



Site Audit Report

No Scrape Area, North of Swale, Former Schofields Aerodrome, off
Mariners Avenue, Schofields

Audit Number: MP169_02_R

25 June 2021



Document Information

Site Audit Report

Former Schofields Aerodrome, No Scrape Area, North of Swale, off Mariners Avenue, Schofields

Audit Number: MP169_02

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Contents

List of Acronyms	iv
1.0 Introduction.....	1
1.1 Audit Objective	1
1.2 Scope of the Audit.....	2
1.3 Audit Exclusions	3
1.4 Previous Site Audit.....	3
2.0 Site Details.....	4
2.1 Location.....	4
2.2 Zoning.....	4
2.3 Adjacent Uses.....	4
2.4 Site Condition.....	5
2.5 Proposed Development.....	5
2.6 Site History	6
3.0 Summary of Previous Audit and Environmental Investigations	7
4.0 Evaluation of Quality Assurance and Quality Control	9
5.0 Environmental Quality Criteria.....	15
5.1 Soil and Water Quality Criteria.....	15
6.0 Evaluation of Validation	17
6.1 Overview	17
6.2 Survey Data.....	18
6.3 Stratigraphy.....	19
6.4 Soil and Leachate Analytical Results.....	20
6.4.1 Soil.....	20
6.4.2 Leachate	21
6.5 Groundwater Levels	22
6.6 Groundwater Analytical Results	24
6.7 Validation Works Required.....	25
6.8 Auditor's Opinion	27
7.0 Assessment of Risk	28
7.1 Human Health.....	28

7.1.1	Soil.....	28
7.1.2	Groundwater.....	28
7.2	Ecology.....	29
7.2.1	Terrestrial.....	29
7.2.2	Aquatic.....	29
7.3	Auditor's opinion.....	30
8.0	Contamination Migration Potential	31
8.1	Auditor's Opinion	31
9.0	Compliance with Regulatory Guidelines and Directions	32
9.1	Notification.....	32
9.2	Development Approvals.....	32
9.3	Waste Disposal	32
9.4	VENM and Other Imported Materials	32
9.5	Licenses.....	33
10.0	Conclusions and Recommendations	34
11.0	Other Relevant Information	35

Table 3.1:	Summary of audit and assessment events	7
Table 4.1:	Summary of Investigations.....	9
Table 4.2:	QA/QC – Sampling and Analysis Methodology Assessment	9
Table 4.3:	QA/QC – Field and Lab Quality Assurance and Quality Control	12
Table 6.1:	Auditor's Review and Verification of Key Elements.....	17
Table 6.2:	Stratigraphy based on the logs of the validation soil bores	19
Table 6.3:	Summary of VENM thickness observed in validation soil bores.....	19
Table 6.4:	Summary of soil validation results (mg/kg).....	21
Table 6.5:	Summary of BH01_5.1 leachate analytical results (µg/L)	22
Table 6.6:	Groundwater level data from June 2017 GME.....	23
Table 6.7:	Summary of groundwater investigation analytical results (µg/L).....	24
Table 6.8:	Compliance with validation requirement.....	25

Appendix A: Attachments

Appendix B: EPA Guidelines

Appendix C: List of Street Addresses and Current/Proposed Land Parcels within No Scrape Area, North of Swale



List of Acronyms

Acronym	Definition
Measures	
%	per cent
µg/L	Micrograms per Litre
ha	Hectare
km	Kilometres
m	Metre
mAHD	Metres Australian Height Datum
mbgl	Metres below ground level
mbtoc	Metres below top of casing
mg/kg	Milligrams per Kilogram
mm	Millimetre
General	
AFFF	Aqueous Film Forming Foam
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Governments and Australian State and Territory Governments
ASLP	Australian Standard Leaching Procedure
CEMP	Construction Environmental Management Plan
CLM Act	NSW <i>Contaminated Land Management Act 1997</i>
COC	Chain of Custody
Council	Blacktown City Council

Acronym	Definition
DHA	Defence Housing Australia
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EMP	Environmental Management Plan
EPA	Environment Protection Authority (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act
FFTA	Former Fire Training Area
GME	Groundwater Monitoring Event
HDPE	High-density Polyethylene
HEPA	Heads of EPAs Australia and New Zealand
HIL	Health Investigation Level
MEA	Material Emplacement Area
NATA	National Association of Testing Authorities
NEMP	National Environmental Management Plan
NEPM ASC	National Environment Protection (Assessment of Site Contamination) Measure
NHMRC	National Health and Medical Research Council
PFAS	Per-and poly-fluoroalkyl substances
PFHxS	Perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate



Acronym	Definition
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RAAF	Royal Australian Air Force
Ramboll	Ramboll Australia Pty Ltd
RAN	Royal Australian Navy
RAP	Remediation Action Plan
RPD	Relative Percent Difference

Acronym	Definition
SAR	Site Audit Report
SAS	Site Audit Statement
SEPP	State Environmental Planning Policy
SWL	Standing Water Level
TBA	To be announced
VAC	Validation Acceptance Criteria
-	On tables is "not calculated", "no criteria" or "not applicable"



1.0 Introduction

A site contamination audit (the audit) has been conducted in relation to an area known as 'No Scrape Area, North of Swale' (the site or audit site or North of Swale) located within a new residential development at the new suburb of Nirimba Fields (the Nirimba Fields), NSW 2763.

As shown in Attachment 1, 2 and 8 (**Appendix A**), the North of Swale audit site is located approximately in the eastern section of the Nirimba Fields housing estate. The larger Nirimba Fields housing estate has an approximate total area of 135 hectare and forms part of the former Schofields Aerodrome.

'No Scrape Area', approximately 4.4 ha, is the Former Firefighting Training Area (FFTA) of the former aerodrome and it is divided into two subareas:

- North of Swale (approximately 1.15 ha) – This is the audit site.
- South of Swale (approximately 3.25 ha).

The No Scrape Area, North of Swale (audit site) is further sub-divided (refer to Attachment 3 and 4 in **Appendix A**) into:

- 'Area of Interest' – an area where PFAS impacted soil was not excavated and remains in-situ.
- Remaining area where PFAS impacted soil was excavated and removed from site.

1.1 Audit Objective

The audit was conducted to provide an independent review by an EPA-accredited site auditor of whether the nature and extent of per-and poly-fluoroalkyl substances (PFAS) contamination at the audit site has been appropriately determined and to assess the suitability and appropriateness of the validation report prepared for the audit site, i.e. a "Site Audit" as defined in Section 4 (1) (b) (i and v) of the NSW *Contaminated Land Management Act* 1997 (the CLM Act).

Blacktown City Council (Council) issued a Development Consent (DA 18-00972) dated 17 January 2019 (also referred to as Stage 3) for proposed subdivision. The consent condition relevant to the audit was as follows:

- Section 12.14 Site contamination.
- Section 12.14.2 'A NSW Environment Protection Authority accredited Site Auditor shall review the validation report and submit to Council a Site Audit Statement. The Site Audit Statement shall verify that the investigation, remediation and validation was carried out in accordance with the aforementioned guidelines and that the site is suitable for proposed use'.

Blacktown City Council (Council) also issued the following Development Consents:

- Development Consents (DA 20-00149) dated 16 February 2021 (also referred to as stages 4C) for proposed subdivision.
- Development Consents (DA 20-001496) dated 29 June 2020 (also referred to as stages 5A) for proposed subdivision.
- Development Consents (DA 20-001282) dated 23 December 2020 (also referred to as stages 5C) for subdivision works.



The condition stated for these development consents is as follows:

- Site Contamination.
- Prior to the issue of a Subdivision Certificate, an EPA recognised accredited geoscientist is to validate the site as suitable for residential development in accordance with the strict residential use criteria as set out in the National Environment Protection (Assessment of Site Contamination) Measures (NEPM) 1999 as amended 2013.

The auditor considers the above conditions (for stages 4C, 5A and 5C) do not clearly request a "Site Audit" as defined in the NSW *Contaminated Land Management Act* 1997 (the CLM Act). However, as Blacktown Council interpret these conditions to mean that the audit is required for statutory purposes, the auditor listed them on the Site Audit Notification (SAN) was sent to EPA.

The SAN (MP169-02) was issued dated 19 February 2025 to the EPA. Note that the Development Consent was provided to the Auditor on 5 February 2025.

Please note that:

- SAR and SAS were re-issued as R1 to reflect minor changes associated with the now statutory nature of the audit.
- The contamination or status of the site since the completion of the audit have not been taken into account in the re-issued audit.

1.2 Scope of the Audit

Details of the Audit are:

Requested by: [REDACTED] on behalf of Defence Housing Australia (DHA)

Request/Commencement Date: 12 February 2021

Auditor: [REDACTED]

Accreditation No.: [REDACTED]

The scope of the Audit included:

- Review of the following reports:
 - *PFAS Validation Report*, Former Schofields Aerodrome – No Scrape Area, North of Swale, draft, revision D1, prepared by Ramboll Australia Pty Ltd (Ramboll) dated 3 May 2021.
 - *PFAS Validation Report*, Former Schofields Aerodrome – No Scrape Area, North of Swale, draft, revision D2, prepared by Ramboll dated 24 May 2021.
 - *PFAS Validation Report*, Former Schofields Aerodrome – No Scrape Area, North of Swale, draft, revision D3, prepared by Ramboll dated 3 June 2021.
 - *PFAS Validation Report*, Former Schofields Aerodrome – No Scrape Area, North of Swale, final, revision F1, prepared by Ramboll dated 22 June 2021. (This is referred to as 'the Validation Report' or 'Ramboll 2021c').
- The following reports were provided to the auditor for information only as it was prepared either prior to the auditor's engagement for the larger Nirimba Fields; or prepared for areas outside of the audit site:
 - *Site Contamination Due Diligence Assessment*, Former Schofields Aerodrome, Schofields NSW, prepared by JBS Environmental Pty Ltd (JBS) dated October 2012 (referred to as 'JBS 2012').
 - *Site Audit Report – Part of Former Schofields Aerodrome*, Lot 400 in DP1171596, audit number GN481, prepared by ENVIRON Australia Pty Ltd (Environ) dated September 2013 (referred to as 'Environ 2013').



- *Targeted Phase 2 PFAS Site Investigation*, Former Schofields Aerodrome Quakers Hill NSW, prepared by Ramboll Environ Australia Pty Ltd dated November 2017 (referred to as 'Ramboll 2017').
- *PFAS Leachate Analysis – Former Schofields Aerodrome*, prepared by Ramboll Australia Pty Ltd (Ramboll) dated 31 May 2018 (referred to as 'Ramboll 2018').
- *Former Schofields Aerodrome, Quakers Hill, NSW: Screening Assessment of Potential Risks from the PFAS Impacted Soil Layer*, final, revision F2, prepared by Ramboll dated 16 April 2021. (This is provided as Appendix 8 of the final PFAS Material Emplacement Area [MEA] Validation Report and referred to as 'Ramboll 2021a').
- *PFAS MEA Validation Report*, Former Schofields Aerodrome, final, revision F1, prepared by Ramboll 21 May 2021 (referred to as 'PFAS MEA Validation Report' or 'Ramboll 2021b').
- *PFAS Assessment Overview Letter - Former Schofields Aerodrome/Nirimba Fields, Quakers Hill NSW*, draft D5, prepared by Ramboll dated 21 May 2021. This is hereafter referred to as the Overview Letter.
- *Former Schofields Aerodrome/Nirimba Fields, Quakers Hill, NSW: Potential Risks Associated with PFAS Impacted Scraped Soil*, draft v2, prepared by Ramboll dated 12 April 2021. This is provided as Appendix 2 of the Overview Letter.
- A site visit by the Auditor on 26 April 2021.
- Discussions with DHA and with Ramboll who undertook the investigation and validation works.

1.3 Audit Exclusions

The following aspects of the environment or items are excluded this Section B1 and B2 site contamination audit:

- Only the nature and extent of PFAS contamination at the No Scrape Area North of Swale (the audit site) associated with historical site activities and site use as an aerodrome, is assessed as part of this audit. All other contaminants are excluded as a Section A Site Audit Report was completed for the entire former Schofields Aerodrome (refer to **Section 2.7**).
- Only the No Scrape Area North of Swale (the audit site), which includes Area of Interest, is assessed as part of this audit. All other areas within the larger Nirimba Fields housing estate are excluded (including No Scrape Area South of Swale).
- This audit does not include the suitability of the fill material (being Virgin Excavated Natural Material [VENM]) overlying the former site surface at the audit site for the proposed residential development.
- The validation and review of the surplus or waste material generated or removed from the audit site due to construction.

1.4 Previous Site Audit

In the wider Nirimba Fields housing estate, a Site Audit Report and Site Audit Statement has previously been completed by the auditor for an area external to the audit site:

- *Site Audit Report, PFAS MEA, Former Schofields Aerodrome, off Mariner Avenue, Schofields, NSW 2762 and Site Audit Statement* dated 22 June 2021 (reference: MP169_01). PFAS MEA is located approximately 400 m north-west of the audit site.



2.0 Site Details

2.1 Location

The audit site locality is shown on Attachment 1, 2 and 13 (**Appendix A**).

Due to the subdivision of the site into multiple sub-lots as part of the residential development, there are multiple street address and land title identifiers within the audit site. The complete list of current and proposed street addresses and associated land parcel legal description, provided in Appendix 8 of the Validation Report, are presented in **Appendix C**.

The site details are as follows:

Street address:	Former Schofields Aerodrome, off Mariner Avenue, Schofields NSW 2762 For the sub-lots which have been subdivided – 100 Mariner Avenue, 102 Mariner Avenue and 35 Firefly Street, Nirimba Fields NSW 2763 (refer to Appendix C).
Identifier:	Part Lot 4100 Deposited Plan (DP) 1261628; Lot 2335 to Lot 2337 DP1252016 and Lot 5001 to 5003 DP 1261629 (refer to Appendix C).
Local Government:	Blacktown City Council.
Owner:	Defence Housing Australia (DHA).
Site Area:	Approximately 1.15 ha.

2.2 Zoning

The current zoning of the audit site is:

- R2 – Low density residential as per the Blacktown Local Environmental Plan Amendment (Sydney Region Growth Centres – Schofields Precinct) 2014.
- RE1 – Public recreation.
- SP2 – Infrastructure.

2.3 Adjacent Uses

The audit site is located in the eastern section of the Nirimba Fields housing estate (refer to Attachment 1 and 9, **Appendix A**). Based on the plans provided in the Validation Report, the surrounding site use includes:

- North – Newly constructed access roads and residential properties.
- East – The Blacktown Richmond Railway line and then residential properties further east.
- South – A newly constructed swale running east to south-eastern and vacant land to the south awaiting redevelopment.
- West – Newly constructed access roads and residential properties and then vacant land, a sediment pond further west and Eastern Creek (located approximately 800 m north-west of the audit site).



In a wider context, the Nirimba Fields (former Schofields Aerodrome) is bounded by:

- North – New residential development (Altrove development) and vacant land.
- East – Blacktown-Richmond Railway line corridor followed by residential properties and parkland.
- South – Industrial properties, Nirimba Education Precinct (university/TAFE and a high school).
- West – Eastern Creek, Stonecutters Ridge Golf Club and a new residential development.

2.4 Site Condition

The Validation Report indicated that the audit site was a construction site for residential development in March-April 2021 and provided the following description:

- Construction of residential houses had commenced, and filling of the site (reportedly with VENM) had been undertaken to raise the site surface above the flood plain.
- Temporary drainage channels were constructed, and they drained into a temporary sediment basin (adjacent to Eastern Creek) in the western portion of the Nirimba Fields.

Site photographs from 30 and 31 March 2021 are provided in Appendix 3 of the Validation Report and they confirmed the site had been cleared and new residential properties were being constructed nearby. A new swale located south of the site was yet to be constructed. This swale will drain surface run-off from the off-site area in the east and the site. There was no surface water body present at the site.

The site surface appeared to be topographically flat and covered by fill soil. The site generally slopes down gently towards south-east towards the proposed swale.

As indicated in **Appendix C**, there are three low-density residential houses already constructed (or under construction) within the audit site.

