

Urbis Pty Ltd

**Beechwood Homes, Thornton
North**

Preliminary Site Contamination
Investigation

November 2003



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1. Introduction

1.1 General

A Preliminary Site Contamination Assessment was carried out by GHD on a parcel of land located on Raymond Terrace Road, Thornton NSW (Figure 1, Appendix A). The assessment was undertaken on behalf of Beechwood Homes (the client).

The objectives of the investigation were:

- ▶ To identify past and present potentially contaminating activities on the site;
- ▶ To report on the site condition;
- ▶ To assess whether contamination is likely to be an issue for the proposed redevelopment of the site for residential land use; and
- ▶ To recommend any further investigation that may be required.

The investigation was carried out in general accordance with the requirements for a Preliminary Site Investigation as described in the NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (1997).

1.2 Scope of Works

The scope of works for the Preliminary Site Contamination Assessment was designed to assess the past and present activities and conditions that could result in soil and/or groundwater contamination, and obtain limited representative data to support the assessment. To this end the following were undertaken:

- ▶ A review of the Maitland City Council Section 149 (2) Certificates for the site to identify any reference regarding potential for contamination;
- ▶ A review of historical and current aerial photographs;
- ▶ Consultation where possible with land owners to identify former activities on the property;
- ▶ Review of any other relevant information held by Maitland City Council and the client;
- ▶ A site inspection by a GHD Environmental Scientist to identify any existing activities or conditions within or adjoining the site that could have potentially caused or indicate contamination; and
- ▶ Limited soil sampling of 44 locations and analysis of selected samples for organochlorine pesticides (OCP), Total Petroleum Hydrocarbons (TPH) in the C₁₀-C₃₆ range and heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc).



In November 2003, additional investigations were conducted to include the northern portion of Lot 12 DP 603613, which had not been previously targeted by the above scope of works. The scope of the additional works included review of the documents described above, site inspection of the northern section of land, limited soil sampling of four locations and analysis of selected samples for OCP, BTEX, TPH in the C₆-C₃₅ range and heavy metals.



2. Site Condition and Surrounding Environment

2.1 Site Location

The site is located to the north of Raymond Terrace Road, Thornton NSW. Site plans are presented in Figures 1 and 2 in Appendix A. The property (Lot 12 DP 603613) covers an area of approximately 53 ha.

2.2 Property Identification Information

The property has been identified as Lot 12 DP 603613 and zoned by Maitland City Council as 1(b) Secondary Rural Land.

2.3 Site Conditions

A GHD Environmental Scientist undertook the initial site inspection on 5 May 2003, and an additional site inspection was undertaken on 4 November 2003. The site consisted of gently undulating pastures with a small number of trees, sloping to the west towards Four Mile Creek. Four turkey farms and associated infrastructure were located across the site.

Three of the farms consisted of three sheds each plus associated infrastructure and residence, the other farm consisted of four sheds plus associated residence and infrastructure. Three of the farms were located in the southern half of the site; the fourth is located in the northeastern corner.

Several of the sheds associated with the various turkey farms were constructed from a combination of brick and fibro-cement sheeting, which potentially may contain asbestos. The turkey sheds appeared to be constructed from corrugated iron, however a comprehensive evaluation of the sheds was not undertaken and there is the potential that asbestos containing material may have been used in their construction.

There was evidence of an oil stain approximately 2 m² adjacent to an above ground diesel tank located on the east side of turkey farm 1 as identified on Figure 2 (sample location TN1). Oil staining (approximately 1 m²) was also noted adjacent to a square aboveground storage tank located to the east of turkey farm 4 and adjacent to a concrete pad with an area of approximately 4 m² (sample location TN22). The contents of the tank was not identified but is thought to be either diesel or heating oil. In addition, the location of this tank was close to the boundary of the site and there is a possibility that this tank may be located offsite.

There was no other evidence of chemical usage or storage during both site inspections, although assessment of the various sheds contents was not undertaken.

Three large water tanks were located north of the storage tank near turkey farm 4. A Holden engine located between two of the tanks was used to drive the water pumps. A 20 L fuel drum was identified near the engine. No staining was noted on surface soils in this area.



The remainder of the property consisted of well vegetated pastures, with the paddocks delineated by barbed wire fences. Several of the paddocks contained small dams for the watering of stock. Apart from the storage of oils and fuels and the associated oil staining associated with the above ground diesel storage tanks, there were no obvious sources or signs of contamination.

A small dam in the northern section of the site had been used for the disposal of solid waste i.e. car bodies, old footings, 44 gallon drums, car batteries and white goods which also were potential sources of contamination.

Discussions with employees of the turkey farms identified two areas used as burial pits. These were located on the east and west side of farm number 3 as identified on Figure 2, outside the quarantine exclusion zone. There is the potential that other areas may have been used as burial pits, which were not known or identified by the employee interviewed.

During the November site inspection, a disturbed area of soil located on the north western side of the site was identified (near sample location TN21 on Figure 2). This area may have been used for the disposal of solid waste or used as burial pits.

Surrounding Land Uses

During the field investigation the land uses surrounding the property were identified as follows:

North: Farmland and turkey sheds are located to the north. The Morpeth Sewerage Treatment Works is located further north approximately 1.2 km from the site;

South: A residential area; Raymond Terrace Road; A residential area of Thornton; the Great Northern Railway and lightly timbered paddocks;

West: Low lying land and wetlands surrounding Four Mile Creek; the Don Macindoe Memorial Flying Field; the Maitland War Memorial, and the residential area of Metford.

East: Poultry sheds and heavily timbered paddocks are located to the east.

2.4 Sensitive Receptors

During the site inspection a GHD environmental scientist noted the following sensitive receptors within the area surrounding the site:

- ▶ Four Mile Creek and associated wetlands located directly to the west and down gradient of the site; and
- ▶ Residential housing located to the southwest of the site.



3. Topography and Hydrology

3.1 Topography

The main topographic feature of the site is a gully running diagonally across the site from the southeast corner to the northwest portion of the site with water flowing in a north westerly direction towards Four Mile Creek. This gully appears to drain the majority of the southern portion site, with the exception of a small area on the western boundary, which dips westward toward Four Mile Creek. The northern portion of the site drains north west towards Four Mile Creek.

The site varies in height between 10 m Australian Height Datum (AHD) and 30 m AHD.

3.2 Hydrology

The general topography of the land indicates that all would eventually drain into Four Mile Creek. During the site investigation, no surface water other than dams and Four Mile Creek was noted. Four Mile Creek eventually drains into wetlands approximately 8.5 km southwest of the site.



4. Geology and Hydrogeology

4.1 Geology

The Newcastle Geological Mapsheet S1 56-2 1:250,000 shows the site to be underlain by the Tomago Coal Measures which is comprised of shale, mudstone, sandstone, tuff, and coal. The map also shows that quaternary marine and freshwater deposits, which are comprised of gravel, sand, silt, clay and/or "Waterloo Rock", may also be present in the area of the site.

A review of the Newcastle Soil Landscape Map identified the site as being within the Beresfield Soil Landscape Group. The Beresfield Soils are highly erodible and potentially subject to water logging (Newcastle Soil Landscape Series 1995).

The upper 300 mm of soil at the site generally consisted of light brown silty loams with traces of gravel. Small outcroppings of stone were noticed along gully lines.

4.2 Hydrogeology

No details are available on the depth of groundwater at the site. However, GHD personnel with experience drilling in the area expect the groundwater depth to be between 5 and 10 metres below the ground surface. It is expected that regional groundwater flow would be to the west/southwest, generally following the ultimate course of Four Mile Creek.

4.3 Geotechnical Investigation

A Preliminary Geotechnical Investigation (Douglas Partners, 2003) was undertaken of the subject site, which included a desk top study, a site walkover and test pitting.

The investigation found that silty sand/sandy silt topsoils were present at depths of 0.2 m to 0.6 m, with sandy clay/clayey sand, silty clay and sandstone/siltstone present in subsurface layers. Groundwater was not encountered with pits excavated to a depth of 2.8 m below surface level.

