

**PRELIMINARY HYDROGEOLOGICAL
ASSESSMENT – ASH PONDS
TALLAWARRA LANDS, YALLAH, NSW**

Prepared for:

TRUenergy
Level 33, 385 Bourke Street
MELBOURNE VIC 3000

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23 November 2010

TRUenergy
Level 33, 385 Bourke Street
MELBOURNE VIC 3000

Attention: Anthony Savenkov

Dear Anthony

**RE: PRELIMINARY HYDROGEOLOGICAL ASSESSMENT – ASH PONDS, TALLAWARRA
LANDS, YALLAH, NSW**

We are pleased to present our report for the above site.

We draw your attention to the attached sheets titled “Important Information about your Coffey Environmental Report”. These sheets should be read in conjunction with this report.

Thank you for your commission for this work and we look forward to the opportunity of being of assistance again in the future. Should you have any questions in relation to the report, please do not hesitate to contact Corinna De Castro or the undersigned.

For and on behalf of Coffey Environments Pty Ltd



MANUEL FERNANDEZ
Associate Environmental Engineer

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ABBREVIATIONS

AHD	Australian Height Datum
Bgl	below ground level
DO	Dissolved Oxygen
EC	Electrical Conductivity
µg/L	micrograms per litre
mg/L	milligrams per litre
MW	Monitoring Well
NOW	NSW Office of Water
RL	Reduced Level
SWL	Standing Water Level
TDS	Total Dissolved Solid
TOC	Top of Casing

1 INTRODUCTION

1.1 General

Coffey Environments Australia Pty Ltd (Coffey) was commissioned by TRUenergy Tallawarra Pty Ltd (TRUenergy) to carry out a preliminary hydrogeological assessment at the former ash pond areas of the Tallawarra lands surrounding the Tallawarra Power Station, Yallah Bay Road, Yallah, NSW, hereafter referred to as the 'site' (Figure 1). The work was completed generally in accordance with our proposal, ENAUWOLL04009AC-P01, dated 14 October 2010.

Coffey has previously assessed the groundwater quality at Tallawarra Lands (Coffey Environments, 2010a and 2010b). The assessments identified elevated concentrations of heavy metals (including arsenic, copper, nickel and zinc) and ammonia above the adopted investigation levels for protection of aquatic ecosystems. The report recommended that any future disturbance to the ash ponds should take into account groundwater issues and ensure that the disturbances avoid creating preferential pathways for groundwater to discharge directly into the surrounding receiving environment (Coffey Environments, 2010b).

The objective of this assessment by Coffey was to gain a preliminary understanding of the hydrogeological conditions in the areas of the ash ponds, including:

- Assessing groundwater flow directions and likely preferential pathways in the vicinity of the ash ponds;
- Assessing potential groundwater volumes flowing from the ash ponds; and
- A qualitative assessment of potential impacts to groundwater levels as a result of the proposed development.

1.2 Scope of Work

The following scope of work was carried out to meet the project objective:

- Data review including:
 - Subsurface conditions at the site from previous investigations;
 - Historical information available for filling of the ash ponds;
 - Rainfall and evaporation data;
 - Groundwater level data; and
 - Tidal fluctuation of Lake Illawarra.
- Site visit by a Senior Hydrogeologist to assess likely recharge and discharge processes and to conduct one gauging round of groundwater level measurement from ten existing Coffey monitoring wells (MW01 to MW10). One additional monitoring well (TAGM/D3) previously installed by others was included in the gauging round.
- Survey of monitoring well MW10 and surface water bodies including the lake in the southern section of Ash Pond 3, surface water bodies to the west and south of Ash Pond 3, Macquarie Rivulet and Duck Creek. The survey of surface water bodies was conducted on the same day as the

groundwater level measurements, in order to assess potential connections between surface water and groundwater.

- Qualitative impact assessment included an overview of the proposed development and identifying potential impacts of the development on the groundwater system. This included identification of short-term construction impacts from excavation dewatering and long-term impacts from the development such as the area of impermeable surfaces (decrease in groundwater recharge) and clearing of vegetation with sufficient root depth to impact groundwater levels (decrease in evapotranspiration).
- Meeting with Eco Logical Australia on site was conducted to review findings following assessment of groundwater flow directions and the ecological risk assessment.
- Reporting of the above information in relation to the project objective, including preparation of a groundwater contour map and two cross sections showing lithology through the ash ponds and developing a preliminary hydrogeological site conceptual model.

2 SITE CHARACTERISATION

2.1 Site Location and Landuse

The site is located on the eastern side of the Princes Highway, Yallah, NSW and occupies an area of about 535.9ha. The site is irregular in shape with an approximate length (north-south) of 3.4km and an approximate width (east-west) of 2km. The site excludes the area occupied by Tallawarra gas fired power station and public access areas around the Lake Illawarra foreshore, owned by the Lake Illawarra Authority. The northern portion of the site is generally vacant and used for grazing land. The northern portions of the site have the occasional structure and several farm dams. The area south of Yallah Bay Road has been significantly disturbed to allow development of three ash ponds which were filled with ash during the operation of the coal fired power station. This area has also been significantly filled.

The surrounding landuses include:

- Princes Highway to the west;
- Residential dwellings to the north and south;
- Lake Illawarra to the east; and
- The power station located near the central southeastern boundary, north of Yallah Bay Road.

The site locality, site layout and general surrounding landuses are shown in Figure 1.

2.2 Topography and Surface Water Drainage

The study area has varying topography from near level ground to steep slopes. The topography near the northern site boundary forms part of a steep hill side (Mount Brown) sloping down towards the east, south and southeast. South of these steep areas, the slope flattens slightly and becomes rolling hills. The ground surface south of Yallah Bay Road is generally near level (<1° grade) and forms part of an alluvial floodplain and wetlands with exception of areas near the western boundary. The area near the western site boundary (south of Yallah Bay Road) appears to be locally elevated rising towards the Princes Highway to the west and sloping down towards the east.

Reference to the Albion Park 1:25,000 Topographic Map indicates that the study area is at an elevation between 0m and 100m above Australian Height Datum (AHD). This was consistent with survey data provided by Landteam which indicated an elevation between 0m and 110m AHD.

In areas north of Yallah Bay Road, surface water is expected to follow the land topography initially discharging into several unnamed watercourses and farm dams that occupy this area of the site. Some of these watercourses appear to flow into Duck Creek or directly into Lake Illawarra. The area south of Yallah Bay Road is bisected by Duck Creek which flows from the northwest to the east before discharging into Lake Illawarra. Wollingurry Creek and several drains/unnamed watercourses occupy this area of the site and flow into Duck Creek. This area of the site is also occupied by three ash settling ponds which have been mostly filled with ash derived from the former coal fired power station. One of the ponds (Ash Pond 3) in the south western area of the site was only partially filled with ash allowing the remaining areas to be filled with water.

The topography and watercourses are shown in Figure 1 and Figure 2.

2.3 Rainfall and Evaporation

The Port Kembla automatic weather station (AWS) 68131 is approximately 12 km to the north east of the site at an elevation of 9 m AHD. Climate data has been recorded at this location since 1963. Recorded data at Port Kembla has been sourced from the Bureau of Meteorology website www.bom.gov.au. No pan evaporation data is available from the Port Kembla station and limited pan evaporation data is available in the study area. Pan evaporation data was sourced from the University of Wollongong (website), which is located approximately 14 km to the north east of the site.

Table 1 lists the mean rainfall and pan evaporation recorded at Port Kembla and the University of Wollongong respectively. Mean rainfall is approximately 1104 mm. Mean monthly rainfall is highest from February to April and lowest in winter and spring. Evaporation also varies with the seasons and is highest in the spring and summer months (from October to February). Mean annual evaporation is 1278 mm, which exceeds mean annual rainfall.

Table 1: Mean Rainfall at Port Kembla and Evaporation at University of Wollongong

	Rainfall (mm)	Pan Evaporation (mm)
Monthly		
January	94	152
February	129	120
March	141	105
April	104	84
May	88	71
June	112	63
July	54	74
August	73	90
September	59	108
October	89	127
November	88	129
December	74	158
Annual		
Mean	1104	1278

2.4 Geology

Reference to the 1:50,000 Kiama Geological Series Sheet (9028-1, First Edition) prepared by the NSW Department of Mines (1974) indicates the study area is underlain by the following four geological units:

- Alluvium;
- Dapto Latite Member;
- Budgong Sandstone; and
- Berry Siltstone.

The Dapto Latite Member, Budgong Sandstone and Berry Siltstone form part of the Shoalhaven Group of rocks. The geological map has been overlaid onto the site aerial photograph and is shown in Figure 2.

The geological map shows the area south east of Ash Pond 2 as alluvium, while subsurface investigations (Coffey Environments, 2010a) have indicated this area is underlain by shallow bedrock of the Berry Siltstone formation, as illustrated in Figure 3.

The geological map provides a description of each of these units along with their depositional sequence. This has been summarised in Table 2.

Table 2: Summary of Local Geological Units

Geological Unit	Geological Description	Age and Depositional Sequence
Alluvium (Qa)	Alluvium, gravel, beach and dune sand	Quaternary. At the site typically overlies the Berry Siltstone.
Dapto Latite Member (Psgd)	Melanocratic coarse grained to porphyritic latite	Early Permian. At the site overlies the Budgong Sandstone.
Budgong Sandstone (Psg)	Red-brown and grey volcanic sandstone	Early Permian. At the site overlies the Berry Siltstone.
Berry Siltstone (Psb)	Mid-grey to dark-grey siltstone to fine sandstone	Early Permian. The oldest identified geological formation at the site.

2.5 Ash Pond Details

2.5.1 History

Three ash ponds were constructed at the site between around 1955 and 1983 for the placement of ash, a by-product from the former coal fired power station. The ash ponds occupy approximately two-thirds of the lower lying area south of Yallah Bay Road. The ash pond walls were constructed of fill comprising a combination of coalwash and soil that appears to have been placed directly on the former ground surface, as there has been no evidence of excavation revealed in the site history (Coffey Environments, 2010a). Typically the ash pond bund walls are in the order of 5m high and approximately 30m wide but this is variable. The ash ponds were progressively filled with ash that was hydraulically pumped into the ponds via overland pipelines until the power station ceased operations in 1989. As the ponds reached capacity, they were capped with coalwash and/or general fill and revegetated. Ash Pond 3 did not reach its full capacity with several areas filled with water.

2.5.2 Subsurface Conditions

The origin and quality of the fill used to construct the bund walls of the ash ponds were not confirmed through the history study conducted previously (Coffey Environments, 2010a). The fill used to construct the bund walls was assessed as an engineered type fill, and as such it was considered unlikely to contain significant quantities of materials such as concrete, timber, bricks, etc, that would result in areas where preferential groundwater flow could occur.

Fourteen (14) locations were either excavated or drilled through the fill bund walls of the ash ponds (Coffey Environments, 2010a). The materials encountered in the bund walls included a general fill material (comprising clay, clayey silt or sand) and coalwash. 19 locations were either excavated or

drilled through the ash ponds. Ash was exposed at the surface, in particular in Ash Pond 3. Typically a coalwash or clay cap was encountered ranging in thickness between 0.05m and 0.6m.

Ash was identified below the cap to depths of between 0.15m and 11m. Typically natural clayey soils were noted at the base of the ponds. At some locations silty sand, sand or weathered rock was encountered at the base of the ponds.

2.5.3 Geotechnical Laboratory Results

The laboratory testing results previously reported (Coffey Environments, 2010a) indicated the following:

- Most of the samples from the ash material indicated about 90% of the material passed the 75µm sieve, indicating the tested samples contained silt or clay sized particles.
- For the ash samples, a significant proportion of the soil was graded in the 'silt' particle size range in three out of the four samples tested in hydrometer test samples.
- Out of the 16 samples tested within the ash, 6 contained predominantly (>50%) sand sized particles. The remaining 10 samples tested within the ash contained predominantly silt or clay sized particles.
- Some variability occurs within the ash materials, with some silty and some sandy ash materials.

2.6 Hydrogeology

2.6.1 Groundwater Levels and Flow

Ten groundwater monitoring wells have been installed by Coffey: MW01 to MW09 as part of the initial site investigation (Coffey Environments, 2010a) and MW10 as part of a further assessment of groundwater quality (Coffey Environments, 2010b). Monitoring well borelogs are attached in Appendix A and details are summarised in Table 3. Monitoring wells MW06 and MW08 are screened in the ash within Ash Pond 2. Monitoring wells MW03 and MW04 are located within Ash Pond 3 and are screened in the underlying alluvial/estuarine or residual material. The remaining monitoring wells are screened in alluvial/estuarine sediments with one monitoring well MW07 screened in weathered sandstone bedrock of the Berry Siltstone formation. Monitoring well locations are shown in Figure 3.

Groundwater levels from the gauging round conducted on the 22 October 2010 are detailed in Table 4. In the alluvial/estuarine sediments, groundwater levels range from 0.79m AHD at MW09 adjacent to Lake Illawarra, to 1.25m AHD at MW10. Groundwater levels within Ash Pond 3 ranged from 2.17m AHD at MW03 to 2.24m AHD at MW04 for the natural alluvial/estuarine sediments below. Cone Penetration Test (CPT) data (see below) would suggest that these levels are also representative of the ash material in Ash Pond 3. MW07 screened in weathered sandstone bedrock was dry. Groundwater levels within the ash in Ash Pond 2 ranged from 3.75m AHD at MW06 to 6.02m AHD at MW08 in the south eastern saltmarsh inundated area. This inundated area is bunded and considered as separate to the rest of the Ash Pond 1 and 2 system. Surface water drainage from Ash Pond 1 is directed towards the inundated area.

Additional groundwater level data has been collated from the Coffey piezocone data collected during fieldwork from February to June 2010 (Coffey Environments, 2010a). Piezocone groundwater levels are summarised in Table 5.

Table 3: Groundwater Monitoring Well Details

Well ID	Easting (m MGA)	Northing (m MGA)	Location	Date Completed	Total Well Depth (m bgl)	Screen Interval (m bgl)	Screened Lithology	Diameter & Type of PVC Casing	Elevation Top of PVC Casing (m AHD)	Elevation Ground Surface (m AHD)
MW01	297731.9	6176080.1	Eastern edge of Ash Pond 3	4/3/2010	6.0	3.0 to 6.0	Alluvial/Estuarine	50mm Class 18	2.82	2.68
MW02	297791.3	6176388.2	Eastern edge of Ash Pond 3	4/3/2010	5.8	2.8 to 5.8	Alluvial/Estuarine	50mm Class 18	3.05	2.34
MW03	297545.0	6176690.5	Within Ash Pond 3	3/3/2010	5.8	2.8 to 5.8	Alluvial/Residual (Weathered Sandstone)	50mm Class 18	3.98	3.42
MW04	297590.9	6176299.8	Within Ash Pond 3	3/3/2010	6.2	3.2 to 6.2	Estuarine	50mm Class 18	3.33	3.14
MW05	298381.4	6176516.4	South of Ash Pond 2	5/3/2010	7.5	4.5 to 7.5	Alluvial/Estuarine	50mm Class 18	4.7	4.21
MW06	298481.4	6176739.3	Within Ash Pond 2	11/6/2010	7.5	3.0 to 7.5	Fill - Ash	42mm Class 18	10.92	10.28
MW07	298872.6	6176432.4	South of Ash Pond 2	5/3/2010	5.6	2.6 to 5.6	Weathered Sandstone (Berry Siltstone)	50mm Class 18	8.51	8.19
MW08	298837.0	6176677.1	Within Ash Pond 2	10/3/2010	3.6	0.6 to 3.6	Fill - Ash	42mm Class 18	6.51	5.96
MW09	298827.3	6177103.4	East of Ash Pond 1 adjacent to Lake Illawarra	5/3/2010	5.8	2.8 to 5.8	Alluvial/Estuarine	50mm Class 18	3.07	2.38
MW10	297882.1	6176850.0	Outside ash ponds	17/8/2010	4.5	1.5 to 4.5	Alluvial/Estuarine	50mm Class 18	2.59	1.95

Table 4: Monitoring Well Groundwater Levels from 22 October 2010

Well ID	Location	Elevation Top of PVC Casing (m AHD)	Elevation Ground Surface (m AHD)	Groundwater Depth (m bgl)	Groundwater Level (m AHD)
MW01	Eastern edge of Ash Pond 3	2.82	2.68	1.71	0.97
MW02	Eastern edge of Ash Pond 3	3.05	2.34	1.18	1.17
MW03	Within Ash Pond 3	3.98	3.42	1.25	2.17
MW04	Within Ash Pond 3	3.33	3.14	0.92	2.24
MW05	South of Ash Pond 2	4.7	4.21	3.23	1.02
MW06	Within Ash Pond 2	10.92	10.28	6.57	3.75
MW07	South of Ash Pond 2	8.51	8.19	Dry to 5.6m bgl	Dry to 2.6m AHD
MW08	Within Ash Pond 2	6.51	5.96	0.02	6.02
MW09	East of Ash Pond 1	3.07	2.38	1.61	0.79
MW10	Outside ash ponds	2.59	1.95	0.71	1.25

Table 5: Piezocone Inferred Groundwater Levels from February to June 2010

Piezocone Number	Easting (m MGA)	Northing (m MGA)	Location	Elevation Ground Surface (m AHD)	Estimated Groundwater Depth (m bgl)	Inferred Groundwater Level (m AHD)
CPT08	298454.7	6177349.4	North of Ash Pond 1	6.8	4.0	2.8
CPT09	298680.0	6177326.0	North of Ash Pond 1	3.2	1.0	2.2
CPT10	298388.0	6177188.0	Ash Pond 2	11.2	4.0	7.2
CPT11	298181.4	6177162.5	Ash Pond 2	10.8	4.0	6.8
CPT12	298117.6	6177055.0	Ash Pond 2	7.2	3.2	4.0
CPT13	298420.0	6177065.0	Ash Pond 2	10.8	5.0	5.8
CPT14	298231.0	6176960.0	Ash Pond 2	10.8	7.1	3.7
CPT15	298459.3	6176891.9	Ash Pond 2	12.9	7.1	5.8
CPT16	298815.2	6176921.7	Ash Pond 1	9.8	7.0	2.8
CPT17	298700.0	6176819.0	Ash Pond 2	10.5	0.7	9.7
CPT18	298838.0	6176755.0	Ash Pond 2	6.2	0.7	5.5
CPT19	298213.7	6176625.5	Ash Pond 2	6.4	3.2	3.2
CPT20	298311.5	6176684.9	Ash Pond 2	10.5	7.1	3.4
CPT21	298478.6	6176702.6	Ash Pond 2	10.2	7.1	3.1
CPT22	298606.3	6176579.0	Ash Pond 2	10.1	7.1	3.0
CPT23	297824.0	6176645.0	Ash Pond 3	4.7	1.2	3.5
CPT24	297544.9	6176624.0	Ash Pond 3	3.4	1.4	2.0
CPT25	297769.5	6176589.1	Ash Pond 3	3.6	1.4	2.3
CPT26	297513.1	6176372.0	Ash Pond 3	3.2	0.6	2.6
CPT27	297646.9	6176307.9	Ash Pond 3	3.1	0.6	2.5
CPT28	297780.0	6176306.0	East of Ash Pond 3	1.4	1.2	0.3
CPT29	297577.0	6176183.0	Ash Pond 3	2.9	0.6	2.3

Groundwater elevations from the ten Coffey monitoring wells and one additional monitoring well (TAGM/D3) previously installed by others have been included in the interpreted groundwater contour map shown in Figure 3. Piezocone locations within Ash Pond 1 and 2 have been incorporated into the groundwater contour map to provide additional data in this area.

Surface water locations in the study area were surveyed by Landteam on the same day as the groundwater gauging round was conducted (22 October 2010) and are also included in Figure 3. The contour map shows that south of Duck Creek groundwater flow is to the north east towards Duck Creek, to the east towards Lake Illawarra and to the south east towards Macquarie Rivulet. Groundwater flow north of Duck Creek is radial from the elevated Ash Pond 1 and 2 area, towards Duck Creek and Lake Illawarra.

Hydraulic gradients vary from 0.001 in the low lying wetland area east of Ash Pond 3 to steeper gradients of around 0.05 in the elevated Ash Pond 1 area towards Lake Illawarra.

The elevated groundwater levels within the ash ponds are above the natural sediment and with currently available data it is not known whether these two groundwater systems are connected. There is a possible unsaturated zone between the groundwater level within the ash ponds and the estuarine/alluvial sediments below, or alternatively it may be connected as a continuous saturated zone. In Ash Pond 3, monitoring wells MW03 and MW04 both recorded groundwater inflow during drilling within the ash (approximately 0.3m below ground level) and in the natural clay below (between 2.5m and 3m below ground level). Based on the moisture condition recorded on the borelogs for MW03 and MW04 (wet from the initial groundwater inflow depth around 0.3m), there appears to be a continuous saturated zone in this area of Ash Pond 3. Insufficient data exists to assess this for Ash Ponds 1 and 2. Nested piezometers screened separately in the ash material and natural sediment would be required to further assess a possible unsaturated zone below the ash ponds.

Groundwater flow from the ash ponds to the surrounding environment is assessed as being predominantly vertical flow through the base of the ponds rather than horizontal flow through the bund walls. No groundwater was observed as seepage from the bund walls during site visits for the current assessment and from discussions with Coffey staff who previously conducted the subsurface investigations earlier in 2010. Most of the bund walls for Ash Pond 1 and 2 are vegetated with a range of species including swamp oaks (*Casuarina* and other tree species) and weeds. It is therefore assessed that if groundwater were to flow horizontally through the bund walls in this area, the groundwater would be intercepted as evapotranspiration.

The ash level within Ash Pond 3 is lower than the bund walls and groundwater levels on the eastern edge of Ash Pond 3 are at an elevation of approximately 1m AHD (MW01 and MW02), which is at a similar elevation to the surface water in the drainage channel flowing north to Ducks Creek. The drainage channel is located approximately 10m from monitoring wells MW01 and MW02. The lake in the southern part of Ash Pond 3 is connected to the groundwater surface, as illustrated in Figure 3. Surface water overflows from the lake are directed to the lake outside the bund wall to the west, which then flows in a series of drainage channels flowing east along the southern Ash Pond 3 boundary, and then north towards Duck Creek along the eastern Ash Pond 3 boundary.

Away from the ash ponds in the more elevated areas north of Yallah Bay Road, it is likely that the groundwater will be within fractures or extremely weathered seams within the Budgong Sandstone. This is consistent with the results of our previous investigation (Coffey Geosciences, 2002) where two groundwater monitoring wells were installed to depths of 1.7m and 4m north of the power station within the residual or weathered sandstone rock. These wells were observed to be dry at the time of

monitoring. Groundwater within the residual clay above the bedrock may be considered as an ephemeral perched groundwater system depending on rainfall recharge, although most rainfall would run off due to the steep slopes and nature of the clay soils (low infiltration rates).

Groundwater monitoring wells located in the lower areas of the power station near the foreshore of the lake recorded depths to groundwater ranging between 1.76m and 2.23m below ground level (Coffey Geosciences, 2002). This is similar to groundwater levels reported for the power station area this year (Earth2Water, 2010).

2.6.2 Aquifer Properties

Movement of groundwater within the ash ponds and the natural alluvial/estuarine sediments is governed by aquifer properties including hydraulic conductivity, effective porosity (specific yield) and by the hydraulic gradient in the aquifer.

The potential volumes of groundwater flowing from the ash ponds was assessed as part of the current hydrogeological assessment in order to provide preliminary information for the Groundwater Dependent Ecosystems (GDEs) risk assessment conducted by Eco Logical Australia (2010).

Since groundwater flow from the ash dams was assessed as being predominantly vertical flow through the base of the ash ponds rather than horizontal flow, vertical hydraulic conductivity values were calculated from horizontal conductivity data assessed as part of the previous piezocone investigation works (Coffey Environments, 2010a). The time for 50% pore pressure dissipation was assessed and horizontal conductivity values were calculated using the method by Robertson et al (1997). Results for the pore pressure dissipation tests from the previous investigation are presented in Appendix B.

It is evident that pore water pressure dissipation times are variable, which is typical for this type of test. Several tests appear to have been conducted in drainage layers (in sand or other higher permeability material) encountered in the ash or underlying alluvial/estuarine sediments, resulting in shorter dissipation test times. Such variations consisting of vertically and laterally discontinuous and irregular lenses are consistent with the visual and laboratory data from test pits and boreholes previously carried out at the site (Coffey Environments, 2010a).

Horizontal hydraulic conductivities measured from the dissipation tests are detailed in Table 6 and ranged from 0.0002 m/day in the fine ash material to 0.02 m/day in the coarser ash material. This is similar to the natural sediments below where horizontal hydraulic conductivities ranged from 0.0001 m/day to 0.01 m/day. Vertical hydraulic conductivity values for both the ash material and underlying natural sediment were calculated using average thicknesses of fine grained and coarse grained material based on borelogs from the previous investigation (Coffey Environments, 2010a). In general, there were more layers varying between fine grained and coarser grained material in the ash material compared to the natural sediment, where thicker intervals of clay material were observed.

The results of this analysis showed that vertical hydraulic conductivity values were similar for the ash and natural sediments as listed below:

- Ash material – 0.0007 m/day; and
- Alluvial/estuarine sediment – 0.0009 m/day.

Table 6: Piezocone Dissipation Tests – Hydraulic Conductivity Results

Piezocone Number	Location	Total CPT depth (m bgl)	Estimated Groundwater Depth (m bgl)	Dissipation Test Depth (m bgl)	Test Lithology	Horizontal Hydraulic Conductivity ¹ (m/day)		
						Lower Value	Upper Value	Average
Within Ash Ponds								
CPT10	Ash Pond 2	23.6	4.0	12.0	Clay	0.00026	0.00035	0.0003
				15.0	Clay	0.00043	0.00060	0.0005
CPT11	Ash Pond 2	18.8	4.0	12.0	Sandy clay	0.00138	0.00190	0.0016
CPT12	Ash Pond 2	18.0	3.1	5.0	Ash - coarse	0.00095	0.00138	0.0012
				8.5	Ash - fine	0.00052	0.00078	0.0006
				12.0	Clay	0.00017	0.00026	0.0002
CPT13	Ash Pond 2	20.0	5.0	11.0	Sandy clay	0.00320	0.00449	0.0038
				13.5	Sandy clay	0.00104	0.00147	0.0013
CPT14	Ash Pond 2	21.2	7.1	13.4	Clay	0.00026	0.00035	0.0003
CPT15	Ash Pond 2	21.0	7.1	15.0	Clayey sand	0.01115	0.01547	0.0133
CPT16	Ash Pond 1	9.2	7.0	6.0	Ash - fine	0.00017	0.00026	0.0002
CPT19	Ash Pond 2	23.8	3.2	4.0	Ash - coarse	0.01616	0.02238	0.0193
				12.0	Clay	0.00009	0.00009	0.0001
CPT20	Ash Pond 2	16.8	7.1	12.0	Clay	0.00052	0.00078	0.0006
CPT21	Ash Pond 2	13.0	7.1	10.0	Clayey sand	0.01184	0.01642	0.0141
CPT24	Ash Pond 3	10.6	1.4	4.0	Ash - coarse	0.00320	0.00449	0.0038
CPT25	Ash Pond 3	12.5	1.4	8.0	Sandy clay	0.00156	0.00225	0.0019
CPT29	Ash Pond 3	8.4	0.6	1.5	Ash - coarse	0.00216	0.00294	0.0025
				5.5	Sandy clay	0.00544	0.00752	0.0065
Outside Ash Ponds								
CPT08	North of Ash Pond 1	5.0	4.0	4.0	Clay	0.00070	0.00090	0.0008
CPT09	North of Ash Pond 1	17.8	1.0	5.0	Clay	0.00035	0.00052	0.0004
				10.0	Clay	0.00026	0.00043	0.0003
CPT28	East of Ash Pond 3 (Embankment)	20.2	1.2	1.5	Sandy clay	0.00389	0.00544	0.0047
				5.5	Clay	0.00026	0.00043	0.0003
CPT30	West of Ash Pond 2	10.5	2.0	5.0	Clayey sand	0.01201	0.01668	0.0143

¹ Calculated from pore pressure dissipation test using method by Robertson et al, 1997.

Reference values for hydraulic conductivity values of ash material from other published studies are listed in Table 7. The values listed for fly ash (0.0002 and 0.0004 m/day) and the geometric mean for the field testing from South Africa (0.02 m/day) are similar to the site data. The value for the coarse bottom ash material (15 m/day) is five orders of magnitude greater and illustrates the possible range of hydraulic conductivity if the ash material is predominantly coarse grained.

Table 7: Reference Values for Ash Hydraulic Conductivity

Report Reference	Study Location	Hydraulic Conductivity Values (m/day)				
		Fly Ash (Fine)	Bottom Ash (Coarse)	Average Saturated	Geometric Mean - Lab Testing	Geometric Mean - Field Testing
Muhardi et al, 2010	Tanjung Bin Ash, Malaysia	0.0004	15			
Mudd, 2000	Latrobe Valley, Victoria, Australia			0.3		
Yeheyis, 2008	Ontario, Canada	0.0002				
October et al, 2009	Various locations, South Africa				0.18	0.02

In order to assess the potential volumes of groundwater flowing from the ash ponds, the following assumptions and data were used:

- The vertical hydraulic gradient is one. A unit gradient does not take into account the material below the base of the ash ponds and is a worst case scenario for driving hydraulic head. For this case, the material below the ash would need to be nearly desaturated.
- The vertical hydraulic conductivity is 0.0007 m/day. This is a conservative value, however it is not a worst case scenario as it does not take into account scale effects of the test method, the possibility of connected zones of higher permeability in coarse ash material or the potential conduit effects of previous boreholes drilled through the ash ponds and backfilled without the use of grout.
- The area of Ash Pond 1 is approximately 170,994 m².
- The area of Ash Pond 2 is approximately 465,716 m².
- The area of Ash Pond 3 is approximately 644,887 m².

Based on the above, the potential volumes of groundwater flowing from the ash ponds are:

- Flow from Ash Pond 1 and 2 is approximately 446 m³/day or 163 ML/year.
- Flow from Ash Pond 3 is approximately 451 m³/day or 165 ML/year.
- Total flow of 328 ML/year.

The maximum seepage rate through the base of the ash will, in the long term, be limited by the rate of rainfall recharge into the ash.

Stormwater volumes for the developed site scenario were modelled as part of the drainage assessment conducted (BMT WBM, 2010). It was assessed that surface water volumes discharging into Duck Creek would be around 763 ML/year (once evaporation losses and proposed storage in rainwater tanks had been factored in). Average flows in Duck Creek were not reported in the drainage assessment or flood risk assessment by Bewsher (2010). The six hour duration 100 year ARI peak flow for Duck Creek at the Lake Illawarra outlet was reported to be 289 m³/s or around 24,970 ML/day (Bewsher, 2010). For the Duck Creek surface water catchment, average flows of approximately 1 m³/s or around 86 ML/day are considered reasonable (pers. comm. Bewsher, 2010). The Duck Creek tidal limit coincides with the bridge access point to the northern boundary of Ash Pond 3.

2.6.3 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined as ecosystems whose current composition, structure and function are reliant on a supply of groundwater (Eamus, 2009). Potential GDEs present at the site are detailed in the GDE risk assessment study (Eco Logical Australia, 2010). It was assessed that potential dependency on groundwater was likely for all terrestrial vegetation types at the site, including the SEPP 14 wetlands south of Duck Creek and in the vicinity of Lake Illawarra. The estuarine alluvial wetlands were assessed as being more dependent on tidal inundation of saline waters rather than groundwater dependency.

For all ecosystems on site it was assessed that alterations to hydrological regimes (both surface and groundwater) could potentially threaten the vegetation communities.

2.6.4 Registered Groundwater Bores

A survey of groundwater bores within a 4.5 km radius of the study area registered with the NSW Office of Water (NOW) was carried out as part of the previous Coffey investigation (Coffey Environments, 2010a). The search results indicated that there were 40 registered bores but only nine of which had work summary sheets. The groundwater bores were located in an inferred upgradient direction and generally to the north and west of the site. The closest bore, GW033541, was located approximately 1.5 km to the north west of the site. The work summary sheets and groundwater bore locations are presented in Appendix C.

2.7 Hydrogeological Conceptual Model

2.7.1 Recharge

Groundwater recharge to the aquifer can occur via the following processes:

- Direct rainfall infiltration;
- Runoff from the hills to the north and west reporting to the estuarine/alluvial aquifer; and
- Recharge from bedrock.

Groundwater flow at the site is expected to be dominantly within the estuarine/alluvial aquifer which is generally continuous over the site, as well as flow of groundwater within the ash ponds. The upper layers of the underlying bedrock may provide minor groundwater recharge in dryer times but are expected to have lower overall permeability compared with the estuarine/alluvial aquifer.

2.7.2 Discharge

Discharge of groundwater from the aquifer will occur via the following processes:

- Lateral flow to Lake Illawarra and other surface water bodies including Duck Creek, Wollingurry Creek and drainage channels;
- Evapotranspiration by vegetation with sufficient root depth;
- Evaporation from ponded water; and
- Leakage to bedrock.

The upper layers of the underlying bedrock may accept groundwater leakage from the estuarine/alluvial aquifer in wetter times and are expected to have lower overall permeability compared with the estuarine/alluvial aquifer.

2.7.3 Schematic Conceptual Model

The elements of the hydrogeological system discussed in the previous sections are summarised in two cross sections. Figure 4 shows the locations of the cross sections and Figure 5 and Figure 6 show the schematic hydrogeological conceptual model for the site and surrounding area.

3 PROPOSED SITE DEVELOPMENT

The development proposal involves the establishment of a number of land uses throughout the study area. Details regarding the proposed development were obtained from the Urban Design Masterplan (Warren Lee Urban Design, 2010).

