RAAF Base Williamtown - Stage 2B Environmental Investigation
Preliminary Ecological Risk Assessment
Key findings and future activities

About the Investigation
The Department of Defence (Defence) has engaged an independent environmental consultant, AECOM, to undertake an environmental investigation and assessment of the soil, surface water, sediment, biota and groundwater at, and in the vicinity of, RAAF Base Williamtown (the site) and surrounds (off-site), including the NSW Environment Protection Authority (EPA) Investigation Area.

The method used to complete the environmental investigation is consistent with relevant Australian standards and the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) framework. The Assessment of Site Contamination NEPM is a legal instrument and provides a detailed and consistent process to be used by environmental auditors, site assessors, landowners, developers, industry and regulators when assessing land contamination.

More information about the Assessment of Site Contamination NEPM is available at www.nepc.gov.au/nepms/assessment-site-contamination

The investigation is part of Defence’s review its properties around Australia that used legacy aqueous fire-fighting foam (AFFF) containing per- and poly-fluoroalkyl substances (PFAS) including perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexane sulfonate (PFHxS) as active ingredients.

Defence has phased out the use of AFFF containing these chemicals as active ingredients and is proactively managing the presence of PFAS across its estate.

The first report completed as part of this environmental investigation was the Environmental Site Assessment (ESA) which was published in July 2016. The second report completed was the Human Health Risk Assessment (HHRA), also published in July 2016.

A Preliminary Ecological Risk Assessment (ERA) has now been undertaken, as required by the NEPM. The ESA, HHRA and ERA reports are available on the project website: www.defence.gov.au/id/Williamtown/Documents.asp

Objectives of the ERA
The objective of the Preliminary ERA was to assess the potential for adverse effects on land-based (terrestrial) and water-based (aquatic) native wildlife species as a result of direct exposure (e.g. ingestion) to PFAS in soil, sediment and surface water within the Investigation Area. The Preliminary ERA also considered potential adverse effects due to bioaccumulation of PFAS in food sources within the Investigation Area that are consumed by wildlife (e.g. PFAS in fish and plant tissue).

This ERA is considered to be preliminary in nature because this is the first ERA completed for the Investigation Area. Data from the ESA and HHRA, along with data collected specifically for ERA purposes, has been used to complete this assessment.

The data collected as part of the ESA and HHRA were focused on the assessment of potential human health impacts, so there are some limitations associated with applying this data to the assessment of potential ecological risks.

This Preliminary ERA is intended to inform future sampling, risk assessment and management approaches, and is not intended to provide the final conclusion with regard to risks to all ecological receptors within the Investigation Area.

The ERA focused on the areas shown on the map on the following page.

Preliminary ERA Investigation
Development of the Preliminary ERA involved the:
• Review of data collected during the ESA and HHRA and the findings of ecological field surveys conducted on, and surrounding the site.
• Interpretation of laboratory analysis from soil, groundwater, surface water, sediment, pasture plant, fruit, vegetable, chicken egg, and fish samples.
• Identification of ecological receptor species. These are terrestrial or aquatic animals inhabiting environments in the Investigation Area that may be affected by exposure to PFAS. Potential risks to domestic animals (e.g. pets and livestock) were not assessed. Their exposures are different from those experienced by wildlife.
• Identification of indicator species: As it is not possible to assess risks to every single animal species in the Investigation Area, a range of indicator species were identified.
Indicator species are animal species which are representative of a larger group of animals with similar food and habitat requirements. These species are likely to be exposed to PFAS in the same ways, within the Investigation Area.

- Determination of the main pathways through which indicator species may be exposed to PFAS. Exposure pathways for different indicator species vary depending on the food they eat, the habitat they live in and the way they interact with the environment. For example, fish-eating birds living near local waterways are likely to be exposed to PFAS differently than migratory birds only accessing the Investigation Area for parts of the year. Fish-eating birds are also likely to be exposed to PFAS from different sources than birds that feed primarily on plants.

- Assessment of potential risks to indicator species. This was done by comparing the amount of PFAS likely to be ingested by the animal with the exposure concentrations considered acceptable for animals (birds or mammals).