The investigation also identified the rubbish dump in the northwest of the site and two locations that appeared to be filled-in trenches, as discussed elsewhere in this Preliminary Site Contamination Investigation report.



5. Site History

5.1 Previous Investigations

GHD understands that no previous investigations have been undertaken at the site.

5.2 Aerial Photographs

The 1954 aerial photograph shows the site to be lightly to moderately timbered, with numerous tracks and no indications of development.

By 1975 the site had been cleared for pastures including the creation of several small dams and a poultry farm located in the north east corner of the site. The poultry farm consisted of two sheds and associated infrastructure.

By 2001 three more poultry farms each consisting of three sheds, associated infrastructure and residences had been established in the southwest of the site and another two poultry sheds added to the original farm in the north east corner of the site.

From this review it can be concluded that the current site operations commenced sometime between 1954 and 1975, with full production beginning in the period between 1975 and 2001.

5.3 Section 149 Certificates

The 149 certificates for Lot 12 DP 603613 state that the land has not been identified as land including or comprising critical habitat nor listed as containing any areas or buildings of Environmental or State heritage. The land is not affected by any matters arising under Section 59(2) of the *Contaminated Land Management Act 1997*.



6. Potential Contaminants of Concern

Based on historical review of the site there is a low potential for significant contamination. However, a number of potential contaminant sources and areas of potential contamination have been identified on the site.

Table 6.1 presents the potential contaminants and associated areas of the site.

Table 6.1 Potential Sources of Contamination

Possible Source	Potential Contaminants
Pesticides, herbicides and fertilisers applied to pastures and/or around buildings	Organochlorine pesticides (OCP), organophosphate pesticides (OPP), Heavy metals
Imported fill	Heavy metals, Total Petroleum hydrocarbon (TPH), Benzene, Toluene, Ethyl benzene and Xylene (BTEX), PAHs, pH, OCPs and Polychloride biphenyls (PCB)
Paint used on the building materials of the sheds and houses	Lead, zinc
Fuel storage	TPH, BTEX, PAH, lead
Fibre cement building products	Asbestos
Waste Disposal Areas	Heavy metals, Total Petroleum hydrocarbon (TPH), Benzene, Toluene, Ethyl benzene and Xylene (BTEX), PAHs, pH, OCPs and Polychloride biphenyls (PCB), asbestos
Burial Pits	Biological hazards

Due to the lack of persistence in soils, analysis is not usually undertaken for OPPs. Based on the scope of works for the project, no samples of the building materials or the paints used on the buildings were analysed for lead, zinc or asbestos.



7. Sampling and Analysis Plan and Methodology

7.1 Data Quality Objectives

The purpose of establishing data quality objectives is to ensure the field investigations and analyses are undertaken in a way that enables the collection and reporting of reliable data on which to base the site assessment. The data quality objectives (DQOs) and the procedures designed to achieve these objectives are listed below.

- ▶ Data Representativeness – Sampling on a systematic basis across the site to obtain samples from representative locations and strata across the entire area. The sampling locations were developed after the site historical investigation and giving close consideration to the overall purpose(s) of the investigation. Sampling intervals were selected in the field based on observed soil strata at each location.
- ▶ Document Completeness – Ensuring reliability and accuracy in any observations made during data collection (eg. completion of field environmental notes); and ensuring clarity in instructions and directions given to all those who have the potential to influence the quality of the data (eg. completion of field and laboratory chain of custody documentation).
- ▶ Data Comparability – Use of NATA certified laboratory, standard laboratory methodology and use of consistent sampling techniques (by professional staff in accordance with GHD's Standard Field Operating Procedures).
- ▶ Precision and Accuracy for Sampling and Analysis – Achievement of required RPDs (Relative Percent Differences) for duplicate analysis and laboratory QC results within the relevant Quality Control Criteria.
- ▶ Decision Rules – Data was compared against investigation guidelines made or endorsed by NSW EPA.

7.2 Rationale For Sampling And Analysis Plan

The sampling and analytical program was based on GHD's knowledge of the site, information obtained from Beechwood Homes, GHD's experience on similar sites and guidelines made or approved by the NSW EPA.

Based on the information provided by Beechwood Homes, the total area of the site is approximately 53 ha. Based on the available site history and uniform land use, GHD sampled 22 locations in the pastures on generally a systematic basis and 26 locations around the buildings with soil samples taken on each side of the building. The samples were taken to provide a preliminary indication of contaminant concentrations in representative areas of the site. Sampling locations are presented in Figure 2 in Appendix A.

Targeted sampling of waste disposal area, burial pits and areas adjacent to the residences was not undertaken during this phase of the investigations it was beyond the scope of this investigation.



7.3 Field Work

A GHD Environmental Scientist conducted initial field investigations on 5 May 2003 and additional investigations on 4 November 2003. All fieldwork was undertaken in accordance with the GHD Standard Field Operating Procedures.

Soil samples were collected to a maximum depth of 0.3 metres, using a hand auger or shovel. Samples were collected at the surface (0.0 m – 0.1 m) and at depth (0.2–0.3 m).

Duplicate samples (including blind and split duplicates) were taken for Quality Control purposes at a rate of 1 in 10 samples.

To prevent cross-contamination of samples, all sampling equipment was thoroughly decontaminated using Decon 90 solution and rinsed with tap water between each sampling interval. A new pair of disposable latex gloves was worn by personnel for the collection of each sample.

The collected samples were immediately transferred to appropriate sample containers, which had been pre-treated in a manner appropriate for the laboratory analysis. All sample containers were clearly labelled with the sample number, sample location, sample depth, sample date and samplers initials. The sample containers were then transferred to a chilled cooler for sample preservation prior to and during shipment to the testing laboratory. A Chain-of-Custody form was forwarded with the samples to the testing laboratory.

Soil conditions encountered in all boreholes completed during the investigations were tabulated detailing soil characteristics, with any features such as discolouration, staining, odours and other indications of contamination being noted (see Table A in Appendix B).

7.3.1 Laboratory Analytical Program

Laboratory analysis was undertaken using a NATA accredited laboratory. Details of the number of sample locations, parameters and number of analyses are summarised in Table 7.1 below.

Table 7.1 Investigation Analytical Program

Analyte	Number of Samples Analysed ³
Heavy Metals ¹	46
OCP ²	21
TPH/C ₆ – C ₉ and BTEX	1
TPH/C ₁₀ – C ₃₆	2

1. Metals included As, Cd, Cr, Cu, Hg, Pb, Ni, and Zn.
2. Composite samples were prepared in the laboratory from sub samples of individual submitted samples.
3. Excluding duplicate samples



While OPP was identified as a potential contaminant, due to its lack of persistence in soils it was not analysed. PAHs were not analysed, as there was no evidence of ash material at the locations sampled. PAHs could be associated with areas of hydrocarbon contamination. Although the diesel stained area may contain PAHs, analysis was not in the scope of the works. The potential presence of asbestos was based on visual assessment of soils for fragments of asbestos bearing materials (ABM).



8. Quality Assurance / Quality Control

8.1 Field Quality Assurance / Quality Control (QA/QC)

8.1.1 Field Quality Assurance

All fieldwork was conducted in general accordance with the GHD Field Operating Procedures (FOP). The FOP ensure that all environmental samples were collected by a set of uniform and systematic methods.

The FOP describes many field activities including:

- ▶ Implemented decontamination procedures;
- ▶ Sample identification procedures;
- ▶ Information requirements for soil bore logs;
- ▶ Chain of custody information requirements;
- ▶ Sample duplicate frequency; and
- ▶ Field equipment calibration requirements.

