Information sheet for environmental audits and preliminary risk screen assessments (PRSAs)

Publication 2009 June 2021

Victoria's audit system

An environmental audit system has operated in Victoria since 1989. The *Environment Protection Act 2017* (the Act) provides for the appointment of environmental auditors. It also provides for Environment Protection Authority (EPA or the Authority) to have a system of preliminary risk screen assessments (PRSAs) and environmental audits. These are used in the planning, approval, regulation and management of activities, and in protection of human health and the environment.

Under the Act, the functions of an environmental auditor include to:

- conduct PRSAs and environmental audits
- prepare and issue PRSA statements and reports, and environmental audit statements and reports.

The purpose of a PRSA is to:

- assess the likelihood of the presence of contaminated land
- determine if an environmental audit is required
- recommend a scope for the environmental audit if an environmental audit is required.

The purpose of an environmental audit is to:

- assess the nature and extent of the risk of harm to human health or the environment from contaminated land, waste, pollution, or any activity
- recommend measures to manage the risk of harm to human health or the environment from contaminated land, waste, pollution, or any activity
- make recommendations to manage any contaminated land, waste, pollution or activity.

Upon completion, all PRSAs and environmental audits require preparation of either a PRSA statement, accompanied by a PRSA report, or an environmental audit statement, accompanied by an environmental audit report.

A person may engage an environmental auditor to conduct a PRSA or an environmental audit.

EPA administers the environmental audit system and ensures an acceptable quality of environmental auditing is maintained. This is achieved by assessing auditor applications and conducting a quality assurance program. These measures ensure that PRSAs and environmental audits that environmental auditors undertake are completed in accordance with the relevant sections of the Act or any other Act, and with the guidelines the Authority or other government agencies have published.

File structures

EPA stores digital statements and reports from PRSAs and environmental audits in three parts:

- Part A, the PRSA or environmental audit report
- Part B, report appendices
- Part C, the PRSA statement and executive summary or environmental audit statement and executive summary.

Report executive summaries, findings and recommendations should be read and relied upon only in the context of the whole document, including any appendices and the PRSA statement or environmental audit statement.

Currency of PRSAs and environmental audits

PRSAs and environmental audits are based on the conditions encountered and information reviewed at the time of preparation. They don't represent any changes that may have occurred since the completion date. As it's not possible for the PRSA or audit report to present all data that could be of interest to all readers, consideration should be made to any appendices or referenced documentation for further information.

When information about the site changes from what was available at the time the PRSA or environmental audit was completed, or where an administrative error is identified, an environmental auditor may amend or withdraw PRSA or environmental audit statements and/or reports. Users are advised to check EPA's website to ensure documents' currency.

PDF searchability and printing

EPA can only provide PRSAs and environmental audit statements, reports and appendices that the environmental auditor provided to EPA via the EPA portal on the EPA website.

All statements and reports should be in a Portable Document Format (PDF) and searchable; however at times some appendices may be provided as image-only PDFs, which can affect searchability.

The PDF is compatible with Adobe Acrobat Reader, which is downloadable free from Adobe's Website (www.adobe.com).

Further information

For more information on Victoria's environmental audit system, visit EPA's website or contact EPA's Environmental Audit Unit.

Web: www.epa.vic.gov.au

Email: environmental.audit@epa.vic.gov.au

AUSTRALIAN
ENVIRONMENTAL AUDITORS

Environmental Audit Report

Muirhead North Stage 1A – Portion of Lot 9370,
Lee Point, Northern Territory

Prepared for
Defence Housing Australia

Prepared by
Australian Environmental Auditors Pty Ltd

Date
8 November 2022

Job No.
EA0975

Environmental Audit ID
NTEPA2017/0102-030

AUSTRALIAN
ENVIRONMENTAL AUDITORS

Environmental Audit Report

Muirhead North Stage 1A – Portion of Lot 9370
Lee Point, Northern Territory

Prepared for:
Defence Housing Australia
120 Bay Street
Port Melbourne, VIC 3207

Prepared by:
Australian Environmental Auditors Pty Ltd
Suite 21, 1 Ricketts Road
Mount Waverley, VIC 3149

Date of Report:
8 November 2022

Author:

Jean-Paul Pearce
Environmental Auditor (Contaminated Land)
Appointed under Division 1 of Part 8.3 of the *Environment Protection Act 2017* (Vic.)

Version Control Record

Document File Name	Auditor	Internal Auditor Reviewer	Distribution
EA0975	JPP	ANM	• Northern Territory Environment Protection Authority • Development Assessment Services • Defence Housing Australia • Australian Environmental Auditors Pty Ltd
Version	**Date Issued**	**Date Reviewed**	
EPA DRAFT	4 November 2022	3 November 2022	
FINAL	8 November 2022	-	

Environmental audit statement

Under Part 8.3 of the *Environment Protection Act 2017*

Publication F1032 published September 2021

The purpose of an environmental audit is:

a) to assess the nature and extent of the risk of harm to human health or the environment from contaminated land, waste, pollution or any activity; and
b) to recommend measures to manage the risk of harm to human health or the environment from contaminated land, waste, pollution or any activity; and
c) to make recommendations to manage the contaminated land, waste, pollution or activity.

This statement is a summary of the findings of an environmental audit conducted under Part 8.3 of the *Environment Protection Act 2017* for:

Muirhead North Stage 1A – Portion of Lot 9370, Lee Point, Norther Territory

Further details are provided in the environmental audit report that accompanies this statement.

Section 1: Environmental audit overview

Environmental audit ID number:	NTEPA2017/0102-030

Environmental auditor details

Name:	Jean-Paul Pearce
Company:	Australian Environmental Auditors Pty Ltd
Address:	335 Carrington Street, Adelaide, South Australia 5000
Phone:	0412 854 635
Email:	jppearce@envaud.com.au

Site owner or occupant

Name:	N/A
Company:	Defence Housing Australia

Environmental auditor engaged by

Name:	Mr Chris Grimm
Company:	Defence Housing Australia
Relationship to site owner:	Senior Development Manager

Environmental audit statement

Reason for the environmental audit

☒ Requirement under the *Planning and Environment Act 1987* (e.g. planning permit)
Condition of Development Application DP19/0050 Condition 29

☐ Requirement under the *Environment Protection Act 2017* (e.g. remedial notice or licence)

☐ Requirement under other legislation

☐ Other

Section 2: Environmental audit scope

Details of the site in respect of which the environmental audit was conducted

Site/premises name:	Muirhead North Stage 1A
Address:	544 Lee Point Road, Lee Point, Northern Territory
Title details:	Portion of Lot 9370
Area (m^2):	81,700

☒ a plan of the site is attached

Use or proposed use for which the site is being audited

Sensitive land use categories

Note that sensitive land uses in the *Environment Reference Standard* (ERS 2021) are categorised as lower and high density. Lower density is where there is generally substantial access to soil and high density is restricted to developments that make maximum use of available land space, and there is minimal access to soil. For planning purposes, the *Ministerial Direction No.1* (MD No.1) considers secondary schools and children's playgrounds to be sensitive land uses.

☐ High density

☒ Other (lower density)

☒ Residential land use
☒ Child care centre
☐ Pre-school
☐ Primary school
☐ Secondary school

☐ Children's playground (indoor)
☐ Children's playground (indoor)

Other land use categories

☒ Recreation/open space
☐ Parks and reserves
☐ Agricultural
☒ Commercial
☐ Industrial
☐ Other land uses not captured by the above as described here:

Environmental audit statement

Elements of the environment assessed in the environmental audit

☐ Ambient air
- ☐ all environmental values were considered
- ☐ all environmental values other than the following were considered:

☐ Ambient sound
- ☐ all environmental values were considered
- ☐ all environmental values other than the following were considered:

☒ Land
- ☒ all environmental values that apply to the land use category were considered
- ☐ all environmental values that apply to the land use category, other than the following, were considered:

☒ Water
- ☐ Surface water
  - ☐ all environmental values that apply to the applicable segment were considered OR
  - ☐ all environmental values that apply to the applicable segment, other than the following, were considered:
- ☒ Groundwater
  - ☒ all environmental values that apply to the applicable segment were considered OR
  - ☐ all environmental values that apply to the applicable segment, other than the following, were considered:

Standards and reference documents considered

Environment Reference Standard 2021
National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended from time to time
Northern Territory Waste Management and Pollution Control Act 1998
NT EPA, *Northern Territory Contaminated Land Guideline,* June 2017
Additional technical standards are detailed in the EAR.

Assumptions made during the environmental audit or any limitations

None

Exclusions from the environmental audit and the rationale for these

Excludes ambient air except associated with any soil and groundwater derived sources (i.e. vapour intrusion, LFG, etc). Exclude surface waters as none are present on site, but risk to offsite surface water will be assessed as part of the groundwater. Exclude ambient sound as not relevant to contaminated land. It is noted that these are standard exclusions for a contaminated audit for site suitability.

This statement is accompanied by the following environmental audit report:

Title:	Muirhead North Stage 1A – Portion of Lot 9370, Lee Point, Northern Territory
Report no:	1
Date:	8 November 2022

Section 3: Results and recommendations of the environmental audit

Environmental audit statement

Land use suitability

Based on my assessment of the site in relation to the risk of harm to human health or the environment from contaminated land, waste or pollution, I am of the opinion that the site is **suitable for the following land uses if the recommendations I have made in this statement are complied with:**

Sensitive land use categories

☒ High density

☒ Other (lower density)

☒ Residential land use
☒ Child care centre
☒ Pre-school
☒ Primary school
☒ Secondary school

☒ Children's playground (indoor)
☒ Children's playground (indoor)

Other land use categories

☒ Recreation/open space
☒ Parks and reserves
☒ Agricultural
☒ Commercial
☒ Industrial
☐ ~~Other land uses not captured by the above as described here:~~

Results of the environmental audit

Based on my assessment of the risk of harm to human health or the environment **from contaminated land for Muirhead North Stage 1A – portion of Lot 9370 Lee Point, Northern Territory**, I conclude that the site is suitable for the proposed uses of low density residential, child care, recreational / open space and commercial land uses along with less sensitive land uses (i.e. high density residential and industrial land uses subject to compliance with the audit recommendations.

Recommendations

1. Asbestos containing materials were found on the audit site and have been removed as far as reasonably practicable. Small quantities of bonded asbestos cement (AC) fragments may remain within the soil and be uncovered during excavation works. These AC fragments are not anticipated to represent a health risk to occupiers of the completed development. If encountered during future development or use of the audit site, any fragments must be handled and disposed in accordance with the *NT Work Health and Safety Regulations 2011*, including the use of an appropriately licensed contractor.
2. If groundwater is to be extracted from the site, advice including testing, should be sought from a suitably qualified professional to ensure the groundwater is suitable for the intended use.
3. Any soil proposed to be excavated and disposed of off site after the completion of the audit, must be classified by a suitably qualified professional in accordance with relevant NT guidelines.
4. Any fill material proposed to be imported to the audit site after the completion of the environmental audit, must be tested and classified as per relevant NT EPA guidance.

Other related information

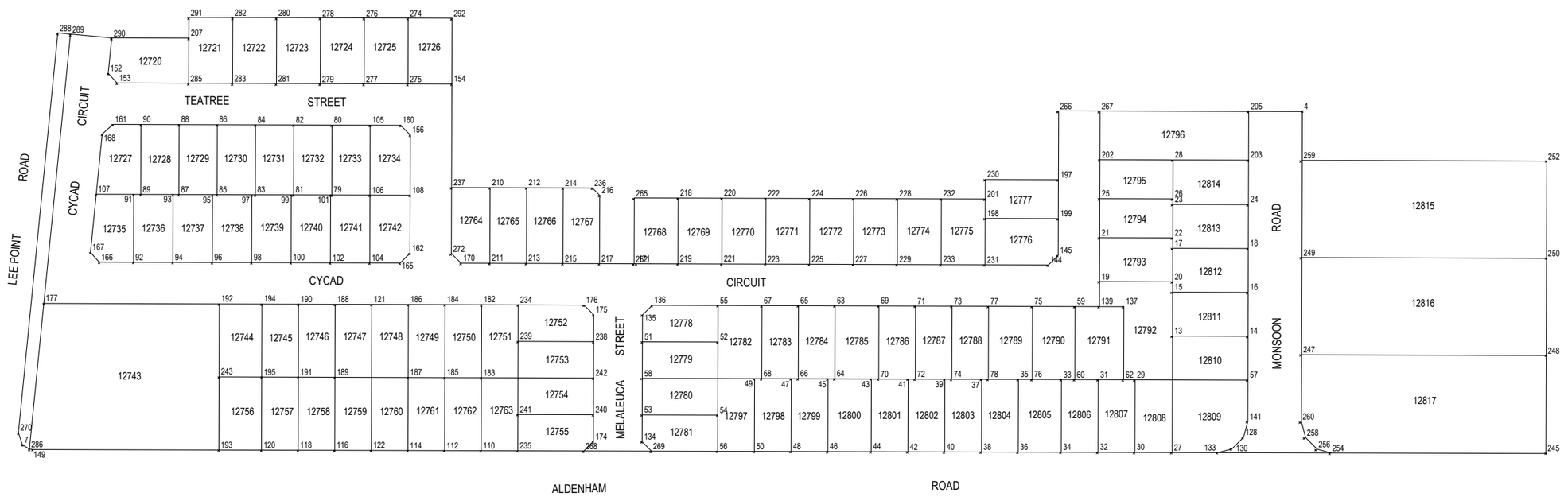
- Groundwater at the site contains naturally elevated concentrations of cobalt, copper, nickel and zinc. The levels are considered typical of the natural groundwater quality surrounding the site and do not constitute contamination in accordance with Clause 4 of the *Environment Reference Standard 2021*.
- Soil at the audit site contains naturally elevated concentrations of nickel and manganese. The levels are considered typical of the regional soil quality surrounding the audit site and do not indicate the presence of contaminated land or represent a health or ecological risk. Local natural plants, grasses and fauna are likely to be adapted to these concentrations of analytes, however there may be some impact on the development of some introduced plants, grasses and fauna. It is recommended that advice is sought from a qualified horticulturalist regarding the suitability for vegetation and soil improvements that may be appropriate for the site.
- Not all land uses for which the audit site is considered suitable by this environmental audit may be allowed under the existing zoning of the Darwin planning scheme.
- In accordance with Section 214 of the Act, the person in management or control of the site must provide a copy of this statement to any person who proposes to become the person in management or control of the site.

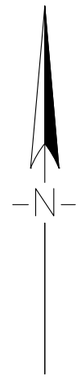
Section 4: Environmental auditor's declaration

I state that:

- I am appointed as an environmental auditor by the Environment Protection Authority Victoria under the *Environment Protection Act 2017*. I am Suitably Qualified Person in accordance with Section 68 of the Waste Management and Pollution Control Act.
- The information contained in this statement represents a true and accurate summary of the findings of the environmental audit that I have completed.

Date:	8 November 2022
Signed:	
Name:	Jean-Paul Pearce
	Environmental Auditor





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2	706134.270	8634037.690	39	705987.661	8633947.861	76	706023.501	8633947.754	113	705767.427	8633948.569	150	705839.520	8633918.412	187	705767.427	8633948.569	225	705932.142	8633995.027	262	705860.142	8633995.242
3	706112.330	8634057.757	40	705987.572	8633918.020	77	706005.590	8633977.807	114	705767.337	8633918.603	151	705645.778	8634087.920	188	705737.467	8633978.609	226	705950.222	8634021.973	265	705860.223	8634022.242
4	706134.330	8634057.691	41	705972.581	8633947.906	78	706005.501	8633947.807	115	705737.377	8633948.659	152	705644.341	8634073.406	189	705737.377	8633948.659	227	705950.141	8633994.973	266	706034.330	8634057.990
5	705613.324	8633919.010	42	705972.492	8633918.060	79	705736.076	8634023.450	116	705737.287	8633918.682	153	705647.947	8634069.413	190	705722.442	8633978.654	228	705968.222	8634021.919	267	706051.330	8634057.939
6	705611.996	8633919.190	43	705957.501	8633947.951	80	705736.161	8634052.150	117	705722.352	8633948.704	154	705785.362	8634069.003	191	705722.352	8633948.704	229	705968.141	8633994.919	268	705839.520	8633918.412
7	705609.122	8633920.957	44	705957.412	8633918.100	81	705720.396	8634023.497	118	705722.263	8633918.722	155	705764.311	8634052.066	192	705689.922	8633978.751	230	706004.246	8634029.812	269	705867.294	8633918.338
8	705607.491	8633925.912	45	705939.716	8633948.004	82	705720.481	8634052.197	119	705707.327	8633948.749	156	705768.299	8634048.054	193	705689.743	8633918.808	231	706004.141	8633994.812	270	705607.491	8633925.912
9	706099.648	8633917.723	46	705939.627	8633918.147	83	705704.716	8634023.544	120	705707.238	8633918.762	157	705768.154	8633999.517	194	705707.417	8633978.699	232	705986.222	8634021.865	271	705623.672	8634090.001
10	706146.114	8633917.600	47	705924.641	8633948.049	84	705704.802	8634052.243	121	705752.492	8633978.564	158	705641.872	8634048.450	195	705707.327	8633948.749	233	705986.141	8633994.865	272	705785.154	8633999.466
11	706034.246	8634029.722	48	705924.552	8633918.187	85	705689.036	8634023.590	122	705752.312	8633918.643	159	705646.265	8634052.418	196	706004.246	8634029.812	234	705812.591	8633978.384	273	705785.443	8634096.003
12	706034.330	8634057.990	49	705909.571	8633948.094	86	705689.122	8634052.290	123	705863.579	8633974.232	160	705764.311	8634052.066	197	706034.246	8634029.722	235	705812.412	8633918.483	274	705767.443	8634096.056
13	706081.054	8633965.582	50	705909.482	8633918.227	87	705673.356	8634023.637	124	705867.591	8633978.220	161	705646.265	8634052.418	198	706004.198	8634013.812	236	705843.035	8634026.293	275	705767.362	8634069.057
14	706112.054	8633965.489	51	705863.546	8633963.232	88	705673.442	8634052.337	125	706110.188	8633923.994	162	705768.154	8633999.517	199	706034.198	8634013.722	237	705785.235	8634026.466	276	705749.443	8634096.110
15	706081.108	8633983.582	52	705894.546	8633963.139	89	705657.676	8634023.684	126	706111.949	8633930.489	163	705764.142	8633995.529	200	705860.223	8634022.242	238	705843.546	8633963.292	277	705749.362	8634069.110
16	706112.108	8633983.489	53	705863.457	8633933.232	90	705657.762	8634052.384	127	706105.416	8633919.250	164	705640.672	8633995.898	201	706004.222	8634021.812	239	705812.546	8633963.384	278	705731.443	8634096.164
17	706081.162	8634001.581	54	705894.456	8633933.139	91	705654.796	8634023.693	128	706110.188	8633923.994	165	705764.142	8633995.529	202	706051.270	8634037.939	240	705843.457	8633933.292	279	705731.362	8634069.164
18	706112.162	8634001.489	55	705894.591	8633978.139	92	705654.713	8633995.856	129	706099.648	8633917.723	166	705640.672	8633995.898	203	706112.270	8634037.757	241	705812.457	8633933.384	280	705713.443	8634096.218
19	706051.121	8633987.940	56	705894.412	8633918.266	93	705670.956	8634023.644	130	706105.416	8633919.250	167	705637.066	8633999.891	204	706051.330	8634057.939	242	705843.502	8633948.342	281	705713.362	8634069.218
20	706081.121	8633987.850	57	706112.000	8633947.489	94	705670.873	8633995.808	131	705863.424	8633922.232	168	705641.872	8634048.450	205	706112.330	8634057.757	243	705689.832	8633948.801	282	705695.443	8634096.272
21	706051.175	8634005.939	58	705863.501	8633948.232	95	705687.116	8634023.596	132	705867.294	8633918.338	169	705785.154	8633999.466	207	705677.418	8634087.825	244	706234.669	8634037.379	283	705695.362	8634069.272
22	706081.175	8634005.850	59	706041.090	8633977.701	96	705687.033	8633995.760	133	706099.648	8633917.723	170	705789.142	8633995.454	208	705843.035	8634026.293	245	706234.311	8633917.367	284	705677.443	8634096.325
23	706081.216	8634019.581	60	706041.001	8633947.701	97	705703.276	8634023.548	134	705863.424	8633922.232	171	705861.142	8633995.239	209	705846.026	8634023.284	246	706146.114	8633917.600	285	705677.363	8634069.326
24	706112.215	8634019.489	61	706061.090	8633977.641	98	705703.193	8633995.711	135	705863.579	8633974.232	172	705839.591	8633978.303	210	705801.035	8634026.419	247	706134.031	8633957.894	286	705611.996	8633919.190
25	706051.223	8634021.939	62	706061.000	8633947.641	99	705719.436	8634023.500	136	705867.591	8633978.220	173	705843.579	8633974.292	211	705800.942	8633995.419	248	706234.431	8633957.585	287	705628.850	8634089.489
26	706081.222	8634021.850	63	705942.591	8633977.996	100	705719.352	8633995.663	137	706061.090	8633977.641	174	705843.424	8633922.292	212	705816.035	8634026.374	249	706134.151	8633997.789	288	705623.672	8634090.001
27	706080.911	8633917.773	64	705942.501	8633947.996	101	705735.596	8634023.451	138	706051.270	8634037.939	175	705843.579	8633974.292	213	705815.942	8633995.374	250	706234.550	8633997.479	289	705628.850	8634089.489
28	706081.270	8634037.850	65	705927.591	8633978.040	102	705735.512	8633995.615	139	706051.090	8633977.671	176	705839.591	8633978.303	214	705831.035	8634026.329	251	706134.270	8634037.690	290	705645.778	8634087.920
29	706065.690	8633947.628	66	705927.501	8633948.041	103	705751.756	8634023.403	140	706112.270	8634037.757	177	705617.912	8633978.966	215	705830.942	8633995.329	252	706234.669	8634037.379	291	705677.443	8634096.325
30	706065.601	8633917.813	67	705912.591	8633978.085	104	705751.672	8633995.566	141	706111.949	8633930.489	178	706112.330	8634057.757	216	705846.026	8634023.284	253	706140.416	8633919.146	292	705785.443	8634096.003
31	706050.596	8633947.673	68	705912.501	8633948.085	105	705751.841	8634052.103	142	706030.141	8633994.734	179	706112.270	8634037.757	217	705845.942	8633995.285	254	706146.114	8633917.600			
32	706050.506	8633917.853	69	705960.591	8633977.942	106	705751.756	8634023.403	143	705861.142	8633995.239	180	706051.330	8634057.939	218	705878.222	8634022.188	255	706135.672	8633923.918			
33	706035.501	8633947.718	70	705960.501	8633947.942	107	705639.426	8634023.739	144	706030.141	8633994.734	181	706051.270	8634037.939	219	705878.142	8633995.188	256	706140.416	8633919.146			
34	706035.411	8633917.893	71	705975.591	8633977.897	108	705768.225	8634023.354	145	706034.153	8633998.722	182	705797.566	8633978.429	220	705896.222	8634022.134	257	706133.949	8633930.423			
35	706017.831	8633947.771	72	705975.501	8633947.897	109	705797.477	8633948.479	146	706034.246	8634029.722	183	705797.477	8633948.479	221	705896.142	8633995.135	258	706135.672	8633923.918			
36	706017.741	8633917.940	73	705990.590	8633977.852	110	705797.387	8633918.523	147	705843.424	8633922.292	184	705782.541	8633978.474	222	705914.222	8634022.081	259	706134.270	8634037.690			
37	706002.746	8633947.816	74	705990.501	8633947.852	111	705782.452	8633948.524	148	705839.520	8633918.412	185	705782.452	8633948.524	223	705914.142	8633995.081	260	706133.949	8633930.423			

