



**ENVIRONMENTAL EARTH
SCIENCES**

CONTAMINATION RESOLVED

**AUDITOR CERTIFICATION
REPORT & STATEMENT OF
REASONS: HOME HILL FIRE
STATION, 83 TENTH AVENUE,
HOME HILL, QLD
QUEENSLAND FIRE AND EMERGENCY
SERVICES**

9 MARCH 2020

719052_HOME HILL

VERSION 1

9 March 2020

Queensland Fire and Emergency Services

24 Corporate Drive
Cannon Hill QLD 4170

Attention: **Dr Raymond Bott**
Inspector

Dear Ray

**Auditor Certification and Statement of Reasons: Detailed Site Investigation (DSI) of
Home Hill Fire Station, 83 Tenth Avenue, Home Hill, Queensland**

Please find enclosed a copy of my report entitled as above. Thank you for the opportunity to undertake this work.

Following evaluation of the site investigation report (SIR) in relation to relevant guidelines, policy and legislation, the Contaminated Land Auditor (CLA) has concluded that the SIR meets the objectives of the project, in that the DSI and SIR:

- was undertaken in accordance with current best-practice methodologies, cognisant of and in accordance with applicable guidance and legislation;
- fulfils the objectives of the project with regards to the characterisation of per and poly fluoroalkyl substances (PFAS) impact (concentration and distribution) on and at the boundaries of the subject site; and
- complies with the relevant elements of the *Environmental Protection (EP) Act.1994* (Chapter 7, Part 8, Subsections 389 (1) and (2)).

Based on the above determination, the CLA agrees with the conclusions of the SIR that the site does not currently pose an unacceptable, human health risk but that further (off-site) investigation is warranted to quantify potential impacts to off-site receptors (human and ecological).

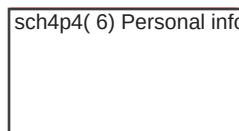
If you have any queries concerning this report, contact the undersigned on (07) 3852 6666.

For and on behalf of
Environmental Earth Sciences QLD



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719052_QFES_HH AuditorCert_V1

EXECUTIVE SUMMARY

Environmental Earth Sciences QLD was commissioned by Queensland Fire and Emergency Services (QFES) to undertake the contaminated land auditor (CLA) role for a per and poly fluoroalkyl substances (PFAS) assessment of the Home Hill Fire Station (83 Tenth Avenue, Home Hill, QLD “the site”), legally described as Lot 6, H616666 and Lot 8, SP123356. The CLA function was necessary due to QFES’s requirement that a third party review all investigation activities and reporting outcomes for the site to ensure compliance with relevant requirements of Chapter 7, Part 8, Subsections 389 (1) and (2) of the *Environmental Protection (EP) Act 1994*.

The following site investigation report (SIR) was provided by AECOM as a Contaminated Land Investigation Document (CLID) and is the subject of this Auditor Certification Report:

- AECOM (2019b). PFAS Detailed Site Investigation Home Hill Fire Station, 83 Tenth Avenue, Home Hill, Queensland. Prepared for Queensland Fire and Emergency Services. Ref: 60609758 Revision 0 (Final). Dated 10 February 2020.

Following evaluation of the SIR in relation to relevant guidelines, policy and legislation (in particular NEPC 2013, HEPA 2018, DES 2018 and the *EP Act 1994*), the CLA has concluded that the SIR meets the objectives of the project, in that the DSI and SIR (CLID):

- was undertaken in accordance with current best-practice methodologies, cognisant of and in accordance with applicable guidance and legislation;
- fulfils the objectives of the project with regards to the characterisation of PFAS impact (concentration and distribution) on and at the boundaries of the subject site; and
- complies with the relevant elements of the *EP Act. 1994* (Subsections 389 (1) and (2)).

Based on the above determination, the CLA agrees with the conclusions of the CLID that the site does not currently pose an unacceptable, direct-contact human health risk in the context of on-going commercial/ industrial land use. However, based on the identification of elevated contaminant concentrations (sum of PFOS & PFHxS) greater than human health and ecological assessment criteria in all four on-site groundwater monitoring bores, further (off-site) investigation is warranted.

The off-site investigation should seek to confirm (or otherwise) to what extent impacted groundwater (and potentially surface water) has migrated beyond the site boundary and if so, whether contaminants have migrated off-site at concentrations likely to pose an unacceptable human and/ or ecological health risk to sensitive receptors located down-gradient of the site.

The above notwithstanding, the CLA does not consider that PFAS concentrations within the site boundary pose an unacceptable risk to human and/ or ecological site users and thus does not preclude on-going use of the site for commercial/ industrial purposes. Rather, additional off-site investigation should be undertaken to determine if notification, remediation and/ or management actions should be implemented to comply with legislation and mitigate risks to any identified off-site receptors along a complete exposure pathway.

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1 INTRODUCTION

Environmental Earth Sciences QLD was commissioned by Queensland Fire and Emergency Services (QFES) to undertake the contaminated land auditor (CLA) function in relation to the per and poly fluoroalkyl substances (PFAS) assessment project at the Home Hill Fire Station (83 Tenth Avenue, Home Hill, QLD “the site”), legally described as Lot 6, H616666 and Lot 8, SP123356. The CLA function was necessary due to QFES’s requirement that a third party CLA review all investigation activities and reporting outcomes for the site to ensure compliance with relevant elements of Chapter 7, Part 8, Subsections 389 (1) and (2) of the *Environmental Protection (EP) Act 1994*.

The following report was provided by AECOM and is the subject of this Auditor Certification Report:

- AECOM (2019b). PFAS Detailed Site Investigation Home Hill Fire Station, 83 Tenth Street, Home Hill, Queensland. Prepared for Queensland Fire and Emergency Services. Ref: 60609758 Revision 0 (Final). Dated 10 February 2020.

2 OBJECTIVES

The objectives of the CLA works were to:

- evaluate the efficacy of the detailed site investigation (DSI) and the accompanying site investigation report (SIR) in achieving the objective of characterising PFAS impacts (concentration and distribution) within and adjacent to the boundaries of the site;
- confirm that works were undertaken in accordance with best practice and all relevant national and state legislation/guidelines; and
- certify (or, where justified, propose amendments to ensure) that the SIR report fulfils the Department of Environment and Science (DES) requirements for a SIR that is a contaminated land investigation document (CLID)¹.

3 SCOPE OF WORK

The following scope of works was undertaken to meet the objectives:

- communication with the suitably qualified person (SQP) (James Peachy of AECOM) and review of documents regarding the sampling and analysis methodology;

¹ As far as practicable, noting that the investigation has been undertaken specifically to target PFAS only.

- a site visit immediately following the soil sampling/groundwater bore installation program (on 1 August 2019);
- review of the CLID, including revisions following the initial review; and
- provision of this report and appended auditor certification and declaration.

4 SITE IDENTIFICATION AND SETTING

4.1 Location and property description

The regional locality of the site is provided on **Figure 1** and site identification details provided in **Table 1**. The subject property lot and site layout are provided on **Figures 1 and 2**.

Table 1: Site details

Item	Details
Site address	83 Tenth Avenue, Home Hill, QLD 4806
Registered site owner	The State of Queensland
Registered address of site owner	Public Safety Business Agency, L13 Makerston House, 30 Makerston Street, Brisbane, QLD 4000
Site occupier	Queensland Fire and Emergency Services (QFES)
Local government area	Burdekin Shire Council
Zoning/ future zoning	Public Purposes
Lot and plan	Lot 6, H616666 and Lot 8, SP123356 It is understood the site is shared with the Queensland Ambulance Service (QAS)
Tenure	Freehold
Latitude/longitude	-19.66099, 147.41598
Site area	1,811 m ²
Current/future use	Ongoing fire station use (commercial/ industrial)
Environmental Management Register (EMR)/Contaminated Land Register (CLR)	Not listed on the EMR or CLR





4.2 Site description and surrounds

4.2.1 Site

At the time of the audit, the site was an operational fire station, comprising several buildings relating to the various administration, operational and training activities required to discharge this role. It is understood the site is not a permanently staffed fire station and is manned by approximately eight auxiliary firefighters. The site is also shared with the Queensland Ambulance Service (QAS) who use a storage shed at the north-eastern end of the site (see **Figure 2**), and share the office/ administration facilities of the current fire station building.

Key site features included:

- An old fire station building (eastern end of the site) disused since pre-2002;
- A storage shed, currently used by QAS;
- The current, operational combined fire station and ambulance centre located at the south-western end of the site which comprised the main engine bay as well as a number of interconnected rooms including office/ administration and ablution facilities;
- A decommissioned² concrete in-ground water tank (Case 4 pit) with dimensions of approximately 0.9 metres (m) x 2.4 m (deep) and a former holding capacity of 1,530 L; and
- A hardstand storage area along the southern boundary of the site used for wrecked cars.

It was noted approximately 60% of the site is vegetated (grass-cover) with the remainder of the site sealed with concrete. Access to the site is via hardstand driveways from the north-east (Eleventh Avenue) and south-west (Tenth Avenue).

Further to the above it is noted that State Emergency Service (SES) buildings and associated storage sheds (constructed between 1970 and 1975) are located to the south of the site on Lot 7 H616103, within the current cadastral boundary, but beyond the current site boundary.

4.2.2 Surrounds

Surrounding land uses include:

- **Northeast:** Eleventh Avenue is located adjacent to the site, to the north-east, with residential properties located beyond at a range of approximately 20-30 metres;
- **Southeast:** An SES building and storage shed are located adjacent to the site, to the south. Various buildings associated with the Home Hill Health Centre are located at a range of between 10 and 90 m of the southern site boundary and the closest residential

² Note: The Case 4 pit was not in use at the time of inspection, having been decommissioned via sand infill and concrete capping.

property is located approximately 50 m to the south. Additional residential properties are located beyond Eighth Street, approximately 180 m south of the site boundary.

- **Southwest:** Tenth Avenue bounds the site to the south-west, with open, grassed parkland and the Home Hill bowls club beyond; the clubhouse building is located at a distance of approximately 110 m south-west of the site. Residential houses and commercial/industrial properties are located further south west, beyond Ninth Avenue
- **Northwest:** Tenth Street with residential housing beyond at a range of approximately 20 m. A service station, located at Michelle's Caravan Park, is located approximately 400 m to the north-west.

Review of the available environmentally sensitive area (ESA) mapping indicates that the site is located within a Category C, River Improvement Area. In addition:

- Wetlands at Burdekin River (approximately 2.7 km to the north/ north-west are classified as "moderate potential aquatic and terrestrial GDEs" (BOM, 2020) and "Category B: Endangered Regional Ecosystems (Biodiversity status)" (DES 2020³);

No subterranean ecosystems were recorded at or in the vicinity of the site.

No further ESAs were reported within 4 km of the site.

See **Figure 1** for these features.

5 SUMMARY OF SITE HISTORY

The site history review detailed by AECOM (AECOM, 2019a) included a review of client-supplied, publicly available and third-party information from the following sources:

- Historical air photographs obtained from the Queensland Governments online mapping portal (QImagery online) from 1958, 1959, 1964, 1969, 1979, 1989, 1994, 2003 and 2005.
- Historical land title details from the Department of Natural Resources, Mines and Energy (DNRME).
- Search of DES's Environmental Management Register (EMR) and Contaminated Land Register (CLR); and
- Review of previous environmental reports/ sampling activities undertaken at the site (namely, QFES 2016 water sampling); and
- Interviews with nominated QFES personnel and site inspection (13 February 2019).

³ <https://environment.des.qld.gov.au/management/maps-of-environmentally-sensitive-areas/> nocache

The purpose of the review was to identify potential historic sources of PFAS at and in the vicinity of the site in order to facilitate the development of a robust, PFAS-specific investigation strategy.

The results of the historic data review determined that the site has been used as a fire station for approximately 52 years (since 1968) when the original “old fire station building” was constructed. It is understood the SES building, to the south, was constructed between 1970 and 1975 and the new fire station building, at the south-east end of the site, was built in 2002.

Accordingly, a number of PFAS sources were identified at the site (primarily via information obtained during site interviews), associated with past fire-fighting activities, foam usage (training exercises) and storage practices, specifically:

- Training use/ application of firefighting aqueous film forming foam (AFFF) containing PFAS (3M Lightwater) between circa 1968 and 2003 to sealed/ unsealed areas during training exercises.
 - This may also include overspray and/or surface run-off toward then, unsealed areas of the site/ perimeter drainage; and
- Storage/ transfer of 3M Lightwater (to/ from 20L drums) within the existing fire station building and in training areas at the site.

In addition, although not part of the current investigation, it is recognised that the SES building/ shed to the south-east of the site, may also have been used for the storage of AFFF in the past. No information was available pertaining to the potential historical storage and/or use of AFFF by the SES.

No inadvertent releases of foam/ significant spillage/ leakage events were recorded.

6 POTENTIAL FOR CONTAMINATION AND CONCEPTUAL SITE MODEL DEVELOPMENT

A conceptual site model (CSM) of the site can be formed by considering the geophysical characteristics at play at the site, the contaminant source, potential receptors and the pathways to the receptors. The CSM, as required by the NEPC (2013), is an iterative process constantly being updated during the investigation process as more information becomes available.

6.1 Physical setting, topography, hydrology and drainage

The site is located at an elevation of between 10 and 20 m Australian Height Datum (m AHD) and is flat. Stormwater drainage at the site is directed via two underground stormwater drainage lines, to the west of the site, prior to discharge to the municipal system along Tenth Avenue. There are no stormwater drainage lines located in either the central or north eastern portions of the site.

