APPENDIX 12. PFAS EXPOSURE PATHWAYS REVIEW

Williamtown Sand Syndicate – Per- and Polyfluoroalkyl Substances Annual Risk Review

398 Cabbage Tree Road, Williamtown, New South Wales, 2318

20232071

27 January 2022

NCA23R2071

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27 January 2022
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Subject: Williamtown Sand Syndicate – Per- and Polyfluoroalkyl Substances Annual Risk Review
398 Cabbage Tree Road, Williamtown, New South Wales, 2318

Executive Summary

Kleinfelder Australia were engaged by Wedgetail Project Consulting, on behalf of the Williamtown Sand Syndicate (WSS) to undertake a review of the 2022 quarrying activities at Newcastle Sand and determine whether these activities have changed the potential for local residents to be exposed to per- and polyfluoroalkyl substances (PFAS). Regional PFAS contamination in the quarry area is related to contamination at and from the Department of Defence (DoD) Williamtown Royal Australian Air Force Base ("the Base"). PFAS has been identified in sediment, surface water, groundwater and biota (terrestrial and aquatic) within and surrounding the Base.

The Newcastle Sand quarry is located at 398 Cabbage Tree Road, Williamtown ("the Site") and is situated partially within the New South Wales Environment Protection Authority (EPA) defined Williamtown Management Area (WMA). The Site is located within the WMA broader management zone, defined as an area where PFAS could be identified at the current time and into the future. EPA precautionary advice to minimise PFAS exposure within the broader management zone includes avoiding the use of groundwater and surface water and consuming home-grown produce.

This report forms the requirement to Schedule 3 Condition 48 in the Development Consent SSD-6125 which requires an assessment of whether quarrying operations are increasing the risk of PFAS exposure for local residents and the environment.

Since 2007, the DoD have been investigating the PFAS presence in various media at and surrounding the Base. The investigations have included multiple rounds of soil, sediment, surface water and groundwater sampling within the EPA defined WMA. Off-Base PFAS surface water and groundwater, PFAS fate and transport models and human and ecological health risk assessments have also been conducted. The human health risk assessment identified four "risk zones", designated zones A through D and corresponding with a risk hierarchy such that Zone A is the highest risk and Zone D is the lowest. Part of the Site is situated within the low-risk zone C, with the north-western Site area located outside the defined risk zones. Zones C and D broadly correspond with the WMA broader management area.

The principal PFAS of concern with the Base and WMA is PFOS, which generally comprises >60% of the PFAS present.

A review of the available information, that includes the Site setting, PFAS sampling and analysis undertaken at the Site and those conducted by the DoD at the Base and surrounding area leads to the following conclusions:

- PFAS migration from primary or secondary Base sources is unlikely to reach the Site.
- PFAS are not present in Site soil.
- In surface water, PFAS was not present this monitoring period. Past detections were mainly at SW4 along the eastern most boundary.

- The PFAS in this area is likely sourced from an irrigation channel that is at or near the level of the major channel to the east.

- PFAS are generally not considered present in groundwater. While there were two sporadic 6:2 FTS occurrences, these are not considered to represent widespread contamination within the aquifer onsite.
- In 2022 PFAS in the wash plant water and wash plant fines were assessed:
  - Concentrations of PFAS (PFOA, PFOS and PFHxS) were reported at similar concentrations to previous years with concentrations below the site-specific trigger values.
  - PFAS concentrations (PFPeA, PFOS) were reported in wash plant fines (silt and organic material) in three of four samples. The reported concentrations are similar to previous results and do not exceed the screening criteria.
  - Based on the wash plant sample results, it is probable that a minor PFAS source is present in the wash plant or within the silt and organic material.
- The floor of the quarry is based on maintaining a 0.7m buffer above the maximum predicted ground water level. The ground water elevation (GWE) across the Site was considerably higher than historical levels due to the above average rainfall present for the majority of the year. Groundwater elevation exceeded the inferred maximum levels at five locations (BH1, BH1A, BH2, BH10 & BH11) during ten separately measured occasions this year.
- At the highest groundwater table levels, quarry floor levels always remained at worst, 166mm above the groundwater table and did not intercept groundwater. The nearest groundwater sampling point to the current quarry floor islocated at BH1/BH1A, adjacent to current quarrying activities in Sector 3. Given there was no interception of groundwater and groundwater is not contaminated, this is unlikely to have resulted in any increased risk to on-, or off-Site receptors.

The DoD-commissioned human health risk assessment (HRA) determined that the Site is within PFAS Risk Zone C for impacts originating from the Base. This quarry PFAS risk assessment review for 2022 compared the upper exposure scenario (i.e., highest concentration) for risk zone C detailed within the DOD HRA with potential exposures from the quarry and concludes:

- The only product produced onsite where repeatable PFAS detections have occurred and have a potential risk to nearby residents and ecological receptors is the wash plant fines (silt and organic material) where the stockpiled fines could be transported from the Site via dust dispersion. This is unlikely as:
  - Dust mitigation measures undertaken by Newcastle Sand are likely to reduce this risk, and the fines form an agglomerated matrix, more consolidated and bound than existing silts and clays onsite.
  - The PFAS concentrations are below the human and ecological health screening criteria and the risk is therefore low and acceptable.
  - Fines are approved for use within rehabilitation or to be blended for use as a landscaping product. With the repeated detections of PFAS, prior to offsite removal and sale of the material it will be necessary to assess concentrations within this material to ensure it is suitable and consistent with relevant criteria.
- Other quarrying operations will not increase the PFAS risk to residents because:
  - PFAS was not detected in any surface water samples in 2022.
  - PFAS reported at other Site monitored locations are sporadic and do not indicate PFAS contamination is present.
  - Quarrying operations could result in the establishment of a short-term groundwater mound, however, this is unlikely to change the current groundwater flow regime.
  - The Base PFAS groundwater plumes are not estimated to intersect the eastern Site boundary prior to 2050, with the predicted PFAS concentrations unlikely to exceed human health drinking water criteria until significantly after 2050, if at all.
  - Historical prevailing wind directions and dust mitigation measures undertaken by the quarry operator will not result in additional PFAS impacts to nearby residents.

