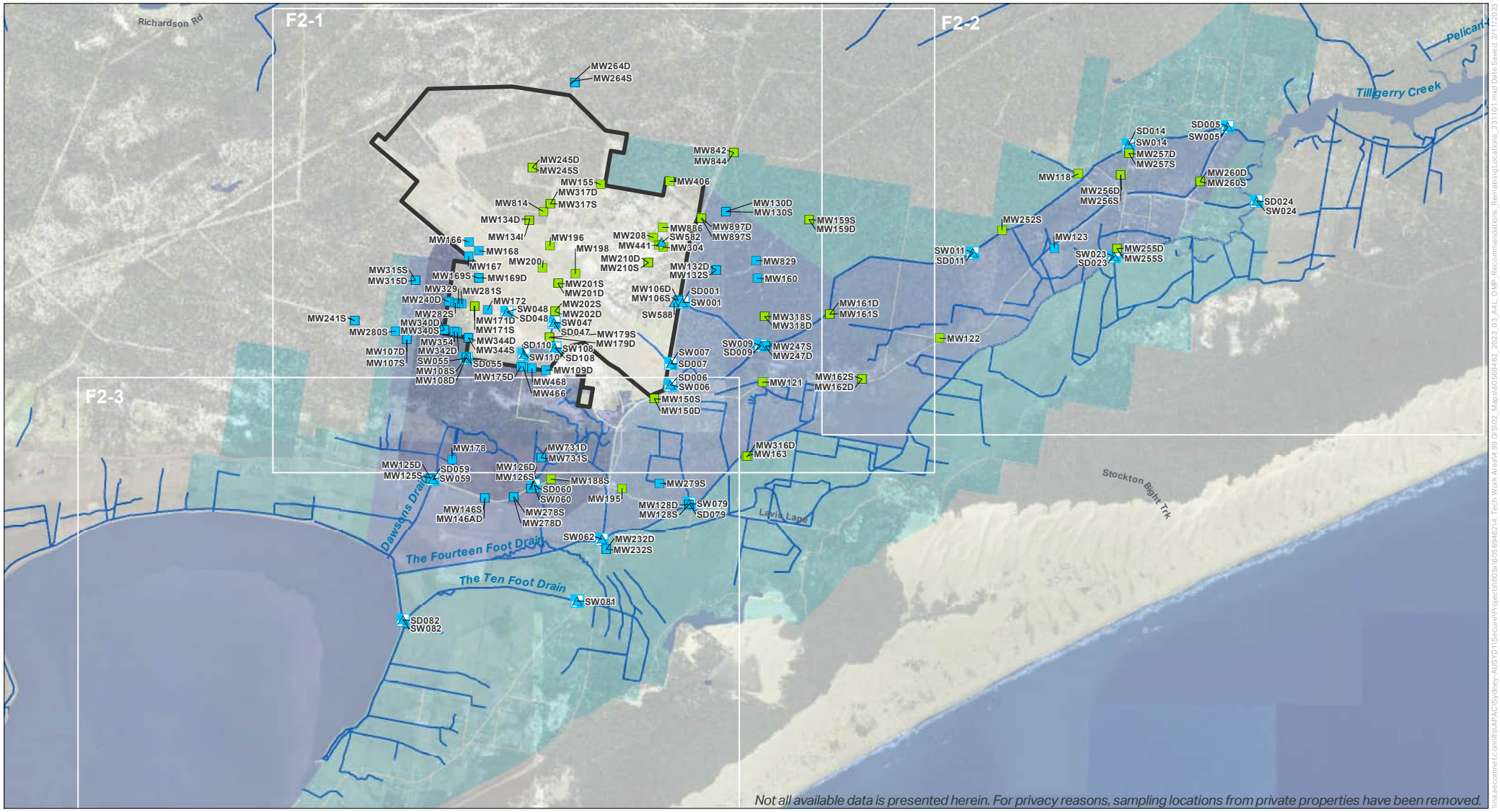
DEPARTMENT OF DEFENCE



Not all available data is presented herein. For privacy reasons, sampling locations from private properties have been removed.

FIGURE F1-0: OMP LOCATIONS - OVERVIEW

Legend

- RAAF Base Williamtown
- Off-Base Drainage
- Primary Management Zone
- Secondary Management Zone
- Broader Management Zone
- Groundwater
- Sediment
- Surface Water
- Annual Sampling
- Biannual Sampling

N

0 0.25 0.5 km

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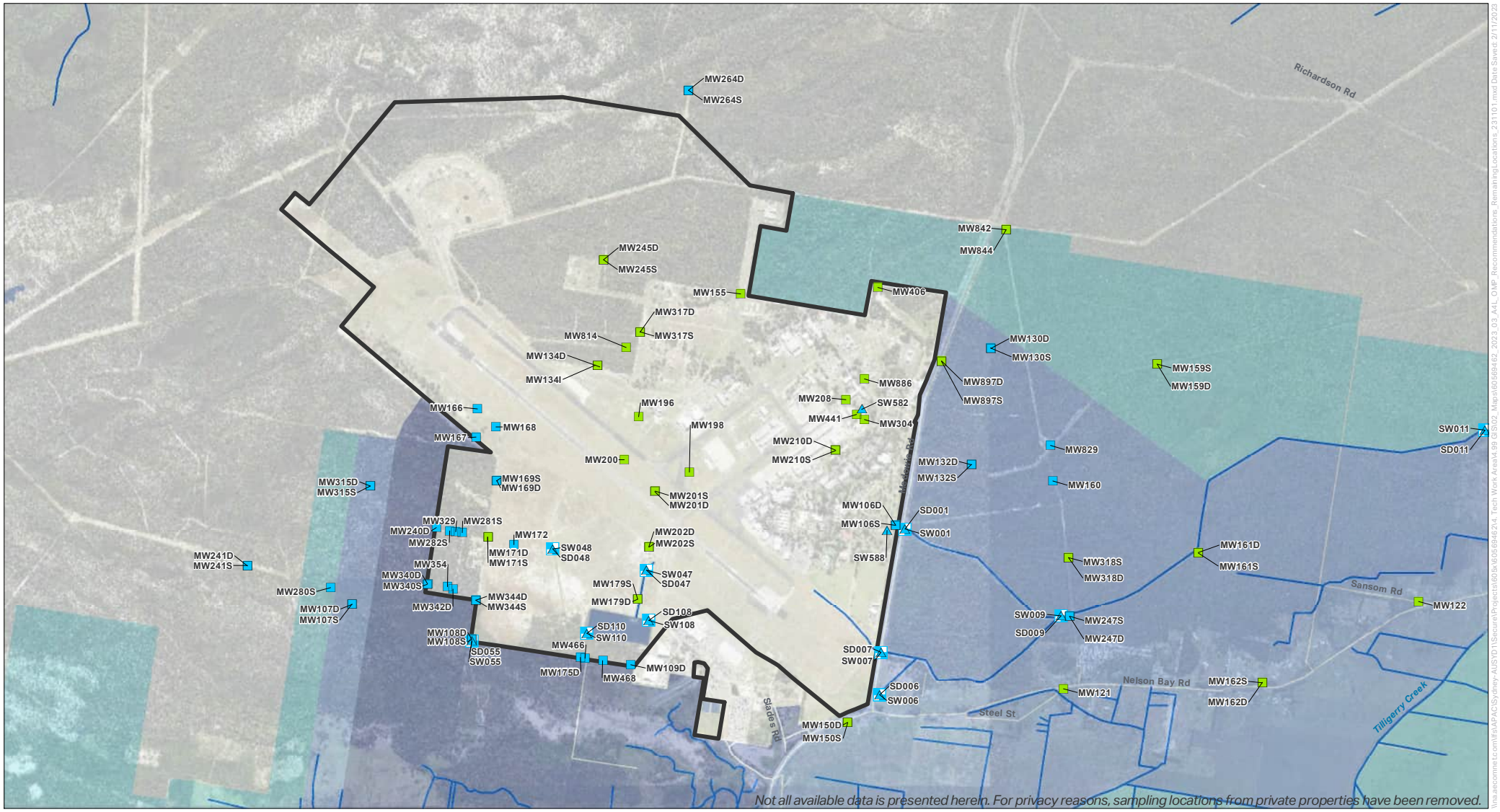

FIGURE F1-1: OMP LOCATIONS - BASE AND WEST

Legend

- RAAF Base Williamtown
- Off-Base Drainage
- Primary Management Zone
- Secondary Management Zone
- Broader Management Zone
- Groundwater
- Sediment
- Surface Water
- Annual Sampling
- Biannual Sampling