Slight depressions, which may result in accumulated water following a rainfall event, were noted along the southern boundary and in the grassed area in the centre of the site, formerly used for AFFF training exercises. Refer to **Figure 2** for these features.

The closest hydrological feature to the site is an un-named water course (drainage channel) located approximately 590 m to the north of the site, at its closest point. The flow channel runs in a broadly easterly direction, before veering south-east and eventually discharging to Macdonald Creek at a point approximately 8.2 km to the south-east of the site.

Additional water features in the vicinity of the site include:

- Drainage channels, located approximately 830 m to the south-west (running north west from an associated surface water feature), 1 km to the south east and 1.4 km to the south of the site, respectively;
- Un-named surface water features (farmers dams), located approximately 1.8 km north-east, 1.3 km and 2.3 to 2.6 km north west of the site, respectively;
- Burdekin River, the main water course in the area, is located 2.7 km to the north-west of the site, at its closest point. The river flows to the east and eventually discharges to the Coral Sea at a point 10 km east of the site; and
- Plantation Creek, which drains to Burdekin River, approximately 3.8 km to the north-west, at its closest point.

6.2 Geology and soils

According to GSQ (1968) and the Geoscience Australia portal (<http://portal.geoscience.gov.au/>) the site is underlain by Quaternary flood plain alluvium, comprising clay, silt, sand and gravel. This is supported by DNRM (2020) which reports this unit as Qa "alluvium" described as "clay, silt, sand and gravel, floodplain alluvium". GSQ (1968) indicates that this unit is likely underlain by residual soil and sub-cropping bedrock (Upper Carboniferous to Lower Permian aged granite).

According to the DNRM Soils map⁴ the site is likely to be underlain by Burdekin Deltaic deposits including Dermosols, Kandosols or Rudosols, (alluvial soils associated with major distributary channels; Landscape Unit B), comprising clay loams, and fine sandy to light medium clays.

According to the Australian Soil Classification System (ASC, Isbell 2002):

Dermosols are described as:

"Soils other than Vertosols, Hydrosols, Calcarosols and Ferrosols which:

- *Have B2 horizons with structure more developed than weak throughout the major part of the horizon; and*

⁴ DNRM (2005) 1: 50,000 Lower Burdekin Delta Area North and South Burdekin Water Board areas Soils Map

- *Do not have clear or abrupt textural B horizons.*

Kandosols are described as:

“Soils other than Hydrosols which have all of the following:

- *B2 horizons in which the major part is massive or has only a weak grade of structure.*
- *A maximum clay content in some part of the B2 horizon which exceeds 15% (i.e. heavy sandy loam, SL+).*
- *Do not have a tenic B horizon.*
- *Do not have clear or abrupt textural B horizons.*
- *Are not calcareous throughout the solum, or below the A1 or Ap horizon or to a depth of 0.2m if the A1 horizon is only weakly developed.”*

Rudosols are described as:

“Soil with negligible (rudimentary) pedologic organisation apart from

- (a) minimal development of an A1 horizon; or*
- (b) the presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils are apedal or only weakly structured in the A1 horizon and show no pedological colour changes apart from the darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present.”*

The above notwithstanding, it is noted that soils in the vicinity of the Home Hill settlement are likely to have undergone significant modification during development. This is reflected in information held by ASRIS (CSIRO, 2020) which reports the soils underlying the site should be considered Anthroposols.

Anthroposols are described according to the ASC (Isbell 2002) as:

“Soils resulting from human activities which have led to a profound modification, truncation or burial of the original soil horizons, or the creation of new soil parent materials by a variety of mechanical means.

Where burial of a pre-existing soil is involved, the anthropic materials must be 0.3 m or more thick. Pedogenic features may be the result of in situ processes (usually the minimal development of an A1 horizon, sometimes the stronger development of typical soil horizons) or the result of pedogenic processes prior to modification or placement (i.e. the presence of identifiable pre-existing soil material).”

6.3 Acid Sulfate Soils

According to ASRIS (CSIRO, 2020) the site is located in an area with an extremely low probability for the occurrence of acid sulfate soils (ASS). This is supported by acid sulfate soil

mapping (CSIRO Land and Water 2018⁵) which designates the site area as an area where there is “*an extremely low probability of occurrence (1-5%) in riparian areas with Kandosols, Ferrosols, Tenosols, Rudosols, Podosols and Kurosols <1mAHd*”.

No information was available from the Burdekin Shire Council with regards to probability of acid sulfate soil occurrence. Therefore, the Auditor considers that potential acid sulfate soil occurrence requires no further consideration at this site.

6.4 Hydrogeology

6.4.1 Results of registered bore search

Queensland Globe (DNRm, 2020) was used by the Auditor and AECOM (2019b) to search for registered bores in the vicinity of the site. The database indicated that there are a total of 24 bores within a 1 km radius of the site (refer **Figure 1**), of which six are located within 500 m of the site boundary.

Given the expected receptors for groundwater migration (Burdekin River approximately 3 km the north), of the six bores within 500 m it is noted one bore was located directly north and four to the north-east of the site:

- One bore (RN175675), located 370 m north-east, is listed as “water supply” and is screened from 18.8 to 20 m in coarse sand (alluvium), with a yield of 2.6 L/s and a reported standing water level (SWL) of 9.45 m (January 2018);
- One bore (RN175547), located 390 m north-east, is listed as for “water supply” and is screened between 18.9 and 20.12 m in brown, coarse sand (alluvium) with a yield of 2.6 L/s and a reported SWL of 9.45 m (October 2017). The quality of the water supply is listed as potable;
- One bore (RN175674), located 420 m north east, is listed as for “water supply” and is screened between 18.8 and 20 m in brown coarse sand (alluvium) with a yield of 2.6 L/s and a reported SWL of 10.3 m (January, 2018). The quality of the water supply is listed as potable;
- One bore (RN175546), located 460 m north east, is listed as for “water supply” and is screened between 18.9 and 20.12 m in brown coarse sand (alluvium) with a yield of 2.6 L/s and a reported SWL of 9.45 m (May, 2017). The quality of the water supply is listed as potable; and
- One bore (RN153225), located 490 m north, is listed as “water supply” and is screened between 15.15 to 16.15 m in fine to medium clayey sand (Burdekin River Alluvium) with a yield of 7.5 L/s and a reported SWL of 6.5 m (December, 2011). The quality of the water supply is listed as potable.

A further seven monitoring bores, listed for “water supply”, with similar screened depths, yields and standing water levels (anticipated as potable water supply bores screened within

⁵ CSIRO Land and Water (2018) Atlas of Australian Acid Sulfate Soils Version 2,

the Burdekin River Alluvium) were identified to the north, north east and north west of the site. Refer to **Figure 1** for these features.

The bore cards for the registered bores detailed above have been provided in **Appendix D**.

It is acknowledged based on the above that there is a potential that additional unregistered bores could be present down-gradient of the site.

6.4.2 Aquifers and aquitards

It is anticipated that the uppermost aquifer beneath the site will be present within the unconsolidated Quaternary alluvial sediments (Burdekin River Alluvium). This unit is expected to be present from approximately 7m depth, with the shallow portion of the aquifer (8-11 m depth) demonstrating yields of approximately 2.5 L/s and the deeper portion (>15 m) demonstrating higher yields in the region of 7.5 L/s associated with coarser grain materials. Water quality is, in the main, reported as “potable”. No information pertaining to salinity of the aquifer has been provided on the bore cards reviewed.

6.4.3 Groundwater dependent ecosystems (GDEs)

The Auditor also used BOM (2020) to determine whether local surface ecosystems have been classified as GDEs. The map indicates that wetlands at Burdekin Creek, approximately 3 km north of the site are classified as “moderate potential aquatic and terrestrial GDEs” (BOM, 2020) and Category B endangered regional ecosystems (biodiversity status) ESAs (DES, 2020).

No subterranean ecosystems were recorded at or in the vicinity of the site.

6.4.4 Summary of groundwater usage and potential receptors

With reference to the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* and AECOM (2019b, Sections 3.6, 3.7 and 3.8) a review of potential groundwater receptors and likely impacts to receptors/ users of the receiving water body has been undertaken.

Given that environmental values and water quality objectives for the Haughton Basin are still under development, the CLA concurs that, as per DES guidance, the Queensland *Water quality objectives* should be applied as default objectives. Relevant environmental values (EVs) for the site therefore include:

- aquatic ecosystems (surface water);
- irrigation (surface water and groundwater);
- farm supply/ use (surface water and groundwater);
- stock water (surface water and groundwater);
- industrial use;
- aquaculture;

- human consumption/ drinking water;
- primary, secondary and visual recreation (surface water); and
- cultural and spiritual values (surface water).

The Auditor completed a review of the identified potential groundwater/ surface water receptors and agrees with those listed in AECOM (2019b). Results have been compared against adopted assessment criteria of aquatic ecosystems and drinking water as these are the most sensitive receptors. In terms of potential length of flow-path to these key potential receptors, the nearest expected down-gradient water supply bore (potential drinking water receptor, RN175675) is 370 m distant, whilst the nearest GDE is approximately 3 km to the north (Burdekin River).

6.5 Chemicals of potential concern

This investigation was undertaken to investigate human health and ecological health risks at the site associated with PFAS contamination only. Accordingly, no assessment and/or commentary is provided pertaining to other chemicals of potential concern (CoPCs) that could be present at the site associated with historic activities (e.g. placement of fill, legacy landfilling activities and, historic fire station use).

For the purposes of this assessment therefore CoPCs comprise:

- PFAS compounds (28 analyte suite, refer **Table 2**); and
- PFAS compounds (28 analyte suite – total oxidisable precursor assay (TOPA) analysis).

Table 2: PFAS Compounds (28 analyte suite) – CoPCs

PFAS Group	Compound	Acronym	Carbon Chain Length	CAS No.
Perfluoroalkyl Sulfonic Acids	Perfluoro butane sulfonic acid	PFBS	4	375-73-5
	Perfluoropentane sulfonic acid	PFPeS	5	2706-91-4
	Perfluorohexane sulfonic acid	PFHxS	6	355-46-4
	Perfluoroheptane sulfonic acid	PFHpS	7	375-92-8
	Perfluorooctane sulfonic acid	PFOS	8	1763-23-1
	Perfluorodecane sulfonic acid	PFDS	10	335-77-3
Perfluoroalkyl Carboxylic Acids	Perfluorobutanoic acid	PFBA	4	375-22-4
	Perfluoropentanoic acid	PFPeA	5	2706-90-3
	Perfluorohexanoic acid PFHxA	PFHxA	6	307-24-4
	Perfluoroheptanoic acid	PFHpA	7	375-85-9
	Perfluorooctanoic acid	PFOA	8	335-67-1
	Perfluorononanoic acid	PFNA	8	375-95-1
	Perfluorodecanoic acid	PFDA	10	335-76-2

PFAS Group	Compound	Acronym	Carbon Chain Length	CAS No.
	Perfluoroundecanoic acid	PFUnDA	11	2058-94-8
	Perfluorododecanoic acid	PFDODA	12	307-55-1
	Perfluorotridecanoic acid	PFTTrDA	12	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	14	376-06-7
Perfluoroalkyl Sulfonamides	Perfluorooctane sulphonamide	FOSA	8	754-91-6
	N-Methyl perfluorooctane	MeFOSA	8	31506-32-8
	N-Ethyl perfluorooctane	EtFOSA	8	4151-50-2
	N-Methyl perfluorooctane	MeFOSE	8	2448-09-7
	N-Ethyl perfluorooctane	EtFOSE	8	1691-99-2
	N-Methyl perfluorooctane	MeFOSAA	8	N 2355-31-9
	N-Ethyl perfluorooctane	EtFOSAA	8	2991-50-6
Fluorotelomer Sulfonic Acids	4:2 Fluorotelomer sulfonic acid	4:2 FTS	4	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2 FTS	6	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2 FTS	8	39108-34-4
	10:2 Fluorotelomer sulfonic	10:2 FTS	10	120226-60-0

6.6 Source to receptor pathway evaluation

AECOM (2019a)⁶ developed a source, pathway and receptor exposure model for the site in both graphical and written form. This included consideration of the site's physical characteristics that could provide a pathway to potential receptors for the CoPCs that may be identified in environmental media on the site.

The site history assessment allowed for a preliminary conceptualisation of the potential location and likely distribution of these chemicals in environmental media at the site. This in turn, facilitated the design of a robust sampling and analytical program to identify and quantify such chemicals at the site and along the site boundaries, if present.

The Auditor reviewed and approved (following discussion) the preliminary CSM and the corresponding sampling plan for the SI works (AECOM, 2019a) in March 2019 prior to the commencement of intrusive works.

7 FIELD PROGRAM

7.1 Auditor site inspection

The Auditor visited the site on 31 July 2019 to confirm in-field methodologies utilised by AECOM and ground-truth the site setting details identified during the data review phase. Due

⁶ AECOM (2019a) *Preliminary Site Investigation and Sampling, Analysis and Quality Plan, QFES*, April 2019

to the rapidity of the drilling program and mobilisation limitations, the Auditor was unable to attend site during soil sampling and bore installation. However, a site inspection and validation of the works completed by the SQP's site representative (permanent bore installation locations, soil bore, sediment/surface water sampling locations) was undertaken immediately thereafter.

Final soil sampling and permanent groundwater monitoring bore locations are presented on **Figure 2** above.