8.1.2 Field Quality Control

Field quality control procedures used during the project comprised the following:

Blind Duplicates (Soil): These are prepared in the field by duplicating the original sample and placing two equivalent portions into two separate containers. The blind duplicate sample is sent anonymously to the project laboratory. For the blind duplicate sample pair, RPDs (relative percentage difference) were calculated. Blind duplicates provide an indication of the analytical precision of the project laboratory, but may also be affected by factors such as sampling methodology or inherent heterogeneity of the sample medium. Three duplicate samples were analysed for heavy metals.

8.2 Laboratory Quality Assurance / Quality Control (QA/QC)

8.2.1 Laboratory Quality Assurance

The analytical laboratories undertook the analyses utilising their own internal procedures and their test methods (for which they are NATA accredited) and in accordance with their own quality assurance system which forms part of their NATA accreditation.



8.2.2 Laboratory Quality Control

Laboratory quality control procedures used during the project and reported comprised the following:

- ▶ **Laboratory Duplicate Samples:** Analysis of duplicate sub-samples from one sample submitted for analytical testing and analysis of the samples in the one batch. A laboratory duplicate provides data on the analytical precision (repeatability) of an analytical batch;
- ▶ **Spiked Samples:** A sample is spiked by adding a known concentration of the target analyte(s) to the sample matrix prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques; and
- ▶ **Laboratory Blank:** Usually an organic or aqueous solution that is as free of analyte as possible and contains all the reagents in the same volume as used in the processing of the samples. The reagent blank must be carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample. Other internal laboratory quality control procedures, as required for NATA registration, are performed and are not reported by the laboratories. These procedures and results can be provided on request.



9. Basis For Contamination Assessment

9.1 Relevant Guidelines

The following guidelines were used to assess the soil contamination status of the site:

- ▶ NSW Environment Protection Authority (EPA) (1994) "Guidelines for Assessing Service Station Sites";
- ▶ NSW EPA (1998) "Guidelines for the NSW Site Auditor Scheme";
- ▶ Australian and New Zealand Environmental Conservation Council / National Health and Medical Research Council (ANZECC / NHMRC) (1992) "Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites"; and
- ▶ National Environment Protection Council (NEPC) (1999) "National Environmental Protection (Assessment of Site Contamination) Measure 1999" (NEPM).

9.2 Assessment Criteria

The NEPM (1999) includes a range of Soil Investigation Levels including Ecological Investigation Levels (EILs) largely similar to the Environmental Investigation Thresholds (EITs) listed in the Australian and New Zealand Guidelines for The Assessment and Management of Contaminated Sites (ANZECC/NHMRC 1992). Health Investigation Levels (HILs) listed in the NEPM are generally the same as the Health-based Soil Investigation Levels (HBSILs) listed in the Guidelines for the NSW Site Auditor Scheme (NSW EPA, 1998). However, the criteria in these guidelines are restricted to non-volatile and semi-volatile substances and do not include all the potential contaminants that may be at the site. Therefore, for the substances not included in these guidelines, the Threshold Concentrations (TC) from the Guidelines for Assessing Service Station Sites (1994) have been used.

Essentially both EILs and HILs are default values designed to protect the environmental and human receptors respectively. ANZECC/NHMRC recommends that generally where EITs are exceeded, an investigation should take place, but it is stressed that the values are intended as a guide only and site specific factors need to be taken into account when assessing data. It is stated in the NEPM that "in general terms the guideline values will protect the most sensitive receptor", and of the receptors considered, the most sensitive and hence most stringent guidelines are for the protection of plant life.

The NEPM also uses the ANZECC / NHMRC 1992 definition of Investigation Level as the concentration above which further appropriate investigation and evaluation will be required. The EILs are based on consideration of phytotoxicity and soil survey data, and supported by the "ANZECC B" EITs. It is acknowledged that future ecologically-based guidelines will be developed at regional level and related to land use, and that specific circumstances may warrant the use of more pertinent regional values.



The basis on which the HILs (or HBSILs) have been set should be assessed for relevance to the situation under consideration. HILs are provided for a range of different exposure settings or land uses:

- ▶ "A" Standard, Residential with garden/accessible soil (includes children day-care centres, kindergartens, pre-schools and primary schools);
- ▶ "D" Residential with minimal opportunities for soil access;
- ▶ "E" Parks, recreational open space and playing fields (including secondary schools); and
- ▶ "F" Commercial/industrial (includes shops, offices, factories and industrial sites).

GHD understands that the site is to be redeveloped for the provision of residential purposes, and the current zoning is 1 (b) Secondary Rural Land. Therefore the investigation level considered appropriate for this assessment is Setting A for Standard Residential with garden/accessible soil. EILs have also been used to provide guidance with respect to potential environmental impacts.

It is stated in the NEPM [Schedule B(7a)] that the HILs provide "a trigger to assist in judging whether a detailed investigation of a site is necessary". It is also stated "the levels should not be interpreted rigidly" and "the proposed land use, distribution of contaminants and the frequency distribution of elevated levels will all be very important in interpreting the results for a site". Separate health and environmental investigation levels have been established to take into account the different sensitivities of humans and other components of the environment. The HILs are typically higher than, or in rare cases (eg lead) equal to, or less than the EILs. Site specific decisions need to be made to determine whether health or environmental levels (or both) should apply.

The methodology used when assessing contamination levels in soils at the site was to use the EILs and HILs as cut off points to classify soils either as:

- ▶ Soils not contaminated, which pose no risk to the environment or human health and warrant no further action, i.e. concentrations less than or equal to the EILs;
- ▶ Soils containing elevated concentrations of contaminants, which may pose a risk to the environment (in particular plant species) but pose no risk to human health under the proposed land use scenario, i.e. concentrations greater than the EILs and less than the HILs. These soils may warrant some form of remediation or management subject to further assessment giving consideration to environmental and health risks and proposed land use; and
- ▶ Soils significantly contaminated which pose a risk to both the environment and human health, i.e. concentrations greater than or equal to the HILs. Soils in this category would likely require remediation or management to permit the proposed land use, or would require a Site Specific, Risk Based Assessment to further determine potential risk to human health and the environment.

The methodology used to develop Ecological Investigation Levels (EILs) and Health Investigation Levels (HILs) for this site was in accordance with EPA recommendations and comprised the following (in order of preference).



Ecological Investigation (EIL or TC)

- ▶ NEPC (1999) NEPM Schedule B(1), Ecological Investigation Levels;
- ▶ NSW EPA (1998) "Guidelines for the NSW Site Auditor Scheme", Provisional Phytotoxicity – Based investigation Levels;
- ▶ ANZECC (1992), "Guidelines for the Assessment and Management of Contaminated Sites", Environmental Investigation Thresholds; and
- ▶ NSW EPA (1994) "Guidelines for Assessing Service Station Sites", Threshold Concentration for Sensitive Land Use - Soils (protection of terrestrial organisms in soil).

Health Investigation Levels (HIL or TC)

- ▶ NEPC (1999) NEPM Schedule B(1), Health Investigation Levels, Exposure Setting A: Standard Residential.
- ▶ NSW EPA (1998) "Guidelines for the NSW Site Auditor Scheme" incorporating the National Environmental Health Forum (1996), Soil Series No. 1, Health Based Soil Investigation Levels, Exposure Setting A: Standard Residential.
- ▶ NSW EPA (1994) "Guidelines for Assessing Service Station Sites", Threshold Concentration for Sensitive Land Use - Soils (human health based levels).

Table 9.1 provides a summary of the investigation levels that were used to assess contamination levels.