N

0 0.25 0.5 km

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RAAF BASE WILLIAMTOWN

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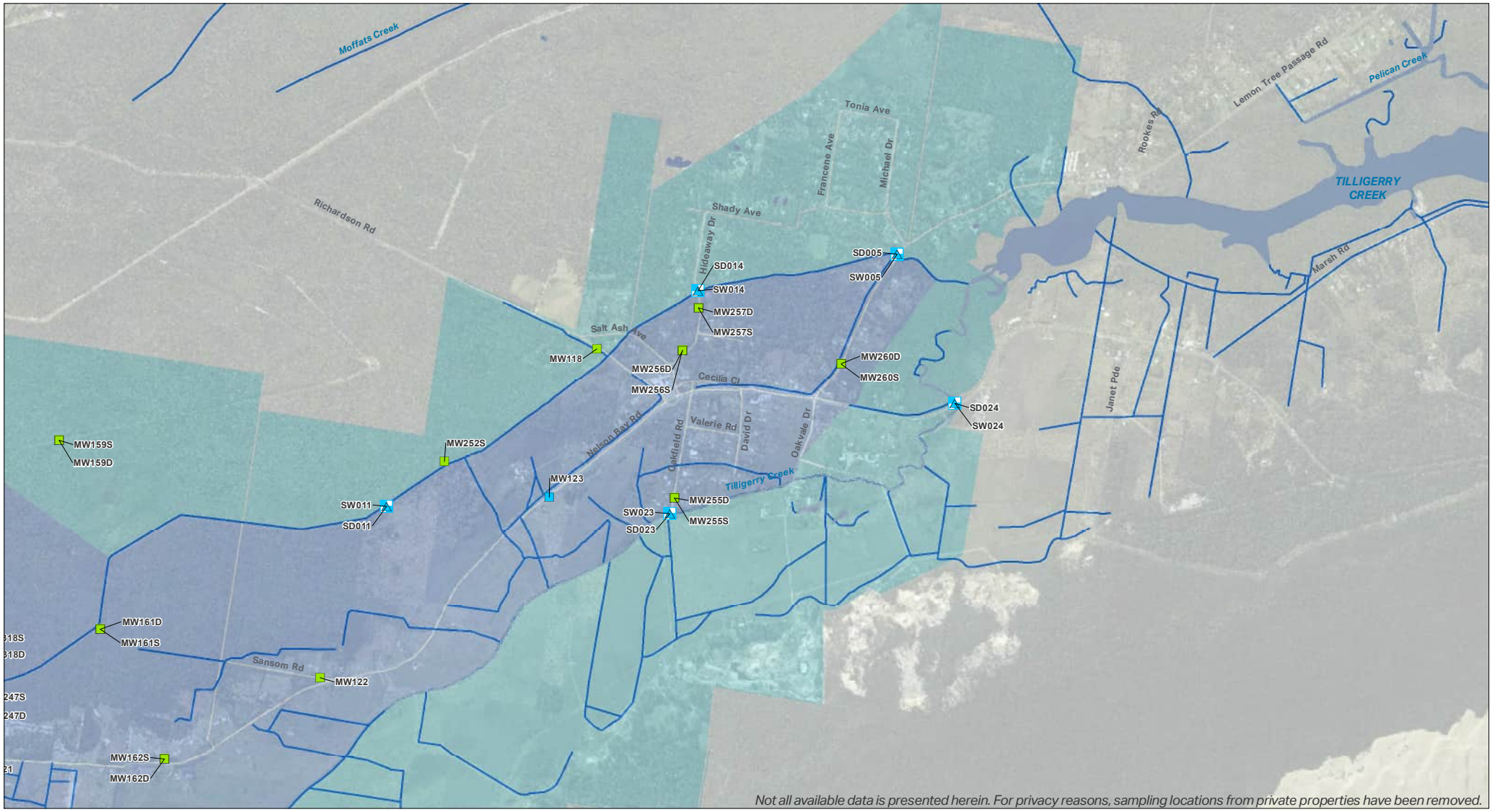

FIGURE F1-2: OMP LOCATIONS - EAST

Legend

- RAAF Base Williamtown
- Off-Base Drainage
- Secondary Management Zone
- Broader Management Zone
- Groundwater
- Sediment
- Surface Water
- Annual Sampling
- Biannual Sampling

N

0 0.25 0.5 km

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PFAS OMP
RAAF BASE WILLIAMTOWN

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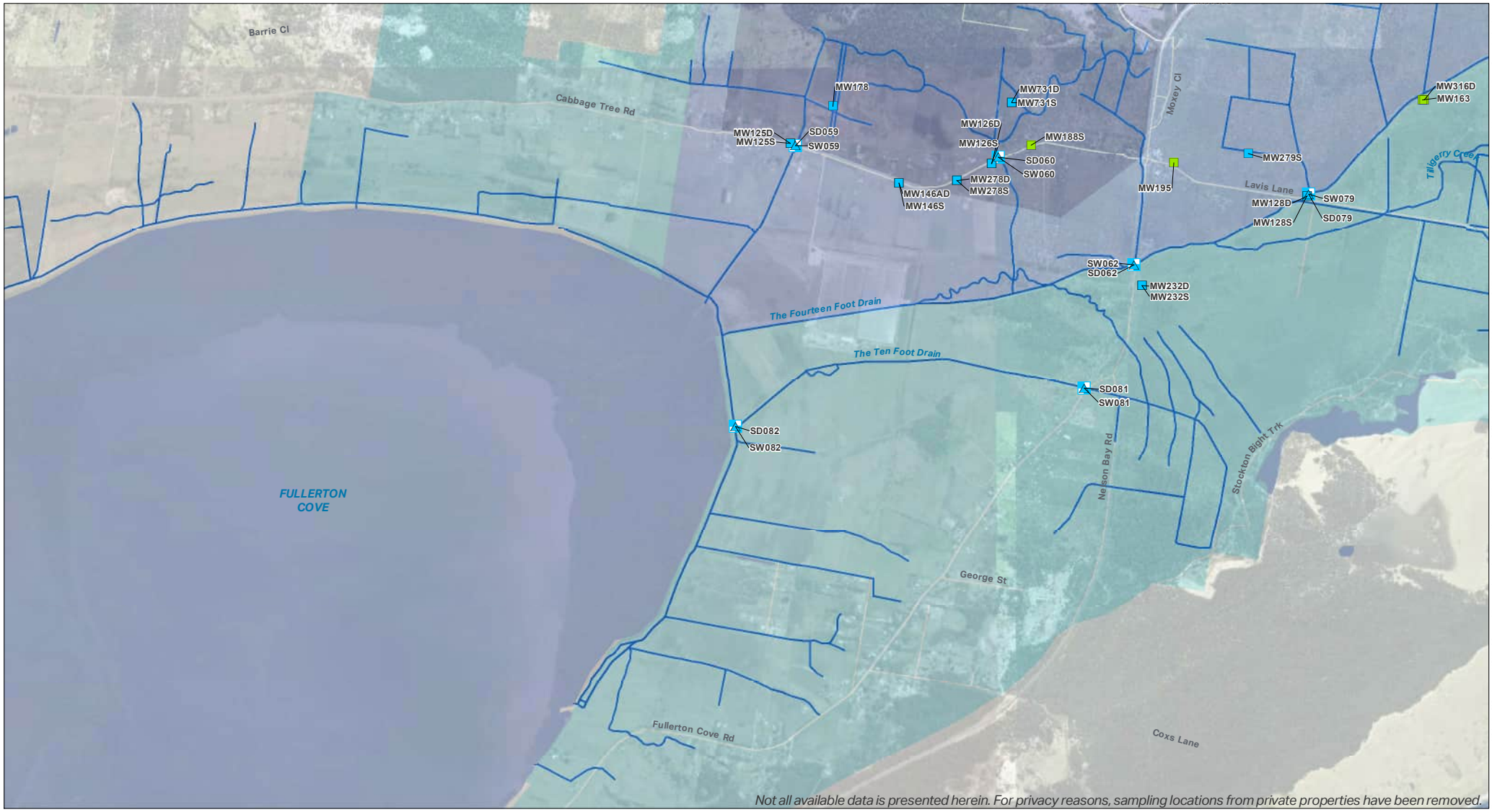

FIGURE F1-3: OMP LOCATIONS - SOUTH

Legend

- RAAF Base Williamtown
- Off-Base Drainage
- Primary Management Zone
- Secondary Management Zone
- Broader Management Zone
- Groundwater
- Sediment
- Surface Water
- Annual Sampling
- Biannual Sampling

N

0 0.25 0.5 km

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FIGURE F3: BIOTA SAMPLING AREA

Legend

- RAAF Base Williamtown
- Biota Sampling Area
- State Conservation Area
- Watercourse

N

0 1 2 km

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APPENDIX B SAMPLE LOCATION INFORMATION