1 INTRODUCTION & OBJECTIVES

Wedgetail Project Consulting commissioned Kleinfelder to undertake a review of Department of Defence (DoD) and the NSW EPA information regarding PFAS contamination that originated from the Williamtown Royal Australian Air Force (RAAF) Base ("the Base"). The Site is within the NSW EPA declared WMA.

The WMA was established by the NSW EPA following DoD commissioned testing of sediment, soil, groundwater, surface water and aquatic and terrestrial biota which identified a large area affected by PFAS contamination originally sourced from the Base (**Figure 1**). The EPA management area is comprised of three zones:

- Primary – high PFAS concentrations have been observed.
- Secondary – low PFAS concentrations have been identified.
- Broader – topography and hydrology are used to suggest that PFAS could be identified in the future.

The Site is within the broader management area where the Site's eastern boundary is 1.4 km from the Base's western boundary.

In accordance with Condition 48 of the quarry approval note an annual review of the current available PFAS information relating to PFAS exposure pathways for contamination originating from the Base is required to be conducted. The review is to assess if the quarrying activities have resulted in an increased PFAS exposure for local residents. Condition 48 states the following:

> *"In conjunction with preparation of each Annual Review, unless otherwise agreed with the Secretary, the Applicant shall engage a suitably qualified and experienced independent expert, approved by the Secretary, to review the currently available information on exposure pathways for PFAS contamination originating from the Williamtown RAAF Base, as may be applicable to local residents and the development. This report must assess whether or not quarrying operations are increasing the risk of PFAS exposure for local residents and/or the environment, to the satisfaction of the Secretary. The Applicant must ensure that the Review of PFAS Exposure Pathways reports are placed on its website and are available to the CCC and any interested person on request."*

2 OBJECTIVE

The objective of this review is to assess if the quarrying activities have resulted in an increased PFAS exposure for local residents.

3 SITE SETTING

The site is located approximately 1.4 km to the southwest of the Base's western boundary. The general land use in the vicinity of the Site is large-lot residential and farming. Residential properties are located to the Site's east, west and south with larger conservation reserves on the northern boundaries. The Tilligerry Habitat Reserve forms part of the western and northern Site boundaries.

The Williamtown area receives a mean annual rainfall of 1,127.6 mm, with the highest rainfall months typically between January and June, where the monthly mean rainfall typically exceeds 100 mm (Bureau of Meteorology weather station 061078). Mean monthly temperatures range between 17°C and 28°C, indicating the climate is warm temperate. The prevailing 9 AM wind directions at the Base are north-westerly (25%) and westerly (22%), i.e., away from the Site. Calm is the third most common observation (14%). Wind directions toward the Site are north-easterly (6%) and easterly (5%). Predominant 3 PM wind directions are south-easterly (24%) and southerly (16%). Afternoon wind directions toward the Site are easterly (14%) and north-easterly (8%).

Geologically the Site is located within the Tomago Sandbeds, a linear series of shallow sand dunes that cover approximately 200 km^2 between Newcastle and Lemon Tree Passage, that have a mean thickness of 20 metres[1]. The beds were deposited from the Hunter and Karuah rivers during a period of high sea level and overlie clay and rock. The aquifer is the Tomago Sandbeds, with the underlying clay and rock generally acting as a barrier to vertical groundwater migration. The DoD 2022 (www.defence.gov.au/environment/pfas/Williamtown/publications.asp) groundwater hydraulic gradients indicate

[1] Crosbie, R.S., 2003. Regional scaling of groundwater recharge. PhD Thesis, University of Newcastle.

a potential southerly groundwater flow direction and with a groundwater mound present to the south of the onsite stormwater retention basin known as Lake Cochran Lake Cochran (**Figure 1** and **Figure 2 below**).