The description of the site presented in the Validation Report was generally consistent with the auditor's observation from the site visit conducted on 26 April 2021.

2.5 Proposed Development

As shown in Attachment 9, 10 and 11 (**Appendix A**), the former Schofields Aerodrome is being developed into a new residential estate called Nirimba Fields. The development master plan (Attachment 9) for the Nirimba Fields comprised residential lots, a primary school, playing fields, netball courts, parks and commercial/retail facilities.

The audit site is proposed to be developed into low density residential properties (mainly in the western and northern portion), a playground/recreation area in the middle portion and new network of access roads (orientated roughly north-south and east- west) as part of the overall development of the Nirimba Fields housing estate.

For the purposes of this audit, the following land use scenario has been assumed as 'low density residential with accessible soil' land use scenario.



2.6 Site History

The high-level site history of the former aerodrome was summarised in the Validation Report as follows:

- Pre-1851 – Greenfield site.
- 1851 to 1942 – Agricultural land (dairy and orchards).
- 1942 to 1975 – Training base and airfield by Royal Australian Air Force (RAAF) and Royal Australian Navy (RAN). The site included runways, repair stores, sleeping huts, offices, sewerage treatment plant, machine gun test butt and a fire training area. Aqueous film forming foam (AFFF) were used for firefighting purpose at the former fire training area (FFTA). A separate section of the former aerodrome was used as a migrant hostel. A piggery and a sports field and weapons electrical engineering school were present from 1952 to 1975.
- 1975 to 1993 – Former aerodrome was used by Schofields Flying Club where light planes were housed and maintained.
- 1986 – The piggery was demolished and an airship (blimp) hangar was constructed.
- 1993 to 2017 – Vacant and miscellaneous use (such as go-cart track, driver training, film set, training facility for Sydney 2000 Olympics). Demolition of some structures. The northern part of the former aerodrome was used as a staging area for the Blacktown-Richmond rail line duplication.
- 2018 to current – Land clearing to facilitate construction of new residential estate Nirimba Fields which included “significant land raising earthworks” to mitigate flooding risk from Eastern Creek. The PFAS MEA was understood to be constructed between May 2018 and December 2020.

The audit site was previously part of the FFTA, two drainage channels and a roadway. AFFF containing PFAS chemicals were used at FFTA.

In the auditor’s opinion, the site history review conducted provides an adequate indication of past activities. In relation to PFAS contamination, previous site use as a FFTA confirmed the presence of PFAS contamination sources within the audit site.



3.0 Summary of Previous Audit and Environmental Investigations

Table 3.1 provides a summary of the audit and environmental investigations conducted to date that are relevant to the audit site.

Table 3.1: Summary of audit and assessment events

Date	Description	Reference
2005	Section A Site Audit Report for the entire former Schofields Aerodrome was completed by [REDACTED] (ref: Site Audit Report, Lot 4 DP853847 Part of Schofields Aerodrome and Site Audit Statement [SAS] GN 6-1 dated 16 May 2005. The SAS stated that the former aerodrome (including PFAS MEA) was suitable for sensitive use including <i>“residential with accessible soil, including garden...excluding poultry”</i> and <i>“day care centre, preschool, primary school”</i>.	Environ 2005 (as referenced in JBS 2012 and Environ 2013).
2012	JBS conducted due diligence assessment to identify risk of unexpected finds and residual contamination as a burial pit containing asbestos, stockpiles, hazardous building material and minor unexploded ordnance were identified. This investigation focused on previous locations of buildings and infrastructure, underground structures, areas covered by bitumen and stockpiles. No sampling and laboratory analysis of soil, sediment or groundwater was conducted. This assessment concluded that generally, the former aerodrome is suitable for the proposed redevelopment for mixed uses however, recommended further remediation works to be conducted where residual contamination was identified. It was also recommended that a construction environmental management plan (CEMP) be developed.	JBS 2012.
2013	Section A Site Audit Report for the entire former Schofields Aerodrome was completed by [REDACTED] (ref: Site Audit Report – Part of Former Schofields Aerodrome, Lot 400 in DP1171596 and Site Audit Statement [SAS] GN481 dated 25 September 2013. This 2013 audit was conducted to incorporate results of investigation and remediation conducted and the changes in guidelines and legislation since 2005. An environmental management plan (EMP) was prepared to identify and manage unexpected finds. No significant contamination was found in groundwater and the audit recommended that if groundwater was abstracted, its suitability for use be assessed. The audit also indicated that the major sources of contamination have been removed from the former aerodrome. The SAS stated that the former aerodrome was suitable for sensitive use including <i>“residential with accessible soil, including garden...excluding poultry”</i> and <i>“day care centre, preschool, primary school”</i>.	Environ 2013.
May to October 2017	A targeted PFAS environmental assessment was conducted at the FFTA because Aqueous Film Forming Foam (AFFF) was used. This included soil, sediment and shallow groundwater testing within and around the FFTA. Groundwater monitoring events (GME) were conducted in May, June and August 2017. Isolated PFAS impacts in top-soil, sediment and shallow groundwater were found at and in the vicinity of the FFTA. The PFAS soil impacts were delineated with two areas highlighted (Refer to Attachment 1, 2 and 3, Appendix A): • Soil within FFTA that are not suitable for re-used due to contamination. This material was placed in PFAS MEA. • Shallow surface soil within the No Scrape Area that are not suitable for reuse as topsoil. This material was also placed in PFAS MEA.	Ramboll 2017; Attachment 5, 6 and 7 (Appendix A)



Date	Description	Reference
May 2018	Additional PFAS leachate analysis was conducted on the PFAS-contaminated top-soil within the No Scrape Area for the purpose of assessing whether the material can be excavated, mixed with geotechnically suitable VENM soil (because of its high organic content) and placed at PFAS MEA. Toxicity characteristic leaching procedure (TCLP) was conducted on soil PFAS.	Ramboll 2018.
May 2018 to March 2021	Excavation of material from No Scrape Area (which encompasses FFTA) and placement of material into PFAS MEA. Limited information is provided in the PFAS MEA Validation Report about the 'construction' of PFAS MEA. Ramboll indicated that they were not aware of a remedial action plan [RAP] prepared to implement the recommendations discussed in their 2018 report. The volume of PFAS impacted soil excavated from No Scrape Area is reported as 4,600 m³. A small portion of No Scrape Area, North of Site (shown as Area of Interest in Attachment 3 in Appendix A) was not excavated and remain in-situ. Following this, VENM fill material was imported into the audit area as part of the bulk site leveling earthworks for Nirimba Fields.	Ramboll 2021b and 2021c.
December 2020	Validation works conducted of PFAS MEA on 9 and 10 December 2020. This included advancement of 14 soil bores (via push tubes drilling method) within PFAS MEA and collection and analysis of soil validation samples for PFAS compounds. The PFAS MEA Validation Report conducted a screening assessment of potential risks associated with the PFAS MEA (provided as Appendix 8 of the Validation Report) and concluded that <i>"the PFAS MEA is considered suitable for future low-density residential with garden and accessible soil with respect to the PFAS material placement layer"</i>.	Ramboll 2021b.
March 2021	Validation works conducted of the audit site on 30 and 31 March 2021. The validation approach adopted in the Validation Report includes: • Drilling of 17 validation soil bores (16 on-site and one off-site bores) via push tubes drilling method. • Collection and analysis of soil validation samples for PFAS compounds. • Review of groundwater monitoring data collected from 2017. • Review of available survey data associated with the site leveling works undertaken. Australian Standard Leaching Procedure (ASLP) was undertaken on one soil sample only which reported elevated PFAS concentrations. No groundwater monitoring was conducted as part of the validation activity. The purpose of the Validation Report is stated to be <i>"to assess whether the No Scrape Area, North of Swale is suitable for future residential land use with respect to the PFAS and whether it is adequately protective of the environment following removal of PFAS impacted topsoils and/or covering with VEMN"</i>. The Validation Report concluded that <i>"the No Scrape Area, North of Swale is considered suitable for future low-density residential with garden and accessible soil with respect to residual PFAS concentrations due to historical usage"</i>.	Ramboll 2021c; Attachment 3, 4 and 8 (Appendix A).



4.0 Evaluation of Quality Assurance and Quality Control

The auditor has assessed the overall quality of the data by review of the information presented in the referenced reports, supplemented by field observations. The data sources are summarised in Table 4.1.

Table 4.1: Summary of Investigations

Investigations	Field Investigations	Analytical Data Obtained
Targeted Phase 2 PFAS Site Investigation at the FFTA and No Scrape Area - Ramboll (2017).	Soil, sediment and groundwater.	PFAS.
PFAS Leachate Analysis of samples from the FFTA and No Scrape Area - Ramboll (2018).	Leachate.	PFAS.
PFAS Validation Report for the North of Swale - Ramboll (2021c).	Soil and Leachate.	PFAS.

For the Ramboll (2021c) validation field program, field investigations for the audit site (i.e. North of Swale) were conducted in the same mobilisation as the South of Swale field investigations. Therefore, field quality control samples conducted for both areas are reported together.

The auditor's assessment specific to PFAS data from the audit site and the wider No Scrape Area (including FFTA) where relevant follows in Table 4.2 and Table 4.3.

Table 4.2: QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Data Quality Objectives (DQO) Ramboll (2017) defined specific DQOs in accordance with the seven steps process outlined in NSW EPA (2017) Guidelines for the NSW Site Auditor Scheme. Ramboll (2021c) defined DQOs in accordance with US EPA, which was endorsed in Section 5 of Australian Standard guideline AS4482.1-2005.	The DQOs presented in the Ramboll (2017) and Ramboll (2021c) reports are considered appropriate for the investigations undertaken at the respective FFTA and PFAS MEA sites.
Sampling pattern, locations, and sampling density <u>North of Swale</u> Soil: A reduced sampling density of 16 sample locations (instead of 22 sample locations for an approximate area of 1.15 ha, recommended by EPA 1995) was developed with respect to the objectives of the targeted validation works.	Groundwater information for up and down-hydraulic gradient of the audit site is available. It is appropriate that sampling density is higher in 'Area of Interest' where there is a higher potential for PFAS contamination. The investigation locations adequately target the various strata in the audit site, in line with the objectives of the validation works.



Sampling and Analysis Plan and Sampling Methodology

Auditor's Opinion

For the 'Area of Interest', the sampling density was 6 samples (instead of 7 locations recommended by EPA 1995). Ramboll (2021c) indicated that the sampling density was reduced because:

- Low potential for soil disturbance at depths greater than 3 m.
- The reduced potential for PFAS contamination to be present as PFAS impacted soil has been excavated from the audit site (and moved to PFAS MEA).
- Survey information provided for the cut and fill activity that had occurred, thus greater confidence for the depth of natural soil surface.

FFTA and No Scrape Area

Soil: Approximately 35 soil samples were analysed from 32 locations. Samples were collected from shallow and deeper test pits, grab surface samples from 11 step-out locations around the FFTA. The sample locations were designed to target potential pathways and effectively map the distribution of PFAS associated contamination with on-site historical FFTA activities (Ramboll, 2017).

Groundwater: A total of 11 monitoring bores were installed around the vicinity of the FFTA. The majority of the bores were targeted to the west of the site, in the assumed down-gradient positions of the FFTA, with the exception of one bore in the FFTA.

Sediment: A total of nine grab sediment samples were taken at the drainage lines within or near the FFTA. One sediment location was up-gradient of the FFTA and three samples were down-gradient of the FFTA.

Sample depths

North of Swale

Soil: Samples were collected based on the anticipated depth of the former site surface and when a change in strata was evident – from the VENM fill material immediately above the natural soil. Samples were also collected in the overlying VENM near the interface and approximately 0.5 m in the underlying natural soil beneath the interface.

FFTA and No Scrape Area

Soil: Samples were collected from within the shallow fill (0-0.2m) of the 12 test pits, step-out locations (grab surface) around the FFTA, were analysed to assess and delineate contamination (presence of PFAS) related to the FFTA.

Groundwater: Monitoring bores were installed to depths ranging between 3.3 and 5 mbgl to assess shallow groundwater conditions at and in the vicinity of the FFTA. In the groundwater sampling events (May, June and August 2020), low flow (peristaltic pump) sampling method was used to sample groundwater from the bottom of the monitoring bore screened interval.

Sediment: Grab sediment samples were collected from surface scrape.

The soil sampling strategy was appropriate and adequate to characterise the PFAS contamination at depth at the former site surface.

Similarly, the overall sampling strategy was appropriate and adequate to characterise the various media in the wider No Scrape Area.

Well construction

FFTA and No Scrape Area

The 11 monitoring bores were installed to depths of 3.3 to 5 mbgl, with screen intervals of 2.5 to 3 m placed in graded filter sand. Bores were constructed of 50 mm diameter unplasticized polyvinyl chloride pipe with 0.5 mm slotted screen fitted with an end cap. A bentonite seal of approximately 0.5 m thickness was placed above the screen and the well backfilled with drilled spoil to the ground surface.

Acceptable.



Sampling and Analysis Plan and Sampling Methodology

Auditor's Opinion

Sample collection method

Acceptable.

North of Swale

Soil: Sample collection was by hand from the disposable push tube sleeve of the soil boreholes advanced using a drill rig.

FFTA and No Scrape Area

Soil: Collection of surface soil grab samples were by hand from the decontaminated trowel, and test pit samples by hand either directly from freshly excavated soil or from the middle of the excavator bucket to reduce the potential for cross contamination from the excavation bucket.

Groundwater: The monitoring bores were installed by solid flight augers. The wells were developed using either a pump or disposable bailer to ensure a good interface across the slotted screen section with the groundwater bearing strata, and to ensure removal of introduced drilling water (where relevant) after the installation of the wells. The wells were left for a minimum of one week to stabilise prior to sampling (Ramboll, 2017). Samples were collected with low flow peristaltic pump with new silicon tubing for each well.

Sediment: Collection of sediment grab samples was by hand from the decontaminated trowel.

Decontamination procedures

Acceptable.

Ramboll indicated that sampling equipment (including trowel, hand auger, interface meter and water quality meter) was decontaminated by rinsing with a dilute solution of Alconox® (PFAS-free detergent) followed by rinsing with deionised water (PFAS-free water) provided by the laboratory. Drilling equipment was generally decontaminated with fresh water between locations. Dedicated disposable nitrile gloves were reportedly used for each new sample.

Sample handling and containers

Acceptable.

Soil, sediment and groundwater samples (for PFAS analysis) were placed in laboratory-supplied plastic jars and bottles (comprised of polypropylene or high-density polyethylene, HDPE). Samples were chilled in non-chemical-based ice which had been double-bagged (polyethylene plastic) and secured to avoid meltwater from contacting sample containers in the Esky™ during storage and subsequent transport to the laboratory (Ramboll 2021c).

Chain of Custody (COC)

Acceptable. A spot check of COC was conducted and the COC was found to be filled-in appropriately.

Completed chain of custody forms were provided in the reports.

Detailed description of field screening protocols

Acceptable.

Groundwater: Field parameters were measured during well purging and sampling.

Calibration of field equipment

The calibration certificates for every equipment used in the monitoring programs were not provided (e.g. interface meter and low flow pump calibration certificates for August 2017 GME were missing) in the Ramboll (2017) report. While it cannot be verified that all groundwater monitoring equipment was sufficiently calibrated, the auditor notes that the comparable groundwater results were measured in the GMEs and this suggests the absence of systematic data errors associated with field equipment.

Groundwater: The Ramboll (2017) report stated that calibration certificates of water quality meter equipment was provided, and Appendix 8 of Ramboll (2017) report contained calibration certificates for the water quality meter, oil/water interface meter, multi-parameter water meter, peristaltic pump, and micropurge flow cell dated May, June and August 2017.



Sampling and Analysis Plan and Sampling Methodology

Auditor's Opinion

Sampling logs

Soil: Borehole logs were provided within the reports (Ramboll 2017 and 2021c) indicating sample depth, lithology and contamination (odour and staining, as observed).

Groundwater: Field sampling logs from August 2017 were provided, indicating standing water level (SWL), field parameters, methodology and observations.

Sediment: No sampling logs from June and August 2017 were provided.