PFAS Ongoing Monitoring Plan
RAAF Base Williamtown

Sample Location Information

On/Off-Base	Area	Location ID	Historical Name	Matrix Type	Easting	Northing	Top of Casing Elevation (m AHD)	Screen Interval (mbgl)	Sampling Frequency	Total in Area
On-Base	Former & Current Fire Station (Facility 165)	MW196		Groundwater	391067.540	6371029.000	6.76	0.8 - 3.8	Annual	7
On-Base	Former & Current Fire Station (Facility 165)	MW198		Groundwater	391345.470	6370725.360	6.11	0.8 - 3.8	Annual	
On-Base	Former & Current Fire Station (Facility 165)	MW200		Groundwater	390988.640	6370792.480	6.47	1 - 4	Annual	
On-Base	Former & Current Fire Station (Facility 165)	MW201D	MW201_D	Groundwater	391156.130	6370617.920	5.81	18.1 - 19.6	Annual	
On-Base	Former & Current Fire Station (Facility 165)	MW201S	MW201_S	Groundwater	391157.420	6370619.430	5.8	1 - 4	Annual	
On-Base	Former & Current Fire Station (Facility 165)	MW202D	MW202_D	Groundwater	391123.470	6370312.140	5.17	19.5 - 21	Annual	
On-Base	Former & Current Fire Station (Facility 165)	MW202S	MW202_S	Groundwater	391124.490	6370312.950	5.21	0.8 - 3.8	Annual	
On-Base	Former DEMS Landfill (Facility 394)	MW171D	MW171_D	Groundwater	390238.080	6370367.200	4.97	18.8 - 20.3	Annual	13
On-Base	Former DEMS Landfill (Facility 394)	MW171S	MW171_S	Groundwater	390238.630	6370369.860	5.02	0.7 - 3.7	Annual	
On-Base	Former DEMS Landfill (Facility 394)	MW172		Groundwater	390381.890	6370326.900	4.88	0.7 - 3.7	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW240D	MW240_D	Groundwater	389953.970	6370418.760	5.742	18.5 - 20	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW281S	MW281_S	Groundwater	390096.831	6370391.813	5.29	1 - 4	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW282S	MW282_S	Groundwater	390029.022	6370401.492	5.37	1 - 4	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW329		Groundwater	390061.870	6370398.025	6.1215	2.4 - 5.39	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW340D	MW340_D	Groundwater	389908.339	6370109.093	4.9554	17 - 20	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW340S	MW340_S	Groundwater	389904.372	6370106.927	4.96194	2 - 5	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW342D	MW342_D	Groundwater	390047.305	6370082.577	4.76384	17 - 20	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW344D	MW344_D	Groundwater	390174.365	6370020.042	4.52071	17 - 20	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW344S	MW344_S	Groundwater	390170.968	6370020.705	4.77721	2 - 5	Bi-annual	
On-Base	Former DEMS Landfill (Facility 394)	MW354		Groundwater	390017.342	6370094.311	4.99285	2 - 5	Bi-annual	
On-Base	Former Fire Training Area / Pit (Facility 479)	MW166		Groundwater	390180.440	6371071.560	7.1	0.8 - 3.8	Bi-annual	5
On-Base	Former Fire Training Area / Pit (Facility 479)	MW167		Groundwater	390173.610	6370916.820	7.19	0.7 - 3.7	Bi-annual	
On-Base	Former Fire Training Area / Pit (Facility 479)	MW168		Groundwater	390283.560	6370972.820	6.78	0.7 - 3.7	Bi-annual	
On-Base	Former Fire Training Area / Pit (Facility 479)	MW169D	MW169_D	Groundwater	390286.310	6370678.240	5.8	18 - 19.5	Bi-annual	
On-Base	Former Fire Training Area / Pit (Facility 479)	MW169S	MW169_S	Groundwater	390286.100	6370676.810	5.83	0.7 - 3.7	Bi-annual	
On-Base	HWC Pump Station 7 (PS7)	MW134D	MW134_D	Groundwater	390841.655	6371311.353	8.75	18.5 - 20	Annual	6
On-Base	HWC Pump Station 7 (PS7)	MW134I	MW134_I	Groundwater	390840.764	6371311.745	8.71	10 - 11.5	Annual	
On-Base	HWC Pump Station 7 (PS7)	MW245D	MW245_D	Groundwater	390873.232	6371892.027	9.311	18.5 - 20	Annual	
On-Base	HWC Pump Station 7 (PS7)	MW245S	MW245_S	Groundwater	390873.171	6371892.968	9.292	1 - 4	Annual	
On-Base	HWC Pump Station 7 (PS7)	MW317D	MW317_D	Groundwater	391074.310	6371493.500	7.96	18.5 - 20	Annual	
On-Base	HWC Pump Station 7 (PS7)	MW317S	MW317_S	Groundwater	391074.570	6371495.370	7.97	1 - 4	Annual	
On-Base	Lake Cochran	MW108D	MW108_D	Groundwater	390150.053	6369806.549	3.08	18.5 - 20	Bi-annual	8
On-Base	Lake Cochran	MW108S	MW108_S	Groundwater	390150.040	6369805.272	2.95	2 - 5	Bi-annual	
On-Base	Lake Cochran	MW109D	MW109_D	Groundwater	391022.625	6369664.782	3.157	18.5 - 20	Bi-annual	
On-Base	Lake Cochran	MW175D	MW175_D	Groundwater	390748.110	6369705.670	4.11	19.5 - 21	Bi-annual	
On-Base	Lake Cochran	MW179D	MW179_D	Groundwater	391061.230	6370026.550	4.76	18.5 - 20	Annual	
On-Base	Lake Cochran	MW179S	MW179_S	Groundwater	391062.530	6370026.330	4.71	0.8 - 3.8	Annual	
On-Base	Lake Cochran	MW466	W66	Groundwater	390771.594	6369702.376	4.32	unknown	Bi-annual	
On-Base	Lake Cochran	MW468	W68	Groundwater	390870.680	6369687.930	4.02	unknown	Bi-annual	
On-Base	North-East Landfill	MW406	W6	Groundwater	392381.420	6371741.140	8.27	unknown	Annual	1
On-Base	Northern Boundary	MW155	MW155D	Groundwater	391628.530	6371705.370	7.96	1.5 - 3.8	Annual	1
On-Base	Trade Waste Treatment (Facility 480)	MW106D	MW106_D	Groundwater	392480.672	6370432.290	4.77	18.5 - 20	Bi-annual	8
On-Base	Trade Waste Treatment (Facility 480)	MW106S	MW106_S	Groundwater	392479.396	6370433.468	4.678	3.5 - 5	Bi-annual	
On-Base	Trade Waste Treatment (Facility 480)	MW208		Groundwater	392206.680	6371122.880	6.99	1.2 - 4.2	Annual	
On-Base	Trade Waste Treatment (Facility 480)	MW210D	MW210_D	Groundwater	392148.550	6370846.040	7.35	18.5 - 20	Annual	
On-Base	Trade Waste Treatment (Facility 480)	MW210S	MW210_S	Groundwater	392149.680	6370843.300	7.22	2 - 5	Annual	
On-Base	Trade Waste Treatment (Facility 480)	MW304	BH531	Groundwater	392309.320	6371014.010	8.29	0.6 - 5.5	Annual	
On-Base	Trade Waste Treatment (Facility 480)	MW441	W41	Groundwater	392263.938	6371042.324	7.669	5 - 6	Annual	
On-Base	Trade Waste Treatment (Facility 480)	MW886	DFIG_MW02	Groundwater	392307.298	6371236.578	7.91	2 - 5	Annual	
Off-Base	Cabbage Tree Road	MW124		Groundwater	388956.782	6368599.356	2.42	6 - 7.5	Gauge only	9
Off-Base	Cabbage Tree Road	MW125D	MW125_D	Groundwater	389753.894	6368475.203	2.173	18.5 - 20	Bi-annual	
Off-Base	Cabbage Tree Road	MW125S	MW125_S	Groundwater	389754.887	6368474.495	2.197	6 - 7.5	Bi-annual	
Off-Base	Cabbage Tree Road	MW126D	MW126_D	Groundwater	390861.585	6368364.380	1.794	18.5 - 20	Bi-annual	