During the Auditor inspection the entire site was traversed on foot. The surface of the site consisted of a flat area containing a combination of concrete hardstand, unsealed, grassed areas and operational fire and combined ambulance station (QAS) buildings and sheds.

No sub-surface infrastructure was observed on the site at the time of the inspections that could "be affected by contaminants" or "be a barrier to or facilitate the migration of contaminants", other than the stormwater and sewer networks, hydrant lines and underground electrical/ communication networks and associated bedding sands potentially providing a conduit to contaminant migration. However, the Auditor noted:

- It is understood a concrete, in-ground tank (the Case 4 pit) formerly used for pump testing and water drafting training was decommissioned in-situ, in the centre of a hardstand area, behind (to the south west of) the old fire station building via pump-out, sand infill and capping with concrete. Bedding sands in the vicinity of this tank could influence contaminant migration.

It was observed that there were no obvious indications of uses for, or activities carried out on the surrounding land that could affect the safety of or cause environmental harm to the subject land. No soil stockpiles or inert waste was present across the site at the time of the inspection.

It is therefore concluded that no "waste storage, treatment or disposal" has occurred on the site as per the definition in Schedule 3 of the EP Act 1994 (Notifiable Activity no.37), hence no waste has been "disposed of or stored on the land". As per the definition of "waste" in s.13(1), (2) and (3) of the EP Act 1994 "including anything" that is "left over" or "surplus" to an activity, it is considered that the "left over" and "surplus" material does not constitute "waste" as per the definition in s.389(1)(d) because it was not "disposed of or stored".

In addition to the above, and with particular reference to s.389(1)(d)(ii) of the EP Act 1994, there was no evidence of any potential contamination of the land or the presence of any hazardous contaminant on the site at the time of the inspection.

7.2 Field investigations

Field investigations comprised the following events:

- Preliminary Site Investigation (PSI, reported in AECOM 2019a), summarised in AECOM, (2019b):
 - **Event 1** (13 February 2019): site inspection to identify areas of potential environmental concern (including interviews with selected QFES personnel regarding historic site activities) – reported in (AECOM, 2019a);

- Detailed Site Investigation (DSI, reported in AECOM, 2019b):
 - **Event 2** (24 - 25 July 2019):
 - Drilling of four soil bores (HH_BH01 to HH_BH04), installation of four monitoring bores (HH_MW01 to HH_MW04) and bore development; and
 - Advancement of four shallow bores (HH_SS1 and HH_SS4);
 - Collection of two sediment samples (HH_SED01 to HH_SED02); and
 - **Event 3** (6 August 2019):
 - Groundwater monitoring event (HH_MW01 to HH_MW04) and monitoring bore survey.

It is noted that co-located surface water samples were to be located alongside sediment samples from site drainage lines (AECOM, 2019a). However, this could not be completed, as all drainage lines were dry at time of sampling.

Sampling locations are presented on **Figure 2**.

7.2.1 Soil sampling methodology

Boreholes were advanced to a clearance depth of 1.5 metres below ground level (m BGL) via non-destructive drilling techniques (NDD) prior to follow-on with a mechanical drill rig (Geoprobe equipped with push-tube) to the maximum target depth of 10 m BGL for soil sample collection and logging. Each bore was subsequently "reamed out" to target depth by Proactive using a Geoprobe drilling rig equipped with solid stem augers for groundwater monitoring bore installation at each location.

Hole diameters were 60 mm and 100 mm for soil and groundwater bores respectively. All boreholes were advanced to natural material.

The shallow soil bores (HH_SS1 to HH_SS4) were advanced via hand auger to a maximum depth of 0.5 m BGL to assess shallow soil conditions.

Samples were generally collected from each borehole from surface (or materials immediately underlying the concrete slab) (0-0.2 m), subsurface (0.2 – 0.5 m) and every metre thereafter, or, where a change in lithology or visual/olfactory signs of contamination were evident until the target depth was achieved.

Samples were collected from each location, directly from the push-tube liner, solid stem auger cuttings and/or hand auger, by hand, using a fresh, clean pair of nitrile gloves for each sampling interval. Soil samples were collected into laboratory-supplied PFAS-suitable containers and immediately stored on ice for transport to the laboratory under appropriate, chain of custody (COC) control.

Representative samples were submitted for laboratory analysis for the identified contaminants of concern as per the agreed SAQP, namely:

- Three samples from each borehole/monitoring bore installation (two within the 0 to 1 m bgl depth interval and one at depth, within the saturated zone); and
- Two samples from each shallow bore (HH_SS1 to AY_HH4), within the 0 to 1 m depth interval.

7.2.2 Lithology encountered

The lithology encountered at the site comprised between 0.4 m (HH_BH02 and HH_BH03) to 0.8 m (HH_BH01 and HH_BH04) of fill material overlying natural and disturbed natural materials (Anthroposols) described as orange, dry, loose sand and brown silty clay (Quaternary floodplain alluvium), with increasing moisture content with depth.

Fill material observed was generally described as dark brown to black silty sand.

No visual and/ or olfactory evidence of contamination (e.g. foreign materials, odour or stain) was identified during the drilling program.

7.2.3 Groundwater assessment

Four groundwater bores (HH_MW01 to HH_MW04) were installed by AECOM (2019b). Each bore was screened within medium to coarse grain sands below where the reported water strike (very moist to wet) materials were observed.

During the gauging and sampling event, undertaken post-drilling, in August 2019, stabilised SWLs in all four monitoring bores were reported within the screened interval at a consistent depth of approximately 8 m bgl across the site. Screened intervals ranged from:

- HH_MW01; screened in sand (7 m to 10 m bgl);
- HH_MW02; screened in sand (7 to 10 m bgl);
- HH_MW03; screened in sand (7 to 10 m bgl); and
- HH_MW04; screened in sand (6 to 9 m bgl).

Based on the groundwater elevations reported, local groundwater flow direction was inferred toward the north/north-east. Although it was noted that the potential for a proportion of groundwater flow toward the east or west could not be fully discounted given the absence of groundwater elevation data in this area.

The field chemistry within the bores showed that the groundwater was fresh (salinity 303.9 to 440.1 as total dissolved solids (TDS)) and slightly acidic (pH 6.39 to 6.5).

No visual and/or olfactory evidence of contamination (e.g. odour, sheen, foaming) was identified during the groundwater sampling program.

7.2.4 Surface water and sediment assessment

Two sediment samples were collected from site drainage channels for assessment. Co-located surface water samples could not be collected given the site drainage channels were dry at time of collection.

The sediment samples were collected as grab samples, at each location, using a gloved hand. To minimise potential for cross-contamination, a fresh, clean pair of nitrile gloves was donned prior to sample collection at each location.

Each sampling container (bottle or jar) was filled to zero headspace prior to capping, storage on ice and submission to the nominated laboratory.

7.3 Auditor's comments on field program

The Auditor considers that the sampling and analytical program was suitable to fulfil the requirements of the investigation and the assessment works were performed in accordance with best practice methodologies.

While it is noted that due to the size, shape and orientation of the current lot and the resulting, required positioning of permanent groundwater bore installations, some uncertainty remains as to whether a proportion of the local groundwater flow may be toward the east/west, the Auditor does not consider this to have adversely affected the findings of the groundwater assessment.

Any data gaps associated with groundwater flow and contaminant delineation will be addressed in a subsequent phase of work intended to focus on off-site assessment (refer to Sections 11 and 12 below).

8 LABORATORY ANALYTICAL PROGRAM REVIEW

Samples were analysed by Australian Laboratory Services (ALS) as the primary laboratory and National Measurement Institute (NMI) as the secondary laboratory. Both laboratories are accredited with the National Association of Testing Authorities (NATA) for the methods used.

Primary samples, intra laboratory duplicates and rinsates were sent to ALS in Stafford (QLD), and inter laboratory duplicates were sent to NMI in Ryde (NSW).

Intra and inter laboratory duplicates and rinsates were analysed as part of AECOMs quality assurance/quality control (QA/QC) procedures.

8.1 Analytical schedule and suites

The following analytical schedule (Table 3) was used for the sampling events.

Table 3: Analytical schedule

Sampling Location	Analyte	Primary samples	QA/QC		
			Intra laboratory duplicate	Inter laboratory duplicate	Rinsate
SOIL & SEDIMENT					
HH_BH01-HH_BH04	PFAS (28)	12	1	1	4
HH_SS1 to HH SS4	PFAS (28)	6	1	1	
HH_SE01 to HH_SED02	PFAS (28)	2	1	1	
HH_SS1	TOPA	1			
GROUNDWATER					
HH_MW01 – HH_MW04	PFAS (28)	4	1	1	1
HH_MW03	TOPA	1			

Notes:

PFAS (28) – per and polyfluoroalkyl substances 28 compound suite (refer Table 2)

TOPA: total oxidisable precursor assay

The Auditor agrees with the analytical schedule used and that it is considered sufficient to characterise PFAS impacts (concentration and distribution) within and adjacent to the boundaries of the site and identify the potential for off-site contaminant migration.

8.2 Procedures for quality control and quality assurance

Quality control is achieved by using NATA registered laboratories using ASTM standard methods supported by internal duplicates, the checking of high, abnormal or otherwise anomalous results against background and other chemical results for the sample concerned.

Quality assurance is achieved by confirming that field results, or anticipated results based upon comparison with field observations, are consistent with laboratory results. Also, that sampling methods are uniform, and decontamination is thorough. In addition, the laboratory undertakes additional internal quality assurance procedures and tests.

These quality assurance/quality control (QA/QC) processes were undertaken as part of this assessment, including collection and analysis of intra and inter laboratory duplicates and rinsate blanks. No trip blanks and/or trip spikes were analysed as part of this assessment.

Field observations are compared with laboratory results when they are not as expected. Confirmation, re-sampling and re-analysis of a sample are undertaken if the results are not consistent with field observations and/or measurements. In addition, field duplicate sample

results have to be within the acceptable range of reproducibility. A discussion of the quality of internal laboratory results and field duplicate relative percentage difference (RPD) calculations was included in AECOM (2019b) Appendix G and are discussed below.

The following was noted with regards to the QA/QC procedures:

- Sample integrity and container requirements were documented as acceptable;
- Holding time compliances were documented as acceptable with the exception of moisture content associated with sample HH_SS1_0.5 (TOPA), batch EB1921187;
 - It is noted the moisture content holding time exceedance is associated with the required re-batching of samples for TOPA analysis and moisture content was undertaken within the required holding time, as part of the initial, standard PFAS analytical run,
- Laboratory matrix spike results were mostly within acceptable control limits;
 - It is noted that matrix interference was recorded primarily for sediment sample HH_SED02 for which matrix spike non-conformances were recorded for 15 analytes, potentially indicative of suppressed analyte recovery in this sample;
- Laboratory duplicate % RPD results were acceptable;
- All laboratory QA/QC method blanks were found to be acceptable; and
- Field replicate and triplicate RPD values were acceptable or, where non-conformances were identified, were appropriately assessed and deemed acceptable for use.

It is therefore the opinion of AECOM (2019b) and the Auditor that the data quality process for both field and laboratory components of the investigation were appropriate to enable the report conclusions to be relied upon.

9 ASSESSMENT CRITERIA REVIEW

9.1 Soil

Site investigation criteria were selected to provide an appropriate indication of the environmental status of the site with consideration given to the current and future land-uses as determined by existing site zoning and information provided by QFES. The adopted assessment criteria and rationale for their selection is detailed in Section 5.0 (AECOM, (2019b).

Typically for a soil contaminant concentration to be considered acceptable for the respective land-use criteria, the data set must conform to the following requirements:

- the 95% upper confidence limit (UCL) of the arithmetic mean of analytical results is below the site criteria;

- the arithmetic (or geometric in cases where the data is log normally distributed) mean is below the site criteria;
- the standard deviation is less than 50% of the site criteria; and
- no single sample analytical result is greater than 250% of the site criteria.

Soil analytical results have been tabulated (AECOM 2019b, Appendix B, Table T4) and compared to NEMP (2018) guidelines for human health and, ecological indirect exposure, namely:

- Soil criteria for investigation – human health-based guidance value (industrial/commercial);
- ecological guideline values for indirect exposure (industrial/ commercial); and
- ecological guideline values for indirect exposure (residential).

The Auditor notes that although the site is and is intended to continue as a commercial/ industrial property, AECOM has also assessed the soil analytical results against ecological guideline values for indirect exposure for the residential land-use exposure setting given:

- Parts of the site (particularly along the northern boundary) and areas adjacent to the site (to the north and south) are unsealed therefore there is a potential (albeit low) for exposure of terrestrial organisms (albeit transient as a result of ongoing land-uses) in these areas; and
- The PFAS DRAFT NEMP Version 2.0 (HEPA 2019 unpublished, draft for consultation) intends to adopt, the current residential guideline (0.01 mg/kg) as standard for both exposure scenarios, albeit endorsing modification of the guideline⁷ for commercial/ industrial sites on a case by case basis where use of a residential exposure scenario is deemed too conservative, for example:
 - The site is intensively developed with the percentage of the surface area covered by hard surfaces higher than 80 % of each hectare (to be applied separately to each hectare).
 - Secondary consumers are effectively absent from the site;
 - The site is situated in an extensively built-up urban setting; and
 - The site is not in close proximity to waterways, drainage networks or groundwater.

⁷ Up to a maximum guideline concentration of 0.14 mg/kg, equivalent to the currently endorsed commercial/industrial ecological guideline criteria for indirect exposure.

