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Kings Forest Development

Precinct 5

SEDIMENT AND EROSION MANAGEMENT PLAN

Address:	Depot Road Kings Forest NSW
Lot & RP Description:	Lot 1 on DP781633 Lot 6 on DP875446 Lot 40 on DP7482
Local Government:	Tweed Shire Council
Prepared for:	PROJECT 28 PTY LTD
Prepared by:	**Mortons – Urban Solutions** Level 2, 19 Short Street (PO Box 2484) Southport Qld 4215 Ph: (07) 5571 1099 Fax: (07) 5571 1088 Email: mortons@urbansolutions.net.au

DATE: APRIL 2020

CIVIL ENGINEERING TOWN PLANNING PROJECT COORDINATION

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Prepared for:
PROJECT 28 Pty Ltd

Property Address:
Depot Road
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Real Property Description:
Lot 1 on DP781633
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DOCUMENT CONTROL

Report Summary

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1.0 INTRODUCTION

Mortons Urban Solutions have been commissioned to compile a Sediment and Erosion Management Plan for the first sequence of the bulk earthworks for the "Proposed Kings Forest Development" site located on Depot Road, Kings Forest in far north eastern New South Wales.

The subject site currently sits as a collection of large, undeveloped allotments. Ultimately the site will house a mixed residential, commercial and community use development across 437 hectares including housing, community and education facilities, commercial facilities, a golf course, active open space and environmental protection areas. The development is anticipated to cater for approximately 11,000 new residents.

The Development is a State Significant Project under the NSW Government State Environment Planning Policy (Major Development). The inclusion of the project as a Major Development results in the NSW Minister for Planning assuming the role of consent authority for assessment of the initial concept plan and project applications under the NSW Environmental Planning and Assessment Act.

Sequence 1 of the project incorporating Precinct 5 of the Development covering 67 hectares is approved under application MP08_0194 (as modified) as approved by the Minister. The Major Approval covers bulk earthworks, roadworks, development of a service station and food and drink premises in Precinct 1 and the subdivision of Precinct 5 into a total of 376 residential Lots.

This submission is for the Bulk earthworks Sequence 1 which covers Precinct 5 and Part Precinct 4 with a spoil area shown in Precinct 6 within this current application;

1. Bulk Earthworks – Erosion and Sediment control - (Reference 12301-BE1-ESC);
2. Bulk Earthworks – Bulk earthworks Engineering Drawings- (Reference 12301-BE1).

Phasing of works as presented in this plan is approved as per drawing12301-SK-050 Rev A as amended by Condition 9f of Major Approval MP08_0194(as modified), which reads;

Staging of Bulk Earthworks

9. Staging of the bulk earthworks shall be in accordance with the following:

a) A Construction Certificate application for Bulk Earthworks shall be lodged for each of the proposed 8 (eight) sequences or stages for the earthworks as detailed in the bulk earthworks drawings numbers 12301-ALL-041 Revision B prepared by Mortons Urban Solutions dated 16 October 2012.

b) An earthworks phasing diagram shall be submitted with each application for a construction certificate for bulk earthworks to define maximum exposed areas.

c) A detailed construction management strategy is to be provided for each sequence/stage of the bulk earthworks, identifying how the site and earthworks are to be programmed and managed.

d) Bulk earthworks for the site are to be limited to a maximum exposed disturbed area (that has not been permanently vegetated) not exceeding a maximum of 5ha at any time to reduce exposed areas, unless otherwise approved by the Secretary at the request of the Proponent.

e) Bulk Earthworks Sequence 9 is to be further managed by being broken down into smaller maximum exposed areas, no greater than 5ha.

f) Notwithstanding d) above, the Kings Forest Precinct 1-5 Earthworks Phasing Diagram dated 29 January 2013 Revision A is approved subject to the following modifications:

   i. Phase 1 shall be further broken down into two phases with a maximum exposed area no greater than 5.5ha.

   ii. Phase 2 shall be broken down into two phases with a maximum exposed area no greater than 9ha.

   iii. Phase 3 shall be broken down into two phases with a maximum exposed area no greater than 7ha.

iv. Phase 6 shall be broken down into two phases with a maximum exposed area no greater than 9ha.

g) Works are to be topsoiled, mulched and seeded within 7 days after completion to protect the exposed areas from water and wind erosion.

The report outlines the soil and water management requirements for the site during the earthworks construction phases. The aim of the report is to assess the erosion risk at the site and identify suitable measures to overcome these erosion risks though monitoring and maintenance procedures and construction staging. These preventative measures are to be installed in accordance with the *Tweed Shire Councils Design Specification D7, Stormwater Quality*, the *Best Practice Erosion and Sediment Control (IECA Australasia, November 2008)* and any other referenced statutory authority policy.

Any part of the plan herein is a guide in the use of suitable measures which could be implemented on the construction site. However not all of the measures may be applicable depending on the construction methodology employed. While all efforts have been made to ensure compliance, it is the ultimate responsibility of the Principal Contractor to implement best practices to manage the severity and extent of soil erosion during the construction phases in accordance with all relevant policies.

2.0 THE SITE AND ITS CONTEXT

2.1 Project Works

The site is located across Lot 1 on DP781633, Lot 6 on DP875446, Lot 40 on DP7482 and Lot 50 on DP1188902. The site is bounded by an unnamed access track to the east, Blacks Creek to the south, and neighbouring undeveloped allotments to the north and west.

The Precinct 5 site covers a total area of 67 Hectares and it is expected that the total area will be disturbed at some point during the bulk earthworks and subsequent phases. To limit the area of disturbance at any one time, the initial Sequence has been divided into seven phases. The aim is to not expose more than 5hectares at any one time.

The initial works packages as outlined in Section 1.0 will cover Phases 1 to 7, as approved as per drawings, 12301-ALL-041 Rev B and 12301-SK-050 Rev A as amended by Conditions A6 and 9f of Major Approval MP08_0194(as modified).

The subject site is identified in Figure 1 and the phasing of the Sequence 1 works are shown on Mortons-Urban Solutions Drawing 12301-BE1-ESC-070 included in **Appendix A**. This phasing is in accordance with the approved drawings, 12301-ALL-041 Rev B and 12301-SK-050 Rev A as amended by Conditions A6 and 9f of Major Approval MP08_0194(as modified).

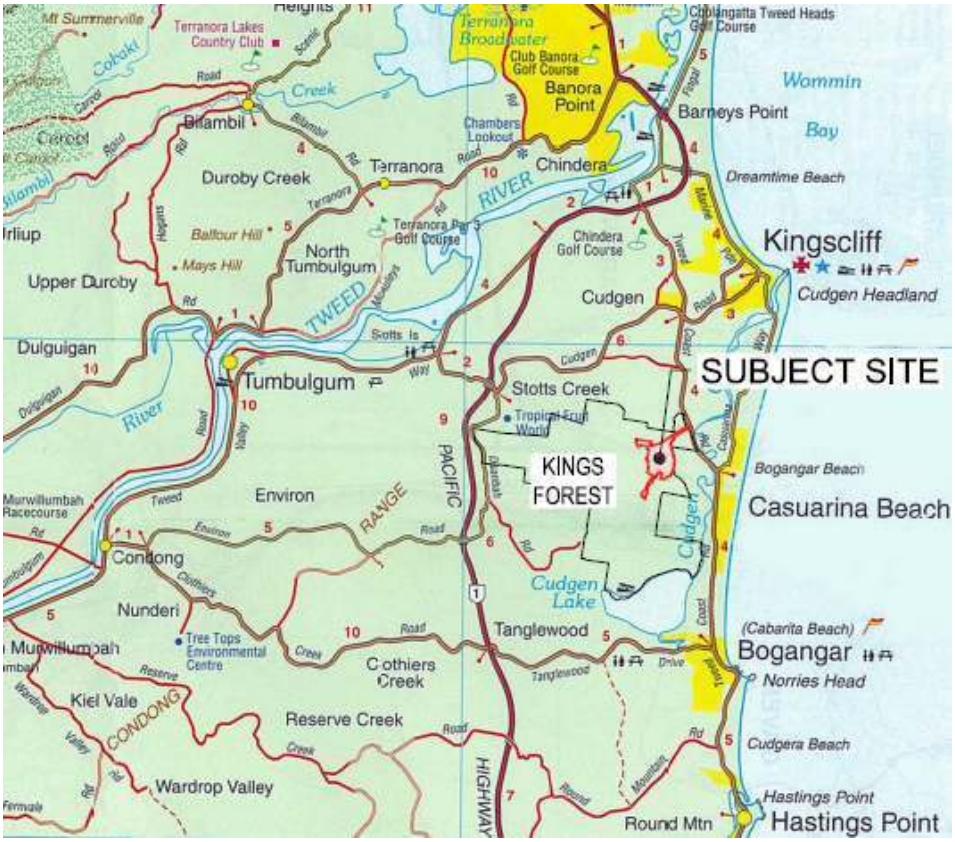

Figure 1: Locality Plan

Source: www.google.com.au/maps

Figure 2: Satellite view of subject Lots
Source: www.google.com.au/maps

2.2 Site Analysis

The proposed earthworks will consist of preliminary stripping, clearing and grubbing and dewatering of existing low points. Cut to fill of on-site material will then follow. Currently the site is used as undeveloped pasture with scattered vegetation and natural drainage channels.

The site has generally flat topography, good grass cover and unsealed private roads running over the site. Areas of high relief exist towards the western and north-western extremities of the site. The partially sealed Depot Road in the north of the site links the site to Tweed Coast Road; the main arterial to the Pacific Motorway which it intersects at Chinderah 6km north of the site.

All areas of the site appear to drain via shallow natural channels and gullies to Blacks Creek southwest of the site. Some channels appear to not permanently drain to the creek owing to the topography of the site. Aerial photography indicates the channels appear to terminate at low points within the site. The entire Precinct 5 site is subject to an overall catchment area of 67 Hectares; with this entire catchment draining into Blacks Creek via the existing channels. Phases 1 to 7 cover an area of 44.7 Hectares.

Figure 3: Environmental Buffers with Koala fence location adjacent works

The site is subject to a Cultural Heritage no-go zone to the northeast of the site; which no personnel nor construction equipment will be permitted to enter. In addition, an ecological buffer zone is conditioned around the perimeter of the site which will include a combination of permanent koala fencing and temporary construction phase koala fencing.

The land appears to be acceptable for use in urban development however being close to a water course there will need to be a moderate degree of soil and water constraints implemented and standard design techniques incorporated to minimise the potential of sediment leaving the site.

3.0 SITE INSTRUCTIONS

The sediment and erosion management report is to be read in conjunction with the engineering plans and any other information in relation to the development of the site. All works are to be undertaken in conjunction with the *Tweed Urban Stormwater Quality Management Plan, Tweed Shire Council Construction Specifications D7 Stormwater Quality and C211 Control of Erosion and Sedimentation*, the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009) and the instructions outlined in this report.

Per Item 2a) of Tweed Shire Council's *Development Design Specification D7*, this Erosion and Sediment Control Plan is required for the issue of a Construction Certificate prior to commencing works.

3.1 Disturbance of Soils

The report *Geotechnical Investigation Proposed Residential Subdivision Depot Road, Kings Forest* by Cardno Bowler (Appendix B) provides analysis on existing soil types. The report from 6 sample locations in Precinct 5 indicates a generally consistent layer of topsoil up to 100mm thick, overlaying generally a 3 to 5 metres layer of loose to very dense sand, overlaying indurated sand in all samples. No clay was encountered in Precinct 5. It is therefore assumed that the material is of Emerson Class 8 and thus type 'D' sediment basins may be adopted.

Proper calibration of model parameters is essential to get good efficiency and prediction results and to reduce the error of forecasts. Large areas of Australia are poorly covered when it comes to the field measurements of soil erosion and the extrapolation of information for isolated areas is confined to the local conditions and individual data measured. Predictability rates will vary and a 'one-size fits all' equation is difficult to declare. The most widely recognised 'universal' application is the Universal Soil Loss Equation (USLE) and has been described by Gilley and Flanagan (2007) as of the most significant developments in soil and water conservation in the 20th century. This was revised by the US Department of Agriculture (USDA) to incorporate additional research that was statistically derived from a large empirical database generated from plot experiments (Simms et al. 2003).

The 'revised' equation known as RUSLE is the most widely accepted to calculate sheet and rill erosions and has been adapted for Australian conditions using the SOILOSS equation, as follows:

$$A = R \times K \times L \times S \times C \times P$$

Where:

A = average annual soil loss,

R = rainfall erosivity factor

K = soil erosivity factor

L = slope length factor

S = slope steepness factor

C = groundcover factor

P = soil conservation practice factor

The R and K factors are in SI units so that the average annual soil loss has units of tonnes per hectare per year (t/ha/yr). This calculated value is used as an index of sheet and rill erosion potential.

3.1.1 R factor

The rainfall erosivity factor (R) is a measure of the erosive power of rainfall. Potential erosion hazards based on the R-factor are the typical upper slope gradient and the rainfall erosivity relating to the site location (Morse 2004). Using data supplied and calculated by the Australian Government Bureau of Meteorology (n.d), the R-factor is estimated from the 2 year 6 hour log-Pearson Type III rainfall intensities where the intensity data is derived from the Australian Rainfall and Runoff database and supplied as a grid at a spacing of 0.025 degrees. Where *Is* is the 2 year 6 hour log-Pearson Type III rainfall intensity the R-factor is given as follows:

$$R = 164.74\,(1.1177)^{Is}(Is)^{0.6444} \qquad \text{(MJ.mm/(ha.h.y)}$$

Using Tables E1 and E2 of Appendix E International Erosion Control Association Australasia's *Best Practice Erosion and Sediment Control,* an **R-factor of 5119 MJ.mm/ha/h/year** has been adopted for the site.

3.1.2 K factor

The soil erodibility factor (K) is a measure of the resistance of the soil to sheet and rill erosion and is estimated from the data on the soils particle size distribution, organic matter content, surface structure and profile permeability. With the site being primarily filled the origin of any imported material is unknown. A **K-factor of 0.05** has been adopted based on the assumption that the material being imported may have a reasonable clay content. This value could be adjusted based on the material being sourced and tested if required.

3.1.3 L and S factors

From the plans provided it is noted that slope lengths will exceed the acceptable maximum limit of 80m (IECA, 2009). It is suggested that these lengths should be shortened by incorporating measures such as contour banks and swale drains into the design. The location of the finished roadways gives reason to install the construction haul roads in the same position which could also effectively break up the slope length to the maximum allowable. There are locations on all stages of the project where the slope lengths will measure close to the maximum allowable 80m length. This distance has been used in the soil loss calculations.

The slope gradients immediately after topsoil stripping and prior to any benching during construction have been measured at generally between 0.5% and 5%. For the purpose of this calculation a slope length of 80 metres and slope gradient of 5% have been adopted.

Using Table E3.3 of Appendix E International Erosion Control Association Australasia's *Best Practice Erosion and Sediment Control,* a **LS factor of 1.19** is adopted.

3.1.4 P factor

The Conservation Practices factor (P) is the ratio applied to disturbed lands and how surface management practices such as restricting the velocity of the runoff and impeding its nature to flow directly downhill have been addressed. Management practices in earthworks can limit soil erosion, as such the P factor can be condensed by reducing the smoothness and compaction of the exposed areas. While practices such as track-walking along the contour and up and down the slope, or leaving the top 300mm uncompacted can reduce the value and the contractor will be encouraged to take such measures on site. However, the default value for a compacted and smooth surface condition of an urban construction site of **1.3** (IECA 2009) will be conservatively adopted for the project.

3.1.5 C factor

The cover and management factor (C) introduces the combined effect of all interrelated vegetative cover and management variables. It is the measure of the additional erosion from the frequent disturbance by cultivation (Rosewell 1997) or in the case of earthworks, the stripping and removal of topsoil exposing the bare subsoil. The C factor measures the protection of the soil surface from raindrop impact by vegetative material at some height above the soil surface (canopy cover) and the additional protection from raindrop impact and overland flow by cover in contact with the soil surface (surface cover) (Simms et al. 2003).

The C-factor will vary based on the distribution of erosive rainfall, the disturbance of the soil and the ground cover maintained. Values can vary from 0 for well protected soils to 1.5 for finely tilled, ridged surfaces that produce a great deal of runoff leaving it susceptible to rill erosion (Simms et al. 2003). As the C factors are calculated as an average, annual value based on an estimate of ground cover at an unknown time during the year. The C factor can be overestimated and a seasonally weighted C factor based on the seasonal distribution of ground cover and erosive rain is suggested as more realistic.

Rosewell (1997) displays concerns of estimating a C factor in areas where there is high rock cover and also in areas where the rainfall is markedly seasonal. The **C-factor of 1** has been conservatively adopted for this construction site where the topsoil will have been stripped, there is no ground cover and the working surface has been 'grubbed'.

3.1.6 Calculated soil loss

The project will be divided in to 8 separate phases as nominated in Condition A6 of major approval MP08_0194(as modified) to reduce the exposure time of any disturbed areas and to limit the size of the sediment basins to a more reasonable and economical size. The first phases of the works which are represented on drawing 12301-BE1-ESC-070 contained within **APPENDIX A** will take an estimated 18 weeks (4.5 months) to construct. Mortons-Urban Solutions propose that Phases 1 to 6 will be constructed in the package 'Bulk Earthworks 1', with Phases 7 to 10 to follow in a separate package.

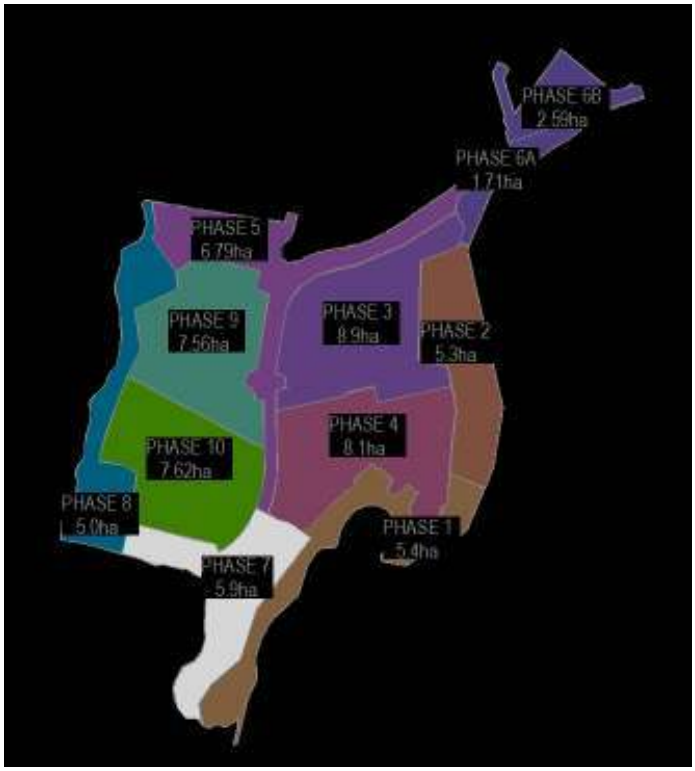

Figure 4: Construction Phasing

Adopting a conservative assumption, the calculations for predicted soil loss (T) and the sizing of each sediment basin will be based on a disturbance period of 6 months.

Based on topography and anticipated construction timing, the construction phases have been divided into 11 soil loss catchments, per Figure 4 and 14 basin catchments per Figure 5:

Figure 5: Soil Loss Catchments – based on topography

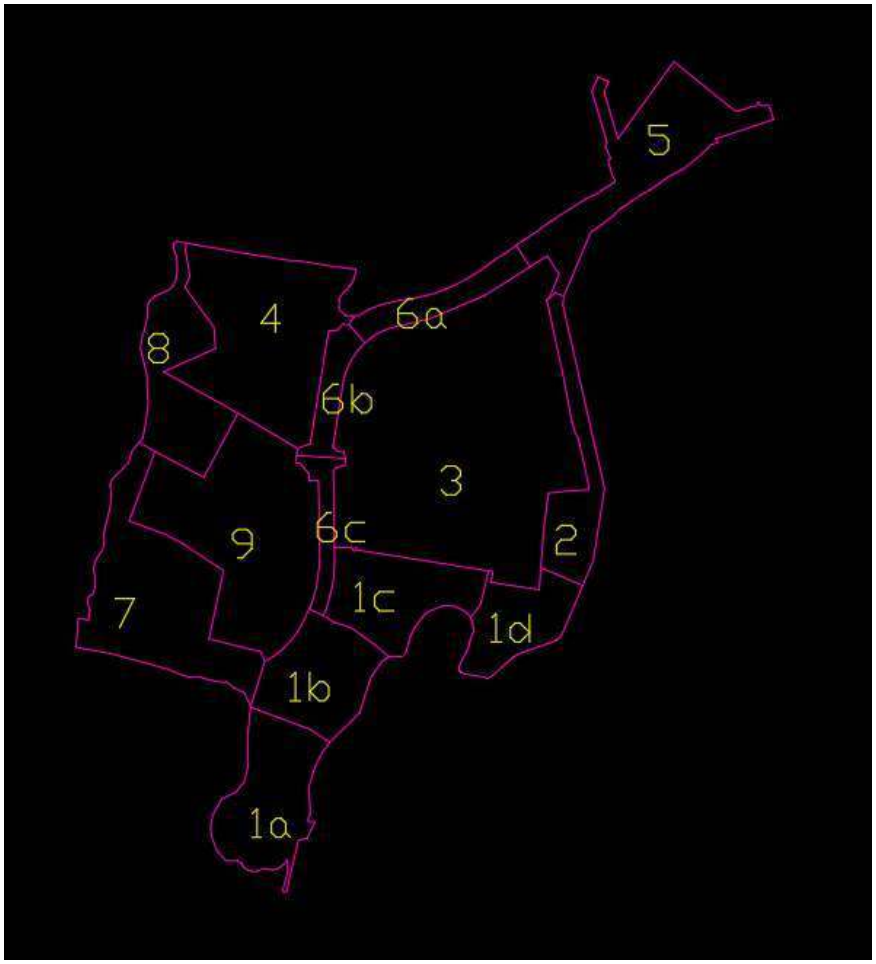

Figure 6: Basin Catchments – based on proposed construction sequencing

Mortons-Urban Solutions estimate that soil will be exposed and works completed and stabilised at a rate of approximately 4 to 5 Hectares per month.

Works are to be conducted sequentially from Phase 1 to Phase 10; however several phases of work may be exposed at once. Total soil exposure at any time will be limited to a total of 4 Hectares. During periods of less than 120mm/month mean rainfall or less than 10mm rainfall predicted within the next 7 days, this may be increased to 5 Hectares. Development approval conditions require stabilisation of each phase before moving onto the next phase. In catchments over 5 Hectares in area; a maximum of 5 Hectares disturbed at any one time will apply subject to the above limits.

RUSLE Parameter	Soil Loss Catchment 1	Soil Loss Catchment 2	Soil Loss Catchment 3	Soil Loss Catchment 4	Soil Loss Catchment 5	Soil Loss Catchment 5a
Construction Phase	1	2	2, 3, 4	1 & 4	5	5
Rainfall Erosivity (R)1	5119	5119	5119	5119	5119	5119
Soil Erodibility (K)	0.05	0.05	0.05	0.05	0.05	0.05
LS Factor	1.19	1.19	1.19	1.19	1.19	1.19
Erosion Control Factor (P)	1.3	1.3	1.3	1.3	1.3	1.3
Ground Cover (C)	1	1	1	1	1	1
Catchment Area (Ha)	4.13	2.33	17.59	3.60	3.13	3.30
Disturbed Site Area (B) (Ha)	4.13	2.33	17.59	3.60	3.13	3.30
Calculated Soil Loss from RUSLE (A)	396 t/ha/yr	396 t/ha/yr	396 t/ha/yr	396 t/ha/yr	396 t/ha/yr	396 t/ha/yr
Predicted duration of disturbance (months/12) (T)	0.17	0.10	0.73	0.15	0.13	0.14
Predicted total soil loss R = A x B x T (Tonnes)	282	90	5103	214	161	179

Table 1a – Calculated Soil Loss

RUSLE Parameter	Soil Loss Catchment 6	Soil Loss Catchment 7	Soil Loss Catchment 8	Soil Loss Catchment 9	Soil Loss Catchment 10
Construction Phase	6	7	8	9	10
Rainfall Erosivity (R)1	5119	5119	5119	5119	5119
Soil Erodibility (K)	0.05	0.05	0.05	0.05	0.05
LS Factor	1.19	1.19	1.19	1.19	1.19
Erosion Control Factor (P)	1.3	1.3	1.3	1.3	1.3
Ground Cover (C)	1	1	1	1	1
Catchment Area (Ha)	4.66	5.94	5.04	7.56	7.60
Disturbed Site Area (B) (Ha)	4.66	5.94	5.04	7.56	7.60
Calculated Soil Loss from RUSLE (A)	396 t/ha/yr	396 t/ha/yr	396 t/ha/yr	396 t/ha/yr	396 t/ha/yr
Predicted duration of disturbance (months/12) (T)	0.19	0.25	0.21	0.32	0.32
Predicted total soil loss R = A x B x T (Tonnes)	358	582	420	942	954

Table 1b – Calculated Soil Loss

In accordance with the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009) the site is over 150 tonnes of soil loss for the period of disturbance and is classed as a high risk. By staging and careful planning of the construction of the works, the reduction in the areas of exposed material will reduce this potential soil loss significantly. Based on the proposed construction staging shown in *Appendix D* and described in *Section 4.0* the potential soil loss can be reduced significantly at any one time.

Careful management regimes are to be undertaken to ensure that disturbed lands have a ground cover factor (C-factor) greater than 0.10 only when a 3-day rain forecast is unlikely. It is expected that C-factors will reach values of 1.0 during construction however they should be kept to a maximum of 0.10 for stockpiles and constructed areas after 10 working days from completion of works (this value should be increased to a maximum of 0.05 for waterways or areas subject to concentrated flows). In a period of 20 days of inactivity (even if works are to continue later) all lands must have a maximum C-factor of 0.15.

3.2 Sediment Basin Calculations

High average annual rainfalls have been recorded for the region with intense storm patterns being documented. With this high intensity rainfall and the high erosion potential for the site, it is desirable to keep all site activities restricted to periods where rainfall erosivity is low (April-October). By keeping disturbance to a minimum and following best practice techniques during the construction period, the soil loss from site can be isolated as much as possible.

The sizing of a sediment basin on a construction site within the Tweed Shire requires principal criteria to be satisfied. As outlined by the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009) these design standards require the basin settling zone to be able to contain all run-offs expected from a y-percentile, x-day rainfall depth where depending on the sensitivity of the receiving waters and/or the duration that the structure is in use.

While it is extremely likely that works for all stages except Phase 5 will be completed within 6 months, a conservative assumption is taken that the works will exceed 6 months. As such, an 80th percentile, 5-day rainfall depth of **38mm** (IECA, 2018) has been adopted. This figure will be used for the design of the sediment basin settling zone.

Based on the soils discovered during the geotechnical investigation, a project surface material described as a silty sand has been assumed. This corresponds as a Soil Hydrological **Group A**

(IECA 2018). Using the values provided in *Table B7 –'Typical single storm event volumetric runoff coefficients' in Appendix B of the 'Best Practice Erosion and Sediment Control Manual'*(IECA 2009; table B.18) the suggested volumetric runoff coefficient (C_v) for the rainfall event adopted (38mm) is given as **0.16**.

The proposed sediment basin designs are shown in Tables 2a - 2c and the calculations included in *Appendix C*.

Sediment Basin Data	Basin 1a*	Basin 1b*	Basin 1c*	Basin 1d*	Basin 2	Basin 3
Construction Phase	1	1	1	1	2	2, 3, 4
80^h percentile, 5 day rainfall event	38mm	38mm	38mm	38mm	38mm	38mm
Soil Hydrological Group	A	A	A	A	A	A
Volumetric Runoff Coefficient (C_v)	0.16	0.16	0.16	0.16	0.16	0.16
Catchment Area	3.59 Ha	3.17 Ha	3.22 Ha	2.30 Ha	2.33 Ha	17.59 Ha
Settling Zone Volume	371.5m^3	334.1m^3	338.4m^3	237.6m^3	240.5m^3	1336.3m^3
Sediment Storage Volume	186m^3	167m^3	169m^3	119m^3	120m^3	668m^3
Total Basin Volume	557.5m^3	501.1m^3	507.4m^3	356.6m^3	360.5m^3	2004.3m^3
Basin Shape (L:W ratio = 1:3, average depth = 1.5m)	11.1m x 33.4m	10.6m x 31.7m	10.6m x 32.0m	9.0m x 26.8m	9.0m x 27.0m	21.1m x 63.3m

Table 2a – Sediment Basin Sizing

Sediment Basin Data	Basin 4	Basin 5	Basin 6a*	Basin 6b*	Basin 6c*	Basin 7
Construction phase	5, 9	6	6	6	6	7, 8, 10
80^h percentile, 5 day rainfall event	38mm	38mm	38mm	38mm	38mm	38mm
Soil Hydrological Group	A	A	A	A	A	A
Volumetric Runoff Coefficient (C_v)	0.16	0.16	0.16	0.16	0.16	0.16
Catchment Area	6.98 Ha	4.66 Ha	1.36 Ha	1.07 Ha	0.87 Ha	6.18 Ha
Settling Zone Volume	635.0m^3	466.6m^3	161.3m^3	132.5m^3	113.8m^3	580.3m^3
Sediment Storage Volume	318.0m^3	233.0m^3	81.0m^3	66.0m^3	57.0m^3	290.0m^3
Total Basin Volume	953.0m^3	699.6m^3	242.3m^3	198.5m^3	170.8m^3	870.3m^3
Basin Shape (L:W ratio = 1:3, average depth = 1.5m)	14.6m x 43.7m	12.5m x 37.4m	7.3m x 22.0m	6.7m x 20.0m	6.2m x 18.6m	13.9m x 41.8m

Table 2b – Sediment Basin Sizing

Sediment Basin Data	Basin 8	Basin 9
Construction phase	8	9, 10
80^{h} percentile, 5 day rainfall event	38mm	38mm
Soil Hydrological Group	A	A
Volumetric Runoff Coefficient (C_v)	0.16	0.16
Catchment Area	3.44 Ha	8.11 Ha
Settling Zone Volume	$354.2m^3$	$712.8m^3$
Sediment Storage Volume	$177.0m^3$	$356m^3$
Total Basin Volume	$531.2m^3$	$1068.8m^3$
Basin Shape (L:W ratio = 1:3, average depth = 1.5m)	10.9m x 32.6m	15.4m x 46.3m

**may be constructed as an infiltration trench instead of a basin.*

Table 2c – Sediment Basin Sizing

Note: The basin sizes are based on the entire stripping and clearing of each phase. It is advised to reduce the area of exposed surface at any one time in accordance with the relevant authority regulations. A reduction in basin sizes could also be achieved by additional smaller basins of an analogous total volume strategically placed around the site.

3.3 Peak Flow Calculations

The Rational formula has been used to calculate the peak flows for the project. Based on the slope gradient and lengths as previously tabled and using a roughness coefficient to mimic the predicted exposed surface, a time of concentration (t_c) value was derived for all basin catchments of the project using Friends Equation.

Basin Catchment	T_c (minutes)	Rainfall Intensity ($I_{2,tc}$) (mm/hr)	Basin Catchment	T_c (minutes)	Rainfall Intensity ($I_{2,tc}$) (mm/hr)
1a	12	**119.4**	**5**	14	**112.8**
1b	12	**119.4**	**6a**	8	**133**
1c	12	**119.4**	**6b**	8	**140**
1d	10	**126**	**6c**	7	**147**
2	10	**126**	**7**	15	**109.5**
3	23	**87.9**	**8**	12	**119.4**
4	16	**102.9**	**9**	17	**102.9**

Table 3 – Runoff Design Detail for Basin Catchments

Using the ARI data supplied as part of *Appendix C* and based on the design standard of 1 in 2 year ARI for a temporary drainage structure constructed for a period of less than 12 months (IECA 2009; table 4.3.1), rainfall intensities $I_{yr,tc}$) was interpolated from Tweed Shire Council IFD Charts (Reference Development Design Specification D5).

The runoff coefficient (C_{10}) for such a rainfall event based on a soil hydrological group Type A soil is shown as **0.35** (IECA Best Practice Erosion and Sediment Control, Page A.7). Using this information and a frequency factor of 0.85, the following peak flows shown in *Table 3* were calculated for a 1 in 2 year ARI event with the detailed calculations supplied as part of *Appendix C*.

Peak Flow Data	Catchment 1a	Catchment 1b	Catchment 1c	Catchment 1d	Catchment 2	Catchment 3
Horton's roughness value (n)	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275
Length of flow path (L)	80m	80m	80m	80m	80m	80m
Slope Gradient (S)	5%	5%	5%	5%	5%	5%
Time of Concentration (t_c) using Friends Equation	12 mins.	12 mins.	12 mins.	10 mins.	10 mins.	23 mins.
Soil Hydrological Group	A	A	A	A	A	A
Runoff Coefficient for ARI of 10 years (C_{10})	0.35	0.35	0.35	0.35	0.35	0.35
Rainfall Intensity ($I_{2yr,tc}$)	119.4mm/hr	119.4mm/hr	119.4mm/hr	126mm/hr	126mm/hr	87.9mm/hr
Catchment Area (A)	3.59Ha	3.17Ha	3.22Ha	2.30Ha	2.33Ha	17.59Ha
Frequency Factor (F_y)	0.85	0.85	0.85	0.85	0.85	0.85
Peak Flow (Q_y) using Rational Formula	0.355m^3/s	0.313m^3/s	0.318m^3/s	0.240m^3/s	0.243m^3/s	1.279m^3/s

Table 4a – Peak Flow Data for 1 in 2 year ARI

Peak Flow Data	Catchment 4	Catchment 5	Catchment 6a	Catchment 6b	Catchment 6c	Catchment 7
Horton's roughness value (n)	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275
Length of flow path (L)	80m	80m	80m	80m	80m	80m
Slope Gradient (S)	5%	5%	5%	5%	5%	5%
Time of Concentration (t_c) using Friends Equation	16mins.	14 mins.	8 mins.	8 mins.	7 mins.	15 mins.
Soil Hydrological Group	A	A	A	A	A	A
Runoff Coefficient for ARI of 10 years (C_{10})	0.35	0.35	0.35	0.35	0.35	0.35
Rainfall Intensity ($I_{2yr,8min}$)	102.9mm/hr	112.8mm/hr	133mm/hr	140mm/hr	147mm/hr	109.5mm/hr
Catchment Area (A)	6.98Ha	4.66Ha	1.36Ha	1.07Ha	0.87Ha	6.18Ha
Frequency Factor (F_y)	0.85	0.85	0.85	0.85	0.85	0.85
Peak Flow (Q_y) using Rational Formula	0.594m^3/s	0.435m^3/s	0.150m^3/s	0.124m^3/s	0.106m^3/s	0.560m^3/s

Table 4b – Peak Flow Data for 1 in 2 year ARI

Peak Flow Data	Catchment 8	Catchment 9
Horton's roughness value (n)	0.0275	0.0275
Length of flow path (L)	80m	80m
Slope Gradient (S)	5%	5%
Time of Concentration (t_c) using Friends Equation	12mins.	17 mins.
Soil Hydrological Group	A	A
Runoff Coefficient for ARI of 10 years (C_{10})	0.35	0.35
Rainfall Intensity ($I_{2yr,8min}$)	119.4mm/hr	102.9mm/hr
Catchment Area (A)	3.44Ha	8.11Ha
Frequency Factor (F_y)	0.85	0.85
Peak Flow (Q_y) using Rational Formula	0.340m^3/s	0.690m^3/s

Table 4c – Peak Flow Data for 1 in 2 year ARI

Note: The peak flows are based on the entire stripping and clearing of the stage in one phase. It is advised to reduce the area of exposed surface at any one time in accordance with the relevant authority regulations.

3.4 Water Quality Objectives

As outlined in the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009) the allowable maximum concentration of total suspended solids (TSS) discharging from site during the construction phase is 50mg/L.

The release of flow from the site to any waterway, stormwater drain or drainage line leading to a waterway or area of native vegetation over this limit will be sensibly enforced and is generally linked to one or more failures in the design, operation or maintenance of control devices on the site. It is intended to employ appropriate measures and best practice methods to ensure water quality objectives are met. Where possible, water from external catchments will be diverted around the site via lined, cut-off drains while runoff from the exposed site will be channelled to detention sediment basins and treated to meet the water quality objectives. Additional measures including sediment fencing and bunding will also be incorporated to minimise the run-off potential of turbid water into adjacent waterways.

Testing and treatment of the detained runoff prior to release and the monitoring of water quality at any points of discharge into adjacent waterways is to be undertaken by an environmental representative nominated by the principal contractor and approved by the superintendent. Testing and treatment is to be undertaken during and after any rainfall event that generates stormwater run-off on site or as directed by the superintendent.
If the upper limit level of the TSS is exceeded, the local authority shall be notified in order to identify and present feedback on problems within the design and maintenance procedure.

A water quality monitoring schedule or approved similar showing all the inspection details is to be utilised and kept on-site at all times.

3.5 Site Stabilisation

To maximise the success of the revegetation works, the amelioration of the topsoil may be required and the addition of lime to reduce the acidity of the topsoil may also need to be introduced subject to testing. The rates for fertilisation and liming of the topsoils are to be provided by an experienced landscape architect or horticulturalist.

Due to the fact the topsoil is known to be often hard setting it should not be respread when wet. The preparation and quality of the soil should be in accordance with *Brisbane City Council's S190 Landscape Specifications* (2001a) and the application of the topsoil to batters should only be

undertaken where keying (e.g. track-walking) into the subsoil is possible. Where placed on slopes greater than 25% the topsoil should be kept to a depth of 40-60mm to reduce the risk of possible slumping. On batters where the slope is less than 25% at least 75mm of topsoil should be placed.

Where the slope on the site will restrict stabilising techniques such as drill seeding, it is suggested a primary stabilisation method such as hydromulching be adopted. Seeding used for temporary stabilisation purposes is to be applied in accordance with the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009) with written verification of the applied spray rates and mix used to be produced by the supplier. Depending on the season when the works will occur, suggested seed mixes as described in *Table 4* shall be adopted.

The use of mulched material from local species removed during the earthworks phase can be used in places where protection is required. This mulch shall be maintained until the vegetative cover can provide protection against erosion.

Mix Type	**Period Applied**	**Ingredient**	**Application Rate**	**Fertilise prior to application**
Grass seed mix 1	October to March	Japanese Millet Paspalam Nicorae (Blue Dawn) Boothriochloa pertusa (Indian Blue Grass)	8kg/ha 25kg/ha 2kg/ha	F10-300kg/ha
Grass seed mix 2	April to September	Perennial Rye Paspalam Nicorae (Blue Dawn) Boothriochloa pertusa (Indina Blue Grass or Dawson, Yeppoon or Keppel in decreasing order or preference)	5kg/ha 25kg/ha 2kg/ha	F10-300kg/ha

Table 5 – Hydromulch Seed Mix Rates

4.0 CONSTRUCTION STAGING

It is intended to control the onsite erosion by limiting the exposure of the disturbed areas where and suggested to divide this work into seven phases. These phases will be the areas shown in ***Appendix A*** as Phases 1 to 7 respectively and are to be constructed in ascending order; with works to drain into basins initially with any runoff to flow over previously constructed and stabilised phases.

Upon completion and stabilisation of the subsequent stage, works will then proceed with the next stage therefore reducing the exposure of disturbed land at any one time. The erosion and sediment control phases are described below.

Stage 1 Site Preparation

1. Ensure all staff have had all necessary Induction training particularly construction staff engaged in undertaking initial subsurface disturbance must undergo a Cultural Heritage Induction prior to working on site and are familiar with the findings of Aboriginal objects or human remains procedures as outlined within the Cultural Heritage Management plan as part of the Construction Phase Environmental Management Plan.
2. Erection of No-Go Zone fencing around areas of cultural heritage significance vegetation identified to be retained in the approved Vegetation Management Plan
3. Erection of No-Go zone flagging to areas adjacent to the construction access track and to areas around site amenities
4. Installation of lined clean water diversion and sediment fencing where shown indicatively on Drawing 12301-BE1-ESC-070. Location of clear water drains to be confirmed with Superintendent prior to commencement.
5. Installation of stabilised site access off Tweed Coast Road. ***All access to site during the construction will be from this location.***
6. Construction of a main access track for on-site equipment to use to limit unnecessary disturbance.
7. Excavate and construct stormwater infiltration beds per final design complete. Note the beds should be constructed using local material to the approval of geotechnical engineer; no dispersive material to be used.
8. Construct lined dirty water catch drains (including rock check dams and batter chutes etc.) to discharge into infiltration beds.
9. Install site amenities at suitable location. Note: site amenities and storage area to remain in the same location for all stages of works. Sealed roadways to remain intact where possible.

10. Clear and grub and establish spoil area 1 shown on drawing 12301-BE1-005 partially covering future works phases 7, 8 and 10. Prepare spoil area 2 (to west of Phase 8) same as above as operationally necessary. Protect exposed faces of stockpiles and install catch drain to upslope and sediment fence to downslope.

11. Clear and grub and strip areas to be readily worked and avoid opening excessive amounts of exposed ground. Progressively strip and stockpile topsoil to Phase 1. Where necessary protect exposed faces of stockpiles and install catch drain to upslope and sediment fence to downslope.

Stage 1 Earthworks

12. Cut to fill and import fill in areas to design levels shown.
13. Complete construction of earthworks where shown.
14. Respread topsoil and progressively stabilise areas as completed using approved method (hydromulching, drill seeding or alternative as approved by superintendent). Erect No-Go zone flagging to prevent vehicle and pedestrian access to these areas.
15. Complete works to Phase 1 and include all control devices to completed works.
16. Leave No-Go Zone barriers and sediment fencing to creek boundary until completion of all works.

Stage 2 Site Preparation

1. Ensure all staff have had all necessary Induction training particularly construction staff engaged in undertaking initial subsurface disturbance must undergo a Cultural Heritage Induction prior to working on site and are familiar with the findings of Aboriginal objects or human remains procedures as outlined within the Cultural Heritage Management plan as part of the Construction Phase Environmental Management Plan.
2. Erection of No-Go Zone fencing around areas of cultural heritage significance and vegetation identified to be retained in the approved Vegetation Management Plan
3. Installation of sediment fencing and lined cleanwater diversion drains where shown indicatively on Drawing 12301-BE1-ESC-070. Location of cleanwater drains to be confirmed with Superintendent prior to commencement.
4. Construction of a main access track and no-go zone flagging.
5. Excavate and construct stormwater infiltration beds per final design complete. Note the beds should be constructed using local material to the approval of geotechnical engineer; no

dispersive material to be used.

6. Construct lined dirty water catch drains (including rock check dams and batter chutes etc.) to discharge into sediment basin
7. Clear and grub and strip areas to be readily worked and avoid opening excessive amounts of exposed ground. Progressively strip and stockpile topsoil to Phase 2.

Stage 2 Earthworks

8. Cut to fill and import fill in Phase 2 areas to design levels shown.
9. Complete construction of earth works where shown.
10. Respread topsoil and progressively stabilise Stage 2 areas as completed. Erect No-Go zone flagging to prevent vehicle and pedestrian access to these areas.
11. Complete works to Stage 2 area and include all control devices to completed works.

Stage 3 Site Preparation

1. Ensure all staff have had all necessary Induction training particularly construction staff engaged in undertaking initial subsurface disturbance must undergo a Cultural Heritage Induction prior to working on site and are familiar with the findings of Aboriginal objects or human remains procedures as outlined within the Cultural Heritage Management plan as part of the Construction Phase Environmental Management Plan.
2. Erection of No-Go Zone fencing around areas of cultural heritage significance and vegetation identified to be retained in the approved Vegetation Management Plan
3. Installation of bunds, sediment fencing and lined cleanwater diversion drains where shown indicatively on Drawing 12301-BE1-ESC-070. Location of cleanwater drains to be confirmed with Superintendent prior to commencement.
4. Construct main access tracks through works area
5. Excavate sediment basin complete. Soil dispersivity and Emerson class testing to be conducted; basin type to be confirmed by Superintendent on provision of testing results.
6. Construct lined dirty water catch drains (including rock check dams and batter chutes etc.) to sediment basin.
7. Strip areas to be readily worked and avoid opening excessive amounts of exposed ground. Progressively strip and stockpile topsoil to Phase 3 area.

Stage 3 Earthworks

8. Cut to fill and import fill to design levels shown.
9. Complete construction of earth works where shown.

10. Respread topsoil and progressively stabilise Stage 3 areas as completed. Erect No-Go zone flagging to prevent vehicle and pedestrian access to these areas.
11. Complete works to Stage 3 area and include all control devices to completed works e.g. gully inlet protection and turf lining of drains etc.

Stage 4 Site Preparation

1. Ensure all staff have had all necessary Induction training particularly construction staff engaged in undertaking initial subsurface disturbance must undergo a Cultural Heritage Induction prior to working on site and are familiar with the findings of Aboriginal objects or human remains procedures as outlined within the Cultural Heritage Management plan as part of the Construction Phase Environmental Management Plan.
2. Erection of No-Go Zone fencing around areas of cultural heritage significance and vegetation identified to be retained in the approved Vegetation Management Plan
3. Installation of bunds, sediment fencing and lined cleanwater diversion drains where shown indicatively on Drawing 12301-BE1-ESC-070. Location of cleanwater drains to be confirmed with Superintendent prior to commencement.
4. Construct main access tracks through works area
5. Excavate sediment basin complete.
6. Construct lined dirty water catch drains (including rock check dams and batter chutes etc.) to sediment basin
7. Strip areas to be readily worked and avoid opening excessive amounts of exposed ground. Progressively strip and stockpile topsoil to Phase 4 area.

Stage 4 Earthworks

12. Cut to fill and import fill in Phase 4 areas to design levels shown.
13. Complete construction of earth works where shown.
14. Respread topsoil and progressively stabilise Phase 4 areas as completed. Erect No-Go zone flagging to prevent vehicle and pedestrian access to these areas.
15. Complete works to Phase 4 area and include all control devices to completed works.

Stage 5 Site Preparation

1. Ensure all staff have had all necessary Induction training particularly construction staff engaged in undertaking initial subsurface disturbance must undergo a Cultural Heritage Induction prior to working on site and are familiar with the findings of Aboriginal objects or

human remains procedures as outlined within the Cultural Heritage Management plan as part of the Construction Phase Environmental Management Plan.

2. Erection of No-Go Zone fencing around areas of cultural heritage significance and vegetation identified to be retained in the approved Vegetation Management Plan
3. Installation of bunds, sediment fencing and lined cleanwater diversion drains where shown indicatively on Drawing 12301-BE1-ESC-070. Location of cleanwater drains to be confirmed with Superintendent prior to commencement.
4. Construct main access tracks through works area
5. Excavate sediment basin complete.
6. Construct lined dirty water catch drains (including rock check dams and batter chutes etc.) to sediment basin
7. Strip areas to be readily worked and avoid opening excessive amounts of exposed ground. Progressively strip and stockpile topsoil to Phase 5 area.

Stage 5 Earthworks

8. Cut to fill and import fill in Phase 5 areas to design levels shown.
9. Complete construction of earth works where shown.
10. Respread topsoil and progressively stabilise Phase 5 areas as completed. Erect No-Go zone flagging to prevent vehicle and pedestrian access to these areas.
11. Complete works to Phase 5 area and include all control devices to completed works.

Stage 6 Site Preparation

1. Ensure all staff have had all necessary Induction training particularly construction staff engaged in undertaking initial subsurface disturbance must undergo a Cultural Heritage Induction prior to working on site and are familiar with the findings of Aboriginal objects or human remains procedures as outlined within the Cultural Heritage Management plan as part of the Construction Phase Environmental Management Plan.
2. Erection of No-Go Zone fencing around areas of cultural heritage significance and vegetation identified to be retained in the approved Vegetation Management Plan
3. Installation of bunds, sediment fencing and lined cleanwater diversion drains where shown indicatively on Drawing 12301-BE1-ESC-070. Location of cleanwater drains to be confirmed with Superintendent prior to commencement.
4. Construct main access tracks through works area
5. Excavate infiltration beds
6. Construct lined dirty water catch drains (including rock check dams and batter chutes etc.) to infiltration beds

7. Strip areas to be readily worked and avoid opening excessive amounts of exposed ground. Progressively strip and stockpile topsoil to Phase 6 area.

Stage 6 Earthworks

8. Cut to fill and import fill in Phase 6 areas to design levels shown.
9. Complete construction of earth works where shown.
10. Respread topsoil and progressively stabilise Phase 6 areas as completed. Erect No-Go zone flagging to prevent vehicle and pedestrian access to these areas.
11. Complete works to Phase 6 area and include all control devices to completed works.

Stage 7 Site Preparation

1. Ensure all staff have had all necessary Induction training particularly construction staff engaged in undertaking initial subsurface disturbance must undergo a Cultural Heritage Induction prior to working on site and are familiar with the findings of Aboriginal objects or human remains procedures as outlined within the Cultural Heritage Management plan as part of the Construction Phase Environmental Management Plan.
2. Erection of No-Go Zone fencing around areas of cultural heritage significance and vegetation identified to be retained in the approved Vegetation Management Plan
3. Installation of bunds, sediment fencing and lined cleanwater diversion drains where shown indicatively on Drawing 12301-BE1-ESC-070. Location of cleanwater drains to be confirmed with Superintendent prior to commencement.
4. Construct main access tracks through works area
5. Excavate infiltration beds
6. Construct lined dirty water catch drains (including rock check dams and batter chutes etc.) to infiltration beds
7. Strip areas to be readily worked and avoid opening excessive amounts of exposed ground. Progressively strip and stockpile topsoil to Phase 6 area.

Stage 7 Earthworks

8. Cut to fill and import fill in Phase 6 areas to design levels shown.
9. Complete construction of earth works where shown.
10. Respread topsoil and progressively stabilise Phase 6 areas as completed. Erect No-Go zone flagging to prevent vehicle and pedestrian access to these areas.

Complete works to Phase 6 area and include all control devices to completed works.

Final Site Stabilisation

1. Upon stabilisation of exposed areas and with the written confirmation of the superintendent, clean out and fill sediment basins to all areas of works.
2. Remove site amenities, construction access where necessary and disestablish site
3. Where necessary scarify, topsoil and stabilise any remaining disturbed area (i.e. construction access points etc.).
4. Upon successful stabilisation of disturbed areas and with written confirmation from the superintendent remove all control devices where directed.

General

The staging of the works are to be undertaken as described above, along with the stage methodology, the following points are to be adhered to:

- All site workers are to clearly recognise areas where access is limited or restricted. No-Go zones where existing vegetation is to be preserved shall be protected using barrier fencing or a similar distinguishable perimeter protection.
- No works from a following stage are to be undertaken until all the works in the preceding stage are completed.
- Construction areas are to be kept to a maximum of 5m from the edge of any essential engineering activity
- Access areas are to be limited to a maximum of 10m
- Soil materials are to be replaced in the same order they are removed from the ground. All subsoils are to be buried and topsoils to remain on the surface at the completion of the works
- Large, unprotected areas are to be kept moist (not wet) during windy weather to keep dust suppressed
- Earth batters shall be constructed with as low a gradient as possible with grades and lengths in accordance with those outlined in the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009)
- All earthworks including drains and spillways to be constructed in a manner to withstand a minimum of a 10 year ARI storm event.
- The stabilisation of areas should be undertaken immediately after the respreading of the topsoil is completed.
- Foot and vehicle traffic to be kept away from all recently stabilised areas

- Stabilised areas are to be maintained to include regular watering patterns, mowing/slashing of excessive growth and restabilising areas with unsuccessful strike.
- Progressive stabilisation and soil cover requirements as outlined in the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009)
- Stockpile heights have been restricted to heights of 2.0m. In areas where stockpiles are to remain in place for more than 10 days, stabilisation with vegetation or synthetic material should be added to exposed surfaces. Stockpiles are to be placed at least 2.0m clear from potential hazardous areas such as steep slopes and concentrated flow paths. All flows are to be directed around stockpiles with sediment fencing placed downstream.
- Any other measures deemed necessary by the superintendent shall be installed
- For the details of all devices to be used on site refer to standard details as shown in *Appendix C* and in accordance with the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009)
- An adequate supply of materials for the maintenance and repair of all control devices on site is to be stored for immediate usage if required.

Sediment Basin Construction

The effectiveness of the basins to trap sediment laden water relies on the correct installation and maintenance of the device. The following points should be adhered to:

- It is assumed based on Cardno Bowler's geotechnical report that Type C basins may be utilised. Testing of any imported fill for dispersivity and Emerson class to be presented to the Superintendent prior to confirmation of basin type.
- The batters and embankments are to be constructed at the appropriate batter slopes and stabilised. Dispersible material is not to be used for this construction.
- For personal safety the internal batter gradients of the basin should have a gradient of between 40% and 20% depending on factors such as the depth of water surcharging, the protection of the basin and the 'slipperiness' of the saturated sediment
- The basin inlet is to be restricted to one point only to prevent the basin 'short-circuiting' and reducing the amount of time the turbid water has to settle
- The inlet should be stabilised and a forebay area introduced to reduce the flow velocity. This will allow the early settling of any large particles as well as prevent the re-suspension of settled sediment already in the basin.
- Where possible the basin is to be of a minimum length to width ratio of 3:1 (baffles should be installed if required to allow the minimum length to width ratio to be achieved.

- A suitable all weather access to the basin is to be installed for flocculation, de-watering, de-silting and maintenance purposes.
- Based on a design life of between 3 to 12 months the minimum design storm to be used for the emergency spillway design is to be 1 in 20 year ARI (IECA 2009; table B12). Refer 'Flow Calculations' attached as part of *Appendix C* for calculated peak flow values for this storm period.

  The emergency overflow weir is to be correctly installed and stabilised and should be of open construction to avoid blockages. The crest should be at least 300mm above the primary outlet, 300mm below the basin embankment if formed in virgin soil or 450mm below the basin embankment if formed from fill (IECA 2009).
- Outlet structures on the basin are specified to be designed to pass the peak flow from the design storm event and have an outlet at least 300mm below any emergency outlet
- The basin outlet is to be lined to prevent scour. The Auckland Regional Council (1999) recommends the spillway be well compacted with a high standard of stabilisation and constructed with a trapezoidal cross section of width equal to the basin floor width or 6m whichever is the greater. To avoid hydrological damage downstream the construction should allow stream flows to mimic at least a 2-year ARI event (IECA 2009; table 4.3.1). Refer section 3.3 and 'Storm Flow Calculations' attached as part of *Appendix C* for calculated peak flow values for this storm period.
- The de-watering method of the basin (by pumping or an outlet decant system) is to be installed. Water is to be drawn from the surface of the basin away from the sediment storage zone.
- No-Go fencing is to be installed where required to prevent access from unauthorised persons. It is suggested to comply with the local who require safety fencing to basins where the sediment depth exceeds 300mm or the permanent water level exceeds 150mm.
- A depth gauge is to be installed to monitor when the basin has reached capacity for de-watering and de-silting.
- A supply of coagulant for flocculation as well as all testing and de-watering equipment is to be stored to allow convenient and immediate usage when required.

5.0 SPECIAL MEASURES FOR PROTECTION OF SEPP 14 WETLAND

5.1 Additional Storage within Construction phase Basins

Within this report we have provided basin sizing for catchments within and surrounding this first sequence of work (Bulk Earthworks). These basins have been sized for the total catchment size instead of the 5Ha limit of maximum exposed area as required as part of the major approval Conditions. Reference to Tables 2a and 2b, Sediment Basin sizing shows the catchment areas in excess of the 5ha limit. These Basins numbered 3, 4 and 7 will provide additional storage over and

above the requirements to assist in protecting the SEPP 14 wetlands with receiving construction runoff.

5.2 Additional Storage within the Major Swale located in the 20m Ecological Buffer

As part of the construction of the bulk earthworks it involves the formation of a swale which is located in the Outer 20m ecological area. This swale acts as a Conveyance and quality device to water leaving the site to Backs Creek to the south of the development.

We have included the drawing 12301-BE1-ESC-085 within the Erosion and Sediment Control set of Drawings. This drawing titled Special Protection measures to the SEPP 14 Wetlands. This drwing indicates how close the wetland boundary comes to the bulk earthworks ands allows us to demonstrate additional measures of protection.

Paragraph 5.1 above describes the additional storage within the basin sizing as the first level of protection. The next level is the amount of additional storage that can be held back which is over and above the additional storage within the Construction Phase Basins.

The final design profile of the swale incorporates bunds set at various levels which are there to promote infiltration. We are disregarding infiltration rates at this stage but as the strata is sand the infiltration rate will add to the amount of protection being provided.