No groundwater field sampling log was provided for the May and June 2017 monitoring events in Ramboll (2017) report. However, data from the May and June 2017 GMEs were presented in the results tables. The sediment sampling log was also not provided. While this indicated that provision of field documentation could be improved, this omission is not considered to alter the overall conclusions made in the audit.

Table 4.3: QA/QC – Field and Lab Quality Assurance and Quality Control

Field and Lab QA/QC

Auditor's Opinion

Field quality control samples

North of Swale

Soil: For the Ramboll (2021c) validation field program, a total of 92 primary samples (33 samples for North of Swale and 59 samples for South of Swale) were collected and ten blind and ten split duplicate samples, which complies with PFAS NEMP.

A total of ten rinsate blanks (two blanks for North of Swale and eight blanks for South of Swale) were collected at a frequency one in 10, and three field reagent blanks and field blanks in line with one each per sample batch.

No duplicate was collected for ASLP analysis of one sample.

FFTA and No Scrape Area

Soil: In the Ramboll (2017) investigation, a total of four field duplicates and triplicates were sampled for 26 primary soil samples. One rinsate blank sample was collected.

In the Ramboll (2018) investigation, one duplicate was sampled in four in-situ primary grab samples analysed for TCLP for PFAS compounds.

With the exception of one rinsate blank sample collected and analysed in October 2017, no rinsate and trip blanks were collected during the 2017 and 2018 investigations. Rinsate blanks were not collected during the 2018 soil investigation because Ramboll did not adopt a decontamination procedure during the soil sampling events.

Groundwater: In the Ramboll (2017) investigation, of the 22 groundwater samples collected in May, June and August 2017, a total of three blind duplicate and two split duplicate samples were submitted for analysis.

A split groundwater duplicate was not collected in the May 2017 GME even though a blind duplicate was collected. No rinsate sample was collected in the May 2017 GME.

Three rinsate samples were collected and analysed during the June and August 2017 monitoring events.

Sediment: A set of blind and split duplicate was collected in August 2017.

The 2017 soil and groundwater investigation was conducted prior to the issue of PFAS NEMP 1.0 in January 2018. The collection of field duplicates for the 2017 investigation are considered adequate as compliant with the NEPM requirement of 1 in 20 samples.

The lack of rinsate blanks (2018) was not considered to affect the quality of the data since soil samples were directly placed into PFAS-free laboratory supplied jars using dedicated disposable nitrile gloves for each new sample.

The lack of trip blanks and spikes were not considered to be an issue as PFAS is not a volatile compound. Given that other QC measures were adopted as part of the investigation and the consistency of the results, the non-compliance was not considered to be significant in the context of the audit overall.



Field and Lab QA/QC

Auditor's Opinion

Field quality control results

The results of field quality control samples were generally within appropriate limits. The following exceptions are noted:

Soil: In the Ramboll (2021c) investigation, three RPDs (74.5% to 150%) for two soil duplicate samples for PFOS and sum of PFHxS and PFOS were outside the acceptable limits and they are all from samples collected at South of Swale. Ramboll indicated that the exceedances in soil are likely due to the heterogeneous nature of the fill materials mixing with natural soil at the interface.

The soil rinsate samples analysed reported concentrations below the practical quantitation limit (PQL) for all analytes.

Groundwater: In the Ramboll (2017) investigation, RPDs for inter-laboratory groundwater duplicate samples for PFHxS and PFHpA were 75% and 91%, respectively. Ramboll indicated that the minor RPD exceedances were likely attributed to sample heterogeneity. The primary sample indicated the highest PFHxS concentration and the inter-laboratory duplicate sample indicated the highest PFHpA concentration (however no site criteria existed for PFHpA). None of the duplicate samples are from monitoring bores located at or near the PFAS MEA.

The groundwater rinsate samples analysed reported concentrations below the PQL for all analytes.

Overall, in the context of the dataset reported, the elevated RPD results are not considered significant and the field quality control results are acceptable.

National Association of Testing Authorities (NATA) registered laboratory and NATA endorsed methods

Acceptable.

Laboratories used included: Australian Laboratory Services (ALS) Environmental, Eurofins MGT and EnviroLab
Laboratory certificates were NATA stamped.

Analytical methods

Acceptable.

Analytical methods were included in the laboratory test certificates. Both EnviroLab and ALS Environmental provided brief method summaries of in-house NATA accredited methods used based on United States Environmental Protection Agency (USEPA) for extraction and analysis in accordance with the NEMP 2.0.

Holding times

Ramboll reported that holding times have been met however, a review of laboratory certificates by the auditor indicated that the holding times for moisture content analysis for SS104 had not been met.

The non-compliance in holding time for moisture content analysis is not considered to be significant in the context of the audit overall.

Practical Quantitation Limits (PQLs)

Soil: PQLs were less than the threshold criteria for the contaminants of concern.

Groundwater: PQLs were less than the threshold criteria for the contaminants of concern with the following exception:

Perfluorooctane sulfonate (PFOS) PQL ranged between 0.0003 to 0.01 µg/L (Ramboll, 2017) was above the NEMP 2.0 99% species protection guideline value of 0.00023 µg/L.

Ultra trace analysis was not conducted for PFOS to obtain the lower PQL for PFOS, and the higher laboratory's PQL was adopted as a screening level in accordance with guidance from the NEMP 2.0.

Soil:

Overall, the PQLs are considered to be acceptable.

Groundwater:

The PQLs do not materially affect the outcome of the audit.



Field and Lab QA/QC

Auditor's Opinion

Laboratory quality control samples

Majority of the laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks, internal standards and duplicates were undertaken by the laboratory at the appropriate frequency except for one matrix spike frequency that was below guideline recommendation.

One minor non-compliance from laboratory control sample is not considered to be significant in the context of the audit overall.

Laboratory quality control results

The results of laboratory quality control samples (Ramboll 2017) were generally within appropriate limits, with the following exceptions:

In the context of dataset reported, the number of samples collected and the relative consistency of results between sampling events, the non-conformances are not considered significant and the laboratory quality control results are acceptable.

Soil

- In three batches of samples, matrix spike (MS) recoveries for selected PFAS compounds could not be determined as the background level was greater than or equal to 4x spike level.
- In one batch of samples, surrogate recoveries were less than lower data quality objective.

Groundwater

In one batch of samples, MS recoveries for PFHxS and PFOS could not be determined as the background level was greater than or equal to 4x spike level.

Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy)

Predetermined DQIs were set in the Ramboll report for laboratory analyses including field blanks, field duplicates, internal laboratory QC samples, COC documentation and laboratory NATA accreditation. These were discussed with regard to the five category areas. There was limited discussion regarding actions required if data do not meet the expected objectives.

An assessment of the data quality with respect to the five category areas has been undertaken by the auditor and is summarised below.

In considering the data as a whole, the auditor concludes that:

- Samples were collected using suitable procedures, and field rinsate, reagent and blank samples were all considered acceptable.
- While minor variation in field duplicates, laboratory control samples and omissions in documentation were identified, the results were generally consistent indicating the data is likely to be representative of the overall conditions on the audit site.
- Primary and secondary laboratories provided sufficient information to conclude that the dataset was generally precise. Ramboll adopted the higher of the duplicate results in their assessment and interpretation of contamination.
- Overall, the dataset is considered to adequately characterise the site condition and was relied upon for this audit.



5.0 Environmental Quality Criteria

The overall environmental objectives of the assessment and validation of the audit as documented in the Validation Report are to:

- “confirm the appropriateness of the excavation of PFAS impacted soil.
- assess the residual risk (posed to relevant receptors and protected environmental value of soil, groundwater and surface water) associated with residual soil left in situ within Area of Interest in consideration of the recommendations described in Ramboll 2018 and NEMP 2.0 (2020) guidance for PFAS impacted material reuse”.

This is achieved by evaluating the contamination status of the soil profile and the thickness of the barrier layer (VENM fill material) placed above the former site surface against:

- Environmental quality criteria protecting human health and ecosystem (refer to Section 5.1).
- The separation distance, vertically and laterally, between the contamination to human receptors (e.g., residents living on the current raised site surface) and ecological receptors (e.g., surface water and groundwater beneath and down-gradient of the audit site).
- Leachability potential for residual PFAS contamination to migrate from the soil into the water table.

The Validation Report also presented its own validation requirements of the Area of Interest and this is discussed in **Section 6.7** below.

5.1 Soil and Water Quality Criteria

The auditor has assessed the PFAS contamination status against the following guideline (endorsed by EPA):

- PFAS National Environmental Management Plan Version 2 [PFAS NEMP 2.0 or NEMP] (HEPA 2020).

Based on the proposed development the criteria for ‘residential with garden/accessible soil’ was referred to as it is the most sensitive land use proposed at the audit site. The environmental quality criteria adopted in this audit are:

- Human health guideline values:
 - Drinking water quality and recreational water quality guideline value (Table 1 of NEMP for groundwater and surface water).
 - Residential with garden/assessable soil health investigation level (HIL) A (Table 2 of NEMP for soil).
- Ecological Assessment:
 - 99% freshwater species protection (Table 5 of NEMP for groundwater and surface water). The auditor adopted the conservative approach and considered Eastern Creek to be a slightly to moderately disturbed ecosystem. Therefore, in line with guidance from Australian and New Zealand Guidelines for Fresh and Marine Water Quality framework and Section 8.6.3 of PFAS NEMP, due to bioaccumulation and biomagnification nature of PFAS, the next higher level of protection was adopted (i.e. 99% instead of 95%). As indicated in Table 5 of NEMP, for this audit, the laboratory detection limit for PFOS can be adopted ‘as default’ as the guideline value for 99% species protection is generally below the PQL. The auditor notes that the NEPM 99% value is likely to be conservative.
 - Ecological direct exposure and ecological indirect exposure for all land uses (Table 3 of NEMP for soil).



The environmental quality criteria referenced by the Auditor are consistent with the Validation Acceptance Criteria (VAC) adopted by Ramboll, with the exception of the following:

- Ecological criteria for Eastern Creek. Ramboll (2021) adopted 95% level of species protection (instead of 99% level of species protection) for screening soil leachate results for PFOS and PFOA. Ramboll considered this to be “*conservative as aquatic receptors are not expected to be directly exposed to the leachate*” (page 20). However, this is not considered to materially affect the audit, as the Validation Report refers to the screening assessment (i.e. Tier 2 assessment of aquatic risks) conducted for PFAS MEA (Ramboll 2021a) and this screening assessment considered both 95% and 99% species protection guideline levels.



6.0 Evaluation of Validation

6.1 Overview

The Validation Report stated that a Remediation Action Plan (RAP) was not prepared for the excavation of PFAS soil from the audit site. As mentioned previously, no excavation of PFAS impacts had occurred within the Area of Interest. This is followed by placement of VENM as part of the overall site development which raised the surface from a natural soil base.

Ramboll presented multiple lines of evidence to define and demonstrate the environmental aspect of the audit site and this is outlined in Table 6.1 below. They also validated the audit site against the PFAS NEMP material reuse requirements (even though the PFAS impacted soil was not 'reused' but left in-site on-site) and their recommendations from 2018 (refer to **Section 6.7**).

Table 6.1: Auditor's Review and Verification of Key Elements

Element	Multiple lines of evidence	Key outcomes and comments
Thickness of VENM layer overlying former site surface.	Survey and cut & fill data (refer to Section 6.2). Stratigraphic information from the validation soil boreholes (refer to Section 6.3). Ramboll indicated that the area where less than 3 m of overlying VENM was identified was in the area of the swale bank where there would be low human accessibility and PFAS impacted soil was not reused or retained. Furthermore, all analytical results for PFAS from the validation sampling in this area were below PQL.	Average VENM thickness: • 4.7 m (residential area). • 3.5 m (recreational area). • 2.1 m (swale bank). The auditor considers the thickness of overlying VENM present to satisfy the environmental quality criteria, including the validation requirements.
Nature of PFAS impacted soil.	Soil results (refer to Section 6.4.1). Leachate results (refer to Section 6.4.2).	All validation results were below the adopted soil and leachate quality criteria with the exception of one sample BH05_5.1 (and its duplicates) collected at the VENM-natural soil interface in the Area of Interest. Further risk assessment was conducted as part of the Validation Report (refer to Section 7.0). Overall, the risk to human health and ecological receptors are considered by the auditor to be low and acceptable (refer to Section 7.3).



Element	Multiple lines of evidence	Key outcomes and comments
Depth to groundwater from former site surface.	Survey and cut & fill data (refer to Section 6.2). Stratigraphic information from the validation soil boreholes (refer to Section 6.3). Groundwater levels (refer to Section 6.5).	Average separation distance between groundwater and in situ PFAS impacted soil (remaining in the Area of Interest): 0.97 m. Range of separation distance between groundwater and in situ PFAS impacted soil (remaining in the Area of Interest): 0.2 m (at BH103) to 1.5 m (at BH108). The in situ PFAS impacted soil was concluded to be less than 2 m above the seasonal maximum groundwater level on average. As the validation criterion was not met, further risk assessment work was conducted (refer to Section 8.0). Overall, the auditor considers that the potential for PFAS contamination at the audit site to migrate to Eastern Creek is low (refer to Section 8.1).
Nature of groundwater.	Groundwater analytical results (refer to Section 6.6).	PFAS groundwater concentrations exceeding the ecological and human health guideline values were measured at monitoring bores located within the audit site. As the water quality criteria were not met, further risk assessment work was conducted (refer to Section 8.0). Overall, the auditor considers that the potential for PFAS contamination at the audit site to migrate to Eastern Creek is low (refer to Section 8.1).

6.2 Survey Data

The earthworks contractor for the Nirimba Field development prepared a cut and fill plan dated 23 March 2021 for the audit site. This is provided as Figure 4 of the Validation Report (presented as Attachment 4, **Appendix A**) and this was used by Ramboll to design their intrusive validation field program. This indicated greater than 4 m of VENM was placed in western portion of the site (areas proposed for residential use) and that the thickness of VENM decreases towards the swale (eastern site boundary).

Furthermore, after the completion of the VENM placement, the final site surface was surveyed (refer to Appendix 11 of the Validation Report provided as Attachment 12, **Appendix A**). The data confirms that the elevation of the northern and western corners of the site is 25 mAHD or higher and drops to approximately 22.6 mAHD in the central eastern section along the new proposed off-site swale.

Overall, the auditor considers the available survey data to be adequate.



6.3 Stratigraphy

The sub-surface profile of the audit site, based on the findings of the validation soil testing conducted in March 2021, is summarised in Table 6.2.

Table 6.2: Stratigraphy based on the logs of the validation soil bores.

Approximate depth (mbgl)	Subsurface Profile
0.0 to 0.9 - 5.3	FILL (imported overlying VENM): gravelly/sandy clay, brown, moderate plasticity, dry, hard, with sandstone and shale gravels, cobbles and boulders.
0.9 - 5.3 to 6.3 (maximum depth of assessment)	Silty CLAY (natural soil): Dark brown, low to moderate plasticity with minor rootlets present. Increasing plasticity and moisture with depth.

No sign of contamination was visually observed by Ramboll (2017 and 2021c).

The auditor notes that weathered shale was logged around 3.3 m and 3.8 m below the former natural surface at on-site groundwater monitoring bores BH103 and BH108 respectively back in 2017. The intrusive validation works conducted in 2021 did not extend to such depth.

Table 6.3 is a compilation of the VENM thickness based on stratigraphy observed in the validation soil bores (based on bore logs in Appendix 4 of the Validation Report) and it shows that within the residential areas, VENM thickness greater than 3 m were recorded.

Table 6.3: Summary of VENM thickness observed in validation soil bores

Bore ID	Location	Land use	Thickness of VENM observed (m)
BH01	Area of Interest.	Residential.	5.1.
BH02	Area of Interest.	Infrastructure (road).	4.3.
BH03	Remaining area.	Recreation.	3.0.
BH04	Remaining area.	Infrastructure (road).	3.0.
BH05	Remaining area.	Infrastructure (road).	5.3.
BH06	Remaining area.	Infrastructure (swale bank).	2.7.
BH09	Remaining area.	Recreation.	2.2.
BH10	Remaining area.	Residential.	4.2.
BH11	Remaining area.	Infrastructure (swale bank).	0.9.
BH17	Remaining area.	Infrastructure (swale bank).	2.6.
BH38	Remaining area.	Residential.	4.5.
BH39	Area of Interest.	Residential.	5.0.
BH40	Area of Interest.	Residential.	5.1.



