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PRELIMINARY CONTAMINATION AND GEOTECHNICAL ASSESSMENT

PROPOSED RESIDENTIAL SUBDIVISION CATHERINE HILL BAY

Prepared for

COAL & ALLIED INDUSTRIES LTD

Project 39662.06-01

OCTOBER 2010

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12 October 2010

PRELIMINARY CONTAMINATION AND GEOTECHNICAL ASSESSMENT PROPOSED RESIDENTIAL SUBDIVISION CATHERINE HILL BAY

1. INTRODUCTION

This report presents the results of a preliminary contamination and geotechnical assessment for a proposed residential subdivision at Catherine Hill Bay. The assessment was carried out at the request of Coal & Allied Industries Ltd, in consultation with Catylis Pty Ltd.

The assessment comprised the following components:

- Desktop review of regional geology, hydrogeology, and acid sulphate soils;
- Review of previous mining operations beneath the subject site;
- History review including a review of aerial photos since 1954 and interviews with a former mine manager and mine employee;
- Site walkover survey to describe the current site condition and surface features;
- Subsurface investigation by test pit and drilling;
- Soil sampling and chemical testing;
- Comments on actual and anticipated development constraints and opportunities including the following:
  - Potential contamination;
  - Depth, extent and nature of filling, including the presence of potentially combustible material;

- Depth of groundwater;
- Presence of soft alluvial soils and acid sulphate soils;
- Likely founding conditions;
- Presence of aggressive soil conditions with respect to buried structures;
- Presence of shallow rock.

- General recommendations for further investigation.

The contamination assessment was being carried out in general accordance with the NSW EPA "Guidelines for Consultants Reporting on Contaminated Sites" (Ref 2) and SEPP 55 "Remediation of Land" (Ref 3).

2. PROPOSED DEVELOPMENT

It is proposed that the entire Catherine Hill Bay (Middle Camp) site, owned by Coal & Allied Industries Limited (Coal & Allied) be rezoned / listed as a 'State Significant Site' in Schedule 3 of State Environmental Planning Policy (SEPP) (Major Development). A draft Schedule 3 listing will be prepared with the Concept Plan Application.

The Concept Plan for a residential subdivision and conservation land transfer of the Catherine Hill Bay (Middle Camp) site will apply to the entire 569 ha Catherine Hill Bay (Middle Camp) site. The key parameters for the proposed development of the site are as follows:

- Dedication of 526.58 ha of conservation land to the New South Wales Government (NSWG) that is identified in the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan, comprising approximately 93% of the Catherine Hill Bay (Middle Camp) site;
- Maximum dwelling yield of 222 dwellings (including 57 integrated housing lots) and three super lots over 28.2 ha;
- Two developable areas are identified under the Concept Plan located to the north of the Middle Camp heritage township:
  - Developable area A (northeast) = 7.32 ha;
  - Developable area B (northwest) = 20.88 ha.

- Indicative development staging. The number of lots and extent of staging for release areas will be largely dictated by the service infrastructure requirements as well as responding to market forces;
- The provision of associated infrastructure;
- Torrens title subdivision of the Catherine Hill Bay (Middle Camp) site. The Torrens title subdivision and boundary realignment of Coal & Allied land will enable the following:
  - Transfer of land 526.58 ha in area that is owned by Coal & Allied to be excised and to be dedicated to NSWG for conservation land;
  - Transfer of land 1.6 ha in area that is owned by Coal & Allied, located between the cemetery and the oval and including the adjacent car park to Lake Macquarie City Council;
  - Enable land 12.38 ha in area that is owned by Coal & Allied comprising four houses north-west of Northwood Road and land 0.17 ha east of Flowers Drive, to be retained by Coal & Allied post transfer of the conservation land.

Approval will not be sought under the Concept Plan for a specific lot or road layout. An indicative lot layout will indicate how the dwelling yield of 222 dwellings could be achieved on the site.

Similarly, approval will not be sought under the Concept Plan for subdivision or construction of individual houses. However, the desired future character of the proposed concept plan will be included in Urban Design Guidelines. Urban Design Guidelines will be prepared to inform the Concept Plan in respect of urban form, built form, open space and landscape, access and movement and visual impact for the site.

It is proposed to dedicate land for conservation purposes as part of the Major Project Application via a Voluntary Planning Agreement between Coal & Allied and the NSWG in accordance with s.93F of the Environmental Planning & Assessment Act, 1979.

The proposed Concept Plan and a Plan showing the proposed development areas and conservation areas are included in the Preliminary Environmental Assessment prepared by Urbis.

3. SITE IDENTIFICATION

This report comprises an assessment of the proposed development areas which are within Part Lot 223, DP 110298, within the Lake Macquarie City Council area.

The extent of each of the potential development areas is shown on Figure 1 below. Each area is described as follows:

- ***Area A*** is located on the eastern side of Flowers Drive with an overall area of 7.32 ha;
- ***Area B*** includes the former Pit E and is situated north of the Middle Camp township on the western side of Flowers Drive. The area has an irregular shape with an overall area of about 20.88 ha.

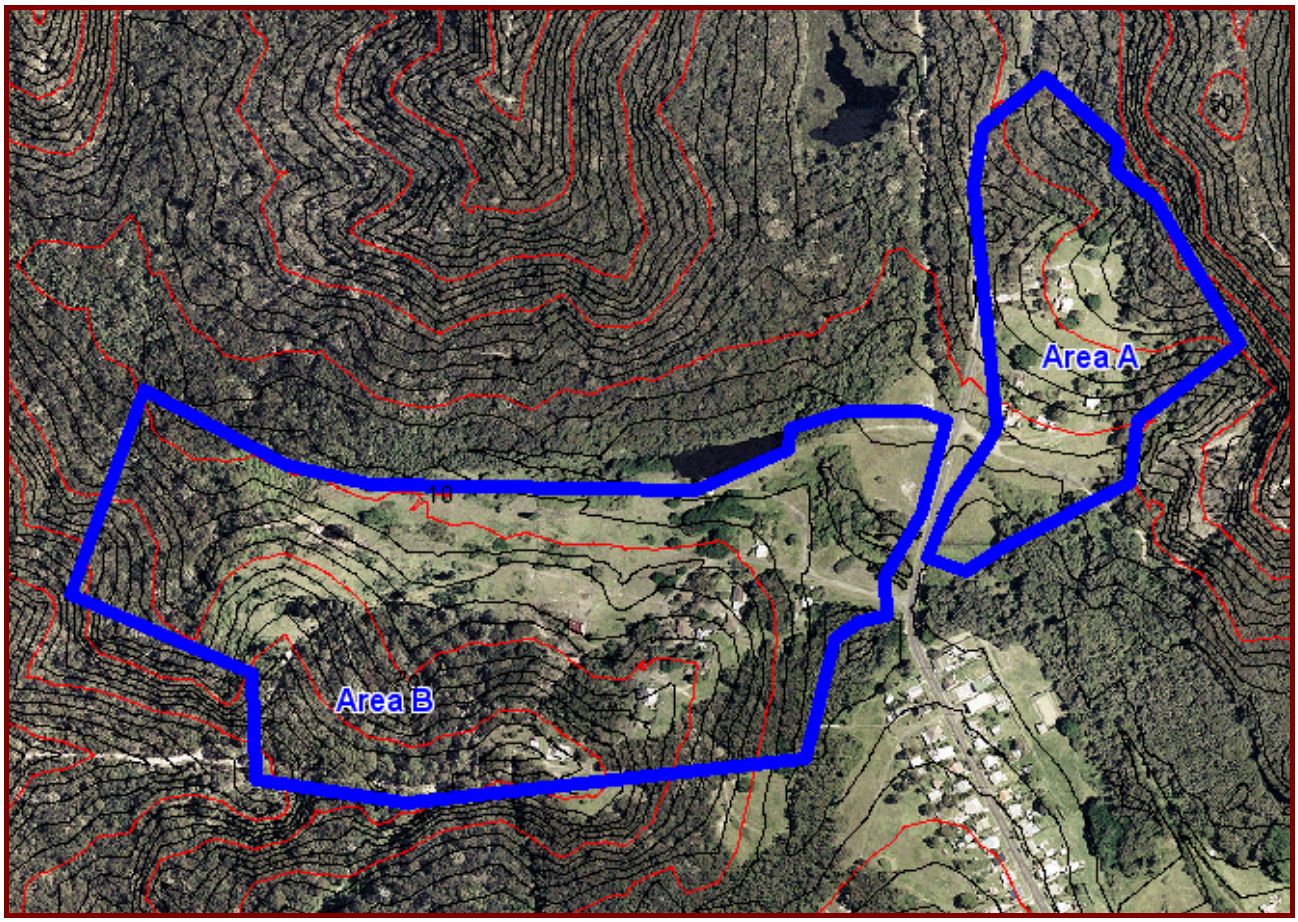

Figure 1 – Proposed Development Areas

Adjacent land use comprises the following:

- North – bushland, upslope of site;
- South – residential adjacent to Flowers Drive and bushland falling to the south from a ridge line which runs along the southern boundary;
- East – residential/cemetery/beach, generally falling to the east;
- West – bushland, upslope of the site.

4. DESKTOP REVIEW

4.1 Regional Geology and Hydrogeology

The 1:100,000 scale Newcastle Coalfield Regional Geology map indicates the site is generally underlain by the Triassic Age Narrabeen Group and the underlying Permian Age Moon Island Beach Subgroup of the Newcastle Coal Measures, which typically comprise conglomerate, sandstone, siltstone, coal and tuff. A weathered residual soil zone would be expected near the surface, with rock depths generally shallow. On the eastern parts of the site these formations are expected to be overlain by thin Quaternary sandy alluvial deposits. A tongue of alluvial soils is situated across the northern part of Area B, associated with the creek flowing east to Middle Camp Beach. Surface geology is mapped on Drawing 4, attached.

Reference to the soil landscape map for Gosford-Lake Macquarie indicates the soils at the site fall into three typical landscapes as follows:

Awaba: The majority of the site soils in the areas of Narrabeen Group and Moon Island Beach Subgroup surface geology are mapped as the Awaba Landscape and typical limitations include the following:

- Localised steep slopes with localised mass movements;
- High erosion hazard;
- Strongly acidic.

Wyong: The alluvial soils are mapped as the Wyong Landscape and typical limitations include the following:

- Seasonal/permanent water logging;
- Foundation hazard;
- Stream bank erosion;
- Acid sulphate potential;
- Strongly acidic;
- Saline subsoils.

Disturbed: The landscape associated with the former mine area known as Pit E in Area B is mapped as a disturbed landscape. Possible limitations include the following:

- Mass movement hazards;
- Foundation hazard;
- Unconsolidated low wet bearing strength;
- Poor drainage;
- Erosion hazard;
- Toxic materials.

Reference to the Catherine Hill Bay Acid Sulphate Soil Risk Map prepared by the Department of Land & Water Conservation indicates that there is an area of acid sulphate soil adjacent to the northern boundary of Area B. The acid sulphate soils are within the alluvial soils associated with the creek flowing east to Middle Camp Beach, between 1 m and 3 m below the ground surface (indicated by hatching on Drawing 4). The acid sulphate soil risk map indicates that there is no known occurrence of acid sulphate soil materials across the remainder of the site.

The regional groundwater flow regime is probably to the east and north-east of the site, towards the creek and the Pacific Ocean, which is approximately 0.5 km from the site, and is considered to be the nearest sensitive receptor. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

The nearest registered groundwater wells are registered for domestic and stock purposes, and are described below:

- GW080447 (N6331410, E371876) Domestic and Stock Use. Located on subject site. No bore details published; and
- GW048991 (N6331240, E372095) Domestic Use. Located adjacent to site and west of Flowers Drive. Drillers log indicates: Water bearing zone from 30.50 m to 33.60 m depth within Shale, Static Water Level at 9.0 m depth.

The depth to groundwater will vary across the site, ranging from relatively shallow on the eastern parts of the site, to significant depth on the higher portions of the site such as the Southern Area.

There is no specific data available regarding groundwater quality, however surface water quality testing has previously been undertaken by DP for the site (Ref 12) which indicated the following:

- Total Phosphorus were greater than ANZECC trigger levels for slightly to moderately disturbed systems in both dry and wet weather sampling rounds;
- E coli was detected in all samples from both rounds. When compared to the ANZECC trigger levels for recreational use, with secondary contact, most samples fell below the trigger levels during dry weather and exceeded them in the wet;
- When compared to ANZECC trigger levels for lowland rivers, the turbidity was typically within the range expected for slightly disturbed catchments;
- Concentrations of Copper, Zinc and Ferrous Iron were typically above ANZECC trigger levels for most samples, however elevations of such parameters are not unusual in the natural environment and could be typical background levels. Very slightly elevated concentrations of lead were observed at some locations for the wet weather event;
- Oil and grease concentrations were below detection limit for all samples;
- Although there is no criterion for total coliforms there appeared to be a relationship between the concentration of E coli and total coliforms, with higher concentrations occurring in the wet weather.

4.2 Mine Workings

Record traces (RT) of former mine workings have been sourced from the Department of Primary Industries - Minerals and indicate that the site is underlain by coal mine workings in two seams, the Wallarah and the Great Northern. The record traces indicate the following:

Great Northern Seam RT 739

Only the south-western corner of Area B (Pit E area) is underlain by workings in the Great Northern Seam. The RT indicates base of seam levels in the order of -40 m AHD in this area with a dip (increasing depth) to the south. Therefore the depth of cover is more than 50 m. The workings in this area were undertaken in 1996 and comprise bord and pillar workings with extensive pillar extraction. Bore logs on the RT suggest a seam thickness in the range 3.3 m to 3.5 m.

Wallarah Seam RT 295

The Wallarah Seam is the upper seam and was worked from Pit E, located in Area B. The workings comprised bord and pillar workings with pillar extraction in some areas. Workings in the vicinity of Pit E were completed in the period 1896 to 1903, with the workings beneath the southern portions of the site continuing up to about 1935. The seam thickness shown on the RTs ranged from 2.8 m to 3.5 m. Details of the working section (mined coal thickness) were not provided.

The record traces indicate that there was no mining on the eastern side of Flowers Drive. There was also no mining along the base of the gully feature in Area B as the depth of cover was very shallow.

Depth of Cover

The depth of cover to the mine workings ranges from about 10 m along the northern edge of the workings near the former Pit E, to over 50 m.

A detailed mine subsidence risk assessment has been carried out and is reported separately (Ref 1). This report provides a detailed assessment of the depth to mine workings, the risk of mine subsidence and likely restrictions to development due to potential mine subsidence.

5. SITE HISTORY

5.1 General

The brief review of site history comprised the following:

- Interview(s) with former mine manager, Mr Greg Cole-Clark, and local resident and former mine employee, Mr Joe Warren;
- Review of historical aerial photos;
- Searches with NSW Department of Environment and Climate Change (DECC) and Lake Macquarie City Council Property Enquiry.

5.2 Interviews with Personnel Familiar with the Site

Mr Joe Warren

An interview was conducted on site with Joe Warren on 17 January 2007. He indicated that his family had been in Catherine Hill Bay for three generations and had lived there all his life (since 1949). Mr Warren grew up in a house near Pit E, on the northern part of land proposed for development, however never worked from Pit E.

- The former coal mine Pit E was located in Area B, to the west of Flowers Drive;

- Various structures and fences were asbestos and were demolished, however, he cannot remember what was done with the asbestos;
- He did not recall any local refuse tip in the area;
- Coal was stockpiled in various locations in the 1950s due to the low price of coal, mostly either side of Flowers Drive, near Pit E, including the southern parts of Area A.;
- He identified the location of various former structures associated with the former Pit E in Area B, including the following, which have been marked on Drawing 2 attached:
  - Stables;
  - Stone lined well;
  - Locomotive shed;
  - Electrical transformer;
  - Bathhouse;
  - Rail lines and sidings;
  - Fitters shed.
- The well on site was fed by a pipeline running from a dam to the north of the site;
- There were three coal fired steam locomotives which ran coal to the wharf at the southern end of the ocean beach;
- The bathhouse water ran into the creek;
- The pit was decommissioned in the 1960s. The structures were mostly metal and were taken to the wharf and shipped away for scrap;
- Once the mining operations in Pit E were ceased and the Crangan Bay pit was developed (several km to the west of the site), the screening plant was retained and a bitumen sealed haul road was constructed to bring coal from the Crangan Bay Pit. The coal was then transferred to the wharf via the rail line. The haul road ran from near the former fitters shop, in a south westerly direction to the southern site boundary;
- Site regrading occurred in the 1980s, and comprised reshaping and grassing the surface. Many of the concrete footings were left in place, including the transformer foundations.

Mr Greg Cole-Clark

Greg Cole-Clark was under mine manager at Wallarah Colliery from 1979 to 1980 and from 1989 to 1994 was mine manager at Chain Valley Colliery, while living at Catherine Hill Bay. Mr Cole-Clark indicated the following in January 2007:

- The screening plant at Pit E was no longer present in 1982 on a visit to Catherine Hill Bay;
- There was a water supply pipeline from Moonee Colliery to the south;
- The bath-house probably had an asbestos roof;
- A new substation was constructed to the south of the former pit entries, with power supply coming from underground;
- The site was re-contoured in 1980-81 by Hugh Liddell;
- The fan shaft to the east of the tunnel entries was used for inspections and was probably filled during the early 1980s;
- The mine entries were probably filled by collapsing the entry and contouring the surface.

