Soil Contamination Report (SEPP 55)
Rezoning for Residential Subdivision
Moama NSW

"Pinterry"
312 Perricoota Road, Moama NSW
(A & L Pitman)

October 2016

ADVANCED ENVIRONMENTAL SYSTEMS
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TABLE OF CONTENTS

Executive Summary

State Environmental Planning Policy No.55: Remediation of Land (SEPP 55) requires consent authorities to consider contaminated sites matters when rezoning land or assessing development applications. In this instance an application is to be submitted to Murray River Council for the land to be rezoned from Primary Production (RU1) to Residential land use.

The preliminary site assessment provides information in relation to soil sampling and analysis conducted at "Pinterry" 312 Perricoota Road (Lot 11, DP285511), Moama (~7.45 ha). Sampling was aimed at identifying the potential contaminants and areas in which they were used or disposed of.

The soil contamination assessment is principally based on concerns relating to contaminants from past and current agricultural practices, in particular herbicide and pesticide usage. This report outlines the limitations of the investigation and assessment, lists the presence and in particular, the concentrations of any contaminants and specifies further actions that may be required. This involves a precautionary action in the vineyard area requiring the cultivation of topsoil that should be conducted using a rotary hoe.

The use of agricultural sprays (herbicides and pesticides) does not appear to have contributed to any measurable site contamination. Very slightly elevated levels of copper, chrome and arsenic were found close to pine posts but they are under the National Environment Protection Measure (NEPM 2013) Health Investigation Levels within the vineyard area of Lot 11, DP285511.

The measured levels of metals in the soil should not preclude the consideration of the site for residential land use.

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Rezoning for Residential Subdivision

Moama NSW

1. Introduction

Background

Advanced Environmental Systems was requested to undertake site assessment, soil testing and screening for potential chemical contamination at "Pinterry", Moama, NSW (Figure 1). Specifically, this report provides an assessment of the results of the investigation in relation to potential land contamination on the future subdivision lots.

State Environmental Planning Policy No.55: Remediation of Land (SEPP 55) requires consent authorities to consider contaminated site matters when rezoning land or assessing development applications. In this instance an application is to be submitted to Murray River Council for the land to be rezoned from Primary Production (RU1) to Residential land use with lots of ~750 m^2. The lot assessed in this study is Lot 11 DP285511 (~7.45 ha, Figure 3).

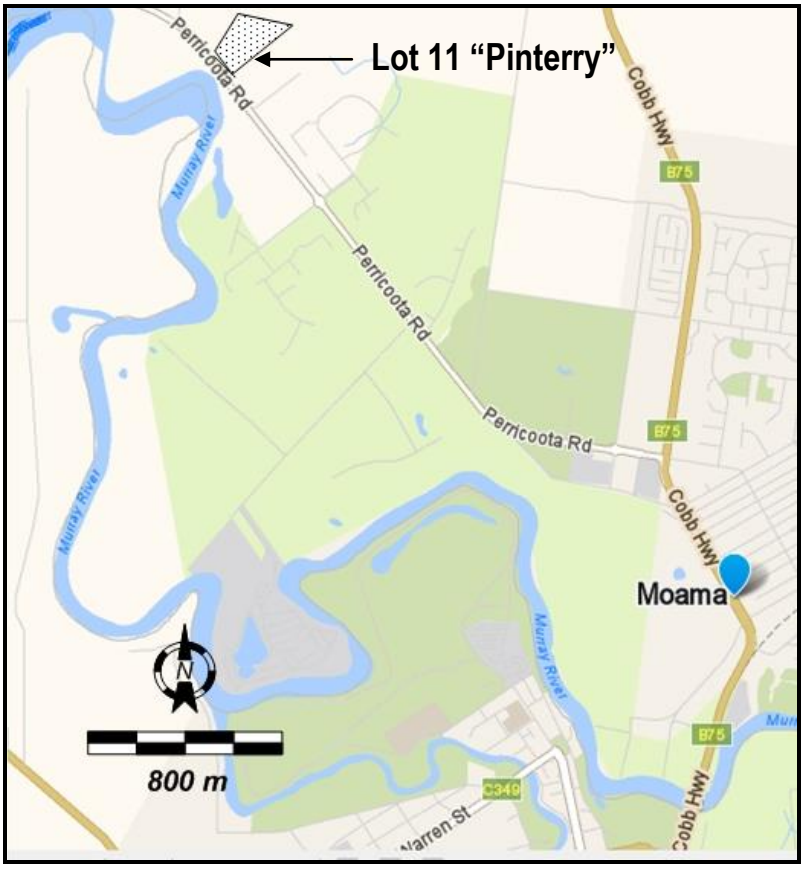


Figure 1. Location of the subdivision and study area

In considering planning applications for the use of land, known to have been used for agriculture, industry, mining or the storage of chemicals, gas, wastes and liquid fuel, responsible authorities require applicants to provide adequate information on the potential for contamination. The current arrangements stipulated in the planning guidelines provide an effective framework for responding to contamination of sites, where they are identified.

The purpose of the investigation is to identify potential contamination and limit future exposure to harmful contaminants in the course of redevelopment and future use of the land. The report follows the requirements of the Office of Environment and Heritage (OE&H - which includes the Environment Protection Authority - EPA) for a preliminary site investigation.

