ENVIRONMENTAL SITE ASSESSMENT
Meriton Apartments Warriewood Project
Macpherson St and Boondah Rd, Warriewood NSW

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1. INTRODUCTION

In November 2003, an Environmental Site Assessment (ESA) was undertaken on the existing residential, agricultural and open space areas known as the Meriton Warriewood redevelopment, located at Macpherson and Boondah Sts, Warriewood. The redevelopment site consists of several distinct land parcels which have been recently acquired by Meriton Apartments Pty Ltd (Meriton) for the purposes of a residential development. The ESA was designed to assess the suitability of levels of contamination within sub-surface materials on the redevelopment site for a future standard residential use.

The overall objective of the ESA has been to characterise the contamination status of the soils underlying the site. The investigation has been undertaken by first undertaking a site history review of the site. Potential contamination sources have been identified from the site history review. Based on these, a soil sampling program has been designed and undertaken to assess for the presence of contamination. The results of soil sampling and analysis have been reviewed and compared to published assessment criteria to determine the presence of contamination. The information provided in this report summarises the investigation undertaken, assesses the contamination status of the soils, and provides a recommendation as to the suitability of the redevelopment site for a future standard residential land use.

This report has been prepared by reference to relevant guidelines provided within the National Environment Protection (Assessment of Site Contamination) Measure 1999, NSW EPA (1995) 'Sampling Design Guidelines' and NSW EPA (1994) 'Guidelines for the Assessment of Service Station Sites'.

3. SITE HISTORY

A review of the site history has been undertaken. The objective of the site history review is to identify potential contamination sources. Potential contamination sources would be as a consequence of the sites former use(s). The site history review has been undertaken by:

- Site walkover;
- Review of historical Title Deeds held for the site; and
- A review of historical aerial photographs.

3.1 SITE WALKOVER

A site walkover was undertaken on the redevelopment area on 6th October, 2003 by EAA. The following general land-uses were observed during this walkover:

- A former commercial storage yard located on Boondah Rd at the south-east of the redevelopment area. Storage of various items of industrial equipment including machinery and former aboveground storage tanks was observed here.
- A former plantation forest was observed in the central and eastern part of the redevelopment area, bordering Boondah St at the east.
- A low lying swampy area is observed at the south-west of the redevelopment area. Some areas of the ground in this area are observed to be waterlogged. A small stream is located nearby to this area. This area appears to have been partially cleared, but essentially present in its native condition.
- Existing rural-residential properties are observed at the north of the redevelopment area bordering Macpherson St. These consist of dwellings near to Macpherson St, and yard areas used for various agricultural purposes. Agricultural uses were typically observed to be restricted to the grazing of livestock, including horses. Yard areas had been cleared of vegetation and were observed to be grassed.

3.2 REVIEW OF TITLE DEEDS

Historical title deeds for the lots that form the area of the current Warriewood allotment for redevelopment have been obtained and reviewed. Relevant observations from each of these title deeds are summarised in **Table 1** following. Copies of historical title deeds have been provided as **Appendix C** of this report.

Table 1: Summary of Observations from Title Deed Review

Year	Summary of Relevant Information Recorded on Title Deed
1831	Portion 12 of the Parish, being an area of 250 acres was granted to James Jenkins by the Crown.
1895	Part of Portion 2/11, including the current Lot 2 in DP 26902 and Lot 2 in DP 207630, is observed to have been transferred to Edward Macpherson. Mr Macpherson is noted on the title deed as being a gentleman from Woollahra.
1902	Portion 97, including the current Lot 502, is observed to have been transferred to Thomas Green from the Crown. Mr Green is noted on the title deed as being a licensed vietualler from Drummoyne. Later that year, the Portion 97 is observed to have been transferred to Owen Reilly. Mr Reilly is noted as being a labourer from Camperdown.
1907	Part of Portion 2/11 (including the current Lot 2 in DP 26902 and Lot 2 in DP 207630) is observed to have been transferred to Septimus Macpherson. Mr Macpherson is noted on the title deed as being a gentleman from Sydney.
1909	Part of Portion 97 (including the current Lot 502) is observed to have been transferred to Frederick Brand. Mr Brand is noted on the title deed as being a labourer from Narrabeen.
1910	Lot 10 of Section A, which includes the current Lots 1 and 2 in DP519428 and Lot 1 in DP207630 is observed to Warriewood Limited from the Crown.
1926	Lot 6 of Section C, consisting of part of Lot 502 in DP 1049982 and Lots 1 and 2 in DP 519428 was transferred to Thomas Brand. Mr Brand is noted on the title deed as being a dairy farmer from Mona Vale.
1927	Lot 5 of Section C, consisting of part of the current Lot 2 in DP 519428 and Lot 1 in DP207630, is observed to have been transferred to John Clark. Mr Clark is noted on the title deed as being a clerk from Warriewood.
1932	Lot 5 of Section C (consisting of part of the current Lot 2 in DP 519428 and Lot 1 in DP207630) is observed to have been transferred to Glass House Tomatoes Limited. Part of Portion 2/11 (including the current Lot 2 in DP 26902 and Lot 2 in DP 207630) is observed to have been transferred to Narrabeen Beach Estates Limited. Portion 96, consisting of Lot 1 in Deposited Plan 207630 is also observed to have been transferred to Narrabeen Beach Estates Limited.
1934	Lot 6 of Section C (consisting of part of Lot 502 in DP 1049982 and Lots 1 and 2 in DP 519428) was transferred to Frederick Brand. Mr Brand is noted as being a dairy farmer from Warriewood. In later title deeds he is referred to as a gardener from Warriewood. Later that year the lot is transferred to both Thomas and Frederick Brand. Lot 5 of Section C (consisting of part of the current Lot 2 in DP 519428 and Lot 1 in DP207630) is observed to have been transferred to Glass House Products Limited.
1936	Lot 6 of Section C (consisting of part of Lot 502 in DP 1049982 and Lots 1 and 2 in DP 519428) and part of Portion 97 (including the current Lot 502) was leased to George Kent. Mr Kent is noted as being a dairyman from Crows Nest.

Table 1 (cont.): Summary of Observations from Title Deed Review

Year	Summary of Relevant Information Recorded on Title Deed
1944	Part of Portion 2/11 (including the current Lot 2 in DP 26902 and Lot 2 in DP 207630) and Portion 96 (consisting of Lot 1 in Deposited Plan 207630) is observed to have been transferred to the Council of the Shire of Warringah.
1953	Lot B of Portion 12, a narrow strip of land passing through the current narrow access lane to the existing Lot 502 in DP 1049982 and to the west of the current Lot 1 in DP 519428, is observed to be owned by Frederick Brand. Mr Brand is noted as being a dairyman from Warriewood.
1956	Lot B of Portion 12 (a narrow strip of land passing through the current narrow access lane to the existing Lot 502 in DP 1049982 and to the west of the current Lot 1 in DP 519428) Part of Portion 97 (including the current Lot 502 in DP 1049982) and Lot 14 in DP 26902 is observed to have been transferred to Anton Radaich and Ivan Bosnich. Mr Radaich is noted on later title deeds as being retired and from Brookvale. Mr Bosnich is noted as being a gardener from Brookvale. Part of Portion 2/11 (including the current Lot 2 in DP 26902 and Lot 2 in DP 207630) and Portion 96 (consisting of Lot 1 in Deposited Plan 207630) are observed to have been subdivided by into Lot 1 in DP 26902, consisting of the current Lots 1 and 2 in DP 207630, and the current Lot 14 in DP 26902 and Lot 2 in DP 26902. Lot 2 in DP 26902 is observed to have been transferred to George Grbic. Mr Grbic is noted on the title deed as being a farmer from Warriewood. Lot 14 in DP 26902 is observed to have been transferred to Wallace Gibson. Mr Gibson is noted on the title deed as being a Company Director from Melbourne. Later that year the property is observed to have been transferred to Anton Radaich and Ivan Bosnich.
1957	Lot 5 of Section C (consisting of part of the current Lot 2 in DP 519428 and Lot 1 in DP207630) is observed to have been transferred to Samuel Thompson. Mr Thompson is noted on the title deed as being a chemist from Homebush.
1958	Lot 5 of Section C (consisting of part of the current Lot 2 in DP 519428 and Lot 1 in DP207630) is observed to have been transferred to Angelos Bedelis and John Bedelis. Both are noted on the title deeds as being market gardeners from Warriewood.
1960	Lot B of Portion 12 (a narrow strip of land passing through the current narrow access lane to the existing Lot 502 in DP 1049982 and to the west of the current Lot 1 in DP 519428) Part of Portion 97 (including the current Lot 502 in DP 1049982) and Lot 14 in DP 26902 is observed to have been transferred to Boondah Investments Pty Limited. Lot 1 in DP 26902 (consisting of the current Lots 1 and 2 in DP 207630) is observed to have been transferred to Boondah Investments Pty Limited.
1963	Lot B of Portion 12 (a narrow strip of land passing through the current narrow access lane to the existing Lot 502 in DP 1049982 and to the west of the current Lot 1 in DP 519428) Part of Portion 97 (including the current Lot 502 in DP 1049982) and Lot 14 in DP 26902 is observed to have been transferred to Bridge Acceptance Pty Limited. Lot 1 in DP 26902 (consisting of the current Lots 1 and 2 in DP 207630) is observed to have been transferred to Bridge Acceptance Pty Limited. Lot 1 in DP 207630 is observed to have been transferred to Lagaros Racovitis. Mr Racovitis is noted on the title deed as being a market gardener from Warriewood. Lot 2 in DP 207630 is observed to have been transferred to Haig Properties Pty Limited.