Review of Historical Aerial Photos

The following historical aerial photos were reviewed:

Table 1 – Aerial Photo Review

Year	Approximate Scale	Black and White/Colour
1954	1:40000	Black and White
1966	1:38000	Black and White
1975	1:40000	Black and White
1984	1:40000	Black and White
1996	1:50000	Colour
2006	1:25000	Colour

1954 Aerial Photograph (Drawing 2)

- Existing houses present along Flowers Drive;
- Most of existing houses present at south east and east parts of Areas A and B;
- Most houses have fences;
- Pit E infrastructure present including numerous buildings, tracks, cleared areas and railway lines with coal cars evident, as shown on Drawing 2;
- Creek is close to existing alignment, widened 'dam' not evident;
- Quarry evident east of Area A;
- Dam present to north of Area B.

1966 Aerial Photograph

- Pit E present, but no activity evident (no coal cars);
- Additional area of cleared ground around Pit E, including possible haul roads running up to western boundary;
- Fences around houses are no longer evident;
- Extensive clearing at quarry east of Area A.

1975 Aerial Photograph

- Possible ponded water in creek alignment at Area A;
- Pit E infrastructure gone;
- Some regrowth of cleared areas.

1984 Aerial Photograph

- Haul road from former Pit E site to Pacific Highway clearly evident;
- Additional clearing around Pit E Area B;
- Widening of creek to form 'dam' in Area B evident.

1996 Aerial Photograph

- Area B/Pit E mostly grassed;
- Regrowth of cleared areas.

2006 Aerial Photograph

- No significant changes.

The review of aerial photos was difficult due to the relatively small scale and poor resolutions.

Lake Macquarie City Council Property Enquiry

A property enquiry search for Lot 223 DP 1102989 on Lake Macquarie City Council's website indicated the following:

- Comprises bush fire prone land;
- Presence of acid sulphate soils;
- Within a coastal zone;
- Within LEP 2004 Conservation Area and Heritage Item Schedule 4;
- Low lying land present;
- Within Mine Subsidence District.

NSW Department of Environment Climate Change and Water

A property information inquiry with the NSW Department of Environment Climate Change and Water (DECCW) indicated that the site has no statutory notices issued under the provision of the Contaminated Land and Management Act.

5.3 Summary of Site Development

As discussed above, Pit E of the Wallarah Colliery was situated on the northern part of the site, west of Flowers Drive. Drawing 2 shows an aerial photo of the site from 1954. A number of the former site features have been identified from discussions with Joe Warren, a local resident and Greg Cole-Clark, former resident and mine manager.

Infrastructure on the site included the following:

- Pit head with overhead coal stackers;
- Series of rail sidings and a rail line running to the wharf. The extent of the rail lines is shown in yellow. There were four steam locomotives on the site, which were kept in a locomotive shed;
- Horse stables;
- Brick well, which is still present, to the east of the stable sheds;
- Former fitters sheds, shown on Drawing 2;
- Former power transformer, on thick concrete slab. The slab is still present;
- Workshop building with concrete floor and fibro lining, which is still present on the site;
- Bathhouse with coal fired boilers;
- Numerous other unidentified infrastructure;
- Several houses;
- Electrical substation.

6. SITE CONDITION

A site walk over survey was conducted by a senior engineer and assistant on 17 January 2007. The following observations were made.

Topography

Area B is the site of the former Pit E, it follows a valley feature which falls to the east. Area A is located on the eastern side of Flowers Drive and includes the lower portions of the gully. Slopes on the north and south sides of the valley are generally in the order of 5^{o} to 15^{o} and locally up to 25^{o} in the south-east corner. Surface levels range from about 40 m AHD in the south west corner to 4 m AHD along the creek line.

A creek runs along the northern boundary in the western part of the site, with a widening forming a 'dam' feature (Photo 2), and then heads south east diagonally across the site and passes though culverts below Flowers Drive, continuing to the east.

Vegetation

Most of the site has a locally undulating surface with a grassy ground cover however dense vegetation encroaches onto the western, southern and eastern boundaries of the western parts of the site (Photo 3). The western parts, in particular, contain dense weeds, suggesting prior disturbance.

Photo 1 – Looking west up valley

Photo 2 – Dam feature in creek

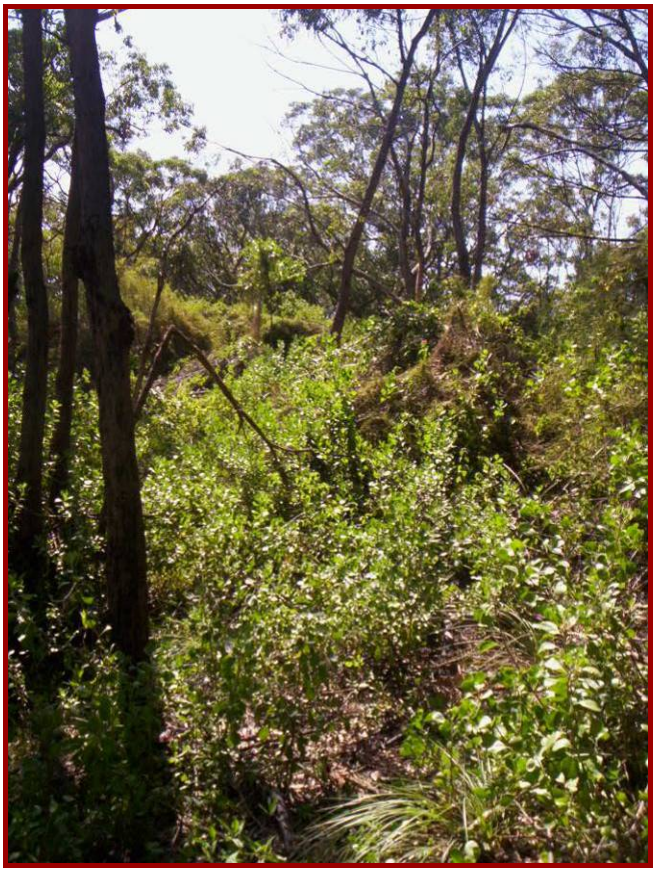

Photo 3 – Dense weeds on western part of site

Existing Development

Much of the site, mostly the central western grassed areas, is used for the grazing of horses (Photo 1).

The south-eastern slopes of the gully contains existing sparse residential development, with bitumen sealed access roads, no kerb and guttering, and single and two storey buildings of varying construction (Photos 4 to 7). The houses have tank water and septic tanks for sewage disposal. Some of the grassed areas around the houses had been terraced/regraded (Photo 6).

There are also some residences on the eastern side of Flowers Drive, of single storey construction with gravel access tracks and generally timber/fibro construction.

Photos 4 and 5 – Existing houses

Photo 6 – Terraced ground

Photo 7 – Timber/fibro house

Former Pit E Site

The former Pit E site is located on the central western parts of Area B, where the site is mostly grassed. The surface is locally undulating, suggesting a previous disturbance and fill platforms are evident in places. Various concrete footings and slabs are visible across the area, as well as the following features:

- Existing shed, with concrete floor, steel external cladding and fibro internal cladding (Photos 8 and 9);
- Buried water pipelines, probably from the Moonee Colliery site to the south;
- Remnant bitumen haul road surface running from near the existing building to the south-west (Photo 10);

- In filled stone lined well;
- Former stable foundations;
- Former transformer footings;
- Former substation, on elevated concrete platform behind the existing shed (Photo 11);
- The former railway siding comprising a fill embankment extending into the forested area at the western end of Area B;
- A drill sump on the western part of the site (Photo 14).

The former pit entries were not visible, however, are believed to be to the east of the existing shed.

Photos 8 and 9 – Showing generally disturbed ground with existing shed in background

Photo 10 – Bitumen seal from former haul road

Photo 11 – Former substation platform

Other Features

Other features in Area B include the following:

- Various areas of mounded filling, in particular along the southern boundary;
- Several pothole subsidence features were noted in western parts of the site, including one pothole with overall dimensions of about 8 m by 13 m and 3 to 4 m deep (Photos 12 and 13);
- A steel pipe was observed in a trench near the western boundary, which is possibly a former buried culvert which has been exposed by erosion (Photo 15).

Photo 12 – Pothole

Photo 13 – Possible pothole

Photo 14 – Drill sump

Photo 15 – Steel pipe

7. SURFACE FEATURE MAPPING

Various site surface features described in the sections above have been mapped on Drawing 3. The general categories of surface condition are described below.

Heavily Disturbed Ground

As outlined above much of the site included mining infrastructure and as a consequence the associated land has been heavily disturbed. The original ground surface in the area is expected to have been reworked and in many places filled. It is understood that the Pit E site (Area B) was regraded in the 1980s following decommissioning of the mine (in 1960s) and now comprises grassed pasture. There are also more localised areas of disturbed ground in Area A. The estimated extent of disturbed ground is shown on Drawing 3.

Mounded Filling

In addition to areas of disturbed ground, some obvious areas of mounded filling were identified, shown in purple on Drawing 3.

Cleared Ground

Much of the site has previously been cleared, the greatest extent of which appears to have been in the 1970s. Much of the cleared areas have been disturbed, however in some area minimal disturbance is evident, as mapped in yellow on Drawing 3. In such areas minor cut and fill may have occurred, in particular associated with construction of numerous existing residences present in such areas. Many of the residences are expected to include asbestos materials.

8. FIELD WORK

8.1 Sampling Rationale

A systematic sampling procedure was conducted for the current assessment to address the potential sources of contamination identified in the desktop and walk over assessments.

A total of 48 pits and five boreholes were sampled and analysed as part of the current assessment.

Samples were selected for analysis on the basis of the likely presence of contamination, based on material type, visual or olfactory evidence of possible contamination (ie. odour or staining), proximity to a potential source of contamination, and whether generally representative of soil/fill conditions.

8.2 Methods

The field work was undertaken between the 31 July 2007 and 18 September 2007 and comprised the following:

- Excavation of 94 test pits to depths of up to 3.0 m using a backhoe as follows:
  - Areas A and B: Pits 1 to 44 and 65 to 68;
  - Pits 45 to 53 and 56, 61 and 63 and Bores 104 to 106 were excavated/drilled in areas outside of the currently proposed development and the results are not included in this report.;
  - Note: Pits 54, 55, 57 to 60, 62 and 64 were not excavated due to access restrictions.
- Drilling of five bores (Bores 101 to 103, 107 and 108) in Area B to depths of up to 7 m, in areas where the filling or soft soil was deeper than the 3 m limit of the test pits.

The test locations were set out by an environmental engineer from DP who also logged the subsurface profile in the pits and boreholes and collected samples for identification and testing purposes. The test pits were pegged on completion and then surveyed by Monteath & Powys Pty Ltd. The locations of the pits and boreholes are shown on Drawing 1, Appendix D and co-ordinates are listed in Table 3, Section 8.5.

Samples for environmental purposes were generally collected from the near surface, and at regular depth intervals or changes in strata within each pit and borehole. Soil samples were collected directly from the side walls of the test pits or bores or from the excavator bucket or auger using disposable gloves. Care was taken to remove any extraneous material deposited on the sample.

All sampling data was recorded on DP chain of custody sheets, and the general sampling procedure comprised:

- Decontamination of all sampling equipment using a 3% solution of phosphate free detergent (Decon 90) and tap water prior to collecting each sample;
- The use of disposable gloves for each sampling event;
- Transfer of samples into laboratory-prepared glass jars, and capping immediately;
- Collection of 10% replicate samples for QA/QC purposes;

- Collection of replicate soil samples in zip-lock plastic bags at each depth for PID screening;
- Labelling of sample containers with individual and unique identification, including project number, sample location and sample depth;
- Placement of the sample jars and replicate sample bags into a cooled, insulated and sealed container for transport to the laboratory;
- Use of chain of custody (C-O-C) documentation ensuring that sample tracking and custody could be cross-checked at any point in the transfer of samples from the field to the laboratory.

The process of obtaining samples and their transportation, storage and delivery to laboratories for analysis was documented on a DP standard chain-of-custody form. Copies of completed forms are contained in Appendix C.

Replicate samples for each sample were screened for the presence of volatile organic compounds (VOCs), using a Photovac 2020 photo-ionisation detector (PID) with a 10.6 eV lamp, calibrated to 100 ppm Isobutylene. The PID is capable of detecting over 300 VOCs.

Samples collected for the assessment of acid sulphate soil conditions were wrapped in plastic wrap and plastic bags to exclude air, and stored and transported on ice. Samples were then refrigerated in the DP laboratory.

The work was undertaken in accordance with the DP quality system and procedures for contamination assessments as presented in the company's field procedures manual. A list of the procedures used and other information on quality assurance and quality control, including analysis of replicate samples, is found in Appendix C.

8.3 Data Quality Objectives (DQOs)

Table 2 summarises data quality objectives (DQOs) and the procedures designed to enable achievement of the DQOs.

Table 2 – Data Quality Objectives

DQO	Achievement Evaluation Procedure
Documentation completeness	Completion of field and laboratory chain of custody documentation, completion of borehole logs.
Data completeness	Analysis of appropriate determinants based on site history and on-site observation.
Data comparability	Use of NATA certified laboratory, use of consistent sampling technique.
Precision and accuracy for sampling and analysis	Achievement of 50% RPD for replicate analysis, acceptable levels for laboratory QC criteria.

8.4 Results

The subsurface conditions are presented in detail in the test pit and borehole logs, Appendix A. These should be read in conjunction with the general notes preceding them, which explain definitions of the classification methods and descriptive terms.

Areas A and B (Pits 1 to 44 and 65 to 68, Bores 101 to 103, 107 and 108)

The typical soil profile in comprised the following:

Depth (m)	Description
Surface	
	FILLING, generally clay with layers of coal/chitter, some building rubble
0.3 m to 3.2 m	
	CLAY, stiff to very stiff
0.4 m to 6 m	
	SANDSTONE/CLAYSTONE, extremely low strength >7 m

Bores 103, 107 and 108, and Pits 14, 31, 35, 37, 42, 44 and 65 located along the creek line encountered very soft to firm clay and loose sand to depths in the range 0.6 m to 6 m. Groundwater was encountered at 0.7 m to 0.9 m depth at these bores. It is noted that groundwater levels are transient and may vary with climatic conditions.

8.5 Summary

A summary of the depth of filling, depth to rock and depth of groundwater is presented in Table 3, below. Depths of filling and depth to rock are also presented on Drawing 1, Appendix D.

Table 3 – Summary of Depth of Filling, Rock, Backhoe Refusal and Groundwater

Location	Area	Easting	Northing	Surface Level (AHD)	Depth of Fill (m)	Depth of Soft/Loose Alluvial Soil (m)	Depth to Rock (m)	Depth of Backhoe/Auger Refusal (m)	Depth of Groundwater (m)
Pit 1	B	371184	6331931	40.4	1.8	NE	1.8	2.4	
Pit 2	B	371170	6332018	24.0	0.4	NE	0.4	1.15	
Pit 3	B	371176	6332172	11.8	0.55	NE	0.9	>2.7	
Pit 4	B	371207	6331996	32.2	0.4	NE	1.0	1.75	
Pit 5	B	371226	6332062	24.2	0.15	NE	1.35	1.7	
Pit 6	B	371210	6332122	15.8	0.4	NE	2.0	>2.9	
Pit 7	B	371247	6332024	27.2	0.8	NE	0.8	1.25	
Pit 8	B	371274	6332162	10.2	2.9	NE	>3.1	>3.1	1.15 seepage
Pit 9	B	371322	6331874	36.6	1.2	NE	>3.0	>3.0	
Pit 10	B	371305	6332044	19.2	2.0	NE	>2.65	>2.65	
Pit 11	B	371276	6332126	12.3	0.5	NE	>2.8	>2.8	
Pit 12	B	371359	6332056	14.9	0.9	NE	>2.8	>2.8	
Pit 13	B	371364	6332100	12.1	>0.2	NE	>0.2	>0.2	
Pit 13A	B	371371	6332097	11.8	0.45	NE	>2.65	>2.6	
Pit 14	B	371356	6332134	10.1	0.45	1.4	>2.9	>2.9	
Pit 15	B	371416	6331907	33.4	NE	NE	1.4	1.5	
Pit 16	B	371432	6332033	17.5	0.3	NE	>2.65	>2.65	
Pit 17	B	371441	6332080	14.4	>3.0	NE	>3.0	>3.0	
Pit 18	B	371450	6332117	9.4	>0.3	NE	>0.3	>0.3	
Pit 19	B	371450	6332165	6.9	>2.0	NE	>2.0	>2.0	1.2
Pit 20	B	371475	6331977	23.2	0.25	NE	1.5	2.0	
Pit 21	B	371485	6332047	15.2	>0.12	NE	>0.12	>0.12	
Pit 22	B	371487	6332073	15.0	>3.0	NE	>3.0	>3.0	
Pit 23	B	371508	6332003	18.3	>1.35	NE	>2.7	>2.7	
Pit 24	B	371523	6332059	14.4	0.8	NE	>3.0	>3.0	
Pit 25	B	371514	6332096	10.7	>1.15	NE	>1.15	>1.15	
Pit 26	B	371509	6332134	8.1	>0.45	NE	>0.45	>0.45	
Pit 27	B	371541	6331995	16.6	0.25	NE	2.6	>2.9	

Table 3 – Summary of Depth of Filling, Rock, Backhoe Refusal and Groundwater (continued)