**Indicator species included in the ERA**

Based on field surveys and the types of habitat present in the Investigation Area, it was determined that the following types of animals could potentially be exposed to PFAS in soil, sediment, surface water and in the food they eat (either plants or other animals). Indicator species were then selected to represent each of the types of animal species shown in the table to the right.

<table>
<thead>
<tr>
<th>Type of animal</th>
<th>Indicator species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds that eat plants (herbivorous). This group also includes semi-aquatic birds.</td>
<td>Red-rumped Parrot, Australian Wood Duck, Black Swan.</td>
</tr>
<tr>
<td>Birds that eat insects (inverivorous), or plants and animals/insects (omnivorous)</td>
<td>Yellow Wagtail, Masked Lapwing, Straw-necked Ibis, Noisy Miner, Ruff, Chestnut Teal.</td>
</tr>
<tr>
<td>Predatory reptiles (carnivorous)</td>
<td>Eastern Bearded Dragon, Red-bellied Black Snake, Carpet Python.</td>
</tr>
<tr>
<td>Predatory birds (carnivorous)</td>
<td>Black-shouldered Kite, Wedge-tailed Eagle.</td>
</tr>
<tr>
<td>Water based animals (aquatic)</td>
<td>Double-banded Plover, Red-necked Avocet.</td>
</tr>
<tr>
<td>Reptiles that eat fish (piscivorous)</td>
<td>Yellow-bellied Sea Snake.</td>
</tr>
<tr>
<td>Aquatic mammals that eat fish (piscivorous)</td>
<td>New Zealand Fur Seal, Bottlenose Dolphin.</td>
</tr>
</tbody>
</table>
Exposure pathways considered in the Preliminary ERA
The way an animal may be exposed to PFAS is called an exposure pathway. The Preliminary ERA identified the following main exposure pathways for animal species living in the Investigation Area:

Direct exposure through ingestion:
• Incidental ingestion of PFAS in soil, surface water and sediment (during feeding)
• Ingestion of PFAS in surface water.

Bioaccumulation in food sources:
• Ingestion of PFAS accumulated in terrestrial plants and animals as part of their diet
• Ingestion of PFAS accumulated in aquatic plants and animals as part of their diet.

An assessment of the relevant exposure pathways for each animal was used to estimate the cumulative amount of PFAS entering the animal. The Preliminary ERA assumed that each animal’s food was sourced entirely within the Investigation Area and always contained PFAS.

This is likely to have resulted in an overestimate of exposure for animals that source their food over large distances and for animals that eat food that does not contain PFAS. This approach was adopted to provide a conservative estimate of potential exposure and to assist in understanding where ecological risks may occur in order to guide future assessments.

Method used to assess potential risk from direct exposure
The potential for adverse effects to wildlife as a result of direct exposure to PFAS in soil, surface water and sediment was assessed by comparing PFAS concentrations detected in samples against screening benchmarks published by Australian and international regulatory agencies. These screening benchmarks represent the PFAS concentrations considered acceptable for plants and animals.

Method used to assess potential risk from dietary intakes
The potential for adverse effects to wildlife as a result of ingesting PFAS accumulated in plants or animals were assessed by estimating how much food each indicator species would consume and what concentration of PFAS may be present in their food source(s).

Concentrations of PFAS directly measured in plant, fish and terrestrial mammal samples were used to estimate dietary intakes of PFAS for animals eating these food types. Not all types of potential food source(s) could be sampled, and therefore some substitute food sources were used to estimate the amount of PFAS in the diet of some animals.

For example, no frog samples have been collected, and so concentrations reported in fish were assumed to represent dietary exposures for animals that may eat frogs as part of their diet.

Estimated dietary exposure concentrations were then compared to toxicity reference values available for birds and mammals reviewed or published by international regulatory agencies. Toxicity reference values are concentrations at which low or no adverse effects are considered likely to occur.

Key findings of the preliminary ERA
The Preliminary ERA presented the following conclusions with regard to risks to plants and animals. Note that areas referenced below are those represented on the map on previous page.

Direct Exposure
Risks associated with exposure to PFAS affected soil for plants and animals:
• On-Site – direct exposure to PFAS in soil has the potential to pose an unacceptable risk.
• Off-Site – direct exposure to PFAS in soil poses a low and acceptable risk.