9.2 Groundwater and surface water

Groundwater and surface water analytical results have been tabulated (AECOM 2019b, Appendix B) and compared to the guidelines presented in **Table 4** below, as summarised in:

- NHMRC (2019) Guidance on Per and Polyfluoroalkyl Substances in Recreational Water; and
- HEPA (2018) PFAS National Environmental Plan (NEMP), January 2018.

Table 4: Adopted assessment criteria – groundwater and surface water

Media	Environmental value	PFAS compound	Applicable guideline value (µg/L)
Groundwater	Human health – drinking water	Sum of PFHxS & PFOS	0.07
		PFOA	0.56
Groundwater discharging to surface water/ surface water	Aquatic ecosystem protection – 99%	PFOS	0.00023
			0.051
	Human health – recreational contact	PFOA	19
		Sum of PFHxS & PFOS	2.0
		PFOA	10

Notes:

- 0.07: (NEMP, 2018),
0.051: (Batley et al, 2018 – draft guidance, after AECOM 2019b);
2.0: (NHMRC, 2019)

9.3 Sediment

No published and/or endorsed criteria are currently available for the assessment of PFAS in sediment.

9.4 Auditor's comments

The Auditor has reviewed the results and confirms that the criteria have been correctly applied, noting that the draft guidance applied by AECOM (2019b) for ecosystem protection has not been ratified by Australian regulators.

Furthermore, it is noted, in the absence of endorsed assessment criteria for sediments, the laboratory limit of reporting (LOR) has been used as an initial screening (presence/absence) assessment for sediments and, the identification of a detectable concentration of PFAS,

above LOR in sediment, does not necessarily constitute a human and/or ecological health risk. Rather, any detection above LOR in sediments should be considered a trigger for further assessment/ consideration in relation to potential, complete, exposure pathways.

10 REVIEW OF RESULTS

10.1 Soil results compared to guidelines

10.1.1 Discussion

Detectable concentrations of PFAS, greater than the laboratory limit of reporting (LOR) were recorded in all 18 soil samples analysed.

The highest proportion of PFAS was generally observed at shallow depth (in fill materials) consistent with a “top-down” mode of contamination associated with historic application of AFFF during training activities followed by leaching and/or vertical infiltration through the soil profile.

Compositional analysis indicates that while the widest range of PFAS compounds were detected within the shallow depth interval 0.1 to 0.5 m bgl, the PFAS signature was dominated by PFOS and PFHxS throughout the soil profile and into the water-table.

Comparison with the adopted assessment criteria confirmed:

- No exceedances of the human health assessment criteria (commercial/ industrial land-use scenario);
- One exceedance of the ecological guideline criterion for PFOS (HH_SS1 at 0.5 m BGL, 0.223 mg/kg) (ecological indirect exposure, commercial/industrial scenario, criteria 0.14 mg/kg); and
- Nine exceedances of the ecological guideline criterion for PFOS (ecological indirect exposure, residential scenario, criteria 0.01 mg/kg) within the uppermost 2-3 metres, for which ecological assessment criteria typically applies.
 - Noting (as discussed in Section 9 above) that assessment against the ecological indirect exposure limits was undertaken as a conservative measure, to account for the southern, unsealed portion of the site where secondary consumers such as insectivorous birds and/or mammals could forage.
- An additional ecological exceedance was reported at a depth of 9 m BGL at HH_BH03, although, as per above, typically a 2-3 m vertical limit is placed on ecological assessment, associated with typical root zone depths and anticipated activity zone for invertebrate and vertebrate organisms within the soil profile.

10.1.2 Auditor interpretation of soil PFAS data

Given the site is understood to have been subject to ongoing commercial/ industrial use for the past 52 years and underlying site soils are understood to comprise fill material overlying anthroposols, significantly modified by human activity, the single ecological guideline exceedance (commercial/industrial) reported at HH_SS1 at 0,5 m depth is not deemed significant, nor considered to pose a significant ecological health risk.

Furthermore, while widespread exceedances of the residential ecological indirect exposure limit were identified, as noted above, assessment against residential criteria is a conservative approach, given the likely transient nature of wildlife likely to be directly exposed on site, and ongoing commercial/ industrial activities associated with operational fire and ambulance station use.

10.2 Groundwater results compared to guidelines

10.2.1 Discussion

Detectable concentrations of PFAS were recorded in all four monitoring bores at the site with compositional analysis confirming the PFAS groundwater signature to be dominated PFOS and PFHxS (approximately 90% of the PFAS mass present) with a further nine compounds accounting for the remaining 10%. This distribution is deemed indicative of potential higher mobility of shorter-chain compounds in the subsurface and/or higher solubility of shorter chain compounds in groundwater.

Comparison with the adopted assessment criteria confirmed:

- Sum of PFOS and PFHxS concentrations exceeded the human health assessment criterion for drinking water and recreational water quality guideline in all four monitoring bores (HH_MW01 – HH_MW04), with the highest concentration reported in bore HH_MW03, located adjacent (south) of the decommissioned, Case 4 pit and down-gradient of the SES storage shed (See **Figure 2**); and
- PFOS concentrations in all four groundwater bores exceeded the adopted ecological guideline value (99% species protection – fresh water).

10.2.2 Auditor interpretation of groundwater PFAS data

Given the above, and, based on the assessment completed to date, the Auditor considers that the extent of PFAS in groundwater has not yet been fully delineated and, given the observed concentrations of PFOS and PFHxS in groundwater in particular, there is a potential that these compounds have migrated beyond the site boundaries (particularly to the north and east) at concentrations greater than human health and ecological assessment criteria. Given the location and proximity of the nearest down-gradient groundwater receptor (RN175675, 370 m to the north-east) and the potential for unregistered off-site bores down-gradient of the site, this warrants further investigation.

While it is noted, based on currently available groundwater elevation data and associated groundwater contours, off-site migration appears primarily toward the north/ north-east, there

is a potential for localised flow to the east and west. Further assessment should also be undertaken to resolve this data gap.

Observation of potential receptors for groundwater discharge indicates that an unnamed drainage channel is located approximately 590 m to the north of the site and the Burdekin River, the main water course in the area, is located at a distance of approximately 3 km.

In addition to the above, given the highest concentrations of PFHxS and PFOS in groundwater were observed down-gradient of the historic SES storage shed in HH_MW03, it is recommended that any additional investigation seek to confirm if PFAS has been historically used and/or stored within the SES area (Lot 7, SP123356) adjacent to the site, to the south.

10.3 TOPA analysis

The results of the TOPA analysis (completed on one soil and one groundwater sample) determined that the soil and groundwater analytical results are likely indicative of a degraded PFAS product that is unlikely to significantly increase or alter via biotransformation or oxidation processes, over time.

10.4 Sediment results

10.4.1 Discussion

No published criteria are currently available to directly assess human health and/or ecological risks associated with PFAS in sediments therefore the sediment assessment was undertaken as a screening assessment to determine presence/ absence of PFAS compounds in sediment.

Consistent with the soil and groundwater data, the sediment PFAS signature was dominated by PFOS with detectable concentrations of PFOS recorded in both sediment samples collected at the site, ranging from 0.0021 mg/kg (HH_SED01, southern boundary) and 0.0004 mg/kg (HH_SED02, northern boundary) (LOR 0.0002 mg/kg). A small range of other PFAS compounds were reported at detectable concentrations in HH_SED02 only, at concentrations at or close to the laboratory LOR.

10.4.2 Auditor interpretation of sediment PFAS data

The presence of detectable PFAS compounds in sediment samples, indicates that drains along the boundaries of the site have, in the past, captured contaminated surface run-off and could act as preferential pathways for the migration of PFAS via surface water drainage and sediment transport.

However, noting the drains are concrete lined and ephemeral in nature, the distance to the closest surface water course likely to be impacted (~500 m north), the lack of direct connection to this water course, the likelihood of transport at distance beyond the site boundary, is deemed low.

Furthermore, the detectable concentrations of PFAS compounds in sediment were at, or just above laboratory LOR and are therefore deemed unlikely to pose a significant human and/or ecological health risk.

As discussed above, detectable concentrations of PFAS compounds in sediment, in the absence of a ratified assessment criteria, do not necessarily confirm the existence of a viable human and/or ecological health risk, rather provide confirmation of contaminant presence and that further assessment of viable source-pathway-receptor relationships may be required to appropriately quantify the risk.

10.5 Data quality, data gaps and other considerations

Based on the results obtained from the assessment, including QA/ QC data, it is concluded that the data quality is appropriate and as such the results can be relied upon.

AECOM (2019b) outlined that any RPD exceedances were a result of heterogeneity and did not affect the outcomes of the report. AECOM (2019b) also reviewed document completeness, data completeness, data comparability, data representativeness and precision and accuracy for sampling and analysis. No outliers were reported when compared to the adopted evaluation criteria.

The Auditor has undertaken his own assessment of the data and arrived at the same conclusions as the SQP. This assessment has included a check of RPD calculations (discussed above), as well as comparison of field and laboratory collected data (where available).

10.6 Confirmation of conceptual site model and source-receptor pathway linkages

Based on the findings of the CLID (AECOM, 2019b), it can be confirmed that all possible source to receptor pathway linkages have been identified and quantified to the extent practicable within the limitations of this investigation:

- AECOM (2019b) concludes there is no unacceptable human health and/ or ecological risk associated with the identified PFAS concentrations on-site, within the commercial/ industrial exposure context; and
- AECOM (2019b) considers that, based on the groundwater investigation completed to date, there is a potential that impacted groundwater may have or be migrating beyond the site boundary at concentrations greater than human health (drinking water/ recreational) and/ or ecological assessment criteria and that further investigation to appropriately delineate the PFAS plume and quantify risks posed to down-gradient sensitive receptors should be undertaken.

The Auditor concurs with AECOMs conclusions and considers further off-site investigation is warranted to appropriately assess risk to off-site receptors and determine management and/ or remediation strategies, if required. Specifically, the potential exposure pathway associated with off-site groundwater migration and subsequent groundwater use (potable/ other) and discharge to sensitive receptors needs to be investigated and quantified in order to allow an assessment of environmental harm.

11 ASSESSMENT OF REPORT AGAINST S389 OF EP ACT 1994

11.1 Key descriptive elements; (S389 (1)), EP Act (1994)

In summary, it is the Auditor's opinion that the CLID reviewed has provided adequate information about the land, as it has described the relevant elements, and the Auditor has assessed these descriptions against s.389(1) of the EP Act (1994).

A summary of the findings of the Audit is provided in this report (statement of reasons), with a reference table for each element in **Table 5** below.

11.2 Endorsement of statements under S389 (2) of the EP Act (1994)

Following on from the above summary of reasons for accepting the CLID, the Auditor is able to endorse the statements made in the CLID relating to s.389(2) of the EP Act (1994):

- Insufficient data has been collected (chemical and physical) beyond the site boundary to determine whether the site is prescribed contaminated land;
- The extent of PFAS contamination on the land has been assessed to an acceptable degree and it has been determined that the site is suitable for on-going commercial/ industrial land-use;
- Further data is required to be collected off-site to determine the extent that the land is impacting, or has the potential to impact on, any receptors or beneficial uses of groundwater; and
- It is the Auditor's opinion that the CLID complies with the contaminated land NEPM (NEPC, 2013).

Table 5: Auditors assessment of CLID contents

Subsections of section 389 of the <i>Environmental Protection Act 1994</i>		Reference to CLID (i.e. sections, pages and/or paragraphs) that comply with the corresponding subsection of section 389 of EP Act	Reference to auditor's statement of reasons (i.e. sections, pages and/or paragraphs) of why each requirement has been deemed compliant
(1)(a)	the reasons particulars of the land have been recorded in a relevant land register	Table 2	Section 4
(1)(b)	a description of all surface and subsurface infrastructure on the land, including details of the location, size and type of the infrastructure	Section 2.2 Site Layout and features/Figure 2	Sections 4.2 and 7.1
(1)(c)	a description of the surrounding area of the land, including a description of each of the following in the surrounding area:	Section 3	Section 4.2
(1)(c)(i)	- all environmentally sensitive areas	Section 3.7 GDEs and Environmentally sensitive areas	Section 4.2 and 6.4.3
(1)(c)(ii)	- the location of all water, watercourses and wetlands	Section 3.4 Hydrology, Section 3.7 GDEs and Environmentally sensitive areas	Sections 6.1 and 6.4.3
(1)(c)(iii)	- the location of all storm water drainage	Section 2.2 Site layout and features/ Figure 2, Section 2.4 Previous environmental investigation, Section 3.4 Hydrology	Sections 6.1 and 7.1
(1)(c)(iv)	- all uses of the land, including uses that may affect the safety of the relevant land or cause environmental harm	Section 2.2 Site Layout and features, Section 2.3 Surrounding land use	Sections 4 and 5
(1)(c)(v)	- all activities carried out that may affect the safety of the relevant land or cause environmental harm	Section 2.4 Previous environmental investigations/ Table 1	Section 5
(1)(d)	for waste disposed of or stored on the land that contains, or may potentially contain, hazardous contaminants:		
(1)(d)(i)	- details of the location, volume and type of the waste	Section 2.4 Previous environmental investigation	Section 7.1