Location	Area	Easting	Northing	Surface Level (AHD)	Depth of Fill (m)	Depth of Soft/Loose Alluvial Soil (m)	Depth to Rock (m)	Depth of Backhoe/Auger Refusal (m)	Depth of Groundwater (m)
Pit 28	B	371534	6332113	8.7	>1.6	NE	>1.6	>1.6	
Pit 29	B	371570	6332061	13.2	0.4	NE	>2.8	>2.8	
Pit 30	B	371568	6332098	10.4	0.55	NE	0.55	0.6	
Pit 31	B	371584	6332131	7.3	0.75	1.4	>2.7	>2.7	
Pit 32	B	371602	6331926	22.9	1.2	NE	1.8	>2.7	
Pit 33	B	371646	6332156	6.6	>3.0	NE	>3.0	>3.0	2.9
Pit 34	B	371694	6332010	12.1	0.7	NE	1.2	1.9	
Pit 35	B	371710	6332160		1.2	1.7	>3.0	>3.0	0.9
Pit 36	B	371721	6332150	6.4	>2.8	NE	>2.8	>2.8	
Pit 37	B	371780	6332067	4.7	1.3	2.0	>3.0	>3.0	1.5-2.0
Pit 38	B	371816	6332139	4.7	1.0	NE	>3.0	>3.0	
Pit 39	B	371816	6332204	6.7	1.4	NE	>3.0	>3.0	
Pit 40	B	371816	6332252	7.7	0.8	NE	>3.0	>3.0	
Pit 41	A	371878	6332106	3.5	0.9	NE	>3.0	>3.0	
Pit 42	A	371890	6332159	5.5	1.3	1.6	>2.2	>2.2	
Pit 43	A	372032	6332381	26.1	0.4	NE	0.8	1.3	
Pit 44	A	371961	6332198	9.7	1.2	1.7	>3.0	>3.0	
Pit 45 to 53	Located outside of currently proposed development								
Pit 54 - 55	Unused numbers								
Pit 56	Located outside of currently proposed development								
Pit 57-60	Unused numbers								
Pit 61	Located outside of currently proposed development								
Pit 62	Unused numbers								
Pit 63	Located outside of currently proposed development								
Pit 64	Unused numbers								
Pit 65	B	371582	6332164	5.2	0.6	2.5	>3.0	>3.0	0.5
Pit 66	B	371270	6332091	17.5	0.4	NE	>3.0	>3.0	NE
Pit 67	B	371480	6332124	8.4	0.4	NE	0.65	0.7	NE
Pit 68	B	371513	6332034	14.8	>1.1	NE	>1.1	>1.1	NE
Bore 101	B	371503	6332068	15.0	3.2	NE	>3.95	>3.95	NE
Bore 102	B	371449	6332081	14.6	3.1	NE	>4.95	>4.95	NE
Bore 103	B	371678	6332177	5.6	1.8	4.7	4.7	>4.95	0.9

Table 3 – Summary of Depth of Filling, Rock, Backhoe Refusal and Groundwater (continued)

Location	Area	Easting	Northing	Surface Level (AHD)	Depth of Fill (m)	Depth of Soft/Loose Alluvial Soil (m)	Depth to Rock (m)	Depth of Backhoe/Auger Refusal (m)	Depth of Groundwater (m)
Bore 104 to 106	Located outside of currently proposed development								
Bore 107	C	371444	6332169	7.2	1.05	NE	6	>7.0	0.9
Bore 108	B	371578	6332167	5.6	1.6	5.2	5.2	5.75	0.9

Notes to Table 3:

NE – Not Encountered

The presence of potentially combustible material (coal and chitter) was noted on the borehole and test pit logs, and is summarised in Table 4, below.

Table 4 – Potentially Combustible Material within Test Bores and Pits

Test Pit/ Bore	Depth (m)	Approx % (1)	Test Pit/ Bore	Depth (m)	Approx % (1)
B101	0.1-1.5	70-80	TP31	0-0.4	30
B101	1.5-2.9	30	TP31	0.4-0.6	5
B102	0.7-1.15	-	TP31	0.6-0.75	60
B102	1.15-1.3	90	TP32	0.1-0.3	-
B103	0-1.8	-	TP32	0.3-1.2	10
B107	0-1.15	-	TP33	0.2-0.7	10
B108	0-1.6	-	TP33	1.1-1.7	-
TP1	0-1.8	10	TP33	1.7-2.2	15
TP2	0-0.4	10	TP34	0-0.7	10
TP3	0-0.55	30	TP35	0-0.35	-
TP4	0-0.4	-	TP35	0.35-0.5	10
TP6	0-0.4	-	TP36	0-2.4	-
TP8	0-0.6	-	TP36	2.4 >2.8	15
TP8	0.85-1.8	5	TP37	0-1.3	-
TP8	2.6-2.9	-	TP38	0-0.4	50
TP9	0-0.55	10	TP38	0.4-1.0	70-80
TP9	0.55-1.2	40	TP39	0.1-1.1	-
TP10	0.4-1.3	5	TP39	1.1-1.4	10
TP10	1.3-1.7	-	TP40	0-0.3	-
TP12	0-0.9	10	TP40	0.3-0.8	5
TP13	0-0.15	20	TP41	0-0.2	30

Table 4 – Potentially Combustible Material within Test Bores and Pits (continued)

Test Pit/ Bore	Depth (m)	Approx % (1)	Test Pit/ Bore	Depth (m)	Approx % (1)
TP13A	0.1-0.45	30	TP28	0-0.6	10
TP14	0-0.2	20	TP28	0.6-0.7	50
TP16	0-0.3	10	TP28	1.1-1.2	60
TP17	0.75-1.2	50	TP28	1.2 >1.6	10
TP17	1.2-2.6	70 (2)	TP29	0-0.1	5
TP17	2.6 >3.0	10	TP30	0-0.55	10
TP19	0-0.25	30	TP41	0.2-0.9	-
TP19	0.25-2	10	TP42	0-0.4	-
TP20	0-0.25	5	TP42	0.4-0.9	10
TP21	0-0.1	5-10	TP42	0.9-1.3	-
TP22	0 >3.0	10	TP43	0-0.4	5
TP23	0.35-1.35	10	TP44	0.7-1.2	-
TP24	0-0.2	30	TP65	0-0.5	20
TP24	0.45-0.8	50-70	TP66	0-0.35	-
TP25	0 >1.1	-	TP67	0-0.4	30-40
TP26	0 >0.45	50	TP68	0.05-0.35	5
TP27	0-0.15	30	TP68	0.35 >1.1	80
TP27	0.15-0.25	10			

Notes to Table 4:

(1) Approximate percentage only, based on visual assessment
(2) Includes cobbles

8.6 Contaminant Observations

Based on the results of the site walkover survey and subsurface assessment, potential sources of contamination from the former site uses include the following:

- Fill materials (source unknown), may contain a range of contaminants including asbestos, hydrocarbons, heavy metals etc;
- Filling is present in areas marked as mounded filling (Drawing 3) and disturbed ground as well as minor filling within cleared or developed areas;
- Oil and grease from the coal mining operations including disturbed and cleared areas;

- Ash associated with boilers and power generator (the location of which is unknown) which may contain dioxins, furons, metals or PAHs;
- Asbestos lining from buildings, fences and fly tipping. This may be present in filling, disturbed ground or cleared areas;
- Possible PCBs from substation and power transformer;
- Herbicides and pesticides associated with spraying the rail corridor;
- High nutrient run-off from grazed fields and septic tanks.

Observations of potential contamination within the test bores and pits are summarised in Table 5 below:

Table 5 – Contaminant Observations within Test Bores and Pits

Potential Contaminant Observation	Location/Depth (m)
Fibro fragments	TP18/0 >0.3
Deleterious Material (concrete, timber corrugated iron, rubber, metal, bricks, cable, footings, sleepers, rails)	TP1/0-1.1
	TP4/0-0.4
	TP9/0-0.55
	TP13/0.15 >0.2
	TP18/0 >0.3
	TP21/>0.1
	TP23/0.6, 0.9
	TP25/0.5
	TP26/>0.3
	TP28/1.4
	TP42/0.9-1.3
	TP65/0.4
Black slag	TP68/0-0.05
Black tar film on concrete slab	TP23/0.9
Slight hydrocarbon odour	TP36/2.4-2.8

The results of PID screening on soil samples are shown on the test pit logs in Appendix A, and generally suggest the absence of gross volatile hydrocarbon impact.

There was no visual or olfactory evidence (ie. staining or odours) to suggest the presence of gross contamination within the soils investigated.

Seepage water was observed in some of the pits. There was no visual or olfactory evidence (ie. staining or odours) to suggest the presence of gross contamination within seepage water.

It is noted, however, that groundwater was not sampled or analysed to confirm groundwater constituents.

9. LABORATORY TESTING

9.1 Contamination

9.1.1 General

Laboratory testing was undertaken by SGS Environmental, a National Association of Testing Authorities, Australia (NATA) registered laboratory. Analytical Methods used are shown on the laboratory sheets in Appendix C.

A total of 93 soil samples from the pits and boreholes were selected to provide an assessment of soil/fill conditions. The samples were selected to target the identified potential sources of contamination (Ref 1).

The selected samples were analysed for the following potential contaminants:

- Total Recoverable Hydrocarbons (TRH);
- Polycyclic Aromatic Hydrocarbons (PAH);
- Organochlorine Pesticides (OCP);
- Organophosphorus Pesticides (OPP);
- Polychlorinated Biphenyls (PCB);
- Benzene, Toluene, Ethyl Benzene, Xylene (BTEX);
- Metals: Arsenic (As); Cadmium (Cd); Chromium (Cr); Copper (Cu); Lead (Pb); Mercury (Hg); Nickel (Ni); Zinc (Zn).

Quality Control/Quality Assurance (QA/QC) testing comprised nine soil replicate samples.

In addition, two fibro samples and two soil samples from test pits were analysed for asbestos.

TCLP leachability testing for selected metals was conducted on eight samples that exceeded sensitive landuse criteria for TRH (where offsite disposal is likely) to further assess the waste classification.

Eight soil samples were analysed for full chromium suite as part of the acid sulphate soil assessment. The results of acid sulphate soil investigation is presented in Section 9.

Ten soil samples were analysed for aggressivness (sulphate, chloride and pH), and combustibility testing was undertaken on 20 samples. The results of this testing is presented in Section 10.

9.1.2 Analytical Results

The results of chemical analysis of soil samples are presented in the laboratory report sheets (Appendix C), and are summarised in Tables 6 to 10, below.

Table 6 – Laboratory Results for Metals in Soil

Test Location	Depth(m)	Metal							
		As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Pit 1	1.2	<PQL	0.1	5.7	37	**21**	0.05	**4.7**	49
Pit 2	0.05	<PQL	0.3	5.4	11	**14**	<PQL	2	89
Pit 3	0.5	<PQL	0.1	6.3	21	**15**	0.05	**4.5**	15
Pit 4	0.05	<PQL	0.1	3.2	9.6	9	<PQL	2.3	43
Pit 5	0.05	3	0.2	6.8	3.1	10	<PQL	0.9	48
Pit 6	0.1	<PQL	<PQL	2.9	6.9	6	<PQL	2	7.2
Pit 7	0.1	<PQL	0.2	**12**	10	**14**	<PQL	**4.6**	39
Pit 8	1	<PQL	<PQL	1	<PQL	2	<PQL	<PQL	4.6
Pit 8	2.7	<PQL	<PQL	6.9	9.1	9.8	0.07	3.1	9.3
Pit 9	0.2	<PQL	0.5	6.1	510	**34**	0.07	**7.6**	820
Pit 10	1.1	10	0.3	**26**	65	**23**	<PQL	3.4	29
Pit 11	0.4	5	0.1	10	5.1	8	<PQL	1.6	9.2
Pit 12	0.7	<PQL	0.1	5.9	26	**29**	0.1	**7.5**	38
Pit 13	0.1	4	1.4	**14**	97	**250**	0.05	**13**	1100
Pit 13A	0.35	**30**	1	9.2	1000	**1000**	**0.6**	**12**	1100
Pit 14	0.3	3	0.1	4.9	1.7	7	<PQL	0.5	4.4
Pit 15	0.1	4	0.2	10	6.6	7	<PQL	1.4	27
Pit 16	0.2	6	0.2	10	34	**20**	<PQL	2	16
Pit 17	1.9	4	0.2	5	64	**20**	**0.5**	**9.3**	69
D11	Pit 17/1.9	<PQL	<PQL	4.5	15	9.6	**0.5**	**6**	49
Pit 18	0.15	4	0.8	**11**	360	**260**	<PQL	**9.2**	2100
Pit 19	0.7	4	0.4	9.3	250	**140**	0.13	**9.2**	210
D9	Pit 19/0.7	4	0.4	10	300	**180**	0.15	**9.9**	240
Pit 20	0.1	<PQL	0.1	5.9	4.6	9.9	<PQL	0.99	20
Pit 21	0.05	5	0.9	**28**	110	**190**	<PQL	**8.5**	750
Pit 22	0.3	3	0.3	9.7	280	**130**	0.08	**9.1**	290
Pit 22	2.8	<PQL	<PQL	2.8	11	8	<PQL	**5.3**	20
D13	Pit 22/2.8	<PQL	<PQL	2.6	13	10	<PQL	**5.6**	20
Pit 23	0.02	8	0.4	**14**	45	**34**	<PQL	3.7	98
Pit 23	0.9	6	0.3	**11**	41	**38**	0.08	**5.6**	64
Pit 24	0.6	<PQL	<PQL	3.8	47	**13**	0.37	**5.3**	16
Pit 25	0.5	<PQL	0.4	8.5	26	**25**	0.09	**12**	68

Table 6 – Laboratory Results for Metals in Soil (continued)

Test Location	Depth(m)	Metal							
		As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Pit 26	0.3	3	0.3	8.1	27	**150**	<PQL	**6.5**	65
Pit 27	0.05	<PQL	0.3	**20**	16	**31**	0.06	2.6	86
Pit 28	0.15	<PQL	0.2	5.2	16	**53**	0.05	3.3	62
Pit 28	1.4	<PQL	0.2	10	21	**22**	0.06	11	98
Pit 29	0.3	6	0.2	10	2.8	8	<PQL	0.8	7.4
Pit 30	0.05	<PQL	<PQL	2.7	1.3	4	<PQL	0.9	10
Pit 31	0.7	<PQL	0.1	3.3	36	**31**	0.1	**4.2**	48
Pit 32	0.2	3	0.2	4.2	16	**19**	0.1	**5.3**	43
D18	Pit 32/0.2	9	0.2	3.5	14	**22**	0.08	**5.4**	44
Pit 32	0.8	<PQL	0.2	9.3	10	**33**	<PQL	2	43
Pit 33	0.1	<PQL	<PQL	2.7	2.9	5	<PQL	1.7	8.6
Pit 33	1.3	7	0.2	6.3	71	**39**	0.1	**9.7**	22
Pit 33	2.8	<PQL	<PQL	5.3	0.5	3	<PQL	0.5	1.8
Pit 34	0.3	3	0.3	**11**	11	**29**	0.1	2.5	100
Pit 36	0.8	<PQL	0.1	**12**	30	**12**	<PQL	**16**	8.8
Pit 36	2.5	4	**2.1**	8.4	140	**86**	0.1	**10**	890
Pit 37	1.2	<PQL	<PQL	5.3	17	**19**	0.08	**7.2**	20
D21	Pit 37/1.2	<PQL	<PQL	5.3	15	**19**	0.06	**5.4**	12
Pit 38	0.3	<PQL	0.1	8.3	21	**18**	0.13	**8**	21
Pit 39	0.05	<PQL	<PQL	3.7	4.5	7	<PQL	1.3	7.6
Pit 39	1	<PQL	<PQL	4.5	13	9.7	0.06	3.7	10
Pit 40	0.6	<PQL	<PQL	2.3	7.9	**27**	<PQL	1.3	35
Pit 41	0.6	<PQL	<PQL	3.4	6.9	7	<PQL	**6**	13
Pit 42	0.3	<PQL	<PQL	3	8.5	6	<PQL	2	10
D24	Pit 42/0.3	<PQL	<PQL	3.1	29	9.2	<PQL	2.3	17
Pit 43	0.1	<PQL	0.3	6.4	12	**170**	<PQL	2.1	230
Pit 44	0.9	8	1.5	6.4	55	**37**	0.17	25	110
Pit 45 to 63	Located outside of currently proposed development and/or not excavated								
Pit 65	0.2	<PQL	0.3	7.2	29	**28**	0.08	**4.4**	91
Pit 66	0.25	<PQL	0.2	5.4	18	**31**	<PQL	3.6	42

Table 6 – Laboratory Results for Metals in Soil (continued)

Test Location	Depth(m)	Metal							
		As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Pit 67	0.05	<PQL	0.4	7.8	69	**180**	<PQL	**5.1**	290
Pit 68	0.02	**460**	7.5	**120**	4500	**6100**	<PQL	19	73000
D14	Pit 68/0.02	**450**	5.9	**73**	2500	**2700**	<PQL	20	50000
Bore 101	1.0	4	0.2	17	15	11	0.16	1.9	37
Bore 101	2.5-2.95	<PQL	<PQL	2.7	14	5	<PQL	15	16
D101	B101/1.0	4	0.3	21	15	10	0.13	1.6	47
Bore 102	0.2	<PQL	0.2	14	27	18	<PQL	10	75
Bore 102	1.0	3	0.2	8.7	21	19	<PQL	3.9	42
Bore 102	2.5-2.95	<PQL	0.1	5	70	9.7	0.08	8.3	19
Bore 103	0.1	4	0.2	10	34	39	0.12	5.7	32
Bore 103	1.0-1.45	<PQL	1.4	8.1	73	45	0.06	7.6	320
Bore 107	0.1	<PQL	0.3	6.4	67	60	0.12	5.8	180
Bore 108	1.0	<PQL	0.1	4.9	13	11	0.05	4.4	32
C201 to C222	Located outside of currently proposed development								
Laboratory PQL		3	0.1	0.3	0.5	1	0.05	0.5	0.3
NEHF A[1] (Ref 4)		100	20	100	1000	300	15	600	7000
NEHF E[1] (Ref 4)		200	40	200	2000	600	30	600	14000
Service Station Sites [2] (Ref 5)		NC	NC	NC	NC	300	NC	NC	NC
General Solid Waste (Ref 8)		100	20	100	NC	100	4	40	NC
Restricted Solid Waste (Ref 8)		400	80	400	NC	400	16	160	NC