In this case the future intended use is residential housing. The National Environment Protection Measure (NEPM) Guidelines (2013, Appendix 2) indicate that residential land use is the "most sensitive" of land use categories in terms of Health Based Investigation Levels (HILs).

Before deciding on a Planning Permit application Council must also consider any significant effects which the existing and future use may have on the environment.

The preliminary site assessment provides information in relation to soil sampling and analysis. Depending on the results of the site assessment, Council decides if a detailed contaminated site investigation is required (Figure 2).

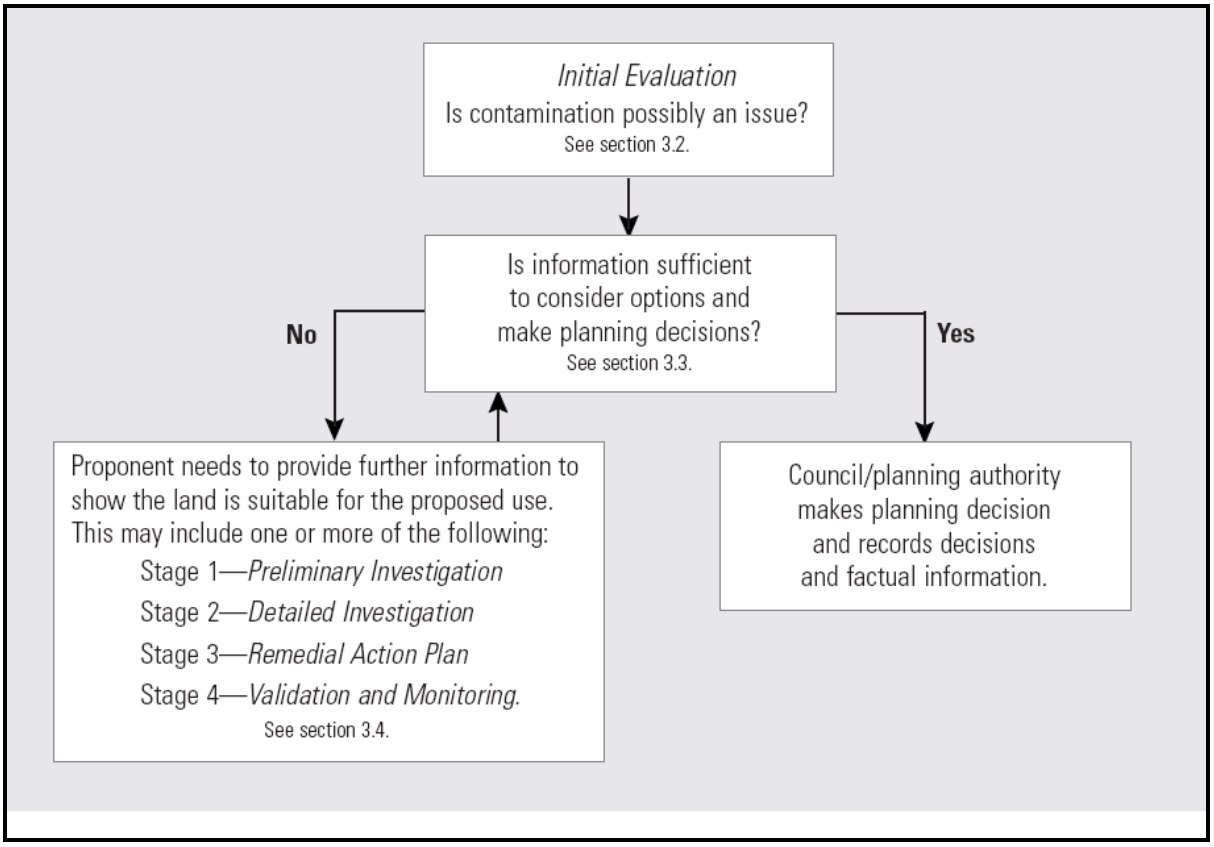


Figure 2. Decision process for land use rezoning

Site identification

The site is located at 312 (Lot 11, DP285511) Perricoota Road, Moama, NSW (Figure 1 and 3).

Figure 3. SEPP 55 Investigation study area and sample sites

2. Site Information

2.1 Site History and Land Use

Following clearing, which occurred in the 1870-1880's, the land was used for dryland grazing and cropping. Irrigation development first occurred in the area around 1911 and developed extensively from thereon, with a second wave of irrigation development around the 1950s.

Since irrigation development, the study area has been used for beef and hay production up until the 1990s when

it was developed for viticulture. The site is zoned for Primary Production (RU1) and is used for irrigated horticulture, specifically grape production. There are no dams evident that may have been used for refuse or waste disposal. A small pump shed is located on the north side of the property.