Table 9.1 Soil Assessment Criteria

Parameter	Environmental Criteria (EIL ^(a) or TC) (mg/kg)	Health-Based Criteria (HIL A ^(f) or TC) (mg/kg)
pH	6-8 ^(d) pH units	-
Arsenic	20	100
Cadmium	3	20
Chromium	50 ^(b)	100 ^(c)
Copper	100	1000
Lead	300	600
Nickel	60	600
Zinc	200	7000
Mercury	1	15
TPH C6-C9	-	65 ^(e)
C10-C36	-	1000 ^(e)
Benzene	1 ^{(e)(g)}	1 ^{(e)(h)}
Toluene	1.4 ^{(e)(h)}	130 ^(e)
Ethyl Benzene	3.1 ^{(e)(h)}	50 ^(e)
Xylene	14 ^{(e)(h)}	25 ^(e)



Parameter	Environmental Criteria (EIL ^(a) or TC) (mg/kg)	Health-Based Criteria (HIL A ^(f) or TC) (mg/kg)
Organochlorine Pesticides (indiv)	0.2 Dieldrin ^(d)	10 Aldrin+Dieldrin 50 chlordane 200 DDT + DDD + DDE 10 heptachlor

Notes: All units in mg/kg unless otherwise noted.

- a) Primarily NEPC (1999) NEPM Schedule B(1), Ecological Investigation Levels.
- b) ANZECC (1992), Guidelines for the Assessment and Management of Contaminated Sites, Environmental Investigation Thresholds Level where valance state is not distinguished but expected to be Cr(III).
- c) ANZECC (1992), Guidelines for the Assessment and Management of Contaminated Sites, Environmental Investigation Thresholds Based on Cr(VI).
- d) ANZECC (1992), Guidelines for the Assessment and Management of Contaminated Sites, Environmental Investigation Thresholds.
- e) From NSW EPA (1994) Guidelines for Assessing Service Station Sites, Threshold Concentration for Sensitive Land Use - Soils.
- f) NEPC (1999) NEPM Schedule B(1), Health Investigation Levels, Exposure Setting A: Standard Residential.
- g) From NSW EPA (1994) Guidelines for Assessing Service Station Sites, Threshold Concentration for Sensitive Land Use. A lower benzene concentration may be needed to protect groundwater.
- h) From NSW EPA (1994) Guidelines for Assessing Service Station Sites, Netherlands MPC to protect terrestrial organisms in soil.



10. Quality Control Assessment Guidelines And Methodology

The results of the field and laboratory quality control samples will be assessed to determine:

- ▶ The quality of the data generated;
- ▶ If the data meets the objectives of the study; and
- ▶ If the data is acceptable for the intended use.

10.1 Field Quality Control

Assessment of field quality control duplicate samples will be undertaken by calculating the Relative Percent Difference (RPD) of duplicate samples. The criteria to be used for the assessment of RPD is based on guidelines given in AS4482.1 1997 which states that an RPD value within 30-50% is acceptable. By comparison, the NEPM (1999) Schedule B(3) states the RPD between results of split samples should in general be within 30%, however this variation can be expected to be higher for organic analysis than for inorganics, and for low concentrations of analytes.

The significance of RPDs of results should be evaluated on the basis of sample technique, sample variability, and absolute concentration relative to criteria and laboratory performance.

Duplicate samples will be analysed at a rate of approximately 10% of the total samples taken. Assessment of field quality control duplicates was undertaken by calculating the Relative Percentage Differences (RPDs). RPD is defined as:

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where C_o = Analyte concentration of the original sample

C_d = Analyte concentration of the duplicate sample

The EPA in its correspondence of September 1997, titled 'Update on Issues Relevant to Contaminated Sites Management in NSW' state that the RPD between these samples should generally be within 30% of the mean concentration. It is noted that this variation may be higher for organics, or for cases where analyte concentrations are small. This is consistent with quality control objectives described in the NEPM.

(While field duplicates were collected as part of the investigations, they have not been analysed, due to the preliminary nature of the investigations).



10.2 Laboratory Quality Control

Assessment of laboratory QC was undertaken internally by the individual laboratories, however, the results were independently reviewed and assessed by GHD.

Duplicates were assessed by calculating the Relative Percent Difference (RPD) and blanks should return analyte concentrations as not detected. Percent Recovery (P) is used to assess spiked samples and surrogate standards. Acceptable values for RPD will be generally as outlined above, while P can vary depending on the type of analyte tested, concentrations of analytes, and sample matrix but should normally range from about 70-130%. However, the Analytical Laboratories have their own criteria for assessing these results.



11. Investigation Results

11.1 Field Investigation Results

Soils at the site generally consisted of light brown silty loam with a trace of gravel. No evidence of fill material was observed or encountered in the locations sampled. No visual signs of contamination were evident in any soil sample collected from the pastures. There was evidence of hydrocarbon contamination adjacent to two separate above ground diesel tanks where surface staining was noticed at the eastern side of the turkey farm 1 and on the eastern side of turkey farm 4 as identified on Figure 2.

11.2 Soil Analytical Results

A site plan showing all soil sample locations is presented in Figure 2 in Appendix A. A total of 48 boreholes were excavated, with 95 samples collected (including QA/QC samples). A total of 46 original samples were analysed for Heavy Metals, 2 for TPH, 1 for BTEX, 19 composites prepared in the laboratory and analysed for OCP and 2 original samples analysed for OCP. Three duplicate samples were also analysed for heavy metals.

Summaries of the laboratory results are presented in Tables B to D in Appendix B. Table A in Appendix B presents a summary of the number of samples analysed and a description of the soils sampled. Detailed laboratory reports and COC (Chain of Custody) documents are provided in Appendix C.

In documenting these results, comparison has been made to the site assessment criteria, including Ecological Investigation Levels (EIL) and Standard Residential with accessible soil (HIL A), as discussed in Section 9.

Heavy Metals

Sample S2E-0.0 contained an arsenic concentration slightly exceeding the EIL. Samples S3W-0.0 and S8S-0.0 contained copper concentrations exceeding the EIL. One duplicate sample TQA3 had a lead concentration (453 mg/kg) exceeding the HIL A of 300 mg/kg, although the concentration in the corresponding original sample was only 18 mg/kg. Samples S2E-0.0, S3E-0.0, S3W-0.0, S5E-0.0, S7W-0.0, S8N-0.0, S8S-0.0, S9S-0.0, S10S-0.0, S11N-0.0, S11S-0.0 and S12N-0.0 contained zinc concentrations exceeding the EIL.

Organics

Concentration of OCPs were below the HILs in the samples analysed. All samples analysed for OCPs were below laboratory PQLs with the exception of Comp 14 (0.1 mg/kg dieldrin). However Comp 14 was still below the EIL and well below the HIL for dieldrin.

Samples TN01-0.0 and TN22 0.0, which were collected from two separate areas of hydrocarbon staining, reported levels of TPH C₁₀-C₃₆ exceeding the TC. BTEX concentrations were reported below the laboratory PQL for sample TN22 0.0 (TN01-0.0 was not analysed for BTEX).



11.3 Laboratory QA/QC

Relative Percent Differences (RPDs) were calculated for duplicated soil samples as part of the QA/QC program, and are presented in Tables E, Appendix B.

All RPDs for the duplicate pair TQA1 and TN12-0.0 were within the acceptable criteria. The RPD for chromium (67%) exceeded the recommended criteria of 30%-50%, due to the low levels detected (2 and 1 mg/kg respectively) where small variations result in a large RPD.

All RPDs for the duplicate pair TQA3 and TN17-0.0 were within acceptable criteria of between 30% and 50% with the exception of lead (185%). Due to the correlation in results between the original sample and the duplicate sample for the other metals, GHD believes that this high result was caused by sample heterogeneity for lead.

All RPDs for the duplicate pair SQA1 and S7E-0.0 were within acceptable criteria of between 30% and 50% with the exception of chromium, copper, nickel and zinc (33%, 59%, 133% and 45% respectively). GHD believes that these high RPDs are due to the low concentrations, where a small variation results in a high RPD.

The NATA certified laboratory results sheets refer to a quality control program comprising the analysis of spikes, method blanks and duplicate samples. The results reported indicate that the laboratory was achieving levels of performance within their recommended control limits during the period when the samples from this program were analysed.