The drawings show that the series of bunds through the channel provides a significant buffer over and above the sizing of the construction basins provided.

5.3 Installed Infrastructure to assist in protection measures

In this first phase of works along with the construction of the swale there is also the construction of a balancing pipe that can link the swale and allow a low flow option to drain down sections of the Stormwater drainage system. The Culvert outlet to Blacks Creek will also be constructed. If in extreme weather the contractor will be able to block the inlet/outlets to these systems which will again provide another layer of storage which can settle or be flocculated prior to release.

5.4 Infiltration

By using the swale as both construction basin locations and having them act as the next level of protection this will encourage the infiltration process which will assist the SEPP 14 wetlands by ensuring that groundwater flows are maintained.

6.0 MAINTENANCE AND MONITORING

During the construction process, a maintenance and monitoring system is to be established. A self-

auditing check sheet set similar to those attached in *Appendix E* are to be completed for each relevant inspection undertaken by the site supervisor.

These inspections are to be conducted immediately before site closure, immediately following rainfall events (with the potential to generate runoff on site) and at least weekly.

The inspections will include the recording of the functionality of the device, any corrective actions required for a faulty device and any maintenance required to devices. Corrective actions are to be undertaken within 48 hours of the inspection or immediately if rainfall is imminent.

The maintenance and installation of all on-site sediment and erosion management works are to be overseen by a suitably qualified person. These include but are not limited to:

- Maintenance of drainage systems.
- Stockpile locations.
- Maintenance of stabilised areas
- Monitoring stabilised areas to ensure erosion has been reduced to the acceptable levels
- Removal of pollutants from sediment traps.
- Water quality monitoring in accordance with the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2009)
- Sediment detention basin maintenance to ensure all sediment laden waters are directed to them
- Sediment removal from the basin settling zone to ensure the design capacity is not exceeded
- Replacement of all degradable products to ensure devices are in full working order

All copies of monitoring and maintenance reports are to be forwarded to the superintendent on a regular basis. Copies are also to be kept on site for presentation to relevant authorities if required.

Any suggested measures in addition to the sediment and erosion control plan caused by changes in conditions or where devices are inadequate should be discussed between all parties at the earliest opportunity. Further preventative methods and revision of the plan will be undertaken as necessary.

7.0 CONCLUSION

The report aims to reduce the impact on the environment caused by the works proposed for Precinct 5. With the implementation of sensible and best practice measures described herein, as well as those described in the *Best Practice Erosion and Sediment Control* (IECA Australasia, 2008) the standards and objectives for water quality should be achieved resulting in a better and more cost-effective environmental outcome.

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Sunshine Coast Regional Council 2008, '*Manual for Erosion & Sediment Control Version 1.2',* November 2008.

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APPENDIX A

Erosion & Sediment Control Plans

Prepared by Mortons Urban Solutions

KINGS FOREST

PRECINCTS 2 , 5 & PART 4 OF MAJOR APPROVAL NO. MP08_0194 (AS MODIFIED)

BULK EARTHWORKS

SEDIMENT AND EROSION CONTROL

12301-BE1-ESC

SCHEDULE OF DRAWINGS

NUMBER	REV. NO.	TITLE
GENERAL		
12301-BE1-ESC-000	D	COVER SHEET
FINAL SURFACE SEDIMENT & EROSION CONTROL		
12301-BE1-ESC-070	C	OVERALL PHASING PLAN
12301-BE1-ESC-071	B	PLAN SHEET 1
12301-BE1-ESC-072	B	PLAN SHEET 2
12301-BE1-ESC-073	C	PLAN SHEET 3
12301-BE1-ESC-074	B	PLAN SHEET 4
12301-BE1-ESC-075	B	PLAN SHEET 5
12301-BE1-ESC-076	B	PLAN SHEET 6
12301-BE1-ESC-077	C	PLAN SHEET 7
12301-BE1-ESC-078	C	PLAN SHEET 8
12301-BE1-ESC-080	D	BASIN CATCHMENT AREA
12301-BE1-ESC-081	C	DETAILS
SEPP14 WETLANDS		
12301-BE1-ESC-085	B	SEPP 14 PLAN SHEET 1

MORTONS urbansolutions
Urban & Regional Planning
Civil Engineering
Project Coordination

CLIENT:

PROJECT 28 PTY LTD

ASSOCIATED CONSULTANTS:

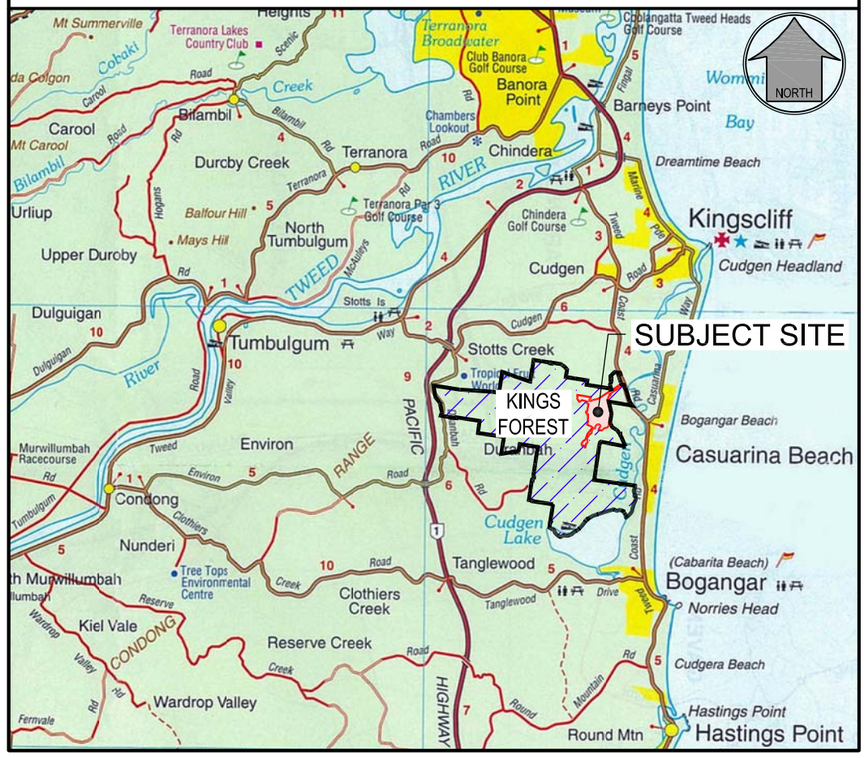
JWA Ecological Consultants

LANDSURV

GILBERT SUTHERLAND

REAL PROPERTY DESCRIPTION:
Lot 7 on DP875447, Part of Lot 6 on DP875446,
Lot 1 on DP781633, Lot 40 on DP7482,
Lot 2 on DP819015, Lot 1 on DP129737,
Lot 37A on DP13727, Lot 38A on DP13727,
Lot 38B on DP13727, Lot 1 on DP706497,
Lot 76 on DP755701, Lot 323 on DP755701,
Lot 272 on DP755701, Lot 96 on DP755701
& Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

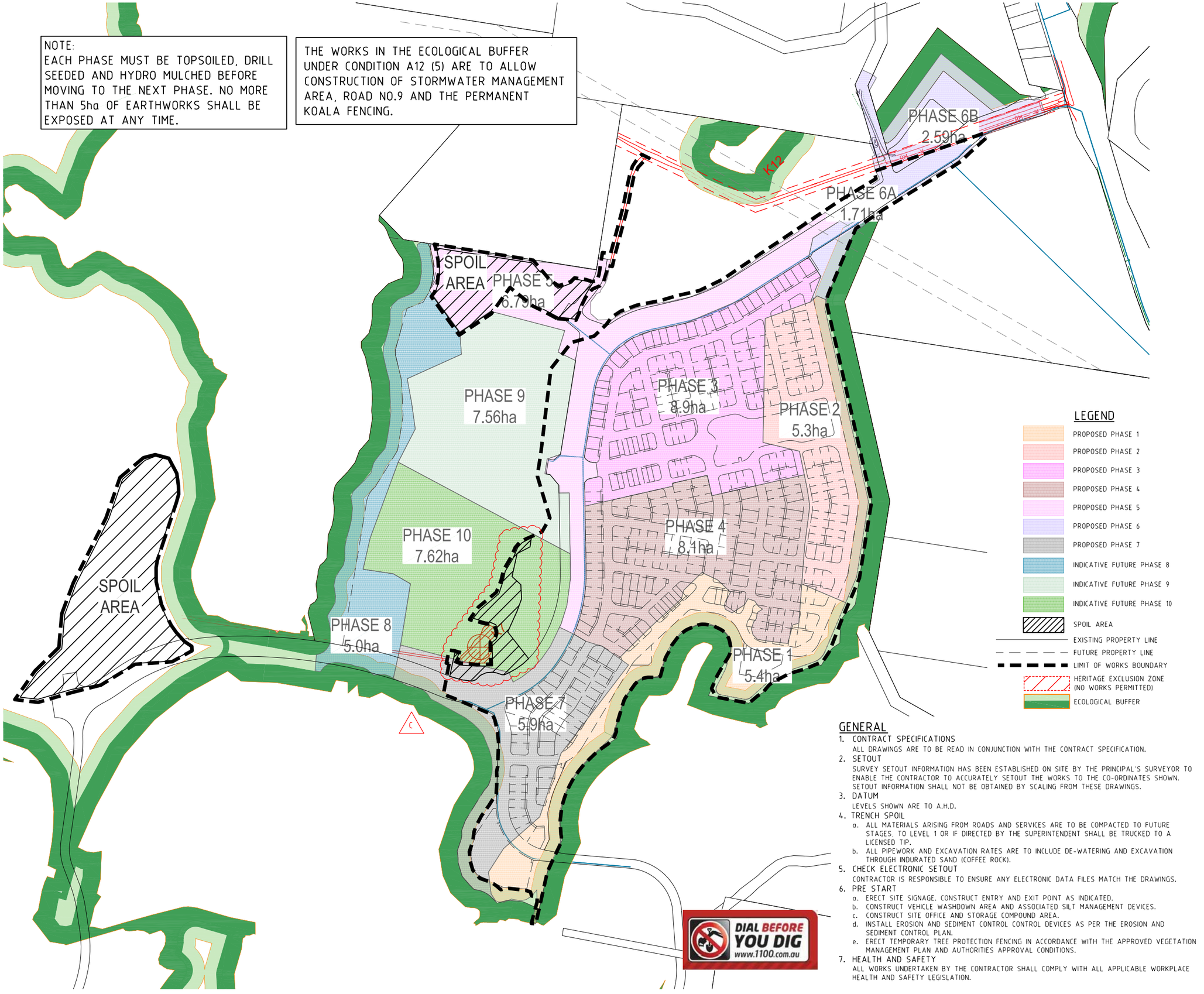
LOCALITY PLAN



DRAWING NUMBER	AMEND.
12301-BE1-ESC-000	D

NOTE:
EACH PHASE MUST BE TOPSOILED, DRILL SEEDED AND HYDRO MULCHED BEFORE MOVING TO THE NEXT PHASE. NO MORE THAN 5ha OF EARTHWORKS SHALL BE EXPOSED AT ANY TIME.

THE WORKS IN THE ECOLOGICAL BUFFER UNDER CONDITION A12 (5) ARE TO ALLOW CONSTRUCTION OF STORMWATER MANAGEMENT AREA, ROAD NO.9 AND THE PERMANENT KOALA FENCING.



GENERAL

1. CONTRACT SPECIFICATIONS
   ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE CONTRACT SPECIFICATION.
2. SETOUT
   SURVEY SETOUT INFORMATION HAS BEEN ESTABLISHED ON SITE BY THE PRINCIPAL'S SURVEYOR TO ENABLE THE CONTRACTOR TO ACCURATELY SETOUT THE WORKS TO THE CO-ORDINATES SHOWN. SETOUT INFORMATION SHALL NOT BE OBTAINED BY SCALING FROM THESE DRAWINGS.
3. DATUM
   LEVELS SHOWN ARE TO A.H.D.
4. TRENCH SPOIL
   a. ALL MATERIALS ARISING FROM ROADS AND SERVICES ARE TO BE COMPACTED TO FUTURE STAGES, TO LEVEL 1 OR IF DIRECTED BY THE SUPERINTENDENT SHALL BE TRUCKED TO A LICENSED TIP.
   b. ALL PIPEWORK AND EXCAVATION RATES ARE TO INCLUDE DE-WATERING AND EXCAVATION THROUGH INDURATED SAND (COFFEE ROCK).
5. CHECK ELECTRONIC SETOUT
   CONTRACTOR IS RESPONSIBLE TO ENSURE ANY ELECTRONIC DATA FILES MATCH THE DRAWINGS.
6. PRE START
   a. ERECT SITE SIGNAGE. CONSTRUCT ENTRY AND EXIT POINT AS INDICATED.
   b. CONSTRUCT VEHICLE WASHDOWN AREA AND ASSOCIATED SILT MANAGEMENT DEVICES.
   c. CONSTRUCT SITE OFFICE AND STORAGE COMPOUND AREA.
   d. INSTALL EROSION AND SEDIMENT CONTROL CONTROL DEVICES AS PER THE EROSION AND SEDIMENT CONTROL PLAN.
   e. ERECT TEMPORARY TREE PROTECTION FENCING IN ACCORDANCE WITH THE APPROVED VEGETATION MANAGEMENT PLAN AND AUTHORITIES APPROVAL CONDITIONS.
7. HEALTH AND SAFETY
   ALL WORKS UNDERTAKEN BY THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE WORKPLACE HEALTH AND SAFETY LEGISLATION.

PROJECT NAME
KINGS FOREST
BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION
Lot 7 on DP875447, Part of Lot 6 on DP875446, Lot 1 on DP781633, Lot 40 on DP7482, Lot 2 on DP819015, Lot 1 on DP129737, Lot 37A on DP13727, Lot 38A on DP13727, Lot 38B on DP13727, Lot 1 on DP706497, Lot 76 on DP755701, Lot 323 on DP755701, Lot 272 on DP755701, Lot 96 on DP755701 & Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT
PROJECT 28 PTY LTD

NORTH

0 30 60 90 120 150m
Scale 1:3000 - A1 (1:6000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

PRE	DATE	AMENDMENT
C	12-10-20	LIMIT OF WORKS AMENDED
B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION

ASSOCIATED CONSULTANTS
LANDSURV
GILBERT SUTHERLAND
JWA Ecological Consultants

DRAWING TITLE
OVERALL PHASING PLAN

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Urban & Regional Planning
Civil Engineering
Project Coordination
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Suite 9, 19 Short St
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DESIGNED	RB	DRAWN	CB
APPROVED		RPEQ 4706	DATE 27-03-20

DRAWING NUMBER 12301-BE1-ESC-070
AMEND. C

LEGEND

- EXISTING PROPERTY LINE
- EXISTING CONTOURS (mAHD)
- EXISTING STORMWATER
- EXISTING PERMANENT KOALA EXCLUSION FENCE
- EXISTING TEMPORARY NO-GO FENCE - POWER WEBBING WITH 2 STRANDS WIRE AND STAR PICKETS A7 8m CENTERS.
- FUTURE PROPERTY LINE
- FUTURE KERB (INVERT)
- FUTURE CONTOURS
- PROPOSED STORMWATER
- DESIGN CONTOURS (m)
- SEDIMENT FENCE
- CATCH DRAIN
- TEMPORARY SEDIMENT BASIN
- ROCK CHECK DAM
- BUND
- LIMIT OF WORKS BOUNDARY
- PERMANENT KOALA EXCLUSION FENCE
- TEMPORARY KOALA EXCLUSION FENCE
- TEMPORARY CONSTRUCTION LIMIT FENCE
- HERITAGE EXCLUSION ZONE (NO WORKS PERMITTED)
- ECOLOGICAL BUFFER
- SPOIL AREA

B

NOTE:

SEDIMENT AND EROSION CONTROL MEASURES SHOWN RELATES TO THE FINISHED SURFACE ONLY.
THE CONTRACTOR IS TO PREPARE A CONSTRUCTION PHASE SEDIMENT AND EROSION CONTROL PLAN BASED ON MUS SEDIMENT AND EROSION CONTROL PLAN.

PHASE 7

PHASE 1 TOPSOIL 95m x 18m

PHASE 1

BASIN 1B (PHASE 1)
SIZE: 10.55m x 32m
BASIN VOLUME: 501.1m^3
MIN SURFACE AREA: 334.1m^2
(CONSTRUCTED SWALE DESIGN BASE LEVEL).
NO SPILLWAY REQUIRED.

TURF LINED DRAIN FROM SPILL WAY TO BASIN FLOOR OF MAJOR SWALE LINE CHANNEL TO PREVENT SCOUR.

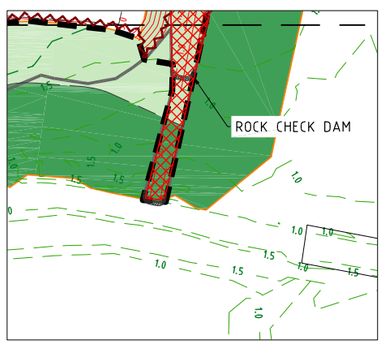
LINE WATER ENTRANCE POINT TO BASIN TO PREVENT SCOUR.

BASIN 1A (PHASE 1)
SIZE: 11.3m x 33.4m
BASIN VOLUME: 557.5m^3
MIN SURFACE AREA: 371.5m^2

SPILLWAY

PERMANENT STABILISATION JUTE LINING, PLANTING AND SCOUR TO BE INSTALLED AS SOON AS CULVERT AND CHANNEL IS CONSTRUCTED.

SEDIMENT FENCE



INSET 1.0

PHASE 1 WORKS

AREA	5.3Ha
TOPSOIL VOLUME	5,296m^3

DIAL BEFORE YOU DIG www.1100.com.au

SEDIMENT AND EROSION

1. THE OBJECTIVE OF THE EROSION AND SEDIMENT CONTROL PLAN IS TO ENSURE THAT ALL REASONABLE AND PRACTICABLE MEASURES ARE IMPLEMENTED TO MINIMISE SHORT AND LONG-TERM EROSION AND ADVERSE EFFECTS OF SEDIMENT TRANSPORT.
2. NOTWITHSTANDING THE DETAILED EROSION AND SEDIMENT CONTROL DEVICES SHOWN ON THESE DRAWINGS, THE CONTRACTOR MUST PREPARE A SITE SPECIFIC EROSION AND SEDIMENT CONTROL PLAN PREPARED IN ACCORDANCE WITH IECA'S BEST PRACTICE EROSION & SEDIMENT CONTROL (BPESC) DOCUMENT, SECTION D7.07 OF DEVELOPMENT DESIGN SPECIFICATION D7 - STORMWATER QUALITY. THE CONSTRUCTION PHASE EROSION AND SEDIMENT CONTROL SHALL BE DESIGNED, CONSTRUCTED AND OPERATED IN ACCORDANCE WITH D7 AND ITS ANNEXURE A - "CODE OF PRACTICE FOR SOIL AND WATER MANAGEMENT ON CONSTRUCTION WORKS". SOIL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE DESIGNED IN ACCORDANCE WITH THE DOCUMENT "MANAGING URBAN STORMWATER - SOILS & CONSTRUCTION VOLUME 1 (2004) BY LANDCOM".
3. THE CONTRACTOR'S EROSION AND SEDIMENT CONTROL PLAN MUST INCLUDE WATER QUALITY MONITORING REQUIREMENTS IN ACCORDANCE WITH THE APPROVED STORMWATER MANAGEMENT PLAN (SMP). THE PLAN MUST OUTLINE THE PROPOSED PROCEDURES FOR THE TESTING, FLOCKING AND TRIGGERS FOR PUMP OUT OF ALL SEDIMENT BASINS IN ACCORDANCE WITH THE APPROVED SMP.
4. PRIOR TO THE COMMENCEMENT OF WORKS ONSITE THE CONTRACTOR MUST MAKE THEMSELVES AWARE OF ALL PREVIOUS GEOTECHNICAL REPORTS AND DETERMINE THE DISPERSIVE CHARACTERISTICS OF THE SOIL (INCLUDING PERFORMING ANY SOIL TESTS IF REQUIRED). THE RESULTS OF THIS REVIEW AND ANY TESTS MUST BE INCLUDED IN THE CONTRACTOR'S EROSION AND SEDIMENT CONTROL PLAN. A COPY OF ALL TEST RESULTS MUST BE PROVIDED TO THE SUPERINTENDENT.
5. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO CONTROL EROSION AND DOWNSTREAM SEDIMENTATION DURING ALL STAGES OF CONSTRUCTION (INCLUDING THE MAINTENANCE PERIOD). NOTWITHSTANDING THE CONTROL MEASURES OR FINISHED EARTHWORKS DESIGN SHOWN ON THESE DRAWINGS, THE CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING ADDITIONAL OR ALTERNATIVE EROSION & SEDIMENT CONTROL MEASURES TO MINIMISE SEDIMENT ACROSS OR LEAVING THE SITE.
6. AT ALL TIMES THE CONTRACTOR SHALL MONITOR THE PREVAILING WEATHER CONDITIONS (INCLUDING WEEKENDS AND PUBLIC HOLIDAYS) AND AT ALL TIMES REMAINS RESPONSIBLE TO:
   a) CLEAN AND REPAIR CONTROL DEVICES WHENEVER THE ACCUMULATED SEDIMENT REDUCES THEIR CAPACITY BY 50%.
   b) MAINTAIN POSITIVE GRADES OF ALL PERIMETER BANKS AND SWALES TO AN OUTLET.
   c) PROTECT ANY DOWNSTREAM CONSTRUCTION.
   d) CONTROLLING DUST.
   e) MEASURES HAVE BEEN INSTALLED IN ACCORDANCE WITH DETAILS OUTLINED IN THEIR EROSION AND SEDIMENT CONTROL PLAN AND AS DIRECTED BY THE SUPERINTENDENT.
7. THE CONTRACTOR'S PLAN SHALL ALLOW FOR SUITABLE ACCESS TO ALLOW MAINTENANCE OF ALL SEDIMENT CONTROL DEVICES. NO ADDITIONAL VEGETATION CLEARING IS PERMITTED FOR GAINING ACCESS UNLESS APPROVED BY THE SUPERINTENDENT.
8. THE CONTRACTOR MAY REQUEST APPROVAL FROM THE SUPERINTENDENT TO REUSE THE STOCKPILED MULCH FOR STABILISING BATTERS ONLY IN LOCATIONS WHERE THE APPROVED LANDSCAPE OPW DESIGN REQUIRES MULCH ULTIMATELY.
9. CONSTRUCTION STOCKPILING
   a) TOPSOIL SHALL BE STRIPPED AND STOCKPILED IN LOCATIONS NOMINATED ON THE CONSTRUCTION DRAWINGS OR IN LOCATIONS AGREED WITH THE SUPERINTENDENT.
   b) ADDITIONAL VEGETATION CLEARING IS NOT PERMITTED TO FACILITATE THE STOCKPILING OF MATERIALS UNLESS SHOWN ON THE APPROVED VEGETATION MANAGEMENT PLAN.
   c) ANY STOCKPILE SITE MUST BE CLEAR OF ADJACENT PROPERTY BOUNDARIES SO AS NOT TO CAUSE A NUISANCE TO ADJOINING PROPERTIES.
   d) NO STOCKPILES ARE TO BE LOCATED WITHIN THE TREE PROTECTION ZONE OF VEGETATION.
   e) A TEMPORARY SILT FENCE IS TO BE ERECTED APPROXIMATELY 5m FROM TOE OF BATTER ON LOW SIDE OF STOCKPILING.
10. NOTWITHSTANDING THE DETAILS SHOWN IN THE CONTRACTOR'S EROSION AND SEDIMENT CONTROL PLAN, DURING CONSTRUCTION THE CONTRACTOR MUST:
    a) SIZE ALL TEMPORARY SEDIMENT BASINS APPROPRIATELY TO TREAT THE UPSTREAM CATCHMENT. NOTE THAT THE PERMANENT BIO BASINS SHOWN ON THESE DRAWINGS ARE SIZED FOR THE ULTIMATE CATCHMENT NOT FOR THE CONSTRUCTION PHASE.
    b) PLACE A ROCK BUND AROUND ALL HEADWALLS DURING CONSTRUCTION.
    c) PROVIDE KERB INLET PROTECTION TO ALL GULLIES.
    c) PLACE A MINIMUM 1.0m WIDE TURF STRIP BEHIND ALL KERBS AND IN A HERRINGBONE LAYOUT WITHIN THE ROAD VERGE.
    d) MAINTENANCE (INCLUDING FLOCCULATION IF REQUIRED AND PUMP OUT) OF ALL CONSTRUCTION SEDIMENT BASINS (WHETHER EXISTING OR NEW).
    e) CLEAN OUT OF ALL GROSS POLLUTANT TRAPS, SEDIMENT FOREBAYS AND ALL OTHER PERMANENT SEDIMENT CONTROL DEVICES AT BOTH ON AND OFF MAINTENANCE.
    f) ALL PIPEWORK AND EXCAVATION RATES ARE TO INCLUDE DE-WATERING AND EXCAVATION THROUGH INDURATED SAND (COFFEE ROCK).
11. CONTRACTOR TO CONFIRM THE EXTENTS OF REQUIRED GRASSING TREATMENTS WITH THE SUPERINTENDENT ATLEAST 7 DAYS PRIOR TO FINAL TRIMMING.
12. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT GRASSING STRIKE RATES ARE ACHIEVED AT THE ON AND OFF MAINTENANCE INSPECTIONS IN ACCORDANCE WITH COUNCIL REQUIREMENTS. THIS INCLUDES THE SUPPLY AND INSTALLATION OF ANY REQUIRED CHEMICAL/FERTILIZER AMELIORATION TO ACHIEVE THE SPECIFIED GRASS STRIKE RATES.
13. GEOFABRIC LINING OF CHANNELS AND CHECK DAMS MAY BE REQUIRED SUBJECT TO THE SITE CONDITIONS.
14. BATTERS WITHIN PUBLIC OPEN SPACE TO BE VEGETATED IN ACCORDANCE WITH APPROVED OPEN SPACE MANAGEMENT PLAN AND LANDSCAPING OPW. CONTRACT DOCUMENTATION WILL SPECIFY WHETHER THIS IS THE CIVIL CONTRACTOR OR THE LANDSCAPE CONTRACTOR'S RESPONSIBILITY TO SUPPLY AND INSTALL. THE CIVIL CONTRACTOR IS RESPONSIBLE FOR PROVIDING SUITABLE ACCESS FOR THE LANDSCAPE CONTRACTOR TO PERFORM THEIR WORKS.
15. MAINTENANCE PERIOD (PRE TO POST CONSTRUCTION)
    a) ALL PROTECTION MEASURES ARE TO BE INSPECTED AND MAINTAINED REGULARLY
    b) REPAIRS ARE TO BE EFFECTED IMMEDIATELY.
    c) SILT AFTER RAIN IS TO BE CLEANED FROM STREETS AND ALLOTMENTS IMMEDIATELY AND CORRECTIVE ACTION TAKEN TO AVOID A RE-OCCURRENCE.
    d) AT OFF-MAINTENANCE AND ONLY WHEN DIRECTED BY COUNCIL, REMOVE AND DISPOSE OFFSITE ALL TEMPORARY EROSION AND SEDIMENT CONTROL DEVICES.

PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION
Lot 7 on DP875447, Part of Lot 6 on DP875446, Lot 1 on DP781633, Lot 40 on DP7482, Lot 2 on DP819015, Lot 1 on DP129737, Lot 37A on DP13727, Lot 38A on DP13727, Lot 38B on DP13727, Lot 1 on DP706497, Lot 76 on DP755701, Lot 323 on DP755701, Lot 272 on DP755701, Lot 96 on DP755701 & Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

PRE	DATE	AMENDMENT
B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION

ASSOCIATED CONSULTANTS

LANDSURV
GILBERT SUTHERLAND
JWA Ecological Consultants

DRAWING TITLE

PHASE 1

SEDIMENT AND EROSION PLAN

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Urban & Regional Planning
Civil Engineering
Project Coordination
MUS Pty Ltd T/As:
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DESIGNED	RB	DRAWN	JB
APPROVED		RPEQ	4706
		DATE	27-03-20

DRAWING NUMBER: 12301-BE1-ESC-071
AMEND.: B

NOTE:
REFER TO DRAWING 12301-BE1-ESC-080 AND 12301-BE1-ESC-081 FOR BASIN CATCHMENT AREAS AND DETAILS.

PHASE 3

PHASE 2

PHASE 4

PHASE 2 TOPSOIL 95m x 18m

TURF LINE CHANNEL TO BASE OF SWALE TO PREVENT SCOUR.

TURF LINE CHANNEL TO BASE OF SWALE TO PREVENT SCOUR.

TURF LINE CHANNEL TO BASE OF SWALE TO PREVENT SCOUR.

PROVIDE CUT OFF DRAIN TO PERIMETER TO PREVENT ADJACENT AREA RUNOFF.

ENSURE ALL CATCHDRAINS ARE FREE DRAINING TO PROPOSED TEMPORARY SEDIMENT BASIN LOCATIONS.

BASIN 2 (PHASE 2 WORKS)
SIZE: 9m x 27m
BASIN VOLUME: 360.5m^3
MIN SURFACE AREA: 240.5m^2
(CONSTRUCTED BELOW SWALE DESIGN BASE LEVEL). NO SPILLWAY REQUIRED.

LINE WATER ENTRANCE POINT TO BASIN TO PREVENT SCOUR.

PHASE 2 WORKS

AREA	5.3Ha
TOP SOIL VOLUME	5,293m^3

B

PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

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PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION
PRE	DATE	AMENDMENT

ASSOCIATED CONSULTANTS

LANDSURV
GILBERT SUTHERLAND
JWA Ecological Consultants

DRAWING TITLE

PHASE 2

SEDIMENT AND EROSION PLAN

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Urban & Regional Planning
Civil Engineering
Project Coordination
MUS Pty Ltd T/As
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DESIGNED	RB	DRAWN	JB
APPROVED		RPEQ 4706	DATE 27-03-20

DRAWING NUMBER	AMEND.
12301-BE1-ESC-072	B

PHASE 5

PHASE 9

PHASE 3

NO MORE THAN 5ha OF THIS PHASE EXPOSED AT ANY TIME

PHASE 2

PHASE 4

PHASE 3 WORKS	
AREA	8.9Ha
TOP SOIL VOLUME	8,903m^3

BASIN 3 (PHASE 3)
SIZE: 21.1m x 63.3m
BASIN VOLUME: 2004.3m^3
MIN SURFACE AREA: 1336.3m^2

CONSTRUCT TEMPORARY SEDIMENT BASIN. BASIN TO REMAIN IN PLACE UNTIL FUTURE CIVIL WORKS ARE CONSTRUCTED AND ULTIMATE BASINS ARE ESTABLISHED.

SPILLWAY

TURF LINE DRAIN TO DIRECT OVERFLOW TO MAJOR SWALE.

TURF LINED TO BASE OF MAJOR DRAINAGE SWALE TO PREVENT SCOUR.

PHASE 3 TOPSOIL 80m x 18m

PHASE 3 TOPSOIL 80m x 18m

NOTE:
REFER TO DRAWING 12301-BE1-ESC-080 AND 12301-BE1-ESC-081 FOR BASIN CATCHMENT AREAS AND DETAILS.

NORTH

0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

PROJECT NAME
KINGS FOREST
BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION
Lot 7 on DP875447, Part of Lot 6 on DP875446, Lot 1 on DP781633, Lot 40 on DP7482, Lot 2 on DP819015, Lot 1 on DP129737, Lot 37A on DP13727, Lot 38A on DP13727, Lot 38B on DP13727, Lot 1 on DP706497, Lot 76 on DP755701, Lot 323 on DP755701, Lot 272 on DP755701, Lot 96 on DP755701 & Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT
PROJECT 28 PTY LTD

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

C	12-10-20	BASIN AMENDED
B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION
PRE	DATE	AMENDMENT

ASSOCIATED CONSULTANTS
LANDSURV
GILBERT SUTHERLAND
JWA Ecological Consultants

DRAWING TITLE
PHASE 3
SEDIMENT AND EROSION PLAN

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DESIGNED	RB	DRAWN	JB
APPROVED		RPEQ 4706	DATE 27-03-20

DRAWING NUMBER 12301-BE1-ESC-073
AMEND. C

PHASE 2

PHASE 4 WORKS

AREA	8.1Ha
TOP SOIL VOLUME	8,115m^3

PHASE 4 TOPSOIL 146m x 18m

PHASE 4

NO MORE THAN 5ha OF THIS PHASE EXPOSED AT ANY TIME

DIRECT FLOW TO SEDIMENT DRAINAGE BASIN 2.

BASIN 2 (PHASE 2 WORKS)
SIZE: 9m x 27m
BASIN VOLUME: 360.5m^3
MIN SURFACE AREA: 240.5m^2
(CONSTRUCTED BELOW SWALE DESIGN BASE LEVEL).

BASIN 1C (PHASE 4)
SIZE: 10.6m x 31.9m
BASIN VOLUME: 507.4m^3
MIN SURFACE AREA: 338.4m^2

DIRECT ALL FLOWS TO BASIN ENTRY

SPILLWAY

TURF LINE CHANNEL TO BASE OF SWALE TO PREVENT SCOUR.

PHASE 1

HASE 7

NOTE:
REFER TO DRAWING 12301-BE1-ESC-080 AND 12301-BE1-ESC-081 FOR BASIN CATCHMENT AREAS AND DETAILS.

B

PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION
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PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	..	

PRE	DATE	AMENDMENT
B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION

ASSOCIATED CONSULTANTS

LANDSURV
GILBERT SUTHERLAND
JWA Ecological Consultants

DRAWING TITLE

PHASE 4

SEDIMENT AND EROSION PLAN

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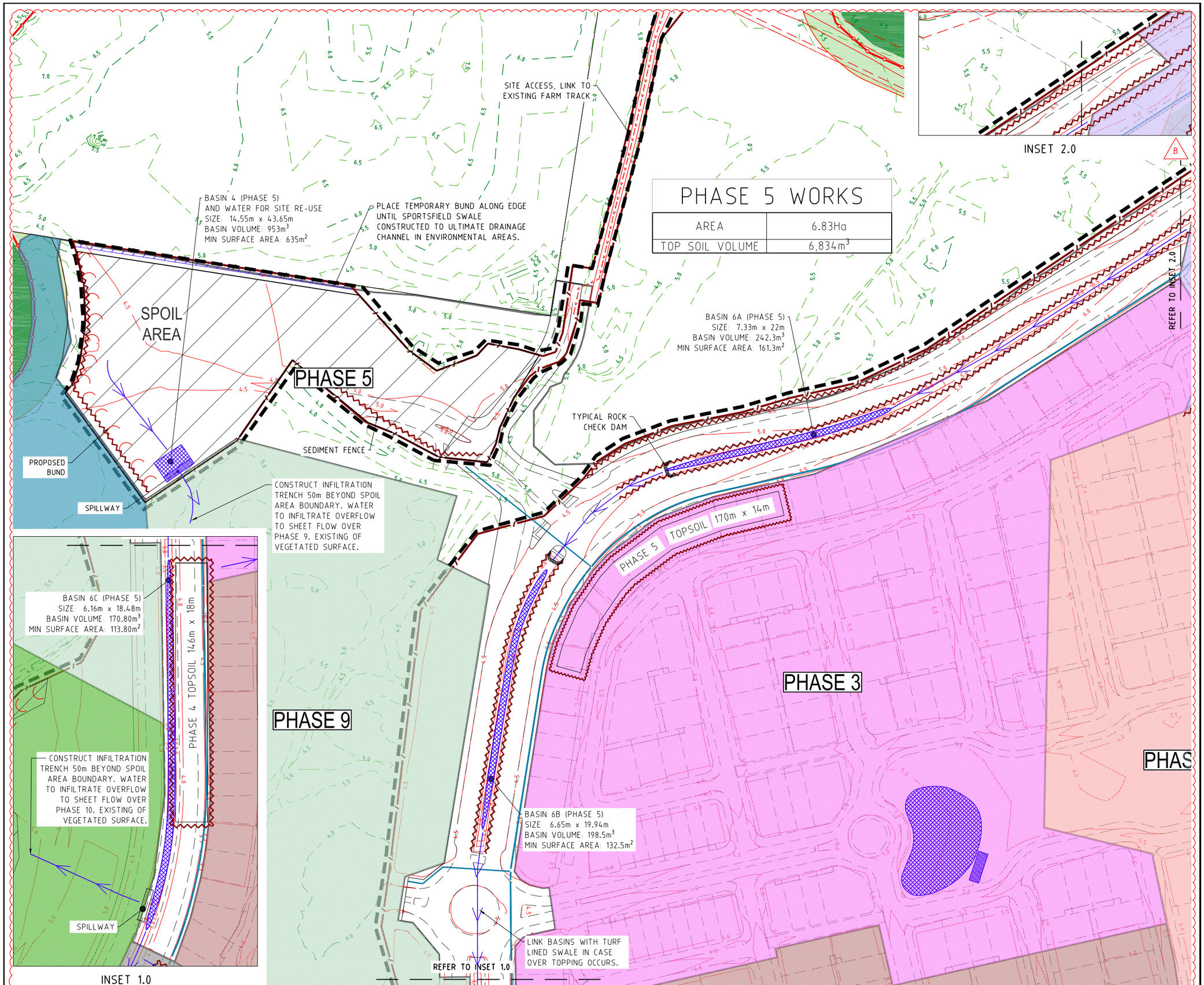
APPROVED		RPEQ 4706	DATE 27-03-20

DRAWING NUMBER	AMEND.
12301-BE1-ESC-074	B



PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION

Lot 7 on DP875447, Part of Lot 6 on DP875446, Lot 1 on DP781633, Lot 40 on DP7482, Lot 2 on DP819015, Lot 1 on DP129737, Lot 37A on DP13727, Lot 38A on DP13727, Lot 38B on DP13727, Lot 1 on DP706497, Lot 76 on DP755701, Lot 323 on DP755701, Lot 272 on DP755701, Lot 96 on DP755701 & Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

PRE	DATE	AMENDMENT
B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION

ASSOCIATED CONSULTANTS

LandSurv
GILBERT SUTHERLAND
JWA Ecological Consultants

DRAWING TITLE

PHASE 5 AND SPOIL

SEDIMENT AND EROSION PLAN

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PHASE 6A

PROVIDE VEHICLE SHAKEDOWN.

ENSURE CATCHDRAIN IS FREE DRAINING.

SEDIMENT FENCE

PHASE 6 TOPSOIL 80m x 10m

DIRECT ALL 6A CATCHMENT TO MAJOR SWALE. TURF ENTRY TO HEAD OF SWALE TO PREVENT SCOUR. ALL FLOWS TO BASIN 2.

C1

K3

B

PHASE 6A WORKS

AREA	1.71Ha
TOP SOIL VOLUME	1,719m^3

PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION

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PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 10 20 30 40 50m

Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

PRE	DATE	AMENDMENT
B	18-05-20	SHEET AND LAYOUT AMENDED
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PHASE 6A

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12301-BE1-ESC-076	B

PHASE 8

PROPOSED BUND

FUTURE BASIN 7

SPOIL AREA

ALL VEHICLE MOVEMENTS WILL BE RESTRICTED TO THE EXISTING TRACK UNTIL FURTHER APPROVALS FOR THE KINGS FOREST PARKWAY ROAD CONSTRUCTION ARE RECEIVED.

PHASE 7 TOPSOIL 80m x 10m

TURF LINE CHANNEL TO BASE OF SWALE TO PREVENT SCOUR.

PHASE 7

NO MORE THAN 5ha OF THIS PHASE EXPOSED AT ANY TIME

CONSTRUCT TURF LINED CHUTE TO PREVENT SCOUR.

BASIN 1B (PHASE 1)
SIZE: 10.55m x 32m
BASIN VOLUME: 501.1m^3
MIN SURFACE AREA: 334.1m^2
(CONSTRUCTED SWALE DESIGN BASE LEVEL).

PHASE 7 WORKS

AREA	6.3Ha
TOPSOIL VOLUME	6,3612m^3

SEDIMENT FENCE

LINE WATER ENTRANCE POINT TO BASIN TO PREVENT SCOUR.

BASIN 1A (PHASE 1)
SIZE: 11.3m x 33.4m
BASIN VOLUME: 557.5m^3
MIN SURFACE AREA: 371.5m^2

SPILLWAY

CONSTRUCT TURF LINED CHUTE TO PREVENT SCOUR.

NOTE:
REFER TO DRAWING 12301-BE1-ESC-080 AND 12301-BE1-ESC-081 FOR BASIN CATCHMENT AREAS AND DETAILS.

PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION
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PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

PRE	DATE	AMENDMENT
C	12-10-20	SPOIL AREA AMENDED
B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION

ASSOCIATED CONSULTANTS

LANDSURV
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DRAWING TITLE

PHASE 7

SEDIMENT AND EROSION PLAN

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DRAWING NUMBER	AMEND.
12301-BE1-ESC-077	C

B

NOTE:
SPOIL AREA IS LOCATED IN A DEPRESSION. SPOIL AREA WOULD NEED TO COMPLETELY FILL BEFORE ANY WATER CAN LEAVE SPOIL AREA SITE.

SILT FENCE

500mm HIGH PROPOSED BUND

CLEAN WATER DIVERSION DRAIN

OVERFLOW FROM BUNDED AREA DIRECTED TO LOW POINT OVER VEGETATED AREA. IF TOPPING IS LIKELY TO OCCUR.

SPILL-WAY

SHAKEDOWN GRID

SPOIL AREA

ALL VEHICLE MOVEMENTS WILL BE RESTRICTED TO THE EXISTING TRACK UNTIL FURTHER APPROVALS FOR THE KINGS FOREST PARKWAY ROAD CONSTRUCTION ARE RECEIVED.

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& Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

C	12-10-20	FENCE ALIGNMENT AMENDED
B	18-05-20	SHEET AND LAYOUT AMENDED
A	07-04-20	ISSUE FOR INFORMATION
PRE	DATE	AMENDMENT

ASSOCIATED CONSULTANTS

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SPOIL AREA

SEDIMENT AND EROSION PLAN

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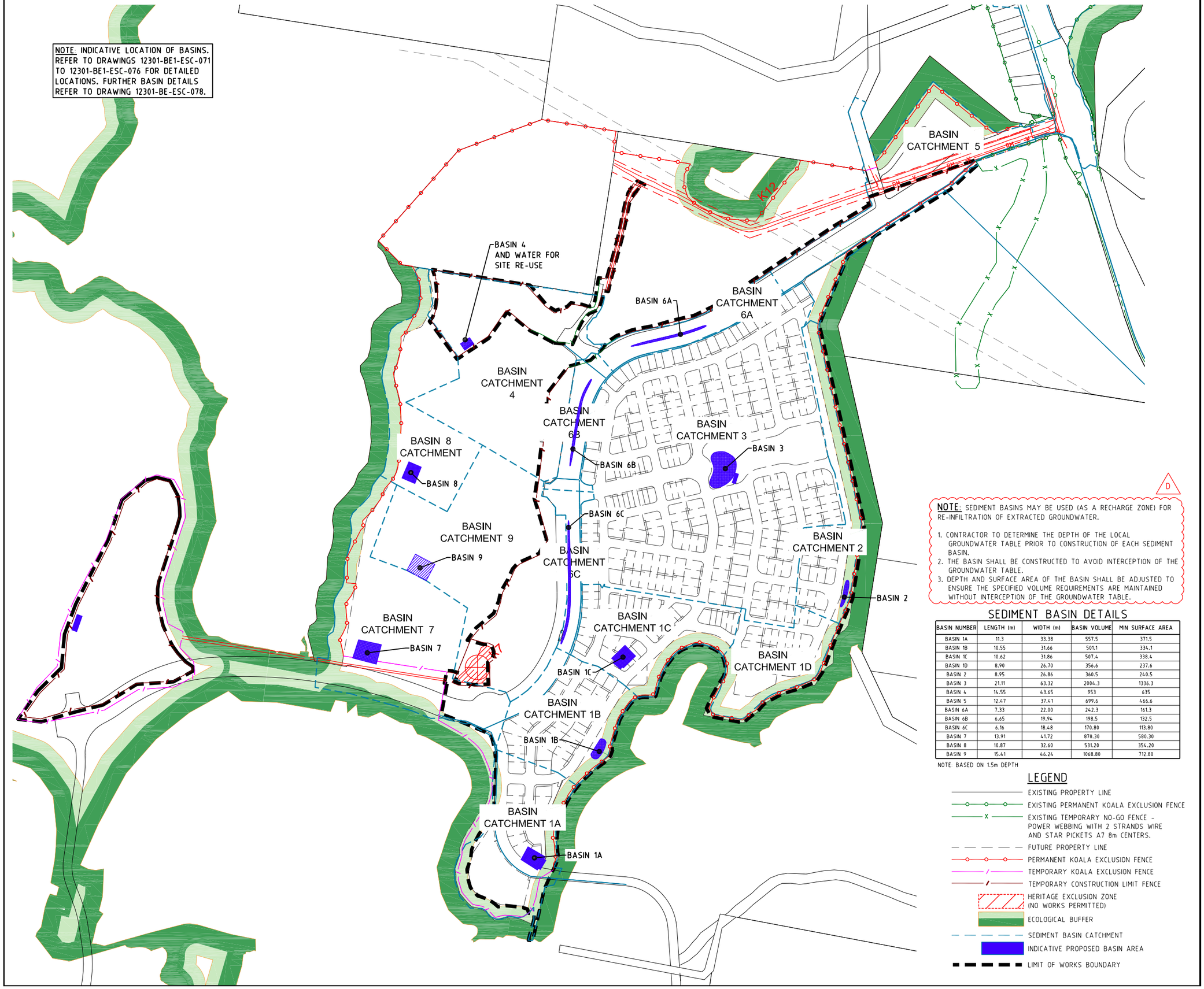
APPROVED		RPEQ 4706	DATE 27-03-20

DRAWING NUMBER	AMEND.
12301-BE1-ESC-078	C

NOTE: INDICATIVE LOCATION OF BASINS. REFER TO DRAWINGS 12301-BE1-ESC-071 TO 12301-BE1-ESC-076 FOR DETAILED LOCATIONS. FURTHER BASIN DETAILS REFER TO DRAWING 12301-BE-ESC-078.



NOTE: SEDIMENT BASINS MAY BE USED (AS A RECHARGE ZONE) FOR RE-INFILTRATION OF EXTRACTED GROUNDWATER.

1. CONTRACTOR TO DETERMINE THE DEPTH OF THE LOCAL GROUNDWATER TABLE PRIOR TO CONSTRUCTION OF EACH SEDIMENT BASIN.
2. THE BASIN SHALL BE CONSTRUCTED TO AVOID INTERCEPTION OF THE GROUNDWATER TABLE.
3. DEPTH AND SURFACE AREA OF THE BASIN SHALL BE ADJUSTED TO ENSURE THE SPECIFIED VOLUME REQUIREMENTS ARE MAINTAINED WITHOUT INTERCEPTION OF THE GROUNDWATER TABLE.

SEDIMENT BASIN DETAILS

BASIN NUMBER	LENGTH (m)	WIDTH (m)	BASIN VOLUME	MIN SURFACE AREA
BASIN 1A	11.3	33.38	557.5	371.5
BASIN 1B	10.55	31.66	501.1	334.1
BASIN 1C	10.62	31.86	507.4	338.4
BASIN 1D	8.90	26.70	356.6	237.6
BASIN 2	8.95	26.86	360.5	240.5
BASIN 3	21.11	63.32	2004.3	1336.3
BASIN 4	14.55	43.65	953	635
BASIN 5	12.47	37.41	699.6	466.6
BASIN 6A	7.33	22.00	242.3	161.3
BASIN 6B	6.65	19.94	198.5	132.5
BASIN 6C	6.16	18.48	170.80	113.80
BASIN 7	13.91	41.72	870.30	580.30
BASIN 8	10.87	32.60	531.20	354.20
BASIN 9	15.41	46.24	1068.80	712.80

NOTE: BASED ON 1.5m DEPTH

LEGEND

- EXISTING PROPERTY LINE
- EXISTING PERMANENT KOALA EXCLUSION FENCE
- EXISTING TEMPORARY NO-GO FENCE - POWER WEBBING WITH 2 STRANDS WIRE AND STAR PICKETS AT 8m CENTERS.
- FUTURE PROPERTY LINE
- PERMANENT KOALA EXCLUSION FENCE
- TEMPORARY KOALA EXCLUSION FENCE
- TEMPORARY CONSTRUCTION LIMIT FENCE
- HERITAGE EXCLUSION ZONE (NO WORKS PERMITTED)
- ECOLOGICAL BUFFER
- SEDIMENT BASIN CATCHMENT
- INDICATIVE PROPOSED BASIN AREA
- LIMIT OF WORKS BOUNDARY

PROJECT NAME

KINGS FOREST

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PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 30 60 90 120 150m
Scale 1:3000 - A1 (1:6000 - A3)

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

PRE	DATE	AMENDMENT
D	14-12-20	NOTE AMENDED
C	12-10-20	FENCE ALIGNMENT AND SPOIL AREA AMENDED
B	14-05-20	BASIN AREAS AND NOTES AMENDED
A	07-04-20	ISSUE FOR INFORMATION

ASSOCIATED CONSULTANTS

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DRAWING TITLE

BASIN CATCHMENT AREA & DETAILS

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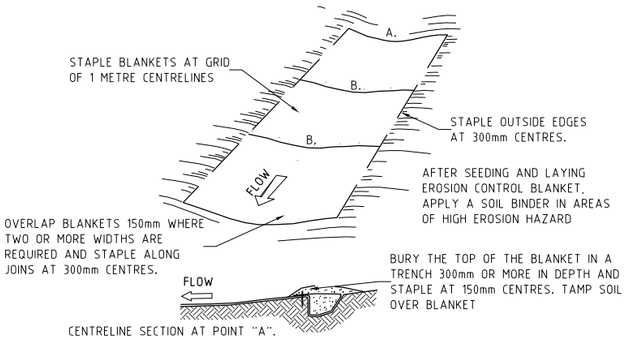
DRAWING NUMBER	AMEND.
12301-BE1-ESC-080	D

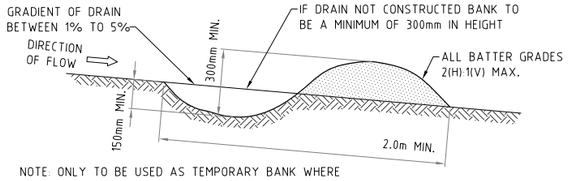


CONSTRUCTION NOTES:

1. REMOVE ANY ROCKS, CLODS, STICKS OR GRASS FROM THE SURFACE BEFORE LAYING MATTING.
2. ENSURE THAT TOPSOIL IS AT LEAST 75mm DEEP.
3. COMPLETE FERTILISING AND SEEDING BEFORE LAYING THE MATTING.
4. ENSURE FABRIC WILL BE CONTINUOUSLY IN CONTACT WITH THE SOIL BY GRADING THE SURFACE CAREFULLY FIRST.
5. LAY THE FABRIC IN "SHINGLE-FASHION", WITH THE END OF EACH UPSTREAM ROLL OVERLAPPING THOSE DOWNSTREAM. ENSURE EACH ROLL IS ANCHORED PROPERLY AT ITS UPSLOPE END.
6. ENSURE THAT THE FULL WIDTH OF FLOW IN THE CHANNEL IS COVERED BY THE MATTING UP TO THE DESIGN STORM EVENT, USUALLY IN THE 10-YEAR ARI TIME OF CONCENTRATION STORM EVENT.
7. DIVERT WATER FROM THE STRUCTURE UNTIL VEGETATION IS STABILISED PROPERLY.

CONCENTRATED FLOW CATCH DRAIN

NOT TO SCALE



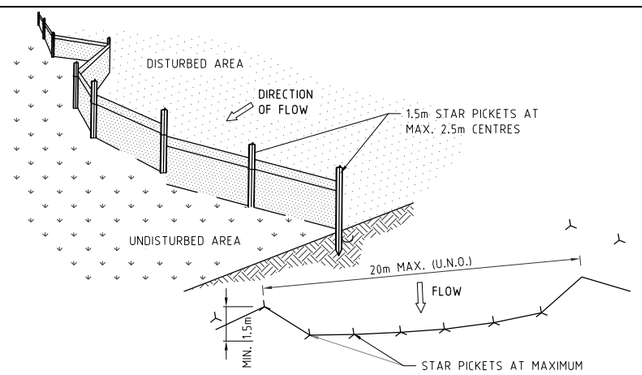
NOTE: ONLY TO BE USED AS TEMPORARY BANK WHERE MAXIMUM UPSLOPE LENGTH IS 80 METRES

CONSTRUCTION NOTES:

1. BUILD WITH GRADIENTS BETWEEN 1 PERCENT AND 5 PERCENT
2. AVOID REMOVING TREES AND SHRUBS IF POSSIBLE - WORK AROUND THEM
3. ENSURE THE STRUCTURES ARE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT COULD IMPEDE WATER FLOW.
4. BUILD THE DRAINS WITH CIRCULAR, PARABOLIC OR TRAPEZOIDAL CROSS SECTIONS NOT V SHAPED
5. ENSURE THE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE
6. COMPLETE PERMANENT OR TEMPORARY STABILISATION WITHIN 10 DAYS OF CONSTRUCTION

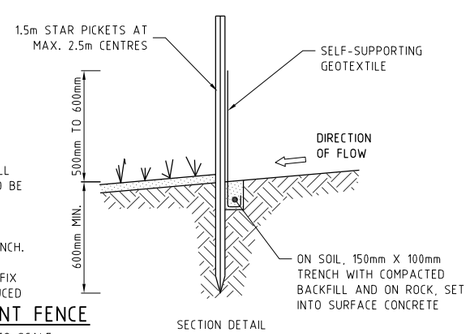
EARTH BANK (LOW FLOW)

NOT TO SCALE



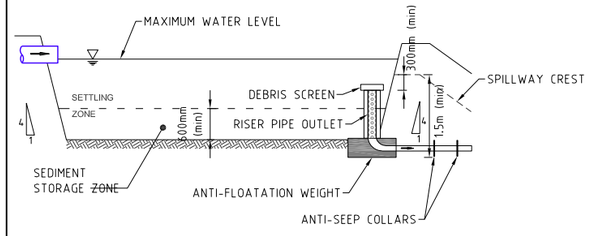
CONSTRUCTION NOTES:

1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED
3. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE



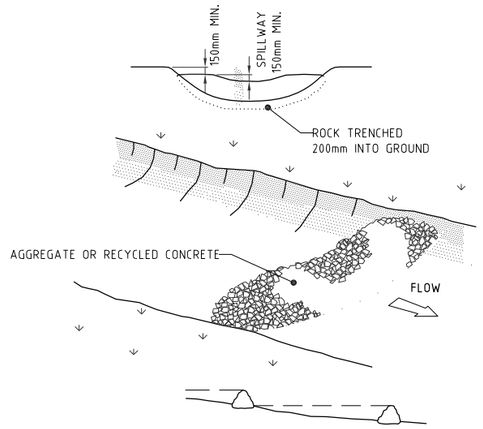
SEDIMENT FENCE

NOT TO SCALE



TYPICAL SEDIMENT BASIN NOTES:

1. TYPICAL BASIN SECTION BASED ON 'TYPE C' BASIN, SIZED AS PER APPENDIX B, IECA BEST PRACTICE EROSION AND SEDIMENT CONTROL CURRENT AS AT JULY 2019
2. CONFIGURATION SHOWN IS FOR 'TYPE C' BASIN, SELECTED INDICATIVELY BASED ON CARDNO BOWLER REPORT GEOTECHNICAL INVESTIGATION PROPOSED RESIDENTIAL SUBDIVISION DEPOT ROAD, KINGS FOREST DATED 7 APRIL 2011. CONTRACTOR TO PROVIDE FOR TESTING TO CONFIRM INSITU SOIL IS SUITABLE FOR 'TYPE C' SEDIMENT BASINS IN ALL LOCATIONS AS PER TABLE B2, APPENDIX B, IECA BEST PRACTICE EROSION AND SEDIMENT CONTROL AND CONFIRM WITH SUPERINTENDENT PRIOR TO APPROVAL FOR CONSTRUCTION.
3. BASIN SLOPE SHOWN INDICATIVELY AS PER TABLE B4, APPENDIX B, IECA BEST PRACTICE EROSION AND SEDIMENT CONTROL. SOIL TYPE TO BE CONFIRMED WITH SUPERINTENDENT PRIOR TO APPROVAL FOR CONSTRUCTION.
4. BASIN SECTION IS TYPICAL, SUBJECT TO DETAILED DESIGN BY STORMWATER CONSULTANT OR CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL.