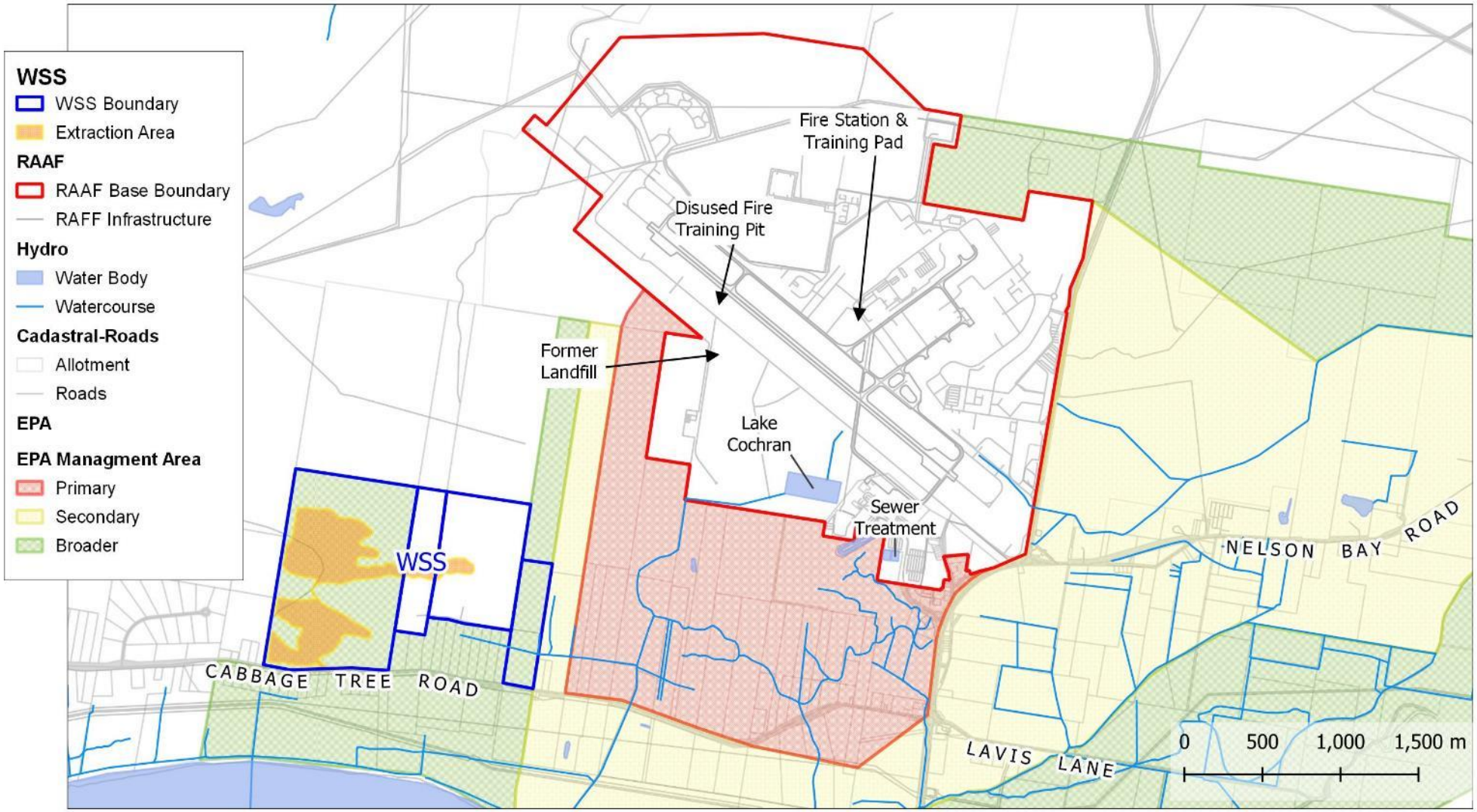

Figure 1. Site regional context.

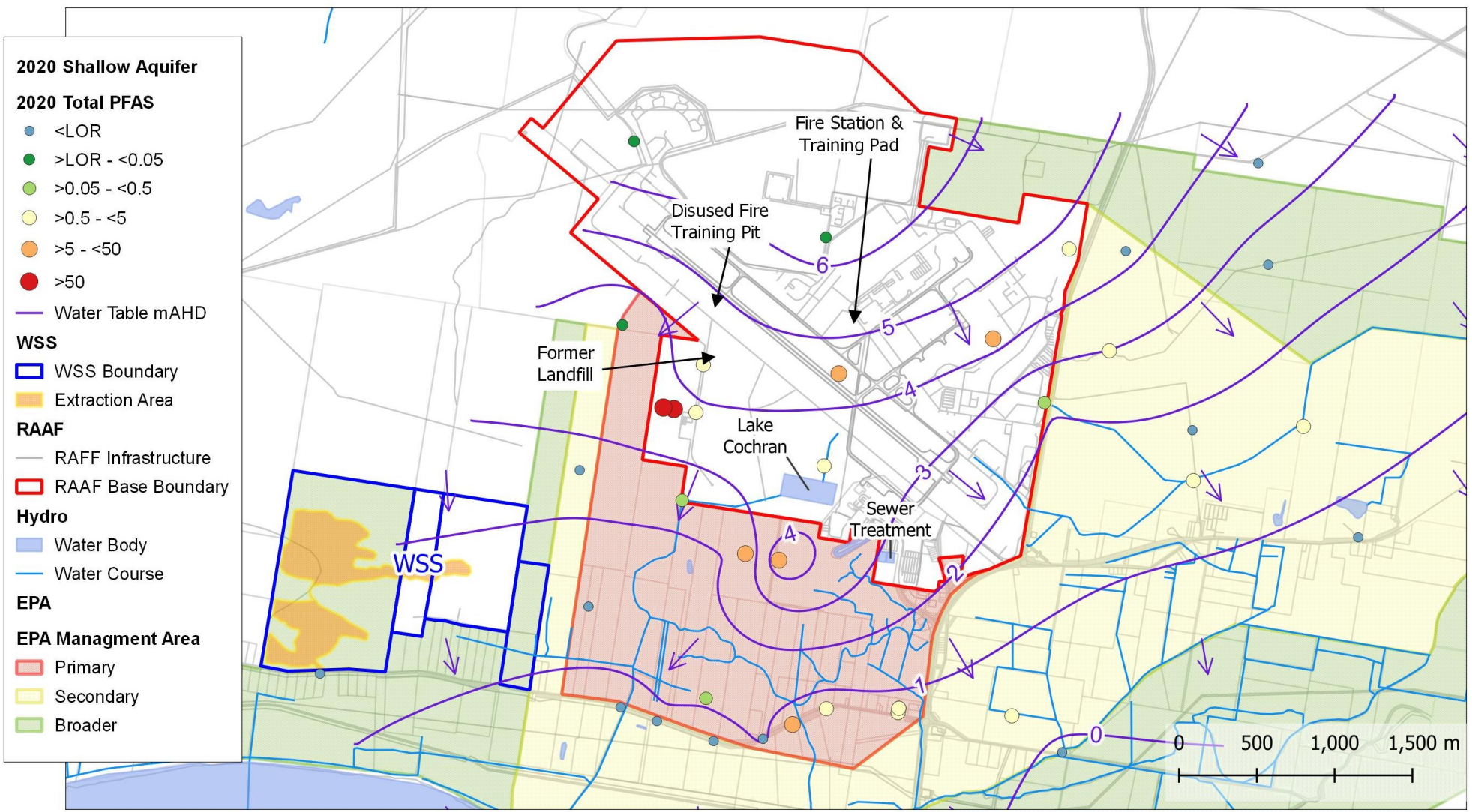

Figure 2. May 2020 shallow aquifer water table elevations, potential groundwater flow direction and total PFAS concentrations.

The Tomago Sandbeds aquifer form an important water resource in the area. The low salinity groundwater combined with relatively shallow water table depth (mean depth 1.5 m below ground level) have, historically resulted in the extensive use of the resource as a stock watering, irrigation and drinking water supply.