12. Discussion of Results/Site Characterisation

12.1 Contamination issues

In 46 samples taken from representative areas of the site, no concentrations of heavy metals exceeded the HILs except for lead in one duplicate sample. However 1 sample slightly exceeded the EIL for arsenic, 2 samples exceeded the EIL for copper and 12 samples contained levels of zinc that exceeded the EIL. All samples analysed for OCPs were below HILs and 18 of the 19 samples analysed for OCPs were below the laboratory PQLs.

None of the samples collected from the pasture areas of the site had zinc levels above the EIL, therefore it is assumed that the elevated zinc levels are associated with building materials or activities undertaken around the poultry buildings.

There may be some phytotoxicity issues associated with zinc (and to a lesser extent copper and arsenic) concentrations in soils around the buildings. These areas should be further assessed prior to construction of housing in these areas.

Apart from two small areas of TPH impacted surface staining (approximately 3 m²) located adjacent to above ground diesel tanks at the east side of turkey farm 1 and the eastern side of turkey farm 4 as identified in Figure 2, there are no other apparent TPH contamination issues associated with the site.

Several of the sheds associated with the various turkey farms were constructed from a combination of brick and fibro-cement sheeting, which potentially may contain asbestos. The turkey sheds appeared to be constructed from corrugated iron, however a comprehensive evaluation of the buildings was not undertaken and there is the potential that asbestos containing materials were used in their construction.

Due to the age of the buildings there is the potential that lead-based paints were used and that the fibre cement sheeting used in building construction may contain asbestos. Prior to building demolition, an assessment should be undertaken to determine if lead-based paint or asbestos bearing materials are present. Soil samples should also be taken from under the buildings following demolition to assess whether any pesticides have been used (eg for termite treatment).

The areas of surface staining associated with the above ground fuel storage tanks on as identified in Figure 2, should be excavated and remediated to reduce TPH levels below the relevant criteria or disposed of to a licensed waste management facility before the particular areas of the site are redeveloped.

The small dam in the northern section of the site that has been used for the disposal of solid waste i.e. car bodies, old footings, 44 gallon drums, car batteries and white goods, should be remediated with the items being appropriately disposed of at a licensed waste management facility. Following excavation, the area should be validated. The area of disturbed soil near sample location TN21 should also be investigated by means of a test pit.



There may be potential contamination due to the turkey burial pits such as pathogens and bacteria. These burial areas should be excavated and proper disposal of the carcasses should take place.

12.2 Suitability for Redevelopment

The site history, field inspections and analytical results indicate that most of the site is likely to be free from significant contamination and suitable for redevelopment without further assessment. The only likely contamination issues are those associated with the existing operations on the site.

Twelve soil samples from the area of existing buildings exceeded EILs. Surface soils in areas such as these may pose phytotoxic effects to any sensitive plants in these areas. However, the effects are unlikely to be significant for less sensitive landscaping areas.

There is also the possibility of past pesticide treatment under buildings (eg for termite treatment). Hence the areas of existing buildings should be validated after demolition and before construction of new dwellings in these areas. The investigations also identified an area of waste disposal, two minor areas of hydrocarbon staining and two turkey burial pits, which will require remediation prior to redevelopment of these areas of the site.

The possible presence of deeper areas of contamination should be considered during any works on the site. During development of the site, if soils appear to be significantly different to those described in this report or appear to be visually contaminated, it is recommended that an experienced environmental consultant be engaged to assess, validate and remediate (if necessary) suspected impacted soils.



13. Conclusions

GHD was commissioned by Beechwood Homes to undertake a Preliminary Site Contamination Assessment of a property located on Raymond Terrace Road, Thornton, NSW. The investigation was required as Beechwood Homes wish to redevelop the site for residential purposes.

The site currently consists of gently undulating pastures with a small number of trees, generally draining towards the southwest and northwest towards Four Mile Creek. Four turkey farms and associated infrastructure are located across the site. The historical review indicated that potentially contaminating activities undertaken on the site were limited to those activities associated with the current turkey farming operations. Hence there is likely to be little potential for sources of significant contamination other than those associated with the farms and machinery storage sheds located on the site, and associated areas of waste disposal or burial.

To investigate potential contamination of soils, a total of 48 hand auger holes were excavated across the site, with selected samples analysed for TPH, BTEX, heavy metals and OCPs.

The results of the investigation reported heavy metals concentrations below the HIL A criteria for standard residential purposes (except for lead in one duplicate sample). However a number of surface samples from the areas of existing buildings exceeded the EILs for zinc, copper and arsenic. The two TPH C₁₀-C₃₆ samples recorded concentrations in excess of the NSW EPA Threshold Concentrations for Sensitive Land Use. These samples were associated with surface staining located adjacent to an above ground diesel tank on the eastern side of turkey farm 1 and an above ground storage tank on the eastern side of turkey farm 4 as identified in Figure 2. No OCPs were detected in any of the samples analysed. One area of building waste disposal in a former dam, and two turkey burial pits were identified during the investigations. An area of disturbed soil was also identified on the north western side of the site. This area may have been used for the disposal of solid waste or used as burial pits.

Based on the scope of work and findings of the historical review and site investigations, it is considered that with the exception of the areas identified, the majority of the site is suitable for redevelopment for residential purposes.

There may be some phytotoxic effects due to metal contamination in surface soils in the vicinity of the buildings and sheds, however they are unlikely to be significant for less sensitive landscaping species. The limited extent of TPH impact, as evident from the small size of the oil stained area, indicates this contamination does not pose any significant risk to health or the environment.



14. Recommendations

The oil stained areas should be excavated and the soil remediated or disposed of as appropriate before the particular areas of the site are redeveloped. Prior to building demolition, an assessment should be undertaken for the presence of lead-based paints and asbestos bearing materials. The soils under existing buildings should also be validated after demolition to assess whether any past pesticide treatment (eg for termites) has occurred.

The waste disposal areas and the two turkey burial pits will require remediation prior to redevelopment of these areas of the site.

Consideration should also be given to more detailed investigations (eg geophysics) to ascertain whether there are any other potential burial areas.

The possible presence of deeper areas of contamination should be considered during any works on the site. During development of the site, if soils appear to be significantly different to those described in this report or appear to be visually contaminated, it is recommended that an experienced environmental consultant be engaged to assess, validate and remediate (if necessary) suspected impacted soils.



15. References

Australian and New Zealand Guidelines for the Management of Contaminated Sites, 1992, Australian and New Zealand Environment and Conservation Council and National Health and Medical Research Council (ANZECC/NHMRC 1992).

Contaminated Sites: Guidelines for Assessing Service Station Sites, 1994, NSW Environment Protection Authority (NSW EPA 1994).

Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 1998, NSW Environment Protection Authority (NSW EPA 1998).

Contaminated Sites: Guidelines for the NSW Site Auditor Scheme 1998, NSW Environment Protection Authority (NSW EPA 1998).

Contaminated Sites: Sampling Design Guidelines 1995, NSW Environment Protection Authority (NSW EPA 1995).

Managing Land Contamination Planning Guidelines SEPP 55 – Remediation of Land Department of urban Affairs and Planning (1998).

National Environmental Protection (Assessment of Site Contamination) Measure 1999, (NEPC 1999).

Newcastle Geological Map Sheet SI 56-2, 1:25,000. Department of Mineral Resources.

Report on Preliminary Geotechnical Investigation: Proposed Residential Subdivision, Area C, Thornton North, Douglas Partners (2003).

Soil Landscapes of Newcastle 1:100,000 Sheet. Department of Land and Water Conservation (1995).



16. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties. Information sources may include communications with persons such as local residents, which has not necessarily been corroborated by other records. The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent and experienced person with experience in environmental investigations, before being used for any other purpose. GHD Pty Ltd accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by GHD Pty Ltd, and should not be relied upon by other parties, who should make their own enquires.