The proposed development areas are illustrated in Figure 7 and include:

- Northern Precinct - Residential development in the north east of the site along the Lake Illawarra foreshore.
- Central Precinct - Residential development, a local centre and an employment zone in the central western parts of the site, north of Duck Creek and Yallah Bay Road.
- Central Precinct - An employment area and tourism facility in the central and eastern parts of the site.
- Lakeside (Southern) Precinct - An employment precinct, primary school, retirement village and residential development in the south west of the site.
- Significant dedication of various parts of the site for environmental and open space purposes, as listed by Eco Logical Australia (2010):
 - Provision of a significant environmental corridor for Duck Creek.
 - A large environmental reserve in the south east incorporating two SEPP 14 wetlands.
 - Conservation of two artificial wetlands in the south west for incorporation into open space areas.
 - An environmental reserve on the upper slopes of Mount Brown.
 - An environmental reserve on the central western boundary.
 - Provision of riparian zones for affected waterways.
 - Large areas of open space reserves.

4 IMPACT ASSESSMENT

Coffey has previously assessed the groundwater quality at Tallawarra lands. The assessments identified elevated concentrations of heavy metals (including arsenic, copper, nickel and zinc) and ammonia above the adopted investigation levels for protection of aquatic ecosystems. The report recommended that any future disturbance to the ash ponds should take into account groundwater issues and ensure that the disturbances avoid creating preferential pathways for groundwater to discharge directly into the surrounding receiving environment (Coffey Environments, 2010b).

A qualitative assessment of potential impacts to groundwater levels as a result of the proposed development has been conducted and reported in the following sections.

4.1 Construction

Proposed construction which may impact the groundwater system in the short-term includes excavations during construction of services including sewer pump stations, potential groundwater quality impacts due to mobilisation of groundwater contaminants from construction of trenches through ash pond walls and potential disturbance of Acid Sulfate Soils (ASS).

4.1.1 Excavations

Bulk earthworks information was provided by Northrop Consulting Engineers and the location of cut and fill areas including the location of proposed sewer pump stations are attached as Appendix D.

It is understood that the deepest excavations on site will be for construction of the sewer pump stations, to a maximum depth of 8m below finished surface level. Three sewer pump stations are proposed, as illustrated in Appendix D. They are located in the northern precinct development, in the central precinct area north of Duck Creek and in the southern lakeside precinct. Mitigation measures may be required to limit drawdown during construction. Long term impacts are expected to be negligible as the pump station excavations will be lined. An approximate assessment of construction drawdown for the sewer pump station in Ash Pond 3 follows.

Approximate fill depths in this area are 2m, therefore the proposed excavation will be to approximately 4m below current ground surface within Ash Pond 3. Groundwater levels at monitoring wells MW03 and MW04 were measured in October 2010 as 1.25m and 0.92m below ground surface.

Based on steady state groundwater equations, the potential radius of influence of groundwater drawdown from the perimeter of the excavation has been assessed. The following assumptions were adopted for the calculations:

- Average groundwater level was taken as 1m below current ground surface;
- Dewatering to a sump level of 5m below current ground surface was adopted;
- Hydraulic conductivity of 0.1 m/day (considered a conservative value);
- Initial aquifer thickness of 7m;
- Uniform rainfall infiltration rate of 0.0003 m/day (10% of annual average rainfall).

Taking into account the listed assumptions, it is assessed that groundwater levels will recover at a distance of approximately 90m from the excavation. The maximum drawdown at the excavation would

be 4m below the current groundwater level. During extended dry periods the radius of influence may be further than 90m, however it is assessed that groundwater drawdown will not impact receptors including the wetland area to the east or the closest registered groundwater bore approximately 1.5 km to the north west of the site.

Potential impacts of lowering the groundwater level on Acid Sulfate Soils (ASS) are discussed further in Section 5.1.3.

It is assessed that long term groundwater inflow would range from 0.1 L/s to 0.5 L/s. During high rainfall events, an increase in groundwater inflow may occur, however it is still expected that the rate of groundwater inflow would be unlikely to exceed 1 to 2 L/s unless local flooding occurred.

The main factors affecting the potential groundwater inflow are the depth of the excavation below the existing groundwater level and the assumed permeability of the alluvial/estuarine sediments. The adopted hydraulic conductivity of 0.1 m/day is considered reasonable however localised increased permeability and therefore larger volumes of groundwater inflow could occur during excavations.

It is recommended that groundwater inflow is observed during construction activities and dewatering pumping options revised accordingly as necessary.

Temporary dewatering licence requirements will need to be considered and consultation with the NSW Office of Water is recommended. Groundwater may need to be pumped to a temporary holding pond/tank. As part of the dewatering licence sampling would be conducted and depending on the results, groundwater may need to be taken off site for disposal rather than discharged to the stormwater or surface water systems. There is also the potential for re-injection of groundwater if necessary, though this is also subject to licence controls such as sampling results and maintaining similar levels for parameters such as pH and total dissolved solids (TDS).

4.1.2 Preferential Pathways

During construction excavation it will be important not to create preferential pathways for the groundwater to discharge directly to receptors such as Duck Creek and Lake Illawarra. Mitigation measures would include limiting excavation in ash pond bund walls, and if excavation is to take place, engineering controls such as sheet piles to provide a barrier to groundwater flow.

4.1.3 Acid Sulfate Soils

The results of the ASS assessment (Coffey, 2010a) confirmed that ASS are present within certain parts of the site. A combination of a desk study, field mapping, logging and analytical testing was used to assess the approximate extent of areas of the site where ASS could exist in the soil profile. These areas were predominantly in the southern parts of the site with current/former lower lying alluvial/estuarine environments.

Specific developments within areas where ASS have been assessed likely to occur and/or in nearby areas that could result in a lowering of the water table in ASS areas would need to be assessed individually based on the proposed construction methods and types of disturbance. Developments in these areas that are likely to disturb underlying natural soils or have an impact which lowers the groundwater level would trigger the need for further specific assessment and where necessary, development of ASS management plans.

The proposed sewer pump station excavation within Ash Pond 3 may require further specific ASS assessment. Groundwater drawdown is assessed as being a maximum of 4m at the excavation. It is recommended that monitoring bores be established in the vicinity of the excavation to monitor groundwater levels during construction and a contingency plan developed to respond to development of adverse impacts.

4.2 Operation

The operation of the proposed development will potentially impact groundwater through changes in recharge and evapotranspiration processes and potential changes to groundwater quality. A qualitative assessment of the impacts is described in the following sections.

4.2.1 Recharge and Evapotranspiration

Increased hardstand and buildings across the site will locally reduce rainfall recharge. Based on information provided in the Masterplan (Warren Lee Urban Design, 2010), the approximate decrease in available rainfall recharge area for the site has been assessed and compared with the potential decrease in evapotranspiration rates due to clearing of vegetation.

Table 8 identifies potential changes in recharge and evapotranspiration rates. The total decrease in recharge area was assessed assuming that the total area to be developed will no longer be available for rainfall infiltration into the groundwater system.

Clearing of approximately 27 hectares of vegetation (as detailed by Eco Logical Australia, 2010) will decrease evapotranspiration rates in the local area and therefore groundwater levels may rise. The changes in groundwater levels due to the balance between recharge and evapotranspiration will depend on the evapotranspiration rate of local vegetation. With the exception of the inundated saltmarsh area within Ash Pond 2, groundwater levels measured at the site vary from 0.7 m below the ground surface (at MW10) to 6.6 m below the ground surface (at MW06). Evapotranspiration is expected to be largely associated with transpiration from trees.

The areas to be cleared of trees and included in the evapotranspiration assessment are illustrated on Figure 7. The main area to be cleared is approximately 20 hectares in size and is planted swamp oak and weeds within Ash Pond 2. A smaller area of approximately 2 hectares will be cleared on the north eastern boundary of Ash Pond 3.

There is no available information on quantification of evapotranspiration by vegetation on site. As a preliminary assessment of possible evapotranspiration rates the following assumptions were adopted:

- An average water requirement for a tree with a canopy area of 20m² is 100L/day;
- This equates to an amount of 5L per m² per day.

Table 8: Potential Changes in Recharge and Evapotranspiration Rates

	Northern Precinct	Central Precinct	Southern Precinct
Total area (ha)	110	210	215
Developed area (ha)	22	95	51
Decreased recharge (ML/year) (assumes whole developed area)	24	105	56
Cleared vegetation – trees (ha)	NA	20 (Ash Pond 2)	2 (Ash Pond 3)
Decreased evapotranspiration (ML/year)	NA	360	36
Decreased recharge (ML/year) (ash ponds separately)	NA	39 (Ash Pond 2)	56 (Ash Pond 3)

Table 8 shows that there may be a net increase in groundwater levels within the Ash Pond 2 area and a potential decrease in groundwater level within the Ash Pond 3 area. The amount of change will depend on rainfall recharge rates, evapotranspiration rates, and for Ash Pond 3, the amount of recharge infiltrating from the lake to the groundwater system.

Groundwater monitoring during construction and operation will provide information on the response of the groundwater system to these changes and a contingency plan developed to respond to development of adverse impacts.

4.2.2 Groundwater Quality

The potential impacts and changes to groundwater quality would be related to proposed development within the ash ponds and changes to the surface water regime. Development of an impermeable surface on Ash Pond 2 and Ash Pond 3 will result in less rainfall infiltration through the ash material and will also act to minimise the conduit effect of previous boreholes drilled within the ash ponds. This is considered as a benefit as less groundwater flow from the ash ponds may result. To quantify such changes in groundwater flow numerical groundwater simulation would be required.

Construction of service trenches and ongoing use and maintenance of services as part of the development has the potential to create preferential pathways for groundwater discharge from the ash ponds if the trenches are at an elevation below the groundwater level. Minimising construction of trenches through ash pond bund walls and engineering controls if necessary would mitigate the risk of groundwater migration.

The development has the potential to impact groundwater quality through changes in the surface water regime such as stormwater discharge. Surface water management specifies a set quantity of water to maintain the aquatic habitat in the lake within Ash Pond 3. The proposed Water Sensitive Urban Design (WSUD) measures (outlined in the drainage assessment by BMT WBM, 2010) ensures controls are in place prior to discharge to groundwater or surface water bodies (especially the lake in Ash Pond 3). Controls include stormwater treatment, biofiltration ponds, bunding and sediment controls.

5 CONCLUSIONS

The objective of this assessment by Coffey was to gain a preliminary understanding of the hydrogeological conditions in the areas of the ash ponds, including:

- Assessing groundwater flow directions and likely preferential pathways in the vicinity of the ash ponds;
- Assessing potential groundwater volumes flowing from the ash ponds; and
- A qualitative assessment of potential impacts to groundwater levels as a result of the proposed development.

Based on the results of the preliminary hydrogeological assessment, the following conclusions are made:

- Groundwater flow south of Duck Creek is to the north east towards Duck Creek, to the east towards Lake Illawarra and to the south east towards Macquarie Rivulet. Groundwater flow north of Duck Creek is radial from the elevated Ash Pond 1 and 2 area, towards Duck Creek and Lake Illawarra.
- Groundwater flow from the ash ponds to the surrounding environment is assessed as being predominantly vertical flow through the base of the ponds rather than horizontal flow through the bund walls.
- Vertical hydraulic conductivity values were assessed as similar for the ash material (0.0007 m/day) and alluvial/estuarine sediment (0.0009 m/day).
- The potential volumes of groundwater flowing from the ash ponds were assessed as a total flow of 328 ML/year. In the long term the maximum seepage rate would be limited by the rate of rainfall recharge to the ash.
- During construction excavation it will be important not to create preferential pathways for the groundwater to discharge directly to receptors such as Duck Creek and Lake Illawarra. Mitigation measures would include limiting excavation in ash pond bund walls, and if excavation is to take place, engineering controls such as sheet piles to provide a barrier to groundwater flow.
- Increased hardstand and buildings across the site will locally reduce rainfall recharge.
- Clearing of approximately 27 hectares of vegetation will decrease evapotranspiration rates in the local area and therefore groundwater levels may rise.
- There may be a net increase in groundwater levels within the Ash Pond 2 area due to clearing of trees and a potential decrease in groundwater level within the Ash Pond 3 area due to impermeable surfaces. The amount of change will depend on rainfall recharge rates, evapotranspiration rates, and for Ash Pond 3, the amount of recharge infiltrating from the lake to the groundwater system.
- Development of an impermeable surface on Ash Pond 2 and Ash Pond 3 will result in less rainfall infiltration through the ash material and will also act to minimise the conduit effect of previous boreholes drilled within the ash ponds. This is considered as a benefit as less groundwater flow from the ash ponds may result. To quantify such changes in groundwater flow numerical groundwater simulation would be required.

6 RECOMMENDATIONS

Based on the outcomes of the preliminary hydrogeological assessment, the following recommendations are made:

- Short term dewatering licence requirements will need to be considered and consultation with the NSW Office of Water is recommended.
- It is recommended that groundwater inflow and drawdown are monitored during construction activities and dewatering pumping options revised accordingly as necessary.
- The proposed sewer pump station excavation within Ash Pond 3 may require further specific ASS assessment. Groundwater drawdown is assessed as being a maximum of 4m at the excavation. It is recommended that monitoring bores be established in the vicinity of this excavation and the excavations for the other two pump stations, to monitor groundwater levels during construction and a contingency plan developed to respond to development of adverse impacts. The use of sheet piling for excavations for the pump stations should be considered if drawdown is excessive.
- If a more detailed and quantitative hydrogeological assessment is required assessing the changes in groundwater levels as a result of changes in recharge and evapotranspiration rates, numerical groundwater modelling would be recommended. Such an assessment would also require additional collection of groundwater field data for model calibration such as logging of groundwater levels for at least a period of a few months to assess the response of groundwater levels to rainfall recharge and seasonal variations and field assessment of hydraulic conductivity (targeting the ash ponds). This would require pump testing and installation of additional monitoring wells.

7 LIMITATIONS

The findings contained in this report are the result of discrete/specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition at the areas of the site assessed at the time the investigations were carried out.

Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

This report should be read in conjunction with the attached sheet entitled 'Important Information About Your Coffey Environmental Report'

8 REFERENCES

- Bewsher Consulting Pty Ltd (2010) Tallawarra Lands Flood Risk Assessment (Ref: J1898R_1, dated 27 October 2010).
- BMT WBM Pty Ltd (2010) Tallawarra Lands Concept Plan Drainage Assessment (Ref: RN1854.001.01, dated 7 October 2010).
- Coffey Environments Pty Ltd (2010a) Geotechnical, Contamination and Groundwater Investigation - Tallawarra Lands, Yallah, NSW (Ref: ENVIWOLL00250AB-R04, dated 19 August 2010).
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- Yeheyis (2008) Evaluation of Coal Fly Ash for Use in Mine Waste Management. University of Western Ontario.

Important information about your **Coffey** Environmental Report

Uncertainties as to what lies below the ground on potentially contaminated sites can lead to remediation costs blow outs, reduction in the value of the land and to delays in the redevelopment of land. These uncertainties are an inherent part of dealing with land contamination. The following notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report has been written for a specific purpose

Your report has been developed on the basis of a specific purpose as understood by Coffey and applies only to the site or area investigated. For example, the purpose of your report may be:

- To assess the environmental effects of an on-going operation.
- To provide due diligence on behalf of a property vendor.
- To provide due diligence on behalf of a property purchaser.
- To provide information related to redevelopment of the site due to a proposed change in use, for example, industrial use to a residential use.
- To assess the existing baseline environmental, and sometimes geological and hydrological conditions or constraints of a site prior to an activity which may alter the sites environmental, geological or hydrological condition.

For each purpose, a specific approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible, quantify risks that both recognised and unrecognised contamination pose to the proposed activity. Such risks may be both financial (for example, clean up costs or limitations to the site use) and physical (for example, potential health risks to users of the site or the general public).

Scope of Investigations

The work was conducted, and the report has been prepared, in response to specific instructions from the client to whom this report is addressed, within practical time and budgetary constraints, and in reliance on certain data and information made available to Coffey. The analyses, evaluations, opinions and conclusions presented in this report are based on those instructions, requirements, data or information, and they could change if such instructions etc. are in fact inaccurate or incomplete.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man and may change with time. For example, groundwater levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project and/or on the property.

Interpretation of factual data

Environmental site assessments identify actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from indirect field measurements and sometimes other reports on the site are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how well qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of Coffey through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other problems encountered on site.

Important information about your **Coffey** Environmental Report

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered with redevelopment or on-going use of the site. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. In particular, a due diligence report for a property vendor may not be suitable for satisfying the needs of a purchaser. Your report should not be applied for any purpose other than that originally specified at the time the report was issued.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other professionals who are affected by the report. Have Coffey explain the report implications to professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel), field testing and laboratory evaluation of field samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Contact Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to land development and land use. It is common that not all approaches will be necessarily dealt with in your environmental site assessment report due to concepts proposed at that time. As a project progresses through planning and design toward construction and/or maintenance, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

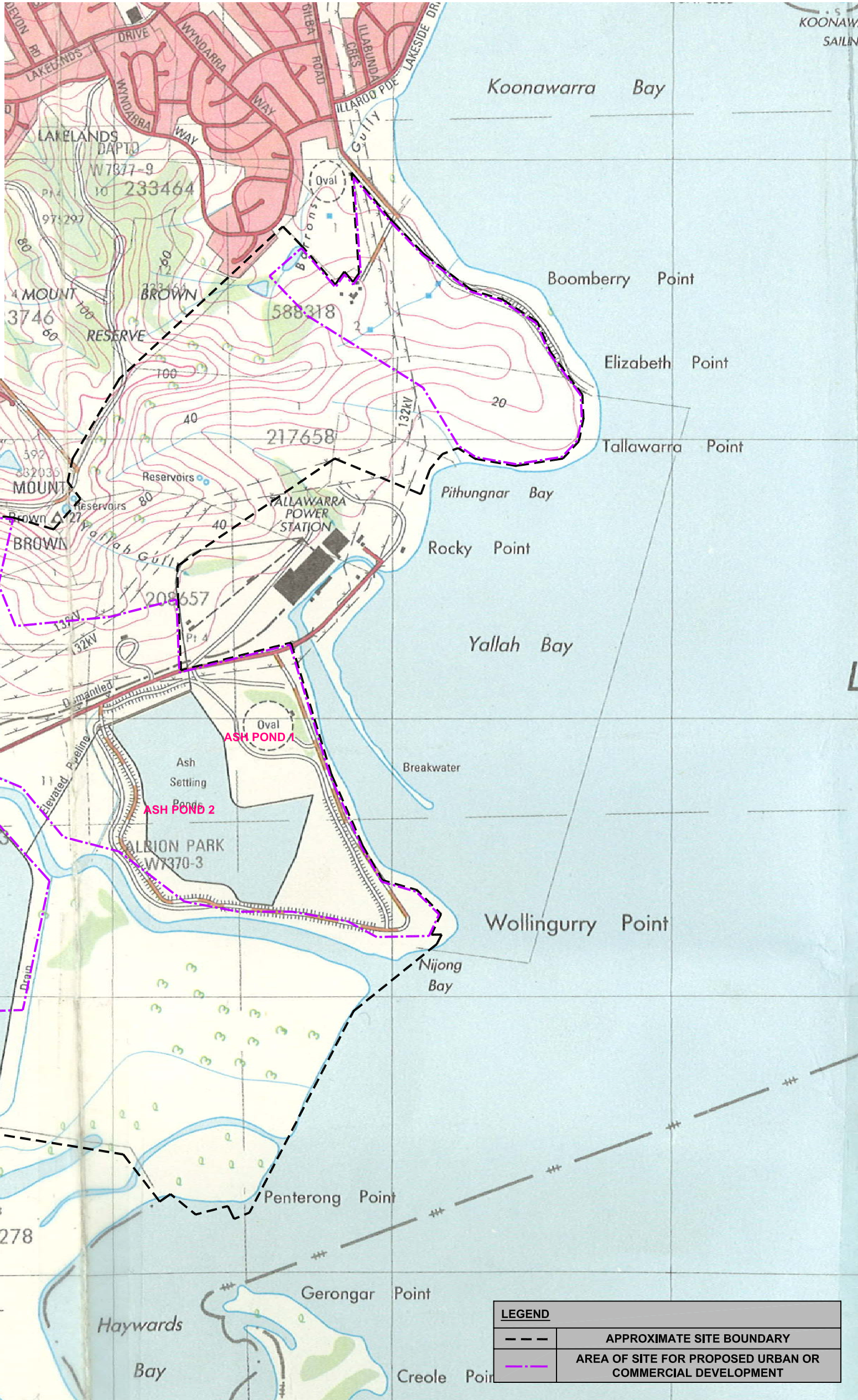
Responsibility

Environmental reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

Figures

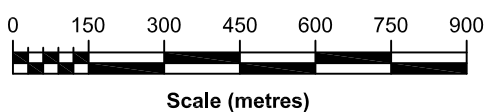


REGIONAL MAP (1:500,000)



LEGEND	
---	APPROXIMATE SITE BOUNDARY
---	AREA OF SITE FOR PROPOSED URBAN OR COMMERCIAL DEVELOPMENT

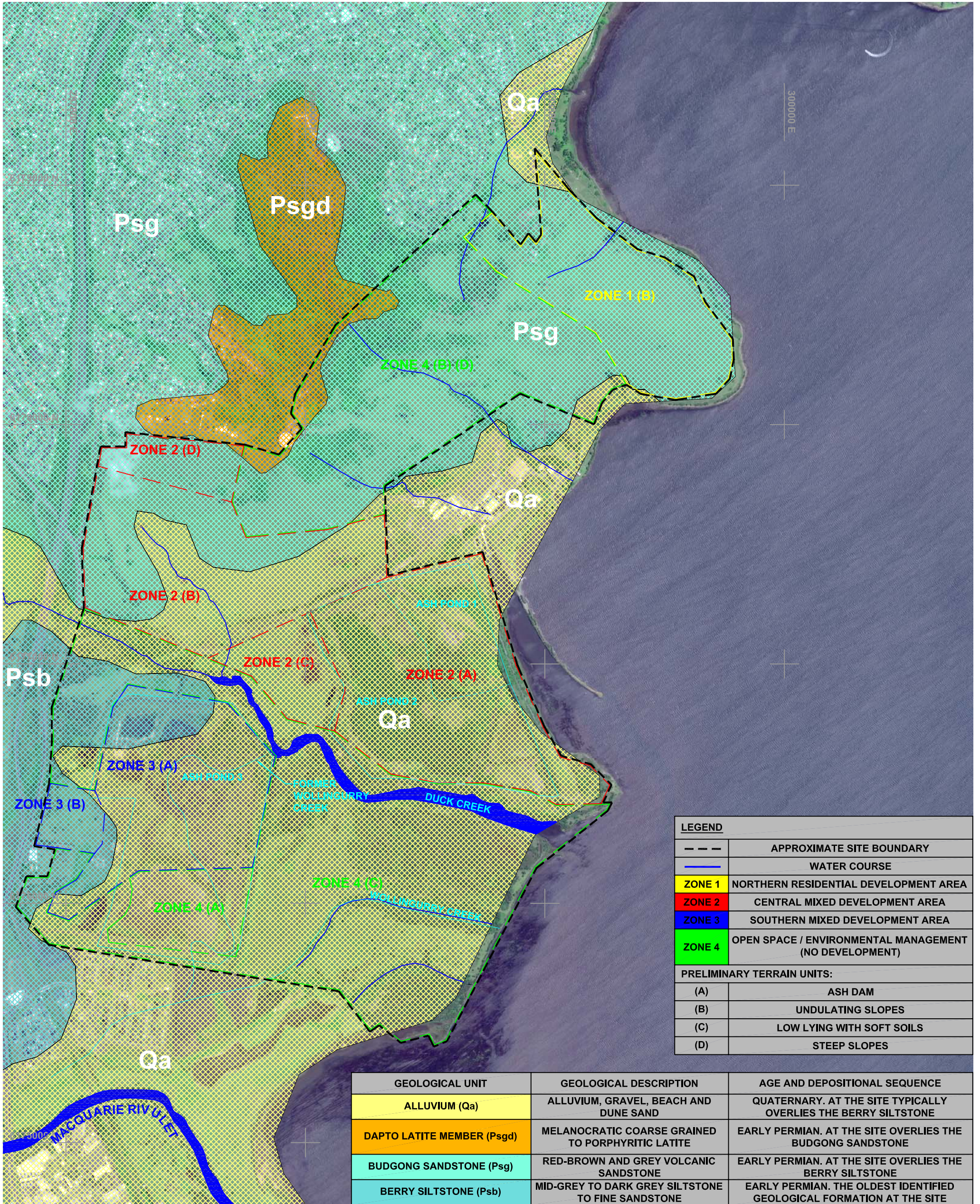
TOPOGRAPHIC IMAGE SOURCE: ALBION PARK 9028-1-N TOPOGRAPHIC MAP 1:25,000 2nd Ed, CENTRAL MAPPING AUTHORITY OF NSW, 1986
 AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 2010
 AERIAL IMAGE ©: DIGITAL GLOBE 2010



drawn	CDC/AW
approved	PT
date	23/11/10
scale	1:15 000
original size	A3



client:	TRUENERGY
project:	PRELIMINARY HYDROGEOLOGICAL ASSESSMENT - ASH PONDS TALLOWARRA LANDS, YALLAH, NSW
title:	SITE LOCALITY PLAN
project no:	ENAUWOLL04009AC
figure no:	FIGURE 1



LEGEND	
---	APPROXIMATE SITE BOUNDARY
—	WATER COURSE
ZONE 1	NORTHERN RESIDENTIAL DEVELOPMENT AREA
ZONE 2	CENTRAL MIXED DEVELOPMENT AREA
ZONE 3	SOUTHERN MIXED DEVELOPMENT AREA
ZONE 4	OPEN SPACE / ENVIRONMENTAL MANAGEMENT (NO DEVELOPMENT)
PRELIMINARY TERRAIN UNITS:	
(A)	ASH DAM
(B)	UNDULATING SLOPES
(C)	LOW LYING WITH SOFT SOILS
(D)	STEEP SLOPES

GEOLOGICAL UNIT	GEOLOGICAL DESCRIPTION	AGE AND DEPOSITIONAL SEQUENCE
ALLUVIUM (Qa)	ALLUVIUM, GRAVEL, BEACH AND DUNE SAND	QUATERNARY. AT THE SITE TYPICALLY OVERLIES THE BERRY SILTSTONE
DAPTO LATITE MEMBER (Psgd)	MELANOCRATIC COARSE GRAINED TO PORPHYRITIC LATITE	EARLY PERMIAN. AT THE SITE OVERLIES THE BUDGONG SANDSTONE
BUDGONG SANDSTONE (Psg)	RED-BROWN AND GREY VOLCANIC SANDSTONE	EARLY PERMIAN. AT THE SITE OVERLIES THE BERRY SILTSTONE
BERRY SILTSTONE (Psb)	MID-GRAY TO DARK GREY SILTSTONE TO FINE SANDSTONE	EARLY PERMIAN. THE OLDEST IDENTIFIED GEOLOGICAL FORMATION AT THE SITE

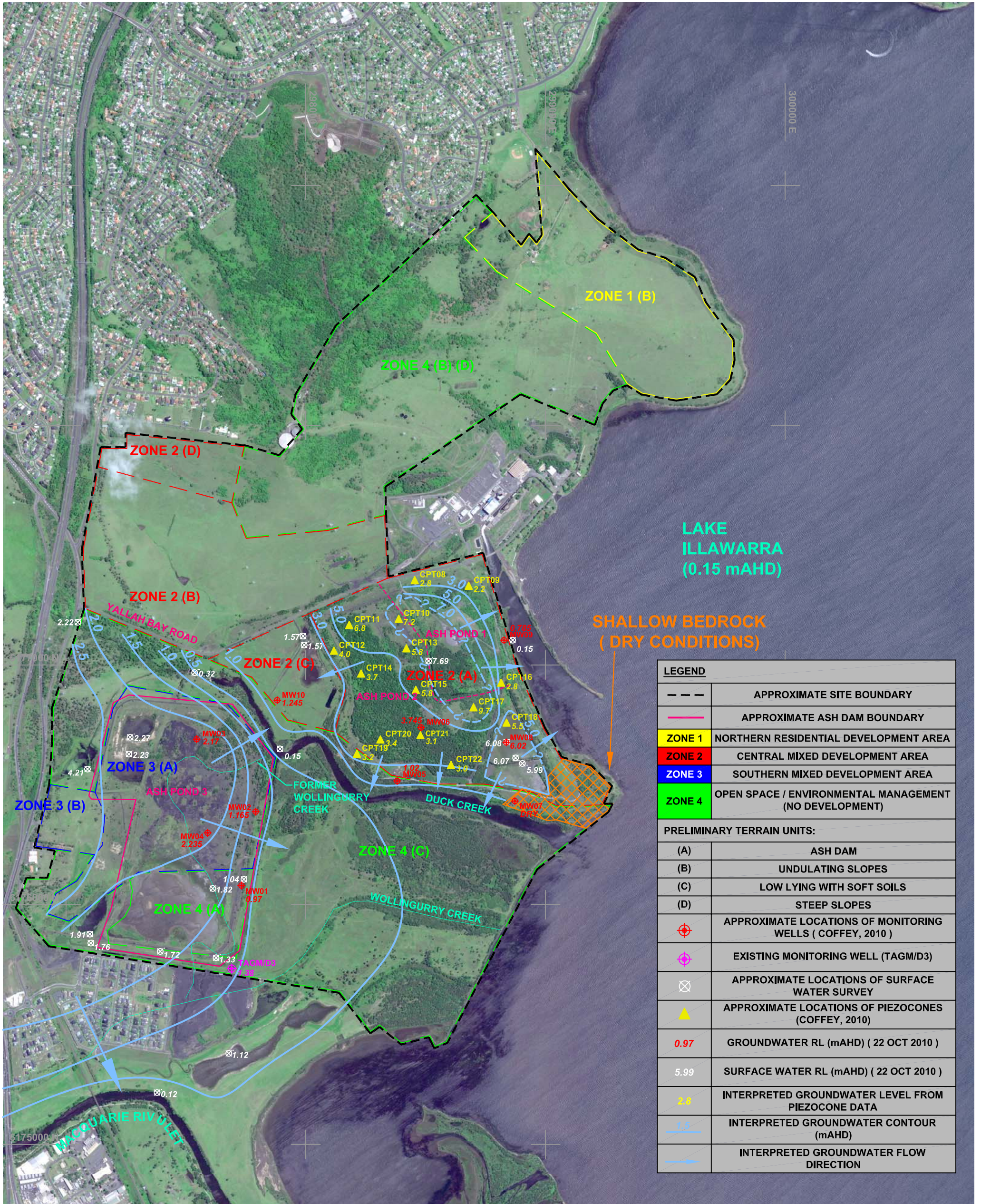
AERIAL IMAGE SOURCE: WOLLONGONG CITY COUNCIL 2010
 GEOLOGICAL MAP: 1:50,000 KIAMA GEOLOGICAL SERIES SHEET (9028-1, 1st EDITION) PREPARED BY THE NSW DEPARTMENT OF MINES (1974) FOR GEOLOGICAL SURVEY OF NSW



drawn	CDC / MH
approved	PT
date	23/11/10
scale	1:15 000
original size	A3

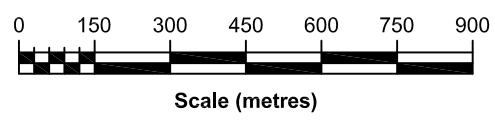


client:	TRUENERGY
project:	PRELIMINARY HYDROGEOLOGICAL ASSESSMENT - ASH PONDS TALLAWARRA LANDS, YALLAH, NSW
title:	SITE LAYOUT PLAN SHOWING GEOLOGY MAP
project no:	ENAUWOLL04009AC
figure no:	FIGURE 2



LEGEND	
---	APPROXIMATE SITE BOUNDARY
---	APPROXIMATE ASH DAM BOUNDARY
ZONE 1	NORTHERN RESIDENTIAL DEVELOPMENT AREA
ZONE 2	CENTRAL MIXED DEVELOPMENT AREA
ZONE 3	SOUTHERN MIXED DEVELOPMENT AREA
ZONE 4	OPEN SPACE / ENVIRONMENTAL MANAGEMENT (NO DEVELOPMENT)
PRELIMINARY TERRAIN UNITS:	
(A)	ASH DAM
(B)	UNDULATING SLOPES
(C)	LOW LYING WITH SOFT SOILS
(D)	STEEP SLOPES
⊗	APPROXIMATE LOCATIONS OF MONITORING WELLS (COFFEY, 2010)
⊕	EXISTING MONITORING WELL (TAGM/D3)
⊗	APPROXIMATE LOCATIONS OF SURFACE WATER SURVEY
▲	APPROXIMATE LOCATIONS OF PIEZOCONES (COFFEY, 2010)
0.97	GROUNDWATER RL (mAHD) (22 OCT 2010)
5.99	SURFACE WATER RL (mAHD) (22 OCT 2010)
2.9	INTERPRETED GROUNDWATER LEVEL FROM PIEZOCONES DATA
1.5	INTERPRETED GROUNDWATER CONTOUR (mAHD)
→	INTERPRETED GROUNDWATER FLOW DIRECTION