Table 1 (cont.): Summary of Observations from Title Deed Review

Year	Summary of Relevant Information Recorded on Title Deed
1966	Lot 2 in DP 519428 is observed to have been transferred to Tom Bedelis only. Mr Bedelis is noted as being a market gardener from Warriewood. Lot 1 in DP 519428 is observed to have been transferred to Angelos Bedelis only. Mr Bedelis is also noted on the title deed as being a market gardener from Warriewood.
1969	Lot B of Portion 12 (a narrow strip of land passing through the current narrow access lane to the existing Lot 502 in DP 1049982 and to the west of the current Lot 1 in DP 519428) Part of Portion 97 (including the current Lot 502 in DP 1049982) and Lot 14 in DP 26902 is observed to have been transferred to Haig Properties Pty Limited.
1970	Lot 1 in DP 519428 is observed to have been transferred to McCormack Earthmovers Pty Limited.
1972	Lot 2 in DP 26902 is observed to have been transferred to Capital Wires Pty Limited.
1974	Lot 1 in DP 207630 is observed to have been transferred to Patkana Racovitis. Mrs Racovitis is noted as being a widow from Warriewood.
1977	Lot 2 in DP 26902 is observed to have been transferred to Keith Eagles and Rosemary Eagles. Mr Eagles is noted on the title deed as being a sullage contractor from Warriewood. Mrs Eagles is noted as being his wife.
1978	Lot B of Portion 12 (a narrow strip of land passing through the current narrow access lane to the existing Lot 502 in DP 1049982 and to the west of the current Lot 1 in DP 519428) Part of Portion 97 (including the current Lot 502 in DP 1049982) and Lot 14 in DP 26902 is observed to have been transferred to Warriewood Valley Pty Limited. Lot 1 in DP 519428 is observed to have been transferred to Warriewood Valley Pty Limited. Lot 2 in DP 207630 is observed to have been transferred to Warriewood Valley Pty Limited.
1985	Lot 1 in DP 207630 is observed to have been transferred to George Zammit and Jean Zammit. The occupations of Mr and Mrs Zammit are not noted on the title deed. On a later title deed Mr Zammit is noted as being a Timber Merchant from Narrabeen. Mrs Zammit is noted as being domestic duties and also from Narrabeen.
1990	Lot 1 in DP 207630 is observed to have been transferred to Jean Zammit. Mrs Zammit's occupation is noted as being domestic duties.
1991	Lot 2 in DP 26902 is observed to now be owned by Rosemary Eagles, Christopher Eagles, Glen Eagles and Sharon Eagles. It is noted that Keith Eagles has passed away.
2003	Lot B of Portion 12 (a narrow strip of land passing through the current narrow access lane to the existing Lot 502 in DP 1049982 and to the west of the current Lot 1 in DP 519428) and part of Portion 97 are subdivided to form the current Lot 502 in DP 1049982. Lot 502 is observed to have been transferred to Meriton Property Management Pty Limited. Lot 1 in DP 519428 is observed to have been transferred to Meriton Property Management Pty Limited. Lot 2 in DP 207630 is observed to have been transferred to Meriton Property Management Pty Limited. Lot 1 in DP 207630 is observed to have been transferred to Karimbla Properties Pty Limited. Lot 14 in DP 26902 is observed to have been transferred to Meriton Property Management Pty Limited.

3.3 AERIAL PHOTOGRAPHS

All available historical aerial photographs held by the Map Information Centre were reviewed by EAA. Aerial photographs of the site and surrounding areas were available for 1951, 1961, 1970, 1978, 1986, 1994 and 2002. Relevant observations from each are summarised following.

3.3.1 1951 Aerial Photograph

The allotments appear to have been cleared and developed apart from some remnant areas of native bushland at the south and south-west. Macpherson St can be observed to be present in its approximate current location, however Boondah St is not apparent. The area of Macpherson St in proximity of the site appears to be used for agricultural purposes. Several long narrow buildings are able to be observed on the majority of the properties in the area of the allotment. These are most likely glass houses, or shade houses. Other areas can be observed to have planted in regular shapes. However, it does not appear that a market garden use is occurring. Some houses, corresponding to the approximate location of some of the current dwellings, are able to be observed near to Macpherson St.

3.3.2 1961 Aerial Photograph

A road in the approximate current location of Macpherson St is still able to be observed. The long narrow structures are also able to be observed to be present in proximity of the allotment, typically near to Macpherson St and the central area of the allotment. Cleared planted areas are able to be observed over the remainder of the allotment. No further houses are able to be observed to have been constructed in the vicinity of the allotment since 1951. Limited additional development can be observed in the surrounding area.

3.3.3 1970 Aerial Photograph

The current location of Macpherson St and Boondah St are able to be observed on the aerial photograph. The area at the south-west of the allotment is observed to have been cleared of vegetation. The area of the allotment at the south-east, bordering Boondah St only is observed to have 11 long narrow structures present on it, and a homestead has been constructed adjoining Boondah St to the north-east of the buildings.

The majority of the long, narrow buildings have been removed from the central, northern and eastern areas of the allotment. The homesteads as observed currently on the site can be observed to be present adjoining Macpherson St. Several long narrow buildings are still observed to be present near to the western boundary of the allotment. A cleared earthen roadway also appears to have been constructed along the southern boundary of the allotment.

3.3.4 1978 Aerial Photograph

The area of the allotment at the south-west adjoining Boondah St is observed to have been completely cleared, apart from the homestead. The long narrow structures are still observed to be present near the western boundary of the allotment. The same homesteads are still observed to be present adjoining Macpherson St.

A narrow strip of land along the western boundary of the allotment and the southern part of the allotment (apart from the area adjoining Boondah St) are observed to have been planted in rows with small trees or shrubs. These may be the 'match stick' trees that are currently present on the site. Several lots, to the west and south of the site have been likewise planted. The long narrow buildings are still observed to be present on several properties adjoining Macpherson St.

3.3.5 1986 Aerial Photograph

The area of the allotment at the south-west, adjoining Boondah St is observed to have had a large light coloured structure constructed at the southern corner of the property. An area at the centre of this property is also observed to have been sealed with a light coloured material (similar to the crushed brick observed during the site inspection). The long narrow structures are observed to have been completely removed from the allotment. The areas at the western boundary and the southern area of the site appear to have been cleared and now consist of grassed areas. The remainder of the allotment is unchanged.

3.3.6 1994 Aerial Photograph

The area adjoining Boondah St is unchanged. Some trees are observed to be present on the western boundary and the southern area of the site, with localised areas being quite heavily wooded. The remainder of the allotment is observed to be grassed.

3.3.7 2002 Aerial Photograph

The area adjoining Boondah St is unchanged. The strip of land at the western boundary, and the southern part of the site, are observed to now be heavily wooded. The homesteads on Macpherson St are still observed to be present and the remainder of the site grassed.

4. POTENTIAL SOURCES OF CONTAMINATION

Based on the review of the information sources in compiling the site history, the following conclusions can be made in regards to previous activities undertaken on the redevelopment site:

- Areas of the allotment have been used for agricultural purposes. This has included market gardens, the operation of glass houses and other related agricultural activities. Based on aerial photos, there was limited evidence of traditional market garden activity being undertaken.
- Limited areas of the allotment, typical at the west and south, have most likely been used for plantation forests.
- The area of the allotment at the south-east adjoining only Boondah St has also been used as a commercial yard, most likely for the storage and maintenance of equipment associated with the activities of a sullage contractor.
- Residential uses, associated with houses provided for the practitioners of these enterprises have also occurred on each of the respective lots.

Based on this, the redevelopment allotment, apart from the former commercial yard at the south-east of the allotment, can be concluded to have only been used for agricultural and residential purposes. Sources of potential contamination associated with these land uses are restricted to substances that may be associated with historical pesticide application. It is advised in NSW EPA (2002) 'Authorised Officers Manual' that these are restricted to organochlorine pesticides (OCPs) and heavy metals (including As, Cd, Cr, Cu, Pb, Hg, Ni and Zn). Consequent of the absence of evidence of filling of the sites, where these are present, it is anticipated that they will be present at near surface depths (consequent of surface application). There is a likelihood that the former commercial yard at the south of the redevelopment area was also historically used for agricultural purposes.

It is noted that potentially hazardous substances are typically associated with intensive agricultural applications including market gardens and orchards. There is a low potential that previous agricultural uses of the site have included these agricultural activities. The likely presence of potentially hazardous substances (ie. pesticides) on a former market garden or orchard site is discussed in NSW EPA (2002). "The likelihood of high residual contamination in the cultivated areas is relatively low given that modern agricultural chemicals are generally not persistent. Also, the use of the more residual organochlorine pesticides, eg. Dieldrin, heptachlor and DDT, gradually diminished in the early 1980's and from 1986-87 have either been restricted or prohibited from agricultural use. In addition, the predicted persistence of these compounds is only 5 to 15 years."

Based on the review of acid sulfate soils maps, there is also a potential that low-lying or swampy areas of the site may contain potential or actual acid sulfate soils.

5. SAMPLING AND ANALYSIS

5.1 SAMPLING OBJECTIVES

The Environmental Site Assessment was designed to detect any significantly extensive soil contamination present within the soils on the site, which may pose an unacceptable risk to future residential users of the site or present a potential risk to the environment.

5.2 SAMPLING LOCATIONS

A total of 76 sampling locations were taken across the area of the site. NSW EPA (2002) in providing guidance for assessing orchard and market garden contamination in the 'Authorised Officers Manual' recommends a total of 70 sampling locations for an area of assessment of 10 hectares. The site area is less than 10 hectares. Consequently 70 sample locations were considered adequate to assess for the presence of contamination related to the former agricultural use of the site. These locations were undertaken by placing a grid-based sampling pattern across the site.