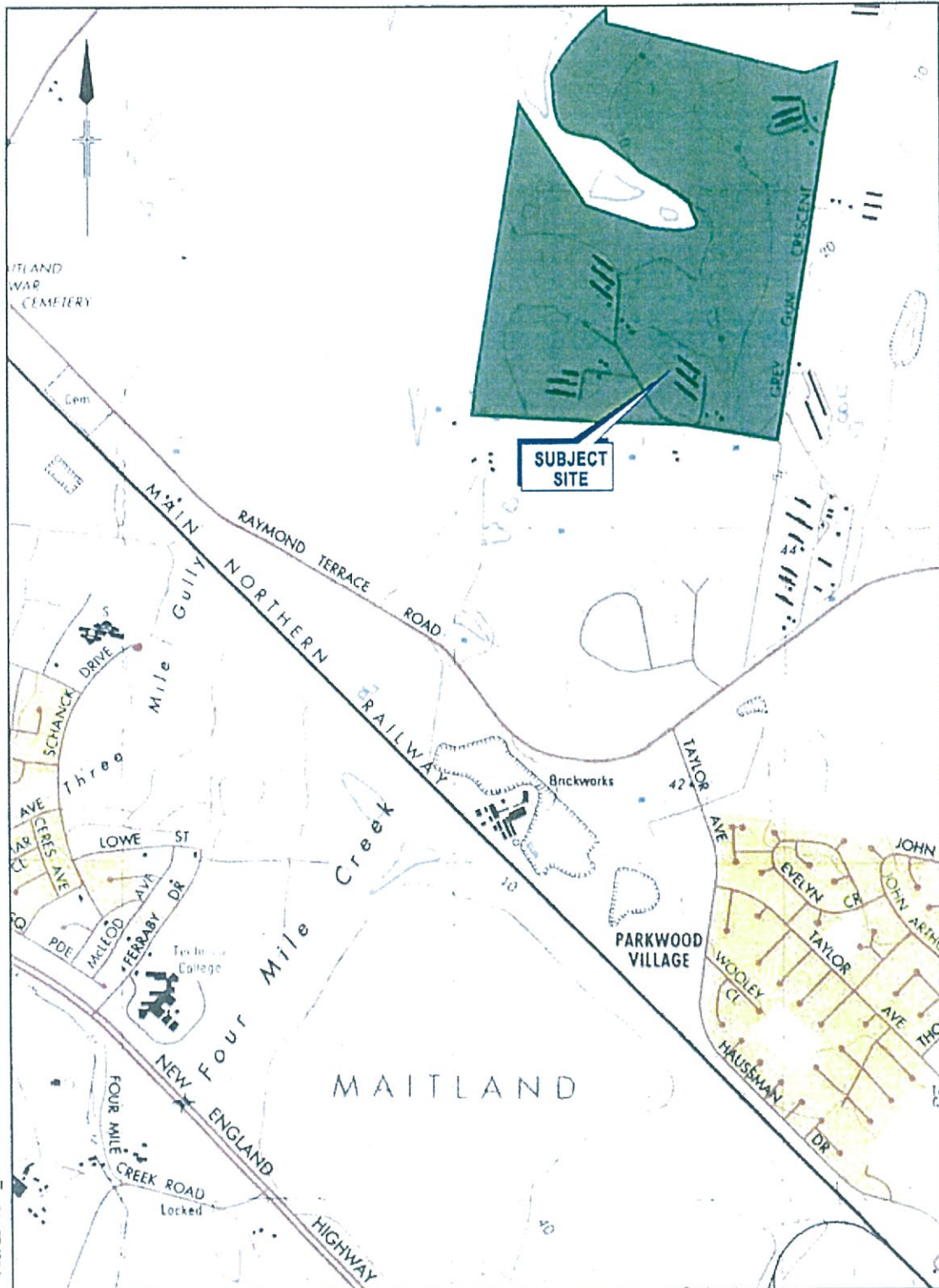
The extent of sampling of soils and subsequent analysis has been necessarily limited, and has been targeted towards areas where contamination is considered to be most likely, based on the knowledge of the site history and visual observation. This approach maximises the probability of identifying contaminants; however, it may not identify contamination that occurs in unexpected locations or from unexpected sources.

Further, soil, rock and aquifer conditions are often variable, resulting in non-homogenous contaminant distributions across a site. Contaminant concentrations have been identified at chosen sample locations; 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 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 herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, GHD Pty Ltd reserves the right to review the report in the context of the additional information.



Appendix A
Figures

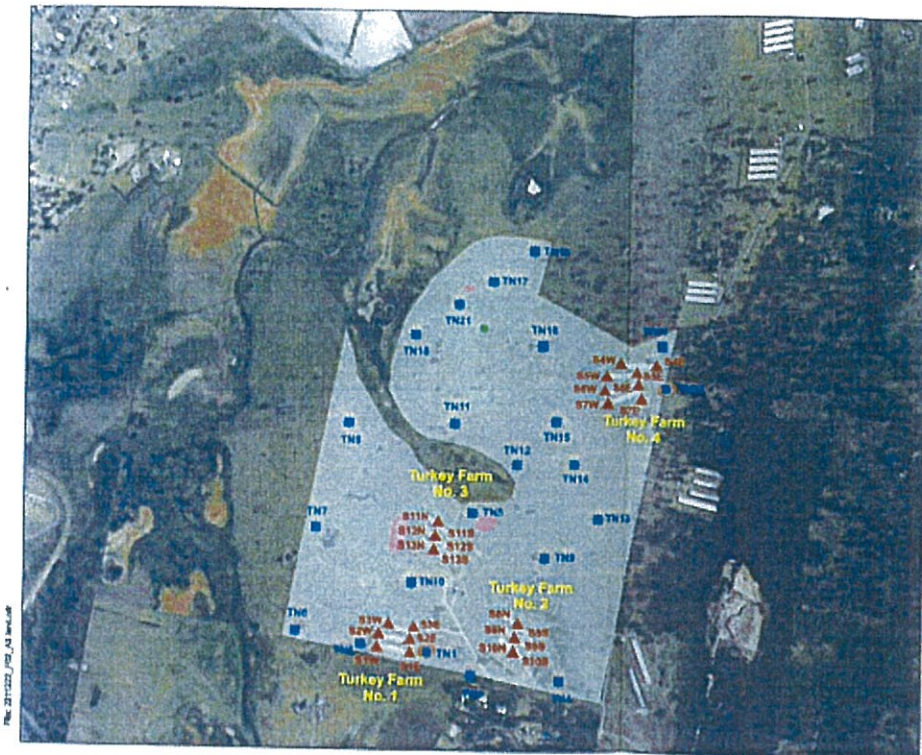


File: 2211222_F01.odr

Approximate Scale 1: 25 000

Figure 1
Location Plan

(Source: Beresfield 9232-3-N 1:25000 2nd Ed. Topographic Map)



File: 201202_102_A3.mxd

Figure 2
Sampling Location Plan



Appendix B
Summary Tables

Client: Beechwood Homes
 Title: Table A - Sample Register
 Job No: 2211222

Sample ID	Sample Interval (m)	Duplicate Sample	Date Sampled	TPH (C ₄ -C ₉) / BTEX	TPH (C ₁₀ -C ₃₄)	Metals ¹	OCPs	Lithology	Comment
TN1-0.0	0.0-0.1	-	5-May-03	-	1	1	-	Silty, Light Brown, Trace gravel	Area of oil staining.
TN1-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty, Light Brown, Trace gravel	-
TN2-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty Loam, Trace gravel dark brown	-
TN2-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty Loam, Trace gravel dark brown	-
TN3-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Clay, light brown	-
TN3-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Clay, light brown	-
TN4-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silt, clay, light brown	-
TN4-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silt, clay, light brown	-
TN5-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam dark brown	-
TN5-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam dark brown	-
TN6-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
TN6-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN7-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
TN7-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN8-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
TN8-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN9-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
TN9-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN10-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
TN10-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN11-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
TN11-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN12-0.0	0.0-0.1	TOA1	5-May-03	-	-	1	-	Silty loam	-
TN12-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN13-0.0	0.0-0.1	-	5-May-03	-	-	1	-	gravel, clay, loam	-
TN13-0.2	0.2-0.3	-	5-May-03	-	-	-	-	gravel, clay, loam	-
TN14-0.0	0.0-0.1	-	5-May-03	-	-	1	-	silty loam, gravel	-
TN14-0.2	0.2-0.3	-	5-May-03	-	-	-	-	silty loam, gravel	-
TN15-0.0	0.0-0.1	-	5-May-03	-	-	1	-	silty loam	-
TN15-0.2	0.2-0.3	-	5-May-03	-	-	-	-	silty loam	-
TN16-0.0	0.0-0.1	TOA2	5-May-03	-	-	1	-	silty loam	-
TN16-0.2	0.2-0.3	-	5-May-03	-	-	-	-	silty loam	-
TN17-0.0	0.0-0.1	TOA3	5-May-03	-	-	1	-	silty loam	-
TN17-0.2	0.2-0.3	-	5-May-03	-	-	-	-	silty loam	-
TN18-0.0	0.0-0.1	-	5-May-03	-	-	1	-	silty loam	-
TN18-0.2	0.2-0.3	-	5-May-03	-	-	-	-	silty loam	-
S1E-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty clay brown	-
S1E-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty clay brown	-
S1W-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S1W-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S2E-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S2E-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S2W-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S2W-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-

Client: Beechwood Homes
 Title: Table A - Sample Register
 Job No: 2211222

Sample ID	Sample Interval (m)	Duplicate Sample	Date Sampled	TPH (C ₁ -C ₄)/BTEX	TPH (C ₁₀ -C ₁₄)	Metals ¹	OCPs	Lithology	Comment
S3E-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S3E-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S3W-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S3W-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S4E-0.0	0.0-0.1	-	5-May-03	-	-	1	-	gravel, silt, trace clay	-
S4E-0.2	0.2-0.3	-	5-May-03	-	-	-	-	gravel, silt, trace clay	-
S4W-0.0	0.0-0.1	-	5-May-03	-	-	1	-	gravel, silt, trace clay	-
S4W-0.2	0.2-0.3	-	5-May-03	-	-	-	-	gravel, silt, trace clay	-
S5E-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam, clay	-
S5E-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam, clay	-
S5W-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silt, trace gravel	-
S5W-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silt, trace gravel	-
S6E-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty clay brown	-
S6E-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty clay brown	-
S6W-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty clay brown	-
S6W-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty clay brown	-
S7E-0.0	0.0-0.1	SQA1	5-May-03	-	-	1	-	Silt, trace gravel	-
S7E-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silt, trace gravel	-
S7W-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silt, trace gravel	-
S7W-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silt, trace gravel	-
S8N-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silt, trace gravel	-
S8N-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S8S-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S8S-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S9N-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S9N-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S9S-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S9S-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S10N-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S10N-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S10S-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S10S-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S11N-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S11N-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S11S-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S11S-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S12N-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S12N-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S12S-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S12S-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S13N-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S13N-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
S13S-0.0	0.0-0.1	-	5-May-03	-	-	1	-	Silty loam	-
S13S-0.2	0.2-0.3	-	5-May-03	-	-	-	-	Silty loam	-
TN19	0.0-0.1	-	4-Nov-03	-	-	1	1	Silty loam	-

Table A - Soil Sample Register
 G:\2211222 - Tables_Thornton Nord\.xls

Client: Beechwood Homes
 Title: Table A - Sample Register
 Job No: 2211222

Sample ID	Sample Interval (m)	Duplicate Sample	Date Sampled	TPH (C ₆ -C ₉)/BTEX	TPH (C ₁₀ -C ₃₈)	Metals [†]	OCPs	Lithology	Comment
TN20	0.0-0.1	-	4-Nov-03	-	-	1	1	Silty loam	-
TN21	0.0-0.1	-	4-Nov-03	-	-	-	-	Silty loam	-
TN22	0.0-0.1	-	4-Nov-03	1	-	-	-	Silty loam	Area of oil staining.
Comp 1	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from TN06-0.0, TN02-0.0, TN10-0.0
Comp 2	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from TN07-0.0, TN05-0.0, TN08-0.0
Comp 3	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from TN01-0.0, TN03-0.0, TN04-0.0
Comp 4	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from TN15-0.0, TN11-0.0, TN12-0.0
Comp 5	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from TN13-0.0, TN14-0.0, TN09-0.0
Comp 6	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from TN16-0.0, TN17-0.0, TN18-0.0
Comp 7	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from STE-0.0, S1W-0.0
Comp 8	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S2E-0.0, S2W-0.0
Comp 9	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S3E-0.0, S3W-0.0
Comp 10	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S4E-0.0, S4W-0.0
Comp 11	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S5E-0.0, S5W-0.0
Comp 12	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S6E-0.0, S6W-0.0
Comp 13	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S7E-0.0, S7W-0.0
Comp 14	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S8S-0.0, S8N-0.0
Comp 15	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S9S-0.0, S9N-0.0
Comp 16	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S10S-0.0, S10N-0.0
Comp 17	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S11S-0.0, S11N-0.0
Comp 18	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S12S-0.0, S12N-0.0
Comp 19	-	-	5-May-03	-	-	-	1	-	Prepared in the Lab from S13S-0.0, S13N-0.0
TQA1	-	TN12-0.0	5-May-03	-	-	1	-	-	-
TQA3	-	TN16-0.0	5-May-03	-	-	1	-	-	-
SOA1	-	S7E-0.0	5-May-03	-	-	1	-	-	-
Total	-	-	-	1	2	49	21	-	-

[†] Metals includes As, Cd, Cr(total), Cu, Pb, Ni, Zn, and Hg

Client: Beachwood Homes
 Title: Table B - Soil Analytical Results - Metals
 Job No: 2211222

21	Exceeds EILs
100	Exceeds HIL "A"

NB: Results expressed in mg/kg (ppm) dry weight unless otherwise specified

Sample ID	Duplicate	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
PQL	-	1	1	1	1	1	1	1	0.1
EILs ¹	-	20	3	50	100	60	600	200	1
HIL - Exceeds HIL "A"	-	100	20	100	100	100	100	100	10
TN1-0.0	-	6	<1	7	18	7	22	139	<0.1
TN2-0.0	-	5	<1	2	8	<1	19	55	<0.1
TN3-0.0	-	3	<1	4	2	<1	8	5	<0.1
TN4-0.0	-	6	<1	<1	2	<1	7	14	<0.1
TN5-0.0	-	5	<1	8	3	<1	12	5	<0.1
TN6-0.0	-	5	<1	3	7	2	27	56	<0.1
TN7-0.0	-	3	<1	1	2	<1	8	8	<0.1
TN8-0.0	-	5	<1	6	2	<1	14	12	<0.1
TN9-0.0	-	2	<1	<1	2	<1	9	4	<0.1
TN10-0.0	-	2	<1	2	3	<1	14	12	<0.1
TN11-0.0	-	3	<1	1	3	<1	12	9	<0.1
TN12-0.0	TOA1	4	<1	1	<1	<1	13	12	<0.1
TN13-0.0	-	19	<1	14	<1	<1	17	14	<0.1
TN14-0.0	-	9	<1	5	3	<1	16	20	<0.1
TN15-0.0	-	4	<1	1	4	2	10	84	<0.1
TN16-0.0	-	4	<1	2	8	2	23	57	<0.1
TN17-0.0	-	6	<1	5	3	<1	18	16	<0.1
TN18-0.0	-	4	<1	4	2	<1	13	7	<0.1

Table B - Soil Metals
 G:\2211222 Tables_Thornton North.xls

Cliant: Beachwood Homes
 Title: Table B - Soil Analytical Results - Metals
 Job No: 2211222