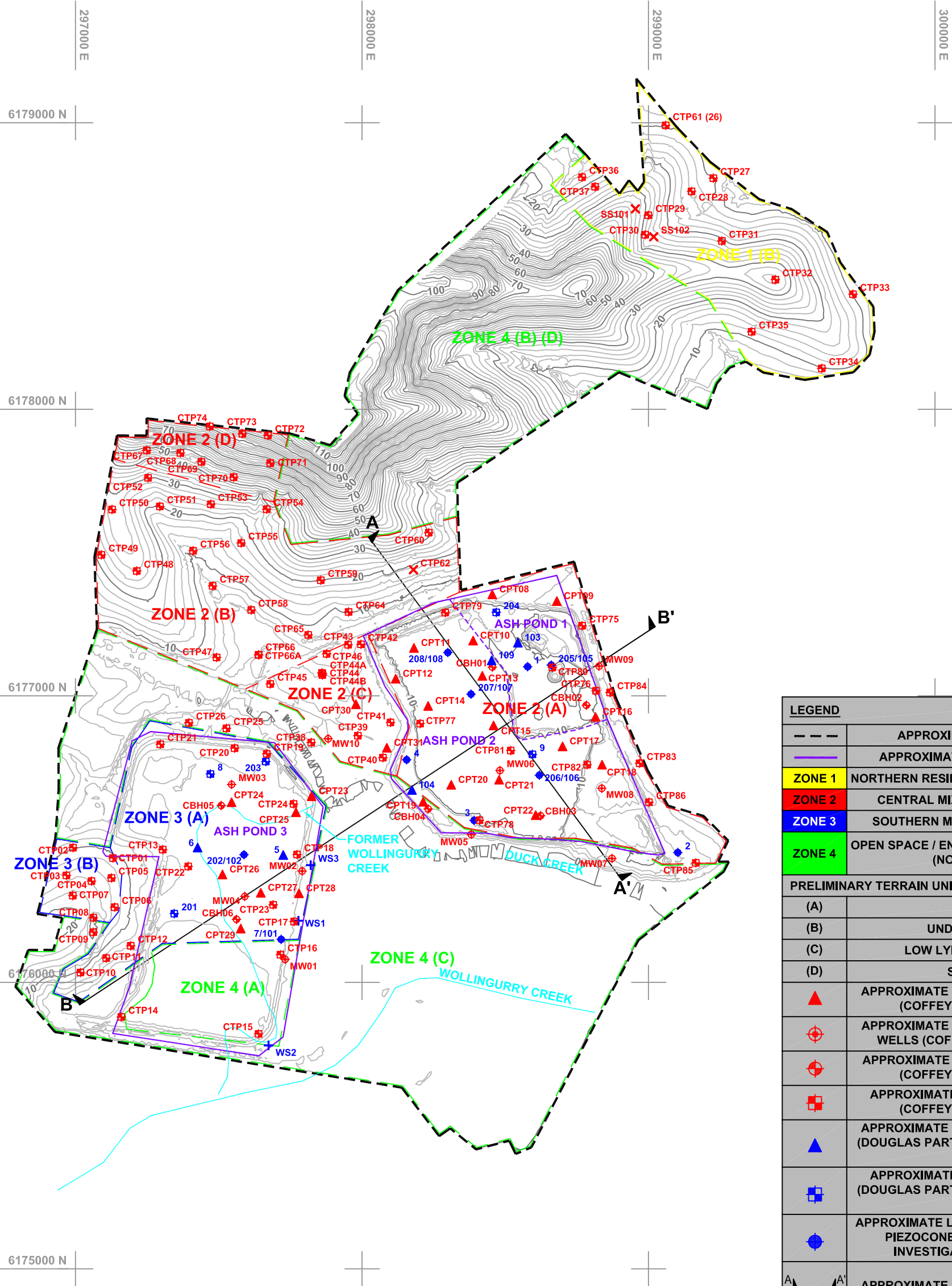
AERIAL IMAGE SOURCE: WOLLONGONG CITY COUNCIL 2010



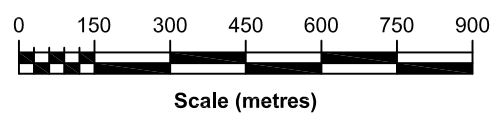
drawn	CDC/AW
approved	PT
date	23/11/10
scale	1:15 000
original size	A3



client:	TRUENERGY
project:	PRELIMINARY HYDROGEOLOGICAL ASSESSMENT - ASH PONDS TALLAWARRA LANDS, YALLAH, NSW
title:	INTERPRETED GROUNDWATER CONTOUR MAP
project no:	ENAUWOLL04009AC
figure no:	FIGURE 3



LEGEND	
---	APPROXIMATE SITE BOUNDARY
---	APPROXIMATE ASH POND BOUNDARY
Yellow	ZONE 1 NORTHERN RESIDENTIAL DEVELOPMENT AREA
Red	ZONE 2 CENTRAL MIXED DEVELOPMENT AREA
Blue	ZONE 3 SOUTHERN MIXED DEVELOPMENT AREA
Green	ZONE 4 OPEN SPACE / ENVIRONMENTAL MANAGEMENT (NO DEVELOPMENT)
PRELIMINARY TERRAIN UNITS:	
(A)	ASH DAM
(B)	UNDULATING SLOPES
(C)	LOW LYING WITH SOFT SOILS
(D)	STEEP SLOPES
▲	APPROXIMATE LOCATIONS OF PIEZOCONES (COFFEY INVESTIGATION, 2010)
⊕	APPROXIMATE LOCATIONS OF MONITORING WELLS (COFFEY INVESTIGATION, 2010)
⊕	APPROXIMATE LOCATIONS OF BOREHOLES (COFFEY INVESTIGATION, 2010)
⊕	APPROXIMATE LOCATIONS OF TEST PITS (COFFEY INVESTIGATION, 2010)
▲	APPROXIMATE LOCATIONS OF PIEZOCONES (DOUGLAS PARTNERS INVESTIGATIONS, 2006 AND 2007)
⊕	APPROXIMATE LOCATIONS OF TEST PITS (DOUGLAS PARTNERS INVESTIGATIONS, 2006 AND 2007)
⊕	APPROXIMATE LOCATIONS OF TEST PITS AND PIEZOCONES (DOUGLAS PARTNERS INVESTIGATIONS, 2006 AND 2007)
A-A'	APPROXIMATE CROSS SECTION LOCATIONS



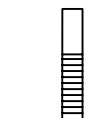




drawn	CDC/AW
approved	PT
date	23/11/10
scale	1:15 000
original size	A3

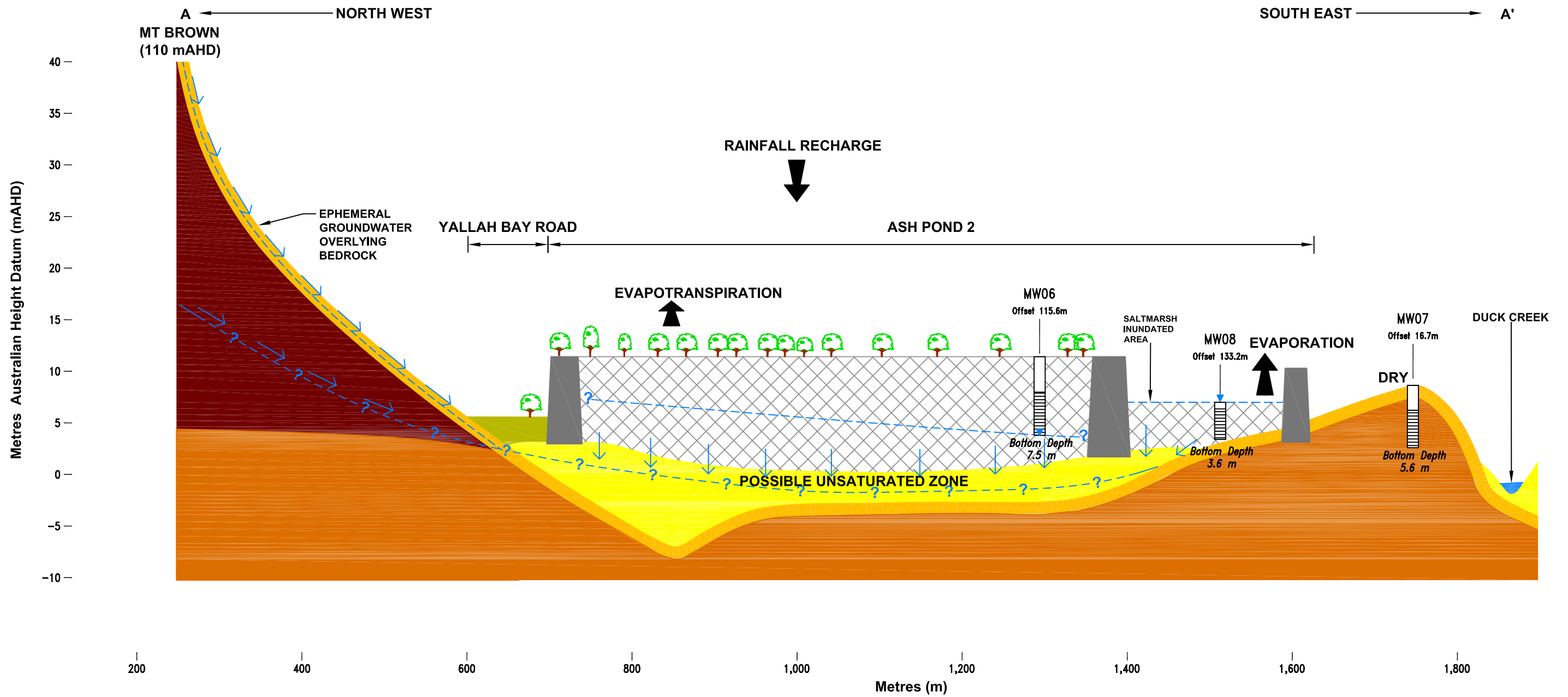


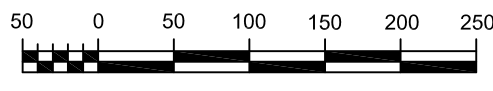
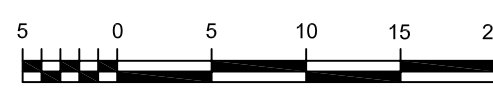

client:	TRUENERGY
project:	PRELIMINARY HYDROGEOLOGICAL ASSESSMENT - ASH PONDS TALLAWARRA LANDS, YALLAH, NSW
title:	SITE LAYOUT PLAN SHOWING APPROXIMATE CROSS SECTION LOCATIONS ON SURVEYED CONTOUR PLAN
project no:	ENAUWOLL04009AC
figure no:	FIGURE 4

LEGEND







-  FILL - ASH
-  FILL - YALLAH BAY ROAD AREA
-  ALLUVIAL / ESTUARINE SEDIMENTS
-  RESIDUAL CLAY
-  BERRY SILTSTONE BEDROCK
-  BUDGONG SANDSTONE BEDROCK
-  FILL - BUND WALL (CLAY / COALWASH)

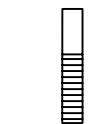




-  MONITORING WELL
-  WELL SCREEN
-  STANDING GROUNDWATER LEVEL
-  INTERPRETED GROUNDWATER LEVEL
-  INTERPRETED GROUNDWATER FLOW DIRECTION

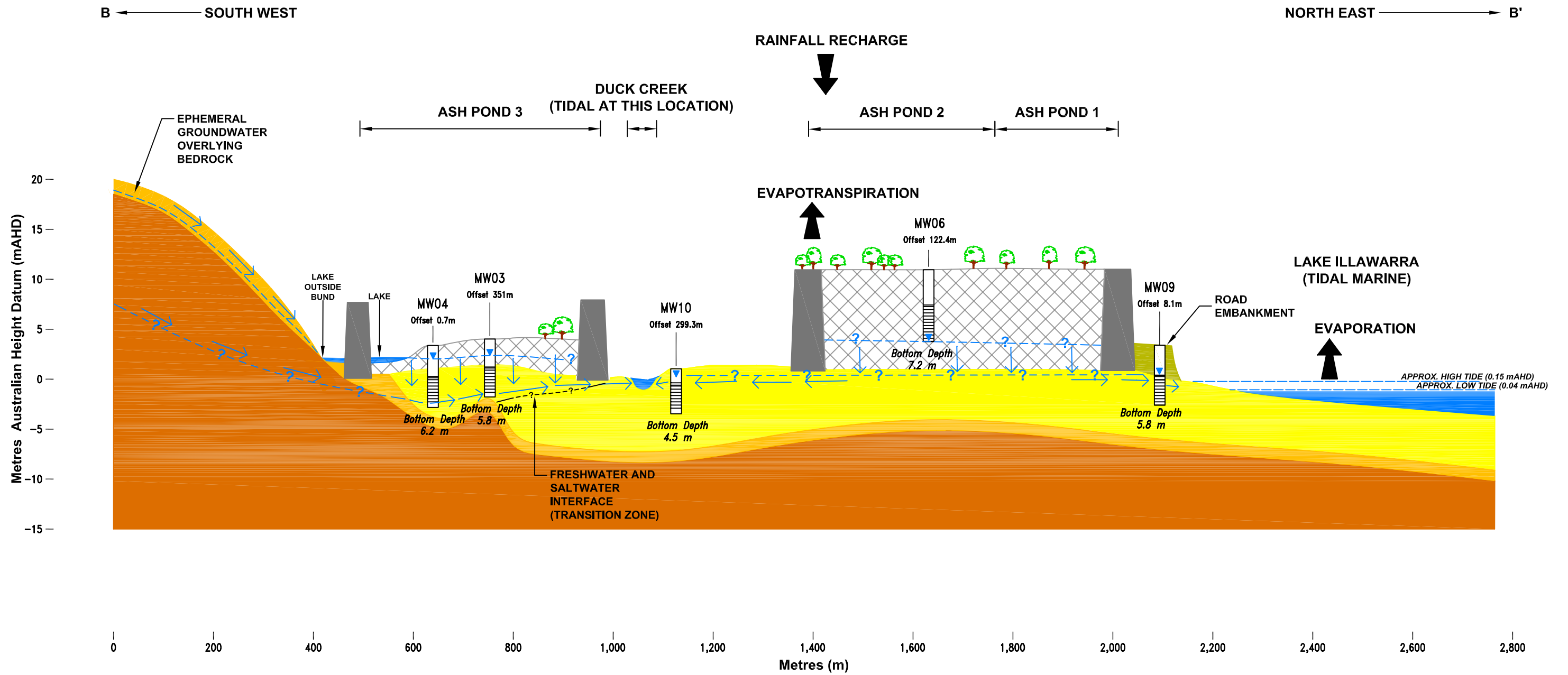


revision		description	drawn	approved	date	 Horizontal Scale (metres)  Vertical Scale (metres)	drawn	CDC/MH	 SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE	client:	TRUENERGY			
											project:	PRELIMINARY HYDROGEOLOGICAL ASSESSMENT - ASH PONDS TALLAWARRA LANDS, YALLAH, NSW		
											scale:	AS SHOWN	title:	HYDROGEOLOGICAL CONCEPTUAL MODEL INTERPRETED GEOLOGICAL CROSS SECTION A-A'
											original size:	A3	project no:	ENAUWOLL04009AC
											approved:	PT	figure no:	FIGURE 5
								date:	23/11/10					

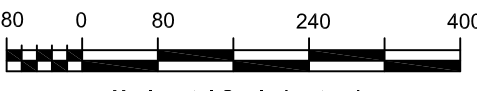
LEGEND

-  FILL - ASH
-  FILL - SILTY SAND / COALWASH
-  ALLUVIAL / ESTUARINE SEDIMENTS
-  RESIDUAL CLAY
-  BERRY SILTSTONE BEDROCK
-  FILL - BUND WALL (CLAY / COALWASH)

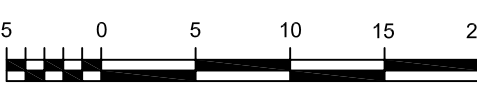
-  MONITORING WELL
-  WELL SCREEN
-  STANDING GROUNDWATER LEVEL
-  INTERPRETED GROUNDWATER LEVEL
-  INTERPRETED GROUNDWATER FLOW DIRECTION



revision	description	drawn	approved	date



Horizontal Scale (metres)



Vertical Scale (metres)


drawn: CDC/MH

approved: PT

date: 23/11/10

scale: AS SHOWN

original size: A3



coffey
environments

SPECIALISTS IN ENVIRONMENTAL,
SOCIAL AND SAFETY PERFORMANCE

client: TRUENERGY

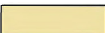


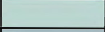
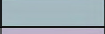


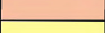

project: PRELIMINARY HYDROGEOLOGICAL ASSESSMENT - ASH PONDS TALLAWARRA LANDS, YALLAH, NSW

title: HYDROGEOLOGICAL CONCEPTUAL MODEL INTERPRETED GEOLOGICAL CROSS SECTION B-B'

project no: ENAUWOLL04009AC

figure no: FIGURE 6

Land uses:

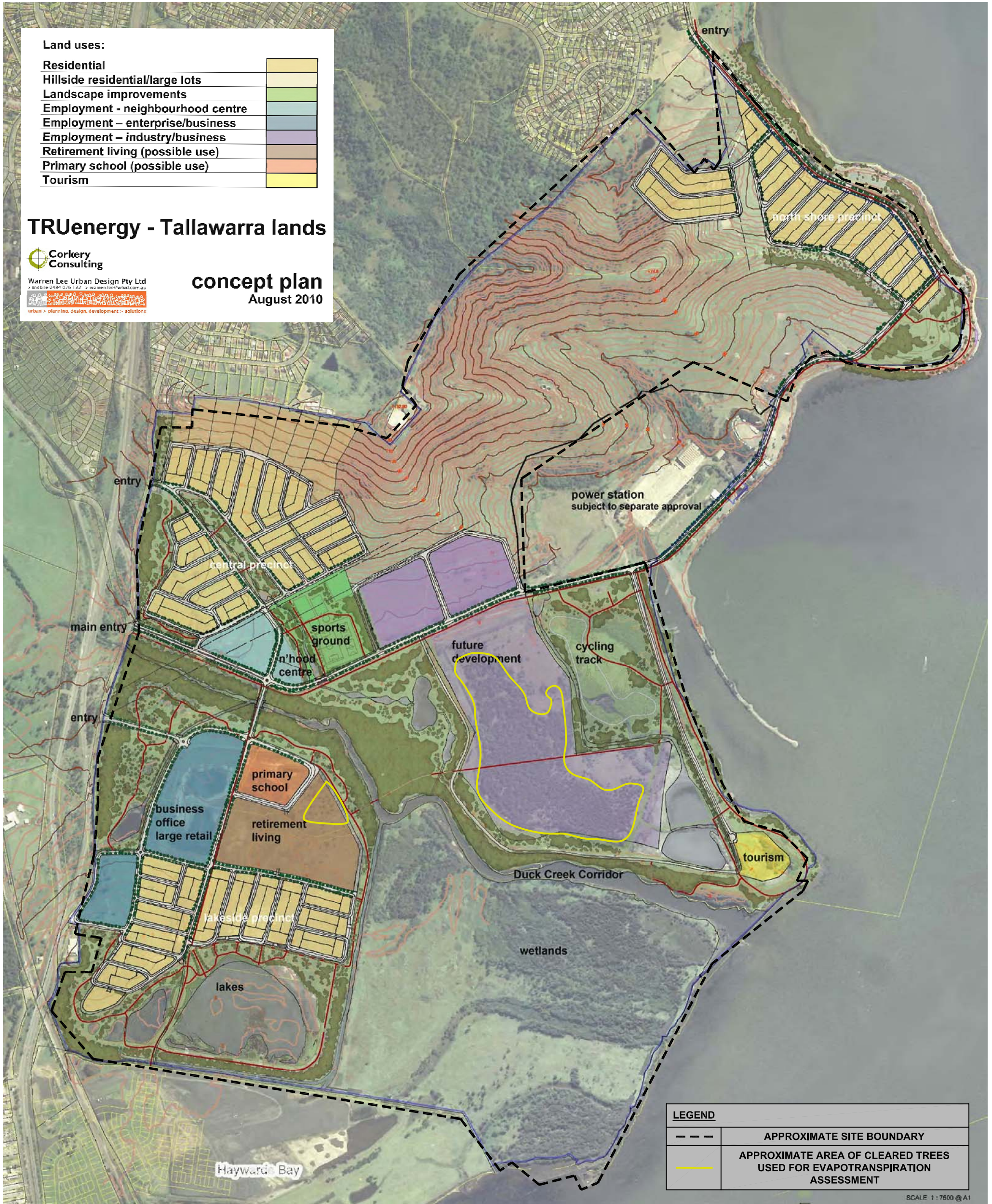
Residential	
Hillside residential/large lots	
Landscape improvements	
Employment - neighbourhood centre	
Employment - enterprise/business	
Employment - industry/business	
Retirement living (possible use)	
Primary school (possible use)	
Tourism	



TRUenergy - Tallawarra lands



Warren Lee Urban Design Pty Ltd
 mobile 0434 076 122 -> warrenlee@wud.com.au
 www.warrenlee.com.au
 urban > planning, design, development > solutions

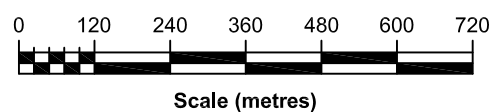
concept plan
 August 2010



LEGEND	
	APPROXIMATE SITE BOUNDARY
	APPROXIMATE AREA OF CLEARED TREES USED FOR EVAPOTRANSPIRATION ASSESSMENT

SCALE 1 : 7500 @ A1

PLAN SOURCE: WARREN LEE URBAN DESIGN PTY LTD, TRUENERGY TALLAWARRA LANDS MASTERPLAN, 17 AUG 2010



drawn	CDC / MH
approved	PT
date	23/11/10
scale	1:12 000
original size	A3



client:	TRUENERGY
project:	PRELIMINARY HYDROGEOLOGICAL ASSESSMENT - ASH PONDS TALLAWARRA LANDS, YALLAH, NSW
title:	PROPOSED DEVELOPMENT - CONCEPT MASTERPLAN 17 AUGUST 2010
project no:	ENAUWOLL04009AC
figure no:	FIGURE 7

Appendix A

Monitoring Well Borelogs

Engineering Log - Piezometer

Client: **TRUenergy**

Date started: **4.3.2010**

Principal:

Date completed: **4.3.2010**

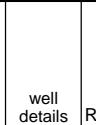






Project: **Geotechnical, Contamination & Groundwater Invest.**





Logged by: **DJD**

Borehole Location: **Zone 4 (a) Tallawarra Lands, Yallah, NSW**

Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 297731.9	slope: -90°	R.L. Surface: 2.82
hole diameter: 150	Northing: 6176080.12	bearing:	datum:

drilling information					material substance						
method	penetration	support	notes samples, tests, etc	well details	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
HOLLOW FLIGHTS	123	N	12.36pm - 25/06/10		1			FILL; Sandy GRAVEL: Fine to coarse grained, black/dark grey (coal and shale), fine to coarse grained sand. ...Becoming Sandy GRAVEL: Medium to coarse grained, fine to coarse grained sand, with a trace of cobbles to to 100mm diameter at 1.0m to 1.9m.	D/M	MD	FILL/COALWASH No odour
					2			...Becoming Sandy GRAVEL: Fine to coarse grained, fine to coarse grained sand at 1.9m to 2.5m.	M/W	MD/D	
					3		SM	Silty SAND: Fine to coarse grained, dark grey/grey.			ALLUVIAL/ESTUARINE? No odour
					4		CL	CLAY: Medium plasticity, dark grey, with some fine to coarse grained sand and silt.	>Wp/>Wl		ALLUVIAL/ESTUARINE? No odour
					5		CL	CLAY: Medium plasticity, grey-brown/grey, with some shells and shell fragments up to 20mm diameter (bivalve shells) and silt.	>Wp	S/F	ESTUARINE No odour
					6					VS/S	
					7			Borehole terminated at 6m			
					8						

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
--	--	---	---	---

Borehole No. **MW 02**

Engineering Log - Piezometer

Sheet 1 of 1
Office Job No.: **ENVIWOLL00250AB**

Client: **TRUenergy**

Date started: **4.3.2010**

Principal:

Date completed: **4.3.2010**

Project: **Geotechnical, Contamination & Groundwater Invest.**

Logged by: **DJD**

Borehole Location: **Zone 3 (a) Tallawarra Lands, Yallah, NSW**

Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 297791.28	slope: -90°	R.L. Surface: 3.05
hole diameter: 150	Northing: 6176388.22	bearing:	datum:

drilling information					material substance						
method	penetration	support	notes samples, tests, etc	well details	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
HOLLOW FLIGHT	1 2 3	N	11.13am-25/06/10		1			FILL; Sandy GRAVEL: Fine to coarse grained, sub-angular, black (coal and shale), fine to coarse grained sand.	M	MD/D	FILL/COALWASH No odour
					2				M/W		
					3		SW	SAND: Fine to coarse grained, brown/grey, with a trace of silt. ...Becoming grey/pale yellow at 3.0m.	M		ALLUVIAL No odour
					4		SM	Silty SAND: Fine to medium grained, grey/pale grey.	W M/W		ALLUVIAL/ESTUARINE? No odour
					5						
					6		CL	CLAY: Medium plasticity, dark grey, with some shell fragments, shells up to 20mm diameter (bivalves) and silt. Borehole terminated at 5.8m	>Wp	S/F	ESTUARINE No odour
					7						
					8						

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Piezometer

Client: **TRUenergy**

Date started: **3.3.2010**

Principal:

Date completed: **3.3.2010**

Project: **Geotechnical, Contamination & Groundwater Invest.**

Logged by: **DJD**

Borehole Location: **Zone 3 (a) Tallawarra Lands, Yallah, NSW**

Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 297545.01	slope: -90°	R.L. Surface: 3.98
hole diameter: 150	Northing: 6176690.48	bearing:	datum:

drilling information				material substance			
method	penetration	support	notes, samples, tests, etc	well details	depth metres	material	structure and additional observations
1 2 3				RL		soil type: plasticity or particle characteristics, colour, secondary and minor components.	
HOLLOW FLIGHT		N			1	FILL; Gravelly SAND: Fine to coarse grained, black, fine to coarse grained sub-angular gravel (coal and shale). FILL; SILT: Low to medium plasticity, pale grey/grey, with a trace of fine grained sand. ...Fill behaving as liquid due to moisture at 0.3m.	FILL/COALWASH FILL/ASH No odour
			8.35am - 25/06/10		2	...Clayey SILT at 1.6m to 2.4m.	
					3	CLAY: Medium plasticity, brown/grey, with a trace of fine grained sand and silt.	ALLUVIAL No odour
					4	CLAY: Medium plasticity, orange/brown, with some fine to medium grained sand and silt.	RESIDUAL No odour
					5	CLAY: Medium plasticity, brown/pale yellow, with a trace of silt.	XW SANDSTONE No odour
					6	CLAY: Medium plasticity, grey/pale green with orange/yellow patches, with a trace of fine to medium grained sand and silt.	XW/HW SANDSTONE No odour
					7	Borehole terminated at 5.8m	MW 03 Terminated at 5.8m on highly weathered sandstone
					8		

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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PIEZOMETER ENVIWOLL00250AB - LOGS.GPJ COFFEY.GDT 20.7.10

Engineering Log - Piezometer

 Client: **TRUenergy**

 Date started: **3.3.2010**

Principal:

 Date completed: **3.3.2010**

 Project: **Geotechnical, Contamination & Groundwater Invest.**

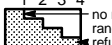



 Logged by: **DJD**

 Borehole Location: **Zone 3 (a) Tallawarra Lands, Yallah, NSW**

 Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 297590.91	slope: -90°	R.L. Surface: 3.33
hole diameter: 150	Northing: 6176299.76	bearing:	datum:

drilling information					material substance						
method	penetration	support	notes samples, tests, etc	well details	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
1 2 3					RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			
HOLLOW FLIGHT		N			3			FILL; Gravelly SAND: Fine to coarse grained, black, fine to coarse grained, sub-angular coal and shale gravel. FILL; Clayey SILT: Low to medium plasticity, pale grey to grey. ...Fill behaving as liquid at 0.25m.	M M/W W/>W	L/MD MD	FILL - COALWASH No odour FILL-ASH No odour
			9.52am - 25/06/10		1						
					2						
					2						
					1		CL	CLAY: Medium plasticity, dark grey/brown, with some silt, with a trace of fine to medium grained sand.	>Wp	S/F	ALLUVIAL/ESTUARINE? No odour
					3		CL	CLAY: Medium plasticity, grey/orange/brown, with some silt, with a trace of fine to medium grained sand.	Wp	F/St	ALLUVIAL No odour
					3		CL/CH	CLAY: Medium to high plasticity, dark grey, with some silt, with some shell fragments (bivalves).	>Wp	VS/S	ESTUARINE No odour
					4						
					4		CL/CH	CLAY: Medium to high plasticity, dark grey, with some silt, with some shell fragments (bivalves).			
					5						
					6						
					6						
					7						
					8						
					-3			Borehole terminated at 6.2m			
					7						
					-4						
					8						

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Piezometer

 Client: **TRUenergy**

 Date started: **5.3.2010**

Principal:

 Date completed: **5.3.2010**

 Project: **Geotechnical, Contamination & Groundwater Invest.**

 Logged by: **DJD**

 Borehole Location: **Zone 2 (a) Tallawarra Lands, Yallah, NSW**

 Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 298381.41	slope: -90°	R.L. Surface: 4.70
hole diameter: 100	Northing: 6176516.39	bearing:	datum:

drilling information				material substance				
method	penetration	support	notes, samples, tests, etc	well details	depth metres	material	structure and additional observations	
1 2 3						soil type: plasticity or particle characteristics, colour, secondary and minor components.		
ADT		N			0	FILL; Silty SAND: Fine to coarse grained, dark grey/grey.	M D/M	FILL/TOPSOIL No odour
					1	FILL; Clayey SILT: Low plasticity, pale grey/grey, with a trace of fine to medium grained sand.	Wp	F/St FILL/ASH No odour
					2	FILL; CLAY: Low to medium plasticity, pale brown/white/pale yellow mottled, with a trace of fine to medium grained sub-angular to sub-rounded gravel and silt.		St/VSt FILL No odour FILL/ALLUVIAL? No odour
					3	FILL; CLAY: Medium to high plasticity, red/brown with pale orange mottling, with a trace of fine to medium grained, sub-rounded gravel, sub-rounded sandstone gravel and silt. (Hard to distinguish as residual or fill due to mixed up cuttings.		
					4	CLAY: Medium plasticity, pale brown/pale yellow mottled, with some fine to medium grained sand, with a trace of fine to medium grained sub-rounded sandstone gravel and silt.		VSt ALLUVIAL No odour
			2.06pm - 24/06/10		5	CLAY: Medium plasticity, pale brown/grey, with a trace of fine to medium grained sand and silt.	>Wp	S ALLUVIAL/ESTUARINE? No odour
					6	CLAY: Medium plasticity, dark grey, with a trace of rootlets, shell fragments and silt.		ESTUARINE Brackish/organic odour
					7	CLAY: Medium plasticity, brown, with some medium to coarse grained sand, fine grained sub-angular gravel and shell fragments, with a trace of silt.	Wp	F
					8	CLAY: Low to medium plasticity, dark grey, with some fine to medium grained sand, with a trace of silt.	>Wp	S/F

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water ▼ 10/1/98 water level on date shown ▲ water inflow ▼ water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Piezometer

 Client: **TRUenergy**

 Date started: **11.6.2010**

Principal:

 Date completed: **11.6.2010**

 Project: **Geotechnical, Contamination & Groundwater Invest.**

 Logged by: **DJD**

 Borehole Location: **Zone 2 (a) Tallawarra Lands, Yallah, NSW**

 Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 298481.42	slope: -90°	R.L. Surface: 10.92
hole diameter: 50	Northing: 6176739.28	bearing:	datum:

drilling information					material substance							
method	penetration	support	water	notes samples, tests, etc	well details	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
	1 2 3					RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			
PUSH TUBE		N				10			FILL; Gravelly SAND: Fine to coarse grained, dark grey/black, fine to medium grained, sub-angular to sub-rounded gravel. FILL; Clayey SILT: Low plasticity, pale grey.	D/M	L/MD	FILL - COALWASH No odour
						1			FILL; SAND: Fine grained, grey, with some silt. FILL; SILT: Low plasticity, pale grey, with a trace of clay.	M	VS/Fb	FILL - ASH No odour
						2			FILL; Clayey SILT: Low plasticity, grey. FILL; SILT: Low plasticity, pale grey, with a trace of clay. FILL; Clayey SILT: Low plasticity, grey.	D/M	St/Fb	
						3			FILL; SAND: Fine grained, grey/dark grey, with some silt. FILL; Clayey SILT: Low plasticity, grey.	D	VL/L	
						4			FILL; SAND: Fine grained, grey/dark grey, with some silt. FILL; Clayey SILT: Low plasticity, grey, with a trace of fine grained sand.	D/M	MD	
						5			...Liquification of soil from 4.4m to 4.5m. FILL; SAND: Fine grained, dark grey, with some silt.	M	VSt-H/Fb	
						6			FILL; Sandy SILT: Low plasticity, grey, fine grained sand, with a trace of clay.	D/M	L/MD	
						7			FILL; SAND: Fine to medium grained, grey, with some silt. FILL; Sandy SILT: Low plasticity, grey/dark grey, fine of medium grained sand. FILL; SAND: Fine to medium grained, grey, with some silt. FILL; Sandy SILT: Low plasticity, grey/dark grey, fine grained sand.	M	St	
						8			Borehole terminated at 7.2m	W	D	

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Piezometer

 Client: **TRUenergy**

 Date started: **5.3.2010**

Principal:

 Date completed: **5.3.2010**

 Project: **Geotechnical, Contamination & Groundwater Invest.**

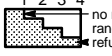



 Logged by: **DJD**

 Borehole Location: **Zone 2 (a) Tallawarra Lands, Yallah, NSW**

 Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 298872.57	slope: -90°	R.L. Surface: 8.51
hole diameter: 100	Northing: 6176432.36	bearing:	datum:

drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	well details	depth metres	material	structure and additional observations
ADT		N			8	FILL; CLAY: Low to medium plasticity, dark brown, with some fine to coarse grained sand and fine to coarse grained sub-rounded gravel (coal and shale) and silt.	FILL No odour
					1	Gravelly SAND: Fine to coarse grained, pale brown/yellow, fine to coarse grained sub-rounded to sub-angular sandstone gravel, with a trace of silt.	RESIDUAL No odour
					2	Gravelly SAND: Fine to coarse grained, pale brown/yellow, fine to coarse grained sub-rounded to sub-angular sandstone gravel, with some low to medium plasticity clay.	XW/HW SANDSTONE No odour
					3	SANDSTONE: Fine grained, pale brown/pale yellow.	HW SANDSTONE (BERRY SILTSTONE) No odour
					4	...Becoming pale brown/pale grey at 2.3m.	
					5	...Becoming pale grey/white at 3.85m.	
					6	...Becoming brown/grey at 5.0m.	
					6	Borehole terminated at 6m	