Additional sample locations were required to be placed at Lot 2 in DP 26902. This area of the site is also observed to have been subject to a former commercial/industrial use. This part of the site is observed to be an area of 6,000m^2. NSW EPA (1995) 'Sampling Design Guidelines' advises that 15 sample locations are appropriate for a site area of 6,000m^2. Observing that only approximately 40% of the site had been used for a commercial/industrial purpose, an additional six sample locations were placed on this area of the site. This meant that a total of 12 sample locations were undertaken on this lot.

A total of 76 sample locations were placed for the assessment of the allotment area. Sample locations are shown on **Figure 4**. Sampling was undertaken on 9th November, 2003.

5.3 SAMPLING METHODS

Samples were collected using a hand auger. The hand auger was penetrated to the required depth in the soil profile and removed. Soils samples were removed directly from the bucket of the hand auger. Soil samples were collected from the near-surface depth intervals of 0.1-0.2m. Boreholes were typically placed to a depth of 0.5m (to assess for the presence of fill materials). A Sample Register describing each soil sample is provided as Table A to **Appendix A**.

Soil samples were placed directly into food grade soil jars provided with Teflon lined lids. Soil jars were transferred immediately to a cooled esky. Soils were observed by the field engineer during sampling works to assess for any visual or olfactometric evidence of contamination. At the cessation of the sampling works, as per the guidance provided to NSW EPA (2002), soil samples were composited into single samples as three point composites (ie. three discrete samples in close proximity were selected and mixed to form a single sample).

Table A provided to **Appendix A** contains detail on the individual samples used to form each composite sample. This was done by mixing, halving and quartering the samples in a mixing tray. Individual soil samples were retained in partly emptied soil jars in a refrigerator (for potential individual analysis). Additional individual soil samples were retained for sample locations where analysis for volatile constituents, and those related to acid sulfate soils were required.

The auger was cleaned between each sampling location. The mixing tray was cleaned between each preparation of composite samples.

All samples were analysed in the field by the use of a photo-ionisation detector. Results of PID analysis are summarised in **Table A** provided to **Appendix A**. Selected samples were analysed in the field for actual or potential acid sulfate soils by the field method described in New South Wales Acid Sulfate Soils Management Advisory Committee (1998) 'Acid Sulfate Soils Planning Guidelines'.

5.4 ANALYTE SELECTION

The composited surface sample from each location was analysed for heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn) and organochlorine pesticides (OCPs). Detail of the analysis regime implemented during the assessment is provided in **Table A** provided to **Appendix A**.

Additional individual samples collected from Lot 2 in DP 56902 at the south-east of the site were additionally analysed for Total Petroleum Hydrocarbons (TPH), Monocyclic Aromatic Hydrocarbons (including benzene, toluene, ethyl benzene and xylene – collectively known as BTEX) and Polycyclic Aromatic Hydrocarbons (PAHs). Where elevated PID readings were recorded elsewhere, it was proposed to additionally analyse for TPH and BTEX. However, no elevated PID readings were recorded during the assessment.

Two individual samples collected of material below the level of a perched water table, for the water logged area at the south-west of the redevelopment allotment were additionally analysed for the POCAS test. This was consequent of indeterminate results of field testing for the presence of potential acid sulfate soils, and the greatest potential for actual or potential acid sulfate soils to be present in waterlogged areas, and at depths below the water table.

6. QUALITY ASSURANCE / QUALITY CONTROL

6.1 GENERAL

Quality control and quality assurance applied to the project included:

- **Collection and analysis of field duplicate soil samples.** These should be collected and analysed at least at a rate of 1 in 20, or 5% of the primary samples for field duplicates, based on AS4482.1-1997[1]. Each field duplicate sample is forwarded to the primary analytical laboratory as "blind samples" (duplicate identity undisclosed) and analysed for the same target analytes as their respective primary sample.

  Field duplicates are collected (and tested) to identify the variation in analyte concentration between samples collected from the same sampling point and also for checking the repeatability of the primary laboratories analytical methodology. Thus, field duplicates provide a check that the field sampling and laboratory techniques are uniform.

  The primary analytical laboratory used for the assessment was SGS Laboratories at Matraville, NSW.

- **Collection and analysis of split duplicate soil samples.** These should be collected and analysed at least at a rate of 1 in 20, or 5% of the primary samples for split duplicates, based on AS4482.1-1997. However for small sample batches (less than 30 samples analysed) the sum of the analysis rate of blind and split duplicate samples should be at least 10%. The 'split' sample of each split duplicate sample is forwarded to an alternate analytical laboratory and analysed for the same target analytes as their respective primary sample.

  Split duplicates are collected (and tested) to identify the variation in analyte concentration between samples collected from the same sampling point and also for checking the precision of the primary laboratories analytical methodology. Thus split duplicates provide a check that the field sampling practices are uniform and laboratory techniques are appropriate.

  The secondary analytical laboratory used for the assessment was MGT Environmental Consulting located at Oakleigh Victoria.

- **Preparation of Equipment Rinsate Blanks**. These are prepared by decontamination of the sampling equipment in the usual manner, then pouring high purity water (obtained from the primary laboratory) over the equipment and catching this water in a clean sample container. For the case of the hand auger used in this assessment, the rinse water was poured over the cutting head. The captured water is then analysed for target analytes of interest.

[1] Australian Standard 4482.1-1997 entitled: *"Guide to the sampling and investigation of potentially contaminated soils- Part 1: Non-volatile and semi-volatile compounds"* (Section 8.2).

Analysis of equipment rinsate blanks provides two main functions:

- it provides a check that the sampling equipment used has not caused cross contamination of the samples, and
- that the equipment decontamination procedure has removed all traces of residual target analytes.

One equipment rinsate blank was prepared at cessation of the day's sampling for the hand auger.

- **Trip Blanks and Trip Spikes**. No trip blanks and trip spikes were prepared with this assessment, as no volatile constituents have been identified as constituents of potential concern. Trip blanks and trip spikes are required where analysis is performed for volatile analytes.

- **Maintaining the integrity of the samples**. This was achieved by using sample containers which were prepared and spiked with the appropriate preservative by the primary analytical laboratory and transferring the samples to a chilled esky immediately after sampling and whilst in transport to the project laboratories.

- **Extraction and analysis of samples within recommended holding times**. For target analytes tested during this investigation these holding times are:

  I. 6 months for heavy metals in soil samples, apart for mercury which is 28 days, and

  II. 14 days for OCPs in soils of which the extract must be tested within 40 days.

- **Completion of sample logs during collection of soil samples**. The sample logs aid in the documentation of soil characteristics, dates soil was sampled, depth and location of sampling, identification of person who described (logged) and collected the sample, and the method used for the collection of the soil sample. Logs of stockpile samples collected were maintained by the EAA field personnel and are summarised as **Appendix A**.

- **Sample transportation to the project laboratories with completed Chain of Custody (COC) documentation.** These COC's provide a history of sample movement and specify the analysis required, type of preservation used in the sample and the dates when samples were collected and dispatched to and received by the laboratories. Copies of the completed (and laboratory endorsed) Chain of Custodies are provided in **Appendix B**.

- **Use of NATA accredited test laboratories.** For this project an independent NATA accredited laboratories was used; SGS Australian Environmental Laboratories Matraville, NATA accredited laboratory No. 2562 was used as the primary analytical laboratory and MGT Environmental Consulting Pty Ltd was used as the alternate analytical laboratory.

6.2 LABORATORY ANALYTICAL METHODS

The laboratory analytical methods and limit of reporting (LOR) are shown on the official Test Certificates issued by the project laboratories and summarised for convenience in **Table 2**.

Table 2: Summary of Lab Reporting Limits and Methods

Target Analyte	SGS		Method Summary
	Soils		
	Method	LOR (mg/kg)	
Arsenic	SEM20	3	The target metals are quantified in acid (HNO_3/HCl)* digests or extracts by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICPAES). This ALS Method is based on APHA and USEPA Standard Procedures.
Cadmium	SEM20	0.1	
Chromium	SEM20	1	
Lead	SEM20	1	
Nickel	SEM20	1	
Copper	SEM20	1	
Zinc	SEM20	1	
Mercury	SEM-005	0.05	CVAAS/FIMS
OCPs	SEO-005	0.1	sonication extraction using acetone / hexane followed by gas chromatography separation with electron capture detection
TPH	SEO-017 SEO-020	20/50	C_6-C_9: Determination by purge and trap gas chromatography recovery following extraction with DCM/Acetone C_{10}-C_{36}: Gas chromatography following extraction with DCM/Acetone
BTEX	SEO-017	0.2/0.5	Determination by purge and trap gas chromatography recovery following extraction with DCM/Acetone
PAH (total)/individual/b(a)p	SEO-030	0.1/0.05	The samples are solvent (DCM/Acetone) extracted in a mechanical tumbler and Capillary Gas Chromatography quantifies the 16 USEPA Priority PAH pollutants in an aliquot of the solvent extract with Mass Spectroscopy detection (GCMS). This ALS Method is based on USEPA 8270B.

6.3 DATA QUALITY OBJECTIVES

The quality control procedures adopted during the project are described in the previous sections. The data quality objectives for the QC samples are as follows:

- Analysis of 1 duplicate sample for every 10 primary samples tested consisting of field duplicates and split duplicates at approximate rates of 1 in 20.
- The Relative Percent Difference (RPD) for **both the field duplicate and field split samples** are required to fall within or below the range of 30-50% as per the guidance provided to AS4482.1-1997.
- All samples must be extracted and analysed within the appropriate holding time for the target analyte and matrix.
- All analyte concentrations in the equipment rinsate blank shall be below laboratory analytical limits of detection.
- Laboratory quality control data must fall within their statistically determined control limits.