There is a well-developed man-made surface waterway network within the Williamtown area. Site surface water runoff may discharge to two unnamed surface water channels; one channel discharges directly to Fullerton Cove and the other joins Dawsons Drain, approximately 650 metres from the Site's eastern boundary. Within the Base Lake Cochran acts as a stormwater collection point which also discharges to the off-Base Dawsons Drain and ultimately Fullerton Cove to the South. An extract from the Soil and Water Management Plan (SWMP) has been included as **Figure 3** below and shows the current mapping of the drainage network.

4 2022 QUARRYING ACTIVITIES SUMMARY

The subject land where the quarry is located occupies four land titles and has an area of 175 hectares (ha), with the quarry disturbance area occupying approximately 43 ha. Approximately 3.25 megatonnes of sand is planned to be quarried from elevated areas over a period of up to 15 years. Sand will be excavated from an elevation of 24 mAHD to an elevation no less than 0.7 metres above the highest estimated water table elevation. The anticipated minimum excavation elevations are approximately 5.6 mAHD in the north and 3.8 mAHD in the south.

Groundwater is not being extracted by the Site operators for quarrying operations, which rely on water sourced from Hunter Water. WSS have commenced a comprehensive groundwater and surface water monitoring program to monitor water levels and quality from the Site and to ensure that sand is not extracted from an elevation less than 0.7 metres above the maximum estimated water table elevation.

Various works have occurred at the Site throughout 2022 (see **Figure 1**). Quarrying operations continued to be carried out within Sector 7B. Proceeded by vegetation clearing and quarrying operations conducted in Sector 3 moving west and north into Sectors 3A, 3B, 4 and 4A. A wash plant was constructed within the central area of Sector 1 in July 2021. A second sand wash plant is being constructed in Sector 3 and quarrying and vegetation clearing operations have begun moving North through Sector 4. Sectors are shown on **Figure 1** below.

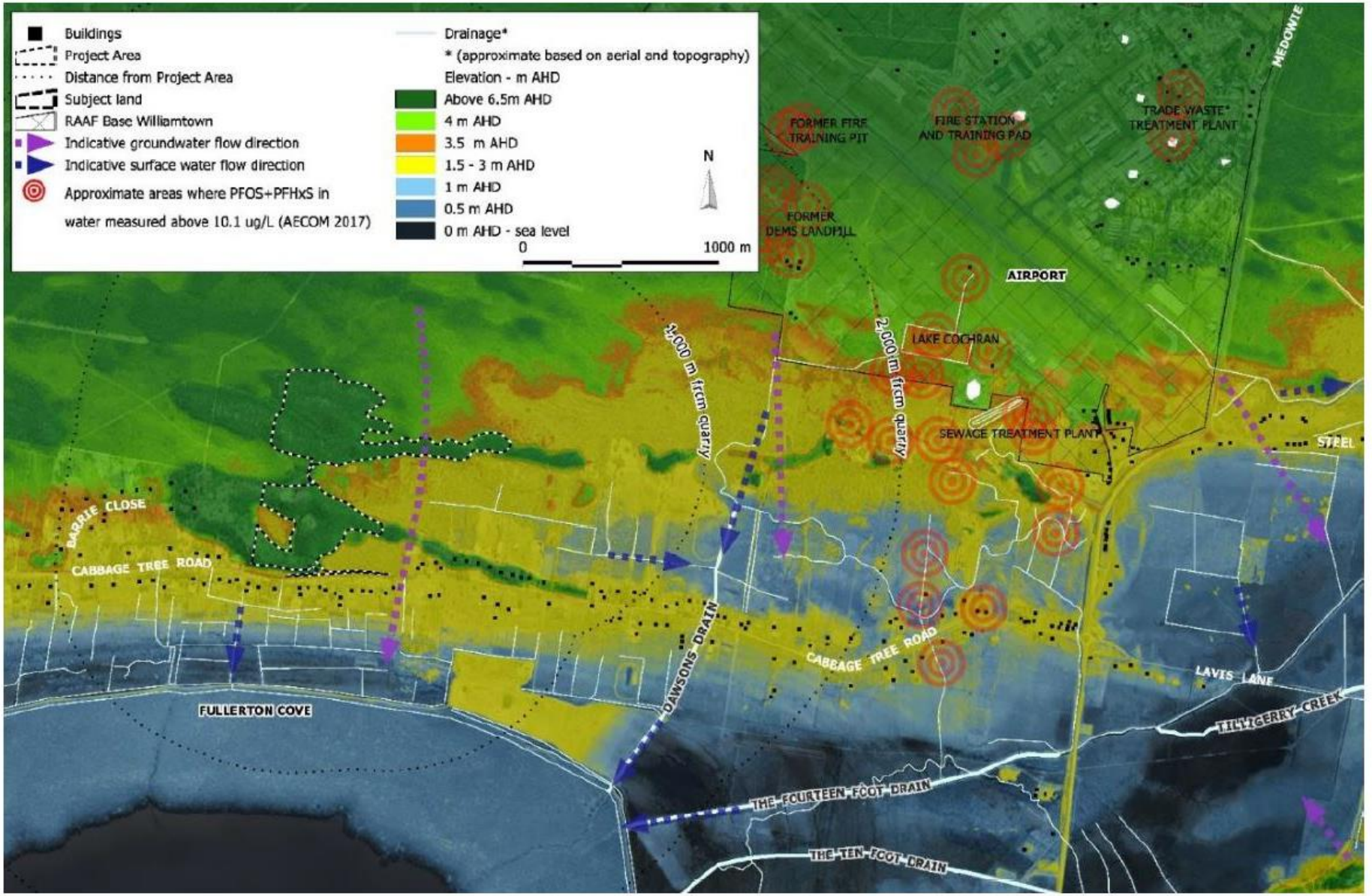

Figure 3. Elevation and drainage network of the project area and subject land in relation to surrounding lands.