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Piezometer

 Client: **TRUenergy**

 Date started: **10.3.2010**

Principal:

 Date completed: **10.3.2010**

 Project: **Geotechnical, Contamination & Groundwater Invest.**

 Logged by: **DJD**

 Borehole Location: **Zone 2 (a) Tallawarra Lands, Yallah, NSW**

 Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 298836.96	slope: -90°	R.L. Surface: 6.51
hole diameter: 100	Northing: 6176677.11	bearing:	datum:

drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	well details	depth metres	material	structure and additional observations
ADT		N			6 1 5 2 4 3	FILL; Clayey SILT: Low to medium plasticity, pale grey/grey. ...With some fine to medium grained sand ...Becoming Sandy SILT: Low to medium plasticity, pale grey, fine to medium grained sand at 2.5m to 3.5m.	D/M F M D >WI
					3	SANDSTONE: Fine grained, brown/orange/grey. Borehole terminated at 3.6m	M HW SANDSTONE No odour
					4 2 5 1 6 0 7 8		

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water ▼ 10/1/98 water level on date shown ▲ water inflow ▼ water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Piezometer

 Client: **TRUenergy**

 Date started: **5.3.2010**

Principal:

 Date completed: **5.3.2010**

 Project: **Geotechnical, Contamination & Groundwater Invest.**

 Logged by: **DJD**

 Borehole Location: **Zone 2 (a) Tallawarra Lands, Yallah, NSW**

 Checked by: **CCQ/SM**

drill model & mounting: GEOPROBE TRACK	Easting: 298827.33	slope: -90°	R.L. Surface: 3.07
hole diameter: 100	Northing: 6177103.43	bearing:	datum:

drilling information					material substance						
method	penetration	support	notes samples, tests, etc	well details	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
ADT	1 2 3	N	12.00pm - 24/06/10		0			FILL; Silty SAND: Fine to coarse grained, dark brown/dark grey, with some fine to coarse grained sub-rounded to sub-angular gravel (coal and sandstone).	M	MD	FILL No odour
					1						
					2			FILL; CLAY: Medium plasticity, black/dark grey, with some fine to medium grained sand, with a trace of rootlets and silt.	>Wp	F	FILL/ALLUVIAL No odour
					3		CL	CLAY: Medium plasticity, red-brown/orange, with some fine to coarse grained sand, with a trace of fine to medium grained sub-rounded sandstone gravel and silt.		F/St	ALLUVIAL/ESTUARINE? Brackish/organic odour
					4		CL	CLAY: Medium plasticity, pale grey/pale brown, with a trace of fine to coarse grained pale brown sand and fine to medium grained sub-rounded sandstone gravel and silt.			
					5		CL	CLAY: Medium plasticity, pale grey, with a trace of fine to coarse grained sand and silt.	Wp	F	
					6		CL	CLAY: Medium plasticity, pale grey/pale yellow mottled, with a trace of fine to coarse grained sand and fine to medium grained sub-rounded gravel (possibly jarosite?) and silt.	>Wp	F/St	
					7		SC	Clayey SAND: Fine to coarse grained, pale grey with some pale yellow mottling, low to medium plasticity clay.	W	L/MD	
					8			Borehole terminated at 6m			

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Piezometer

 Client: **TRUenery Tallawarra**

 Date started: **17.8.2010**

Principal:

 Date completed: **17.8.2010**

 Project: **Further Assessment Of Groundwater Quality - Ash Pond**

 Logged by: **DJD**

 Borehole Location: **Yallah Bay Road, Yallah NSW**

 Checked by: **JMF**

drill model & mounting: Gemco 210B, Trailer	Easting:	slope: -90°	R.L. Surface:	Not Measured
hole diameter: 100	Northing:	bearing:	datum:	Not Measured

drilling information					material substance						
method	penetration	support	notes samples, tests, etc	well details	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
ADV	1 2 3	N						TOPSOIL; CLAY: Medium plasticity, dark brown, with some silt.	Wp	F	TOPSOIL No odour
					0.5		CL	CLAY: Medium plasticity, brown/yellow, with a trace of silt.	W	F/St	ALLUVIAL No odour
			24/08/10				SC	Clayey SAND: Fine to coarse grained, pale brown, medium plasticity clay.		L/MD	
					1.0		CL	CLAY: Medium plasticity, orange/brown, with some silt, with a trace of fine to coarse grained sand.	Wp	F/St	
							GC	Clayey GRAVEL: Fine to medium grained, orange/brown, medium plasticity clay.	W	L/MD	
					1.5		SC	Clayey SAND: Fine to coarse grained, pale grey, medium plasticity clay. ...Becoming orange-clay at 1.65m.	M/W	MD	ALLUVIAL/ESTUARINE Slight organic/brackish odour
					2.0						
					2.5		SC	Clayey SAND: Fine to coarse grained, grey, medium plasticity clay.	W	L/MD	
					3.0		CL	Clayey SAND: Fine to coarse grained, dark grey, medium plasticity clay. Sandy CLAY: Low to medium plasticity, dark grey, fine to coarse grained sand, with a trace of rootlets.	>Wp	S/F	ESTUARINE Organic/brackish odour
					3.5						
					4.0						

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4 no resistance ranging to refusal water ▼ 10/1/98 water level on date shown ▲ water inflow ▼ water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Borehole No. **MW10**

Engineering Log - Piezometer

Sheet 2 of 2
Office Job No.: **ENAUWOLLO4009AB**

Client: **TRUenergy Tallawarra**

Date started: **17.8.2010**

Principal:

Date completed: **17.8.2010**

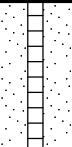

Project: **Further Assessment Of Groundwater Quality - Ash Pond**

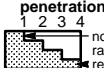



Logged by: **DJD**

Borehole Location: **Yallah Bay Road, Yallah NSW**

Checked by: **JMF**

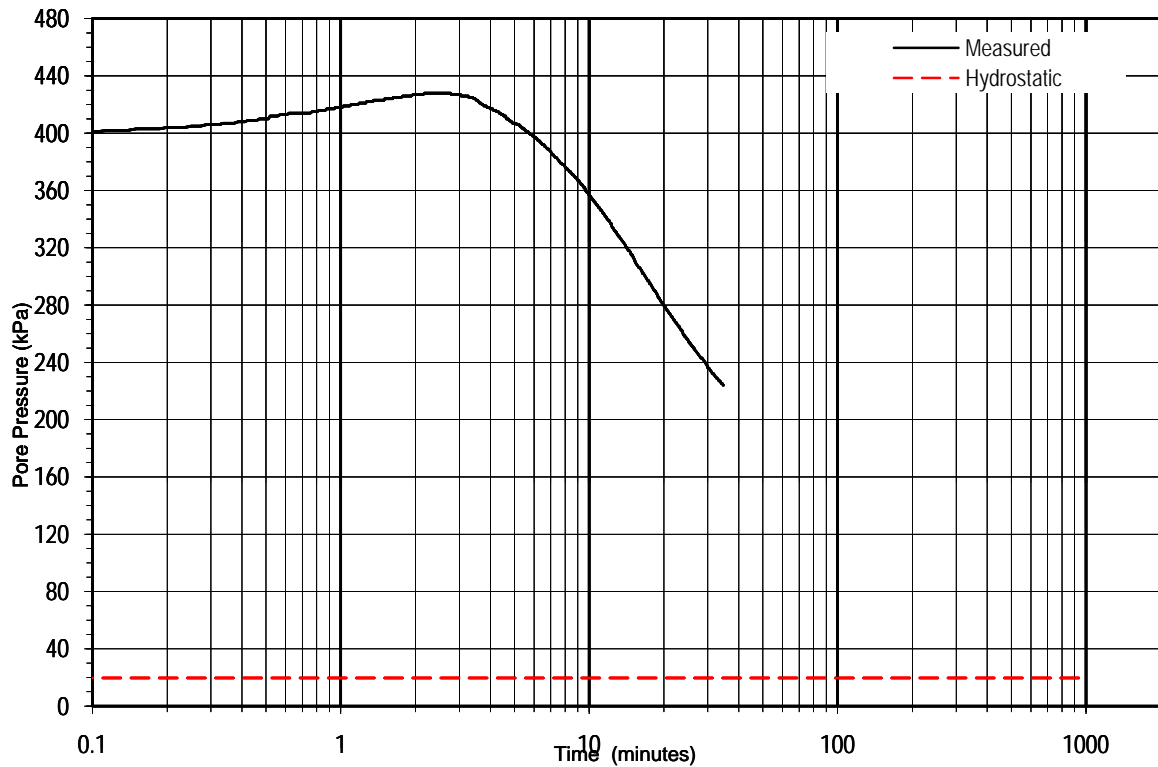
drill model & mounting: Gemco 210B, Trailer	Easting:	slope: -90°	R.L. Surface:	Not Measured
hole diameter: 100	Northing:	bearing:	datum:	Not Measured

drilling information					material substance								
method	penetration	support	water	notes samples, tests, etc	well details	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
ADV	1 2 3	N					4.5		CL	Sandy CLAY: Low to medium plasticity, dark grey, fine to coarse grained sand, with a trace of rootlets. <i>(continued)</i>	>Wp	S/F	
							5.0						
							5.5						
							6.0						
							6.5						
							7.0						
							7.5						
							8.0						
Borehole terminated at 4.5m													

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool DT diatube B blank bit V V bit T TC bit TBX Tubex *bit shown by suffix e.g. ADT	support C casing N nil penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone P pressure meter Bs bulk sample R refusal E environmental sample PID PID measurement WS water sample PZ piezometer ALT air lift test	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Appendix B

Piezocone Dissipation Tests




TEST DATA & INFERRED SOIL PARAMETERS

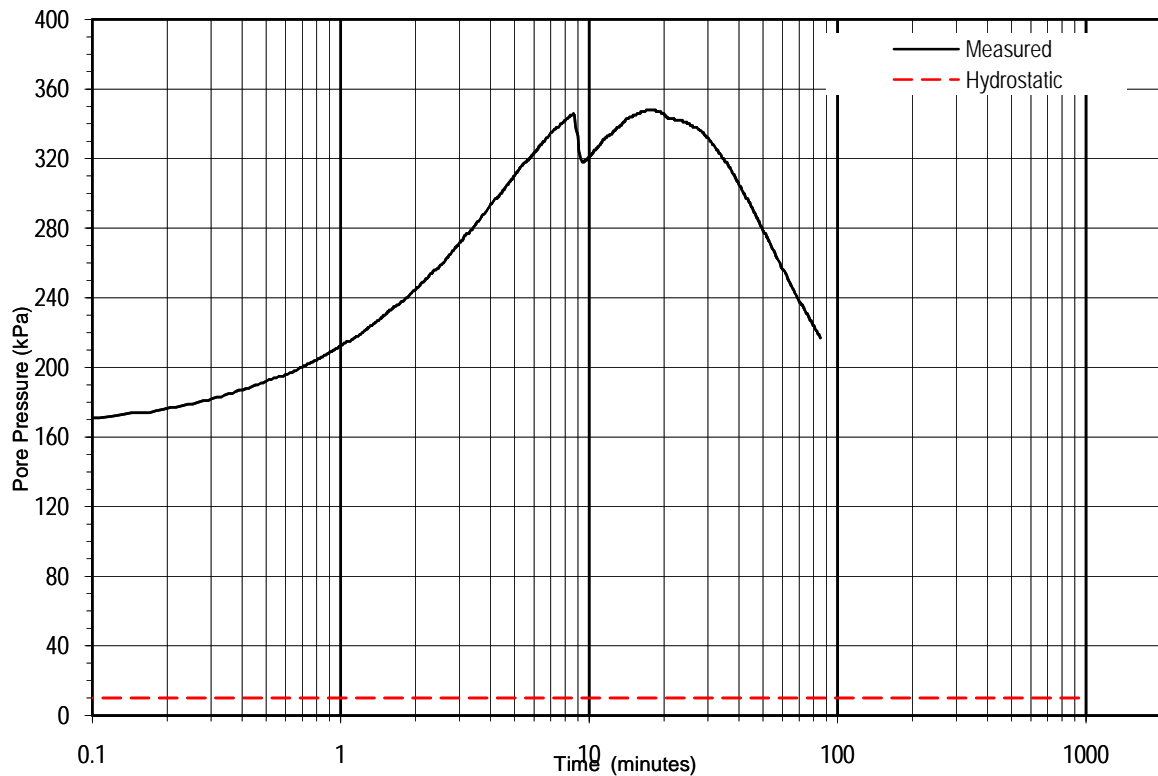
Inferred soil type:

CLAY

Static pore pressure, u_o	20	kPa	(calculated from inferred water level)
Maximum pore pressure, u_i	428	kPa	(measured from test data)
Final pore pressure at end of test	224	kPa	(measured from test data)
Test duration	35	min	(measured from test data)
Time for 50% dissipation of u , t_{50}	35	min	(measured from test data)
Horizontal coefficient of consolidation, c_H	6	$m^2/year$	
	to	8	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.8×10^{-6}	cm/s	
	to	1.1×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_{R2} , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_{R2} , of between 20 and 40, and a modulus of volume change, m_{v2} , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT08 PPDT at 4.00m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



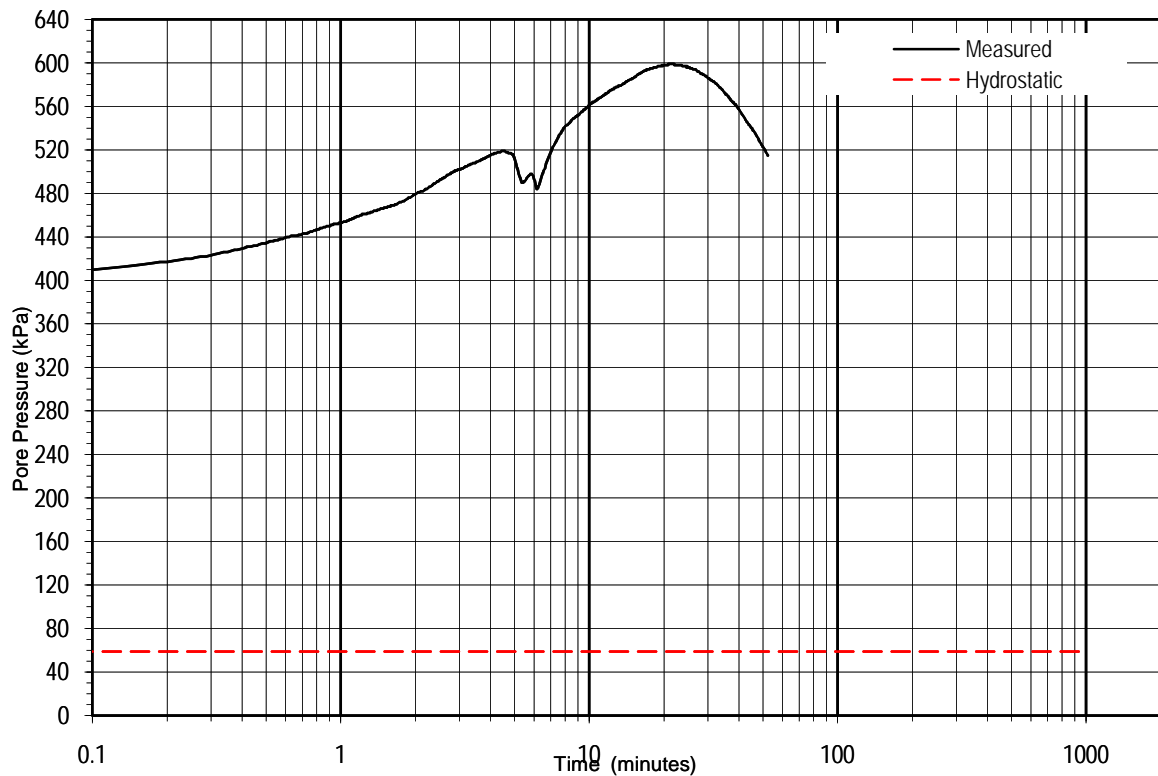
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	10	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	310	kPa	(measured from test data)
Final pore pressure at end of test	217	kPa	(measured from test data)
Test duration	85	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	64	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	3	$m^2/year$	
	to	4	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.4×10^{-6}	cm/s	
	to	0.6×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT09 PPDT at 5.02m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



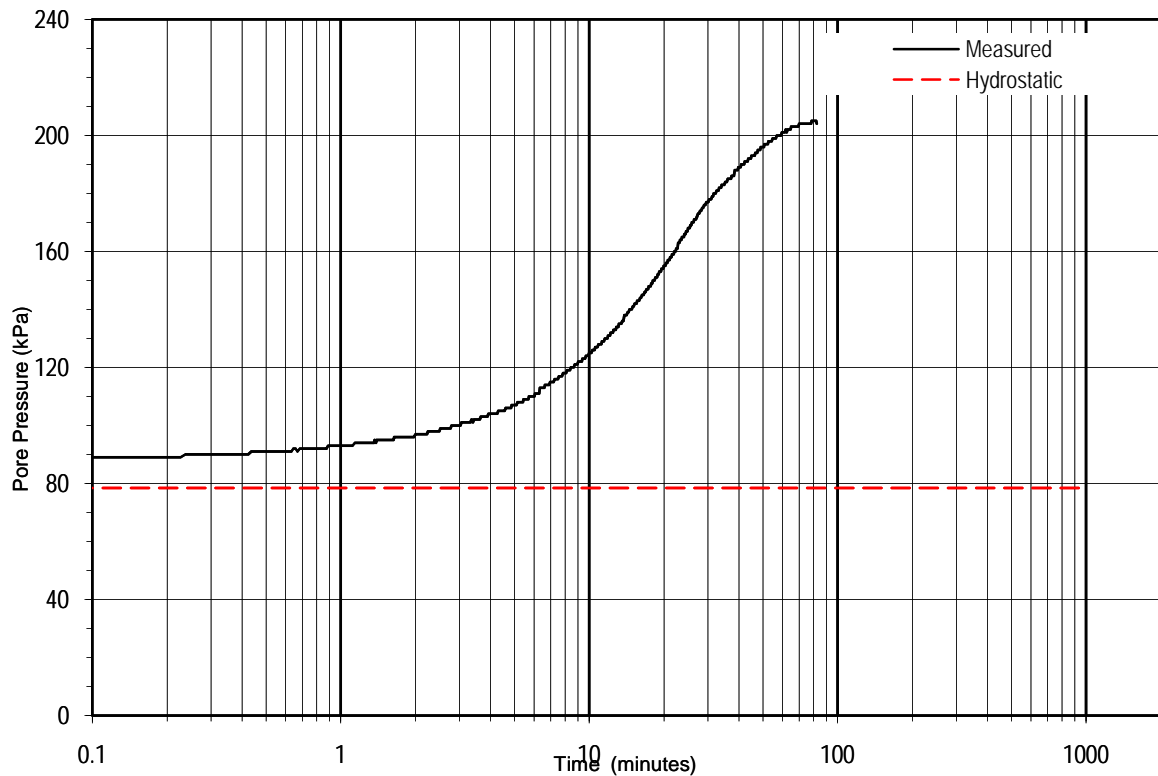
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	59	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	561	kPa	(measured from test data)
Final pore pressure at end of test	515	kPa	(measured from test data)
Test duration	52	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	76	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	3	$m^2/year$	
	to	4	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.3×10^{-6}	cm/s	
	to	0.5×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT09 PPDT at 10.00m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



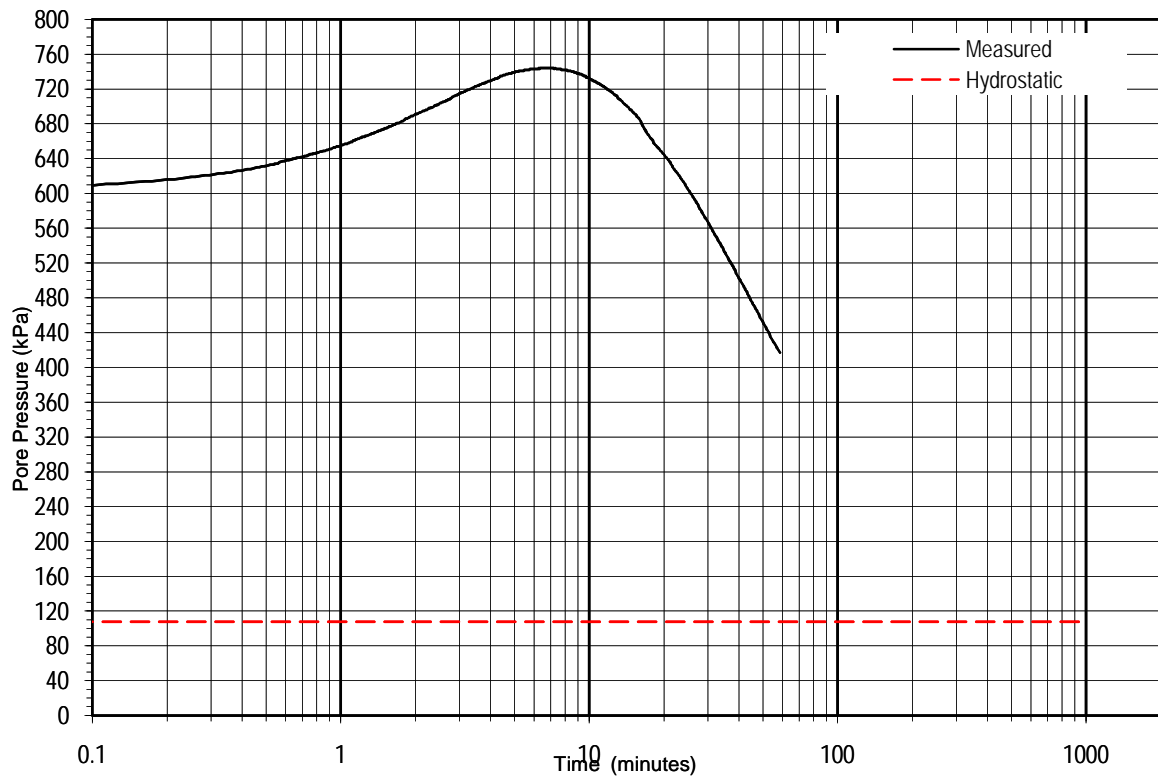
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	78	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	125	kPa	(measured from test data)
Final pore pressure at end of test	204	kPa	(measured from test data)
Test duration	82	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	101	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	2	$m^2/year$	
	to	3	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.3×10^{-6}	cm/s	
	to	0.4×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT10 PPDT at 12m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



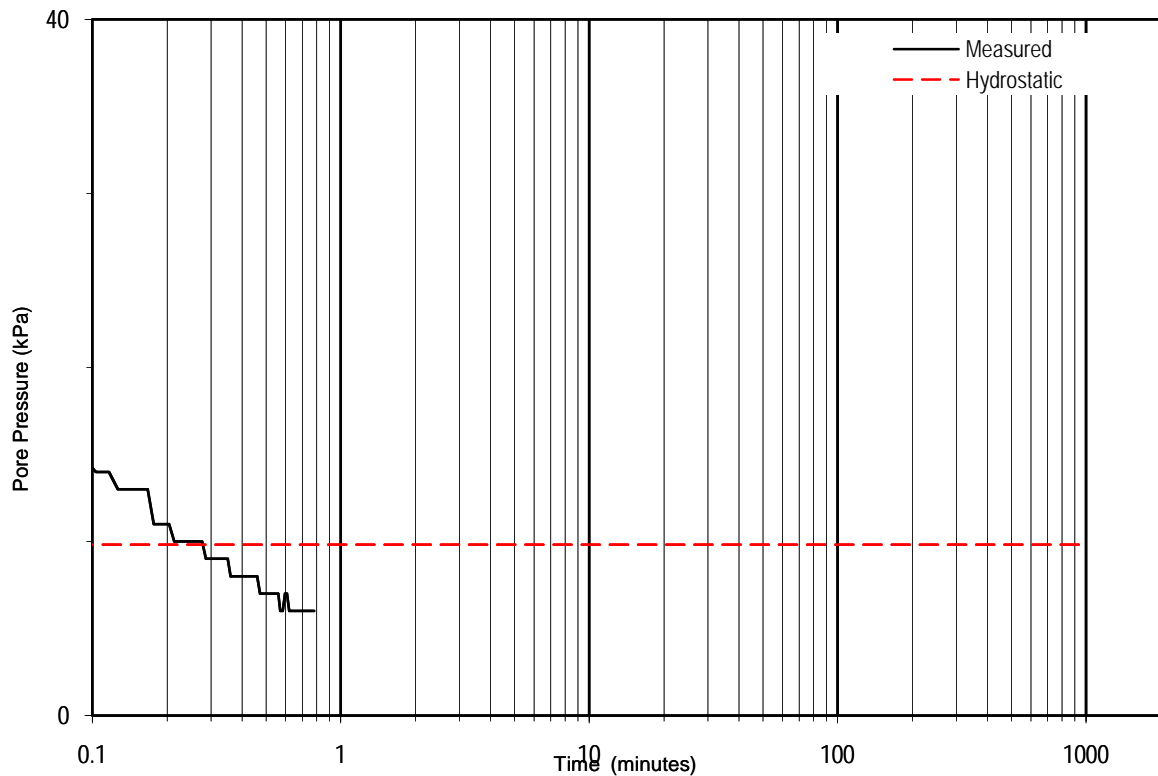
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	108	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	744	kPa	(measured from test data)
Final pore pressure at end of test	417	kPa	(measured from test data)
Test duration	59	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	56	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	4	$m^2/year$	
	to	5	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.5×10^{-6}	cm/s	
	to	0.7×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT10 PPDT at 14.98m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




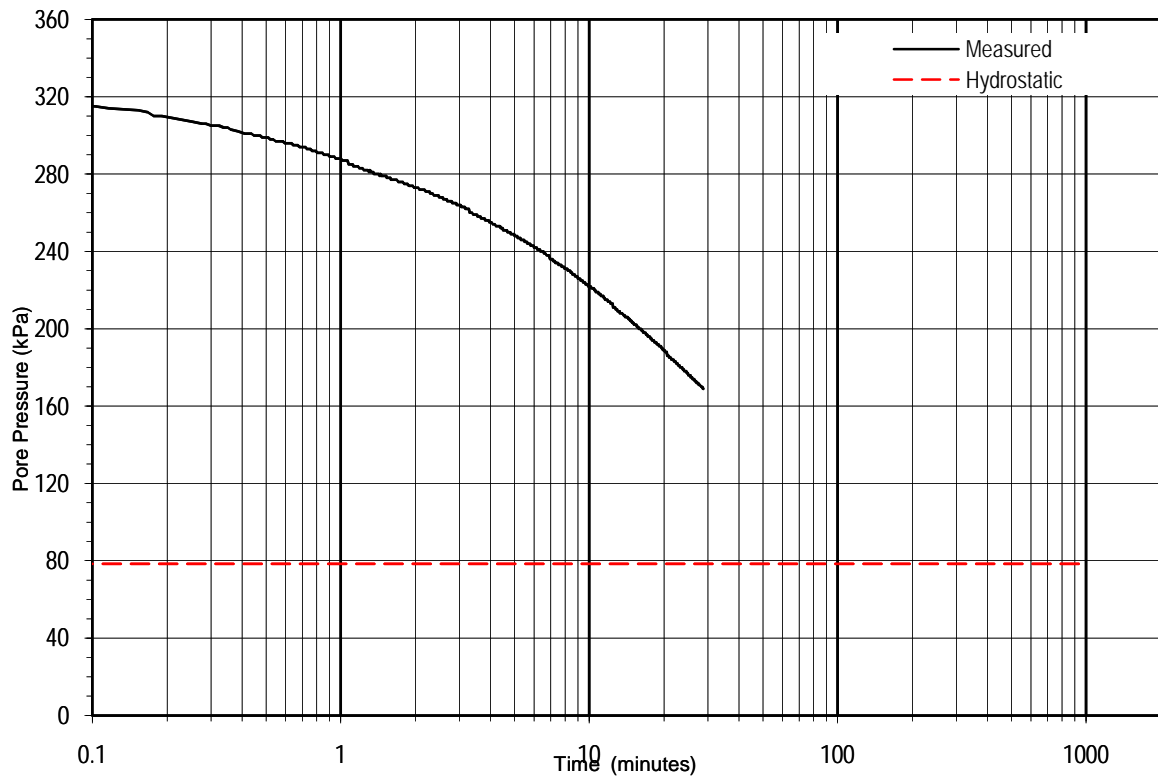
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **SAND**

Static pore pressure, U_o	10	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	18	kPa	(measured from test data)
Final pore pressure at end of test	6	kPa	(measured from test data)
Test duration	1	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT11 PPDT at 5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



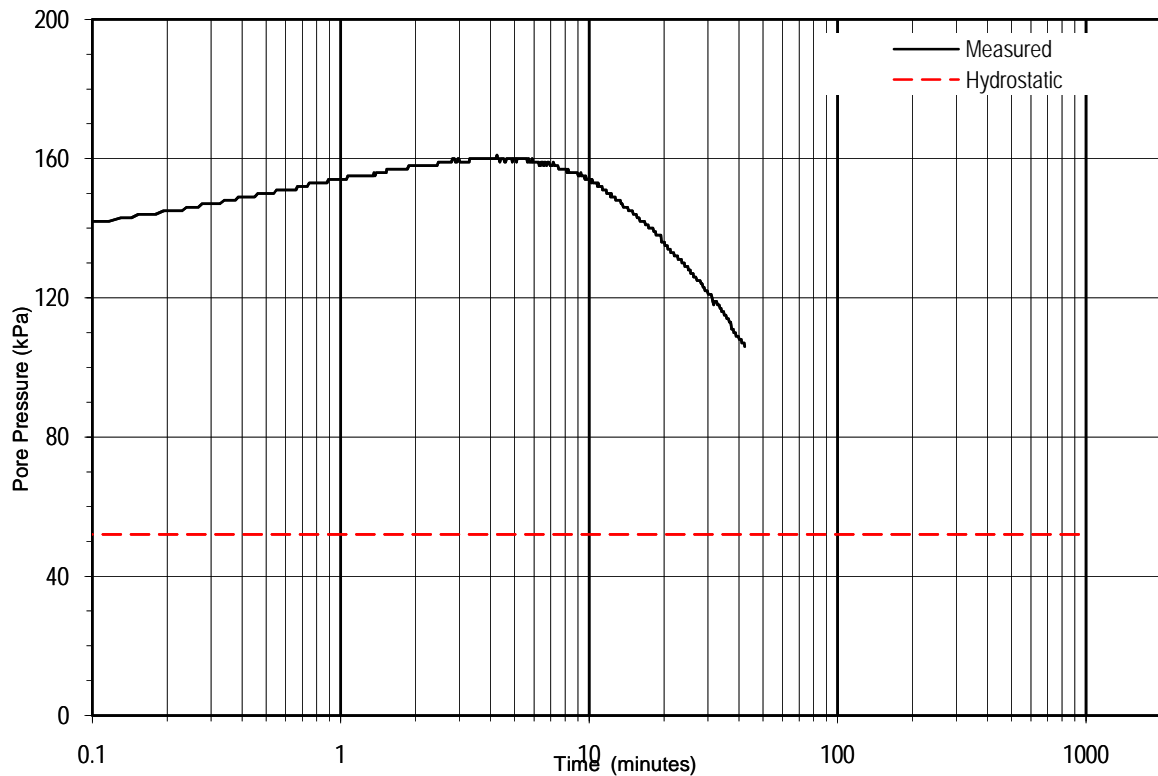
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	78	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	319	kPa	(measured from test data)
Final pore pressure at end of test	169	kPa	(measured from test data)
Test duration	29	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	17	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	12	$m^2/year$	
	to	17	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	1.6×10^{-6}	cm/s	
	to	2.2×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT11 PPDT at 12m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