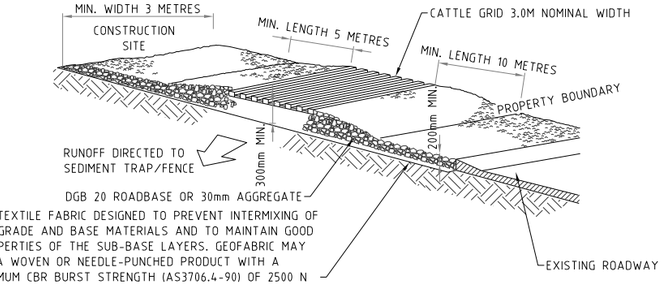


CONSTRUCTION NOTES:

1. CHECK DAMS CAN BE BUILT WITH VARIOUS MATERIALS, INCLUDING ROCKS, LOGS, SANDBAGS AND STRAW BALES. THE MAINTENANCE PROGRAM SHOULD ENSURE THEIR INTEGRITY IS RETAINED (ESPECIALLY WHERE CONSTRUCTED WITH STRAW BALES) WHERE BALES ARE USED, REPLACEMENT MAY BE REQUIRED EVERY TWO TO FOUR MONTHS
2. TRENCH CHECK DAM 200mm INTO THE GROUND ACROSS WHOLE WIDTH. WHERE ROCK IS USED, FILL TRENCHES TO AT LEAST 100mm ABOVE GROUND SURFACE TO REDUCE RISK OF UNDERCUTTING.
3. TRENCH MAXIMUM HEIGHT SHOULD NOT EXCEED 600mm ABOVE GULLY FLOOR. THE CENTRE SHOULD ACT AS A SPILLWAY, BEING AT LEAST 150mm LOWER THAN OUTER EDGES
4. SPACE DAMS SO THE TOE OF THE UPSTREAM DAM IS LEVEL WITH THE SPILLWAY OF THE FOLLOWING DOWNSTREAM DAM.

ROCK CHECK DAM

NOT TO SCALE

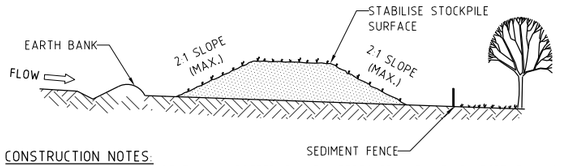


CONSTRUCTION NOTES

1. STRIP THE TOPSOIL, LEVEL THE SITE AND COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15 METRES LONG OR TO BUILDING ALIGNMENT AND AT LEAST 3 METRES WIDE.
5. WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.

STABILISED SITE ACCESS SHAKER GRID

NOT TO SCALE

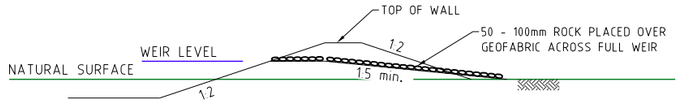


CONSTRUCTION NOTES:

1. PLACE STOCKPILES MORE THAN 2 (PREFERABLY 5) METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT
4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP TO REDUCE THE C-FACTOR TO LESS THAN 0.10
5. CONSTRUCT EARTH BANKS ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES 1 TO 2 METRES DOWNSLOPE.

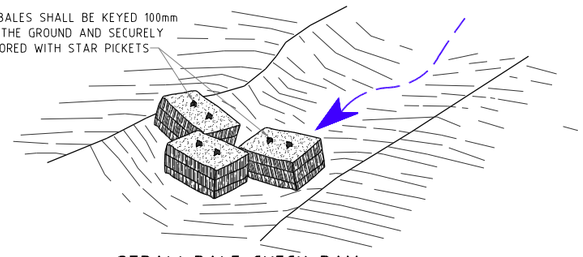
STOCKPILES

NOT TO SCALE



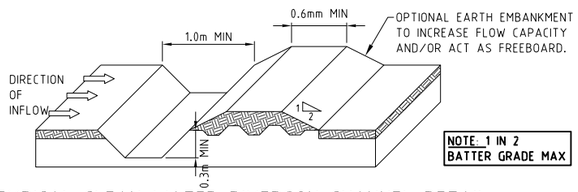
WEIR PROTECTION DETAIL

NOT TO SCALE



STRAW BALE CHECK DAM

NOT TO SCALE



TYPICAL CLEAN WATER DIVERSON CHANNEL DETAIL

NOT TO SCALE

CLEANWATER DIVERSION CHANNEL NOTES:

1. MAXIMUM BANK SLOPE PROVIDED AS A GUIDE ONLY. ACTUAL BANK SLOPE SHOULD BE BASED ON GEOTECHNICAL AND LANDSCAPING ADVICE WHERE PRACTICABLE
2. CLEANWATER DIVERSION CHANNELS TO HAVE MINIMUM LONGITUDINAL GRADIENT OF 0.5%
3. CHANNELS TO BE VEGETATED BY TURFING OR OTHER METHOD AS AGREED WITH SUPERINTENDENT. VEGETATED CHANNELS TO BE WELL ESTABLISHED PRIOR TO WORKS.
4. ALL CHANNEL OUTLETS TO BE STABILISED WITH A ROCK PAD PER IECA FACT SHEET OS-1 OUTLET STRUCTURES

PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION

Lot 7 on DP875447, Part of Lot 6 on DP875446, Lot 1 on DP781633, Lot 40 on DP7482, Lot 2 on DP819015, Lot 1 on DP129737, Lot 37A on DP13727, Lot 38A on DP13727, Lot 38B on DP13727, Lot 1 on DP706497, Lot 76 on DP755701, Lot 323 on DP755701, Lot 272 on DP755701, Lot 96 on DP755701 & Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

ISSUES	DATE	
TENDER	07-04-20	
COUNCIL	..	
CONSTRUCTION	...	

A	07-04-20	ISSUE FOR INFORMATION
PRE	DATE	AMENDMENT

ASSOCIATED CONSULTANTS

LANDSURV
GILBERT SUTHERLAND
JWA Ecological Consultants

DRAWING TITLE

FINAL SURFACE AND SEDIMENT AND EROSION DETAILS

MORTONS urbansolutions
Urban & Regional Planning
Civil Engineering
Project Coordination
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Southport QLD 4215

DESIGNED RB	DRAWN JB
APPROVED	RPEQ 4706 DATE 27-03-20

DRAWING NUMBER	AMEND.
12301-BE1-ESC-081	C

BASIN 1C

UPSTREAM STORAGE VOLUME TO RL 4.8 = 348.8m³

BUND RL 4.8

UPSTREAM STORAGE VOLUME TO RL 4.4 = 205.4m³

BUND RL 4.4

UPSTREAM STORAGE VOLUME TO RL 3.4 =1,163.1m³

BASIN 1B

UPSTREAM STORAGE VOLUME TO RL 3.0 =1,292m³

PIPE IL 3.0

NOTE THIS PIPE CAN BE BLOCKED TO PROVIDE ADDITIONAL STORAGE.

BASIN FLOOR RL 2.7

SPILLWAY RL 3.25

BUND RL 3.8

BASIN FLOOR RL 1.8

SPILLWAY RL 2.5

IL PIPE OUT 2.25

TO BE BLOCKED IF REQUIRED TO INCREASE STORAGE VOLUME TO THIS OUTLET TO BLACKS CREEK.

UPSTREAM STORAGE VOLUME TO RL 2.25 =104.7m³

BASIN 1A

INSTALL 0.5m BUND AROUND BASIN AS ADDITIONAL PROTECTION MEASURE.

Q3 MONTH 60 MINUTE DURATION RAINFALL EVENT GENERATES 20.4mm RAIN. = 1,020m³ RAINFALL FOR A 5 Ha SITE ASSUMING NO INFILTRATION.

EASTERN SWALE: 3,114m³ AVAILABLE FOR INFILTRATION, PRIOR TO WATER LEAVING SITE

EDGE OF SEPP14 COASTAL WETLANDS

PERMANENT STABILISATION TO BE PUT INTO PLACE IMMEDIATELY AFTER EARTHWORKS PLUS PINNED JUTE PROTECTIVE LINING TO ASSIST REGENERATION.

LEGEND

- EXISTING PROPERTY LINE
- EXISTING PERMANENT KOALA EXCLUSION FENCE
- EXISTING TEMPORARY NO-GO FENCE - POWER WEBBING WITH 2 STRANDS WIRE AND STAR PICKETS A7 8m CENTERS.
- FUTURE PROPERTY LINE
- PERMANENT KOALA EXCLUSION FENCE
- TEMPORARY KOALA EXCLUSION FENCE
- TEMPORARY CONSTRUCTION LIMIT FENCE
- ECOLOGICAL BUFFER
- SEPP14 COASTAL WETLAND BOUNDARY
- INDICATIVE PROPOSED BASIN AREA
- LIMIT OF WORKS BOUNDARY

PROJECT NAME

KINGS FOREST

BE1 SEDIMENT & EROSION CONTROL

REAL PROPERTY DESCRIPTION

Lot 7 on DP875447, Part of Lot 6 on DP875446, Lot 1 on DP781633, Lot 40 on DP7482, Lot 2 on DP819015, Lot 1 on DP129737, Lot 37A on DP13727, Lot 38A on DP13727, Lot 38B on DP13727, Lot 1 on DP706497, Lot 76 on DP755701, Lot 323 on DP755701, Lot 272 on DP755701, Lot 96 on DP755701 & Lot 326 on DP755701
PARISH OF CUDGEN .
COUNTY OF ROUS .

CLIENT

PROJECT 28 PTY LTD

NORTH

0 10 20 30 40 50m

Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER	xx-xx-xx	
COUNCIL	..	
CONSTRUCTION	...	

PRE	DATE	AMENDMENT
B	12-10-20	SPOIL AREA AMENDED
A	13-05-20	ISSUE FOR INFORMATION

ASSOCIATED CONSULTANTS

LANDSURV
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JWA Ecological Consultants

DRAWING TITLE

SPECIAL MEASURES
SEPP 14 WETLANDS

MORTONS urbansolutions
Urban & Regional Planning
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Project Coordination

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DESIGNED	RB	DRAWN	JB
APPROVED		RPEQ 4706	DATE 27-03-20

DRAWING NUMBER	AMEND.
12301-BE1-ESC-085	B

APPENDIX B

Geotechnical Investigation

Proposed Residential Subdivision Depot Road, Kings Forest

Prepared by Cardno Bowler

Cardno Bowler
Shaping the Future

Geotechnical Investigation
Proposed Residential Subdivision
Depot Road, Kings Forest

Job Number	9528gs.10
Prepared for	Project 28 P/L
Date of Report	7 April 2011

ABN 74 128 806 735

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Document Control

Version	Date	Author		Reviewer	
Draft	20 August 2010	Gary Samuels		David Bowler	
1	7 April 2011	Gary Samuels		David Bowler	

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1 INTRODUCTION

A geotechnical investigation was carried out for a proposed residential subdivision, Depot Road, Kings Forest, as requested by Project 28 Pty Ltd.

We understand the overall project involves the development of a residential subdivision, infrastructure, culvert, proposed clubhouse, two bridges, road networks and proposed private open space (including lake).

Details on proposed structural loads, types etc were not known at the time of the preparation of this report. Conceptually the lake is proposed to be some 5m deep and have slope edges in the order of 1V in 3H or 4H. Cut/fill heights are understood to vary across the site but may be up to 4.5m in both instances.

The objectives of the investigation as outlined in our proposal Ref: E6708-A dated 23 April 2010 were as follows:

- Determine the nature and certain engineering parameters of subsurface strata.
- Assess the allowable bearing capacity and moisture reactivity of the subsurface strata to allow the indicative selection and design of a suitable footing system for the proposed structures.
- Consider the excavatability of material to be cut and its suitability for use as fill.
- Assess the nature of subsurface strata in the areas to be filled with regards to settlement.
- Provide comment on subsurface conditions and likely foundation options at each proposed structure, including culverts, bridges, club house and pump station/commercial site.
- Carry out computerised stability analysis for existing drain edges at specific locations.
- Comment on depth to groundwater, if encountered.
- Determine the subsurface conditions at the proposed perched lake location near the entrance to the site.
- Carry out an assessment to determine the ground conditions at the proposed lake and undertake computerised stability analysis to determine suitable lake edge batters for long term stability.
- Make note of any potential borrow areas of rock or clay for use as structural fill, clay liners etc.
- Carry out a slope stability assessment.

This report must be read in conjunction with our attached *'General Notes'* and the ASFE publication *'Important Information About Your Geotechnical Engineering Report'* and *'Guidelines for Hillside Construction'*, Australian Geomechanics Society Journal, Volume 37, No. 2, May 2002.

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2 SITE DESCRIPTION

The subject block, was located on the southern side of Depot Road, Kings Forest.

The site, at the time of investigation, was generally flat, low lying pastoral land covered with short slashed grass. The site was irregular in shape and generally vacant. Numerous drainage gullies were located throughout the site and areas of high relief were noted near the western and northwestern extremities. Several residential buildings, sheds etc were noted at or near these high relief areas. Some thickly wooded areas of clumping trees were sporadically scattered throughout the site.

The low lying areas of the site had ponding water at surface in part, and was noted to be poorly drained.

Refer to Plates 1 to 6 for typical site conditions encountered during the investigation.

PLATE 1: TYPICAL SITE VIEW LOOKING WEST

PLATE 2: TYPICAL LOW LYING LAND IN THE FOREGROUND WITH HIGH RELIEF AREAS IN THE BACKGROUND

PLATE 3: TYPICAL VIEW OF LOW LYING LAND LOOKING SOUTH

PLATE 4: TYPICAL VIEW OF LOW LYING LAND LOOKING EAST

PLATE 5: HIGH RELIEF AREA NEAR WESTERN BOUNDARY

PLATE 6: ABANDONED SHED NEAR WESTERN BOUNDARY

3 INVESTIGATION WORK

3.1 Fieldwork

Fieldwork for the investigation was carried out between the 23 June to 18 July 2010 and included the following works:

- Pushing of 39 CPT probes to refusal.
- Drilling of 11 deep boreholes (DBH).
- Drilling of 9 shallow boreholes (SBH) to 6m or refusal

The test locations are shown on the attached site plan, Figure 1. The material encountered at each location is described on borehole/CPT log sheets included in Annex A.

Dynamic Cone Penetrometer tests were carried out beside each shallow borehole and these tabulated test results are included on the shallow borehole logs.

Fieldwork was carried out in accordance with Australian Standard, AS1726-1993 *'Site Investigation Code'*, and the Queensland State Planning Policy 1/03 *'Mitigating the Adverse Impacts of Flood, Bushfire and Landslide'*.

3.2 Laboratory Testing

Samples of representative strata were recovered and returned to our NATA accredited soils laboratory and our subcontractor, Trilabs Pty Ltd, where the following tests were carried out:

- Moisture Content
- Particle Size Distribution
- Atterberg Limits
- Oedometer Testing (Trilabs)

The laboratory test results are included in Annex B. Laboratory testing was carried out in accordance with Australian Standard AS1289 *'Laboratory Testing For Engineering Purposes'*.

4 SUBSURFACE CONDITIONS

4.1 Subsurface Strata

The investigation work indicated that variable subsurface conditions existed at the test locations. However, generally loose to very dense sand and indurated sand were encountered from surface to depth.

The borehole/CPT logs in Annex A should be referred to for the detailed description of material encountered at each investigation location. A summary is detailed in Table 1.

Table 1: Summary of Subsurface Strata

Soil Descriptions/Depth (m)										
Location	**Test No.**	**Topsoil**	**Sand**			**Sandy Clay**		**Weathered Rock**	**TD**	**Ground-water Level (m)**
			Very loose to loose	**Loose to very dense**	**Indurated**	**Soft to firm**	**Stiff or better**			
Commercial site and pump station	CPT39	0.0-0.1	-	0.1-4.0	4.0-TD	-	-	-	4.6	NM
	CPT38/ DBH1	0.0-0.1	-	0.1-4.5	4.5-11.5	-	11.5-18.7	18.7	18.7	0.4
Precinct 5	CPT1	0.0-0.1	-	0.1-3.0	3.0-TD	-	-	-	7.2	NM
	CPT2/ DBH2	0.0-0.1	-	0.1-4.5 12.0-TD	4.5-12.0	-	-	-	20.0	NM
	CPT3	0.0-0.1	-	0.1-1.8 2.6-3.5	1.8-2.6 3.5-TD	-	-	-	5.6	NM
	CPT4	0.0-0.1	-	0.1-4.0	4.0-TD	-	-	-	-	NM
	CPT5	0.0-0.1	-	0.1-5.0	5.0-TD	-	-	-	6.9	NM
	SBH8 (swale)	0.0-0.1	0.1-0.5	0.5-3.5	3.5-TD	-	-	-	6.0	0.4
Area Just North of Precinct 5	CPT6	0.0-0.1	-	0.1-3.0	3.0-TD	-	-	-	5.0	NM
Bridge (Near Hoop Pine)	CPT19	0.0-0.1	-	0.1-21.0 32.0-39.0	-	-	21.0-32.0[(d)]	-	42	NM
	CPT20/ DBH4	0.0-0.1	20.0-34.0	0.1-20.0 34.0-TD	-	-	-	-	40	2.5
Road Alignment from Precinct 5 to Bridge (Hoop Pine)	CPT17	0.0-0.1	-	0.1-4.5	4.5-TD	-	-	-	8.14	NM
	CPT18	0.0-0.1	-	0.1-1.2	1.2-TD	-	-	-	3.9	NM
Precinct 13	CPT27	0.0-0.1	-	0.1-2.2	2.2-TD	-	-	-	5.1	NM
	CPT28	0.0-0.1	-	0.1-6.2	6.2-TD	-	-	-	7.0	2.4

Table 1 continued

Location	Test No.	Topsoil	Sand			Sandy Clay		Weathered Rock	TD	Ground-water Level (m)
			Very loose to loose	Loose to very dense	Indurated	Soft to firm	Stiff or better			
Proposed Clubhouse	CPT29/ DBH5	0.0-0.1	-	0.1-3.5 12.0-20.5 22.5-24.0	3.5-12.0	-	20.5-22.5 24.0-TD	-	30.0	-
Bebo Arch	CPT26/ DBH6	0.0-0.1	-	0.1-2.6 9.0-13.5 16.2-22.7 28.5-TD	2.6-9.0 13.5-16.2	-	22.7-28.5	-	30.0	1.0
Precinct 12	CPT24	0.0-0.1	-	0.1-15.0	-	-	15.0-TD[(d)]	-	19.8	NM
	CPT25	0.0-0.1	-	0.1-2.2	2.2-TD	-	-	-	4.2	NM
Culvert	CPT23/ DBH7	0.0-0.1	-	0.1-14.5	-	14.5-15.7	15.7-22.6	22.6	22.6	2.5
	CPT22/ DBH8	0.0-0.3[(e)]	9.3-12.0	0.3-3.6	-	3.6-9.3	12.0-TD	-	23.5	NM
Approach to culvert from Precinct 12	CPT21	0.0-0.1	20.0-TD	0.1-20.0	-	-	-	-	42	NM
Proposed Lake	CPT30	0.0-0.1	-	0.1-2.0	2.0-TD	-	-	-	2.5	NM
	CPT32	0.0-0.1	-	0.1-1.8	1.8-TD	-	-	-	2.5	NM
	CPT33	0.0-0.1	-	0.1-1.5	1.5-TD	-	-	-	2.3	NM
	SBH6	0.0-0.3	-	0.3-2.0 3.4-TD	2.0-3.4	-	-	-	6.0	1.3
Town Centre	CPT7/ DBH3	0.0-0.1	-	0.1-4.0 9.0-24.0	4.0-9.0	-	24.0-TD	-	25.5	NM
	CPT8	0.0-0.1	-	0.1-3.8	3.8-TD	-	-	-	5.8	NM
	CPT9	0.0-0.1	-	0.1-2.6	2.6-TD	-	-	-	6.5	NM
	CPT10	0.0-0.1	-	0.1-2.2	2.2-TD	-	-	-	3.7	NM
Proposed Perched Lake	SBH9	0.0-0.1	-	0.1-5.6	5.6-TD	-	-	-	6.0	0.4
Drainage Channels	SBH1	0.0-0.3	-	0.3-1.9	1.9-TD	-	-	-	3.1[(c)]	0.8
	SBH2	0.0-0.2	-	0.2-2.1 3.2-TD	2.1-3.2	-	-	-	6.0	-
	SBH7	0.0-0.2[(e)]	0.2-1.2	1.2-TD	-	-	-	-	6.0	0.9

Table 1 continued

Location	Test No.	Topsoil	Sand			Sandy Clay		Weathered Rock	TD	Ground-water Level (m)
			Very loose to loose	Loose to very dense	Indurated	Soft to firm	Stiff or better			
High Topographic Areas	SBH3	0.0-0.2	-	3.8-TD	-	-	0.0-3.8	-	6.0	3.7
	SBH4	0.0-0.2[(e)]	-	-	-	-	0.2-0.8	0.8-TD	1.1[(f)]	NE
	SBH5	0.0-0.2	-	-	-	-	0.2-1.5	1.5-TD	1.7[(f)]	NE
Balance	CTP11	0.0-0.1	-	0.1-2.5	2.5-TD	-	-	-	3.3	NM
	CPT12/ DBH9	0.0-0.1	-	0.1-3.5 7.5-14.8	3.5-7.5	-	14.8-27.0	27.0-TD	3.0	0.3
	CPT13	0.0-0.1	-	0.1-1.4	1.4-TD	-	-	-	3.0	NM
	CPT14	0.0-0.1	-	0.1-2.3	2.3-TD	-	-	-	2.6	NM
	CPT15	0.0-0.1	-	0.1-1.95	1.95TD	-	-	-	2.8	NM
	CPT31	0.0-0.1	0.1-0.6	0.6-1.3 1.7-2.5	1.3-1.7 2.5-TD	-	-	-	3.1	NM
	CPT34/ DBH10	0.0-0.1	-	0.1-2.2 6.0-13.0 16.5-18.0[(g)] 25.8-TD[(g)]	2.2-6.0	-	13.0-16.5 18.0-25.8	-	30	0.3
	CPT35	0.0-0.1	-	0.1-1.7	1.7-TD	-	-	-	3.2	NM
	CPT37/ DBH11	0.0-0.1	-	1.8-8.3	-	8.3-10.5	0.1-1.8 10.5-13.8	13.8-TD	16.5	1.8

NOTES:

a) All depths measured in metres below ground level at the time of the investigation.
b) TD = Termination Depth.
c) All above CPT tests were pushed to refusal.
d) Interbedded stiff sandy clay/loose clayey sand.
e) Fill.
f) TC bit refusal for drill rig.
g) Gravel bands throughout.
h) NM = Not measured.
i) NE = Not encountered.

Groundwater levels, where encountered, were generally between 0.3m and 2.5m below existing site level. Refer to Table 1 above for details of where groundwater was encountered and at what depth.

Due to the sites close proximity to Cudgen Creek, groundwater levels could be expected to fluctuate. Groundwater could be expected to be a significant civil issue for cut areas of the site and as such, dewatering is expected to play a major role in the speed at which the civil works are able to progress.

4.2 Laboratory Test Results

A summary of laboratory test results is provided in the Table 2 below. Refer to Annex B for details on the oedometer testing outputs.

Table 2: Classification and Vane Shear Test Results

Particle Size Distribution, Atterberg Limits, Linear Shrinkage and Moisture Content									
Bore No	**Depth (m)**	**% Sand & Gravel**	**% Clay & Silt**	**Moisture Content (%)**	**Liquid Limit (%)**	**Plasticity Index (%)**	**Linear Shrinkage (%)**	**Pocket Penetrometer (kPa)**	**Vane Shear (kPa)**
SHB3	0.8-0.9	10	90	38.8	14.5	19	14.5	-	-
	3.0-3.1	12	88	39.8	39.8	17	13.5	-	-
BH8	7.5-7.95	-	-	-	-	-	-	10-15	15

5 GEOTECHNICAL ASSESSMENT

5.1 Earthworks

Based on supplied earthworks plans (Mortons Urban Solutions), cut/fill levels are expected to be up to 2.5m in both instances.

Site Preparation

All site preparation work should generally be carried out in accordance with AS3798.2007 *'Guidelines on Earthworks for Commercial and Residential Developments'*.

The site should be stripped of all topsoil from the fill footprints, and stockpiled for landscaping usage, if required. A stripping depth in the order of 0.1m is indicated from the information gathered at the investigation locations. Where any minor existing fill was encountered, this fill is expected to be *'uncontrolled'* and as such over excavation in these areas should be undertaken and the fill removed and replaced with select fill or be recompacted.

After stripping and fill removal, the newly exposed surface should be proof rolled using a vibrating 10 tonne (static weight) smooth drum roller. Any loose/soft areas should be removed and recompacted or replaced using a compacted select fill. As discussed, dewatering may be required due to the presence of a high water table in order to avoid heaving during the earthworks process.

Depressions formed by the removal of vegetation, existing structures, underground services etc, should have all disturbed soil cleaned out and be backfilled with compacted select fill material.

Trafficability

During the investigation, the fieldwork plant used became *'bogged'* on numerous occasions, and as such, it is likely that in order to maintain some manoeuvrability around the site, that a series of haul roads will need to constructed.

If at any stage there is a need for haul roads to be developed the following construction method is recommended:

- Strip the grass and organic root zone and allow the surface to dry to promote some surface crust. If necessary, geogrids may be placed over the stripped surface.
- Following stripping and drying, place a minimum thickness of say 500mm to 600mm of granular material of a maximum particle size of 75mm over the stripped surface.
- After the initial lift, subsequent lifts, preferably with granular material can be placed and compacted in the conventional way.

Excavatability

No problems should be encountered in excavating the near surface material on site. Most soils encountered on site should be within the excavation limits of a small dozer (eg Cat D6 or similar) in bulk excavations or medium size backhoe (eg Case 580 or similar) in trench excavations.

'TC' bit limit was achieved in SBH4 and SBH5, in the high relief areas of the site, in weathered rock. While there is no direct reliable relationship between drilling resistance and excavatability, as a rule of thumb the limit of the *'TC'* bit may be taken as indicative of the limit of excavation of a medium sized dozer in bulk excavation (Cat D7E, D8) or a large excavator in trench excavation (Kato or Hymac).

Generally below the *'TC'* bit limit, larger excavation equipment, explosives, compressor driven pneumatic tools, or hydraulic rock breakers would be required for excavation.

Structural Fill Placement

With the exception of the topsoil stratum, all materials encountered during the investigation are considered acceptable for use as structural fill provided that any pre-treatment (moisture conditioning, removal of oversize), is carried out prior to fill placement. The clays on site are highly plastic and could be expected to result in stiff raft foundation types if encountered in significant thicknesses or where used as fill. Given this, the clays are considered poor quality structural fill. However, the sand/weathered rock strata are considered a more suitable material for use as structural fill when compared to the clays on site.

Any structural clay bearing fill should be placed in loose layers not greater than 200mm thick at a moisture content in the range -2% to +3% of the standard optimum moisture content (to minimise the potential for post compaction volume change due to moisture content variations) and be compacted to a minimum dry density ratio of 95% and 98% of the maximum dry density determined by AS1289 5.1.1 (standard compaction) for residential and commercial areas respectively.

Measures should be adopted to ensure that this clay bearing fill material is not allowed to dry out prior to the placement of succeeding layers of fill and final covering with building slabs and road pavements.

Any structural sand fill should be placed in loose layers not greater than 200mm thick, and be compacted to a minimum density index of 70% and 80%, for residential and commercial areas respectively, in accordance with AS1289 5.5.1 using a vibrating smooth roller drum not less than 10 tonne in static weight.

It is recommended that the placement of all structural fill be inspected and tested by Cardno Bowler to Level 1 requirements, during the earthworks operations to ensure that all fill is placed in a *'controlled manner'*, in accordance with AS3798-2007.

The near surface silty sand encountered on the site is known to be particularly difficult to work and compact, especially if it becomes wet. The material has relatively good engineering properties if it is compacted in place to the required density and confined by overlying layers. However, if the moisture content is too high at the time of site preparation work, it tends to be spongy and will heave under the load of construction equipment, can be difficult to traffic and compact, and is slow to drain and dry out. Some dewatering management plan is likely to be required in order to maintain some manoeuvrability of plant during the bulk earthworks.

5.2 Batter Slopes

For initial design purposes, previous experience in the area has indicated that the following maximum unprotected batter slopes may be adopted for the cut and fill batters on the site.

Table 3: Maximum Unprotected Batter Slopes

Material Type	Short Term (Maximum)	Long Term (Maximum)
Residual Clays (cut)	1V:1H	1V:2H
Residual Sands (Cut)	1V:2H	1V:2.5H
Fill Batters(1)	1V:2H	1V:2H
Weathered Rock	1V:1H	*

Notes:

1. (1) All fill batters should be overfilled, compacted and cut back at the maximum angles recommended above and with some form of erosion protection to minimise any potential unnecessary scour effects due to weathering.
2. * Denotes requirement for detailed stability assessment.

5.3 Building Footings

Residential Precincts

Final site classifications will be a function of the geometry of the building platforms and the reactivity of the material that comprises said platform. This will need to be confirmed on a site by site basis post construction.

Assuming that the predominate structural fill material to be used is sand/weathered rock and that the fill is placed as per Section 5.1 of this report, then in the cut areas Class 'S' sites are likely and in the fill areas Class 'M' to 'H' sites can be expected.

General Structures

For the following proposed structures, Town Centre, Commercial Site and Pump Station, Bridge (near Hoop Pine), Clubhouse and Bebo Arch, depending on structural loads, both high and deep level footings may be appropriate for these structures. See below for footing options and allowable bearing capacities for design purposes.

High Level Footings

For lightly loaded, small structures such as residential buildings, sheds, etc, high level, strip/pad footings or stiff raft systems may be considered.

The following allowable bearing capacities, as shown in Table 3 below, may be used to assess the footing pressures that may be applied to the various strata by strip/pad footings without causing bearing capacity failure.

Table 4: Allowable Bearing Capacities Strip/Pad footings

Material Type	Allowable Base Bearing Capacity
Controlled Fill	100
Natural Sands	100
Residual Clay	100
Weathered Rock	600

Deep Level Footings

Should loads be such that deep level footings are required to support structures, alternative deep level footing types include bored piles, grout injected piles, driven piles, push piles and screw in steel piles.

Bored Piles

Using the Australian Standard AS2159-1995 *'Piling - Design and Installation'*, the design of a bored or grout injected pile footing system may be based on the following formulae:

$S^* \leq R_g^*$

where $R^*_g = \phi_g R_{ug}$

R^*_g = Design Geotechnical Strength

S^* = design action effect (design load as the combination of factored loads which produce the most adverse effect on the pile).

ϕ_g = Geotechnical Reduction Factor

R_{ug} = Ultimate Geotechnical Strength

$R_{ug} = f_s A_s + f_b A_b$

f_s = Ultimate skin friction pressure

f_b = Ultimate base bearing pressure

A_b = Plan area of pile base

A_s = Surface area of pile

For piles founding into clay or weathered rock:

$f_s = S \alpha$

$f_b = S N_c$

where α = Adhesion factor

N_c = Bearing capacity factor which varies between 5 and 9 depending on the depth of the pile

S = Undrained shear strength

For piles founding into sands or gravels:

$f_s = K_s \sigma'_v \tan \delta$

$f_b = \sigma'_{vb} N_q$

where σ'_v = vertical effective stress at relevant depth

σ'_{vb} = vertical effective stress at the base of pile or at limiting depth

N_q = Bearing capacity factor due to overburden pressure

K_s = Earth pressure co-efficient

δ = Angle of sidewall friction

The parameters shown in Table 4 may be used for footing design purposes. However, if bored piles are adopted, the base of the piles must be inspected during construction to ensure that material of adequate capacity supports each pile. It is essential that the base of each pile is free from any water-softened materials and any debris. Pile bases should be **cleaned using a clean out bucket or cleaning plate.** This instruction should be made **explicit** to the piling contractor.

However, due to the presence of a high water table, there may be a need for pumps to be utilised and or a full casing sealed into the rock or an impermeable layer to maintain the integrity of the pier base depending on the water influx into the pier hole.

If the pumping of water is not considered a satisfactory method to keep the water influx low, other possibilities include drilling the bore under bentonite suspension to the end bearing rock. Concrete is placed into the bore by tremie, and the bentonite suspension is displaced by the concrete. The major disadvantages with this method is that unless the waste suspension is collected, the site can become very wet. There are also difficulties with the checking of base cleanliness.

If may be prudent to drill a test pier on this site if bored pier construction methods are to be utilised to assess the suitability of this method and to determine if water inflow can be controlled.

Grout injected piles are another construction type that may be suitable. However, this piling technique is not favoured as some difficulties with base cleanliness and end resistance can occur with grout injected piles socketted through clay into rock.

Table 5: Geotechnical Parameters for Bored Piles

Material Type			Design Equivalent Skin Friction $\phi_g f_s$ (kPa)	Design Equivalent Base Bearing Capacity $\phi_g f_b$ (kPa)
Fill			NR	NR
Natural Sands	› Loose [f] or better	Depth 1 to 2m	4	100
		3	5	200
		4	6	270
		5	7	400
		6	9	560
Indurated Sand [g]			20	600
Clay	› Soft		NR	NR
	› Stiff or better		6	180
Weathered Rock			35	1000

Notes:

a) NR = Not Recommended

b) Ignore top 1.5m of profile in pile capacity calculations.

c) The above values were compiled assuming that the pile depth will be at least 5 times that of its pile diameter.

d) A geotechnical strength reduction factor (ϕ_g) of 0.4 has been applied to the ultimate parameters in the calculation of the above design equivalent capacities.

e) The geotechnical strength reduction factor could be increased should dynamic or static pile testing be carried out. If this is the case, then Cardno Bowler should be contacted.

f) For sands, the values shown above are indicative only and will vary depending on depth and strength of a material at a given location. As such these values should be used for preliminary design purposes only and confirmed with a more detailed assessment once structural loads are known.

g) The thickness of the indurated sand layer would need to be checked to ensure that it is sufficient, in comparison with the dimensions of the footing, to support the applied load.

If, during bored pier or other operations, suspected weaker material is encountered below the limit of the investigation work, Cardno Bowler should be contacted immediately to assess the nature of this strata.

Screw Piles

This deep foundation method is performed by screwing in a compression auger head which has a hollow steel tube connected to a hollow helix.

When the bearing strata is reached the steel cage is placed down the hollow tube and the tube filled with concrete. The auger head and steel tube are then unscrewed. The auger head is slowly withdrawn and concrete pumped out the end of the head under pressure filling the bore with concrete whilst being removed.

Nominal screw pile sizes are shown in Table 5.

Table 6: Nominal Screw Pile Sizes

Minor Diameter (mm)	Maximum Helix Diameter (mm)
410	550
460	510
510	660
560	700

In the calculation of allowable base bearing and allowable skin friction capacity, the following shaft sizes may be adopted:

- Base bearing = minor diameter + 150mm
- Skin friction = minor diameter + 100mm

The major advantage with this form of pile installation is that high ground water levels have not effect on pile construction.

The disadvantage with this piling technique is that subsurface materials, including the founding stratum, cannot be visually assessed during the construction process.

Driven Piles

Driven precast concrete piles are a possible foundation type where the founding stratum is at depth. These have the advantage of not being effected by groundwater during construction.

Piles driven to near refusal into weathered rock can generally be designed based on the pile section capacity rather than on a consideration of the soil or rock properties. Typical precast concrete pile sizes and nominal capacities are provided in Table 6 below.

Table 7: Indicative Pile Sizes and Capacities

Pile Size (mm square)	Nominal Capacity (kN)
235	600-700
275	1000-1200
300	1400-1500
350	1600-1800

The range in capacity for a given size reflects variation between individual piling contractors.

Piles would be expected to refuse in weathered rock with consecutive SPT ‘N’ values of about 50 or greater.

Vibrations and the pile cap associated with this type of installation are the major drawbacks related to driven pile construction. The vibrations of a driven pile drop hammer may potentially cause structural damage to existing pipes etc, this must be considered carefully if this technique is to be utilised.

Cast insitu concrete driven piles with enlarged bases are another piling option. This is a method where a withdrawable tube containing a plug of gravel or dry concrete is driven down by blows from an internal drop hammer to the founding depth. When the founding depth is reached the concrete is

placed and the concrete plug hammered out to form a bulb end. A reinforcing cage and concrete are then placed and the tube is withdrawn.

Nominal pile capacities for this type of construction are displayed in Table 7.

Table 8: Cast – Insitu (Enlarged Base) Driven Pile Capacities

Shaft Diameter	Working Load (kN)
400	1000
500	1500
600	2500

Loads are based on a base diameter of at least 1.5 times the shaft diameter.

A specialist piling contractor should be consulted to confirm pile capacities.

Culvert

For the culvert, based on existing ground conditions, some settlement could be expected under fill plus culvert loads (say 60kPa). This settlement could be in the order of up to 195mm and take some 6 to 12 months to achieve the near completion (say 90%) of primary consolidation. Preload of this area may be considered to increase the rate of settlement or piling of the structure may be an alternative which would alleviate any settlement issues. Settlement is discussed in more detail below.

Note: Laboratory testing is still currently underway and as such the values mentioned above are based on previous experience with soft clays and as such are subject to variation based on the results of the laboratory testing and subsequent analysis.

5.4 Settlement

Based on provided fill heights, the subsurface profile encountered during the investigation and anticipated building loads, some settlement could be expected across the site. However, given the predominately sand nature of the subsurface profiles encountered, this settlement could be expected to be elastic and occur almost immediately upon loading. This elastic settlement could be expected to be in the order of up to 100mm. Given the requirement for proof rolling and the anticipated compression of the subsurface strata under loads imposed by haul trucks, plant etc, the majority of the site is not expected to require any additional pre-treatment prior to the commencement of the earthworks.

However, at the culvert location and CPT37/DBH11 (Precinct 16) compressible soft clay was encountered. In both areas, some filling is proposed. Consolidation settlement could be expected under structure plus fill loads.

The consolidation settlement, which will occur in the soft clays, is time and load dependent. Primary settlement occurs under loading as pore pressures are dissipated. In the loose to medium dense sands settlement is expected to occur quickly, essentially upon loading.

Compressible clay thicknesses of 1.2m and 5.7m were encountered at the culvert and 2.2m at DBH11. Given these thicknesses and using an Mv (coefficient of compressibility) of 1.6 x 10^{-3} kPa^{-1}, the following theoretical primary consolidation is anticipated.

Table 9: Estimated Consolidation Rates for Various Marine Clay Thicknesses

Location	Indicative Primary Consolidation (mm)
Culvert	75-365
DBH11	160

In addition to the above, up to 100mm of elastic settlement may also occur.

The rate of settlement is expected to be in the order of 6 to 12 months in order to achieve T_{90} (90% consolidation under structural fill loads only.

Surcharge

If time is available, it would be prudent to surcharge the culvert alignment in order to accelerate the consolidation. The maximum height of fill/surcharge placed must be controlled to prevent bearing capacity failure in the underlying soft soils. Based on the shear strength of the soft soils, a maximum initial fill height of 4 metres is recommended (including surcharge), with fill batter slopes not steeper than 3H:1V. Additional fill, if required, may be placed once some consolidation of the underlying soft clay soils has occurred giving some increase in strength following dissipation of excess pore pressure.

Based on 2m of structural fill and 2m of surcharge (4m total fill height), T_{90} could be expected to occur within approximately 3 months.

Monitoring

The settlement times discussed in Table 8 are dependent upon the drainage achieved in the compressible clays. These times are provided for planning purposes only. Monitoring of the settlement must be carried out on site to determine when settlements are complete. This should consist of the use of settlement plates installed across the site once stripping has been completed and prior to the placement of fill. Settlement plates should be monitored once each week during the filling program and fortnightly thereafter for a period of 6 weeks. The frequency of readings after this initial monitoring may vary depending upon the results recorded.

5.5 Proposed Lake

It is understood that a 1V:3H cut lake edge batter, some 5.0m deep, is proposed to construct the lake.

Based on the fieldwork conducted to date, the stratigraphy in the lake area comprises predominately of loose to medium dense and indurated sands. Given this our preliminary findings indicate that the lake will be suitable for the proposed lake edge batter of 1V:3H with regards to stability.

With regards to suitability of spoil materials for use as structural fill during lake excavation, the sand spoil is considered good material for use as structural fill.

The residual clay encountered in the higher topographic areas of the site appear suitable for use as a clay liner for the lake base and edges, however, this is based on a visual and classification assessments only. It is recommended that further testing of this strata be conducted to determine its permeability if it is to be considered for a clay liner usage.

5.6 Existing Drains

Based on the existing geometry of the drains and the proposal to add surcharge to the drain edges with structural fill, a series of analyses were undertaken to assess the long term stability of the drainage channels given the predominate sand subsurface strata.

In order to maintain an adequate factor of safety against instability, it is recommended that the drains be remodelled so that the drain batters do not exceed 1V:3H. Alternatively the drains could be steeper but would need to be retained (i.e. gabion wall) and given the significant lengths of the drainage system, this would seem impractical.

Some form of erosion protection may also need to be considered on the drainage channel batters, i.e. rip/rap in order to minimise potential erosional effects and batter/edge deterioration.

5.7 Slope Stability Assessment

Fieldwork for this component of the investigation was carried out by a Senior Engineering Geologist on 28 June 2010.

The fieldwork exercise included a broadscale inspection, where possible, of the entire site to assess the following;

- Determine slope angle
- Observe vegetation
- Note any evidence of tension cracking
- Note any evidence of seepage
- Note any evidence of soil creep
- Note any evidence of previous slips
- Geological features
- Subsurface conditions
- Drainage issues

No physical evidence of previous movement, seepage, soil creep etc was observed during the mapping exercise across the site in its current state.

Slope angles varied from less than 10^{o} (17%) to greater than 17^{o} (30%) across the high relief areas of the site and over possible individual building areas.

For sloping blocks, it is recommended that cut/filling construction be restricted to the area on the blocks where **natural** slope angles are less than 14^{o} (say 25%) and where residual soils/weathered rock existed. This cut and fill should be limited to heights not exceeding 1m without more detailed geotechnical investigation work. Where slopes exceed 14° (say 25%) it is recommended that no cut/fill be undertaken without detailed geotechnical assessment.

Where the lot varies significantly in slope percentage, the final proposed building location will have a significant bearing on the most likely dwelling type. Should the building be constructed over an area which is less than 15% slope and residual soils or weathered rock are encountered, then a slab-on-ground may be considered. Where the slope exceeds 15%, or where colluvium was encountered, pole type or split level homes should be considered. A combination slab-on-ground, split level, pole type dwelling may be considered where slope percentages vary across a proposed building platform and appropriate soils allow for this type of construction. Where slopes exceed 25%, pole type homes should be considered only. A final decision on the most appropriate building type will need to be made at the design stage of the proposed building.

The above should be considered 'indicative' only and subject to variation depending on the results of the site specific geotechnical investigation required to be carried out to finalise site classifications for footing design.

The above assumes that appropriate subsurface and surface drainage control measures will be designed, installed and certified in order to control groundwater and surface runoff.

If pole type dwellings are proposed, these dwellings should be of a lightweight, flexible construction using timber/steel, suspended timber floors and cladding. Also pole supports should be designed to resist any lateral loading due to creep within the soils.

Once final cut/fill levels are known for the bulk earthworks, it is recommended that a detailed slope stability assessment, using cross sectional drawings, be carried out by Cardno Bowler to provide recommendations for slope stability.

The stability of an area under construction will largely be a function of adequate drainage control. Therefore, it is assumed that stormwater management will be designed and constructed in accordance with recognised building practices/standards to control all drainage issues.

For sloping land, it is recommended that removal of vegetation (with the exception of topsoil stripping) be kept to a minimum and that any vegetation removal only be undertaken where it is necessary in order to construct building platforms.

Based on the mapping exercise and fieldwork to date, no physical evidence was observed to indicate previous instability or potential future instability across proposed allotments in their existing state, nor was any literature noted to indicate any previous movement.

Further to the above, a quantitative hazard rating has been assigned to the sloping areas of the site, the results of this assessment indicated that lots varied in hazard rating from very low to low. For details of this analysis, refer to Annex C of this report.

The development of this site is not expected to adversely affect the current stability of adjoining properties provided the recommendations above are adhered to and adequate civil/hydraulic and structural issues are addressed.

Given the results of our assessment, the site is considered acceptable for its proposed usage with regards to stability.

As this investigation is *'broadscale'* all findings should be considered preliminary only. It is recommended that proposed cut/fill levels for building pad construction be reviewed and analysed by Cardno Bowler prior to the commencement of any earthworks to confirm the theoretical stability factor of safety (FOS) against failure is $\geq$1.5. Further, during the construction phase of the project, Cardno Bowler should be engaged to inspect the cut/fill batters and certify that the required FOS can be achieved or whether remediation works are required.

6 CONSTRUCTION INSPECTIONS

It is recommended that placement of all structural fill and footing excavations be inspected, tested and certified where necessary, by Cardno Bowler Pty Ltd to ensure recommendations made in this report have been adhered to.

Should subsurface conditions other than those described in this report be encountered, Cardno Bowler Pty Ltd should be consulted immediately and appropriate modifications developed and implemented if necessary.

7 CONCLUSIONS AND RECOMMENDATIONS

The following is a summary of the conclusions and recommendations in regard to the geotechnical investigation for the proposed residential subdivision at Depot Road, Kings Forest. However, the preceding sections of this report should be read for a full description of the conclusions and recommendations.

1. The subsurface conditions at the site generally consisted of loose to vey dense sand and indurated sand from surface to depth.

2. The site preparation work should generally be carried out in accordance with AS3798.2007 *'Guidelines on Earthworks for Commercial and Residential Developments'*.

3. Based on proposed earthworks and assuming fill types and adequacy of fill placement, the classification of allotments across the site is likely to vary from Class 'S', 'M' and 'H' in accordance with AS2870-1996 *'Residential Slabs and Footings'*.

4. Depending on structural loads both high and deep level footings may be appropriate to support the proposed development on the subject site. Recommended bearing capacity parameters to allow the proportioning of footings, depending on the applied load, are included in Section 5.3. Recommended geotechnical parameters for pile design are included in Section 5.3.

5. Refer to Section 5.4 of this report for issues relating to potential settlements.

6. Section 5.5 should be reviewed for comments with regards to lake stability and the use of on site borrow material as a clay liner.

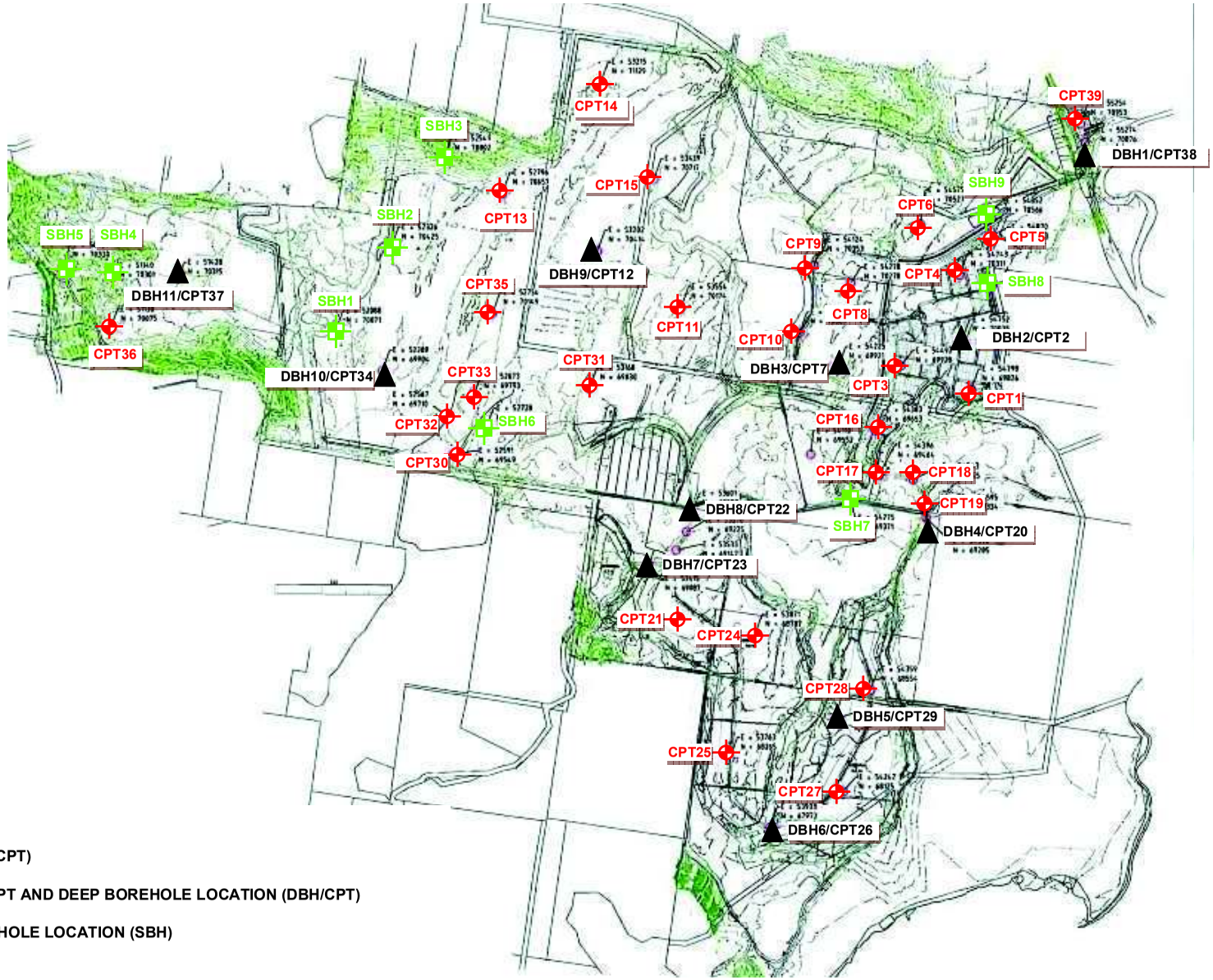
7. Refer to Section 5.6 for issues relating to existing drainage channel stability.

8. Refer to Section 5.8 for comments on existing slope stability in the high topographic areas of the site.

Yours faithfully

GARY SAMUELS
PRINCIPAL

DAVID BOWLER
SENIOR PRINCIPAL



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KEY

- APPROXIMATE CPT LOCATION (CPT)
- APPROXIMATE COMBINATION CPT AND DEEP BOREHOLE LOCATION (DBH/CPT)
- APPROXIMATE SHALLOW BOREHOLE LOCATION (SBH)

NOT TO SCALE

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Associated Offices in Perth, Vietnam and Papua New Guinea.

SITE INVESTIGATION LOCATION PLAN

PROPOSED RESIDENTIAL SUBDIVISION

KINGS FOREST ESTATE

JOB NO.: 9528

FIGURE 1

GENERAL NOTES

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April 2005

GENERAL

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the introduction section(s) of the document. The report should not be used by other parties or for other purposes as it may not contain adequate or appropriate information.

TEST HOLE LOGGING

The information on the Test Hole Logs (Boreholes, Backhoe Pits, Exposures etc.) has been based on a visual and tactile assessment except at the discrete locations where test information is available (field and/or laboratory results).

Reference should be made to our standard sheets for the definition of our logging procedures (Soil and Rock Descriptions).

GROUNDWATER

Unless otherwise indicated the water levels given on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeabilities. Further variations of this level could occur with time due to such effects as seasonal and tidal fluctuations or construction activities. Final confirmation of levels can only be made by appropriate instrumentation techniques and programmes.

INTERPRETATION OF RESULTS

The discussion and recommendations contained within this report are normally based on a site evaluation from discrete test hole data. Generalised or idealised subsurface conditions (including any cross-sections contained in the report) have been assumed or prepared by interpolation/extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in the generalised ground conditions used for this report can occur, particularly between discrete test hole locations. Furthermore, certain design or construction procedures may have been assumed in assessing the soil structure interaction behaviour of the site.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed in this report should be referred to this firm for appropriate assessment and comment.

FOUNDATION DEPTH

Where referred to in the report, the recommended depth of any foundation (piles, caissons, footings, etc.) is an engineering estimate of the depth to which they should be constructed. The estimate is influenced and perhaps limited by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The depth remains, however, an estimate and therefore liable to variation. Footing drawings, designs and specifications based upon this report should provide for variations in the final depth depending upon the ground conditions at each point of support.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in this report for the inclusion in the contract documents or engineering specification of the subject development, such reproduction should include at least all the relevant test hole and test data, together with the appropriate standard description sheets and remarks made in the written report of a factual or descriptive nature.

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions that any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE / The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predications. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage,* to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional test are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use*. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by The Institution of Engineers Australia, National Headquarters, Canberra, 1987.

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Annex A

Fieldwork Results

September, 2001

SOIL DESCRIPTION

This procedure involves the description of a soil in terms of its visual and tactile properties, and relates to both laboratory samples and field exposures as applicable. A detailed soil profile description, in association with local geology and experience, will facilitate the initial (and often complete) site assessment for engineering purposes.

The method involves an evaluation of each of the items listed below and is in general agreement with the Site Investigation Code AS1726-1993.

SOIL TYPE
The soil is described on the basis of the grain size composition of the constituent particles, and the plasticity of the fraction of material passing the 425µm sieve.

Furthermore, as most natural soils are part combinations of various constituents, the primary soil is described and modified by minor components. In brief, the system is as follows;

SILT OR CLAY AS MINOR COMPONENT		GRAVEL OR SAND AS MINOR COMPONENT	
% Fines	**Modifier**	**% Coarse**	**Modifier**
≤5 >5 ≤12 >12	omit, or use "trace" describe as "with clay/silt" as applicable prefix soil as "silty/clayey" as applicable	≤15 >15 ≤30 >30	omit, or use "trace" describe as "with sand/gravel" as applicable prefix soil as "sandy/gravelly' as applicable

Note: For soils containing both sand and gravel the minor coarse fraction is omitted if less than 15%, or described as "with sand/gravel" as applicable when greater than 15%.

The appropriate classification group symbol for soil classification is also given before the soil type description in accordance with AS1726-1993, Table A1.

For granular soils, an assessment of grading (well, uniform, gap or poor), particle size (fine, medium etc), angularity, shape and particle composition may also be given.

COLOUR
Colour is important for correlation of data between test holes and for subsequent excavation operations. The prominent colour is noted, followed by (spotted, mottled, streaked etc.) secondary colours as applicable. Colour should be described in the "moist" condition, though both wet and dry colours may also be appropriate.

MOISTURE
The moisture condition of the soil is described by the appearance and feel of the soil using one of the following terms:
Dry cohesive soils - hard, friable or powdery; granular soils - cohesionless, free funning.
Moist soil cool, darkened colour: cohesive soils - can be moulded; granular soils - tend to cohere.
Wet soil cool, darkened colour: cohesive soils - usually weakened, free water on hands when handling; granular soils - tend to cohere.

In addition, the presence of any seepage or free water is noted on all test hole logs.

CONSISTENCY/RELATIVE DENSITY
Granular soils are generally described in terms of relative density (density index) as listed in Table A5 AS1726. These soils are inherently difficult to assess and normally a penetration test procedure (SPT, DCP or CPT) is used in conjunction with published correlation tables. Alternatively, insitu density tests can be conducted in association with minimum and maximum densities performed in the laboratory.

Cohesive soils can be assessed by direct measurement (shear vane), or estimated approximately by tactile means and/or the aid of a geological pick as given on the following table. It is emphasised that a "design shear strength" must take cognisance of the insitu moisture content and the possible variations of moisture with time.

