ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

AUDITOR CERTIFICATION REPORT & STATEMENT OF REASONS: AIRLIE BEACH FIRE STATION, 2495 SHUTE HARBOUR ROAD, MANDALAY, QLD

QUEENSLAND FIRE AND EMERGENCY SERVICES

4 MARCH 2020
719052 AIRLIE BEACH
VERSION 1

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

4 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 Airlie Beach Fire Station, 2495 Shute Harbour Road, Mandalay, 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 to site users and is suitable for ongoing commercial/ industrial use, but that potential exposure linkages and associated risks to off-site receptors should be further investigated.

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
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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 Airlie Beach Fire Station (2495 Shute Harbour Road, Mandalay, QLD 4802 “the site”), legally described as Lot 276/HR1926.

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 Airlie Beach Fire Station, 2495 Shute Harbour Road, Mandalay Queensland. Prepared for Queensland Fire and Emergency Services. Ref: 60609758 Revision 0 (Final). Dated 10 February 2020.

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

- was undertaken in accordance with current best-practice methodologies, cognisant of and in accordance with applicable guidance and legislation;
- fulfils the objectives of the project with regards to the characterisation of PFAS impact (concentration and distribution) on and at the boundaries of the subject site; and
- complies with the relevant elements of the *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 CLID that the site does not currently pose an unacceptable, direct-contact human health and/or ecological risk in the context of on-going commercial/ industrial land use.

Elevated contaminant concentrations (sum of PFOS and PFHxS) greater than human health and ecological assessment criteria were recorded in all four on-site groundwater monitoring bores at and along the boundaries of the site, indicating there is a potential that impacted groundwater has migrated beyond the site boundaries, to the north-east. However, given the presence of a (potentially PFAS impacted) landfill in this direction, and no sensitive human (groundwater users) or significant terrestrial/ aquatic receptors close to the site, the risks of impact from PFAS sourced from the site can be considered low.

The above notwithstanding, the CLA considers it would be prudent to determine aquifer properties (hydraulic conductivity and groundwater velocity) at the site, to confirm the extent of likely PFAS migration beyond the site boundary and to obtain (as possible) further information pertaining to the historic landfill to determine if this represents a viable source of PFAS to the environment.

Furthermore, it is recommended that clarification be sought from the bowls club (located south-east) and the sports club (north and north-west) as to the source of irrigation water applied to unsealed areas, to confirm no un-registered bores are present in the vicinity of the site that could represent previously unidentified sensitive receptors.

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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) role for the per and poly fluoroalkyl substances (PFAS) assessment project at the Airlie Beach Fire Station (2495 Shute Harbour Road, Mandalay, QLD "the site"), legally described as Lot 276 HR1926.

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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 meets 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.

- site visits immediately following the soil sampling/ groundwater bore installation program and during the groundwater sampling program (on 30 July 2019 and 8 August 2019, respectively);
- 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	2495 Shute Harbour Road, Mandalay, QLD 4802
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	Whitsunday Regional Council
Zoning/ future zoning	Special use
Lot and plan	Lot 276/ HR1926
Tenure	Freehold
Latitude/longitude	-20.27797, 148.72772
Site area	4,930 m^2
Current/future use	Ongoing fire station use (commercial/ industrial)
Environmental Management Register (EMR)/ Contaminated Land Register (CLR)	Lot 276/HR1926 is 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 single storey building at the south-western end of the site housing the main engine bay and interconnected rooms: office/administration area, ablution and personnel changing facilities;
- A number of single storey buildings/sheds including training rooms, a chemical/foam storage shed and a workshop/gym area along the north-western boundary, understood to have been used, historically as a foam store;
- A series of sealed shipping containers utilised for periodic confined space/heat and smoke rescue training at the north eastern end of the site;
- A decommissioned[2] concrete in-ground water tank (Case 4 pit) with dimensions of approximately 1.6 metres (m) x 1 m x 1.8 (deep) and a former holding capacity of 2,830 L; and
- Open hardstand areas and driveways occupying approximately 40 % of the site area (excluding building footprints), with open, grassed areas covering the remaining area, at the north-eastern end of the site, southern and south western corners. It is understood the north-eastern end of the site was formerly used for foam training exercises.

4.2.2 Surrounds

The site is rectangular and lies in an approximate north east to south west alignment. Surrounding land uses include:

- **Northeast:** Whitsunday Sports Park (former Airlie Beach landfill) lies adjacent to the site, comprising an area of hardstand carparking with open, unsealed grassed areas (sports oval) beyond. Undeveloped bushland is located beyond the sports oval at a range of approximately 210 m from the site boundary. A boat yard (Edge's Boatyard) is located beyond the bushland on the western bank of Campbell Creek, approximately 500 m to the north-east of the site.
- **Southeast:** Airlie Beach Bowls club is located adjacent to the site, to the south-west with an area of undeveloped bushland and additional commercial properties beyond.
- **Southwest**: Shute Harbour Road is located adjacent to the site, to the south-west, with residential properties beyond along Shute Harbour Drive, Plantation Drive and Lemau

[2] Note: The Case 4 pit was not in use at the time of inspection, having been decommissioned via sand infill and concrete capping between 2016 and 2018.

Court. The closest residential properties identified are located approximately 30 m south-west along Lemau Court.

- **Northwest:** A gravel surface access driveway to the Whitsunday Sports Park is located adjacent to the site to the north-west, with commercial buildings (the Whitsunday PCYC Youth Club and Airlie Beach Skate Park) beyond. Further bushland areas are located further to the north-west at an approximate distance of 140 m with further commercial properties located approximately 450 m to the north west. Pioneer Bay is located 230 m north-west – 330 m north of the site boundary, at its closest point.

Review of available environmentally sensitive areas (ESA) mapping (BOM, 2020) indicates that there are a number of aquatic and terrestrial groundwater dependant ecosystems (GDEs) in the vicinity of the site including:

- Moderate potential aquatic GDEs described as “alluvia with groundwater connectivity to underlying fractured rocks” were identified adjacent to the site, to the east and 750 m to the south-east associated with existing wetlands at Campbell Creek and Airlie Creek;

- Low potential aquatic GDEs described as “Wetland – fractured rocks” were identified approximately 1-2 km from the site associated with Campbell Creek, Airlie Creek and Flame Tree Creek;

- Moderate potential terrestrial GDEs within 500 m of the site to the east, south-east and south of the site, beyond Shute Harbour Road, described as “Riparian vegetation – alluvia with groundwater connectivity to underlying fractured rock aquifer”; and

- Low potential terrestrial GDEs within 500 m of the site to the south-east, beyond Shute Harbour Road, described as “Riparian vegetation – fractured rock, low potential.”

In addition to the above, according to DES (2020)[3], it is understood that the site is located within a Category C Coastal Management District. Areas along the Pioneer Bay coastline, approximately 230 m to the north of the site and 460 m north-east of the site associated with Campbell Creek are classified as “Category B Marine Plants ESAs” and a High Potential Terrestrial GDE – vegetation. In addition, an area to the south of the site is classified as a Category B: Endangered Regional Ecosystem ESA.

Pioneer Bay, and the Coral Sea beyond are classified as “Category B World Heritage Area ESAs.”

See **Figure 1** for these features.

No subterranean GDEs were identified within 4 km of the site.

[3] https://environment.des.qld.gov.au/management/maps-of-environmentally-sensitive-areas/_nocache

5 SUMMARY OF SITE HISTORY

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

- Historical air photographs obtained from the Queensland Governments online mapping portal (QImagery online) from 1945, 1960, 1970, 1975, 1985, 1996, 2001, 2004 and 2017.
- 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)
- Review of previous environmental reports/sampling activities undertaken at the site (namely, QFES, 2016 water sampling); and
- Interviews with nominated QFES personnel and site inspection (13 February 2019).

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

The results of the historic data review determined that the site has been used as a fire station for approximately 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 aqueous film forming foam (AFFF) containing PFAS (3M Lightwater) between circa 1990 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.

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

In addition to the above, the historic review noted that the footprint of the former Airlie Beach landfill site (now the Whitsundays Sports Park), may have partially encroached beneath the north-eastern portion of the existing site area in the past. As the landfill may have historically received waste containing PFAS, this may represent an additional on- and off-site source of PFAS contamination.