Bore ID	Location	Land use	Thickness of VENM observed (m)
BH41	Remaining area.	Recreational.	4.5.
BH42	Off-site.	Residential.	4.9.
BH43	Area of Interest.	Residential.	5.2.
BH44	Area of Interest.	Residential.	5.1.
		Average (residential area).	4.7.
		Average (recreational area).	3.50.
		Average (swale bank).	2.1.

Note: VENM thickness less than 3 m are shown in red.

The locations with less than 3 m VENM fill are all located in areas where PFAS impacted soil has been excavated and areas zoned for non-sensitive (infrastructure and recreational) land use.

The VENM thickness observed at the validation soil bores are generally consistent with the cut and fill plan dated 23 March 2021 provided in Attachment 4 of **Appendix A**.

6.4 Soil and Leachate Analytical Results

6.4.1 Soil

Table 6.4 below summarises the analytical soil results from the validation soil bores drilled to intersect:

- VENM layer immediately above the former site surface (natural soil).
- The former site surface (natural soil) at the interface with overlying VENM fill.
- Underlying natural soil below the former site surface.

The results have been assessed against the environmental quality criteria. Soil sampling locations are shown as Attachment 3, **Appendix A**.



Table 6.4: Summary of soil validation results (mg/kg)

Analyte	No. of samples	No. of detections	Maximum concentration	No. of samples exceed NEMP ecological guideline value	No. of samples exceed NEMP human health investigation level (HIL A)
PFOS.	37 ¹	3	0.015	0 (for direct ecological exposure). 3 ² (for indirect ecological exposure).	—
PFOA.	37 ¹	3	0.0006	0 (for direct exposure).	0
Sum of PFOS and PFHxS.	37 ¹	3	0.0224	—	3 ²

Notes:

1. 35 primary samples and 2 duplicate samples.
2. Sample NS_BH01_5.1 (primary) and its blind duplicate QC01 and split duplicate QC02.

One primary sample (BH01_5.1) and corresponding blind and split duplicates (QC01 and QC02) measured PFOS and sum of PFOS and PFHxS concentrations above the ecological and human health investigation levels. These samples are collected at the natural soil interface and BH01 is located at the Area of Interest.

It must be noted that PFAS compounds are not volatile and do not pose an inhalation risk to human health.

Other than samples from BH01, all other sampling locations recorded results below the adopted criteria and laboratory PQL including:

- 10 samples from VENM fill.
- 16 samples from VENM-natural soil interface (i.e. original site surface).
- 8 samples from natural soil below the interface.

6.4.2 Leachate

Sample BH01_5.1 was analysed for leachability and its ASLP analytical results are presented in Table 6.5.



Table 6.5: Summary of BH01_5.1 leachate analytical results (µg/L)

Analyte	NEMP ecological guideline value (95% species protection)	NEMP ecological guideline value (99% species protection)	NEMP drinking water quality guideline value	Concentration
PFOS.	0.13	0.00023	—	0.52
PFOA.	220	19	0.56	0.02
Sum of PFOS and PFHxS.	—	—	0.07	0.95

Leachate sum of PFOS and PFHxS concentration was reported above the drinking water guideline level. The auditor notes that, with the availability of reticulated water supply, groundwater and surface water at and near the vicinity of the audit site is not used for drinking water purposes and therefore, this environmental value is not considered to be realised or relevant for the site. It must be noted that PFAS compounds are not volatile and do not pose an inhalation risk to human health.

The PFOS concentration was above the ecological criteria (for 95% and 99% level of species protection) which implies that there may potentially be an unacceptable risk to ecological receptors if the leachate migrates to the aquifer or surface water body. Further discussion on the assessment of risk to aquatic receptor, namely Eastern Creek, is presented in **Section 8.0** below.

6.5 Groundwater Levels

The Validation Report indicated that groundwater was not observed during the drilling of the validation soil bores in 2021 where a maximum depth of 6.3 below site level was reached.

Groundwater levels for the audit site are inferred from historical groundwater monitoring events (GME) conducted in May, June and August 2017 (Ramboll 2017). Among the three GMEs, the water table was shallowest in June 2017 and therefore, adopting the most conservative approach, water levels from June 2017 GME were used in this audit.

There were two groundwater monitoring bores (BH103 and BH108) within the audit site and three bores (BH101, BH102 and BH105) in the vicinity (refer to Attachment 8, **Appendix A**). Based on measured levels, the inferred groundwater flow direction is to the west/north-west towards Eastern Creek.

Table 6.6 shows the water levels and depth below the former site surface measured in June 2017. The average depth to groundwater from the original site surface is calculated to be 0.97 m (shallowest being 0.19 mbgl at BH103 located in Area of Interest).



Table 6.6: Groundwater level data from June 2017 GME

Bore ID	Location	June 2017 groundwater level		Former site surface (pre-VENM filling)	Depth of groundwater (reference to former site surface pre-VENM filling)
		mbtoc	mAHD	mAHD	mbgl
BH101	Off-site.	2.1	20.0	21.4	1.4
BH102	Off-site.	1.4	19.7	20.5	0.7
BH103	On-site (Area of Interest).	1.0	19.9	20.0	0.2
BH105	Off-site.	1.8	19.7	20.7	1.0
BH108	On-site (Remaining area – swale bank).	2.3	20.1	21.6	1.5
Average					1.0

Source: Appendix 10 of Validation Report

While June 2017 gauging data from BH103 suggests that the water table was only 0.2 m below the PFAS impacted soil left in situ at Area of Interest, validation soil bore BH01, located less than 10 m away from BH103, did not encounter groundwater when it was extended 1.2 m into the original site surface (i.e. approximately 18.8 mAHD) in 2021.

The Validation Report interpreted the absence of groundwater at BH01 to indicate the low permeability of natural clay present at the wider Nirimba Fields and concluded that groundwater is typically around 2 m below the original site surface. The auditor notes that the Environ (2013) audit report previously indicated that groundwater depth of 'typically' less than 2 mbgl for the former aerodrome and the water level at the off-site PFAS MEA was around 1.6 to 2.2 m below surface and concurs with Ramboll that the water level is likely to be deeper than 0.2 m.

With the bulk filling of VENM conducted at the Nirimba Fields, the depth to groundwater for the current surface is now greater than the depths shown in Table 6.6. Using the final (i.e. current) site surface elevation (presented in Attachment 12, Appendix A), the depths to groundwater within the audit site are inferred to be:

- Greater than 5 m at BH103 (> 25 mAHD measured at BH01 minus 20.0 mAHD).
- Approximately 2.9 m at BH108 (23 mAHD minus 20.1 mAHD).

A review of NSW registered bore database was conducted by Ramboll on 5 March 2021 and registered groundwater bores were not encountered within a 1 km radius of the audit site (refer to Appendix 9 of the Validation Report). Environ (2013) audit report indicated that there were three registered bores located within a 5 km radius of the Nirimba Fields. There are no groundwater abstraction bores located in the vicinity or down-gradient of audit site and between the audit site and Eastern Creek.



6.6 Groundwater Analytical Results

Groundwater analytical results from BH101, BH102, BH103, BH105 and BH108 measured during the most recent GME (August 2017) are summarised below in Table 6.7 and Attachment 6 (**Appendix A**).

Table 6.7: Summary of groundwater investigation analytical results (µg/L)

Analyte	No of samples	No of detection	Maximum concentration	Exceeding NEMP ecological guideline value	Exceeding NEMP drinking water guideline value	Exceeding NEMP recreational water guideline value
PFOS.	7 ¹	4	0.0631	4 ²	—	—
PFOA.	7 ¹	4	0.0111	0	0	0
Sum of PFOS and PFHxS.	7 ¹	3	0.595	—	2 ³	0

Notes:

1. 5 primary samples and 2 duplicate samples (QC09 blind duplicate of BH108 and QC10 split duplicate of BH102).
 2. 3 primary samples (BH102, BH103 and BH108) and QC10 (split duplicate of BH102).
 3. 2 primary samples (BH102 and BH103).
- No criteria available.

It should be noted that the groundwater sampled from on-site bores measured concentrations exceeding:

- The ecological criterion (BH103 and BH108).
- The human health drinking water criterion (BH103 only).

Further discussion on the assessment of risk to groundwater receptors is presented in **Section 8.0**.

BH104 and BH109, both located south-east of the No Scrape Area, are considered up-hydraulic gradient from the No Scrape Area. The auditor notes that they reported the following concentrations in the August 2017 monitoring event:

- BH104:
 - 0.002 µg/L PFOS, above NEMP 99% species protection ecological guideline value.
 - 0.305 µg/L Sum PFHxS and PFOS, above the NEMP drinking water guideline value.
- BH109:
 - 0.0099 µg/L PFOS, above NEMP 99% species protection ecological guideline value.
 - 0.166 µg/L Sum PFHxS and PFOS, above the NEMP drinking water guideline value.



6.7 Validation Works Required

The following validation works were required at the audit site to demonstrate that:

- The Area of Interest (where PFAS impacted soil remains in situ) is posing an acceptable risk for proposed residential land use.
- The portion of the site where PFAS impacted soil has been excavated (i.e., areas outside of Area of Interest), is posing an acceptable risk for the proposed land use.

Given that a RAP was not prepared for the excavation of PFAS impacted soil from the audit site, the validation requirements of the audit site were listed in Section 7 and the validation acceptance criteria in Section 8 of Validation Report (Ramboll 2021c).

The validation requirements are derived from Section 12.2 of NEMP 'Reuse requiring consultation with the environmental auditor' and previous recommendations from Ramboll (2018) assessment. Technically speaking, the PFAS impacted soil was not 'reused' within the audit site, however, "*to provide a more robust risk assessment*", Ramboll adopted the same validation requirements as off-site PFAS MEA (where PFAS soil was placed at depth) when validating the in situ PFAS impacted soil at depth within the Area of Interest. The auditor concurs with this approach.

The validation requirements are listed and discussed in Table 6.8. This audit also considers the validation program in light of the environmental objective of the audit site discussed in **Section 5.0**.

Table 6.8: Compliance with validation requirement

Source of Validation Requirement	Validation Requirements adopted in the Validation Report	Validation Met?	Discussions
Section 12.2 of NEMP (Material Reuse Requirements)	Fill or burial less than 2.0 m above the seasonal maximum groundwater level.	No.	As indicated in Section 6.5 , the groundwater level was inferred to be on average 1 m below the in situ PFAS impacted soil with the Area of Interest. Further discussion on potential contaminant migration in groundwater is presented in Section 8.0 . Overall, the potential risk for PFAS to migrate from Area of Interest to Eastern Creek is considered low and acceptable.
	Reuse within 200 m of a surface water body or wetland area.	No.	The nearest surface water body is the sedimentation basin located approximately 100 m south of the audit site. It is noted that groundwater beneath the audit site is not inferred to migrate towards this surface water body.
	Reuse in (or in the vicinity of and able to be transported to) areas which can be identified with any of the nine matters of national environmental significance protected under the <i>Environment Protection and Biodiversity Conversation Act</i> (EPBC Act), and areas of environmental significance as identified in specific jurisdictions.	Yes.	There is no national environmental significance at or in the vicinity of the audit site.



Source of Validation Requirement	Validation Requirements adopted in the Validation Report	Validation Met?	Discussions
	Fill, burial or reuse in locations potentially affected by reasonably foreseeable future rises in groundwater or sea level, or near stormwater drains.	No.	As part of the housing estate development, concrete stormwater drainage lines are to be constructed at the audit site. As the drains are new (installed to modern standards), the likelihood of leaks is considered to be low. Furthermore, if there are leakages, the scale and volume of leakage from the stormwater drains should be small and localised. There is a new swale being constructed to the east of the audit site (approximately 90 m east of the Area of Interest) and this swale is design to collect stormwater from the audit site and drains to the sedimentation basin east of the audit site. As indicated in Section 6.5, the final depth to groundwater at the Area of Interest is at least 4 m and therefore, is unlikely to intersect stormwater lines. The auditor considers that the potential for additional leaching from in situ PFAS soil at the Area of Interest due to stormwater drains is likely to be low.
	Reuse on agricultural land.	Yes.	There is no agricultural land use at the audit site.
	Reuse as fill in residential developments.	No.	As indicated in Attachment 3 and 8 (Appendix A), the Area of Interest is within a residential area. An assessment of risk has been conducted for the sub-surface in situ PFAS contamination and refer to Section 7.0 for further discussion.
	Reuse as fill on public open space/parkland/recreational land.	No.	As indicated in Attachment 3 and 8 (Appendix A), the north-eastern corner of the Area of Interest is proposed to be used as recreational land. An assessment of risk has been conducted for the sub-surface in situ PFAS contamination for residential land use (which is more sensitive than recreational land use). Refer to Section 7.0 for further discussion.
	Inclusion in compost, fertilisers or soil conditioners.	Yes.	PFAS material was not used in compost, fertilisers or soil conditioners at the audit site.
Recommendations from Ramboll (2018)	Shallow surface soil with the No Scrape Area are to be excavated and mixed with geotechnically more suitable and PFAS impacted soil for placement at depth as follows:		
	The mixed soil when placed remains within the original vicinity of the No Scrape Area.	Yes.	The PFAS impacted soil (Area of Interest) has remained within the No Scrape Area.
	The mixed soil when placed are not within the vicinity of any proposed stormwater drains.	No.	Refer to comments above in relation to stormwater drains.



Source of Validation Requirement	Validation Requirements adopted in the Validation Report	Validation Met?	Discussions
	The mixed soil when placed are at least 1 m above current site level, which equates to approximately 2 m above current groundwater level.	No.	The in situ PFAS impacted soil (in the Area of Interest) is inferred on average to be less than 2.0 m above the seasonal water table. Refer to Section 6.5 for discussion on groundwater separation distance and Section 8.0 for further discussion on potential contaminant migration.
	At least 3 m of VENM is placed on top of the mixed soil when placed to form the final site surface.	Yes.	As indicated in Table 6.3, greater than 3 m of VENM was placed on top of PFAS impacted soil at the Area of Interest. The Validation Report clarified that the only area with less than 3 m of overlying VENM is at the swale bank or recreational area where: - There remains no PFAS impacted soil (as they were excavated). - No validation result exceeding the adopted criteria was reported (at BH06, BH09, BH11 and BH17).
	The mixed soil be placed at least 750 m away from Eastern Creek.	Yes.	The distance between the audit site and Eastern Creek is approximately 800 m. The auditor notes that Section 8 of Ramboll (2018) actually stated greater than 800 m (not 750 m) but overall, this inconsistency does not change the validation outcome.
	Groundwater extraction for any purposes is not permitted within the new development.	Yes.	The Validation Report stated that groundwater extraction is not allowed within the new development. The auditor notes that reticulated water supply is readily available in the new residential development.
	Between 4 to 6 m of VENM is imported to raise site levels across the new development to infill the existing drainage channels whilst installing a new drainage network within imported VENM discharging directly to Eastern Creek.	Yes.	Based on VENM thickness observed at validation soil bores presented in Table 6.3, BH02 (4.3 m) and BH05 (5.3 m), VENM greater than 4 m was placed to fill the former drainage channels. The auditor notes that BH06 and BH09 are also located in the former drainage channels and the thickness of VENM imported at these two locations are shallower than 4 m because they are at or close to the swale bank.
	Site redevelopment activities will be undertaken to be protective of construction workers from the observed concentrations of PFAS.	Yes	Construction Environmental Management Plan (CEMP) was reported in the Validation Report to been used to manage site development works.

6.8 Auditor's Opinion

Overall, the validation of the audit site was considered to be generally adequate and sufficient. The validation evaluated the location, depth and risk to human and ecological receptor associated with the remaining in situ PFAS impacted soil for the proposed sensitive land use. Where the validation criteria were not met, further works including a risk screening assessment was undertaken as part of the Validation Report.