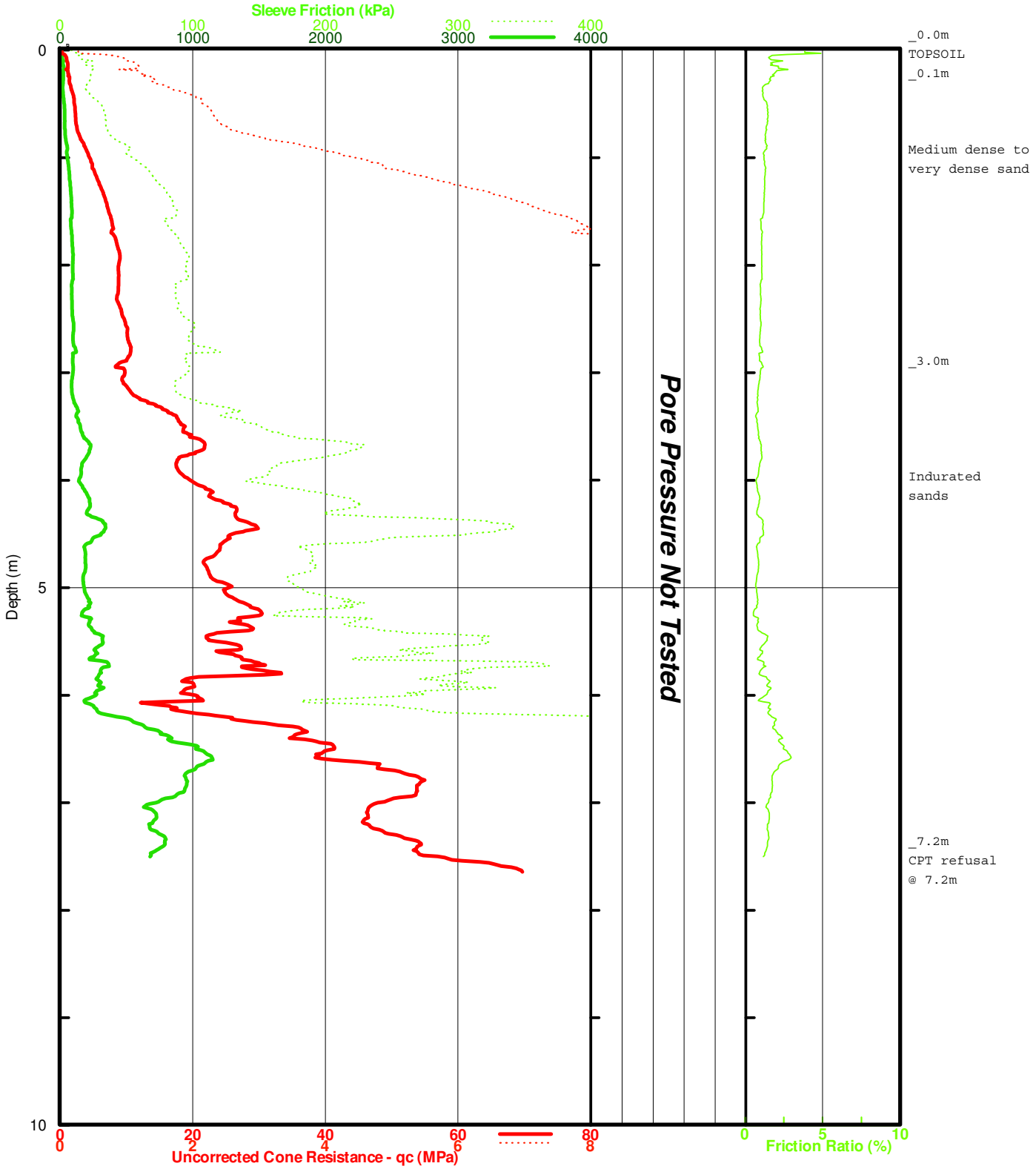
Term	Tactile Properties	Undrained Shear Strength (kPa)
Very Soft	Exudes between the fingers when squeezed in the hand.	≤12
Soft	Easily penetrated by thumb about 30-40mm. Pick head can be pushed in up to shaft. Moulded by light finger pressure.	>12 ≤25
Firm	Penetrated by thumb 20-30mm with moderate effort. Sharp end of pick pushed in some 30-40m. Moulded by strong finger pressure.	>25 ≤50
Stiff	Indented by thumb about 4mm with moderate effort. Pick pushed in up to 10mm. Cannot be moulded in fingers.	>50 ≤100
Very Stiff	Readily indented by thumb nail. Slight indentation produced by pushing pick into soil.	>100 ≤200
Hard	Difficult to indent with thumb nail. Requires power tools for excavation.	>200

STRUCTURE/OTHER FEATURES
The structure of the soil may be described with reference to: zoning, where soils consist of separate zones differing in colour, grain size or other properties; defects, including fissures, cracks, root-holes and the like; cementing, with the strength (weakly to strongly), and nature of the cementing agent; additional observations including geological origin, odour and the like. In addition, the presence of other features (ferricrete nodules, organic inclusions) should also be noted as applicable.

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-01



Job Number : G1006-105
Test Date : 22/06/2010
DGPS Position :56 J 0554891, 6870004
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

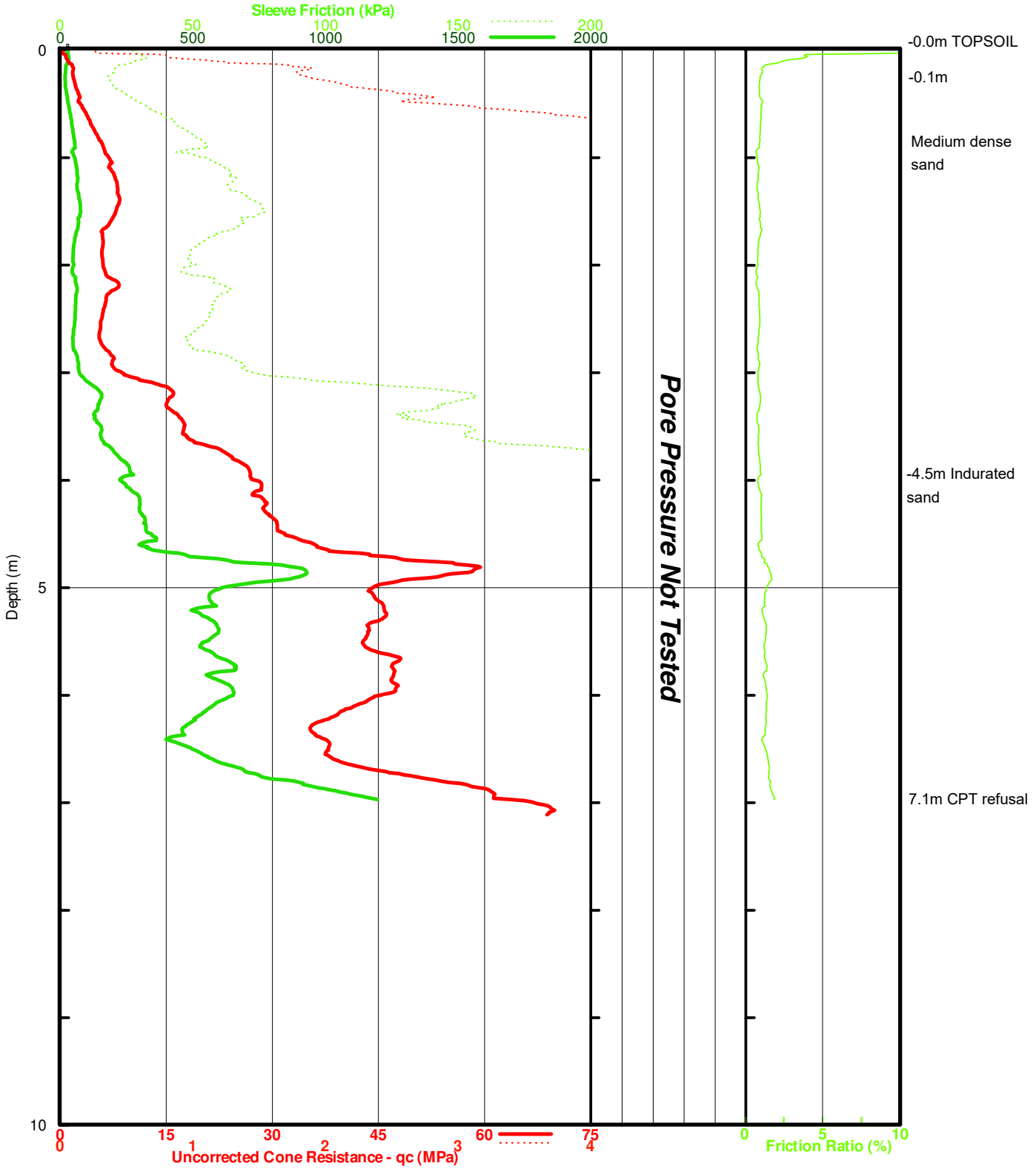
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-02



Job Number : G1006-105
Test Date : 22/06/2010
DGPS Position : ,
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

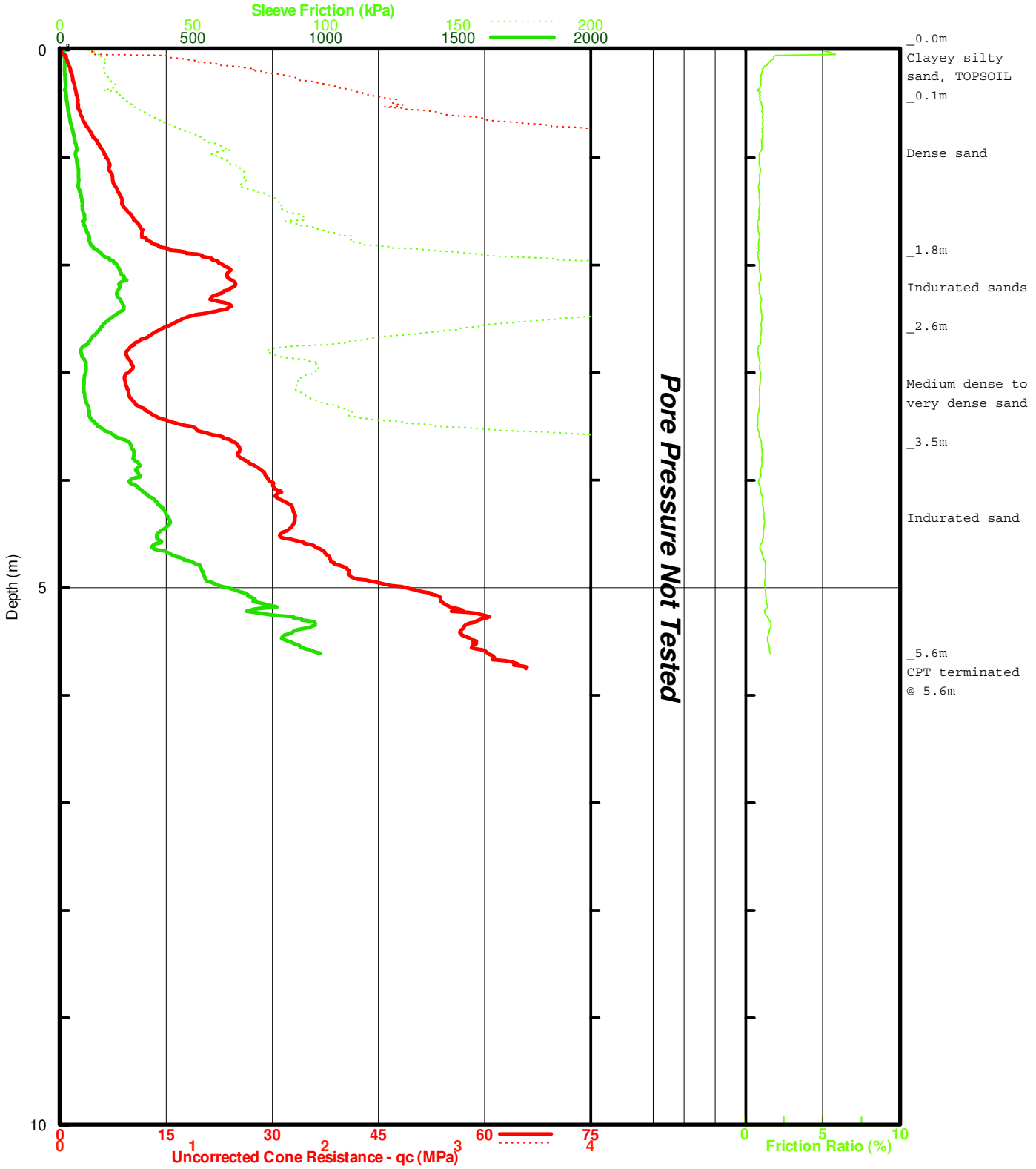
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-03



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Test Date : 23/06/2010
DGPS Position : 56 J 0554608, 6870113
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

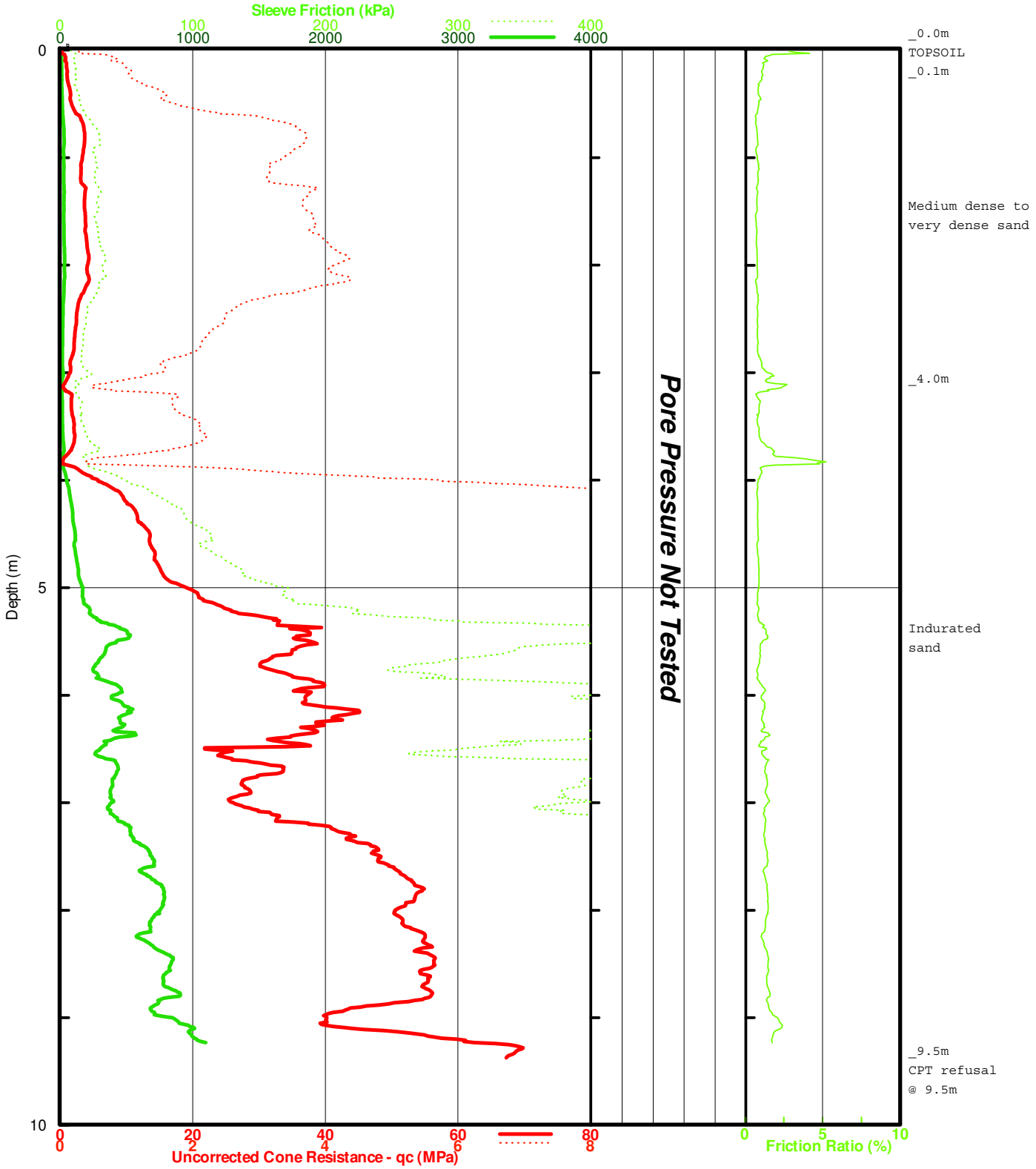
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-04



Job Number : G1006-105
Test Date : 29/06/2010
DGPS Position : 56 J 0554847, 6870498
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

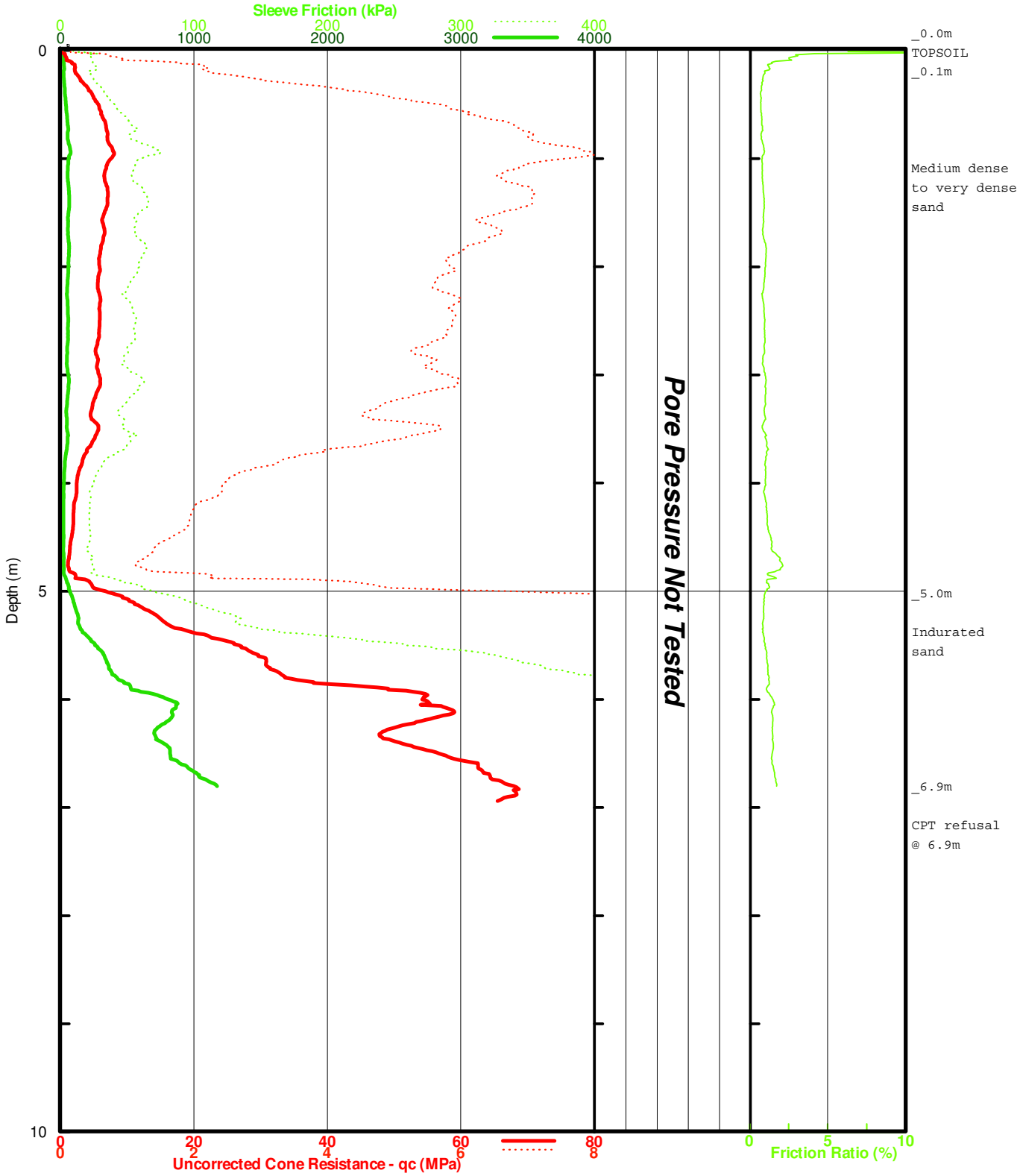
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-05



Job Number : G1006-105
Test Date : 29/06/2010
DGPS Position : 56 J 0554991, 6870626
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

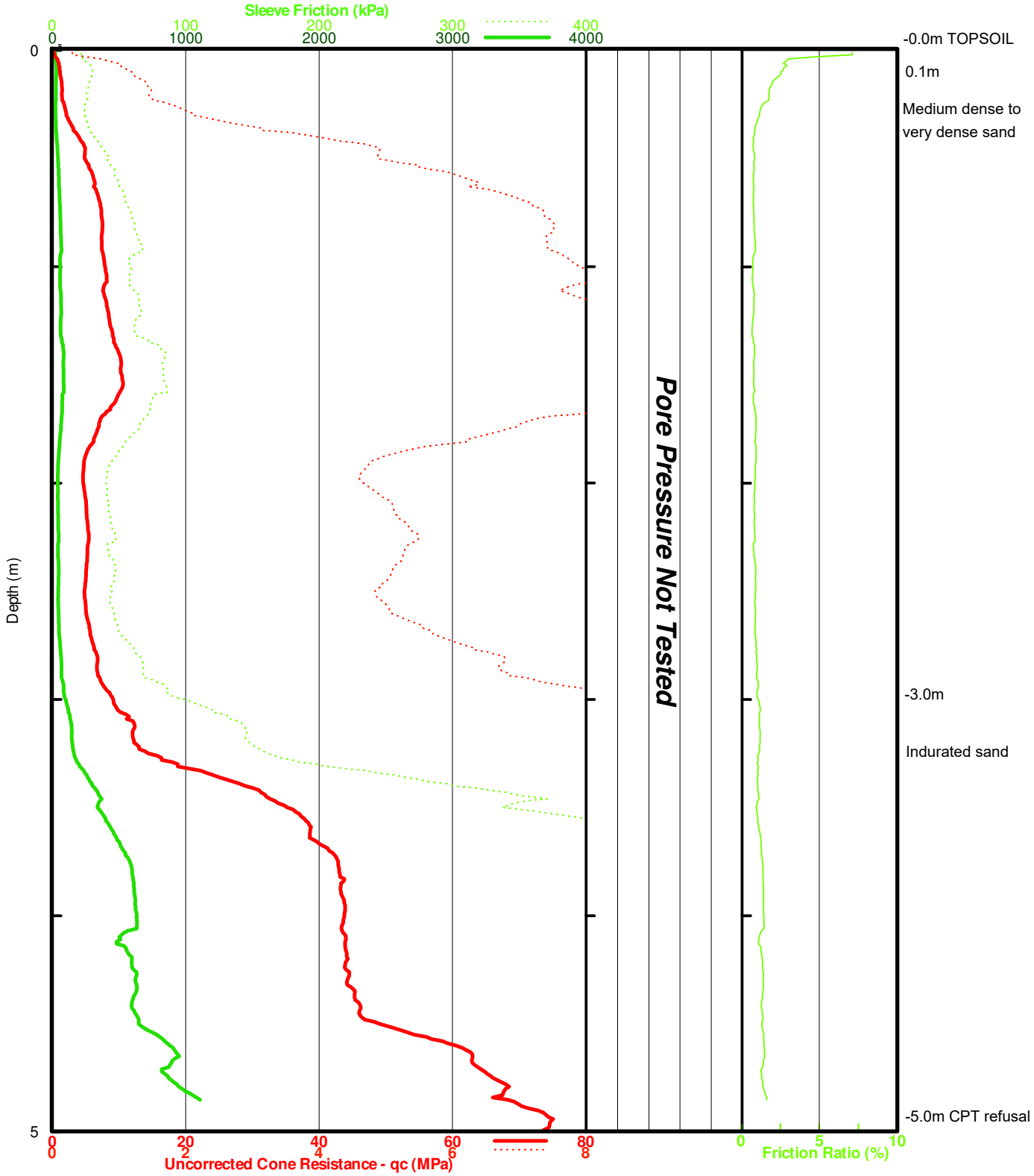
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-06



Job Number : G1006-105
Test Date : 29/06/2010
DGPS Position : 56 J 0554565, 6870551
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

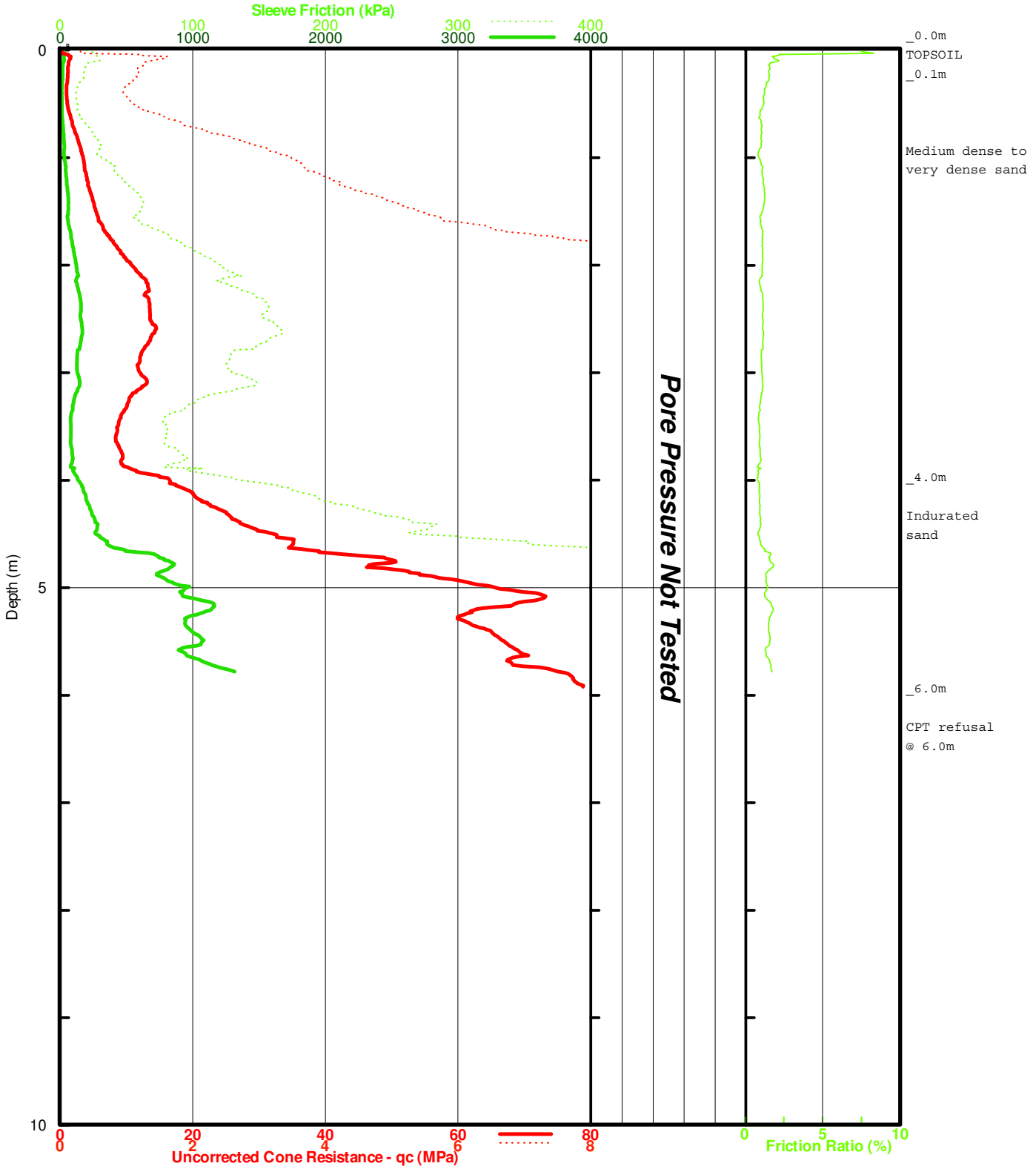
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-07



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Test Date : 02/07/2010
DGPS Position : 56 J 0554326, 6870108
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

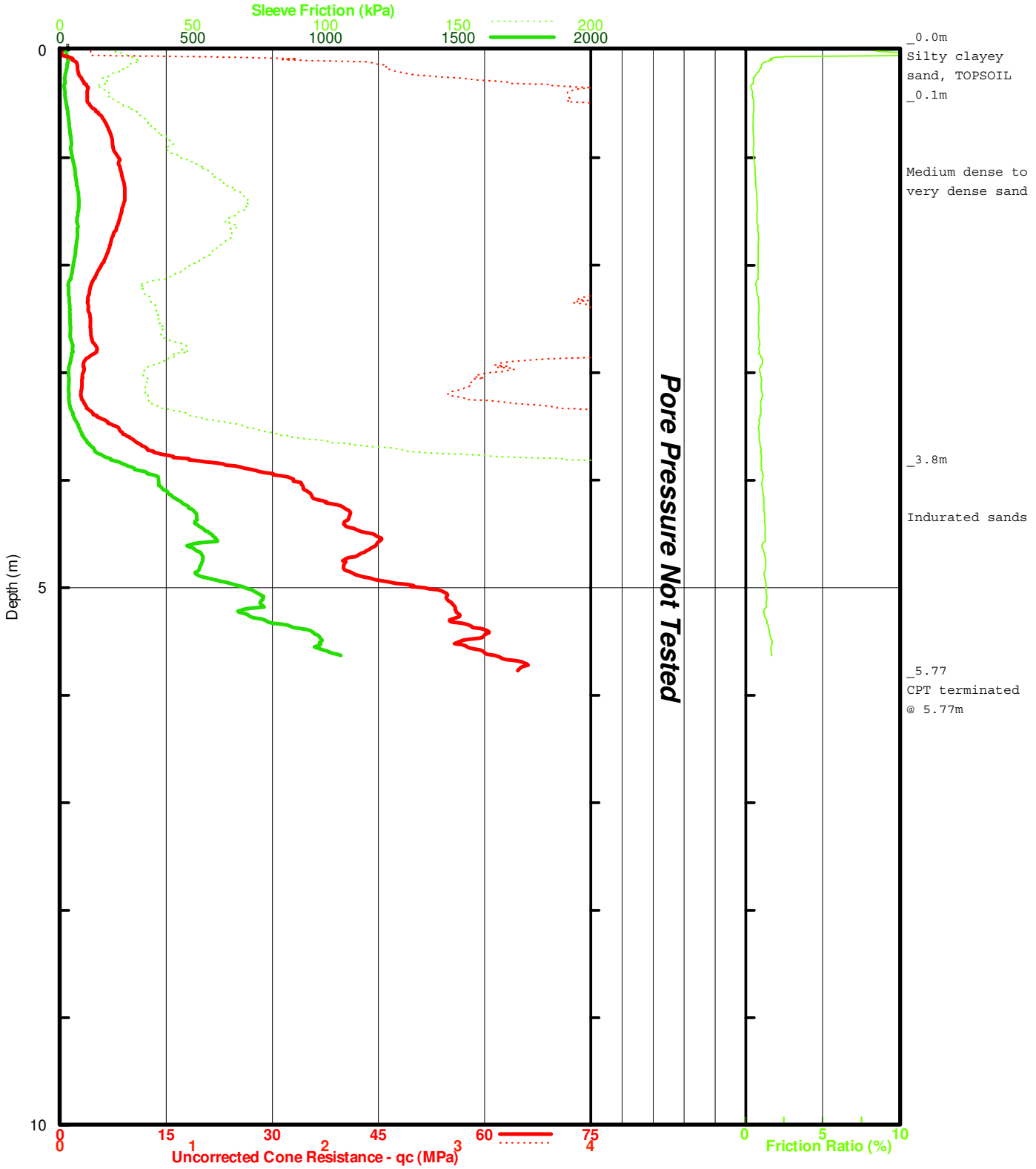
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-08



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Test Date : 23/06/2010
DGPS Position : 56 J 0554381, 6870456
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

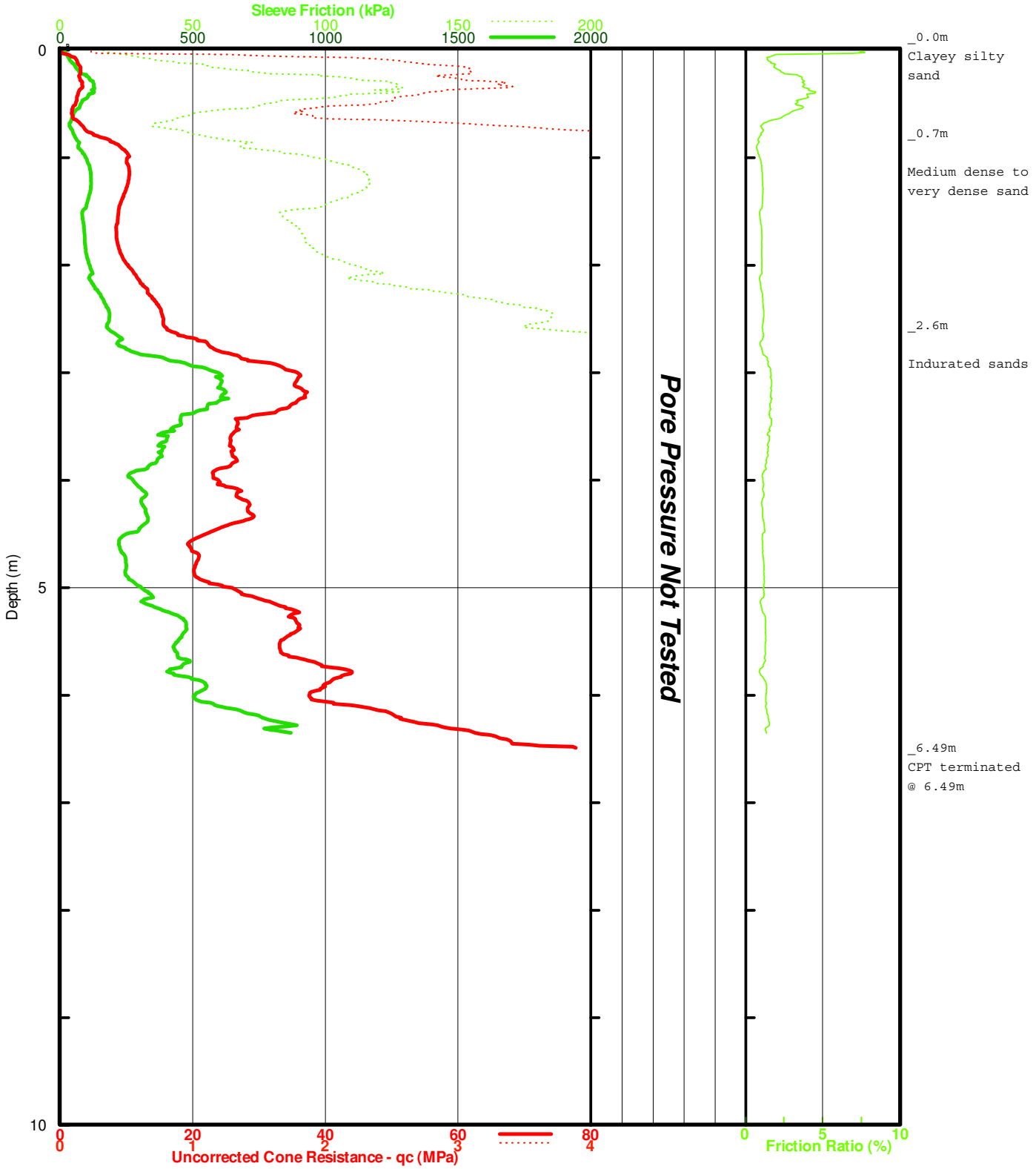
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-09



Job Number : G1006-105
Test Date : 23/06/2010
DGPS Position : 56 J 0554214, 6870481
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

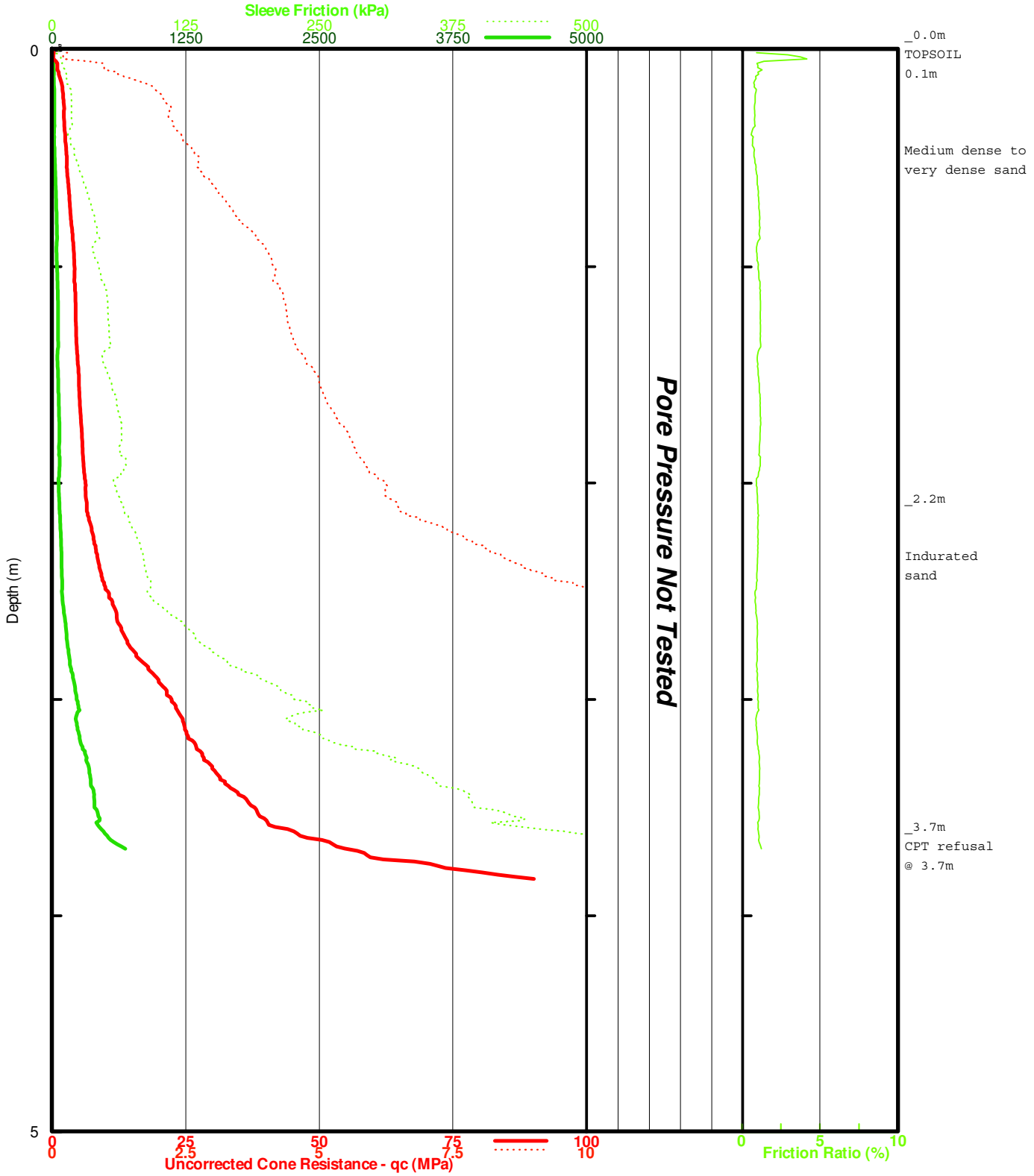
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-10



Job Number : G1006-105
Test Date : 02/07/2010
DGPS Position : 56 J 0554164, 6870253
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

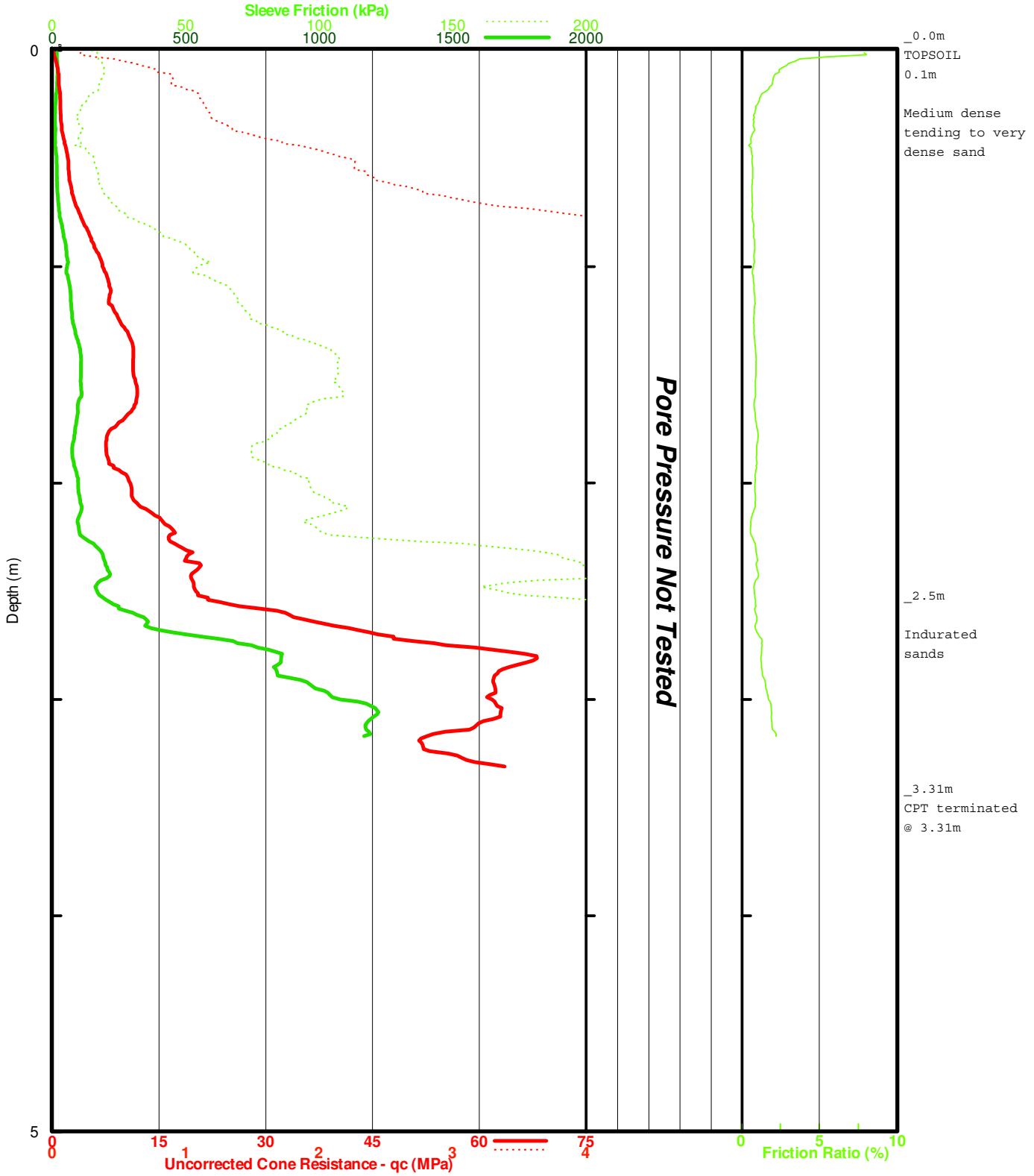
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-11



Job Number : G1006-105
Test Date : 24/06/2010
DGPS Position : 56 J 0553588, 6870159
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

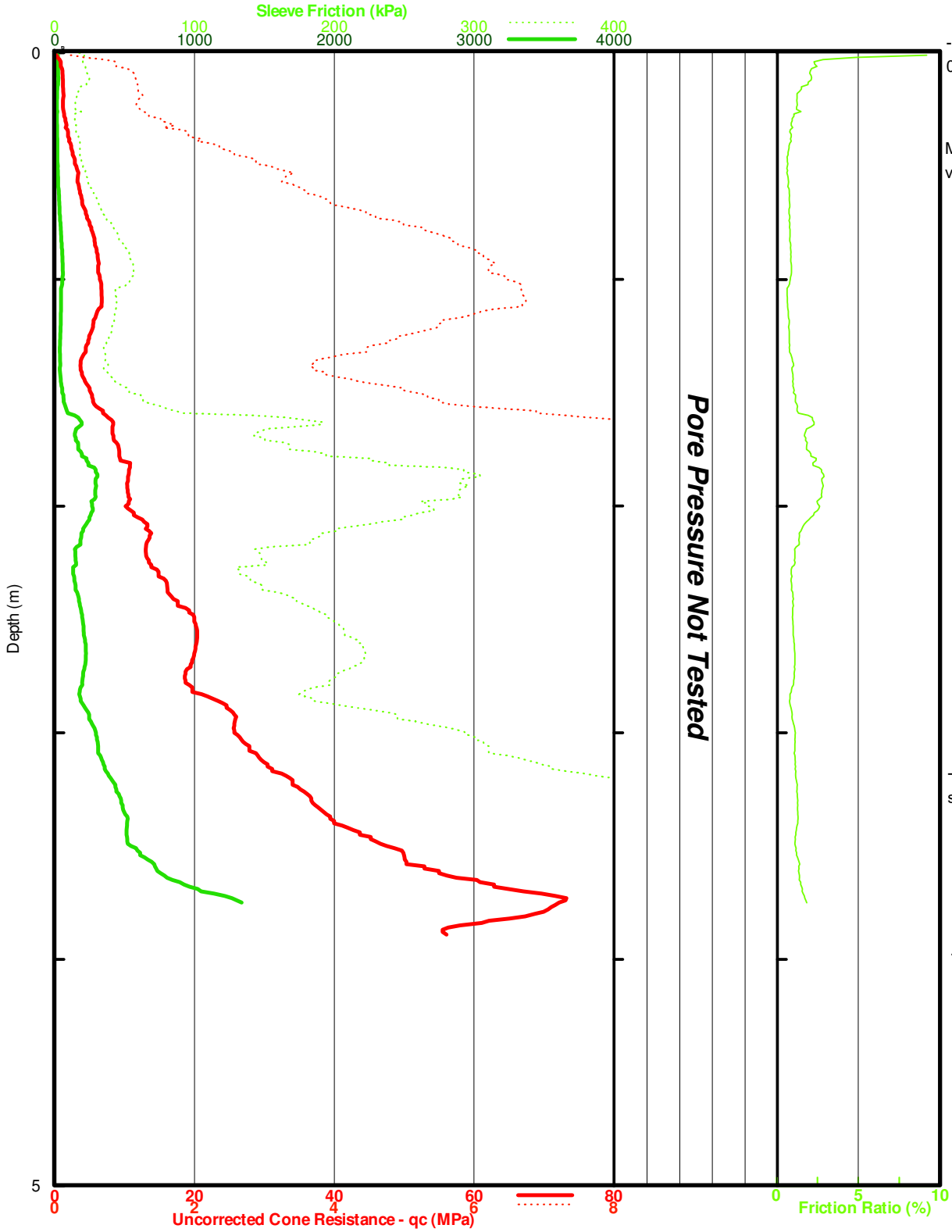
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-12



- 0.0m TOPSOIL
0.1m

Medium dense to very dense sand

-3.5m Indurated sand

- 3.9m CPT refusal

Job Number : G1006-105
Test Date : 02/07/2010
DGPS Position : 56 J 0553210, 6870395
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

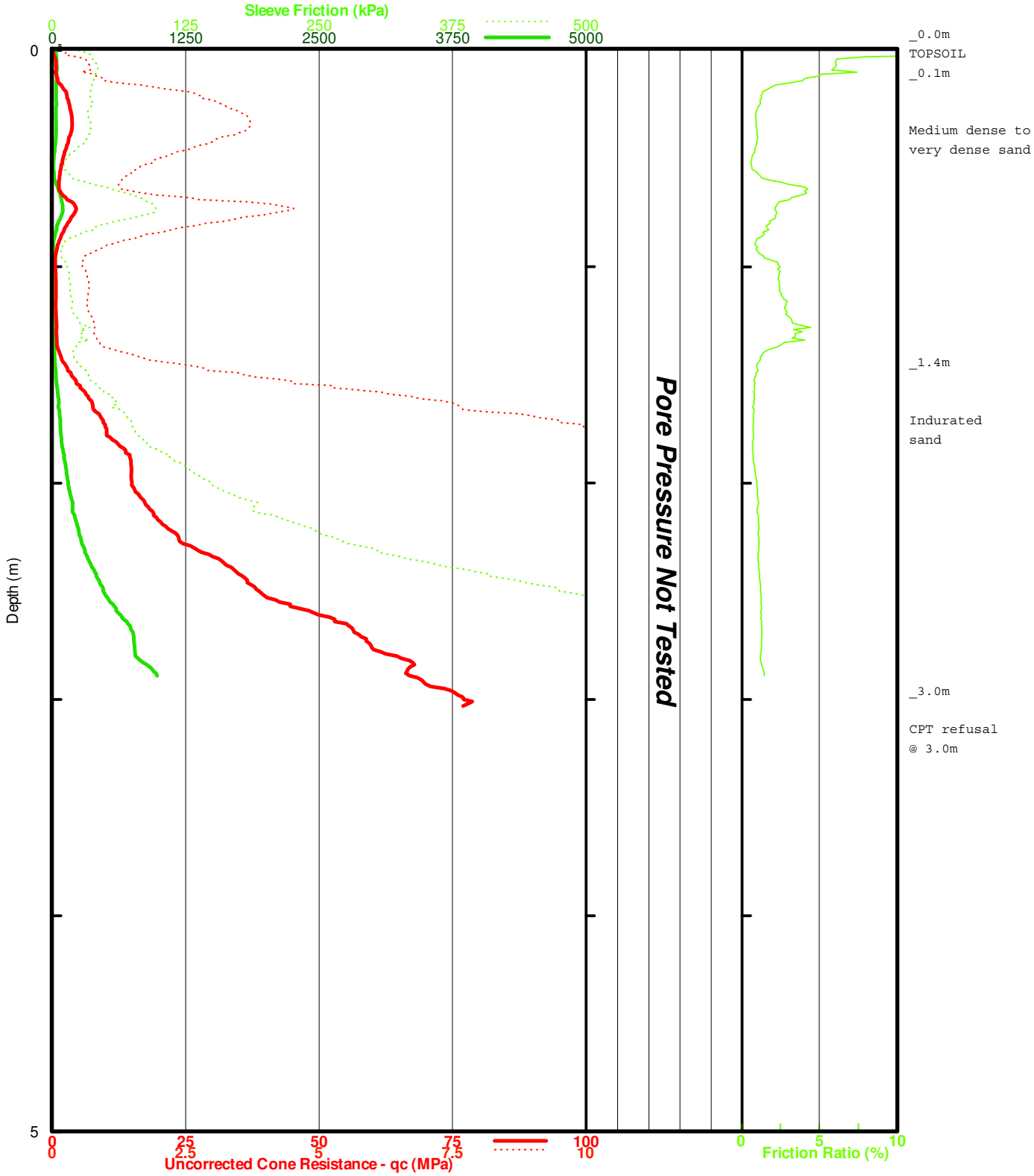
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-13



Job Number : G1006-105
Test Date : 25/06/2010
DGPS Position : 56 J 0552756, 6870667
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

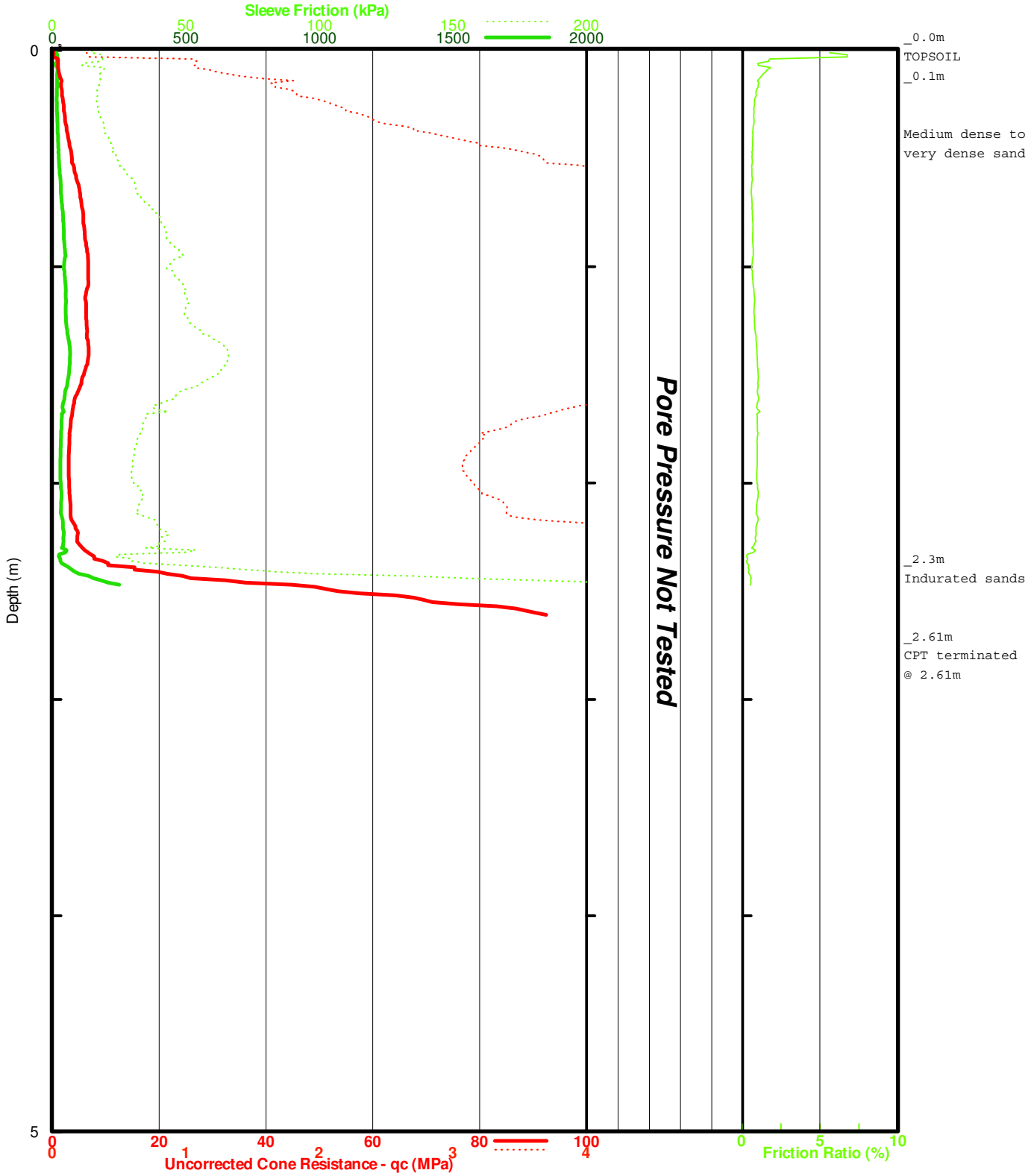
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-14



Job Number : G1006-105
Test Date : 24/06/2010
DGPS Position : 56 J 0553236, 6871105
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

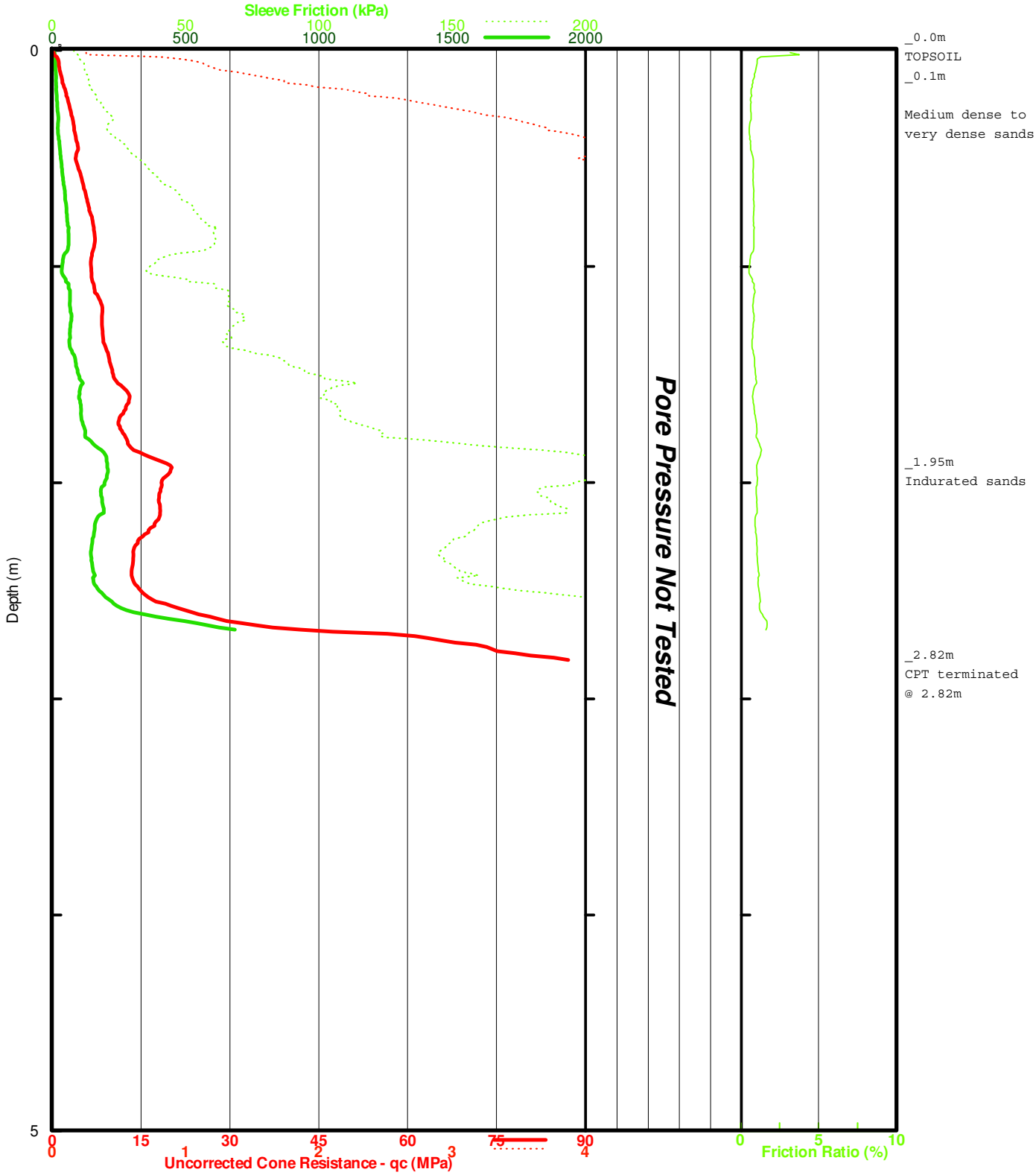
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-15



Job Number : G1006-105
Test Date : 24/06/2010
DGPS Position : 56 J 0553420, 6870732
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

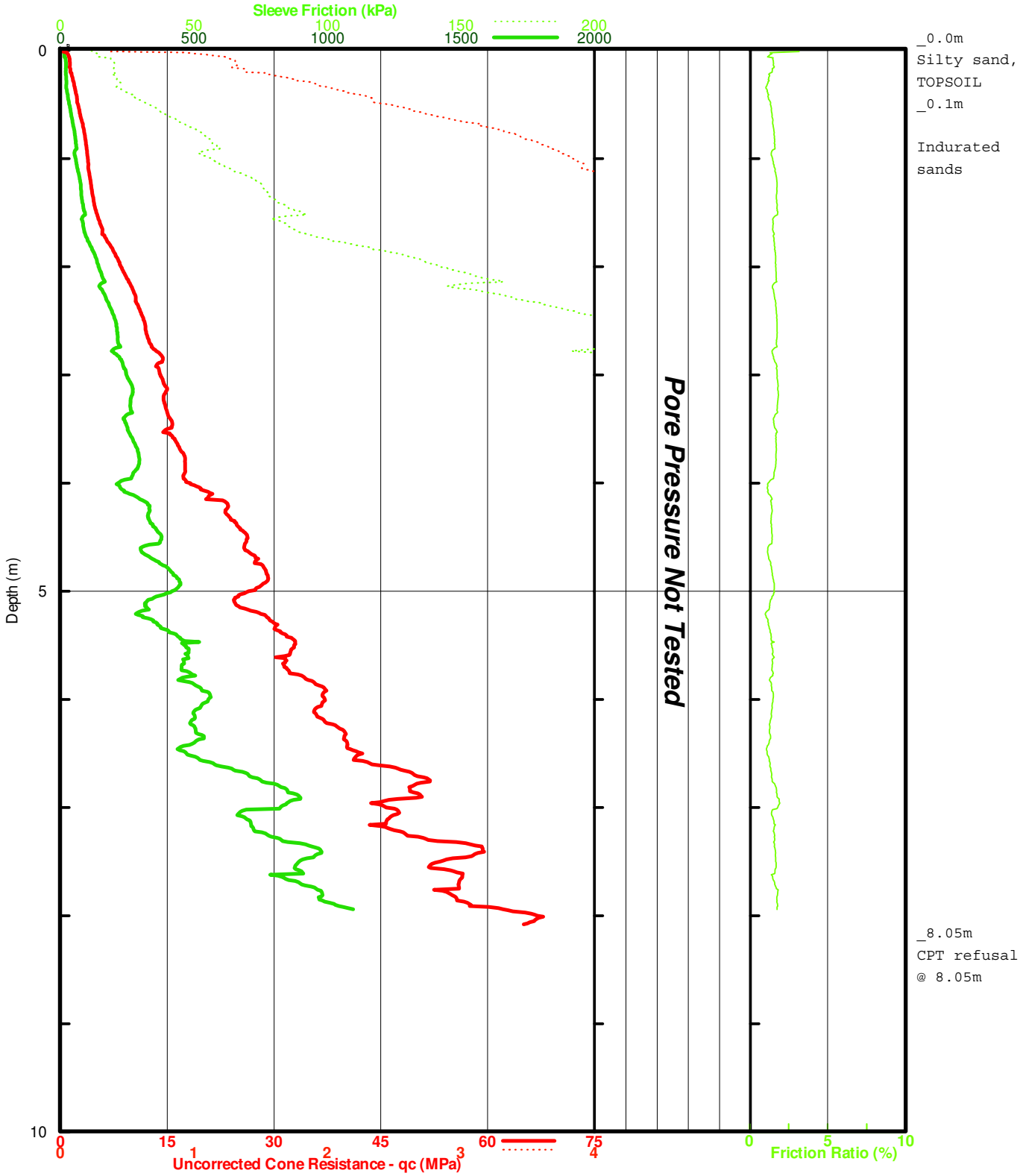
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-16



Job Number : G1006-105
Test Date : 22/06/2010
DGPS Position : ,
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

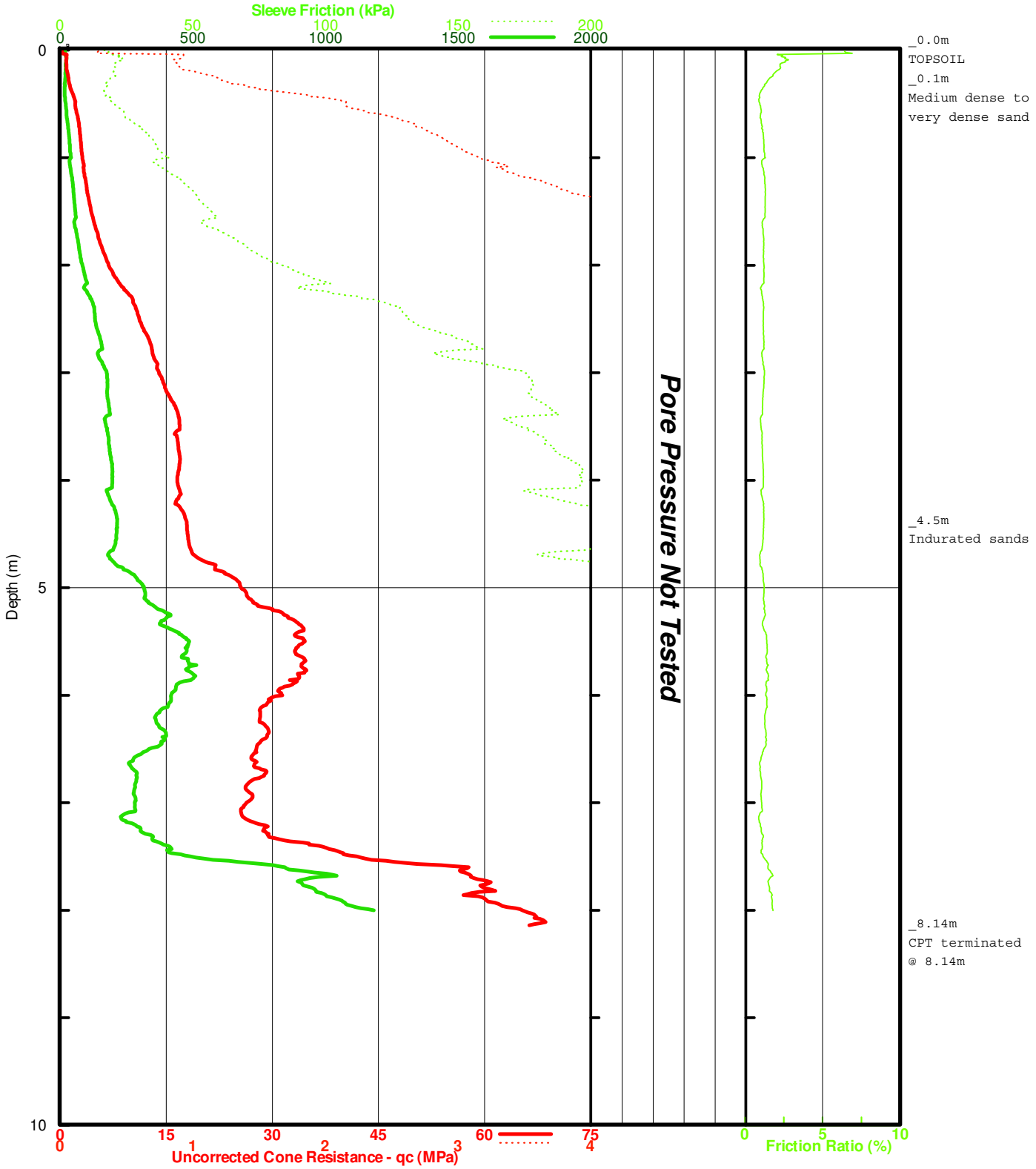
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-17



Job Number : G1006-105
Test Date : 23/06/2010
DGPS Position : 56 J 0554472, 6869650
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

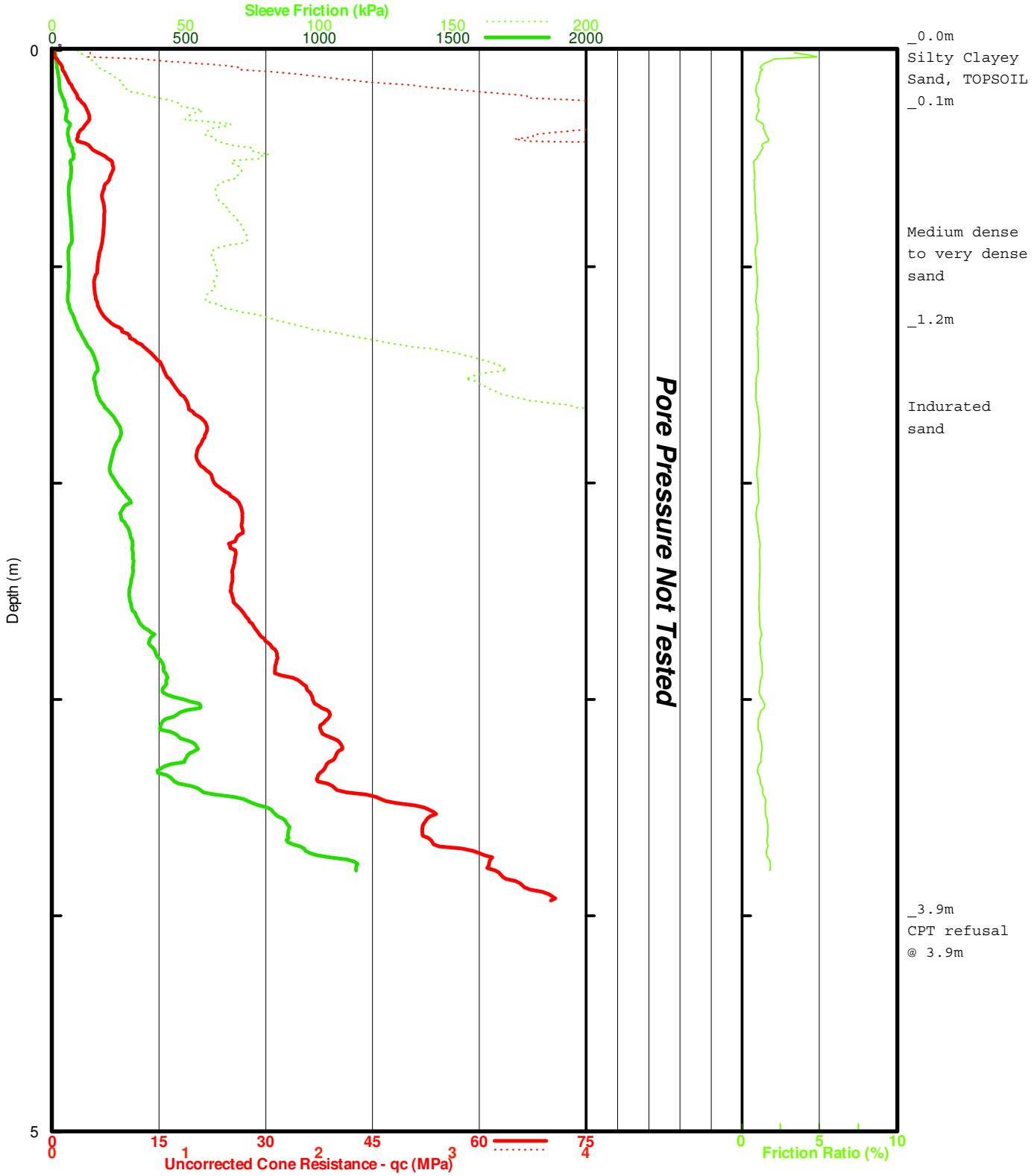
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-18



Job Number : G1006-105
Test Date : 22/06/2010
DGPS Position : ,
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

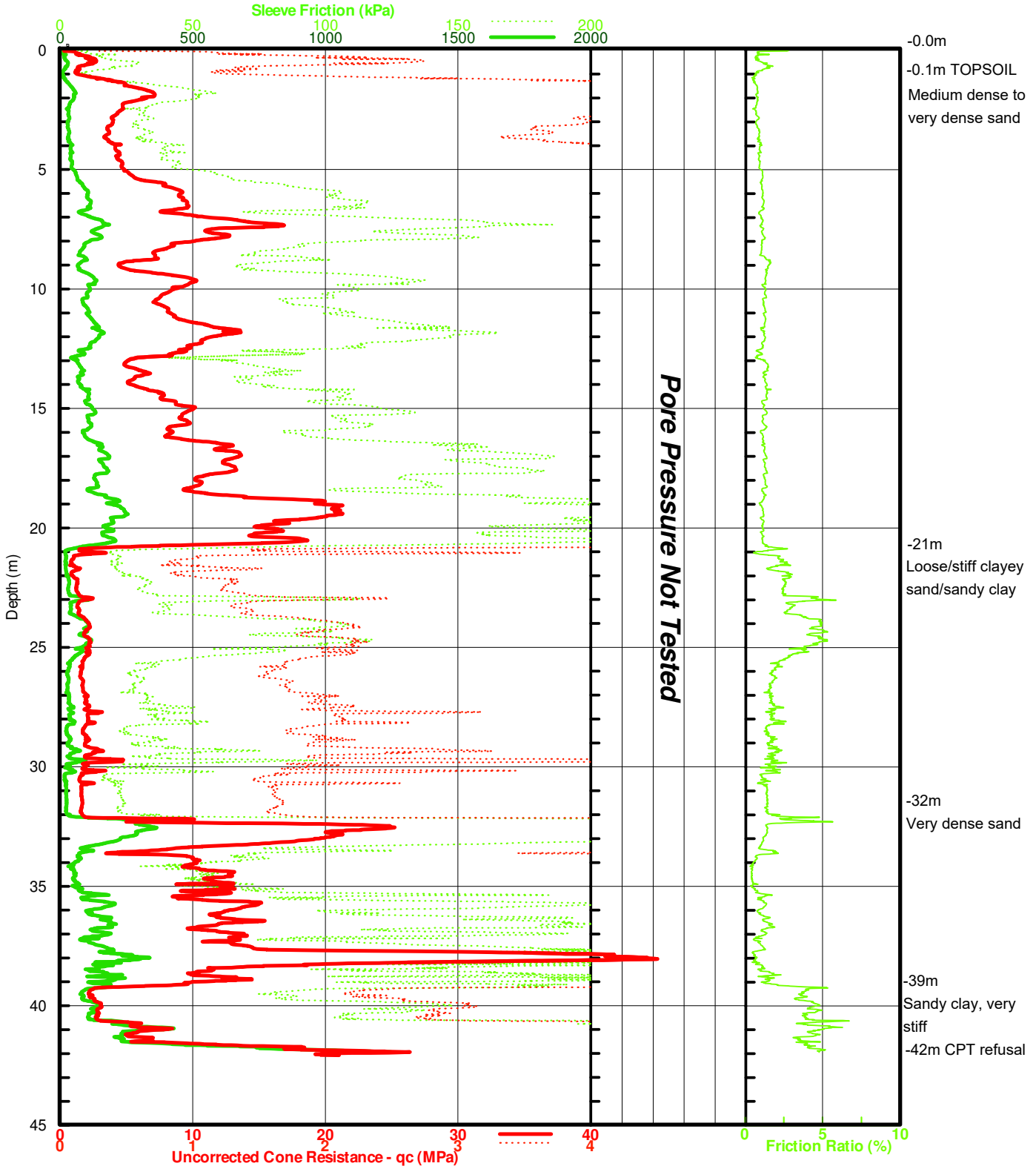
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-19



Job Number : G1006-105
Test Date : 03/07/2010
DGPS Position : 56 J 0554577, 6869312
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

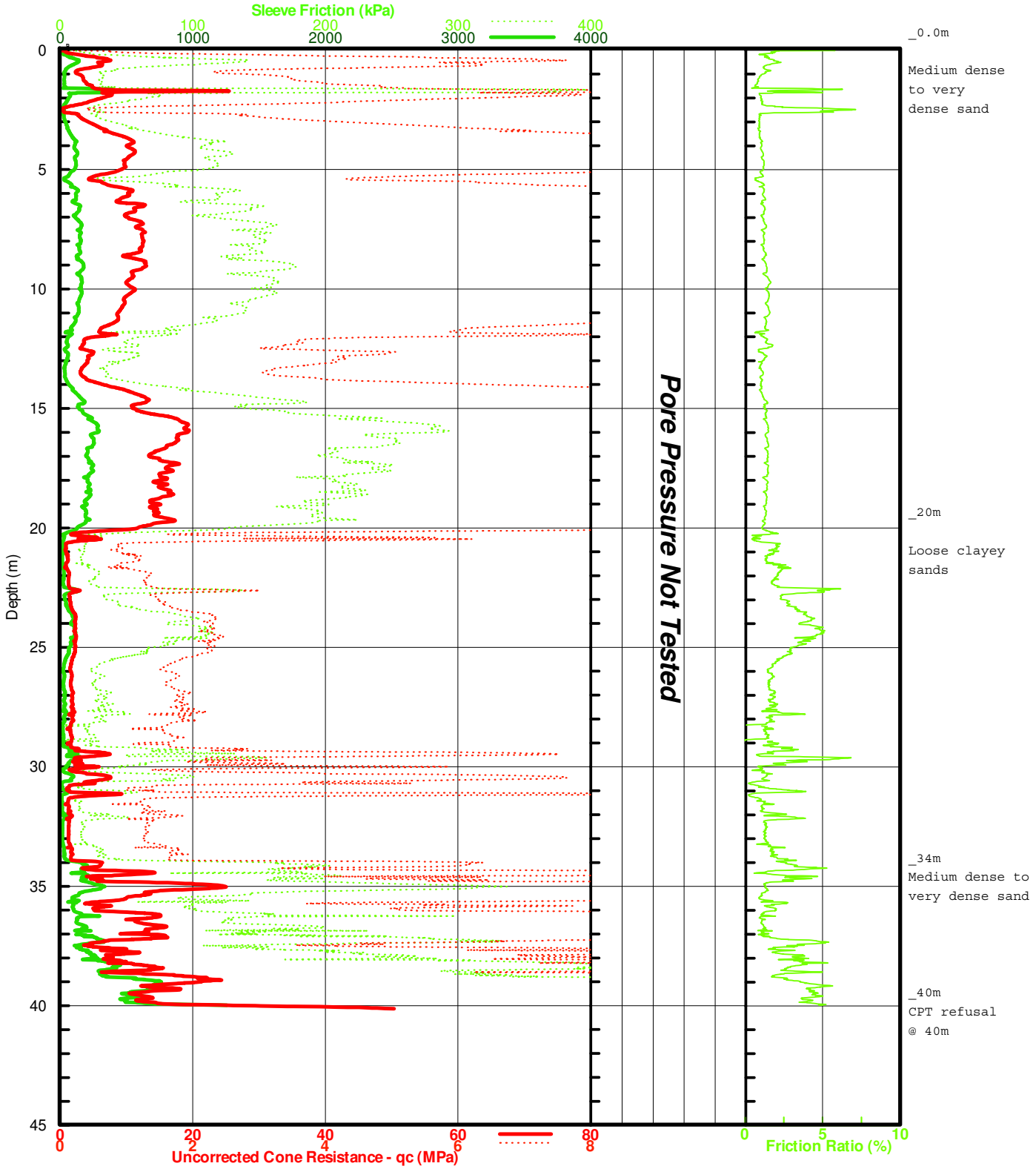
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-20



Job Number : G1006-105
Test Date : 01/07/2010
DGPS Position : 56 J 0554593, 6869299
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

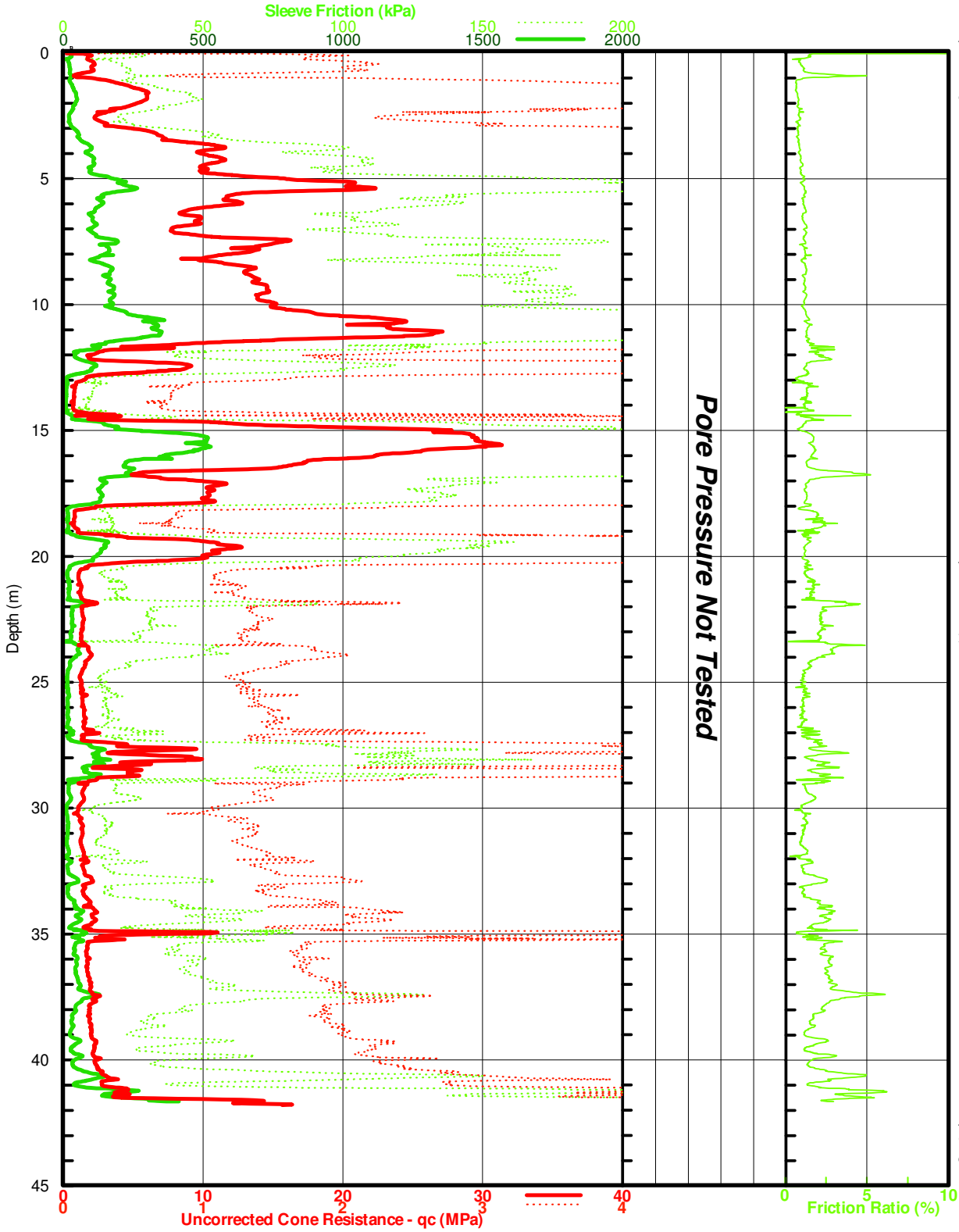
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-21



Job Number : G1006-105
Test Date : 01/07/2010
DGPS Position : 56 J 0554322, 6869346
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Engineers Request

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

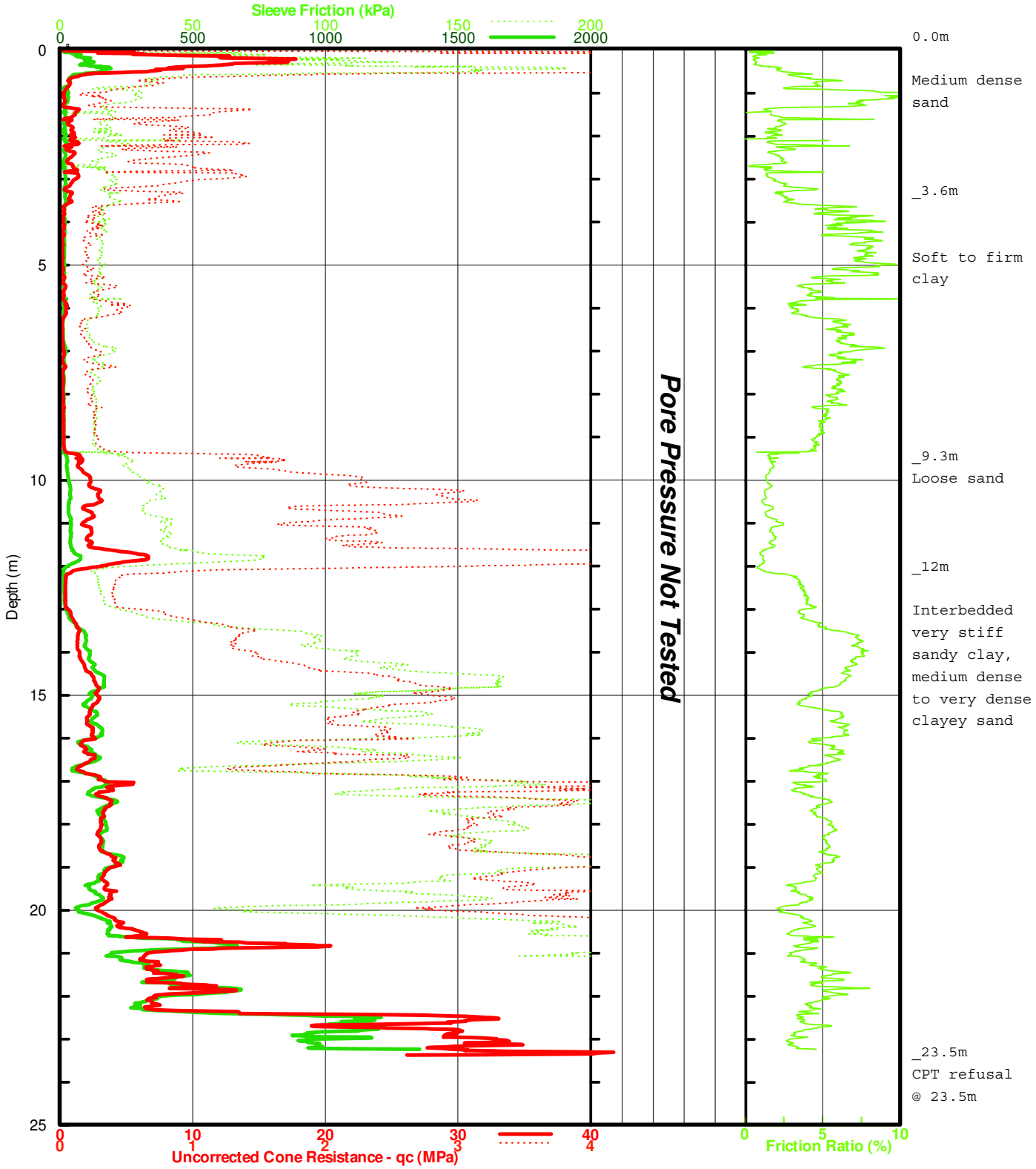
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-22



Job Number : G1006-105
Test Date : 01/07/2010
DGPS Position : 56 J 0553589, 6869328
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

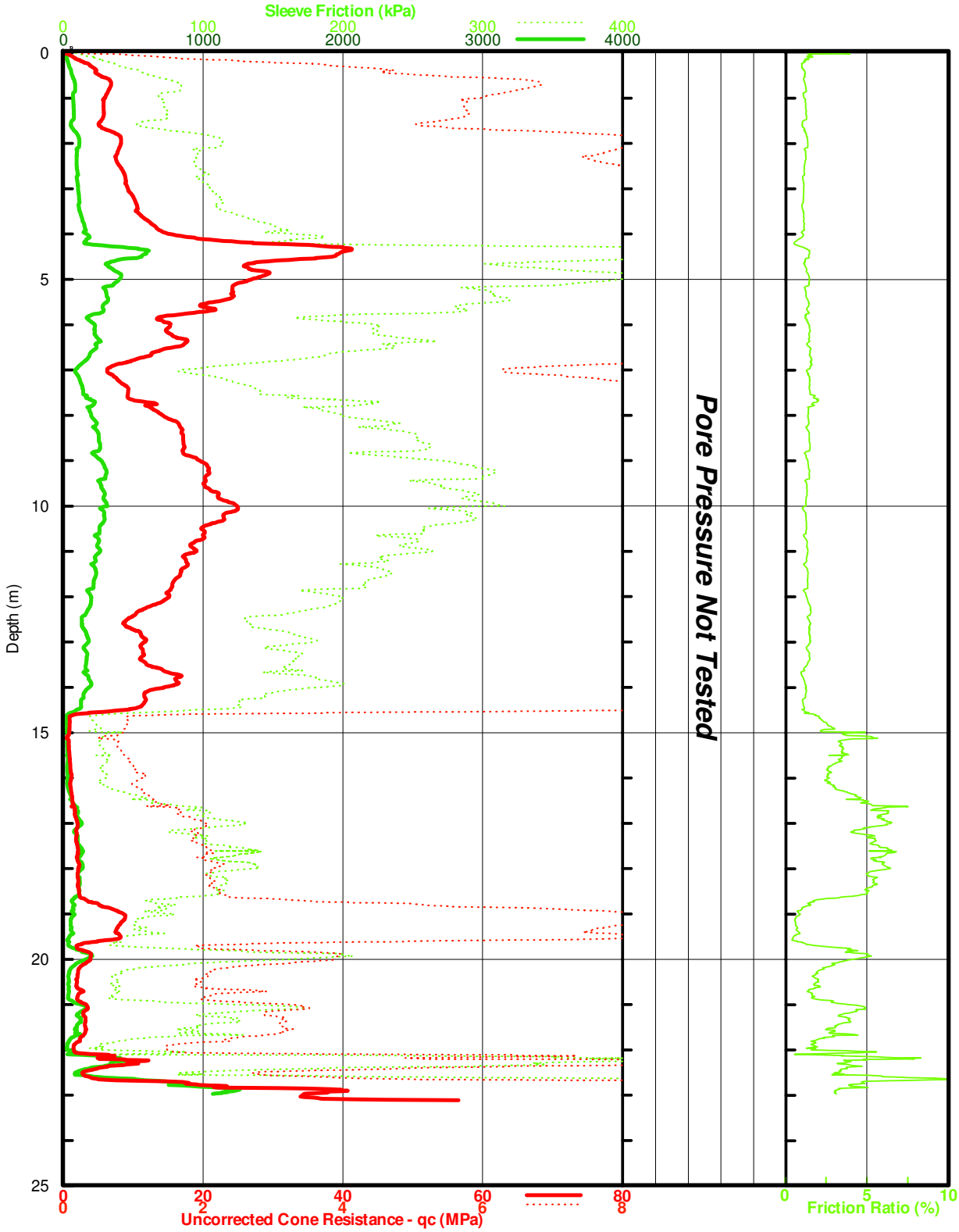
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-23



Job Number : G1006-105
Test Date : 30/06/2010
DGPS Position : 56 J 0553481, 6869021
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

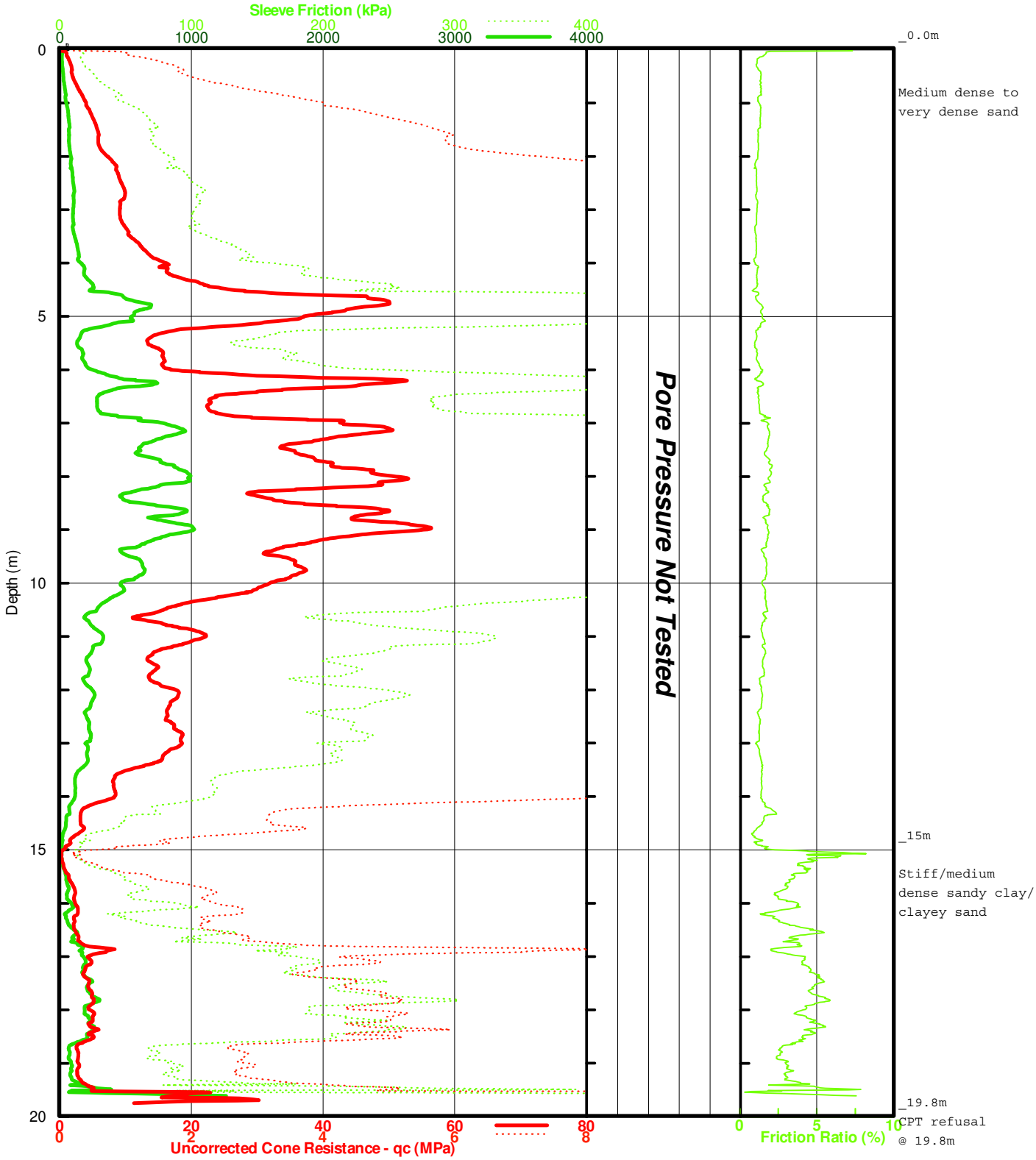
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-24



Job Number : G1006-105
Test Date : 30/06/2010
DGPS Position : 56 J 0553841, 6868863
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

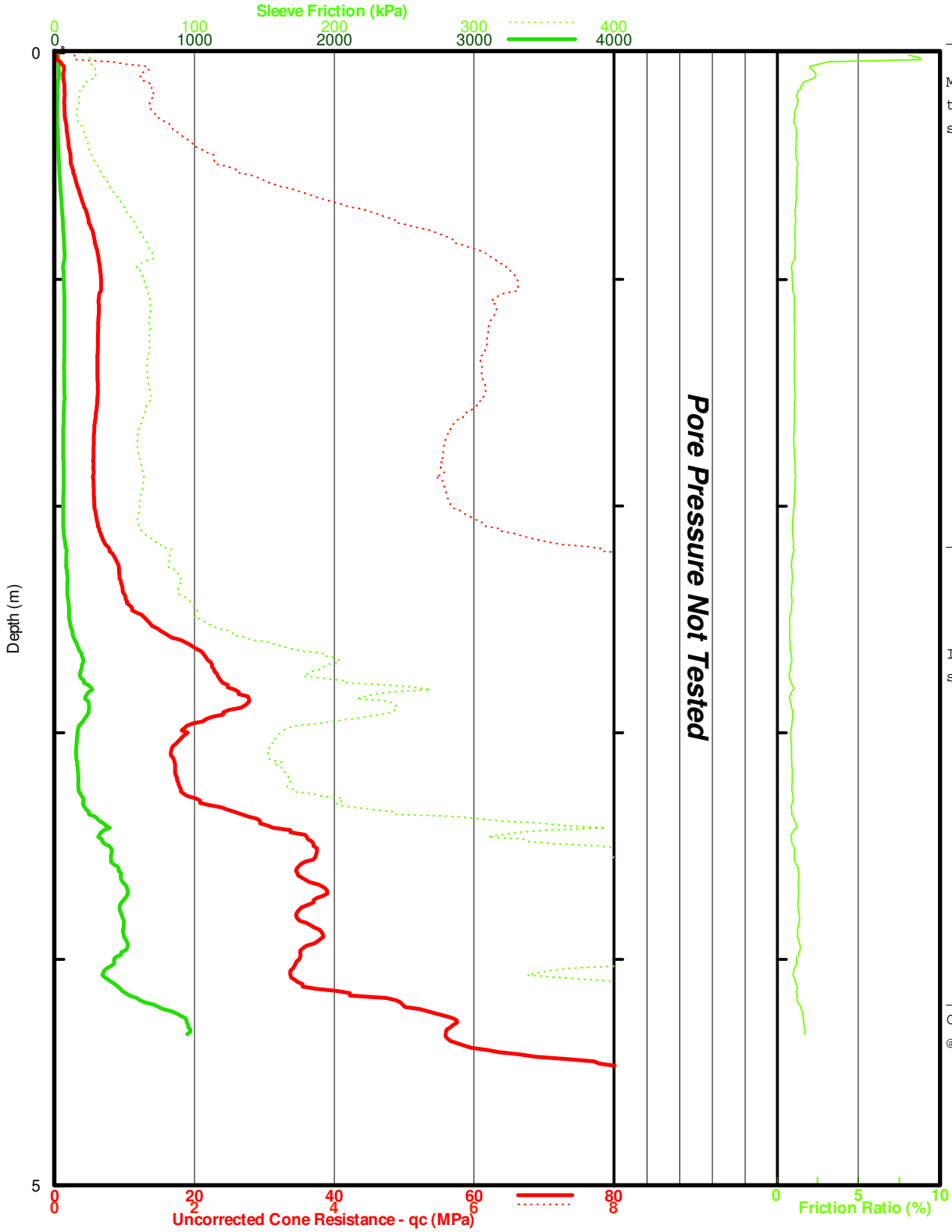
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-25



Job Number : G1006-105
Test Date : 30/06/2010
DGPS Position : 56 J 0553672, 6868293
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

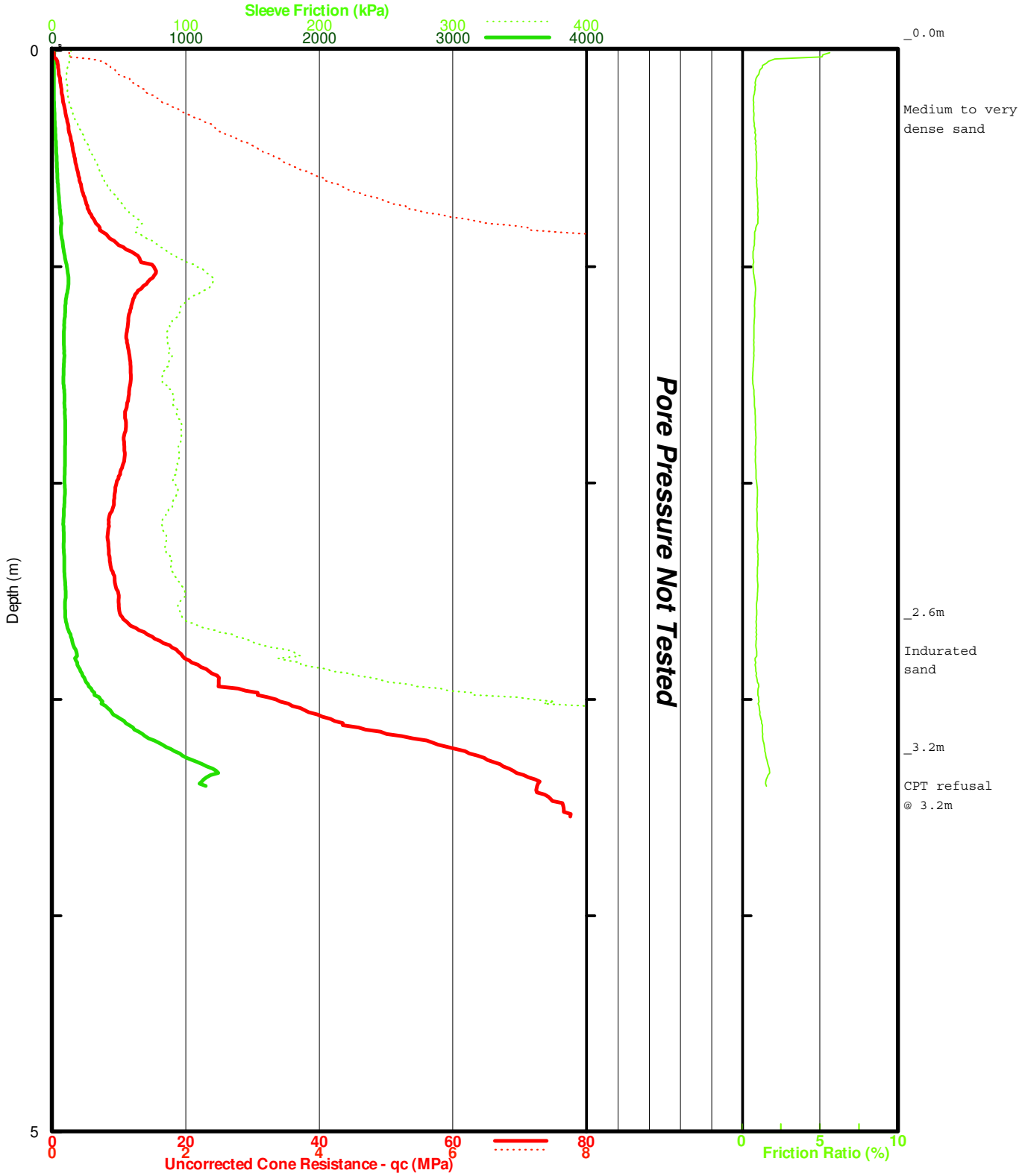
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-26



Job Number : G1006-105
Test Date : 30/06/2010
DGPS Position : 56 J 0553937, 6867892
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michel O'Rourke

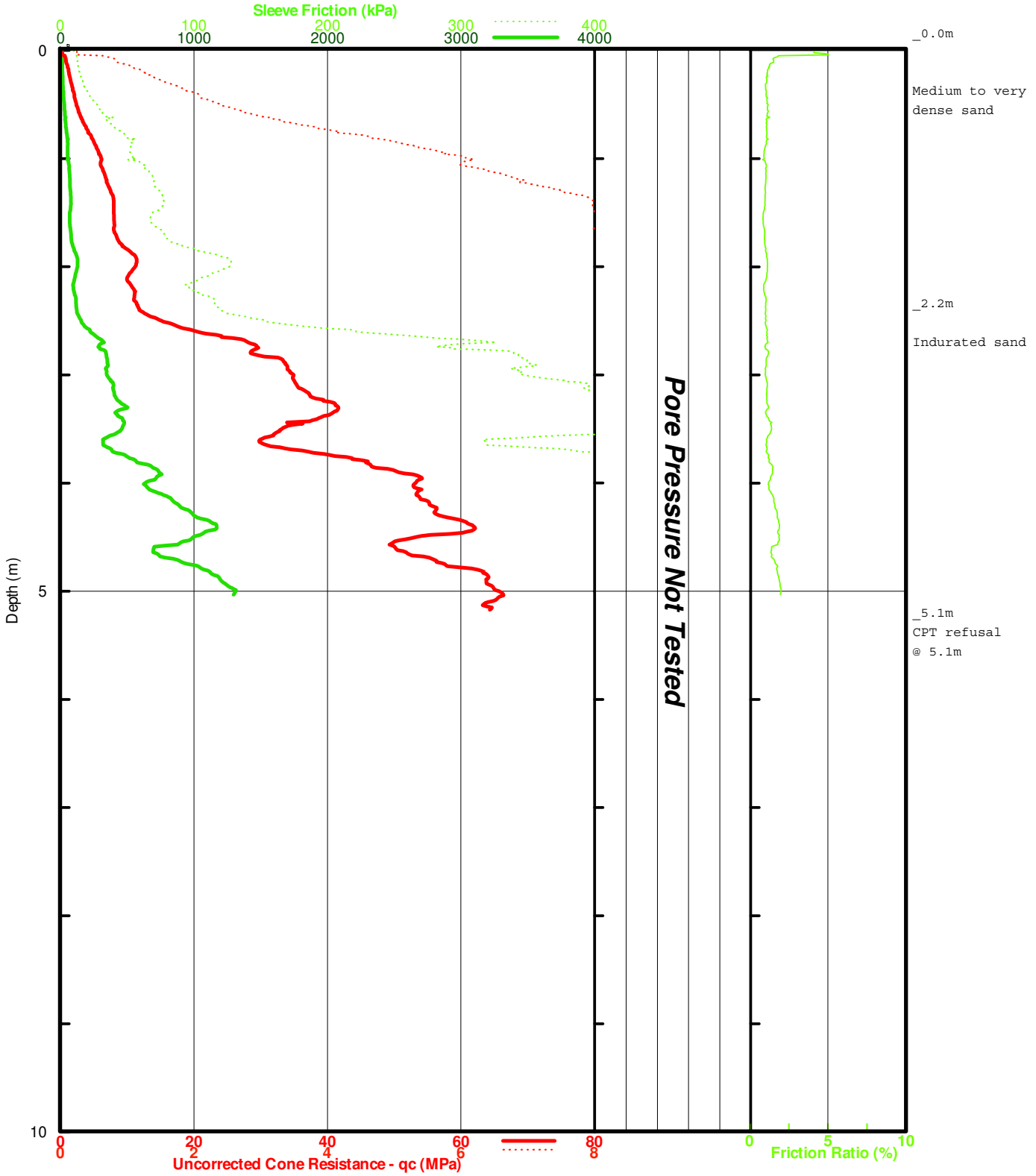
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-27



Job Number : G1006-105
Test Date : 30/06/2010
DGPS Position : 56 J 0554231, 6868112
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

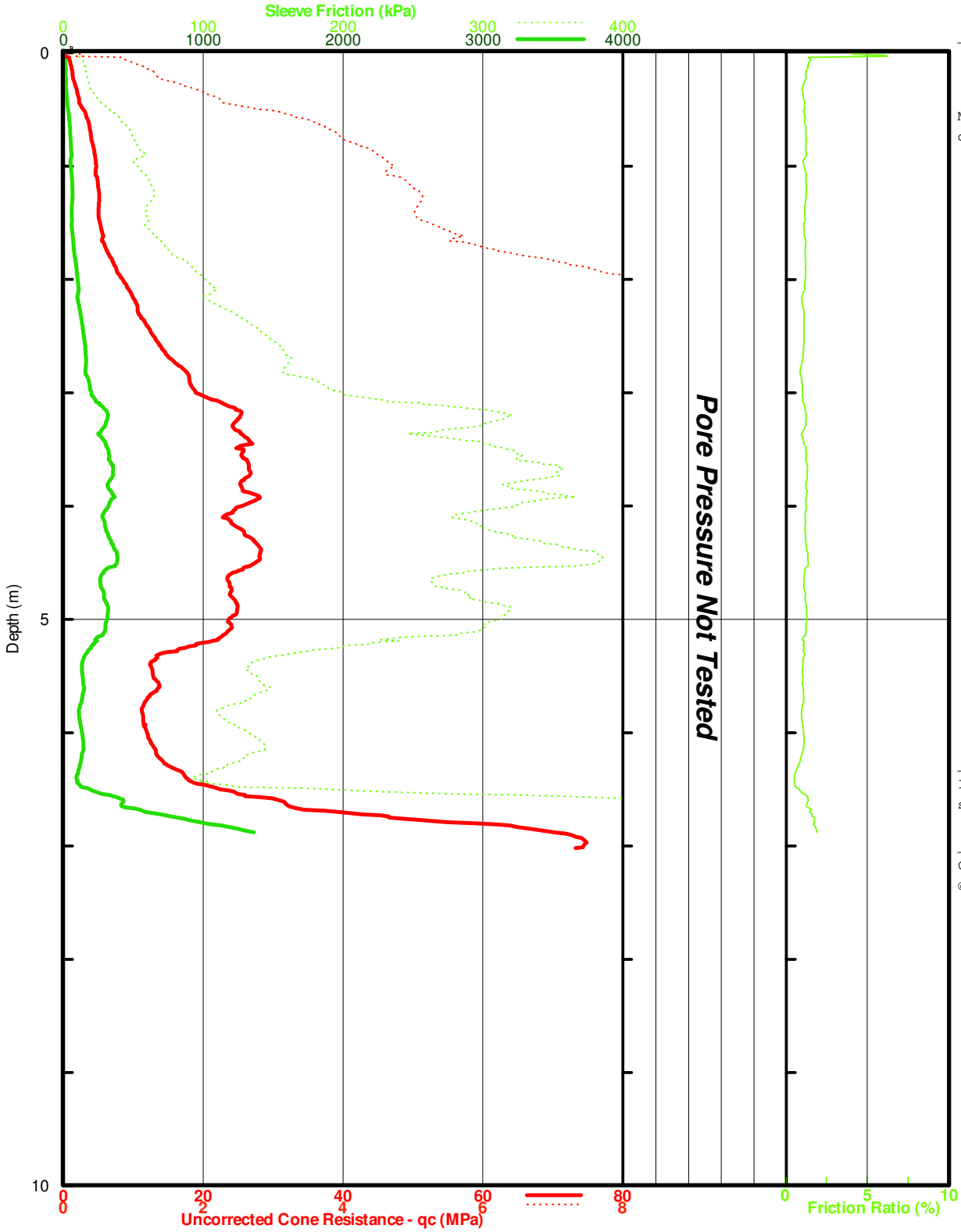
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-28



Job Number : G1006-105
Test Date : 30/06/2010
DGPS Position : 56 J 0554183, 6868493
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

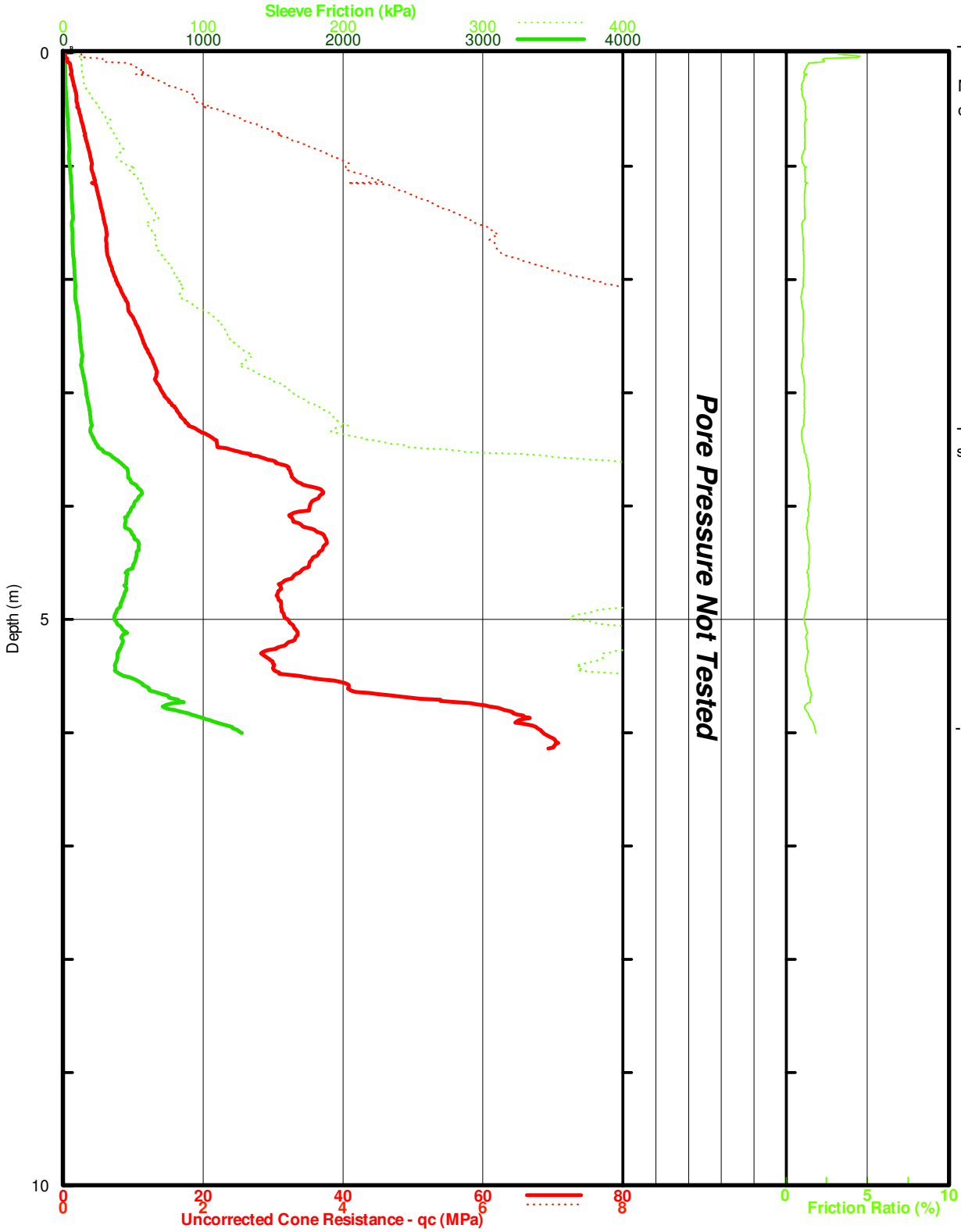
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-29



-0.0m

Medium to very dense sand

-3.5m indurated sand

- 6.1m CPT refusal

Job Number : G1006-105
Test Date : 30/06/2010
DGPS Position : 56 J 0554011, 6868614
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