Risks associated with exposure to PFAS affected sediment and surface water, at the reported concentrations:
• On-Site - PFAS in sediment and surface water has the potential to pose an unacceptable risk to aquatic animals and plants which inhabit Lake Cochran
• Off-Site - PFAS in sediment and surface water has the potential to pose an unacceptable risk to aquatic animals and plants in Dawson’s Drain (Area A & C). Sediments in Moors Drain, Fullerton Cove/Hunter Wetlands and Tilligerry Creek (estuarine section)/Port Stephens are considered to pose a low and acceptable risk. However, further work is necessary to determine potential risks associated with surface water concentrations in all waterways surrounding the site.

The phrase ‘low and acceptable’ is standard terminology used in ecological risk assessments completed consistent with the National Environment Protection (Assessment of Site Contamination) Measure (NEPM). This phrase refers to circumstances where the exposure is estimated to be below levels at which adverse effects are not expected to occur. Even though there is no consistent international evidence that PFOS/PFOA cause adverse effects in ecosystems, this phrase is used to describe potential risks.
Bioaccumulation and Dietary Exposures

Bioaccumulation in plants:
- On-Site – exposure to PFAS bioaccumulated in plants may pose a potentially unacceptable risk to plant eating birds and mammals which access the site.
- Off-Site – risks to plant eating birds in off-site areas are considered to be low and acceptable.

Bioaccumulation in terrestrial invertebrates (earthworms):
- On-Site – potential risks were identified for invertebrate eating birds and mammals that access the site.
- Off-Site – risks to invertebrate eating birds and mammals were identified to be low and acceptable in off-site areas, however additional data collected will be undertaken to confirm this conclusion.

Bioaccumulation in terrestrial mammals (rabbits), invertebrates (earthworms) and fish:
- Potential risks were identified for predatory mammals and birds which use the site and surrounding freshwater waterways as food sources.
- Risks to predatory reptiles (e.g. snakes) were identified to be low and acceptable for all off-site areas.

Bioaccumulation in fish tissue:
- Potential risks to fish from bioaccumulation within tissue were identified to have the potential to pose an unacceptable risk on-site and within Area A.
- Risks to fish from bioaccumulation within tissue are low and acceptable for Areas B, C, D and E.
- Dietary exposures for fish eating aquatic/terrestrial birds and terrestrial mammals which access Lake Cochran, Dawsons Drain and Moors Drain was identified to pose a potential risk to these animals.
- Dietary exposures for fish eating aquatic birds, aquatic reptiles and aquatic mammals (e.g. dolphins) were estimated to pose a low and acceptable risk in estuarine areas (Area D and E).

Future Activities in Relation to the ERA

Further Considerations

The Preliminary ERA is the first step in understanding potential ecological impacts from PFAS detected within the Investigation Area.

The results of the Preliminary ERA provide an initial understanding of the potential for adverse effects to wildlife from direct exposure to PFAS impacted soil, sediment and surface water within habitats present in the Investigation Area.

The outcomes of the Preliminary ERA also provide an initial understanding of potential risks that may result from the accumulation of PFAS in terrestrial and aquatic plants and animals consumed by wildlife.

This is the first step in understanding potential ecological impacts from PFAS detected within the Investigation Area.

AECOM has used the findings of this Preliminary ERA to provide a conservative estimate of potential exposure and assist in understanding where further assessment is required to complete a Detailed ERA in 2017.

Keeping the community informed

Defence is committed to regularly updating the community throughout the investigation. The project website will be updated as the investigation progresses.

Community information sessions, direct mail and factsheets will be provided as new information becomes available.

Enquiries or requests relating to individual properties will be considered on a case-by-case basis.

Contact the project team

Phone: 1800 011 443 freecall (business hours)
Web: www.defence.gov.au/id/Williamtown
Email: Williamtown.defence@aecom.com
Post: RAAF Base Williamtown Stage 2
   Environmental Investigation Project
   C/AECOM Australia Pty Ltd
   PO Box 1307
   Fortitude Valley Qld 4006

National Hotline Number: 1800 365 414
Email: PFCDefenceCoordination@golder.com.au

Media enquiries should be directed to Defence Media Operations on (02) 6127 1999 or media@defence.gov.au.