0 50 100
metres

SURVEY & PLANNING CONSULTANTS
10 HARVEY STREET
DARWIN NT 0801
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FAX. (08) 8981 5205
darwin@eja.com.au
www.eja.com.au
earl james & associates

MUIRHEAD NORTH
LOT 9370, TOWN OF NIGHTCLIFF

LOT 1A BOUNDARY COORDINATES

Client: **DEFENCE HOUSING AUSTRALIA**

DHA Defence Housing Australia

Scale: 1:2000 (A3)
Datum:

Drawn by: SH
Date: 4/11/2022
Cad File: 11060-9.DWG

Drawing No: **22/11060/9**

Executive Summary

This report details the results of an environmental audit of the property known as Muirhead North Stage 1A – Portion of Lot 9370, Lee Point, Northern Territory (the site). The location of the site is shown in Figure 1.

The environmental audit was completed in response to and in accordance with Section 208 of the *Environment Protection Act 2017* and the guidelines issued by EPA Victoria for the environmental audits of contaminated sites, including *Guidelines for Conducting Environmental Audits* (EPA Publication 2041) and *Environmental Auditor Guidelines – Provision of Statements and Reports for Environmental Audits and Preliminary Risk Screen Assessments* (EPA Publication 2022). In accordance with EPA Publication 2022, the tables below summarises the results of the audit completed.

Table 1: Summary of Audit Report Information

Item	Detail
Auditor	Jean-Paul Pearce
Auditor account number	289162
Date EPA notified of audit	21 September 2022
Environmental Audit reference	NTEPA2017/0102-030
Name of person requesting audit	Mr Chris Grimm Senior Development Manager Defence Housing Australia (Herein referred to as requestor)
Relationship of person requesting audit to site	Authorised representative of the site owner/developer
Name of site owner	Defence Housing Australia
Date of auditor engagement	15 September 2022
Completion date of the audit	8 November 2022
Reason for audit	Condition of the Development Application DP19/0050 Condition 29
Elements of the environment assessed	Land and water (groundwater)
Planning permit number or requirement detail if applicable	DP19/0050
EPA Region	Darwin
Municipality	Lee Point
Dominant – Lot on plan	Portion of Lot 9370, refer to Figure 2.
Additional – Lot on plan(s)	Not applicable
Site/premises name	Muirhead North Stage 1A
Building/complex sub-unit No.	-
Street/Lot – Lower No.	544
Street/Lot – Upper No.	-

Item	Detail	
Street Name	Lee Point	
Street type (road, court, etc.)	Road	
Street suffix (North, South etc.)	-	
Suburb	Lee Point	
Postcode	0810	
Site area (in square metres)	81,700 m^2 (stage 1A only)	
Plan of site/premises showing the audit site boundary attached	Refer to survey plan, Figure 3.	
Members and categories of support team utilised	Bridget Roder (AEA) for technical audit support and Alyson Macdonald for peer review of audit report	
Further work or requirements	None	
Nature and extent of continuing risk of harm	Risks in groundwater have not been found to be significant, however the condition of the groundwater should be tested by an appropriately qualified environmental consultant (to determine the suitability thereof) prior to being utilised for extractive use. Risks in soil vapour have not been found to be significant. Risks in soils have not been found to be significant with all known on-site ACM having been removed from site. ACM has been encountered beyond the site boundary and is not a risk to this site provided offsite asbestos removal and earthworks are managed in accordance with relevant guidance.	
Outcome of environmental audit report	Environmental Audit Statement with recommendations	
Land use suitability	Suitable for the proposed use (and less sensitive uses) subject to compliance with recommendations.	
Has groundwater cleanup been undertaken as far as reasonably practicable?	Not applicable	
Does groundwater contamination remain at the site and is the site the source?	No	
If groundwater contamination remains, does it extend off-site?	Not applicable	
Is a GQRUZ recommended?	No	
If applicable, please indicate which of the following are threatened environmental values of groundwater	For example, site-sourced and regional pollution.	
	Water dependent ecosystems and species	No
	Potable water supply (desirable)	No
	Potable water supply (acceptable)	No
	Potable mineral water supply	N/A
	Agriculture and irrigation (irrigation)	No
	Agriculture and irrigation (stock watering)	No
	Industrial and commercial	No
	Water-based recreation (primary contact recreation)	No
	Traditional Owner cultural values	No

Item	Detail	
	Buildings and structures	No
	Geothermal properties	N/A
Is ongoing groundwater monitoring required?	No	
Is ongoing vapour/gas monitoring required?	No	
Are vapour/gas mitigation measures required?	No	

Table 2: Physical Site Information

Item	Detail
Current EPA permissions/s and related permission ID if applicable	DP19/0050 Condition 29
Historical land use	Undeveloped bushland
Current land use	Development site pending completion of audit
Proposed future land use	Low density residential with a child care centre, café, residential sales office, pocket park, internal roads, road verges and a drainage reserve.
Current land use zoning	Future Development (FD)
Proposed land use zoning	Future Development (FD)
Surrounding land use – north (if applicable)	The balance of Lot 9370 comprising bushland, and beyond is located Power and Water Corporation sewer pump station and compound and Lee Point Village Resort.
Surrounding land use – south (if applicable)	The residential suburb of Muirhead
Surrounding land use – east (if applicable)	The balance of Lot 9370, comprising undeveloped and generally undisturbed woodland, and beyond is Buffalo Creek Management Area and Leanyer Swamp.
Surrounding land use – west (if applicable)	Lot 4873 zoned Future Development, and beyond is a Conservation zoned area comprising monsoon vine thicket and the Casuarina Coastal Reserve.
Has EPA been notified about the site under Section 40 of the *Environment Protection Act 2107*[1]?	No - not applicable
Nearest surface water receptor – name	Buffalo Creek
Nearest surface water receptor – direction	800 m East

[1] Section 40 refers to a duty to notify EPA of notifiable contamination. Further information in relation to this can be found in EPA Publication 2008 *Notifiable Contamination Guideline: Duty to Notify of Contaminated Land.*

Item	Detail
Likely point of groundwater discharge	Buffalo Creek
Site aquifer formation	Fractured and weathered rock
Groundwater flow direction	East
Groundwater TDS range (mg/L)	120 - 200
Groundwater segment	A1
Are there multiple aquifers impacted by pollution at the site?	No
Perched groundwater depth – upper (metres below ground level (mbgl))	Not applicable
Perched groundwater depth – lower (mbgl)	Not applicable
Regional groundwater depth – upper (mbgl)	Groundwater levels not measured during the wet season, when water levels are expected to be higher, potentially within 2 mbgl.
Regional groundwater depth – lower (mbgl)	Approximately 5
Number of bores within 2 km	30
Closest extractive use (distance in m)	900
Zone of groundwater plume influence (m from site boundary)	Not applicable
Year groundwater last monitored	2022

Read in Conjunction with Audit Report

This executive summary summarises the key points of the audit report. The executive summary must be read in conjunction with the full audit report (Australian Environmental Auditors Pty Ltd, ref. EA0975, *Environmental Audit Report, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point, Northern Territory,* 8 November 2022).

List of Abbreviations

Note: Chemical nomenclature follows rules defined by the International Union of Pure and Applied Chemistry (IUPAC) unless otherwise stated.

Abbreviation	Description
ACM	asbestos containing materials
AF	asbestos fines
AHD	Australian height datum
AMP	asbestos management plan
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	acid sulphate soil
B(a)P	benzo(a)pyrene
BTEX	benzene, toluene, ethylbenzene and xylenes
BTEXN	benzene, toluene, ethylbenzene, xylenes and naphthalene
BToC	below top of casing
CEC	cation exchange capacity
CoC	chain-of-custody
CoPC	chemical of potential concern
CoT	certificate(s) of title
CSM	conceptual site model
CUSFARP	clean-up as far as reasonably practicable
DNAPL	dense non-aqueous phase liquid
DSI	detailed site investigation
DQI	data quality indicator
DQO	data quality objective
EAO	environmental audit overlay
EAR	environmental audit report
EAS	environmental audit statement
EIL	ecological investigation level
EMP	environmental management plan
EPA	Environment Protection Authority
ERS	environmental reference standard
ESL	ecological screening level
GIS	geographic information system
GME	groundwater monitoring event
GQMP	groundwater quality management plan
GQRUZ	groundwater quality restricted use zone
HIL	human health-based investigation level
HSL	human health screening level
HVOC	halogenated volatile organic compound
LPG	liquid petroleum gas
LNAPL	light non-aqueous phase liquid
LOR	limit of reporting
mAHD	metres Australian height datum
MAH	monocyclic aromatic hydrocarbon
mBGL	metres below ground level
mBTOC	metres below top of casing
NA	not applicable

Abbreviation	Description
NAPL	non-aqueous phase liquid
NATA	National Association of Testing Authorities, Australia
NE	no exceedance
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
OCP	organochlorine pesticide
OPP	organophosphate pesticide
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PFAS	per- and poly-fluoroalkyl substances
PID	photoionisation detector
PSI	preliminary site investigation
PQL	practical quantitation limit
QA/QC	quality assurance/quality control
RAP	remediation action plan
RB	rinsate blank
RPD	relative percent difference
SAQP	sampling and analysis quality plan
SEPP	state environment protection policy
SS	suspended solids
SWL	standing water level
TB	trip blank
TCE	trichloroethene
TDS	total dissolved solids
TEQ	toxic equivalence quotient
TIT	triple interceptor trap
ToC	top of casing
TRHs	total recoverable hydrocarbons
TPHs	total petroleum hydrocarbons
UCL	upper confidence limit
US EPA	United States Environmental Protection Agency
UST	underground storage tank
VC	vinyl chloride
VHC	volatile chlorinated hydrocarbons
VOC	volatile organic compound

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1 Introduction

This Environmental Audit Report (EAR) and accompanying Environmental Audit Statement (EAS) were prepared by Jean-Paul Pearce, an employee of Australian Environmental Auditors Pty Ltd (AEA) and Environmental Auditor (Contaminated Land) appointed under Division 1 of Part 8.3 of the Victorian *Environment Protection Act 2017* (the Victorian Act).

This EAR was prepared in response to a request from Mr Chris Grimm of Defence Housing Australia (DHA) to conduct an environmental audit of the site under Section 208 of the Act to satisfy a condition of the development application.

DHA contracted Agon Environmental (Agon) to undertake environmental site investigations for the purpose of providing sufficient information to allow this audit to be completed.

This EAR has been prepared in accordance with Section 208 of the Victorian Act and relevant Victorian and Northern Territory EPA guidance including NT EPA Contaminated Land Guideline and Vic EPA Publications 2022 and 2041. The EAS has been prepared in accordance with Section 210 of the Victorian Act and relevant Victorian and Northern Territory EPA guidance including Vic EPA Publication 2041.

1.1 Audit Site Definition

The site subject to this environmental audit is identified as Muirhead North Stage 1A – Portion of Lot 9370, Lee Point, Northern Territory (the site), and is 81,700 m^2 in area. Further details are provided in Table 1 of the Executive Summary.

The site is located on the Lee Point Peninsular approximately 17 km north of the Darwin central business district. The site location is shown in Figure 1, the certificate of title is included in Appendix B, and a plan showing the boundaries of the site is provided as Figure 3.

1.2 Current Site Use

At the time of the Auditor's engagement the site had reached practical completion for the development associated with the civil and headworks. The site had been cleared of vegetation, general fill had been placed across the site to final design grade, the internal road network had been constructed and landscaped, individual allotments were demarcated, and service infrastructure installed.

1.3 Proposed Use

The site is proposed to be developed for low density residential use with a child care centre, residential sales office, café, pocket park, internal roads, road verges and a drainage reserve. The development plan is shown in Figure 4.

The proposed development is consistent with the most sensitive land use category of *Sensitive Use – Low density* under Part 4 of the *Environment Reference Standard 2021* (ERS) and ASC NEPM Human Health Investigation Level (HIL) A.

1.4 Reason for the Environmental Audit

The audit of the site was completed to meet development application requirements relating to the Lee Point Master-Planned Urban Development (Development Application DP19/0050 Condition 29) as follows:

> *A qualified person, under Section 68 of the Waste Management and Pollution Control Act, must provide certification that the site is suitable for the intended use on the advice of Environment, Department of Environment and Natural Resources, to the satisfaction of the consent authority.*

A qualified person under Section 68 of the *Waste Management and Pollution Control Act* is an EPA appointed Environmental Auditor (Contaminated Land) and certification from an Auditor that a site is suitable for use is an EAR and EAS.

The audit included assessment of the site regarding historical activities potentially impacting on environmental values. The auditor considered the site conditions relative to the proposed use and assessed the suitability of the site for the proposed use, as well as all potential protected environmental values, as required by EPA guidelines.

1.5 Independence of the Environmental Auditor

The environmental audit system depends on the auditor undertaking an independent assessment of the site condition and risks to environmental values. EPA guidelines provide guidance on the auditor maintaining their independence and avoiding potential conflicts of interest.

To the best of the auditor's knowledge, the auditor and his support team have not been involved with this site prior to this audit. The auditor and his support team have no financial association with the consultant or requestor beyond the payment for audit services by the requestor. Based on EPA guidance, the auditor is therefore not aware of any real or perceived conflicts of interest which should prevent the audit from being completed.

2 Audit Framework and Scope of Works

The framework under which the environmental audit was completed, and a summary of the scope and methodology adopted is outlined in the following sections. In the absence of a NT EPA audit accreditation system, the audit has been undertaken in accordance with the Vic EPA audit system.

2.1 Purpose of an Environmental Audit

The Victorian *Environment Protection Act 2017* describes the purpose of an environmental audit as:

(a) to assess the nature and extent of the risk of harm to human health or the environment from contaminated land, waste, pollution or any activity; and

(b) to recommend measures to manage the risk of harm to human health or the environment from contaminated land, waste, pollution or any activity; and

(c) to make recommendations to manage the contaminated land, waste, pollution or activity.

Land is defined in the Victorian Act to include groundwater and permanently affixed buildings and structures. In this case the audit is to assess potentially contaminated land, and to determine land use suitability for the proposed low density residential site use.

Elements of the environment for the purposes of an audit include ambient air, ambient sound, land and water (including groundwater and surface water). Each of these elements must be considered by the auditor, unless they have been excluded from the audit scope (refer to Section 2.3).

An environmental value is defined in the Victorian Act as '*a use, an attribute or a function of the environment*' that Victorians value, and the ERS elaborates that environmental values are sought to be achieved or maintained in Victoria. Some examples are water that is safe to drink; air quality that sustains life, health and wellbeing; land that is suitable for production of food; and an ambient sound environment that supports sleep at night. The environmental values are inferred to apply equally in the NT.

The assessment of whether the site condition threatens the achievement or maintenance of relevant environmental values is undertaken by comparison against published qualitative and quantitative assessment criteria.

The outcome of the environmental audit is an environmental audit statement (EAS), which indicates that the site is either:

- not suitable for the proposed use (that is, detrimental to the environmental values associated with the nominated land use), or
- suitable for the proposed use (that is, not detrimental to the environmental values associated with the nominated land use) if the EAS recommendations are complied with, or
- suitable for the proposed use subject to recommendations relating to its use and management.

2.2 Environmental Legislation, Regulations and Guidelines

In completing this environmental audit, the auditor has drawn upon a range of data in forming an opinion regarding the environmental condition of the site. The amount, quality and nature of the data required to form this opinion is consistent with that recommended in relevant guidelines and standards published at the time of the audit.

2.2.1 Legislation

Section 68 of the Northern Territory Waste Management and Pollution Control Act 1998 (WMPC Act), Register of qualified persons, specifies that:

(1) The NT EPA must cause to be established and maintained a register of:

(a) persons qualified to perform environmental Audits for the purposes of an environmental Audit program…

It is understood that in early 2011 persons accredited under the NSW Site Auditor Scheme or the Victorian Environmental Auditor Scheme were approved as a class of person suitable to undertake environmental audits in the Northern Territory. The NT EPA recently recognised auditors accredited in other jurisdictions (i.e. SA, Qld and WA). The auditor must comply with the requirements and guidelines of their accrediting jurisdiction (in this case Vic EPA) and NT EPA guidelines.

The audit was undertaken in accordance with Section 47d of the WMPC Act which states in part that:

An environmental Audit is an evaluation of any of the following:

(d) the likelihood of waste management problems or pollution resulting in environmental harm occurring and the adequacy of safeguards in place to prevent their occurrence or limit their impact on the environment;

(f) the types, amount, distribution or mobility of contaminants or waste present in the environment.