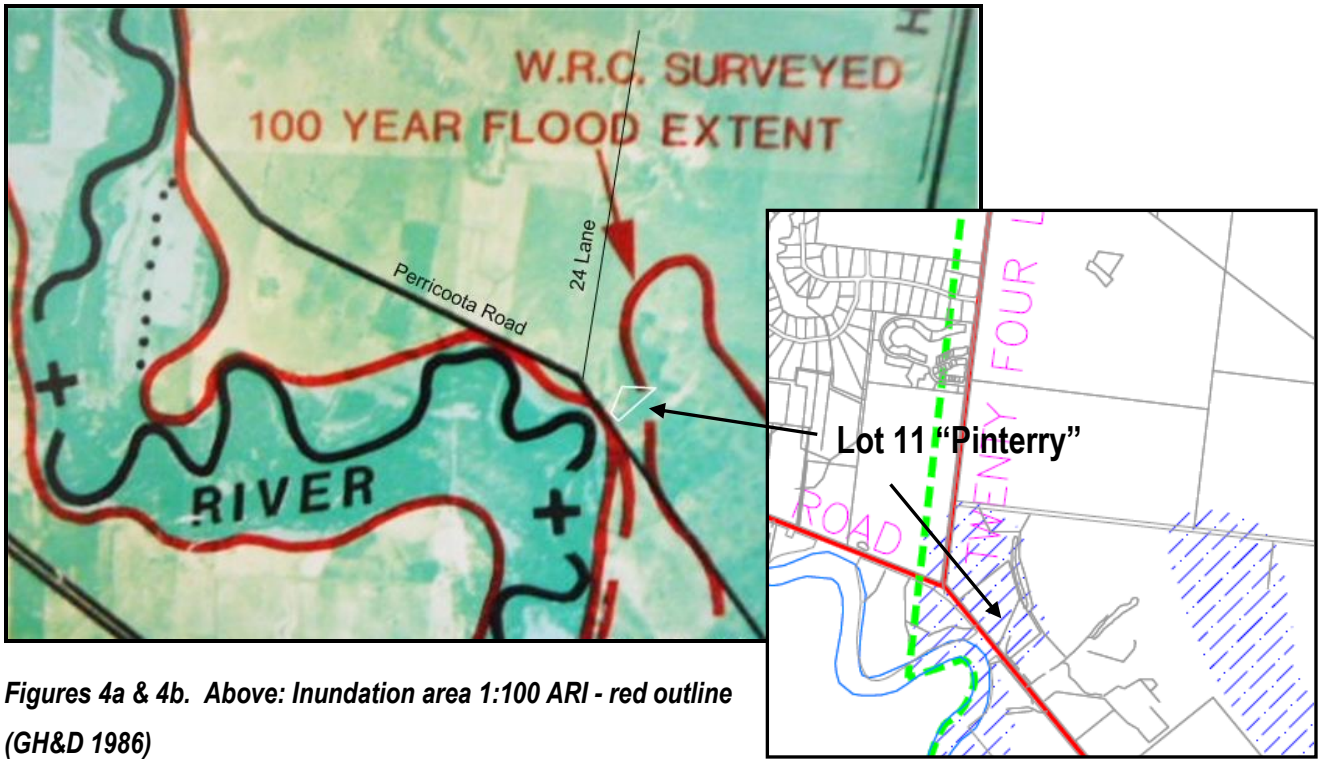
2.2 Site environmental features

The land forms part of the Riverina alluvial plains and is adjacent to the Murray River. The topography (Figure 5) is flat to gently sloping (0-2%) which is consistent with the general locality.

Where there is grass cover the surface soil has moderate infiltration characteristics, but can be prone to dispersion and surface sealing where vegetation is bared off and the surface is exposed to the elements. Surface sealing increases runoff and the potential for the spread of any soil contaminants.

Drainage of the subject site and surrounding areas links to the Murray River. When runoff does occur, some dispersed clays may be present in the water.

The block has a minor drainage depression along its northern boundary and this area is subject to flooding in flash floods and 1:100 year average recurrence interval (ARI) flood events (GHD 1986). The remaining southern portion of the block may be subject to flooding in the case of a probable maximum flood (PMF) event (Murray Shire SLUP 2010, Figures 4a & 4b).



Figures 4a & 4b. Above: Inundation area 1:100 ARI - red outline (GH&D 1986)
Right: Probable maximum flood extent - Blue hatching (SLUP 2010)

Local water table depths are at 8-10 m. Within the aquifer system water quality varies, but is generally saline (E.C. >10,000 US/cm) with the regional sub-surface flows to the north-west.

Local habitat areas include the Murray River corridor which comprises several Ecological Vegetation Classes (EVC's), including Grey box woodland.

2.3 Soil type and description

In more recent classifications (McKenzie *et. al.* 2004) the soils are classified as Hypocalcic Red Sodosols (Figure 4), previously known as a Red Brown Earth. This is a common soil type on the prior stream levees of the flat Riverine Plain of New South Wales with clay loam topsoils and mottled brown clay subsoils. The soil is characterised by a brown clay-loam topsoil (0-10 cm) of massive structure. The subsoil (10 cm+) is red-brown angular blocky medium clay.

Figure 5. Hypocalcic red sodosol

2.4 Site Observations

The soil contamination assessment is principally based on concerns relating to contaminants from past and current agricultural practices, in particular herbicide and pesticide usage. In conducting the assessment, the risk of contamination from other hazardous site activities and associated substances is considered (e.g. Oil leakage from power transformers, asbestos in buildings). In this instance the greatest potential hazards are from past fertiliser use (DDT and Dieldrin) and residue of heavy metals, such as copper ,chrome, arsenate (CCA) derived from treated pine posts in the vine lines (Figure 5).

Figure 6. Site overview, Lot 11

Degradation of vegetation and loss of canopy cover has been observed in some local tree species in the area over the past 10 years. Weeds and grasses previously covered most of the ground on the site with 90 per cent coverage during winter and 65 per cent coverage during summer thus minimising the risk of erosion and reducing the potential for runoff.

Garden area on southern end of Lot 11

3. Soil Testing

3.1 Sampling Methodology

Soil sampling was conducted within the 7.45 ha of the subject land on 22nd September 2016. Sampling was generally conducted as indicated by the National Environmental Protection Measure (2013), Schedule B (5a) Guideline on Data Collection. Materials and despatch procedures are outlined in Appendix 3. Within Lot 11 sixty soil samples were collected from the surface horizon (0-100 mm) and bulked to make up six samples for full contaminant screening and analysis. Sampling was randomly distributed in the garden area and transects established in the vineyard to ascertain the impact of past and current agricultural activities (Figure 3). Treatment areas considered included:

- Home garden area;
- Mixed sampling within vine rows (Rows 24/25 and 42/43);
- Spot sampling within the herbicide spray line (Row 99);
- Spot sampling in the grassed inter-row area (Row 84/85);
- Sampling immediately adjacent to CCA treated pine posts (Row 61 – Metals only).

Each transect or sub-sample location was referenced and recorded using a GPS system. In order to compare samples with local background levels, a control sample was collected from the river reserve near the vineyards.

Other local control samples also formed a data base for comparison with the soils sample results from Lot 11.

Sampling depth was limited to the surface horizon, since if there is contamination, it will most likely be concentrated at the point of pesticide application or chemical contamination. Sampling at levels deeper than 100 mm was not conducted, because the purpose of the preliminary assessment was to determine the presence or absence of contaminants, not the extent of their distribution. Establishing the extent of any contaminant, including depth, is generally part of a second detailed assessment.

It should be noted that although all care has been taken during site observation and sampling, there is the potential for 'hotspots' to remain undiscovered. Where a preliminary investigation indicates that soil contaminants are present, a detailed site investigation may be sought by the planning authority.

3.2 Analysis and Assessment Plan

The National Environmental Protection Measure (2013 Assessment of Site Contamination) was the key reference document for this report. The assessment criteria of results followed Health-based Investigation Levels (HILs) and Ecological-based Investigation Levels (EILs). Health-based guidelines have been established by NEPM (2013) for a range of land uses including the proposed future use, which is residential housing (Appendix 2).

All samples were forwarded to ALS Labotratories, a NATA certified laboratory. A range of contaminants were investigated including heavy metals, agricultural chemical residues, organochlorines, carbamates, organophosphates and hydrocarbons.

Representative samples will indicate if contaminants are still present from pesticide application in any land use. For example, under a previous pasture regime, DDT or Lindane could have been used and would show up in any set of samples. Based on previous land use for pasture, the soils were analysed for Organochlorine pesticides, such as Dieldrin, the by-product of pesticide Aldrin. Despite the fact that it has not been used in agriculture since 1992, residues can remain.

3.3 Results

Organochlorine and derivatives of other pesticide groups were not at detectable levels (Appendix 1) in any of the soil samples submitted to the laboratory. Furthermore, the analyses did not reveal any agricultural pesticide or herbicide contaminants in concentrations exceeding either HILs or EIL's.

Sampling was also conducted for metal contaminants detailed in Table 1, as well as Appendix 1. Arsenic, copper and chromium levels were slightly elevated in the samples close to treated pine posts within Lot 11(Results - Appendix 1), compared to control site and other areas examined, but all parameters were under the specified HILs, although arsenic, copper and chromium were slightly above the EIL minimum. However, they are within what is considered to be the background range for a wide range of soils.

Chromium levels do come closer to the HIL guideline figure of 100 ppm. Soil disturbance and leaching following removal of the vineyards posts will reduce the chromium levels to below what they currently are. In the case of nickel, the EIL is exceeded; however, it appears to be within the natural variation for nickel levels in the area and does not pose a hazard to human health. It must be noted that these results are from composite sub-samples and some small areas of soil close to the posts may record levels above the HIL and EIL guideline (NEPM 2013).

Table 1. Summary of results of potential contaminant concentration (Highlighted figures indicate parameter levels outside local range or EIL guideline, but within the HIL guideline. Detailed results –refer Appendix 1.)