Notes to Table 6:

All results in mg/kg on a dry weight basis
PQL – Practical Quantitation Limits
NC – No Criteria
1 – Health Based Criteria for A - Residential Land Use,
E – Parks and open space for C201 to C222
2 – Threshold Concentration for Sensitive Land Use
3 – Chromium (VI) (Conservative)
Shaded results exceed NEHF A Health based Criteria Areas A to D, and NEHF E Criteria for proposed road alignment (Pits C201 to C222)
Bold results exceed NSW EPA General Solid Waste Guidelines

Table 7 – Laboratory Results for TRH and BTEX in Soil

Test Location	Depth (m)	PID (ppm)	Analyte							
			TRH				BTEX			
			C_6 - C_9	C_{10} - C_{14}	C_{15} - C_{28}	C_{29} - C_{36}	Benzene	Toluene	Ethyl Benzene	Xylene
Pit 1	1.2	<1	<PQL	33	260	98	<PQL	<PQL	<PQL	<PQL
Pit 2	0.05	<1	<PQL	<PQL	86	73	<PQL	<PQL	<PQL	<PQL
Pit 3	0.5	<1	<PQL	38	310	140	<PQL	<PQL	<PQL	<PQL
Pit 4	0.05	<1	<PQL	30	270	150	<PQL	<PQL	<PQL	<PQL
Pit 5	0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 6	0.1	<1	<PQL	50	350	140	<PQL	<PQL	<PQL	<PQL
Pit 7	0.1	<1	<PQL	<PQL	97	75	<PQL	<PQL	<PQL	<PQL
Pit 8	1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 8	2.7	<1	<PQL	22	160	80	<PQL	<PQL	<PQL	<PQL
Pit 9	0.2	<1	<PQL	<PQL	200	130	<PQL	<PQL	<PQL	<PQL
Pit 10	1.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 11	0.4	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 12	0.7	<1	<PQL	<PQL	190	99	<PQL	<PQL	<PQL	<PQL
Pit 13	0.1	<1	<PQL	72	1200	1100	<PQL	<PQL	<PQL	<PQL
Pit 13A	0.35	<1	<PQL	<PQL	760	640	<PQL	<PQL	<PQL	<PQL
Pit 14	0.3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 15	0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 16	0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 17	1.9	<1	<PQL	78	920	590	<PQL	<PQL	<PQL	<PQL
D11	Pit 17/1.9	<1	<PQL	42	590	490	<PQL	<PQL	<PQL	<PQL
Pit 18	0.15	<1	<PQL	26	450	1200	<PQL	<PQL	<PQL	<PQL
Pit 19	0.7	<1	<PQL	<100	840	2000	<PQL	<PQL	<PQL	<PQL
D9	Pit 19/0.7	<1	<PQL	<PQL	900	1800	<PQL	<PQL	<PQL	<PQL
Pit 20	0.1	<1	<PQL	<PQL	<PQL	100	<PQL	<PQL	<PQL	<PQL
Pit 21	0.05	<1	<PQL	<PQL	340	690	<PQL	<PQL	<PQL	<PQL
Pit 22	0.3	<1	<PQL	<PQL	<PQL	61	<PQL	<PQL	<PQL	<PQL
Pit 22	2.8	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D13	Pit 22/2.8	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 23	0.02	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Table 7 – Laboratory Results for TRH and BTEX in Soil (continued)

Test Location	Depth (m)	PID (ppm)	Analyte							
			TRH				BTEX			
			C_6 - C_9	C_{10} - C_{14}	C_{15} - C_{28}	C_{29} - C_{36}	Benzene	Toluene	Ethyl Benzene	Xylene
Pit 23	0.9	<1	<PQL	<PQL	<PQL	100	<PQL	<PQL	<PQL	<PQL
Pit 24	0.6	<1	<PQL	42	860	650	<PQL	<PQL	<PQL	<PQL
Pit 25	0.5	<1	<PQL	36	420	270	<PQL	<PQL	<PQL	<PQL
Pit 26	0.3	<1	<PQL	57	530	320	<PQL	<PQL	<PQL	<PQL
Pit 27	0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 28	0.15	<1	<PQL	<PQL	160	100	<PQL	<PQL	<PQL	<PQL
Pit 28	1.4	<1	<PQL	<PQL	160	130	<PQL	<PQL	<PQL	<PQL
Pit 29	0.3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 30	0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 31	0.7	<1	<PQL	<PQL	230	130	<PQL	<PQL	<PQL	<PQL
Pit 32	0.2	<1	<PQL	<PQL	89	<PQL	<PQL	<PQL	<PQL	<PQL
D18	Pit 32/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 32	0.8	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 33	0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 33	1.3	<1	<PQL	<PQL	290	240	<PQL	<PQL	<PQL	<PQL
Pit 33	2.8	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 34	0.3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 36	0.8	<1	<PQL	41	420	180	<PQL	<PQL	<PQL	<PQL
Pit 36	2.5	<1	<PQL	23	2100	1800	<PQL	<PQL	<PQL	<PQL
Pit 37	1.2	<1	<PQL	<PQL	300	140	<PQL	<PQL	<PQL	<PQL
D21	Pit 37/1.2	<1	<PQL	28	250	100	<PQL	<PQL	<PQL	<PQL
Pit 38	0.3	<1	<PQL	22	200	91	<PQL	<PQL	<PQL	<PQL
Pit 39	0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 39	1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 40	0.6	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 41	0.6	<1	<PQL	<PQL	65	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 42	0.3	<1	<PQL	<PQL	55	<PQL	<PQL	<PQL	<PQL	<PQL
D24	Pit 42/0.3	<1	<PQL	43	340	160	<PQL	<PQL	<PQL	<PQL
Pit 43	0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Table 7 – Laboratory Results for TRH and BTEX in Soil (continued)

Test Location	Depth (m)	PID (ppm)	Analyte							
			TRH				BTEX			
			C_6 - C_9	C_{10} - C_{14}	C_{15} - C_{28}	C_{29} - C_{36}	Benzene	Toluene	Ethyl Benzene	Xylene
Pit 44	0.9	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 65	0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 66	0.25	<1	<PQL	<PQL	53	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 67	0.05	<1	<PQL	20	140	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 68	0.02	<1	<PQL	<PQL	<50	<PQL	<PQL	<PQL	<PQL	<PQL
D14	Pit 68/0.02	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 101	1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 101	2.5-2.95	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D101	B101/1.0	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 102	0.2	<1	<PQL	<PQL	58	180	<PQL	<PQL	<PQL	<PQL
Bore 102	1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 102	2.5-2.95	<1	<PQL	<PQL	52	56	<PQL	<PQL	<PQL	<PQL
Bore 103	0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 103	1.0-1.45	<1	<PQL	<PQL	63	80	<PQL	<PQL	<PQL	<PQL
Bore 107	0.1	<1	<PQL	<PQL	190	170	<PQL	<PQL	<PQL	<PQL
Bore 108	1	<1	<PQL	<PQL	<PQL	87	<PQL	<PQL	<PQL	<PQL
Laboratory PQL			20	20	50	50	0.5	0.5	0.5	1.5
NEHF A[1] (Ref 4)			NC	NC			NC	NC	NC	NC
NEHF E[1] (Ref 4)			NC	NC			NC	NC	NC	NC
Service Station Sites [2] (Ref 5)			65	1000 total			1	1.4/130[1]	3.1/50[1]	14/25[1]
General Solid Waste (Ref 8)			650	10000 total			10	288	600	1000
Restricted Solid Waste (Ref 8)			2600	40000 total			40	1152	2400	4000

Notes to Table 7:

All results in mg/kg on a dry weight basis
PQL – Practical Quantitation Limits
NC – No Criteria
PID – Photoionisation Detector
1 – Health Based Criteria for A - Residential Land Use, E - Parks and open space for C201 to C222
2 – Threshold Concentration for Sensitive Land Use
Shaded results exceed NEHF A Health based Criteria

Table 8 – Laboratory Results for OCP, OPP, PCB and PAH in Soil

Test Location	Depth (m)	Total PAH	Benzo(a) Pyrene	PCB	Total OPP	Total OCP	Aldrin + Dieldrin	Chlordane	DDT	Heptachlor
Pit 1	1.2	<5.28	0.08	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 2	0.05	<3.05	0.05	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 3	0.5	<7.22	**0.12**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 4	0.05	<7.61	**0.11**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 5	0.05	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 6	0.1	<8.93	**0.13**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 7	0.1	<3.17	0.07	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 8	1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 8	2.7	<4.77	0.07	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 9	0.2	<10.65	**0.25**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 10	1.1	<1.65	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 11	0.4	<1.65	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 12	0.7	<4.70	**0.1**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 13	0.1	54	**3.2**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 13A	0.35	13	0.96	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 14	0.3	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 15	0.1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 16	0.2	<1.65	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 17	1.9	<9.57	**0.17**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D11	Pit 17/1.9	<6.54	**0.14**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 18	0.15	<6.08	**0.18**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 19	0.7	<5.47	**0.17**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D9	Pit 19/0.7	<5.06	**0.16**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 20	0.1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 21	0.05	<4.81	**0.31**	<1.40	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 22	0.3	<1.85	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 22	2.8	<1.97	0.07	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D13	Pit 22/2.8	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 23	0.02	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 23	0.9	<2.59	**0.09**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 24	0.6	<11.06	**0.26**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 25	0.5	<9.67	**0.27**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 26	0.3	<10.53	**0.23**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 27	0.05	<2.49	**0.09**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 28	0.15	<4.31	**0.11**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 28	1.4	<4.29	**0.09**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 29	0.3	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 30	0.05	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Table 8 – Laboratory Results for OCP, OPP, PCB and PAH in Soil (continued)

Test Location	Depth (m)	Total PAH	Benzo(a) Pyrene	PCB	Total OPP	Total OCP	Aldrin + Dieldrin	Chlordane	DDT	Heptachlor
Pit 31	0.7	<5.52	**0.12**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 32	0.2	<2.35	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D18	Pit 32/0.2	<1.75	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 32	0.8	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 33	0.1	<1.65	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 33	1.3	<5.59	**0.19**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 33	2.8	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 34	0.3	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 36	0.8	<7.81	**0.11**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 36	2.5	<7.34	**0.34**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 37	1.2	<5.91	**0.11**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D21	Pit 37/1.2	<4.59	**0.09**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 38	0.3	<4.98	0.08	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 39	0.05	<1.95	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 39	1	<2.15	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 40	0.6	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 41	0.6	<2.86	0.06	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 42	0.3	<2.96	0.06	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D24	Pit 42/0.3	<7.42	**0.12**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 43	0.1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 44	0.9	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 65	0.2	<1.65	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 66	0.25	<2.86	0.06	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 67	0.05	<4.81	**0.11**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 68	0.02	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D14	Pit 68/0.02	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 101	1	<1.85	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 101	2.5-2.95	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D101	B101/1.0	<1.85	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 102	0.2	<1.75	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 102	1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 102	2.5-2.95	<2.05	0.05	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 103	0.1	<1.65	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 103	1.0-1.45	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 107	0.1	<3.78	0.08	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Bore 108	1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Laboratory PQL		1.55	0.05	0.9	0.4	2.5	0.2	0.2	0.2	0.1

NEHF A[1] (Ref 4)	20	1	10	NC	NC	10	50	200	10

Table 8 – Laboratory Results for OCP, OPP, PCB and PAH in Soil (continued)

Test Location	Depth (m)	Total PAH	Benzo(a) Pyrene	PCB	Total OPP	Total OCP	Aldrin + Dieldrin	Chlordane	DDT	Heptachlor
NEHF E[1] (Ref 4)		40	2	20	NC	NC	20	100	400	20
Service Station Sites[2] (Ref 5)		20	1	NC	NC	NC	NC	NC	NC	NC
General Solid Waste (Ref 8)		200	0.8	50	NC	NC	NC	NC	NC	NC
Restricted Solid Waste (Ref 8)		800	3.2	50	NC	NC	NC	NC	NC	NC

Notes to Table 8:

All results in mg/kg on a dry weight basis
PQL – Practical Quantitation Limits
NC – No Criteria
1 – Health Based Criteria for A - Residential Land Use, E - Parks and open space for C201 to C222
2 – Threshold Concentration for Sensitive Land Use
Shaded results exceed NEHF A Health based Criteria
Bold results exceed NSW EPA General Solid Waste

Table 9 – Laboratory Results for Asbestos in Soil and Fibro Fragments

Sample Identification	Sample Type	Asbestos Detected
Pit 18/0.15m	Fibro	Amosite and Chrysotile Asbestos Detected
Pit 18/0.15 m	soil	Chrysotile Asbestos Detected

Table 10 – TCLP Leachability Testing

Sample	Depth (m)	Cadmium (Cd)		Chromium (Cr)(2)		Nickel (Ni)		Lead (Pb)		Mercury (Hg)	
		Total (mg/kg)	TCLP (mg/L)	Total (mg/kg)	TCLP (mg/L)	Total (mg/kg)	TCLP (mg/L)	Total (mg/kg)	TCLP (mg/L)	Total (mg/kg)	TCLP (mg/L)
Pit 13	0.1	NT	NT	14	<PQL	13	0.011	250	0.035	NT	NT
Pit 17	1.9	NT	NT	NT	NT	9.3	0.011	20	<PQL	0.54	<PQL
Pit 18	0.15	NT	NT	11	<PQL	9.2	0.010	260	0.220	NT	NT
Pit 19	0.7	NT	NT	NT	NT	9.2	0.015	140	0.049	NT	NT
Pit 24	0.6	NT	NT	NT	NT	5.3	<PQL	13	<PQL	NT	NT
Pit 36	2.5	2.1	0.055	NT	NT	10	0.13	86	0.19	NT	NT
D9	Pit 19/0.7	NT	NT	NT	NT	9.9	0.015	180	0.053	NT	NT
D11	Pit 17/1.9	NT	NT	NT	NT	6	<PQL	NT	NT	0.54	<PQL
Laboratory PQL		0.1	0.002	0.3	0.005	0.5	0.009	1	0.02	0.05	0.0005
General Solid Waste with TCLP (Ref 6)		100[1]	1	1900[1]	5	1050[1]	2	1500[1]	5	50[1]	0.2

Notes to Table 10:
(1) – General Waste Classification guidelines for Total Concentrations when used with TCLP Results (Ref 6)
(2) – Chromium (VI) criteria used to assess Chromium concentrations
PQL – Practical Quantitation Limit
NT – Not Tested
TCLP – standard NSW EPA TCLP test

9.2 Acid Sulphate Soil

Laboratory testing comprised 32 acid sulphate screening tests. The results of the screening tests are presented in Table 11, below.

Table 11 – Results of Acid Sulphate Soil Screening Tests

Sample ID	Sample Depth [a] (m)	Sample Description	Screening Test Results			
			pH			Strength of Reaction [b]
			pH_F	pH_{FOX}	pH_F - pH_{FOX}	
Pit 8	1.15	Filling – clayey silt	5.1	3.5	1.6	1
Pit 35	1.3	Soft to firm silty clay, trace organics	5	2.8	2.2	1 2
Pit 37	1.5	Soft to firm silty clay, abundant organics (possible filling)	5.8	3.2	2.6	1
Pit 37	2	Stiff silty clay, abundant organics (possible filling)	6.5	3.3	3.2	1
Pit 37	2.5	Stiff silty clay, abundant organics (possible filling)	6.4	3.1	3.3	1
Pit 37	2.9	Stiff silty clay, abundant organics (possible filling)	6.7	4.4	2.3	1
Pit 38	1.2	Firm to stiff silty clay, trace organics	5.2	3.9	1.3	1
Pit 38	1.7	Stiff sandy clay, trace gravel	5.4	4.4	1	1
Pit 38	2.2	Stiff sandy clay, trace gravel	5.9	3.9	2	1
Pit 38	2.7	Very stiff silty clay, trace sand	5.9	4.6	1.3	1
Pit 41	1.1	Stiff silty clay, abundant organics	5.9	2.9	3	1 2
Pit 42	1.4	Very soft to soft silty clay, trace organics	6.2	4	2.2	1
Pit 44	1.3	Stiff silty sandy clay, some organics	6.4	4.2	2.2	1
Pit 44	1.6	Very soft to soft silty clay	6.6	5.8	2.2	1
Pit 65	2.9	Firm to stiff clayey silt/silty clay, some sand	6	3.1	2.9	1 2
Bore 103	2	Firm silty clay	6.6	4.2	2.4	3
Bore 103	2.5	Firm silty clay	6.5	3.6	2.9	2
Bore 103	2.5-2.95	Firm to stiff silty clay	6.4	3.6	2.8	1 2
Bore 103	3.5	Firm to stiff silty clay	5.8	3.5	2.3	1 2
Bore 103	4	Firm to stiff silty clay	5.8	3.6	2.2	1 2
Bore 103	4.05-4.45	Sand	6.1	2.7	3.4	1 2
Bore 107	2	Sandy silty clay	5.9	3.6	2.3	3
Bore 107	2.5	Sandy silty clay	6.1	3.4	2.7	2
Bore 107	2.5-2.95	Sandy silty clay	6.3	3.1	3.2	2
Bore 107	3.5	Soft to firm sandy clay	6.1	3.1	3	2
Bore 107	4	Sand, some gravel	6.4	4.1	2.3	1
Bore 107	4.0-4.45	Sand, some gravel	6.3	2.9	3.4	1

Table 11 – Results of Acid Sulphate Soil Screening Tests (continued)

Sample ID	Sample Depth [a] (m)	Sample Description	Screening Test Results			
			pH			Strength of Reaction [b]
			pH_F	pH_{FOX}	pH_F - pH_{FOX}	
Bore 107	5.5-5.95	Sand, bands of silty sand and gravelly sand	6.4	2.6	3.8	1
Bore 108	2	Silty sand	6	3	3	3
Bore 108	2.5	Firm silty sandy clay	6.2	3.1	3.1	2
Bore 108	2.5-2.95	Firm silty sandy clay	6.1	3.3	2.8	1 2
Bore 108	4.0-4.45	Silty sandy gravel	6.2	2.2	4	1
Guideline		Sands to loamy sands	<4[d]	<3.5[e]	≥1[e]	-
		Sandy loams to light clays				
		Medium to heavy clays and silty clays				

Notes to Table 11:

a Depth below ground surface
b Strength of Reaction
1 denotes no or slight reaction
2 denotes moderate reaction
3 denotes high reaction
4 denotes very vigorous reaction
F denotes bubbling/frothy reaction indicative of organics
H denotes heat generated
d For actual acid sulphate soils (ASS)
e Indicative value only for Potential Acid Sulphate Soils (PASS)
Shaded results indicate an exceedence of QASSMAC criteria (Ref 8)

The QASSIT guidelines suggest that a soil pH<4 in water is an indicator of actual acid sulphate soils. The results of screening tests therefore suggest the absence of actual acid sulphate soils at the locations and depths tested.

The QASSIT guidelines also suggest that indicators of potential acid sulphate soils (PASS) include the following:

- Soil pH <3.5 in H_2O_2 (ie. pH_{FOX});
- Drop of 1 pH unit or more between pH_F and pH_{FOX}.

32 samples exhibited a pH drop of greater than one unit, and 12 also indicated a soil pH of less than 3.5 in hydrogen peroxide, suggesting that potential acid sulphate soils may be present within sand, silt and clay soils at a range of depths across the site.

It is noted that the above test method is a qualitative method only and gives an indication of the intensity of total acidification (pH). The ASSMAC guidelines indicate that peroxide may also oxidise organic matter (in addition to pyrite) to produce acids which are unlikely to form under natural conditions, thus giving a falsely high indication of acid sulphate potential.

Based on the results of the screening tests and the identified ASS areas on the risk maps, six soil samples were selected for detailed laboratory testing, comprising the Full Chromium Suite in accordance with QASSIT guidelines (Ref 7 and 8).

Detailed test results are contained in the attached laboratory report sheets, and are summarised in Table 12, below.

Table 12 – Results of Detailed Acid Sulphate Soil Laboratory Testing

Sample ID	Sample Depth [a] (m)	Sample Description	Laboratory Results			
			pH_{KCL}	Scr %S	s-TAA %S	Net Acidity[c] %S
Pit 35	1.3	Soft to firm silty clay, trace organics	4.5	<0.02	0.07	0.07
Pit 37	2.5	Stiff silty clay, abundant organics (possible filling)	5.2	0.08	0.04	0.12
Pit 65	0.8	Very soft clayey silt, abundant organics, some sand	4.7	0.02	0.06	0.08
Bore 103	4.0 – 4.45	Sand	5.2	0.06	0.02	0.08
Bore 107	5.5 – 5.95	Sand, bands of silty sand and gravelly sand	5.3	0.06	<0.02	0.06
Bore 108	2.5 – 2.95	Firm silty sandy clay	4.5	0.02	0.08	0.10
Guideline		Sands to loamy sands	-	-	-	0.03
		Sandy loams to light clays				0.06[f]/0.03[g]
		Medium to heavy clays and silty clays				0.1[f]/0.03[g]

Notes to Table 12:

a Depth below ground surface
c Calculated from ABA equation in ASS Laboratory Methods Guidelines (Ref 9)
f QASSMAC Action Criteria for disturbance of 1-1000 tonnes of material
g QASSMAC Action Criteria for disturbance of more than 1000 tonnes of material
Shaded results indicate an exceedence of QASSMAC criteria (Ref 8)
Scr – Chromium reducible sulphur
TAA – Titratable actual acidity

9.3 Combustibility Testing

Combustibility testing was undertaken on 17 fill samples containing coal materials to determine the percentage of combustible material. The results of testing are shown in Table 13, below.

Table 13 – Results of Combustibility Testing

Test Location/Depth (m)	Total Combustibles (%)
B101/1.0-1.45	**45.8**
B106/0.1	17.8
B108/0.5	24.2
TP4/0.05	**58.8**
TP8/2.7	**35.6**
TP9/0.7	**38.7**
TP17/0.8	27.6
TP17/2.4	**55.0**
TP19/0.1	25.0
TP24/0.6	**57.6**
TP25/1.0	**40.3**
TP33/1.3	**32.9**
TP33/1.8	3.0
TP36/0.8	**44.8**
TP36/1.8	**30.8**
TP39/0.5	**56.2**
TP41/0.6	25.6

Notes to Table 13:

Combustibility estimated from % ash created on a dry weight basis

Reference should be made to the attached laboratory report sheets for details.

9.4 Aggressivity Testing

Aggressivity testing was undertaken on ten selected soil samples across the site, and comprised pH, Chloride and Sulphate testing, summarised in Table 14, below.

Table 14 – Results of Aggressivity Testing

Test Location/Depth (m)	pH (pH Units)	Chloride*, Cl (mg/kg)	Sulphate*, SO4 (mg/kg)
TP4/0.5	5.6	21	<20
TP8/1.0	5.3	6	13
TP10/1.1	5.7	5.2	30
TP12/1.0	6.8	17	9.4
TP23/1.4	6.3	25	100
TP28/1.4	5.8	<5	<20
TP36/0.8	4.4	8.8	17
TP44/0.9	6.3	14	12
PQL	NA	0.5	2

Notes to Table 14:

* 1:5 soil:water
NA Not Applicable

Reference should be made to the attached laboratory report sheets for details.

10. ASSESSMENT OF CONTAMINATION

10.1 Assessment Criteria

Results of the chemical analyses were compared to the following NSW EPA recommended guidelines.

- NSW EPA (1998). Contaminated Sites – Guidelines for the Site Auditor Scheme 2nd Edition, April 2006 (Ref 4);
- NSW EPA (1994). Contaminated Sites – Guidelines for Assessing Service Station Sites, December 1994, (Ref 5);
- NSW EPA (1999). Environmental Guidelines: Assessment, Classification & Management of Liquid and Non-Liquid Wastes (Ref 6).

The NSW EPA Guidelines for the NSW Site Auditor Scheme (Ref 4) contain National Environmental Health Forum (NEHF) levels for various beneficial use scenarios including: low density residential (A), high density residential (D), recreational (E) and commercial/industrial (F). These criteria are applicable where aesthetic and ecological concerns are not an issue. Health based criteria for standard residential uses with access to soil (NEHF A), are considered to be appropriate for the proposed residential development.

The NSW EPA Guidelines for Assessing Service Station Sites (Ref 5) were used to assess total TRH and BTEX contamination across the site. The criteria used are threshold concentrations for sensitive land use.

The NSW EPA Environmental Guidelines for the Assessment, Classification & Management of Liquid & Non-Liquid Wastes (Ref 6) was used to assess soil conditions for possible off-site disposal to a licensed landfill.

10.2 Assessment of Contamination

Soil chemical analysis results for Areas A and B were generally within the health based criteria for low density residential land use (ie. NEHF A), and NSW EPA sensitive land use criteria for TRH and BTEX, with the following exceptions:

- Metals: Pit 13A/0.3m (Pb), Pit 68/0.02 (As, Cr, Cu, Pb, Zn), D14 (Cu, Pb, Zn);
- TRH: Pit 13/0.1, Pit 13A/0.35, Pit 17/1.9 (and D11), Pit 18/0.15, Pit 19/0.7 (and D9), Pit 24/0.6, Pit 36/2.5; and
- Total PAH and Benzo(a)pyrene: Pit 13/0.1 m.

The results of laboratory analysis also indicated the presence of bonded asbestos in fibro sheet fragments found within filling containing deleterious materials in Pit 18. Asbestos fibres were also found in soil filling in Pit 18.

Laboratory results for total concentrations indicated the waste classifications ranged between general solid and restricted waste. This classification is relevant for off-site disposal if proposed. Additional TCLP testing indicates the samples with TRH concentrations exceeding NEHF A guidelines are classified as general solid waste.

10.3 Conclusions

Area A

The results of assessment in Area A indicate that there was minimal industrial development on the site, with primarily residential uses on the more elevated northern parts of the site. The stockpiling of coal and general placement of filling occurred on the lower southern parts of the site.

The results of preliminary sampling and analysis of the filling on the southern portions of the site indicates the absence of gross contamination. Detailed assessment of this part of the site is recommended prior to construction.

Area B

Area B contains the former Pit E, which included heavy industry, as described in Section 5. Potential contaminants identified in this area include fibro sheeting, and various fill materials. The results of preliminary sampling and analyses indicates the presence of the following contaminants which exceed residential land use criteria:

- TRH was detected in several test pits, generally towards the centre of the site where the most dense industrial parts of the former Pit E site were located;
- Elevated lead, PAH and Benzo(a)pyrene were also detected at one of these test pits (Pit 13/13A);

- A thin layer of black slag was identified near the north east corner of the existing mine building (Pit 68). This material contained elevated metals concentrations above the residential land use criteria. The material is expected to classified as hazardous waste, and may require immobilising treatment by a licenced contractor prior to off-site disposal. Black slag was only observed in this location and hence may be a localised occurrence.

The results of laboratory analysis also indicated the presence of bonded asbestos in fibro sheet fragments and asbestos fibres in soil at Pit 18. It should be noted that the composition of filling across the site may be variable. The possible presence of further fibro fragments (possibly asbestos based) within fill across the site cannot therefore be discounted.

Material identified as exceeding the land use criteria will require remediation, which may include immobilisation prior to off site disposal at a licenced landfill. Leachability testing on samples containing elevated TRH concentrations indicate the material could be disposed of at a licenced landfill as general solid waste.

Previous land uses on the more elevated southern portions of the site generally comprise residential on the eastern parts, with a number of haul roads running through otherwise undisturbed forest on the western parts. The results of limited investigation in these area indicated the absence of gross contamination, however additional sampling and testing is recommended across Area B to further delineate contamination 'hot spots'.

Summary

The results of the preliminary assessment indicated that site remediation will be required in Area B, concentrated on the former Pit E site, with possible less extensive remedial work in Area A. Additional investigation is recommended across the site prior to development to provide additional delineation of affected areas.

Remediation, where required, would include the preparation of a remediation action plan (RAP), appropriate excavation and removal/disposal/capping of contaminated soil, followed by validation sampling and analysis to the requirements of SEPP 55 and NSW DECC. Immobilisation of the black slag material by a licensed contractor may be required prior to disposal.

Based on the known and potential contaminants in parts of the site and the ability to remediate the above listed contaminants, Douglas Partners is satisfied that the land will be suitable, after remediation, for residential purposes. The land is required to be remediated before the land is used for such a purpose and the following must be undertaken as part of any application for land subdivision to ensure that the site is suitable for residential development with respect to contamination:

- Detailed contamination assessment for Areas A and B in accordance with SEPP 55 and NSW DECC guidelines;
- Development of a Remediation Action Plan based on the results of the detailed contamination assessment and verification through the NSW DECC site auditor process undertaken;
- Appropriate remediation conducted to remove identified contaminants exceeding the DECC land use criteria;
- Deleterious materials and possible associated surface impact removed;
- Validation testing and verification;
- Validation of asbestos contamination should be conducted by a qualified asbestos consultant;
- Waste classification to DECCW guidelines of any materials destined for off-site disposal at a licensed landfill.

11. GEOTECHNICAL CONSTRAINTS

11.1 Disturbed Ground and Mounded Filling

Extensive filling was encountered in the former Pit E site, Area B, to depths ranging up to 3.2 m and on Area A up to 1.3 m.

Potential constraints associated with disturbed ground and mounded filling include the following:

- Presence of contamination, as described in Section 10 above, in particular possible buried asbestos;
- Uncontrolled filling, which has implications for building footings, requiring that the filling either be reworked or footings be founded in suitable bearing strata below the filling using piles;
- Uncontrolled filling also has implications for services such as roads, pavements, water and sewer;
- Potential for combustion of the coal, as discussed in Section 12.4 below.

11.2 Founding Conditions

Much of areas A and B are covered with uncontrolled surface filling, and as discussed in Section 11.2.2 areas with uncontrolled filling present will require the reworking of filling or the use of piled footings.

There are soft and loose alluvial soils associated with the creek which passes along the northern boundary of Area B. This alluvial soil is generally overlain by filling. These areas are mapped as hatched on Drawing 4. If development is proposed in these area the use of piled footings or ground improvement is likely to be required.

Reference to Table 2 and the results of the mine subsidence bores (Ref 1) indicate that the depth to rock is often of the order of 5 to 10 m. Suitable founding strata for piled footings would include the overlying stiff to hard clay, or the underlying weathered rock.

In the south west parts of Area B and the northern parts of Area A, ground conditions are expected to comprise a deep residual clay profile with no filling, or localised/minor filling. In these areas, shallow footings founded in the natural clay soils are likely to be acceptable. These clay soils are expected to be reactive which means that they shrink and swell with changing moisture conditions, leading to ground surface movements. Soil reactivity can be readily accommodated in design, and should be confirmed during future detailed investigations prior to development by classifying building sites in accordance with AS 2870-1996 (Ref 1).

11.3 Acid Sulphate Soils

A preliminary acid sulphate soil assessment was undertaken with reference to the ASSMAC "Acid Sulphate Soils Manual" (Ref 7) and QASSIT "Soil Management Guidelines" (Ref 8), and comprised the following:

- Review of available acid sulphate risk maps (Refer section 3.1);
- 32 screening tests on selected soil samples for pH in water (pH_F) and pH in hydrocarbon peroxide (pH_{FOX});
- Five samples tested for the full chromium suite to assess acid sulphate potential.

The results of detailed laboratory testing indicate the presence of potential acid sulphate soils in seven of the samples tested, across a range of soil types and depths within the alluvial soils on the northern parts of the site. These areas of alluvial soil are considered to have a high risk of being Potential Acid Sulphate Soils and are as mapped as hatched on Drawing 4.

A general acid sulphate soil management procedure is presented below, however preparation of a detailed Acid Sulphate Soil Management Plan (ASSMP) should be prepared prior to construction, if disturbance of the alluvial areas is proposed.

Soil

- Any natural alluvial soils excavated should be stockpiled separately prior to lime treatment in a bunded area to collect any leachate that may form;

- Lime treatment would involve mixing Agricultural Grade Lime into the stockpiled soil to neutralise any acid generated by the acid sulphate soils. Based on the laboratory test results the rate of lime application is estimated to be approximately 10 kg/m^3 soil;
- Further on-site screening tests by DP would then be required to verify that adequate neutralisation has occurred, and if necessary adjust the liming rate;
- The base of any excavation in the affected soils should be limed at a rate of approximately 1 kg/m^2.

Groundwater

- Groundwater extracted during dewatering (if required during construction) should be tested for pH prior to discharge;
- Dewatering monitoring would involve regular visits by DP personnel to measure dewatering pH. The frequency would depend on the construction programme and monitoring results, however it is likely to initially be daily, possibly reducing to weekly once excavations are complete and consistent results are being achieved;
- If the pH of discharge water is below natural levels, a lime slurry should be added to raise the pH to within natural groundwater levels.

In summary, the treatment of acid sulphate soils and groundwater should be undertaken in a controlled manner to minimise the potential for generation and migration of acidic leachate. Monitoring of soil neutralisation and discharge water, should be undertaken during any disturbance of acid sulphate soils.

11.4 Combustion

Coal and chitter (low quality coal) was encountered within the filling in most test pits across Area A and B. As indicated in Table 3, the thickness of layers including coal and the percentage of coal within these layers was variable, with visual estimates ranging from 5% to 80%.

The results of laboratory testing on selected samples indicated percentages of combustible materials within the range 3% to 58% with eight of the twenty samples having a percentage greater than 30%. When the laboratory results were correlated with the visual estimates of percentage combustibles in Table 3, the laboratory results generally indicated slightly lower results.

In situ combustion of such material can occur if the material is ignited by an external source such as a surface fire, or lightening. Combustion is encouraged if there is a ready supply of oxygen as typically occurs in loose filling, especially on steep slopes.

We are unaware of any local or state or national guidelines with respect to combustible material, however Wollongong Council has developed guidelines. According to Wollongong Council Guidelines for the use of chitter material in residential development (copy attached), chitter material must have an average combustibility not exceeding 30%, and a maximum combustibility not exceeding 40%.

It is considered that there is some risk of combustion of coal and chitter filling occurring, however the risk of this can be reduced by applying appropriate engineering solutions. Various engineering solutions to manage the potential for combustion may include one or more of the following:

- Removal of combustible material;
- Blending of inert material with combustible material;
- Compaction of the material;
- Limiting batter slopes, generally to less than about 4H:1V;
- Capping with a compacted inert layer.