6 POTENTIAL FOR CONTAMINATION AND CONCEPTUAL SITE MODEL DEVELOPMENT

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

6.1 Physical setting topography, hydrology and drainage

The site is located at an elevation approximately 4 m Australian Height Datum (m AHD). The site is generally flat with a slight slope toward the north-east. It is understood that:

- stormwater drainage at the site is collected in a concrete spoon drain located on the western boundary and an earthen drain located along the eastern boundary; and
- surface water also drains via overland flow toward the north-eastern corner of the site, toward an apparent topographic low where “frequently pooled water” is observed during periods of high rainfall.

The closest hydrological feature to the site is Pioneer Bay, located approximately 330 m directly north of the site. Additional surface water features in the vicinity of the site include:

- Campbell Creek at a distance of 460 m to the south-east and 580 m north-east of the site, at its closest points running in a broadly northwest to south easterly direction, before draining to Pioneer Bay;
- Lucas Creek, which runs in a broad north to south direction forming a confluence with Campbell Creek at a point approximately 900 m to the west of the site boundary;
- Airlie Creek, which runs in a broadly north to south direction, also draining to pioneer Bay, located approximately 1.4 km west of the site, at its closest point; and
- Flametree Creek, which also runs in a broadly north to south direction, parallel with Campbell Creek, at a range of approximately 1.8 km to the east, eventually draining to Funnel Bay

No additional surface water courses and/or features are present within 1 km of the site boundary.

6.2 Geology and soils

According to the Geoscience Australia portal (http://portal.geoscience.gov.au/) the site is underlain by the Early Permian aged Airlie Volcanics which comprise acid to intermediate volcaniclastics and lavas. This is supported by information held by Queensland Globe (DNRM, 2020) and GSQ (1971) which describe the unit as “Pll: Airlie Volcanics” comprising felsic to intermediate volcaniclastics and lavas. To the north of Shute Harbour Road this unit is overlain by Quaternary aged “coastal mud, silt and minor evaporites” (GSQ, 1971).

Records held by the Australian Resource Information System (ASRIS) (CSIRO, 2020) indicate that soils underlying the site are likely to be categorised as Hydrosols which are defined, according to the Australian Soil Classification System (ASC, Isabell 2002), as:

"Soils other than Organosols, Podosols and Vertosols *in which the greater part of the profile is saturated for at least 2 -3 months in most years."*

6.3 Acid Sulfate Soils

Detailed acid sulfate soil (ASS) mapping has been performed by DNRW (2007b) with associated field reconnaissance, sampling, analysis and reporting by DNRW (2007a). Also available on Queensland Globe (DNRM, 2020), this information indicates that the south-western portion of the site along Shute Harbour Road is "low potential" (LP) ASS, whilst the north-eastern portion and adjacent landfill, bowls club and sports club is "acid sulfate soil on disturbed land" (S_{DL}). Adjacent low-lying swamp land is classified as "S0", which indicates potential ASS (PASS) from the surface, with three nearby boreholes (samples 608, 605 and 647) containing up to 4.4%S as chromium reducible sulfur (CRS).

As such, the Auditor considers that potential acid sulfate soil occurrence does require consideration on this site in the event that soil is excavated or dewatering is undertaken.

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 10 bores within a 1 km radius of the site (refer **Figure 1**), four of which are located within 500 m of the site boundary.

Given the expected receptors for groundwater migration (Pioneer Bay approximately 230 m to the north/ 330 m north-west) and Campbell Creek approximately 500 m north-east, it is noted that all identified groundwater bores are hydraulically up, or cross gradient of the site.

Of the four bores identified within 500 m of the site;

- Bore RN63581, located 250 m north-west, is listed as "abandoned and destroyed" and is screened from 17 to 24 m in andesite (Airlie Volcanics) with an unspecified yield, SWL and water quality;
- Bore RN63932, located 330 m south-east, has no construction details or water quality parameters listed;
- Bore RN63950, located 400 m south-east, is listed as "abandoned and destroyed" and is screened from 9.1 to 12.8 m in conglomerate (Whitsunday Volcanics) with a yield of 8.84 L/s and an SWL of 3.59 m (October, 1968); and
- Bore RN63423, located 460 m south-east, has minimal construction details although it is understood the bore may have been drilled to a target depth of 183 m bgl. Water quality

parameters indicate an alkaline, brackish water quality (pH 7.4, electrical conductivity of 2,300 µS/cm and TDS of 1,260 mg/L).

6.4.2 Aquifers and aquitards

It is anticipated that the uppermost regional aquifer beneath the site will be present within the Airlie Volcanics (also known as the Whitsunday Volcanics). This unit is expected to be present from approximately 9 to 17 m depth with a yield of up to 8.84 L/s (based on limited, available data). Water quality may range from fresh to brackish (limited information available). It is expected that to the north of Shute Harbour Road there is potential for a surficial aquifer/ aquitard to be present in Quaternary sediments.

6.4.3 Groundwater dependent ecosystems

The Auditor also used BOM (2020) to determine whether local surface ecosystems have been classified as groundwater dependent ecosystems (GDEs). The map indicated:

- Moderate potential aquatic GDEs described as “wetland: alluvia with groundwater connectivity to underlying fractured rock aquifers” were identified to the east and 750 m to the south-east associated with existing wetlands, Campbell Creek and Airlie Creek;
- Low potential aquatic GDEs described as “Wetland: fractured rocks” were identified approximately 1 – 2 km from the site associated with Campbell Creek, Airlie Creek and Flametree Creek;
- Low and moderate potential terrestrial GDEs (riparian vegetation) were identified within 500 m of the site, to the south-east and south.

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 the proximity of Campbell Creek, values for the Whitsunday Coastal Creeks (freshwaters) were deemed most applicable for the site. 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);
- human consumption/drinking water;
- primary, secondary and visual recreation (surface water); and

- cultural and spiritual values (surface water).

The Auditor completed a review of the identified potential groundwater/ surface water receptors and agrees with those listed in AECOM (2019b). Results have been compared against adopted assessment criteria of aquatic ecosystems, recreational contact and drinking water as these are the most sensitive receptors.

In terms of potential length of flow path to key potential down-gradient receptors, the nearest down-gradient surface water bodies are Pioneer Bay (230 m north) and Campbell Creek (approximately 460 m to the north-east) with the nearest GDEs also located at both Pioneer Bay and Campbell Creek to the north and east of the site.

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

PFAS Group	Compound	Acronym	Carbon Chain Length	CAS No.
	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 30 July 2019 to confirm in-field methodologies utilised by AECOM and ground-truth the site setting details identified during the data review phase. Due to the rapidity of the drilling program and mobilisation limitations, the Auditor was unable to attend site during soil sampling and bore installation. However, a site inspection and

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

validation of the works completed by the SQP's site representative (permanent bore installation locations, soil bore, sediment/ surface water sampling locations) was undertaken immediately thereafter.

Furthermore, an additional site inspection was undertaken by the Auditors representative during the groundwater monitoring event undertaken on 8 August 2019.

Final soil sampling and permanent groundwater monitoring bore locations are presented on **Figure 2** above. During each Auditor inspection, the site was traversed on foot. The surface of the site was generally flat with a slight slope toward the northeast and contained a combination of concrete hardstand, unsealed, grassed areas and buildings/ sheds/ shipping containers associated with current, fire station usage (i.e. engine bays, administrative and training facilities [heat and smoke], workshop and storage areas).

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 existing sewer networks 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 at the site via pump-out, sand infill and capping with concrete. Bedding sands in the vicinity of this tank could influence contaminant migration.

No evidence of an underground stormwater system (e.g. manhole covers/ access points) were identified during the walkover.

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 inspection. However:

- Available historical information (aerial photographs) and information obtained during the intrusive investigation program indicates that the former Airlie Beach Landfill was historically present adjacent to the site, to the north (now Whitsunday Sports Park) and that this landfill may, in part, underlie the northern extent of the site (as evidenced by recovery of foreign material during the advancement of bore AB_BH04).

- The presence of landfill materials partially underlying the site may represent both a potential migration pathway for contaminants in the subsurface and a potential source of historic PFAS contamination, noting that the type of waste historically accepted at the landfill, extent and/or condition of a landfill liner and/or landfill cap is not known.

It is therefore concluded that "waste storage, treatment or disposal" may have occurred on the site (former landfilling activities) as per the definition in Schedule 3 of the EP Act 1994 (Notifiable Activity no.37), and waste has been "disposed of or stored on the land".

Based on the above, and with particular reference to s.389(1)(d)(ii) of the EP Act 1994, there was evidence of potential contamination of the land at the time of inspection, albeit no direct evidence of the presence of a hazardous contaminant.