Parameter Heavy metals - Trace elements	**Gulval Road Control**	**Merool Lane Control**	**P'coota Road Control**	**Lot 11**	**HIL - Health based soil guideline**	**EIL - Ecological-based soil guideline-Fresh – Aged contaminant**	**General background ranges**
Arsenic	3.5	4.4	24	36	100	20-40	1-50
Cadmium	< 0.5	< 0.5	< 0.4	< 0.4	0.3	Not specified	<1
Chromium (VI)	17	19	31	74	100 (Cr VI)	25-130 (Cr III)	5-1000
Copper	8.9	15	35	95	6,000	30-120	2-100
Lead	8	15	5.8	18	300	270	2-200
Mercury	< 0.1	< 0.1	< 0.1	< 0.1	<0.05	10	0.03
Molybdenum	< 10	< 10	< 5	< 5	3,800	Not specified	Not specified
Nickel	11	12	17	16	400	10-170	5-500
Selenium	< 2	< 2	< 2	< 3	200	Not specified	Not specified
Silver	< 5	< 5	< 0.2	< 5	Not specified	Not specified	Not specified
Tin	< 10	< 10	< 10	< 5	Not specified	Not specified	Not specified
Zinc	32	59	43	38	7,400	25-500	10-300

On a broader scale, the assessment and documentation of the extent of any contamination around CCA treated posts located on the property is outside the scope of this preliminary study, but given the results from this site and other nearby sites (AES Unpublished data 2016), it is likely that there is only a very low level contamination around pine posts.

Other potential contaminates, including hydrocarbons, were well below the Limit of Reporting (LOR) and were recorded as a "less than" (<) value (Appendix 1) indicating that there is no cause for concern in relation to these parameters in the area delineated Lot 11 (Figure 3).

4. Discussion

What is a contaminated Site?

A contaminated site is one at which hazardous substances occur at concentrations above background levels and where assessment indicates they may pose or are likely to pose a hazard to health or the environment. In this instance the results of sampling are indicative of some CCA substances (i.e. from. pine posts) having been leached from the posts into the soil profile. However, the concentrations of metals are localised close to the

posts and not at a level where they are likely to qualify the site as contaminated (Morrell and Huffman 2004; AES Unpublished data 2016).

Duty to Report

A landowner or a person whose activities have caused land to be contaminated is required to notify OE&H that the land is contaminated if a substance contaminating the land (a 'contaminant') is present at levels above any of those specified by the guidelines; in particular the Health Investigation Level (HIL) specified for that contaminant for the current or proposed approved use of the land in the National Environment Protection Measure 2013 (Assessment of Site Contamination). Since only nickel exceeds the Ecological Investigation Level (EIL) guideline level at the very lowest of the range and that it appears to be occurring 'naturally' at that level in the local soils (refer Table 1), it is not considered to be a contaminant in this case.

Is Regulation Required?

In some circumstances a site may be contaminated, but OE&H may consider that the contamination is not significant enough to warrant regulation. A site may contain contaminants at levels above the triggers, but in view of the limited exposure pathways available the contamination will not be considered significant enough to warrant regulation.

Where OE&H considers that a contaminated site does not warrant regulation, any contamination issue should be addressed by the proponent and the planning consent authority as part of the development approval process. In this instance the land use is going to be changed, therefore the planning authority may require the site to be remediated to a level suitable for the proposed new use. The apparent limited area of potential contamination would not require Regulation in this case.

Future Directions

Based on the laboratory results, the presence of heavy metals poses a possible, but unlikely, threat to future use of Lot 11 for residential purposes. Even though the parameters of concern are below guideline levels there is still the potential for hotspots to remain undiscovered. A precautionary approach should be adopted.

Given the measured concentration of contaminants, HILs could be exceeded in this instance, on a spot basis. Remediation should involve cultivation with a rotary hoe to a depth of 10 cm in the area of the vineyard. A remedial action Plan (RAP) is not required in this instance.

5. Conclusions and Recommendations

The purpose of this investigation was to ascertain if there are any contaminated soils present on Lot 11. Only nickel exceeded the "guideline" EIL. However, some other heavy metals such as copper, chromium and arsenic were above background levels close to pine posts. Given that some copper, chromium and arsenic levels are elevated, and other metals may be present at high levels (in spots), then as a precaution, cultivation of topsoil (depth 10 cm) should be conducted using a rotary hoe at the vineyard site on Lot 11.

Recommendations

1. Further detailed contaminated site investigations will not be required.
2. A site Remedial Action Plan (RAP) will not be needed since contaminant levels are either close to background and control site levels or below HIL recommended levels.
3. As a precaution soil across the vineyard area should be cultivated with a rotary hoe to a depth of 10cm.
4. The presence of soil with slightly higher levels of some metals in the soil on Lot 11 should not impede the rezoning of the land and associated residential development land use.

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7. Appendices

Appendix 1. Laboratory Results - Control samples

Parameter	Gulval Road Control	Merool Lane Control	Perricoota Road Control
Heavy metals - Trace elements			
Arsenic	3.5	4.4	3.5
Cadmium	< 0.5	< 0.5	< 0.5
Chromium	17	19	17
Copper	8.9	15	8.9
Lead	8	15	8
Mercury	< 0.1	< 0.1	< 0.1
Molybdenum	< 10	< 10	< 10
Nickel	11	12	11
Selenium	< 2	< 2	< 2
Silver	< 5	< 5	< 5
Tin	< 10	< 10	< 10
Zinc	32	59	32

Laboratory Results – Site samples

					Sample No.	4930652	4930653	4930654	4930655	4930656	4930657
					Client Sample ID	Garden	Row 24/25	Row 99 Spreyline	Row 84/85 Interow	Row 61 Pine Posts	Row 42/43
					Sample Date	26/09/16	26/09/16	26/09/16	26/09/16	26/09/16	26/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Phenols(Halo)	2,4-Dichlorophenol	120-83-2	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	2,6-Dichlorophenol	87-65-0	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	Pentachlorophenol	87-86-5	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	2,3,4,5-Tetrachlorophenol	4901-51-3	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	2,3,4,6-Tetrachlorophenol	58-90-2	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	2,3,5,6-Tetrachlorophenol	935-95-5	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	2,4,5-Trichlorophenol	95-95-4	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	2,4,6-Trichlorophenol	88-06-2	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(Halo)	Total Phenols (Halogenated)	64743-03-9(Hal	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Analysis	Analyte	CAS #	LOR								
Phenols(NonHalo)	Phenol	108-95-2	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(NonHalo)	Total Cresols	1319-77-3	<1	mg/kg		<1	<1	<1	<1		<1
Phenols(NonHalo)	2,4-Dimethylphenol	105-67-9	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(NonHalo)	2,4-Dinitrophenol	51-28-5	<30	mg/kg		<30	<30	<30	<30		<30
Phenols(NonHalo)	2-Methyl-4,6-Dinitrophenol	534-52-1	<10	mg/kg		<10	<10	<10	<10		<10
Phenols(NonHalo)	2-Nitrophenol	88-75-5	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(NonHalo)	4-Nitrophenol	100-02-7	<0.5	mg/kg		<0.5	<0.5	<0.5	<0.5		<0.5
Phenols(NonHalo)	2-Cyclohexyl-4,6-Dinitrophenol	131-89-5	<30	mg/kg		<30	<30	<30	<30		<30
Phenols(NonHalo)	Dinoseb	88-85-7	<10	mg/kg		<10	<10	<10	<10		<10
Phenols(NonHalo)	Total Phenols (non Halogenated)	64743-03-9(Non	<30	mg/kg		<30	<30	<30	<30		<30
Analysis	Analyte	CAS #	LOR								
Cyanide	Cyanide, as CN	57-12-5	<5	mg/kg		<5	<5	<5	<5		<5
WAD CN	WAD Cyanide	WAD_CYANIDE	<5	mg/kg		<5	<5	<5	<5		<5
SO4	Sulfate	14808-79-8	<10	mg/kg		<25 LNT	<25 LNT	<25 LNT	<25 LNT		<25 LNT
Total Cr 6+ DA	Hexavalent Chromium (Total) Soil DA	18540-29-9	<1	mg/kg		<1	<1	<1	<1		<1
Analysis	Analyte	CAS #	LOR								
MS Total Metals	Aluminium	7429-90-5	<5	mg/kg						16000	
MS Total Metals	Antimony	7440-36-0	<5	mg/kg						<5	
MS Total Metals	Arsenic	7440-38-2	<5	mg/kg		5	<5	<5	<5	36	<5
MS Total Metals	Barium	7440-39-3	<5	mg/kg		97	100	120	93	130	140
MS Total Metals	Beryllium	7440-41-7	<5	mg/kg		<5	<5	<5	<5	<5	<5
MS Total Metals	Boron	7440-42-8	<10	mg/kg		<10	<10	<10	<10	<10	<10
MS Total Metals	Cadmium	7440-43-9	<0.2	mg/kg		<0.2	0.2	<0.2	<0.2	0.3	0.3

					Sample No.	4930652	4930653	4930654	4930655	4930656	4930657
					Client Sample ID	Garden	Row 24/25	Row 99 Spreyline	Row 84/85 Interow	Row 61 Pine Posts	Row 42/43
					Sample Date	26/09/16	26/09/16	26/09/16	26/09/16	26/09/16	26/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
MS Total Metals	Chromium	7440-47-3	<5	mg/kg		17	26	23	26	74	28
MS Total Metals	Cobalt	7440-48-4	<5	mg/kg		6	9	9	8	11	14
MS Total Metals	Copper	7440-50-8	<5	mg/kg		11	26	25	15	95	17
MS Total Metals	Iron	7439-89-6	<10	mg/kg						20000	
MS Total Metals	Lead	7439-92-1	<5	mg/kg		11	15	14	15	18	19
MS Total Metals	Manganese	7439-96-5	<5	mg/kg		460	670	690	610	920	1400
MS Total Metals	Mercury	7439-97-6	<0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
MS Total Metals	Molybdenum	7439-98-7	<5	mg/kg						<5	
MS Total Metals	Nickel	7440-02-0	<5	mg/kg		10	16	15	16	18	25
MS Total Metals	Selenium	7782-49-2	<3	mg/kg		<3	<3	<3	<3	<3	<3
MS Total Metals	Silver	7440-22-4	<5	mg/kg						<5	
MS Total Metals	Strontium	7440-24-6	<5	mg/kg						59	
MS Total Metals	Thallium	7440-28-0	<5	mg/kg						<5	
MS Total Metals	Thorium	7440-29-1	<5	mg/kg						10	
MS Total Metals	Tin	7440-31-5	<5	mg/kg						<5	
MS Total Metals	Titanium	7440-32-6	<5	mg/kg						56	
MS Total Metals	Uranium	7440-61-1	<5	mg/kg						<5	
MS Total Metals	Vanadium	7440-62-2	<5	mg/kg		23	30	29	32	38	33
MS Total Metals	Zinc	7440-66-6	<5	mg/kg		27	36	36	34	78	39
Analysis	**Analyte**	**CAS #**	**LOR**								
TRH (C6-C10) &	TPHC6-C9	C6-C9	<20	mg/kg		<20	<20	<20	<20		<20
TRH (C6-C10) &	TRHC6-C10	C6-C10	<20	mg/kg		<20	<20	<20	<20		<20
TRH (C6-C10) &	TRHC6-C10 minus BTEX	F1-BTEX	<20	mg/kg		<20	<20	<20	<20		<20
Analysis	**Analyte**	**CAS #**	**LOR**								
TRH F2	TRH>C10-C16 minus Naphthalene	F2-NAPHTHAL	<20	mg/kg		<20	<20	<20	<20		<20
TRH & TPH	TPH C10-C14	C10-C14	<20	mg/kg		<20	<20	<20	<20		<20
TRH & TPH	TPH C15-C28	C15-C28	<50	mg/kg		<50	<50	<50	<50		<50
TRH & TPH	TPH C29-C36	C29-C36	<50	mg/kg		<50	<50	<50	<50		<50
TRH & TPH	TRH>C10-C16	C10-C16	<20	mg/kg		<20	<20	<20	<20		<20
TRH & TPH	TRH>C16-C34	C16-C34	<50	mg/kg		<50	<50	<50	<50		<50
TRH & TPH	TRH>C34-C40	C34-C40	<50	mg/kg		<50	<50	<50	<50		<50
TRH & TPH	Sum of TRH>C10-C40	C10-C40	<50	mg/kg		<50	<50	<50	<50		<50
TRHHB	TRH>C10-C16 Aliphatic	TRH>C10_C16	<20	mg/kg		<20	<20	<20	<20		<20