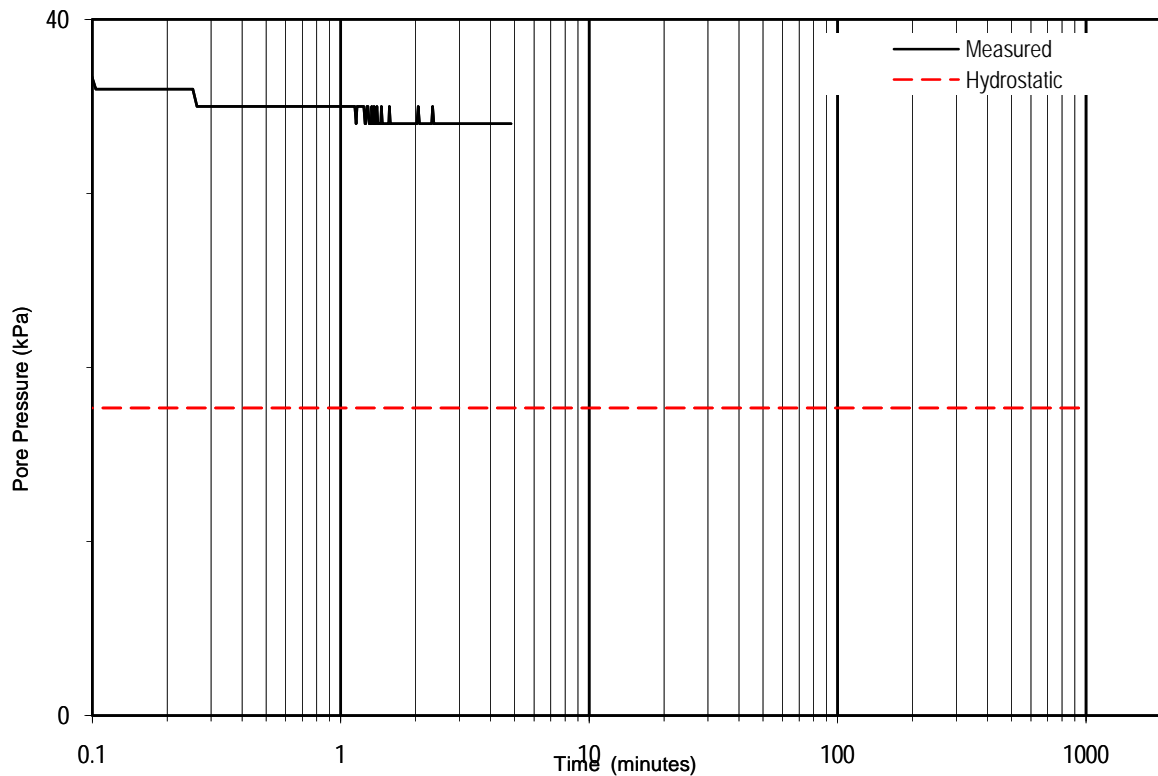
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	52	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	161	kPa	(measured from test data)
Final pore pressure at end of test	106	kPa	(measured from test data)
Test duration	42	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	42	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	5	$m^2/year$	
	to	7	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.6×10^{-6}	cm/s	
	to	0.9×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT12 PPDT at 8.5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




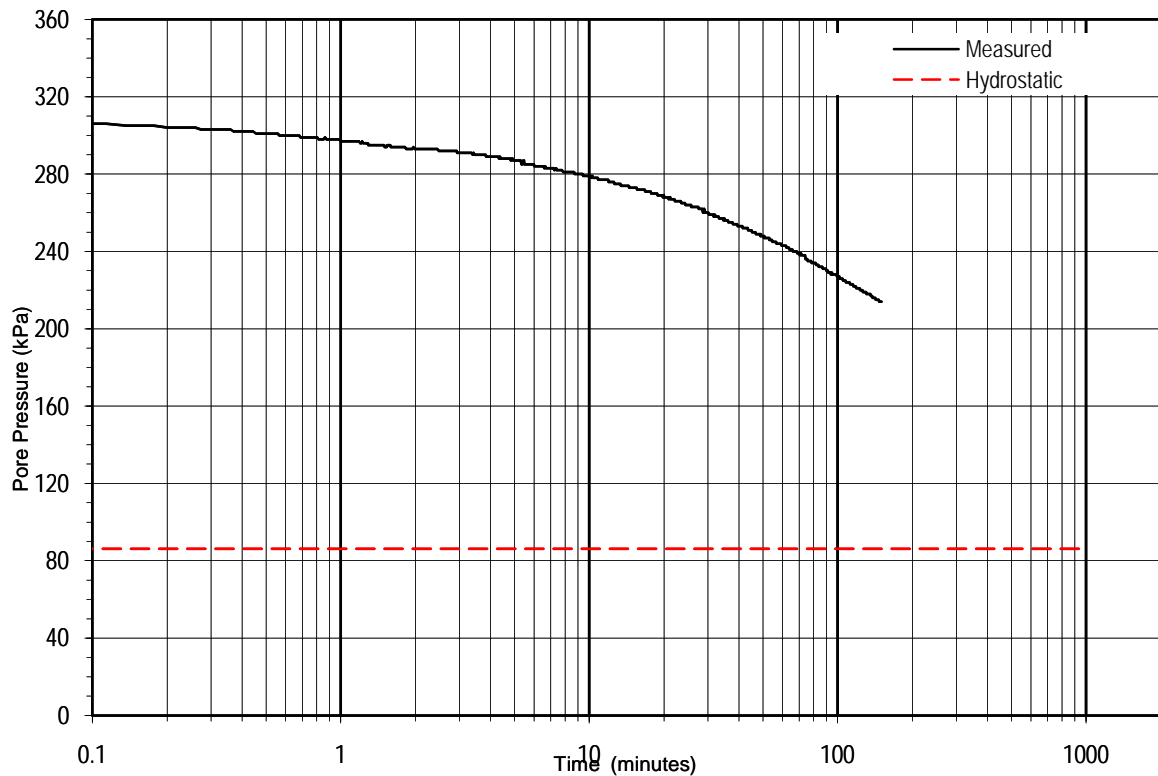
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	18	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	38	kPa	(measured from test data)
Final pore pressure at end of test	34	kPa	(measured from test data)
Test duration	5	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	23	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	9	$m^2/year$	
	to	12	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	1.1×10^{-6}	cm/s	
	to	1.6×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT12 PPDT at 5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



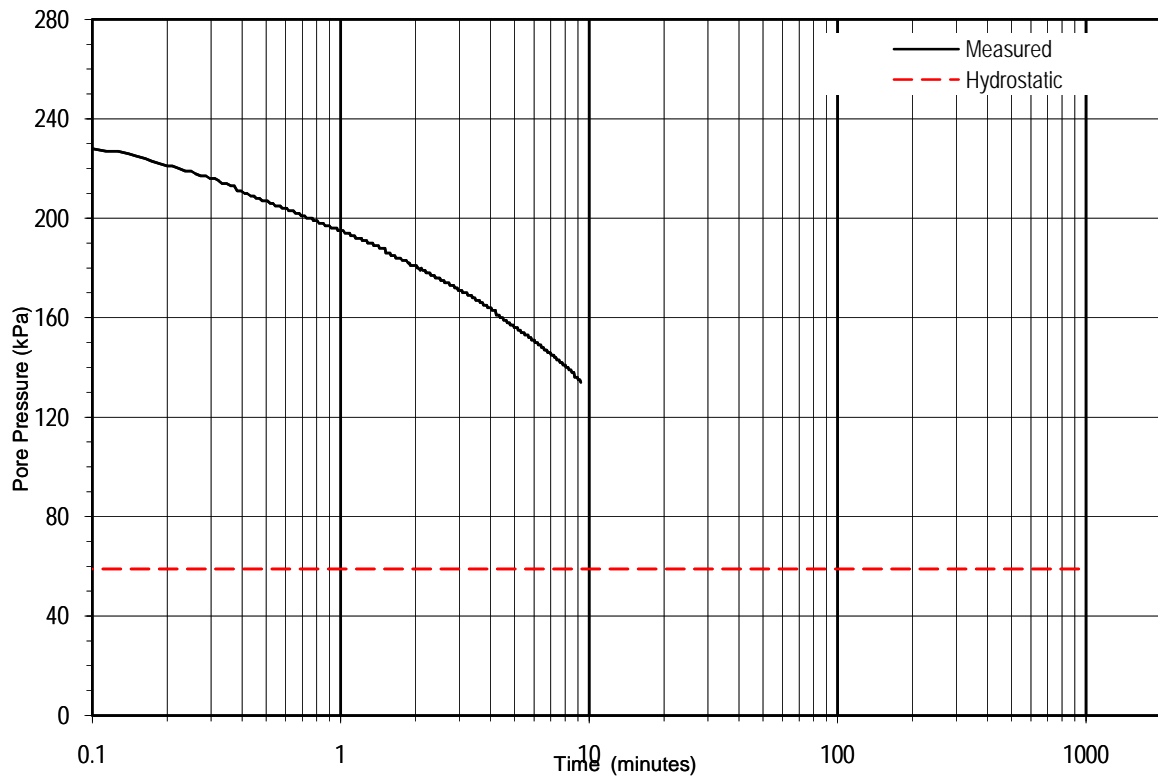
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_0	86	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	307	kPa	(measured from test data)
Final pore pressure at end of test	214	kPa	(measured from test data)
Test duration	150	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	125	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	2	$m^2/year$	
	to	2	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.2×10^{-6}	cm/s	
	to	0.3×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT12 PPDT at 11.98m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



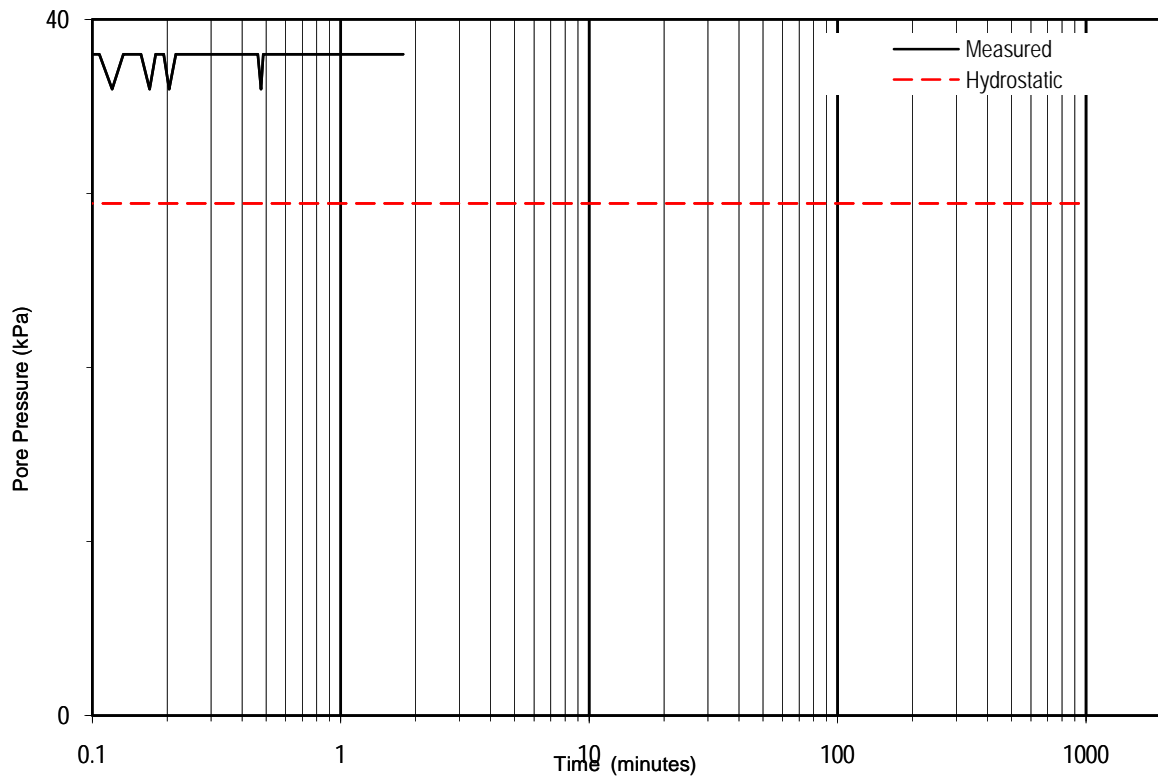
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **Sandy Clay**

Static pore pressure, U_o	59	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	232	kPa	(measured from test data)
Final pore pressure at end of test	134	kPa	(measured from test data)
Test duration	9	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	7	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	29	$m^2/year$	
	to	40	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		3.7×10^{-6}	cm/s
	to	5.2×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT13 PPDT at 11.01m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




TEST DATA & INFERRED SOIL PARAMETERS

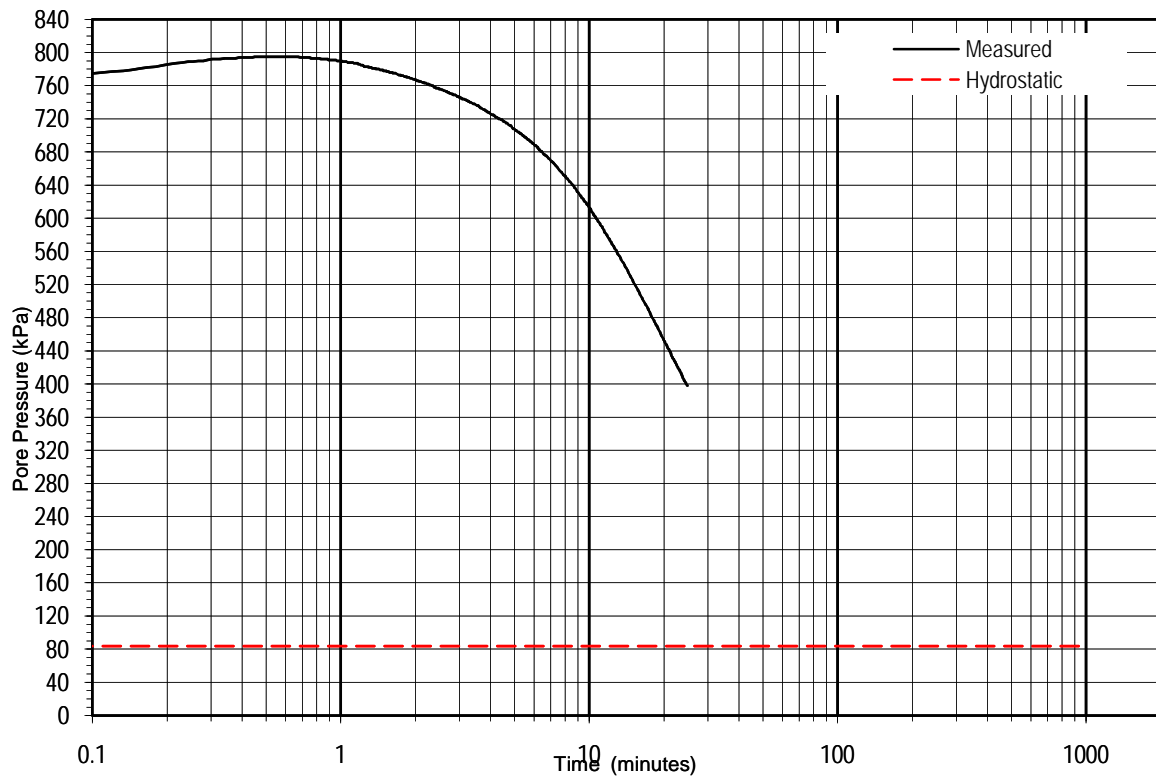
Inferred soil type:

CLAY

Static pore pressure, U_o	29	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	38	kPa	(measured from test data)
Final pore pressure at end of test	38	kPa	(measured from test data)
Test duration	2	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	25	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	8	$m^2/year$	
	to	11	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	1.0×10^{-6}	cm/s	
	to	1.4×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT13 PPDT at 8m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



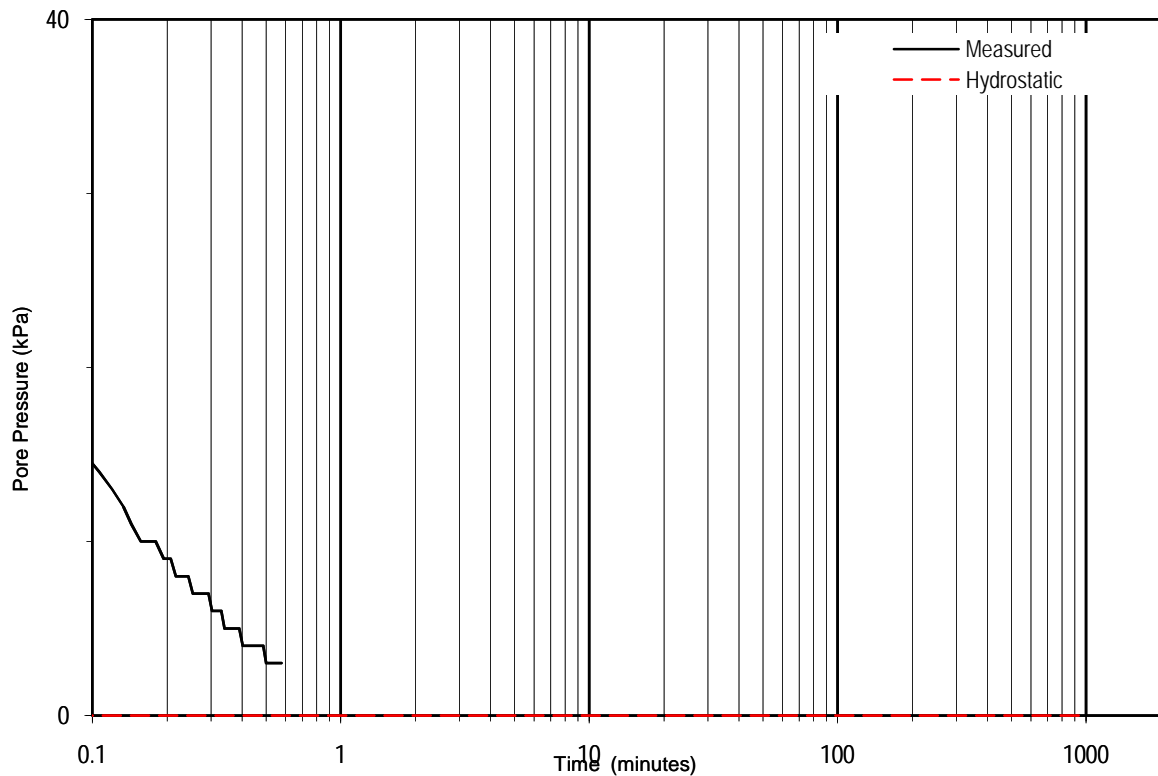
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	83	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	795	kPa	(measured from test data)
Final pore pressure at end of test	398	kPa	(measured from test data)
Test duration	25	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	21	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	9	$m^2/year$	
	to	13	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	1.2×10^{-6}	cm/s	
	to	1.7×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT13 PPDT at 13.51m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



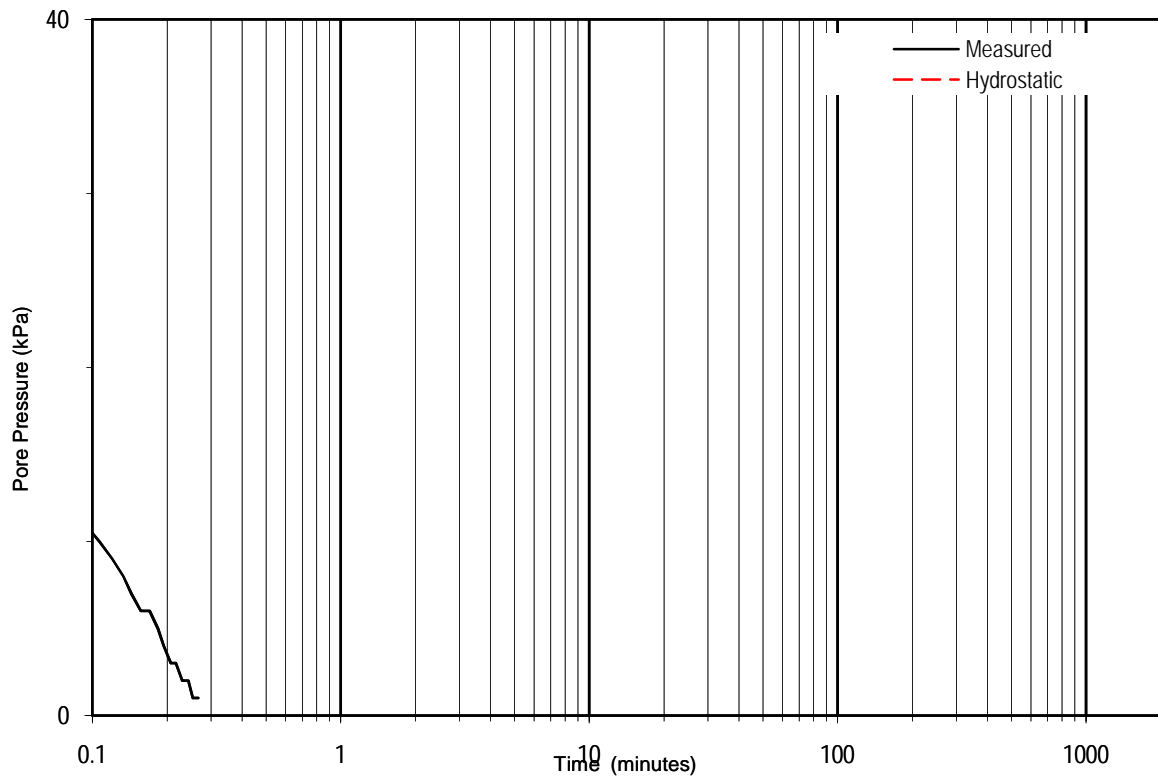
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **SAND?**

Static pore pressure, U_0	0	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	28	kPa	(measured from test data)
Final pore pressure at end of test	3	kPa	(measured from test data)
Test duration	1	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT14 PPDT at 5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




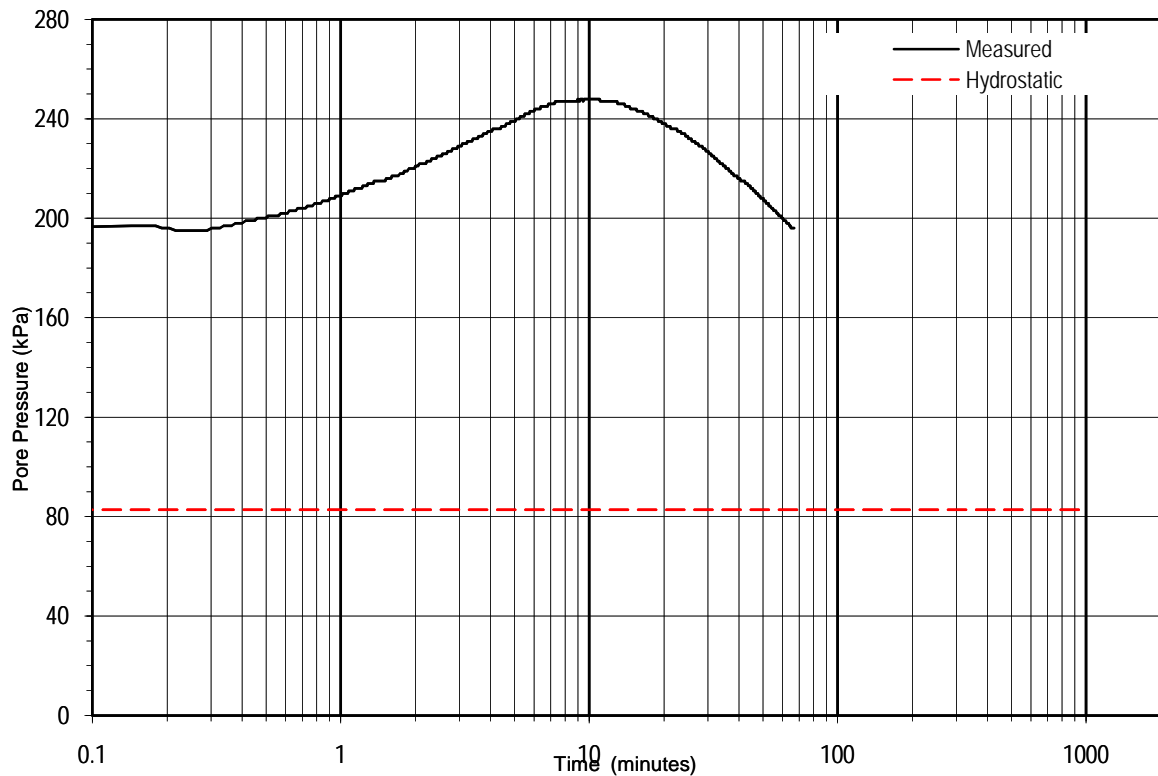
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **SAND?**

Static pore pressure, U_o	-10	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	25	kPa	(measured from test data)
Final pore pressure at end of test	1	kPa	(measured from test data)
Test duration	0	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT14 PPDT at 4m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



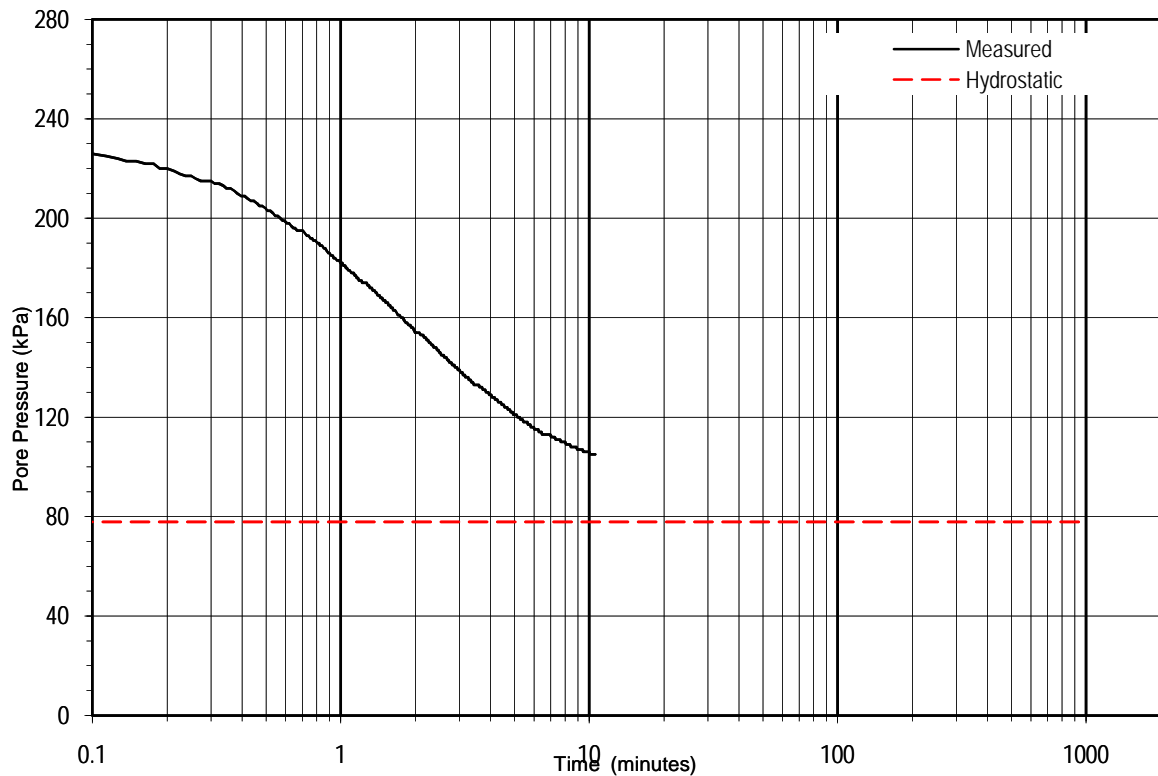
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	83	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	248	kPa	(measured from test data)
Final pore pressure at end of test	196	kPa	(measured from test data)
Test duration	67	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	87	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	2	$m^2/year$	
	to	3	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.3×10^{-6}	cm/s	
	to	0.4×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT14 PPDT at 13.44m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



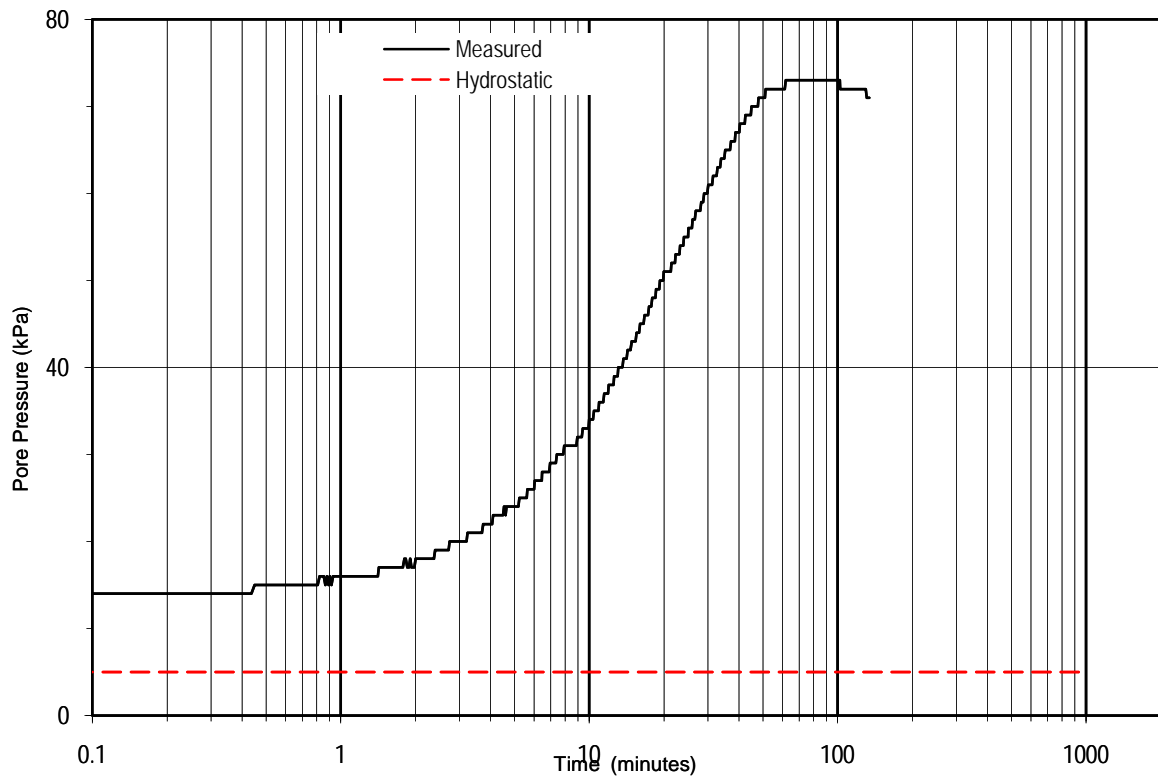
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **Sandy Clay/Clayey Sand?**

Static pore pressure, U_o	78	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	231	kPa	(measured from test data)
Final pore pressure at end of test	105	kPa	(measured from test data)
Test duration	11	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	2	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	98	$m^2/year$	
	to 139	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	12.9×10^{-6}	cm/s	
	to 17.9×10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT15 PPDT at 15.04m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

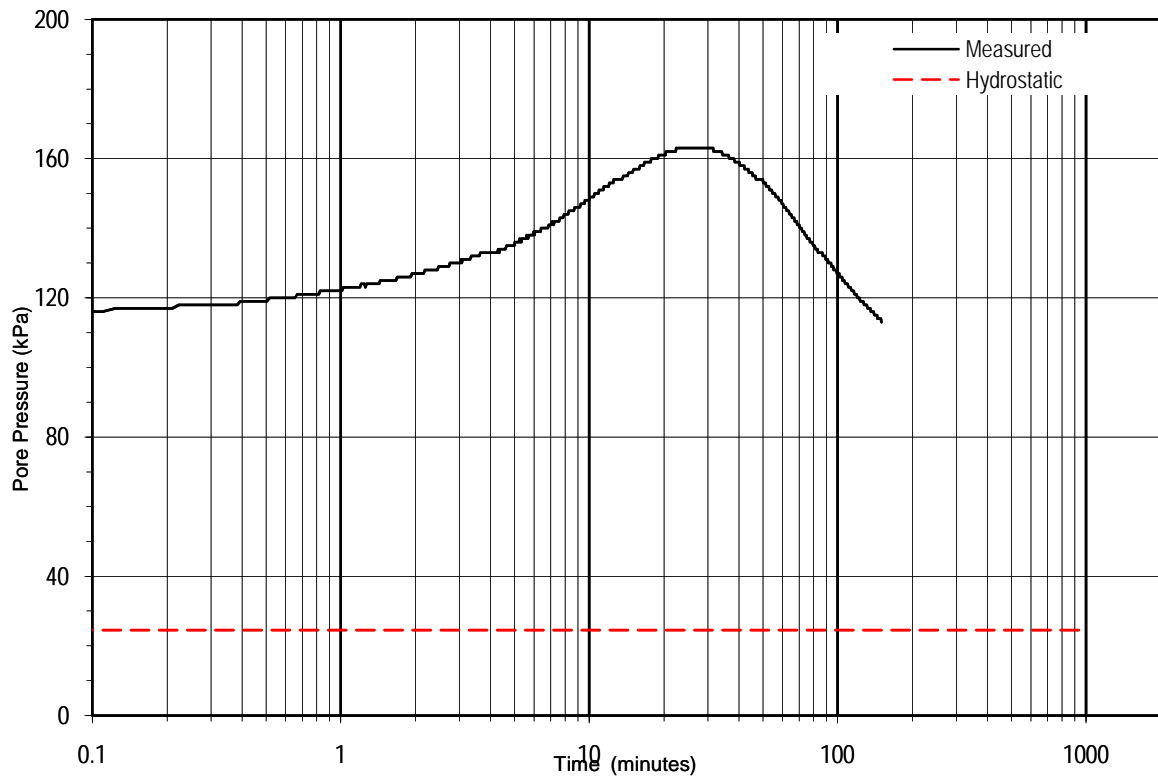
Inferred soil type:

CLAY

Static pore pressure, U_o	5	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	34	kPa	(measured from test data)
Final pore pressure at end of test	71	kPa	(measured from test data)
Test duration	134	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	1111	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	0	$m^2/year$	
to	0	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.0×10^{-6}	cm/s	
to	0.0×10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT16 PPDT at 4.01m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