When conducting this environmental audit, the following key pieces of legislation (and subordinate legislation) were considered:

- *Northern Territory Waste Management and Pollution Control Act 1998* (WMPC Act),
- *Victorian Environment Protection Act 2017* (Act No. 51/2017) (Vic.);
- *Victorian Environment Protection Regulations 2021* (SR No. 47/2021);
- *Victorian Planning and Environment Act 1987* (Vic.) Section 12 (2)(a) Ministerial Direction No. 1 Potentially Contaminated Land. (Act No. 45/1987. Direction 15 August 2021);
- *Victoria Water Act 1989* (Vic.) (Act No. 80/1989); and
- *Victorian Environment Reference Standard* (2021), Victorian Government Gazette, S245, 26 May 2021.

2.2.2 Audit Guidance Documents

The main guidance documents for environmental auditing of contaminated land within Northern Territory and Victoria are:

- NT EPA, *Northern Territory Contaminated Land Guideline,* June 2017; and
- EPA Victoria Publication 2041, *Guidelines for Conducting Environmental Audits*, February 2022.

A list of other key guidance documents for environmental auditing includes, but is not limited to:

- NT EPA, *Guideline for the Preparation of an Environmental Management Plan*, May 2015;
- EPA Victoria Publication 2001, *Guidance for the Cleanup and Management of Contaminated Groundwater*, July 2021;
- EPA Victoria Publication 865.13, *Environmental Auditor Guidelines for Appointment and Conduct*, March 2022; and
- EPA Victoria Publication 2022, *Environmental Auditor Guidelines – Provision of Statements and Reports for Environmental Audits and Preliminary Risk Screen Assessments*, August 2021.

Additional guidance documents include:

- Standards Australia (1999) *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile Compounds*, AS4482.2-1999 (recently withdrawn);
- Standards Australia (2005) *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 1: Non-Volatile and Semi-Volatile Compounds*, AS4482.1-2005 (recently withdrawn);
- National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM), as amended May 2013, Australian Government;
- WA DoH (2021) Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia, Department of Health;
- HEPA (2020) PFAS National Environmental Management Plan (NEMP), Heads of EPAs Australia and New Zealand; and
- NSW EPA (2022) Contaminated Land Guidelines - Sampling Design Guidelines, NSW Environment Protection Authority, August 2022 (in lieu of AS4482 withdrawal).

2.3 Audit Scope

To conduct and complete this environmental audit, the auditor has:

- Submitted the proposed scope to EPA;
- Identified the elements and environmental value(s) of the site and surrounds requiring protection, as defined by the ERS;
- Reviewed and provided comments on the scope of investigations;
- Reviewed and evaluated all relevant site assessment reports and additional background information necessary to develop an understanding of the contamination status of the site and the completeness / adequacy of the site characterisation;
- Inspected the site to be aware of its condition and to view various stages of environmental assessment;
- Assessed the nature and extent of the risk of harm to human health or the environment posed by the condition of the site with respect to (potentially) contaminated land;
- Prepared this audit report which summarises the review undertaken and includes the reasons for the findings and any recommendations to manage contaminated land (if required); and
- Prepared the Environmental Audit Statement (EAS), which provides an opinion on the suitability of the site in its current condition, from a contamination perspective, for various land uses.

The elements of the environment which were assessed as part of this environmental audit included land and groundwater, with all applicable environmental values considered. The scope of environmental audit which was inferred to be accepted by EPA excluded the following elements:

- Ambient sound – not considered relevant to potential impacts from the former site use;
- Ambient air – not considered relevant to potential impacts from the former site use; and
- Surface water – not considered relevant for this site as there are no on-site surface water bodies. Risk to offsite surface water bodies from contaminated soils and groundwater will be assessed through soil and groundwater, respectively.

2.3.1 Audit Team and Expert Support

Support and assistance in conducting the audit was provided by the following AEA personnel:

- Bridget Roder, Senior Environmental Engineer – project management, review of assessor's reports and sampling plans and draft audit reporting; and
- Alyson Macdonald, Principal Human Health Risk Assessor – peer review of audit report and statement.

The use of the auditor's expert support team was not considered necessary for this audit due to the absence of complex residual site contamination.

2.3.2 Previous Environmental Audits and Assessments

The current audit commenced on 15 September 2022, and is the first for this site. This audit area is the first stage (Stage 1A), of what is understood will be a staged development.

Prior to audit commencement EcOz were engaged to undertake a preliminary site investigation (PSI) for the whole of Lot 9370 in 2015. The scope of works comprised a site history and site inspection.

Further assessments were undertaken in the area including an EIS which was prepared for Defence Housing SA (dated October 2017), as part of the Lee Point Master-planned Urban Development. The area assessed included two properties bisected by Lee Point Road, including a former Department of Defence installation (2CRU) on the western side, and undeveloped crown land on the eastern site (which incorporates this audit area). As part of the EIS a site audit report was included for the 2CRU Defence site[2]. The audit report was only for a portion of the former 2CRU site associated with the base infrastructure which is concentrated in the northern portion of the site, which has since been decommissioned. The base area is approximately 500 m north west of this audit site. The audit report documents the assessment, remediation and validation works undertaken. The outcome of the Audit was that the Auditor found the site to be suitable for residential purposes with conditions for a CEMP, and no use of groundwater other than for monitoring purposes.

The most recent pre-audit works were undertaken by Agon Environmental (Agon) who were engaged to undertake a preliminary site investigation (PSI) for Lot 4873 and Lot 9370 in 2021 (which incorporates some of the audit site). During documentation of the PSI, the site inspection identified that the site had been subject to illegal waste dumping activities, with suspected ACM positively identified as a constituent of illegally dumped construction and demolition waste. As a result Agon completed a ground survey for ACM on Lot 9370, and subsequently an asbestos removal program was undertaken across Stage 1A in September 2021. Agon documented the asbestos removal works, including clearance inspections / certificates (refer to the PSI, provided in Appendix B for details).

In September 2022 the PSI was refined by Agon to focus on Stage 1A for the purpose of the audit.

A figure showing the Lots referenced in this section is provided as Figure 2.

2.3.3 Reports Reviewed

The following documents were finalised prior to commencement of the audit, and were reviewed primarily for background purposes:

- EcOz Environmental Consultants (2015), *Muirhead North: Stage 1 Preliminary Site Investigatio*n. Dated 22 April 2015;
- AECOM (2016) *Site Audit Report – 2CRU, Lee Point, Darwin, NT*. Dated 19 July 2016;
- Begnaze (2010) *Heritage and Archaeological Investigations, Over Block 4873, Lee Point Road, Darwin*. Dated November 2010;

[2] AECOM (2016) Site Audit Report – 2CRU, Lee Point, Darwin, NT. Dated 19 July 2016.

- GHD (2010) Report fort Lee Point Road Defence Site, NT – Environmental Site Assessment. Dated December 2010;
- SMEC (2015) *Preliminary Geotechnical Investigation and Assessment – Muirhead North Due Diligence*. Dated January 2015;
- SMEC (2015) *Contaminated Land Review Report – DOD Site, Lee Point Road, NT*. Dated April 2014;
- G-tek Australia (2006) *Unexploded Ordnance Assessment – Receiver Station Site Lee Point, NT*. Dated 31 May 2006;
- Cardno *Groundwater Well Logs and Location Plan* (individual logs and plan provided, but no report was provided); and
- Agon Environmental (2022a), *Preliminary Site Investigation – Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT*. Dated 2 September 2022.

The following documents were provided to the auditor for review and comment during the audit period, and were subsequently revised to meet auditor requirements (if required, only the final versions are listed below):

- Agon Environmental (2022b), *RE: Development Stage 1A – Review of PSI & SAQP Lee Point Road, Lee Point, Northern Territory*. Dated 5 October 2022; and
- Agon Environmental (2022c), *Detailed Site Investigation – Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT*. Dated 25 October 2022.

A copy of the Preliminary Site Investigation (PSI) and Detailed Site Investigation (DSI) documents are provided in Appendix B.

A review of the above reports did not identify reference to any relevant reports that have not been provided for review by the auditor.

2.3.4 Consultation with the Requestor and the Consultant(s)

During the course of the audit, the auditor issued a series of formal review letters to the requestor and their consultant. These letters typically document the outcome of the auditor's review of work plans and draft reports.

In addition, the auditor also provided numerous emails to the requestor and consultant. Copies of these documents are held with AEA.

2.3.5 Correspondence and Liaison with EPA

The auditor submitted an *Environmental Audit Notification* to the EPA on 21 September 2022.

The auditor submitted the *Proposed Scope of Environmental Audit* to the EPA on 21 September 2022 which was inferred as accepted by EPA by subsequent correspondence with EPA.

The auditor enquired with EPA whether there were any site contamination reports pertaining to the site or the adjacent sites. The EPA checked whether any reports were on file, but no reports were provided.

2.3.6 Site Inspections

The auditor and/or his assistant undertook site inspections to:

- familiarise with the site and surrounding area;
- verify observations noted by the consultant;
- observe a portion of sampling work and verify sampling methods; and

- confirm final site condition.

A summary of the site inspections and pertinent observations is provided in Section 4.1.

2.3.7 Verification Sampling

The auditor considered that verification sampling was not necessary to complete the audit. This determination was made based upon:

- the lack of unexpected or unexplained pollution;
- the competency of the consultant who conducted the sampling and the laboratories which conducted the analysis;
- the quality of the documentation provided by the consultant and laboratories; and
- the verification between consultant's documentation and site observations by the audit team.

2.3.8 Uncertainties of the Audit Process

This audit report has been prepared for DHA for the purposes described in the audit report. This document may not be suitable for other purposes.

The auditor has prepared this document in good faith but is unable to provide certification outside of areas over which he had some control or is reasonably able to check.

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

The auditor notes that any comments and conclusions provided in this document regarding the suitability of the site for the proposed land use are implicitly limited to consideration of contamination related issues as defined under the Victorian *Environment Protection Act 2017*.

3 Site History and Environmental Setting

3.1 History of the Site

Site history information was provided primarily within Agon's PSI documents (2022a and 2022b).

For the purposes of the audit, the available site history information can be summarised as follows:

- In 2019 Lot 9370 was acquired by DHA. Prior to this the Lot was identified as undeveloped (Greenfield) Crown Land;
- The western and central Lot 9370 area, including Stage 1A, was subject to extensive extraction / borrowing of soil materials circa 1970;
- Lot 9370, including Stage 1A, has been subject to extensive illegal waste dumping over an extended period of time, with asbestos as a waste constituent (surface wastes were first evident in a 1997 aerial photograph);
- Within the greater Lot 9370 area (outside Stage 1A) the site comprises military remnants (machine gun emplacement) and a telecommunication tower; and
- Development of Stage 1A commenced in 2021 comprising the removal of surface ACM and asbestos impacted material. To date the following works have been completed on site: vegetation clearance, cut and filling of the site to grade levels, internal road network construction, demarcation of individual allotments and installation of service infrastructure.

3.2 Adequacy of Site History Information

Table 3 provides information on the site history information sources investigated and adequacy for the audit purpose.

Table 3: Adequacy of Site History Information

Information Requirements	Undertaken	Auditor's Comments
Land uses (previous and current)	Yes	Historical certificates of titles, historical aerial photographs and other sources were reviewed to obtain this information and were documented in the consultant's reports.
Owners, occupiers and users (previous and current)	Yes	Historical certificates of title were reviewed to obtain this information and were documented in the consultant's reports.
Current and historical title search	Yes	Reviewed back to 1959.
Historical aerial photographs for the Site and adjacent properties	Yes	Historical aerial photographs (1944, 1955, 1973, 1985, 1988, 1997, 2001, 2006, 2010, 2015, 2020 and 2022).
Environmental Audit Reports and Statements and Certificates for site and surrounding area	Yes	Documented in consultant's report and separately verified by auditor.
Landfill Register	Yes	There is no NT EPA register for landfills. The Auditor undertook a review of known landfills in the area with none identified within 500 m of the site.
Unexploded Ordnance (UXO)	Yes	A UXO assessment was undertaken for an adjacent site (former Lot 9737). The G-Tek report provided for Lot 9737 (Agon, 2022b) did not identify the presence of UXOs on former Lot 9373. The Auditor undertook a review on the Department of Defence online UXO map and the site and surrounds were not identified as having a potential for UXO.

Information Requirements	Undertaken	Auditor's Comments
Groundwater database review	Yes	Agon undertook a search for groundwater data near the site using Northern Territory Groundwater Data Portal, documented in the consultant's reports.
Historical drainage plans and trade waste records	No	Formerly greenfield, no notable activities expected.
Local planning scheme, environmental overlays and Council records	Yes	Documented in consultant's report.
Search of dangerous goods register	No	Formerly greenfield, no notable activities expected.
Review of asbestos register (if applicable)	No	No asbestos register available. Asbestos identified in soils and remediation undertaken.
Interviews with person knowledgeable with the site	Yes	Agon interviewed Neal Adamson (employed by Department of Defence in the capacity of Regional Environment and Sustainability Officer – Northern Territory) in relation to knowledge of Defence-related fire training, equipment testing, and suppression activities in the areas of interest.
Detailed site inspection	Yes	Numerous site inspections undertaken by Agon (2022a).
Chemical inventory and storage details (including USTs)	No	Formerly greenfield, no notable activities expected.
Review of previous investigations and critique on adequateness of data	Yes	Documented in consultant's report.
Chronological list of land use activities including potential information gaps and uncertainties	Yes	Documented in consultant's report.
List of potential contaminating activities, likely contaminants and locations	Yes	Documented in the consultant's report.
Potential off-site sources of contamination identified	Yes	Documented in the consultant's reports.
Site plan showing historical site layout (if relevant)	Yes	Documented in the consultant's report.
Environmental setting (i.e. nearby ecological receptors)	Yes	Documented in the consultant's report.
Local geology and hydrogeology	Yes	Documented in the consultant's report.
Potential for acid sulphate soils	Yes	Documented in the consultant's report.

Based on the information provided, the auditor considers that the site history investigations have been generally undertaken with regard to relevant legislations and guidelines. The auditor notes that the data gaps identified in the above table and those inherent within site history investigations have been adequately addressed through broad screen analysis of both soil and groundwater.

The auditor considers that there is sufficient site history information to provide a suitable level of confidence regarding the historical uses of the site as they relate to the potential for contamination and to inform the requirements for detailed site investigations. The auditor therefore considers the site history investigations as adequate.

3.3 History of Surrounding Land Use

The site history identified the following off-site land uses that have potential relevance to the audit:

- The northern portion of Lot 9370 has also been subject to illegal waste dumping. Fragments of asbestos have been observed on-site; and
- Lot 4873, located to the west of the site, was formerly used for Defence purposes since circa 1950. Between 1963 and 1966 military defence infrastructure (bunkers and batteries) were established. The site was also used by Defence as the 2CRU Transmission facility from 1961 to 2000, and decommissioned / demolished post 2015.

3.4 Environmental Audits Completed Near the Site

No relevant audits were identified by the NT EPA pertaining to the site or adjacent sites.

3.5 Underground Storage Tanks

No Underground Storage Tanks (USTs) were identified on-site, either as part of the PSI or during development of the site.

However, the off-site Audit Report (AECOM, 2016) identified two 10,000 L steel lined fuel storage tanks in a pit on the 2CRU site (located approximately 500 m north west of the Audit site). The USTs were removed as part of the remediation works for the site. Both tanks were noted to be empty, and the excavation pit did not display visual or olfactory signs of contamination. Soil validation samples were collected from the base and walls of the excavation, with all final results reported concentrations below the nominated criteria. Groundwater was not encountered on-site (standing water was not detected in two bores which were advanced to 21m). Based on soil and groundwater results the Auditor considered that nothing was identified that would render the site unsuitable (from a contamination perspective) for a residential end use. Therefore, the potential for these former USTs to have impacted on the current audit site is considered low. Refer to the audit report provided in Appendix B, for further details.

3.6 Potential Contamination Sources and Contaminants of Concern

The auditor considers that the key on-site potential contaminants of concern and likely locations for the site include:

- Dumping of uncontrolled waste and fill identified as containing construction and demolition (C&D) waste, located in stockpiles and isolated fragments on-site - (metals, total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, ethylbenzene, xylenes (BTEX), organochlorine pesticides (OCPs) and asbestos (bonded asbestos containing material (ACM) and asbestos fines (AF) / fibrous asbestos (FA)); and
- Importation of fill, used to raise the site to final grade levels - metals, TRH, PAHs, BTEX, OCPs and asbestos (ACM and AF/FA).

It is noted that sand quarrying activities have historically been undertaken on-site, and although this activity itself is not considered a potential source of significant contamination, the activity can result in or be associated with uncontrolled filling and illegal dumping within the resulting excavation.

Figure 5 shows the former location of uncontrolled waste and asbestos illegally dumped on-site.

The auditor considers that the key potential contaminants of concern from the off-site sources include:

- Historical illegal dumping of waste and use of uncontrolled imported fill (potential contaminants as per above) associated with Stage 1B to the north of the site; and
- Defence works and Defence establishments (metals, explosives, petroleum hydrocarbons, solvents and firefighting chemicals such as solvents, surfactants, fluorotelomers and perfluorochemicals) associated with the former 2CRU Defence property to the west of the site.

The results of the site history investigation indicate that the site is a potential source of contamination, particularly associated with the illegal dumping of C&D waste (and ACM) and quarrying activities throughout Stage 1 (on- and off-site).

The site history also indicated that potential off-site sources of contamination associated with former Defence activities (specifically the 2CRU) to impact on the site (i.e. migration of contaminated groundwater) were low based on the AECOM audit report (2016).

4 Site Characterisation

4.1 Site Description and Observations from AEA Site Inspections

At the time of the auditor's initial site inspections on 19 and 20 September 2022, the majority of site development works had been completed, including:

- vegetation clearance;
- cut and filling of the site to grade levels;
- construction of the internal road network;
- demarcation of individual allotments using rows of mulch;
- installation of service infrastructure;
- landscaping of road verges; and
- importation/reuse of mulch for garden beds, etc.

A summary of the key observations is provided in Table 4 below.

Table 4: Summary of Auditor Inspections

Date	Reason for Inspection	Observations
19 and 20 September 2022	Observe site investigations and site condition	Site development completed effectively ready for handover as noted above. Observed excavation of test pits across the site. A layer of compacted fill present across the residential lots in varying thickness overlying natural soils. Trace foreign inclusions noted in fill and top of natural as recorded by Agon, but not considered aesthetically unacceptable. No visual or olfactory indicators of contamination. No potential ACM observed on-site. Inspection of the surrounding properties undertaken with evidence of illegal dumping observed across the undeveloped land to the north and west including surface ACM being present.

4.2 Surrounding Land Uses

The surrounding land uses observed by the auditor are as follows:

- North: The balance of Lot 9370 comprising bushland, followed by Power and Water Corporation sewer pump station and compound and Lee Point Village Resort.
- East: The balance of Lot 9370, comprising undeveloped and generally undisturbed woodland, followed by the Buffalo Creek Management Area and Leanyer Swamp.
- South: The residential suburb of Muirhead (low density residential use).
- West: Lot 4873 zoned Future Development, and beyond is located a Conservation zoned area comprising monsoon vine thicket and the Casuarina Coastal Reserve.

4.3 Council Planning Scheme

The site is zoned Future Development (FD). The purpose of the zoning is as follows, as per the NT Planning Scheme (2020):

'*Identify an area that is intended for future rezoning and development in accordance with the Strategic Framework. Development is limited to a level that will not prejudice future development or is compatible with planned future purposes.'*

A plan of the area zoning plan is provided as Appendix C.

4.4 Topography and Surface Waters

The site gently slopes in an easterly direction, and drains in an easterly direction towards a drainage line present north and east of the site (refer to Figure 6). The drainage line flows into the Buffalo Creek, and into Shoal Bay (Darwin Harbour). To the west of the site is an approximate north-south ridge line, such that most of the Defence site to the west of the audit site is inferred to slope west down to the coast.

There are no on-site surface water bodies. Significant surface water is not expected to enter the site from neighbouring properties or streets.

The nearest surface water body is Buffalo Creek, located approximately 800 m east of the site.

4.5 Geology and Hydrogeology

4.5.1 Regional Geology

A review of the 1:250,000 Geological Survey of the Northern Territory (2006 edition) indicates that the site is located on fractured and weathered rock, which consists of shale, greywacke and sandstone and is part of the Cretaceous Darwin Formation.

4.5.2 Site Geology

The general geology comprises shallow silty sandy topsoils with organic matter, overlying medium dense to dense residual sands. The residual sands were generally underlain by cemented sandy laterite or extremely weathered to highly weathered sandstone.

4.5.3 Regional Hydrogeology

Agon undertook a review of the 1:250,000 Hydrogeology map for the Northern Territory which indicates that aquifers underlying the site occur in fractured and weathered rock; siltstone and shale with minor sandstone, quartzite and dolostone. Groundwater flow direction is expected to follow the local topography, which based on regional elevation indicates an on-site flow path to the east towards Buffalo Creek and Leanyer Swamp. Groundwater is anticipated to flow to the west beyond the western site boundary.

4.5.4 Registered Bore Search and Current Extractive Uses

A 2 km radius bore search was undertaken by Agon (2022a) using NR Maps online database, and this was cross-checked by AEA. The Agon search identified 30 registered bores, with a total of three bores listed as being used for extractive purposes (production) and the remainder for investigation or unknown purposes.

The bores have been installed at various depths, ranging from 1.3 to 30.5 mbgl. Recorded standing water levels ranged from <1 to 3.6 mbgl. Salinities recorded in the closest registered wells ranged from 540 to 900 mg/L TDS.

The nearest extractive bore (RN002839) was located approximately 900 m south of the site, likely cross hydraulic gradient. There are no bores located down hydraulic gradient of the site. However, Agon identified the presence of an additional three groundwater monitoring wells within Lot 9370, but outside the site area, which were not present on the NR maps database. These groundwater wells were installed by Cardno in 2016 for investigative purposes. No information is available for the groundwater wells other than bore logs (provided in Agon's PSI documentation, 2022a). Agon sampled these wells as part of the DSI works (refer to Section 6).

Based on the available information, it is possible that groundwater is being used for domestic purposes, such as watering gardens in the vicinity of the site, however the auditor considers potential use to be limited, due to the low yielding aquifer, availability of mains water and undeveloped or urbanised land use.

4.5.5 Site-specific Hydrogeology

The TDS concentration of groundwater recovered on the site ranged from 120 to 200 mg/L, classifying the groundwater as Segment A1 on the basis of the TDS.

Depths to groundwater were approximately 4.9 to 5.4 mbgl. Survey information was not available for these wells, and Agon did not survey the wells as part of these works. As such SWLs have not been converted to mAHD. Note that sampling was undertaken during the dry season and the standing water levels did not stabilise, purging dry. A shallower groundwater depth is anticipated during the wet season.

Groundwater flow was inferred to the east towards Buffalo Creek (approximately 800 m from the site).

4.6 Initial Conceptual Site Model

A written preliminary conceptual site model (CSM) was prepared by Agon (2022a), which provided an assessment of preliminary site conditions against the essential elements of a CSM, as stated in Section 4.3 of Schedule B2 of the ASC NEPM. The CSM was updated by Agon as part of the DSI (Agon, 2022c). The following sections provide the auditor's summary and interpretation of the CSM.

The initial CSM is presented on the basis of potentially complete exposure pathways, prior to the intrusive investigation. Subsequent sections of this report (Sections 6 to 9) discuss whether exposure pathways are considered to be complete, based on the DSI results.

4.6.1 Known and Potential Sources of Contamination

The primary potential sources of contamination are the illegal dumping of C&D waste and importation of fill material. The primary off-site potential sources of contamination are from the adjacent Defence establishment. Further details of potential sources of contamination are provided in Section 3.6.

4.6.2 Contaminants of Potential Concern

Based on the former use of the site (undeveloped, natural bushland) the main contaminants of potential concern are considered to be associated with the uncontrolled importation of fill; heavy metals, TRHs, BTEX, PAHs, pesticides, and asbestos.

4.6.3 Potential Mechanisms of Contamination

The most likely mechanism of contamination for both fill and uncontrolled illegal C&D waste is considered to be '*top down*' spills.

The mechanisms of contamination associated with off-site sources is primarily lateral migration in groundwater.

4.6.4 Potentially Affected Media

The potentially affected media are primarily soil and groundwater. If volatile contaminants are observed in soil or groundwater, then further consideration of soil vapour and air (ambient and indoor air once development has been completed) will be necessary.

4.6.5 Human and Ecological Receptors

The auditor considers that the human receptors of most concern are future site residents (following redevelopment), construction workers associated with the development, and intrusive maintenance workers on the site. Risk to off-site human receptors, such as maintenance workers in the road, will need consideration if the site is a source of contamination that could migrate off-site.

The auditor considers that the ecological receptor of most concern is the nearest surface water receptor which receives groundwater discharge. This is likely to be Buffalo Creek (800 m to the east). There are unlikely to be any significant ecological receptors on the site itself following development, as the proposed development comprises low density residential, commercial use, internal roads and a drainage reserve.

4.6.6 Potential and Complete Exposure Pathways

Table 5 presents a summary of the auditor's assessment regarding the potential and complete exposure pathways which are of most concern. These are generally consistent with Agon's determinations for on- and off-site receptors.

The CSM was updated on the basis of environmental investigations undertaken by Agon.

Table 5: Initial Source – Pathway – Receptor Assessment

Source	Pathway/s	Receptor/s	Preliminary Potential Linkage
On-site soil	Dermal contact and incidental ingestion	• Construction workers for proposed development; • Users of proposed development (maintenance workers); and • Users of proposed development (residents, workers, visitors).	Possible Possible Possible
	Inhalation of dust (and potential asbestos fibres)	• Construction workers for proposed development; • Users of proposed development (maintenance workers); and • Users of proposed development (residents, workers, visitors).	Possible Possible Possible
	Inhalation of vapours	• Construction workers for proposed development; and • Users of proposed development (residents, visitors, maintenance workers).	Possible Possible
	Direct contact with structures	• Infrastructure in contact with contaminated soils or ASSS	Possible
Groundwater underlying the site	Discharge into surface water	Nearby surface water bodies.	Possible, although unlikely given distance
	Inhalation of vapours	• Construction workers for proposed development, particularly in trenches/excavations • Users of proposed development (residents, workers, visitors, maintenance workers) • Off-site intrusive maintenance workers, residents or workers	Possible Possible Possible
	Dermal contact and ingestion by humans	• Construction workers for proposed development • Persons extracting groundwater for use in domestic supply (drinking and cooking water, washing etc), irrigation or for filling swimming pools.	Limited as groundwater is >3 mbgl. Not proposed on-site, unlikely down-gradient due to poor yield and limited development (recreation area).
	Extraction for stock	Ingestion by stock in down-gradient locations	Unlikely due to limited

Source	Pathway/s	Receptor/s	Preliminary Potential Linkage
	watering	(off-site)	development (recreation area) and poor aquifer yield.
	Extraction for irrigation	Plants (gardens and crops)	Not proposed on site, unlikely down-gradient due to poor aquifer yield and limited development (recreation area).
	Underground structures intersecting groundwater	Concrete or steel piles or deep basements following redevelopment	Possible given local hydrological conditions which can raise and fall based on seasonal rainfall.

Final Site Conditions

Following the site investigation (and early asbestos removal), no soil contamination was identified on-site. All concentrations met the Tier 1 human health criteria for the proposed development (residential, commercial and public open space). Some concentrations of nickel, manganese and zinc were reported above EILs. As detailed in Section 8.1, these concentrations were considered to be naturally occurring and not reflective of site derived contamination.

Therefore, based on the proposed development there are no complete source-pathway-receptor linkages.

Elevated groundwater concentrations were reported above the nominated criteria, however concentrations were considered to be regional (background) and not associated with a site derived source.

Refer to the following sections for further detail, specifically Sections 8 and 9 of this EAR.

5 Selection of Relevant Environmental Values, Indicators and Objectives

In order to determine whether site contamination is present and whether there is a potential risk to human health or the environment, objectives for the protection of relevant environmental values must first be defined. The environmental values and objectives are specified in the ERS, with screening criteria selected by the consultant and reviewed by the auditor, as summarised below. Where the consultant has selected criteria which are not from an EPA-approved guideline, they should provide an explanation for the auditor to consider. Where the auditor considered that alternative criteria were more appropriate, this has also been discussed below.

The environmental assessments reviewed as part of the works discussed in this audit included site investigation and remediation works. The site investigation stage included a Tier 1 (screening) risk assessment. The appropriate objectives for this stage are screening levels or investigation levels, and are principally sourced from Schedule B1 of the ASC NEPM. At the investigation stage, criteria for both human health and ecological assessment (environmental values) should be selected, based on the proposed use, allowable uses under zoning and setting of the audit site.

The ASC NEPM clearly states that the screening levels "*are not clean-up or response levels nor are they desirable soil quality criteria*". If screening levels are exceeded, a more detailed assessment is warranted.

5.1 Environmental Values of Land

The Victorian Act defines an environmental value as a use, an attribute or a function of the environment. Part 4 of the ERS states that the environmental values of land to be protected are:

(a) Land dependent ecosystems and species,

(b) Human health,

(c) Buildings and structures,

(d) Aesthetics, and

(e) Production of food, flora and fibre.

Table 4.2 from the ERS, which is reproduced below as Table 6, defines the environmental values which require protection for the different land use categories. Based on the proposed development, the land use is as follows:

- *Sensitive Use – Low Density* with regard to both direct contact and vapour intrusion pathway;
- *Commercial* with regard to both direct contact and vapour intrusion pathway*;*
- *Recreation / Open Space* with regard to both direct contact and vapour intrusion pathway*;* and
- *Urban residential* with regard to ecosystem protection.

Table 6: Environmental Values that Apply to the Land Use Categories

Environmental Values		Land Use Category						
		Parks & Reserves	Agricultural	*Sensitive Use*		Recreation /Open Space	*Commercial*	Industrial
				High density	*Other (lower density)*			
Land dependent ecosystems and species	Natural ecosystems	✓	N/A	N/A	**N/A**	**N/A**	**N/A**	N/A
	Modified ecosystems	✓	✓	N/A	✓	✓	**N/A**	N/A
	Highly modified ecosystems	N/A	✓	✓	✓	✓	✓	✓
Human health		✓	✓	✓	✓	✓	✓	✓
Buildings and structures		✓	✓	✓	✓	✓	✓	✓
Aesthetics		✓	N/A	✓	✓	✓	✓	N/A
Production of food, flora and fibre		✓	✓	N/A	✓	**N/A**	**N/A**	N/A

Notes: N/A = not applicable.
Sensitive use includes residential use, a childcare centre, pre-school or primary school.
Industrial use includes land used for utilities and industrial activities.

5.2 Adopted Soil Assessment Criteria

The following table (from Part 4 of the ERS) provides the indicators and objectives which are to be used to determine whether the level of any contaminant poses an unacceptable risk to protected environmental values of land.

Table 7: Indicators and Objectives for the Land Environment

Environmental Value	Indicators	Objectives
Land dependent ecosystems and species	Inorganic and organic contaminants set out in Appendix A of Schedule B2 of the ASC NEPM and any other contaminants present at the site as determined by the current use or site history assessed in accordance with the ASC NEPM.	The objective for each indicator is the Ecological Investigation or Screening Level in the ASC NEPM, unless – a) there is no such investigation or screening level; or b) due to site specific characteristics the more appropriate objective is: i) the level derived using the risk assessment methodology described in the ASC NEPM; or ii) the background level determined in accordance with Section 36 of the Act, in which case the objective for the indicator is (i) or (ii), as applicable.
Human health	Inorganic and organic contaminants set out in Appendix A of Schedule B2 of the ASC NEPM, and any other contaminants present at the site as determined by the current use or site history assessed in accordance with the ASC NEPM.	The objective for each indicator is the health investigation or screening level in the ASC NEPM, unless – a) there is no such investigation or screening level; or b) due to site specific characteristics the more appropriate objective is: i) the level derived using the risk assessment methodology described in the ASC NEPM; or ii) the background level determined in accordance with Section 36 of the Act, in which case the objective for the indicator is (i) or (ii), as applicable.
Buildings and structures	pH, sulfate, chloride, redox potential, salinity or any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings or other structures.	Land that is not corrosive to or otherwise adversely affecting the integrity of structures or building materials.
aesthetics	Any chemical substance or waste that may be offensive to the senses.	Land that is not offensive to the senses of human beings.
Production of food, flora and fibre	Inorganic and organic contaminants set out in Appendix A of Schedule B2 of the ASC NEPM and any other contaminants present at the site as determined by the site history assessed in accordance with the ASC NEPM.	The levels specified in the Food Standards Code detected in any food, flora or fibre produced at the site. Levels that do not adversely affect produce quality or yield.

5.2.1 Land Dependent Ecosystems and Species (LDES)

The ASC NEPM provides two types of soil criteria which are based upon protection of the environment, namely Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs). Both the EILs and ESLs are to be applied to assess risks to terrestrial ecosystems and apply to the upper 2 m of the soil profile. The EILs and ESLs differ with respect to the contaminants considered and the methodologies used when applying the screening levels.

The EILs cover zinc, arsenic, naphthalene, DDT, chromium (III), copper, lead and nickel. An EIL calculator has been provided as part of the *'ASC NEPM Toolbox'* which allows for the derivation of EILs, based on site-specific parameters including age of contamination, traffic volume, soil parameters (iron content, pH, organic carbon content and cation exchange capacity (CEC)) and the ambient background concentration (ABC) of the

analyte. Depending on site conditions, such as different soil layers having significantly different properties, more than one set of EILs may need to be derived.

For petroleum hydrocarbons and related chemicals, the ESLs are based upon two documents prepared by Dr Michael Warne[3,4], which in broad terms provide a review of guidance provided by the Canadian Council of the Ministers of the Environment (CCME).

For this site, Agon used the ASC NEPM toolbox to derive imported fill and natural criteria. The methodology is provided in Appendix G of Agons DSI report (2022c). Background concentrations were not measured, but were estimated by selecting parameters in the toolbox. The auditor considered the EIL methodology used was appropriate for initial screening purposes. Agon also applied the ESLs for urban residential/public open space use, which the auditor considered appropriate to meet the proposed development plan.

5.2.2 Human Health – Direct Contact Pathways

The ASC NEPM provides Health Investigation Levels (HILs) for four different generic land use settings:

- *'HIL A – Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry), also includes childcare centres, preschools and primary schools.*
- *HIL B – Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.*
- *HIL C – Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. This does not include undeveloped public open space where the potential for exposure is lower and where a site-specific assessment may be more appropriate.*
- *HIL D – Commercial/industrial, includes premises such as shops, offices, factories and industrial sites.'*

The ASC NEPM states the HILs generally apply to the top 3 m of soil for residential use and site-specific conditions should determine the depth to which other HILs apply.

For the proposed development, the entire site has conservatively been assessed against HIL A criteria.

Schedule B1 of the ASC NEPM states that when comparing results to Tier 1 screening levels, where it is appropriate for the exposure being evaluated, consideration should be given to:

- The maximum concentrations detected in relation to the screening levels;
- The 95% upper confidence limit (UCL) of the arithmetic mean concentrations in relation to the screening levels;
- The implications of localised hotspots;
- The standard deviation of the data (i.e. should be <50% of screening level); and
- The magnitude of any screening level exceedances (i.e. should be <250% of screening level).

5.2.3 Human Health – Vapour Intrusion Pathways

The ASC NEPM provides Health-based Screening Levels (HSLs) for vapour intrusion (i.e. migration of contaminants in subsurface indoor air in the vapour phase) based directly upon Friebel & Nadebaum (2011). HSLs are provided for petroleum hydrocarbons in soil, groundwater and soil vapour and generally for the same four land use settings as the HILs. However, the ASC NEPM also clarifies that the vapour intrusion HSLs

[3] Warne, M (2010) Review of the appropriateness of the Canadian petroleum hydrocarbon country-wide standards in soil, for incorporation into the Australian National Environment Protection (Assessment of Site Contamination) Measure, National Environment Protection Council, Australia.

[4] Warne, M (2010) Review of the appropriateness of selected Canadian Soil Quality Guidelines (benzene, benzo(a)pyrene, ethylbenzene, toluene and xylenes), for incorporation into the Australian National Environment Protection (Assessment of Site Contamination) Measure, and recommended ecological investigation levels, National Environment Protection Council, Australia.

are applicable to ground floor land use. "*For multistorey buildings where [solely] non-residential uses (eg car parking or commercial use) exist in a basement or at ground level, then land use category D (commercial/industrial) should be applied.*"

For the proposed development, the entire site has conservatively been assessed against HSL A for the vapour intrusion pathway assuming sandy soils.

For some soil types and depths, the HSL is higher than the theoretical vapour phase saturation limit. In these instances, no HSL is provided and it is assumed to be not limiting (NL). Before the HSLs for vapour intrusion can be used, they must be shown to be applicable using the applicability checklist provided in Friebel & Nadebaum (2011). This was not documented by the consultant, but Auditor review of the investigation and CSM identified that the requirements have been met for use of HSLs.

The ASC NEPM also includes interim vapour intrusion HILs for trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), tetrachloroethene (PCE), cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride (VC). In the absence of more applicable criteria these HILs are considered to be applicable for screening purposes.

Where criteria are not provided in Friebel & Nadebaum (2011) or the ASC NEPM, reference is made to other reputable guidance sources on a case by case basis.

5.2.4 Asbestos in Soil

The ASC NEPM provides HSLs for asbestos in soil, including bonded asbestos containing material (ACM), friable asbestos (inclusive of asbestos fines less than 7 mm in diameter and fibrous asbestos) and 'all forms of asbestos'. The criteria are both quantitative (i.e. % w/w) and qualitative (i.e. no visible asbestos). The consultant included visual and laboratory assessment of asbestos.

5.2.5 Buildings and Structures

Australian Standard AS2159 (2009) *Piling – Design and Installation* provides exposure classification values for concrete and steel piles in soil (non-aggressive to severely aggressive) based upon chlorides, sulphates and pH. In the absence of a directly applicable Victorian EPA endorsed criteria, these guidelines are considered to be appropriate in assessing the potential for detrimental impacts of site soils to buildings and structures.

In addition, the presence of other aggressive chemical compounds (e.g. acids) may be potentially detrimental to buildings or structures. The presence of ASS/PASS to influence the pH of site soils and groundwater has been considered in this context and is described in more detail below.

The ASC NEPM states that the management limits are relevant for '*operating sites where significant sub-surface leakage of petroleum compounds has occurred and when decommissioning industrial and commercial sites'*. The ASC NEPM states that the intent of the management limits is to minimise the potential for petroleum hydrocarbons to cause the formation of light non-aqueous phase liquid (LNAPL), fire/explosive hazards and effects on buried infrastructure.

5.2.6 Acid Sulphate Soils

Acid sulfate soils (ASS) may, in some circumstances, be detrimental to the current or proposed use of a site. This would occur following oxidation of pyrite resulting in acid conditions. Once these soils are disturbed as a result of an activity, actual or potential ASS may result in site contamination.

A combination of field indicators and laboratory analysis is used to test for the presence of actual or potential ASS. NT Land Suitability Guidelines[5] provide assessment criteria for the purpose of identifying land constrained by acid sulfate:

'Soils where greater than 0.02% oxidisable sulfur is present … as indicated by NATA accredited soil testing results, undertaken according to nationally recognised methods and recognised in a standard test (ie

[5] Northern Territory Government (2020) Northern territory Land Suitability Guidelines. Dated July 2020.

Chromium Reducible Sulfur or SPOCAS), and collected at appropriate depth and density, preferably in accordance with the published Queensland sampling guidelines (Ahern et al., 1998). The level of risk is dependent on both the level of oxidisable sulfur and volumes of soil disturbed.'

5.2.7 Aesthetics

The aesthetic condition of soil is assessed with respect to the guidance provided in Schedule B1 of the ASC NEPM. In general terms, consideration is given to the presence of non-hazardous foreign materials, discoloration and odorous soils.

Other than the MLs, the ASC NEPM does not provide any quantitative criteria for aesthetics. If required, theoretical odour thresholds may be identified for volatile and semi-volatile contaminants which are found to be present at an audit site.

5.2.8 Production of Food, Flora and Fibre

The Food Standards Code provides maximum levels for various organic and inorganic chemicals in various foods, with the levels for each chemical varying dependent on the food type. The Food Standards Code does not provide threshold criteria for contaminant levels in soils. The correlation between contaminant levels in soils and resulting contaminant levels in food, flora and fibre produced in soils is complex and related to the bioavailability of the contaminant, the rate at which the contaminant is taken up by the crop/stock and the ability of various crop/stock to regulate the contaminant.

As a conservative measure and in the absence of directly applicable criteria, it is assumed that the site has been contaminated at potentially unacceptable levels with respect to the production of food, flora and fibre if the contaminants of concern are present at levels above those adopted for LDES. It is noted that a site may not be suitable for the production of food, flora and fibre due to natural background levels of a range of contaminants (i.e. arsenic).

5.3 Environmental Values of Groundwater

Part 5 of the ERS divides groundwater into seven segments on the basis of TDS concentration ranges. The following table, which is based on Table 5.3 of the ERS, defines the environmental values of groundwater which require protection for each segment. Based upon the available TDS data for the adjacent off-site wells (range 120 to 200 mg/L), the water table aquifer at the site is classified as Segment A1.

The auditor considered Segment A1 to be appropriate to the audit site.

Table 8: Environmental Values that Apply to the Groundwater Segments

Environmental Value	Segment (TDS mg/L)						
	A1 (0–600)	A2 (601–1200)	B (1201–3100)	C (3101–5400)	D (5401–7100)	E (7101–10,000)	F (>10,001)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓	N/A	N/A	N/A	N/A	N/A	N/A
Potable water supply (acceptable)	**N/A**	✓	N/A	N/A	N/A	N/A	N/A
Potable mineral water supply #	✓	✓	✓	✓	N/A	N/A	N/A
Agriculture and irrigation (irrigation)	✓	✓	✓	N/A	N/A	N/A	N/A
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	N/A

Environmental Value	Segment (TDS mg/L)						
	A1 (0–600)	A2 (601–1200)	B (1201–3100)	C (3101–5400)	D (5401–7100)	E (7101–10,000)	F (>10,001)
Industrial and commercial	✓	✓	✓	✓	✓	N/A	N/A
Water-based recreation (Primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Building and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties *	✓	✓	✓	✓	✓	✓	✓

The site is not within a declared mineral water resource area and this environmental value is not considered relevant.
* Groundwater at the site was not found to have geothermal properties (described in the ERS as a natural thermal capacity which corresponds to a temperature between 30 and 70 degrees Celsius), and therefore this environmental value was not considered relevant at this site.

5.4 Adopted Groundwater Assessment Criteria

5.4.1 Water Dependent Ecosystems and Species (WDES)

Table 5.4 of the ERS clarifies that water dependent ecosystems and species includes both surface waters and subterranean waters with a hydrogeological setting conducive to the presence of troglofauna and stygofauna. In Australia, stygofauna exist within alluvial, karstic, calcrete and certain fractured rock aquifers, however very limited information has been published to date on where stygofauna are likely to be present. Troglofauna are found in caves, so their likely presence is more readily mapped. At this site, no known subterranean ecosystems are present.

For groundwater dependent surface water ecosystems, the screening criteria should be applied to groundwater at the point of discharge to the receiving surface water body, as per Table 5.4 of the ERS. Based on the nearby surface water features and inferred regional groundwater flow direction, the likely point of discharge is Buffalo Creek, located approximately 800 m east of the site.

The Ecology & Heritage Partners, Lee Point Master-planned Urban Development – Water Quality Monitoring Plan, April 2018 specifies that Buffalo Creek is classified as a highly disturbed system and adjacent Sandy Creek as a slightly-moderately disturbed system.

As per Section 17 of the ERS, the most likely discharge point falls conservatively within the Lakes and Swamps segment. This is conservatively considered to be a slightly to moderately disturbed marine ecosystem with environmental quality objectives corresponding to a 95% level of protection as defined in the ANZG (2018) *Australian and New Zealand for Fresh and Marine Water Quality*. These guidelines are based on toxicity data for surface water species. Different guidelines are provided for marine and freshwater environments. For groundwater, freshwater or marine water guidelines are applied on the basis of the assumed receiving environment.

Table 9: Environmental Values of Inland Waters

Environmental Values	Segment	Aquatic Reserves	Rivers and Streams						Wetlands
		Aquatic Reserves	Highlands	Uplands A	Uplands B	Central Foothills and Coastal Plains	Urban	Murray and Western Plains	Lakes and Swamps
Water dependent ecosystems and species that are:	Largely unmodified	✓	✓	✓	✓	N/A	N/A	N/A	**N/A**
	Slightly to moderately modified	N/A	N/A	N/A	N/A	✓	N/A	✓	✓
	Highly modified	N/A	N/A	N/A	N/A	N/A	✓	N/A	**N/A**
Human consumption after appropriate treatment		✓ if water is sourced for supply in a special water supply catchment area set out in Schedule 5 of the *Catchment and Land Protection Act 1994* or in accordance with the *Safe Drinking Water Act 2003*.							
Agriculture and irrigation		N/A	✓	✓	✓	✓	✓	✓	✓
Human consumption of aquatic foods		✓	✓	✓	✓	✓	✓	✓	✓
Aquaculture		✓ if the environmental quality is suitable and an aquaculture licence has been approved in accordance with the *Fisheries Act 1995*							
Industrial and commercial		N/A	N/A	✓	✓	✓	✓	✓	**N/A**
Water-based recreation (primary contact)		✓	✓	✓	✓	✓	✓	✓	✓
Water-based recreation (secondary contact)		✓	✓	✓	✓	✓	✓	✓	✓
Water-based recreation (aesthetic enjoyment)		✓	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values		✓	✓	✓	✓	✓	✓	✓	✓
Navigation and shipping		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Default guideline values (DGVs) for toxicants are provided on the ANZG website, along with a reliability estimate from unknown to low, moderate and high reliability. For this audit, DGVs were accessed from the website in October 2022. It is important to note that metals criteria are based upon dissolved metals concentrations (i.e. 0.45 µm filter used when collecting sample, acid preservation).

There is no Australian guidance document which provides suitable criteria for assessing the significance of TRH concentrations in groundwater with respect to the maintenance of ecosystems EV. The Dutch intervention level for mineral oil of 0.6 mg/L[6] is commonly used as an initial screening criteria for TRH when assessing the objectives of the maintenance of ecosystems beneficial use. However, the intervention level is explicitly not risk based (i.e. it is a policy value). In addition, the level is based on the analytical standard for alkanes and does not apply to the aromatic portion of a petroleum mixture (i.e. not directly comparable to TRH results). As such, although the intervention level may be commonly used due to the absence of an appropriate criteria, the exceedance of this intervention level does not indicate an unacceptable risk. The auditor considers that a preferable approach is to focus upon the contaminants which are known to pose the greatest risks based on available information (i.e. BTEX, naphthalene).

For environmental values that do not have specific environmental quality indicators or objectives provided in the ERS, the objectives for WDES can be adopted. This is based on the assumption that water-based

[6] Ministry for Housing, Spatial Planning and the Environment, Directorate-General for Environmental Protection (2009) Soil Remediation Circular 2009.

ecosystems and species are typically the most sensitive environmental value to contamination. In this audit, the WDES objectives have been adopted for Traditional Owner cultural values (TOCV).

5.4.2 Potable Water Supply

Table 5.4 of the ERS refers to the current version of the *Australian Drinking Water Guidelines* (ADWG) when assessing drinking water use, which is currently National Health and Medical Research Council (NHMRC) version 3.8 (2022).

The NHMRC drinking water criteria are largely based upon the World Health Organisation (WHO) drinking water criteria. However, there are some compounds where NHMRC has drawn a different conclusion to WHO and a number of other compounds where WHO provides some criteria but NHMRC has not adopted any criteria. Consideration to WHO criteria is given on a case by case basis, as deemed appropriate by the auditor. In the absence of more applicable criteria, WHO (2008)[7] criteria have been adopted to assess TRH.

5.4.3 Agriculture and Irrigation (Irrigation)

To assess risks from use of groundwater for irrigation of agriculture, parks and gardens, reference has been made to the water quality objectives for irrigation waters in Section 4.2 of the ANZECC (2000), as these are retained under ANZG (2018).

5.4.4 Agriculture and Irrigation (Stock Watering)

To assess risks to livestock consuming groundwater, reference has been made to Sections 4.3 and 9.3 of ANZECC (2000), as ANZG (2018) has not yet been updated for stock watering. It is assumed that livestock could consume metals which are dissolved, complexed within an organic compound or bound to sediments (i.e. non-filtered total concentrations).

ANZECC (2000) does not provide livestock drinking water guidance for organic contaminants. ANZECC (2000) recommends that human drinking water criteria are adopted for pesticides. In the absence of more applicable data, the auditor adopts the same approach for other organics.

5.4.5 Industrial and Commercial

The earlier version of the ANZECC (2000) Guideline (i.e. 1992) provided criteria for a range of contaminants and industrial processes, however, ANZECC (2000) states that:

> *'After extensive consultation with representative industrial groups, the current guidelines provide no specific guidance for industrial water use, because industrial water requirements are so varied (both within and between industries) and sources of water for industry have other coincidental environmental values that tend to drive management of the resource. Industrial water use continues to be a recognised environmental value that has high economic benefit to the community. It must be given adequate consideration during the planning and management of water resources.'*

It is understood that the current informal EPA Victoria policy is to also consider the appropriateness of industrial water use based upon a qualitative approach (i.e. related elevated concentrations of a contaminant). For the purpose of the audit, groundwater objectives for other uses are expected to be protective of this environmental value.

5.4.6 Water-Based Recreation (Primary Contact Recreation)

The ERS specifies that *E. coli* count should be less than 10 per 100 mL, or zero per 100 mL if human faecal sources of contamination have been identified (such as septic tanks or sewerage infrastructure).

[7] WHO (2008) *Petroleum Products in Drinking Water*, Background Document for Development of WHO Guidelines for Drinking-Water Quality.

Environmental quality objectives and indicators for long-term chemical hazards are based on National Health and Medical Research Council (NHMRC 2008) *Guidelines for Managing Risks in Recreational Water*, which in turn reference the *Australian Drinking Water Guidelines* (NHMRC, latest version 3.8 dated September 2022).

Where inhalation of vapours and dermal contact are not a concern, the relevant health based drinking water criteria is multiplied by 10 to represent incidental ingestion. Where inhalation of vapours and/or dermal contact are a concern, the relevant health-based drinking water criteria are adopted without modification. In some instances, it is important to consider the foundation of the drinking water criteria value and determine whether it is logical to multiply the criteria by 10 (e.g. nitrate drinking water criteria is based upon protecting bottle fed infants, which is not relevant for primary contact recreation exposure).

5.4.7 Buildings and Structures

For the protection of buildings and structures, the ERS specifies that the following indicators should be considered: pH, sulphate, chloride, redox potential, salinity and any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings or other structures. Australian Standard AS2159-2009 *Piling – Design and Installation* provides values for pH, sulphate and chloride for building and structures, and reference should also be made to the ASC NEPM.

It is noted that the AS2159 criteria for sulphate in water is provided as sulphate-SO_3. A conversion to sulphate-SO_4 (i.e. 100 ppm S-SO_4 = 80 ppm S-SO_3) results in a sulphate-SO_4 criteria for non-aggressive conditions of 375 mg/L.

6 Summary of Investigation Process and Findings

Prior to Auditor engagement a number of investigations were undertaken on-site as part of due diligence reporting to facilitate the development of residential and open space land use.

A summary of the environmental works undertaken by SMEC and Agon, and associated Auditor inputs are provided in Table 10.

Table 10: Summary of Environmental Site Assessment and Auditor Inputs

Date	Consultant	Description of Activity
Pre-Audit Activities		
January 2015	SMEC	Geotechnical investigation within Lot 9370 (which includes Stage 1A)
August 2021	Agon	ACM ground survey within Stage 1A
September 2021	Agon	PSI Report completed
September 2021	Agon	Asbestos removal program and surface clearance certification within Stage 1A
Audit Activities		
15, 16 & 26 September 2022	Agon	Soil assessment and groundwater sampling
19-20 September 2022	AEA	Site inspections
21 September 2022	AEA	Notification of 53X Audit to NT EPA lodged
3 October 2022	Agon	Draft DSI report issued to AEA
7 October	Agon	Inspection of mulch present on-site and provision of asbestos clearance certificate
25 October 2022	Agon	Final DSI report issued to AEA

Shading: Grey: Consultant Inputs, Blue: Auditor Inputs, Green: Site Investigation

It is noted that the site development works were completed prior to commencement of the audit which prevented the auditor from observing the original site condition, the site condition following remediation and the site condition prior to filling and sealing of the ground surface. This resulted in the inability to inspect soils beyond each sampling location and the ground surface of residential lots (roads and verges were covered already). However, the Auditor considers that the data collected is sufficient to adequately characterise the Site for audit purposes, given:

- The relatively consistent site use (undeveloped native bushland with localised uncontrolled filling) and lack of significant gaps in understanding of historical site use;
- The thorough site walkover by Agon, removal of all identified ACM and provision of asbestos clearance certificates as part of the asbestos removal works in 2021;
- The soil investigations undertaken included 120 locations, which exceeds the AS4482.1 (and NSW EPA Sampling Design Guidelines) recommended number of sampling locations for an approximately 8.17 hectare (ha) site (90 locations);
- The large number of samples collected across the Site, and analysed for asbestos (n=102) which all reported the absence of asbestos finds;
- the comprehensive suite of analysis undertaken, which did not identify the presence of contamination onsite; and
- The absence of unexpected finds (including suspect ACM) reported by the earthworks contactor during grubbing and excavation of geotechnically unsuitable materials.

The following section provides a summary of the detailed site investigations undertaken at the site. A summary of the preliminary site investigation (site history) is provided in Section 3.2.

6.1 Soil Investigations

A summary of the soil investigations and soil sampling undertaken at the site is provided in the following table.

Table 11: Summary of Soil Investigations at the Site

Date (Consultant)	Sample Locations	Sampling Methodology
12 to 20 August 2021 (Agon)	ACM ground survey	The survey comprised two field staff walking 5 m fixed transects established north to south across the Stage 1A area. Where suspect ACM was identified, the location was recorded, and representative samples of suspected ACM were collected.
15 and 16 September 2022 (Agon)	Test Pits TP01 to TP112 Hand Augers BH01 to BH08	Grid based test pits (n=112) were excavated across the site within the nominated allotments, to a maximum depth of 1.8 m. Targeted hand augers (n=8) were advanced within the road verges to a maximum depth of 0.5 m. Analysis for CoC and selected samples for a broader analytical suite.
26 September 2022 (Agon)	MW01 to MW03	Groundwater sampling of off-site wells (n=3) Analysis for CoC and selected samples for a broader analytical suite.

The soil and groundwater investigation sampling locations are shown on Figure 7.

The results of the soil investigations are summarised below.

Fill materials were observed across the site in the form of reworked site soils, construction materials (service trench sands and road sub-base) and mulch for landscaping. The reworked site soils were described as brown gravelly sandy silt, with trace amounts of isolated fragments of glass, metal, concrete, plastic and wood chips. The fill and reworked natural soils appeared well compacted, likely for geotechnical requirements of future dwellings, but this level of compaction could reduce ease of plant growth.

The mulch was described as dark black / grey brown sandy silt, and at one location (BH06) which was sampled from the road verge the same was reported to contain the presence of ash/cinders, but it is considered that the soil described would not at levels that would be aesthetically offensive. Fill material was typically less than 0.5 m thick, however did range up to a depth of 1.2 m associated with cut/fill activities to meet the final grade levels.

Natural soils consisted of grey brown sandy silt, underlain by yellow brown gravelly sandy silt (consistent with weathered siltstone) to the maximum depth of investigation at 1.8 mbgl.

No potential ACM was observed in soils during the 2022 soil investigations at the site (i.e. post ACM removal and clearance in 2021) or on the site surface during site inspections by Agon or the auditor/assistant. Testing of soils confirmed no asbestos fragments or fibres.

ACM has been identified in mulch within other states and at the request of the auditor, the mulch was inspected at this site for ACM with none identified by Agon.

The fill materials across the site met both EIL and HIL A criteria, with the exception of concentrations of manganese and zinc reported above EILs which were considered to be indicative of natural concentrations. Low levels of TRHs (>C_{16}-C_{40} fractions, maximum 150 mg/kg) and aldrin + dieldrin (maximum 0.87 mg/kg) were detected in fill within the road verges at concentrations below all relevant ESLs and HSLs. All other analytes were below laboratory detection limits or assessment criteria.

The natural soils across the site contained elevated concentrations of nickel (up to 23 mg/kg) with respect to the ecosystem criteria adopted by Agon. Agon derived 95% UCL_{mean} for nickel concentrations in natural soils and found that concentrations were below the site derived EILs (7 mg/kg). It is considered that nickel is naturally occurring at the site.

Soil pH levels ranged between 5.2 and 7.5 pH units, with some samples from both natural soils and fill material reported outside the adopted background range of 6 to 8 pH units. This was not considered to represent contamination, but rather naturally acidic soil, as the levels were similar in the fill and natural soils.

All other natural soil concentrations were below either laboratory detection limits or adopted assessment criteria.

No volatile contaminants were detected in soil at levels above the vapour intrusion screening levels.

No asbestos was encountered during the 2022 soil investigations.

6.2 Groundwater Investigations

A summary of the groundwater investigations undertaken at the site is provided in the following table.

Table 12: Summary of Groundwater Investigations at the Site

Date (Field Work)	Sample Locations	Sampling Methodology and Depth
GME1 26 September 2022 (Agon)	Off-site wells MW01 to MW03 (sample)	Gauging of existing MW01, MW02 and MW03. The wells were purged dry twice, due to poor recharge with standing water levels not stabilising during purging. Analysis of samples for PFAS, metals, cyanide, PAHs, TRH/BTEX, OCPs, PCBs, VOCs, phenols and pH.

The groundwater well locations are shown on Figure 7 (no survey data was available for the wells, as such groundwater contours were not provided by Agon).

Prior to the groundwater sampling, a test pit was excavated to the full reach of the excavator (greater than 4 m depth) in the lowest elevation on-site (eastern end of site) to check for groundwater. No obviously moist soils or groundwater inflow was noted within excavation.

The findings of the groundwater investigations are summarised as follows:

- Inferred groundwater flow direction underlying the site was east, consistent with the surface topography which slopes towards the east and expected regional flow towards the Buffalo Creek Catchment. Standing water levels ranged from 4.869 to 5.434 mbgl;
- Standing water levels within the groundwater wells were unable to be maintained during sampling, with the wells purging dry twice before sampling, indicating a low yielding formation (it is also considered that recharge would be seasonal);
- Field readings reported redox potential in the range 91 to 122 mV, dissolved oxygen levels ranging from 4.10 to 6.38 mg/L (these values will be influenced by the sampling method), TDS values ranging between 122 and 202 mg/L, and pH ranging between 4.0 and 4.4 (acidic conditions);
- No measurable separate phase hydrocarbons (NAPL) or sheen was reported in groundwater from on-site or off-site wells, and no odours were reported;
- Concentrations of cobalt, copper, nickel and zinc exceeded marine WDES criteria for all samples. Concentrations of nickel also exceeded potable ADWG (health) for MW02;
- pH values were indicative of acidic conditions, with values in all wells reported below potable ADWG (aesthetic) and irrigation ANZECC guidelines;

- Concentrations of other PAHs, MAHs, VOCs, phenols, PCBs, OCPs and TRH were either reported below LORs or adopted environmental values assessment criteria.

6.3 Potential for Vapour Intrusion

The groundwater and soil results did not identify that a vapour intrusion risk required assessment. Refer to Sections 6.1 and 6.2.

6.4 Building and Other Structures

As per EPA Publication 2022, '*Land is defined in section 6 of the EP Act 2017 and means any land, whether publicly or privately owned, and includes any buildings or other structures permanently affixed to the land….*'.

At the time of the audit, no buildings were present on-site, however, the underground service network for the proposed development had been recently installed. It is assumed that the infrastructure that has been installed and is proposed under the development will be built in accordance with industry standards and therefore investigation of use of hazardous building materials (i.e. lead based paints, asbestos, PCBs, etc) is not necessary.

6.5 Auditor's Opinion on Investigations

When preparing this section of the EAR, the auditor has given particular attention to Section 9.3 of EPA Publication 2041 which states that an EAR should include an outline of *'…the approach and steps taken to review, evaluate and verify data relied upon in the audit report'.*

The auditor considered as a whole, the data collected was within acceptable error margins as determined through the assessor's Data Quality Objectives (DQO) (refer to Section 7 and Appendix M of Agon's DSI report (2022c)). As such, the auditor considers that the data collected is sufficient to adequately characterise the site for audit purposes, given:

- The lack of significant systematic errors with the data collection process;
- Absence of major gaps in understanding of the site use over time;
- All identified point sources of contamination were investigated with the soil investigation undertaken including 112 grid and 8 targeted locations, which exceeds the AS4482.1 (and NSW EPA Sampling Design Guidelines) recommended number of sampling locations for an approximately 8.2 hectare site (90 locations).
- The groundwater investigations comprised three off-site wells (inferred to be located down hydraulic gradient of the site) which were monitored. The groundwater investigations did not identify site derived groundwater contamination, which supports the adequacy of the soil investigations across the site.
- The substantial number of samples collected across the site and the comprehensive suite of analysis undertaken, which addresses inherent data gaps in site histories.
- The laboratory analysis was undertaken by NATA accredited laboratories.
- The site-specific geology and hydrogeology are consistent with anticipated regional conditions.
- The analytical results are consistent with expectations based on the site history and field observations.
- Absence of contamination observed during the site inspection by the audit team, consistent with the anticipated site conditions.

The auditor considers the quantity and quality of the site investigations undertaken to be adequate to characterise the nature and extent of contamination at the site. Further information on the quality assurance and quality control review is provided in Appendix D. The auditor considers the data collected is sufficient for the purposes of this environmental audit. The auditor is of the view that the site has been assessed and characterised adequately within the means and information available to the auditor at the time of preparing this EAR.

7 Remediation

The following section provides a summary of the remediation/clean up works undertaken at the site. The remediation works were undertaken prior to auditor engagement. The summary provided below is based on information provided in the PSI and supporting documents.

The auditor is required to report the condition of the land and/or groundwater prior to clean up and post clean up. The condition prior to clean up is inferred by the information provided in the background reports as remediation was undertaken prior to commencement of the site audit and relates purely to removal of illegally dumped waste including asbestos.

7.1 Asbestos Removal and Clearance Works

The asbestos survey undertaken by Agon in August 2021 identified the presence of asbestos at multiple locations across the site. In total, the survey identified 35 distinct locations where surface ACM was present, all of which were considered to be attributed to illegal surface dumping activities. In addition to the identified surface ACM, three dumped vehicles were found to be present on-site with asbestos containing rear brake pads. The location of former ACM and asbestos across the site is shown on Figure 5.

ACM was observed in the form of scattered surface debris (sparsely distributed across a small surface area), soil waste stockpiles (with ACM observed in and / or immediately surrounding the soil mass), mixed waste stockpile (typically C&D waste with ACM debris observed in and / or immediately surrounding the waste mass).

In September 2021 Agon supervised the removal of asbestos on-site (undertaken by licensed asbestos removal contractor, McMahon Services Australia), and provided asbestos clearance inspection certificates (by a licensed asbestos assessor, Agon). The removal program comprised:

- Excavation of C&D waste and waste soil stockpiles to natural surface and subsequent emu-pick;
- Emu pick of scattered debris;
- Removal of the brake pads on the car wrecks;
- Disposal of asbestos and asbestos impacted material; and
- Visual inspections after completion of asbestos removal works and issue of asbestos clearance certificate for each area.

All nominated areas were visually inspected by Agon, and cleared of visible surface asbestos debris. As the inspection was limited to visible surface debris, Agon recommended that the civil works contractor remain vigilant during development works to identify any potential subsurface ACM debris which may become apparent through soil disturbances.

Agon provided the following information regarding the civil earthworks undertaken by BMD (the civil works contractor) '*BMD has reported no unexpected contamination finds, including suspect ACM, were encountered during the civil works programme*.' Further, Agon did not observe any asbestos during the soil investigation works, summarised in Section 6.1.

7.2 Off-site Soil Disposal and Importation of Fill Material

In total 337.5 tonnes of asbestos and asbestos impacted material were removed from Stage 1A as part of the remediation works (as detailed above). The asbestos and asbestos impacted soil was disposed of at Shoal Bay Waste Management Facility, waste disposal dockets were provided in Agon's PSI (2022a).

During construction works the following fill was imported to site by BMD:

- 2,230 tonnes of Type 2a underground service bedding material, sourced from Boral Quarry, Mt Bundey and Halkitis Brothers Mt Bundy Station Quarry;
- 915 tonnes of sand for electrical trench backfill, sourced from DCT Quarry, Howard Springs, NT;

- 3,311 tonnes of Type 2 subgrade replacement material, sourced from Lavercombe Quarry, Virginia, NT;
- Mulch was site sourced (mulched cleared vegetation) and purchased from Shoal Bay Waste Management Facility (SMWMF);
- 9,500 m^3 of general fill for earthworks, sourced from surplus virgin excavated natural material (VENM) from Stages 1- 7 of the Muirhead (Breezes) residential development located to the south of the site. Historically the land where this material was sourced from was described as an 'Aerial Farm' but was the Defence 'Lee Point Receiving Station' that was established in the 1950s and was decommissioned between 2006 and 2010. The historical aerial photographs show the area as undeveloped cleared grassland. Soil investigations undertaken as part of the DSI for the site characterised the soil as general fill.

Agon provided a surface contour figure in the DSI (2022c), which shows the stripped site surface (i.e. post grubbing and excavated removal of geotechnically unsuitable materials) overlaid against the final surface level. The figure shows general filling levels across the site, which Agon consider consistent with those levels observed during the investigation.

7.3 Auditor's Opinion on Remediation Data

The auditor considers that as a whole, the remediation data collected to be within acceptable error margins as determined through the assessor's quality assurance program (refer to Section 7 and Appendix M of Agon's DSI report (2022c)). As such the auditor considers that the data collected is sufficient to adequately characterise the site for the audit purposes, given:

- The lack of significant systematic errors with the validation data collection process;
- All visible asbestos was identified and removed by Agon, and clearance certificate issues by a LAA;
- Comprehensive soil investigation, and analysis of asbestos, undertaken post remediation works;
- Laboratory undertaken by NATA accredited laboratories;
- The analytical results are consistent with expectations based on the site history and field observations; and
- The site inspection undertaken by the audit team, and intrusive investigations undertaken by Agon post remediation, did not observe the presence of asbestos.

The auditor considers the quantity and quality of the remediation validation undertaken to be adequate to characterise the nature and extent of contamination at the site. The auditor considers the data collected is sufficient for the purposes of this environmental audit.

8 Environmental Values Assessment – Land

8.1 Final Soil Condition

The final soil condition at the site is characterised by investigation samples collected by Agon in 2022 (as detailed in the DSI, 2022c).

Reported exceedances of the adopted soil quality objectives are summarised in the following table. The post-remediation soil analytical results are provided in Agon's DSI (Appendix H).

Table 13: Residual Soil Analytes Comparison with Ecological/Human Health Direct Contact Criteria (mg/kg)

Analyte	n	n > PQL	Max.	Number of Samples > Criteria					
				EIL/ESL Urban Res.	EIL/ESL Com/Ind	HIL/ *HSL A*	HIL/ *HSL B*	HIL/ *HSL C*	HIL/ *HSL D*
Arsenic	296	278	43	0 >100	0 >160	0 >100	0 >500	0 >300	0 >3,000
Chromium (total)	165	165	220	0>350**	0>620**	0>120,000*	0>120,000*	0>120,000*	n/a
Chromium (VI)	158	0	<LOR	-	-	0>100	0>500	0>300	0>3,600
Cobalt	161	15	21	-	-	0 >100	0 >600	0 >300	0 >4,000
Copper	296	76	15	0 >40	0 >50	0 >6,000	0 >30,000	0 >17,000	0 >240,000
Lead	296	262	23	0 >1,100	0 >1,800	0 >300	0 >1,200	0 >600	0 >1,500
Manganese	161	154	1,300	26 >220*	-	0 >3,800	0 >14,000	0 >19,000	0 >60,000
Nickel	296	102	23	32 >7	17 >8	0 >400	0 >1,200	0 >1,200	0 >6,000
Selenium	161	5	2	0 >10^	-	0 >200	0 >1,400	0 >700	0 >10,000
Zinc	296	116	300	1 >170	1 >220	0 >7,400	0 >60,000	0 >30,000	0 >400,000
pH (pH units)	8	8	Range 5.2-7.5		-	-	-	-	-
Aldrin +dieldrin	185	6	0.87	-	-	0>6	0>10	0>10	0>45
Asbestos	102	0	<LOR	-	-	No asbestos observed or detected by the laboratory			

Notes:
Table includes primary samples only, unless duplicate results were higher.
EILs were calculated by Agon on the basis of site-specific soil parameters.
Italics text relate to HSLs; Shaded box relates to exceedances.
* Criteria from USEPA Regional Screening Level table (April 2019 version); ** Criteria based on Cr(III); # Criteria from CCME (1999 & 1991).
^ EPA Publication 1828.2 Table 3 Fill material upper limit.

8.1.1 Land Dependent Ecosystems and Species (LDES)

Concentrations of manganese, nickel and zinc were reported in at least one soil sample above the adopted ecosystem criteria for urban residential use. Of these analytes nickel and zinc concentrations also exceeded the commercial/industrial ecosystem criteria in at least one sample.

The zinc exceedance was detected in one fill sample. The 95% UCL_{mean} for zinc in fill calculated by Agon was 19 mg/kg, well below the ecological criteria of 170 mg/kg. The Auditor considers that the isolated concentration does not present a risk to on-site ecological receptors, as it is limited to one sample and concentrations were less than 2.5 times the criteria).

The nickel and manganese exceedances were present in both natural and fill soils. The 95% UCL_{mean} for nickel and manganese in fill and natural calculated by Agon was 4 mg/kg and 172 mg/kg respectively, below the ecological criteria of 7 mg/kg and 220 mg/kg. Agon considered that based on the distribution and range of concentrations reported through the profile, these concentrations were within natural background variation

and not considered significant in relation to ecological receptors for the proposed land use. The Auditor considers that the concentrations are likely indicative of natural concentrations with no evidence of a site derived source or area of impact.

The auditor therefore considers that the condition of the site would not adversely impact this environmental value for the proposed land use.

8.1.2 Human Health

Following the targeted soil remediation works, there were no residual exceedances of human health screening criteria remaining on-site.

On the basis of the Tier 1 screening results, the auditor considers that the condition of the site is suitable for the proposed low density residential land use.

Vapour intrusion risks from volatile contaminants in groundwater is discussed in Section 9.4.5.

8.1.3 Aesthetics

Following the soil remediation works and DSI investigation no aesthetic impacts we identified.

In addition to the intrusive investigations, a clearance certificate was provided by Agon for the mulch imported to site (at the time of the inspection the material was located in stockpiles / mounds). The certificate (provided in Appendix B) confirmed that asbestos residue / debris was not visible in the assessed area.

8.1.4 Production of Food, Flora and Fibre

Following the soil remediation works and DSI investigation no evidence of contamination was identified, with concentrations meeting the Tier 1 screening results for human health and the environment. No evidence of point sources were identified with concentrations in soil likely to be indicative of natural background conditions. The auditor considers that the site condition meets the guidelines for production of food, flora and fibre.

8.1.5 Future Buildings and Other Structures

Overall, the soil condition for the environmental value of buildings and structures was considered to be 'moderate to mild' in accordance with AS2159-2009, based on the following results:

- pH results ranging from 5.2 to 7.5 pH units, and
- the site is not located in a known area of potential acid sulphate soil.

According to a review of the Atlas of Australia Acid Sulfate Soils the site is in an area which has not been assessed yet. The nearest potential occurrence of acid sulfate soils would be Buffalo Creek catchment, approximately 800 m from the eastern boundary of the site.

The QLD ASS Technical manual (QLD Government 2014, reference by the NT Land Suitability Assessment Guidelines) indicates that "all disturbances to soils, groundwater hydrology or surface water drainage patterns in coastal areas below 5 mAHD should be investigated, designed and managed to avoid potential adverse effects from ASS." This applies to areas where the ground level is above 5 m AHD but where excavation may occur below 5 mAHD.

The pre-construction site contour data (Agon, 2022c) indicates an elevation range from 12 mAHD at the eastern boundary to a high point of 25 mAHD at Lee Point Road. The EcOz PSI (2015) considered that the risk of exposing ASS was low, with site assessment of ASS not deemed necessary by SMEC (DHA's engineering contractor).

Agon also considered the potential for ASS / PASS to be present at site. As documented in the PSI (Agon, 2022a), reviewed the Atlas of Australian Acid Sulfate Soils which indicated that the site was in an area of extremely low probability of occurrence, and the 1:50,000 Greater Darwin Region Acid Sulfate Soils map showed that the site is within an area which has not been assessed yet.

The auditor therefore considers that the condition of the site would not adversely impact this environmental value.

8.1.6 Existing Buildings and Other Structures

In assessing the environmental values of land, the auditor is required to assess the risk the land presents to building and structures (as discussed above), but also the risk from any buildings or other structures permanently affixed to the land. This is considered to relate to the use of hazardous materials (asbestos, lead based paints, PCBs, etc) in the construction of the buildings and not other risks (i.e. structural integrity, etc).

At the time of the audit, no buildings were present on-site, however, the underground service network for the proposed development had been recently installed. It is assumed that the infrastructure that has been installed and is proposed under the development will be built in accordance with industry standards and free of prohibited hazardous building materials (i.e. lead based paints, asbestos, PCBs, etc). The Auditor therefore considers that existing buildings and other structures do not present a risk to the environmental values of the land.

9 Environmental Values Assessment – Groundwater

9.1 Groundwater Contamination and the EP Act

EPA Publication 2001 outlines how the duty to manage contaminated land (Section 39 of the EP Act) applies to groundwater. Where contaminated groundwater is present, the duty holder must "*minimise risks of harm to human health and the environment from contaminated groundwater so far as reasonably practicable, which includes… undertaking clean up activities where reasonably practicable".*

Publication 2001 also outlines the following responsibilities of environmental auditors, where contaminated groundwater is identified as part of the audit:

- Document the clean up that has occurred in the EAR;
- Provide their opinion on the adequacy of this clean up; and
- If the EAS includes auditor recommendations to manage residual groundwater contamination, the EAR must include a management plan that outlines roles and responsibilities to implement that plan.

The process of demonstrating that 'clean up so far as reasonably practicable' has been achieved is commonly abbreviated to CUSFARP. Appendix 2 of EPA Publication 2001 provides a checklist for CUSFARP information which is required to be provided to EPA as part of the audit report. The completion of the checklist was not required for this site.

In accordance with the Principles of Environmental Protection (Part 2.3 of the Victorian Act), the auditor must assess the practicability of clean up as a measure to manage any identified risks of harm before recommending engineering or administrative management measures.

9.2 Source of Groundwater Contamination

Inferred down hydraulic off-site data was obtained by Agon (2022c) for the purpose of understanding the potential for site derived groundwater contamination.

9.2.1 Regional Contamination and Natural Background Concentrations

Concentrations of cobalt, copper, nickel and zinc were above one or more assessment criteria during the GME. These analytes are not considered site-derived contamination for the following reasons:

- Concentrations were consistent across all three wells, at concentrations deemed to be background (regional or naturally occurring);
- These analytes were not identified as key site-sourced contaminants of concern within the site history; and
- Concentrations of these analytes in soil during site investigations were not indicative of an obvious on-site source.

Therefore, the Auditor considers that the site is not a source or co-source of cobalt, copper, nickel and zinc contamination in groundwater but most likely indicative of the natural groundwater conditions surrounding the site.

9.3 Extent and Nature of Groundwater Contamination Following Remediation

9.3.1 Summary of Impacted Environmental Values of Groundwater

A summary table of the currently impacted environmental values is provided in Table 14 below and is consistent with Attachment C of EPA Publication 2001.

Table 14: Impacted Environmental Value Summary Table

Impacted Environmental Value	Contaminant(s)
Water dependent ecosystems and species[1]	Cobalt (B/N), copper (B/N), nickel (B/N), zinc (B/N) (However not applicable on site).
Potable water supply	Nickel (B/N).
Mineral water supply	Not applicable.
Agriculture and irrigation (irrigation)	pH (B/N).
Agriculture and irrigation (stock watering)	pH (B/N).
Water based recreation (primary contact recreation)	Not precluded.
Industrial and commercial[2]	Not precluded.
Traditional Owner cultural values[1]	Refer to WDES – not applicable on site.
Buildings and structures	Not precluded.
Geothermal properties	Not applicable.

(B/N) = background elevation (naturally occurring); (R) = regional contamination.

1 Based on concentrations in the vicinity of the site, whilst criteria apply at the point of exposure/receptor.

2 No chromium criteria are available for commercial or industrial use, as suitability for these uses are highly dependent on the specific use proposed. It is recommended that suitability for a specific commercial or industrial use is evaluated on an individual basis.

9.4 Groundwater Risk Assessment

Section 9.4.3 of EPA Publication 2041 states that 'EPA expect the audit to include measures to prevent impacts from the audit site to other sites'. If the site is a source of groundwater contamination, the auditor must therefore consider whether this contamination is likely to impact off-site environmental values. However if the site is not the source of groundwater contamination (as in this case), the auditor only needs to consider potential impacts on on-site environmental values.

9.4.1 Extractive Groundwater Uses

Based on Segment A1, protected extractive uses of groundwater include potable water supply, water-based recreation, irrigation, stock watering and commercial and industrial use. For non-source sites, only on-site environmental values are considered relevant.

The proposed development will not include any extractive use of groundwater. It is also noted that extractive use on site in the future is unlikely, based on the natural aquifer characteristics (relatively low yield and naturally elevated concentrations of inorganics), availability of mains water, highly urbanised site location and the building footprint (covering the majority of the site). As there are no existing or likely extractive uses of groundwater at the site, there are no complete exposure pathways, and the risks posed to human health and the environment from groundwater contamination are therefore considered to have been minimised.

In the event that water is extracted within the audit area for use it is recommended that the groundwater is tested, and advice should be sought from a suitably qualified professional to ensure the groundwater is suitable for the intended use.

9.4.2 Water Dependent Ecosystems and Species, Traditional Owner Cultural Values

Concentrations of cobalt, copper, nickel and zinc exceeded the WDES criteria on-site. However, concentrations were considered naturally occurring and did not represent contamination.

The groundwater quality objectives for WDES apply at the point of discharge to surface water, no surface water bodies exist on site. The auditor considers that in the case where groundwater is not proposed to be

extracted, TOCV should also be applied at the point of discharge. As the site is not considered a source of groundwater contamination and there are no on-site surface water bodies, these environmental values are not considered relevant at this site as there are no complete exposure pathways. Further, as the concentrations were considered naturally occurring, local natural plants, grasses and fauna are likely to be adapted to these concentrations of analytes, and therefore unlikely to present an unacceptable risk.

9.4.3 Other Non-Extractive Groundwater Uses

Based on the depth to groundwater, the only relevant on-site non-extractive groundwater use relates to building foundations that may extend into groundwater, that is Buildings and Structures. For non-source sites, only on-site environmental values are considered relevant, therefore potential down-gradient uses such as recreational use of Buffalo Creek have not been considered.

Groundwater is classified as 'moderate to mild' based on AS2159-2009 and therefore Buildings and Structures is not an impacted environmental value, based on the following:

- pH in groundwater ranged from 5.2 to 7.5 pH units and is considered slightly acidic.

9.4.4 Consideration of Potential NAPL

No measurable NAPL or sheen has been reported for groundwater from the off-site wells and dissolved hydrocarbon concentrations were below saturation limits.

9.4.5 Consideration of Potential Vapour Risks from Groundwater

There were no detectable concentrations of volatile contaminants in groundwater.

10 Audit Findings

10.1 Opinion on Whether the Condition of the Site Represents a Risk of Harm to Human Health or the Environment

The auditor considers that the condition of the site soils do not represent a risk of harm to human health or the environment under the proposed site use.

The condition of groundwater is not considered to represent a risk of harm to human health or the environment under the proposed development.

