ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

AUDITOR CERTIFICATION REPORT & STATEMENT OF REASONS: TOOWOOMBA FIRE STATION, 201 ANZAC AVENUE, HARRISTOWN, QLD

QUEENSLAND FIRE AND EMERGENCY SERVICES

13 MARCH 2020
719052 TOOWOOMBA
VERSION 1.0

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

13 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 Toowoomba Fire Station, 201 Anzac Avenue, Harristown, 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 and/or ecological health risk so site users and is suitable for ongoing commercial/ industrial use. Whilst there appears to be a low potential for off-site PFAS migration via groundwater, and hence the site is not considered to pose an unacceptable risk to off-site human health and/or ecological receptors based on the available on-site data, further assessment (on- and off-site) is recommended.

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

For and on behalf of
Environmental Earth Sciences QLD

Report Author
Mark Stuckey
Contaminated Land Auditor

Project Manager/ Auditor Assistant
Kat Spruth
Senior Environmental Scientist

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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 Toowoomba Fire Station (201 Anzac Avenue, Harristown, QLD "the site"), legally described as Lot 2, RP132831.

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 Toowoomba (Anzac Avenue) Fire Station, 201 Anzac Avenue, Harristown, Queensland. Prepared for Queensland Fire and Emergency Services. Ref: 60609758 Revision 0 (Final). Dated 26 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. Further, although elevated contaminant concentrations (sum of PFOS & PFHxS) greater than human health and ecological assessment criteria were identified in all five on-site groundwater monitoring bores, based on the distribution of concentrations observed, there is an apparent a low potential for off-site migration of PFAS contamination in groundwater.

Given the above, 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. Whilst the PFAS contamination plume appears largely restricted to the centre of the site, and the site is deemed to pose an acceptable risk to off-site down-gradient human and/or ecological receptors (based on current on-site data), further investigation is recommended.

Additional assessment could be undertaken, including to the north-west and west of the site, to validate that surface water, sediment, soil and groundwater contamination poses a negligible risk to off-site receptors (commercial/ industrial properties and potential transient ecological receptors associated with open, undeveloped ground).

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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 Toowoomba Fire Station (201 Anzac Avenue, Harristown, QLD, "the site"), legally described as Lot 2 RP132831. 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*.

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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 during the soil sampling/ groundwater bore installation program (on 20 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	201 Anzac Avenue, Harristown, Toowoomba, QLD 4350
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	Toowoomba Regional Council
Zoning/ future zoning	Medium impact industry/ manufacturing and industrial land use
Lot and plan	Lot 2, RP132831
Tenure	Freehold
Latitude/longitude	-27.571767, 151.924085
Site area	6,457 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

Figure 1: Site location Plan (reproduced from AECOM 2019b)

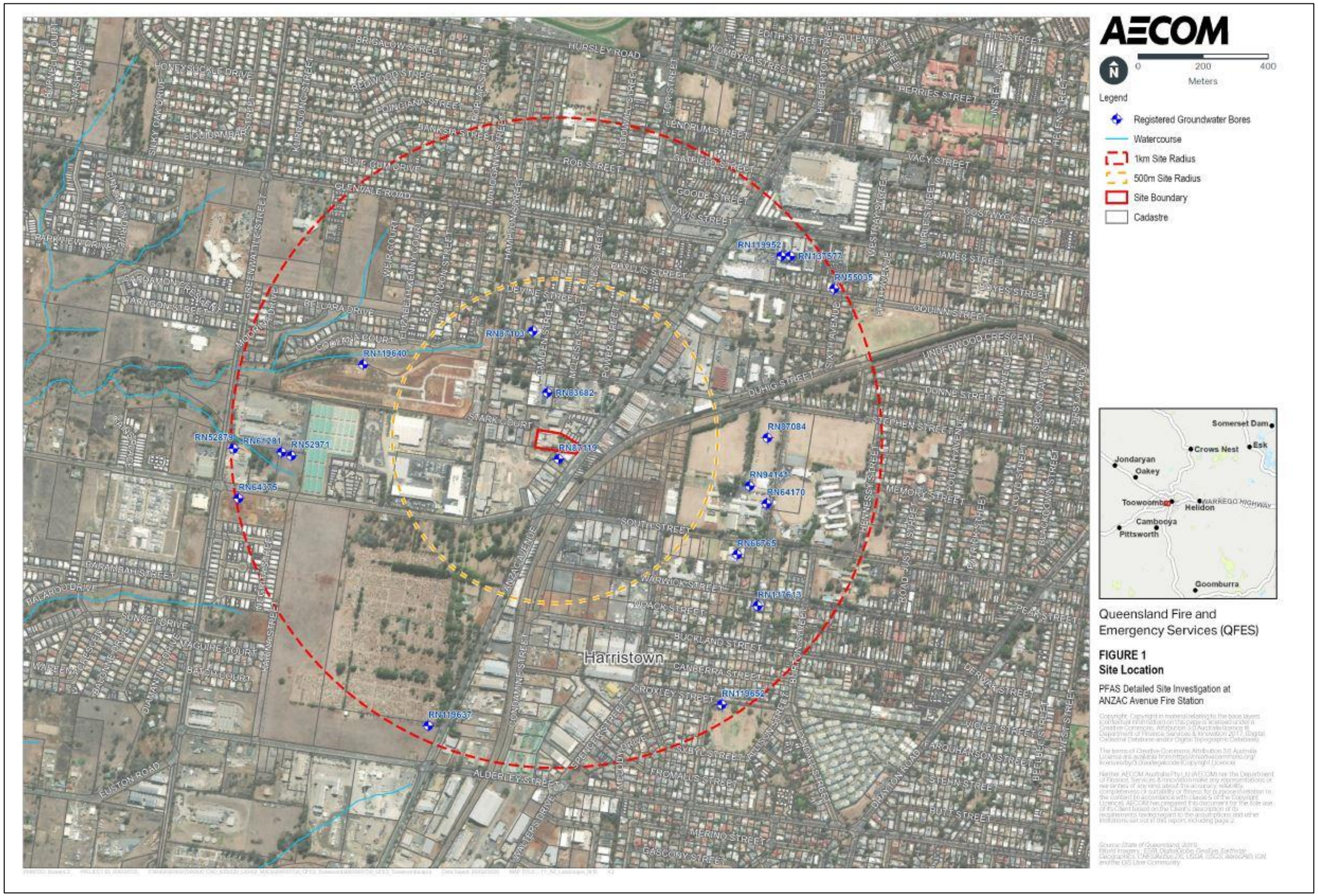
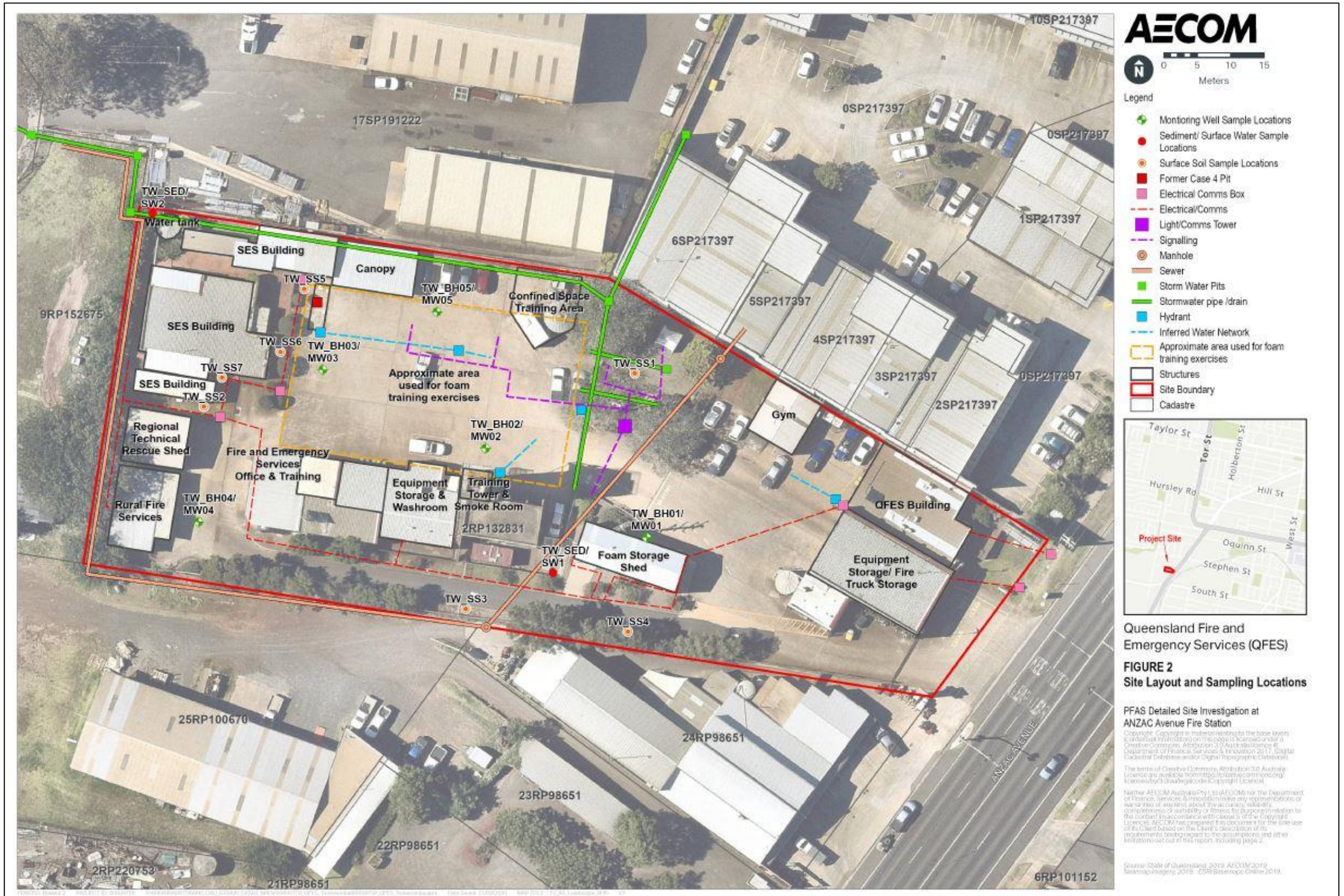