Removal of all combustible material would be difficult to achieve in practice, as the majority of the filling contains some intermixed combustible material and full segregation would be impractical. Identification of 'hot-spots' and removal or blending with less combustible material would be more achievable and could be undertaken as part of site regrading activities, and together with either partial or full depth compaction of the filling and limiting batter slopes, would be expected to reduce the risk of combustion significantly. It may be possible to reduce the requirements for removal/blending of combustible material if the site is capped with a compacted inert material.

It is recommended that additional investigation be undertaken in Areas A and B prior to development to further characterise the distribution of combustible material to allow refinement of suitable options for management of the combustible material.

Slope Stability

There was generally no evidence of previous or incipient deep seated slope instability observed over the site. The site is generally considered to have a low to moderate risk of slope instability with respect to the natural topography.

The northern slopes of the Area B include an outcrop of the Wallarah Seam which dips out of the slope. This area should be subject to specific investigation prior to development.

In the event that significant cuts or fills are proposed for the site, further geotechnical investigation to specifically assess the risk of slope instability due to the cuts and fills should be undertaken. Such risks are generally managed by limiting batter slopes, drainage measures or suitably designed support.

Erosion

There was generally no obvious soil erosion evident on the site, however based on the Soil Landscape Sheet for Gosford – Lake Macquarie the soils on the slopes typically have high erosion potential.

Water quality may be impacted due to sediment laden run-off from the topsoil material occurring during construction. Such potential erosion and sedimentation are readily amenable to mitigation measures such as silt fences, revegetation/reshaping batters, drainage structures (catch drains), sediment traps and sedimentation basins.

Excavatability

The depth to rock at the test pit locations was typically 3 m or more, with the general exceptions of the following:

- The northern parts of Area A;
- The southern higher elevation parts of Area B.

Soil and weak rock encountered to the depth of backhoe/auger refusal as shown on Table 2 would be readily excavatable using hydraulic excavators or small bulldozers. Beyond the depth of backhoe/auger refusal large earthmoving equipment may be required for excavation, such as excavators with rock teeth or bulldozers with rippers. There is some risk that heavy ripping or pneumatic/hydraulic hammering may be required if medium or high strength rock occurs within the depth of excavation.

Aggressive Soils

The soil landscape mapping suggest the possible presence of naturally acidic or saline soils which may be aggressive to buried structures or services. The results of testing listed in Table 14 above indicate generally non-aggressive and mild exposure classifications when compared to the requirements for steel/concrete piles presented in AS 2159-1995 (Ref 10), however one sample, Pit 36 within coal chitter filling, in Area B indicated a Moderate classification.

It is recommended, however, to provide sufficient concrete cover and appropriate strength to accommodate for the environment and any changes in conditions.

12. MINE SUBSIDENCE CONSTRAINTS

Potential constraints due to mine subsidence is the subject of a detailed mine subsidence risk assessment (Ref 11) which should be read in conjunction with this report.

13. GROUNDWATER DEPENDANT ECOSYSTEMS

13.1 Distribution

It is understood that Groundwater Dependant Ecosystem (GDE) communities have been identified in the vicinity of the proposed development on Areas A and B. The GDE communities in proximity to the site, as labelled on Drawing 104 attached, are described as follows:

- ***GDE 1*** Strip of Swamp Mahogany running in a strip along the northern side of Area B. This strip generally follows a creek line which also includes an artificial pond.
- ***GDE 2*** Freshwater wetland complex upstream of GDE 1 within former mine water storage dam upslope of site and downstream strip of Swamp Mahogany along the Western side of Flowers Drive.
- ***GDE 3*** Swamp Mahogany in low lying area around creek between Areas A and B.
- ***GDE 4*** Swamp Mahogany to south of Area A in low lying areas around creek.
- ***GDE 5*** Swamp Mahogany in south east corner of Area B on well drained easterly trending slopes at elevations in the order of 5 m to 15 m AHD.
- ***GDE 6*** Swamp Mahogany to south of site in a north easterly trending gully on the opposite side of a ridge to Area B.
- ***GDE 7*** Continuation of GDE 6 above, however located down slope of the development area.
- ***GDE 8*** Riparian Melaluca Swamp Woodland on northern slopes of Area A.
- ***GDE 9*** Apple-Palm Gully Forest to the north-west of Area B.

Alluvial Soils

Alluvial soils were encountered in the following location as shown on Drawing 104:

- A strip of alluvial soils which follow the creek line to the north of Area B (including GDE1 and 3) and the south of Area A (GDE4). The extent of this alluvium adjacent to the site was confirmed by subsurface investigation, with the remaining sections to the east of the site based on surface mapping;
- In-filled gully to the south of Area B which partly underlies GDE 5. This alluvium is unmapped, however it presence was confirmed by subsurface investigation. The indicated extent within the gully is approximate.

The alluvial soils comprised very soft to firm clay and loose sand to depths in the range 0.6 m to 6 m. Groundwater was encountered at depths in the range 0.9 m to greater than 3 m to the north of Area B and at about 6.5 m in the area to the south of Area B.

Residual Soils

The remainder of the site comprised residual clay soil overlying weathered rock. On the central northern parts of Area B the residual soils are overlain by filling, generally clay with layers of coal chitter, to depths in the range 0.3 m to 3.2 m. There was generally no free groundwater encountered within the depth of investigation in these areas.

Mine Workings

The southern parts of Area B, where residual soils were encountered, are underlain by bord and pillar mine workings. The level of the floor of the workings along the northern fringe is generally in the order of 0 m AHD and the workings fall to the south. The workings encountered below Area B were dry, however are expected to be flooded further to the south.

13.2 Conceptual Groundwater Model

Based on the results of the desktop assessment, the subsurface investigation and the site topography a conceptual groundwater model has been developed for the site as follows:

- Groundwater recharge on the parts of the site proposed for development in Areas A and B is very limited due to the low permeability clay soil and weathered rock and the well drained slopes. The vast majority of rainfall is expected to either run off or be lost by evapo-transpiration;
- Some recharge may occur in these areas due to infiltration through mine subsidence induced cracks in the rock. This would be expected to infiltrate near vertically to the mine workings;
- The mine workings fall to the south and any infiltration to the mine workings would be expected to drain to the workings to the south of the site;
- The alluvial soils are expected to comprise unconfined aquifers perched above the less permeable underling residual soils and rock;
- The alluvial areas are in low lying areas such as creeks and gullies and recharge to the aquifers occurs within these low lying areas. The source of the recharge water is from surface runoff from surrounding areas as well as direct rainfall within the areas. Groundwater recharge from the adjacent areas of residual soils will be very minor;
- Groundwater will flow within the alluvial areas, generally following the fall of the creek/gully as well as interact with the surface water flows in the creek. In times high rainfall and high creek levels the aquifer will be recharged and in times of low rainfall and low creek levels the groundwater may provide base-flow back to the creek and help maintain the water levels in the pond;
- There may be minor salt water intrusion into the underlying fractured rock aquifer along the beach front, however this is well removed from the site and no saltwater intrusion effects would be expected to occur on the site. This situation is not expected to change post development.

13.3 Effect Of Development On Groundwater Levels

The footprint of the development is generally on residual soils or filling over residual soils with some very minor encroachments onto alluvial soils as shown on Drawing 104. Only the alluvial soils are considered to represent groundwater aquifers, these being perched aquifers within the alluvium and essentially hydraulically isolated from the residual soils and rock.

Groundwater recharge to the aquifers is considered to be due to direct rainfall in the alluvial areas as well as runoff from the surrounding residual soil areas, however not due to groundwater recharge from the residual soil areas.

Potential interactions between the proposed development and the GDEs identified in Section 13.1 and shown on Drawing 104 are expected to be as follows:

GDEs 1, 3 and 4 - These areas are generally within the creek and alluvial aquifer fringing the north of Area B and the south of Area A. The groundwater will generally be controlled by recharge from the upslope areas, which will include the developed areas. Groundwater levels could also be affected by changes in the creek bed levels or other controls such as weirs or culverts which may affect surface water flows and levels.

GDE 2 – This area is upslope of the proposed areas of development and therefore will not be affected by the proposed development.

GDE 5 - This is within the proposed development however is on a well drained and elevated part of the site, well above any measured or expected groundwater and therefore it is considered that this area is not associated with groundwater.

GDE 6 - This area is within an alluvial in-filled gully with a water table at depth. The area is however on the opposite side of a ridge line to the proposed development and hydraulically isolated from the proposed development for both surface water flows and groundwater flows. Therefore the proposed development will not affect the groundwater in this area.

GDE 7 – This is an area of possible alluvial infill. Recharge to this area will be primarily from the surface runoff catchment which is almost entirely shared with GDE6, with a very small proportion of the development area directly upslope. Therefore any effect the development would have on groundwater levels would be insignificant.

GDEs 8 and 9 – These are within shallow gullies over residual soils and the presence of GDEs is likely to be associated with shallow periodic saturation of the surface soils due to surface runoff rather than a water table aquifer.

13.4 Summary

In summary it is considered that the only GDEs which could be affected by the proposed development are GDEs 1, 3, 4 along the creek line. GDEs 5 and 8 are within the development boundary however it is considered that these are not associated with groundwater. Provided that the existing surface water flow rates / levels and fluctuations thereof within the creek are maintained there will be minimal impact on the groundwater levels and therefore GDEs. This can be achieved by appropriate water sensitive urban design, which would include the provision of surface water storage devices such as ponds or swales to limit peak flows.

The use of buffer zones is often an appropriate method to limit the impact of development on the groundwater regimes as the buffers reduce the impact of edge effects such as changes in groundwater recharge due to the development. In this case however such buffers would be ineffective and unnecessary. This is because the extent of the aquifer along the creek is very limited and any buffer zones would be located on residual soils which are hydrogeologically isolated from the aquifer.

The potential for adverse impacts on groundwater quality from the proposed development would most likely come from surface runoff. As with groundwater/surface water levels, the surface water quality and therefore groundwater quality can be managed by appropriate water sensitive urban design. It is proposed that the development of the site will incorporate water sensitive urban design measures including a detailed surface water management plan which will be prepared prior to any construction on site.

14. ADDITIONAL INVESTIGATIONS

Contamination

Based on the results of assessment to date it is considered that detailed contamination assessment is required in Areas A and B.

Areas of additional investigation should include, but not necessarily limited to, the following:

- Further assessment of the presence of, and delineation of contaminated filling, and/or contamination from mining operations. A range of potential contaminants should be assessed, including heavy metals, PAH, TRH, BTEX, OCP/CPP pesticides, PCBs and asbestos;
- Assessment of groundwater quality near locations of soil contamination;
- Specific assessment for PCBs in the vicinity of the former transformer and substation associated with the former Pit E in Area B;
- Assessment of surface fibro to confirm the presence of asbestos in fibro fragments and possibly in near surface soils. Assessment of asbestos materials should be undertaken by a qualified asbestos consultant.

Remediation, if required, would include the preparation of a remedial action plan, appropriate excavation and removal/disposal/capping of contaminated soil, followed by validation sampling and analysis in accordance with NSW EPA (Ref 2) and SEPP 55 (Ref 3) guidelines.

Geotechnical

Additional geotechnical investigation is expected to be required prior to development which may include the following:

- Additional assessment of combustible material and improvement measures;
- Specific foundation investigation for proposed buildings or excavations;
- Site classifications to AS 2870;

- Earthworks procedures and specifications;
- Pavement thickness design for roads.

15. LIMITATIONS

Douglas Partners (DP) has prepared this report for this project at Minmi in accordance with DP's proposals dated 22 June 2007 and 20 January 2010. The work was carried out under Rio Tinto Short Form General Conditions for Consultancy Services, August 2004 as amended by DP letter of 6 September 2007. This report is provided for the exclusive use of the Coal & Allied Industries Ltd and Catylis for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party.

The results provided in the report are considered to be indicative of the sub-surface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. DP's advice may be based on observations, measurements, tests or derived interpretations. The accuracy of the advice provided by DP in this report is limited by unobserved features and variations in ground conditions across the site in areas between test locations and beyond the site boundaries or by variations with time. The advice may be limited by restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site. Should variations in subsurface conditions be encountered, then additional advice should be sought from DP and, if required, amendments made.

This report must be read in conjunction with the attached "Notes Relating to This Report" and any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions from review by others of this report or test data, which are not otherwise supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

Will Wright
Principal

Stephen Jones
Principal

REFERENCES

1. Douglas Partners Pty Ltd, Phase 2 – Mine Subsidence Risk Assessment, Proposed Residential Subdivision, Catherine Hill Bay", Prepared for Coal and Allied Operations Pty Limited, Project 39662D, September 2007.

2. NSW EPA Contaminated Sites "Guidelines for Consultants Reporting on Contaminated Sites", November 1997.

3. NSW DUAP and EPA, "Managing Land Contamination, Planning Guidelines. SEPP55 – Remediation of Land" August 1998.

4. NSW EPA Contaminated Sites "Guidelines for NSW Site Auditor Scheme, 2nd Edition", April 2006.

5. NSW EPA Contaminated Sites "Guidelines for Assessing Service Station Sites", December 1994.

6. NSW DECC, Waste Classification Guidelines – Part 1: Classifying Waste, April 2008.

7. ASSMAC (1998) "Acid Sulphate Soil Manual", New South Wales Acid Sulfate Soil Management Advisory Committee, August 1998.

8. Dear SE, Moore NG, Dobos SK, Watling KM and Ahern CR "Soil Management Guidelines" in "Queensland Acid Sulphate Soil Technical Manual", Department of Natural Resources and Mines, November 2002.

9. Australian Standard AS 2870-1996 "Residential Slabs and Footings – Construction", June 1996, Standards Australia.

10. Australian Standard AS 2159-1995 "Piling – Design and Installation", Standards Australia.

11. Douglas Partners Pty Ltd, Mine Subsidence Risk Assessment, Southern Area – Catherine Hill Bay, Prepared for Coal and Allied Operations Pty Limited, Project 39662B, September 2007.

12. Douglas Partners, "Report on Baseline Water Quality Assessment, Proposed Development, Catherine Hill Bay", August 2007.

APPENDIX A

NOTES RELATING TO THIS REPORT
BOREHOLE LOGS – BORES 101 TO 103, 107 AND 108
TEST PIT LOGS – PITS 1 TO 44 AND 65 TO 68

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water

table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA

This classification system provides a standardized terminology for the engineering description of the sandstone and shales in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Under this system rocks are classified by Rock Type, Degree of Weathering, Strength, Stratification Spacing, and Degree of Fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2mm) fragments
Sandstone:	More than 50% of the rock consists of sand sized (.06 to 2mm) fragments
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06mm) granular particles and the rock is not laminated
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated
Shale:	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. clayey sandstone, sandy shale.

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh	Fs	Rock substance unaffected by weathering, limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics (Reference).

Strength Term	Is(50) MPa	Field Guide	Approx. qu MPa*
Extremely Low:	0.03	Easily remoulded by hand to a material with soil properties	0.7
Very Low:	0.1	May be crumbled in the hand. Sandstone is “sugary” and friable.	2.4
Low:	0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium:	1	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
High:	3	A piece of core 150 mm long x 50 mm dia. cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very High:	10	A piece of core 150 mm long x 50 mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely High:		A piece of core 150 mm long x 50 mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	

* The approximate unconfined compressive strength (qu) shownin the table is based on an assumed ratio to the point load index of 24:1. This ratio may vary widely.

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks

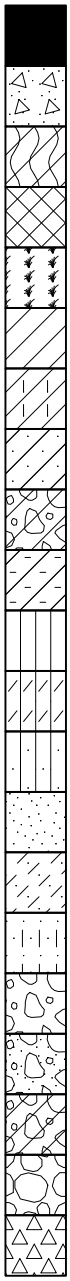
Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter.
Highly Fractured:	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured:	Core lengths are mainly 30 mm - 100 mm with occasional shorter and longer sections.
Slightly Fractured:	Core lengths are generally 300 mm - 1000 mm with occasional longer sections and occasional sections of 100 mm - 300 mm.
Unbroken:	The core does not contain any fracture.