Subsections of section 389 of the <i>Environmental Protection Act 1994</i>		Reference to CLID (i.e. sections, pages and/or paragraphs) that comply with the corresponding subsection of section 389 of EP Act	Reference to auditor's statement of reasons (i.e. sections, pages and/or paragraphs) of why each requirement has been deemed compliant
(1)(d)(ii)	- details of any potential contamination of the land caused by disposing of or storing the waste on the land	Section 2.4 Previous environmental investigation	Section 10
(1)(e)	a description of the geology and hydrogeology of the land	Section 3.2 Soil type and ASS; Section 3.3 Geology; Section 3.5 Hydrogeology	Sections 6.2, 6.3 and 6.4
(1)(f)	details of any environmentally relevant activities or notifiable activities carried out on the land, including the materials used and waste produced during the carrying out of the activities	Section 2.1 Site Identification, Section 2.4 Previous Environmental Investigation	Sections 1 and 5
(1)(g)	details of any earthworks carried out on the land, including the materials used and waste produced during the earthworks	Section 2.2 Site layout and features, Section 2.4 Previous Environmental Investigation, Section 4.0 fieldwork	Sections 5 and 7
(1)(h)	if work has been carried out on the land to remediate the contamination of the land—the contamination levels recorded on the land before and after the work was carried out	Not applicable	Not applicable
(1)(i)	for a draft site management plan:		
(1)(i)(i)	- the proposed objectives to be achieved and maintained under the plan	N/A	N/A
(1)(i)(ii)	- the proposed methods for achieving and maintaining the objectives	N/A	N/A
(1)(i)(iii)	- the proposed monitoring and reporting compliance measures for the land	N/A	N/A
(2)(a)	a statement (a <i>site suitability statement</i>) of the uses or activities for which the site is suitable	-	Cover Letter and Section 12

Subsections of section 389 of the <i>Environmental Protection Act 1994</i>		Reference to CLID (i.e. sections, pages and/or paragraphs) that comply with the corresponding subsection of section 389 of EP Act	Reference to auditor's statement of reasons (i.e. sections, pages and/or paragraphs) of why each requirement has been deemed compliant
(2)(b)	a statement of the following matters:		
(2)(b)(i)	- whether the land is prescribed contaminated land	Section 6: Results, Section 7: Discussion, Figs 2-5	Sections 10 and 11.2
(2)(b)(ii)	- if the land is contaminated—the extent to which the land is contaminated		
(2)(b)(iii)	- for a draft site management plan—whether the proposed objectives, methods and measures stated in the plan under subsection (1)(i) are appropriate	N/A	N/A
(2)(b)(iv)	- the extent to which the assessment of the land is in accordance with the contaminated land ASC NEPM	Section 1.3: Objectives, Section 4: Fieldwork- DSI, Section 8: Conceptual site model, Appendix G: Data quality evaluation	Sections 11 and 12

12 AUDITOR CONCLUSION AND RECOMMENDATIONS

The following evaluation has been made on the CLID (AECOM, 2019b):

- the SIR adequately justifies the conclusions in the context of site history, level of assessment, development of a robust CSM, and relevant aspects of NEPC (2013), NEMP (2018) and DES (2015 and 2018) in particular;
 - the CSM developed for the site (AECOM, 2019b) adequately identifies CoPC including their sources and potential pathways to identified receptors at and about the site, and then allocates appropriate Tier 1 criteria to ensure the identified potential receptors are protected by concentrations at the source/s; and
 - the conclusions of the final CLID (AECOM 2019b) are therefore underpinned by a robust assessment and consistent with the appropriate guidelines and legislation.

In summary, the CLID findings have determined that while soil contamination in excess of adopted ecological indirect exposure guidelines exists at the site, given the ongoing and legacy commercial/ industrial use of the site, and the relatively low concentrations identified, this does not constitute a significant ecological risk and the site is suitable for on-going commercial/ industrial use.

However, noting that concentrations of PFOS and PFHxS in groundwater at the site exceed relevant guideline criteria, there is a potential that impacted groundwater has migrated beyond the site boundaries. Accordingly, the CLA considers that further off-site investigation is warranted to comply with legislation and quantify the risk (if any) to off-site human and/ or ecological receptors along a complete exposure pathway and therefore determine what notification, remediation and/ or management measures may be necessary at the site to mitigate these risks.

13 LIMITATIONS

Mark Stuckey of Environmental Earth Sciences has prepared this CLA report (719052_QFES_HH_AuditorCert_V1) in accordance with Section 568 of the *EP Act 1994* and DES (2018). The Report has been prepared solely to support the CLA's (Mark Stuckey's) certification of the CLID prepared by the SQP for the site.

The Report relates only to those matters relevant to certification of the CLID under relevant provisions of the *EP Act 1994*. It is not intended, nor is it suitable, for any other purpose and should not be relied upon for any other purpose.

The Report only considers the contaminated land aspects of the site (in relation to PFAS compounds only) and does not provide an opinion regarding other aspects of the site or the environment not related to site contamination such as (but not limited to):

- hazardous building materials in buildings or structures;
- structures, footings, infrastructure and the like (whether above or below ground);
- the suitability of fill materials for any use and any geotechnical considerations;
- regulatory responsibilities or obligations (for which a legal opinion should be sought);
- work health and safety legislation; or
- the suitability of any engineering design.

If specialist technical review of such additional issues is required, then separate advice should be obtained from appropriate specialists.

The Auditor is not one of the specialists who prepared the CLID. The Auditor has independently evaluated the CLID and its site suitability statement prepared by the SQP in order to certify that the CLID complies with the content requirements of Sections 389(1) and 389(2) of the EP Act as far as practicable, noting the investigation was undertaken to characterise PFAS contamination, only. In preparing the Report, the Auditor has assessed the suitability of the SQP to prepare the CLID in accordance with the *EP Act*, and has relied on the experience, expertise and integrity of the SQP, as declared by the SQP.

Whilst the Auditor has taken reasonable measures to verify the accuracy and completeness of information presented by the SQP and included in the CLID, neither the Auditor nor Environmental Earth Sciences accepts any liability for misrepresentation of information or for the omission of any information in the CLID that is material to the Auditor's certification.

Sampling and chemical analysis of environmental media are based on guidance made and approved by the relevant regulatory authorities. Conclusions arising from the assessment of environmental data are based on the sampling and analysis considered appropriate based on these regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants. Ground conditions between sampling locations may vary, and this should be considered when extrapolating between sampling points.

As environmental sampling for this program has been undertaken to characterise the concentration and distribution of PFAS compounds only, no warranty or guarantee is provided that other hazardous and/ or toxic chemicals associated with previous historic land uses do not exist at the site. Furthermore, it is noted that assessment of risk is based on currently available guidance; given regulatory standards change over time and there may be materials present at the site that whilst not considered hazardous at the present time may be considered hazardous in the future.

Changes to the site conditions may occur subsequent to the investigations described in this Report, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this Report are based on the available information at the time of the investigation of the site.

Should new information become available about contamination at the site that may materially affect the validity or appropriateness of the conclusions in the Report, the Auditor reserves the right to review the Report in the context of any such additional information.

14 REFERENCES

- AECOM (2019a) *Preliminary Site Investigation and Sampling, Analysis and Quality Plan*, QFES, April 2019
- AECOM (2019b) *PFAS Detailed Site Investigation Home Hill Fire Station, 83 Tenth Avenue, Home Hill, Queensland* Ref: 60609758 Revision 0 – Final. 10 February 2020
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ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services

The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for.

Data should not be separated from the report

A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change

Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Obtain regulatory approval

The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose.

APPENDIX A: AUDITOR CERTIFICATE OF APPROVAL

Certificate

Environmental Protection Act 1994

Certificate of Approval

Approval No: CLAD06400917

This certificate of approval as an auditor is issued by the chief executive¹ pursuant to section 573 (2)(a) of the Environmental Protection Act 1994.

1. Approved person

Mark Stuckey

2. Approved auditor functions

The approved person is approved to perform auditor's functions under 568(b) of the *Environmental Protection Act 1994* and relevant auditor's functions pursuant to the provisions of the *Planning Act 2016*.

3. Term of approval

This approval will remain in force until **9 October 2020** unless it is earlier cancelled or suspended.

4. Conditions of approval

The approved person must comply with the most recent version of The Queensland Auditor Handbook for Contaminated Land, Module 4: Code of Professional Conduct.

sch4p4(6) Personal information

Signature

09/10/2017

Date

Chris Loveday

Director
Environmental Services and Regulation
Department of Environment and Heritage Protection
Delegate of the chief executive
Environmental Protection Act 1994

Enquiries:

Ralph Riese

A/Manager,
Regulatory Capability and Customer Service
Department of Environment and Heritage
Protection
Phone: (07) 3330 5706

¹ The Director-General of the Department of Environment and Heritage Protection is the chief executive under the *Environmental Protection Act 1994*.

APPENDIX B: AUDITOR CERTIFICATION AND DECLARATION

Auditor certification and declaration

Contaminated land investigation document

This template is for use by an auditor, in relation to a function under s. 568(b) of the Environmental Protection Act 1994 (EP Act), to certify a contaminated land investigation document under s. 389(3) of the EP Act, and to make a declaration under s. 574C of the EP Act.

1. Details of the auditor's function

Auditor

Name	Mark Stuckey
Company	Environmental Earth Sciences
Registered business address	Unit 3, 1 Ross Street, Newstead, QLD
Telephone	Unit 3, 1 Ross Street, Newstead QLD
Email	mstuckey@eesigroup.com
Auditor approval number (Qld)	CLAD06400917

Details of the contaminated land investigation document

Title of the contaminated land investigation document: PFAS Detailed Site Investigation: Home Hill Fire Station, 83 Tenth Avenue, Home Hill, Queensland. Rev 0 (FINAL). 10 February 2019. Author: James Peachey (SQP)
The contaminated land investigation document comprises (tick all applicable boxes): ☒ site investigation report ☐ validation report ☐ draft site management plan ☐ draft amended site management plan
Objective of the contaminated land investigation document: ☐ Required by a notice issued by the administering authority under the EP Act (notice reference number:) ☒ Prepared voluntarily to remove, or change details of, land on the environmental management register (EMR) or contaminated land register (CLR) ☐ Other (provide details):
Title(s), version number, date, and author(s) of report(s) or draft site management plan(s) evaluated—for each separate document forming a component of the contaminated land investigation document. AECOM (2019a) Preliminary Site Investigation and Sampling, Analysis and Quality Plan, QFES, April 2019

Auditor certification and declaration
Contaminated land investigation document

Title(s), version number, date, and author(s) of any report(s) or plan(s) previously submitted to the administering authority that forms part of the current contaminated land investigation document.

Auditor engagement

Auditor was engaged by:

☒ Owner ☒ Occupier ☐ Developer ☐ Administering authority
☐ Other (provide details):

Name of person/company who engaged the auditor:

Raymond Bott, Queensland Fire and Emergency Services

Date auditor was commissioned: 18/07/2019

Relevant land

Lot on plan Lot 8/ SP123356	Title(s) of attached site plan(s): Ref: 49015321, 50262221 and 50312846
Street address 83 Tenth Avenue, Home Hill, QLD	Postcode 4806
Local government area Burdekin Shire Council	EMR/CLR ID (if applicable)
Registered owner name The State of Queensland (represented by Public Safety Business Agency)	Registered owner address Public Safety Business Agency, Level 13 Makerston House, 30 Makerstne Street, Brisbane, QLD 4000

Is there a radiation Impact on site?

☐ Yes—you must provide a support expert's statement
☒ No

Support expert(s) engaged by auditor

☒ No support expert was engaged
☐ One support expert was engaged—the support expert's details are provided below.
☐ More than one support expert was engaged—a full list of each support expert's details is attached.

Name

N/A

Company

N/A

Describe the matter(s) for which the support expert provided expert advice:

N/A

☐ Support expert's report (or other document) attached

Auditor certification and declaration Contaminated land investigation document

2. Auditor's certification and declaration

Certification

I certify that the contaminated land investigation document complies with ss. 389(1) and 389(2) of the *Environmental Protection Act 1994* having regard to the guidance provided in the *Queensland auditor handbook for contaminated land, Module 6: Content requirements for contaminated land investigation documents, certifications and audit reports* (Department of Environment and Science, 2018).

In particular, I certify that the site suitability statement provided in the contaminated land investigation document accurately states the uses or activities for which the land is suitable.

I have attached an audit report, titled *719052_QFES_HH AuditorCert_V1.0*, about my conclusions with respect to the requirements of subsections 389 (1) and 389(2) of the *Environmental Protection Act 1994*. The audit report explains and justifies how I arrived at my decision to certify that the contaminated land investigation document and its site suitability statement comply with ss. 389(1) and 389(2) of the EP Act.

Declaration

I am an auditor approved to undertake a function under s. 568(b) of the *Environmental Protection Act 1994*.

I declare that:

1. I possess qualifications and experience relevant to the audit of the contaminated land investigation document, or, where not, I have engaged an appropriately qualified and experienced support expert.
2. I have not knowingly included false, misleading or incomplete information in my certification of the contaminated land investigation document.
3. I have not knowingly failed to reveal any relevant information or document to the administering authority.
4. The certification of the contaminated land investigation document, including the audit report, addresses the relevant matters for the audit and is factually correct.
5. The opinions I have expressed in the certification and audit report are honestly and reasonably held.