21	Exceeds EILs
(0.0)	Exceeds HIL "A"

NB: Results expressed in mg/kg (ppm) dry weight unless otherwise specified

Sample ID	Duplicate	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
PQL	-	1	1	1	1	1	1	1	0.1
EILs 1	-	20	3	50	100	60	600	200	1
HIL - Exposure - Sampling A	-	100	20	100	1000	500	300	500	10
TN19-0.0	-	3	<1	3	1	<1	6	8	<0.1
TN20-0.0	-	18	<1	22	16	2	17	85	<0.1
S1E-0.0	-	12	<1	2	26	<1	17	99	<0.1
S1W-0.0	-	10	<1	6	7	<1	13	54	<0.1
S2E-0.0	-	23	<1	20	83	3	23	529	<0.1
S2W-0.0	-	17	<1	12	20	<1	22	132	<0.1
S3E-0.0	-	11	<1	10	41	3	16	269	<0.1
S3W-0.0	-	7	<2	10	327	5	20	747	<0.2
S4E-0.0	-	8	<1	3	4	<1	16	35	<0.1
S4W-0.0	-	11	<1	9	24	6	12	51	<0.1
S5E-0.0	-	6	<1	5	20	7	12	674	<0.1
S5W-0.0	-	5	<1	9	18	10	11	166	0.1
S6E-0.0	-	3	<1	4	1	<1	8	35	<0.1
S6W-0.0	-	7	<1	3	3	<1	9	36	<0.1
S7E-0.0	-	4	<1	5	6	1	11	26	<0.1
S7W-0.0	-	7	<1	7	20	5	16	363	<0.1
S8N-0.0	-	7	<2	13	51	9	17	574	<0.2
S8S-0.0	-	20	<2	22	111	6	23	721	<0.2

Table B - Soil Metals
 G:\2211222 Tables_Thornton North.xls

Client: Beechwood Homes
 Title: Table B - Soil Analytical Results - Metals
 Job No: 2211222

21	Exceeds EILs
1807	Exceeds HIL "A"

NB: Results expressed in mg/kg (ppm) dry weight unless otherwise specified

Sample ID	Duplicate	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
PQL	-	1	1	1	1	1	1	1	0.1
EILs ¹	-	20	3	50	100	60	600	200	1
HIL - Exposure (Standard Residential)	-	1807	21	1807	1807	1807	1807	1807	1807
S9N-0.0	-	6	<1	6	17	<1	10	92	<0.1
S9S-0.0	-	9	<2	16	82	8	18	972	<0.2
S10N-0.0	-	5	<1	5	19	<1	12	86	<0.1
S10S-0.0	-	12	<1	7	26	2	14	295	<0.1
S11N-0.0	-	8	<1	8	34	5	15	391	<0.1
S11S-0.0	-	5	<1	4	13	1	15	225	<0.1
S12N-0.0	-	9	<1	5	17	8	10	234	<0.1
S12S-0.0	-	7	<1	5	7	<1	11	67	<0.1
S13N-0.0	-	9	<1	6	11	6	9	84	<0.1
S13S-0.0	-	3	<1	4	<1	<1	8	21	<0.1
TOA1	TN12-0.0	5	<1	2	2	<1	17	16	<0.1
TOA3	TN17-0.0	4	<1	4	3	1	453	12	<0.1
SOA1	S7E-0.0	7	<1	7	11	5	11	41	<0.1

¹ Ecological Investigation Level (Interim Urban) (NEPM, 1999)

² Health Investigation Level "A" (Standard Residential) (NEPM, 1999)

³ Cr(VI) Guideline Value

Client: Beechwood Homes
 Title: Table C Soil Analytical Results - OCPs
 Job No: 2211222

NB: Results expressed in mg/kg (ppm) dry weight unless otherwise specified

OCPs	Duplicate	alpha-BHC	HCB	beta-BHC & gamma-BHC	delta-BHC	Heptachlor	Aldrin	Dieldrin	Heptachlor epoxide	Chlordane - trans	Chlordane - cis	DDD	DDE	DDT	Endrin	Endosulfan 1	Endosulfan 2	Endrin aldehyde	Endosulfan sulfate	Endrin ketone	Methoxychlor	
POI	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2
Comp 1	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 2	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 3	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 4	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 5	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 6	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 7	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 8	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 9	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 10	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 11	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 12	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 13	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 14	-	<0.10	<0.10	<0.2	<0.10	<0.10	<0.10	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.4	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.4
Comp 15	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 16	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 17	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 18	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
Comp 19	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
TN19 0.0	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2
TN20 0.0	-	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2

¹ Health Investigation Level "A" (Standard Residential) (NEPM, 1999)

² Total of Aldrin and Dieldrin

⁴ Total of Trans-chlordane and cis-chlordane

⁵ Total of DDT, DDD and DDE

Client: Beechwood Homes

Title: Table D Soil Analytical Results - TPH and BTEX

Job No: 2211222

NB: Results expressed in mg/kg (ppm) dry weight unless otherwise specified

TPH	Duplicate	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	Total Detected TPH (C ₁₀ -C ₃₆)	Benzene	Toluene	Chlorobenzene	Ethyl Benzene	m&p - Xylene	o-Xylene
POL	2	50	100	100	100	-	0.2	0.2	0.2	0.2	0.2	0.2
TIC (Sensitivity limit used)	55					1000	1	1.4		3.1		1.4
TN01-0.0	-	4480	34000	2840	260	21120	-	-	-	-	-	-
TN22 0.0	<2	186	3530	260	3976	3976	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

1. Threshold Criteria from NSW EPA Guidelines for Assessing Service Station Sites (1994)

Client: Beechwood Homes
 Title: Table E: RPD Results
 Job No: 2211222

Sample ID	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
PQL	1	1	1	1	1	1	1	0.1
TN12-0.0	4	<1	1	<1	<1	13	12	<0.1
Duplicate	5	<1	2	2	<1	17	16	<0.1
RPD %	22	NA	67	NA	NA	27	29	NA

Sample ID	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
PQL	1	1	1	1	1	1	1	0.1
TN17-0.0	6	<1	5	3	<1	18	16	<0.1
Duplicate	4	<1	4	3	1	453	12	<0.1
RPD %	40	NA	22	0	NA	135	29	NA

Sample ID	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Mercury (Hg)
PQL	1	1	1	1	1	1	1	0.1
S7E-0.0	4	<1	5	6	1	11	26	<0.1
Duplicate	7	<1	7	11	5	11	41	<0.1
RPD %	55	NA	33	59	133	0	45	NA



Appendix C
Laboratory Certificates and Chain of
Custody Forms



CERTIFICATE OF ANALYSIS

CONTACT: MR BOB CAMPBELL
CLIENT: GHD PTY LTD
ADDRESS:
 PO BOX 5403
 NEWCASTLE WEST NSW 2302
ORDER No.: 2211222
PROJECT: THORNTON NORTH

BATCH: NE10100
SUB BATCH: 0
LABORATORY: NEWCASTLE
DATE RECEIVED: 06/05/2003
DATE COMPLETED: 15/05/2003
SAMPLE TYPE: SOIL
No. of SAMPLES: 48

COMMENTS

Samples as received digested by USEPA method 200.2 (modified) prior to the determination of metals. Results reported on a dry weight basis. LOR's raised for samples S8N-0.0, S8S-0.0, S9S-0.0 and S3W-0.0 due to high moisture content (>50%). All analysis and Laboratory QC conducted in accordance with Schedule B(3) NEPM Guideline on Laboratory Analysis of Potentially Contaminated Soil (December 1999). Analysis conducted by ALS Sydney, NATA Site No. 10911. This report supersedes any previous preliminary reports of the same batch number.

JOB No.	2211222
ENTERED TO DATABASE	21/5/03
INITIAL	BC
DATE	21 MAY 2003
REF NO	G44114
NAME	BC
ACTIVE	

NOTES

This is the Final Report and supersedes any preliminary reports with this batch number. All pages of this report have been checked and approved for release.

ISSUING LABORATORY: NEWCASTLE

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Signatory Greg Vogel

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