REFERENCE

International Society of Rock Mechanics, Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1 Final Draft October 1972

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

GRAVEL

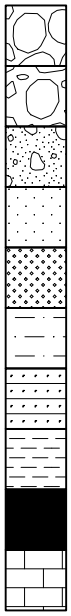
SANDY GRAVEL

CLAYEY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

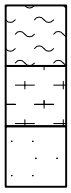
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

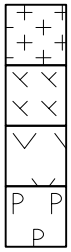


SLATE, PHYLITTE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

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BOREHOLE LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371503
NORTHING: 6332068
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 39662C
DATE: 09 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	FILLING: Generally comprising fine to coarse grained sandy silty gravel, abundant organics, humid		A,PID	0.2		<1ppm		
		FILLING: Generally comprising brown/black sandy silt coal chitter (approximately 70% - 80%) with trace organics, humid		A,PID	0.5		<1ppm		
	0.8	FILLING: Generally comprising orange-brown silty clay, some slightly fine to coarse grained sand some coal chitter in parts, M>Wp		A,PID	1.0		<1ppm		
1	1.1	FILLING: Generally comprising brown/black sandy silt coal chitter (approximately 70% - 80%) with trace organics, humid From 1.5m 30% coal chitter		S			1,0,0 N = 0		1
					1.45				
2				A	2.0				2
	2.25	FILLING: Grey-brown silty sand filling generally comprising fine to coarse grained sand, some fine gravel, some coal chitter in parts, damp-humid			2.5				
				S			0,0,0 N = 0		
	2.9	CLAYEY GRAVEL: (Loose) orange-brown clayey fine gravel, slightly coarse grained sand, wet			2.95				
3	3.2	SILTY CLAY: Stiff orange-brown silty clay, some fine to coarse grained sand, M>Wp							3
					3.5				
				S	3.7		1,2,4 N = 6		
				pp	3.8		160kPa		
4	3.95	Bore discontinued at 3.95m, limit of investigation		pp	3.9		190kPa		4
5									5
6									6
7									7

RIG: 4WD Utility Mounted Drilling Rig **DRILLER:** Foody **LOGGED:** CMR **CASING:**
TYPE OF BORING: 100mm diameter, solid flight auger
WATER OBSERVATIONS: Free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371449
NORTHING: 6332081
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 39662C
DATE: 09 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		FILLING: Dark brown sandy silty filling generally comprising fine to medium grained sand, abundant organics, some fine to coarse gravel, humid-damp		A	0.2				
		From 0.05m, light brown, trace organics		A	0.5				
		From 0.2m, grading to sandy silt							
	0.7	FILLING: Dark brown silty clayey sand filling generally comprising fine to coarse grained sand, some coal chitter, humid-damp		A	1.0				
1					1.0				1
	1.15	FILLING: Black silty sandy gravel filling (90% coal chitter) generally comprising fine to coarse grained sand, fine gravel, humid		S			1,1,9 N = 10		
	1.3								
	1.45	FILLING: Light brown gravelly sand filling generally comprising fine to coarse gravel, fine to medium grained sand, humid-damp			1.45				
2		FILLING: Brown/black gravelly silty sand filling generally comprising fine gravel, fine to coarse grained sand, humid-damp		A	2.0				2
				A	2.5				
				S			7,4,3 N = 7		
3					2.95				3
	3.1	SANDY SILTY CLAY: Stiff light brown mottled grey brown sandy silty clay, M>Wp		A	3.5				
	3.7	SILTY CLAY: Stiff orange brown mottled medium brown silty clay with some sand, M>Wp		A,pp	3.9				
4					4.5				4
		From 4.5m, hard, M<Wp		pp	4.7		>450kPa		
				S			4,9,14 N = 23		
				pp	4.9		>450kPa		
5	4.95	Bore discontinued at 4.95m, limit of investigation			4.95				5
6									6
7									7

RIG: 4WD Utility Mounted Drilling Rig **DRILLER:** Foody **LOGGED:** CMR **CASING:**
TYPE OF BORING: 100mm diameter, solid flight auger (u-bit)
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371680
NORTHING: 6332177
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 39662C
DATE: 09 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
									Stickup 0.525m
									Bentonite seal from surface to 0.1m
	0.3	FILLING: Generally comprising grey brown clayey silt/silty clay with some coal chitter, some rootlets, humid, M>Wp		A,PID	0.1		<1ppm		
		FILLING: Generally comprising dark brown black sandy silt / coal chitter with trace gravel, moist to wet		A,PID	0.5		<1ppm		
1		From 0.9m saturated		A,PID	1.0		<1ppm		1
					1.0				
				S,PID			<1ppm		
					1.45				
	1.8	SILTY CLAY: Firm dark brown silty clay, M>Wp							
2				A,PID	2.0		<1ppm		2
				A,PID	2.5		<1ppm		5mm sand from 0.1m to 4.7m
				S			4,2,3		
		From 2.7m firm to stiff grey brown		pp	2.7		N = 5		
							220kPa		
3				pp	2.9		160kPa		3
									Class 18 PVC screen from 1.7m to 4.7m
				A	3.5		90-120kPa		
4				A	4.0				4
	4.05	SAND: Brown fine to coarse grained sand, saturated			4.0		1,2,2		
							N = 4		
					4.45				
	4.7	SANDSTONE: Very light to light, heavily weathered grey brown fine to coarse grained sandstone							End cap
5	4.95	Bore discontinued at 4.95m, refusal		A	4.9				5
6									6
7									7

RIG: 4WD Utility Mounted Drilling Rig **DRILLER:** Foody **LOGGED:** CMR **CASING:**
TYPE OF BORING: 100mm diameter, solid flight auger (u-bit)
WATER OBSERVATIONS: Free groundwater observed at 0.9m
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371444
NORTHING: 6332169
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 39662C
DATE: 10 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
									Stickup 0.35m
		FILLING: Generally comprising dark brown black sandy silt/coal chitter with trace rootlets to 0.1m, damp		A,PID	0.1				Bentonite seal from surface to 0.2m
		From 0.5m wet		A,PID	0.5				
1		From 0.9m some clay and gravel, subrounded		A	1.0				
	1.05								
	1.15	GRAVELLY SAND: Brown fine to coarse grained gravelly sand with trace coal and chitter, subrounded		S	1.0		1,1,1 N = 2		
		SILTY CLAY: Soft dark grey brown silty clay with trace sand and abundant organics, M>Wp			1.45				
	1.7								
		SANDY SILTY CLAY: Grey mottled brown silty clay slighty sandy, M>Wp							
2				A	2.0				
				B	2.45		3,1,2 N = 3		
				S	2.5				
3									
	3.2								
		SANDY CLAY: (Soft to firm) dark grey brown sandy clay with some silt, M>Wp		A	3.5				5mm sand from 0.2m to 6.5m
	3.6	SANDY SILTY CLAY: (Stiff) dark grey brown sandy silty clay, M>Wp							
4	4.0			A	4.0				
		SAND: Loose brown fine to medium grained sand with some gravel, saturated			4.0				
				S			2,4,5 N = 9		
				A	4.45				
					4.5				
5				A	5.0				Class 18 PVC screen from 3.5m to 6.5m
					5.5				
		From 5.5m loose to medium dense bands of silty sand and gravelly sand.		S			4,5,7 N = 12		
6	6.0				5.95				
		PEBBLY SANDSTONE: Extremely low to very low, extremely weathered to highly weathered grey brown fine to coarse grained pebbly sandstone							End cap
		From 6.7 very low to low							
7	7.0	Bore discontinued at 7.0m, refusal							

RIG: 4WD Utility Mounted Drilling Rig **DRILLER:** Foody **LOGGED:** CMR **CASING:**
TYPE OF BORING: 100mm diameter, solid flight auger (u-bit)
WATER OBSERVATIONS: Free groundwater observed at 0.9m
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371578
NORTHING: 6332167
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 39662C
DATE: 10 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
									Stickup 0.440m
		FILLING: Generally comprising dark brown black fine to coarse grained silty sand/coal chitter with trace rootlets to 0.1m, moist to wet		A,PID	0.1		<1ppm		Bentonite seal from surface to 0.2m
				A,PID	0.5		<1ppm		
	0.6	FILLING: Generally comprising (very soft to soft) silty sandy clay with abundant sand coal chitter and organics, M>Wp		A,PID	1.0		<1ppm		
1				S	1.0		1,1,1 N = 2		1
					1.45				
	1.6	SILTY SAND: (Loose) light grey brown fine to medium grained brown silty sand with trace gravel, subrounded		A	2.0				
2									2
	2.2	SILTY SANDY CLAY: Firm dark brown silty sandy clay, M>Wp		A	2.5				5mm sand from 0.2m to 5m
				S			3,3,3 N = 6		
3					2.95				3
	3.2	SILTY SANDY GRAVEL: Loose grey brown fine to medium sub-angular/subrounded silty sandy gravel, subrounded		A	3.5				Class 18 PVC screen from 2m to 5m
4				A	4.0				4
				S	4.0		2,4,6 N = 10		
					4.45				
5				A	5.0				5 End cap
	5.2	SANDSTONE: Extremely low to very low, extremely weather to highly weathered grey brown fine to coarse grained sandstone		S	5.5		10-130mm		
		From 5.6m very low to low			5.63				
	5.8	Bore discontinued at 5.8m, refusal							
6									6
7									7

RIG: 4WD Utility Mounted Drilling Rig **DRILLER:** Foody **LOGGED:** CMR **CASING:**
TYPE OF BORING: 100mm diameter, solid flight auger (u-bit refusal @ 5.75m
WATER OBSERVATIONS: Free groundwater observed at 0.9m
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371184
NORTHING: 6331931
DIP/AZIMUTH: 90°/--

PIT No: 1
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0	FILLING - Generally comprising brown and dark brown silty sandy clay with some reinforced concrete, wood, (timber) and corregated iron, coal and coal chitter (10%) and trace roots/rootlets to 0.3m, M>Wp		D,PID	0.05		<1ppm		
				D,PID	0.5		<1ppm		
	1								1
	1.1	FILLING - Generally comprising dark brown-black clayey sandy silt / coal chitter, damp							
	1.4	FILLING - Generally comprising brown silty sandy clay with some coal and coal chitter, M>Wp		D,PID	1.7		<1ppm		
	1.8	SANDSTONE - Extremely low to very low strength, highly weathered, light brown and grey-brown fine to medium grained sandstone with some pebbles		D,PID	1.9		<1ppm		
	2								2
	2.4	Pit discontinued at 2.4m, refusal							
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371170
NORTHING: 6332018
DIP/AZIMUTH: 90°/--

PIT No: 2
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.07	FILLING - Generally comprising dark brown sandy silt with some gravel and coal chitter, damp		D,PID	0.05		<1ppm		
		FILLING - Generally comprising brown and grey-brown sandy clayey silt with some coal chitter (10%) and subrounded gravel, damp to moist		D,PID	0.3		<1ppm		
	0.4	PEBBLY SANDSTONE - Extremely low to very low strength, extremely to highly weathered fine to medium grained pebbly sandstone		D,PID	0.43		<1ppm		
	1								1
				D	1.1				
	1.15	Pit discontinued at 1.15m, refusal							
	2								2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371176
NORTHING: 6332172
DIP/AZIMUTH: 90°/--

PIT No: 3
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising dark brown-black sandy silt / coal chitter (approximately 30%) with some coal fragments 20mm x 20mm, trace rootlets to 0.5m, damp		D,PID	0.1		<1ppm		
				D,PID	0.5		<1ppm		
	0.55	SILTY GRAVELLY SAND - Grey to light brown fine to coarse grained sand, silty gravelly sand, humid		D,PID	0.7		<1ppm		
		from 0.7m, grading to sandstone							
	0.9	PEBBLY SANDSTONE - Extremely low to very low strength, extremely weathered, light brown and light orange-brown fine to coarse grained pebbly sandstone							
	1								1
				D	1.4				
	2								2
				D	2.4				
	2.7	Pit discontinued at 2.7m, limit of investigation							
	3								3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371207
NORTHING: 6331996
DIP/AZIMUTH: 90°/--

PIT No: 4
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising brown-black sandy silt / coal chitter with some rubber and steel conveyor rollers and trace roots and rootlets, damp		D,PID	0.05		<1ppm		
	0.4	SILTY CLAY - Hard, brown and orange-brown silty clay, M<Wp		D,PID,pp	0.5		>450 kPa, <1ppm		
1	1.0	SANDSTONE - Extremely low to very low strength, extremely weathered, light grey-brown and light orange -brown fine to medium grained sandstone		D,PID	1.1		<1ppm		1
	1.75	from 1.7m, very low to low strength Pit discontinued at 1.75m, refusal							
2									2
3									3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371226
NORTHING: 6332062
DIP/AZIMUTH: 90°/--

PIT No: 5
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.15	FILLING - Generally comprising dark brown and brown fine to coarse grained clayey silty sand with some gravel and rootlets, damp to moist		D,PID	0.05		<1ppm		
		SILTY CLAY - Very stiff, brown mottled red-brown silty clay, M>Wp		D,PID, pp	0.2		210 kPa, <1ppm		
	1			D,pp	0.8		310-340 kPa		1
	1.35	CLAYSTONE - Extremely low to very low strength, extremely to highly weathered, light grey and orange-brown claystone		D	1.4				
		from 1.6m, very low to low strength							
	1.7	Pit discontinued at 1.7m, refusal							
	2								2
	3								3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371210
NORTHING: 6332122
DIP/AZIMUTH: 90°/--

PIT No: 6
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising dark brown-black sandy silt / coal chitter, damp		D,PID	0.1		<1ppm		
	0.4	SILTY CLAY - Very stiff, brown and grey-brown silty clay, M>Wp		D,PID, pp	0.5		260-320 kPa, <1ppm		
	1	from 0.9m, hard, light grey-brown mottled red-brown		D,pp	1.2		>450 kPa		1
		from 1.7m, grading to claystone		D,pp	1.7		>450 kPa		
	2 2.0	CLAYSTONE - Very low to low strength, moderately weathered, grey claystone		D	2.3				2
	2.9	Pit discontinued at 2.9m, limit of investigation							
	3								3

RIG: 4WD Case 580 LE
LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371247
NORTHING: 6332024
DIP/AZIMUTH: 90°/--

PIT No: 7
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising dark brown clayey silt, slightly sandy and gravelly, damp		D,PID	0.1		<1ppm		
	0.2	FILLING - Generally comprising orange and red-brown gravelly silty clay, subrounded fine to medium grained gravel, M≥Wp, damp		D,PID	0.6		<1ppm		
	0.8	PEBBLY SANDSTONE / CONGLOMERATE - Extremely low strength, extremely weathered, light grey-brown and orange-brown pebbly sandstone / conglomerate		D,PID	0.9		<1ppm		
	1.25	Pit discontinued at 1.25m, refusal							

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371274
NORTHING: 6332162
DIP/AZIMUTH: 90°/--

PIT No: 8
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising dark brown-black coal chitter with trace rootlets to 0.3m, damp		D,PID	0.1		<1ppm		
				D,PID	0.5		<1ppm		
	0.6	FILLING - Generally comprising brown fine to medium grained silty clayey sand with some gravel, moist		D,PID	0.8		<1ppm		
	0.85	FILLING - Generally comprising grey clayey silt, slightly cemented with trace coal (5%) and sand, moist to wet		D,PID	1.0		<1ppm		
	1			D	1.15			▽	
				D,PID	1.7		<1ppm		
	1.8	FILLING - Generally comprising soft to firm, grey-brown mottled orange-brown silty clay, M>Wp		D,PID,pp	1.9		50-90 kPa, <1ppm		
	2			D,pp	2.3		300 kPa		
		from 2.3m, (very stiff)		D,PID	2.4		<1ppm		
		from 2.4m, some gravel and sand							
	2.6	FILLING - Generally comprising dark brown-black sandy silt / coal chitter		D,PID	2.7		<1ppm		
	2.9	SILTY CLAY - Generally comprising very stiff silty clay with some sand and gravel, M>Wp		D,PID,pp	3.0		300 kPa, <1ppm		
	3								
	3.1	Pit discontinued at 3.1m, limit of investigation							

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: Seepage at 1.15m

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▽ Water level

CHECKED
Initials:
Date:

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Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371322
NORTHING: 6331874
DIP/AZIMUTH: 90°/--

PIT No: 9
PROJECT No: 39662C
DATE: 06 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising dark brown-black sandy silt with some clay, gravel, coal chitter (10%), bricks, steel pins and other building material		D,PID	0.2		<1ppm		
	0.55	FILLING - Generally comprising dark brown-black sandy silt / coal chitter (approximately 40%)			0.6				
				D,PID B	0.7		<1ppm		
					0.9				
1									1
	1.2	SILTY GRAVELLY SAND - Light brown fine to coarse grained silty gravelly sand, moist (possibly filling)		D,PID	1.3		<1ppm		
	1.6	SILT CLAY - Very stiff, brown mottled red-brown slightly gravelly, trace sand, M>Wp		D,pp	1.7		270-330 kPa		
2									2
	2.3	GRAVELLY SILTY CLAY - Very stiff, light brown and orange and red-brown gravelly silty clay, M<Wp		D,pp	2.5		250-300 kPa		
		from 2.6m, grading to silty clayey gravel		D	2.9				
3	3.0	Pit discontinued at 3.0m, limit of investigation							3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371305
NORTHING: 6332044
DIP/AZIMUTH: 90°/--

PIT No: 10
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising brown and light brown sandy silt with some clay and subrounded gravel, trace rootlets to 0.15m, humid		D,PID	0.2		<1ppm		
	0.4	FILLING - Generally comprising very stiff, brown and light orange-brown sandy silty gravelly clay; trace coal fragments (5%), M>Wp		D,PID,pp	0.6		300 kPa, <1ppm		
	1			D,PID,pp	1.1		250-300 kPa, <1ppm		1
	1.3	FILLING - Generally comprising dark brown-black sandy silt / coal chitter (5mm to 60mm), and trace bricks		D,PID,pp	1.6		250 kPa, <1ppm		
	1.7	FILLING - Generally comprising (very stiff), brown and orange-brown silty clay, M>Wp		D,PID,pp	1.9		250 kPa, <1ppm		
	2 2.0	SILTY CLAY - Hard, red mottled light grey-brown silty clay, M<Wp		D,PID,pp	2.1		>450 kPa, <1ppm		2
				D,pp	2.6		>450 kPa		
	2.65	Pit discontinued at 2.65m, slow progress							
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371276
NORTHING: 6332126
DIP/AZIMUTH: 90°/--

PIT No: 11
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising firm to stiff, brown and dark brown sandy clayey silt with trace rootlets and some fine grained gravel, damp to moist		D,PID	0.1		<1ppm		
				D,PID,pp	0.4		100 kPa, <1ppm		
	0.5	SILTY CLAY - Very stiff to hard, orange and red-brown mottled grey-brown silty clay, M<Wp		D,PID,pp	0.6		380->450 kPa, <1ppm		
	1								1
		from 1.5m, hard, grey mottled red orange-brown, trace sand and gravel, M≤Wp		D,pp	1.5		>450 kPa		
	2								2
				D,pp	2.3		>450 kPa		
	2.8	Pit discontinued at 2.8m, slow progress							
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371359
NORTHING: 6332056
DIP/AZIMUTH: 90°/--