Figure 2: Site layout and sampling locations (reproduced from AECOM 2019b)



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. Key site features included:

- One two-storey building along the eastern edge of the site housing the main engine bay, and a number of interconnected rooms including office/administration areas, ablution and equipment storage areas;
- A storage shed, located adjacent to the southern boundary, used for the storage of foam, firefighting appliances and operational equipment;
- A training tower and smoke room;
- A combined office and training building, connected to the training tower and smoke room, understood to operate as an equipment and personal protective equipment (PPE) maintenance facility, with a designated washroom and breathing apparatus (BA)/ hazardous materials (HAZMAT) facility;
- Four buildings in the western end of the site, occupied by the State Emergency Services (SES) comprising three demountable buildings designated fr storage and training and one building utilised as an office area with a 2,000 L above-ground water tank, located adjacent to the buildings western outer wall. It is understood this building is the regional office for SES operations in the southwestern region.
- A storage and equipment shed, located adjacent to the centre of the site western boundary, used by QFES Regional Technical Rescue (RTS) for equipment storage;
- A demountable building, located on the southern portion of the western boundary with a 2,000L water tank on the western exterior wall, used by the Rural Fire Service (RFS);
- A confined space training area in the central northern portion of the site, comprising an old grain silo, several large concrete pipes and drains;
- A small raised landscaped area (unsealed, grass surface, with shrubs, separated by a 1.0 m high retaining wall), located along the northern boundary, with a small garden shed within
- A decommissioned[2] concrete in-ground water tank (Case 4 pit) with a former holding capacity of 165,400 L formerly used for static water supply and collection of stormwater run-off; and

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

- Open hardstand areas utilised for car-parking, outdoor storage covering approximately 90% of the remaining site surface

The site is accessed via hardstand driveway from Anzac Avenue, to the east.

4.2.2 Surrounds

Surrounding land uses include:

- **North:** A commercial retail park (189 Anzac Avenue) and a metal working workshop are located adjacent to the site, to the north with further commercial/industrial properties beyond. Residential properties are present along Stephen Street, approximately 195 m to the north. Two Toowoomba Regional Council Depots are present approximately 130 m to the north of the site on the east and west sides of Anzac Avenue “Harristown East” and “Harristown West” Depots, respectively. Note that Mark Stuckey has previously provided Auditor Certification of CLIDs for both these sites, certifying that they are “suitable for unrestricted use” (Environmental Earth Sciences, 2017 and 2018).

- **East:** Anzac Avenue with commercial/ industrial properties including the Stock Exchange Hotel an automotive workshop and the South Western Railway line beyond. The Concordia Lutheran College and Harristown State High School are located 350 m and 580 m to the east, respectively.

- **South:** Commercial buildings and a former scrap yard adjoin the site, to the south with the Drayton and Toowoomba Cemetery beyond (approximately 300 m from the site boundary). The nearest residential properties are located at a range of approximately 470 m, to the south east along Warwick Street. A BP fuel depot is situated approximately 800 m to the south of the site.

- **West:** An open, undeveloped area, understood to be a former scrap yard, is located adjacent to the site, to the west with an Ergon Energy Depot and welding works present beyond. Note that Environmental Earth Sciences has previously investigated the Ergon Energy Depot (Environmental Earth Sciences, 2009).

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 Toowoomba Regional Council Interactive mapping portal and the Queensland Governments (QImagery online) from 1946, 1955, 1963, 1971, 1972, 1975, 1982, 1988, 1992, 1994, 1998, 2000, 2003, 2006,2009, 2010, 2013, 2015, 2017 and 2018.

- 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

- Interviews with nominated QFES personnel and site inspection (22 January 2019).

The purpose of the review was, primarily, 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 a fire station for approximately 44 years (since 1975). 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 the late 1980's 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.

It is not known in what year concrete hardstand was placed at the site, or if AFFFs were historically applied to unsealed surfaces prior to placement of hardstand, therefore infiltration and subsequent mobilisation in the subsurface may have occurred.

No inadvertent releases of foam/significant spillage/ leakage events at the site were recorded. However, it is noted

In addition to the above it is noted a fuel farm (potentially an off-site source of PFAS) was historically (pre-2006) located adjacent to the site, to the north.

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 (S-P-R linkages). The CSM, as required by the NEPC (2013), is an iterative process constantly being updated during the investigation process as more information becomes available. NEPC (2013) details S-P-R analysis in Schedule B2 Section 4, and geophysical characteristics in Schedule B2 Sections 3.4 (environmental setting), 3.5 (geology and hydrogeology), 5.2 (Data Quality Objectives, DQOs) 5.3 (SAQPs) and 6 (sampling design, in particular density and depth of sampling in Section 6.4).

6.1 Physical setting topography, hydrology and drainage

Surface levels at the site range from approximately 648 metres Australian Height Datum (m AHD) in the east to 645 m AHD in the west/ north west. The site is effectively halved into two areas with surface levels in the east approximately 1.5-2 m higher than the western half of the site. The two areas are connected via a gently sloping ramp in the centre of the site.

Stormwater at the site is collected, in the western half, via a perimeter drain which runs parallel to the northern boundary, connecting to the municipal drainage system in the norther western corner of the site, which in turn, drains to the west, along Stark Court. No stormwater drains were observed in the eastern portion of the site and it is understood surface water is likely to runoff via the ramp to the west and subsequently be captured in the perimeter drains therein.

The closest hydrological feature to the site is an unnamed “non-perennial” water course, likely ephemeral, located approximately 325 m to the north-west and 771 m west of the site. The water course runs broadly to the southwest, discharging to Spring Creek approximately 3.6 km to the south-west of the site.

Additional water features in the vicinity of the site include:

- Several unnamed ponds/surface water features approximately 1.4 km to the north at the Clifford Park Racecourse,
- A tributary of Spring Creek, located approximately 300 m north-west of the site at its closest point (see **Figure 1**);
- West Creek located approximately 2.2 km east of the site;
- The Black Gully, located approximately 2.8 km to the north; and
- East Creek, located approximately 4.15 km to the east.

6.2 Geology and soils

According to the Geoscience Australia portal (http://portal.geoscience.gov.au/) the site is underlain by the Tertiary (Cenozoic) Main Range Volcanics which comprise alkali-olivine basalt, minor tuff, sandstone and mudstone. DNRM (2020) – Queensland Globe, describes this unit as “Td, duricrusted palaeosols at the top of deep weathering profiles, including ferricrete and silcrete, duricrusted old land surfaces”.