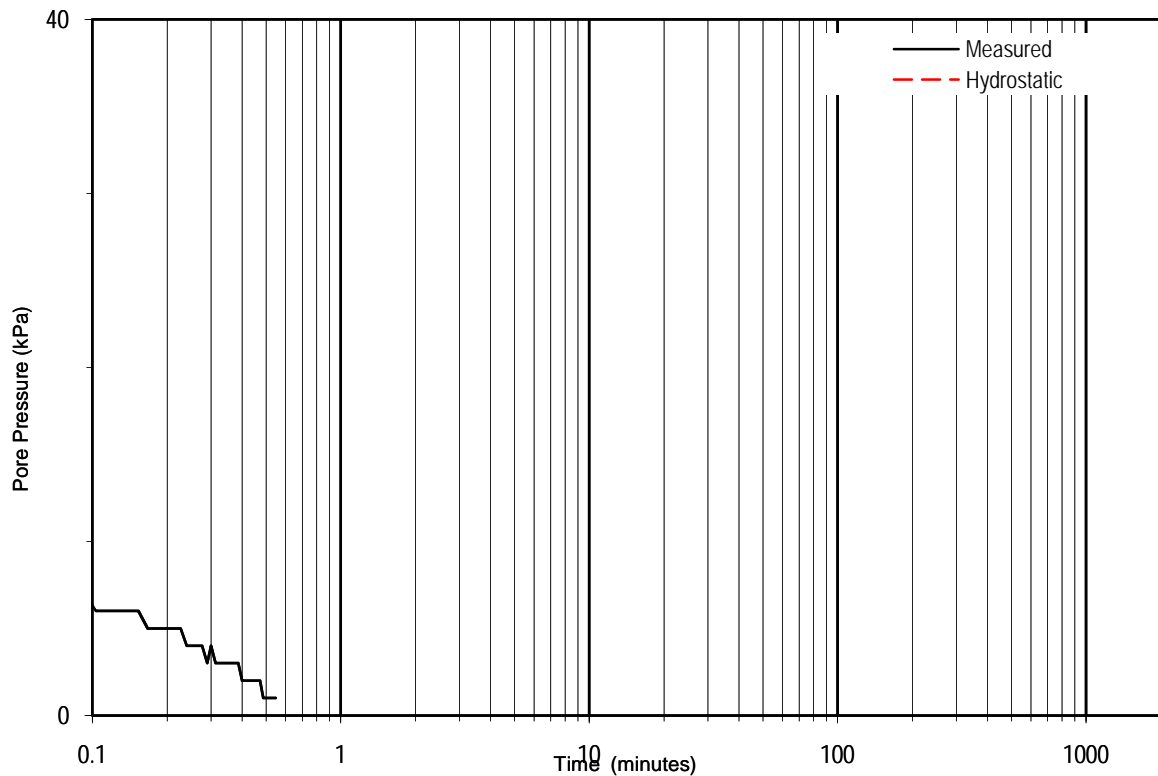
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	25	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	148	kPa	(measured from test data)
Final pore pressure at end of test	113	kPa	(measured from test data)
Test duration	150	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	112	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	2	$m^2/year$	
	to	3	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.2×10^{-6}	cm/s	
	to	0.3×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT16 PPDT at 6m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



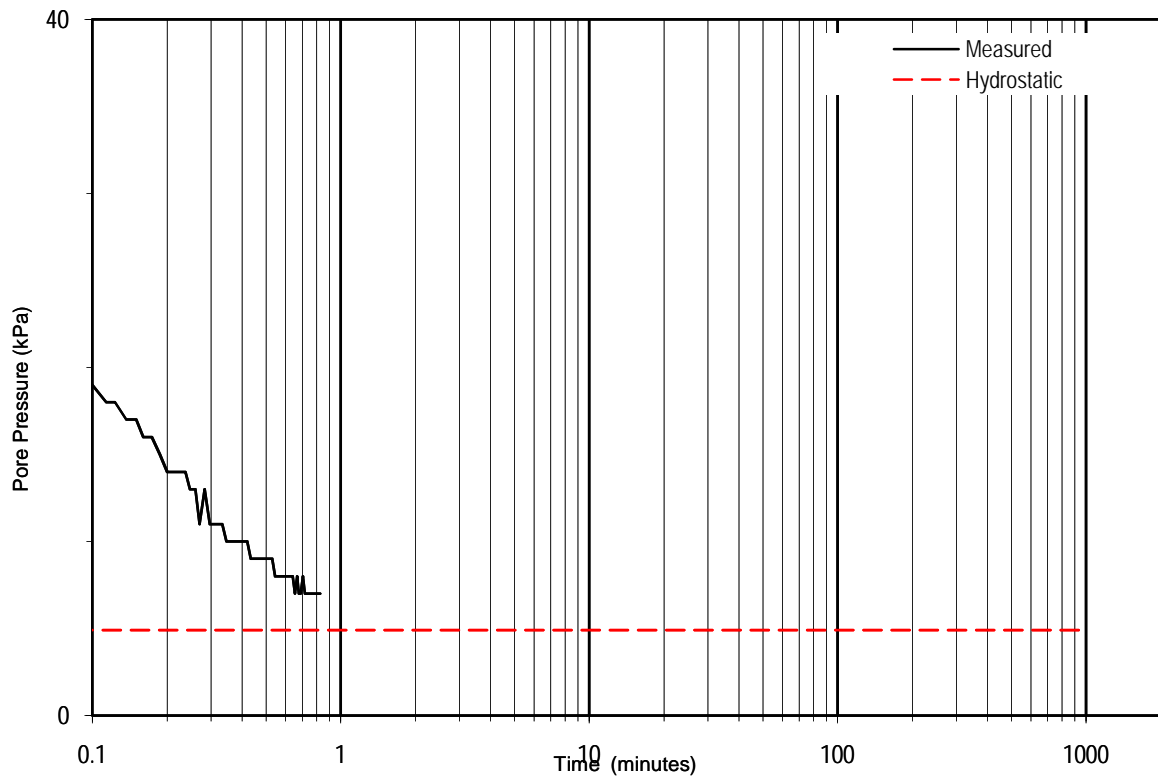
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **SAND?**

Static pore pressure, U_o	-10	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	8	kPa	(measured from test data)
Final pore pressure at end of test	1	kPa	(measured from test data)
Test duration	1	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	1	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT17 PPDT at 2.5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




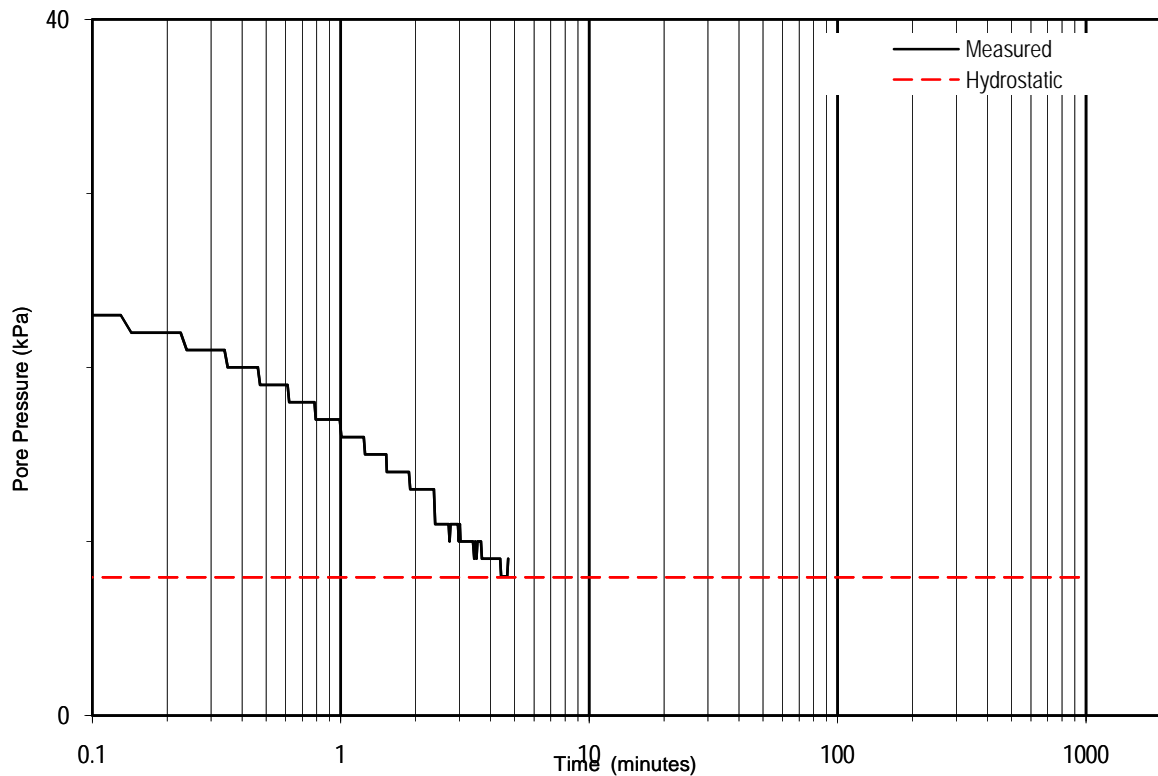
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **SAND?**

Static pore pressure, U_o	5	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	22	kPa	(measured from test data)
Final pore pressure at end of test	7	kPa	(measured from test data)
Test duration	1	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT18 PPDT at 2.5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




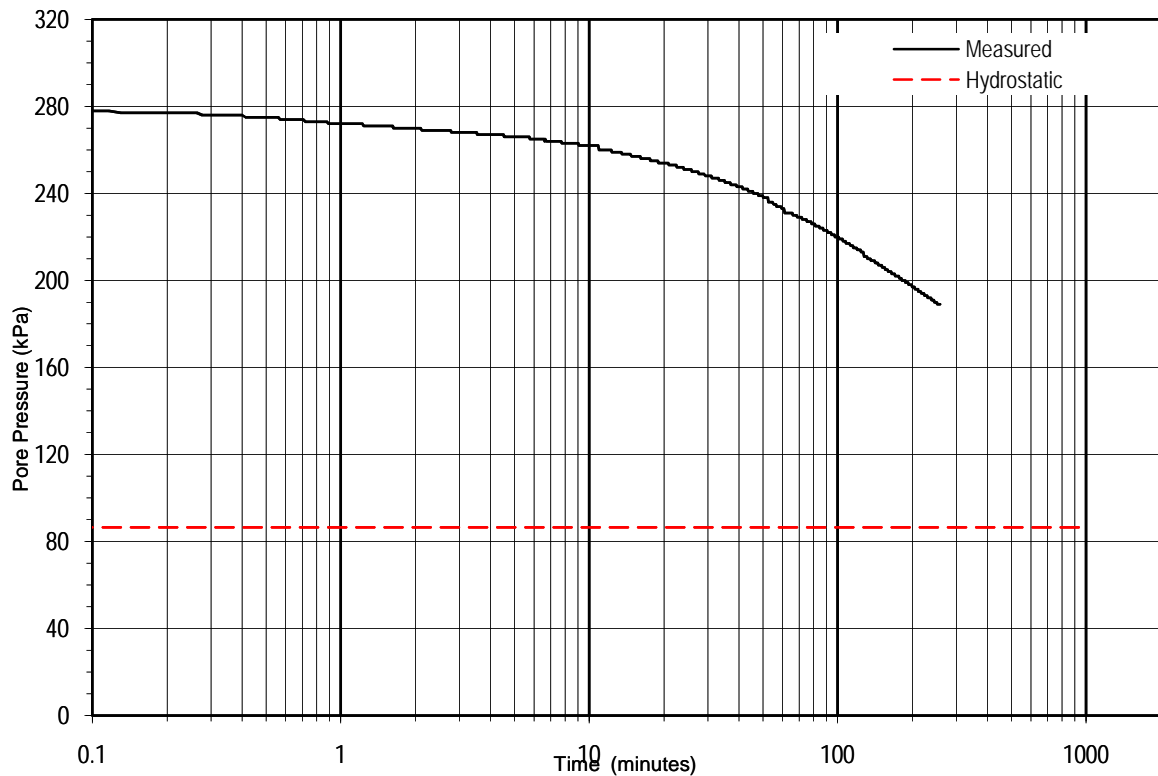
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **Clayey Sand/Sandy Clay?**

Static pore pressure, U_o	8	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	23	kPa	(measured from test data)
Final pore pressure at end of test	9	kPa	(measured from test data)
Test duration	5	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	1	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	142	$m^2/year$	
	to 202	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	18.7×10^{-6}	cm/s	
	to 25.9×10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT19 PPDT at 4.01m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



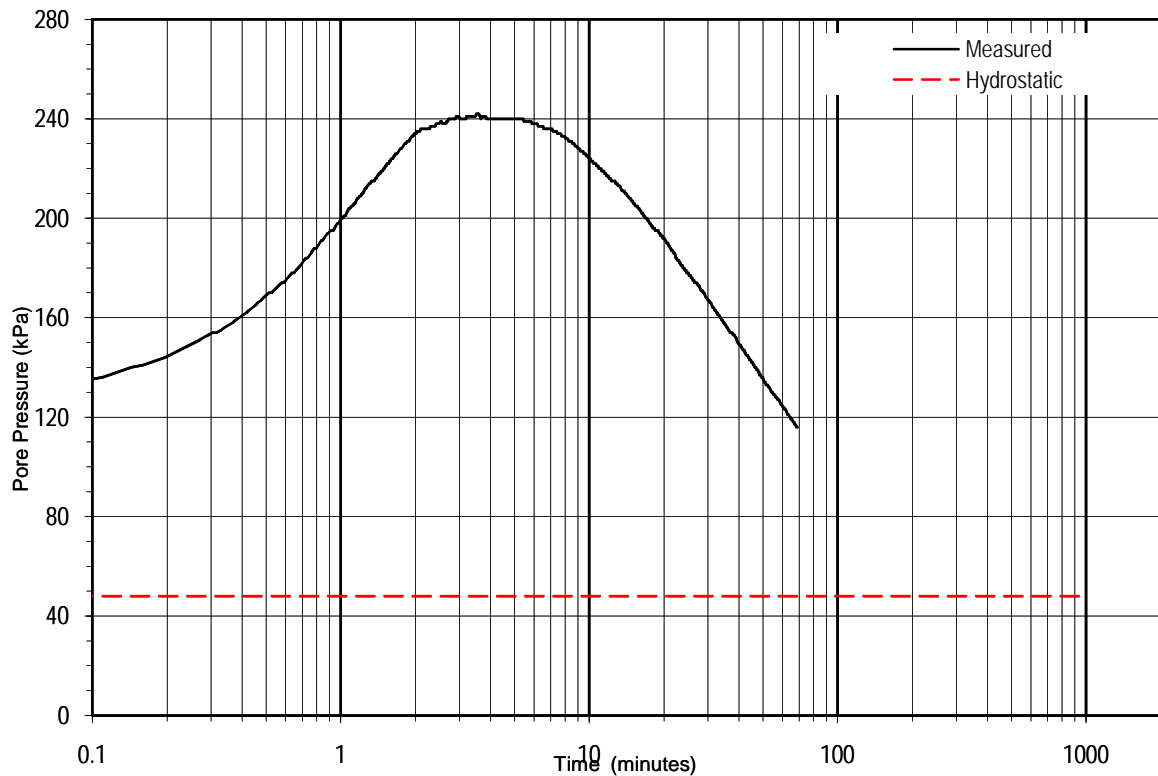
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_0	86	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	278	kPa	(measured from test data)
Final pore pressure at end of test	189	kPa	(measured from test data)
Test duration	258	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	351	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	1	$m^2/year$	
	to	1	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.1×10^{-6}	cm/s	
	to	0.1×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT19 PPDT at 12.01m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

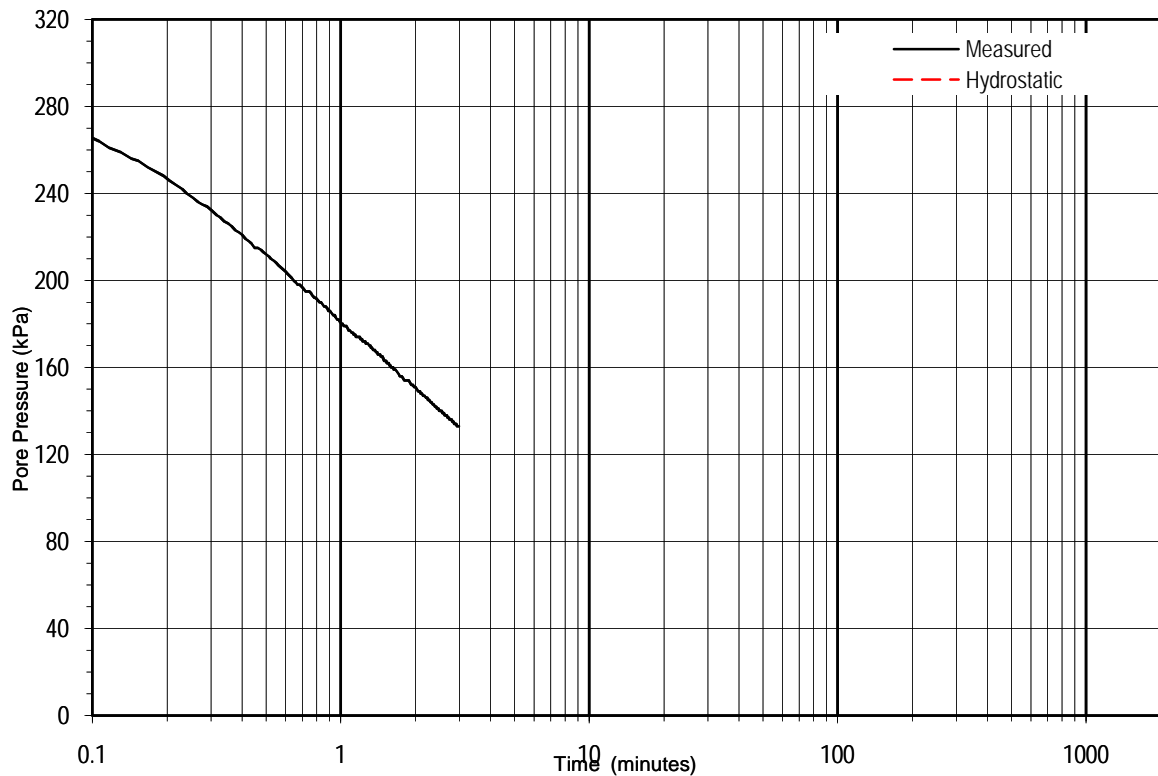
Inferred soil type:

CLAY

Static pore pressure, U_o	48	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	242	kPa	(measured from test data)
Final pore pressure at end of test	116	kPa	(measured from test data)
Test duration	69	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	43	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	5	$m^2/year$	
	to	7	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.6×10^{-6}	cm/s	
	to	0.9×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT20 PPDT at 12m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



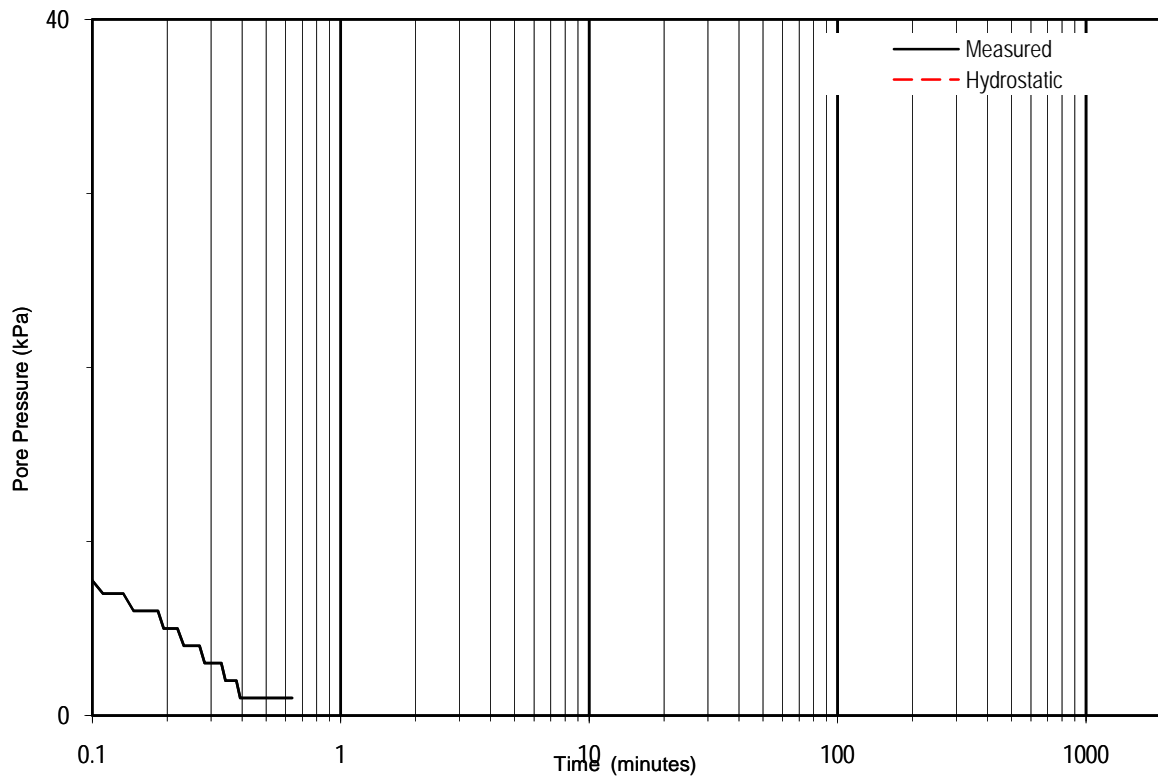
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **Clayey Sand/Sandy Clay?**

Static pore pressure, U_o	-30	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	288	kPa	(measured from test data)
Final pore pressure at end of test	133	kPa	(measured from test data)
Test duration	3	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	2	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	105	$m^2/year$	
	to 149	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	13.7×10^{-6}	cm/s	
	to 19.0×10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT21 PPDT at 10.05m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



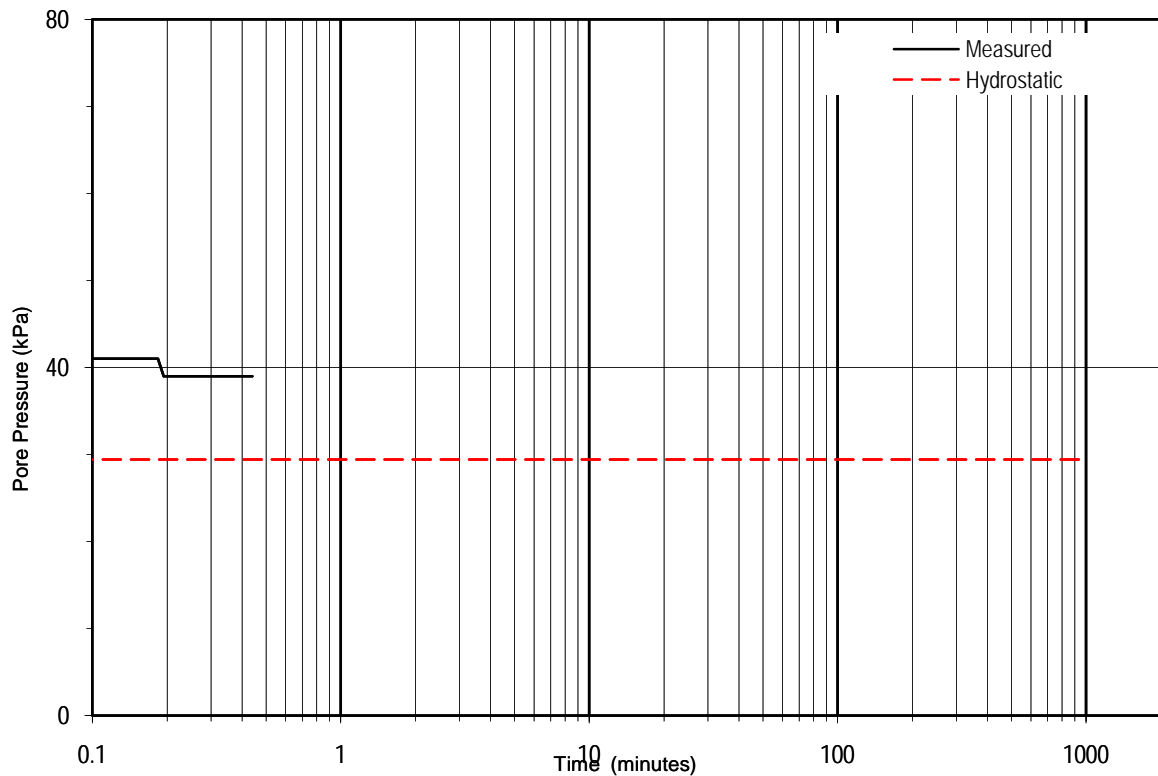
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	-40	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	10	kPa	(measured from test data)
Final pore pressure at end of test	1	kPa	(measured from test data)
Test duration	0	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	1161	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	0	$m^2/year$	
	to	0	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.0×10^{-6}	cm/s	
	to	0.0×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT22 PPDT at 3m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

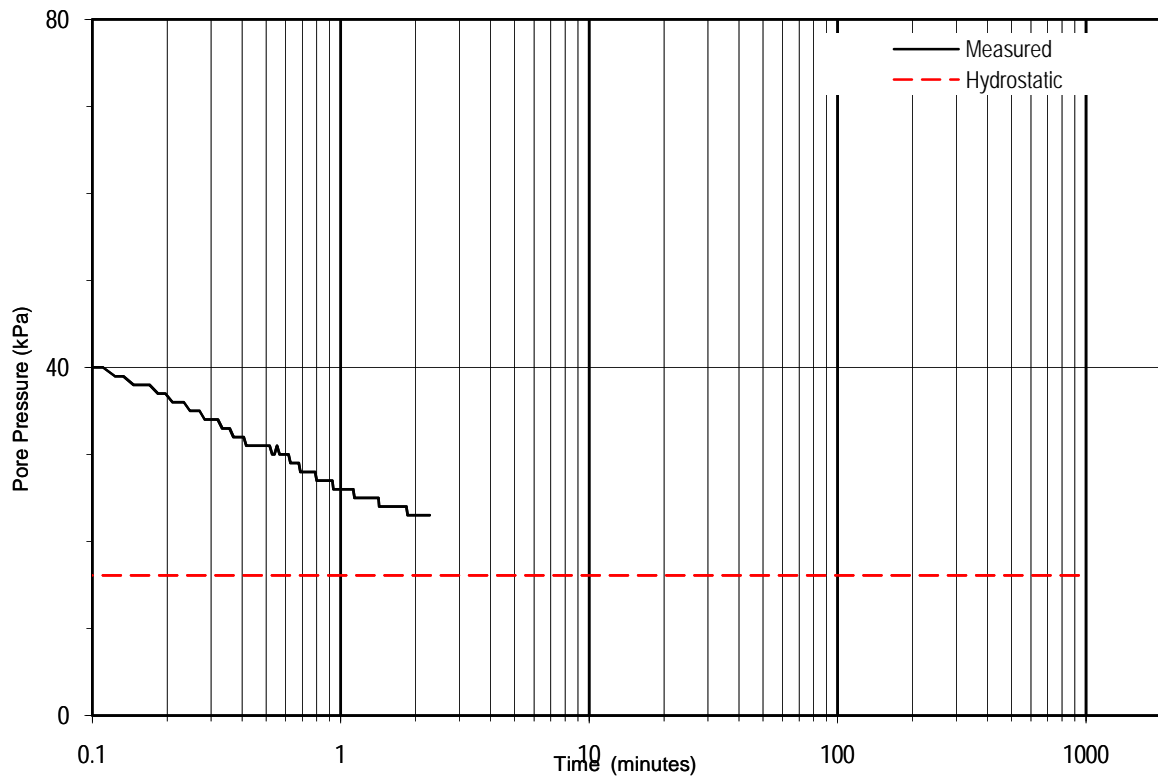
Inferred soil type:

SAND

Static pore pressure, U_o	29	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	41	kPa	(measured from test data)
Final pore pressure at end of test	39	kPa	(measured from test data)
Test duration	0	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	1	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
to	N.A.	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
to	N.A.	$\times 10^{-6} cm/s$	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT23 PPDT at 6m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

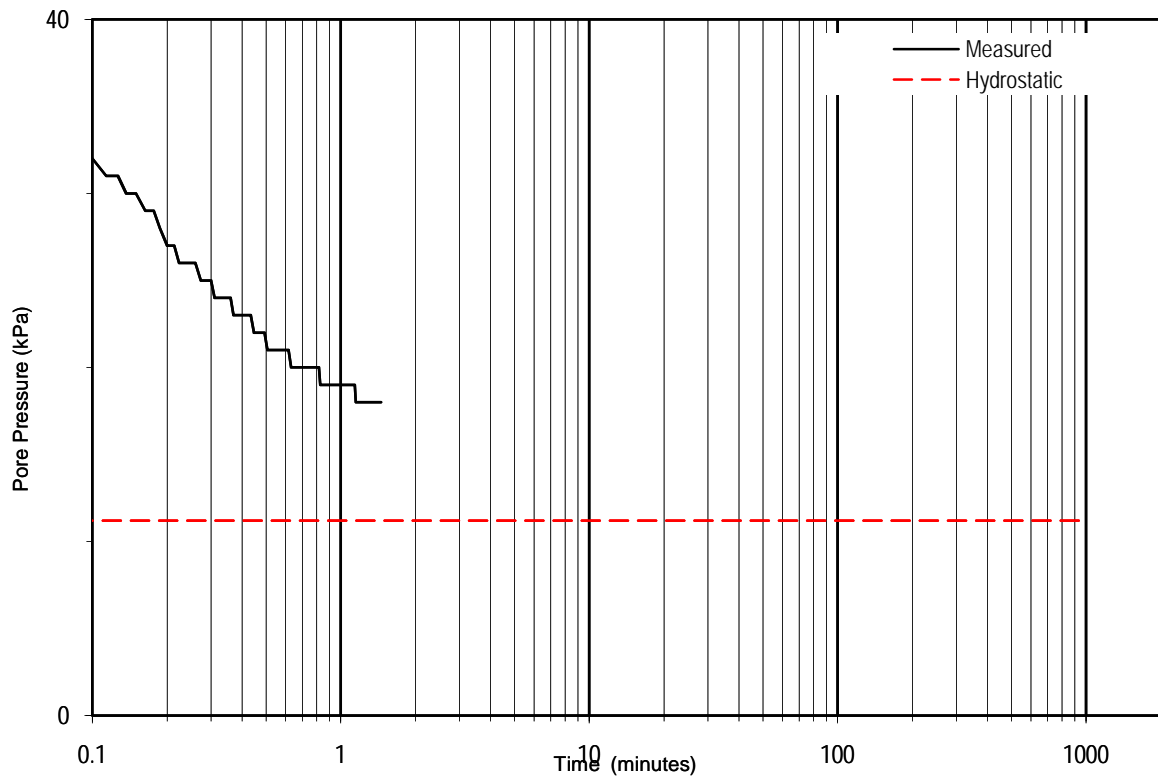
Inferred soil type:

SAND

Static pore pressure, U_o	16	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	44	kPa	(measured from test data)
Final pore pressure at end of test	23	kPa	(measured from test data)
Test duration	2	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	1	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} \text{ cm/s}$	
	to	N.A.	$\times 10^{-6} \text{ cm/s}$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT24 PPDT at 3m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

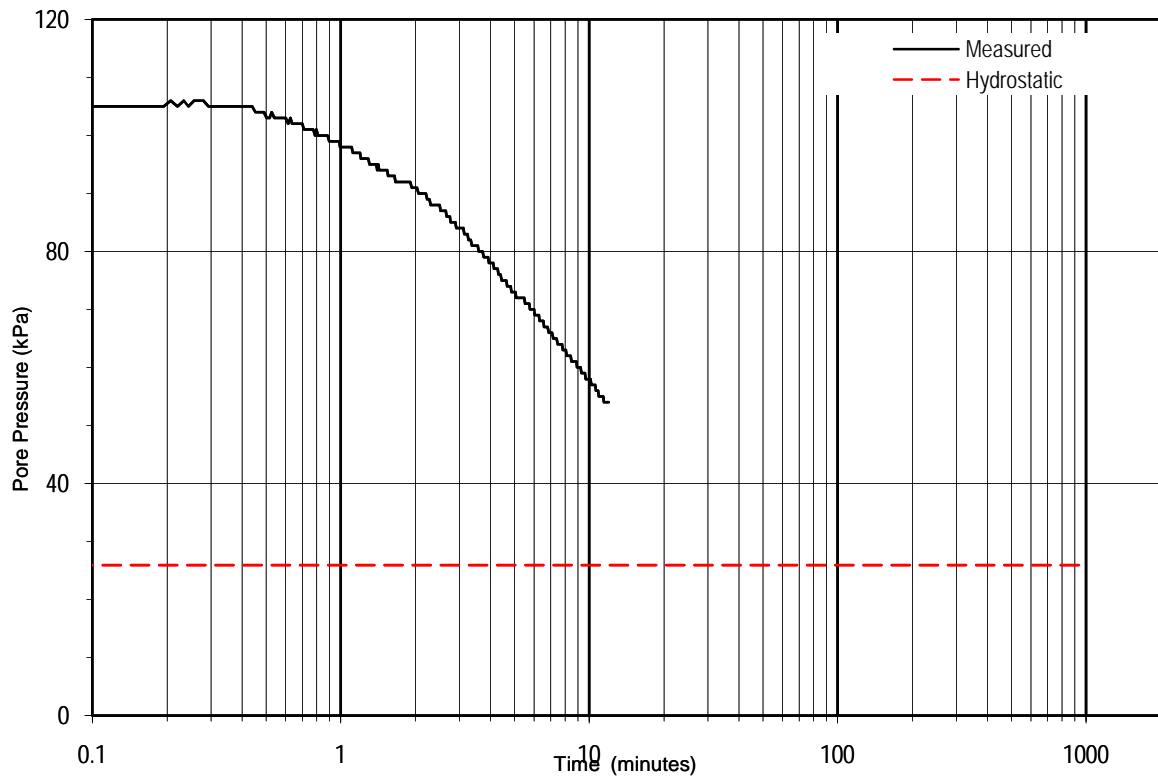
Inferred soil type:

SAND

Static pore pressure, U_o	11	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	38	kPa	(measured from test data)
Final pore pressure at end of test	18	kPa	(measured from test data)
Test duration	1	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT24 PPDT at 2.5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