PIT No: 12
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising brown and orange-brown gravelly silty clay with some coal (10%) and sand and trace rootlets to 0.1m, M>Wp		D,PID	0.3		<1ppm		
	0.5	FILLING - Generally comprising dark brown black sandy silt, trace coal chitter with trace gravel and bricks, damp to moist		D,PID	0.7		<1ppm		
	0.9	SANDY SILTY CLAY - Very stiff, grey mottled orange-brown sandy silty clay with some gravel, M>Wp		D,PID,pp	1.0		270 kPa, <1ppm		
	1	from 1.1m, firm to stiff		D,pp	1.2		70-150 kPa		
	2	from 2m, stiff to very stiff		D,pp	2.2		180-220 kPa		
		from 2.5m, very stiff to hard with some iron-cemented gravel, M<Wp		D,pp	2.7		>450 kPa		
	2.8	Pit discontinued at 2.8m, slow progress							
	3								

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371364
NORTHING: 6332100
DIP/AZIMUTH: 90°/--

PIT No: 13
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.15	FILLING - Generally comprising dark brown to black fine to medium grained silty sand with 20% coal chitter / trace fine rootlets, damp		D,PID	0.1		<1ppm		
	0.2	CONCRETE - Brown concrete							
		Pit discontinued at 0.2m, refusal on concrete slab							
	1								1
	2								2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371371
NORTHING: 6332097
DIP/AZIMUTH: 90°/--

PIT No: 13A
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING - Generally comprising light brown sandy gravelly silt with some clay, trace rootlets, humid		D,PID	0.05		<1ppm		
		FILLING - Generally comprising dark brown fine to medium grained silty sand with 30% coal chitter and trace gravel, damp		D,PID	0.35		<1ppm		
	0.45	GRAVELLY SAND - Light brown fine to medium grained gravelly sand, damp		D,PID	0.5		<1ppm		
	1								1
	1.2	GRAVELLY SANDY SILTY CLAY - Firm to stiff, light brown mottled light orange-brown gravelly sandy silty clay, M>Wp		D,pp	1.3		60-150 kPa		
		from 1.7m, very stiff orange-brown mottled grey-brown		D,pp	1.9		300-350 kPa		
	2								2
		from 2.5m, iron-cemented gravel and sand		D,pp	2.6		320-370 kPa		
	2.65	Pit discontinued at 2.65m, slow progress							
	3								3

5 10 15 20

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371356
NORTHING: 6332134
DIP/AZIMUTH: 90°/--

PIT No: 14
PROJECT No: 39662C
DATE: 01 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising dark brown-black sandy silt / coal chitter (20%), trace rootlets to 0.2 m, damp		D,PID	0.05		<1ppm		
	0.2	FILLING - Generally comprising grey silty gravelly sand, moist		D,PID	0.3		<1ppm		
	0.45	GRAVELLY SAND - Grey-brown mottled orange-brown fine to coarse grained gravelly sand, slightly clayey, damp to moist		D,PID	0.5		<1ppm		
	1								1
	1.4	GRAVELLY SILTY CLAY - Very stiff, orange-red-brown mottled grey fine grained gravelly silty clay, M>Wp		D,pp	1.5		230-330 kPa		
	2								2
				D,pp	2.3		200-260 kPa		
		from 2.7m, stiff		D,pp	2.7		150-200 kPa		
	2.9	Pit discontinued at 2.9m, limit of investigation							
	3								3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371416
NORTHING: 6331907
DIP/AZIMUTH: 90°/--

PIT No: 15
PROJECT No: 39662C
DATE: 31 Jul 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		SILTY SAND - Brown fine to coarse grained silty sand with trace gravel and roots/rootlets, damp		D,PID	0.1		<1ppm		
	0.25	SILTY CLAY - Very stiff, orange and red-brown silty clay, M>Wp		D,PID,pp	0.3		350 kPa, <1ppm		
	0.4	SILTY CLAY - Very stiff, red and orange-brown mottled light grey silty clay, M>Wp							
	1			D,pp	0.8		380 kPa		1
		from 1.2m, grading to claystone		D	1.2				
	1.4	CLAYSTONE - Very low to low strength, highly to moderately weathered, light brown and light orange-brown claystone							
	1.5	Pit discontinued at 1.5m, refusal							
	2								2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371432
NORTHING: 6332033
DIP/AZIMUTH: 90°/--

PIT No: 16
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising brown and dark brown fine to coarse grained silty sand with some gravel and coal chitter (10%), trace rootlets to 0.15m, damp		D,PID	0.2		<1ppm		
	0.3	SILTY CLAY - Very stiff, light brown and mottled light orange-brown silty clay, slightly gravelly, M>Wp		D,PID,pp	0.4		270 kPa, <1ppm		
	0.55	SILTY CLAY - Hard, light grey mottled red-brown silty clay with trace sand, M<Wp		D,pp	0.8		>450 kPa		
	1								1
		from 1.5m, slightly gravelly gravel		D,pp	1.7		400->450 kPa		
	2								2
	2.65	Pit discontinued at 2.65m, slow progress		D,pp	2.6		>450 kPa		
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371441
NORTHING: 6332080
DIP/AZIMUTH: 90°/--

PIT No: 17
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	FILLING - Generally comprising brown fine to medium grained silty sand with some gravel, trace rootlets, damp							
		FILLING - Generally comprising light orange-brown fine to medium grained clayey silty sand, slightly gravelly, damp		D,PID	0.3		<1ppm		
	0.75	FILLING - Generally comprising dark brown-black fine to medium grained silty sand / coal and coal chitter (50%), damp to moist		D,PID	0.8		<1ppm		
	1								1
		from 1.2m, 70% coal and coal chitter including cobble sized rock fragments		D,pp	1.3		<1ppm		
				D,PID	1.9		<1ppm		
	2								2
				D,PID	2.4		<1ppm		
	2.6	FILLING - Generally comprising grey-brown fine to coarse grained silty sand with some coal and coal chitter (10%)							
				D,PID	2.9		<1ppm		
	3 3.0	Pit discontinued at 3.0m, limit of investigation							3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371450
NORTHING: 6332117
DIP/AZIMUTH: 90°/--

PIT No: 18
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising dark brown-black fine to medium grained silty sand with abundant building rubble (including concrete footings, bricks, metal tubes, iron and corrugated fibro), damp		D,PID	0.15		<1ppm		
	0.3	Pit discontinued at 0.3m, due to historical remains							
	1								1
	2								2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371450
NORTHING: 6332165
DIP/AZIMUTH: 90°/--

PIT No: 19
PROJECT No: 39662C
DATE: 01 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising dark brown-black sandy silt / coal chitter (30%), trace rootlets to 0.2m, moist to damp		D,PID	0.1		<1ppm		
	0.25	FILLING - Generally comprising brown gravelly silt with some sand and coal and trace rootlets and coal, moist		D,PID	0.3		<1ppm		
	0.5	FILLING - Generally comprising dark grey-brown silt with trace sand, gravel, coal, moist to wet		D,PID	0.55		<1ppm		
	0.6	FILLING - Generally comprising brown and dark brown-black silty gravelly sand, generally comprising medium to coarse grained sand, slightly cemented, wet		D,PID	0.7		<1ppm		
	0.8	FILLING - Generally comprising grey-brown and orange-brown fine to medium grained clayey silty sand, slightly gravelly with some coal fragments		D,PID	1.0		<1ppm		
1		from 1.2m, saturated, grading to gravelly sand						▼	1
				D,PID	1.7		<1ppm		
2	2.0	Pit discontinued at 2.0m, due to continual collapse							2
3									3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: Free groundwater observed at 1.2m

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371475
NORTHING: 6331977
DIP/AZIMUTH: 90°/--

PIT No: 20
PROJECT No: 39662C
DATE: 06 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising grey-brown silty sand with some gravel and trace coal chitter, dry to moist		D,PID	0.1		<1ppm		
	0.25	SILTY CLAY - Hard, light orange-brown mottled red-brown silty clay with some gravel, M<Wp		D,PID,pp	0.4		400->450 kPa, <1ppm		
	0.6	SILTY CLAY - Very stiff to hard, light grey-brown mottled red-brown silty clay							
	1			D,pp	1.1		370-430 kPa		1
	1.5	CLAYSTONE - Extremely low to very low strength, extremely weathered, light grey and red-brown claystone		D,pp	1.7		>450 kPa		
		from 1.9m, very low strength, highly weathered							
	2 2.0	Pit discontinued at 2.0m, refusal							2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371485
NORTHING: 6332047
DIP/AZIMUTH: 90°/--

PIT No: 21
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
									5 10 15 20
	0.1	FILLING - Generally comprising grey-brown and brown fine to medium grained silty sand with some gravel and coal chitter (<10%) and trace rootlets		D,PID	0.05		<1ppm		
	0.12	CONCRETE - Grey-brown and brown concrete							
		Pit discontinued at 0.12m, refusal							
	1								1
	2								2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371487
NORTHING: 6332073
DIP/AZIMUTH: 90°/--

PIT No: 22
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - Generally comprising brown to dark brown fine to coarse grained silty sand with some gravel and coal chitter (10%) and trace clay and rootlets to 0.15m, damp		D,PID	0.3		<1ppm		
				D,PID	0.8		<1ppm		
	1	from 0.9m, grey-brown							1
				D,PID	1.3		<1ppm		
				D,PID	1.8		<1ppm		
	2								2
				D,PID	2.3		<1ppm		
				D,PID	2.8		<1ppm		
	3 3.0	Pit discontinued at 3.0m, limit of investigation							3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371508
NORTHING: 6332003
DIP/AZIMUTH: 90°/--

PIT No: 23
PROJECT No: 39662C
DATE: 03 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	FILLING - Generally comprising dark brown clayey silt with some subrounded, subangular gravel, trace rootlets, humid to damp		D,PID	0.02		<1ppm		
		FILLING - Generally comprising very stiff grey-brown mottled red-brwon silty clay, trace rootlets, trace cobbles, M<Wp		D,PID,pp	0.2		200-250 kPa, <1ppm		
	0.35	FILLING - Generally comprising stiff, brown mottled grey-orange silty sandy clay with some cobbles and coal chitter and gravel, M>Wp							
		at 0.6m, disused electrical cables		D,PID,pp	0.7		100-200 kPa, <1ppm		
		at 0.9m, concrete slab, black tar film		D,PID,pp	0.9		<1ppm		
1									1
	1.35	SILTY CLAY - Stiff, orange-brown / red-brown silty clay, M>Wp		D,PID,pp	1.4		100-200 kPa, <1ppm		
	1.9	SILTY CLAY - Hard, grey mottled red-brown silty clay, M<Wp							
2				D,PID,pp	2.1		400-450 kPa, <1ppm		2
		from 2.4m, grading to sandy silty clay		D,PID,pp	2.6		>450 kPa, <1ppm		
	2.7	Pit discontinued at 2.7m, slow progress							
3									3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371523
NORTHING: 6332059
DIP/AZIMUTH: 90°/--

PIT No: 24
PROJECT No: 39662C
DATE: 02 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.2	FILLING - Generally comprising dark brown-black fine to medium grained silty sand with 30% coal, coal chitter and trace gravel and rootlets to 0.1m, damp		D,PID	0.15		<1ppm		
	0.45	FILLING - Generally comprising grey-brown fine to coarse grained silty sand with trace gravel, damp		D,PID	0.35		<1ppm		
	0.8	FILLING - Generally comprising dark brown-black sandy silt / coal and coal chitter (50%-70%), damp		D,PID	0.6		<1ppm		
1		SILTY CLAY - Stiff to very stiff, grey-brown silty clay with some extremely low strength claystone boulders		D,PID,pp	0.9		200 kPa, <1ppm		1
				D,pp	1.8		180-220 kPa		
2	2.0	SANDY SILTY CLAY - Very stiff, light grey mottled red-brown sandy silty clay with some sandstone cobbles, M>Wp							2
				D,pp	2.8		250-350 kPa		
3	3.0	Pit discontinued at 3.0m, limit of investigation							3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371514
NORTHING: 6332096
DIP/AZIMUTH: 90°/--

PIT No: 25
PROJECT No: 39662C
DATE: 03 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.012	FILLING - Generally comprising brown fine to coarse grained silty sand with trace coal chitter fragments, gravel and rootlets, humid		D,PID	0.05		<1ppm		
		FILLING - Generally comprising dark brown-black sandy silt / coal and coal chitter with some cobble / chitter fragments, damp							
		at 0.5m, two concrete footings		D,PID	0.5		<1ppm		
	1								1
	1.1	Pit discontinued at 1.1m, due to historical remains							
	2								2
	3								3

RIG: 4WD Case 580 LE
LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371509
NORTHING: 6332134
DIP/AZIMUTH: 90°/--

PIT No: 26
PROJECT No: 39662C
DATE: 01 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising dark brown-black sandy silt / coal chitter (50%), trace rootlets to 0.2m, damp							
		from 0.3m, concrete footings and railway sleeper with metal rail spurs							
	0.45	Pit discontinued at 0.45m, due to historical remains							
	1								1
	2								2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371541
NORTHING: 6331995
DIP/AZIMUTH: 90°/--

PIT No: 27
PROJECT No: 39662C
DATE: 03 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.15	FILLING - Generally comprising dark brown fine to coarse grained silty sand with trace gravel with 30% coal chitter, trace rootlets, humid to damp		D	0.05				
	0.25	FILLING - Generally comprising dark brown fine to coarse clayey gravelly sand, some coal chitter and trace bricks, humid to damp		D	0.2				
	0.5	SANDY SILTY CLAY - Stiff, grey-brown mottled orange-brown sandy silty clay with some ironcemented gravel, M>Wp		D,pp	0.3		100-150 kPa		
		SILTY CLAY - Very stiff, orange-brown mottled red-brown silty clay, M>Wp		D,pp	0.6		200-220 kPa		
	1	from 0.9m, ironcemented sand and gravel, M<Wp		D,pp	1.0		300-350 kPa		1
	1.2	SANDY SILTY GRAVELLY CLAY - Very stiff grey-brown mottled red-orange-brown sandy silty gravelly clay, M<Wp							
	2			D,pp	1.8		300-350 kPa		2
	2.6	PEBBLY SANDSTONE - Extremely low to very low strength, extremely to highly weathered, light grey-brown and orange-red-brown, fine to coarse grained pebbly sandstone		D	2.8				
	2.9	Pit discontinued at 2.9m, limit of investigation							
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED	
Initials:	
Date:	

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371534
NORTHING: 6332113
DIP/AZIMUTH: 90°/--

PIT No: 28
PROJECT No: 39662C
DATE: 01 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - Generally comprising brown-dark brown silty sand with some coal chitter, trace rootlets to 0.4m, damp		D,PID	0.15		<1ppm		
	0.6								
	0.7	FILLING - Generally comprising, dark brown-black sandy silt / coal chitter (50%), moist		D,PID	0.65		<1ppm		
		FILLING - Generally comprising brown-dark brown fine to medium grained silty clayey sand, moist		D,PID	0.8		<1ppm		
	1								1
	1.1								
	1.2	FILLING - Generally comprising dark brown-black sandy silt / coal chitter (50%, wet		D,PID	1.15		<1ppm		
		FILLING - Generally comprising brown and dark brown fine to medium grained silty sand with some coal chitter and gravel, damp to moist							
		at 1.4m, timber sleeper (concrete footing)		D,PID	1.4		<1ppm		
	1.6	Pit discontinued at 1.6m, due to historical remains							
	2								2
	3								3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371570
NORTHING: 6332061
DIP/AZIMUTH: 90°/--

PIT No: 29
PROJECT No: 39662C
DATE: 03 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING - Generally comprising dark brown fine to coarse grained silty sand with trace gravel, coal fragments and rootlets, humid to damp		D,PID	0.05		<1ppm		
		FILLING - Generally comprising light grey-brown fine to coarse grained silty sand, damp to moist		D,PID	0.3		<1ppm		
	0.4	SANDY SILTY CLAY - Very stiff, brown sandy silty clay, M>Wp		D,PID,pp	0.5		200-230 kPa, <1ppm		
	0.55	SILTY CLAY - Very stiff to hard, orange-brown mottled red-brown silty clay with trace sand and gravel, M>Wp		D,pp	0.7		350->450 kPa		
	0.9	SILTY CLAY - Very stiff, grey-brown mottled red-brown silty clay with some iron-cemented sand and gravel, M<Wp		D,pp	1.0		300-380 kPa		
	2			D,pp	2.0		380-450 kPa		
		from 2.5m, grading to sandy silty clay		D,pp	2.7		320-360 kPa		
	2.8	Pit discontinued at 2.8m, limit of investigation							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Land Development
LOCATION: Flowers Drive, Catherine Hill Bay

SURFACE LEVEL: --
EASTING: 371568
NORTHING: 6332098
DIP/AZIMUTH: 90°/--

PIT No: 30
PROJECT No: 39662C
DATE: 01 Aug 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.08	FILLING - Generally comprising grey-brown sandy silt, fine to coarse grained sand, abundant rootlets, some coal, damp		D,PID	0.05		<1ppm		
		FILLING - Generally comprising brown and dark brown gravelly clayey sand, fine to coarse grained sand, some coal trace rootlets to 0.4m some bricks at 0.4m		D,PID	0.3		<1ppm		
	0.55 0.6	PEBBLY SANDSTONE / CONGLOMERATE - Very low strength, moderately weathered, light brown pebbly sandstone, fine to medium grained gravel							
		Pit discontinued at 0.6m, refusal							
	1								1
	2								2
	3								3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 4WD Case 580 LE

LOGGED: Reid

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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