Off-Base	Cabbage Tree Road	MW126S	MW126_S	Groundwater	390859.700	6368364.000	1.79	5.5 - 7	Bi-annual	
Off-Base	Cabbage Tree Road	MW178		Groundwater	389989.490	6368679.850	1.76	1.2 - 4.2	Bi-annual	
Off-Base	Cabbage Tree Road	MW230S	MW230_S	Groundwater	-	-	0.939	2.5 - 4	Bi-annual	
Off-Base	Cabbage Tree Road	MW238D	MW238_D	Groundwater	-	-	2.211	18.5 - 20	Bi-annual	
Off-Base	Cabbage Tree Road	MW238S	MW238_S	Groundwater	-	-	2.27	1 - 4	Bi-annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW130D	MW130_D	Groundwater	393004.197	6371405.978	5.858	15 - 16.5	Bi-annual	14
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW130S	MW130_S	Groundwater	393002.625	6371406.828	5.794	1 - 4	Bi-annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW132D	MW132_D	Groundwater	392897.695	6370765.961	6.138	15 - 16.5	Bi-annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW132S	MW132_S	Groundwater	392896.755	6370766.519	6.082	3 - 6	Bi-annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW159D	MW159_D	Groundwater	393918.000	6371319.400	5.26	18.5 - 20	Annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW159S	MW159_S	Groundwater	393918.570	6371319.290	4.987	0.7 - 3.7	Annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW160		Groundwater	393345.050	6370675.530	4.212	1 - 4	Bi-annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW318D	MW318_D	Groundwater	393430.690	6370254.380	2.63	18.5 - 20	Annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW318S	MW318_S	Groundwater	393430.740	6370255.700	2.67	1 - 4	Annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW829	PS9_BORE 30, MW652	Groundwater	393331.000	6370871.000	unknown	unknown	Bi-annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW842	SK3496_D	Groundwater	393087.000	6372057.000	unknown	unknown	Annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW844	SK3496_S	Groundwater	393087.000	6372057.000	unknown	unknown	Annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW897D		Groundwater	392732.380	6371335.800	7.34	17 - 20	Annual	
Off-Base	East of Site - HWC Pump Station 9 (PS9)	MW897S		Groundwater	392731.690	6371333.830	7.44	3 - 6	Annual	
Off-Base	East of Site - Moors Drain	MW121		Groundwater	393402.288	6369534.793	1.589	4.5 - 6	Annual	5
Off-Base	East of Site - Moors Drain	MW161D	MW161_D	Groundwater	394144.090	6370281.980	2.057	18.8 - 23.3	Annual	
Off-Base	East of Site - Moors Drain	MW161S	MW161_S	Groundwater	394144.490	6370280.230	2.052	1 - 4	Annual	
Off-Base	East of Site - Moors Drain	MW247D	MW247_D	Groundwater	393434.921	6369931.136	2.529	18.5 - 20	Bi-annual	
Off-Base	East of Site - Moors Drain	MW247S	MW247_S	Groundwater	393437.342	6369931.614	2.468	1 - 4	Bi-annual	
Off-Base	East of Site / Nelson Bay Road	MW122		Groundwater	395353.806	6370014.338	1.851	5.5 - 7	Annual	3
Off-Base	East of Site / Nelson Bay Road	MW162D	MW162_D	Groundwater	394497.850	6369568.440	2.876	18.6 - 20.1	Annual	
Off-Base	East of Site / Nelson Bay Road	MW162S	MW162_S	Groundwater	394497.180	6369567.050	2.838	1.5 - 4.5	Annual	
Off-Base	Fullerton Cove	MW147D	MW147_D	Groundwater	-	-	0.81	23.7 - 26.7	Annual	11
Off-Base	Fullerton Cove	MW147S	MW147_S	Groundwater	-	-	0.71	1 - 4	Annual	
Off-Base	Fullerton Cove	MW231D	MW231_D	Groundwater	-	-	0.571	16 - 17.5	Bi-annual	
Off-Base	Fullerton Cove	MW231S	MW231_S	Groundwater	-	-	0.625	1 - 4	Bi-annual	
Off-Base	Fullerton Cove	MW232D	MW232_D	Groundwater	391685.900	6367694.410	1.324	18.5 - 20	Bi-annual	
Off-Base	Fullerton Cove	MW232S	MW232_S	Groundwater	391686.550	6367693.690	1.148	1 - 4	Bi-annual	
Off-Base	Fullerton Cove	MW268D	MW268_D	Groundwater	391033.890	6366027.170	3.362	18.5 - 20	Gauge only	
Off-Base	Fullerton Cove	MW268S	MW268_S	Groundwater	391034.350	6366028.400	3.232	2 - 5	Gauge only	
Off-Base	Fullerton Cove	MW270D	MW270_D	Groundwater	-	-	1.412	18.5 - 20	Bi-annual	
Off-Base	Fullerton Cove	MW270S	MW270_S	Groundwater	-	-	1.411	2 - 4	Bi-annual	
Off-Base	Fullerton Cove	POT382		Groundwater	-	-	n/a	n/a	Bi-annual	
Off-Base	Lavis Lane	MW128D	MW128_D	Groundwater	392595.830	6368186.070	0.843	9.3 - 10.3	Bi-annual	6
Off-Base	Lavis Lane	MW128S	MW128_S	Groundwater	392594.050	6368185.389	0.909	4.7 - 6.2	Bi-annual	
Off-Base	Lavis Lane	MW163		Groundwater	393228.090	6368715.090	1.207	0.5 - 3.5	Annual	
Off-Base	Lavis Lane	MW195		Groundwater	391861.030	6368367.600	1.05	0.8 - 3.8	Annual	
Off-Base	Lavis Lane	MW279S	MW279_S	Groundwater	392270.061	6368420.027	1.295	0.8 - 3.8	Bi-annual	
Off-Base	Lavis Lane	MW316D	MW316_D/MW319D	Groundwater	393238.400	6368714.460	1.2	18 - 20	Annual	
Off-Base	Salt Ash	MW118		Groundwater	396874.979	6371821.789	1.674	4.5 - 6	Annual	11
Off-Base	Salt Ash	MW123		Groundwater	396612.431	6371006.705	1.524	4.5 - 6	Annual	
Off-Base	Salt Ash	MW252S	MW252_S	Groundwater	396036.337	6371201.447	1.103	1 - 4	Annual	
Off-Base	Salt Ash	MW255D	MW255_D	Groundwater	397301.190	6371001.280	1.26	18.5 - 20	Annual	
Off-Base	Salt Ash	MW255S	MW255_S	Groundwater	397301.590	6371002.620	1.258	1 - 4	Annual	
Off-Base	Salt Ash	MW256D	MW256_D	Groundwater	397345.350	6371814.030	1.534	18.5 - 20	Annual	
Off-Base	Salt Ash	MW256S	MW256_S	Groundwater	397343.940	6371812.750	1.518	1 - 4	Annual	
Off-Base	Salt Ash	MW257D	MW257_D	Groundwater	397433.640	6372046.790	1.819	18.5 - 20	Annual	
Off-Base	Salt Ash	MW257S	MW257_S	Groundwater	397433.620	6372045.200	1.639	1 - 4	Annual	
Off-Base	Salt Ash	MW260D	MW260_D	Groundwater	398217.180	6371740.430	2.08	18.5 - 20	Annual	
Off-Base	Salt Ash	MW260S	MW260_S	Groundwater	398216.560	6371738.790	2.124	1 - 4	Annual	
Off-Base	South of Site / Nelson Bay Road	MW150D	MW150_D	Groundwater	392214.992	6369348.446	2.143	18.5 - 20	Annual	2
Off-Base	South of Site / Nelson Bay Road	MW150S	MW150_S	Groundwater	392215.800	6369349.000	2.111	0.6 - 3.6	Annual	
Off-Base	Southern Area	MW104D	MW104_D	Groundwater	-	-	3.919	18.5 - 20	Annual	8
Off-Base	Southern Area	MW104S	MW104_S	Groundwater	-	-	3.955	3.5 - 5	Annual	
Off-Base	Southern Area	MW184D	MW184_D	Groundwater	-	-	3.073	18.5 - 20	Annual	
Off-Base	Southern Area	MW184S	MW184_S	Groundwater	-	-	3.106	1 - 4	Annual	
Off-Base	Southern Area	MW188S	MW188_S	Groundwater	391077.170	6368465.490	1.439	0.8 - 3.8	Annual	
Off-Base	Southern Area	MW188D	MW188_D	Groundwater	391078.557	6368466.180	1.458	18.5 - 20	Annual	