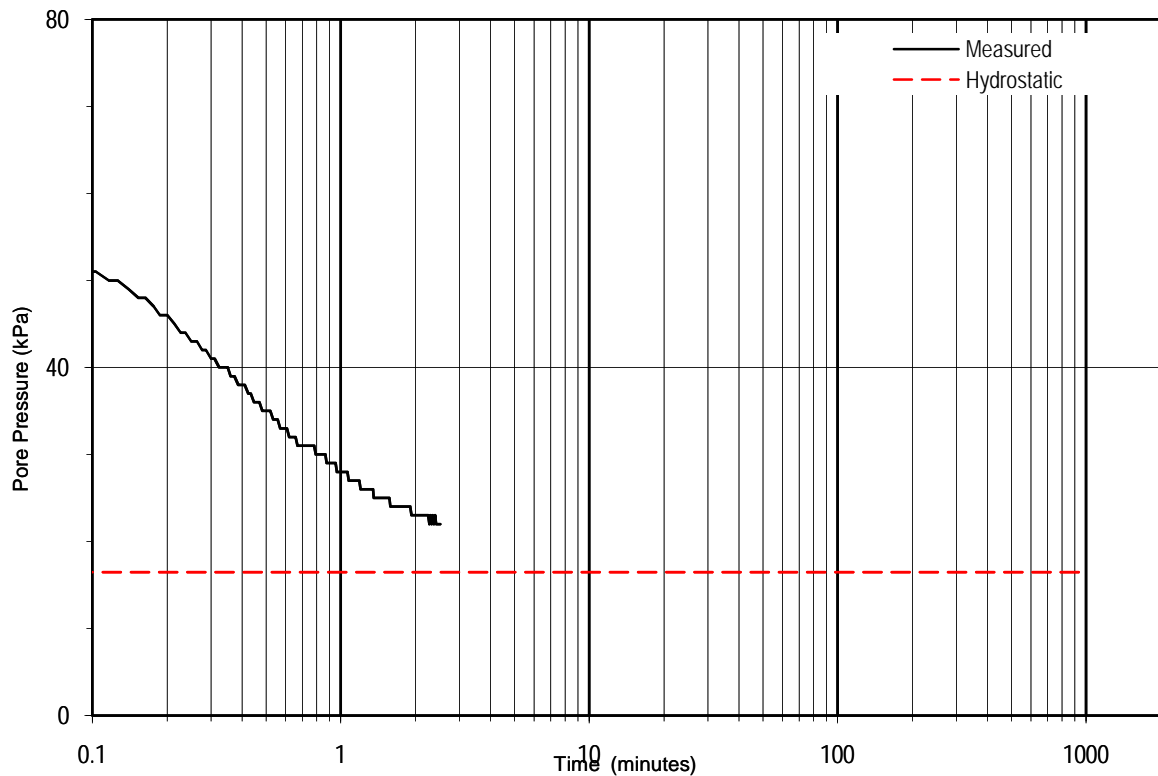
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY/Sandy Clay**

Static pore pressure, U_o	26	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	106	kPa	(measured from test data)
Final pore pressure at end of test	54	kPa	(measured from test data)
Test duration	12	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	7	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	29	$m^2/year$	
	to	41	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		3.7×10^{-6}	cm/s
	to	5.2×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT24 PPDT at 4m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

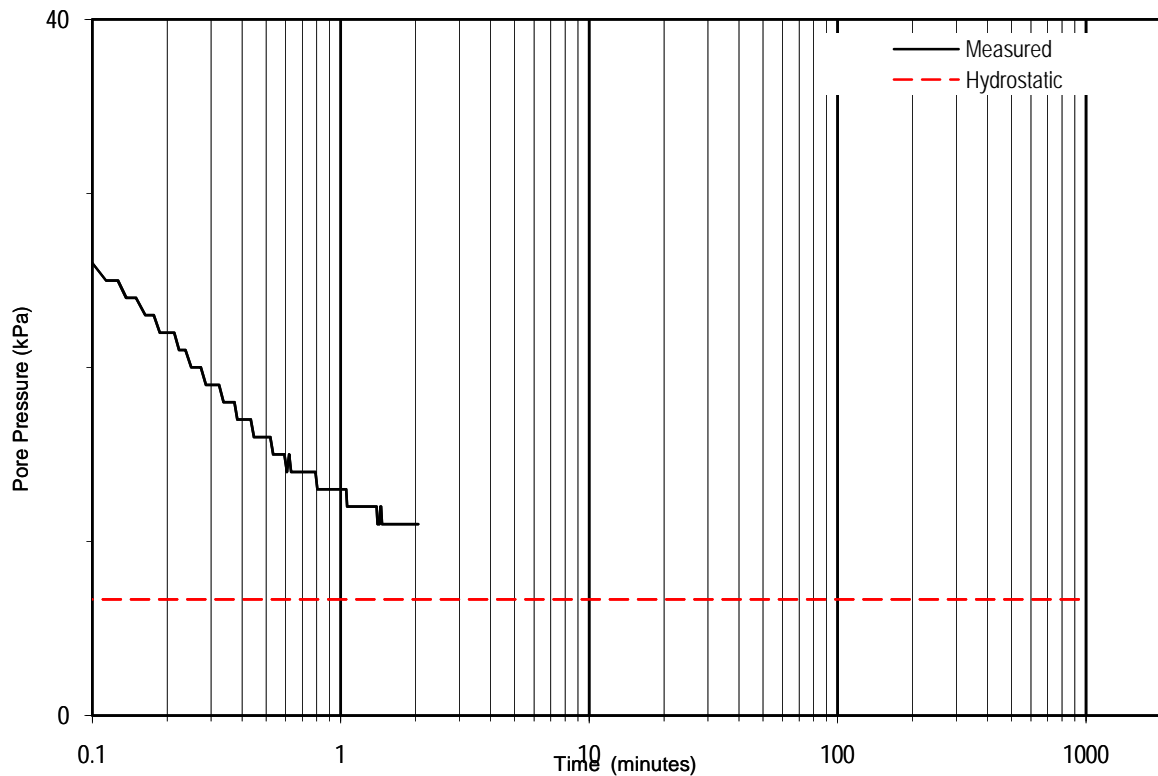
Inferred soil type:

SAND

Static pore pressure, U_o	16	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	56	kPa	(measured from test data)
Final pore pressure at end of test	22	kPa	(measured from test data)
Test duration	3	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
to	N.A.	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
to	N.A.	$\times 10^{-6} cm/s$	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT25 PPDT at 3.98m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

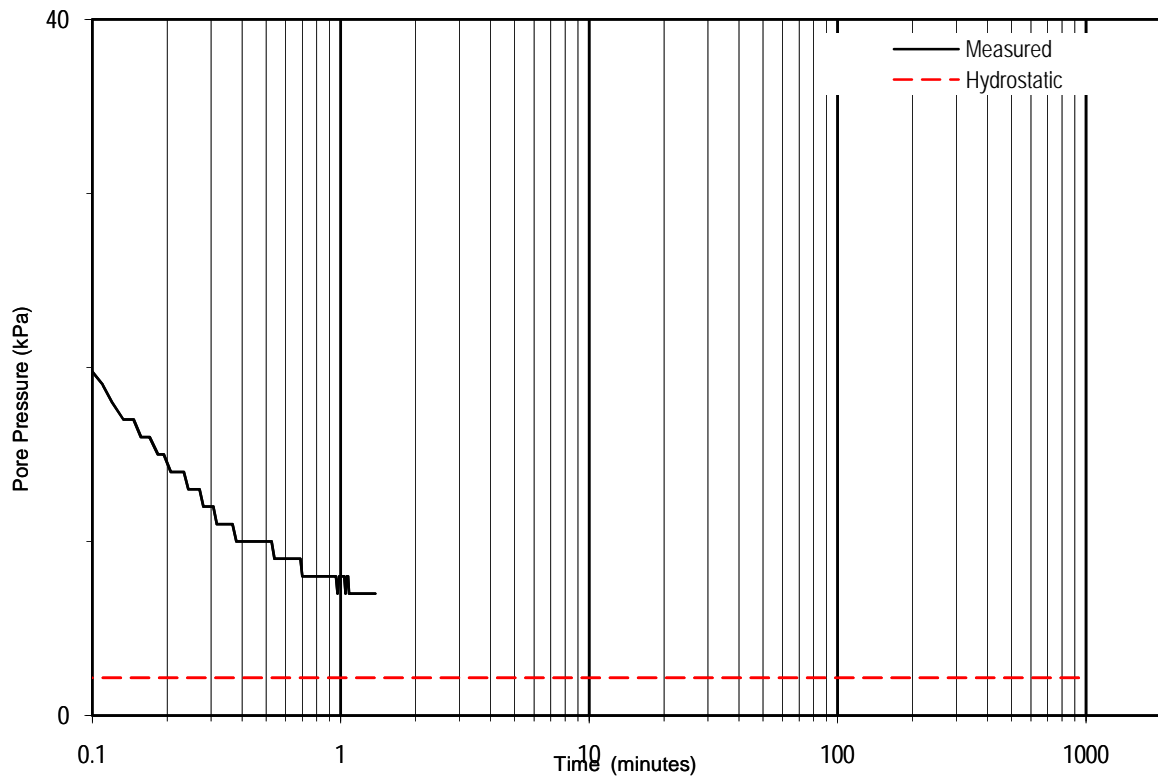
Inferred soil type:

SAND

Static pore pressure, U_o	7	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	30	kPa	(measured from test data)
Final pore pressure at end of test	11	kPa	(measured from test data)
Test duration	2	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(extrapolated from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
to	N.A.	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
to	N.A.	$\times 10^{-6} cm/s$	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT25 PPDT at 2.98m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

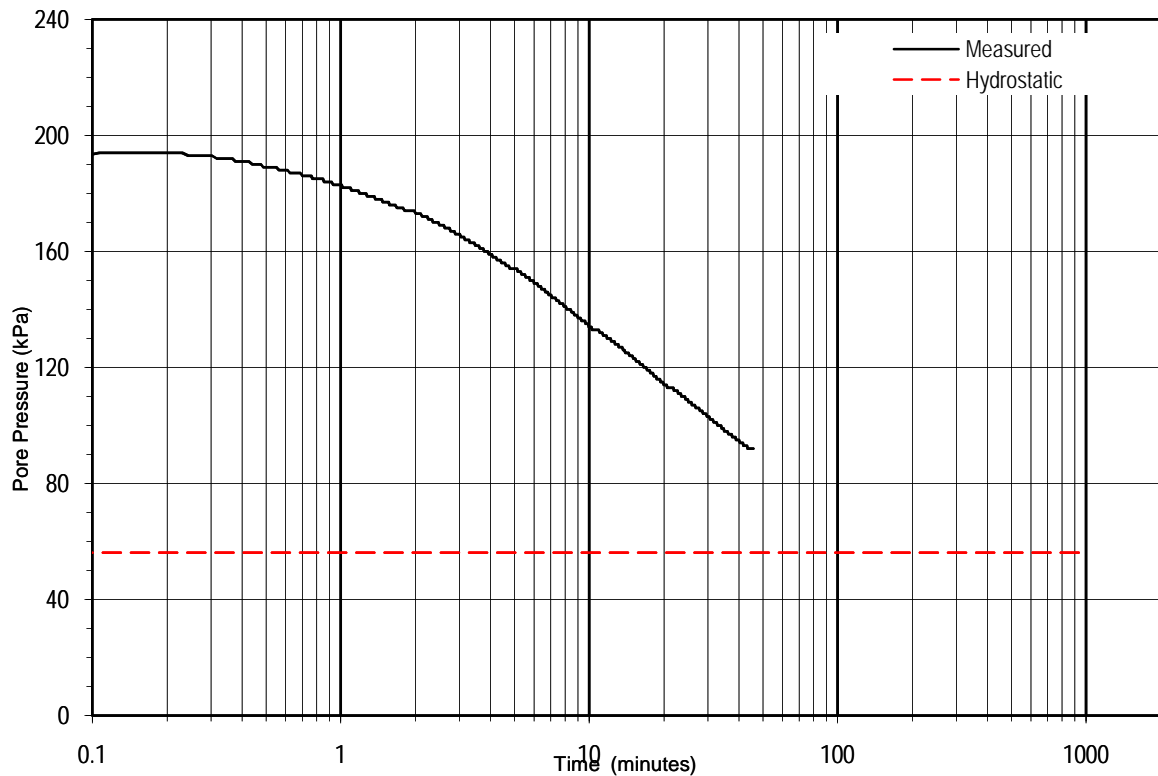
Inferred soil type:

SAND

Static pore pressure, U_o	2	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	25	kPa	(measured from test data)
Final pore pressure at end of test	7	kPa	(measured from test data)
Test duration	1	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT25 PPDT at 2.52m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

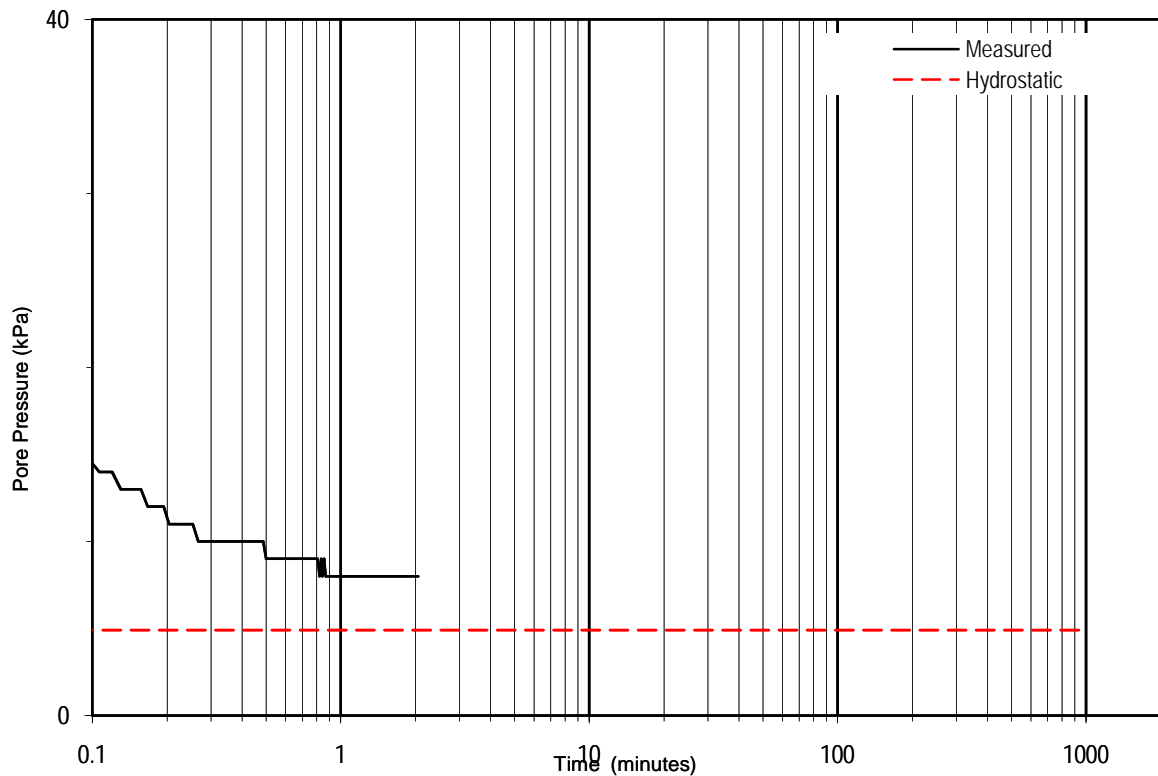
Inferred soil type:

CLAY

Static pore pressure, U_0	56	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	194	kPa	(measured from test data)
Final pore pressure at end of test	92	kPa	(measured from test data)
Test duration	46	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	14	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	14	$m^2/year$	
	to	20	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		1.8×10^{-6}	cm/s
	to	2.6×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT25 PPDT at 8.02m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

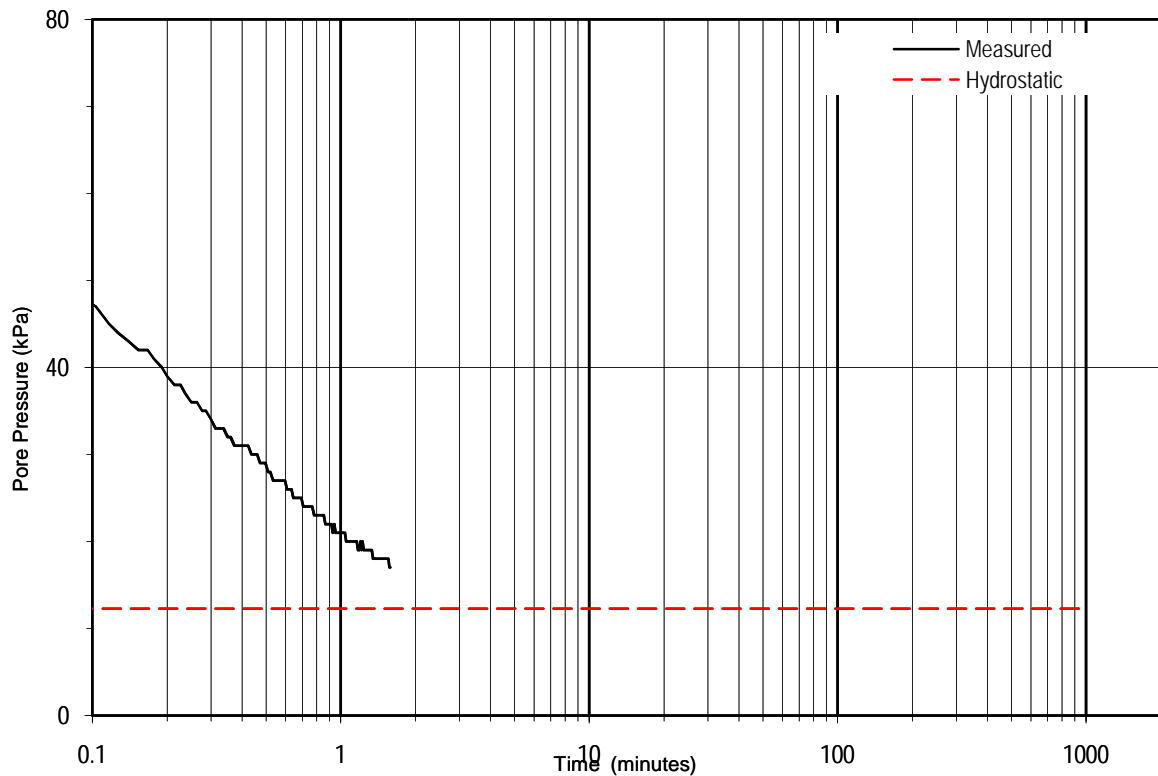
Inferred soil type:

SAND

Static pore pressure, U_o	5	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	19	kPa	(measured from test data)
Final pore pressure at end of test	8	kPa	(measured from test data)
Test duration	2	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT27 PPDT at 1.5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

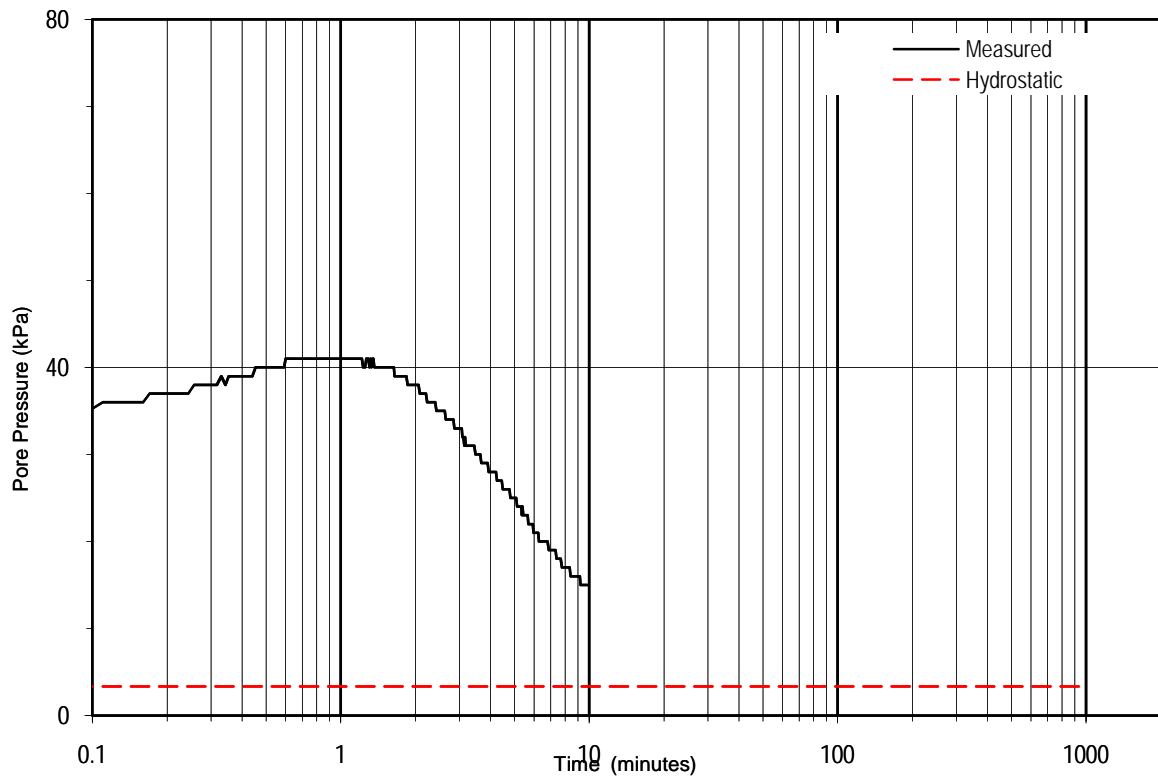
Inferred soil type:

SAND

Static pore pressure, U_o	12	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	54	kPa	(measured from test data)
Final pore pressure at end of test	17	kPa	(measured from test data)
Test duration	2	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	0	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	N.A.	$m^2/year$	
	to	N.A.	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	N.A.	$\times 10^{-6} cm/s$	
	to	N.A.	$\times 10^{-6} cm/s$ (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of $0.0042 kPa^{-1}$.

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT27 PPDT at 2.25m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



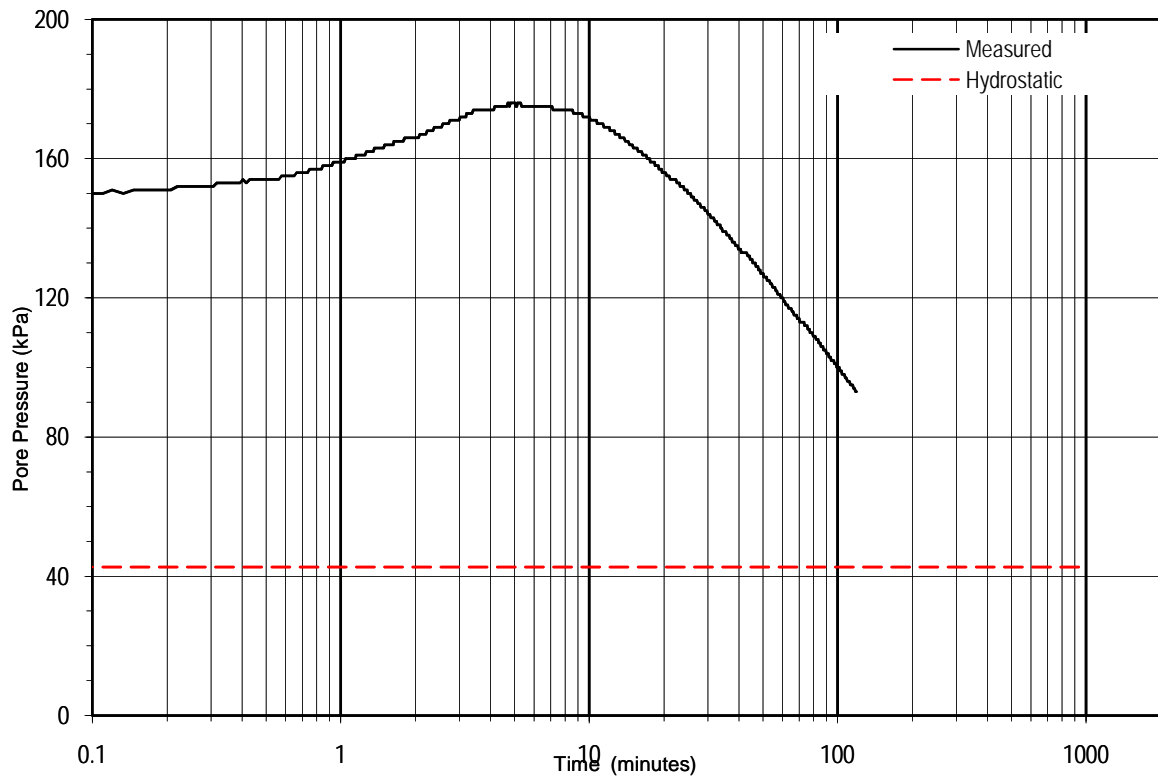
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY/Sandy Clay?**

Static pore pressure, U_o	3	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	41	kPa	(measured from test data)
Final pore pressure at end of test	15	kPa	(measured from test data)
Test duration	10	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	6	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	34	$m^2/year$	
	to	49	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		4.5×10^{-6}	cm/s
	to	6.3×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT28 PPDT at 1.49m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



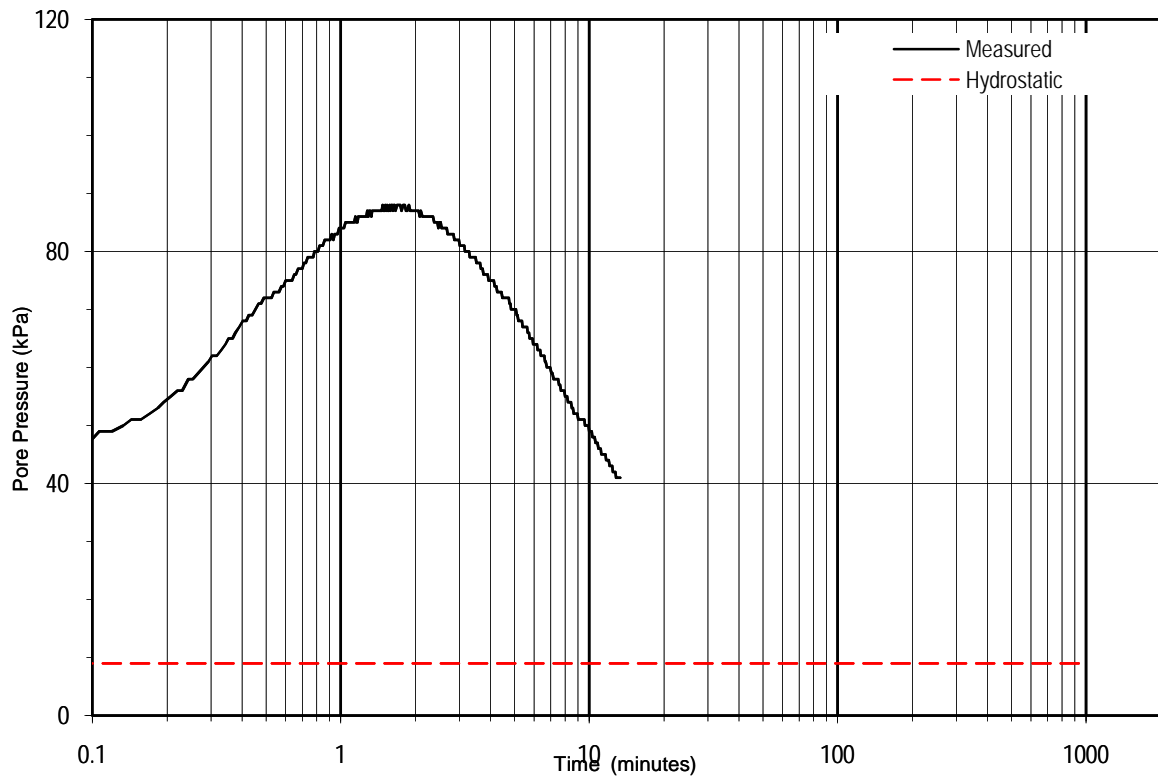
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_0	43	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	176	kPa	(measured from test data)
Final pore pressure at end of test	93	kPa	(measured from test data)
Test duration	119	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	80	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	3	$m^2/year$	
	to	4	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	0.3×10^{-6}	cm/s	
	to	0.5×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT28 PPDT at 5.5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



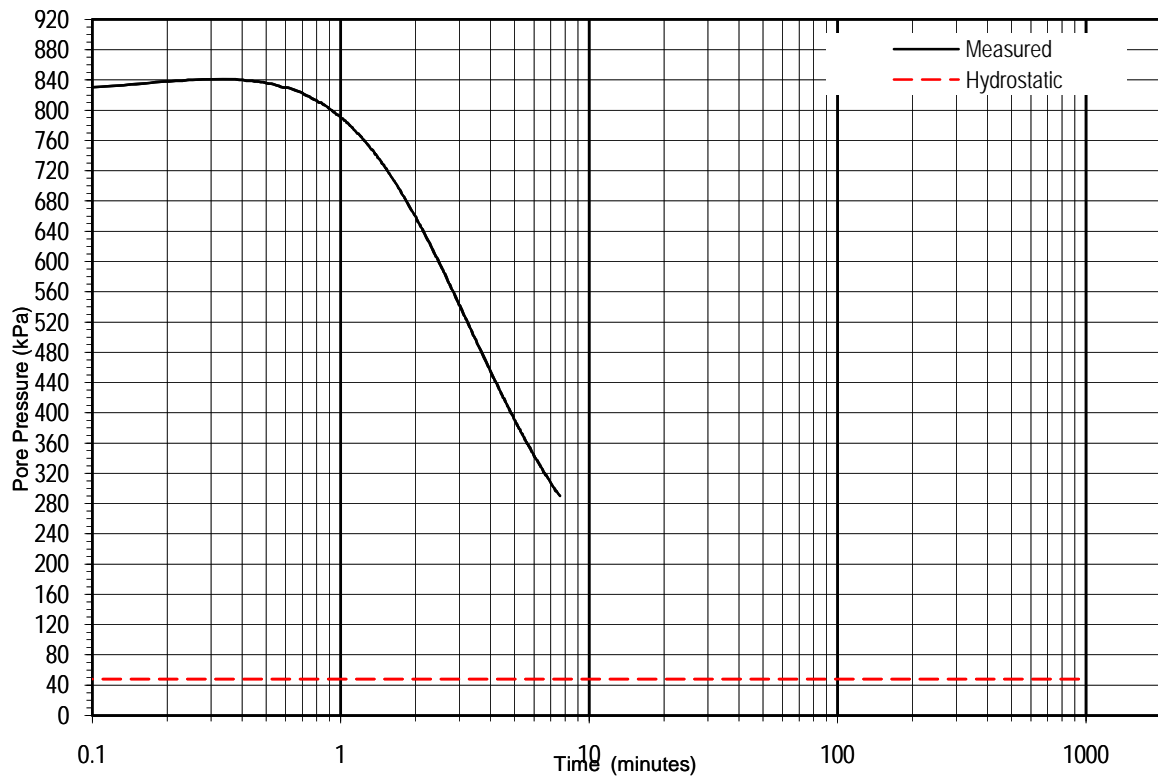
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY**

Static pore pressure, U_o	9	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	88	kPa	(measured from test data)
Final pore pressure at end of test	41	kPa	(measured from test data)
Test duration	13	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	11	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	19	$m^2/year$	
	to	27	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H		2.5×10^{-6}	cm/s
	to	3.4×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT29 PPDT at 1.52m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			




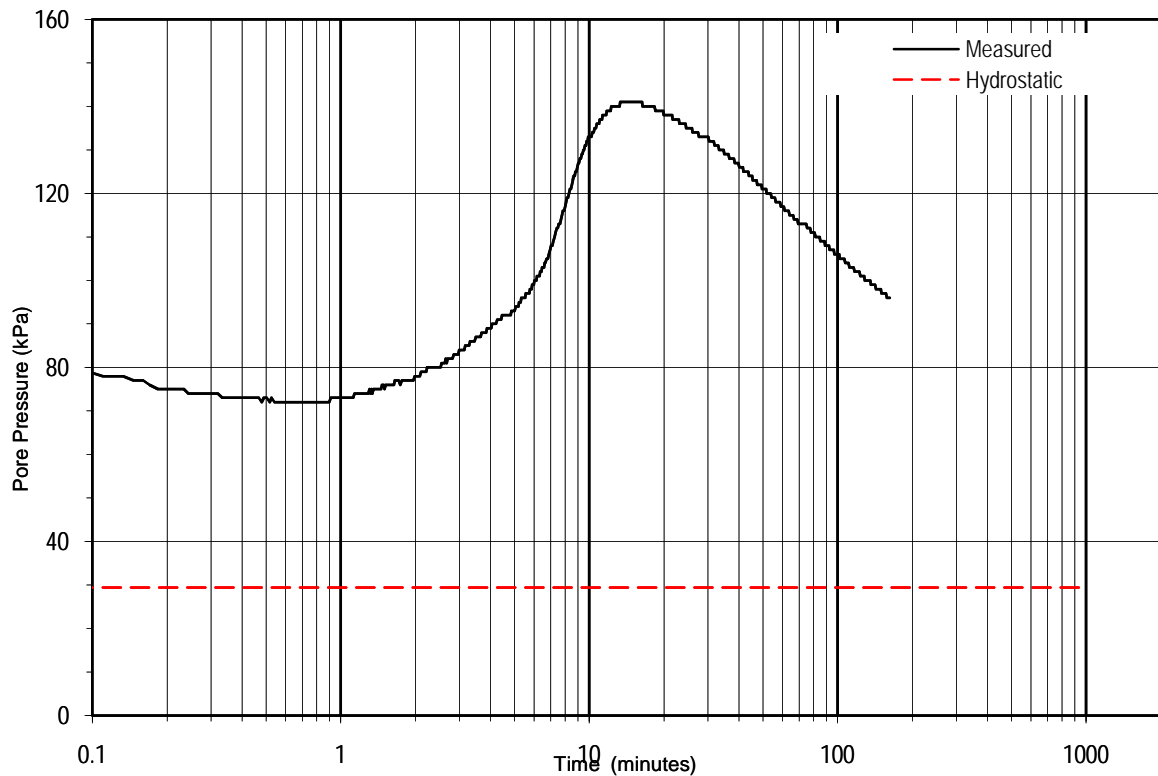
TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **CLAY/Sandy Clay**