7.2 Field investigations

Field investigations comprised the following events:

- Preliminary Site Investigation (PSI, reported in AECOM, 2019a, summarised in AECOM, 2019b):
    - **Event 1** (13 February 2019): site inspection to identify areas of potential environmental concern (including interviews with selected QFES personnel regarding historic site activities) – reported in (AECOM, 2019a);
- Detailed Site Investigation (DSI, reported in AECOM, 2019b):
    - **Event 2** (29 – 30 July 2019):
        - Drilling of four soil bores (AB_BH01 to AB_BH04), installation of four monitoring bores (AB_MW01 to AB_MW04) and bore development;
        - Advancement of five shallow bores (AB_SS01 to AB_SS05); and
    - **Event 3** (8 August 2019):
        - Groundwater monitoring event (AB_MW01 to AB_MW04) and monitoring bore survey; and
        - Collection of five sediment (AB_SED01 to AB_SED05).

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 6.9 m BGL for soil sample collection and logging. Each bore was subsequently “reamed out” to target depth by Proactive using a Geoprobe drilling rig equipped with solid stem augers for groundwater monitoring bore installation at each location.

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

The shallow soil bores (AB_SS1 to AB_SS5) were advanced via hand auger to a maximum depth of 0.5 m BGL to assess shallow soil conditions.

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

Samples were collected from each location, directly from the push-tube liner, solid stem auger cuttings and/or hand auger, by hand, using a fresh, clean pair of nitrile gloves for each sampling interval. Soil samples were collected into laboratory-supplied PFAS-suitable

containers and immediately stored on ice for transport to the laboratory under appropriate, chain of custody (COC) control.

Representative samples were submitted for laboratory analysis for the identified contaminants of concern as per the agreed SAQP (AECOM, 2019a), 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]); and
- Two samples from each shallow bore (AB_SS1 to AB_SS5), within the 0 to 0.5 m depth interval.

7.2.2 Lithology encountered

The lithology encountered at the site generally comprised fill material of variable thickness, ranging from 1.8 m (AB_BH01) to 4.3 m (AB_BH04)[7], overlying disturbed natural and natural materials described as brown, wet, firm silty clays. Boreholes BH01-BH03 all note refusal on rock at depths ranging from 4.5-6.9 m BGL.

The fill material observed was of generally consistent composition across the site (with the exception of that recorded in borehole BH04), comprising silty and sandy clays. Fill material recorded in borehole BH04 comprised a combination of silty and gravelly clay intermixed with apparent landfill waste including plastic bags, glass, concrete, brick, tile, rope cloth and assorted plastic waste products indicating that the former Airlie Beach landfill footprint previously extended beneath the northern portion of the site.

The extent of landfill encroachment under the existing site area was not provided during the investigation. However, no landfill waste was observed during drilling in nearby borehole AB_BH03/MW03 nor in surface/near surface hand auger bores AB_SS4 or AB_SS5.

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

7.2.3 Groundwater assessment

Four groundwater bores (AB_MW01 to AB_MW04) were installed by AECOM (2019b). Each bore was screened across the initial water strike observed during drilling (encountered in each bore at approximately 2.5 to 5 m BGL within clay/silty clay materials.

Post drilling, groundwater gauging data confirmed that stabilised standing water levels (SWLs) in all bores had risen (deemed indicative of a semi-confined aquifer beneath the site). Screened intervals ranged from:

- AB_MW01; screened in clay (3.9 to 6.9 m BGL), wet from 5 m BGL;

[6] With the exception of bore BH04/MW04 where two samples were collected within the 0 to 1 m bgl depth interval only.
[7] Fill thicknesses were generally greater in the eastern half of the site, consistent with the topographic variation observed at site surface, refer Section 6.1

- AB_MW02; screened in silty clay (3.8 to 5.8 m BGL), wet from 2.4 m BGL;
- AB_MW03; screened in disturbed natural and silty clay (1.5 to 4.5 m BGL), wet from 4.3 m BGL; and
- AB_MW04; screened in clay (2.0 to 5.0 m BGL), wet from 3.6 m BGL.

Based on the groundwater elevations reported, local groundwater flow direction was inferred to be toward the north/north-east toward Campbell Creek and Pioneer Bay.

The field chemistry within the bores showed that the groundwater was brackish (salinity 897 to 2,519 as total dissolved solids (TDS)) and neutral to slightly alkaline (pH 6.87 to 7.63).

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

7.2.4 Surface water and sediment assessment

Five sediment samples were collected from site drainage channels for assessment (co-located surface water samples could not be collected as all drainage channels were dry).

Sediment samples were collected as grab samples 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 was filled to zero headspace prior to capping, storage on ice and submission to the nominated laboratory.

7.3 Auditor's comments on field program

The Auditor considers that the sampling design was suitable and that the soil, sediment and groundwater 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					
AB_BH01-AB_BH04	PFAS (28)	12	2	2	4
AB_SS1 to AB SS5	PFAS (28)	10	1	1	
AB_SED1 to AB_SED4	PFAS (28)	4	1	1	
AB_SS5_0.5	TOPA	1			
GROUNDWATER					
AB_MW01 – AB_MW04	PFAS (28)	4	1	1	1
AB_MW03	TOPA	1			

NOTES:
PFAS (28) – per and polyfluoroalkyl substances 28 compound suite (refer **Table 2**)
TOPA: total oxidisable precursor assay

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

8.2 Procedures for quality control and quality assurance

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

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

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

Field observations are compared with laboratory results when they are not as expected. Confirmation, re-sampling and re-analysis of a sample are undertaken if the results are not

consistent with field observations and/or measurements. In addition, field duplicate sample results have to be within the acceptable range of reproducibility. A discussion of the quality of internal laboratory results and field duplicate relative percentage difference (RPD) calculations was included in AECOM (2019b) Appendix G and are discussed below.

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

- Sample integrity and container requirements were documented as acceptable;
- Holding time compliances were documented as acceptable with the exception of;
    - Holding times were exceeded for moisture content associated with TOPA analysis on sample AB_SS5_0.5, although it is noted this breach was due to re-batching and moisture content was completed within holding time for the standard analysis requested;
- Laboratory matrix spike results were mostly within acceptable control limits;
- Laboratory duplicate % RPD results were mostly acceptable;
    - RPDs for laboratory duplicate samples were within acceptable limits for all batches with the exception of two compounds from batch EB1919838 and EB1921176 and a number of samples for laboratory duplicates collected from sites other than Airlie Beach fire station. Non-conformances were deemed indicative of sample heterogeneity within QAQC samples;
- 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 outliers listed above are deemed acceptable, as AECOM and/or the laboratory has provided reasons for the RPD exceedances, and the moisture content discrepancy was due to sample re-batch for TOPA analysis, with the original, standard analysis unaffected.

It is therefore the opinion of AECOM (2019b) and the Auditor that the data quality process for both field and laboratory components of the report was appropriate to enable its 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; and

- potential human health and/or ecological risk posed to off-site and down hydraulic gradient sensitive receptors.

The adopted assessment criteria and rationale for their selection is detailed in Section 5.0 of 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) 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 (fire station), AECOM has also assessed the soil analytical results against ecological guideline values for indirect exposure for the residential land use exposure setting given:

- The Whitsundays Sports Park is an unsealed area, therefore there is a potential for exposure of terrestrial organisms (although it is noted the sports park has been constructed on a former landfill therefore there is a relatively low likelihood of significant, detrimental exposure to in-ground organisms and organisms may already be exposed to chemicals originating from the landfill);
- Parts of the site and areas adjacent to the site, to the north-east, west and south beyond Shute Harbour Road are unsealed and/or contain undeveloped bushland therefore there is a potential (albeit low) for exposure for terrestrial organisms;
- 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/

[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.

industrial sites on a case by case basis where use of a residential exposure scenario is deemed too conservative, for example:

- The site is intensively developed with the percentage of the surface area covered by hard surfaces higher than 80 % of each hectare (to be applied separately to each hectare).
- Secondary consumers are effectively absent from the site;
- The site is situated in an extensively built-up urban setting; and
- The site is not in close proximity to waterways, drainage networks or groundwater.

9.2 Groundwater

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

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

Table 4: Adopted assessment criteria – groundwater

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	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. 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 LOR were recorded in all fourteen 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) in soil;
- Six exceedances of the ecological guideline criterion for PFOS (AB_SS3_0.1, AB_SS03_0.5, AB_SS5_0.1, AB_SS5_0.5, AB_BH03_1.0, AB_BH04_1.0) (ecological indirect exposure, commercial/ industrial scenario, criteria 0.14 mg/kg); and
- Fourteen exceedances (of twenty-two primary samples analysed) of the ecological guideline criterion for PFOS (ecological indirect exposure, residential scenario, criteria 0.01 mg/kg) limited to shallow fill collected from the top 1 metre of material across the site.
    - Noting (as discussed in Section 9 above) that assessment against the ecological indirect exposure limits for residential land-use was undertaken as a conservative measure, to account for the unsealed areas of the site, where

secondary consumers such as insectivorous birds and/or mammals could forage.