Sample Location Information

On/Off-Base	Area	Location ID	Historical Name	Matrix Type	Easting	Northing	Top of Casing Elevation (m AHD)	Screen Interval (mbgl)	Sampling Frequency	Total in Area
Off-Base	Southern Area	MW731D	MW731_D	Groundwater	390971.270	6368702.310	2.19	18.5 - 20	Bi-annual	
Off-Base	Southern Area	MW731S	MW731_S	Groundwater	390970.690	6368699.830	2.05	2.5 - 5.5	Bi-annual	
Off-Base	Southern Area - Cabbage Tree Road	MW146AD	MW146D_A	Groundwater	390352.000	6368257.000	1.62	18.5 - 20	Bi-annual	6
Off-Base	Southern Area - Cabbage Tree Road	MW146S	MW146_S	Groundwater	390352.180	6368257.630	1.802	0.8 - 3.8	Bi-annual	
Off-Base	Southern Area - Cabbage Tree Road	MW271D	MW271_D	Groundwater	-	-	1.308	18.5 - 20	Bi-annual	
Off-Base	Southern Area - Cabbage Tree Road	MW271S	MW271_S	Groundwater	-	-	1.316	1 - 4	Bi-annual	
Off-Base	Southern Area - Cabbage Tree Road	MW278D	MW278_D	Groundwater	390668.714	6368270.854	1.289	18.5 - 20	Bi-annual	
Off-Base	Southern Area - Cabbage Tree Road	MW278S	MW278_S	Groundwater	390670.046	6368271.548	1.253	1.5 - 3	Bi-annual	
Off-Base	West of Site	MW107D	MW107_D	Groundwater	389492.110	6369998.764	3.362	18.5 - 20	Bi-annual	7
Off-Base	West of Site	MW107S	MW107_S	Groundwater	389491.340	6369998.554	3.322	2 - 5	Bi-annual	
Off-Base	West of Site	MW241D	MW241_D	Groundwater	388917.523	6370209.919	5.449	18.5 - 20	Bi-annual	
Off-Base	West of Site	MW241S	MW241_S	Groundwater	388917.717	6370210.859	5.559	1 - 4	Bi-annual	
Off-Base	West of Site	MW280S	MW280S_LT, MW280_S	Groundwater	389373.293	6370090.665	3.831	1 - 4	Bi-annual	
Off-Base	West of Site	MW315D	MW315_D/MW320D	Groundwater	389591.670	6370649.350	6.16	18 - 20	Bi-annual	
Off-Base	West of Site	MW315S	MW315_S/MW320S	Groundwater	389591.670	6370649.350	6.18	1 - 4	Bi-annual	
Off-Base	North of Site - Background	MW264D	MW264_D	Groundwater	391342.219	6372823.069	9.347	18.5 - 20	Bi-annual	2
Off-Base	North of Site - Background	MW264S	MW264_S	Groundwater	391341.189	6372822.252	9.492	1 - 4	Bi-annual	
On-Base	Dawsons Drain (Lake Cochran)	SW055	DD1	Surface water	390150.677	6369798.630	n/a	n/a	Bi-annual	1
On-Base	Lake Cochran	SW108	LC	Surface water	391123.700	6369909.000	n/a	n/a	Bi-annual	2
On-Base	Lake Cochran	SW110	LC_B	Surface water	390783.280	6369838.664	n/a	n/a	Bi-annual	
On-Base	Moors Drain Catchment	SW582		Surface water	392294.930	6371073.140	n/a	n/a	Bi-annual	2
On-Base	Moors Drain Catchment	SW588		Surface water	392432.560	6370405.190	n/a	n/a	Bi-annual	
On-Base	On-Site Drain (East of Former DEMS Landfill)	SW048	BD04	Surface water	390594.587	6370302.505	n/a	n/a	Bi-annual	1
On-Base	On-Site Drain (North of Lake Cochran)	SW047	BD03	Surface water	391110.917	6370186.229	n/a	n/a	Bi-annual	1
Off-Base	Dawsons Drain	SW059	DD2	Surface water	389781.611	6368463.966	n/a	n/a	Bi-annual	3
Off-Base	Dawsons Drain	SW060	DD3	Surface water	390896.510	6368398.705	n/a	n/a	Bi-annual	
Off-Base	Dawsons Drain	SW333		Surface water	-	-	n/a	n/a	Bi-annual	
Off-Base	Fourteen Foot Drain	SW062	DD5	Surface water	391642.635	6367808.154	n/a	n/a	Bi-annual	2
Off-Base	Fourteen Foot Drain	SW600		Surface water	-	-	n/a	n/a	Bi-annual	
Off-Base	Fullerton Cove Ring Drain	SW259	FCD4	Surface water	-	-	n/a	n/a	Bi-annual	1
Off-Base	Moors Drain	SW001	MD1	Surface water	392531.852	6370412.424	n/a	n/a	Bi-annual	7
Off-Base	Moors Drain	SW005	MD5	Surface water	398523.104	6372342.800	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SW006	MD6	Surface water	392391.918	6369501.696	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SW007	MD7	Surface water	392398.750	6369734.616	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SW009	MD8	Surface water	393389.182	6369933.826	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SW011	MD10	Surface water	395719.424	6370956.542	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SW014	MD14	Surface water	397430.793	6372140.735	n/a	n/a	Bi-annual	
Off-Base	Ten Foot Drain	SW081	TFD1	Surface water	391369.231	6367128.789	n/a	n/a	Bi-annual	1
Off-Base	Tilligerry Creek	SW019	TC12	Surface water	-	-	n/a	n/a	Bi-annual	4
Off-Base	Tilligerry Creek	SW023	TC6A	Surface water	397274.000	6370916.000	n/a	n/a	Bi-annual	
Off-Base	Tilligerry Creek	SW024	TC7	Surface water	398841.534	6371521.129	n/a	n/a	Bi-annual	
Off-Base	Tilligerry Creek	SW079	TC2	Surface water	392602.731	6368195.612	n/a	n/a	Bi-annual	
On-Base	Dawsons Drain (Lake Cochran)	SD055	DD1	Sediment	390150.677	6369798.630	n/a	n/a	Bi-annual	1
On-Base	Lake Cochran	SD108	LC	Sediment	391123.700	6369909.000	n/a	n/a	Bi-annual	2
On-Base	Lake Cochran	SD110	LC_B	Sediment	390783.280	6369838.664	n/a	n/a	Bi-annual	
On-Base	On-Site Drain (East of Former DEMS Landfill)	SD048	BD04	Sediment	390594.587	6370302.505	n/a	n/a	Bi-annual	1
On-Base	On-Site Drain (North of Lake Cochran)	SD047	BD03	Sediment	391110.917	6370186.229	n/a	n/a	Bi-annual	1
Off-Base	Dawsons Drain	SD059	DD2	Sediment	389781.611	6368463.966	n/a	n/a	Bi-annual	3
Off-Base	Dawsons Drain	SD060	DD3	Sediment	390896.510	6368398.705	n/a	n/a	Bi-annual	
Off-Base	Dawsons Drain	SD333		Sediment	-	-	n/a	n/a	Bi-annual	
Off-Base	Fourteen Foot Drain	SD062	DD5	Sediment	391642.635	6367808.154	n/a	n/a	Bi-annual	2
Off-Base	Fourteen Foot Drain	SD600		Sediment	-	-	n/a	n/a	Bi-annual	
Off-Base	Fullerton Cove (tidal gate outlet)	SD254	FC1A	Sediment	-	-	n/a	n/a	Bi-annual	3
Off-Base	Fullerton Cove (tidal gate outlet)	SD255	FC1B	Sediment	-	-	n/a	n/a	Bi-annual	
Off-Base	Fullerton Cove (tidal gate outlet)	SD326	FC1C	Sediment	-	-	n/a	n/a	Bi-annual	
Off-Base	Fullerton Cove Ring Drain	SD259	FCD4	Sediment	-	-	n/a	n/a	Bi-annual	1
Off-Base	Moors Drain	SD001	MD1	Sediment	392531.852	6370412.424	n/a	n/a	Bi-annual	7
Off-Base	Moors Drain	SD005	MD5	Sediment	398523.104	6372342.800	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SD006	MD6	Sediment	392391.918	6369501.696	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SD007	MD7	Sediment	392398.750	6369734.616	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SD009	MD8	Sediment	393389.182	6369933.826	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SD011	MD10	Sediment	395719.424	6370956.542	n/a	n/a	Bi-annual	
Off-Base	Moors Drain	SD014	MD14	Sediment	397430.793	6372140.735	n/a	n/a	Bi-annual	
Off-Base	Ten Foot Drain	SD081	TFD1	Sediment	391369.231	6367128.789	n/a	n/a	Bi-annual	1
Off-Base	Tilligerry Creek	SD019	TC12	Sediment	-	-	n/a	n/a	Bi-annual	4
Off-Base	Tilligerry Creek	SD023	TC6A	Sediment	397274.000	6370916.000	n/a	n/a	Bi-annual	
Off-Base	Tilligerry Creek	SD024	TC7	Sediment	398841.534	6371521.129	n/a	n/a	Bi-annual	
Off-Base	Tilligerry Creek	SD079	TC2	Sediment	392602.731	6368195.612	n/a	n/a	Bi-annual	
Total (including 3 gauge-only locations)										**184**

Note: Coordinates for sampling locations on private properties have been removed for privacy reasons.