Static pore pressure, U_0	48	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	841	kPa	(measured from test data)
Final pore pressure at end of test	290	kPa	(measured from test data)
Test duration	8	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	4	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	48	$m^2/year$	
	to	68	$m^2/year$ (method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	6.3×10^{-6}	cm/s	
	to	8.7×10^{-6}	cm/s (method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT29 PPDT at 5.5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			



TEST DATA & INFERRED SOIL PARAMETERS

Inferred soil type: **Clayey Sand/Sandy Clay**

Static pore pressure, U_o	29	kPa	(calculated from inferred water level)
Maximum pore pressure, U_i	133	kPa	(measured from test data)
Final pore pressure at end of test	96	kPa	(measured from test data)
Test duration	162	min	(measured from test data)
Time for 50% dissipation of U , t_{50}	2	min	(measured from test data)
Horizontal coefficient of consolidation, C_H	106	$m^2/year$	
	to 151	$m^2/year$	(method by Teh, 1988, based on t_{50})
Horizontal hydraulic conductivity, k_H	13.9×10^{-6}	cm/s	
	to 19.3×10^{-6}	cm/s	(method by Robertson, 1992, based on t_{50})

- Notes:
1. Piezocone pore pressure element is located at the standard u_2 location immediately behind the cone tip.
 2. Values of c_H presented above are based on a rigidity index, I_R , of between 20 and 40.
 3. Values of k_H presented above are based on a rigidity index, I_R , of between 20 and 40, and a modulus of volume change, m_v , of 0.0042 kPa^{-1} .

drawn	RC		client:	TRUenergy
approved	SM		project:	TALLAWARRA LANDS
date	7-Jul-10		Location	CPT30 PPDT at 5m
scale	As shown		project no:	ENVIWOLL00250AB
original	A4			

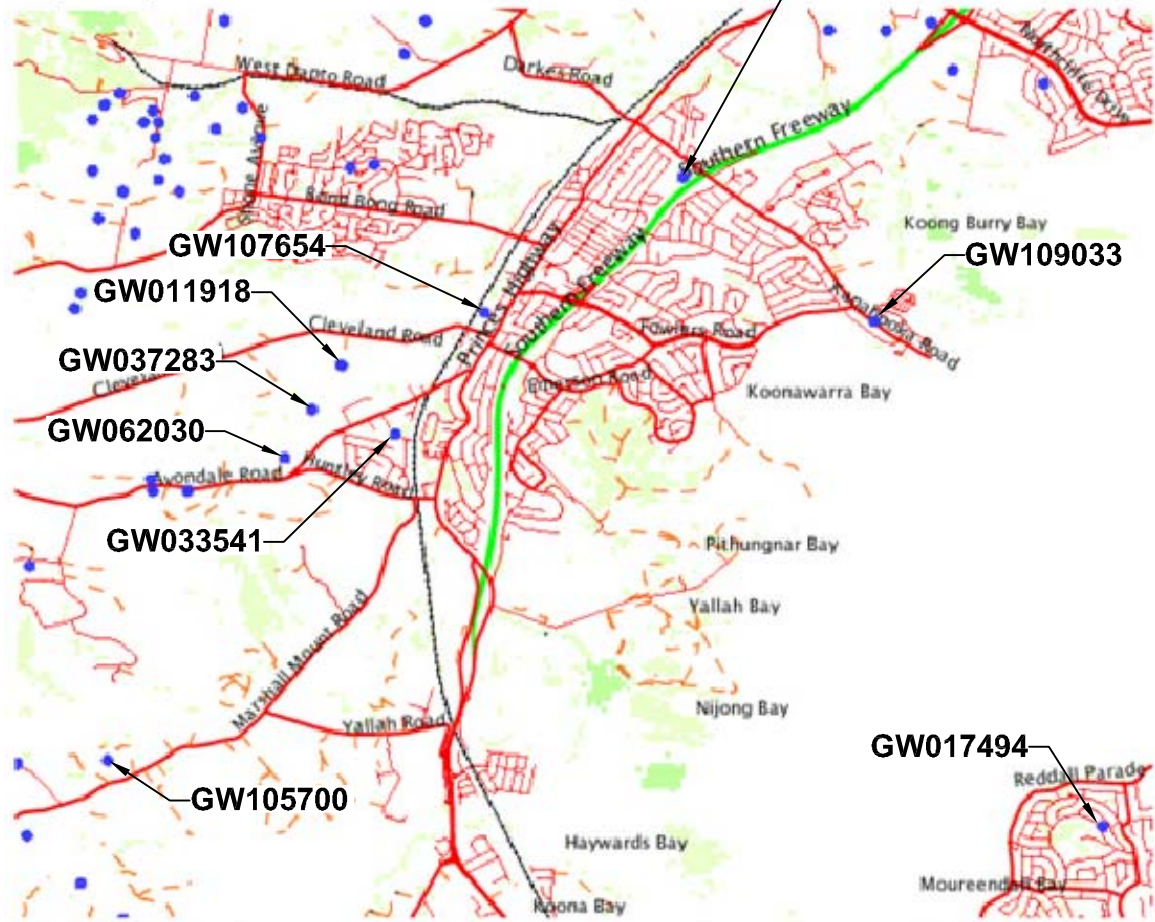
Appendix C

NSW Office of Water Registered Groundwater Bores

Map from the NSW Natural Resource Atlas

Map created with NSW Natural Resource Atlas - <http://nratlas.nsw.gov.au>

Friday, February 12, 2010



0 9 Km

Legend

Symbol	Layer
	Cities and large towns renderImage: Cannot build image from features
	Populated places renderImage: Cannot build image from features
	Towns
	Groundwater Bores
	Catchment Management Authority boundaries
	Major rivers
	Primary/arterial road
	Motorway/freeway
	Railway
	Runway
	Contour
	Background

Topographic base map

COPYRIGHT © 2010 NEW SOUTH WALES GOVERNMENT. MAP HAS BEEN COMPILED FROM VARIOUS SOURCES AND MAY CONTAIN ERRORS OMISSIONS. NO REPRESENTATION IS MADE AS TO ITS ACCURACY OR SUITABILITY

drawn	CCQLT	<p>coffey environments SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE</p>	client:	TRUENERGY		
approved	JMF		project:	GEOTECHNICAL, CONTAMINATION AND GROUNDWATER INVESTIGATION TALLAWARRA LANDS, YALLAH, NSW		
date	20/07/10		title:	GROUNDWATER BORE SEARCH WITH 4.5Km RADIUS OF SITE BOUNDARY		
scale	1:60 000		project no:	ENVIWOLL00250AB-R02	figure no:	FIGURE B1
original size	A4					

Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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[Works Details](#) [Site Details](#) [Form A](#) [Licensed](#) [Construction](#) [Water Bearing Zones](#) [Drillers Log](#)

Work Requested -- GW011918

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW011918
LIC-NUM 10BL004814
AUTHORISED-PURPOSES DOMESTIC INDUSTRIAL STOCK
INTENDED-PURPOSES GENERAL USE
WORK-TYPE Bore
WORK-STATUS Supply Obtained
CONSTRUCTION-METHOD Cable Tool
OWNER-TYPE Private
COMMENCE-DATE
COMPLETION-DATE 1952-01-01
FINAL-DEPTH (metres) 17.30
DRILLED-DEPTH (metres) 0.00
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY BRIDGEWATER ESTATE
GWMA -
GW-ZONE -
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN 214 - WOLLONGONG COAST
AREA-DISTRICT
CMA-MAP 9028-1N
GRID-ZONE 56/1
SCALE 1:25,000
ELEVATION
ELEVATION-SOURCE (Unknown)
NORTHING 6179652.00
EASTING 295710.00
LATITUDE 34 30' 16"
LONGITUDE 150 46' 29"
GS-MAP 0075D3

AMG-ZONE 56
 COORD-SOURCE GD.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
 PARISH KEMBLA
 PORTION-LOT-DP 293

Licensed [\(top\)](#)

COUNTY CAMDEN
 PARISH KEMBLA
 PORTION-LOT-DP 55

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.00	3.90	152			(Unknown)
1	1	Casing	(Unknown)	0.00	12.10	127			(Unknown)

Water Bearing Zones [\(top\)](#)

no details

Drillers Log [\(top\)](#)

no details

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Groundwater Works Summary

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Work Requested -- GW017494

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW017494
LIC-NUM 10BL009983
AUTHORISED-PURPOSES STOCK
INTENDED-PURPOSES STOCK
WORK-TYPE Bore
WORK-STATUS (Unknown)
CONSTRUCTION-METHOD Cable Tool
OWNER-TYPE Private
COMMENCE-DATE
COMPLETION-DATE 1959-12-01
FINAL-DEPTH (metres) 27.40
DRILLED-DEPTH (metres) 27.40
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY ROSEHILL
GWMA 603 - SYDNEY BASIN
GW-ZONE -
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN 214 - WOLLONGONG COAST
AREA-DISTRICT
CMA-MAP 9028-1N
GRID-ZONE 56/1
SCALE 1:25,000
ELEVATION
ELEVATION-SOURCE (Unknown)
NORTHING 6175047.00
EASTING 302290.00
LATITUDE 34 32' 50"
LONGITUDE 150 50' 43"
GS-MAP 0075D3

AMG-ZONE 56
 COORD-SOURCE PR.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
 PARISH TERRAGONG
 PORTION-LOT-DP 1

Licensed [\(top\)](#)

COUNTY CAMDEN
 PARISH TERRAGONG
 PORTION-LOT-DP 10 10970

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.40	27.80	127			Suspended in Clamps

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S- W-L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
15.20	15.20	0.00	Fractured	6.00					(Unknown)
27.40	27.40	0.00	Fractured	6.00	0.15				(Unknown)

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	27.43	27.43	Shale	Water Supply	

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Groundwater Works Summary

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Work Requested -- GW033541

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW033541
LIC-NUM 10BL026435
AUTHORISED-PURPOSES DOMESTIC
INTENDED-PURPOSES IRRIGATION
WORK-TYPE Well
WORK-STATUS Test Hole
CONSTRUCTION-METHOD (Unknown)
OWNER-TYPE Private
COMMENCE-DATE
COMPLETION-DATE 1968-02-01
FINAL-DEPTH (metres) 0.00
DRILLED-DEPTH (metres) 6.10
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY N/A
GWMA 603 - SYDNEY BASIN
GW-ZONE -
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN 214 - WOLLONGONG COAST
AREA-DISTRICT
CMA-MAP 9028-1N
GRID-ZONE 56/1
SCALE 1:25,000
ELEVATION
ELEVATION-SOURCE (Unknown)
NORTHING 6178953.00
EASTING 296185.00
LATITUDE 34 30' 39"
LONGITUDE 150 46' 47"
GS-MAP 0075D3

AMG-ZONE 56
 COORD-SOURCE GD.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 16

Licensed [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 6 751263

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Backfill	Backfill	0.00	6.00	914			

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK-CAT- DESC	S- W-L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
5.40	6.00	0.60	Unconsolidated	3.00					(Unknown)

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	5.48	5.48	Clay		
5.48	6.09	0.61	Sand	Water Supply	

Warning To Clients: This raw data has been supplied to the Department of Infrastructure, Planning and Natural Resources (DIPNR) by drillers, licensees and other sources. The DIPNR does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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Work Requested -- GW037283

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW037283
LIC-NUM 10BL162508
AUTHORISED-PURPOSES DOMESTIC STOCK
INTENDED-PURPOSES DOMESTIC STOCK
WORK-TYPE Bore open thru rock
WORK-STATUS Supply Obtained
CONSTRUCTION-METHOD (Unknown)
OWNER-TYPE Private
COMMENCE-DATE
COMPLETION-DATE 1968-10-01
FINAL-DEPTH (metres) 32.90
DRILLED-DEPTH (metres) 32.90
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY CASSAR
GWMA -
GW-ZONE -
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN 214 - WOLLONGONG COAST
AREA-DISTRICT
CMA-MAP 9028-1N
GRID-ZONE 56/1
SCALE 1:25,000
ELEVATION
ELEVATION-SOURCE (Unknown)
NORTHING 6179191.00
EASTING 295469.00
LATITUDE 34 30' 31"
LONGITUDE 150 46' 19"
GS-MAP 0075D3

AMG-ZONE 56
 COORD-SOURCE GD.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP LT 29 DP 23265

Licensed [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 29 23265

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.20	15.60	152			Suspended in Clamps

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK-CAT- DESC	S- W-L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
9.70	10.00	0.30	Unconsolidated	6.00		0.32			(Unknown)
14.30	14.60	0.30	Unconsolidated	6.00		0.63			(Unknown)
30.40	30.50	0.10	Fractured	6.00		1.26			(Unknown)
31.00	31.30	0.30	Fractured	6.00		4.55			(Unknown)

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL COMMENT
0.00	0.45	0.45	Topsoil	
0.45	2.43	1.98	Clay Grey Puggy	
2.43	9.75	7.32	Clay Sandy	
9.75	12.49	2.74	Silt Sandy Water Supply	
9.75	12.49	2.74	Gravel	
12.49	14.32	1.83	Clay Grey Puggy	
14.32	15.54	1.22	Silt Sandy Water Supply	
14.32	15.54	1.22	Gravel	
15.54	16.45	0.91	Shale Grey Sandy	

16.45 32.91 16.46 Tuff White Light Grey Dark Grey Water Supply

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Groundwater Works Summary

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Work Requested -- GW062030

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW062030
LIC-NUM 10BL122283
AUTHORISED-PURPOSES DOMESTIC IRRIGATION STOCK
INTENDED-PURPOSES IRRIGATION
WORK-TYPE Bore
WORK-STATUS (Unknown)
CONSTRUCTION-METHOD (Unknown)
OWNER-TYPE Private
COMMENCE-DATE
COMPLETION-DATE
FINAL-DEPTH (metres) 6.10
DRILLED-DEPTH (metres) 0.00
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY N/A
GWMA -
GW-ZONE -
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN 214 - WOLLONGONG COAST
AREA-DISTRICT
CMA-MAP 9028-1N
GRID-ZONE 56/1
SCALE 1:25,000
ELEVATION
ELEVATION-SOURCE (Unknown)
NORTHING 6178686.00
EASTING 295247.00
LATITUDE 34 30' 47"
LONGITUDE 150 46' 10"
GS-MAP 0075D3

AMG-ZONE 56
COORD-SOURCE GD.,ACC.MAP
REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
PARISH CALDERWOOD
PORTION-LOT-DP 15

Licensed [\(top\)](#)

COUNTY CAMDEN
PARISH CALDERWOOD
PORTION-LOT-DP NOT AVAILABLE

Water Bearing Zones [\(top\)](#)

no details

Drillers Log [\(top\)](#)

no details

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
 Document Generated on Monday, March 1, 2010

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[Works Details](#) [Site Details](#) [Form A](#) [Licensed](#) [Construction](#) [Water Bearing Zones](#) [Drillers Log](#)

Work Requested -- GW105700

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW105700
LIC-NUM 10BL161971
AUTHORISED-PURPOSES DOMESTIC
INTENDED-PURPOSES DOMESTIC
WORK-TYPE Bore
WORK-STATUS Supply Obtained
CONSTRUCTION-METHOD Down Hole Hammer
OWNER-TYPE Private
COMMENCE-DATE
COMPLETION-DATE 2004-02-12
FINAL-DEPTH (metres) 72.00
DRILLED-DEPTH (metres) 72.00
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY HOUSE WITH NO STEPS
GWMA -
GW-ZONE -
STANDING-WATER-LEVEL 43.00
SALINITY
YIELD 0.20

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN 214 - WOLLONGONG COAST
AREA-DISTRICT
CMA-MAP 9028-1N
GRID-ZONE 56/1
SCALE 1:25,000
ELEVATION
ELEVATION-SOURCE (Unknown)
NORTHING 6175542.00
EASTING 293810.00
LATITUDE 34 32' 28"
LONGITUDE 150 45' 11"
GS-MAP

AMG-ZONE 56
 COORD-SOURCE GIS - Geographic Information System
 REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 1//1039888

Licensed [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 1 1039888

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	12.00	205			Down Hole Hammer
1		Hole	Hole	12.00	72.00	165			Down Hole Hammer
1	1	Casing	PVC Class 9	0.00	12.00	160	148		Screwed and Glued; Driven into Hole

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W- L	D-D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
62.50	63.00	0.50		43.00	64.00	0.02		1.00	500.00

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	6.00	6.00	clay		
6.00	72.00	66.00	siltstone		

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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Work Requested -- GW107654

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW107654
LIC-NUM 10BL165768
AUTHORISED-PURPOSES RECREATION (GROUNDWATER)
INTENDED-PURPOSES RECREATION (GROUNDWATER)
WORK-TYPE Bore
WORK-STATUS
CONSTRUCTION-METHOD Rotary Air
OWNER-TYPE
COMMENCE-DATE
COMPLETION-DATE 2005-02-09
FINAL-DEPTH (metres) 54.00
DRILLED-DEPTH (metres) 54.00
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY DAPTO BOWLING CLUB LTD
GWMA -
GW-ZONE -
STANDING-WATER-LEVEL 6.00
SALINITY
YIELD 0.10

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN
AREA-DISTRICT
CMA-MAP
GRID-ZONE
SCALE
ELEVATION
ELEVATION-SOURCE
NORTHING 6180221.00
EASTING 296918.00
LATITUDE 34 29' 59"
LONGITUDE 150 47' 17"
GS-MAP

AMG-ZONE 56
 COORD-SOURCE
 REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 1 1077277

Licensed [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 1 1077277

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	24.00				Rotary Air
1		Hole	Hole	24.00	54.00				Rotary Air
1	1	Casing	P.V.C.	-0.30	28.00				Glued; Driven into Hole

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S- W-L	D- D- L	YIELD	TEST-HOLE- DEPTH (metres)	DURATION	SALINITY
19.00	19.05	0.05		6.00	0.20	24.00	0.50	Fresh	
40.00	40.15	0.15		6.00	3.60	45.00	0.50	Fresh	
42.00	42.10	0.10		6.00	0.50	47.00	0.50	Fresh	
46.00	46.10	0.10		6.00	0.10	51.00	0.50	Fresh	

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	TOPSOIL		
1.00	10.00	9.00	LANDFILL		
10.00	12.50	2.50	GREY CLAY		
12.50	26.00	13.50	GREY SANDSTONE/SHALE BANDS		
26.00	38.00	12.00	BLUE SHALE		
38.00	54.00	16.00	GREY SANDSTONE		

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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Work Requested -- GW108326

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW108326
LIC-NUM 10BL600597
AUTHORISED-PURPOSES RECREATION (GROUNDWATER)
INTENDED-PURPOSES RECREATION (GROUNDWATER)
WORK-TYPE Bore
WORK-STATUS
CONSTRUCTION-METHOD Rotary Air
OWNER-TYPE
COMMENCE-DATE
COMPLETION-DATE 2005-01-01
FINAL-DEPTH (metres) 54.00
DRILLED-DEPTH (metres) 54.00
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY DAPTO DANDALOO HOTEL
GWMA -
GW-ZONE -
STANDING-WATER-LEVEL 1.00
SALINITY
YIELD 4.40

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN
AREA-DISTRICT
CMA-MAP
GRID-ZONE
SCALE
ELEVATION
ELEVATION-SOURCE
NORTHING 6181654.00
EASTING 298576.00
LATITUDE 34 29' 13"
LONGITUDE 150 48' 23"
GS-MAP

AMG-ZONE 56
 COORD-SOURCE
 REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 8 560853

Licensed [\(top\)](#)

COUNTY CAMDEN
 PARISH CALDERWOOD
 PORTION-LOT-DP 8 560853

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	18.00	200			Rotary Air
1		Hole	Hole	18.00	54.00	160			Rotary Air
1	1	Casing	PVC Class 6	0.30	18.00	160			Glued; Driven into Hole
1	1	Opening	Slots - Vertical	15.00	16.00	160			PVC; SL: 1mm; A: 20mm

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S- W-L	D- D- L	YIELD	TEST-HOLE- DEPTH (metres)	DURATION	SALINITY
13.00	13.03	0.03		1.00		2.50		0.50	Brackish
40.00	40.10	0.10		1.00		4.40		0.50	Brackish

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.20	0.20	TOPSOIL		
0.20	3.00	2.80	SANDY CLAY		
3.00	8.00	5.00	PUGGY CLAY		
8.00	16.00	8.00	COARSE GRAVEL		
16.00	30.00	14.00	GRANITE		

30.00	42.00	12.00	BLUE SHALE
42.00	54.00	12.00	GREY SANDSTONE

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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Work Requested -- GW109033

Works Details [\(top\)](#)

GROUNDWATER NUMBER GW109033
LIC-NUM 10BL601042
AUTHORISED-PURPOSES DOMESTIC
INTENDED-PURPOSES DOMESTIC
WORK-TYPE Bore
WORK-STATUS
CONSTRUCTION-METHOD
OWNER-TYPE Private
COMMENCE-DATE
COMPLETION-DATE 2008-07-14
FINAL-DEPTH (metres) 95.00
DRILLED-DEPTH (metres)
CONTRACTOR-NAME
DRILLER-NAME
PROPERTY WITHNALL
GWMA -
GW-ZONE -
STANDING-WATER-LEVEL
SALINITY
YIELD

Site Details [\(top\)](#)

REGION 10 - SYDNEY SOUTH COAST
RIVER-BASIN
AREA-DISTRICT
CMA-MAP
GRID-ZONE
SCALE
ELEVATION
ELEVATION-SOURCE
NORTHING 6180203.00
EASTING 300231.00
LATITUDE 34 30' 2"
LONGITUDE 150 49' 27"
GS-MAP

AMG-ZONE 56
COORD-SOURCE
REMARK

Form-A [\(top\)](#)

COUNTY CAMDEN
PARISH CALDERWOOD
PORTION-LOT-DP 32//1070753

Licensed [\(top\)](#)

COUNTY CAMDEN
PARISH CALDERWOOD
PORTION-LOT-DP 32 1070753

Water Bearing Zones [\(top\)](#)

no details

Drillers Log [\(top\)](#)

no details

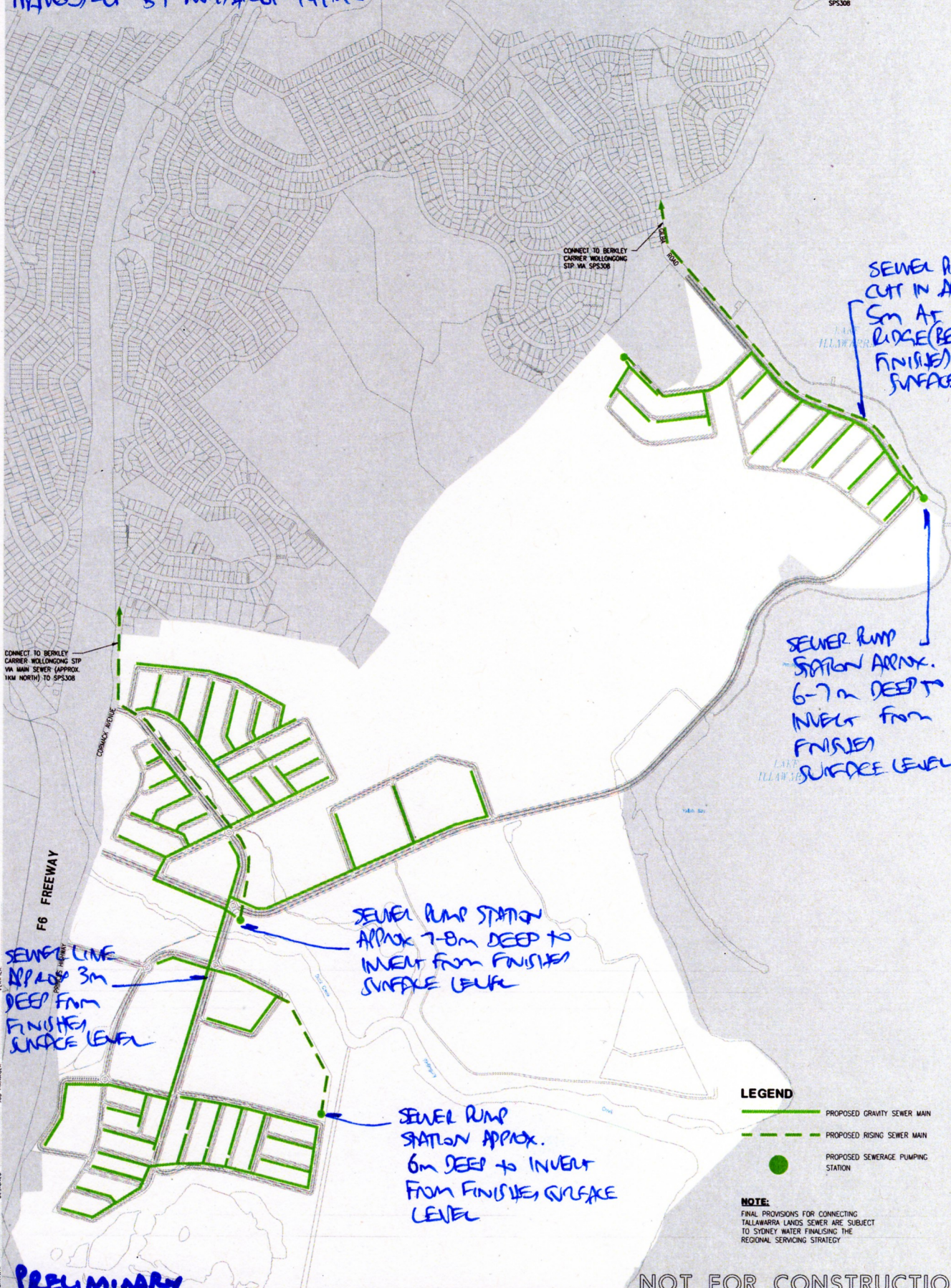
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Appendix D

Preliminary Construction Excavation Plans

MAKES-UP BY NORTHROP-14.11.10

SPS308



CONNECT TO BERKLEY CARRIER WOLLONGONG STP VIA SPS308

CONNECT TO BERKLEY CARRIER WOLLONGONG STP VIA MAIN SEWER (APPROX 100M NORTH) TO SPS308

SEWER ARE CUT IN APPROX 5m AT RIDGE (BELOW FINISHED SURFACE LEVEL)

SEWER PUMP STATION APPROX. 6-7m DEEP TO INVERT FROM FINISHED SURFACE LEVEL

SEWER PUMP STATION APPROX 7-8m DEEP TO INVERT FROM FINISHED SURFACE LEVEL

SEWER LINE APPROX 3m DEEP FROM FINISHED SURFACE LEVEL

SEWER PUMP STATION APPROX. 6m DEEP TO INVERT FROM FINISHED SURFACE LEVEL

LEGEND

- PROPOSED GRAVITY SEWER MAIN
- - - PROPOSED RISING SEWER MAIN
- PROPOSED SEWERAGE PUMPING STATION

NOTE:
FINAL PROVISIONS FOR CONNECTING TALLAWARRA LANDS SEWER ARE SUBJECT TO SYDNEY WATER FINALISING THE REGIONAL SERVICING STRATEGY

PRELIMINARY

NOT FOR CONSTRUCTION

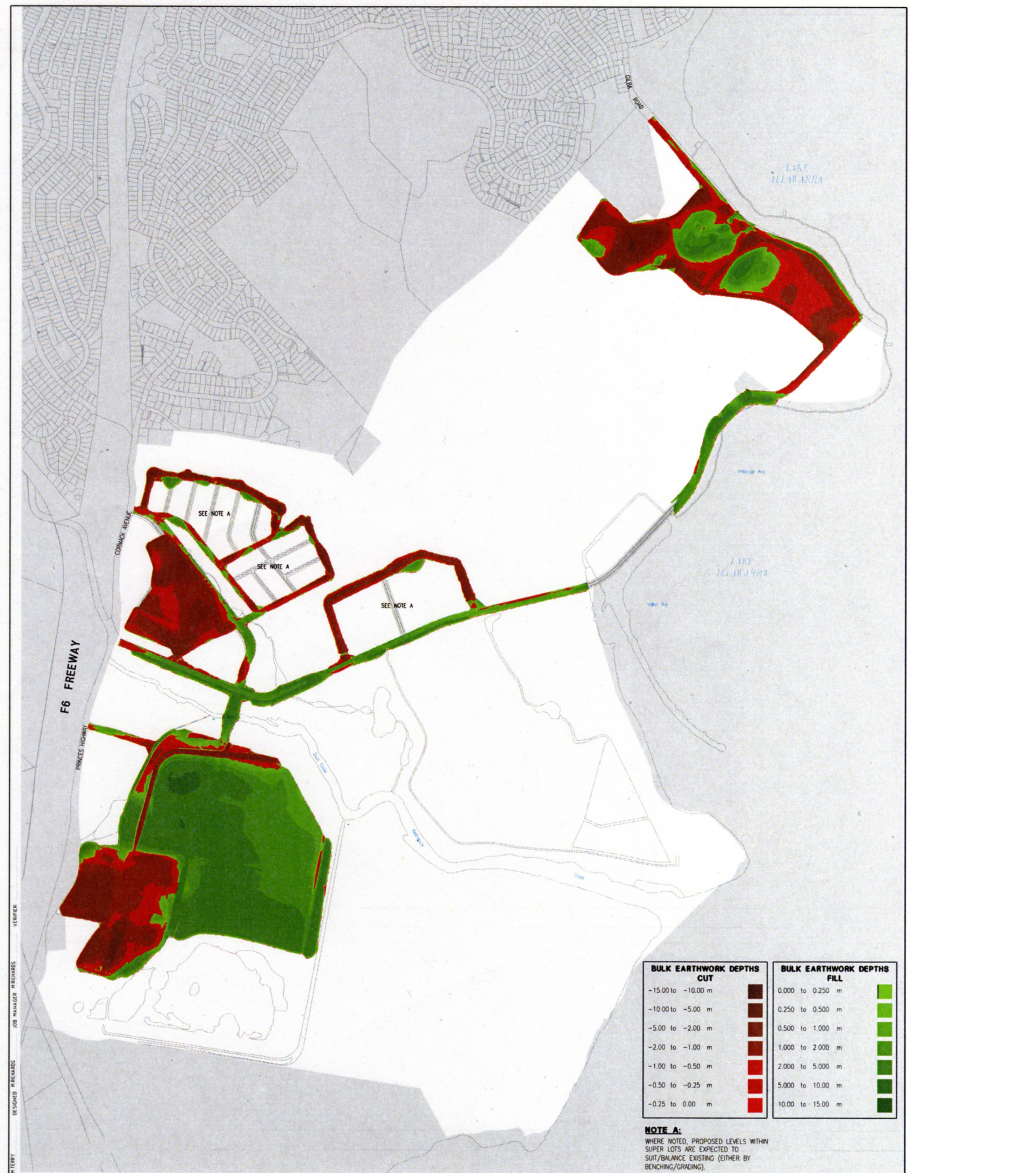
ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE	CLIENT
1	ISSUED FOR PART 3A SUBMISSION		MR	07.10.10	



PROJECT
TALLAWARRA LANDS, YALLAH
PROPOSED MIXED-USE
LAND DEVELOPMENT

DRAWING TITLE
PRELIMINARY SEWER
SERVICING SCHEME

JOB NUMBER
10359
DRAWING NUMBER | **REVISION**
3A-S1 | 1
DRAWING SHEET SIZE = A1



BULK EARTHWORK DEPTHS CUT		BULK EARTHWORK DEPTHS FILL	
-15.00 to -10.00 m	[Dark Red]	0.000 to 0.250 m	[Light Green]
-10.00 to -5.00 m	[Red]	0.250 to 0.500 m	[Light Green]
-5.00 to -2.00 m	[Red]	0.500 to 1.000 m	[Light Green]
-2.00 to -1.00 m	[Red]	1.000 to 2.000 m	[Light Green]
-1.00 to -0.50 m	[Red]	2.000 to 5.000 m	[Light Green]
-0.50 to -0.25 m	[Red]	5.000 to 10.00 m	[Light Green]
-0.25 to 0.00 m	[Red]	10.00 to 15.00 m	[Light Green]

NOTE A:
WHERE NOTED, PROPOSED LEVELS WITHIN SUPER LOTS ARE EXPECTED TO SUIT/BALANCE EXISTING (EITHER BY BENCHING/GRADING).

NOT FOR CONSTRUCTION

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
1	ISSUED FOR PART 3A SUBMISSION		M.R.	07.10.10

CLIENT

AWARDS FOR EXCELLENCE WINNER

NORTHROP
Bringing people, ideas & engineering together
Sydney

15th Cullinan Street, Ph: (02) 9647 4166, P.O. Box 11711
2011 Sydney, NSW, Australia, Fax: (02) 9647 4222, Email: sydney@northrop.com.au

PROJECT

TALLAWARRA LANDS, YALLAH
PROPOSED MIXED-USE LAND DEVELOPMENT

DRAWING TITLE

PRELIMINARY BULK EARTHWORKS PLAN

JOB NUMBER

10359

DRAWING NUMBER | REVISION

3A-BE1 | 1

DRAWING SHEET SIZE = A1

DRAWN: P. TERRY, DESIGNED: RICHARDS, JOB MANAGER: RICHARDS, VERIFIER: