



# **Comprehensive Investigation of Per- and Poly-Fluoroalkyl Substances (PFAS) at RAAF Base Wagga**

Department of Defence

## **Detailed Site Investigation - Executive Summary**

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## Executive Summary

The Department of Defence (Defence) commissioned Jacobs Group (Australia) Pty Ltd (Jacobs) to undertake a Comprehensive Investigation of Per- and Polyfluoroalkyl Substances (PFAS) conditions at Royal Australian Air Force (RAAF) Base Wagga (the Base) in New South Wales (NSW) (the Project). The investigation follows the recommended general process for the assessment of site contamination outlined in Schedule A of the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM) (NEPC 2013) and also considers the guidance provided in the PFAS National Environmental Management Plan (PFAS NEMP) (HEPA, 2018).

The first stage of the Project involved desktop studies and preliminary environmental sampling to develop a Preliminary Conceptual Site Model (CSM). The Preliminary CSM described potential PFAS sources, PFAS transport pathways and the potential for human and environmental exposure. The model was then used to develop a Sampling, Analysis and Quality Plan (SAQP) to guide a Detailed Site Investigation (DSI) involving sampling and laboratory analysis of soil, surface water, sediment, groundwater and biota on the Base and in the surrounding area. The DSI also included the collection of additional soil and water quality data as well as hydrogeological testing to help characterise conditions in the area.

The DSI was completed between September 2017 and February 2018. This report presents the work completed on the Project to date including the findings of the desktop study and preliminary sampling program, the Preliminary CSM and SAQP, the DSI scope of works, investigation findings, conclusions and recommendations for the next stages of the Project. These next stages of the project will include a Human Health and Ecological Risk Assessment (HHERA) to further assess risks identified in the DSI and a PFAS Management Area Plan (PMAP) which will set out actions for risks requiring management.

## Background

Fire-fighting foam which contained PFAS as active ingredients was used at the Base from approximately 1970. From 2004, Defence transitioned to a more environmentally safe product and also made changes to the way it uses fire-fighting foam, including the construction of a purpose built fire extinguisher training facility at the Base.

PFAS are persistent chemicals that can bioaccumulate in humans and animals. Their high solubility and mobility in surface water and groundwater can mean that PFAS can travel long distances. Consumption of water and food grown using impacted water are thought to be the most important sources of human exposure to PFAS.

## Sources of PFAS contamination

The DSI identified three key PFAS source areas on the Base – the former Fire Training Area in the east of the Airport, the current Fire Station on the Base and the Fire Extinguisher Concrete Pad and Former Fire Station area. Leachability testing of soil indicated the potential for significant discharge of PFAS to surface water and groundwater from these areas.

## Extent of PFAS contamination

Geology at the Base and in the surrounding area consists of alluvial deposits (clays, silts, sands and gravels) up to approximately 60 metres thick underlain by granite with sedimentary outcrops. The alluvial deposits consist of two formations; the Cowra Formation and the Lachlan Formation. The Cowra Formation is the upper part of the alluvial deposits and consists primarily of silts and clays with some sand and gravel horizons. These horizons vary in their thickness and lateral persistence. The underlying Lachlan Formation consists of sand and gravel deposits with some clay and silt horizons. This formation is more permeable than the Cowra Formation and is the main groundwater resource in the region.

The Cowra Formation on the Base was found to be dominated by dense high plasticity clays indicating that the formation acts more like an impermeable confining layer over the Lachlan Formation. Therefore, the low permeability nature of this horizon means it is not a significant pathway for vertical PFAS migration. PFAS

concentrations in the Lachlan Formation within the Base were below the adopted investigation criteria for drinking water.

There are three surface water drainage pathways from the Base; drainage to the east to Kyeamba Creek, drainage to the west to Gregadoo Creek and drainage to the north west to the Gumly Gumly wetland and on to Marshalls Creek. Sampling of surface water, sediment and shallow soil along the Kyeamba Creek and Gregadoo Creek drainage pathways has found that PFAS impacts are limited to farm dams and soil in close proximity to the Base and these pathways do not appear to be significant PFAS transport pathways.

However, sampling of stormwater runoff from the Base to the Gumly Gumly wetland has identified significant PFAS impacts in the drainage pathway to the wetland. The wetland then flows on to Marshalls Creek. This pathway is considered a significant path for PFAS transport. Furthermore, drilling investigations conducted during the DSI found the surficial clays of the Cowra Formation to be thinner in the wetland area than on Base and water level monitoring at the Murray Cod Hatchery indicates that there is an enhanced vertical connection between the Cowra and Lachlan Formations in this area.

Sampling of groundwater from the Cowra and Lachlan Formations at the Murray Cod Hatchery and at another property adjoining the Gumly Gumly wetland has identified PFAS impacts exceeding the adopted investigation criteria for drinking water and, in the case of the hatchery, also exceeding the adopted investigation criteria for recreational water use.

Sampling of groundwater bores further downgradient of the wetland, including at the Riverina Water County Council East Wagga Borefield bores, has found that PFAS concentrations are below the laboratory limits of reporting. One exception is a sample from the Gumly Gumly Private Irrigation District (GGPID) bore which had PFAS concentrations above the laboratory limit of reporting but below the adopted investigation criteria for drinking water. Samples collected from the GGPID bore on two other occasions had PFAS concentrations below the laboratory limits of reporting.

Therefore, the extent of PFAS impacts identified above adopted investigation criteria outside the Base appears to be limited to surface water and sediment along the Marshalls Creek drainage pathway and groundwater in the Gumly Gumly wetland and surrounding properties. PFAS impacts were also identified at the Forest Hill Sewage Treatment Plant and around the Forest Hill Council Landfill. However further investigation is required to better understand the source and extent of these impacts.

Furthermore, PFAS concentrations above the drinking water guideline values were identified in a groundwater sample from an existing well installed in the granite bedrock about 400 meters east of the Base. It is difficult to conceptualise a pathway for PFAS migration from the Base to this well via groundwater. The well was installed in 1956 and has not been used for many years. It is possible that the identified PFAS impacts were due to migration of impacted water down the well construction from historical overland drainage. Further assessment of potential flow paths to this well and resampling is recommended as part of the HHERA.

## **Potential risks to human health and the environment**

Concentrations of PFAS in the samples collected were compared to investigation criteria. These criteria were adopted from guideline values presented in the PFAS NEMP. Where concentrations exceed these criteria, further assessment is required to understand whether there is an unacceptable risk to human health or the environment.

Potential risks to human health and the environment that will require further assessment include:

- PFAS impacts in the source areas do not present a human health risk to Base personnel. However, the concentrations exceed the adopted investigation criteria for ecological protection and risks to terrestrial ecology on Base will require further assessment.
- PFAS concentrations in surface water samples from farm dams in the Gumly Gumly wetland and from drainage along the Marshalls Creek pathway exceeded the adopted investigation criteria for recreational water use and for ecological protection. Risks to human health from dermal contact (contact with skin) or incidental ingestion of the water will require further assessment. Potential risks associated with livestock

and other animal exposure and uptake of PFAS from these surface water bodies will also require assessment.

- PFAS concentrations in Marshalls Creek indicate a potential for discharge of PFAS to the Murrumbidgee River. Surface water samples from the river had PFAS concentrations below the laboratory limits of reporting. However, bioaccumulation in fish and other aquatic organisms can occur at concentrations below these limits. Therefore, an assessment of potential risks to human health associated with consumption of fish or shellfish from the Murrumbidgee River and risks to the environment will be needed.
- PFAS concentrations in farm dams close to the Base along the Gregadoo and Kyeamba Creek pathways were below investigation criteria for ecological protection (PFOS) and recreational water use (PFHxS+PFOS). However, there is a risk for bioaccumulation in aquatic organisms (such as yabbies) that could present a risk to human health or the environment. Therefore, further assessment of these risks will be needed.
- PFAS concentrations in the groundwater used to supply the aquaculture ponds at the Murray Cod Hatchery as well as PFAS concentrations in surface water collected from the ponds indicate the potential for uptake of PFAS in the hatchery produce. Further assessment of risks to human health and the environment at the hatchery will be needed.
- PFAS impacts were identified in effluent at the Forest Hill Sewage Treatment Plant and therefore risks to workers at the plant as well as the risks associated with the use of treated effluent will need to be assessed.
- PFAS concentrations in groundwater bores used for drinking water supply were below the adopted investigation criteria for drinking water. There is the potential for migration of PFAS from the Gumly Gumly wetland in the future. Future risks to groundwater bores will require further assessment.

## Conclusions and recommendations

The DSI identified three key source areas of PFAS contamination at the Base. This contamination is migrating from the source areas in surface water runoff to the Gumly Gumly wetland and on to Marshalls Creek. PFAS in the wetland is also migrating to groundwater in the Cowra and Lachlan Formations. The extent of contamination in groundwater bores exceeding the investigation criteria for drinking water is limited to the Gumly Gumly wetland and surrounding properties. While PFAS concentrations above the drinking water guideline value were also identified in a well located approximately 400 meters east of the Base, this well is installed in the granite formation and it is difficult to conceptualise a groundwater migration pathway from the Base to this well. The well has not been used for many years and there are no other known users of groundwater in this area.

The DSI has been completed in accordance with the NEPM and PFAS NEMP guidelines meeting the task and primary objectives that were set for the DSI. The data obtained from the DSI will be used to inform the next stages of the broader investigation program that, where necessary, in accordance with the NEPM will further refine understanding of risk and the need for management and through completion of the following:

- a) A Human Health and Ecological Risk Assessment (HHERA) will be undertaken to further assess risks identified in this DSI. Targeted sampling will be required to obtain data to support the HHERA.
- b) The HHERA will consider potential future risks to groundwater users downgradient of the Base. A groundwater model is being developed to support this assessment. The groundwater model will assist in refining the understanding of the extent of current PFAS impacts in groundwater, potential PFAS migration pathways in groundwater or potential timeframes for PFAS migration. The model will also assist in identifying targeted sampling locations for longer term monitoring.
- c) In addition to the sampling required to support the HHERA, the following sampling is recommended to address potential variability identified in the DSI:
  - i. Sampling of the stormwater runoff from the area that includes the RFS station at Forest Hill during or shortly after a rain event.
  - ii. Sampling of the Cowra and Lachlan Formation wells installed as part of the DSI.
  - iii. Sampling of surface water in Marshalls Creek during or shortly following a rain event.

- iv. Sampling of surface water and sediment in the Murrumbidgee River during the winter low flow period.
  - v. Sampling of the well screened in the granite to the east of the Base (MW223).
- d) A PFAS Management Area Plan will be developed as part of this Project and this will outline actions to manage risks confirmed in the HHERA. Risks to workers involved in sub-surface construction or maintenance works are outside the scope of this Project. However, the PFAS Management Area Plan should include a requirement that a specific assessment of risks to these workers should be undertaken prior to commencement of work in the identified PFAS source areas. This assessment should also consider measures to ensure appropriate storage, handling and disposal of any PFAS impacted materials.

This document is a summary of the DSI only with detail of the investigation undertaken, assumptions and limitations set out in the full version of this document.