6.4 ASSESSMENT OF QUALITY CONTROL SAMPLES

6.4.1 Identification of Field Duplicates and the Rate of Field Duplicate Analysis Compared to the Primary Samples

Two field duplicate pairs were collected and prepared during the assessment. These included the pairs of MSW COMP1 and MSW COMP QA1; and MSW COMP2 and MSW COMP QA2. Duplicate samples were composited from three discrete duplicate samples of the corresponding individual primary sample locations. Of the 25 primary composite samples analysed, two field duplicate samples were analysed. Hence, the analysis rate for field duplicate soil samples have exceeded the minimum criteria specified in Section 8.2 of AS4482.1-1997 (i.e. 1 in 20, or 5% of primary samples) for testing field duplicates, and when combined with rate of analysis for split duplicate samples, is in compliance with the data quality objectives of overall duplicate analysis at the rate of 1 in 10 samples, and has thus met the first of the data quality objectives stated above.

6.4.2 Identification of Split Duplicates and the Rate of Split Duplicate Analysis Compared to the Primary Samples

One split duplicate pair was collected during the assessment. These included the pair of MSW COMP4 and MSW COMP QA4. Duplicate samples were composited from three discrete duplicate samples of the corresponding individual primary sample locations. Of the 25 primary composite samples analysed, one split duplicate sample was analysed. When combined with rate of analysis for field duplicate samples, the rate of duplicate and analysis is in compliance with the data quality objectives of overall duplicate analysis at the rate of 1 in 10 samples, and has thus met the first of the data quality objectives stated above.

6.4.3 Relative Percent Difference (RPD)

The RPD for the intralaboratory (i.e. field duplicates) and interlaboratory (i.e. field split) samples is simply calculated as follows:

RPD = Difference in the 2 results/average of the 2 results X 100

6.5 RPD FOR FIELD DUPLICATES

RPD's have been calculated for each parameter which has recorded concentrations above the laboratory detection limit for each of the duplicate pairs. All calculated RPD's have been found to be acceptable apart from:

- The RPD for arsenic and nickel for the field duplicate pair of MSW COMP2 and MSW COMP QA2; and
- The RPD for DDE for the split duplicate pair of MSW COMP4 and MSW QA4.

It is noted that each of these RPD's have been based on concentrations of analytes very close to the laboratory detection limits. Where analyte concentrations are close to laboratory detection limits, RPD's may be overstated due to imprecision in the data. It is further observed that each of these RPD's has only slightly exceeded the acceptable levels. Consequently, these slight exceedances of the RPD criteria are considered to be acceptable for this assessment.

6.6 HOLDING TIMES

All samples were extracted and analysed within the required holding times.

6.7 Equipment Rinsate Blank

All analyte concentrations in the equipment rinsate blank were below laboratory analytical limits of detection, apart from a slight detection of zinc marginally above the laboratory detection limit. It is noted that it is reported to be common for trace levels of zinc to leach from the teflon based lining provided to cap of the rinsate water bottle. This is most likely what has occurred with the rinsate blank sample here. Consequently, based on the levels of all other analytes being below laboratory limits of detection, the results for the rinsate blank are considered acceptable.

6.8 Laboratory QA/QC

Laboratory QA/QC has been briefly reviewed and found to be sufficient for this study.

6.9 QA / QC Assessment

Based on the results of the QA/QC assessment undertaken for this study it is concluded that generated data for this study is appropriately accurate and representative to meet the objectives of the overall assessment.

7. BASIS FOR ASSESSMENT CRITERIA

The contamination of soil criteria chosen for this site for comparison was a combination of the following:

- National Environment Protection (Assessment of Site Contamination) Measure 1999 Schedule B(1). These guidelines outline the 'Soil Investigation Levels for Urban Redevelopment Sites'. There are several different levels of criteria depending on the accessibility to soils. The assessment criteria used are for the exposure setting of 'standard residential', including residential sites with accessible soils and gardens. These criteria have been required to be divided by a factor of 3 to account for the preparation and analysis of three point composites.

- NSW EPA (1994) 'Guidelines for Assessment Service Station Sites. the guidelines for sensitive land uses provided were used for the assessment of levels of TPH and BTEX constituents.

- NSW Acid Sulfate Soils Management Advisory Committee (1998) 'Acid Sulfate Soil Manual'. The guidelines provided for the identification of actual and potential acid sulfate soils were used for the assessment of POCAS results.

Additional guidance is provided in NSW EPA (1995) 'Sampling Design Guidelines" and NEHF (1998), where the assessment criteria provided to the NEPM have been referenced. NSW EPA (1995) advises that environmental data sets should be statistically analysed by either of the most appropriate of a normal or lognormal distribution to determine a 95% UCL_{avg}. The 95% UCL_{avg} is considered to be the appropriate value to compare to published assessment criteria. Further guidance provided in NEHF (1998) states that where statistical analysis is undertaken, it requires to be ensured that the maximum level of any data point in the data set be less than 250% of the assessment criteria, and the standard deviation of the fitted distribution be less than 50% of the assessment criteria.

8. RESULTS

8.1 FIELD OBSERVATIONS

A sample register describing each of the soil samples is provided as **Appendix A** to this report. Underlying soils were generally found to consist of silty sands and clayey silts. Some silty clays and clays were observed in low lying waterlogged areas at the south-west of the redevelopment allotment. No significant quantities of fill materials were identified on the site, apart form crushed brick used on the lot adjoining Boondah St only to seal driveway and yard areas.

No groundwater was observed during the assessment. Some areas waterlogged with seepage water, and some small areas of surface water, were observed at the south-west of the redevelopment allotment.

8.2 SOIL ANALYSIS

Summarised laboratory results have been provided as **Appendix A** to this report. Copies of laboratory results sheets and all relevant QA/QC documentation has been provided in **Appendix B** to this report.

8.2.1 Heavy Metals

No heavy metal concentrations in soils on the site were found to exceed the modified health based soil criteria for a standard residential use of the site, apart from a slightly elevated level of lead for the sample MSW COMP23. As noted, in Section 7, NSW EPA (1995) provides for statistical analysis of large environmental data sets. Statistical analysis has been undertaken for lead levels and the results are summarised below:

95% UCL_{avg}	= 52.2
standard deviation	= 2.7
maximum	= 210
number of samples	= 25
distribution used:	= lognormal

It can be observed that the maximum level of lead is less then 250% of the modified criteria, the standard deviation of the data set is below 50% of the modified criteria, and the 95% UCL_{avg} concentration is below the modified criteria. No further assessment of lead levels is required.

Heavy metal concentrations in soils in all other samples were found to typically be at background levels observed in urban soils.

8.2.2 OCPs

No OCP concentrations were found to exceed any of the health based assessment criteria for a standard site. Further, no OCPs have been detected at levels above laboratory detection limits, apart from some detections of DDE marginally above laboratory quantification limits.

8.2.3 TPH, BTEX and PAHs

No TPH, BTEX or PAHs concentrations were found to exceed any of the health based assessment criteria for a standard site.

8.2.4 POCAS

POCAS results were assessed against the criteria and methods provided to NSW Acid Sulfate Soils Management Advisory Committee (1998) 'Acid Sulfate Soil Manual'. The soils with most uncertain field test results were assessed. No soils have been found to be classified as either of actual or potential acid sulfate soils.

9. CONCLUSIONS AND RECOMMENDATIONS

An environmental site assessment focusing on site contamination has been undertaken at the proposed residential subdivision site identified as Lot 1 in Deposited Plan 207630; Lot 2 in Deposited Plan 207630; Lot 14 in Deposited Plan 26902; Lot 2 in Deposited Plan 26902; Lot 502 in Deposited Plan 1049982; Lot 1 in Deposited Plan 519428; and Lot 2 in Deposited Plan 519428. The assessment has been undertaken by a review of the potential for contamination for the site from an assessment of the site history. The potential for contamination of the site has been assessed by a program of soil sampling and analysis. The results of the soil sampling and analysis have been assessed to determine the contamination status of the site. Results indicate no acid sulfate soil or environmental contamination is present at levels above the nominated guidelines.

A full quality assurance / quality control (QA/QC) program has been undertaken with the soil sampling and analysis. The assessment of the QA/QC program has found that the generated data is appropriate to be used in the assessment of the allotment.

The allotment described as the subdivision and redevelopment area has been found to be suitable for the proposed residential development.

Prepared by:

Matthew Parkinson
Environmental Engineer

R T Benbow
Principal Consultant

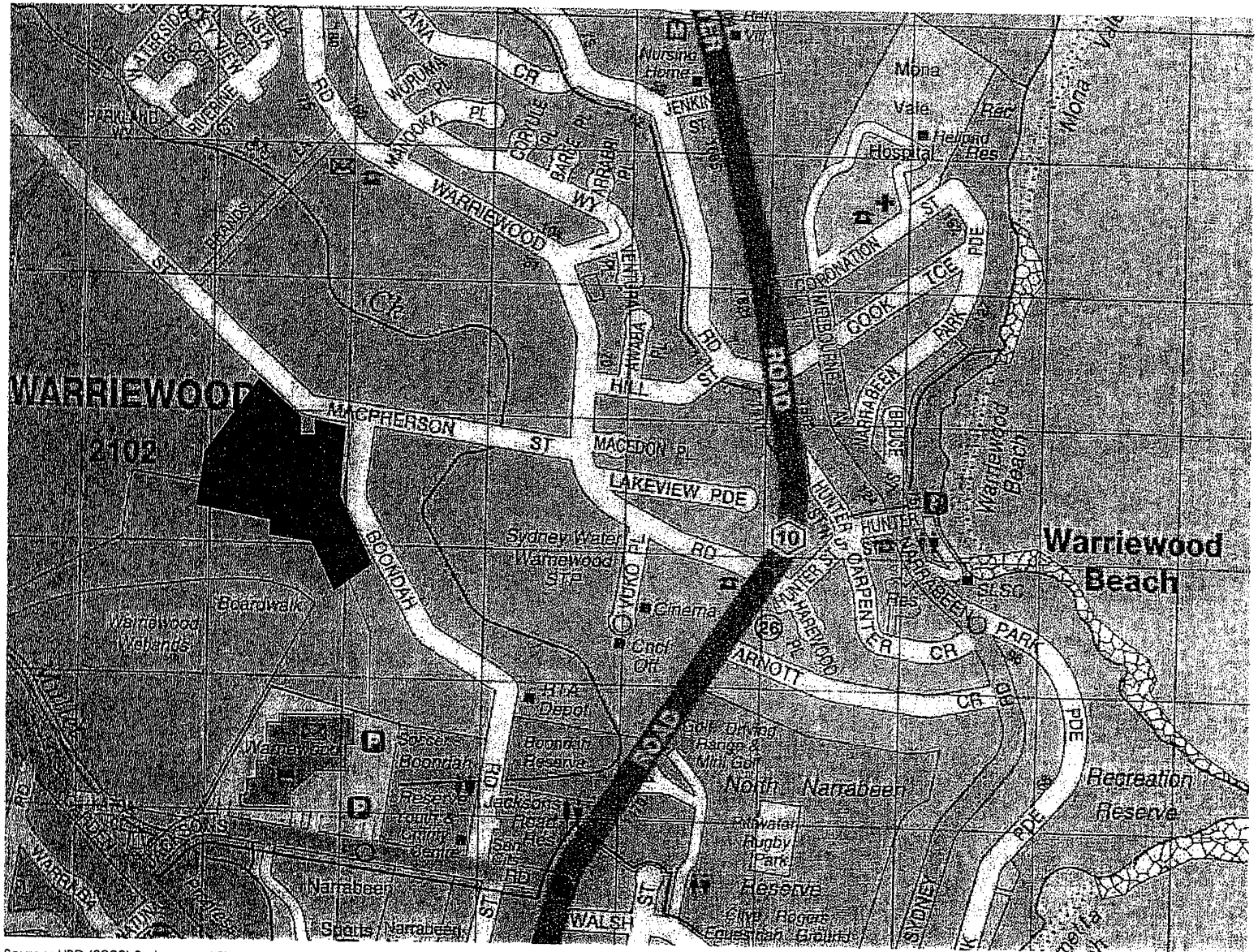
10. LIMITATIONS

This Environment Site Assessment report has been prepared for use by Meriton Apartments who has commissioned the works in accordance with the proposal, project brief and purchase order only, and has been based on information provided by Meriton Apartments. The advice herein relates only to this project and all results and conclusions made should be reviewed by a competent and experienced person with experience in environmental investigations, before being used for any other purpose. EAA accepts no liability for use or interpretation by any person or body other than Meriton Apartments who commissioned the works.

Soil, rock and aquifer conditions are often variable, resulting in non-homogeneous contaminant distributions across a site. Contaminant concentrations have been identified at sample locations determined on a regular grid basis. However, conditions between sample locations can only be inferred on the basis of the estimated geological and hydrogeological conditions and the nature and extent of identified contamination. Boundaries between zones of variable contamination are often indistinct, and have been interpreted based on the available information and the application of professional judgement. The accuracy with which the sub-surface conditions have been characterised depends on the frequency and methods of sampling and the uniformity of sub-surface conditions and is therefore limited by the scope of works undertaken.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined previously. Should further information become available regarding conditions at the site including previously unknown sources of contamination, EAA reserves the right to review this environmental site assessment report in the context of the additional information.

FIGURES

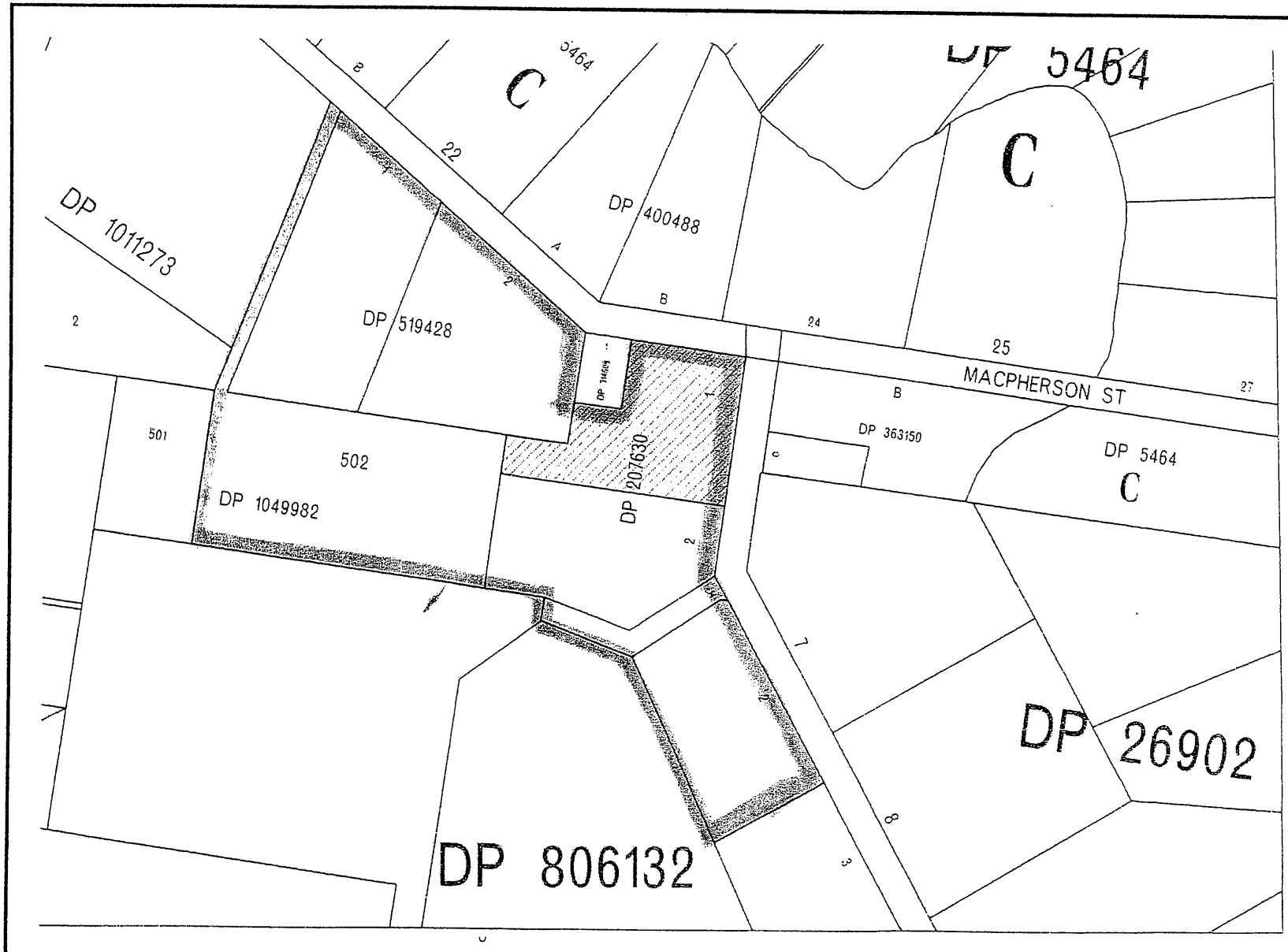


Source: UBD (2002) Sydney and Blue Mountains Street Directory

0 1km

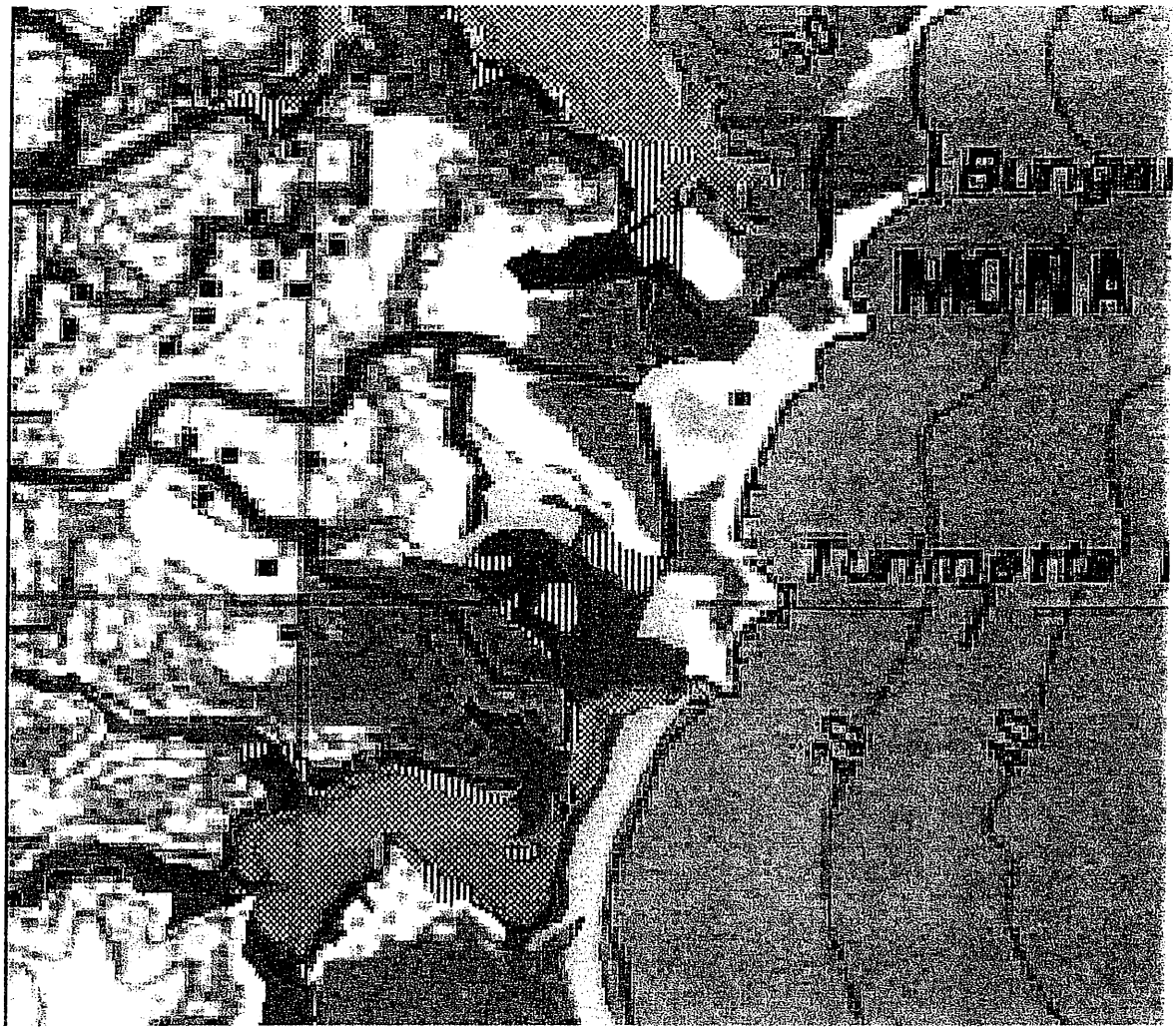
Approximate only

Figure 1 **Locality**



Source: Jenners Title Searching (2003)

Figure 2 | Site Plan showing Lots



- High risk at surface
- High risk < 1 meter below surface
- High risk 1 - 3 meter below surface
- High risk > 3 metres below surface
- High risk Bottom Sediments
- Low risk at surface
- Low risk < 1 meter below surface
- Low risk 1 - 3 meter below surface
- Low risk > 3 metres below surface
- Low risk Bottom Sediments
- Disturbed Land

Source: www.canri.nsw.gov.au

Figure 3 Likely Location of Potential and Actual Acid Sulfate Soils

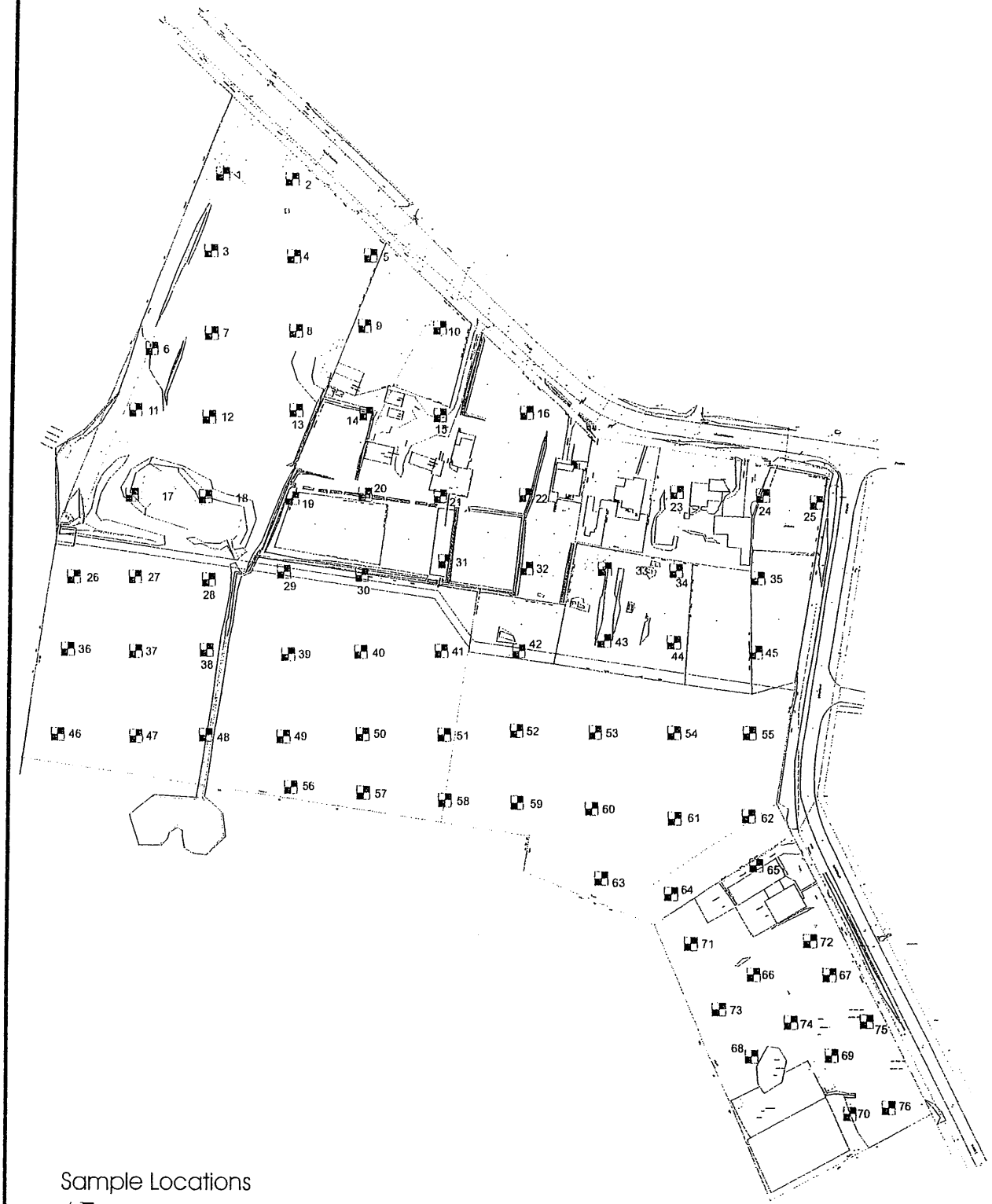


Figure 4 Sampling Plan

APPENDIX A

Sample Summary Tables

Table A Sample Register
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

Sample id	Sample Depth	Sample Type	PID (ppm)	Description	Analytes
MSW1	0.1-0.3m	soil	0.5	SANDY SILT: brown, dry, slight clay content	sample composited
MSW2	0.1-0.3m	soil	0.3	SANDY SILT: brown, dry, slight clay content	sample composited
MSW3	0.1-0.3m	soil	0.8	CLAYEY SILT: brown/grey, dry, some rootlets present	sample composited
MSW4	0.1-0.3m	soil	1.9	CLAYEY SILT: grey, dry, some rootlets present	sample composited
MSW5	0.1-0.3m	soil	2.6	CLAYEY SILT: brown/grey, dry, some rootlets present	sample composited
MSW6	0.1-0.3m	soil	0.7	CLAYEY SILT, grey, dry	sample composited
MSW7	0.1-0.3m	soil	0.1	CLAYEY SILT: grey, dry, some rootlets present	sample composited
MSW8	0.1-0.3m	soil	0	CLAYEY SILT: grey/brown, dry, some rootlets present	sample composited
MSW9	0.1-0.3m	soil	0.3	CLAYEY SILT: grey, dry, some rootlets present	sample composited
MSW10	0.1-0.3m	soil	0.1	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW11	0.1-0.3m	soil	3.8	CLAYEY SILT: grey, dry	sample composited
MSW12	0.1-0.3m	soil	4.1	CLAYEY SILT: grey/brown, dry	sample composited
MSW13	0.1-0.3m	soil	0	CLAYEY SILT: grey/brown, dry	sample composited
MSW14	0.1-0.3m	soil	0.2	CLAYEY SILT: brown/grey, dry, some rootlets present	sample composited
MSW15	0.1-0.3m	soil	0.9	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW16	0.1-0.3m	soil	0.4	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW17	0.1-0.3m	soil	8.3	CLAYEY SILT: dark, dry, some rootlets present	sample composited
MSW18	0.1-0.3m	soil	0.4	CLAYEY SILT: dark, slightly moist, some rootlets present	sample composited
MSW19	0.1-0.3m	soil	0.4	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW20	0.1-0.3m	soil	0.3	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW21	0.1-0.3m	soil	0	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW22	0.1-0.3m	soil	0	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW23	0.1-0.3m	soil	0	GRAVELLY SAND: orange/white, moderate to large angular particles, dry	sample composited