					Sample No.	4930652	4930653	4930654	4930655	4930656	4930657
					Client Sample ID	Garden	Row 24/25	Row 99 Spreyline	Row 84/85 Interow	Row 61 Pine Posts	Row 42/43
					Sample Date	26/09/16	26/09/16	26/09/16	26/09/16	26/09/16	26/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
TRHHB	TRH>C16-C34 Aliphatic	TRH>C16_C34	<50	mg/kg		<50	<50	<50	<50		<50
TRHHB	TRH>C34-C40 Aliphatic	TRH>C34_C40	<50	mg/kg		<50	<50	<50	<50		<50
TRHHB	TRH>C10-C16 Aromatic	TRH>C10_C16	<20	mg/kg		<20	<20	<20	<20		<20
TRHHB	TRH>C16-C34 Aromatic	TRH>C16_C34	<50	mg/kg		<50	<50	<50	<50		<50
TRHHB	TRH>C34-C40 Aromatic	TRH>C34_C40	<50	mg/kg		<50	<50	<50	<50		<50

Laboratory Certificate of Analysis[1]

ALS Water

CERTIFICATE OF ANALYSIS

Batch No:	16-43970	Page	Page 1 of 16
Final Report	582608	Laboratory	Scoresby Laboratory
		Address	Caribbean Business Park, 22 Dalmore Drive, Scoresby, VIC 3179
Client:	Advanced Environmental Systems	Phone	03 8756 8000
Contact:	Monique Aarts	Fax	03 9763 1862
Address:	2/75 Hume Street ECHUCA VIC 3564	Contact:	Trang Phan Client Manager Le-Trang.Phan@alsglobal.com
Client Program Ref:	Pitman	Date Sampled:	26-Sep-2016
ALS Program Ref:	AESMISC	Date Samples Received:	26-Sep-2016
PO No:	Not Available	Date Issued:	29-Sep-2016

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service.

Analysis	Method	Laboratory	Analysis	Method	Laboratory	Analysis	Method	Laboratory
Cyanide	EK026SF	Scoresby	WAD CN	EK028SF	Scoresby	MS Total Metals	CM050 C	Scoresby
OCP	CM048	Scoresby	OES Cations	CM050 D (Si not NATA)	Scoresby	PAH	CM043	Scoresby
PCB	CM048	Scoresby	Phenols(Halo)	CM056	Scoresby	Phenols(NonHalo)	CM056	Scoresby
SO4	ED041GWRG	Scoresby	Total Cr 6+ DA	EG048G	Scoresby	TRH F2	# EP071WRG	Scoresby
TRHHB	# CM097	Scoresby	TRH & TPH (>C10)	EP071WRG	Scoresby	TRH (C6-C10) & F1	CM047 (F1 not NATA)	Scoresby

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	Title	Name	Title
Chatura Perera	Team Leader Nutrients	Hoa Nguyen	Analyst
Hao Zhang	Team Leader Organics	John Earl	Team Leader Metals
Kosta Christopoulos	Deputy Team Leader Organics		

[1] Sampling was conducted on the 22nd September 2016.