Auditor's name	Mark Stuckey	
Company	Environmental Earth Sciences	
Auditor's signature	sch4p4(6) Personal information	
Date	09/03/2020	

APPENDIX C: CORRESPONDANCE WITH SQP

Table 1: Auditor comments on specific sections of the SIR

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
1		Figures	Noting the site elevation it is recommended that topography (e.g. the 10 m contour from Queensland Globe) be included on each site location/ layout plan to assist in estimation/discussion of likely groundwater and surface water flow direction if possible to do so.
2	Figures	Figure 1	<ul style="list-style-type: none"> Given accompanying Table 4 presents data for those registered bores within 500 m of the site, it may be beneficial to add a “500 m site radius” to the Figure. It is noted that an un-named water course (drain?) is presented to the north/north west of the site. Although not shown on Queensland Globe, the auditor notes a secondary (possible drainage line?) is shown on GoogleMaps to the south/ south east of the site and a surface water feature (pond/ lake/ drainage path) is shown to the south west, beyond “Home Hill Stock Feeds”. <p>Can the presence/ absence of these water courses (manmade or otherwise) be validated and presented on the figure (as applicable)? Reference to these waters should also be made in the text.</p>
3		Figures 2 to 6	<ul style="list-style-type: none"> The on-site drainage pathways shown in the south western portion of the site are a little unclear. Should the drainage running east from the engine room be connected to the drainage running north west to south east above the oil/water separator?
4		Figures 4 and 5	Please consider increasing the font size of the exceedances key at the base of the legend. (While it is noted electronically, this does not pose an issue, at print size A4 this data becomes unreadable in hard copy)
5		Figure 7	<ul style="list-style-type: none"> Please provide an indication of inferred groundwater flow direction. A label for “foam storage room” is provided, but no indicative feature on the graphic. Should this read “former foam storage room”? Given this is a CSM and distances are not intended to be represented accurately, consider including off-site water supply bores/water features as these are identified as receptors (see Figure 1). It would be particularly useful to show the depth of the water supply bores graphically – determining if these are target the same, or a deeper aquifer than that targeted by the on-site monitoring bores. <p>The size of the figure could be amended to account for these additions.</p>

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
6	Tables – Appendix B	Table T1	<ul style="list-style-type: none"> Typo (Notes): Australian height datum.
7		Table T3	<ul style="list-style-type: none"> Explain asterix (*) in final column.
8		Table T4	<ul style="list-style-type: none"> Given that commercial/ industrial are the primary criteria and residential used as secondary, consider the following amendment to exceedances mark-up to minimise the potential for external parties mis-reading data: <ul style="list-style-type: none"> Commercial industrial criteria exceedance = purple highlight Residential criteria exceedance = bold text (the use of italic text to present the criteria difference is noted, but this is not as easy to see as bold type).
9	Appendices	Appendix D	<ul style="list-style-type: none"> Can stabilised (post drilling) standing water levels be presented on the bore logs along with initial water strikes? (previous reports have presented this information adjacent to the well installation details column).
10		Appendix G	<ul style="list-style-type: none"> G4.2.4 Matrix spikes - it is noted MS recoveries for a number of compounds were less than the lower data quality objective indicating actual concentrations of these compounds in selected samples may be higher than observed. The record of non-conformances provided is thorough, but a brief concluding sentence/ paragraph should be provided as to how this may impact the data set and any significance. For consideration: Table G1 – noting that the highest number of RPD exceedances occur between the primary and secondary laboratory (referring to the appropriate RPD commentary section in Appendix I text) is it possible, as well as sample heterogeneity that differing lab methods/ lab quality could be the source of the primary/ triplicate sample RPD discrepancies? It is noted that the secondary lab generally records higher concentrations of PFAS compounds than the primary.
11		Appendix H	<ul style="list-style-type: none"> Some of the laboratory documentation provided in Appendix H is pixelated and cannot be used – please ensure laboratory documentation provided in the final report is legible). <p>(The CLA notes that the low-resolution version of the report was reviewed and this issue may not exist within the high resolution version.)</p>

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
12		Executive Summary	<ul style="list-style-type: none"> Key findings of the PSI: <ul style="list-style-type: none"> Is the Case 4 pit a main PFAS source area (or is this implying a secondary source associated with potential storage and uncontrolled release of PFAS-impacted water)? Investigation scope: <ul style="list-style-type: none"> “scope of works was completed” Did the SAQP scope call for surface water co located with sediment samples? Refer to e.g. Airlie Beach report – statement should be made to account for surface waters not being collected due to drainage channels being dry. Key findings of the DSI: <ul style="list-style-type: none"> Bullet 2, 3 and 4: As above – Is the Case 4 pit a main PFAS source area? Note also – according to the inferred groundwater flow direction (north/ north east) no wells have been placed down hydraulic gradient of the Case 4 pit, rather, the Case 4 pit lies down gradient of the QAS storage shed, the SES storage shed and down/ cross gradient to the foam training area Bullet 4: missing word “human health” Refer to previous reports (e.g. Airlie Beach); can commentary be provided regarding the distribution of PFAS compounds in relation to soil type – e.g. fill/ natural?
13	1.2	Background	<p>Please update in relation to most recent comments received from QFES pertaining to staged approach, namely:</p> <ul style="list-style-type: none"> Stage 5: Provide the final SIR to the regulator (DES) and subject to any further requirements, procure a suitable environmental consultant to design an investigation plan to measure and assess offsite impacts. Stage 6: Engage an appropriately qualified third party CLA to audit the suitability of any offsite investigation plan to meet the requirements of DES prior to implementation.
14	2.1	Site identification	The table footnote provided here is unclear. As (according to the footnote), the legal property boundary differs from the site boundary (and therefore the area investigated as part of this assessment) it would be beneficial

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			<p>to provide a figure showing the existing cadastral layout and identify investigated areas from non-investigated areas in relation to the property boundary.</p> <p>It is noted the current site layout figure (Figure 2) does not clearly demarcate Lot 6/H616666, Lot 8 SP123356 and Lot 7 H616102 and therefore the significance of the information provided in the Table footnote, in relation to the investigation, is lost.</p>
15	2.2	Site layout and features	<p>Consider inclusion of dial before you dig (DBYD) service plans to indicate how on-site stormwater and drainage (potential preferential pathways for contaminant migration) connect to municipal supply.</p> <ul style="list-style-type: none"> Is any information available pertaining to when the Case 4 pit was decommissioned? Please include some commentary pertaining to evidence (or lack thereof) of fill placement across the site.
16	2.3	Surrounding Land use	<ul style="list-style-type: none"> Paragraph 1: Introductory commentary is inconsistent with that of Section 2.4 (e.g. urban area surrounded by commercial/ industrial businesses versus "site surrounded by commercial and residential properties and recreational land). Please review references to land use and ensure consistency throughout. <p>Table 3:</p> <ul style="list-style-type: none"> General: Based on site orientation, the four site boundaries are – north east/south east/south west and north west; surrounding land uses would be better considered in this context, rather than standard compass bearings (north, east, south, west). Please review and amend as necessary. South and Southeast: According to Figure F2, the site is defined as the QFES occupied area, with the SES storage shed/ buildings located within the cadastral property boundary, but outside the designated "site" of this investigation. If the Figure F2 site boundaries are correct – the SES site use to the immediate south of the boundary should be described here alongside the Home Hill Health Service. <p>Note: A service station (Michelle's Caravan Park and Service Station) is located approximately 400 m to the north west of the site.</p>
17	2.4	Previous environmental investigation	<p>It is noted Section 2.4 is largely a reproduction/ summary of data provided in the PSI/ SAQP. Please review and ensure consistency. Ensure all relevant information is included.</p>

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			<ul style="list-style-type: none"> Bullet 3: missing word, last sentence? “form storage has always been low volume with drums (<i>do we know approximate volume?</i>) collected from a larger station (<i>do we know which?</i>) on an as needs basis.” Is any information available indicating fire fighting foam is/ has been stored on the SES property in the past? Last bullet – this information would be better placed in the hydrology/ hydrogeological section.
18	3.2	Site topography	“Stormwater drainage consists of perimeter drains”. Is this the case? The figures provided indicate limited site drainage restricted to the south western portion of the site and does not confirm presence of additional drains either around the perimeter of the site, nor drains feeding from site centre, to perimeter drains (particularly in the north east/ eastern half of the site).
19	3.5	Hydrology	<p>Please refer to drainage and surface water layers in Queensland Globe:</p> <ul style="list-style-type: none"> The water course to the north of the site is referenced on Queensland Globe as “a drain”. Can the “canal” designation be confirmed? Although not shown on Queensland Globe, the auditor notes a secondary (possible drainage line?) is shown on GoogleMaps to the south/south east of the site and a surface water feature (pond/ lake/ drainage path) shown to the south west, beyond “Home Hill Stock Feeds”. <p>Can the presence/ absence of these water courses (manmade or otherwise) be validated and presented on the figure (as applicable). Reference to these waters should also be made in text.</p> <ul style="list-style-type: none"> A drainage line is located approximately 850 m to the south west at its closest point, flowing broadly to the north east <p>Are there any records of standing water pooling on site within the naturally occurring depression?</p>
20	3.6	Hydrogeology	<ul style="list-style-type: none"> Paragraph 1 – Recommend rephrase: Based on the proximity of surface water features (Burdekin River) to the site, the inferred groundwater flow direction is to the north/ north east. Paragraph 2 “monitoring purposes”. “...and all of the bores are screened...” Table 5 – please amend for consistency with preceding reports including information on screened interval and other pertinent information as necessary (e.g. Airlie Beach).

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
21	3.8	Groundwater dependent ecosystems	<ul style="list-style-type: none"> Please provide standard footnotes (as per Airlie Beach) for GDE information sources.
22	4.2	Sampling rationale	Note – given a detailed Figure (Figure 2) is provided, presenting each sampling location, consider minimising lengthy location descriptors in favour of sampling purpose, as the location is clearly marked on the Figure.
23	4.2.1	Soil Investigation	Table 8 – Service Location; first sentence; “dial before you dig plans ”?
24	4.2.2	Groundwater Investigation	<p>Table 9</p> <ul style="list-style-type: none"> Well development - Confirm use of foot pump for well development (development at previous sites was completed via bailing). Decontamination – Decontamination of peristaltic low flow pump and bladder pumps are referenced. Please review for consistency and amend references as necessary.
25	6.2.3	Water quality parameters	It is recommended, given data is only available for four locations, that all pertinent data is presented rather than statistics (minimum and maximums).
26	6.3.1	Soil	<ul style="list-style-type: none"> Table 15 – max concentration is listed in mg/kg soil/ ecological guideline criteria listed in µg/L. Please check and amend. Consider presenting the nominated guideline values in this summary table for clarity.
27	6.3.2	Groundwater	Was the laboratory contacted to discuss the anomalous 6:2 FTS reading/ sample re-tested to determine probable cause/ significance of anomalous result? Consider presenting the nominated guideline values in Table 16 for clarity.
28	6.3.4	Sediment	Is there a significance to the sediment moisture content values specified? What is the value of presenting this data?
29	7.1.1	Soil and Geological Conditions	It is noted Section 7.1.1 describes the geological conditions as fill and re-worked anthroposols overlying natural material. However, this is the first mention of re-worked/ disturbed natural. Please review Section 7.1.1 and Section 6.1 for consistency and amend as necessary.
30	7.1.2	Hydrogeology	<ul style="list-style-type: none"> Please refer to earlier comments regarding terminology for groundwater flow direction (i.e. to the north/ north east, not “from south to north”).

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			<ul style="list-style-type: none"> Please review Paragraph 3 for sense.
31	7.2	Soil analytical results	Chart 1 – could consider attempting to overlay soil types (e.g. fill/ natural/ reworked natural) as a background to this chart to provide rapid reference to contaminant occurrence in relation to strata type. If this is too difficult, graphically, would it be possible to provide an indication (point or otherwise) of the fill/ natural interface to aid interpretation?
32	7.3	Groundwater analytical results	<p>Given assessment criteria is provided for sum of PFHxS and PFOS only, it is recognised that this has driven analytical result discussion in several sections. However, based on available data it is understood that PFHxS behaves differently (with regard to mobility in the environment) therefore consideration of these two compounds together, may mask some pertinent information with regard to contaminant transport and potential for offsite migration. This may be particularly pertinent in consideration of contaminant movement, with inferred groundwater flow direction to the north/ north east.</p> <p>Please provide separate discussion for consideration of PFHxS behaviour. Also, please present the concentrations for the individual compounds (PFHxS and PFHxA) in Figure F5 (and other relevant figures, as appropriate).</p>
33	7.4	Comparison of PFAS composition in soil and groundwater samples	As per comments 30 and 31 above, further consideration should be made to PFHxS occurrence and behaviour.
34	8.2	Sources	Should the Case 4 pit be considered a primary PFAS source given it was purported never to have contained AFFF directly? Is inclusion here an indication of a secondary source? Waters may have contained trace PFAS, stored in Case 4 pit with the potential to leak/ spill/ overflow?
35	9.0	Conclusions	Please review and amend as necessary in relation to preceding comments.