APPENDIX C OMP REVIEW

Table 11 OMP monitoring location and frequency review

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
Groundwater						
On-Base						
MW205	-	No	Yes	No	Remove from OMP (replaced with MW441, MW304 and MW886)	Monitoring well MW205 has not been located since the start of the PFAS OMP in November 2019 and therefore it is recommended that this location is removed from the PFAS OMP. It is considered that downgradient impacts from the Trade Waste Treatment Plant and MEOMS Building source area will be captured by MW210S and MW210D.
MW212	-	No	Yes	No	Remove from OMP	Sufficient coverage is provided in this area by MW210S and MW210D therefore it is recommended to remove this monitoring location from the PFAS OMP.
MW441	-	Yes	Yes	No	Add to OMP	It is recommended that MW304, MW441 and MW886 are added to the PFAS OMP as suitable replacement wells for MW205 and MW212, given that they were installed

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW304	-					in more appropriate locations on-base in the area of MEOMS. Note that in May 2021 PFOS+PFHxS was reported at 113 ug/L in MW441 and 15 ug/L in MW304. Additionally, MW304 is down hydraulic gradient to MW441.
MW886	-					MW886 was installed as part of Fuel Transformation investigation project at the refuelling area. Note that in April 2021 PFOS+PFHxS was reported at 63.3 ug/L in MW886, and this location is upgradient to MW304 and MW441. It is recommended that these wells be sampled on an annual basis as per the nearby wells, which were reduced from biannual to annual sampling.
MW240S	-	Yes	Yes	No	Remove from OMP	During the June 2019 monitoring event, MW240S was observed to have been destroyed and could not be sampled. The 2019 SAQP (Rev A) provided alternate location (MW280S) to replace this well. Given MW240S has already been removed from program, it is recommended that the PFAS OMP is updated to reflect this change for completeness.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW280S	-	Yes	Yes	No	Add to OMP	Monitoring well MW280S was added to program as part of the 2019 SAQP (Rev A) as an alternate location for MW240S, which had likely been destroyed as it could not be located. Given it is currently part of the program under the existing SAQP, it is recommended that this location be added to the PFAS OMP for completeness.
MW329	-	Yes	Yes	No	Add to OMP	It is recommended that MW329 is added to the PFAS OMP as a new location to target the high concentrations of PFAS along the central axis of the plume originating from FFTA. Note that in November 2020, PFOS+PFHxS was reported at 194 ug/L in MW329. The lateral extent of this high concentration is monitored by existing wells MW281S and MW282S. It is recommended this well be sampled on a biannual basis as per the nearby wells.
MW340S & MW340D	-	Yes	Yes	No	Add to OMP	It is recommended that MW340S, MW340D, MW354, MW342D, MW344S, MW344D are added to the OMP to monitor the PFAS concentrations on the southern base

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW354	-					boundary at the DEMS area. These wells were installed to assess the extent of the PFAS plume originating from FFTA. The well pairing MW340S/D and MW344S/D are located on the edges of the lateral extent of plume, and MW354/MW342D target approximately the centre of the PFAS plume. The wells will provide early indication of PFAS moving across the bite boundary. Note that in November 2020, PFOS+PFHxS was reported at 120 ug/L in MW354. It is recommended that these wells are sampled on a biannual basis as per the nearby wells.
MW342D	-					
MW344S & MW344D	-					
MW433	-	Yes	Yes	No	Remove from OMP	Sufficient coverage is provided in this area by MW209SD and MW130SD, therefore it is recommended to remove these monitoring locations.
MW156D	-					

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW244S & MW244D	-	Yes	No	No	Remove from OMP	Monitoring wells MW244S and MW244D are located up-hydraulic gradient of main PFAS plume in the north western corner of the base. Since 2017, shallow monitoring well MW244S has reported isolated detects of PFAS near the laboratory limit of reporting. PFAS has not been detected in deep monitoring well MW244D since monitoring commenced in 2017. Given that the monitoring of these locations no longer add significant value in assessing the extent and associated risks of PFAS in groundwater at the base, it is recommended that they be removed from the PFAS OMP.
MW814	PS7_BORE46	No	Yes	No	Remove from OMP	This locations has not been sampled since 2020 as it has not been able to be located, using metal detectors and GPS coordinates, on numerous occasions. Therefore it is recommended to remove the monitoring location from the program. The existing monitoring well network provides sufficient coverage of the plume in this area.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW134I & MW134D	-	No	Yes	No	Retain in OMP, decrease frequency of sampling from biannual to annual	Given that the PFAS OMP monitoring completed to date has not identified significant changes to the nature and extent of PFAS in groundwater at the northern portion of the base, it is recommended that the sampling of these selected on-base locations be reduced from biannually to annually. Given that annual sampling of these locations would be sufficient to identify significant changes in the nature and extent of PFAS at the base.
MW179S & MW179D	-	Yes	Yes	No	Retain in OMP, decrease frequency of sampling from biannual to annual	Given that the PFAS OMP monitoring completed to date has not identified significant changes to the nature and extent of PFAS in groundwater at the base, it is recommended that the sampling of these selected on-base locations be reduced from biannually to annually. It is considered that annual sampling of these locations would be sufficient to identify any significant changes in the nature and extent of PFAS at the base.
MW196	-					
MW198	-					
MW209S & MW209D	-					
MW202S & MW202D	-					
MW208	-					
Southern Area and Cabbage Tree Road						

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW187S & MW187D	-	Yes	Yes	Yes	Remove from OMP	MW187S and MW187D were decommissioned in December 2019 at the request of the private property owner, and therefore no longer able to be sampled. In November 2020, the private property owner declined the participate in the OMP. Therefore, it is recommended that locations MW219S, MW219D, MW274S, MW274D, MW275S be removed from the PFAS OMP.
MW219S & MW219D	-					
MW274S & MW274D	-					
MW275S	-					
MW177	-	Yes	Yes	Yes	Remove from OMP	This location has not been sampled since 2018 as it has either been dry or unable to be reached due to dense vegetation and boggy conditions. Therefore, it is recommended to remove this monitoring location from the program. The existing monitoring well network provides sufficient coverage of the plume in this area.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW226S & MW226D	-	Yes	Yes	Yes	Remove from OMP	These locations have not been sampled since 2019 as they have not been able to be located, using metal detectors on numerous occasions. Therefore it is recommended to remove these monitoring locations from the program. The existing monitoring well network provides sufficient coverage of the plume in this area.
MW229S & MW229D	-	Yes	Yes	Yes	Remove from OMP	These locations have not been sampled since May 2021 as they have not been able to be located, using metal detectors on numerous occasions. Sufficient coverage is provided by nearby monitoring wells MW125S, MW125D, MW271S, MW271D, MW146S and MW146AD in this area, therefore it is recommended to remove this location from the PFAS OMP.
POT085	BWS085	No	No	No	Remove from OMP	While some of these bores and monitoring wells have reported isolated, irregular detects of PFAS since sampling was undertaken in 2014, the majority of locations have reported results consistently below the laboratory LOR.
POT156	BWS156					
POT107	BWS107					
MW137	-					

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW139	-					These locations are outside of the current inferred plume footprint, and the westerly extent is adequately covered through sampling of MW238S, MW238D, MW125S and MW125D. It is recommended that these locations are removed from the PFAS OMP.
MW124	-					
MW236S & MW236D	-					
MW140	-					
MW731S & MW731D	-	Yes	Yes	No	Add to OMP	It is recommended that MW731S and MW731D are added to the OMP to monitor the PFAS concentrations to the south of the base in Southern Area. These wells were installed as part of the off-base extraction planning within private property. The locations provide coverage of the eastern edge of the southern PFAS plume extent. Note that in December 2020, PFOS+PFHxS was reported at 21.6 ug/L in MW731S and 5.22 ug/L in MW731D. It is recommended that these wells be sampled on a biannual basis as per the nearby wells.
South of Base						
MW150S & MW150D	-	No	Yes	Yes	Add to OMP	It is recommended that MW150S and MW150D are added to the OMP as suitable