Table A Sample Register
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

Sample id	Sample Depth	Sample Type	PID (ppm)	Description	Analytes
MSW24	0.1-0.3m	soil	0.6	SANDY SILT: grey, dry, some orange/yellow extremely weathered sandstone also present	sample composited
MSW25	0.1-0.3m	soil	3.7	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW26	0.1-0.3m	soil	2.1	CLAYEY SILT: dark, slightly moist, some rootlets present	sample composited
MSW27	0.1-0.3m	soil	1.1	CLAYEY SILT: dark, slightly moist, some rootlets present	sample composited
MSW28	0.1-0.3m	soil	1	CLAYEY SANDY SILT: dark, slightly moist, some rootlets also present	sample composited
MSW29	0.1-0.3m	soil	1.3	CLAY: light grey, slightly moist, moderate plastiscity, some orange mottling	sample composited
MSW30	0.1-0.3m	soil	0.4	SANDY SILT: grey/brown, dry, some rootlets present	sample composited
MSW31	0.1-0.3m	soil	5.1	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW32	0.1-0.3m	soil	0.1	SANDY SILT: grey/brown, dry, some rootlets present	sample composited
MSW33	0.1-0.3m	soil	0.2	SANDY SILT: grey, dry, some rootlets present	sample composited
MSW34	0.1-0.3m	soil	0.1	SANDY SILT: grey, dry	sample composited
MSW35	0.1-0.3m	soil	0	SANDY SILT: grey, dry, some orange/yellow extremely weathered sandstone also present	sample composited
MSW36	0.1-0.3m	soil	4.3	CLAYEY SILT: dark/brown, dry, some rootlets also present	sample composited
MSW37	0.1-0.3m	soil	0	CLAYEY SANDY SILT: dark, slightly moist, some rootlets also present	sample composited
MSW38	0.1-0.3m	soil	0.1	CLAYEY SILT: orange, saturated	sample composited and POCAS
MSW39	0.1-0.3m	soil	0.2	SANDY SILT: grey, slightly moist, some rootlets present	sample composited
MSW40	0.1-0.3m	soil	0	SANDY SILT: dark/grey, dry, some rootlets present	sample composited
MSW41	0.1-0.3m	soil	0.1	SANDY SILT: dark/grey, dry, some rootlets present	sample composited

Table A Sample Register
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

Sample id	Sample Depth	Sample Type	PID (ppm)	Description	Analytes
MSW42	0.1-0.3m	soil	0.2	SANDY SILT: grey, dry, some rootlets also present	sample composited
MSW43	0.1-0.3m	soil	6.3	SANDY SILT: grey/brown, dry, some rootlets also present	sample composited
MSW44	0.1-0.3m	soil	3.5	SANDY SILT: grey, dry, some rootlets also present	sample composited
MSW45	0.1-0.3m	soil	2.6	SANDY SILT: grey, dry, some rootlets also present	sample composited
MSW46	0.1-0.3m	soil	0.2	CLAYEY SILT: dark/brown, moist, some rootlets also present	sample composited
MSW47	0.1-0.3m	soil	0.3	SILTY CLAY: dark/brown, moist, low plastiscity, some rootlets also present	sample composited
MSW48	0.1-0.3m	soil	0.1	CLAYEY SILT: dark, saturated, some decomposing organic matter also present	sample composited and POCAS
MSW49	0.1-0.3m	soil	0.3	CLAYEY SANDY SILT: dark/brown/grey, slightly moist	sample composited
MSW50	0.1-0.3m	soil	0.1	SANDY SILT: dark/grey, dry, some rootlets present	sample composited
MSW51	0.1-0.3m	soil	0	SANDY SILT: dark/grey, dry, some rootlets present	sample composited
MSW52	0.1-0.3m	soil	0	SANDY SILT: dark/grey, dry, some rootlets present	sample composited
MSW53	0.1-0.3m	soil	0.3	SANDY SILT: grey, dry	sample composited
MSW54	0.1-0.3m	soil	12.7	SANDY SILT: grey, dry, some rootlets also present	sample composited
MSW55	0.1-0.3m	soil	0.5	SANDY SILT: grey, dry, some rootlets also present	sample composited
MSW56	0.1-0.3m	soil	0.4	SANDY SILT: brown/grey, slightly moist, some rootlets presents	sample composited
MSW57	0.1-0.3m	soil	0	SANDY SILT: grey, slightly moist, some rootlets presents	sample composited
MSW58	0.1-0.3m	soil	0.1	SANDY SILT: grey, dry, some rootlets presents	sample composited
MSW59	0.1-0.3m	soil	0	SANDY SILT: grey, dry, some rootlets presents	sample composited
MSW60	0.1-0.3m	soil	0.2	SANDY SILT: dark/grey, slightly moist, some rootlets presents	sample composited
MSW61	0.1-0.3m	soil	2.6	CLAYEY SILT: grey, dry, some rootlets present	sample composited
MSW62	0.1-0.3m	soil	2.4	CLAYEY SILT: grey, dry, some rootlets present	sample composited
MSW63	0.1-0.3m	soil	0.8	CLAYEY SILT: grey/dark, slightly moist	sample composited

Table A Sample Register
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

Sample id	Sample Depth	Sample Type	PID (ppm)	Description	Analytes
MSW64	0.1-0.3m	soil	1.6	CLAYEY SILT: grey/dark, dry, some rootlets also present	sample composited
MSW65	0.1-0.3m	soil	6.4	CLAYEY SILT: grey/dark, dry	sample composited
MSW66	0.1-0.3m	soil	1.3	CLAYEY SAND: yellow/grey, dry, moderate to large sub-angular to angular particles, some extremely weathered sandstone also present	sample composited
MSW67	0.1-0.3m	soil	0.5	CLAYEY SANDY SILT: dark, moist, some rootlets also present	sample composited
MSW68	0.1-0.3m	soil	0.7	SANDY SILT: grey, dry, some pieces of decomposing timber also present	sample composited
MSW69	0.1-0.3m	soil	3.1	CLAYEY SAND: yellow/dark, slightly moist, moderate sized sub-angular particles	sample composited, TPH, BTEX & PAHs
MSW70	0.1-0.3m	soil	2.8	SANDY SILT: orange/brown, dry, some crushed terracotta brick also present	sample composited
MSW71	0.1-0.3m	soil	1.4	SANDY SILT: grey, dry, some rootlets and crushed brick also present	sample composited, TPH, BTEX & PAHs
MSW72	0.1-0.3m	soil	0.3	CLAYEY SANDY SILT: dark, moist, some rootlets also present	sample composited
MSW73	0.1-0.3m	soil	0.4	SANDY SILT: grey, dry, some large pieces of basalt gravel also present	sample composited, TPH, BTEX & PAHs
MSW74	0.1-0.3m	soil	3.4	SANDY SILT: grey, dry, some rootlets and crushed brick also present	sample composited
MSW75	0.1-0.3m	soil	3.1	CLAYEY SANDY SILT: dark, moist, some rootlets also present	sample composited
MSW76	0.1-0.3m	soil	2.1	SANDY SILT: orange/brown, dry, some crushed terracotta brick also present	sample composited
MSW QA1	-	soil	-	Duplicate sample of MSW1	sample composited
MSW QA2	-	soil	-	Duplicate sample of MSW2	sample composited
MSW QA3	-	soil	-	Duplicate sample of MSW3	sample composited

Table A Sample Register
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

Sample id	Sample Depth	Sample Type	PID (ppm)	Description	Analytes
MSW QA4	-	soil	-	Duplicate sample of MSW4	sample composited
MSW QA5	-	soil	-	Duplicate sample of MSW5	sample composited
MSW QA6	-	soil	-	Duplicate sample of MSW9	sample composited
MSW QA7	-	soil	-	Duplicate sample of MSW8	sample composited
MSW QA8	-	soil	-	Duplicate sample of MSW13	sample composited
MSW QA9	-	soil	-	Duplicate sample of MSW14	sample composited
MSW COMP1	-	soil	-	Composite sample of MSW1, MSW2 and MSW3	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP2	-	soil	-	Composite sample of MSW4, MSW5 and MSW9	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP3	-	soil	-	Composite sample of MSW6, MSW7, MSW11 and MSW12	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP4	-	soil	-	Composite sample of MSW8, MSW13 and MSW14	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP5	-	soil	-	Composite sample of MSW10, MSW15 and MSW16	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP6	-	soil	-	Composite sample of MSW17, MSW26 and MSW27	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP7	-	soil	-	Composite sample of MSW18, MSW19 and MSW28	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP8	-	soil	-	Composite sample of MSW20, MSW29 and MSW30	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP9	-	soil	-	Composite sample of MSW21, MSW22 and MSW32	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP10	-	soil	-	Composite sample of MSW23, MSW33 and MSW34	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP11	-	soil	-	Composite sample of MSW24, MSW25 and MSW35	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs

Table A Sample Register
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

Sample id	Sample Depth	Sample Type	PID (ppm)	Description	Analytes
MSW COMP12	-	soil	-	Composite sample of MSW36, MSW46 and MSW47	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP13	-	soil	-	Composite sample of MSW37, MSW38 and MSW48	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP14	-	soil	-	Composite sample of MSW39, MSW40 and MSW49	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP15	-	soil	-	Composite sample of MSW31, MSW41 and MSW42	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP16	-	soil	-	Composite sample of MSW43, MSW44 and MSW53	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP17	-	soil	-	Composite sample of MSW45, MSW54 and MSW55	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP18	-	soil	-	Composite sample of MSW50, MSW56 and MSW57	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP19	-	soil	-	Composite sample of MSW51, MSW52 and MSW58	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP20	-	soil	-	Composite sample of MSW59, MSW60 and MSW63	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP21	-	soil	-	Composite sample of MSW61, MSW62 and MSW64	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP22	-	soil	-	Composite sample of MSW65, MSW71 and MSW72	As, Cd, Cr, Cu, Pb, Hg, Ni & Zn
MSW COMP23	-	soil	-	Composite sample of MSW66, MSW68 and MSW73	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP24	-	soil	-	Composite sample of MSW67, MSW74 and MSW75	As, Cd, Cr, Cu, Pb, Hg, Ni & Zn
MSW COMP25	-	soil	-	Composite sample of MSW69, MSW70 and MSW76	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs

Table A Sample Register
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

Sample id	Sample Depth	Sample Type	PID (ppm)	Description	Analytes
MSW COMP QA1	-	soil	-	Composite sample of MSW QA1, MSW QA2 and MSW QA3	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP QA2	-	soil	-	Composite sample of MSW QA4, MSW QA5 and MSW QA6	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
MSW COMP QA3	-	soil	-	Composite sample of MSW QA7, MSW QA8 and MSW QA9	As, Cd, Cr, Cu, Pb, Hg, Ni, Zn & OCPs
Rinsate Blank	-	water	-	Rinsate blank collected from hand auger	As, Cd, Cr, Cu, Pb, Hg, Ni & Zn