5 SUMMARY OF PFAS INVESTIGATIONS IN THE WMA

PFAS contamination of surface water, groundwater, sediment and aquatic and terrestrial biota within and surrounding the Base has been reported by both the NSW EPA and DoD. A list of reports is available at www.defence.gov.au/environment/pfas/Williamtown/publications.asp.

The contamination is understood to have been the result of the use of aqueous film-forming foam used during firefighting and emergency response training. The known PFAS contamination sources at the Base are:

- Primary sources – Fire station, two landfills and a disused fire training pit.
- Secondary sources – Lake Cochran, the trade waste treatment plant (eastern Base area) and sewage treatment plant.
    - The trade waste treatment plant is not considered a possible source for PFAS contamination that may occur at the Site.

The surface soil samples collected outside the Base boundaries have been predominantly collected across the southern boundary, south of Lake Cochran and the sewerage treatment area. The PFOS + PFHxS concentrations, which generally make up approximately 90% of the total PFAS concentrations in the Williamtown Management Area, in the off-Base surface soil samples range between the laboratory limit of reporting (LOR), 0.2 and 375 micrograms per kilogram (µg/kg). Two soil samples were collected between the Site and the Base's western boundary. The PFOS + PFHxS concentrations in soil were 0.5 and 0.7 µg/kg, with the closest sample to the Site 350 metres northeast (1.3 km from the disused fire training pit (i.e., a primary PFAS source) and 1.1 km from a former landfill (i.e., a secondary PFAS source).

PFOS + PFHxS concentrations above the laboratory LOR (>0.2 to <10 µg/L) have been observed in all surface water samples collected from channels that receive discharge from the Base. Based on the local drainage network, surface water is not considered a likely pathway for PFAS from the Base to the Site under normal flow conditions. However, backwash flooding is considered likely during high rainfall events and could impact upon the Site.

On- and off-Base PFAS groundwater investigations have focused on the Tomago Sandbeds aquifer with shallow and deep groundwater samples collected and analysed. This review focusses on PFAS concentrations in the shallow aquifer.

The 2020 groundwater Base PFAS monitoring results are summarised in **Figure 2** (above). PFOS + PFHxS concentrations above the laboratory LOR were observed to the south of Lake Cochran, beneath the disused fire training burn-pit, former landfill and current fire station and training pad. From the data reviewed it is evident that there is a groundwater mound to the south of Lake Cochran, suggesting the lake is providing groundwater recharge and is consistent with high PFOS + PFHxS concentrations observed down-gradient from the Lake.

The Site is not directly down-hydraulic gradient from any known primary or secondary Base PFAS source, as shown on **Figure 2**.

With regards to the Base groundwater fate and transport model, four "unidentified" PFAS sources (surface water, soil and or groundwater) located to the Site's south were identified. It is possible that one of these sources, located near the Cabbage Tree Road Dawsons Drain bridge, is associated with the Lake Cochran discharge. The other three low PFAS concentration occurrences are located to the Base's south and cannot be directly linked to the source at the Base. The three locations are:

- One Base groundwater monitoring well and three residential monitoring wells located on Cabbage Tree Road, directly south of the Site.
- Groundwater from a residential well located 550 metres to the Site's south.
- Groundwater from a residential well located to the south of lot DP629503. It is noted PFAS were not present above the laboratory LOR in a 2019 groundwater sample from MW139 located approximately 75 metres up-hydraulic gradient from the residential well.

The PFAS groundwater fate and transport model estimated:

- The Base PFAS groundwater plume areas may expand through PFAS dispersion and diffusion.
- That by 2050:

- The disused fire training pit and former landfill plumes may merge, although it is noted that the merged plume is unlikely to intersect the Site's eastern boundary.
- The Lake Cochran PFAS plume should not intersect the Site's eastern boundary.

- The probable Lake Cochran sourced off-Base groundwater "unidentified" PFAS occurrence is beneath the Site's DP814078 parcel (eastern Site area) and has total PFAS concentrations between 0.01 and 0.07 µg/L.

6 SITE PFAS REVIEW

PFAS investigations commissioned by WSS at the Site have involved submission of soil, surface water and groundwater samples to a laboratory that has National Association of Testing Authorities (NATA) accreditation to determine PFAS concentrations in the submitted media. All laboratory results discussed in this report have been compared to the site-specific trigger values established in the Soil and Water Management Plan (SWMP, 2021). A QAQC schedule was also conducted as per NEPM guidelines for PFAS, where one duplicate and triplicate sample was taken for every ten primary samples.

Surface and groundwater sampling locations are shown onError! Reference source not found. Error! Reference source not found. below.

6.1 Soil

Sixteen soil samples collected from ten bore holes between 7th and 17th December 2016 were submitted for PFAS analysis. The samples were all collected from elevated Site areas where sand quarrying is proposed to be undertaken. All samples, including two samples collected within the eastern Site area, i.e., closest to the Base were reported to have total PFAS concentrations below the laboratory LOR.

6.2 Surface Water

Surface water is monitored at four Site locations. Sixteen surface water samples collected from the four locations (SW01, SW02, SW03 & SW04) between January and December 2022 were submitted for PFAS analysis. During the 2022 monitoring period there was no reported results of PFAS compounds detected above the laboratory LOR in any surface water samples.

6.3 Groundwater

Groundwater samples were collected using high-density polyethylene (HDPE) HydraSleeves, with the samples transferred directly into laboratory supplied PFAS specific sample containers. The method is considered suitable for the collection of water samples as outlined in Approved methods for the sampling and analysis of water pollutants in NSW (EPA 2022).

Fourteen groundwater monitoring wells have been installed and either gauged or sampled at the Site (BH1 to BH12A). BH1 and BH12 were decommissioned in June and July of 2022, being replaced with BH1A and BH12A respectively in August 2022. Baseline results and inferred ground water elevation for these locations were taken from their respective predecessor wells until a baseline can be set. Furthermore, gauging of BH1A and BH12A was carried out for the remaining monitoring events after installation but no groundwater sampling will occur until the next annual monitoring round (February 2023).