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
						replacements for MW276S, MW276D and MW120. MW150S and MW150D are located on the road reserve along Nelson Bay Road, and if these wells have been destroyed or cannot be located, alternate locations MW111S and MW111D, approximately 200m to the north of MW150S and MW150D will be considered. It is recommended that these wells be sampled on an annual basis as per the nearby wells.
West of Base						
MW103S & MW103D	-	Yes	Yes	No	Remove from OMP	Monitoring wells MW103S and MW103D are located off base to the west. These locations have not been sampled since 2020 as they have not been able to be accessed due to flooding in the area. Sufficient coverage is provided by nearby monitoring wells MW315S, MW315D, MW166 and MW167 in this area, therefore it is recommended to remove these locations from the PFAS OMP.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW280S	-	No	No	No	Add to OMP	Monitoring well MW280S was added to program as part of the 2019 SAQP (Rev A) as an alternate location to MW240S, which may have been destroyed as it could not be located. Given it is currently part of the program under the existing SAQP, it is recommended that this location be added to the PFAS OMP for completeness. Additionally, it is recommended that this well be sampled on a biannual basis as per the nearby wells.
East of base						
MW209S & MW209D	-	Yes	Yes	No	Remove from OMP	Monitoring wells MW209S and MW209D are located on base near eastern boundary. These locations have not been sampled since May 2022 as they have not been able to be accessed due to being covered by stockpile. Therefore it is recommended to remove these monitoring locations from the program. The new wells MW897S & MW897 will provide sufficient coverage of the plume in this area.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW897S & MW897D	-	Yes	Yes	No	Add to OMP	It is recommended that MW897S and MW897D are added to the OMP to monitor the PFAS concentrations to the east of the base boundary (east of the refuelling area) to complement the existing wells in this area. These wells were installed as part of the NE Landfill characterisation works to assess the extent of the PFAS plume to the east of the base. Note that in August 2021, PFOS+PFHxS was reported at 0.23 ug/L in MW897S and 1.19 ug/L in MW897D. It is recommended that these wells be sampled on an annual basis as per the nearby wells.
POT046	BWS046	No	Yes	Yes	Remove from OMP	Sufficient coverage is provided by nearby monitoring wells MW162S and MW162D in this area, therefore it is recommended to remove this location from the PFAS OMP.
POT059	BWS059	No	Yes	Yes	Remove from OMP	The private property owner has declined to participate in the PFAS OMP and nearby monitoring well MW121 provides sufficient coverage for this area, therefore it is recommended that this location is removed from the PFAS OMP.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW826	-	No	Yes	Yes	Remove from OMP	This location has not been located or successfully sampled since May 2019. Given that nearby wells MW132S, MW132D, MW829 and MW160 provide sufficient coverage of this location, it is recommended that this location is removed from the PFAS OMP.
MW832	PS9_BORE59	Yes	No	No	Remove from OMP	During the May 2020 and November 2020 monitoring events, MW832 was not able to be located and appears to have been buried under sand. Given that nearby well MW132D provides sufficient coverage of this location, it is recommended that this location is removed from the PFAS OMP
MW158S & MW158D	-	No	No	No	Remove from OMP	Monitoring wells MW158S and MW158D are located up-hydraulic gradient of main PFAS plume to the northeast of base. Since 2017, concentrations of PFAS have been reported below the laboratory LOR in both wells. Given that monitoring of these locations no longer adds significant value in assessing the extent and associated risks of PFAS in groundwater at the base, it is recommended that they be removed from the PFAS OMP.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW121	-	No	Yes	Yes	Retain in OMP, decrease frequency from biannual to annual sampling	Given that the PFAS OMP monitoring completed to date has not identified significant changes to the nature and extent of PFAS in groundwater to the east of the base, along Moors Drain, it is recommended that the sampling of these selected off-base locations be reduced from biannually to annually. Given that annual sampling of these locations would be sufficient to identify significant changes in the nature and extent of PFAS to the east of the base.
MW122						
MW162S & MW162D						
MW318S & MW318D.						
Lavis Lane Area						
MW276S & MW276D	-	No	Yes	No	Remove from OMP (replaced with MW150S and MW150D)	

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW120	-					During the OMP implementation period, monitoring wells MW276S and MW276D were observed to have been destroyed. It was recommended at the time that these wells be replaced by nearby monitoring well MW120, however during subsequent sampling events MW120 was also observed to have been destroyed. It is recommended that these locations are removed from the OMP and are replaced with nearby monitoring wells MW150S and MW150D. Note that existing wells MW163, MW121 and MW316 provide additional coverage down hydraulic gradient of these locations.
MW279D	-	Yes	Yes	Yes	Remove from OMP	During the June 2019-June 2020 monitoring period, MW279D was observed to be destroyed. Given that the existing monitoring well network provides sufficient coverage of the plume in this area (specifically MW128D) it is recommended that this location is removed from the PFAS OMP. Note that this change was reflected in the 2021 SAQP.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW163 & MW316D	-	Yes	Yes	Yes	Retain in OMP, decrease frequency from biannual to annual sampling	Given that the OMP monitoring completed to date has not identified significant changes to the nature and extent of PFAS in groundwater to the east of the base, it is recommended that the sampling of these selected off-base locations be reduced from biannually to annually. Given that annual sampling of these locations would be sufficient to identify any significant changes in the nature and extent of PFAS to the east of the base
Salt Ash Area						
POT024	BWS024	No	Yes	Yes	Remove from OMP	During the June 2019 monitoring event, private bore POT024 was observed to have been disconnected as the property had been connected to town water and was therefore unable to be sampled. Given the proximity of the bore to nearby monitoring well MW256SD, no alternative sample location has been proposed and therefore it is recommended the location be removed from the program.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
POT144	BWS024	No	No	No	Remove from OMP	Monitoring wells MW258S, MW2258D, MW263S, MW263D and private bore POT144 are all located up-hydraulic gradient of main PFAS plume to the north of Moors Drain. Since 2015, concentrations of PFAS have been either below the laboratory limit of reporting, or below the adopted human health screening criteria. Given that as the monitoring of these locations no longer adds significant value in assessing the extent and associated risks of PFAS in groundwater at the base, it is recommended they be removed from the PFAS OMP.
MW258S & MW258D	-					
MW263S & MW263D	-					
POT184	BWS184	No	No	Yes	Remove from OMP	Private bore POT184 was not sampled during the OMP implementation period as it was unable to be accessed. It is recommended to remove from the program as sufficient coverage of this area is provided by nearby monitoring wells MW260S and MW260D.
POT087	BWS087	No	No	Yes	Remove from OMP	It is recommended these locations be removed from the PFAS OMP given that nearby monitoring well MW123 provides sufficient coverage of this area, and has consistently reported concentrations of PFAS within the same order of magnitude.
POT089	BWS089					

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
POT252	BWS252	No	No	Yes	Remove from OMP	The private property owner declined to participate in the OMP, therefore it is recommended that this location should be removed. Note that this bore was sampled twice between 2016 and 2017 with concentrations of PFAS reported below the laboratory LOR.
MW165	-	No	Yes	No	Remove from OMP	Monitoring well has not been located since 2019. It was sampled between 2016 and 2019 on five occasions and the results were consistently below the laboratory LOR. As this location is outside of the footprint of the inferred extent of PFAS in groundwater, it is recommended that this location is removed from the PFAS OMP.
MW259S	-	No	Yes	Yes	Remove from OMP	During the June 2019 – 2020 monitoring period, the private landowner declined sampling. As this location is outside of the footprint of the inferred extent of PFAS in groundwater, it is recommended that this location is removed from the PFAS OMP.
MW256S & MW256D	-	No	Yes	No	Retain in OMP, decrease	Given that the PFAS OMP monitoring completed to date has not identified significant changes to the nature and extent

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
MW118	-				frequency from biannual to annual	of PFAS in groundwater in this area, it is recommended that the sampling of these selected off-base locations be reduced from biannually to annually. It is considered that annual sampling of these locations would be sufficient to identify any significant changes in the nature and extent of PFAS along the leading edge of the plume to the east of the base.
MW123	-					
MW257S & MW257D	-					
MW260S & MW260D	-					
Fullerton Cove						
MW233S & MW233D	-	No	Yes	No	Remove from OMP	MW233S and MW233D were decommissioned in August 2019 at the request of the private property owner. Given that these locations are outside of the inferred southern plume extent, it is recommended that they be removed from the PFAS OMP. Note that the southerly extent of the plume is adequately covered through sampling of MW231S, MW231D, MW232S, MW232D, MW219S, MW219D, MW147S and MW147D.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
POT382	-	Yes	Yes	No	Add to OMP	It is recommended that POT382 (residential bore) is added to the PFAS OMP. This location had been added to the sampling program, at the request of the property owner and per previous Defence commitments associated with property access for monitoring wells (MW231S and MW231D) on the property. Note that in December 2020, PFOS+PFHxS was reported at 21.6 ug/L in MW731S and 5.22 ug/L in MW731D. It is recommended that this location be sampled on a biannual basis as per the wells on the same property.
POT257	BWS257	No	Yes	No	Remove from OMP	While some of these bores and monitoring wells have reported isolated, irregular detects of PFAS since sampling was undertaken in 2014, the majority of locations have reported results consistently below the laboratory LOR. These locations are outside of the current inferred plume footprint, and the southerly extent is adequately covered through sampling of MW231S, MW231D, MW232S, MW232D, MW219S, MW219D, MW147S and MW147D. Therefore, it is
MW267S & MW267D	-					
MW235S & MW235D	-					
MW266S & MW266D	-					
POT236	BWS236					
MW268S	-					