Table 2: Requirements of Module 6

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
3.1 Introduction			
State whether the CLID is a site investigation report, validation report, draft site management plan, or a combination of those.	Executive summary, paragraph 3	The report does not meet the definition of a CLID due to the absence of a regulatory trigger. However, the report does state that it is a site investigation report (SIR) for the detailed site investigation (DSI)	No
State why the contaminated land investigation document was prepared and note any statutory triggers.	1.1 General (Introduction)	No statutory triggers listed as none present.	No
State what the desired outcome is (e.g. to have the particulars of the land removed from, or amended on, the relevant land register).	1.3 Objectives	The auditor agrees with the desired outcomes.	No
State whether the document provides final information about the site and its intended use, or whether it is likely that one or more contaminated land investigation documents will be prepared in the foreseeable future for the same site and its same intended use.	1.2 Background	Table 2 confirms both current and future use.	No
3.2 Site Investigations			
Describe and illustrate all the site investigations that were used when preparing the contaminated land investigation document, including any that may have been undertaken for previous purposes.	Executive summary: Key findings of the PSI; Section 2.4: Previous environmental investigation; Section 7.3 Groundwater analytical results	Information pertaining to previous environmental investigations has been provided appropriately.	No
3.3 Reasons the land is on a relevant land register			
Identify and describe the land by the following information:			
· street address of the site	Table 2		No

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
· registered lot-on-plan details		Table 2		No
· owner(s) of the land and their registered address		Table 2		No
· current occupier(s) of the land		Table 2		No
· area of the land (m2 or hectares)		Table 2		No
· map of the site at a suitable scale, showing lot and plan boundaries, and latitude and longitude in decimal degrees		Figure 2		No
· relevant local government authority		Table 2		No
· zoning of the site and the surrounding land on the local government's planning scheme (current and proposed)		Table 2		No
· any proposed changes to the zoning of the site and the surrounding land on the local government's planning scheme		Table 2		No
· any existing, pending or proposed development approval or building works approval.		Not provided	Not relevant to this report	No
State whether or not the land is currently listed on the EMR or the CLR and provide the identifying number on the EMR or CLR. Provide a short history (if available) of when any listing(s) occurred, and any changes that were made to the listings.		Table 2		No
Describe the past and current activities and use(s) of the land that resulted in its potential or actual contamination and its listing on the register. Describe and map the locations where those activities occurred. In particular, address any notifiable activities and/or environmentally relevant activities.		Section 2.2: Site layout and features; Section 2.4 Previous environmental investigation	Figures and text to be updated in consideration of comments pertaining to former activities on site (e.g. foam training).	Yes

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
3.4 Surface and subsurface infrastructure				
	Describe all surface and subsurface infrastructure on the land, including details of the location, size and type of the infrastructure. Relevant infrastructure includes pipes, tanks, drains, dams, bores, buildings and foundations.	Section 2.2 Site layout and features/Figure 2	Additional information would be useful, particularly in relation to clarification on existing, marked up site drainage pathways (as per comments above) and potential offsite migration pathways (e.g. dial before you dig (DBYD) search results to be provided.)	Yes
	Describe any infrastructure that has contributed to contamination of the site, even if that infrastructure has since been removed.	Section 2.2 Site layout and features/Figure 2		No
	Describe any infrastructure that may either retard or increase the movement of contaminants and describe how the effect may occur. For example, bedding sand for stormwater drainage or sewerage pipes can act as a preferential pathway for contaminants even if the pipe itself has been removed.	Section 8.4 Migration mechanisms		No
	Describe any infrastructure that would need to be removed or repositioned to facilitate any remediation of the site.	Not applicable		No
3.5 Site and surrounding area				
	Provide a description of the site and surrounding area of the land. The description of the site and surrounding area must address the following matters (see s. 389(1)(c) of the EP Act):			
	· all environmentally sensitive areas	Section 3.8: GDEs and Environmentally sensitive areas		No
	· the location of all water, watercourses and wetlands	Section 3.4: Hydrology, Section 3.8 GDEs and Environmentally sensitive areas	Section 3.5 please review and confirm information pertaining to surface waters	Yes
	· the location of all stormwater drainage	Section 2.2 Site layout and features		No

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
· all uses of the land, including uses that may affect the safety of the relevant land or cause environmental harm		Section 2.3 Surrounding land use Table 1	Please review in relation to minor comments provided.	Yes
· all activities carried out that may affect the safety of the relevant land or cause environmental harm		Section 2.4: Previous environmental investigation Table 1		No
Describe the climate of the area of the land, and the vegetation on the site and the surrounding area.		Section 3.1		No
Illustrate the description with maps, diagrams and photographs, and include the topography of the area. If the site and/or its surrounding land have areas of low relief, illustrate the topography on maps with contours at no more than 1m intervals.		Section 3.1 Site topography.	Contour plans with 1 m intervals not provided. This data may be useful to assist in determining likely groundwater and surface water flow directions if feasible, contingent on site topography.	Yes
Describe the stormwater drainage, delineate the catchments, and include any stormwater quality improvement devices, weirs, sediment basins, storage dams, and so on. Include the potential for stormwater drainage to affect the movement of contaminants. Also, address flood risk and locations where significantly large pools of water occur during or after rain events.		Section 2.2 Site layout and features; Section 2.4 Previous environmental investigation; Section 3.5 Hydrology		No
3.6 Waste disposed of or stored on the land				
Provide details of any waste that has been disposed of on the land, or that is or was stored on the land. Under Queensland law, waste is defined by s. 13 of the EP Act. The details should include the location, quantity and type of the waste, and the method(s) of its storage or disposal.		Section 2.4 Previous environmental investigation	Waste storage discussed in terms of PFAS only, which is sufficient to meet the objectives of this report.	No
Address any potential contamination of the land caused by storing or disposing of the waste on the land, such as might occur through the failure or breaching of an underground containment cell, the deterioration		Section 2.4 Previous environmental investigation		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
of storage vessels, or an accident such as a fire. That is, disposal should be taken to include accidental spills or releases.			
The description should also include any waste that may have been extracted, then moved or stored at the site during earthworks (see also section 3.9 below). Suitably qualified persons must search all available records when researching information for this section of the report.	Section 2.2	Commentary should be provided regarding emplacement of fill on site (as per comment above).	Yes
3.7 Geology and hydrogeology			
Describe the geology and hydrogeology of the land, including soils, subsoils, rock strata, aquifers, and aquitards.	Section 3.3 Soil type and ASS; Section 3.4 Geology; Section 3.5 hydrology, Section 3.6 Hydrogeology, Section 6.1 Soil conditions, Section 6.2 Hydrogeology		No
Describe the environmental values to be enhanced or protected under the <i>Environmental Protection (Water) Policy 2009</i> .	Section 3.7		No
Guidance: The contaminated land NEPM (particularly its Schedules B2, B3 and B6) provides advice in regard to this requirement. However, there is a large body of research, other texts and sources of information about geology and hydrogeology that should be used to supplement the NEPM. When developing a concept or model of the groundwater system, comply with the <i>Australian groundwater modelling guidelines</i> (National Water Commission, June 2012).			
Assess how the geology and hydrogeology of the land would affect the movement or retention of contaminants within soils, subsoils, and rock strata.	Section 6.1 Hydrogeology and Section 6.3 Soil analytical results, Section 8.0: Conceptual Site Model - PFAS		No
Describe groundwater quality and groundwater levels and flow directions.	Section 3.6: Hydrogeology; Section 6.1 Soil conditions, Section 6.2 Hydrogeology, Section 7.		No
Describe any barriers to, and migration pathways for, the dispersal of contaminants in groundwater.	Section 8.0: Conceptual Site Model - PFAS		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Assess the rate at which any contaminants may move through or out of the ground.	Section 3.6: Hydrogeology; Section 6.1 Hydrogeology; Section 6.1 Soil conditions, Section 6.2 Hydrogeology, Section 7.	<p>Limited information pertaining to the likelihood of “low hydraulic conductivity clays” that may retard vertical and lateral migration of PFAS has been provided.</p> <p>It is noted the purpose of this assessment was to determine the concentration and distribution of PFAS on the site and near the site boundaries. However, now noting that PFAS may be migrating beyond the site boundary, further consideration should be given to the assessment of permeability and hydraulic conductivity of water bearing zones underlying the site, to facilitate the lateral delineation of any PFAS plumes and assessment of risk to off-site receptors.</p> <p>This may be subject to assessment in a subsequent report.</p>	Yes
If there has been irrigation of waste water to land, or subsurface injection of waste water, describe the quantity and quality of waste water and the geological material and strata onto or into which the irrigation or injection occurred.	Not provided	Assumed not to occur	No
Describe the natural geochemistry including acid sulfate soils, or sulfide bearing minerals, if they might be present.	Section 3.3		No
Describe any naturally occurring toxicants that are present in quantities or concentrations that might affect the use or management of the site.	Not provided	Not relevant to this assessment	No
Address liquid and gaseous contaminants that may be dispersed in pore spaces, and assess the potential for, and the likely rate of, dispersal of contaminants to the atmosphere.	Not provided	Not relevant to this assessment	No

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
	Assess whether the dispersal of contaminants from the ground could impact on air quality in buildings.	Not provided	Not relevant to this assessment	No
	If groundwater remediation is required, assess how effectively the site's contamination could be remediated, describe any limitations, and assess the likely residual contamination.	Not provided	Not relevant to this assessment	No
3.8 Environmentally relevant activities or notifiable activities				
	Provide details of any environmentally relevant activities or notifiable activities carried out on the land, whether formerly or currently	Not provided	Please provide reference to ERA search completed during PSI and findings (e.g. no ERAs/ notifiable activities identified at the site)	Yes
	Focus on the materials used and waste produced during the carrying out of the activities that could be sources of on-site or offsite contamination.	Section 8.4 Receptors and exposure pathways		No
	Illustrate on maps where any environmentally relevant activities or notifiable activities were carried out.	Figure F2		No
3.9 Earthworks				
	Provide details of any earthworks carried out on the land, including an inventory of any earth taken out to be treated or dumped elsewhere, and/or earth brought on to the site as fill.	Section 2.2	Commentary should be provided regarding emplacement of fill on site (as per comment above).	Yes
	Provide maps and cross-sections to illustrate how earthworks have changed the topography and geology of the land.	As above	As above.	No
	Integrate the description of any earthworks with the required description of the site's watercourses, wetlands, geology and hydrogeology.	As above	As above.	No
	Address whether the earthworks could be a source of contamination.	As above	As above.	No

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
	Assess how earthworks may have affected how water and/or other liquids move over, into or through the ground dispersing contaminants.	As above	As above.	No
3.10 Contamination				
Provide details of the site investigations and the findings of those investigations with regard to contamination of the site, particularly the extent, fate and movement of contamination. Describe in detail all:				
	· Desk-top assessments of the site	Section 2.4: Previous environmental investigation	Information is summarised. PSI/ SAQP (AECOM, 2019) is referenced for full details of the desktop assessment.	No
	· Site inspections	Section 2.2 Site Layout and features; Section 2.4 Previous environmental investigation	Information is summarised. PSI/ SAQP (AECOM, 2019) is referenced for full details of site inspection & site interview details.	No
	· Sampling of soil, water, and any other media	Section 2.4: Previous environmental investigation (historic data), Section 4: Fieldwork – DSI, Section 6: Results, Section 7: Discussion		No
	Provide maps and diagrams, including cross-sections where necessary, to illustrate the site and where sampling has taken place on the site or its surrounds.	Figures: Site layout & sampling locations	Please refer to individual comments regarding recommended amendments to figures	Yes
	Provide details of a site conceptual model using text, tables and/or diagrams.	Section 8, Table 19		No
	Describe the methods used to take, store, preserve and analyse samples of media. Discuss any limitations to those methods that may affect reliance on the results. Samples must be collected in accordance with appropriate standards, and the chain of custody of samples must be fully recorded. If the samples were handled and/or analysed by a third-party, identify the laboratory or contractor(s) that undertook the work, and state whether or not they are accredited (e.g. by the National Association of	Section 4.0 – Fieldwork Appendix G: Analytical Data Validation	Refer to individual comments regarding additional considerations for data validation (e.g. anomalous 6:2 FTS result).	Yes

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
	Testing Authorities, Australia (NATA)). If the laboratory or contractor is not accredited by NATA or a similar body, explain how the methods have been appropriately validated.			
	Describe and validate the methods used to interpolate and extrapolate, from the sampling results, the spatial extent of any contamination.	Section 6: Results, Section 7: Discussion, Figures 2 to 5.		No
	s. 389(2)(b)(ii) of the EP Act requires that the contaminated land investigation document states the extent to which the land is contaminated. Describe and illustrate (with data tables, maps, diagrams and cross-sections at suitable scales) the location(s) of any residual contamination, and the quantities or concentrations of contaminants.	Section 6: Results, Section 7: Discussion, Figures 2 to 5.		No
	Assess, describe and illustrate the potential risks of contamination either moving off the relevant land to any surrounding area, or moving onto the relevant land from any offsite sources of contamination. The assessment should determine whether there is prescribed contaminated land.	Section 8: Conceptual Site Model - PFAS		No
	Assess the levels of contaminants against applicable criteria, considering all relevant environmental values, including human health, amenity, and ecological values.	Section 6.3 Analytical results, Section 7 discussion, Tables T4 and T5.		No
	Derive environmental values for water pursuant to the Environmental Protection (Water) Policy 2009 (EPP(Water)), Australian water quality guidelines for fresh and marine waters (ANZECC & ARMCANZ, 2000), and the Queensland water quality guidelines 2009 (EHP, republished in 2013). Include environmental values that relate to potential uses; for example, saline groundwater may be treated by reverse osmosis for potable or stock use during a drought, and therefore has a current environmental value. Furthermore, all environmental values that derive from Queensland's environmental protection policies cannot be subsequently disregarded or diminished by applying the contaminated land NEPM's risk-based process.	Section 3.6, Section 5.0	Assessment criteria has been provided in Table 10. However, the NEMP does not provide trigger values for all the identified EVs. Provide commentary on how the adopted assessment criteria will ensure a suitable level of protection for all EVs identified.	Yes