The lithological profile reported in the nearest registered bore (RN87119) located 26 m to the south of the site is described as red clay to 42 m, overlying decomposed basalt (to 51 metres) followed by layers of basalt and honeycomb basalt (Main Range Volcanics) to 73 m, termination depth. This is consistent with the surface geology described from both sources.

According to DNRM (2020), soils at the site comprise deep red clay, acidic soils containing lateritic fragments from the Ruthven-Middle Ridge.

Records held by the Australian Resource Information System (ASRIS) (http://www.asris.csiro.au/mapping/viewer.htm) indicate that soils underlying the site are

likely to be categorised as ferrosols which are defined, according to the Australian Soil Classification System (ASC, Isbell 2002); as:

"Soils other than Vertosols, Hydrosols, and Calcarosols that:

- *Have B2 horizons in which the major part has a free iron oxide content greater than 5% Fe in the fine earth fraction (<2 mm); and*
- *Do not have clear or abrupt textural B horizons or a B2 horizon in which at least 0.3m has vertic properties.*

Ferrosols are almost entirely formed on either basic or ultrabasic igneous rocks, their metamorphic equivalents, or, alluvium derived therefrom."

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 2018[3]) which designates the site area as an area where there is "*an extremely low probability of occurrence (1-5%) in riparian areas with Vertosols <1m*". 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 eighteen bores within a 1 km radius of the site (refer **Figure 1**), of which three are located within 500 m of the site boundary.

Given the expected receptors for groundwater migration (un-named non-perennial water course, 325 m north-west and, various un-named ponds/surface water features 1.4 km north of the site), of the three bores within 500 m, it is noted, two bores were located in this direction and therefore down-gradient of any contamination originating at the site:

- One bore (RN83682) located 121 m north, is listed for "unknown use" and is screened from 34 to 46 m in basalt, with a yield of 5.05 L/s and a reported standing water level (SWL) of 19.3 m (November 1989). Water quality parameters were not provided, nor quality stated, but is suspected to be potable consistent with other bores in the local area. It is noted the basal aquifer is overlain by a clay aquitard to between 1 and 29 m bgl.
- One bore (RN87103) located 340 m north, is listed as "no longer used" and is screened between 24 and 35 m in basalt of the Main Range Volcanics, with an unspecified yield

[3] CSIRO Land and Water (2018) Atlas of Australian Acid Sulfate Soils Version 2

and an SWL of 18.3 m (December 1991). Water quality parameters are not provided. However, water quality is listed as potable.

It is noted an additional registered bore (RN87119) is located within 25 m of the site boundary, but to the south and therefore up-gradient. This bore is listed for “unknown use” and is screened between 54 and 73 m in basalt, with water quality is listed as “potable”.

Of the remaining fifteen bores identified within 1 km of the site boundary;

- One additional bore (RN119640) is located down-gradient of the site, to the north-west at a range of 575 m. This bore is also listed for “water supply” and is screened from 58 to 94 metres in basalt, with a reported SWL of 26 m; and
- Remaining registered bores are located within 585 and 930 m of the site, cross and/or up-gradient, are screened in basaltic materials from a minimum depth of 25 metres bgl, and are generally listed for a combination of unknown use and water supply. Given the observed screening intervals, it is anticipated that a number, if not all, of these bores are utilised as potable water supplies.

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

Further to the above, based on the Groundwater Resources of Queensland 1:2,500,000 mapping it is understood that the aquifer beneath the site (Main Range Volcanics) has an average yield of 5 to 15 L/s and a salinity of 500 to 1500 mg/L. Resultantly, groundwater sourced therein is considered suitable for most purposes, but marginal for both human consumption and low salt crops.

6.4.2 Aquifers and aquitards

It is anticipated that the uppermost aquifer beneath the site will be present the Main Range Volcanics Group. This unit is anticipated to be present from a depth of 24 m bgl.

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:

- Moderate potential aquatic GDEs described as “high rainfall permeable geology (Toowoomba City Basalts) [soaks]” are located approximately 300 m to the north-west, 2.4 km to the east (associated with West Creek) and 200 m south of the site;
- Wetlands located along Spring Creek, approximately 2 km west of the site are described as “low potential aquatic GDEs” associated with low rainfall permeable geology (Toowoomba City Basalt); and
- Existing vegetation approximately 4 km to the south-west of the site associated with the Spring Creek wetlands are also listed as moderate potential terrestrial GDEs described as “basalt contact zones”.

In addition to the above, a number of Category B Endangered Regional Ecosystems (Biodiversity Status) are present to the north, east and south-east of the site associated with various interconnected creek lines including Gowrie Creek, Little Oakey Creek, Gatton Creek and West Creek.

No subterranean GDEs were recorded at or within a 4 km radius 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, Section 3.6) a review of potential groundwater receptors and likely impacts to receptors/ users of the receiving water body has been undertaken.

Given that environmental values (EVs) and water quality objectives for the Toowoomba Region 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);
- aquaculture;
- human consumption/drinking water;
- primary, secondary and visual recreation (surface water);
- industrial use; 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 receptors, RN83682 and RN119640) are 121m north and 575m north-west respectively whilst the nearest GDE is 300 m to the north-west (high rainfall, permeable geology associated with the Toowoomba Basalts).

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	PFDcA	10	335-76-2
	Perfluoroundecanoic acid	PFUnDA	11	2058-94-8
	Perfluorododecanoic acid	PFDoDA	12	307-55-1
	Perfluorotridecanoic acid	PFTrDA	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)[4] 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 20 August 2019 to confirm in-field sampling methodologies utilised by AECOM and ground-truth the site setting details identified during the data review phase.

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

During the Auditor inspection the entire site and surrounding area was traversed on foot. The surface of the site consisted of two topographically distinct areas – with the east of the site approximately 1.9 m higher than the west, connected via a gently sloping ramp in the centre. Site surface cover comprised primarily concrete hardstand and operational fire station buildings and sheds with a discrete, raised landscaped/ vegetated area in the central northern portion of the site (separated from hardstand surrounds by a 1 m high retaining wall) and, landscaping along the southern and western boundaries (refer **Figure 2**).

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 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 static water supply and collection of stormwater run-off was decommissioned in-situ, (in the north-west of the site in an existing car-parking former foam training area) via pump-out, sand infill and capping with concrete. Bedding sands in the vicinity of this tank could influence contaminant migration; and

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

- Given the eastern portion of the site is raised significantly, there is a high likelihood that fill has been placed at the site, in the past. As a result, contingent on the type of fill emplacement, this could impact upon groundwater and/or contaminant migration in the subsurface.

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** (22 January 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** (19-21 August 2019):
        - Drilling of five soil bores (TW_BH01 to TW_BH05), installation of five monitoring bores (TW_MW01 to TW_MW05) and bore development; and
        - Advancement of three shallow soil bores (TW_SS01, TW_SS3 and TW_SS4) and collection of four surface/near surface samples (TW_SS2, TW_SS5, TW_SS6 and TW_SS7);
    - **Event 3** (29-30 August 2019):
        - Groundwater monitoring event (TW_MW01 to TW_MW05) and monitoring bore survey; and
        - Collection of co-located sediment (TW_SED01 and TW_SED02) and surface water (TW_SW1 and TW_SW2) samples.

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 6 m BGL for soil sample collection and logging. Each bore was subsequently "reamed out" and advanced to a target depth of between 16 and 19 metres below ground level (m bgl) by Proactive using a Geoprobe drilling rig equipped with solid stem augers and a groundwater monitoring bors installed at each location.

Hole diameters were 60 mm and 100 mm for soil and groundwater bores respectively. All boreholes (with the exception of PR_SS01) were advanced to natural material.

Shallow soil bores (TW_SS1, TW_SS3 and TW_SS4) were advanced via hand auger to a maximum depth of 0.5 m BGL and surface/near surface samples (TW_SS2, TW_SS5, TW_SS6 and TW_SS7) collected by hand auger from a depth of approximately 0.1 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[5] (two within the 0 to 1 m bgl depth interval and one at depth, within the saturated zone[6]);
- Two samples from each shallow bore (TW_SS1, TW_SS3 and TW_SS4), within the 0 to 1 m depth interval; and
- One sample (0.1 m bgl) each surface/ near surface sample location (TW_SS2, TW_SS5, TW_SS6 and TW_SS7).

[6] With the exception of BH04/MW04 where two samples were collected within the 0 to 1 m bgl depth interval, only.

7.2.2 Lithology encountered

The lithology encountered at the site generally comprised fill material of variable thickness (ranging from 0.3 m (TW_BH04) to 3.6 m (TW_BH02)[7]) overlying disturbed natural and natural materials described as red -brown dry, stiff silty and sandy clays, becoming moist grey/brown mottled clays with increasing plasticity and moisture content, with depth.

Fill material observed on site was variable, including coarse-grained brown sands, gravel aggregate and silty/sandy red/orange clays. Some foreign material, described by AECOM (2019b) as occurring in “trace amounts” including wire, glass, concrete and brick fragments were observed at shallow depth in TW_BH01 and TW_BH02.

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

7.2.3 Groundwater assessment

Five groundwater bores (TW_MW01 to TW_MW05) were installed by AECOM (2019b). Each bore was screened within clay across the water strike (wet materials) observed during drilling.

Post drilling, groundwater gauging data confirmed that stabilised standing water levels (SWLs) in all bores had risen above the level of the initial, observed water strikes to an approximate depth of 11 m bgl (deemed indicative of a semi-confined aquifer). Stabilised SWLs in TW_MW02 and TW_MW05 were reported marginally above the screened interval. Screened intervals ranged from:

- TW_MW01; screened in clay (13 to 19 m BGL);
- TW_MW02; screened in clay (11 to 17.5 m BGL);
- TW_MW03; screened in clay (10 to 16 m BGL);
- TW_MW04; screened in clay (12 to 18 m BGL); and
- TW_MW05; screened in clay (12 to 18 m BGL).

Based on the groundwater elevations reported, local groundwater flow direction was inferred toward the north/north-west towards Spring Creek.

The field chemistry within the bores showed that the groundwater was fresh (salinity 148 to 270 mg/L as total dissolved solids (TDS)) and slightly acidic (pH 4.59 to 5.59).

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

[7] Fill thicknesses were generally greater in the eastern half of the site, consistent with the topographic variation observed during the site inspection, refer Section 6.1

7.2.4 Surface water and sediment assessment

Two co-located surface water and sediment samples were collected from site drainage channels during the assessment.

Surface water samples were collected using the laboratory-supplied container to collect water from the centre of each drain, while 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

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.

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 detailed in **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					
TW_BH01 to TW_BH05	PFAS (28)	14	3	2	4
TW_SS1 to TW_SS7	PFAS (28)	10	1	1	

Sampling Location	Analyte	Primary samples	QA/QC		
			Intra laboratory duplicate	Inter laboratory duplicate	Rinsate
TW_SED01 and TW_SED02	PFAS (28)	2	1	1	
TW_SS1_0.5	TOPA	1			
GROUNDWATER, SURFACE WATER & TAP					
TW_MW01 to TW_MW05	PFAS (28)	5	1	1	1
TW_SW1 and TW_SS2	PFAS (28)	2			
TW_MW02	TOPA	1			

Notes:
PFAS (28) – per and polyfluoroalkyl substances 28 compound suite (refer Table 1)
TOPA: total oxidisable precursors

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 QA/QC processes were undertaken as part of this assessment, including collection and analysis of intra and inter laboratory duplicates and rinsate blanks.

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 TW_SS1_0.5 (TOPA), batch EB1922827;
    - 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;
- Laboratory duplicate %RPD results were generally 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.

The Auditor notes that a sample (QC303) collected from the on-site hydrant used to source water for the high-pressure cleaner (used for cleaning augers and other drill equipment) returned detectable PFHxS at a concentration above the laboratory LOR (0.007 µg/L, criteria 0.002 µg/L), indicative of the potential for cross contamination.

However, following cleaning activities, a rinsate sample was collected from the hollow flight augers (QC304) which did not report detectible concentrations of any PFAS compounds. As such, no significant cross-contamination was deemed likely to have occurred as a result of the use of site hydrant water and, the results obtained during the investigation deemed suitable 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:

- 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 (raised landscape area along the northern boundary and along the southern and western boundaries), and areas adjacent to the site to the west are unsealed therefore there is a potential (albeit low) for exposure for terrestrial organisms (albeit transient as a result of on-going 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 guideline[8] 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

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

- The site is not in close proximity to waterways, drainage networks or groundwater.

9.2 Groundwater

Groundwater analytical results have been tabulated (AECOM 2019b, Appendix B, Table T5) 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

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
		PFOA	19
	Human health – recreational contact	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 twenty-four primary 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);
- Two exceedances of the ecological guideline criterion for PFOS in one location, within the raised, landscaped garden area in the central, northern portion of the site (TW_SS1 at 0.1 m BGL, 0.263 mg/kg and TW_SS1 at 0.5 m BGL, 0.535 and 0.5 m BGL, 0.182 mg/kg) (ecological indirect exposure, commercial/industrial scenario, criteria 0.14 mg/kg); and
- Eleven 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 (indirect, residential criteria) was reported at a depth of 18 m BGL at TW_BH01, 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 soil profile.

10.1.2 Auditor interpretation of soil PFAS data

Given that the reported ecological guideline exceedances were restricted to one location, on disturbed ground, understood to have been subject to ongoing commercial/industrial use for the past 44 years, the ecological guideline exceedances at TW_SS1 at 0.1 and 0.5 m depth

are not deemed significant nor are they 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 majority of the site and, the associated exceedances were recorded beneath concrete hardstand and, considering the likely transient nature of wildlife likely to be directly exposed at the site. Note: all but two of these exceedances (located at TW_SS01) were from samples located beneath an existing concrete slab in active commercial/ industrial areas.

10.2 Groundwater results compared to guidelines

10.2.1 Discussion

Detectable concentrations of PFAS were recorded in all five on-site 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 four of the five monitoring bores (TW_MW01 – TW_MW03 and TW_MW05), with the highest concentration reported in bore TW_MW02, located in the southern portion of the former AFFF training area, in the centre of the site (see **Figure 2**); and

- PFOS concentrations in all five groundwater bores exceeded the adopted ecological guideline value (99% species protection – fresh water) (0.00023 µg/L)

    - Note: PFOS concentrations in two of the bores (TW_MW01 and TW_MW04) did not exceed the draft, Batley *et al*. criteria (0.051 µg/L).

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 been well delineated at the site, particularly in relation to PFOS and PFHxS. Based on the contaminant distribution observed, the groundwater PFAS plume appears largely concentrated at the centre of the site, with low apparent potential for off-site migration.

It is noted that a portion of the plume (maximum PFOS concentrations anticipated ~3,5 µg/L) may extend off the site towards commercial/industrial properties to the north, but is unlikely to extend a significant distance from the northern site boundary.

Given the depth of groundwater in the area (>10 m) and depth of the Main Range Volcanics potable water aquifer (>20 m), the location and distance of the nearest down-gradient

groundwater receptor (RN83682, 121 m north/ RN119640, 575 m north-west) the Auditor does not consider additional off-site investigation is required at this time.

However, should QFES require validation of the groundwater observations and/or wish to fully delineate the extent of the PFAS groundwater plume, a limited additional assessment could be undertaken to the north and west of the site, to validate that groundwater contamination poses a negligible risk to off-site receptors to the north (commercial/ industrial properties) and west (potential transient ecological receptors associated with open, undeveloped ground).

10.3 Surface water and sediment results compared to guidelines

10.3.1 Discussion – surface water

Detectable concentrations of fourteen PFAS compounds were reported in the two surface water samples collected from the on-site drainage pits.

Consistent with soil, groundwater and tap water samples analysed during the investigation, the surface water signature was dominated by PFOS and PFHxS although detectable concentrations of a range of other compounds were also reported.

Comparison with the adopted assessment criteria confirmed:

- Sum of PFHxS and PFOS and/or PFOA concentrations did not exceed the recreational water criteria (2 µg/L); and
- PFOS concentrations in both samples (0.243 µg/L TW_SW1 and 0.374 µg/L TW_SW2) exceeded both the existing (0.00023 µg/L – NEMP (2019) and draft non-ratified (0.051 µg/L AECOM 2019) ecological guideline value (99% species protection – freshwater).

10.3.2 Discussion – sediment

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, only.

Consistent with the surface water 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 0.0355 mg/kg (HH_SED02, north-west corner) and 0.0633 mg/kg (HH_SED01, southern boundary adjacent to the foam storage shed) (LOR 0.0002 mg/kg). A small range of other PFAS compounds were reported at detectable concentrations in both samples only, at concentrations at, or close to the laboratory LOR.

10.3.3 Auditor interpretation of surface water and sediment PFAS data

The presence of a wide range of detectable PFAS compounds in the surface water and 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 (~325 m north-west) and the lack of direct connection to this water course, the likelihood of transport at distance beyond the site boundary, is deemed low. Although an exceedance of the freshwater (99%) criteria was observed in surface water, this is considered a conservative assessment for a concrete-lined, ephemeral drainage pathway and there is considered to be a low risk of impact to nearby water courses associated with this surface water exceedance.

Furthermore, the detectable concentrations of PFAS compounds in sediment were relatively low level (generally less than one order of magnitude above the LOR), with the exception of PFOS. Therefore these levels are considered 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.

Accordingly, the detectable PFAS concentrations in sediment and the surface water guideline criteria exceedance are not considered to pose either a significant human health and/or ecological risk to off-site receptors.

10.3.4 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 outliners 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).

10.4 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 conclusion that the site does not pose an unacceptable human health and/or ecological risk thus is suitable for ongoing commercial/industrial use.

Furthermore, although groundwater guideline exceedances were identified in all five on-site monitoring bores, based on the contaminant concentrations observed (existing plume geometry), the Auditor considers there is a low potential for off-site migration of contamination, via groundwater. Accordingly, the Auditor considers the site, in its current state, does not pose an unacceptable risk to either on-site or off-site, down-gradient sensitive receptors and further (off-site) investigation is not warranted, at this time.

11 ASSESSMENT OF REPORT AGAINST S389 OF EP ACT 1994

11.1 Key descriptive elements under S389 (1) of the 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):

- Sufficient data has been obtained to determine that the site is not 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;
- Sufficient data has been collected to determine that there is a low potential for off-site contaminant migration via groundwater and thus there is deemed a low potential for detrimental impact to either down-gradient sensitive 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 *Environmental Protection Act 1994*		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 *Environmental Protection Act 1994*		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 *site suitability statement*) of the uses or activities for which the site is suitable	-	Cover Letter and Section 12

Subsections of section 389 of the *Environmental Protection Act 1994*		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 SI report adequately justifies the conclusions in the context of site history, level of assessment, development of a robust conceptual site model (CSM), and relevant aspects of NEPC (2013), NEMP (2018) and EHP (2015a and b) in particular:
    - the CSM developed for the site (AECOM, 2019b) adequately identifies CoPC 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. However, given the presence of concrete hardstand across the majority of the site, the legacy and ongoing 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.

Furthermore, it is noted, that while concentrations of PFOS and PFHxS in groundwater at the site exceed relevant guideline criteria, based on the distribution of concentrations observed, there is deemed a low potential for off-site migration via groundwater. Accordingly, the CLA considers that there is a low risk to off-site human and/or ecological receptors and further (off-site) investigation is not required.

The above notwithstanding, the CLA considers that if QFES requires further validation/ surety of site investigation observations completed to date, a limited additional assessment could be undertaken to the north and west of the site, to validate that both soil and groundwater contamination pose a negligible risk to off-site receptors to the north (commercial/ industrial properties) and east (potential transient ecological receptors associated with open, undeveloped ground).

13 LIMITATIONS

Mark Stuckey of Environmental Earth Sciences has prepared this CLA report (719052_QFES_TWA_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.

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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.

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APPENDIX A: AUDITOR CERTIFICATION

Certificate

Environmental Protection Act 1994

Certificate of Approval

Approval No: CLAD06400917

This certificate of approval as an auditor is issued by the chief executive[1] *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.

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: Toowoomba(Anzac Avenue) Fire Station, 201 Anzac Avenue, Harristown, Queensland. Rev 0 (FINAL). 26 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

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 2/RP132831	Title(s) of attached site plan(s): Ref: 14794124
Street address 201 Anzac Avenue, Harristown, Toowoomba, QLD	Postcode 4350
Local government area Toowoomba Regional 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

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_TWA 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 
Date 13/03/2020

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. 1 m and 10 m contours from Queensland Globe) are 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	It may be beneficial to add a "500 m site radius" to the Figure.
3		Figure 4	Please review and revise references to human health guideline value and associated colour coding.
4		Figures 5-6	Please consider presenting additional, individual compounds on relevant exceedance figures (rather than "sum of" for completeness and to aid overall interpretation, particularly with regards to higher mobility compounds (e.g. PFHxS and PFHxA).
5		Figure 7	• Section 3.2 indicates that the site slopes gently from the east to the west/north west. Further, the eastern half of the site is approximately 1 to 1.5 m higher than the western half. These topographical conditions and variable surface heights should be appropriately represented on the graphical CSM and, as relevant, the underlying geology, to further aid interpretation. • Should the Foam training area represented be "former foam training area"? • It is noted the area to the west of the site (as per Section 2.3) comprises cleared grassed area (former commercial/ industrial) with further, existing commercial/ industrial properties beyond. This cleared, grassed area should be shown on the CSM – currently represents a disturbed, terrestrial ecosystem. • Given this is a CSM and distances are not intended to be represented accurately, consider including the referenced off-site water feature and water supply bore are identified as receptors. This would then allow receptors C and D and corresponding migration pathways to be appropriately represented. • Pathway 4 is identified as "leaching of concrete to groundwater or surface water". However, the associated arrow and pathway location appear incorrect, or, surface water likely to be impacted, not shown. If surface water presented is the drainage channel, the figure should be amended to show this (it is understood no surface water bodies are present on site). Please review and amend as necessary.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			• Given a number of underground services run from east to west across and underlying the site, would these be better represented in this orientation on the figure, thus showing potential for contaminant migration across the site, as well as in the cross-sectional format provided. (It is understood that this orientation has been included to clearly show both service channel and associated backfill). Further, if the water supply bore depth and screening interval are known, this would be useful to show, graphically to confirm (or otherwise) that water is sourced from the same aquifer assessed during this investigation. • Please review transport pathway 6 and 7 and associated graphic – if migration along stormwater drains is inferred it would be worthwhile showing this feature. The size of the figure could be amended to account for these additions.
6	Tables – Appendix B	Table T3	• Typo (Notes): Millivolt • Explain asterix (*) in final column. • Table notes: Typo: ORP is “oxidation-reduction potential”
7		Table T7	Noting that PFDoDA appears at limit of reporting in one sediment sample and was not detected in soil, surface water and/ or groundwater samples, was this detection checked with the lab and confirmed?
8	Appendices	Appendix D	• Can stabilised (post drilling) standing water levels be presented on the bore logs along with initial water strikes? • Please review monitoring bore log TW_MW02 for accuracy regarding position of bentonite seal, gravel pack and screening interval (screening interval currently shown as crossing the fill/natural interface). It is noted the labels provided do not match the bore installation graphic details.
9	Appendices	Appendix G	• G4.2.3 Laboratory Duplicates – please provide brief concluding statement as to the nature of the DQO exceeded and why this is not considered to impact the quality of the data reported. • 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 brief concluding sentence/ paragraph should be provided as to how this may impact the data set and any significance.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			• 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 G 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.
10	Appendices	Appendix H	• 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. (The CLA notes that the low-resolution version of the report was reviewed and this issue may not exist within the high resolution version.)
11	Executive Summary		**Key findings of the PSI:** • Paragraph 2: "in" repeated twice, first sentence. • Paragraph 2: plural agreement: after the training exercise**s** were completed" • Is any information available on what occurred following the waste foams capture in the site perimeter drains? Was this subsequently pumped out and removed, left to evaporate? Do the perimeter drains, drain directly to the municipal system? (i.e. foam products drained off-site?) A brief comment would be useful here, with any additional, expanded information provided in the main body text. **Investigation scope** • "scope of works **was** completed" **Key findings of the DSI:** • Bullet 1: "Groundwater was inferred to locally flow toward the west/ north west" • Bullet 2: Noting that the highest concentrations of PFOS in soil were identified in TW_SS01 between 0.1 and 0.5 m bgl, is it possible that the former fire training area extends further to the east, incorporating some, or all of the current, landscaped/ unsealed ground than previously thought (resulting in higher concentrations due to direct application)? Or, based on site observations, does AECOM consider that it is more likely that localised slopes/ surface elevation differences resulted in run-off of foam to the east/ north east, thus impacting the area in the vicinity of TW_SS01? (e.g. It is noted as per Section 3.2, a significant elevation difference exists between the east and west portions of the site).

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			• Bullet 5: In consideration of the above, there is a potential that PFAS concentrations in groundwater are not fully delineated to the east/ north east (as is inferred in the report, based on contaminant concentrations identified in bore MW01) as: ○ no groundwater results are available in the vicinity of TW_SS01, where elevated concentrations of PFOS (approximately 4 x the guideline value) were identified in shallow soils to the maximum investigation extent (0.5 m bgs); and ○ PFOS concentrations in this location were greater at 0.5 m bgs than 0.1 m bgs potentially indicative of some level of vertical migration. While this may be somewhat retarded by the presence of clays, given the confirmed presence of PFAS compounds in groundwater underlying sealed areas, it would be fair to infer PFAS may have migrated to the water table through this unsealed landscaped area (particularly considering that foam was directly applied to vegetation as a wetting agent and, proximity to former foam training areas where foam overflow as a result of localised topographic variation may have occurred).
12	2.1	Site Identification	• Sentence 1, typo "..is access**ed**"
13	2.2	Site layout and features	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. • Bullet 1: Consider sentence sense and supporting information (site feature labels) provided on accompanying figures "…the engine bay…houses two engine bays…" • Bullet 2: Plural agreement "training exercise**s**" • Bullet 3: Please review bullet in relation to site feature labels provided on Figure F2 "foam storage shed". • Bullet 5: Consider plural agreement "fire and emergency services office**s**" or "**The** fire and emergency services office…" • Bullet 6: Please present the location of the Case 4 pit on Figures 2 to 6. • Bullet 7, 8, 9 and 10: Please ensure that site features mentioned in bullets 7 to 10 are presented and labelled on relevant site drawings (e.g. RTS building, water tanks). • First paragraph after the bullet points. "It is noted that no information was identified in the PSI on the emplacement of fill at the fire station". Can additional clarification be provided here. It is noted, according to Section 3.2 topography, that the eastern portion of the site is 1 – 1.5 m higher than the

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			western portion; such an observation made during a site inspection would imply the presence of fill underlying the site. However, it is noted this comment may refer to the lack of information on type/ quantity/ chemical status of fill emplaced at the site. Would be worth revising this statement for clarity. • Can commentary be provided as to current/ former use of site feature (possible building/ canopy) located to the north east of TW_SS01?
14	2.3	Surrounding Land use	• **Table 3:** Commentary for surrounding land uses to the north and east of the site are repeated in the Table (may be set as header row?). Please review and amend. • **North:** the council depot mentioned under 'East' discussion also extends to the west of Anzac Avenue, directly north of the site (these sites are known as Harristown east and west depots, respectively). Also, there is a service station at the NW corner of Anzac Avenue and Stephen Street. • **South**: Sentence 2 "Approximately 800 m south **of** the site" • It is noted the PSI mentions a former fuel depot to the north of the site. Could this be a potential source of historic PFAS- worth referencing this former depot within the appropriate site history section.
15	2.4	Previous environmental investigation	It is noted Section 2.4 is largely a reproduction/ summary of data provided in the PSI/ SAQP. Please review and ensure information provided is consistent and includes all relevant information. • Bullet 2: Indicates firefighting foams have been used at the site since at least the late 1980s. However, the executive summary indicates "1990's – 2003" – please review and amend for consistency. • Bullet 3: Plural agreement "…containers…. **are** now stored…" • Bullet 4: Please review in relation to comment 12 above. Please amend as necessary. (Noting that additional information provided in Bullet 5 implies the application of foam as a wetting agent may have resulted in the identified impact noted in the vicinity of TW_SS01).
16	3.2	Topography	Now that surface levels have been surveyed (alongside well heights) can the information provided here regarding topographic variation across the site be updated in relation to the actual elevation differences recorded during the survey? With regards to site surface drainage – how does the relative height difference across the site impact on surface water/ stormwater flow. Are the east and west portions of the site treated as separate catchments/ is all surface water directed to site drains and fed toward the north west? It is noted that drainage pits/ pathways are largely absent in the eastern portion of the site.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
17	3.3	Soil Type & Acid Sulfate soils	Please review source referencing and findings to ensure consistency (while it is acknowledged these information sources may be correct, previous reports have used ASRIS for information pertaining to soils/ acid sulfate soils). For example, "rock before 1.5 m depth" must be an error.
18	3.4	Geology	• Sentence 1: "..Main Range Volcanics, which comprise basalt…." • Sentence 2: "…the geology beneath the site comprises clay…" • Was the anticipated geology consistent with that identified during the intrusive investigation? Note: please review for consistency with geology reported in the PSI.
19	3.6	Hydrogeology	• Sentence 1 "…beneath the site **comprises** basic volcanics…"

20	3.8	Groundwater dependent ecosystems	• Please review information pertaining to the GDEs identified, according to BOM (2018) a number of aquatic GDEs are present in the vicinity of the site including:
			  ○ Moderate potential aquatic GDEs described as "high rainfall permeable geology (Toowoomba City Basalts) soaks" were identified approximately 300 m to the north west, 2.4 km to the east (associated with West Creek) and 200 m south of the site, respectively.
			  ○ Wetlands located along Spring Creek, approximately 2 km west of the site is described as a low potential aquatic GDE associated with low rainfall permeable geology (Toowoomba City Basalt).
			  ○ Existing vegetation approximately 4 km to the south west of the site associated with the Spring Creek wetlands are also listed as moderate potential terrestrial GDEs described as "basalt contact zones".
			• Paragraph 1: Please provide an indication of where the moderate potential GDE is located (direction and distance) in relation to the site;
			• Paragraph 2: How about in the vicinity of the site?
			• Please include standard footnotes (as per Airlie Beach) for GDE information sources.

21	4.1	Overview	Table 7 – possible typo – surface water sample TW_SW2, rather than SS2?

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
22	4.2	Sampling rationale	Table 8 – TW_BH01 – review this sentence for sense. Was BH01/MW01 not also installed to assess potential for contamination associated with former foam storage within the footprint of the current storage shed, rather than just assess concentrations in the eastern portion of the site?
23	4.3	Soil Investigation	• Service Location; first sentence; “dial before you dig plans”? • Concrete coring was undertaken at five location**s**
24	4.4	Groundwater Investigation	Table 10 Well development – Please confirm use of foot pump for well development (development at previous sites was completed via bailing).
25	5.0	Assessment Criteria	Soil residential human health criteria should also be listed? (0.009/ 0.1 mg/kg for PFOS/ PFHxS and PFOA respectively)
26	6.2.1	Groundwater elevations…	Paragraph 2: suggested re-phrase “groundwater is inferred to locally flow toward the west/ north west”
27	6.3.1	Soil	• Paragraph 2 : “in comparison **to**” • Table 16 – According to Figure 4, PFOS concentrations at TW_SS01 exceeded the human health guideline for commercial/ industrial use. Should Table 16 also show the human health residential values (as per comment 25 above)? • Table 17 & Paragraph 4 – Please review and amend this detail as necessary. The text, Table 17 and Table T4 (Appendix B) details do not match: According to the appended Table T4 for samples within the 0 to 2 m depth interval – a total of 4 samples (2 primary, 2 QA/QC) exceeded the commercial/ industrial ecological (indirect exposure) guideline (0.14 mg/kg), with a total of 13 samples exceeding the residential ecological (indirect exposure guideline) (0.01 mg/kg) – excluding TOPA analysis. (It is noted sample TW_SS02 with a value of 0.0101, approximating rather than exceeding the guideline hasn’t been included in this count).
28	6.3.2	Groundwater	• Please include applicable units for guideline value column in Table 18.
29	6.3.4	Surface water	• Please include applicable units for guideline value column in Table 20.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
30	7.1	Geological and hydrogeological conditions	• Please refer to earlier comments regarding terminology for groundwater flow direction (i.e. to the west/ northwest, not “from southeast to northwest”). • Paragraph 4: as per comment 11 above can elevated surface/ near surface concentrations in the unsealed area to the east of the former foam training area be discussed here? • Paragraph 4 – last sentence suggest amendment “the presence of underground services beneath the concrete and presence of the Case 4 pit…”

31	7.2	Soil analytical results	• Be careful regarding use of the term PFAS as a catch all term, particularly when distribution and/ or behaviour described pertains to a particular PFAS compound.
			• Although commentary here suggests that PFAS compounds decrease with depth, while this is generally true (particularly in relation to the fill vs natural soil profile), it is noted that based on the data collected and presented in Table T4, this statement is not correct for all compounds. For example:
			  ○ BH01 – detectable concentrations of a number of compounds recorded at 18 m depth (reported as <LOR at depths up to 1 m bgs). PFOS concentrations increase with depth;
			  ○ SS01 – PFOS concentrations increase with depth (0.2630 (0.1 m bgs), 0.535 (0.5 m bgs) mg/kg)
			Please review and amend as necessary.
			• 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 shorter chain compounds (such as PFHxS) may behave differently (with regard to mobility and thus potential for offsite migration) therefore consideration of these two compounds together, may mask some pertinent information with regard to contaminant distribution. This may be particularly pertinent in consideration of the potential for off-site migration.
			• It is also noted that the assessment identified some lesser known compounds including PFNA, PFUnDA and FOSA (soil, no guideline criteria), PFDoDA and EtFOSA (sediment, no guideline criteria) and FOSA (groundwater, no guideline criteria). Could some additional discussion be provided around the likely behaviour, mobility and distribution of these other compounds and any implications for their occurrence across the media sampled?
			• Where possible it would be worth presenting concentrations of individual compounds (at minimum PFHxS) on the relevant contamination distribution figures, as appropriate.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			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	Please refer to comment 11 above regarding consideration of contaminant delineation. • Paragraph 2 typo "has have" • Paragraph 2 – please review last sentences pertaining to registered bore location and positions for sense. Last two sentences appear contradictory and are inconsistent with the distances specified in Section 3.6, Table 5. (Closest bore listed as per Table 5 is 25 m south). 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 west/ north west. 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).
33	7.4	Comparison of PFAS composition in soil and groundwater samples	Table 22 – please confirm average groundwater ratio calcs correct – FOSA was detected above LOR in groundwater sample MW05.
34	7.5	Surface water and sediment analytical results	Can any further discussion be provided regarding the occurrence of PFDoDA and EtFOSA compounds in sediment, despite not being detected in either soil or groundwater samples?
35	8.3.2	Secondary sources	• Bullet 3 (suggest referencing Case 4 Pit); • Bullet 4 – Are all drains on/ off site earthen lined or concrete? Please check and amend if necessary.
36	8.4	Migration mechanisms	• As per comment above, if drains are earthen- infiltration via unlined drains should be included as a potential pathway.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments

37	8.6	Assessment of exposure pathways	Table 24:
			• On-site areas (Secondary sources): As per comment 35/ 36 above, please confirm earthen or concrete lined drains and amend as appropriate.
			• PFAS in groundwater – Please check and confirm applicable distances to down-gradient bores (potential potable use) as the distance specified does not appear consistent with that stated in Section 3.6.
			• PFAS in surface water –
			  ○ Receptor: Given that the drainage line does not directly link to Spring Creek and the nearest water course (325 m away) is ephemeral is it not unlikely that aquatic ecosystems will be impacted by contaminants sourced from the site?
			  ○ Consider providing a separate line item to consider terrestrial ecosystems – noting that the undeveloped, grassed land to the immediate west of the site; while representing temporary unoccupied commercial/ industrial land, also could be considered a disturbed, terrestrial ecosystem.
			• Accumulation of PFAS in creek sediment –
			  ○ Receptor: see comment RE aquatic and terrestrial ecosystem considerations, above.

38	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 (m^2 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.	**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		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
· the location of all stormwater drainage	Section 2.2 Site layout and features	Information pertaining to stormwater drainage to be reviewed and confirmed. Amendments to be made if necessary.	**Yes**
· 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. Existing topographical information to be reviewed in relation to minor comments provided.	**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	As above (if required).	**Yes**
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,	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

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
quantity and type of the waste, and the method(s) of its storage or disposal.			
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 of storage vessels, or an accident such as a fire. That is, disposal should be taken to include accidental spills or releases.	Section 2.4 Previous environmental investigation		No
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	Please review in relation to minor comments provided.	**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 *Environmental Protection (Water) Policy 2009*.	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 *Australian groundwater modelling guidelines* (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

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
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
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.	Limited information pertaining to the likelihood of “low hydraulic conductivity clays” that may retard vertical and lateral migration of PFAS has been provided. 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. This may be subject to assessment in a subsequent report.	**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

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
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
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

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
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
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	Please refer to individual comments regarding recommended amendments to CSM	**Yes**

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
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 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.	Section 4.0 – Fieldwork Appendix G: Analytical Data Validation	Refer to individual comments regarding additional considerations for data validation	**Yes**
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	Section 3.6, Section 5.0	Assessment criteria has been provided in Table 14 (noting that human health residential criteria for soil are missing). However, the NEMP does not provide trigger values for all the identified EVs. Provide commentary on how the adopted assessment criteria will	**Yes**

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
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.		ensure a suitable level of protection for all EVs identified.	
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

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
• 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
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: SELECTED REGISTERED BORE CARDS

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
119640	Sub-Artesian Facility	Existing	15/12/2006	Toowoomba	6910 - TOOWOOMBA REGIONAL

Details

Description			
Parish	1580 - DRAYTON		
Original Name	GREENWATTLE/MOORINA DR		
Driller Name	K FAUNTLEROY		
Drill Company	AYR BORING CO		
Const Method	ROTARY AIR		
Bore Line			
D/O File No	T 787/9	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	19/12/2006	**Data Owner**	
Roles	Water Supply		

Location

Latitude	27-34-10	**Basin**	4223
Longitude	151-55-05	**Sub-area**	
GIS Latitude	-27.5695717	**Lot**	6
GIS Longitude	151.9180756	**Plan**	SP184202
Easting	393199		
Northing	6950010	**Map Scale**	
Zone	56	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

7 ***records for RN*** **119640**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	15/12/2006	1	0.00	15.00	Steel Casing	6.400	WT - Wall Thickness	300
A	15/12/2006	2	0.00	100.00	Steel Casing	6.400	WT - Wall Thickness	200
A	15/12/2006	3	58.00	70.00	Perforated or Slotted Casing	10.000	AP - Aperture Size	200
A	15/12/2006	4	82.00	94.00	Perforated or Slotted Casing	10.000	AP - Aperture Size	200
X	15/12/2006	5	20.00	100.00	Gravel Pack	20.000	GR - Gravel Size	420

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	15/12/2006	6	0.00	15.00	Grout			420
X	15/12/2006	7	105.00	156.00	Cuttings or other fill between casing and hole wall			420

Strata Logs

12 *records for RN* **119640**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	3.00	BLACK SOIL
2	3.00	9.00	YELLOW CLAY
3	9.00	15.00	WEATHERED BASALT (MOIST)
4	15.00	30.00	SOFT BASALT
5	30.00	60.00	SOFT BASALT
6	60.00	75.00	FRACTURED BASALT *
7	75.00	85.00	HARD BASALT
8	85.00	96.00	FRACTURED BASALT *
9	96.00	118.00	BROWN CLAY
10	118.00	130.00	GREENISH SHALE
11	130.00	150.00	GREENISH SHALE
12	150.00	156.00	WHITE SANDSTONE

Stratigraphies

0 *records for RN* **119640**

Aquifers

3 *records for RN* **119640**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	15.00		BSLT - Basic Volcanic			N			N	WZ	MAIN RANGE VOLCANICS
2	75.00		BSLT - Basic Volcanic			N		2.00	Y	FR	MAIN RANGE VOLCANICS
3	96.00		BSLT - Basic Volcanic			N		2.00	Y	FR	MAIN RANGE VOLCANICS

Bore Report

From Year:

Pump Tests Part 1

1 *records for RN* **119640**

Pipe	Date	Rec	RN of Pumped Bore	Top (m)	Bottom (m)	Dist (m)	Meth	Test Types	Pump Type	Suction Set (m)	Q Prior to Test (l/s)	Dur of Q PR (mins)	Pres on Arriv (m)	Q on Arriv (l/s/)
A	16/01/2007	1	119640	60.00	94.00	1.10	PUM	CQ RT		94.00				

Pump Tests Part 2

1 *records for RN* **119640**

Pipe	Date	Rec	Test Dur (mins)	SWL(m)	Recov Time (mins)	Resid DD (m)	Max DD or P RED (m)	Q at Max DD (l/s)	Time to Max DD (mins)	Max Q (l/s)	Calc Stat HD (m)	Design Yield (l/s)	Design BP (m)	Suct. Set (m)	Tmsy (m2/Day)	Stor
A	16/01/2007	1	6000	-26.00	660	24.55	59.94	6.00	6000	6.00				94.00		

Bore Conditions

0 *records for RN* **119640**

Elevations

0 *records for RN* **119640**

Water Analysis Part 1

0 *records for RN* **119640**

Water Analysis Part 2

0 *records for RN* **119640**

Water Levels

0 *records for RN* **119640**

Wire Line Logs

0 *records for RN* **119640**

Field Measurements

0 *records for RN* **119640**

Special Water Analysis

0 *records for RN* **119640**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
87119	Sub-Artesian Facility	Existing	03/02/1992	Toowoomba	6910 - TOOWOOMBA REGIONAL

Details

Description	L2 RP220753		
Parish	1580 - DRAYTON		
Original Name			
Driller Name			
Drill Company			
Const Method	ROTARY DRILLER D.OTTO (GRUND		
Bore Line			
D/O File No	T 3423	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	27-34-20	**Basin**	4223
Longitude	151-55-27	**Sub-area**	630
GIS Latitude	-27.572270821	**Lot**	23
GIS Longitude	151.924130444	**Plan**	RP98651
Easting	393799		
Northing	6949716	**Map Scale**	103 - 1: 10 000
Zone	56	**Map Series**	M - Metric Series
Accuracy		**Map No**	9242-58
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

2 ***records for RN*** **87119**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	16/05/1991	1	0.00	76.00	Steel Casing	4.800	WT - Wall Thickness	168
A	16/05/1991	2	54.00	73.00	Perforated or Slotted Casing			

Strata Logs

13 ***records for RN*** **87119**

Rec	Top (m)	Bottom (m)	Strata Description

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	SOIL
2	1.00	42.00	RED CLAY
3	42.00	51.00	DECOMPOSED BASALT
4	51.00	54.00	BASALT
5	54.00	73.00	HONEYCOMB BASALT *
6	73.00	76.00	BASALT
7			.378 L/SEC @ 55 MET
8			2.147 L/SEC @ 61 MET
9			5.052 L/SEC @ 67 MET
10			6.315 L/SEC @ 76 MET
902			SWL 21.5 MET (3/2/1992)
903			(3/2/1992) 6.315 L/SEC AIRLIFT
910			WATER - POTABLE

Stratigraphies

1 ***records for RN*** **87119**

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1			MAIN RANGE VOLCANICS

Aquifers

1 ***records for RN*** **87119**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	54.00	73.00	BSLT - Basic Volcanic							VS	MAIN RANGE VOLCANICS

Pump Tests Part 1

0 ***records for RN*** **87119**

Pump Tests Part 2

0 ***records for RN*** **87119**

Bore Report

From Year:

Bore Conditions

0 *records for RN* **87119**

Elevations

0 *records for RN* **87119**

Water Analysis Part 1

0 *records for RN* **87119**

Water Analysis Part 2

0 *records for RN* **87119**

Water Levels

1 *records for RN* **87119**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	03/02/1992		-21.50	N	Natural Surface		ACT	Actual	NR	NR	Not Recorded	130	Data is of unknown quality

Wire Line Logs

0 *records for RN* **87119**

Field Measurements

0 *records for RN* **87119**

Special Water Analysis

0 *records for RN* **87119**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
87103	Sub-Artesian Facility	Existing	19/12/1991	Toowoomba	6910 - TOOWOOMBA REGIONAL

Details

Description	L1 RP 150239		
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name			
Drill Company			
Const Method	ROTARY DRILLER L. GRUNDY		
Bore Line			
D/O File No	T 3174	**Polygon**	
R/O File No		**Equipment**	SP
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	27-34-07	**Basin**	4223
Longitude	151-55-24	**Sub-area**	630
GIS Latitude	-27.5685125	**Lot**	1
GIS Longitude	151.92331163	**Plan**	RP150239
Easting	393715		
Northing	6950132	**Map Scale**	104 - 1: 100 000
Zone	56	**Map Series**	M - Metric Series
Accuracy		**Map No**	9242-58
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

2 *records for RN* **87103**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	19/12/1991	1	0.00	37.00	Steel Casing	5.000	WT - Wall Thickness	137
A	19/12/1991	2	24.00	35.00	Perforated or Slotted Casing		AP - Aperture Size	137

Strata Logs

7 *records for RN* **87103**

Rec	Top (m)	Bottom (m)	Strata Description

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	3.00	SOIL
2	3.00	16.00	CLAY
3	16.00	36.00	DECOMPOSED BASALT *{.505 L/SEC @ 31M
4	36.00	37.00	BASALT {.757 L/SEC @ 37 MET
902			SWL 18.3 MET (19/12/1991)
903			(19/12/1991) .757 L/SEC AIRLIFT
910			WATER - POTABLE

Stratigraphies

1 *records for RN* **87103**

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1	16.00		MAIN RANGE VOLCANICS

Aquifers

1 *records for RN* **87103**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	16.00	36.00	BSLT - Basic Volcanic							WZ	MAIN RANGE VOLCANICS

Pump Tests Part 1

0 *records for RN* **87103**

Pump Tests Part 2

0 *records for RN* **87103**

Bore Conditions

0 *records for RN* **87103**

Elevations

0 *records for RN* **87103**

Water Analysis Part 1

1 *records for RN* **87103**

Pipe	Date	Rec	Analyst	Analysis	Depth	Meth	Src	Cond	pH	Si	Total	Total	Hard	Alk	Fig. of	SAR	RAH

Bore Report

From Year:

				No	(m)			(uS/cm)		(mg/L)	Ions (mg/L)	Solids (mg/L)	Merit			
A	25/11/1992	1	GCL	148030	37.00	PU	GB	590	7.5	80	372.64	363.69	205	144	2.7	1.1

Water Analysis Part 2

1 ***records for RN*** **87103**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	25/11/1992	1	35.0	2.3	32.5	30.0	0.02	175.0	0.02	0.4	90.0	0.10	5.3	2.0				

Water Levels

1 ***records for RN*** **87103**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality	
A	19/12/1991		-18.30	N	Natural Surface		ACT	Actual	NR	NR	Not Recorded		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **87103**

Field Measurements

0 ***records for RN*** **87103**

Special Water Analysis

0 ***records for RN*** **87103**

Bore Report

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
83682	Sub-Artesian Facility	Existing	14/11/1989	Toowoomba	6910 - TOOWOOMBA REGIONAL

Details

Description	L1 RP110956		
Parish	1580 - DRAYTON		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No	T 220	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles			

Location

Latitude	27-34-13	**Basin**	4223
Longitude	151-55-26	**Sub-area**	630
GIS Latitude	-27.570426968	**Lot**	1
GIS Longitude	151.923791131	**Plan**	RP110956
Easting	393764		
Northing	6949920	**Map Scale**	103 - 1: 10 000
Zone	56	**Map Series**	M - Metric Series
Accuracy		**Map No**	9242-58
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

2 ***records for RN*** **83682**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	14/11/1989	1	0.00	49.00	Steel Casing	4.900	WT - Wall Thickness	168
A	14/11/1989	2	34.00	46.00	Perforated or Slotted Casing	13.000	AP - Aperture Size	168

Strata Logs

5 ***records for RN*** **83682**

Rec	Top (m)	Bottom (m)	Strata Description

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	SOIL DRILLER L GRUNDY DATE 14-11-1989
2	1.00	29.00	CLAY 168 MM.TUBING 0.49 M.
3	29.00	46.00	DECOMPOSED BASALT *WATER BED.
4	46.00	49.00	BASALT SWL.19.3 M.SUPPLY 5.052 LPS.
5	49.00		SLOTS 34-46 M.

Stratigraphies

1 *records for RN* **83682**

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1			MAIN RANGE VOLCANICS

Aquifers

1 *records for RN* **83682**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	29.00	46.00	BSLT - Basic Volcanic							WZ	MAIN RANGE VOLCANICS

Pump Tests Part 1

0 *records for RN* **83682**

Pump Tests Part 2

0 *records for RN* **83682**

Bore Conditions

0 *records for RN* **83682**

Elevations

0 *records for RN* **83682**

Water Analysis Part 1

0 *records for RN* **83682**

Water Analysis Part 2

0 *records for RN* **83682**

Water Levels

0 *records for RN* **83682**

Bore Report

From Year:

Wire Line Logs

0 *records for RN* **83682**

Field Measurements

0 *records for RN* **83682**

Special Water Analysis

0 *records for RN* **83682**

Bore Report

From Year:

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