10.1.2 Auditor interpretation of soil PFAS data

Given approximately half of the site soils are beneath an existing concrete slab and effectively capped on a site understood to have been subject to ongoing commercial/ industrial use for the past 44 years, the ecological guideline exceedances are not deemed significant nor are they considered to pose a significant, realistic 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 that there are no residential land uses within 200 m of the site and the likely transient nature of wildlife likely to be directly exposed at the site.

10.2 Groundwater results compared to guidelines

10.2.1 Discussion

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

Comparison with the adopted assessment criteria confirmed:

- Sum of PFOS and PFHxS concentrations exceeded the human health assessment criterion for drinking water and recreational water quality guideline in all four monitoring bores (AB_MW01 – AB_MW04), with the highest concentrations reported in bores AB_MW03, (8.15 µg/L) and AB_MW04 (6.5 µg/L) located at the north-eastern end of the site within the former foam training area and, potentially, within the footprint of the former landfill (see **Figure 2**); and

- PFOS concentrations in all four groundwater bores exceeded the adopted ecological guideline value (99% species protection – marine/freshwater).

10.2.2 Auditor interpretation of groundwater PFAS data

Given the above, and, based on the assessment completed to date, the Auditor considers that there is a potential that PFOS and PFHxS compounds have migrated beyond the site boundary at concentrations greater than human health and ecological assessment criteria. However, given the presence of a (potentially PFAS impacted) landfill in this direction, and no sensitive human (groundwater users) or significant terrestrial/ aquatic receptors close to the site, the risks of impact from PFAS sourced from the site can be considered low.

The above notwithstanding, the CLA considers it would be prudent to determine aquifer properties (hydraulic conductivity and groundwater velocity) at the site, to confirm the extent of likely PFAS migration beyond the site boundary and to obtain (as possible) further

information pertaining to the historic landfill to determine if this represents a viable source of PFAS to the environment.

Furthermore, it is recommended that clarification be sought from the Bowls Club (located south-east) and the Sports Club (north and north-west) as to the source of irrigation water applied to unsealed areas, to confirm no un-registered bores are present, in the vicinity of the site that could represent previously unidentified sensitive receptors.

10.3 TOPA analysis

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

10.4 Sediment results

10.4.1 Discussion

No published criteria are currently available to directly assess human health and/or ecological risks associated with PFAS in sediments, therefore the sediment assessment focused on the presence of detectable concentrations of PFAS compounds in sediment.

Detectable concentrations of various PFAS compounds were recorded in all sediment samples collected at the site. Consistent with the soil and groundwater data, the sediment PFAS signature was dominated by PFOS. However, unlike the soil and groundwater signature, detectable concentrations of PFUnDA and PFTrDA compounds were reported in five of the six samples collected (including QAQC).

10.4.2 Auditor interpretation of sediment PFAS data

The presence of a wide range of detectable PFAS compounds in the 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, and noting both the distance to the closest surface water courses likely to be impacted (~230 m to Pioneer Bay/ 460 m to Campbell Creek) and the lack of direct connection to these water courses, the likelihood of transport at distance beyond the site boundary is deemed low.

Furthermore, the detectable concentrations of PFAS compounds in sediment were generally at, or just above, laboratory LORs, with the exception of

- PFOS in all four samples, which ranged from 0.0005 mg/kg in AB_SED03 along the north-eastern boundary of the site, to a maximum of 0.0359 mg/kg at AB_SED01 along the south-eastern boundary of the site (LOR 0.0002 mg.kg).

As discussed above (refer Section 9.3), 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, in the absence of a realistic, viable off-site transport pathway and sensitive receptors, the detectable PFAS concentrations in sediment are not considered to pose either a significant human health and/or ecological risk to off-site receptors.

10.5 Data quality, data gaps and other considerations

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

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

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

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

Based on the findings of the CLID (AECOM, 2019), 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 health 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. However, further intrusive assessment down-gradient of the site is not warranted given the presence of a historic landfill that could represent a historic off-site PFAS source and return confounding results.

The Auditor concurs with AECOMs conclusions that the site currently poses an acceptable human health and ecological health risk in the context of ongoing commercial/ industrial use. Furthermore, although there is a potential that contamination, above the adopted guideline criteria, may be migrating off-site to the north/ north-east, the Auditor concurs that off-site investigation that would necessitate drilling through a historic landfill is not warranted.

The Auditor considers that further investigation of aquifer properties (hydraulic conductivity/ groundwater velocity) could be completed to determine potential/ significance of off-site

PFAS migration. Further information could also be obtained to further assess any off-site PFAS contributions from the landfill, and clarification should be sought with regards the source of irrigation water used at the off-site Bowls Club and Whitsunday Sporting Park.

11 ASSESSMENT OF REPORT AGAINST S389 OF EP ACT 1994

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

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

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

11.2 Endorsement of statements; (S389 (2)) EP Act (1994)

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

- Insufficient data has been collected (chemical and physical) beyond the site boundary to determine whether the site is prescribed contaminated land, with such a determination likely to be confounded by the adjacent landfill;
- 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;
- Given the presence of a historic landfill partially underlying and adjacent to the site, further off-site investigation that would necessitate drilling through an existing, historic landfill is not advised, given the results of any such investigation would be inconclusive.; 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)			
(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 including their sources and potential pathways to identified receptors at and about the site, and then allocates appropriate Tier 1 criteria to ensure the identified potential receptors are protected by concentrations at the source/s; and
    - the conclusions of the final CLID (AECOM 2019b) are therefore underpinned by a robust assessment and consistent with the appropriate guidelines and legislation.

In summary, the CLID findings have determined that while soil contamination in excess of adopted ecological, indirect exposure guidelines exists at the site However, given the presence of concrete hardstand, the legacy and ongoing commercial/industrial use of the site and, the relatively low concentrations identified, this does constitute a significant ecological risk and the site is suitable for ongoing commercial/industrial use.

Elevated contaminant concentrations (sum of PFOS and PFHxS) greater than human health and ecological assessment criteria were recorded in all four on-site groundwater monitoring bores at and along the boundaries of the site, indicating there is a potential that impacted groundwater has migrated beyond the site boundaries, to the north-east. However, given the presence of a (potentially PFAS impacted) landfill in this direction, and no sensitive human (groundwater users) or significant terrestrial/ aquatic receptors close to the site, the risks of impact from PFAS sourced from the site can be considered low.

The CLA does however consider that it would be prudent to determine aquifer properties (hydraulic conductivity and groundwater velocity) at the site, to confirm the extent of likely PFAS migration beyond the site boundary and to obtain (as possible) further information pertaining to the historic landfill to determine if this represents a viable source of PFAS to the environment.

Furthermore, it is recommended that clarification be sought from the bowls club (located south-east) and the sports club (north and north-west) as to the source of irrigation water applied to unsealed areas, to confirm no un-registered bores are present, in the vicinity of the site that could represent previously unidentified sensitive receptors.

The above notwithstanding, the CLA does not consider that PFAS concentrations within the site boundary pose an unacceptable risk to human and/ or ecological site users and thus does not preclude on-going use of the site for commercial/ industrial purposes.

13 LIMITATIONS

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

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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. The Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for.

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

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

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

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

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

APPENDIX A: AUDITOR 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: Airlie Beach Fire Station, 2495 Shute Harbour Road, Mandalay Queensland. Rev 0 (FINAL). 10 February 2019. Author: James Peachey (SQP)
The contaminated land investigation document comprises (tick all applicable boxes): ☒ site investigation report ☐ validation report ☐ draft site management plan ☐ draft amended site management plan
Objective of the contaminated land investigation document: ☐ Required by a notice issued by the administering authority under the EP Act (notice reference number:) ☒ Prepared voluntarily to remove, or change details of, land on the environmental management register (EMR) or contaminated land register (CLR) ☐ Other (provide details):
Title(s), version number, date, and author(s) of report(s) or draft site management plan(s) evaluated—for each separate document forming a component of the contaminated land investigation document. AECOM (2019a) Preliminary Site Investigation and Sampling, Analysis and Quality Plan, QFES, April 2019

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.