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
						recommended that these locations are removed from the PFAS OMP.
Surface Water – on-Base						
SW582	-	Yes	Yes	Yes	Add to OMP	It is recommended that the on-base location SW582 is added to the OMP to monitor the interaction between groundwater and surface water drainage pathways for elevated PFAS concentrations in the Moors Drain Catchment. Note that SW582 is suitably located to compliment the new monitoring well locations (i.e. MW441, MW304 and MW886), which are downgradient of the Trade Waste Treatment Plant and MEOMS Building source area. SW582 is located within an underground stormwater drain on the eastern part of the base prior to discharge to Moors Drain. Note that in July 2021, PFOS+PFHxS was reported at 6.03 ug/L in SW582. It is recommended that this location will be sampled on a biannual basis.
SW588	-	Yes	Yes	Yes	Add to OMP	It is recommended that the on-base location SW588 is added to the OMP to monitor the elevated PFAS concentrations in the Moors

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
						Drain Catchment. SW588 is located within an underground stormwater drain on the eastern base boundary, prior to discharge to Moors Drain. Note that in July 2021, PFOS+PFHxS was reported at 10.8 ug/L in SW588. It is recommended that this location will be sampled on a biannual basis.
Surface Water – off-Base						
SW072	FFD4	Yes	Yes	No	Remove from OMP (replaced with SW600)	Access to the property during the 2021 monitoring rounds has not occurred as contact could not be made with property owner. It is recommended that the sample location is removed from the PFAS OMP, and replaced with a new location downstream, closer to MW147S/D, to facilitate more regular access.
SW082	TFD2	Yes	Yes	Yes	Remove from OMP	Access to the property during the 2022 monitoring rounds has not occurred as contact could not be made with property owner. It is recommended that the sample location is removed.
SW600	-	Yes	Yes	No	Add to OMP	New location replacing SW072 in a more accessible location.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
						It is recommended that this location will be sampled on a biannual basis.
SW333	-	Yes	Yes	Yes	Add to OMP	It is recommended that SW333 is added to the OMP to monitor the PFAS concentrations along Dawsons Drain to the south of the base. SW333 will aim to monitor the area where the groundwater model has predicted that groundwater from the base (DEMS and FFTA) upwells. Note that in December 2020, PFOS+PFHxS was reported at 6.25 ug/L in SW333. It is recommended that this location will be sampled on a biannual basis.
Sediment – off-Base						
SD072	FFD4	Yes	Yes	No	Remove from OMP (replaced with SD600)	Access to the property during the 2021 monitoring rounds has not occurred as contact could not be made with property owner. It is recommended that the sample location is removed and replaced with a new location downstream, closer to MW147S/D, to facilitate more regular access.
SD082	TFD2	?	?	?	Remove from OMP	Access to the property during the 2022 monitoring rounds has not occurred as contact could not be made with property

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
						owner. It is recommended that the sample location is removed.
SD600	-	Yes	Yes	No	Add to OMP	It is recommended that this new location is added to replace SD072 in a more accessible area. It is recommended that this location will be sampled on a biannual basis.
SD333	-	Yes	Yes	Yes	Add to OMP	New location to collect sediment sample from the surface water location at SW333. It is recommended that this location will be sampled on a biannual basis.
Soil						
SS101, SS102, SS103, SS104, SS105, SS106, SS107, SS108, SS109, SS110, SS111, SS112	-	No	No	No	Remove from OMP	The OMP monitoring to date of soil samples collected from the Flood Areas has not shown temporal variability or variability of PFOS+PFHxS and PFOA concentrations due to observed flood events, when assessed collectively or by Flood Area, over time and for each sampling event. As a result, it is recommended that the soil sampling locations are removed from the program.
Biota						

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
BIOAFA029 (4x composites) BIOAFA034 (4x composites) BIOAFA036 (4x composites)	-	No	No	No	Retain in OMP, decrease frequency from Annual to Biennial	Given that the monitoring completed to date indicates that the PFOS concentrations are within the same order of magnitude across all sampling periods in the targeted sentinel species, it is recommended that the biota sampling frequency is reduced from annual to biennial.
Event Sampling						
Base Boundaries						
SW055,SW001, SW008	-	No	No	No	Remove from OMP	Given that the event sampling scope of work was completed during the initial PFAS OMP implementation period, it is recommended that this scope item is removed from the PFAS OMP. The data collected to date can be used to inform future projects.
Plume Boundary						
SW059, SW060	-	No	No	No	Remove from OMP	Given that the event sampling scope of work was completed during the initial PFAS OMP implementation period, it is recommended that this scope item is removed from the PFAS OMP. The data collected to date can be used to inform future projects.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
Receiving Environment						
SW005, SW259, SW024	-	No	No	No	Remove from OMP	Given that the event sampling scope of work was completed during the initial PFAS OMP implementation period, it is recommended that this scope item is removed from the PFAS OMP. The data collected to date can be used to inform future projects.
Continuous Level Logger						
Groundwater Hydraulic Gradients						
MW169S, MW107S, MW108S, MW268S, MW235S, MW106S, MW247S, MW255S, MW260S	-	No	No	No	Remove from OMP	Given that this scope of work was completed during the initial PFAS OMP implementation period, it is recommended that this scope is removed from the PFAS OMP. The data collected to date can be used to inform future projects, and data collection can be tailored for project specific requirements.
Base Discharge Points (surface water and groundwater paired locations)						
SW005, MW108S, SW060, MW126S, SW009, MW247S, SW072, SW059	-	No	No	No	Remove from OMP	Given that this scope of work was completed during the initial PFAS OMP implementation period, it is recommended that this scope is removed from the PFAS OMP. The data collected to date can be used to inform future projects, and data

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
						collection can be tailored for project specific requirements.
Receiving Environment (surface water and groundwater paired locations)						
SW082, MW235S, MW235D, SW014, MW257S, SW259, SW024, SW005	-	No	No	No	Remove from OMP	Given that this scope of work was completed during the initial PFAS OMP implementation period, it is recommended that this scope is removed from the PFAS OMP. The data collected to date can be used to inform future projects, and data collection can be tailored for project specific requirements.

Current Location ID	Historical Location ID	Does the Location inform the Nature of PFAS at the Base	Does the Location inform the Extent of PFAS at the Base	Does the Location Inform the Risk Profile at the Base	OMP Review Outcome	Reason
Baseline Data for Future Works (surface water and groundwater paired locations)						
SW582, MW304, MW886	-	No	No	No	Add to OMP	It is noted that there are data gaps in the understanding of the interaction between groundwater and surface water within the Moors Drain Catchment (Eastern Region). Therefore, it is recommended that continuous level logging be undertaken at groundwater / surface water pair locations MW303, MW886 and SW582. These locations are downgradient of the Trade Waste Treatment Plant and MEOMS Building source area, and will aim to provide baseline data to support future remedial/management works. SW582 is located within an underground stormwater drain on the eastern part of the base prior to discharge to Moors Drain.
SW060, MW731S, MW731D	-	No	No	No	Add to OMP	It is noted that the groundwater model has indicated that there is a potential interaction between groundwater and surface water in the Southern Area, in the area of the proposed extraction and treatment of PFAS plume. Therefore, it is recommended that continuous level logging be undertaken at groundwater / surface water pair locations MW731S, MW731D and SW060.

APPENDIX D PFAS ANALYTICAL SUITE

Target analytes	Limit of reporting
	Water (low level) (µg/L)
Perfluoroalkane sulfonic acids	
Perfluorobutane sulfonic acid (PFBS)	0.002
Perfluoropentane sulfonic acid (PFPeS)	0.002
Perfluorohexane sulfonic acid (PFHxS)	0.002
Perfluoroheptane sulfonic acid (PFHpS)	0.002
Perfluorooctane sulfonic acid (PFOS)	0.002
Perfluorodecane sulfonic acid (PFDS)	0.002
Perfluoroalkyl carboxylic acids	
Perfluorobutanoic acid (PFBA)	0.01
Perfluoropentanoic acid (PFPeA)	0.002
Perfluorohexanoic acid (PFHxA)	0.002
Perfluoroheptanoic acid (PFHpA)	0.002
Perfluorooctanoic acid (PFOA)	0.002
Perfluorononanoic acid (PFNA)	0.002
Perfluorodecanoic acid (PFDA)	0.002
Perfluoroundecanoic acid (PFUnDA)	0.002
Perfluorododecanoic acid (PFDoDA)	0.002
Perfluorotridecanoic acid (PFTrDA)	0.002
Perfluorotetradecanoic acid (PFTeDA)	0.005
Perfluoroalkyl sulfonamides	
Perfluorooctane sulfonamide (FOSA)	0.002
N-Methyl perfluorooctane sulfonamide (MeFOSA)	0.005
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	0.005
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	0.005
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	0.005
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	0.002
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	0.002
(n:2) Fluorotelomer sulfonic acids	
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	0.005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	0.005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	0.005

Target analytes	Limit of reporting
	Water (low level) (µg/L)
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	0.005