Appendix 2. HIL and EIL Soil Contamination Levels (NEPM 2013)

Table 1A(1) Health investigation levels for soil contaminants

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
Metals and Inorganics				
Arsenic[2]	100	500	300	3 000
Beryllium	60	90	90	500
Boron	4500	40 000	20 000	300 000
Cadmium	20	150	90	900
Chromium (VI)	100	500	300	3600
Cobalt	100	600	300	4000
Copper	6000	30 000	17 000	240 000
Lead[3]	300	1200	600	1 500
Manganese	3800	14 000	19 000	60 000
Mercury (inorganic)[5]	40	120	80	730
Methyl mercury[4]	10	30	13	180
Nickel	400	1200	1200	6 000
Selenium	200	1400	700	10 000
Zinc	7400	60 000	30 000	400 000
Cyanide (free)	250	300	240	1 500
Polycyclic Aromatic Hydrocarbons (PAHs)				
Carcinogenic PAHs (as BaP TEQ)[6]	3	4	3	40
Total PAHs[7]	300	400	300	4000
Phenols				
Phenol	3000	45 000	40 000	240 000
Pentachlorophenol	100	130	120	660
Cresols	400	4 700	4 000	25 000
Organochlorine Pesticides				
DDT+DDE+DDD	240	600	400	3600
Aldrin and dieldrin	6	10	10	45
Chlordane	50	90	70	530
Endosulfan	270	400	340	2000
Endrin	10	20	20	100
Heptachlor	6	10	10	50
HCB	10	15	10	80
Methoxychlor	300	500	400	2500
Mirex	10	20	20	100
Toxaphene	20	30	30	160
Herbicides				
2,4,5-T	600	900	800	5000
2,4-D	900	1600	1300	9000
MCPA	600	900	800	5000

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
MCPB	600	900	800	5000
Mecoprop	600	900	800	5000
Picloram	4500	6600	5700	35000
Other Pesticides				
Atrazine	320	470	400	2500
Chlorpyrifos	160	340	250	2000
Bifenthrin	600	840	730	4500
Other Organics				
PCBs[8]	1	1	1	7
PBDE Flame Retardants (Br1–Br9)	1	2	2	10

Notes:

(1) Generic land uses are described in detail in Schedule B7 Section 3

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.

(2) Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7).

(3) Lead: HIL is based on blood lead models (IEUBK for HILs A, B and C and adult lead model for HIL D where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate.

(4) Methyl mercury: assessment of methyl mercury should only occur where there is evidence of its potential source. It may be associated with inorganic mercury and anaerobic microorganism activity in aquatic environments. In addition the reliability and quality of sampling/analysis should be considered.

(5) Elemental mercury: HIL does not address elemental mercury. A site-specific assessment should be considered if elemental mercury is present, or suspected to be present,

(6) Carcinogenic PAHs: HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to B(a)P) adopted by CCME 2008 (refer Schedule B7). The B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products.

PAH species	TEF	PAH species	TEF
Benzo(a)anthracene	0.1	Benzo(g,h,i)perylene	0.01
Benzo(a)pyrene	1	Chrysene	0.01
Benzo(b+j)fluoranthene	0.1	Dibenz(a,h)anthracene	1
Benzo(k)fluoranthene	0.1	Indeno(1,2,3-c,d)pyrene	0.1

Where the B(a)P occurs in bitumen fragments it is relatively immobile and does not represent a significant health risk.

Table A2: Summary of the EILs for fresh and aged contamination in soil with various land uses. Presented ranges are the EILs for a range of soil characteristics (NEPM 2013).

Contaminant	Age of contam	Added contaminant limits (mg added/kg soil) or EIL (mg/kg) for various land uses		
		Area of ecological significance[3]	Urban residential/ public open space[4]	Commercial & industrial[5]
Zinc[1]	fresh	7–130	25–500	45–800
	aged	15–280	70–1300	100–2000
Arsenic[2]	fresh	20	50	80
	aged	40	100	160
Naphthalene[2]	fresh	10	170	370
DDT[2]	fresh	3	180	630
Chromium (III)[1]	fresh	25–50	75–160	120–270
	aged	60–130	190–400	310–660
Copper[1]	fresh	15–60	30–120	45–200
	aged	20–80	60–230	85–340
Lead[1]	fresh	110	270	440
	aged	470	1100	1800
Nickel[1]	fresh	1–25	10–170	20–350
	aged	5–95	30–560	55–960

Notes:

[1] = the values presented for zinc, chromium (III), copper and lead are added contaminant limits (ACLs) based on added concentrations. The EIL is calculated from summing the ACL and the ambient background concentration (ABC).

[2] = the values presented for arsenic, naphthalene and DDT are generic EILs based on total concentrations. Insufficient information was available to calculate ACLs for these contaminants.

[3] = The standard protection level is 99%

[4] = The standard protection level is 80%

[5] = The standard protection level is 60%

Appendix 3. *Field Quality Assurance and Quality Control*

Table 1. Details of the subject site assessment

SITE DETAILS	
Location:	Lot 11 Perricoota Road, Moama
Date:	22nd September 2016
Company undertaking assessment:	Advanced Environmental Systems (AES)
Sampler:	Peter Clinnick
Weather Conditions:	15ºC, sunny, SE wind 10 km/hr

Samples were taken from the site between 9.30 am and 1.00 pm on the 22nd September 2016 and dispatched by courier to the laboratory on the next day. These were received by the laboratory the 24th September 2016. A control sample, was taken from an area close by in a previous study. The area was considered to have had a very low density of use (parkland) and potential contamination. Subsequent results confirmed that the control site displayed similar levels of the parameters tested to other control sites in the area.