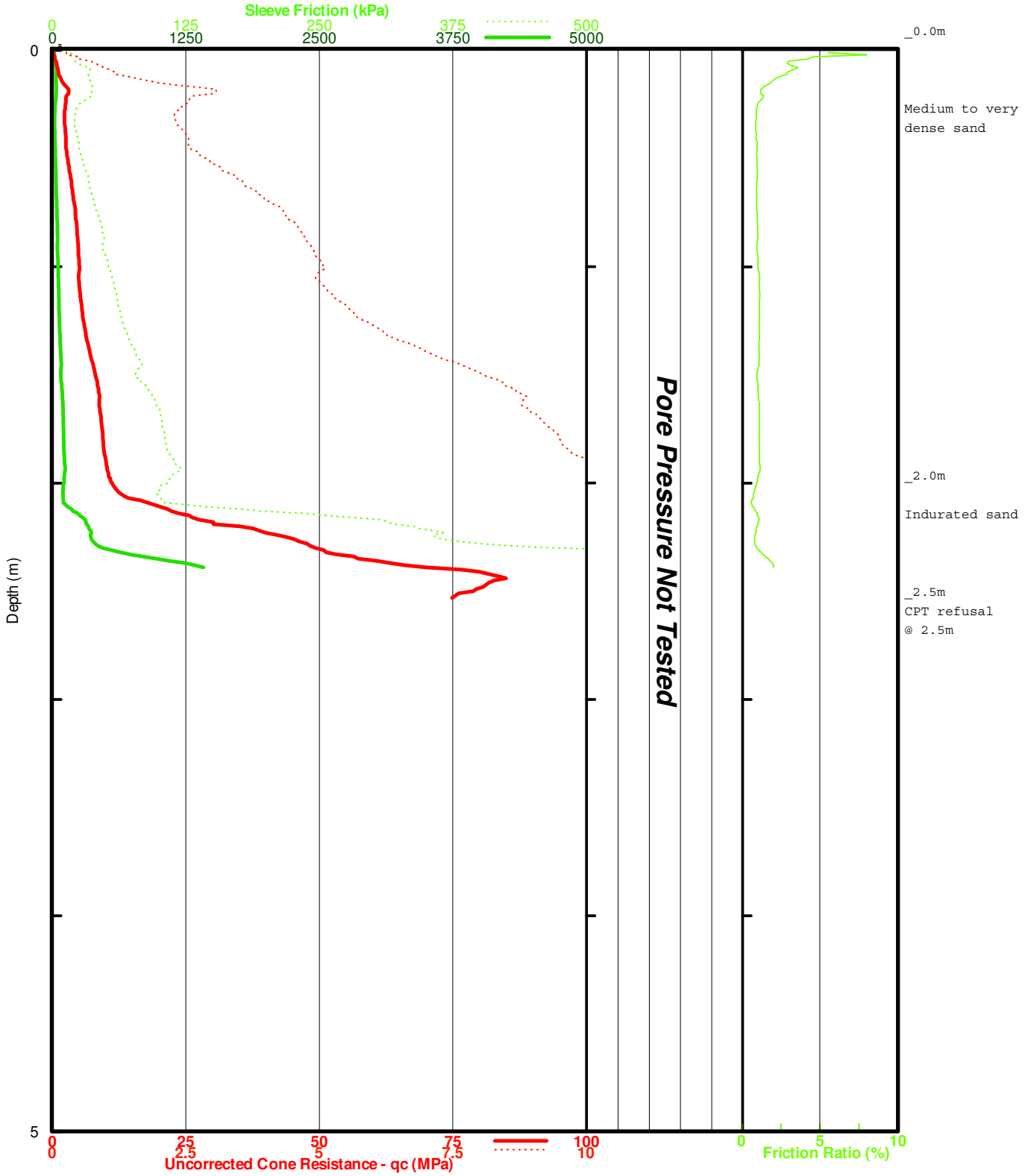
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-30



Job Number : G1006-105
Test Date : 25/06/2010
DGPS Position : 56 J 0552587, 6869541
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

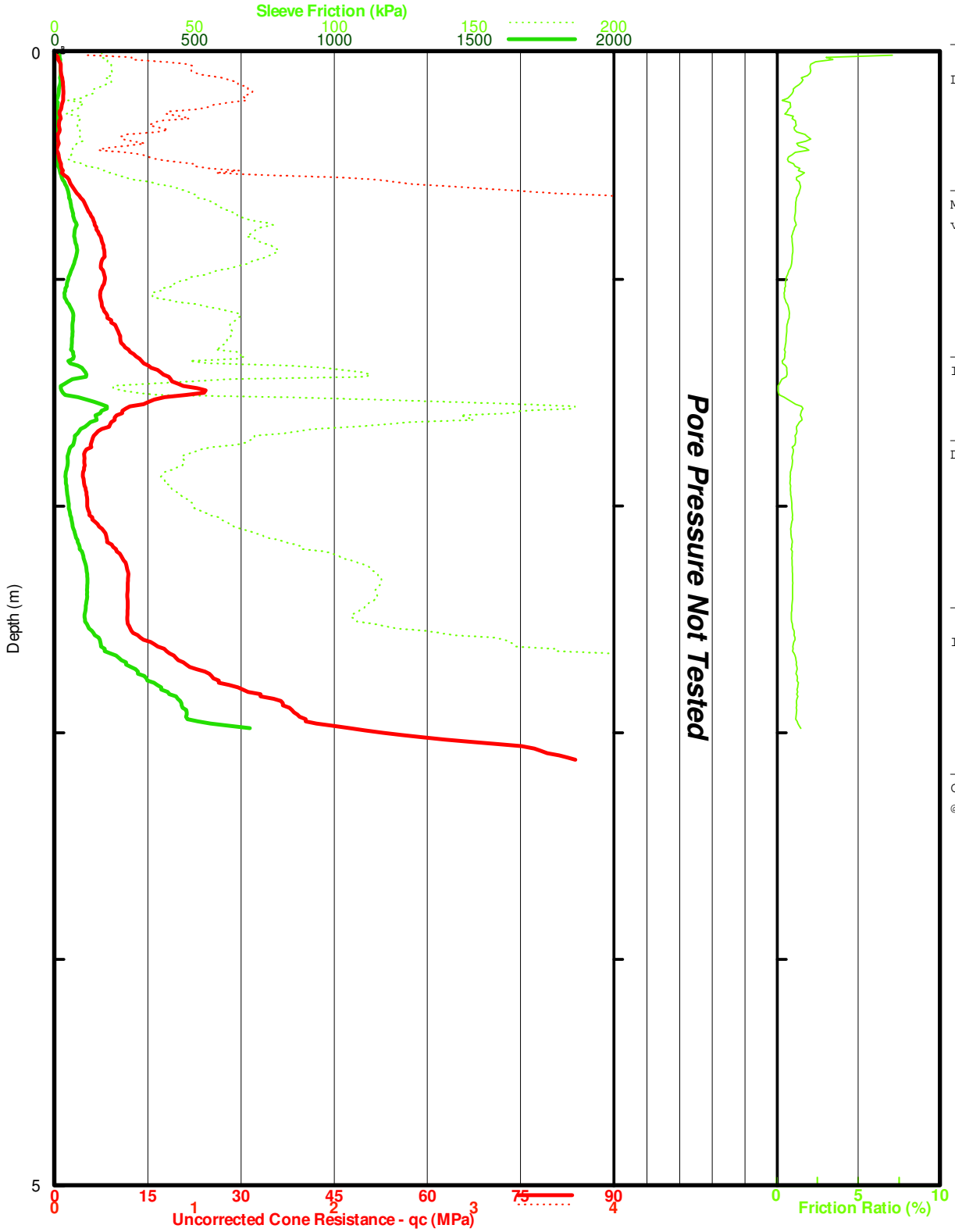
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-31



Job Number : G1006-105
Test Date : 24/06/2010
DGPS Position : 56 J 0553162, 6869833
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

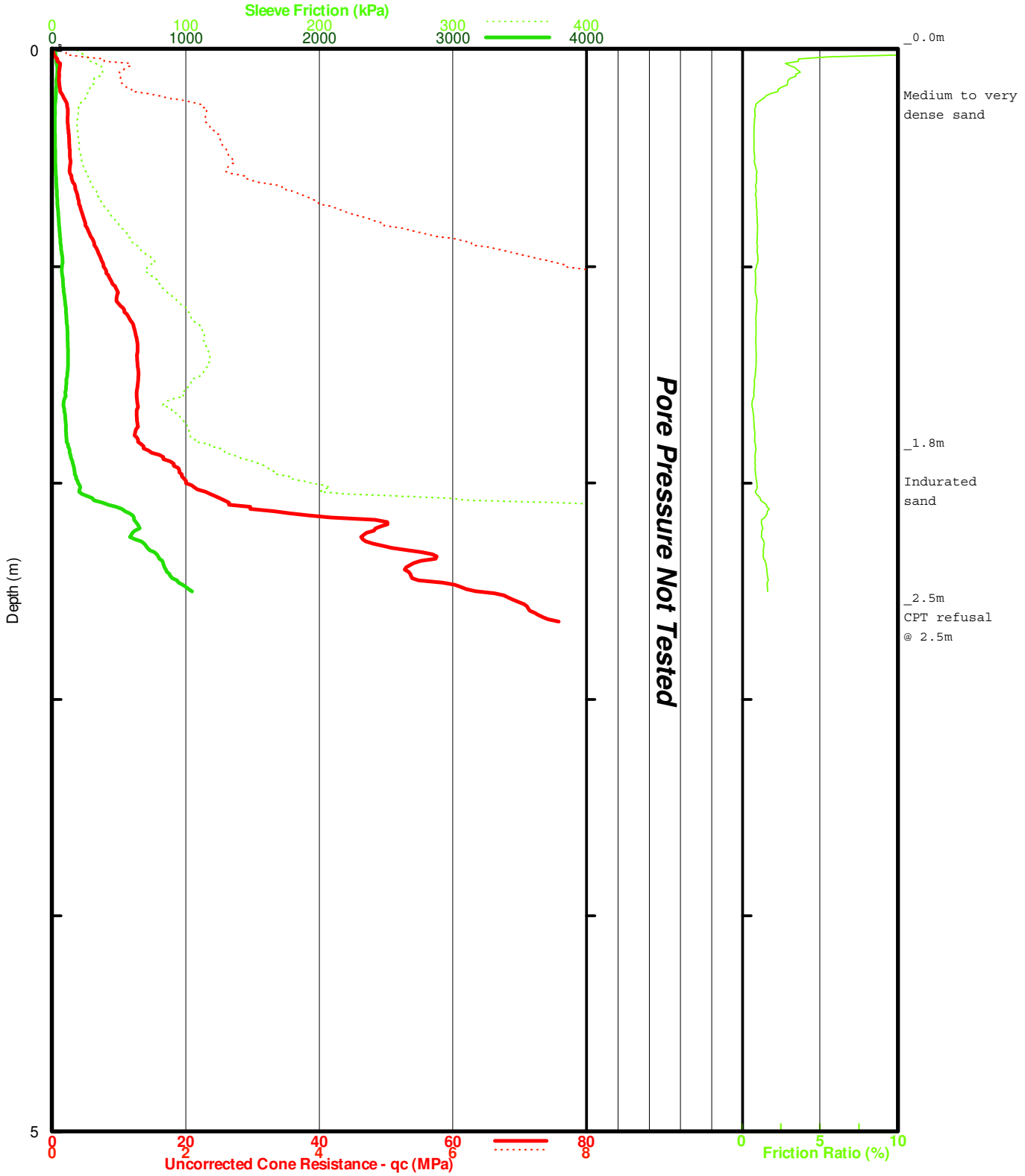
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-32



Job Number : G1006-105
Test Date : 25/06/2010
DGPS Position : 56 J 0552562, 6869708
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

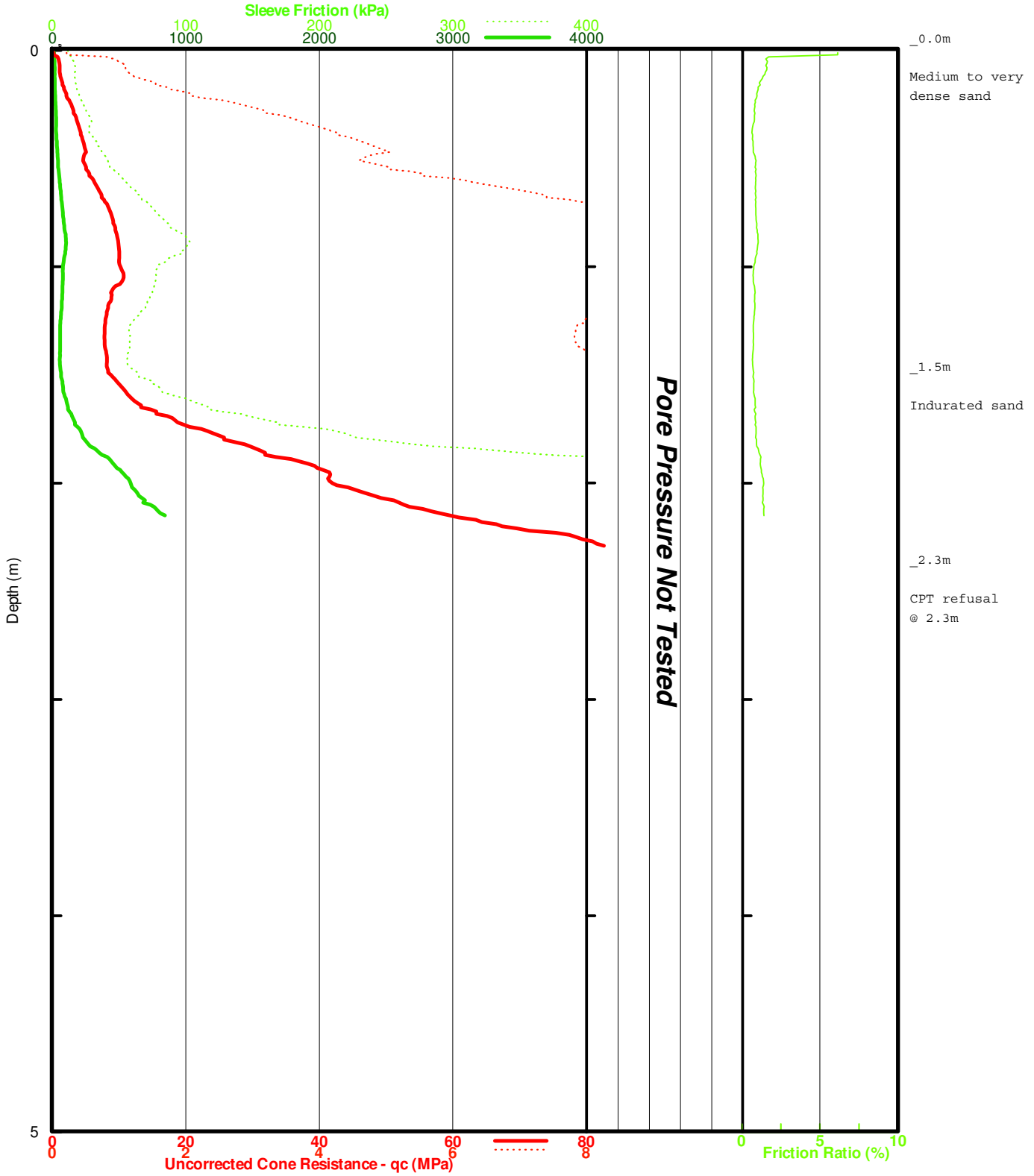
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-33



Job Number : G1006-105
Test Date : 25/06/2010
DGPS Position : 56 J 0552666, 6869784
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

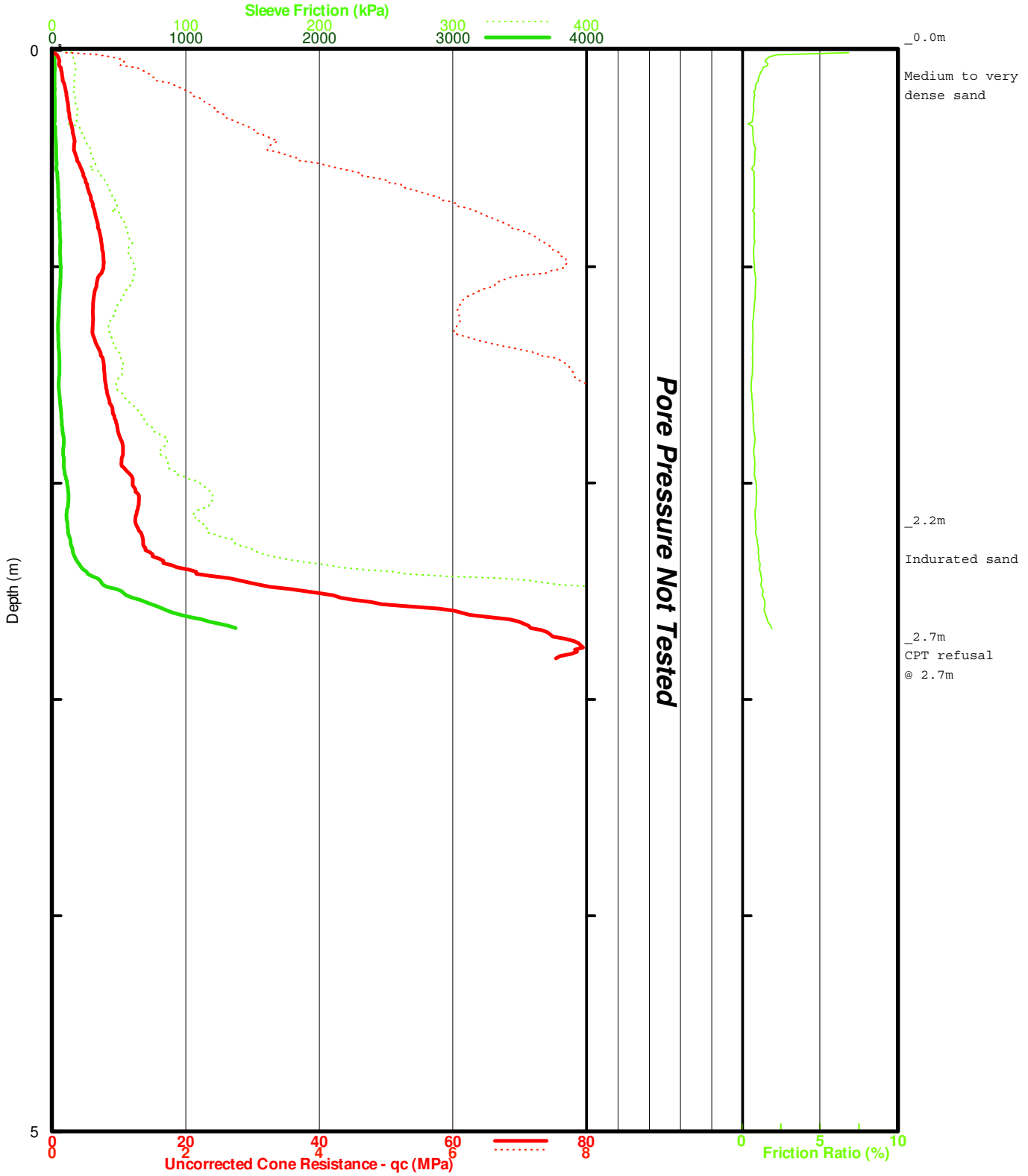
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-34



Job Number : G1006-105
Test Date : 25/06/2010
DGPS Position : 56 J 0552295, 6869901
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

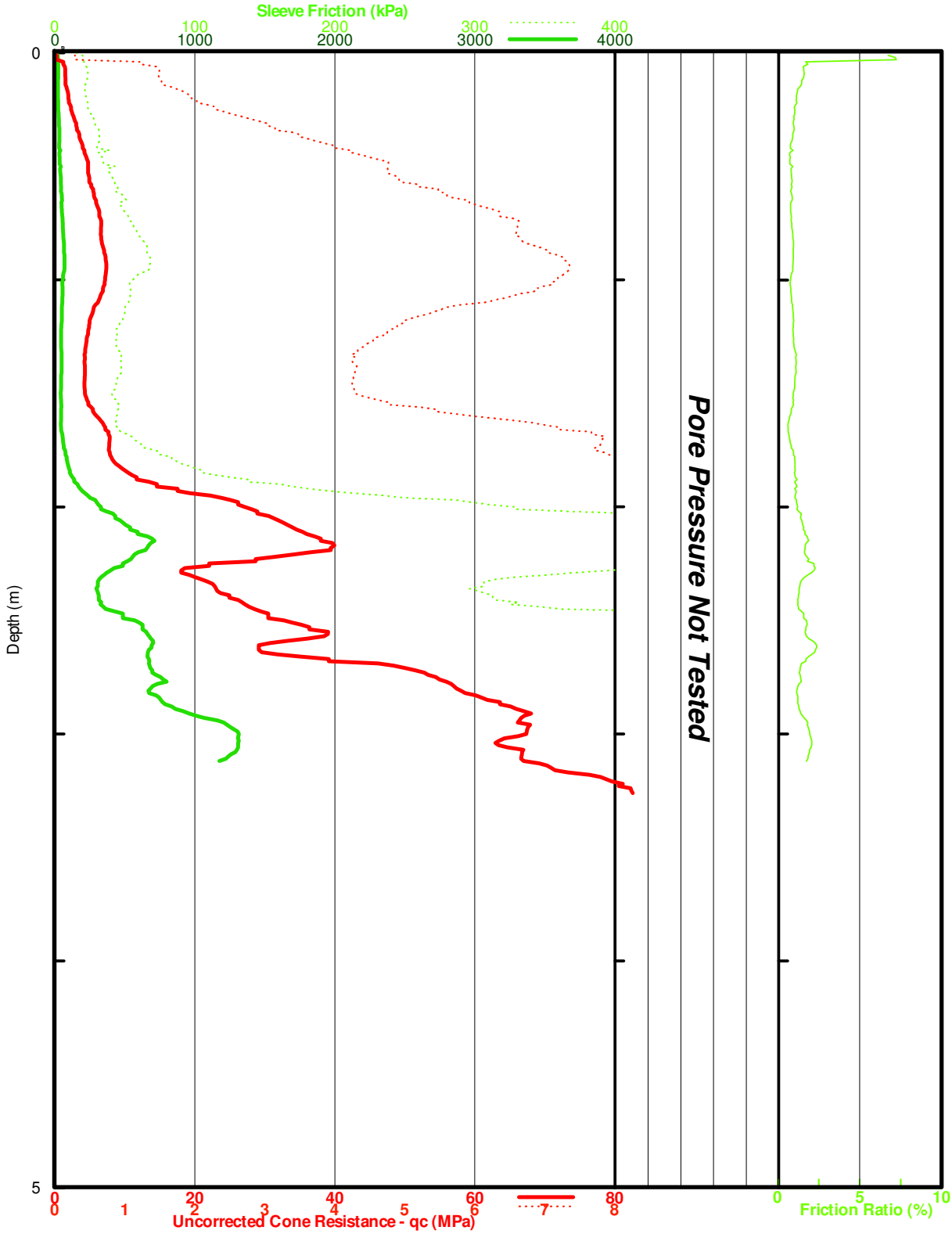
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-35



Job Number : G1006-105
Test Date : 02/07/2010
DGPS Position : 56 J 0552753, 6870161
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

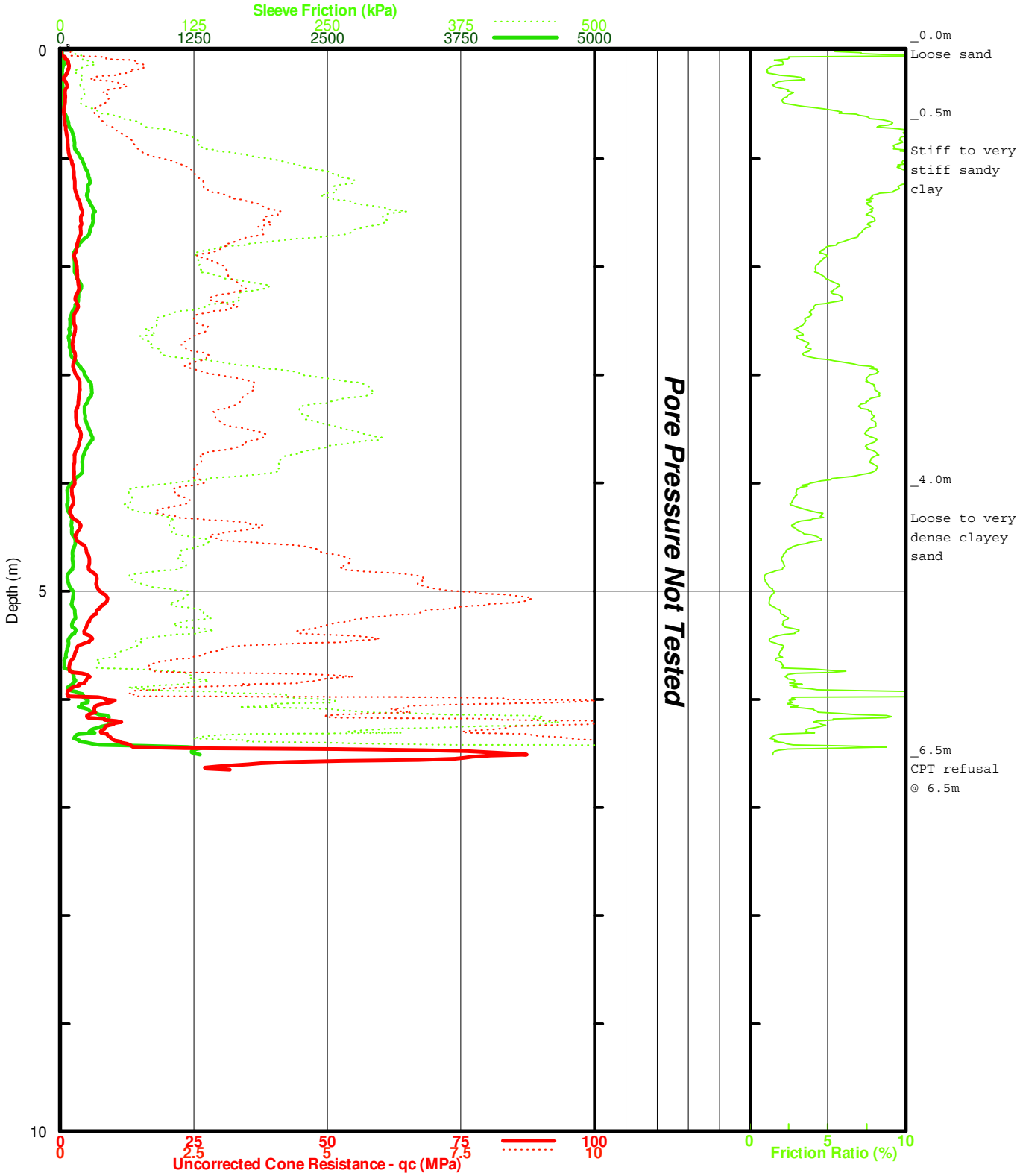
Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-36



Job Number : G1006-105
Test Date : 25/06/2010
DGPS Position : 56 J 0551147, 6870101
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Sleeve Refusal

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

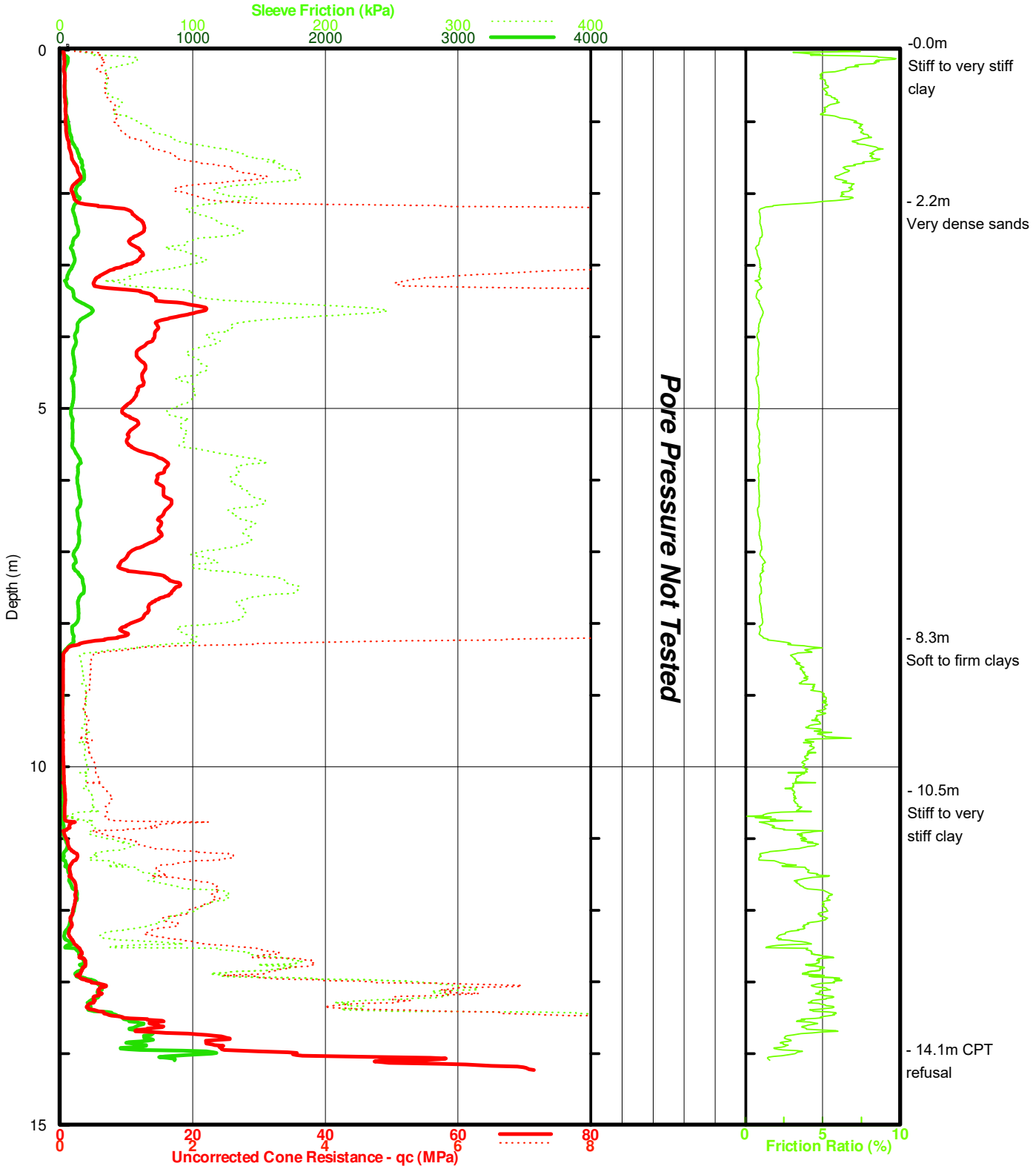
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-37



Job Number : G1006-105
Test Date : 25/06/2010
DGPS Position : 56 J 0551524, 6870216
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

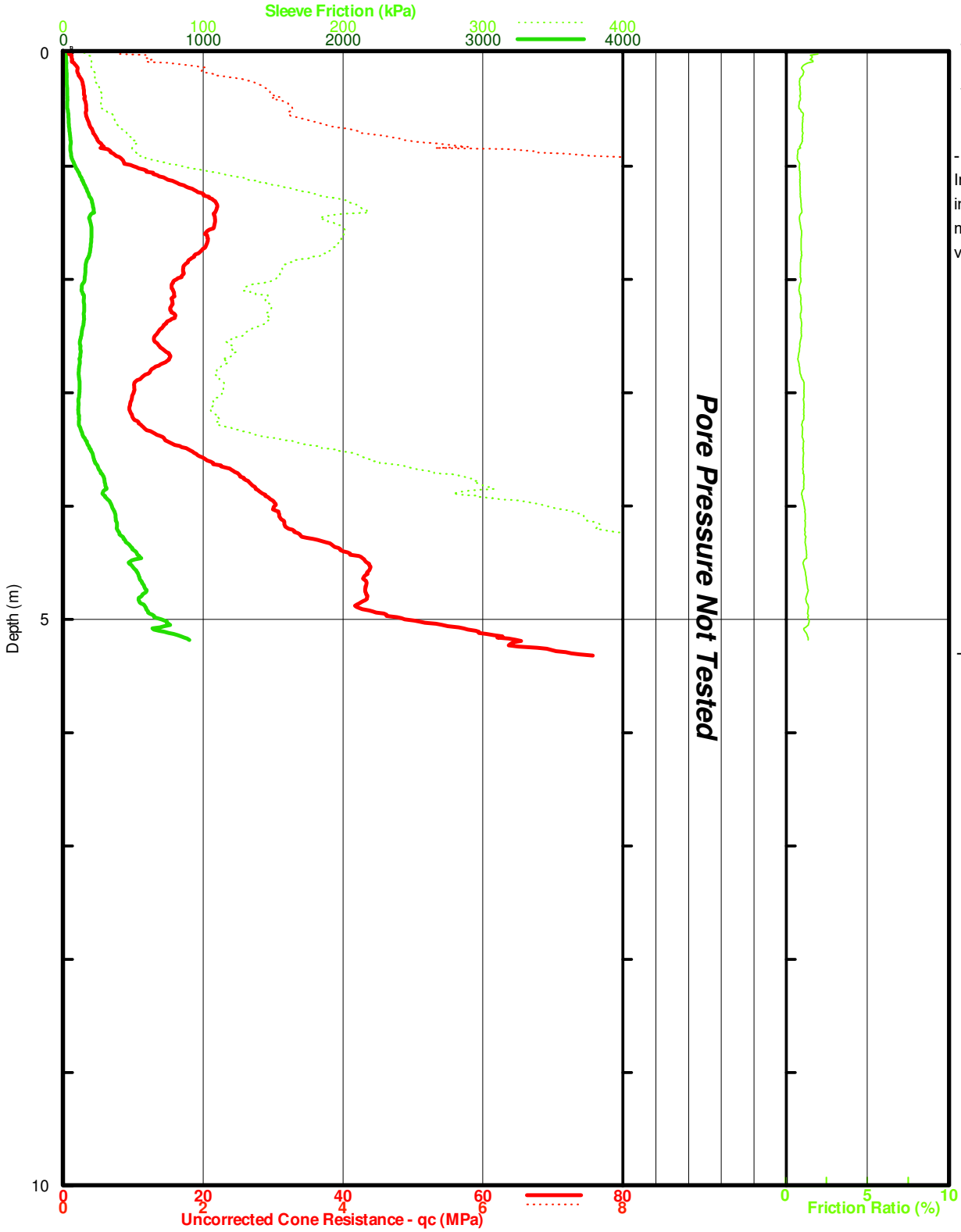
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Insitu Geotech Services Pty Ltd **IGS**

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-38



- 0.0m
Medium dense to very dense sand

- 1.0m
Interbedded indurated sand and medium dense to very dense sand

- 5.2m CPT refusal

Job Number : G1006-105
Test Date : 29/06/2010
DGPS Position : 56 J 0555281, 6870925
DGPS Format : WGS 84

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

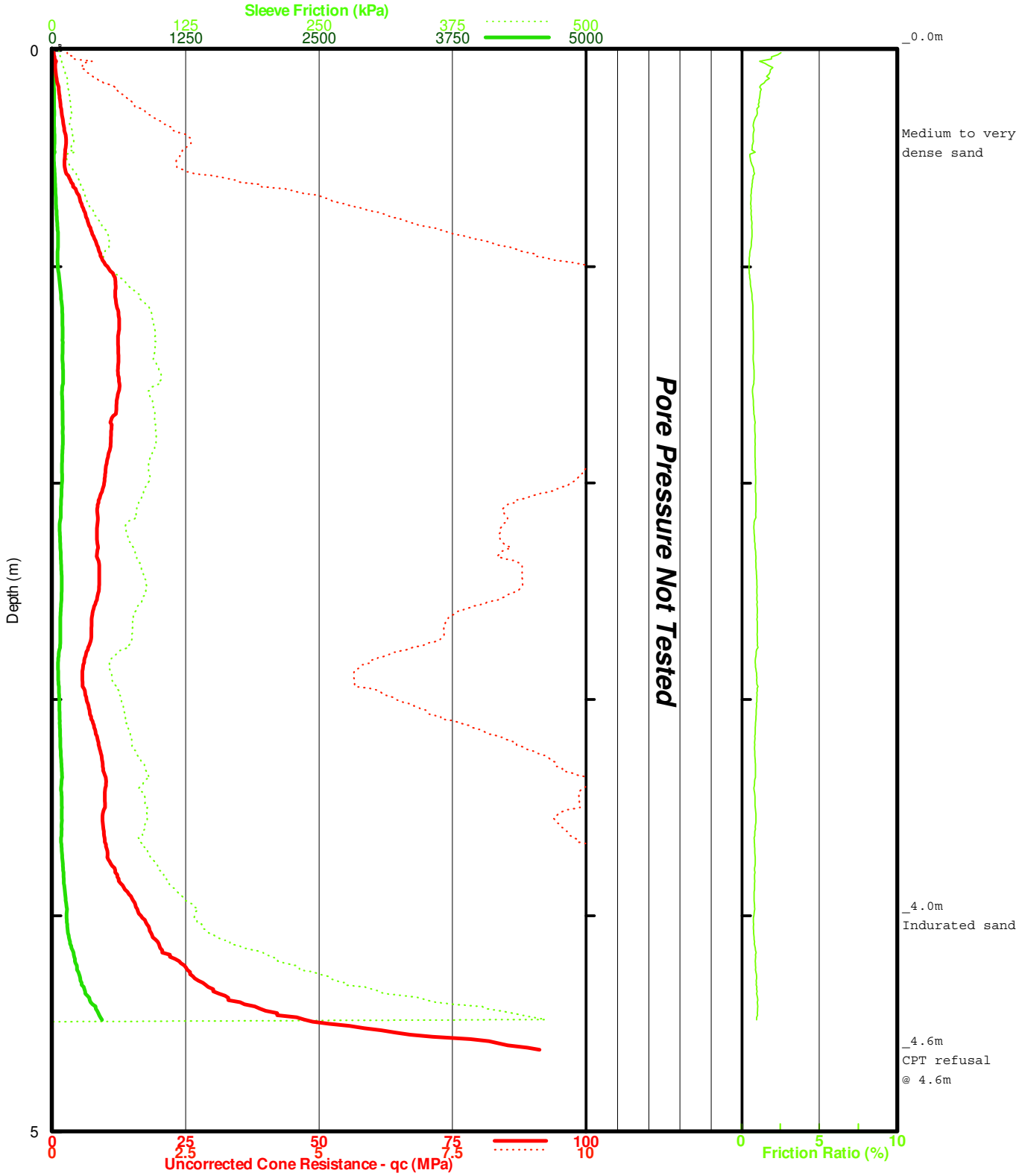
Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

Cardno Bowler
Kings Forest
Casuarina NSW

CPT-39



Job Number : G1006-105
Test Date : 29/06/2010
DGPS Position : 56 J 0555261, 6870996
DGPS Format : WGS 84

Cone Number : S15CFII.E48
Predrill Depth : 0.00m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

Tested By : Russell Vincenzi
Test Class : IGS-3
Checked By : Michael O'Rourke

Insitu Geotech Services Pty Ltd **IGS**

BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH1 - CTP38

Job No: 9528 **Sheet:** 1 of 5

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Hydropower Scout **Bit:** **Driller:** Tony

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 12/7/10 **Date Completed:** 12/7/10 **Logged By:** LB/RH **Date Logged:** 12/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.5						▶							SILTY SAND, fine to medium grained, grey brown, wet, dense, NATURAL Rootzone 0.1m
1.0												SM	
1.5							1.50 - 1.95 m SPT 13, 20, 22 N=42						
2.0													SILTY SAND, fine to medium grained, dark brown, wet, medium dense, organic odour
2.5													
3.0							3.00 - 3.45 m SPT 5, 11, 17 N=27					SM	
3.5													

See Standard Sheets for details of abbreviations & basis of descriptions

Cardno Bowler
7/98 Anzac Ave
HILLCREST QLD 4118
PH: (07) 3800 6446
FAX: (07) 3800 0816

BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH1 - CTP38

Job No: 9528 **Sheet:** 2 of 5

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Hydropower Scout **Bit:** **Driller:** Tony

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 12/7/10 **Date Completed:** 12/7/10 **Logged By:** LB/RH **Date Logged:** 12/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, dark brown, wet, medium dense, organic odour
4.5							4.50 - 4.95 m SPT 26, 30/120mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, indurated, organic odour, cemented
5.0													
5.5												SM	SILTY SAND, fine to medium grained, dark brown, with clay and small gravel, wet, very dense, indurated, organic odour, cemented
												SM	SILTY SAND, fine to medium grained, dark brown, with fine gravel, wet, very dense, indurated, organic odour, cemented
6.0							6.00 - 6.45 m SPT 30/85mm N>50						
6.5													
7.0													
7.5							7.50 - 7.95 m SPT 30/90mm N>50						

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH1 - CTP38

Job No: 9528 **Sheet:** 3 of 5

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Hydropower Scout **Bit:** **Driller:** Tony

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 12/7/10 **Date Completed:** 12/7/10 **Logged By:** LB/RH **Date Logged:** 12/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5													SILTY SAND, fine to medium grained, dark brown, with fine gravel, wet, very dense, indurated, organic odour, cemented
9.0							9.00 - 9.45 m SPT 29, 30/105mm N>50						
9.5												SM	
10.0													
10.5							10.50 - 10.95 m SPT 30/90mm						
11.0													
11.5												CI	SANDY CLAY, intermediate plasticity, fine to medium grained sand, trace of silt, dark brown/grey, wet, moist, stiff, ALLUVIAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH1 - CTP38**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 4 of 5**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type: Hydropower Scout	**Bit:**	**Driller: Tony**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 12/7/10	**Date Completed: 12/7/10**	**Logged By: LB/RH**	**Date Logged: 12/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							U 12.00 - 12.45 m Tube 160kPa						SANDY CLAY, intermediate plasticity, fine to medium grained sand, trace of silt, dark brown/grey, wet, moist, stiff, ALLUVIAL
12.5												CI	
13.0													SILTY CLAY/SANDY CLAY, high to medium plasticity, fine to coarse grained sand, grey, moist, stiff
13.5							U 13.50 - 13.95 m PP=120kPa						
14.0												CI-CH	
14.5													
15.0													SANDY CLAY/CLAYEY SAND, medium to high plasticity, fine to coarse grained sand, blue grey, with silt, hard/dense, moist
							15.20 - 15.60 m SPT 6, 21, 22 N=43						
15.5												SC-CI-CH	

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH1 - CTP38

Job No: 9528 **Sheet:** 5 of 5

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Hydropower Scout **Bit:** **Driller:** Tony

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 12/7/10 **Date Completed:** 12/7/10 **Logged By:** LB/RH **Date Logged:** 12/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SC-CI-CH	SANDY CLAY/CLAYEY SAND, medium to high plasticity, fine to coarse grained sand, blue grey, with silt, hard/dense, moist
16.5							16.50 - 16.95 m SPT 7, 7, 7 N=14						SILTY CLAY, intermediate to high plasticity, blue grey, trace sand and XW fragments, moist, stiff, NATURAL
17.0												CI-CH	
17.5													
18.0							18.00 - 18.45 m SPT 1, 1, 9 N=10					CI-CH	SILTY CLAY, intermediate to high plasticity, blue grey, trace sand and XW fragments, moist, NATURAL
18.5													
19.0													TC BIT REFUSAL IN WEATHERED ROCK BOREHOLE TERMINATED AT 18.70 m
19.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH2 - CTP2

Job No: 9528 **Sheet:** 1 of 5

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Hydropower Scout **Bit:** **Driller:** Tony

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 12/7/10 **Date Completed:** 12/7/10 **Logged By:** LB/RH **Date Logged:** 12/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.5												SM	SILTY SAND, coarse to fine grained sand, light brown, moist, loose, NATURAL Rootzone 0.1m
1.0													
1.5							1.50 - 1.95 m SPT 6, 7, 8 N=13					SP	SAND, medium grained sand, light brown, moist, medium dense
2.0												SM	SILTY SAND, fine to medium grained sand, dark brown, wet, medium dense, poorly cemented, organic odour
2.5													
3.0							3.00 - 3.45 m SPT 2, 3, 11 N=14						
3.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH2 - CTP2**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 2 of 5**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type: Hydropower Scout	**Bit:**	**Driller: Tony**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 12/7/10	**Date Completed: 12/7/10**	**Logged By: LB/RH**	**Date Logged: 12/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained sand, dark brown, wet, medium dense, poorly cemented, organic odour
4.5							4.50 - 4.95 m SPT 17, 30/180mm N>50					SM	SILTY SAND, fine to medium grained sand, dark brown, wet, very dense, well cemented, indurated, strong organic odour
5.0													
5.5													
6.0							6.00 - 6.45 m SPT 25, 30, 30 N=60						
6.5													
7.0													
7.5							7.50 - 7.95 m SPT 30/90mm N>50						

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Job No: 9528**	**Hole No: DBH2 - CTP2** **Sheet: 3 of 5**
Position: REFER TO FIGURE 1		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Hydropower Scout		**Bit:**	**Driller: Tony**
Casing Diameter:		**Contractor: DRILLSURE**	
Date Started : 12/7/10	**Date Completed: 12/7/10**	**Logged By: LB/RH**	**Date Logged: 12/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5													SILTY SAND, fine to medium grained sand, dark brown, wet, very dense, well cemented, indurated, strong organic odour
9.0							9.00 - 9.45 m SPT 20, 30/135mm N>50						
9.5													
10.0												SM	
10.5							10.50 - 10.95 m SPT 17, 26, 30/75mm N>50						
11.0													
11.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD			**Hole No: DBH2 - CTP2**
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**		**Sheet: 4 of 5**
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**		**Surface Elevation:**
Rig Type: Hydropower Scout	**Bit:**		**Driller: Tony**
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 12/7/10	**Date Completed: 12/7/10**	**Logged By: LB/RH**	**Date Logged: 12/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							12.00 - 12.45 m SPT 9, 14, 19 N=33						SILTY SAND, fine to medium grained sand, dark brown, wet, dense, well cemented, indurated, strong organic odour
12.5													
13.0													
13.5							13.50 - 13.95 m SPT 6, 11, 12 N=23						SILTY SAND, fine to medium grained, brown, wet, medium dense, NATURAL
14.0												SM	
14.5													
15.0							15.00 - 15.45 m SPT 10, 13, 10 N=23						SILTY SAND, fine to medium grained, brown, trace clay and small gravel, wet, medium dense, NATURAL
15.5												SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH2 - CTP2

Job No: 9528 **Sheet:** 5 of 5

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Hydropower Scout **Bit:** **Driller:** Tony

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 12/7/10 **Date Completed:** 12/7/10 **Logged By:** LB/RH **Date Logged:** 12/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
													SILTY SAND, fine to medium grained, brown, trace clay and small gravel, wet, dense, NATURAL
16.5							16.50 - 16.95 m SPT 15, 21, 17 N=38						
17.0													
17.5													
18.0							18.00 - 18.45 m SPT 19, 21, 20 N=41						
18.5													
19.0													
19.5							19.50 - 19.95 m SPT 15, 23, 25 N=48						
													BOREHOLE TERMINATED AT 19.95 m

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH3 - CTP7

Job No: 9528 **Sheet:** 1 of 7

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 14/7/10 **Date Completed:** 14/7/10 **Logged By:** LB **Date Logged:** 14/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0													SAND, fine to medium grained, grey/light brown, dry to moist, loose, NATURAL Rootzone 0.1m
1.5							1.50 - 1.95 m SPT 2, 3, 4 N=7					SP	
3.0							3.00 - 3.45 m SPT 6, 72, 16 N=28					SP	SAND, fine to medium grained, grey/light brown, dry to moist, medium dense, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: DBH3 - CTP7**	
		Job No: 9528	**Sheet: 2 of 7**
Position: REFER TO FIGURE 1		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type:		**Bit:**	**Driller:**
Casing Diameter:		**Contractor: DRILLSURE**	
Date Started : 14/7/10	**Date Completed: 14/7/10**	**Logged By: LB**	**Date Logged: 14/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5							4.50 - 4.95 m SPT 30/115mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, poorly cemented, indurated, organic odour
5.0													
5.5													
6.0							6.00 - 6.45 m SPT 18, 24, 17 N=41					SM	SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, dense, poorly cemented, indurated, organic odour
6.5													
7.0													
7.5							7.50 - 7.95 m SPT 30/125mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, very dense, poorly cemented, indurated, organic odour

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH3 - CTP7**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 3 of 7**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 14/7/10	**Date Completed: 14/7/10**	**Logged By: LB**	**Date Logged: 14/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5												SM	SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, very dense, poorly cemented, indurated, organic odour
9.0							9.00 - 9.45 m SPT 32, 24, 24 N=48					SM	SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, dense, organic odour
9.5													
10.0													
10.5							10.50 - 10.95 m SPT 28, 22, 23 N=45						
11.0													
11.5												SM	SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, dense, well cemented, indurated, organic odour

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH3 - CTP7

Job No: 9528 **Sheet:** 4 of 7

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 14/7/10 **Date Completed:** 14/7/10 **Logged By:** LB **Date Logged:** 14/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
12.5							12.00 - 12.45 m SPT 18, 19, 12 N=31						SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, dense, organic odour
13.0													
13.5							13.50 - 13.95 m SPT 26, 26, 15 N=47					SM	SILTY SAND, fine to medium grained, dark brown, wet, dense, organic odour
14.0													
14.5													
15.0							15.00 - 15.45 m SPT 8, 8, 8 N=16						SILTY SAND, fine to medium grained, brown, medium dense, trace of clay, wet, NATURAL
15.5												SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH3 - CTP7

Job No: 9528 **Sheet:** 5 of 7

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 14/7/10 **Date Completed:** 14/7/10 **Logged By:** LB **Date Logged:** 14/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, brown, medium dense, trace of clay, wet, NATURAL
16.5							16.50 - 16.95 m SPT 6, 9, 17 N=26					SM	SILTY SAND, fine to medium grained, light brown, medium dense, trace of clay, wet, NATURAL
17.0													
17.5												SM	SILTY SAND, fine to medium grained, light brown, medium dense, trace of clay, wet, NATURAL
18.0							18.00 - 18.45 m SPT 6, 4, 8 N=12						
18.5													
19.0												SM	SILTY SAND, fine to medium grained, light brown, medium dense, wet, NATURAL
19.5							19.50 - 19.95 m SPT 10, 12, 14 N=26						

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH3 - CTP7

Job No: 9528 **Sheet:** 6 of 7

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 14/7/10 **Date Completed:** 14/7/10 **Logged By:** LB **Date Logged:** 14/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
20.5													SILTY SAND, fine to medium grained, light brown, medium dense, wet, NATURAL
21.0							21.00 - 21.45 m SPT 10, 12, 13 N=25					SM	
21.5													
22.0													
22.5							22.50 - 22.95 m SPT 22, 23, 20 N=43						SILTY SAND, fine to medium grained, blue grey, dense, wet, NATURAL
23.0												SM	
23.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH3 - CTP7

Job No: 9528 **Sheet:** 7 of 7

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 14/7/10 **Date Completed:** 14/7/10 **Logged By:** LB **Date Logged:** 14/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
24.5							24.00 - 24.45 m SPT 2, 5, 5 N=10					SM	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to medium grained sand, wet, blue/grey, stiff, NATURAL
25.0												CI-CH	SILTY CLAY, blue grey, wet, stiff, NATURAL
25.5							25.50 - 25.95 m SPT 2, 5, 5, N=10						BOREHOLE TERMINATED AT 25.50 m
26.0													
26.5													
27.0													
27.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH4 - CTP20

Job No: 9528 **Sheet:** 1 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0													SILTY SAND, fine to medium grained sand, dark brown, dry to moist, loose, NATURAL
													Rootzone 0.1m
0.5													
1.0													
1.5							1.50 - 1.95 m SPT 2, 3, 4 N=7					SM	
2.0													
2.5						▶							Water level
3.0							3.00 - 3.45 m SPT 4, 7, 8 N=15						SILTY SAND, fine to medium grained sand, light brown, dry to moist, medium dense, NATURAL
3.5												SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH4 - CTP20

Job No: 9528 **Sheet:** 2 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5							4.50 - 4.95 m SPT 7, 7, 7 N=14						SILTY SAND, fine to medium grained sand, light brown, dry to moist, medium dense, NATURAL
5.0												SM	
5.5													
6.0							6.00 - 6.45 m SPT 6, 7, 7 N=14						SILTY SAND, fine to medium grained sand, dark brown, dry to moist, medium dense, NATURAL
6.5												SM	
7.0													SILTY SAND, fine to medium grained, dark brown, wet, medium dense, organic odour, NATURAL
7.5							7.50 - 7.95 m SPT 9, 11, 12 N=23					SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH4 - CTP20

Job No: 9528 **Sheet:** 3 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5												SM	SILTY SAND, fine to medium grained, dark brown, wet, medium dense, organic odour, NATURAL
9.0							9.00 - 9.45 m SPT 8, 10, 10 N=21					SM	SILTY SAND, fine to medium grained, brown, wet, medium dense, small bands of indurated, organic odour, NATURAL
9.5													
10.0													
10.5							10.50 - 10.95 m SPT 6, 9, 10, N=19					SM	SILTY SAND, fine to medium grained, dark brown, wet, medium dense, organic odour, NATURAL
11.0													
11.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH4 - CTP20

Job No: 9528 **Sheet:** 4 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							12.00 - 12.45 m SPT 6, 7, 6 N=13					SM	SILTY SAND, fine to medium grained sand, dark brown, wet, medium dense, organic odour, NATURAL
12.5													SILTY SAND, fine to medium grained, light brown, wet, medium dense, organic odour, NATURAL
13.0													
13.5							13.50 - 13.95 m SPT 5, 6, 10 N=16					SM	
14.0													
14.5													
15.0							15.00 - 15.45 m SPT 9, 18, 21 N=39						SILTY SAND, fine to medium grained, dark brown, wet, dense, strong organic odour, NATURAL
15.5												SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH4 - CTP20**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 5 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 16/7/10	**Date Completed: 16/7/10**	**Logged By: LB**	**Date Logged: 16/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
16.5							16.50 - 16.95 m SPT 7, 21, 23 N=44					SM	SILTY SAND, fine to medium grained, dark brown, wet, dense, strong organic odour, NATURAL
17.0													
17.5													SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, dense, strong organic odour, NATURAL
18.0							18.00 - 18.45 m SPT 12, 19, 23 N=42						
18.5												SM	
19.0													
19.5							19.50 - 19.95 m SPT 10, 7, 7 N=14						
												SM-SC	SILTY SAND/CLAYEY SAND, fine to medium grained sands, grey wet, medium dense, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH4 - CTP20

Job No: 9528 **Sheet:** 6 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
20.5													SILTY SAND/CLAYEY SAND, fine to medium grained sands, grey wet, loose, NATURAL
21.0							21.00 - 21.45 m SPT 0, 0, 5 N=5						SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, grey, moist, stiff, NATURAL
21.5												CH	
22.0													
22.5							U 22.50 - 22.95 m PP=250kPa						SANDY CLAY/SILTY CLAY, high plasticity, dark brown, moist, very stiff, NATURAL
23.0												CH	
23.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH4 - CTP20**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 7 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 16/7/10	**Date Completed: 16/7/10**	**Logged By: LB**	**Date Logged: 16/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
24.5							U 24.00 - 24.45 m PP=300kPa					CH	SANDY CLAY/SILTY CLAY, high plasticity, blue grey, moist, very stiff, NATURAL
25.0													
25.5							U 25.50 - 25.95 m PP=110kPa					CH	SANDY CLAY/SILTY CLAY, high plasticity, dark brown, moist, stiff, NATURAL
26.0													
26.5													
27.0							U 27.00 - 27.45 m PP=140kPa						
27.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH4 - CTP20

Job No: 9528 **Sheet:** 8 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												CH	SANDY CLAY/SILTY CLAY, high plasticity, dark brown, moist, stiff, NATURAL
28.5							U 28.50 - 28.95 m PP=sand					SC-SM	CLAYEY SAND/SILTY SAND, fine to medium grained sand, grey brown, moist to wet, stiff, NATURAL
29.0													
29.5													
30.0							30.00 - 30.45 m SPT 7, 4, 5, N=9						BOREHOLE TERMINATED AT 30.00 m
30.5													
31.0													
31.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH5 - CTP29

Job No: 9528 **Sheet:** 1 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0													SILTY SAND, fine to medium grained, grey/brown, dry to moist, loose, NATURAL Rootzone
1.5							1.50 - 1.95 m SPT 2, 4, 5 N=9					SM	
3.0							3.00 - 3.45 m SPT 4, 12, 26 N=38					SM	SILTY SAND, fine to medium grained, grey, dry to moist, dense, NATURAL Becoming indurated at 3.5m

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH5 - CTP29

Job No: 9528 **Sheet:** 2 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
													SILTY SAND, fine to medium grained, grey, dry to moist, very dense, indurated, NATURAL
													Drilling becoming harder
4.5							4.50 - 4.95 m SPT 18, 28, 30/140mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, dry to moist, very dense, NATURAL
5.0													SILTY SAND, fine to medium grained, dark brown, wet, very dense, well cemented, indurated, organic odour, NATURAL
5.5													
6.0							6.00 - 6.45 m SPT 30/135mm						
6.5												SM	
7.0													
7.5							7.50 - 7.95 m SPT 30/95mm N>50						