7.0 Assessment of Risk

7.1 Human Health

7.1.1 Soil

One sampling location BH01 at 5.1 mbgl (sample BH01_5.1 and corresponding blind and split duplicates, QC01 and QC02) reported results above the human health guideline values within the audit site. The contamination was identified to be limited in extent as it was delineated vertically and laterally with the VENM sample above at 4.5 mbgl and natural soil sample below at 5.6 mbgl, and north (BH43) and south (BH44) all reporting concentrations below criteria.

A qualitative risk assessment was conducted in the Validation Report and it concluded the risk to human health to be low because:

- The screening assessment conducted for off-site PFAS MEA (Ramboll 2021a) has indicated that with a minimum VENM thickness of 3 m, PFAS impacted soil does not pose an unacceptable risk to future receptors (including site residents and future intrusive workers). The contaminated soil at the audit site is located below VENM greater than 3 m (averaging 4.7 m thick VENM placed over residential area). Therefore, direct and indirect exposure pathways are not considered to be complete.
- Where future works deeper than 3 m are proposed, a development consent would be required. The presence of the PFAS impacted soil in the Area of Interest will be noted on the SAS that will be issued to Council. Council is required to note the presence of the SAS on the Planning Certificate.
- In addition, the Validation Report states that Blacktown Council requires that all other excavations deeper than 0.6 m (or deeper than 3 m for complying development i.e., swimming pool) would require development approval.
- The potential for future disturbance of the contamination at depth is considered low because the site level of the entire residential development (Nirimba Fields) has been raised uniformly and future development is likely to be denser development (e.g. apartments instead of low density residential houses) with even less access to soil.

While it was not noted in the Validation Report but was previously discussed in the off-site PFAS MEA Validation Report, the auditor notes that due to the high organic content of the PFAS-impacted soil at No Scrape Area, any material excavated would need to be mixed with VENM soil for geotechnical purposes. This meant that the extent of PFAS contamination would be reduced due to dilution.

7.1.2 Groundwater

With the availability of reticulated water supply at the new residential development, the depth to water table being greater than 5 m at BH103 and as groundwater is not permitted to be extracted for potable or non-potable use, the exposure pathway for groundwater at the audit site is not considered to be realised. Therefore, the PFAS impacted groundwater observed at BH103 and elevated leachate ASLP result from BH01_5.1 are not considered to be pose an unacceptable risk to human health.



7.2 Ecology

7.2.1 Terrestrial

The assessment of terrestrial ecological risk was presented in the Validation Report. It noted that the PFOS concentration in soil does not exceed the direct exposure NEMP guideline value of 1 mg/kg but only exceed indirect exposure criterion of 0.01 mg/kg. Again, the elevated concentration was only reported at one sampling location BH01 at the depth of 5.1 m.

The maximum concentration is only 1.5 times (0.015 mg/kg at QC02) the indirect guideline value (0.01 mg/kg) and this is not considered by Ramboll to cause significant adverse effect. Also, the limited extent of the PFAS impact does not suggest significant food chain transfer. Ramboll concluded that the direct and indirect exposure risks to terrestrial ecological receptors is low and acceptable.

The auditor also considered the lines of evidence presented in the screening assessment conducted for off-site PFAS MEA (Ramboll 2021a) namely:

- At a depth of greater than 5 m, exposure to terrestrial ecological receptors will be minimal. The driving pathway behind the indirect guideline value (10 µg/kg) is uptake into soil invertebrates (e.g. earthworms), and subsequent ingestion by small insectivorous mammals. Soil invertebrates will be most common at the surface or in shallow soil; earthworms will have a relatively greater exposure to soil at depth, however, even earthworms have limited exposure to soil below 60 cm depth.
- While deep-rooted trees may have some potential to be exposed to soil at the depth of the PFAS impacted material, the overall concentration to which deep-rooted trees would be exposed would be lower than the concentrations within the PFAS impacted layer, as uptake would occur across the root zone.

7.2.2 Aquatic

The conclusion that risks to aquatic ecological receptors is low and acceptable is supported by the following:

- As the extent of the PFAS soil impact is limited, the volume of leachate generated is also considered to be relatively small.
- The elevated ASLP concentration measured is unlikely to exist in the same concentration in the groundwater aquifer.
- GME conducted in 20217 delineated the PFAS groundwater plume and it only extended approximately 250 m down-gradient from FFTA. Refer to **Section 8.0**.
- Given the majority of the source of PFAS contamination (i.e., topsoil at FFTA and No Scrape Area, outside of Area of Interest) has been removed from the site, leachate contribution to groundwater contamination is expected to decrease (not increase) over time.

The auditor notes that similar groundwater concentrations were measured at BH104 and BH109, located up-gradient of the audit site, presenting background concentrations in the area (refer to **Section 6.6**). Given the very long estimated timeframes to reach the creek, and the likely attenuation of concentrations along the flow path, any additional contribution from the audit site above background conditions is assessed to be negligible.



7.3 Auditor's opinion

Potential risks associated with in situ residual PFAS impacted soil at depth in the Area of Interest have been assessed. The assessment has considered the identified potential receptors associated with the audit site, which include:

- Human health (including site residents and intrusive workers).
- Terrestrial ecological receptors.
- Aquatic ecological receptors.

Taking into account lines of evidence presented in the Validation Report and the screening assessment conducted for off-site PFAS MEA (Ramboll 2021a), the auditor considers the risks to these receptors to be low and acceptable.



8.0 Contamination Migration Potential

The suitability of PFAS impacted soil within the Area of Interest included assessment of the transport of PFAS to groundwater through leaching from the material and migration to surface water in Eastern Creek. Potential transport pathways via dust and surface erosion were not considered complete on the basis of the cover of over 3 m VENM and did not warrant further assessment.

In other areas where there is less than 3 m of VENM present (e.g. northern bank of swale), PFAS impacted soil has been removed from this area and PFAS validation results have reported results below detection limits.

The consultant assessed PFAS leaching and transport of via the following lines of evidence:

- Based on gauging data from June 2017, groundwater level beneath the Area of Interest is likely to be less than 1 m below the in-situ PFAS impacted soil.
- The water table was not intersected during the drilling of the validation soil bores.
- Groundwater flow was identified to be slow based on the clay-dominated natural geology at the site.
- As discussed in **Section 7.2.2** above, the extent and volume of PFAS impacted soil was limited (i.e., observed at one location only) and relatively small based on delineation undertaken and compared to the off-site PFAS MEA.
- The PFAS impacts recorded in the 2017 groundwater investigation, conducted before the excavation of PFAS impacted soil from the No Scrape Area, delineated the PFAS plume to approximately 250 m downgradient from the FFTA (i.e., not reaching Eastern Creek). Now that the majority of the PFAS impacted soil has been removed from the audit site, groundwater contamination from potential leaching from the soil would be even less compared to previous levels. This is also supported by the placement of greater than 4 m VENM within the Area of Interest which would reduce infiltration.
- Using the sensitivity analysis conducted for the screening assessment (Ramboll 2021a) for the off-site PFAS MEA (which is greater in volume and higher in concentrations), PFOS beneath the Area of Interest is estimated to be < 0.03 µg/L due to the smaller volume and lower concentrations. If there is any potential migration, this is not expected to reach the aquatic ecological receptors in Eastern Creek located approximately 800 m away.

The consultant assessed that (referring also to discussion in **Section 7.0**):

- The risk to human health receptors associated with PFAS migration from the audit site (namely the Area of Interest) is low and acceptable on the basis that there are no complete exposure pathways.
- The risk to aquatic ecological receptors associated with PFAS migration from the audit site (namely the Area of Interest) is low and acceptable.

8.1 Auditor's Opinion

Potential migration of PFAS from the audit site has been assessed. The assessment indicates that the potential for PFAS to mobilise and migrate from the Area of Interest towards the creek to be low. The auditor has previously reviewed the screening assessment conducted for the off-site PFAS MEA and recognises that the modelled scenarios and conclusions for PFAS MEA also applies to this audit site. While it was not directly discussed in the Validation Report, the auditor notes that the low site background concentrations of PFAS are measured in up-gradient bores. Subject to maintaining the overlying VENM in the Area of Interest, the auditor considers that there is sufficient evidence to support the consultant's conclusion that the migration of PFAS from the audit site represents a low and acceptable level of risk, and that any additional contribution from the site above background conditions is negligible.



9.0 Compliance with Regulatory Guidelines and Directions

The Auditor has used guidelines currently approved by the EPA under section 105 of the NSW *Contaminated Land Management Act 1997* (**Appendix B**).

The investigation was generally conducted in accordance with State Environmental Planning Policy (SEPP) 55 Planning Guidelines and reported in general accordance with the NSW EPA (2020) Consultants Reporting on Contaminated Sites Contaminated Land Guidelines. The checklist included in that document has been referred to. The EPA's Checklist for Site Auditors using the EPA Guidelines for the NSW Site Auditor Scheme 2017 (October 2017) has also been referred to.

9.1 Notification

Ramboll did not indicate in the Validation Report whether the excavation works (i.e., removal of PFAS impacted soil from the audit site to the PFAS MEA) required any consent from regulatory authorities. The auditor has not been provided further detail on any associated notification to Council in relation to the works undertaken.

9.2 Development Approvals

The Development Consents for the various subdivision approvals included the following consent conditions:

'A NSW Environment Protection Authority accredited Site Auditor shall review the validation report and submit to Council a Site Audit Statement. The Site Audit Statement shall verify that the investigation, remediation and validation was carried out in accordance with the aforementioned guidelines and that the site is suitable for proposed use'.

'Prior to the issue of a Subdivision Certificate, an EPA recognised accredited geoscientist is to validate the site as suitable for residential development in accordance with the strict residential use criteria as set out in the National Environment Protection (Assessment of Site Contamination) Measures (NEPM) 1999 as amended 2013'.

The auditor confirms that this Site Audit Report and the associated Site Audit Statement are considered to address these conditions with respect to investigation, remediation and validation undertaken with respect to PFAS contamination.

9.3 Waste Disposal

While waste disposal is excluded from this audit, no waste or surplus material was documented in the Validation Report to be generated or disposed at the audit site.

9.4 VENM and Other Imported Materials

As stated in **Section 1.3**, this site audit does not include the review of VENM or any other material imported to the site, other than the thickness of VENM fill placed over the audit site.



9.5 Licenses

The Validation Report did not indicate that licences were required for works associated with the audit site.



10.0 Conclusions and Recommendations

Ramboll (2021c) considers that the:

- *“Potential risks to human health are not present as exposure pathways are not complete.*
- *Potential direct and indirect exposure risks to terrestrial and aquatic ecological receptors are low and acceptable.*
- *The No Scrape Area North of Swale is considered suitable for future low-density residential with garden and accessible soil with respect to residual PFAS concentrations due to historical usage.”*

Based on the information presented in the Validation Report and observations made on-site, the auditor concludes that:

- The nature and extent of the PFAS contamination has been appropriately determined.
- The risk to human health and the environment posed by the in situ PFAS impacted soil is acceptable, given the presence of the overlying VENM, for the current and approved uses.

Extraction of groundwater for any purpose within the audit site was documented in the Validation Report to not be permitted.

The site audit statement will be provided to the council and will be noted on the Planning Certificate.



11.0 Other Relevant Information

This audit was conducted on the behalf of Defence Housing Australia for the purpose of assessing whether the nature and extent of per-and poly-fluoroalkyl substances (PFAS) contamination has been appropriately determined to assess the suitability and appropriateness of the validation report prepared for the No Scrape Area, North of Swale i.e. a "Site Audit" as defined in Section 4 (definition of a 'site audit' (b)(i and v)).

This summary report may not be suitable for other uses. Ramboll Australia Pty Ltd included limitations in their report. The audit must also be subject to those limitations. The auditor has prepared this document in good faith, but is unable to provide certification outside of areas over which the auditor had some control or is reasonably able to check.

In drawing conclusions, the auditor used reasonable care to avoid reliance upon data and information that may be inaccurate, however a degree of uncertainty is inherent in all subsurface investigations and there remains the possibility that variations may occur between sample locations. The audit and this report are limited by and rely upon the scope of the review, and the information provided by the Defence Housing Australia and their consultants and representatives through documents provided to the auditor. The auditor's conclusions presented in this report are therefore based on the information made available to them and arising from their own observations conducted during the audit. If the auditor is unable to rely on any of those documents, the conclusions of the audit could change.

It is not possible in a Site Audit Report to present all data which could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.



Appendix A: Attachments

Attachment 1: Site Location and Layout (March 2021)

Attachment 2: Site Location and Historical Site Layout (2017)

Attachment 3: Borehole locations (March 2021) + Criteria Exceedances (Ramboll, 2017)

Attachment 4: Borehole locations (March 2021) and approximate cut/fill ranges

Attachment 5: Previous Soil PFOS and PFHxS + PFOS Criteria Exceedances – FFTA (Ramboll, 2017)

Attachment 6: Previous Groundwater PFOS and PFHxS + PFOS Criteria Exceedances – FFTA (Ramboll, 2017)

Attachment 7: Previous Sediment PFOS and PFHxS + PFOS Criteria Exceedances – FFTA (Ramboll, 2017)

Attachment 8: Inferred Groundwater Elevation (Ramboll, 2017)

Attachment 9: Masterplan

Attachment 10: Staging Plan – Current Zoning Aerial

Attachment 11: Staging Plan – Proposed Zoning Aerial

Attachment 12: Final site surface levels (mAHD)

Attachment 13: No Scrape Boundary Coordinates (North)



Legend

- Swale
- 'No Scrape Area' - Area not suitable for top soil re-use (moved to placement area)
- North of Swale "No Scrape" Area/Validation Area
- PFAS Material Emplacement Area at depth
- Approximate location of Former Fire Fighting Training Area (FFTA)
- Approximate site boundary (comprising majority of Former Schofields Aerodrome)

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Figure 1: Site Location and Layout (March 2021)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome



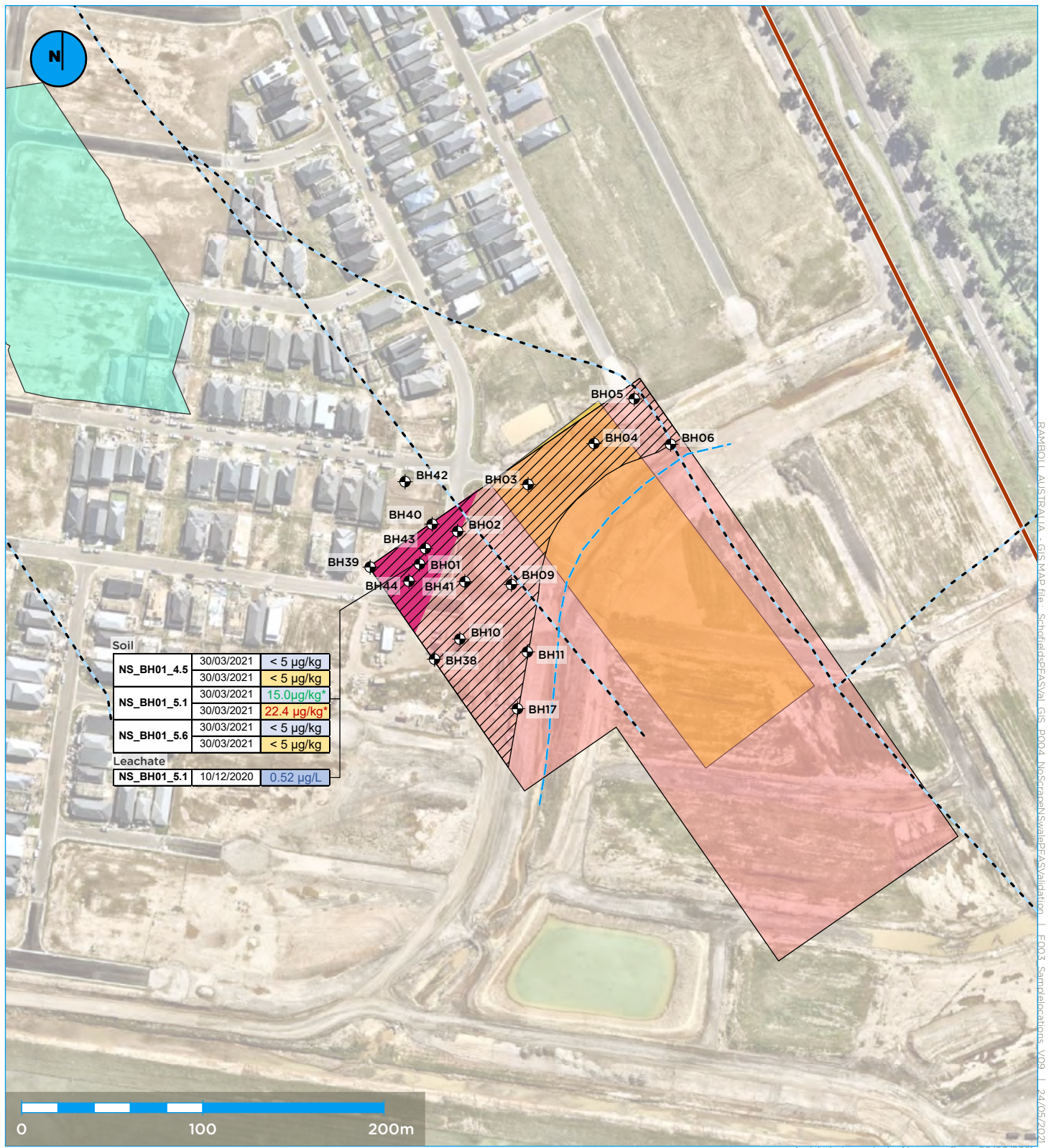
Legend

- Swale
- 'No Scrape Area' - Area not suitable for top soil re-use (moved to placement area)
- North of Swale "No Scrape" Area/Validation Area
- PFAS Material Emplacement Area at depth
- Approximate location of Former Fire Fighting Training Area (FFTA)
- Approximate site boundary (comprising majority of Former Schofields Aerodrome)