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
	Assess how the levels of contaminants would impact on all current and foreseeable future uses, while taking account of the likely extent that the contamination can be remediated (see also the following section).	Section 8 Conceptual site model	An assessment of contaminant remediation has not been completed at this stage of the assessment.	No
	If the land was found to be not contaminated, the contaminated land investigation document should justify how the conclusion was reached, with reference to the site investigations and any remediation (see also the following section).	Not provided	Not relevant to this assessment	No
3.15 Accordance with the NEPM				
As mentioned above, s. 389(2)(b)(iv) of the EP Act requires a contaminated land investigation document to make a statement of the extent to which it is in accordance with the contaminated land NEPM. Nevertheless, the contaminated land NEPM cannot override state legislation or policies. In practice, a contaminated land investigation document must:				
	• explicitly reference the various schedules of the NEPM	Various		No
	• mention which schedules were or were not applicable when preparing the document	Section 1.6		No
	• state the extent to which the applicable schedules were followed	Various	It is noted, given the nature of the investigation (PFAS DSI) that the investigation was undertaken in general accordance with the NEPM, but, generally with greater reference to the NEMP. Reference to applicable NEPM schedules and the NEMP have been made.	No
	• describe the extent of any deviations from the recommendations of the NEPM's schedules	Appendix G- QA/QC		No
	• explain whether any deviations were due to overriding state legislation or policies	As above	As above	No
	• evaluate with reference to current best practice how effective any alternative methods were in comparison to those of the NEPM.	As above	As above	No

Requirement	Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
	The contaminated land investigation document must demonstrate that the investigation components of an assessment of site contamination listed in Section 1 of Schedule B2 of the contaminated land NEPM have been conducted for every stage of investigation. The components include a conceptual site model, data quality objectives, a sampling strategy, and a sampling and analysis quality plan. Those components should be updated as the investigations acquire better information about the site.	Section 8: Conceptual site model, Appendix G: Data quality objectives, Section 4: Fieldwork- DSI.		No

APPENDIX D: SELECT REGISTERED BORE CARDS

Queensland Government
Groundwater Information
Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
175675	Sub-Artesian Facility	Existing	09/01/2018	Ayr	1900 - BURDEKIN
Details			Location		
Description			Latitude	19-39-30	Basin 1200
Parish	6000 - NO LONGER USED		Longitude	147-25-07	Sub-area
Original Name	DOMESTIC		GIS Latitude	-19.6584503827	Lot 24
			GIS Longitude	147.4188380695	Plan RP713255
			Easting	543883	
Driller Name	PARRAVICINI, ROBERT		Northing	7826273	Map Scale
Drill Company	BURDEKIN IRRIGATION CO		Zone	55	Map Series
Const Method	CABLE TOOL		Accuracy	GPS	Map No
Bore Line			GPS Accuracy	20	Map Name
D/O File No	NOR/065185	Polygon	Checked	Yes	Prog Section
R/O File No		Equipment			
H/O File No		RN of Bore Replaced			
Log Received Date	08/02/2018	Data Owner	DNR		
Roles	Water Supply				

Casing 4 records for RN 175675

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	09/01/2018	1	0.00	20.00	Polyvinyl Chloride	5.000	WT - Wall Thickness	115
A	09/01/2018	2	18.80	20.00	Perforated or Slotted Casing	0.500	AP - Aperture Size	115
X	09/01/2018	3	5.00	7.00	Cuttings or other fill between casing and hole wall			150
X	09/01/2018	4	0.00	5.00	Grout			200

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.20	TOP SOIL
2	1.20	7.00	RED SILT
3	7.00	20.00	BROWN COARSE SAND - WATER @ 9.45 METRES
4	20.00		WHITE CLAY BOTTOM

Stratigraphies

0 records for RN 175675

Aquifers

1 records for RN 175675

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	7.00	20.00	SAND - Sand	09/01/2018	-9.45	N	POTABLE	2.60	Y	XX	

Pump Tests Part 1

0 records for RN 175675

Pump Tests Part 2

0 records for RN 175675

Bore Conditions

0 records for RN 175675

Elevations

0 records for RN 175675

Water Analysis Part 1

0 records for RN 175675

Water Analysis Part 2

0 records for RN 175675

Water Levels

0 records for RN 175675

Wire Line Logs

0 records for RN 175675

Field Measurements

0 records for RN 175675

Special Water Analysis

0 records for RN 175675

From Year:

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Queensland Government
Groundwater Information
Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
175674	Sub-Artesian Facility	Existing	05/01/2018	Ayr	1900 - BURDEKIN
Details			Location		
Description			Latitude	19-39-32	Basin 1200
Parish	6000 - NO LONGER USED		Longitude	147-25-11	Sub-area
Original Name	DOMESTIC		GIS Latitude	-19.6590747268	Lot 5
			GIS Longitude	147.4198192388	Plan RP717429
			Easting	543999	
Driller Name	PARRAVICINI, ROBERT		Northing	7826211	Map Scale
Drill Company	BURDEKIN IRRIGATION CO		Zone	55	Map Series
Const Method	CABLE TOOL		Accuracy	GPS	Map No
Bore Line			GPS Accuracy	10	Map Name
D/O File No	NOR/065185	Polygon	Checked	Yes	Prog Section
R/O File No		Equipment			
H/O File No		RN of Bore Replaced			
Log Received Date	08/02/2018	Data Owner	DNR		
Roles	Water Supply				

Casing 4 records for RN 175674

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	05/01/2018	1	0.00	20.00	Polyvinyl Chloride	5.000	WT - Wall Thickness	115
A	05/01/2018	2	18.80	20.00	Perforated or Slotted Casing	0.500	AP - Aperture Size	115
X	05/01/2018	3	5.00	7.00	Cuttings or other fill between casing and hole wall			150
X	05/01/2018	4	0.00	5.00	Grout			200

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.10	TOP SOIL
2	1.10	7.00	RED SILT
3	7.00	20.00	BROWN COARSE SAND - WATER @ 10.3 METRES
4	20.00		STILL GOING DID NOT BOTTOM

Stratigraphies

0 records for RN 175674

Aquifers

1 records for RN 175674

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	7.00	20.00	SAND - Sand	05/01/2018	-10.30	N	POTABLE	2.60	Y	XX	

Pump Tests Part 1

0 records for RN 175674

Pump Tests Part 2

0 records for RN 175674

Bore Conditions

0 records for RN 175674

Elevations

0 records for RN 175674

Water Analysis Part 1

0 records for RN 175674

Water Analysis Part 2

0 records for RN 175674

Water Levels

0 records for RN 175674

Wire Line Logs

0 records for RN 175674

Field Measurements

0 records for RN 175674

Special Water Analysis

0 records for RN 175674

From Year:

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Obligations:

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Queensland Government
Groundwater Information
Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
175547	Sub-Artesian Facility	Existing	07/10/2017	Ayr	1900 - BURDEKIN
Details			Location		
Description			Latitude	19-39-29	Basin 1200
Parish	6000 - NO LONGER USED		Longitude	147-25-07	Sub-area
Original Name	DOMESTIC AND IRRIGATION		GIS Latitude	-19.6581472958	Lot 26
			GIS Longitude	147.4186650573	Plan RP713255
			Easting	543883	
Driller Name	PARRAVICINI, ROBERT		Northing	7826304	Map Scale
Drill Company	BURDEKIN IRRIGATION CO		Zone	55	Map Series
Const Method	CABLE TOOL		Accuracy	GPS	Map No
Bore Line			GPS Accuracy	10	Map Name
D/O File No	NOR/065185	Polygon	Checked	Yes	Prog Section
R/O File No		Equipment			
H/O File No		RN of Bore Replaced			
Log Received Date	27/11/2017	Data Owner	DNR		
Roles	Water Supply				

Casing 4 records for RN 175547

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	07/10/2017	1	0.00	20.12	Polyvinyl Chloride	0.500	WT - Wall Thickness	115
A	07/10/2017	2	18.90	20.12	Perforated or Slotted Casing	0.500	AP - Aperture Size	115
X	07/10/2017	3	5.00	7.00	Cuttings or other fill between casing and hole wall			150
X	07/10/2017	4	0.00	5.00	Grout			200

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.30	TOP SOIL
2	1.30	7.00	RED SILT
3	7.00	20.12	BROWN COARSE SAND
4	20.12		WHITE CLAY BOTTOM

Stratigraphies

0 records for RN 175547

Aquifers

1 records for RN 175547

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	7.00	20.12	SAND - Sand	07/10/2017	-9.45	N	POTABLE	2.60	Y	XX	

Pump Tests Part 1

0 records for RN 175547

Pump Tests Part 2

0 records for RN 175547

Bore Conditions

0 records for RN 175547

Elevations

0 records for RN 175547

Water Analysis Part 1

0 records for RN 175547

Water Analysis Part 2

0 records for RN 175547

Water Levels

0 records for RN 175547

Wire Line Logs

0 records for RN 175547

Field Measurements

0 records for RN 175547

Special Water Analysis

0 records for RN 175547

From Year:

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Queensland Government
Groundwater Information
Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
175546	Sub-Artesian Facility	Existing	05/10/2017	Ayr	1900 - BURDEKIN

Details			Location		
Description			Latitude	19-39-31	Basin 1200
Parish	6000 - NO LONGER USED		Longitude	147-25-12	Sub-area
Original Name	DOMESTIC AND IRRIGATION		GIS Latitude	-19.65861111	Lot 22
			GIS Longitude	147.42	Plan RP717429
			Easting	544028	
Driller Name	PARRAVICINI, ROBERT		Northing	7826242	Map Scale
Drill Company	BURDEKIN IRRIGATION CO		Zone	55	Map Series
Const Method	CABLE TOOL		Accuracy	GPS	Map No
Bore Line			GPS Accuracy	10	Map Name
D/O File No	NOR/065185	Polygon	Checked	Yes	Prog Section
R/O File No		Equipment			
H/O File No		RN of Bore Replaced			
Log Received Date	27/11/2017	Data Owner	DNR		
Roles	Water Supply				

Casing 4 records for RN 175546

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	05/10/2017	1	0.00	20.12	Polyvinyl Chloride	5.000	WT - Wall Thickness	115
A	05/10/2017	2	18.90	20.12	Perforated or Slotted Casing	0.500	AP - Aperture Size	115
X	05/10/2017	3	5.00	7.31	Cuttings or other fill between casing and hole wall			150
X	05/10/2017	4	0.00	5.00	Grout			200

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.20	TOP SOIL
2	1.20	7.31	RED SILT
3	7.31	20.12	BROWN COARSE SAND - WATER @ 9.45
4	20.12		STILL GOING - DID NOT HIT BOTTOM

Stratigraphies

0 records for RN 175546

Aquifers

1 records for RN 175546

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	7.31	20.12	SAND - Sand	05/10/2017	-9.45	N	POTABLE	2.60	Y	XX	

Pump Tests Part 1

0 records for RN 175546

Pump Tests Part 2

0 records for RN 175546

Bore Conditions

0 records for RN 175546

Elevations

0 records for RN 175546

Water Analysis Part 1

0 records for RN 175546

Water Analysis Part 2

0 records for RN 175546

Water Levels

0 records for RN 175546

Wire Line Logs

0 records for RN 175546

Field Measurements

0 records for RN 175546

Special Water Analysis

0 records for RN 175546

From Year:

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Queensland Government
Groundwater Information
Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
153225	Sub-Artesian Facility	Existing	05/12/2011	Ayr	1900 - BURDEKIN
Details			Location		
Description			Latitude	19-39-23	Basin 1200
Parish	2441 - INKERMAN		Longitude	147-24-59	Sub-area
Original Name			GIS Latitude	-19.65642464	Lot 55
			GIS Longitude	147.4165141	Plan H6168
			Easting	543664	
			Northing	7826485	Map Scale
Driller Name	SCHULTZ, JASON		Zone	55	Map Series
Drill Company	B&M DRILLING		Accuracy		Map No
Const Method	CABLE TOOL		GPS Accuracy		Map Name
Bore Line			Checked	Yes	Prog Section
D/O File No		Polygon			
R/O File No		Equipment			
H/O File No		RN of Bore Replaced			
Log Received Date	19/01/2012	Data Owner	DNR		
Roles	Water Supply				

Casing 3 records for RN 153225

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	05/12/2011	1	0.00	15.15	Polyvinyl Chloride	7.550	WT - Wall Thickness	170
A	05/12/2011	2	15.15	16.15	Stainless Steel	1.020	AP - Aperture Size	170
X	05/12/2011	3	0.00	5.00	Grout			325

Strata Logs 5 records for RN 153225

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	3.00	HARD BROWN CLAY
2	3.00	2.70	FINE DRY SAND
3	2.70	7.00	HARD BROWN CLAY
4	7.00	8.50	FINE TO MEDIUM DIRTY CLAY BOUND SAND *
5	8.50	16.15	FINE TO MEDIUM SAND AND STONES *

Stratigraphies 0 records for RN 153225

Aquifers 1 records for RN 153225

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	15.15	16.15	CSAN - Clayey Sand	05/12/2011	-6.50	N	POTABLE	7.50	Y	XX	BURDEKIN RIVER ALLUVIUM

Pump Tests Part 1 0 records for RN 153225

Pump Tests Part 2 0 records for RN 153225

Bore Conditions 0 records for RN 153225

Elevations 0 records for RN 153225

Water Analysis Part 1 0 records for RN 153225

Water Analysis Part 2 0 records for RN 153225

Water Levels 0 records for RN 153225

Wire Line Logs 0 records for RN 153225

Field Measurements 0 records for RN 153225

From Year:

Special Water Analysis	0 records for RN 153225
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