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH5 - CTP29**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 3 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 18/7/10	**Date Completed: 18/7/10**	**Logged By: LB**	**Date Logged: 18/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5												SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, well cemented, indurated, organic odour, NATURAL
9.0							9.00 - 9.45 m SPT 30/120mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, well cemented, indurated, NATURAL
9.5													
10.0													
10.5							10.50 - 10.95 m SPT 23, 30/140mm N>50						
11.0													
11.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH5 - CTP29

Job No: 9528 **Sheet:** 4 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
12.5							12.00 - 12.45 m SPT 12, 19, 27 N=46						SILTY SAND, fine to medium grained, dark brown, wet, dense, NATURAL
13.0													
13.5							13.50 - 13.95 m SPT 12, 17, 20 N=37					SM	
14.0													
14.5													
15.0							15.00 - 15.45 m SPT 8, 12, 12 N=24						SILTY SAND, fine to medium grained, light brown, wet, medium dense, NATURAL
15.5												SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH5 - CTP29

Job No: 9528 **Sheet:** 5 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, light brown, wet, medium dense, NATURAL
16.5							16.50 - 16.95 m SPT 13, 22, 28 N=50					SM	SILTY SAND, fine to medium grained, dark grey, wet, dense to very dense, NATURAL
17.0													
17.5													
18.0							U 18.00 - 18.45 m PP=50kPa					CL-CI	SANDY CLAY/SILTY CLAY, low to medium plasticity, dark grey, moist to wet, soft to firm, NATURAL
18.5												SC-SM	CLAYEY SAND/SILTY SAND, fine to medium grained, dark grey, moist to wet, loose, NATURAL
19.0													
19.5							19.50 - 19.95 m SPT 8, 10, 12 N=22					SM	SILTY SAND, fine to medium grained, dark brown, medium dense, organic odour, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH5 - CTP29

Job No: 9528 **Sheet:** 6 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, dark brown, medium dense, organic odour, NATURAL
20.5													SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained, blue grey, moist, stiff, NATURAL
21.0							21.00 - 21.45 m SPT 1, 5, 4 N=9						Interbedded layers of blue grey sandy clay and clayey sand
21.5												CH	
22.0													
22.5							22.50 - 22.95 m SPT 5, 4, 6 N=10						CLAYEY SAND/SILTY SAND, fine to medium grained, grey green, moist to wet, medium dense, NATURAL
23.0												CH	
23.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH5 - CTP29**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 7 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 18/7/10	**Date Completed: 18/7/10**	**Logged By: LB**	**Date Logged: 18/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							24.00 - 24.45 m SPT 8, 12, 15 N=27						SANDY CLAY/SILTY CLAY, high plasticity, grey with brown, moist, stiff, NATURAL
24.5												CH	
25.0													
25.5							U 25.50 - 25.95 m PP=400kPa						SANDY CLAY/SILTY CLAY, high plasticity, grey with brown, moist, very stiff to hard, NATURAL
26.0												CH	
26.5													
27.0							27.00 - 27.45 m SPT 9, 11, 14 N=25						SANDY CLAY/SILTY CLAY, high plasticity, brown, moist, very stiff, NATURAL
27.5												CH	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: DBH5 - CTP29**	
		Job No: 9528	**Sheet: 8 of 8**
Position: REFER TO FIGURE 1		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type:		**Bit:**	**Driller:**
Casing Diameter:		**Contractor: DRILLSURE**	
Date Started : 18/7/10	**Date Completed: 18/7/10**	**Logged By: LB**	**Date Logged: 18/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												CH	SANDY CLAY/SILTY CLAY, high plasticity, brown, moist, very stiff, NATURAL
28.5							28.50 - 28.95 m SPT 8, 8, 9 N=17					CH	SANDY CLAY/SILTY CLAY, high plasticity, dark grey, clayey sand band, moist, very stiff, NATURAL
29.0													
29.5													
30.0							30.00 m SPT 6, 7, 9 N=16						BOREHOLE TERMINATED AT 30.00 m
30.5													
31.0													
31.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH6 - CTP26

Job No: 9528 **Sheet:** 1 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.5												SM	SILTY SAND, fine to medium grained, light to dark brown, dry to moist, medium dense, NATURAL Root zone 0.1m
1.0						▶							
1.5							1.50 - 1.95 m SPT 10, 13, 15 N=28						
2.0												SM	SILTY SAND, fine to medium grained, dark brown, wet, dense, organic odour, indurated, well cemented, NATURAL
2.5													Becoming denser
3.0							3.00 - 3.45 m SPT 7, 30/110mm N>50						
3.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH6 - CTP26

Job No: 9528 **Sheet:** 2 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, with clay, dark brown, wet, dense, organic odour, indurated, well cemented, NATURAL
4.5							4.50 - 4.95 m SPT 30/100mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, trace of gravel, wet, dense, organic odour, indurated, well cemented, NATURAL
5.0													
5.5													
6.0							6.00 - 6.45 m SPT 30, 30/95mm N>50						
6.5													
7.0													
7.5							7.50 - 7.95 m SPT 21, 26, 27 N>50					SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH6 - CTP26

Job No: 9528 **Sheet:** 3 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5												SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, NATURAL
9.0							9.00 - 9.45 m SPT 9, 10, 12 N=22					SM	SILTY SAND, fine to medium grained, light brown, wet, medium dense, NATURAL
9.5													
10.0												SM	SILTY SAND, fine to medium grained, light brown, trace of clay and gravel, wet, medium dense, NATURAL
10.5							10.50 - 10.95 m SPT 30/95mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, moist to wet, very dense, indurated, NATURAL
11.0													
11.5												SM	SILTY SAND, fine to medium grained, brown, moist to wet, medium dense, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH6 - CTP26

Job No: 9528 **Sheet:** 4 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							12.00 - 12.45 m SPT 8, 11, 16 N=27					SM	SILTY SAND, fine to medium grained, brown, moist to wet, medium dense, NATURAL
12.5												SM	SILTY SAND, fine to medium grained, brown, trace of clay in cuttings, moist to wet, medium dense, NATURAL
13.0													
13.5							13.50 - 13.95 m SPT 30/100mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, indurated, organic odour, NATURAL
14.0													
14.5													
15.0							15.00 - 15.45 m SPT 24, 30/130mm N>50						
15.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH6 - CTP26**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 5 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 18/7/10	**Date Completed: 18/7/10**	**Logged By: LB**	**Date Logged: 18/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, indurated, organic odour, NATURAL
												SM	SILTY SAND, fine to medium grained, dark grey, wet, medium dense, NATURAL
16.5							16.50 - 16.95 m SPT 9, 14, 15 N=29						
17.0													
17.5													
18.0							18.00 - 18.45 m SPT 9, 17, 19 N=36					SM	SILTY SAND, fine to medium grained, dark grey, wet, dense, NATURAL
18.5													
19.0													
19.5							19.50 - 19.95 m SPT 21, 28, 30/140mm N>50					SM	SILTY SAND, fine to medium grained, brown/grey, wet, very dense, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH6 - CTP26

Job No: 9528 **Sheet:** 6 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
20.5												SM	SILTY SAND, fine to medium grained, brown/grey, wet, very dense, NATURAL
21.0							21.00 - 21.45 m SPT 20, 30/120mm N>50					SM	SILTY SAND, fine to medium grained, grey, wet, very dense, NATURAL
21.5													
22.0													
22.5							22.50 - 22.95 m SPT 2, 2, 3 N=5					SC-SM	CLAYEY SANDS/SILTY SANDS, fine to medium grained sand, grey, moist to wet, loose, NATURAL
23.0												CL-CI	SANDY CLAY/SILTY CLAY, low to medium plasticity, grey, fine to medium grained sand, moist to wet, firm, NATURAL
23.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH6 - CTP26

Job No: 9528 **Sheet:** 7 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
24.5							U 24.00 - 24.45 m PP=90kPa					CL-CI	SANDY CLAY/SILTY CLAY, low to medium plasticity, grey, fine to medium grained sand, moist to wet, firm, NATURAL
25.0													
25.5							U 25.50 - 25.95 m PP=160kPa					CL-CI	SANDY CLAY/SILTY CLAY, low to medium plasticity, blue grey, fine to medium grained sand, moist to wet, stiff, NATURAL
26.0													
26.5													
27.0							U 27.00 - 27.45 m PP=80kPa					CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained, brown, moist, firm, NATURAL
27.5												CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, stiff to very stiff, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH6 - CTP26

Job No: 9528 **Sheet:** 8 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 18/7/10 **Date Completed:** 18/7/10 **Logged By:** LB **Date Logged:** 18/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, stiff to very stiff, NATURAL
28.5							28.50 - 28.95 m SPT 18, 30/140mm N>50						Couldn't push a tube, too stiff, SPT instead, sands in the bottom 50-60mm of the tube
												SM	SILTY SAND, fine to coarse grained, dark grey, wet, very dense, NATURAL
29.0													
29.5													
30.0							30.00 m SPT 9, 9, 14 N=23						BOREHOLE TERMINATED AT 30.00 m
30.5													
31.0													
31.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH7 - CTP23**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 1 of 6**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 17/7/10	**Date Completed: 17/7/10**	**Logged By: LB**	**Date Logged: 17/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.5												SM	SILTY SAND, fine to medium grained, grey/dark grey, dry, loose to medium dense, NATURAL Rootzone 0.1m
1.0													
1.5							1.50 - 1.95 m SPT 3, 3, 5 N=8						
2.0												SM	SILTY SAND, fine to medium grained, grey/dark grey, dry to moist, loose, NATURAL
2.5													
3.0						▶	3.00 - 3.45 m SPT 5, 9, 12 N=21						
3.5												SM	SILTY SAND, fine to medium grained, grey/dark grey, wet, medium dense, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: DBH7 - CTP23**	
		Job No: 9528	**Sheet: 2 of 6**
Position: REFER TO FIGURE 1		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type:		**Bit:**	**Driller:**
Casing Diameter:		**Contractor: DRILLSURE**	
Date Started : 17/7/10	**Date Completed: 17/7/10**	**Logged By: LB**	**Date Logged: 17/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5							4.50 - 4.95 m SPT 14, 19, 20 N=39					SM	SILTY SAND, fine to medium grained, dark brown, wet, dense, NATURAL
5.0													
5.5													
6.0							6.00 - 6.45 m SPT 7, 7, 11 N=18					SM	SILTY SAND, fine to medium grained, dark brown, wet, medium dense, NATURAL
6.5													
7.0												SM	SILTY SAND, fine to medium grained, brown, wet, medium dense, NATURAL
7.5							7.50 - 7.95 m SPT 4, 9, 12 N=21						

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH7 - CTP23

Job No: 9528 **Sheet:** 3 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 17/7/10 **Date Completed:** 17/7/10 **Logged By:** LB **Date Logged:** 17/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5												SM	SILTY SAND, fine to medium grained, brown, wet, medium dense, NATURAL
9.0							9.00 - 9.45 m SPT 12, 16, 17 N=33					SM	SILTY SAND, fine to medium grained, dark brown, wet, dense, NATURAL
9.5													
10.0													
10.5							10.50 - 10.95 m SPT 12, 15, 16 N=31						
11.0													
11.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH7 - CTP23

Job No: 9528 **Sheet:** 4 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 17/7/10 **Date Completed:** 17/7/10 **Logged By:** LB **Date Logged:** 17/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
12.5							12.00 - 12.45 m SPT 9, 12, 12 N=24					SM	SILTY SAND, fine to medium grained, dark brown, wet, medium dense, NATURAL
13.0													
13.5							13.50 - 13.95 m SPT 11, 11, 12 N=23					SM	SILTY SAND, fine to medium grained, grey, wet, medium dense, NATURAL
14.0													
14.5												CI-CH	SILTY SANDY CLAY/SILTY CLAY, intermediate to high plasticity, fine to medium grained sand, grey, moist to wet, firm, NATURAL
15.0							U 15.00 - 15.45 m PP=50kPa						
15.5												CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, very stiff, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH7 - CTP23

Job No: 9528 **Sheet:** 5 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 17/7/10 **Date Completed:** 17/7/10 **Logged By:** LB **Date Logged:** 17/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, very stiff, NATURAL
16.5							U 16.50 - 16.95 m PP=280kPa					CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey red/brown, trace of XW fragments, moist, very stiff, NATURAL
17.0													
17.5													
18.0							U 18.00 - 18.45 m PP=350kPa					CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, very stiff, NATURAL
18.5													
19.0													
19.5							U 19.50 - 19.95 m PP=250kPa						

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: DBH7 - CTP23**	
Position: REFER TO FIGURE 1		**Job No: 9528**	**Sheet: 6 of 6**
Rig Type:		**Angle from Horizontal: 90°**	**Surface Elevation:**
Casing Diameter:		**Bit:**	**Driller:**
Date Started : 17/7/10	**Date Completed: 17/7/10**	**Contractor: DRILLSURE**	
		Logged By: LB	**Date Logged: 17/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
20.5													SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, very stiff, NATURAL
21.0							21.00 - 21.45 m SPT 6, 8, 12 N=20					CH	
21.5													
22.0													CLAYEY SAND/SILTY SAND, fine to medium grained sand, brown, moist, medium dense, NATURAL. Extremely weathered
22.5							22.50 - 22.95 m SPT 30/20mm hammer bouncing					SC-SM	TC BIT REFUSAL IN WEATHERED ROCK BOREHOLE TERMINATED AT 22.60 m
23.0													
23.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH8 - CTP22

Job No: 9528 **Sheet:** 1 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
													GRAVELLY CLAY, drilling on laneway with boulders, FILL
0.5												SC-SM	CLAYEY SAND/SILTY SAND, fine to medium grained, dark brown, with organics, organic odour, very loose, moist, NATURAL
1.0													
1.5						▶	1.50 - 1.95 m SPT 2, 1, 0 N=1					SC-SM	CLAYEY SAND/SILTY SAND, fine to medium grained, dark brown, very loose, moist, NATURAL
2.0													
2.5													
3.0							3.00 - 3.45 m SPT WOH					SC-SM	CLAYEY SAND/SILTY SAND, fine to medium grained, dark brown, with less, clay, very loose, moist, NATURAL
3.5													SANDY CLAY, high plasticity, dark grey, fine grained sand, soft, wet, NATURAL
4.0													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH8 - CTP22

Job No: 9528 **Sheet:** 2 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							4.50 - 4.95 m SPT WOH N=0						SANDY CLAY, high plasticity, dark grey, fine grained sand, soft, wet, NATURAL
5.0													
5.5													
6.0							6.00 - 6.45 m SPT WOH N=0						
6.5													
7.0													
7.5							U 7.50 - 7.95 m PP=30kPa						
8.0													
8.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH8 - CTP22

Job No: 9528 **Sheet:** 3 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							U 9.00 - 9.45 m PP=150kPa						SANDY CLAY, high plasticity, dark grey, fine grained sand, stiff, wet, NATURAL
9.5													SILTY SAND, fine to medium grained sand, grey/brown mottled, with organics, organic odour, wet, loose, NATURAL
10.0												SM	
10.5							10.50 - 10.95 m SPT 2, 2, 4 N=6						
11.0													
11.5												SP	INDURATED SAND
													SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, dark grey, wet, very soft, NATURAL
12.0							12.00 - 12.45 m SPT WOH N=0						
12.5												CI-CH	
13.0													Clay becoming harder
												CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, grey, moist, very stiff, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH8 - CTP22

Job No: 9528 **Sheet:** 4 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							U 13.50 - 13.95 m PP=360kPa						SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, grey, moist, very stiff, NATURAL
14.0												CH	
14.5													
15.0							U 15.00 - 15.45 m PP=440kPa						SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, grey red light brown mottle, moist, hard, NATURAL
15.5												CH	
16.0													
16.5							16.50 - 16.95 m SPT 7, 9, 9, N=18						SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, grey, trace of XW, more sand content, moist, very stiff, NATURAL
17.0												CH	
17.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH8 - CTP22

Job No: 9528 **Sheet:** 5 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
18.5							18.00 - 18.45 m SPT 11, 18, 20 N=38					CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained sand, red grey brown, with XW fragments, moist, hard, NATURAL
19.0													
19.5							19.50 - 19.95 m SPT 13, 19, 21 N=40					CH	SANDY CLAY/SILTY CLAY, high plasticity, fine to medium grained, grey, hard, NATURAL
20.0													
20.5													
21.0							21.00 - 21.45 m SPT 10, 18, 25 N=43					XW	WEATHERED ROCK, light brown and grey green, extremely weathered, extremely low strength
21.5													
22.0													Drilling becoming stronger with depth

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH8 - CTP22

Job No: 9528 **Sheet:** 6 of 6

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 16/7/10 **Date Completed:** 16/7/10 **Logged By:** LB **Date Logged:** 16/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
23.0							22.50 - 22.95 m SPT 30, 30/100mm N>50					XW	WEATHERED ROCK, light brown and grey green, extremely weathered, extremely low strength
23.5													
24.0							24.00 - 24.45 m SPT 30/100mm N>50						BOREHOLE TERMINATED AT 24.00 m
24.5													
25.0													
25.5													
26.0													
26.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH9 - CTP35

Job No: 9528 **Sheet:** 1 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 15/7/10 **Date Completed:** 15/7/10 **Logged By:** LB **Date Logged:** 15/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.5						▶						SM	SILTY SAND, fine to medium grained, light brown, moist, medium dense, wet, NATURAL
1.0													
1.5							1.50 - 1.95 m SPT 5, 9, 19 N=19						SILTY SAND, fine to medium grained, dark brown, wet, medium dense, NATURAL
2.0												SM	
2.5													
3.0							3.00 - 3.45 m SPT Fall in - no results						SILTY SAND, fine to medium grained, dark brown, wet, medium dense, NATURAL
3.5												SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH9 - CTP35**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 2 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 15/7/10	**Date Completed: 15/7/10**	**Logged By: LB**	**Date Logged: 15/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, dark brown, wet, medium dense, NATURAL
4.5							4.50 - 4.95 m SPT 30/100mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, trace of clay, wet, very dense, indurated, NATURAL
5.0													
5.5													
6.0							6.00 - 6.45 m SPT 31, 30/90mm N>50					SM	SILTY SAND, fine to medium grained, dark brown, wet, very dense, indurated, NATURAL
6.5													
7.0													
7.5							7.50 - 7.95 m SPT 10, 9, 13 N=22					SM	SILTY SAND, fine to medium grained, dark brown, wet, medium dense, indurated, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH9 - CTP35

Job No: 9528 **Sheet:** 3 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 15/7/10 **Date Completed:** 15/7/10 **Logged By:** LB **Date Logged:** 15/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5												SM	SILTY SAND, fine to medium grained, dark brown, with clay, wet, medium dense, indurated, NATURAL
9.0							9.00 - 9.45 m SPT 6, 8, 12 N=20						SILTY SAND, fine to medium grained sand, brown, wet, medium dense, NATURAL
9.5													
10.0													
10.5							10.50 - 10.95 m SPT 12, 11, 10 N=25					SM	
11.0													
11.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH9 - CTP35

Job No: 9528 **Sheet:** 4 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 15/7/10 **Date Completed:** 15/7/10 **Logged By:** LB **Date Logged:** 15/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
12.5							12.00 - 12.45 m SPT 11, 12, 18 N=30					SM	SILTY SAND, fine to medium grained sand, light brown, wet, medium dense, NATURAL
13.0													
13.5							13.50 - 13.95 m SPT 14, 18, 29 N>50					SM	SILTY SAND, fine to medium grained sand, grey, wet, very dense, NATURAL
14.0													
14.5													
15.0							U 15.00 - 15.45 m PP=150kPa					CL	SANDY CLAY, low plasticity, fine to medium grained sand, grey, trace silts, moist, stiff, NATURAL
15.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH9 - CTP35

Job No: 9528 **Sheet:** 5 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 15/7/10 **Date Completed:** 15/7/10 **Logged By:** LB **Date Logged:** 15/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												CL	SANDY CLAY, low plasticity, fine to medium grained sand, grey, trace silts, moist, stiff, NATURAL
												CL	SANDY CLAY, low plasticity, fine to medium grained sand, grey, trace silts, moist, stiffer, NATURAL
16.5							U 16.50 - 16.95 m PP=450kPa					CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey, moist, hard, NATURAL
17.0													
17.5												CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey, moist, soft, NATURAL
18.0							18.00 - 18.45 m SPT 4, 6, 7 N=13					CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey, moist, stiff, NATURAL
18.5													
19.0													
19.5							U 19.50 - 19.95 m PP=340kPa					CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey with light brown mottle, moist, very stiff, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH9 - CTP35

Job No: 9528 **Sheet:** 6 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 15/7/10 **Date Completed:** 15/7/10 **Logged By:** LB **Date Logged:** 15/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
20.5												CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey with light brown mottle, moist, very stiff, NATURAL
21.0							21.00 - 21.45 m SPT 7, 9, 13 N=22					CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey with light brown red, moist, very stiff, NATURAL
21.5													
22.0													
22.5							U 22.50 - 22.95 m PP=230kPa					CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey with light brown mottle, moist, very stiff, NATURAL
23.0													
23.5												CI-CH	SANDY CLAY/SILTY CLAY, medium to high plasticity, fine to medium grained sand, grey with light brown mottle, with quartz gravels, moist, very stiff, NATURAL
												CI-CL	SANDY CLAY/SILTY CLAY, fine to medium grained sands, low to medium plasticity, grey green, dry to moist, very stiff, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH9 - CTP35

Job No: 9528 **Sheet:** 7 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 15/7/10 **Date Completed:** 15/7/10 **Logged By:** LB **Date Logged:** 15/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							24.00 - 24.45 m SPT 6, 9, 10 N=19						SANDY CLAY/SILTY CLAY, fine to medium grained sands, low to medium plasticity, grey green, dry to moist, very stiff, NATURAL
24.5												CI-CL	
25.0													Drilling becoming harder
25.5							25.50 - 25.95 m SPT 14, 18, 21 N=39						SANDY CLAY/SILTY CLAY, low plasticity, fine to medium grained sand, grey green/brown, dry to moist, hard, NATURAL
26.0													Drilling becoming harder
26.5												CL	
27.0							27.00 - 27.45 m SPT 14, 27, 25 N>50						SANDY CLAY/SILTY CLAY, medium to low plasticity, fine to medium grained sands, grey green, dry to moist, NATURAL
27.5												CI-CL	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH9 - CTP35

Job No: 9528 **Sheet:** 8 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 15/7/10 **Date Completed:** 15/7/10 **Logged By:** LB **Date Logged:** 15/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												CI-CL	SANDY CLAY/SILTY CLAY, medium to low plasticity, fine to medium grained sands, grey green, dry to moist, NATURAL
28.5							28.50 - 28.95 m SPT 18, 23, 23 N=46					XW	WEATHERED ROCK, white with some brown colouration/staining, extremely weathered, extremely low strength
29.0													
29.5													
30.0							30.00 - 30.45 m SPT 30/135mm N>50						BOREHOLE TERMINATED AT 30.00 m
30.5													
31.0													
31.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH10 - CTP34

Job No: 9528 **Sheet:** 1 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 13/7/10 **Date Completed:** 13/7/10 **Logged By:** LB **Date Logged:** 13/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0						▶						SM	SILTY SAND, fine to medium grained, light brown, dry to moist, medium dense, NATURAL
													Water level
1.5							1.50 - 1.95 m SPT 5, 10, 12 N=22						
3.0							3.00 - 3.45 m SPT 10, 30/130mm N>50					SM	SILTY SAND, fine to medium grained sand, dark brown, wet, dense, indurated, NATURAL
												SM	SILTY SAND, fine to medium grained sand, dark brown, wet, very dense, indurated, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH10 - CTP34**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 2 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 13/7/10	**Date Completed: 13/7/10**	**Logged By: LB**	**Date Logged: 13/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5							4.50 - 4.95 m SPT 19, 31, 30 N>50					SC-SM	CLAYEY SAND/SILTY SAND, fine to coarse grained sand, wet, very dense, indurated, NATURAL
5.0													
5.5													
6.0							6.00 - 6.45 m SPT 9, 9, 10 N=19						SILTY SAND, fine to medium grained sand, dark brown, wet, medium dense, NATURAL
6.5												SM	
7.0													
7.5							7.50 - 7.95 m SPT 7, 9, 9 N=18					SM	SILTY SAND, fine to medium grained, brown, wet, medium dense, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH10 - CTP34

Job No: 9528 **Sheet:** 3 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 13/7/10 **Date Completed:** 13/7/10 **Logged By:** LB **Date Logged:** 13/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
8.5												SM	SILTY SAND, fine to medium grained, brown, wet, medium dense, NATURAL
9.0							9.00 - 9.45 m SPT 6, 9, 13 N=22					SM	SILTY SAND, fine to medium grained, light brown, wet, medium dense, NATURAL
9.5													
10.0													
10.5							10.50 - 10.95 m SPT 9, 18, 19 N=37					SM	SILTY SAND, fine to medium grained, light brown, wet, dense, NATURAL
11.0													
11.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH10 - CTP34

Job No: 9528 **Sheet:** 4 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 13/7/10 **Date Completed:** 13/7/10 **Logged By:** LB **Date Logged:** 13/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
12.5							12.00 - 12.45 m SPT 11, 19, 23 N=42					SM	SILTY SAND, fine to medium grained, light brown, wet, dense, NATURAL
13.0												CI	SANDY/SILTY CLAY, intermediate plasticity, fine to medium grained sand, blue grey, wet, very stiff, NATURAL
13.5							U 13.50 - 13.95 m PP=320kPa						
14.0												CI	SANDY/SILTY CLAY, intermediate plasticity, fine to medium grained sand, blue grey, with sandstone gravels/fragments, wet, very stiff, NATURAL
14.5													
15.0							15.00 - 15.45 m SPT 6, 7, 9 N=16					CH	SANDY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, very stiff, NATURAL
15.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH10 - CTP34**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 5 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 13/7/10	**Date Completed: 13/7/10**	**Logged By: LB**	**Date Logged: 13/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												CH	SANDY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, moist, very stiff, NATURAL
16.5							16.50 - 16.95 m SPT 5, 7, 7 N=14					SC	CLAYEY SAND, high plasticity, fine to medium grained sand, blue grey, with silt, dry to moist, medium dense, NATURAL
17.0													
17.5													
18.0							18.00 - 18.45 m SPT 5, 7, 7 N=14					CH	SANDY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey with brown XW, dry to moist, stiff, NATURAL
18.5													
19.0													
19.5							19.50 - 19.95 m SPT 10, 14, 15 N=29					CH	SANDY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey with brown XW, dry to moist, very stiff, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH10 - CTP34**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 6 of 8**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 13/7/10	**Date Completed: 13/7/10**	**Logged By: LB**	**Date Logged: 13/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
20.5													SANDY/SILTY CLAY, high plasticity, fine to medium grained sand, blue grey with brown XW, dry to moist, hard, NATURAL
21.0							21.00 - 21.45 m SPT 12, 16, 18 N=34					CH	
21.5													
22.0													
22.5							22.50 - 22.95 m SPT 8, 10, 10 N=20					CH	SANDY SILTY CLAY, high plasticity, fine to medium grained sands, blue grey/red yellow with XW rock, dry to moist, very stiff, NATURAL
23.0													
23.5												CH	SANDY SILTY CLAY, high plasticity, fine to medium grained sand, blue grey, very stiff, NATURAL

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH10 - CTP34

Job No: 9528 **Sheet:** 7 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 13/7/10 **Date Completed:** 13/7/10 **Logged By:** LB **Date Logged:** 13/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							24.00 - 24.45 m SPT 3, 6, 5 N=11					CH	SANDY SILTY CLAY, high plasticity, fine to medium grained sand, dark brown, stiff, NATURAL
24.5													
												CH	SANDY SILTY CLAY, high plasticity, fine to medium grained sand, dark brown, stiff, NATURAL
25.0													
25.5							U 25.50 - 25.95 m PP=150kPa						
												GC	SANDY GRAVEL/CLAYEY GRAVEL, fine to coarse grained sands, brown, small to medium gravel, grey with silt, wet, stiff, NATURAL
26.0													
26.5												SM	SILTY SAND, fine to medium grained, blue grey, trace clay, wet, medium dense, NATURAL
27.0							27.00 - 27.45 m SPT 3, 9, 8 N=17						
27.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH10 - CTP34

Job No: 9528 **Sheet:** 8 of 8

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 13/7/10 **Date Completed:** 13/7/10 **Logged By:** LB **Date Logged:** 13/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained, blue grey, trace clay, wet, medium dense, NATURAL
28.5							28.50 - 28.95 m SPT 6, 4, 6 N=10					GC	SANDY GRAVEL/CLAYEY GRAVEL, low plasticity, fine to coarse grained sand, small to medium gravel, blue grey, with silt, wet, loose to medium dense, NATURAL
29.0													
29.5												SC-SM	CLAYEY SAND/SILTY SAND, low plasticity, fine to medium grained sand, blue green, with small gravel, dry to moist, dense NATURAL
30.0							30.00 - 30.45 m SPT 14, 18, 19 N=37						BOREHOLE TERMINATED AT 30.00 m
30.5													
31.0													
31.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH11 - CTP37**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 1 of 5**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 14/7/10	**Date Completed: 14/7/10**	**Logged By: LB**	**Date Logged: 14/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.5												CH-CI	SILTY CLAY/SANDY CLAY, fine grained sand, dark brown, dry to moist, hard, NATURAL
1.0													
1.5						▶	1.50 - 1.95 m PP-500kPa						
2.0													
2.5												SM	SILTY SAND, fine to medium grained, light brown, with clay and XW gravels/fragments, wet, medium dense, NATURAL
3.0							3.00 - 3.45 m SPT 3, 3, 12 N=15						
3.5												SM	SILTY SAND, fine to medium grained, light brown, trace of clay and small gravels/fragments, wet, medium dense, NATURAL

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH11 - CTP37**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 2 of 5**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 14/7/10	**Date Completed: 14/7/10**	**Logged By: LB**	**Date Logged: 14/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5							4.50 - 4.95 m SPT 6, 7, 7 N=14						SILTY SAND, fine to medium grained sand, light brown, wet, medium dense, NATURAL
5.0												SM	
5.5													
6.0							6.00 - 6.45 m SPT 8, 9, 10 N=19						
6.5													SILTY SAND, fine to medium grained sand, grey, wet, loose to medium dense, NATURAL
7.0												SM	
7.5							7.50 - 7.95 m SPT 4, 6, 4 N=10						

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH11 - CTP37**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 3 of 5**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 14/7/10	**Date Completed: 14/7/10**	**Logged By: LB**	**Date Logged: 14/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
												SM	SILTY SAND, fine to medium grained sand, grey, wet, loose to medium dense, NATURAL
8.5												CL-CI	SILTY CLAY, low to medium plasticity (low), blue grey, trace of sand, moist, soft, NATURAL. Also contains sea shells
9.0							U 9.00 - 9.45 m PP=40kPa						
9.5													
10.0													
10.5							U 10.50 - 10.95 m PP=350kPa					CI-CH	SANDY CLAY, intermediate to high plasticity (high) fine to medium grained sand, blue green, trace silt, moist, very stiff, NATURAL/RESIDUAL
11.0													
11.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: DBH11 - CTP37**	
Project: KING FOREST ESTATE			
Location:	**Job No: 9528**	**Sheet: 4 of 5**	
Position: REFER TO FIGURE 1	**Angle from Horizontal: 90°**	**Surface Elevation:**	
Rig Type:	**Bit:**	**Driller:**	
Casing Diameter:	**Contractor: DRILLSURE**		
Date Started : 14/7/10	**Date Completed: 14/7/10**	**Logged By: LB**	**Date Logged: 14/7/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							12.00 - 12.45 m SPT 7, 8, 8 N=16						SANDY CLAY, intermediate to low plasticity, fine to medium grained sand, green, with silt, dry to moist, very stiff, NATURAL/RESIDUAL
12.5												CI-CL	
13.0													SANDY CLAY, intermediate to low plasticity, fine to medium grained sand, green, with silt, with brown XW, dry to moist, very stiff, NATURAL/RESIDUAL
13.5							13.50 - 13.95 m SPT 17, 30/95mm N>50					CI-CL	
14.0													WEATHERED ROCK, brown, extremely weathered, extremely low to low strength
14.5													
15.0							15.00 - 15.45 m SPT 30/65mm Hammer Bouncing N>50						
15.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: DBH11 - CTP37

Job No: 9528 **Sheet:** 5 of 5

Position: REFER TO FIGURE 1 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: **Bit:** **Driller:**

Casing Diameter: **Contractor:** DRILLSURE

Date Started : 14/7/10 **Date Completed:** 14/7/10 **Logged By:** LB **Date Logged:** 14/7/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
													WEATHERED ROCK, brown, extremely weathered, extremely low to low strength
16.5							16.50 - 16.95 m SPT 30/40mm Hammer Bouncing N>50						BOREHOLE TERMINATED AT 16.50 m
17.0													
17.5													
18.0													
18.5													
19.0													
19.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH1**
		Job No: 9528	**Sheet: 1 of 1**
Position: 56J 0552002 UTM 6869881		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000		**Bit:**	**Driller: DL**
Casing Diameter:		**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0									1 2 2			SM	SILTY SAND, fine to coarse grained sand, black dark brown, with some root matter, moist to dry, loose, TOPSOIL
									3 3			SM	SILTY SAND, fine to coarse grained sand, grey cream, moist, loose to medium dense, NATURAL
0.5						▶	D 0.50 - 0.60 m		3 4 5 7				
1.0									7 8 11				
									13 11			SM	SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
1.5							D 1.40 - 1.50 m		10 11 10 18 +20				
2.0												XW	COFFEE ROCK
2.5							D 2.50 - 2.60 m						
3.0							D 3.00 - 3.10 m						
3.5													TC BIT REFUSAL BOREHOLE TERMINATED AT 3.10 m

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: SBH2**
Position: 56J 0552228 UTM 6870244	**Job No: 9528** **Angle from Horizontal: 90°**	**Sheet: 1 of 2** **Surface Elevation:**
Rig Type: Q Drill 3000	**Bit:**	**Driller: DL**
Casing Diameter:	**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10 **Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0									2 2			SM	SILTY SAND, fine to coarse grained sand, black dark brown, with some root matter, moist to dry, loose, TOPSOIL
0.5									3 4 5 5 4 7 18 +20			SM	SILTY SAND, fine to coarse grained sand, grey cream, moist, loose to medium dense, NATURAL
1.0							D 1.10 - 1.20 m					SM	SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
1.5													
2.0												XW	COFFEE ROCK
2.5													
3.0												SM	SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
3.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: SBH2**
Position: 56J 0552228 UTM 6870244	**Job No: 9528** **Angle from Horizontal: 90°**	**Sheet: 2 of 2** **Surface Elevation:**
Rig Type: Q Drill 3000	**Bit:**	**Driller: DL**
Casing Diameter:	**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10 **Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
													SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
4.5													
5.0												SM	
5.5							D 5.50 - 5.60 m						Grey, medium plasticity clay with fine to coarse grained and and fine gravel found on end of auger)
6.0													BOREHOLE TERMINATED AT 6.00 m
6.5													
7.0													
7.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD		**Hole No: SBH3**
Project: KING FOREST ESTATE		
Location:	**Job No: 9528**	**Sheet: 1 of 2**
Position: 56J 0552458 UTM 6870784	**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000	**Bit:**	**Driller: DL**
Casing Diameter:	**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10 **Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0							D 0.00 - 0.10 m		3			CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, red, with some roots, dry to moist, very stiff, FILL
									4				
									7			CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, red, with some roots and fine gravel, dry to moist, very stiff, NATURAL
									5				
0.5									4				
									4				
									4				
									4				
							D 0.80 - 0.90 m		4				
1.0									5				
									6				
									5				
									5				
									5				
1.5							D 1.40 - 1.50 m		5				
									5				
									6				
									5				
									7			CI-CH	SILTY CLAY/SANDY CLAY, medium to low plasticity, fine to coarse grained sand, red brown, with some fine to trace of medium gravel, dry to moist, very stiff, NATURAL
2.0									9				
									7				
									7				
									8				
									7				
									7				
2.5									7				
									8				
									9				
									8				
									8				
3.0							D 3.00 - 3.10 m		9				
									8				Trace of fine white gravel
									8				
									8				
									8				
3.5									7				
									8				
									9				
									11			SM	SILTY SAND, fine to coarse grained sand, cream yellow, wet, medium dense to dense, NATURAL
									10				

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH3**
		Job No: 9528	**Sheet: 2 of 2**
Position: 56J 0552458 UTM 6870784		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000		**Bit:**	**Driller: DL**
Casing Diameter:		**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
							D 4.00 - 4.10 m		10				SILTY SAND, fine to coarse grained sand, cream yellow, wet, medium dense to dense, NATURAL
									9				
									10				
									10				
									10				
4.5									+20				
												SM	
5.0													
							D 5.40 - 5.50 m						
5.5													
6.0													BOREHOLE TERMINATED AT 6.00 m
6.5													
7.0													
7.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: SBH4**
Position: 56J 0550894 UTM 6870122	**Job No: 9528** **Angle from Horizontal: 90°**	**Sheet: 1 of 1** **Surface Elevation:**
Rig Type: Q Drill 3000	**Bit:**	**Driller: DL**
Casing Diameter:	**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10 **Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
									10 20			GM-CL	SANDY CLAY/SILTY GRAVEL, low plasticity clay, fine to coarse grained sand, fine to coarse gravel, brown, trace of some roots, dry to moist, hard, FILL
							D 0.20 - 0.30 m					CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, brown cream, with trace of fine gravel, dry to moist, very stiff
0.5												CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse grained sand, cream white, with trace of fine gravel, dry, hard
1.0							D 0.90 - 1.00 m					XW	SILTSTONE, NATURAL
1.5													TC BIT REFUSAL BOREHOLE TERMINATED AT 1.10 m
2.0													
2.5													
3.0													
3.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: SBH5

Job No: 9528 **Sheet:** 1 of 1

Position: 56J 0550825 UTM 6870122 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Q Drill 3000 **Bit:** **Driller:** DL

Casing Diameter: **Contractor:** CARDNO BOWLER

Date Started : 25/6/10 **Date Completed:** 25/6/10 **Logged By:** DL **Date Logged:** 25/6/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
									4 7			CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse graines and, red, with some roots, dry to moist, very stiff, FILL
							D 0.20 - 0.30 m		6			CI-CH	SILTY CLAY/SANDY CLAY, medium to high plasticity, fine to coarse graines and, red, with some roots and fine gravel, dry to moist, very stiff, NATURAL
									6 4				
0.5									10 9 8 6			CI-CL	SILTY CLAY/SANDY CLAY, medium to low plasticity, fine to coarse grained sand, red brown, with some fine to trace of medium gravel, dry to moist, very stiff, NATURAL
1.0							D 0.90 - 1.00 m		6 8 8 15 19 +20				
1.5							D 1.50 - 1.60 m					XW	ROCK
2.0													TC BIT REFUSAL BOREHOLE TERMINATED AT 1.70 m
2.5													
3.0													
3.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH6**
		Job No: 9528	**Sheet: 1 of 2**
Position: 56J 0552619 UTM 6869485		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000		**Bit:**	**Driller: DL**
Casing Diameter:		**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
									2			SM	SILTY SAND, fine to coarse grained sand, grey cream, moist, loose to medium dense, FILL
									3				SILTY SAND, fine to coarse grained sand, grey cream, moist, loose to medium dense, NATURAL
							D 0.40 - 0.50 m		3				
0.5									3				
									4				
									4			SM	
									4				
1.0									4				
									4				
									4				
									5				
									6				SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
									6				
1.5							D 1.50 - 1.60 m		7				
									7			SM	
									11				
									13				
									14				
2.0									+20				
													COFFEE ROCK, wet, NATURAL
2.5													
												XW	
3.0													
3.5													SILTY SAND, fine to coarse grained sand, brown, wet, dense, NATURAL
												SM	

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH6**
		Job No: 9528	**Sheet: 2 of 2**
Position: 56J 0552619 UTM 6869485		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000		**Bit:**	**Driller: DL**
Casing Diameter:		**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
													SILTY SAND, fine to coarse grained sand, brown, wet, dense, NATURAL
4.5													
5.0												SM	
5.5													
							D 5.70 - 5.80 m						
6.0													BOREHOLE TERMINATED AT 6.00 m
6.5													
7.0													
7.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD
Project: KING FOREST ESTATE
Location:

Hole No: SBH7

Job No: 9528 **Sheet:** 1 of 2

Position: 56J 0554193 UTM 6869485 **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Q Drill 3000 **Bit:** **Driller:** DL

Casing Diameter: **Contractor:** CARDNO BOWLER

Date Started : 28/6/10 **Date Completed:** 28/6/10 **Logged By:** DL **Date Logged:** 28/6/10

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
									10 7			GC-SM	CLAYEY GRAVEL/SILTY SAND, roadbase, fine to coarse grained sand, fine to coarse gravel, pale brown, dry, dense, FILL
									2 2 2 1 2 1			SM	SILTY SAND, fine to coarse grained sand, grey cream, moist, very loose, NATURAL
0.5						▶			1				Wet
1.0									1 2 3 3 5 5 6 7 7 6 7 7 8 8 12 11 15 +20				SILTY SAND, fine to coarse grained sand, grey cream, moist, medium dense, NATURAL
1.5													
2.0													
2.5													Wet
3.0													
3.5													

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH7**
		Job No: 9528	**Sheet: 2 of 2**
Position: 56J 0554193 UTM 6869485		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000		**Bit:**	**Driller: DL**
Casing Diameter:		**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5													SILTY SAND, fine to coarse grained sand, grey cream, moist, medium dense, NATURAL
5.0													
5.5												SM	SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
6.0													BOREHOLE TERMINATED AT 6.00 m
6.5													
7.0													
7.5													

See Standard Sheets for details of abbreviations & basis of descriptions

Cardno Bowler
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PH: (07) 3800 6446
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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**		**Hole No: SBH8**
Position: 56J 0554770 UTM 6870009	**Job No: 9528** **Angle from Horizontal: 90°**	**Sheet: 1 of 2** **Surface Elevation:**
Rig Type: Q Drill 3000	**Bit:**	**Driller: DL**
Casing Diameter:	**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10 **Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0						▶			1 2 2 3 2				SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
0.5							D 0.50 - 0.60 m		3 3 4 5 5				
1.0									6 9 9 12 11				
1.5									12 12 13 14 14			SM	
2.0									17 +20				
2.5													
3.0													
3.5												XW	COFFEE ROCK

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH8**
		Job No: 9528	**Sheet: 2 of 2**
Position: 56J 0554770 UTM 6870009		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000		**Bit:**	**Driller: DL**
Casing Diameter:		**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5													COFFEE ROCK
5.0												XW	
5.5													
6.0													BOREHOLE TERMINATED AT 6.00 m
6.5													
7.0													
7.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH9**
		Job No: 9528	**Sheet: 1 of 2**
Position: 56J 0554732 UTM 6870382		**Angle from Horizontal: 90°**	**Surface Elevation:**
Rig Type: Q Drill 3000		**Bit:**	**Driller: DL**
Casing Diameter:		**Contractor: CARDNO BOWLER**	
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
0.0						▶	D 0.00 - 0.10 m		1 2 3 3 4 5 7 7 8 8 7 6 6 6 5 3 4 5 6 6 6 6 5 6 7 8 10 16 +20			SM	SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
0.5													
1.0													
1.5													
2.0													
2.5													
3.0													
3.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

Client: LEDA MANORSTEAD **Project:** KING FOREST ESTATE **Location:**			**Hole No: SBH9**
	Job No: 9528		**Sheet: 2 of 2**
Position: 56J 0554732 UTM 6870382	**Angle from Horizontal: 90°**		**Surface Elevation:**
Rig Type: Q Drill 3000	**Bit:**		**Driller: DL**
Casing Diameter:	**Contractor: CARDNO BOWLER**		
Date Started : 28/6/10	**Date Completed: 28/6/10**	**Logged By: DL**	**Date Logged: 28/6/10**

Depth (m)	Drilling: Auger 'V' Bit	Drilling: Auger 'TC' Bit	Drilling: Washbore	Drilling: Casing	Drilling: Coring	Groundwater (m)	Sample or Field Test	Recovered	DCP	RL (m AHD)	Graphic Log	USCS Symbol	Description (SYMBOL, SOIL NAME, plasticity/particle characteristics, colour, minor components, moisture, consistency, structure, ORIGIN)
4.5												SM	SILTY SAND, fine to coarse grained sand, dark brown black, wet, loose to medium dense, NATURAL
5.0													
5.5												XW	COFFEE ROCK
6.0													BOREHOLE TERMINATED AT 6.00 m
6.5													
7.0													
7.5													

See Standard Sheets for details of abbreviations & basis of descriptions

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Annex B

Laboratory Test Results

September, 2001

LABORATORY TESTING

GENERAL

Samples extracted during the fieldwork stage of a site investigation may be "disturbed" or "undisturbed" (as generally indicated on the test hole logs) depending upon the nature and purpose of the sample as well as the method of extraction. Nominally "undisturbed" samples may suffer a varying degree of disturbance during extraction, transportation, extrusion and testing. This aspect should be taken into account when assessing test results which must of necessity reflect the effects of such disturbance.

All soil properties (as measured by laboratory testing) exhibit inherent variability and thus a certain statistical number of tests is required in order to predict an average property with any degree of confidence. The site variability of soil strata, future changes in moisture and other conditions, and the discrete sampling positions must also be considered when assessing the representative nature of the laboratory programme.

Certain laboratory test results provide interpreted soil properties as derived by conventional mathematical procedures. The applicability of such properties to engineering design must be assessed with due regard to the site, sample condition, procedure and project in hand.

TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 as amended, or Queensland Transport Standards when specified. The routine Australian Standard tests are as follows:

Sample Preparation	Test 1
Moisture Content	Test 2.1.1
Liquid Limit	Test 3.1.1)
Plastic Limit	Test 3.2.1) collectively known as Atterberg Limits
Plasticity Index	Test 3.3.1)
Linear Shrinkage	Test 3.4.1
Particle Density	Test 3.5.1
Particle Size Distribution	Tests 3.6.1, 3.6.2, 3.6.3
Emerson Class Number	Test 3.8.1)
Percent Dispersion	Test 3.8.2) collectively, Dispersion Classification
Pinhole Dispersion Classification	Test 3.8.3)
Organic Matter	Test 4.1.1
Sulphate content	Test 4.2.1
pH Value	Test 4.3.1
Resistivity	Test 4.4.1
Standard Compaction	Test 5.1.1
Modified Compaction	Test 5.2.1
Dry Density Ratio	Test 5.4.1
Minimum/Maximum Density	Test 5.5.1
Density Index	Test 5.6.1
California Bearing Ratio	Tests 6.1.1, 6.1.2
Undrained Triaxial Shear	Test 6.4.1
One Dimensional Consolidation	Test 6.6.1
Constant Head Permeability	Test F7.1
Shrink Swell Index	Test 7.1.1

Where tests are used which are not covered by appropriate standard procedures, details are given in the report.

LABORATORY

Our laboratory is a Registered Laboratory with the National Association of Testing Authorities (NATA).

Cardno Bowler
Shaping the Future
Geotechnical Engineering Consultants
Construction Testing Services
Environmental Consultants
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SOIL CLASSIFICATION TEST REPORT

SAMPLING PROCEDURES: A.S.1289.1.2.1-6.5.3 TEST PROCEDURES: AS1289.2.1.1, .3.1.2, .3.2.1, .3.3.1, .3.4.1

CLIENT:	**LEDA MANORSTEAD**	*JOB No.: GC*	**2494 / 9528**
PROJECT:	**KINGS FOREST SUBDIVISION, KINGSCLIFF**	*REPORT No:*	**1**
		DATE ISSUED:	**25/08/10**
TEST ITEM:	**DISTURBED SAMPLE**		
SITE TEST No.:	**Q 1**	*LOCATION:*	**BOREHOLE No. SBH3**
SAMPLE No.:	**86544**		
DATE SAMPLED:	**17/08/10**	*SOIL DESCRIPTION:*	**MH SILTY CLAY with traces of sand, red brown**
MATERIAL SOURCE:	**INSITU**		
PROPOSED MATERIAL TYPE:	**-**	*ELEVATION m:*	**0.8 - 0.9**

ATTERBERG LIMITS & LINEAR SHRINKAGE

SAMPLE HISTORY: Air Dried

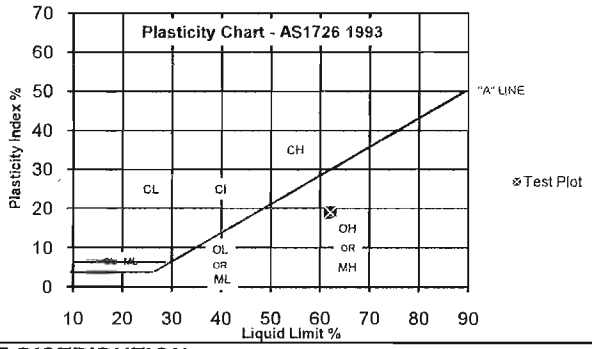
METHOD OF PREPARATION: Dry Sieved

RESULTS

LIQUID LIMIT	**62**	%
PLASTIC LIMIT:	**43**	%
PLASTICITY INDEX	**19**	%
LINEAR SHRINKAGE:	**14.5**	%
FIELD MOISTURE CONTENT:	**38.8**	%

PLASTICITY

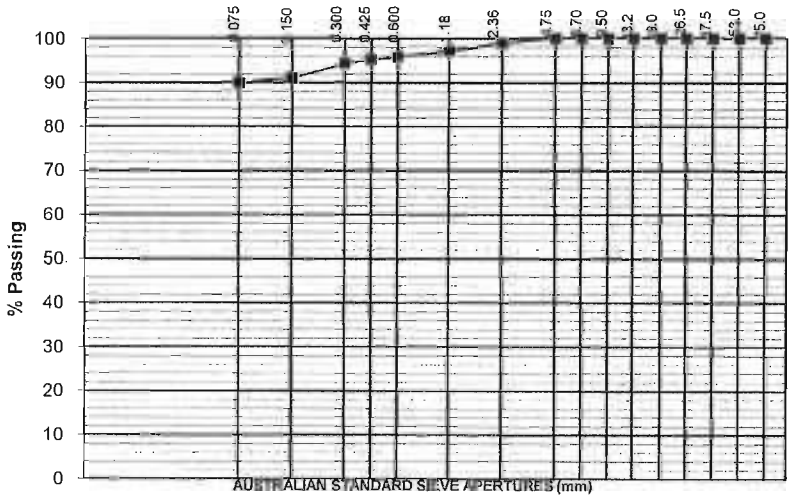
Descriptive Term	Range of L.L.
Of low plasticity	≤ 35
Of medium plasticity	> 35 ≤ 50
Of high plasticity	> 50



PARTICLE SIZE DISTRIBUTION

TEST PROCEDURES AS1289 3.6.1 - WET SIEVED

SIEVE SIZE (mm)	% PASSING (by mass)
75.0	100
53.0	100
37.5	100
26.5	100
19.0	100
13.2	100
9.5	100
6.7	100
4.75	100
2.36	99
1.18	97
0.600	96
0.425	95
0.300	94
0.150	91
0.075	90



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Mr S. Thomas
(Approved Signatory)

Cardno Bowler
Shaping the Future
Geotechnical Engineering Consultants
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Email: cardnobowlergc@cardno.com.au

SOIL CLASSIFICATION TEST REPORT

SAMPLING PROCEDURES: A.S.1289.1.2.1-6.5.3 TEST PROCEDURES: AS1289.2.1.1, .3.1.2, .3.2.1, .3.3.1, .3.4.1

CLIENT:	**LEDA MANORSTEAD**	*JOB No.: GC*	**2494 / 9528**
PROJECT:	**KINGS FOREST SUBDIVISION, KINGSCLIFF**	*REPORT No:*	**2**
		DATE ISSUED:	**25/08/10**
TEST ITEM:	**DISTURBED SAMPLE**		

SITE TEST No.:	**Q 2**	*LOCATION:*	**BOREHOLE No. SBH3**
SAMPLE No.:	**86545**		
DATE SAMPLED:	**17/08/10**	*SOIL DESCRIPTION:*	**MH SILTY CLAY with traces of sand, red brown**
MATERIAL SOURCE:	**INSITU**		
PROPOSED MATERIAL TYPE:	**-**	*ELEVATION m:*	**3.0 - 3.1**

ATTERBERG LIMITS & LINEAR SHRINKAGE

SAMPLE HISTORY: Air Dried

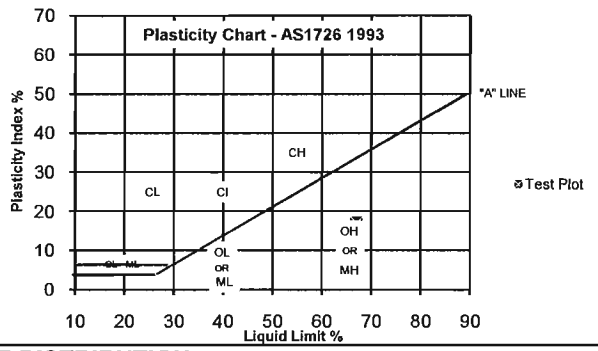
METHOD OF PREPARATION: Dry Sieved

RESULTS

LIQUID LIMIT	**67**	%
PLASTIC LIMIT:	**50**	%
PLASTICITY INDEX	**17**	%
LINEAR SHRINKAGE:	**13.5**	%
FIELD MOISTURE CONTENT:	**39.8**	%

PLASTICITY

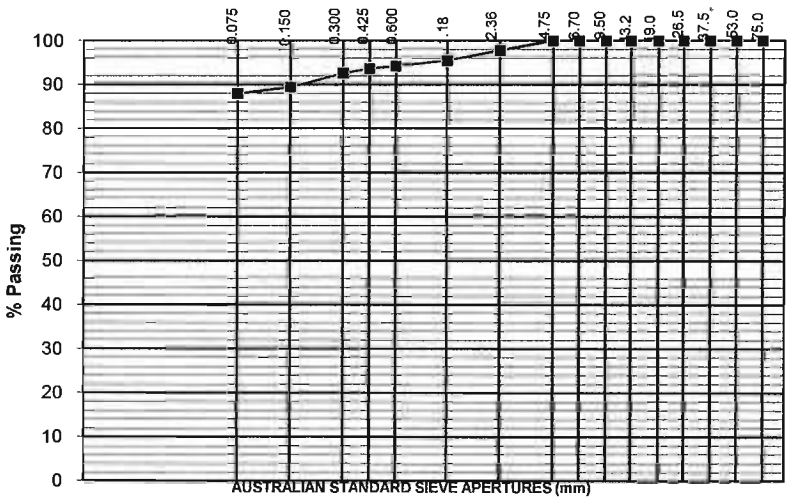
Descriptive Term	Range of L.L.
Of low plasticity	≤ 35
Of medium plasticity	> 35 ≤ 50
Of high plasticity	> 50



PARTICLE SIZE DISTRIBUTION

TEST PROCEDURES: AS1289.3.6.1 - WET SIEVED

SIEVE SIZE (mm)	% PASSING (by mass)
75.0	100
53.0	100
37.5	100
26.5	100
19.0	100
13.2	100
9.5	100
6.7	100
4.75	100
2.36	98
1.18	95
0.600	94
0.425	94
0.300	93
0.150	89
0.075	88



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Mr S. Thomas
(Approved Signatory)