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Figure 2: Site Location and Historical Site layout (2017)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome



Legend

- Borehole location
- Swale
- Former Drainage Channels
- North of Swale "No Scrape" Area/Validation Area
- Area of Interest
- PFAS Material Emplacement Area at depth
- Approximate location of Former Fire Fighting Training Area (FFTA)
- Approximate site boundary (comprising majority of Former Schofields Aerodrome)

Exceedance Criteria

Soil

Sample Location and Depth	Sample Date	Reported Concentration (µg/kg)
		NEMP 2.0 - Eco indirect exposure PFOS 10 µg/kg
		NEMP 2.0 - HILA PFOS + PFHxS 10 µg/kg

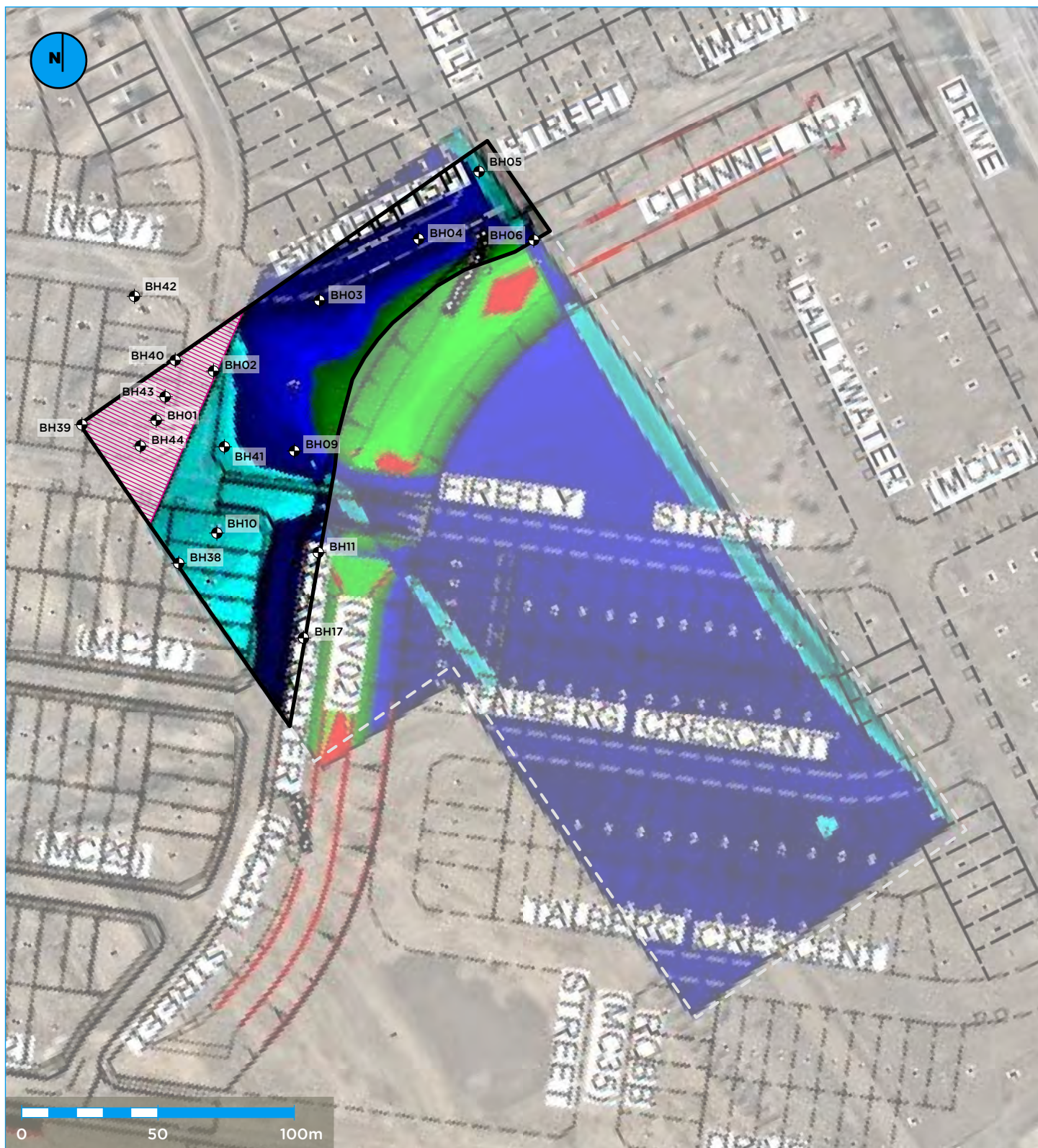
Leachate (Leach Method ASLP)

Sample Location and Depth	Sample Date	Reported Concentration (µg/L)
		NEMP 2.0 - Freshwater 95% protection, PFOS 0.13µg/L

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**Figure 3: Borehole locations (March 2021)
+ Criteria Exceedances (Ramboll, 2017)**

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome



Legend

- Borehole location
- North of Swale "No Scrape" Area/Validation Area
- "No Scrape Area" - Area not suitable for top soil re-use (moved to placement area)
- Area of Interest

Cut/fill range (adapted from CONTOUR_1784C-SK-0375 PFAS NO SCRAPE-B.pdf by Craig and Rhodes)

-2.0 to -1.8 m	0.0 to 0.2 m	2.0 to 2.2 m	4.0 to 4.2 m
-1.8 to -1.6 m	0.2 to 0.4 m	2.2 to 2.4 m	4.2 to 4.4 m
-1.6 to -1.4 m	0.4 to 0.6 m	2.4 to 2.6 m	4.4 to 4.6 m
-1.4 to -1.2 m	0.6 to 0.8 m	2.6 to 2.8 m	4.6 to 4.8 m
-1.2 to -1.0 m	0.8 to 1.0 m	2.8 to 3.0 m	4.8 to 5.0 m
-1.0 to -0.8 m	1.0 to 1.2 m	3.0 to 3.2 m	5.0 to 5.2 m
-0.8 to -0.6 m	1.2 to 1.4 m	3.2 to 3.4 m	5.2 to 5.4 m
-0.6 to -0.4 m	1.4 to 1.6 m	3.4 to 3.6 m	5.4 to 5.6 m
-0.4 to -0.2 m	1.6 to 1.8 m	3.6 to 3.8 m	5.6 to 5.8 m
-0.2 to 0.0 m	1.8 to 2.0 m	3.8 to 4.0 m	5.8 to 300 m

Figure 4: Borehole locations (March 2021) and approximate cut/fill ranges (Ramboll, 2017)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome

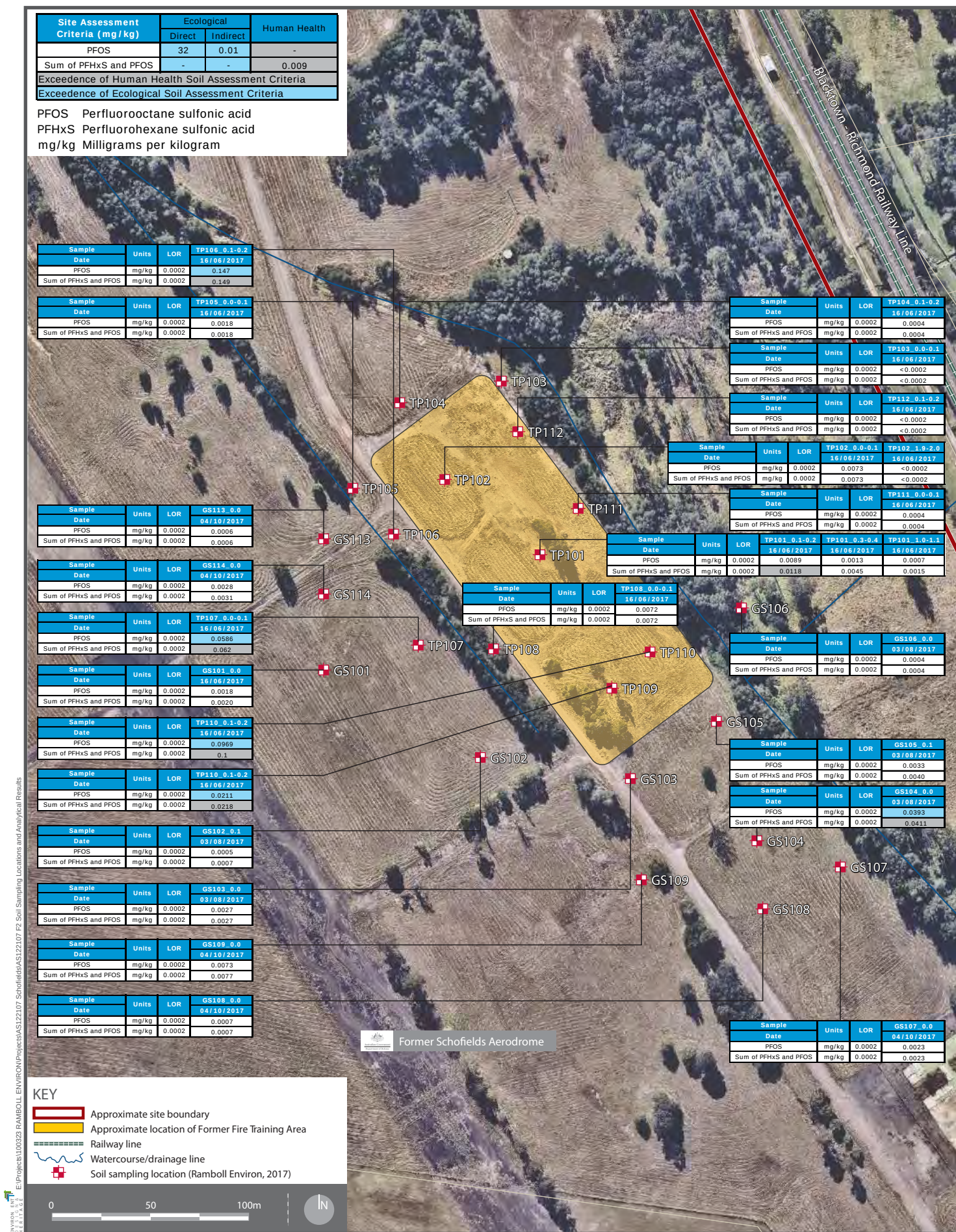


Figure 5: Previous Soil PFOS and PFHxS + PFOS Criteria Exceedances - FFTA (Ramboll, 2017)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome

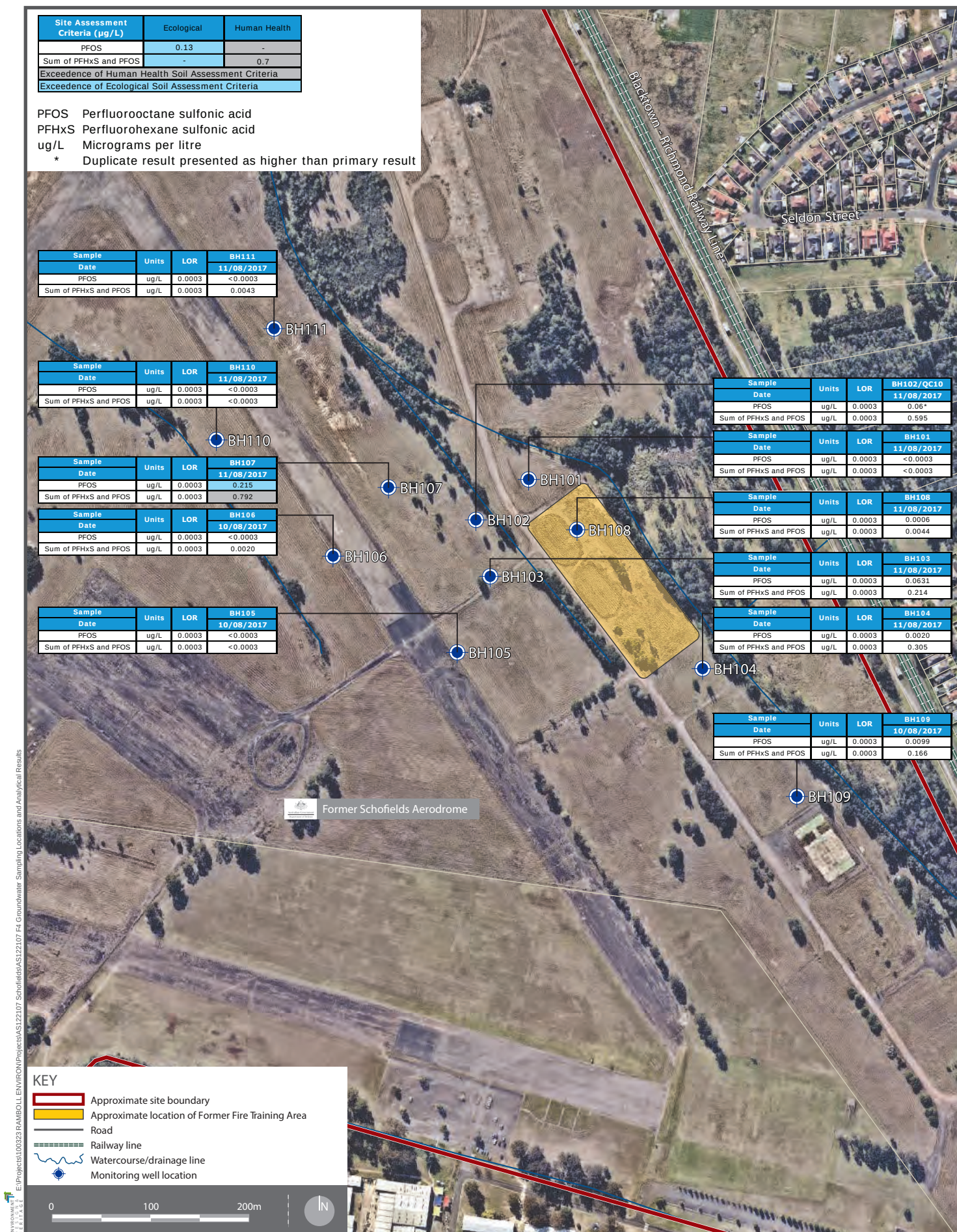


Figure 6: Previous Groundwater PFOS and PFHxS + PFOS Criteria Exceedances – FFTA (Ramboll, 2017)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome

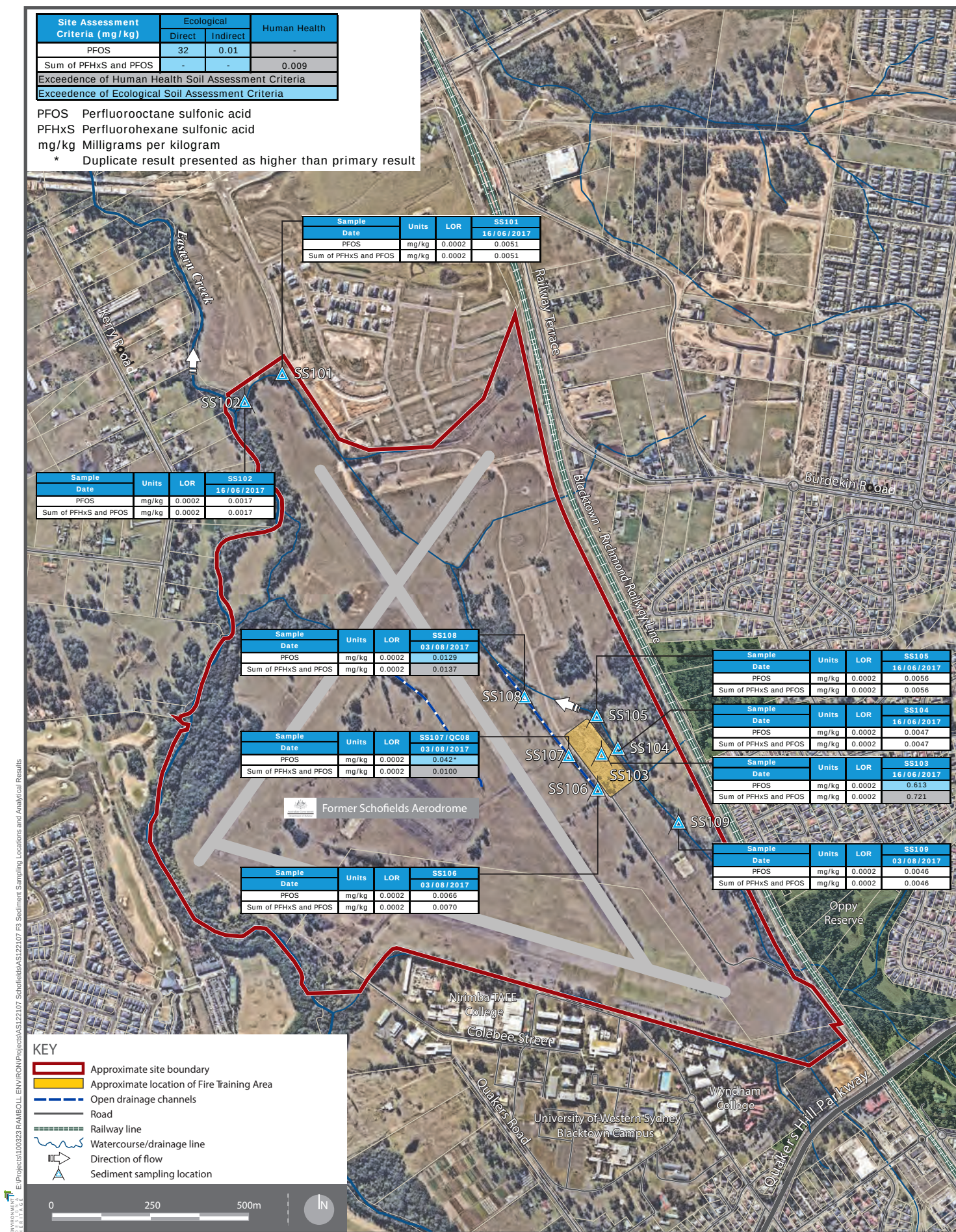
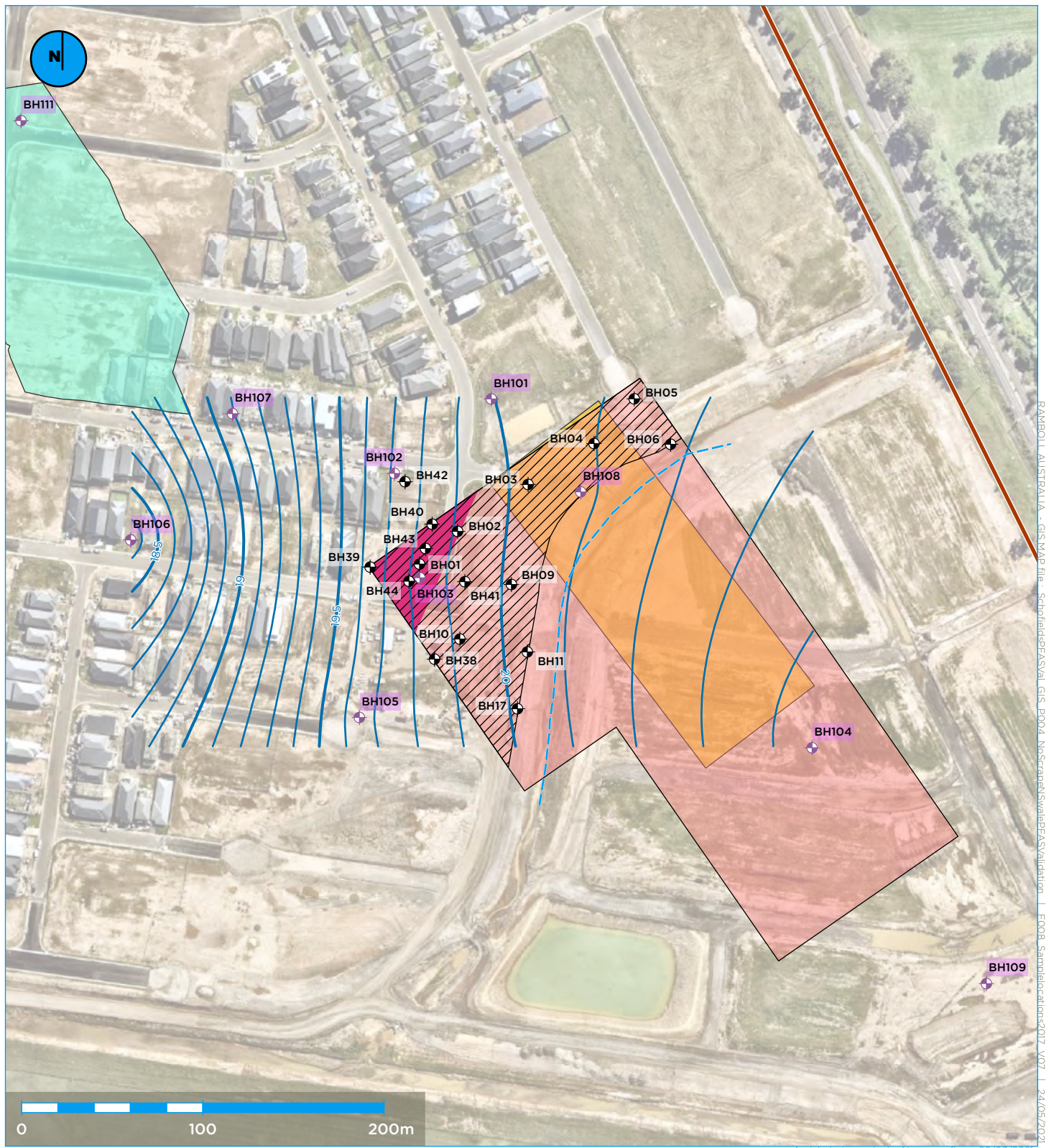


Figure 7: Previous Sediment PFOS and PFHxS + PFOS Criteria Exceedances - FFTA (Ramboll, 2017)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome



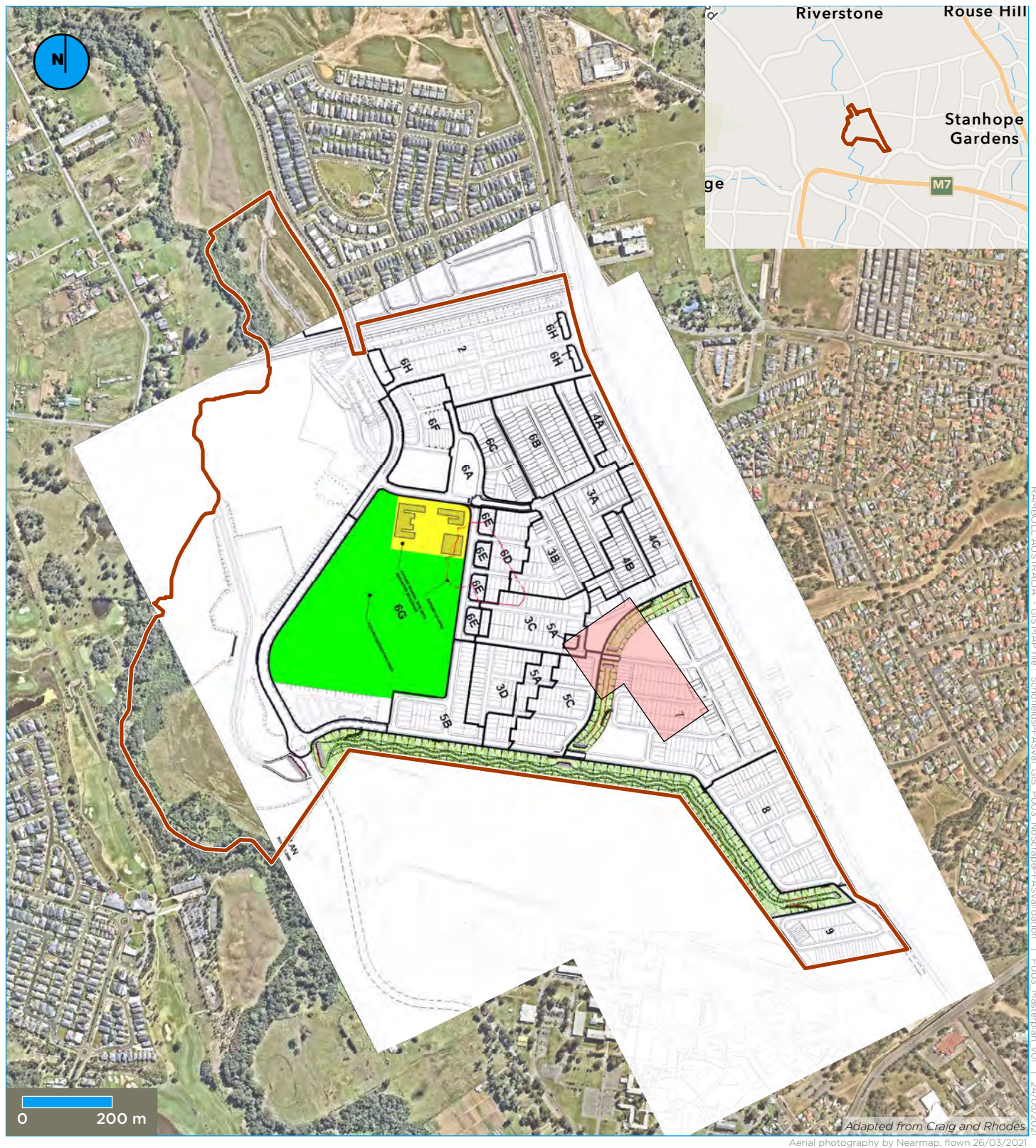
Legend

- Borehole location
- Groundwater well location (2017)
- Swale
- 0.1m Groundwater contours (2017)
- 'No Scrape Area' - Area not suitable for top soil re-use (moved to placement area)
- North of Swale "No Scrape" Area/ Validation Area
- Area of Interest
- PFAS Material Emplacement Area at depth
- Approximate location of Former Fire Fighting Training Area (FFTA)
- Approximate site boundary (comprising majority of Former Schofields Aerodrome)

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Figure 8: Inferred Groundwater Elevation (Ramboll, 2017)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome



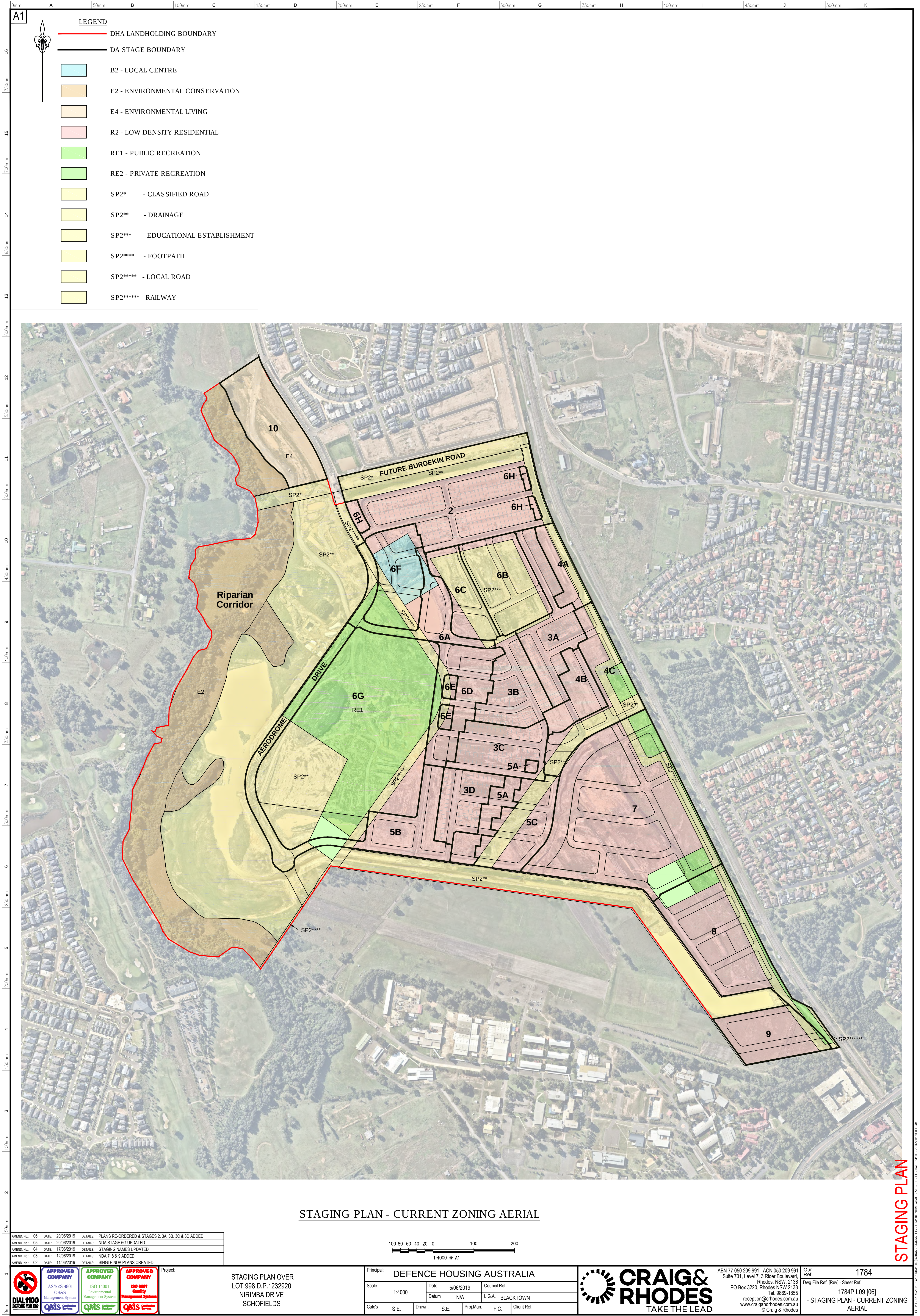
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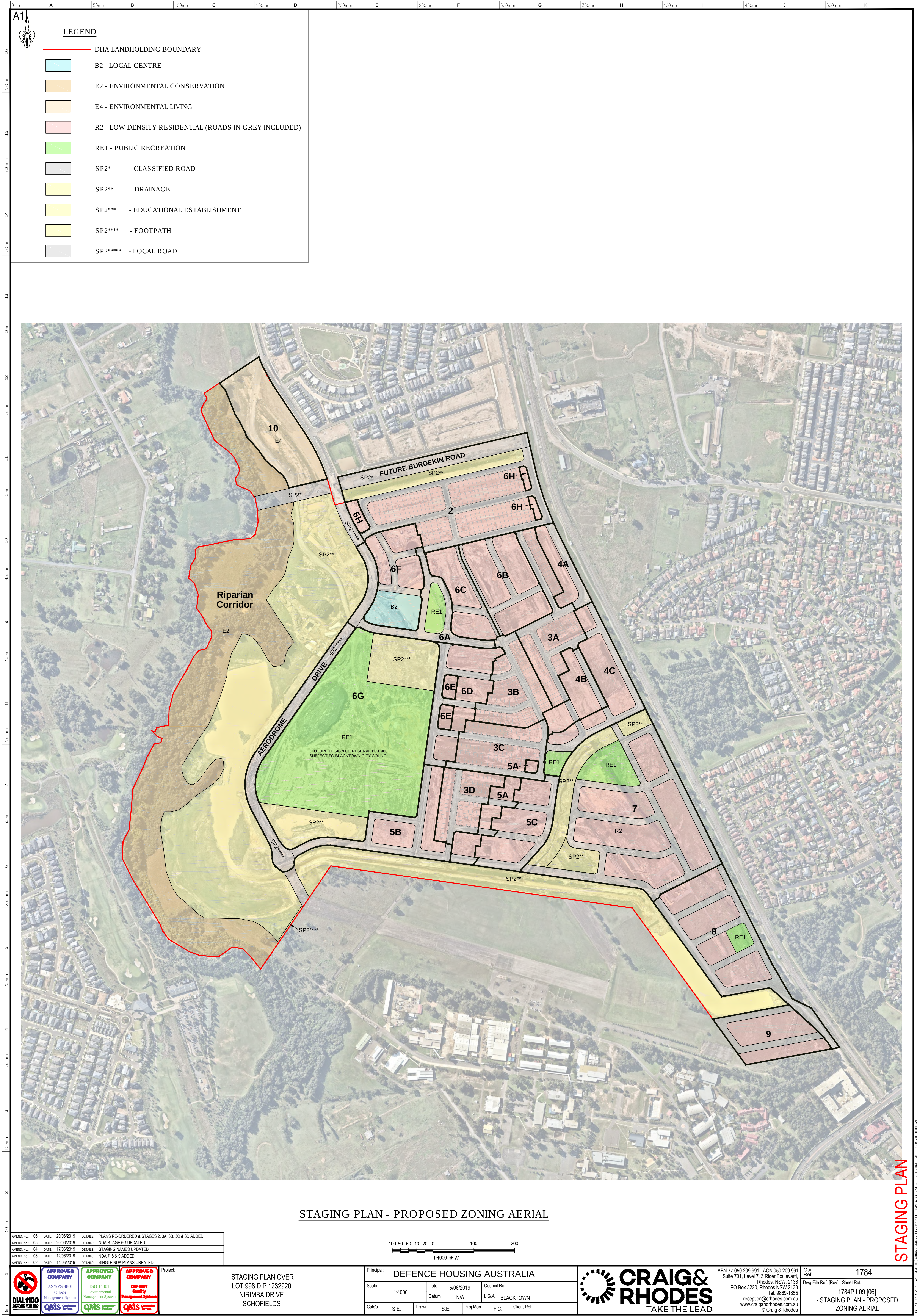
- 'No Scrape Area' - Area not suitable for top soil re-use (moved to placement area)
- Approximate Former Schofields Aerodrome site boundary