10.2 Other Factors Affecting Use of the Site

EPA Publication 2041 notes that the auditor may identify additional information about the site that is not part of the opinion regarding the EAS recommendations, but which may be relevant to the development of the site or future site activities. Such factors are noted below and repeated in the Environment Audit Statement in the section titled "Other Related Information":

- Groundwater at the site contains naturally elevated concentrations of cobalt, copper, nickel and zinc. The levels are considered typical of the natural groundwater quality surrounding the site and do not constitute contamination in accordance with Clause 4 of the *Environment Reference Standard 2021*.
- Soil at the audit site contains naturally elevated concentrations of nickel, and manganese. The levels are considered typical of the regional soil quality surrounding the audit site and do not indicate the presence of contaminated land or represent a health or ecological risk. Local natural plants, grasses and fauna are likely to be adapted to these concentrations of analytes, however there may be some impact on the development of some introduced plants, grasses and fauna. It is recommended that advice is sought from a qualified horticulturalist regarding the suitability for vegetation and soil improvements that may be appropriate for the Site.
- Not all land uses for which the audit site is considered suitable by this environmental audit may be allowed under the existing zoning of the Darwin planning scheme.
- In accordance with Section 214 of the Act, the person in management or control of the site must provide a copy of this statement to any person who proposes to become the person in management or control of the site.

11 Conclusions

11.1 Audit Requirement

This audit was undertaken to satisfy a condition of the development application (DP19/0050 Condition 29). DHA are proposing to develop the site for low density residential purposes, with a child care centre, residential sales office, café, pocket park, internal roads, road verges and a drainage reserve.

11.2 Auditor's Conclusions and Recommendations

The auditor considers that the final condition of the site is suitable for the proposed uses of low density residential, child care, recreational / open space and commercial land uses along with less sensitive land uses (i.e. high density residential and industrial land uses).

An EAS has been issued which states that the condition of the site is acceptable for the environmental values protected under *'Low Density Residential', 'High Density Residential', Recreational / open space'* and *'Commercial' and 'Industrial*' land uses. There are also a number of recommendations in the EAS, including:

1. Asbestos containing materials were found on the audit site and have been removed as far as reasonably practicable. Small quantities of bonded asbestos cement (AC) fragments may remain within the soil and be uncovered during excavation works. These AC fragments are not anticipated to represent a health risk to occupiers of the completed development. If encountered during future development or use of the audit site, any fragments must be handled and disposed in accordance with the *NT Work Health and Safety Regulations 2011*, including the use of an appropriately licensed contractor.
2. If groundwater is to be extracted from the site, advice including testing, should be sought from a suitably qualified professional to ensure the groundwater is suitable for the intended use.
3. Any soil proposed to be excavated and disposed off-site after the completion of the audit, must be classified by a suitably qualified professional in accordance with relevant NT guidelines.
4. Any fill material proposed to be imported to the audit site after the completion of the environmental audit, must be tested and classified as per relevant NT EPA guidance.

12 References

Environmental Legislation and Regulations

Environment Protection Act 2017 (Vic.) No. 51/2017 (as amended by the Environment Protection Amendment Act 2018). Victorian Government Printer.

Environment Protection Regulations 2021, SR No. 47/2021. Victorian Government Printer.

Environment Reference Standard (2021)*,* Victorian Government Gazette, S245, 26 May 2021.

Planning and Environment Act 1987 (Vic.) Section 12 (2)(a) *Ministerial Direction No. 1 Potentially Contaminated Land*. (Act No. 45/1987. Direction 15 August 2021).

Water Act 1989 (Vic.) No. 80/1989, Victorian Government Printer.

Guidelines, Policies and Publications

Australian and New Zealand Environment and Conservation Council (ANZECC) (1992) Australian and New Zealand guidelines for the assessment and management of contaminated sites. (ANZECC).

Australian and New Zealand Environment and Conservation Council) (ANZECC) (1992) *Australian Water Quality Guidelines for Fresh and Marine Waters*. National Water Quality Management Strategy.

Australian and New Zealand Governments and Australian State and Territory Governments (ANZG) (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Available at http://www.waterquality.gov.au/anz-guidelines (accessed 2022).

Friebel E and Nadebaum P (2011) *Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater*. CRC CARE Technical Report no. 10, September 2011, CRC for Contamination Assessment and Remediation of the Environment, Adelaide, Australia.

HEPA (2020) *PFAS National Environmental Management Plan*, Version 2.0, January 2020, Heads of EPAs Australia and New Zealand.

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National Health and Medical Research Council (NHMRC) (2008) *Guidelines for Managing Risks in Recreational Water*.

National Health and Medical Research Council and Natural Resource Management Ministerial Council (NHMRC/NRMMC) (2022) *National Water Quality Management Strategy. Australian Drinking Water Guidelines 6*. Version 3.8 Updated September 2022 (ADWG).

EPA Victoria Publications and Industrial Waste Resource Guidelines

EPA Publication 668. *Hydrogeological assessments (groundwater quality) Guidelines*, September 2006.

EPA Publication 669.1, *Groundwater Sampling Guidelines*. February 2022.

EPA Publication 865.13, *Environmental Auditor Guidelines for Appointment and Conduct*, March 2022.

EPA Publication 1828.2, *Waste Disposal Categories – Characteristics and Thresholds*, March 2021.

EPA Victoria Publication 1915, *Contaminated Land Policy*, February 2021.

EPA Victoria Publication 2001, *Guidance for the Cleanup and Management of Contaminated Groundwater*, July 2021.

EPA Victoria Publication 2022, *Environmental Auditor Guidelines – Provision of Statements and Reports for Environmental Audits and Preliminary Risk Screen Assessments*, August 2021.

EPA Publication 2041, *Guidelines for Conducting Environmental Audits*, February 2022.

IWRG (Industrial Waste Resource Guidelines) 701. *Sampling and analysis of waters, wastewaters, soils and wastes*, 30 June 2009.

Standards

AS 2159-2009 – Standards Australia (2009) Australian Standard. Piling – Design and installation (AS 2159-2009, incorporating Amendment No. 1). (Standards Australia).

AS4482.1-2005 - Standards Australia (2005) *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 1: Non-Volatile and Semi-Volatile Compounds*.

AS4482.2-1999 - Standards Australia (1999) *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile Compounds*.

Other Relevant International Standards

Site-specific Technical Reports

Agon Environmental (2022), *Preliminary Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT*, 2 September 2022.

EcOz (2015), *Muirhead North: Stage 1 Preliminary Site Investigation*, 25 June 2015.

Agon Environmental (2022), *Detailed Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT*, 25 October 2022.

Figures

Figure 1: Site Location Plan

Project : Detailed Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT.			Coordinate System: GDA_1994_MGA_Zone_52	
Figure 01: Site Location	Date: 30.09.2022	Job Number : JC1151	Author: Sam.K	Checked: Chris.G.

Figure 2: Lot Plan

704000 705000 706000 707000 708000

8636000 8635000 8634000

N

Beagle Gulf

Shoal Bay

Lee Point Beach

Buffalo Creek and Creek management Area

Sandy Creek

Lee Point Village Resort

Casuarina Beach

Former 2CRU Transmission Facility Compound

Leanyer Swamp

BUFFALO CREEK ROAD

LEE POINT ROAD

ALDENHAM ROAD

BURNETT ROAD

9458 8700 9375 9239 9461 9312 9370 4873 9370 4224 9731

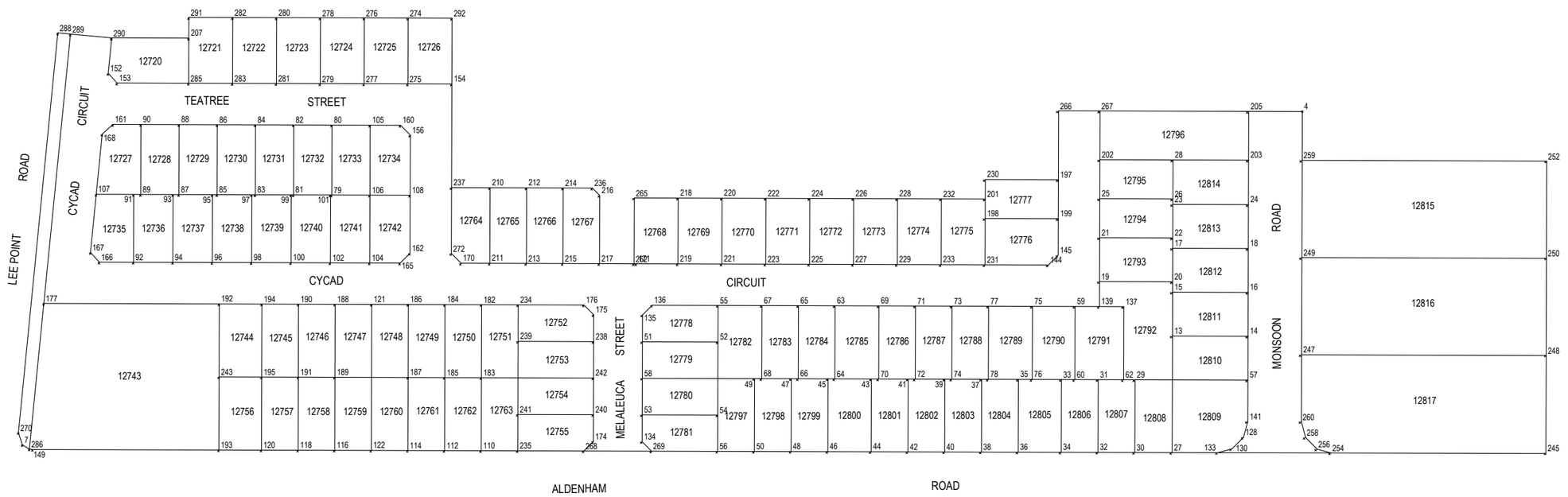
SCALE (@A3) : 1:12,000

0 0.25 0.5 1 Kilometers

Project : Detailed Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT.			Coordinate System: GDA_1994_MGA_Zone_52	
Figure 04: Surrounding Site Features (1)	Date: 03.10.2022	Job Number : JC1151	Author: Sam.K	Checked: Chris.G.

agon ENVIRONMENTAL

Figure 3: Site Survey Plan



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2	706134.270	8634037.690	39	705987.661	8633947.861	76	706023.501	8633947.754	113	705767.427	8633948.569	150	705839.520	8633918.412	187	705767.427	8633948.569	225	705932.142	8633995.027	262	705860.142	8633995.242
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10	706146.114	8633917.600	47	705924.641	8633948.049	84	705704.802	8634052.243	121	705752.492	8633978.564	158	705641.872	8634048.450	195	705707.327	8633948.749	233	705986.141	8633994.865	272	705785.154	8633999.466
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15	706081.108	8633983.582	52	705894.546	8633963.139	89	705657.676	8634023.684	126	706111.949	8633930.489	163	705764.142	8633995.529	200	705860.223	8634022.242	238	705843.546	8633963.292	277	705749.362	8634069.110
16	706112.108	8633983.489	53	705863.457	8633933.232	90	705657.762	8634052.384	127	706105.416	8633919.250	164	705640.672	8633995.898	201	706004.222	8634021.812	239	705812.546	8633963.384	278	705731.443	8634096.164
17	706081.162	8634001.581	54	705894.456	8633933.139	91	705654.796	8634023.693	128	706110.188	8633923.994	165	705764.142	8633995.529	202	706051.270	8634037.939	240	705843.457	8633933.292	279	705731.362	8634069.164
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31	706050.596	8633947.673	68	705912.501	8633948.085	105	705751.841	8634052.103	142	706030.141	8633994.734	179	706112.270	8634037.757	217	705845.942	8633995.285	254	706146.114	8633917.600			
32	706050.506	8633917.853	69	705960.591	8633977.942	106	705751.756	8634023.403	143	705861.142	8633995.239	180	706051.330	8634057.939	218	705878.222	8634022.188	255	706135.672	8633923.918			
33	706035.501	8633947.718	70	705960.501	8633947.942	107	705639.426	8634023.739	144	706030.141	8633994.734	181	706051.270	8634037.939	219	705878.142	8633995.188	256	706140.416	8633919.146			
34	706035.411	8633917.893	71	705975.591	8633977.897	108	705768.225	8634023.354	145	706034.153	8633998.722	182	705797.566	8633978.429	220	705896.222	8634022.134	257	706133.949	8633930.423			
35	706017.831	8633947.771	72	705975.501	8633947.897	109	705797.477	8633948.479	146	706034.246	8634029.722	183	705797.477	8633948.479	221	705896.142	8633995.135	258	706135.672	8633923.918			
36	706017.741	8633917.940	73	705990.590	8633977.852	110	705797.387	8633918.523	147	705843.424	8633922.292	184	705782.541	8633978.474	222	705914.222	8634022.081	259	706134.270	8634037.690			
37	706002.746	8633947.816	74	705990.501	8633947.852	111	705782.452	8633948.524	148	705839.520	8633918.412	185	705782.452	8633948.524	223	705914.142	8633995.081	260	706133.949	8633930.423			

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MUIRHEAD NORTH
LOT 9370, TOWN OF NIGHTCLIFF

LOT 1A BOUNDARY COORDINATES

Client: **DEFENCE HOUSING AUSTRALIA**

DHA Defence Housing Australia

Scale: 1:2000 (A3)
Datum:

Drawn by: SH
Date: 4/11/2022
Cad File: 11060-9.DWG

Drawing No: **22/11060/9**

Figure 4: Development Plan

NOTES

(1) This plan was prepared for the purpose and exclusive use of DEFENCE HOUSING AUSTRALIA as an Investigation into the Development Potential of the land described in the plan and is not to be used for any other purpose or by any other person or corporation. JFP URBAN CONSULTANTS PTY LTD accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this plan in contravention to the terms of this clause or clauses 2, 3, 4, 5, 6 or 7 hereof.

(2) The contours on this plan are approximate and are suitable only for the purpose of this application. The accuracy of the contours has not been verified and no reliance should be placed upon such contours for any purpose other than for the purpose of this application.

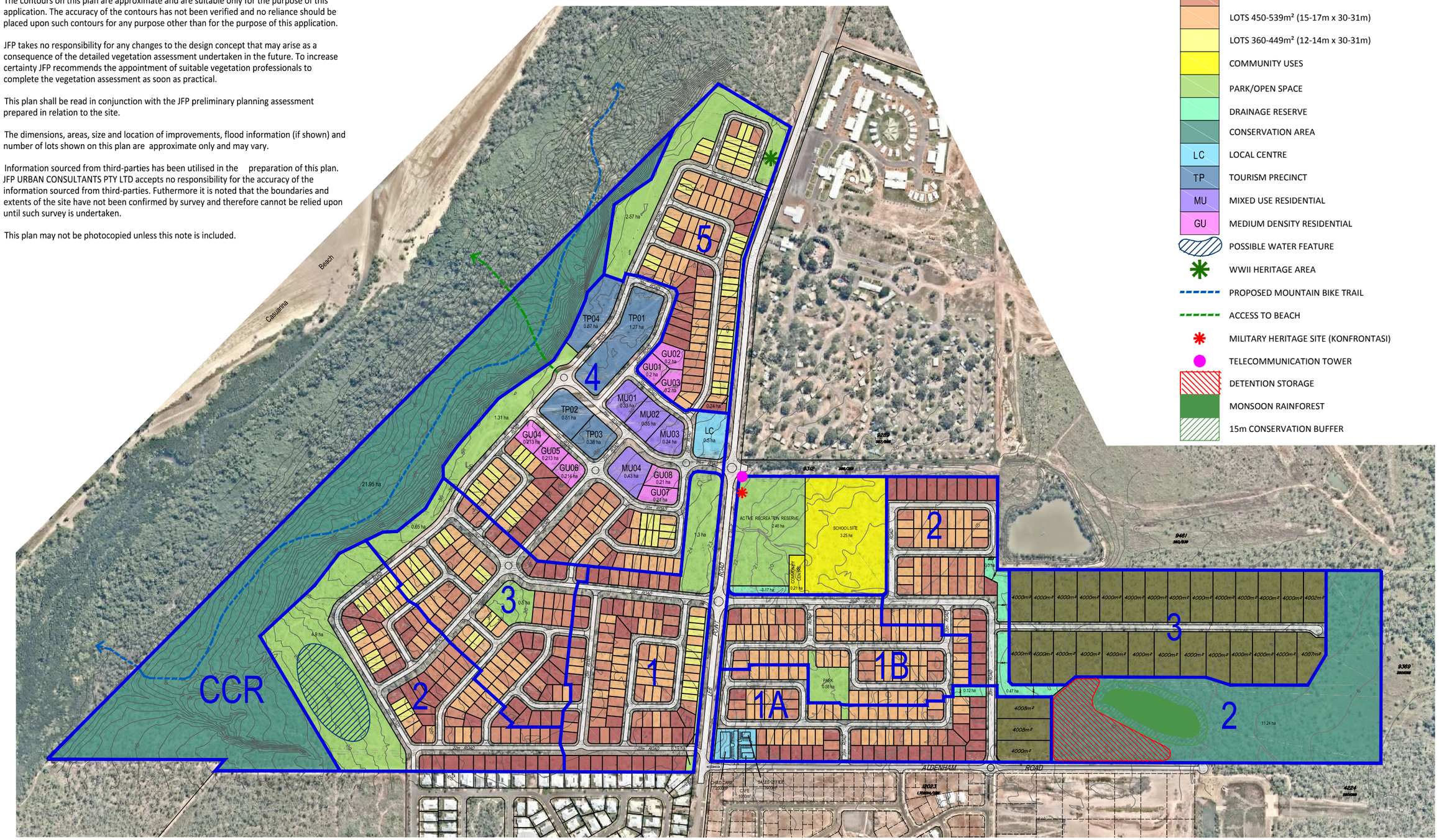
(3) JFP takes no responsibility for any changes to the design concept that may arise as a consequence of the detailed vegetation assessment undertaken in the future. To increase certainty JFP recommends the appointment of suitable vegetation professionals to complete the vegetation assessment as soon as practical.

(4) This plan shall be read in conjunction with the JFP preliminary planning assessment prepared in relation to the site.

(5) The dimensions, areas, size and location of improvements, flood information (if shown) and number of lots shown on this plan are approximate only and may vary.

(6) Information sourced from third-parties has been utilised in the preparation of this plan. JFP URBAN CONSULTANTS PTY LTD accepts no responsibility for the accuracy of the information sourced from third-parties. Futhermore it is noted that the boundaries and extents of the site have not been confirmed by survey and therefore cannot be relied upon until such survey is undertaken.

(7) This plan may not be photocopied unless this note is included.



LEGEND

- STAGING
- LOTS 4000m² & larger (45m frontage min.)
- LOTS 600-750m² (20m x 30-31m)
- LOTS 540-599m² (18-19m x 30-31m)
- LOTS 450-539m² (15-17m x 30-31m)
- LOTS 360-449m² (12-14m x 30-31m)
- COMMUNITY USES
- PARK/OPEN SPACE
- DRAINAGE RESERVE
- CONSERVATION AREA
- LC LOCAL CENTRE
- TP TOURISM PRECINCT
- MU MIXED USE RESIDENTIAL
- GU MEDIUM DENSITY RESIDENTIAL
- POSSIBLE WATER FEATURE
- WWII HERITAGE AREA
- PROPOSED MOUNTAIN BIKE TRAIL
- ACCESS TO BEACH
- MILITARY HERITAGE SITE (KONFRONTASI)
- TELECOMMUNICATION TOWER
- DETENTION STORAGE
- MONSOON RAINFOREST
- 15m CONSERVATION BUFFER

PLANNERS
URBAN DESIGNERS
SURVEYORS
ENGINEERS
LANDSCAPE ARCHITECTS

OVERALL CONCEPT PLAN C

LEE POINT ROAD, LEE POINT, DARWIN
DEFENCE HOUSING AUSTRALIA

JOB NUMBER: M2737P_Overall Concept C
ISSUE: C
NORTH:
SCALE: 1:7000 @ A3
DATE: 16th October 2018

STATISTICS	STAGE 1A	STAGE 1B	STAGE 2	STAGE 3	BALANCE	TOTAL
NO. OF LOTS						
4000m² & larger	3	0	0	27	0	30 (11%)
600-800m² & larger	3	1	39	0	0	43 (16%)
540-599m²	13	17	6	0	0	36 (13%)
450-539m²	77	67	19	0	0	163 (59%)
Commercial	1	0	0	0	0	1 (1%)
TOTAL	97	85	64	27	0	273 (100%)
LENGTH OF NEW						
17m ROAD	750m	750m	495m	580m	0	2575m
20m ROAD	60m	75m	195m	0	0	330m
22m ROAD	140m	0	165m	0	0	305m
25m ROAD	0	285m	210m	0	0	495m
TOTAL	950m	1110m	1065m	580m	0	3705m
SCHOOL SITE AREA	0	0	0	0	3.25ha	3.25ha
COMMUNITY CENTRE AREA	0	0	0	0	0.21ha	0.21ha
ACTIVE RECREATION RESERVE AREA	0	0	0	0	2.47ha	2.47ha
DRAINAGE RESERVE AREA	0.12ha	0	3.65ha	0	0.17ha	3.94ha
PARK AREA	0.04ha	0.54ha	0	0	0	0.58ha
CONSERVATION	0	0	8.24ha	0	0	8.24ha
STAGE AREA	8.17ha	6.89ha	18.13ha	11.87ha	6.11ha	51.17ha

Note: Average residential lot size is 529m²; Average rural lot size is 4020m²

Note: The endorsed plan relates to STAGE 1A only

PROPERTY DESCRIPTION
LOT 9370 ON S901068
TOTAL AREA 51.17 ha

LEGEND
- STAGING
- MONSOON RAINFOREST (0.88 ha)
- 25m CONSERVATION BUFFER (1.26 ha)
- BITING INSECT BUFFER

NOTES

(1) This plan was prepared for the purpose and exclusive use of DEFENCE HOUSING AUSTRALIA to accompany an application to the DEVELOPMENT CONSENT AUTHORITY for approval to subdivide the land described in the plan and is not to be used for any other purpose or by any other person or corporation.
JFP URBAN CONSULTANTS PTY LTD accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this plan in contravention to the terms of this clause or clauses 2, 3 or 4 hereof.