MW239S, located within the DP629503 land parcel, was installed during the DoD investigations. Groundwater from the well was reported to have 0.03 µg/L PFOS in March 2017, however, during WSS monitoring (sampled once in 2019, five times in 2020, 11 times in 2021 and 4 times in 2022) PFAS were below the laboratory LOR.

During the 2022 monitoring period, PFAS was sampled quarterly, with samples taken in February, May, August and November at all available wells as outlined in **Table 1**.

Table 1: Monitoring Well locations Sampled for PFAS (2022)

Monitoring Well ID	February	May	August	November
BH1	✓			
BH2	✓	✓	✓	✓
BH4	✓	✓	✓	✓

Monitoring Well ID	February	May	August	November
BH5	✓			
BH6	✓	✓	✓	✓
BH7	✓	✓	✓	✓
BH8	✓	✓	✓	✓
BH9A	✓	✓	✓	✓
BH11	✓	✓		✓
BH12	✓			
MW239S	✓	✓	✓	✓

Water Table Elevation

During the 2022 monitoring period, groundwater elevation increased to a maximum measured level in July and was higher than historically recorded elevations measured on the Site. There was an average increase of 0.6 m in groundwater elevation recorded when compared to the previous July 2021 levels. The water table elevation contours indicate a southeasterly groundwater flow direction, consistent with the 2019 and 2020 contours (Error! Reference source not found.).

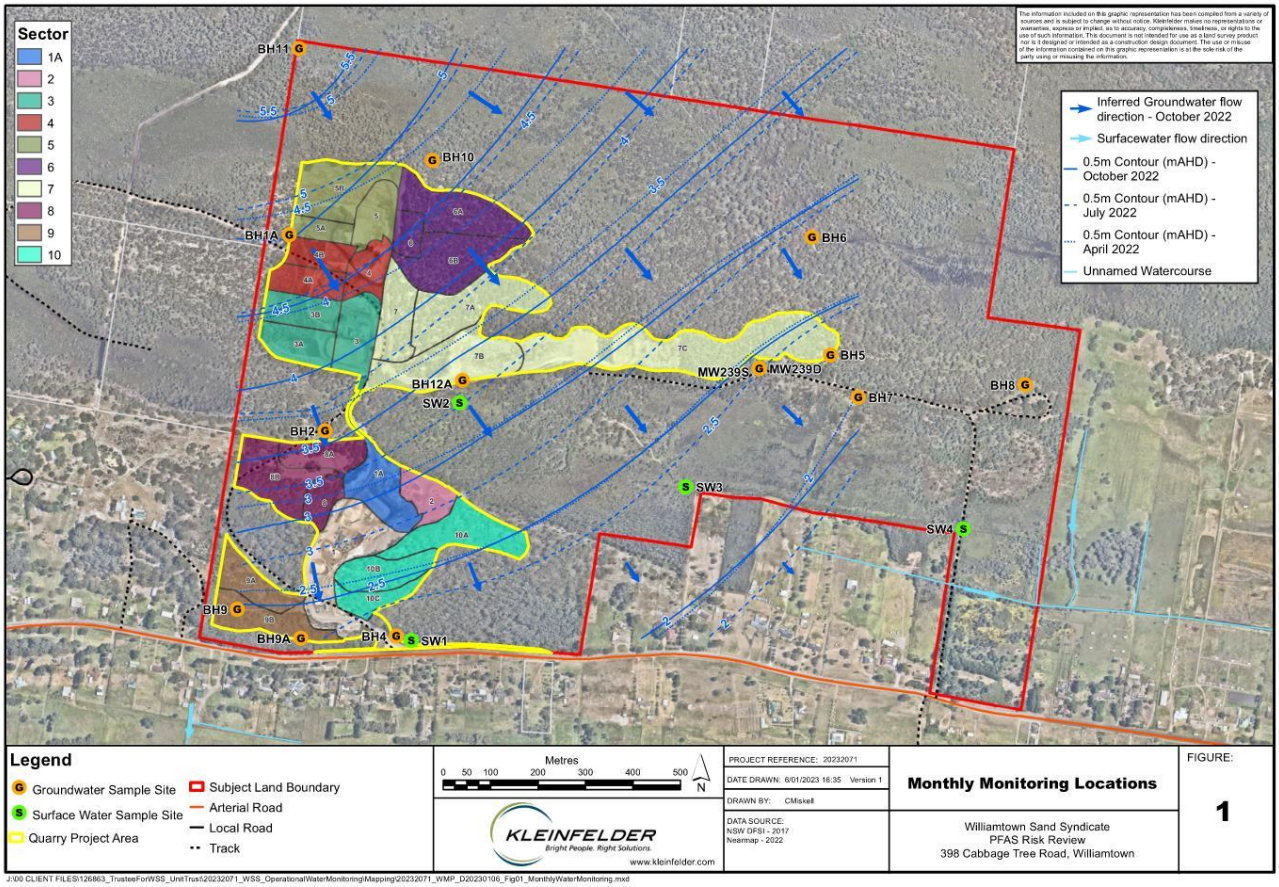

Figure 4: Inferred Groundwater flow direction through the Site during April, July and October 2022

The floor of the quarry is based on maintaining a 0.7m buffer above the maximum predicted ground water level. There were thirty-two (32) instances of Trigger Action and Response Plan (TARP) trigger level exceedances during 2022, all occurring from March to December. This was following a rainfall total of 354mm in March 2022 and above average rainfall for much of the remainder of the year, recorded at the Williamtown RAAF weather station (# 61078). **Table 2** presents all TARP exceedances for 2022.