Table B Metals Results
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

all units in mg/kg

Sample id	Date sampled	Metals							
		As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Assessment criteria [1]		500	100	500 (VI)	5000	1500	75	3000	35000
Ecological Investigation Level [2]		20	3	400 (III)	100	600	1	60	200
PQL		3	0.5	0.5	0.5	2	0.05	0.2	0.5
MSW COMP1	9/11/2003	5	nd	10	10	27	0.06	1	35
MSW COMP2	9/11/2003	4	nd	12	14	49	0.06	1	54
MSW COMP3	9/11/2003	nd	nd	7	9	26	nd	0.7	29
MSW COMP4	9/11/2003	nd	nd	12	12	44	nd	0.8	47
MSW COMP5	9/11/2003	nd	nd	8	6	14	nd	1	30
MSW COMP6	9/11/2003	4	nd	13	13	30	nd	2	38
MSW COMP7	9/11/2003	nd	nd	8	3	17	nd	0.5	9
MSW COMP8	9/11/2003	3	nd	8	31	23	0.06	2	83
MSW COMP9	9/11/2003	nd	nd	9	7	21	nd	0.9	36
MSW COMP10	9/11/2003	nd	nd	9	1	11	nd	0.3	14
MSW COMP11	9/11/2003	nd	nd	5	7	19	nd	0.6	73
MSW COMP12	9/11/2003	10	0.5	17	33	71	0.1	7	310
MSW COMP13	9/11/2003	3	nd	5	40	11	nd	0.7	13
MSW COMP14	9/11/2003	nd	nd	1	2	8	nd	0.4	10
MSW COMP15	9/11/2003	nd	nd	3	5	8	nd	0.4	37
MSW COMP16	9/11/2003	nd	nd	2	2	6	nd	0.3	9
MSW COMP17	9/11/2003	nd	nd	12	4	13	nd	1	25
MSW COMP18	9/11/2003	nd	nd	1	nd	3	nd	nd	3
MSW COMP19	9/11/2003	nd	nd	0.9	nd	8	nd	0.2	4
MSW COMP20	9/11/2003	nd	nd	0.6	0.5	3	nd	nd	0.7
MSW COMP21	9/11/2003	nd	nd	6	9	28	nd	2	300
MSW COMP22	9/11/2003	nd	nd	3	4	16	nd	0.6	16
MSW COMP23	9/11/2003	nd	nd	19	220	210	0.77	10	1000
MSW COMP24	9/11/2003	nd	nd	9	29	47	0.11	2	52
MSW COMP25	9/11/2003	nd	nd	18	42	78	0.05	8	150

Table B Metals Results
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

all units in mg/kg

Sample id	Date sampled	Metals							
		As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Assessment criteria [1]		500	100	500 (VI)	5000	1500	75	3000	35000
Ecological Investigation Level [2]		20	3	400 (III)	100	600	1	60	200
PQL		3	0.5	0.5	0.5	2	0.05	0.2	0.5
MSW COMP QA1	9/11/2003	5	nd	11	10	28	0.06	0.9	24
MSW COMP QA2	9/11/2003	7	nd	13	19	55	0.07	2	52
MSW COMP QA4	9/11/2003	7.4	nd	14	19	64	nd	nd	68

Notes

1 National Environment Protection (Assessment of Site Contamination) Measure 1999 - Schedule B(1) Soil Investigation Levels for 'Standard residential with accessible soils and gardens' setting

2 National Environment Protection (Assessment of Site Contamination) Measure 1999 - Schedule B(1) Ecological Investigation Levels - Interim Urban

nd - not detected

note - all assessment criteria should be divided by 3 for assessment purposes, to account for three point composites, and divided by four for MSW COMP 4 to account for four point compositing

Exceeds Site Assessment Criteria

Exceeds Ecological Investigation Levels

Table C Organochlorine Pesticides Results
Environmental Site Assessment
Meriton Development Site, Macpherson St Warriewood

all units in mg/kg

Sample id	Date sampled	Organochlorine Pesticides																			
		Total OCPs	alpha-BHC	HCB	beta-BHC & gamma-BHC	delta-BHC	Heptachlor	Aldrin	Heptachlor epoxide	Chlordane-trans	alpha-Endosulfan	Chlordane-cis	Dieldrin	DDE	Endrin	beta-Endosulfan	DDD	Endrin aldehyde	Endosulfan sulfate	DDT	Endrin ketone	Methoxychlor
Assessment criteria [1]			-	-	-	-	10	10 [2]	-	50 [3]	-	50 [3]	10 [2]	200 [4]	-	-	200 [4]	-	-	200 [4]	-	-
PQL			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MSW COMP1	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.22	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP2	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.16	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP3	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP4	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.11	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP5	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP6	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP7	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP8	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.21	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP9	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.11	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP10	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP11	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP12	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP13	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP14	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP15	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP16	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP17	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP18	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP19	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP20	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP21	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP22	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP23	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP24	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP25	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP QA1	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.16	nd	nd	nd	nd	nd	nd	nd	nd
MSW COMP QA2	9/11/2003	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.26	nd	nd	nd	nd	nd	nd	nd	nd

APPENDIX B

Laboratory Results and QA/QC Documentation

SGS

18 November 2003 TEST REPORT

Environmental Audits of Australia
13 Daking Street
NORTH PARRAMATTA
NSW 2151

Your Reference: Meriton Apartments Warriewood
Report Number: 25726

Attention: Matt Parkinson

Dear Matt
The following samples were received from you on the date indicated.

Samples: Qty.	32 Soils, 1 Water
Date of Receipt of Samples:	10/11/03
Date of Receipt of Instructions:	10/11/03
Date Preliminary Report Faxed:	17/11/03

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

 # POCAS analysed by SGS Cairns Report No. 46223. See Appendix 1 for results.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

Tania Notaras
Manager Sydney

Jacinta Hurst
Operations Manager

Acid Extractable Metals in Soil Our Reference: Your Reference	UNITS	25726-1 MSW COMP 1	25726-2 MSW COMP 2	25726-3 MSW COMP 3	25726-4 MSW COMP 4	25726-5 MSW COMP 5
Arsenic	mg/kg	5	4	<3	<3	<3
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	10	12	7	12	8
Copper	mg/kg	10	14	9	12	6
Lead	mg/kg	27	49	26	44	14
Mercury	mg/kg	0.06	0.06	<0.05	<0.05	<0.05
Nickel	mg/kg	1	1	0.7	0.8	1
Zinc	mg/kg	35	54	29	47	30

Acid Extractable Metals in Soil Our Reference: Your Reference	UNITS	25726-6 MSW COMP 6	25726-7 MSW COMP 7	25726-8 MSW COMP 8	25726-9 MSW COMP 9	25726-10 MSW COMP 10
Arsenic	mg/kg	4	<3	3	<3	<3
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	13	8	8	9	9
Copper	mg/kg	13	3	31	7	1
Lead	mg/kg	30	17	23	21	11
Mercury	mg/kg	<0.05	<0.05	0.06	<0.05	<0.05
Nickel	mg/kg	2	0.5	2	0.9	0.3
Zinc	mg/kg	38	9	83	36	14

Acid Extractable Metals in Soil Our Reference: Your Reference	UNITS	25726-11 MSW COMP 11	25726-12 MSW COMP 12	25726-13 MSW COMP 13	25726-14 MSW COMP 14	25726-15 MSW COMP 15
Arsenic	mg/kg	<3	10	3	<3	<3
Cadmium	mg/kg	<0.5	0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	5	17	5	1	3
Copper	mg/kg	7	33	40	2	5
Lead	mg/kg	19	71	11	8	8
Mercury	mg/kg	<0.05	0.10	<0.05	<0.05	<0.05
Nickel	mg/kg	0.6	7	0.7	0.4	0.4
Zinc	mg/kg	73	310	13	10	37

Acid Extractable Metals in Soil Our Reference: Your Reference	UNITS	25726-16 MSW COMP 16	25726-17 MSW COMP 17	25726-18 MSW COMP 18	25726-19 MSW COMP 19	25726-20 MSW COMP 20
Arsenic	mg/kg	<3	<3	<3	<3	<3
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	2	12	1	0.9	0.6
Copper	mg/kg	2	4	<0.5	2	0.5
Lead	mg/kg	6	13	3	8	3
Mercury	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	mg/kg	0.3	1	<0.2	0.2	<0.2
Zinc	mg/kg	9	25	3	4	0.7

Acid Extractable Metals in Soil Our Reference: Your Reference	UNITS	25726-21 MSW COMP 21	25726-22 MSW COMP 22	25726-23 MSW COMP 23	25726-24 MSW COMP 24	25726-25 MSW COMP 25
Arsenic	mg/kg	<3	<3	<3	<3	3
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	6	3	19	9	18
Copper	mg/kg	9	4	220	29	42
Lead	mg/kg	28	16	210	47	78
Mercury	mg/kg	<0.05	<0.05	0.77	0.11	0.05
Nickel	mg/kg	2	0.6	10	2	8
Zinc	mg/kg	300	16	1000	52	150

Acid Extractable Metals in Soil Our Reference: Your Reference	UNITS	25726-31 MSW COMP QA1	25726-32 MSW COMP QA2
Arsenic	mg/kg	5	7
Cadmium	mg/kg	<0.5	<0.5
Chromium	mg/kg	11	13
Copper	mg/kg	10	19
Lead	mg/kg	28	55
Mercury	mg/kg	0.06	0.07
Nickel	mg/kg	0.9	2
Zinc	mg/kg	24	52