(2) The contours on this plan are approximate and are suitable only for the purpose of this application. The accuracy of the contours has not been verified and no reliance should be placed upon such contours for any purpose other than for the purpose of this application.

(3) The dimensions, areas, size and location of improvements, flood information (if shown) and number of lots shown on this plan are approximate only and may vary.

(4) This plan may not be photocopied unless this note is included.

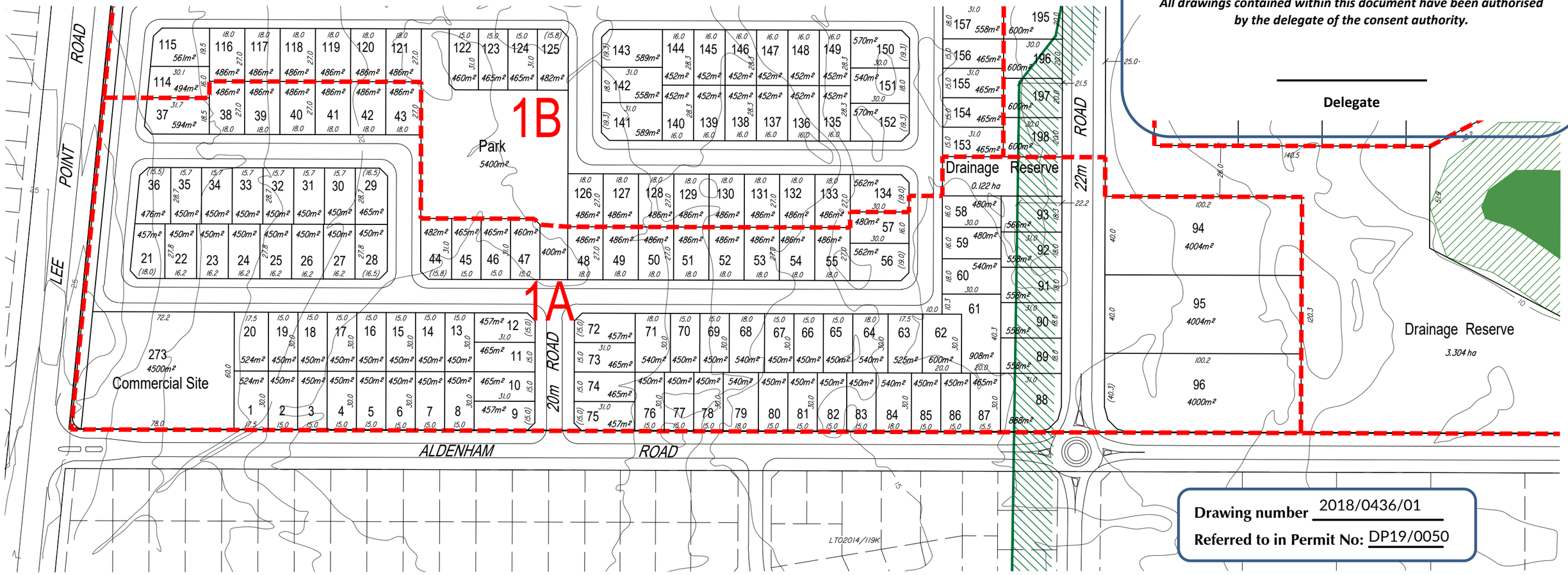
This document contains drawing numbers:
2018/0436/01

Referred to in Permit No: DP19/0050

Issued by the consent authority on: 27 February 2019

All drawings contained within this document have been authorised by the delegate of the consent authority.

Delegate



Drawing number 2018/0436/01

Referred to in Permit No: DP19/0050

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PLANNERS
URBAN DESIGNERS
SURVEYORS
ENGINEERS
LANDSCAPE ARCHITECTS

NORTH: N

SCALE: SCALE: @ A3 1:2000
0 20 40 60 80 100 120 140
THIS SCALE SHOWN IS ORIGINAL DRAWING SCALE - (A3 SIZE)
DO NOT SCALE FROM THIS DRAWING - USE ONLY DIMENSIONS PROVIDED - IF IN DOUBT PLEASE ENQUIRE

DESIGNED	TJM	CHECKED	AD	L.A. DARWIN CITY COUNCIL
DRAWN	RK	APPROVED	GB	COUNCIL REF

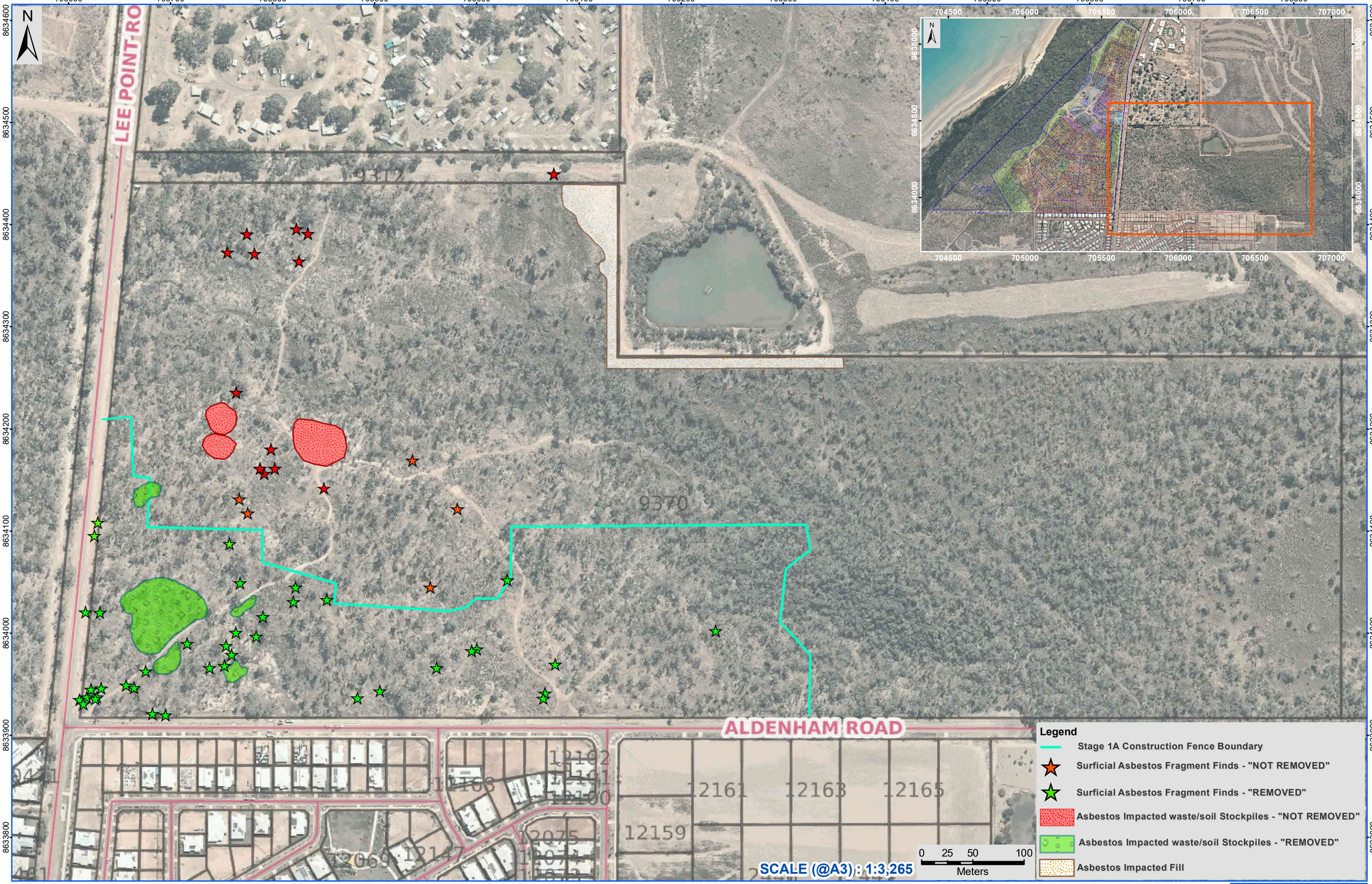
ISSUES:

ISSUE:	DETAILS:	DATE:	INIT:
L	LAYOUT AMENDED	22-04-21	TJM
K	STAGE 1A LAYOUT AMENDED	25-03-21	TJM
J	STAGE 1A LAYOUT AMENDED	01-02-21	TJM
H	CONSERVATION BUFFER UPDATED	03-11-20	TJM
G	LAYOUT AMENDED	19-10-20	TJM
F	STAGES 1A & 3 AMENDED	09-09-20	TJM
A	ORIGINAL	17-05-18	RK

TITLE:
PROPOSAL PLAN STAGES 1-3
DEFENCE HOUSING AUSTRALIA
LEE POINT ROAD, LEE POINT - DARWIN

DETAILS:
PROJECT: M2737P MN_DA2 R1 L
SHEET: 2 OF 4
FILE: M2737P MN_DA2 R1L.dwg
DATE: 22nd April 2021

Figure 5: Former Location of Uncontrolled Waste and Asbestos



Project : Preliminary Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT.			Coordinate System: GDA_1994_MGA_Zone_52	
Figure 07: Known Areas of Environmental Concern.	Date: 01.09.2022	Job Number : JC1146	Author: Sam.K	Checked: Chris.G.

agon ENVIRONMENTAL

Figure 6: Surface Waters

706000 706500 707000

8634500 8634200 8633900

N

Communications Tower

Stormwater Drainage onto site from culverts

Lot 9312

Power and Water sewer pump station compund

Historical machine gun emplacement

Historical machine gun emplacement

LEE POINT ROAD

ALDENHAM ROAD

SAUNDERS STREET

BRIDGE STREET

9461 9312 4873 9370

12160 12161 12162 12163 12164 12165 12166 12159 11931 11932 12446 12445 12444 12443 12167 11929 11930 12450 12449 12448 12447 12651

Legend

- Stage 1A Site Boundary
- Lot Boundaries
- Creekline

0 25 50 100 150 200 Meters

SCALE (@A3) : 1:3,750

Project : Detailed Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT.			Coordinate System: GDA_1994_MGA_Zone_52	
Figure 05: Surrounding Site Features (2)	Date: 20.10.2022	Job Number : JC1151	Author: Sam.K	Checked: Chris.G.

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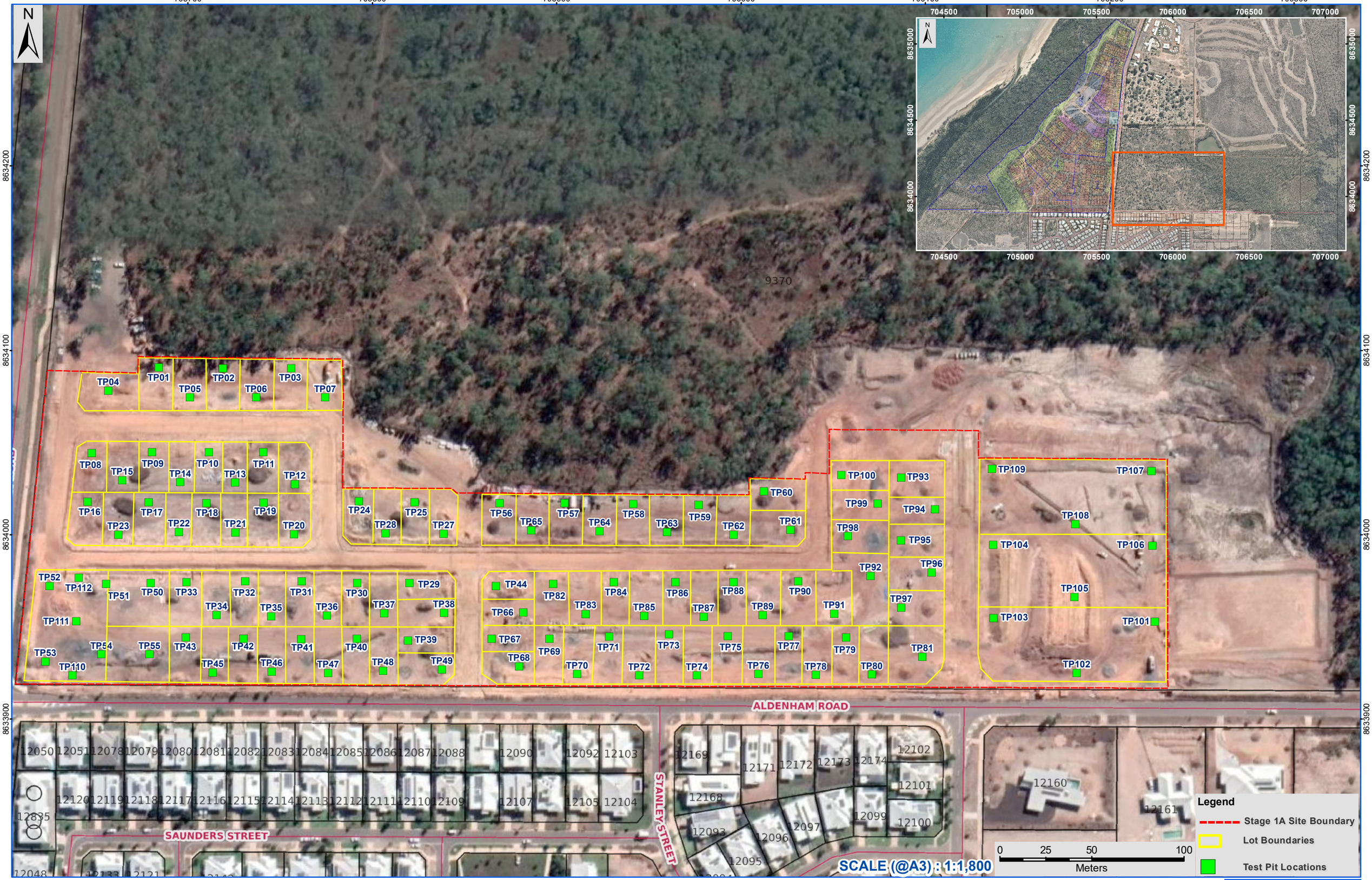
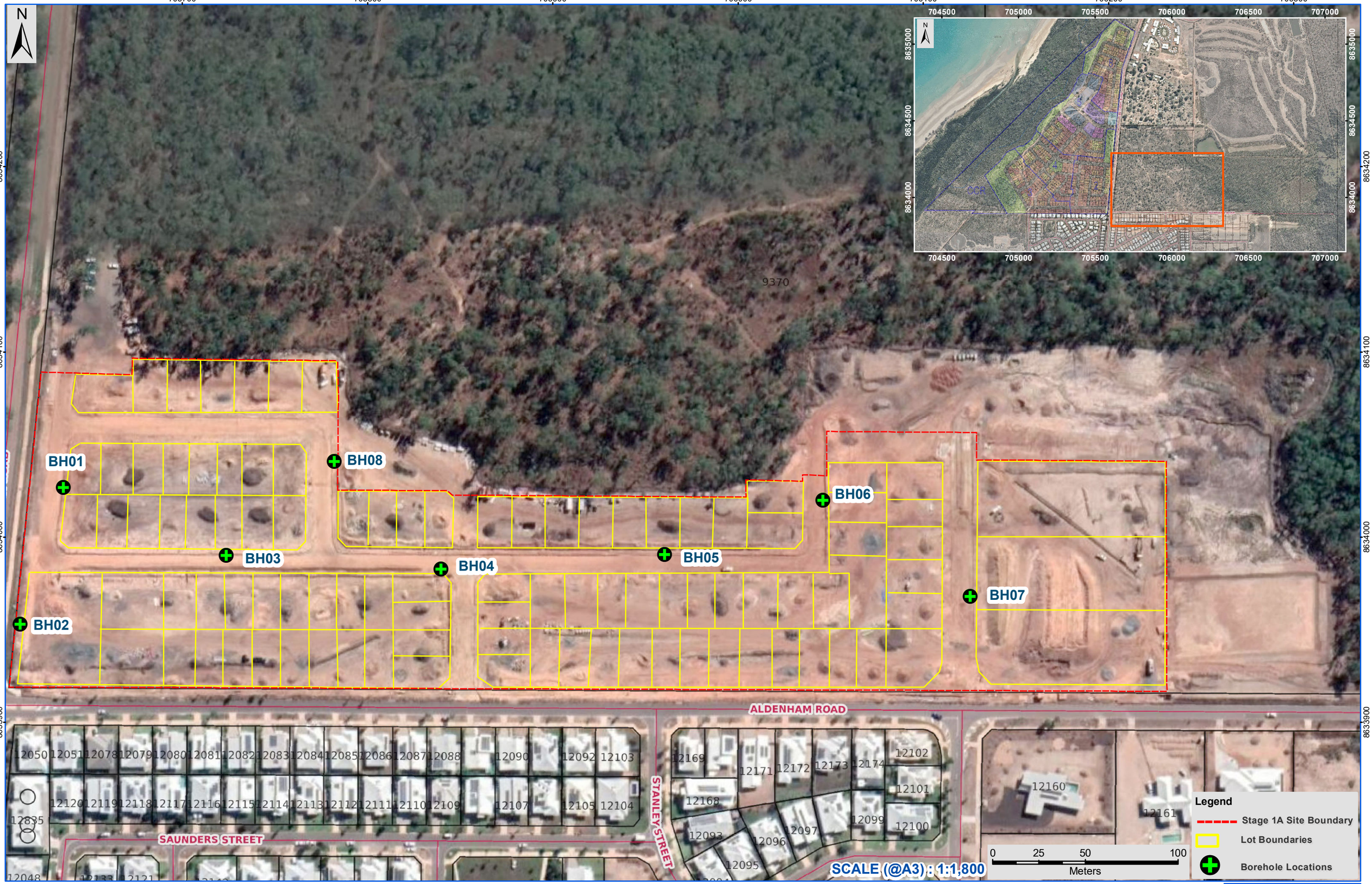
Figure 7: Soil and Groundwater Sampling Locations



Project : Detailed Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT.			Coordinate System: GDA_1994_MGA_Zone_52	
Figure 11: Soil Test Pit Locations	Date: 26.09.2022	Job Number : JC1151	Author: Sam.K	Checked: Chris.G.



Project : Detailed Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT.			Coordinate System: GDA_1994_MGA_Zone_52	
Figure 12: Soil Bore Locations	Date: 30.09.2022	Job Number : JC1151	Author: Sam.K	Checked: Chris.G.

Project : Detailed Site Investigation, Muirhead North Stage 1A – Portion of Lot 9370, Lee Point NT.			Coordinate System: GDA_1994_MGA_Zone_52	
Figure 13: Groundwater Monitoring Well Locations	Date: 26.09.2022	Job Number : JC1151	Author: Sam.K	Checked: Chris.G.

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Appendices

(Refer to digital file: NTEPA2017/0102-030_b)

Appendix A: Certificate of Title

Appendix B: Consultant's Reports

Appendix C: Planning Property Report

Appendix D: Auditor's Review of Quality Assurance/Quality Control

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