Table 2: Groundwater Elevation (GWE) TARP exceedances

Location	TARP Level 1		TARP Level 2		TARP Level 3		Total Months Triggered
	Month	Depth below Max inferred GWE	Month	Depth below Max inferred GWE	Month	Distance above Max inferred GWE	
BH1 & BH1A	May & June	0.311 m and 0.429 m	-	-	July, September, October, November and December	0.304 m, 0.53 m, 0.534 m, 0.31m and 0.013 m	6
BH2	March, April, May, June and November	0.433 m, 0.385 m, 0.265 m, 0.428 m and 0.39 m	August, September, October	0.065 m, 0.129 m and 0.192 m	July	0.097 m	9
BH9	July and August	0.291 m and 0.4 m	-	-	-	-	2
BH9A	July	0.452 m	-	-	-	-	1
BH10	June and November	0.474 m and 0.3 m	May	0.24 m	August	0.091 m	4
BH11	March and December	0.39 m and 0.326 m	April, May, June, November	0.152 m, 0.075 m, 0.233 m and 0.05 m	July, September, October	0.337 m, 0.283 m and 0.26 m	8

Max inferred – the maximum inferred groundwater elevation based on historical ground water elevation data.

- It should be noted, quarry floor levels remained at least 0.166m above the groundwater table at all times and did not intercept groundwater. The nearest current quarry floor is located adjacent to BH1/BH1A. Given there was no interception of groundwater and groundwater is not contaminated, this resulted in no increased risk to on, or off-Site receptors.

In the long-term, groundwater rainfall recharge within the sands is likely to be relatively rapid. The removal of sand above the Site aquifer may result in short-term groundwater mounding, due to increased infiltration and lower evapotranspiration with the mound dissipating due to the high effective porosity of the sands. If a groundwater mound does form beneath the quarried areas, it would be unlikely to significantly change the groundwater flow direction and is more likely to result in producing a steeper off-Site hydraulic gradient. The likelihood that the quarrying would lead to increased groundwater flow from the Base to the Site area is very low.

Rainfall

Rainfall data was obtained from the Bureau of Meteorology (BOM) website for the Williamtown RAAF Base (Station Number 061078), approximately 4km from Site. Higher rainfall totals were recorded in 2022 (1472 mm) than the annual mean total (1127.6 mm). The majority of this rainfall occurred within the first five months of the year with the February-May consecutive period all recording above average rainfall, 292 mm greater than usually experienced this time of year.

This increased rainfall and the further above average rainfall recorded during July (327.4 mm), August (74.4 mm) and October (90.8 mm) raised the ground water elevations across the site from the previous years' already heightened results. It is possible that due to the above average rainfall there was an excess of surface and

groundwater flowing in a south easterly direction through the site that provided a buffer to PFAS compounds from the east of the site.

PFAS

During the baseline 2016 and 2017monitoring period, seven groundwater samples were analysed for PFAS with all concentrations reported below the laboratory LOR.

From the 2019 WSS monitoring, a PFDS equal to the LOR (0.02 µg/L) was reported for BH4 groundwater, however, the concentration was below the laboratory LOR in follow-up samples.

Between January and December 2020, groundwater samples from ten monitoring wells (total = 68 samples) were submitted to the laboratory for PFAS concentration determination. One groundwater sample from BH9 (August) was reported to have a total PFAS concentration of 0.14 µg/L, with all other samples below the laboratory LOR. The PFAS above the LOR was 6:2 FTS.

6:2 FTS is rarely above the laboratory LOR for the samples collected during the Base water monitoring program (37 out of 176 groundwater samples had low 6:2 FTS concentrations (<0.34 µg/L) and four out of 27 surface water samples had low 6:2 FTS concentrations (<0.35 µg/L)) during the 2020 DoD monitoring.

In 2021, 87 Site groundwater samples were submitted to the laboratory for PFAS analysis, with one sample (BH4) reported to have PFAS above the LOR; 0.15 µg/L 6:2 FTS in the November 2021 groundwater monitoring event.

During the 2022 monitoring program a total of 34 Site groundwater samples were submitted to the laboratory for PFAS analysis. With two samples both taken on the 24 of February from BH4 and BH12 reporting 6:2 FTS concentrations marginally above the laboratory LOR (0.05 µg/L) with 0.06 µg/L and 0.07 µg/L respectively.

Groundwater Summary

In summary:

- The increase in water table elevation is a consequence of the above average rainfall for most months after February 2022
- 2022 water table elevations are higher than in previous years. In particular, there was 32 instances where TARP Trigger Levels were exceeded with ten (10) of these being Level 3 exceedances above predicted maximums at BH1/BH1A, BH2, BH10 and BH11
- The potential groundwater flow direction is consistent with the observed 2020 and 2021 directions.
- A low 6:2 FTS concentration was reported in groundwater samples from BH4 and BH12 in February. Low 6:2 FTS concentrations have previously been reported in groundwater samples from BH4 (0.15 µg/L November 2021) BH6 (0.19 µg/L, December 2019) BH9 (0.14 µg/L, August 2020). 6:2 FTS is not a COPC at the Base and is therefore unlikely to represent PFAS migration from the Base.

6.4 Wash Plant Samples

With the approval of a Wash Plant addition to the quarry, a condition of the approval included monitoring for PFAS within the wash plant water and sediment. To provide a greater understanding of PFAS distribution at the Site, the wash plant water (WPW) and wash plant sediment fines (WPF) were submitted to the laboratory for PFAS analysis on a quarterly basis. The laboratory results are summarised below:

- Wash plant water output - samples were collected monthly from January to December:
  - PFOA concentrations in samples collected in November and December recorded 0.01 µg/L (laboratory LOR = 0.01 µg/L). The concentrations are below the adopted criteria (0.07 µg/L).
  - PFHxS concentrations in samples collected in February, June, October, November and December were 0.01 µg/L, 0.01 µg/L, 0.01 µg/L, 0.02 µg/L and 0.01 µg/L respectively (laboratory LOR = 0.01 µg/L)
  - PFOS concentrations in samples collected in January, July, October, November and December were 0.03 µg/L, 0.02 µg/L, 0.02 µg/L, 0.02 µg/L and 0.02 µg/L respectively (laboratory LOR = 0.01 µg/L)
- Four wash plant fines samples (comprising silt and organic particles) were collected from the plant between February and November 2022.
  - PFPeA concentration in a sample collected in February was 0.0002 mg/kg (laboratory LOR = 0.0002 mg/kg)

- PFOS detected in three samples February, May and August 0.001 mg/kg, 0.0012 mg/kg and 0.0006 mg/kg respectively, remaining below the site-specific trigger values.
- All PFAS compounds were below the LOR in November 2022.