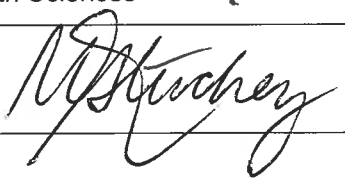
I have attached an audit report, titled *719052_QFES_AB AuditorCert_V1.0*, about my conclusions with respect to the requirements of subsections 389 (1) and 389(2) of the *Environmental Protection Act 1994*. The audit report explains and justifies how I arrived at my decision to certify that the contaminated 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 04/03/2020

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 that the site elevation is generally <10 m above sea level, it is recommended that topography (e.g. 1 m contour from Queensland Globe) be included on each site location/layout plan to assist in estimation/discussion of likely groundwater and surface water flow direction if possible to do so.
2	Figures	Figure 1	• Given accompanying Table 4 presents data for those registered bores within 500 m of the site, it may be beneficial to add a "500 m site radius" to the Figure.
3		Figures 2 – 5	AB_SS01 and AB_SS02 please amend to ensure consistent symbol (colour and type) for both locations (current symbol/colour is a little unclear). Figure 2 – Given former landfilling has been identified both partially underlying the site and, adjacent, to the north east; representing a potential source of PFAS contamination; this should be marked on a plan (be it the site features plan, or, an alternative).
4		Figures 4- 6	Please consider increasing the font size of the exceedances key at the base of the legend. (While it is noted electronically, this does not pose an issue, at print size A4 this data becomes unreadable in hard copy)
6	Tables – Appendix B	Table T1 and Table T2	• Typo (Notes): Australian height datum.
7		Table T4	• Given that commercial/industrial criteria is the primary criteria and residential used as secondary consider the following amendment to exceedances mark-up to minimise the potential for external parties mis-reading data: ○ Commercial industrial criteria exceedance = purple highlight ○ Residential criteria exceedance = bold text (the use of italic text to present the criteria difference is noted, but this is not as easy to see as bold type).

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
8	Executive Summary		• Investigation scope: " The DSI was completed between July and August" • Key findings of the DSI: ○ Bullet 3: where possible (and practical to do so), sample designations and sampling depths should be provided in text after mention e.g. the 2 soil samples containing PFOS exceeding guideline levels and associated sample depths. ○ Bullet 5: suggest rephrasing for clarity. For example: "…The highest PFAS concentrations in groundwater (sum of PFHxS and PFOS) were detected in samples collected from two monitoring wells (AB_MW03 (8.2 ug/L) and AB_MW04 (6.5 ug/L)) located along the north eastern boundary of the site, down hydraulic gradient of site source areas. Note, with regard to the above: MW03 is located in the north eastern corner of the site, rather than along the north eastern boundary as per MW04. Commentary should also be provided relating to MW04 advanced through landfill material (Whitsundays Park closed landfill) and any potential implications in relation to PFAS. It is noted that while MW04 is located down hydraulic gradient of site source area, can the landfill be discounted as a potential source?
9	1.2	Background	Update in relation to most recent comments received pertaining to staged approach received from QFES, namely: • Stage 5: Provide the final SIR to the regulator (DES) and subject to any further requirements, procure a suitable environmental consultant to design an investigation plan to measure and assess offsite impacts. • Stage 6: Engage an appropriately qualified third party CLA to audit the suitability of any offsite investigation plan to meet the requirements of DES prior to implementation.
10	1.5	PFAS Analysis	Footnote (3) – amend in relation to most recent comments received (Proserpine report) pertaining to NEMP Version 2.0.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
11	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 and discharge offsite. • Is any information available pertaining to when the Case 4 pit was decommissioned? • As per previous report comments – please include some commentary pertaining to evidence (or lack thereof) of fill placement across the site. Noting that at the least part of the site may have been constructed on the legacy Whitsundays landfill.
12	2.3	Surrounding Land use	Table 3: • **General:** Based on site orientation, the four site boundaries are – north east/south east/south west and north west; surrounding land uses would be better considered in this context, rather than standard compass bearings, (north, east, south, west). Please review and amend as necessary. Example – Shute Harbour Road bounds the site to the south west, not the West • **West:** According to QLD Globe, the closest residential property to the west is located approximately 460 m to the west on Bottle tree close. • **North, Northeast and Northwest:** please confirm distances from site to bushland at closest point. From the northern boundary a distance varying between 140 m to 211 m can be measured in a north easterly direction, variable contingent on point of measurement (QLD Globe). The distance to “Edges Boatyard” appears closer to 470 m to the north east. Note – minor additional information can be obtained on the legacy landfill located to the north east of the site (current sports field) to upgrade from “anecdotal” information only. Please refer to Whitsunday councils waste management plan located: https://www.whitsunday.qld.gov.au/DocumentCenter/View/3007 (Table 11). It is noted that an assessment was completed by AGE – would it be worth attempting to access this information via a freedom of information request to determine what assessment has been completed in the past (e.g. contingent on report contents - confirm if analysis for PFAS as a contaminant of concern has ever been completed during historic investigations/obtain further detail on types of waste disposed and likelihood of PFAS

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			content has been addressed). Possibly relevant to a future work stage (if off-site assessment is recommended) rather than current assessment in consideration of likely access timeframes.
13	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 consistency. Ensure all relevant information is included. • Bullet 1: Did the aerial photography review provide any indication that part of the landfill may have previously underlain the present-day fire station and, to what extent? (Noting that foreign materials (including glass, plastic bags) were confirmed during borehole advancement in the north eastern portion of the site and as per historical info available on the Council website, comment 12 above.)? • Bullet 5: Could some clarification be provided regarding the last two sentences. It is noted that no information has been provided as to how out-of-date foam was removed from site, but, the next sentence indicates AFFFs were removed by a contactor. Please review and amend as necessary. • Bullet 6: Care should be taken using PFAS as a catch-all phrase. Please review to use specific PFAS compounds and/or provide clarity that only specific PFAS compounds were identified. • Last paragraph – it is noted that the former landfill area at least partially underlies the existing site, as demonstrated by foreign materials observed during drilling.
14	3.3	Soil Type and Acid Sulfate Soils	Noting that Whitsunday Regional Council interactive mapping indicates ASS may be present in portions of the site, it may be worth providing this information on a figure (contingent on available resolution of the data) to provide visibility on where PFAS sorption may be limited. Can some commentary be provided to support or discount the available mapping, based on observations made during the intrusive investigation. Were any acid sulfate soil indicators observed? Are there any groundwater geochemical indicators that may be indicative of ASS occurrence within the site boundary?
15	3.4	Geology	Was the anticipated geology consistent with that identified during the intrusive investigation? Paragraph 2 – it is noted that geological information has been provided based on the bore reports for RN141307 and RN162365. However, it is noted that these are not the closest bores to the site; rather the closest bores are RN63581/ RN63942/RN63950 and RN63423 which may be more representative of the lithology underlying the site. Is geological information available for these bores?

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
16	3.5	Hydrology	Please refer to drainage and surface water layers in Queensland Globe: • Campbell Creek is located approximately 460 m (SE) and 580 m (NE) of the site at its closest point. Although a feature of poor drainage and not naturally occurring – it may be worth mentioning that standing water pools on the site in the north eastern corner on a seasonal basis.
17	3.6	Hydrogeology	• Paragraph 2: Refer to Figure 1; there are 10 registered bores within 1 km of the site (noting RN43553 is marginal). • Nine bores have been included in Table 5 (RN43553 has not be included but is considered marginal). Please review and amend as necessary.
18	3.8	Groundwater dependent ecosystems	Please review and update this section – reference is made to “Proserpine River” within 4 km of the site and associated GDEs therein. A review of the BOM GDE map indicates a number of aquatic and terrestrial GDEs within 4 km of the site including (but not necessarily limited to) – Wetlands at Airlie Creek and Riparian Vegetation.
19	4.2	Sampling rationale	• AB_BH01/MW01 is not adjacent to the Case 4 pit (Figure 2). The bore is located down hydraulic gradient, to the north east of the Case 4 pit. Noting the description indicates the location is “up gradient” of the foam training area, has it been confirmed that training did not occur, in the past, across the open grassed area (where AB_SS3 was positioned)? • AB_BH03/MW03 is located in the north eastern corner of the site. (It is noted east/north east and other directions are often used interchangeably for location descriptions at the site, given the site’s orientation. While neither is incorrect, this does result in some inconsistency of terminology. It is recommended that location descriptors/terminology (with regards to bearings/directions) are agreed from the outset and consistently used throughout to minimise confusion). Once terminology is agreed, Table 7 can be updated as appropriate. Note – given a detailed Figure (Figure 2) is provided, presenting each sampling location, consider minimising lengthy location descriptors in favour of sampling purpose, as the location is clearly marked on the Figure.
20	4.2.1	Soil Investigation	Table 8 – Service Location; first sentence; “dial before you dig **plans**”?

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
21	5.0	Assessment Criteria	Care should be taken to ensure consistency across CLID documents. It is noted that the PSI states that although Campbell Creek falls within the Proserpine River Basin Catchment; the applicable environmental values are those of the "Whitsunday coastal creeks freshwaters". (This is also reflected in section 3.7 Environmental Values) Please review for consistency and amend as necessary. Given Pioneer Bay is the closest water source to the site and, hydraulically down gradient, based on the inferred north easterly flow direction, would it not be appropriate to assess waters potentially discharging to the marine environment against marine criteria? It is noted Campbell Creek, while likely freshwater is located approximately 460 m (SE and up/cross-gradient) and 580 m (NE and down-gradient) of the site at its closest point.
22	6.1	Soil conditions	Suggest "immediately adjacent" is reduced to "adjacent".
23	6.2.3	Water quality parameters	It is noted Table 14 is titled groundwater and surface water results. However, the table presents results for, presumably, the 4 groundwater samples only. According to the introductory paragraph, this table is to present groundwater only. Suggest table is re-titled to indicate groundwater results only are being presented. Further, it is recommended, given data is only available for four locations that all pertinent data is presented rather than statistics (minimum and maximums). Paragraph 2 (beneath table) – typo? "slightly basic"?
24	6.3.1	Soil	• Paragraph 2 - "Error reference source not found" – cross reference to Table 14. • Table 15 – max concentration is listed in mg/kg soil/ ecological guideline criteria listed in ug/L. Please check and amend. • Consider presenting the nominated guideline values in this summary table for clarity. • Last paragraph – was the laboratory contacted to discuss the anomalous PFBA result in AB_SS1. What was the outcome? It is noted this concentration is significantly higher than standard laboratory limit of reporting and warrants further consideration and discussion. Furthermore, it is noted in Table 20 PFBA was detected in groundwater samples; therefore, is it possible this is not an outlier?

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
25	6.3.2	Groundwater	Paragraph 2 – According to Figure 2, AB_BH03/MW03 is located in roughly the centre of the area marked as former training area, not on the north east boundary. Paragraph 3 - Given groundwater is inferred to flow north east, via the landfill toward Pioneer Bay and, there are no down-gradient bores registered for potable use; how relevant is reference to drinking water criteria exceedances here? The closest groundwater bore detailed is 375 m south east (upgradient) – use unspecified and the closest bore confirmed for water supply is located 650 m south west (up gradient). We would not describe 0.505 ug/L as “almost equal to the guideline value”.
26	7.1.1	Soil and Geological Conditions	Please refer to comments above regarding landfill positioning considerations in relation to the site; particularly in relation to the observations of foreign materials in BH04. Please review and amend for consistency. It is noted section 7.1.1 describes the geological conditions as fill and re-worked natural deposits overlying natural material. However, this is the first mention of re-worked/disturbed natural. Please review section 7.1.1 and Section 6.1 for consistency and amend as necessary.
27	7.1.2	Hydrogeology	Please refer to earlier comments regarding consistent use of area location descriptions in relation to features of interest/sampling locations. Please review and amend for consistency throughout.
28	7.2	Soil analytical results	Chart 1 – could consider attempting to overlay soil types (e.g. fill/natural/reworked natural) as a background to this chart to provide rapid reference to contaminant occurrence in relation to strata type. id interpretation.id interpretation. 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. Was AB_SS3 not advanced within a known or potential former foam training area? It seems most likely that the reported concentrations of sum of PFHxS and PFOS recorded in shallow soils here, are most likely attributable to the direct application of foam application to surface and subsequent infiltration. What maintenance activities would involve AFFF? Could the PFAS signature from AB_BH04 (within landfill waste material) be assessed against PFAS signatures from elsewhere on site to provide a high-level indication of potential differing source areas? (Is there sufficient difference to make meaningful comment?)

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
29	7.1	Groundwater analytical results	Note section heading numbering from 7.1 is incorrect (Soil analytical results is listed as 7.2, the next section, groundwater analytical results is listed as 7.1 and so on). Please check and amend. Paragraph 2 – it is understood that the Case 4 pit has only ever contained water; not foam. Why were significant sources of PFAS considered likely to originate from the Case 4 pit? Paragraph 3 – note that groundwater will eventually discharge to Pioneer Bay, via the landfill. 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 and offsite migration) therefore consideration of these two compounds together, may mask some pertinent information with regard to contaminant mobility and transport. This may be particularly pertinent in consideration of contaminant movement, with inferred groundwater direction, to the south east. Please provide separate discussion for consideration of PFHxS and PFHxA behaviour. Also, please present the concentrations for the individual compounds (PFHxS and PFHxA) in Figure F5 (and other relevant figures, as appropriate).
30	7.2	Comparison of PFAS composition in soil and groundwater samples	Refer comment 24 – it is noted that a high level detectable PFBA concentration in soil was considered to represent an outlier. However, as per Table 20, PFBA was also identified in groundwater. Does this require further consideration. Please review and amend as necessary following QA/QC assessment. As per comment 29 above, further consideration should be made to PFHxS occurrence and behaviour
31	8.2	Sources	Given the existing fire station is underlain (at least partially) by landfilling materials (BH04 evidence), which pre-dated the construction of the fire station; historic landfilling of potentially PFAS-containing waste materials should be considered a primary source, as well as an offsite source
32	8.5	Assessment of exposure pathways	Table 21 – “PFAS in concrete lined pits and drains” – while it is noted that the Case 4 pit is concrete lined, earlier in the document, site drainage is described as “earth lined”. Please confirm. If earth, direct infiltration to subsurface could be a pathway rather than leaching of concrete. PFAS in groundwater – the likelihood of off-site human ingestion of groundwater is different from that of incidental direct contact. Given groundwater is potentially migrating off-site to the north east and, there are no down gradient bores in this direction, groundwater abstraction for potable use is of low likelihood. Furthermore,

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			the closest bore for “water supply” has been noted to be 650 m to the south(ish). Can these two exposure pathways be separated to more accurately reflect risks in light of the site-specific circumstances? PFAS in surface water/accumulation of PFAS in creek sediment – given the distance between the site and the creek and, the ephemeral nature of the drains, is this not rather unlikely? Do any drainage lines from the site feed directly into Campbell Creek?
33	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 7.1 Groundwater analytical results	Information pertaining to previous environmental investigations has been provided appropriately. *Note contents page/ section numbers beyond Section 7.0 require updating.	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 (Owner only)		No
· current occupier(s) of the land	Table 2		No
· area of the land (m2 or hectares)	Table 2		No
· map of the site at a suitable scale, showing lot and plan boundaries, and latitude and longitude in decimal degrees	Figure 2		No
· relevant local government authority	Table 2		No
· zoning of the site and the surrounding land on the local government's planning scheme (current and proposed)	Table 2		No
· any proposed changes to the zoning of the site and the surrounding land on the local government's planning scheme	Table 2		No
· any existing, pending or proposed development approval or building works approval.	Not provided	Not relevant to this report	No
State whether or not the land is currently listed on the EMR or the CLR and provide the identifying number on the EMR or CLR. Provide a short history (if available) of when any listing(s) occurred, and any changes that were made to the listings.	Table 2		No
Describe the past and current activities and use(s) of the land that resulted in its potential or actual contamination and its listing on the register. Describe and map the locations where those activities occurred. In particular, address any notifiable activities and/or environmentally relevant activities.	Section 2.2: Site layout and features; Section 2.4 Previous environmental investigation	Figures and text to be updated in consideration of comments pertaining to former activities on site (e.g. foam training). In addition, it would be worth updating the figure to show approximate former landfilling extents, particularly as this is likely to at least partially extend underneath the	**Yes**

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
		site (BH04) and may represent an alternate contamination source.	
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 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 8.3 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	Information provided should be reviewed in relation to commentary provided	**Yes**
· the location of all water, watercourses and wetlands	Section 3.4: Hydrology, Section 3.8 GDEs and Environmentally sensitive areas	Section 3.4 and throughout please confirm details with regard to water courses, distance from site, names and so on.	**Yes**

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		No
· 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 dada may be useful to assist in determining likely groundwater and surface water flow directions if feasible, contingent on-site topography.	**Yes**
Describe the stormwater drainage, delineate the catchments, and include any stormwater quality improvement devices, weirs, sediment basins, storage dams, and so on. Include the potential for stormwater drainage to affect the movement of contaminants. Also, address flood risk and locations where significantly large pools of water occur during or after rain events.	Section 2.2 Site layout and features; Section 2.4 Previous environmental investigation; Section 3.5 Hydrology		No
3.6 Waste disposed of or stored on the land			
Provide details of any waste that has been disposed of on the land, or that is or was stored on the land. Under Queensland law, waste is defined by s. 13 of the EP Act. The details should include the location, quantity and type of the waste, and the method(s) of its storage or disposal.	Section 2.4 Previous environmental investigation	Waste storage discussed in terms of PFAS only, which is sufficient to meet the objectives of this report.	No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
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	Refer to commentary regarding former landfilling activities potentially undertaken partially beneath and adjacent to the site	**Yes**
The description should also include any waste that may have been extracted, then moved or stored at the site during earthworks (see also section 3.9 below). Suitably qualified persons must search all available records when researching information for this section of the report.	Section 2.2	Commentary should be provided regarding emplacement of fill on site (as per comment above). This may also include any information/inference regarding capping that was placed over the existing landfill.	**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	Please refer to commentary regarding consistency in reference/use of selected EVs	**Yes**
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).			No
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 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). This may also include any information/inference regarding capping that was placed over the existing landfill.	**Yes**

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Provide maps and cross-sections to illustrate how earthworks have changed the topography and geology of the land.	As above	As above.	No
Integrate the description of any earthworks with the required description of the site's watercourses, wetlands, geology and hydrogeology.	As above	As above.	No
Address whether the earthworks could be a source of contamination.	As above	As above.	No
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.	Figure F2: Site layout & sampling locations,	Please refer to individual comments regarding recommended amendments to figures	**Yes**

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Provide details of a site conceptual model using text, tables and/or diagrams.	Section 8, Table 19		No
Describe the methods used to take, store, preserve and analyse samples of media. Discuss any limitations to those methods that may affect reliance on the results. Samples must be collected in accordance with appropriate standards, and the chain of custody of samples must be fully recorded. If the samples were handled and/or analysed by a third-party, identify the laboratory or contractor(s) that undertook the work, and state whether or not they are accredited (e.g. by the National Association of 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 (e.g. anomalous PFBA result).	**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.	Please refer to commentary regarding consistency in reference/use of selected EVs	**Yes**
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),	Section 3.6, Section 5.0	Assessment criteria has been provided in Table 10. However, the NEMP does not provide trigger values for all the identified EVs.	**Yes**

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
and the Queensland water quality guidelines 2009 (EHP, republished in 2013). Include environmental values that relate to potential uses; for example, saline groundwater may be treated by reverse osmosis for potable or stock use during a drought, and therefore has a current environmental value. Furthermore, all environmental values that derive from Queensland's environmental protection policies cannot be subsequently disregarded or diminished by applying the contaminated land NEPM's risk-based process.		Provide commentary on how the adopted assessment criteria will 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

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
• describe the extent of any deviations from the recommendations of the NEPM's schedules	Appendix G- QA/QC		No
• explain whether any deviations were due to overriding state legislation or policies	As above	As above	No
• evaluate with reference to current best practice how effective any alternative methods were in comparison to those of the NEPM.	As above	As above	No
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

Kat Spruth

From: Peachey, James <james.peachey@aecom.com>
Sent: Friday, 31 January 2020 9:16 AM
To: Kat Spruth
Cc: Raymond Bott; Mark Stuckey
Subject: RE: 719052: Ayr/Airlie Beach (Rev B) - CLA Comments (2)

Hi Kat

Please find below our responses to the additional comments.

AIRLIE BEACH				
AECOM Comment/ Section reference	**Environmental Earth Sciences comment**	**AECOM response**	**EES (Comment 2)**	**AECOM Response to Comment 2**
12/ 2.3	West: According to QLD Globe, the closest residential property to the west is located approximately 460 m to the west on Bottle tree close.	Bottle Tree Close could not be located. There is a hotel Casa del Mar 460 m to the west.	Please refer to **attached** Figure for Bottle Tree Close location	The property shown along Bottletree Close is a hotel (Casa del Mar). Further review of land use along Mount Whitsunday Drive indicates residential properties have been built on the western side of Mount Whitsunday Drive and to the north of Casa del Mar Hotel. These are approximately 500m to the west-north-west of the site. This has been included in Section 2.3.
29/ 7.1	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 and offsite migration) therefore consideration of these two compounds together, may mask some pertinent information with regard to contaminant mobility and transport.	As no off-site analytical data are available, we consider a discussion on the potential differences in behaviour of different compounds and potential offsite impacts would be speculative. We consider it would be appropriate to include discussion once offsite data becomes available.	While the CLA recognises that no off-site data is available for these compounds, in a number of cases (refer to each report for which comments have been provided) if concentrations of shorter chain compounds (namely PFHxS) are reviewed in relation to site boundaries, there are implications for off-site migration that are masked by only considering the extent of those compounds for which guidelines are available and exceedances occur. The CLA therefore considers there is value in providing	Added new paragraph to Section 7.3: Shorter chain compounds (i.e. compounds with six or fewer perfluorinated carbons) have higher mobility in groundwater relative to longer chain compounds. Due to the main source area (foam training area) being located close to the down-gradient (northeastern) boundary, no wells were positioned down-gradient of this area and therefore there is limited information on the potential mobility of shorter chain compounds. Groundwater samples from monitoring wells positioned

	This may be particularly pertinent in consideration of contaminant movement, with inferred groundwater direction, to the south east. · Please provide separate discussion for consideration of PFHxS and PFHxA behaviour. Also, please present the concentrations for the individual compounds (PFHxS and PFHxA) in Figure F5 (and other relevant figures, as appropriate).	· Our discussion has focused on those compounds which have national published guideline values and which are considered to present a higher risk to human health and ecological receptors. We consider that the results presented on the figures are appropriate.	comment/commentary regarding the observed mobility of those shorter chain compounds, particularly PFHxS. Please review comment response and report within this context to expand relevant sections with further, meaningful information pertaining to observed contaminant mobility and transport.	within the foam training area (AB_MW03 and AB_MW04) are noted to have the highest concentrations of shorter chain compounds including PFHxS, PFBS, PFPeS, PFBA, PFPeA and PFHxA. These compounds are considered to have a higher potential to migrate in groundwater at distance beyond the site boundary.
CLID 3.3	Section 2.2 Figures and text to be updated in consideration of comments pertaining to former activities on site (e.g. foam training). In addition, it would be worth updating the figure to show approximate former landfilling extents, particularly as this is likely to at least partially extend underneath the site (BH04) and may represent an alternate contamination source.	The landfill is labelled on Fig 1. We don't have a good understanding of the layout of the landfill. A FoI request for the AGE report might provide further data.	While the CLA concurs that the exact layout of the landfill is unknown, given wastes were identified in BH04 it would be prudent to show the approximate extent of the landfill at least partially underlying the site, for clarity. At present, the Figure gives no indication that landfilling materials have also been confirmed underlying the north eastern portion of the site, this is important data for interpretation purposes. Note that the CSM figure (Figure 7) does provide a good representation of the likely landfill location and extent.	Figures 2 to 6 have been updated to include the an approximate boundary line (based on historical aerial photography) of the landfill.
AYR				
NEW/Figure 7	• Given this is a CSM and distances are not intended to be represented accurately, consider including off-site water features (particularly down gradient groundwater abstraction bore, noted to be 175 m to the south east and screened to 8 m depth) as groundwater users are listed as receptors. This would then			We are making amendments to these figures as requested.

	allow receptor C and pathway 10 to be appropriately represented. • Pathway 8 is not shown. • Please review positioning of Pathway F label (aquatic ecosystem)– currently placed against the grassed area (terrestrial ecosystem) • Can the figure be amended to show, more clearly, that the closest residential structures are beyond Queen street, to the north west. Perhaps a road graphic could be provided between the grassed area and the building? The size of the figure could be amended to account for these additions.			
15/2.3	Added Coles Express but we could not identify Woolworths servo. BP and Caltex service stations to the NW are identified.	Note – a service station (Coles Express) is located approximately 400 m to the south west/ a service station (Woolworths Petrol) is located approximately 450-500 m to the west.	The CLA notes the Woolworths service station has since been permanently closed and is not readily apparent on Google – the former service station is located at 115 Edwards St (please see **attached** Google maps extract).	We have amended sections 2.3 and 2.4 to identify this service station is closed.
31/ 7.3	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 and offsite migration) therefore consideration of these two compounds together, may mask some pertinent information with regard to contaminant mobility and transport. This may be particularly pertinent in consideration of contaminant movement, with	As no off-site analytical data are available, we consider a discussion on the potential differences in behaviour of different compounds and potential offsite impacts would be speculative. We consider it would be appropriate to include discussion once offsite data becomes available. · Our discussion has focused on those compounds which have national published guideline values and which are considered	While the CLA recognises that no off-site data is available for these compounds, in a number of cases (refer to each report for which comments have been provided) if concentrations of shorter chain compounds (namely PFHxS) are reviewed in relation to side boundaries, there are implications for off-site migration that are masked by only considering the extent of those compounds for which guidelines are available and exceedances occur. The CLA therefore considers there is value in providing comment/commentary regarding the observed mobility of those shorter chain compounds, particularly PFHxS. Please	We have added the following paragraph to 7.3. Shorter chain compounds (i.e. compounds with six or fewer perfluorinated carbons) have higher mobility in groundwater relative to longer chain compounds. The groundwater sample from monitoring well MW03, which is located closest to the down-gradient southeastern site boundary reported relatively higher concentrations of shorter chain compounds including PFHxS (7.13 µg/L), PFBS (0.84 µg/L), PFPeS (1.32 µg/L), PFPeA (1.05 µg/L), PFHxA (2.4 µg/L) compared to groundwater from up-gradient monitoring wells (e.g. MW01). This indicates shorter chain compounds have migrated from up-gradient

	inferred groundwater direction, to the south east. · Please provide separate discussion for consideration of PFHxS and PFHxA behaviour. Also, please present the concentrations for the individual compounds (PFHxS and PFHxA) in Figure F5 (and other relevant figures, as appropriate).	to present a higher risk to human health and ecological receptors. We consider that the results presented on the figures are appropriate.	review comment response and report within this context to expand relevant sections with further, meaningful information pertaining to observed contaminant mobility and transport.	source areas and these compounds are considered to have a higher potential to migrate in groundwater at distance beyond the site boundary.

The reports contain the NHMRC (2019) reference- this is in the references section under Australian Government (2019) NHMRC (2019) Guidance… I will change this to NHRMC (2019).

Please let me know if you have any further comments on these changes.

Regards

James Peachey
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From: Kat Spruth <kspruth@eesigroup.com>
Sent: Wednesday, 29 January 2020 5:17 PM
To: Peachey, James <james.peachey@aecom.com>
Cc: Raymond Bott <Raymond.Bott@qfes.qld.gov.au>; Mark Stuckey <mstuckey@eesigroup.com>
Subject: 719052: Ayr/Airlie Beach (Rev B) - CLA Comments (2)

Hi James, Raymond,

Please find below the CLA's additional, minor additional review comments on Ayr/Airlie beach (Rev B) in tabulated format in relation to AECOMs "response to comments". Pending amendments with regards to items raised below, we are happy to see the reports issued in final.

I understand Raymond has no further comments to add following QFES review of the Ayr report.

Please let us know if you have any comments or queries.

Kind regards,

Kat Spruth – Senior Environmental Scientist
Unit 3, 1 Ross Street Newstead QLD 4006
P:045 999 3323
kspruth@eesigroup.com
www.eesigroup.com

AIRLIE BEACH			
AECOM Comment/ Section reference	**Environmental Earth Sciences comment**	**AECOM response**	**EES (Comment 2)**
12/ 2.3	West: According to QLD Globe, the closest residential property to the west is located approximately 460 m to the west on Bottle tree close.	Bottle Tree Close could not be located. There is a hotel Casa del Mar 460 m to the west.	Please refer to **attached** Figure for Bottle Tree Close location
29/ 7.1	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	As no off-site analytical data are available, we consider a discussion on the potential differences in behaviour of different compounds and potential offsite	While the CLA recognises that no off-site data is available for these compounds, in a number of cases (refer to each report for which comments have been provided) if concentrations of shorter chain compounds (namely PFHxS) are reviewed in relation to site boundaries, there are implications for off-site migration that are masked by only

	behaves differently (with regard to mobility and offsite migration) therefore consideration of these two compounds together, may mask some pertinent information with regard to contaminant mobility and transport. This may be particularly pertinent in consideration of contaminant movement, with inferred groundwater direction, to the south east. · Please provide separate discussion for consideration of PFHxS and PFHxA behaviour. Also, please present the concentrations for the individual compounds (PFHxS and PFHxA) in Figure F5 (and other relevant figures, as appropriate).	impacts would be speculative. We consider it would be appropriate to include discussion once offsite data becomes available. · Our discussion has focused on those compounds which have national published guideline values and which are considered to present a higher risk to human health and ecological receptors. We consider that the results presented on the figures are appropriate.	considering the extent of those compounds for which guidelines are available and exceedances occur. The CLA therefore considers there is value in providing comment/commentary regarding the observed mobility of those shorter chain compounds, particularly PFHxS. Please review comment response and report within this context to expand relevant sections with further, meaningful information pertaining to observed contaminant mobility and transport.
CLID 3.3	Section 2.2 Figures and text to be updated in consideration of comments pertaining to former activities on site (e.g. foam training). In addition, it would be worth updating the figure to show approximate former landfilling extents, particularly as this is likely to at least partially extend underneath the site (BH04) and may represent an alternate contamination source.	The landfill is labelled on Fig 1. We don't have a good understanding of the layout of the landfill. A FoI request for the AGE report might provide further data.	While the CLA concurs that the exact layout of the landfill is unknown, given wastes were identified in BH04 it would be prudent to show the approximate extent of the landfill at least partially underlying the site, for clarity. At present, the Figure gives no indication that landfilling materials have also been confirmed underlying the north eastern portion of the site, this is important data for interpretation purposes. Note that the CSM figure (Figure 7) does provide a good representation of the likely landfill location and extent.
AYR			
NEW/Figure 7	• Given this is a CSM and distances are not intended to be represented accurately, consider including off-site water features (particularly down gradient groundwater abstraction bore, noted to be 175 m to the south east and screened to 8 m depth) as groundwater users are listed as receptors. This would then allow receptor C and pathway 10 to be appropriately represented. • Pathway 8 is not shown.		

	• Please review positioning of Pathway F label (aquatic ecosystem)– currently placed against the grassed area (terrestrial ecosystem) • Can the figure be amended to show, more clearly, that the closest residential structures are beyond Queen street, to the north west. Perhaps a road graphic could be provided between the grassed area and the building? The size of the figure could be amended to account for these additions.		
15/2.3	Added Coles Express but we could not identify Woolworths servo. BP and Caltex service stations to the NW are identified.	Note – a service station (Coles Express) is located approximately 400 m to the south west/ a service station (Woolworths Petrol) is located approximately 450-500 m to the west.	The CLA notes the Woolworths service station has since been permanently closed and is not readily apparent on Google – the former service station is located at 115 Edwards St (please see **attached** Google maps extract).
31/ 7.3	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 and offsite migration) therefore consideration of these two compounds together, may mask some pertinent information with regard to contaminant mobility and transport. This may be particularly pertinent in consideration of contaminant movement, with inferred groundwater direction, to the south east. · Please provide separate discussion for consideration of PFHxS and PFHxA behaviour. Also, please present the concentrations for the individual compounds (PFHxS and PFHxA) in Figure F5 (and other relevant figures, as appropriate).	As no off-site analytical data are available, we consider a discussion on the potential differences in behaviour of different compounds and potential offsite impacts would be speculative. We consider it would be appropriate to include discussion once offsite data becomes available. · Our discussion has focused on those compounds which have national published guideline values and which are considered to present a higher risk to human health and ecological receptors. We consider that the results presented on the figures are appropriate.	While the CLA recognises that no off-site data is available for these compounds, in a number of cases (refer to each report for which comments have been provided) if concentrations of shorter chain compounds (namely PFHxS) are reviewed in relation to side boundaries, there are implications for off-site migration that are masked by only considering the extent of those compounds for which guidelines are available and exceedances occur. The CLA therefore considers there is value in providing comment/commentary regarding the observed mobility of those shorter chain compounds, particularly PFHxS. Please review comment response and report within this context to expand relevant sections with further, meaningful information pertaining to observed contaminant mobility and transport.

In addition to the above, in relation to **ALL** six final documents, please ensure that reference has been made to the updated:

- Guidance on Per and Polyfluoroalkyl (PFAS) in Recreational Water, Canberra: National Health and Medical Research Council (2019)