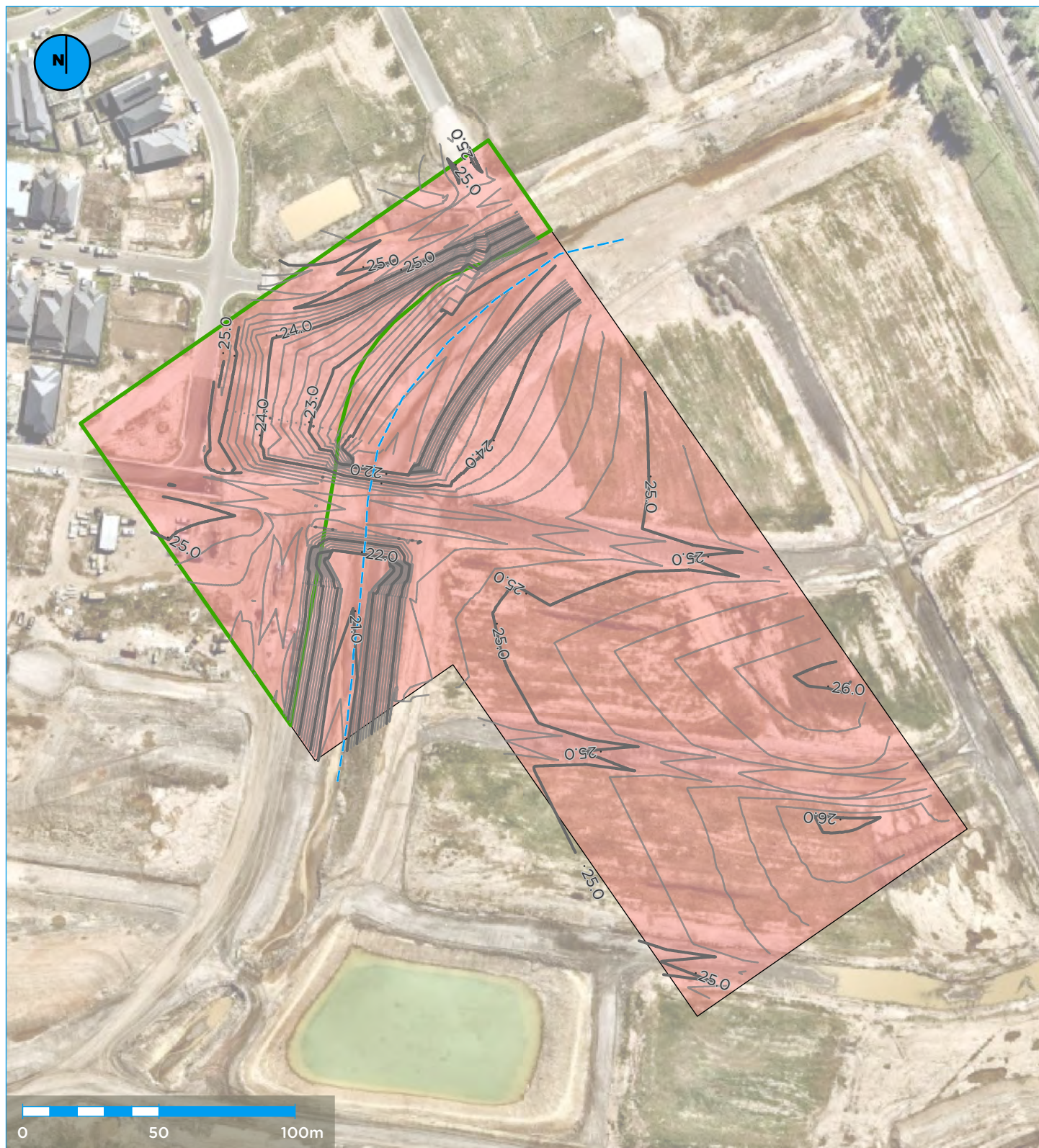
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Appendix 7: Masterplan

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome







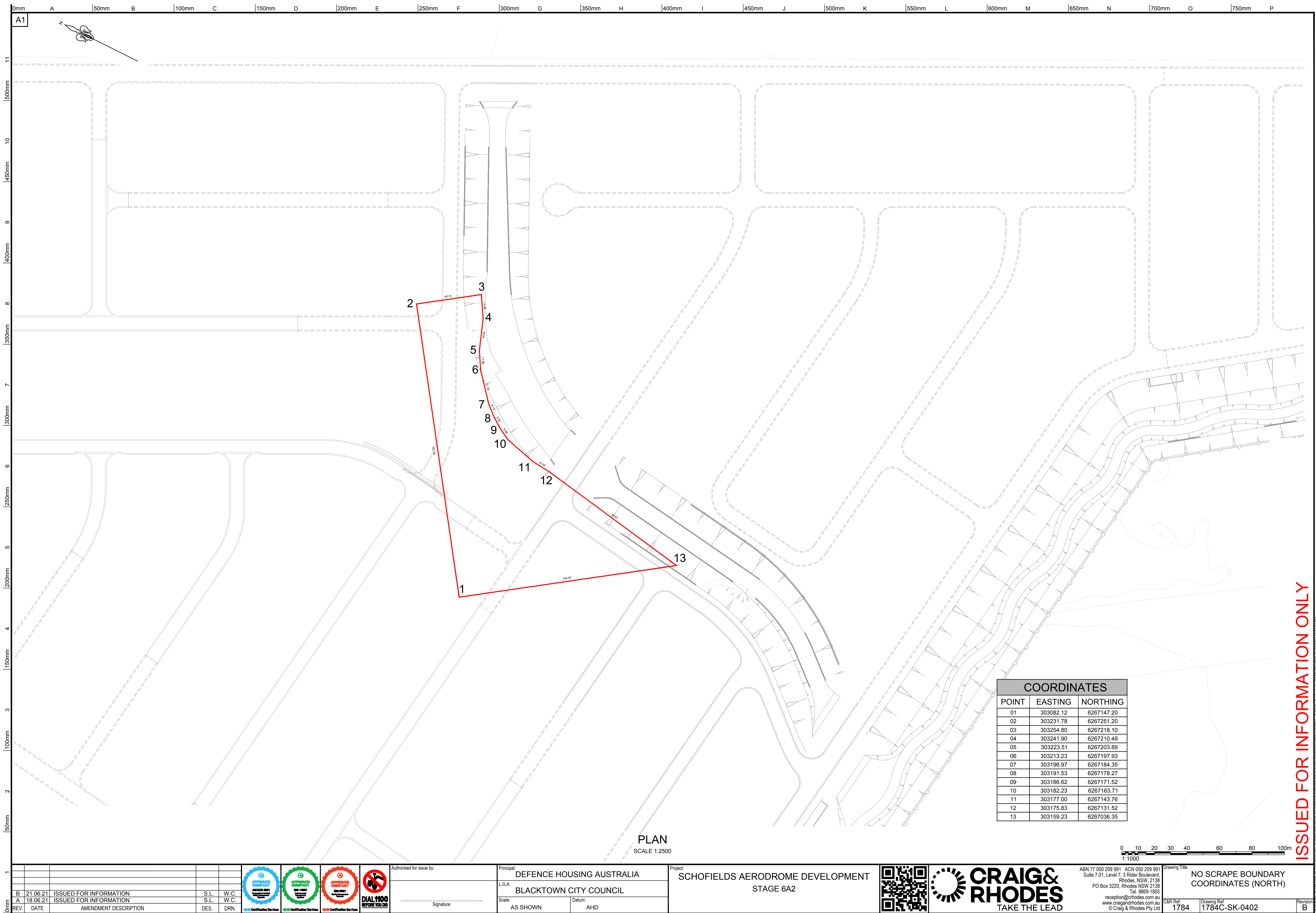
Legend

- Swale
 - 0.2m contours
 - 1m contours
 - North of Swale "No Scrape" Area/Validation Area
 - 'No Scrape Area' - Area not suitable for top soil re-use (moved to placement area)
- Contour supplied by C&R

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Appendix 11 : Final site surface levels (mAHD)

No Scrape Area, North of Swale PFAS Validation Report - Former Schofields Aerodrome





Appendix B: EPA Guidelines



Guidelines made or approved by the EPA under section 105 of the *Contaminated Land Management Act 1997*

(as of: 28 April 2021)

Section 105 of the *Contaminated Land Management Act 1997* (CLM Act) allows the EPA to make or approve guidelines for purposes connected with the objects of the Act. The EPA must consider these guidelines whenever they are relevant. Other people must also consider the guidelines, namely, accredited site auditors when conducting a site audit; contaminated land consultants when investigating, remediating, validating and reporting on contaminated sites; and those responsible for land contamination with a duty to notify the EPA.

A current list of guidelines made or approved by the EPA under the CLM Act appears below.

Guidelines made by the EPA

- Assessment and management of hazardous ground gases: Contaminated land guidelines (PDF 4MB)
- Guidelines for the vertical mixing of soil on former broad-acre agricultural land (PDF 148KB)
- Sampling design guidelines (PDF 2MB)
- Guidelines for assessing banana plantation sites (PDF 586KB)
- Consultants reporting on contaminated land: Contaminated land guidelines (PDF 1MB)
- Guidelines for assessing former orchards and market gardens (PDF 172KB)
- Guidelines for the NSW Site Auditor Scheme, 3rd edition (PDF 999KB)
- Guidelines for the assessment and management of groundwater contamination (PDF 604KB)
- Guidelines on the duty to report contamination under the Contaminated Land Management Act 1997 (PDF 412KB)
- Guidelines that refer to the
 - Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, October 2000), are replaced as of 29 August 2018 by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, August 2018), with the exception of the water quality for primary industries component, which still refer to the ANZECC & ARMCANZ (2000) guidelines
 - National Environment Protection (Assessment of Site Contamination) Measure 1999 are replaced as of 16 May 2013 by the National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013).

Guidelines approved by the EPA

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZG (August 2018)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 3, Primary Industries - Rationale and Background Information (ANZECC & ARMCANZ (October 2000)
- Composite sampling, Lock, W. H., National Environmental Health Forum Monographs, Soil Series No.3, 1996, SA Health Commission, Adelaide. Email enHealth.Secretariat@health.gov.au for a copy of this publication.
- Environmental health risk assessment: Guidelines for assessing human health risks from environmental hazards, Department of Health and Ageing and EnHealth Council, Commonwealth of Australia (June 2012)
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013)* (ASC NEPM)
- Guidelines for the Assessment and Clean Up of Cattle Tick Dip Sites for Residential Purposes, NSW Agriculture and CMPS&F Environmental (February 1996)
- Australian Drinking Water Guidelines, NHMRC and Natural Resource Management Ministerial Council of Australia and New Zealand (2011)

*The ASC NEPM was amended on 16 May 2013.



Appendix C: List of Street Addresses and Current/Proposed Land Parcels within No Scrape Area, North of Swale



Street Address	Primary Plan/Lot Plan	Development Stage Reference	Type
100 Mariner Avenue, Nirimba Fields NSW 2763	2335/DP1252016	Stage 2	Constructed
102 Mariner Avenue, Nirimba Fields NSW 2763	2336/DP1252016	Stage 2	Constructed
35 Firefly Street, Nirimba Fields NSW 2763	2337/DP1252016	Stage 2	Constructed
TBA	5001/DP1261629	Stage 5a	Under construction
TBA	5002/DP1261629	Stage 5a	Under construction
TBA	5003/DP1261629	Stage 5a	Under construction
TBA	4204	Stage 4c	Part of residual lot
TBA	4205	Stage 4c	Part of residual lot
TBA	4206	Stage 4c	Part of residual lot
TBA	4207	Stage 4c	Part of residual lot
TBA	4208	Stage 4c	Part of residual lot
TBA	4209	Stage 4c	Part of residual lot
TBA	5204	Stage 5c	Part of residual lot
TBA	5205	Stage 5c	Part of residual lot
TBA	5206	Stage 5c	Part of residual lot
TBA	5207	Stage 5c	Part of residual lot
TBA	5208	Stage 5c	Part of residual lot
TBA	5209	Stage 5c	Part of residual lot
TBA	5210	Stage 5c	Part of residual lot

Note:

Land parcels shaded in blue are located within 'Area of Interest'.

TBA - To be announced.

Senversa Pty Ltd

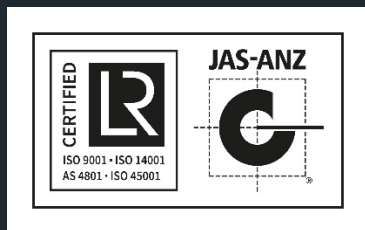
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