Based on the wash plant waste (fines) sample results, a minor PFAS source within the wash plant could be considered. However, it is also likely that low PFAS concentrations within wash plant inputs are concentrated on the silt and organic material.

7 DOD HUMAN HEALTH RISK ASSESSMENT REVIEW

In 2016 the DoD engaged AECOM to undertake an off-Base human health risk assessment (HHRA). The off-Base HHRA was updated in 2017. A summary of the findings of the updated HHRA and relevance to the Site area are provided below.

The HHRA evaluated the potential health risks in the Williamtown area to residents (including recreational and commercial fishers and beef farmers) and non-residents (commercial fishers, council workers and visitors) from exposure to PFAS under both typical and upper exposure scenarios. The exposure scenarios are:

- Typical exposure scenario:
  - Representative of PFAS concentrations that a general or average receptor is likely to be exposed. This is applicable to the majority of the population.
- Upper exposure scenario:
  - Calculated based on the PFAS concentration upper 95th percentile in the relevant media and is applicable for receptors that may be in close proximity to media with elevated PFAS concentrations within a localised area, such as a residential groundwater well.
  - The upper exposure scenario is considered suitable for quarry workers who would have a generally high risk though ingestion (incidental and via inhalation) and residents near the quarry.

Based on the Stage 2B investigation outcomes the HHRA divided the off-Base areas into zones based on the potential risk that PFAS posed. The Site's local area was designated Risk Zone C (low risk), with the risk zone encompassing the entire eastern Site area and the southern proposed extraction area. For reference the northern extraction area is not within an identified risk zone.

The HHRA determined risks for Risk Zone C upper exposure scenarios (pathways) are:

- Ingestion and contact with groundwater – acceptable.
- Dermal contact with soil and Ingestion of soil and dust – acceptable.
- Consumption of homegrown eggs – **elevated**.
- Consumption of locally grown fruit and vegetables – acceptable.
- Incidental ingestion of surface water – **elevated**.
- Surface water contact – acceptable.
- Incidental ingestion and contact with sediment – acceptable.
- Consumption of beef and milk – **elevated**.

7.1 Relevance of Potential On- and Off-Site Exposures

The HHRA determined potential exposure pathways listed above are considered suitable for off-Site residents and on-Site quarry personnel. For nearby residents and quarry personnel, the comparison of the HHRA upper exposure scenario is considered conservative:

- For dust inhalation/soil ingestion because:
  - PFAS have not been reported above the laboratory limit of reporting in soil samples.
  - Dust mitigation measures are required during quarrying activities.
- For groundwater exposure because:
  - The quarry base will not extend to a depth closer than 0.7 metres to the highest estimated water table elevation, hence groundwater management will not be required and groundwater discharge to surface water as a result of quarrying activities will not occur.

- PFAS have essentially not been identified above the laboratory LOR in Site groundwater, hence PFAS present in groundwater from nearby residential wells is unlikely to have been sourced from the Site and may be diluted by Site derived groundwater.
- The designation of Risk Zone C in the Site area was partially based on a very low PFOS concentration from one well, a concentration that was not subsequently repeated.
- Groundwater migration from the Base is unlikely to reach the eastern property before 2050, by which time quarrying operations will have ceased and any complete PFAS migration pathways will be unlikely.

- While SW1 and SW4 are both down gradient of the Site and PFAS was reported above the LOR, the hydraulic connection via surface water is limited due to high infiltration.

Based on the above, the potential for increased PFAS exposure to residents resulting from quarrying activities is considered unlikely.

8 CONCLUSIONS

A review of the currently available information regarding the PFAS contamination originating from the Base and assessed Site derived soil, groundwater and surface water data was undertaken to determine whether quarrying operations will increase the PFAS exposure to nearby residents.

During 2022, sand quarrying activities were ongoing at the Site and expanded into the northern Site area. Construction of a new sand wash plant in this northern section begun in December 2022.

Considering the information reviewed, the following is concluded:

- Base-sourced PFAS is and has historically been unlikely to be transported to the Site via wind, surface water or groundwater – the Site does not appear to have received PFAS from the Base and does not appear to be acting as a local tertiary PFAS source.
- PFAS was not detected in surface waters during 2022.
- The higher-than-average rainfall measured during 2022 had great impact upon ground water elevations during this year, and a probable positive impact on surface water PFAS concentrations buffering outside movements of contaminates onto the site
- The water table exceeded the maximum inferred water level at five locations ten separate times this year. With 32 total occasions of TARP level exceedances. However, the groundwater level remained at least 0.166 m below the base of quarry operations meaning that any potentially contaminated groundwater did not breach the surface.
    - The regular PFAS detections within the wash plant fines requires further investigation to determine source and suitability of material if used or offsite (including the PFAS TCLP requirements).

9 RECOMMENDATIONS

Development of a numerical groundwater flow model that allows for the effects of increased infiltration in the sand extraction areas to be quantitatively assessed should be considered.

The PFAS detections within the wash plant fines requires further investigation of the source of the PFAS and to determine the suitability of material for reuse onsite or offsite (including the PFAS leach testing).

If you require additional information or clarification, please contact the undersigned at +61 (0) 457 426 013. This report should be read in conjunction with the Kleinfelder Statement of Limitations (attached).

Sincerely,

Elaine Spence

Kleinfelder Australia Pty Ltd

Principal Environmental Scientist

Contaminated Land Management

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The findings and conclusions contained within this report are relevant to the conditions of the site and the state of legislation currently enacted in the relevant jurisdiction in which the site is located as at the date of this report.

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