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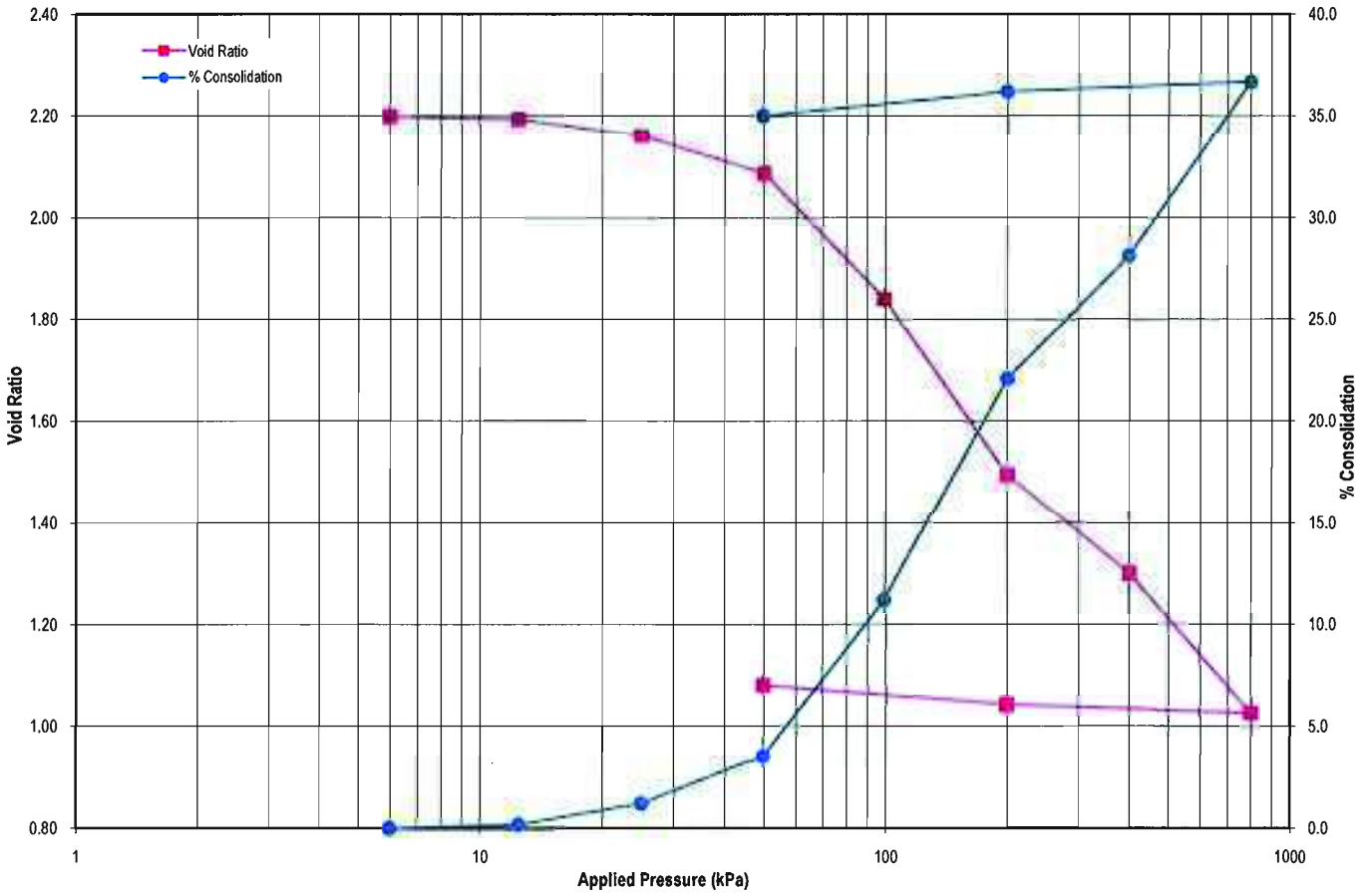
OEDOMETER TEST REPORT

Test Method: AS1289.6.6.1, 3.5.1

Client:	Cardno Bowler Pty Ltd	**Report No.:**	10080357 - OED
Project:	9528	**Test Date:**	16/08/2010
		Report Date:	7/09/2010
Client Id.:	BH8	**Depth (m):**	7.50-7.95

Description: Clay - dark grey



Wet Density (t/m^3):	1.40	Initial Moisture (%):	80.4	Test Condition: Inundated on load	
Particle Density (t/m^3):	2.49	Initial Voids Ratio:	2.199	Initial Degree of Saturation (%):	91.0
Undisturbed sample supplied by the client		Remarks: Tested as Received			Page 1 of 2

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory Number 9926

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Authorised Signatory

J. Russell

Doc. Id.: REP03101

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OEDOMETER TEST REPORT

Test Method: AS1289.6.6.1, 3.5.1

Client:	Cardno Bowler Pty Ltd	**Report No.:**	10080357 - OED
Project:	9528	**Test Date:**	16/08/2010
		Report Date:	7/09/2010
Client Id.:	BH8	**Depth (m):**	7.50-7.95
Description:	Clay - dark grey		

TEST RESULTS

Stage	Load (kPa)	Cc	Cv (m^2/yr) t_{50}	Cv (m^2/yr) t_{90}	Mv ($kPa^{-1}x10^{-3}$)	C_a x 10^{-3}	% Consolidation
1	6-12.5	0.017	316.24	1093.75	0.254	0.16	0.2
2	12.5-25	0.110	7.14	42.78	0.830	0.34	1.2
3	25-50	0.246	7.76	16.93	0.938	3.97	3.5
4	50-100	0.819	0.52	3.70	1.598	7.46	11.2
5	100-200	1.148	0.58	1.45	1.218	9.69	22.0
6	200-400	0.643	1.91	2.44	0.388	9.88	28.1
7	400-800	0.909	0.64	1.20	0.297	13.29	36.6
8	800-200	0.025	5.46	5.78	0.012	1.16	36.2
9	200-50	0.062	0.59	1.64	0.123	2.91	35.0

Remarks: Tested as Received

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Authorised Signatory

James Russell

J. Russell

Doc. Id.: REP03101

Trilab Pty Ltd ABN: 25 065 630 506 PO Box 3317 Newmarket QLD 4051
+61 7 3357 5535

VISUAL Description TEST REPORT

AS1726 Appendix A

Client:	Cardno Bowler Pty Ltd	Report No.	10080357-PP
Project:	9528	Test Date:	14/8/10
		Report Date:	7/9/10

Sample No.	10080357	Client ID: BH8	Depth (m): 7.5-7.95
Classification: Clay – dark grey with sand			
Hand Vane (kPa): 15		Pocket Penetrometer (kPa) : 10-15	

Sample/s supplied by the client

Annex C

Quantitative Hazard Rating Assessment

Appendix B1

LANDSLIDE FREQUENCY ANALYSIS

Analysis No.:

NATURAL SHALLOW LANDSLIDES

KINGS FOREST (WORST CASE SCENARIO)

LOCATION: **Site No.** **Site name:**

1 Basic Frequency

2 Slope Angle

Site		Level	Factor
	Less than 5 degrees	L	0.1
	Between 5 and 15 degrees	M	0.5
	Between 15 and 30 degrees	M	0.8
*	Between 30 and 45 degrees	H	1.2
	More than 45 degrees	M	0.8

3 Slope Shape

Site		Level	Factor
	Crest or ridge	L	0.7
*	Planar	M	0.9
	Convex	M	0.9
	Concave	H	1.5

4 Site geology

Site		Level	Factor
	Volcanic rock	H	1.1
	Sedimentary rock	M	1
*	Low grade metamorphic rock	M	1
	High grade metamorphic rock	L	0.9
	Granitic rock	M	1

5 Material strength

Site		Level	Factor
	Rock at surface	VL	0.1
	Residual soil < 1 m deep	L	0.5
*	Residual soil 1-3 m deep	M	0.9
	Residual soil >3 m deep	H	1.5
	Colluvial soil < 1 m deep	H	1.5
	Colluvial soil 1-3 m deep	VH	2
	Colluvial soil > 3 m deep	VH	4
	Fill (slope regrading)	VH	5

6 Concentration of surface water

Site		Level	Factor
	Ridge	L	0.7
	Crest	M	0.8
	Upper slope	M	0.9
	Mid slope	H	1.2
*	Lower slope	H	1.5

7 Evidence of groundwater

Site		Level	Factor
*	None apparent	L	0.7
	Minor moistness	M	0.9
	Generally wet	H	1.5
	Surface springs	VH	3

8 Evidence of instability

Site		Level	Factor
*	No sign of instability	L	0.5
	Trees bent	H	1.5
	Minor irregularity	VH	2
	Major irregularity	VH	5
	Scarps	VH	10

Summary

		Factor
2	Slope Angle	1.2
3	Slope Shape	0.9
4	Site geology	1
5	Material strength	0.9
6	Concentration of surface water	1.5
7	Evidence of groundwater	0.7
8	Evidence of instability	0.5
9	**Relative Frequency (2x3x4x5x6x7x8)**	0.51

Site Frequency (1 x 9)

APPENDIX C

Data Sheets and Design Calculations

Prepared by Mortons Urban Solutions

1. Erosion Hazard and Sediment Basins

Site Name: Kings Forest

Site Location: Tweed Coast Road, NSW

Precinct/Stage: Bulk Earthworks 1

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	3	2	1d	1c	1b	1a	
Total catchment area (ha)	17.59	2.33	2.3	3.22	3.17	3.59	
Disturbed catchment area (ha)	17.59	2.33	2.3	3.22	3.17	3.59	
Soil analysis (enter sediment type if known, or laboratory particle size data)							
Sediment Type (C, F or D) if known:							If known. Type D is worst-case.
% sand (fraction 0.02 to 2.00 mm)	12	12	12	12	12	12	Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)	12	12	12	12	12	12	
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							Pg 3.15 (IECA)
Soil Texture Group	C	C	C	C	C	C	Automatic calculation from above
Rainfall data							
Design rainfall depth (no of days)	5	5	5	5	5	5	Pg B.33 (IECA)
Design rainfall depth (percentile)	80	80	80	80	80	80	
x-day, y-percentile rainfall event (mm)							
Rainfall R-factor (if known)	5119	5119	5119	5119	5119	5119	Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)							
RUSLE Factors							
Rainfall erosivity (*R*-factor)	5119	5119	5119	5119	5119	5119	Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05	0.05	0.05	0.05	RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	80	80	80	80	80	80	
Slope gradient (%)	5	5	5	5	5	5	
Length/gradient (*LS*-factor)	1.19	1.19	1.19	1.19	1.19	1.19	
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	
Calculations Erosion Hazard							
Soil loss (t/ha/yr)	395	395	395	395	395	395	
Soil Loss Class	4	4	4	4	4	4	Pg 3.4 (IECA)
Soil loss (m^3/ha/yr)	304	304	304	304	304	304	Conversion to cubic metres - assumes 1.3 t/m3
Is a Basin Required?	Yes	Yes	Yes	Yes	Yes	Yes	Refer to Table B1 Pg B.3 (IECA)

Sediment Basin Type

Soil/Catchment Details

Duration of soil disturbance	< 12 months	< 12 months	< 12 months	< 12 months	< 12 months	< 12 months	<70% effective ground cover (C ≥ 0.05)
Is the soil coarse?	Yes	Yes	Yes	Yes	Yes	Yes	< 33% finer than 0.02mm & ≤ 10% dispersive
Are WQOs likely to be met by Type C basin?	Yes	Yes	Yes	Yes	Yes	Yes	Particle settlement testing is recommended
Is automated dosing reasonable or practicable?	No	No	No	No	No	No	Does physical layout allow multiple inflow locations to a forebay?
Required Basin Type	C	C	C	C	C	C	Refer to Table B2 Pg B.4 (IECA)

Version 4

1. Erosion Hazard and Sediment Basins

Site Name: Kings Forest

Site Location: Tweed Coast Road, NSW

Precinct/Stage: Bulk Earthworks 1

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	EXTINT	5	6a	6b	6c	4	
Total catchment area (ha)	3.45	4.66	1.36	1.07	0.87	6.98	
Disturbed catchment area (ha)	3.45	4.66	1.36	1.07	0.87	6.98	
Soil analysis (enter sediment type if known, or laboratory particle size data)							
Sediment Type (C, F or D) if known:							If known. Type D is worst-case.
% sand (fraction 0.02 to 2.00 mm)	12	12	12	12	12	12	Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)	12	12	12	12	12	12	
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							Pg 3.15 (IECA)
Soil Texture Group	C	C	C	C	C	C	Automatic calculation from above
Rainfall data							
Design rainfall depth (no of days)	5	5	5	5	5	5	Pg B.33 (IECA)
Design rainfall depth (percentile)	80	80	80	80	80	80	
x-day, y-percentile rainfall event (mm)							
Rainfall R-factor (if known)	5119	5119	5119	5119	5119	5119	Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)							
RUSLE Factors							
Rainfall erosivity (*R*-factor)	5119	5119	5119	5119	5119	5119	Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05	0.05	0.05	0.05	RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	80	80	80	80	80	80	
Slope gradient (%)	5	5	5	5	5	5	
Length/gradient (*LS*-factor)	1.19	1.19	1.19	1.19	1.19	1.19	
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	
Calculations Erosion Hazard							
Soil loss (t/ha/yr)	395	395	395	395	395	395	
Soil Loss Class	4	4	4	4	4	4	Pg 3.4 (IECA)
Soil loss (m^3/ha/yr)	304	304	304	304	304	304	Conversion to cubic metres - assumes 1.3 t/m3
Is a Basin Required?	Yes	Yes	Yes	Yes	Yes	Yes	Refer to Table B1 Pg B.3 (IECA)

Sediment Basin Type

Soil/Catchment Details							
Duration of soil disturbance	< 12 months	< 12 months	< 12 months	< 12 months	< 12 months	< 12 months	<70% effective ground cover (C ≥ 0.05)
Is the soil coarse?	Yes	Yes	Yes	Yes	Yes	Yes	< 33% finer than 0.02mm & ≤ 10% dispersive
Are WQOs likely to be met by Type C basin?	Yes	Yes	Yes	Yes	Yes	Yes	Particle settlement testing is recommended
Is automated dosing reasonable or practicable?	No	No	No	No	No	No	Does physical layout allow multiple inflow locations to a forebay?
Required Basin Type	C	C	C	C	C	C	Refer to Table B2 Pg B.4 (IECA)

Version 4

1. Erosion Hazard and Sediment Basins

Site Name: Kings Forest

Site Location: Tweed Coast Road, NSW

Precinct/Stage: Bulk Earthworks 1

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	8	7	9				
Total catchment area (ha)	3.44	6.18	8.11				
Disturbed catchment area (ha)	3.44	6.18	8.11				
Soil analysis (enter sediment type if known, or laboratory particle size data)							
Sediment Type (C, F or D) if known:							If known. Type D is worst-case.
% sand (fraction 0.02 to 2.00 mm)	12	12	12				Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)	12	12	12				
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							Pg 3.15 (IECA)
Soil Texture Group	C	C	C				Automatic calculation from above
Rainfall data							
Design rainfall depth (no of days)	5	5	5				Pg B.33 (IECA)
Design rainfall depth (percentile)	80	80	80				
x-day, y-percentile rainfall event (mm)							
Rainfall R-factor (if known)	5119	5119	5119				Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)							
RUSLE Factors							
Rainfall erosivity (*R*-factor)	5119	5119	5119				Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05				RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	80	80	80				
Slope gradient (%)	5	5	5				
Length/gradient (*LS*-factor)	1.19	1.19	1.19				
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	
Calculations Erosion Hazard							
Soil loss (t/ha/yr)	395	395	395				
Soil Loss Class	4	4	4				Pg 3.4 (IECA)
Soil loss (m^3/ha/yr)	304	304	304				Conversion to cubic metres - assumes 1.3 t/m3
Is a Basin Required?	Yes	Yes	Yes	No	No	No	Refer to Table B1 Pg B.3 (IECA)

Sediment Basin Type

Soil/Catchment Details

Duration of soil disturbance	< 12 months	< 12 months	< 12 months				<70% effective ground cover (C ≥ 0.05)
Is the soil coarse?	Yes	Yes	Yes				< 33% finer than 0.02mm & ≤ 10% dispersive
Are WQOs likely to be met by Type C basin?	Yes	Yes	Yes				Particle settlement testing is recommended
Is automated dosing reasonable or practicable?	No	No	No				Does physical layout allow multiple inflow locations to a forebay?
Required Basin Type	C	C	C	N/A	N/A	N/A	Refer to Table B2 Pg B.4 (IECA)

Version 4

2. Sediment Basin Type D

Basin Name	Sub-catchment or Name of Structure						Notes
	3	2	1d	1c	1b	1a	
Total Catchment Area	17.59	2.33	2.3	3.22	3.17	3.59	Total catchment area - from Sheet 1
Rainfall Data							
Design rainfall depth (no of days)	5	5	5	5	5	5	Assume 5 days. Pg B.31 (IECA)
Basin design life	Greater than 6 months	Greater than 6 months	Greater than 6 months	Greater than 6 months	Greater than 6 months	Greater than 6 months	Refer to Table B25 (IECA)
Design rainfall depth (percentile)	80%	80%	80%	80%	80%	80%	Refer to Table B25 (IECA)
K1	17	17	17	17	17	17	Refer to Table B25 (IECA)
K2	11.2	11.2	11.2	11.2	11.2	11.2	Refer to Table B25 (IECA)
Default rainfall depth R (y%, 5 day) rainfall	35.3	35.3	35.3	35.3	35.3	35.3	Enter either a default rainfall depth (Table B26 or B27 IECA) or calculate using rainfall intensity from BOM
Rainfall intensity (1 yr, 120 hr) - (mm/hr)	1.56	1.56	1.56	1.56	1.56	1.56	
R (y%, 5 day) using rainfall intensity	37.72	37.72	37.72	37.72	37.72	37.72	Equation B32 (IECA)
Adopted Rainfall Depth R (y%, 5 day)	37.72	37.72	37.72	37.72	37.72	37.72	Adopted Rainfall Depth
Volumetric Runoff Coefficient							
Soil Hydrologic Group	Group A Sand	Group A Sand	Group A Sand	Group A Sand	Group A Sand	Group A Sand	Refer to Table B28 (IECA). Note that coefficients apply only to pervious surfaces with low to medium gradients. Light to heavy clays compacted by construction equipment should adopt Cv of 1. Loamy soils compacted by construction equipment should adopt coefficient no less than Group D soils therefore additional 5% to Group D.
Cv	0.14	0.14	0.14	0.14	0.14	0.14	Refer to Table B28 (IECA)
Settling Zone							
Basin settling (water) volume (m^3)	940.6	124.6	123.0	172.2	169.5	192.0	Equation B31 (IECA)
Storage Zone Dimensions							
Soil loss (t/ha/yr)	395.0	395.0	395.0	395.0	395.0	395.0	Calculated on worksheet 1
Sediment density (t / m^3)	1.3	1.3	1.3	1.3	1.3	1.3	Generally sediment has a density of 1.3 t / m3
Soil loss (m3/ha/yr)	303.8	303.8	303.8	303.8	303.8	303.8	Based on sediment density above
Put an X here to use 50% of water zone	x	x	x	x	x	x	Fill in one or the other - either an X or nominate the number of months. Refer to Page B.36 (IECA)
Storage (soil) zone design (months)							
Basin storage (soil) volume (m^3)	470.0	62.0	61.0	86.0	85.0	96.0	Refer to Page B.36 (IECA)
Summary of Type D Basin Dimensions							
Basin Name	3	2	1d	1c	1b	1a	
Volume of settlng zone (m^3)	940.6	124.6	123.0	172.2	169.5	192.0	Equation B31 (IECA)
Basin storage (soil) volume (m^3)	470.0	62.0	61.0	86.0	85.0	96.0	Refer to Page B.36 (IECA)
Sediment basin total volume (m^3)	**1410.6**	**186.6**	**184.0**	**258.2**	**254.5**	**288.0**	

Version 4

2. Sediment Basin Type D

Basin Name	Sub-catchment or Name of Structure						Notes
	EXTINT	5	6a	6b	6c	4	
Total Catchment Area	3.45	4.66	1.36	1.07	0.87	6.98	Total catchment area - from Sheet 1
Rainfall Data							
Design rainfall depth (no of days)	5	5	5	5	5	5	Assume 5 days. Pg B.31 (IECA)
Basin design life	Greater than 6 months	Greater than 6 months	Greater than 6 months	Greater than 6 months	Greater than 6 months	Greater than 6 months	Refer to Table B25 (IECA)
Design rainfall depth (percentile)	80%	80%	80%	80%	80%	80%	Refer to Table B25 (IECA)
K1	17	17	17	17	17	17	Refer to Table B25 (IECA)
K2	11.2	11.2	11.2	11.2	11.2	11.2	Refer to Table B25 (IECA)
Default rainfall depth R (y%, 5 day) rainfall	35.3	35.3	35.3	35.3	35.3	35.3	Enter either a default rainfall depth (Table B26 or B27 IECA) or calculate using rainfall intensity from BOM
Rainfall intensity (1 yr, 120 hr) - (mm/hr)	1.56	1.56	1.56	1.56	1.56	1.56	
R (y%, 5 day) using rainfall intensity	37.72	37.72	37.72	37.72	37.72	37.72	Equation B32 (IECA)
Adopted Rainfall Depth R (y%, 5 day)	37.72	37.72	37.72	37.72	37.72	37.72	Adopted Rainfall Depth
Volumetric Runoff Coefficient							
Soil Hydrologic Group	Group A Sand	Group A Sand	Group A Sand	Group A Sand	Group A Sand	Group A Sand	Refer to Table B28 (IECA). Note that coefficients apply only to pervious surfaces with low to medium gradients. Light to heavy clays compacted by construction equipment should adopt Cv of 1. Loamy soils compacted by construction equipment should adopt coefficient no less than Group D soils therefore additional 5% to Group D.
Cv	0.14	0.14	0.14	0.14	0.14	0.14	Refer to Table B28 (IECA)
Settling Zone							
Basin settling (water) volume (m^3)	184.5	249.2	72.7	57.2	46.5	373.2	Equation B31 (IECA)
Storage Zone Dimensions							
Soil loss (t/ha/yr)	395.0	395.0	395.0	395.0	395.0	395.0	Calculated on worksheet 1
Sediment density (t / m^3)	1.3	1.3	1.3	1.3	1.3	1.3	Generally sediment has a density of 1.3 t / m3
Soil loss (m3/ha/yr)	303.8	303.8	303.8	303.8	303.8	303.8	Based on sediment density above
Put an X here to use 50% of water zone	x	x	x	x	x	x	Fill in one or the other - either an X or nominate the number of months. Refer to Page B.36 (IECA)
Storage (soil) zone design (months)							
Basin storage (soil) volume (m^3)	92.0	125.0	36.0	29.0	23.0	187.0	Refer to Page B.36 (IECA)
Summary of Type D Basin Dimensions							
Basin Name	EXTINT	5	6a	6b	6c	4	
Volume of settling zone (m^3)	184.5	249.2	72.7	57.2	46.5	373.2	Equation B31 (IECA)
Basin storage (soil) volume (m^3)	92.0	125.0	36.0	29.0	23.0	187.0	Refer to Page B.36 (IECA)
Sediment basin total volume (m^3)	**276.5**	**374.2**	**108.7**	**86.2**	**69.5**	**560.2**	

Version 4

2. Sediment Basin Type D

	Sub-catchment or Name of Structure						Notes
Basin Name	8	7	9				
Total Catchment Area	3.44	6.18	8.11				Total catchment area - from Sheet 1
Rainfall Data							
Design rainfall depth (no of days)	5	5	5				Assume 5 days. Pg B.31 (IECA)
Basin design life	Greater than 6 months	Greater than 6 months	Greater than 6 months				Refer to Table B25 (IECA)
Design rainfall depth (percentile)	80%	80%	80%				Refer to Table B25 (IECA)
K1	17	17	17				Refer to Table B25 (IECA)
K2	11.2	11.2	11.2				Refer to Table B25 (IECA)
Default rainfall depth R (y%, 5 day) rainfall	35.3	35.3	35.3				Enter either a default rainfall depth (Table B26 or B27 IECA) or calculate using rainfall intensity from BOM
Rainfall intensity (1 yr, 120 hr) - (mm/hr)	1.56	1.56	1.56				
R (y%, 5 day) using rainfall intensity	37.72	37.72	37.72				Equation B32 (IECA)
Adopted Rainfall Depth R (y%, 5 day)	37.72	37.72	37.72				Adopted Rainfall Depth
Volumetric Runoff Coefficient							
Soil Hydrologic Group	Group A Sand	Group A Sand	Group A Sand				Refer to Table B28 (IECA). Note that coefficients apply only to pervious surfaces with low to medium gradients. Light to heavy clays compacted by construction equipment should adopt Cv of 1. Loamy soils compacted by construction equipment should adopt coefficient no less than Group D soils therefore additional 5% to Group D.
Cv	0.14	0.14	0.14				Refer to Table B28 (IECA)
Settling Zone							
Basin settling (water) volume (m^3)	183.9	330.5	433.7				Equation B31 (IECA)
Storage Zone Dimensions							
Soil loss (t/ha/yr)	395.0	395.0	395.0				Calculated on worksheet 1
Sediment density (t / m^3)	1.3	1.3	1.3				Generally sediment has a density of 1.3 t / m3
Soil loss (m3/ha/yr)	303.8	303.8	303.8				Based on sediment density above
Put an X here to use 50% of water zone	x	x	x				Fill in one or the other - either an X or nominate the number of months. Refer to Page B.36 (IECA)
Storage (soil) zone design (months)							
Basin storage (soil) volume (m^3)	92.0	165.0	217.0				Refer to Page B.36 (IECA)
Summary of Type D Basin Dimensions							
Basin Name	8	7	9				
Volume of settling zone (m^3)	183.9	330.5	433.7				Equation B31 (IECA)
Basin storage (soil) volume (m^3)	92.0	165.0	217.0				Refer to Page B.36 (IECA)
Sediment basin total volume (m^3)	**275.9**	**495.5**	**650.7**				

Version 4

3. Flow Calculations

Peak flow is given by the Rational Formula: $Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$

where:
- Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
- F_y is a frequency factor for "Y" years.
- A is the catchment area in hectares (ha)
- $I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) is determined by a range of formulae - see Pg A.9 to A.14 in IECA

A simple method to calculate time of concentration is: $tc\ (hrs) = 0.76 \times (A/100)^{0.38}$

Basic tc calculator: Area (ha): 100

Tc = 0.76 hrs or 46 mins

Structure Details									Notes
Name	3	2	1d	1c	1b	1a			
Catchment Area (ha)	17.59	2.33	2.3	3.22	3.17	3.59			hectares
First time of conc. (tc)	23	10	10	12	12	12			minutes
Second tc (if applicable)									minutes
Third tc (if applicable)									minutes
Total time of conc. (tc)	23	10	10	12	12	12			minutes

Rainfall Intensities

1-year, tc	69.1	100	100	94.6	94.6	94.6			Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	87.9	126	126	119.4	119.4	119.4			
5-year, tc									
10-year, tc									
20-year, tc									
50-year, tc									
100-year, tc									
C10 runoff coefficient	0.35	0.35	0.35	0.35	0.35	0.35			Pg A.7 (IECA)

Frequency Factors

FF, 1-year	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	Can use 0.8 for a construction site
FF, 2-year	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	Can use 0.85 for a construction site
FF, 5-year	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	Can use 0.95 for a construction site
FF, 10-year	1	1	1	1	1	1	1	1	Generally always 1
FF, 20-year	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	Can use 1.05 for a construction site
FF, 50-year	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	Can use 1.15 for a construction site
FF, 100-year	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	Can use 1.2 for a construction site

Flow Calculations									Notes
1-year, tc (m^3/s)	0.946	0.181	0.179	0.237	0.233	0.264			
2-year, tc (m^3/s)	1.279	0.243	0.24	0.318	0.313	0.355			
5-year, tc (m^3/s)									
10-year, tc (m^3/s)									
20-year, tc (m^3/s)									
50-year, tc (m^3/s)									
100-year, tc (m^3/s)									

NB for flow calculations on sediment basin spillways, see Worksheet 3 (if required).

3. Flow Calculations

Peak flow is given by the Rational Formula: $Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$

where:
- Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
- F_y is a frequency factor for "Y" years.
- A is the catchment area in hectares (ha)
- $I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) is determined by a range of formulae - see Pg A.9 to A.14 in IECA

A simple method to calculate time of concentration is: $tc\ (hrs) = 0.76 \times (A/100)^{0.38}$

Basic tc calculator: Area (ha): 100

Tc = 0.76 hrs or 46 mins

Structure Details									Notes
Name	EXTINT	5	6a	6b	6c	4			
Catchment Area (ha)	3.45	4.66	1.36	1.07	0.87	6.98			hectares
First time of conc. (tc)	13	14	9	8	7	17			minutes
Second tc (if applicable)									minutes
Third tc (if applicable)									minutes
Total time of conc. (tc)	13	14	9	8	7	17			minutes

Rainfall Intensities

1-year, tc	91.9	89.2	105.5	111	116.5	81.1			Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	116.1	112.8	133	140	147	102.9			
5-year, tc									
10-year, tc									
20-year, tc									
50-year, tc									
100-year, tc									
C10 runoff coefficient	0.35	0.35	0.35	0.35	0.35	0.35			Pg A.7 (IECA)

Frequency Factors

FF, 1-year	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	Can use 0.8 for a construction site
FF, 2-year	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	Can use 0.85 for a construction site
FF, 5-year	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	Can use 0.95 for a construction site
FF, 10-year	1	1	1	1	1	1	1	1	Generally always 1
FF, 20-year	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	Can use 1.05 for a construction site
FF, 50-year	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	Can use 1.15 for a construction site
FF, 100-year	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	Can use 1.2 for a construction site

Flow Calculations									Notes
1-year, tc (m^3/s)	0.247	0.324	0.112	0.092	0.079	0.441			
2-year, tc (m^3/s)	0.331	0.435	0.15	0.124	0.106	0.594			
5-year, tc (m^3/s)									
10-year, tc (m^3/s)									
20-year, tc (m^3/s)									
50-year, tc (m^3/s)									
100-year, tc (m^3/s)									

NB for flow calculations on sediment basin spillways, see Worksheet 3 (if required).

3. Flow Calculations

Peak flow is given by the Rational Formula: $Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$

where:
- Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
- F_y is a frequency factor for "Y" years.
- A is the catchment area in hectares (ha)
- $I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) is determined by a range of formulae - see Pg A.9 to A.14 in IECA

A simple method to calculate time of concentration is: $tc\ (hrs) = 0.76 \times (A/100)^{0.38}$

Basic tc calculator: Area (ha): 100

Tc = 0.76 hrs or 46 mins

Structure Details									Notes
Name	8	7	9						
Catchment Area (ha)	3.44	6.18	8.11						hectares
First time of conc. (tc)	12	15	17						minutes
Second tc (if applicable)									minutes
Third tc (if applicable)									minutes
Total time of conc. (tc)	12	15	17						minutes

Rainfall Intensities									
1-year, tc	94.6	86.5	81.1						Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	119.4	109.5	102.9						
5-year, tc									
10-year, tc									
20-year, tc									
50-year, tc									
100-year, tc									
C10 runoff coefficient	0.35	0.35	0.35						Pg A.7 (IECA)

Frequency Factors									
FF, 1-year	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	Can use 0.8 for a construction site
FF, 2-year	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	Can use 0.85 for a construction site
FF, 5-year	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	Can use 0.95 for a construction site
FF, 10-year	1	1	1	1	1	1	1	1	Generally always 1
FF, 20-year	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	Can use 1.05 for a construction site
FF, 50-year	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	Can use 1.15 for a construction site
FF, 100-year	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	Can use 1.2 for a construction site

Flow Calculations									Notes
1-year, tc (m^3/s)	0.253	0.416	0.512						
2-year, tc (m^3/s)	0.34	0.56	0.69						
5-year, tc (m^3/s)									
10-year, tc (m^3/s)									
20-year, tc (m^3/s)									
50-year, tc (m^3/s)									
100-year, tc (m^3/s)									

NB for flow calculations on sediment basin spillways, see Worksheet 3 (if required).

APPENDIX D

Site Checklist Example

Prepared by Mortons Urban Solutions

SEDIMENT AND EROSION CONTROL SITE CHECKLISTS

PROJECT : **GENERAL CIVIL CONSTRUCTION SITES**

DESCRIPTION: **CHECKLIST TEMPLATES FOR THE IMPLEMENTATION OF SEDIMENT AND EROSION CONTROL MEASURES**

REVISION A
FEBRUARY 2013

INNOVATIVE SOLUTIONS
SUSTAINABLE OUTCOMES

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1.0 INTRODUCTION

The Sediment and Erosion checklists contained herein outline the possible management requirements during the earthworks and construction phases of a project. The checklists should be completed by the principal contractor, be used as a guide only and any devices installed in accordance with the relevant statutory authority policies.

The checklists are to guide in the use of suitable measures which could be implemented on a civil construction site. However not all of the measures will be applicable to every site and the checklists should be adjusted to suit. While efforts to ensure compliance, it is the ultimate responsibility of the Principal Contractor to implement best practices to manage the severity and extent of soil erosion during the earthworks and construction phases in accordance with all relevant policies.

2.0 MANAGEMENT PLAN

The checklists have been separated into the following:

- Initial Inspection Checklists
- Site Rehabilitation Checklists
- Daily Site Inspection
- Weekly Site Inspection
- Non Conformance Report

3.0 INITIAL INSPECTION CHECKLISTS

Project Name: ***Job No:***

Location of Project:

Principal Contractor:

Principal Contractor Representative:

Reviewer: ***Date:***

Following the preparation and submission of the sediment and erosion control plans and all supporting documentation for the project, the following initial inspections should be undertaken with all relevant stakeholders present.
No earthworks or clearing should commence until all relevant controls are in place and all parties are satisfied that the severity and extent of soil erosion will be adequately managed.

GENERAL

ITEM	CONTROL	CHECKED/OK	
1	Have Sediment and erosion plans been supplied to the Principal Contractor for use?	YES	NO
2	Has an inspection of the project site been carried out to identify areas where possible environmental harm could occur?	YES	NO
3	Does the Principal Contractor agree the plans reflect actual site conditions? (topography shown, sufficient areas for construction operations to occur, any potential constraints or restrictions identified etc.)	YES	NO
4	Does the Principal Contractor agree with the proposed phasing and staging shown on plans?	YES	NO
5	Has the Principal Contractor allowed for sufficient resources to implement the proposed controls?	YES	NO
6	Have areas of existing habitats, wetlands and all vegetation to be retained been identified and buffer zones established with “no-go zone” fencing and signage etc.?	YES	NO
7	Have areas of high erosion potential been identified? (Existing exposed steep batters, areas of exposed dispersible soil etc.)	YES	NO
8	Do the proposed control measures appear adequate to handle the increased runoff generated from additional impervious areas, clearing and proposed construction practices?	YES	NO
9	Is the perimeter of site protected from unlawful pedestrian and vehicle access?	YES	NO
10	Have areas been identified where additional controls (other than those shown on plans) may be required?	YES	NO
11	Have all receiving waterways and potential drainage problems been identified?	YES	NO
12	Have the soil types on site been identified and has any preliminary testing been undertaken? (Testing for acid sulphate soil and dispersible soils etc.)	YES	NO
13	Are procedures in place for the length of the project? (Inspection and reporting intervals, works scheduled around potential wet weather, water testing and maintenance procedures etc.) All checklists and data recorded are to be retained as part of the on-site register.	YES	NO

14	Are all site staff and contractors aware of the sediment and erosion control plan?	YES	NO
15	Are the intended actions defined and understood by all parties?	YES	NO

SITE ESTABLISHMENT

ITEM	CONTROL	CHECKED/OK	
1	Has the location of site office and surrounding amenities been identified?	YES	NO
2	Have off-site and on-site vehicle parking areas been identified?	YES	NO
3	Have site access points been identified and kept to a minimum?	YES	NO
4	Are the access points approved with the local authority?	YES	NO
5	Has the site office area and vehicle parking area been gravelled/sealed to avoid material being tracked off-site and onto public roadways?	YES	NO
6	Have temporary access tracks been minimised and defined through the site?	YES	NO
7	Have material drop off points been identified and located away from retained vegetation and overland flow paths?	YES	NO
8	Have stockpile locations been identified and located away from retained vegetation and overland flow paths?	YES	NO
9	Have suitable locations been identified and adequately constructed for chemical, oil and fuel storage, wash down areas and waste disposal etc.?	YES	NO
10	Have areas for sediment basin(s) been identified and are they sufficient to accommodate the basin sizes calculated?	YES	NO
11	Has an approved rain gauge been installed on-site?	YES	NO
12	Are all initial control devices in place prior to the commencement of any clearing and earthworks?	YES	NO
13	Are additional material supplies available and on-standby to allow for prompt repairs and resetting of devices following a rain event? Including additional sediment fence, geotextile, aggregate and rock, coagulant, pumping and testing equipment etc.	YES	NO
14	Is the site prepared for inclement weather?	YES	NO

DRAINAGE

ITEM	CONTROL	CHECKED/OK	
1	Is drainage from the site access being directed onto site for treatment and not onto any adjacent public roadways?	YES	NO
2	Have clean water catch drains been installed and lined. Are they effective in diverting upslope flows around the site?	YES	NO
3	Have the changes in overland flow paths and site topography been addressed and will all flows be contained and treated on-site?	YES	NO
4	Are clean water and dirty water catch drains shaped correctly and of the correct width and depth?	YES	NO
5	Are constructed drains able to contain flows from the catchments?	YES	NO
7	Are drains diverting flows away from exposed and unstabilised areas?	YES	NO
8	Are drains stabilised with the correct lining (to suit designed flow velocity)?	YES	NO
9	Are all linings suitably anchored?	YES	NO
10	If geofabric is used for lining, is it overlapped in the direction of flow?	YES	NO

11	Are all flows being channelled to prevent erosion or damage to the lining and drain batters?	YES	NO
12	If rock is used for stabilisation does all rock have a geofabric underlay?	YES	NO
13	Is the rock stabilisation laid so the profile does not prevent or constrict the channel flows?	YES	NO
14	Are any check dams required in catch drains and if so are they located at appropriate spacings?	YES	NO
15	Are check dams constructed to ensure water flows over them and does not divert around them? (Are outer edges higher than the crest)	YES	NO
16	Are check dams free draining and not holding water?	YES	NO
17	Do all drains discharge through a stabilised outlet	YES	NO
18	Are outlets positioned to prevent concentrated or unlawful discharge to adjacent properties?	YES	NO
19	Do outlets have sufficient protection and energy dissipaters installed? (Appropriate rock sizing and placement)	YES	NO
20	If water crossings are required on-site, is runoff from the approach roads being constrained from entering the water course	YES	NO
21	If water crossing are in place, is additional damage to the water course being prevented?	YES	NO

EROSION

ITEM	CONTROL	CHECKED/OK	
1	Are all high erosion risk areas covered or stabilised?	YES	NO
2	Are areas of high erosion risk protected from possible rainfall events at the close of each day?	YES	NO
3	Are all batters free from erosion?	YES	NO
4	Are steep batters adequately stabilised and if necessary anchored in place?	YES	NO
5	Is rubbish being contained onsite using acceptable methods?	YES	NO
6	Are any identified dispersible soils protected or covered?	YES	NO
7	Are all stockpile locations located away from concentrated flow paths?	YES	NO
8	Are catch drains located upslope of stockpile locations to divert overland flows away?	YES	NO
9	Are staging plans in place to delay the disturbance of existing ground cover for as long as possible and minimise the time of exposure?	YES	NO
10	Are plans in place to ensure controls are installed prior to new areas being cleared or exposed	YES	NO
11	Are measures in place to accommodate any new surface drainage patterns	YES	NO

SEDIMENT

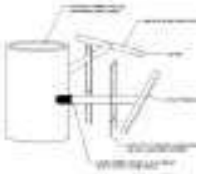
ITEM	CONTROL	CHECKED/OK	
1	Are public access roads clear of sediment tracked by site traffic?	YES	NO
2	Are dust controls in place?		
3	Are there areas where stormwater could bypass sediment traps or fences?	YES	NO
4	Are all reasonable and practical measures being taken to control erosion and prevent sediment laden runoff from leaving site?	YES	NO

5	Are all control devices installed so as not to cause a safety hazard or cause localised flooding?	YES	NO
6	Are controls appropriate for site conditions?	YES	NO
7	Are sediment fences (or suitable control devices) located downstream of stockpile locations?	YES	NO
8	Are sediment fences located along contours and not used in concentrated flow paths?	YES	NO
9	Are sediment fences securely fixed to supports adequately spaced?	YES	NO
10	Do sediment fences have regular returns and spill through weirs? (20m-30m spacings)	YES	NO
11	Are sediment fences securely buried and returned upslope at ends to prevent flow bypass?	YES	NO
12	Is sediment fence material adequate for proposed flows?	YES	NO
13	Will control devices to stormwater inlets allow adequate ponding to capture sediment?	YES	NO
14	Do control devices to stormwater inlets trap sediment and not divert the water away to uncontrolled or unstabilised areas?	YES	NO
15	Will all sediment laden water be captured for treatment prior to being discharged from site?	YES	NO

SEDIMENT BASIN

It is assumed the sediment basin will be constructed and used to accommodate runoff from sites containing higher percentages of silt and clay particles (Type D & F soils) that will require chemical flocculation prior to release.

ITEM	CONTROL	CHECKED/OK	
1	Is the basin inlet adequate to accommodate design flows?	YES	NO
2	Is the basin inlet stabilised using rock with a geotextile underlay (or similar approved stabilisation)?	YES	NO
3	Does the inlet have appropriate energy dissipation controls in place to prevent stirring and resuspension of water in the basin?	YES	NO
4	Has a shallow forebay been installed at the inlet of the sediment basin to reduce flow velocities and allow initial settling?	YES	NO
5	If a forebay has been installed, is the spillway into the sediment basin stabilised and the full width of the basin?	YES	NO
6	Has the basin been constructed to the effective dimensions (min. desirable length to width ratio of 3:1) to allow the maximum distance between the inlet and outlet?	YES	NO
7	If not practicable to construct the sediment basin using the minimum 3:1 length width ratio, have baffles been installed to increase settling time? (baffles to be set below the inlet level to allow water to flow over them and prevent resuspension of settled sediment)	YES	NO
8	Has the basin been constructed to the correct depth to allow for settling and sediment storage?	YES	NO
9	Are the inlet and outlets at the correct levels?	YES	NO
10	Does the basin have a solid, impermeable base?	YES	NO

11	Are the embankments constructed using suitable material and compacted in accordance with relevant specifications?	YES	NO
12	Are batter slopes acceptable and all embankments stable?	YES	NO
13	Could a person achieve a firm footing and exit the basin if they fell in? (considering the 'slipperiness' of the wet material and the batter slopes)	YES	NO
14	Has an emergency spillway been installed to a correct level? (300mm above the primary outlet and 300mm below a natural bank or 750mm below a filled bank)	YES	NO
15	Has the emergency spillway been installed to the correct dimensions? (minimum width of 2.5m and 6.0m in length)	YES	NO
16	Has the emergency spillway been adequately stabilised over its face and downstream?	YES	NO
17	Is energy dissipation in place on the downstream outlets?	YES	NO
18	Has a maintenance vehicle access been provided for maintenance and treatment purposes?	YES	NO
19	Has public safety been considered and access by unauthorised persons limited	YES	NO
20	Is a safety fence required? (When the sediment depth will be greater than 300mm or their will be 150mm of permanent water)	YES	NO
21	Has a depth gauge marker been installed showing the water and sediment desilting depths?	YES	NO
22	Is the coagulant being used for flocculation been approved for use and checked for potential environmental harm?	YES	NO
23	Are the proposed coagulant dosing rates and dosing techniques approved?	YES	NO
24	Is the relevant testing equipment available to test treated water prior to release? (pH, EC and NTU/TSS)	YES	NO
25	If treated water is to be pumped from the basin has a pump inlet been connected to an anchored floatation device?	YES	NO
26	Will the floatation device allow the pump hose to draw water from the surface only and prevent from drawing from the settled sediment zone?	YES	NO
27	If treated water is to be pumped, does the proposed pump have the capability of draining the basin within 24 hours?	YES	NO
28	Will a self-draining outlet system be installed?	YES	NO
	<u>Self Draining System</u> *A possible self draining outlet system could consist of a 1050dia. concrete manhole chamber with 'T' shaped uPVC 100mm dia. outlet arms located at different levels down the chamber. The outlet arms would float on the surface of the basin and decant clean water through holes drilled in the face. The top of the chamber would also be open to allow large flows to outlet.*		
29	If treated water is to outlet from the basin using a self draining system, will it allow clean water to decant from the surface only (using 'T' shaped outlet arms).	YES	NO
30	Is the maximum overflow level of the self draining system chamber lower in height in relation to the emergency spillway level?	YES	NO
31	Are the flow rates (holes drilled) on the outlet arms of the self draining system adequate?	YES	NO
32	Are the outlet arms connected to the self draining system using flexible rubber couplings to allow them to stay on the surface of the water?	YES	NO
33	Is the horizontal movement of the outlet arms restricted?	YES	NO
34	Is the vertical movement of the outlet arms limited by stays (to prevent arms from lowering into sediment zone)?	YES	NO
35	Is outlet pipe from the self draining system placed at the correct level on the	YES	NO

outlet side of the basin wall?

36	Is an anti-seep collar in place around the outlet pipe in the basin wall?	YES	NO
37	Is an anti-vortex plate installed in the self draining system chamber?	YES	NO
38	Is a valve system in place on the downstream pipe to regulate discharge?	YES	NO
39	Are plans in place for the disposal of sediment so as not to cause an erosion hazard? i.e. mixed with site material and buried or removed from site	YES	NO

Comments:

Accepted by the Principal Contractor **YES NO**

Signed: **Date:**

Reviewer signed: **Date:**

4.0 SITE REHABILITATION CHECKLISTS

Project Name: ***Job No:***

Location of Project:

Principal Contractor:

Principal Contractor Representative:

Reviewer: ***Date:***

Site rehabilitation should commence where practical immediately after finished surface levels are achieved. The rehabilitation should commence in stages with the areas of exposure at any one time limited to as little as possible.

TOPSOIL

ITEM	CONTROL	CHECKED/OK	
1	Has the topsoil been tested to ensure no adjustments are required to achieve good revegetation? (pH, nutrients etc.)	YES	NO
2	Is the topsoil free of debris, rocks etc.?	YES	NO
3	Has subsoil surface been conditioned prior to the application of the topsoil?	YES	NO
4	Has the subsoil been scarified to break up the surface and allow keying of both soils? (ensure ripping occurs along the contour)	YES	NO
5	Is the topsoil moist and not wet prior to respreading (to prevent clodding and compaction into an impervious surfaces)	YES	NO
6	Is the topsoil being laid to an adequate depth	YES	NO
7	Is the topsoil allowing adequate coverage of the exposed areas	YES	NO
8	Is the topsoil lightly compacted and roughened to allow moisture infiltration and reduce potential runoff	YES	NO
9	Is there sufficient cultivation and amelioration to topsoil to allow planting?	YES	NO

COVERAGE

ITEM	CONTROL	CHECKED/OK	
1	Do all exposed areas have sufficient cover?	YES	NO
2	Has a plan been implemented to establish cover as the job progresses?	YES	NO
3	Is the stabilisation adequate for the location it is applied? (consider overland flows and ground slope)	YES	NO
4	If grass seeded, is the grass type and application rates acceptable for the season and environment?	YES	NO
5	Has a certificate of the seed analysis been supplied by the revegetation contractor	YES	NO
6	Do drainage channels have adequate cover and anchorage (consider flow velocity)	YES	NO

7	Will the landscaping be undertaken as soon as possible?	YES	NO
8	Has a proposed watering program been implemented?	YES	NO
9	Have turf strips been laid adjacent to newly constructed impervious surfaces (footpaths, back of kerb etc.)?	YES	NO
10	Has turf been laid at a level low enough to ensure overland flows are not impeded?	YES	NO

Comments:

Accepted by the Principal Contractor **YES NO**

Signed: **Date:**

Reviewer signed: **Date:**

5.0 DAILY SITE INSPECTION CHECKLISTS

Project Name: ***Job No:***

Location of Project:

Principal Contractor:

Principal Contractor Representative:

Reviewer: ***Date:***

The daily checklist should be completed by the Principal Contractors site representative and be kept as part of the on-site register. The checklist should be completed prior to and immediately after rainfall causing runoff has occurred. Any damage or rehabilitation identified as part of the inspection should be rectified immediately.

GENERAL

ITEM	CONTROL	CHECKED/OK	
1	Have areas of existing habitats, wetlands and all vegetation to be retained have been inspected for damage or disturbance?	YES	NO
2	Have areas of high erosion potential been inspected for erosion? (existing exposed steep batters, areas of exposed dispersible soil etc.)	YES	NO
3	Has the perimeter of the site been inspected for unlawful access	YES	NO
4	Have receiving waterways been inspected for signs of sediment laden discharge?	YES	NO
5	Have any potential drainage problems been identified?	YES	NO
6	Is the weather being monitored and the site construction works adjusted accordingly?	YES	NO
7	Is the site office and surrounds clear of any debris?	YES	NO
8	Are the site access points clear of sediment and in working order?	YES	NO
9	Are the public roadways adjacent to the site clean of sediment being tracked from site	YES	NO
10	Are material drop off points in good condition?	YES	NO
11	Have chemical, oil and fuel storage, wash down areas and waste disposal areas etc. been inspected and in good condition?	YES	NO
12	Has the rain gauge been emptied and all site rainfall amounts recorded?	YES	NO
13	Is the recorded rainfall data up to date and included in the site register?	YES	NO
14	Is the site prepared for inclement weather?	YES	NO

DRAINAGE

ITEM	CONTROL	CHECKED/OK	
1	Is site access drainage being directed onto site for treatment and not onto the adjacent public roadway?	YES	NO
2	Are clean water catch drains effectively diverting upslope flows around the site?	YES	NO

3	Are all dirty water catch drains in working order?	YES	NO
4	Are drain linings free of sediment and debris and showing no signs of damage or erosion?	YES	NO
5	All linings are suitably anchored and secure?	YES	NO
6	Has rock stabilisation been inspected and is the geofabric underlay showing no signs of damage or erosion?	YES	NO
7	Is the rock stabilisation not preventing or constricting channel flows?	YES	NO
8	Are all check dams clean of silt and debris	YES	NO
9	Are check dams working so flows do not divert around them?	YES	NO
10	Are check dams free draining and not holding water?	YES	NO
11	Are the stabilised outlets clean and free of silt and debris?	YES	NO
12	Have outlets been inspected to ensure no concentrated or unlawful discharge is being released to adjacent properties?	YES	NO
13	Do all outlet protections and energy dissipaters appear to be in working order?	YES	NO
14	Are any on-site water crossings clean and free from sediment laden runoff entering the water course?	YES	NO
15	Are any water crossings free of damage?	YES	NO
16	Are all drains, chutes, batter coverage, water crossings, inlets and outlets free of debris and sediment and in good working order?	YES	NO

EROSION

ITEM	CONTROL	CHECKED/OK	
1	Are all high erosion risk areas covered or stabilised?	YES	NO
2	Are all batters free from erosion?	YES	NO
3	Are areas of high erosion risk protected from possible rainfall events at the close of each day?	YES	NO
4	Are steep batters adequately stabilised and anchored in place?	YES	NO
5	Are any dispersible soils protected or covered?	YES	NO
6	Are all stockpiles free from erosion?	YES	NO
7	Are the catch drains located upslope of stockpiles in good working order and free from debris and sediment?	YES	NO
8	Are earthwork activities being minimised prior to periods of inclement weather?	YES	NO

SEDIMENT

ITEM	CONTROL	CHECKED/OK	
1	Are dust controls in place and working?	YES	NO
2	Is drainage from site access being directed onto site for treatment and not onto adjacent public roadway?	YES	NO
3	Is all stormwater being captured and not bypassing sediment traps or fences?	YES	NO
4	Are all reasonable and practical measures being taken to control erosion and prevent sediment laden runoff from leaving site?	YES	NO
5	Control devices are installed correctly and not causing a safety hazard or localised flooding?	YES	NO
6	All controls appear to be working adequately for site conditions?	YES	NO

7	All sediment traps are free from sediment and in working order?	YES	NO
8	All drains are working?	YES	NO
9	Is all rock stabilisation free of sediment and working?	YES	NO
10	Are sediment fences (or suitable control devices) located downstream of stockpile locations?	YES	NO
11	Are all sediment fences securely fixed, working and clean of sediment and debris?	YES	NO
12	Are all sediment fences securely buried with no evidence of flow bypass?	YES	NO
13	Are sediment fences still located along changing contours and not used in concentrated flow paths?	YES	NO
14	Is the sediment fence material working effectively and containing site flows?	YES	NO
15	Are control devices to stormwater inlets ponding flows and capturing any sediment?	YES	NO
16	Are all control devices to stormwater inlets trapping sediment and not diverting the water away to uncontrolled or unstabilised areas?	YES	NO
17	Are all stormwater inlet control devices in good working order and free from sediment?	YES	NO
18	Does all sediment laden water appear to be captured for treatment prior to being discharged from site?	YES	NO
19	Are outlets clean of debris and sediment build up?	YES	NO

SEDIMENT BASIN

It is assumed the sediment basin will be constructed and used to accommodate runoff from sites containing fine material particles (Type D & F soils) that will require chemical flocculation prior to release.

ITEM	CONTROL	CHECKED/OK	
1	Is the sediment basin inlet stabilisation free from erosion and working?	YES	NO
2	Do the energy dissipaters in the inlet appear to be preventing stirring and resuspension of water in the basin?	YES	NO
3	Is a shallow forebay installed? If so is it free of sediment build up?	YES	NO
4	If a shallow forebay is installed, is the spillway into the basin showing no signs of erosion and appears to be in good working order?	YES	NO
5	If baffles are installed are they in good working order?	YES	NO
6	Are all the basin embankments free from slumping, slip and seepage?	YES	NO
7	Is the emergency spillway free from erosion and in good working order?	YES	NO
8	Are the energy dissipaters in the downstream outlets free from erosion, sediment build-up and debris?	YES	NO
9	Is the safety fence free from damage and restricting unwanted access?	YES	NO
10	Is water quality being achieved prior to discharge? ▪ pH between 6.5 and 8.5 ▪ Total suspended solids (TSS) <50mg/L ▪ Electrical conductivity (EC) is dependant on local geology and soil types and receiving waterway levels in accordance with Queensland Water Quality Guidelines. A moderate representation would be approx. <520us/cm ▪ No visible signs of oil and grease	YES	NO
11	Are records of testing available, up to date and compliant with release conditions? Are all records included in the on-site register?	YES	NO

Comments:

Accepted by the Principal Contractor **YES NO**

Signed: **Date:**

Reviewer signed: **Date:**

6.0 WEEKLY SITE INSPECTION CHECKLISTS

Project Name: ***Job No:***

Location of Project:

Principal Contractor:

Principal Contractor Representative:

Reviewer: ***Date:***

The weekly checklist should be completed by the Principal Contractors site representative and be kept as part of the on-site register. The checklist should be completed in conjunction with the daily inspection checklist with a focus on the site's overall sediment and erosion control and the progressive stabilisation being undertaken. Any changes should be implemented in accordance with the sites changing topography.

GENERAL

ITEM	CONTROL	CHECKED/OK	
1	Do the plans and phasing still reflect actual site conditions? (topography shown, sufficient areas for construction operations to occur, any potential constraints or restrictions identified etc.)	YES	NO
2	Do the proposed control measures appear to be handling increased runoff from additional impervious areas, clearing and proposed construction practices?	YES	NO
3	Are the control devices adequately treating the site? If not are additional controls required (other than those shown on plans)?	YES	NO
4	Are records up to date? Including inspection and reporting intervals, works planning around potential wet weather, water testing and maintenance procedures etc. Any checklists and data recorded are to be retained as part of the on-site register.	YES	NO
5	Is the site office location and surrounding amenities still adequate?	YES	NO
6	Is off-site and on-site vehicle parking adequate?	YES	NO
7	Are site access points satisfactory?	YES	NO
8	Is the stabilised site office area and vehicle parking area working to avoid material being tracked off-site and onto public roadways?	YES	NO
9	Are temporary access tracks through the site still operational?	YES	NO
10	Are material drop off points satisfactory?	YES	NO
11	Are stockpile locations satisfactory?	YES	NO
12	Are chemical, oil and fuel storage, wash down areas and waste disposal etc. functioning effectively?	YES	NO
13	Are control material supplies being restocked and are they sufficient to allow for prompt repairs and resetting of devices following a rain event?	YES	NO

DRAINAGE

ITEM	CONTROL	CHECKED/OK	
1	Are the changes in overland flow paths and site topography being addressed and are devices being amened to suit changes?	YES	NO
2	Do clean water and dirty water catch drains need to be reshaped or any repairs made to the cross sectional area to accommodate flow changes?	YES	NO
3	Do drains appear to be containing flows from catchments?	YES	NO
4	Are drains diverting flows away from exposed and unstabilised areas?	YES	NO
5	Are drains situated upslope of exposed areas?	YES	NO
6	Are the linings of the drains in good condition? (they suit designed flow velocity and do not need changing or relaying)	YES	NO
7	Are all drain linings suitably anchored?	YES	NO
8	Are the drain batters and linings free from erosion and wear?	YES	NO
9	Does the rock used for stabilisation need to be desilted or replaced with clean rock?	YES	NO
10	Do check dams suit the adjusted drain profiles and do the spacing intervals suit any change in slope?	YES	NO
11	Do outlets have sufficient protection and energy dissipaters to suit any changes in site conditions? (appropriate rock sizing and placement)	YES	NO

EROSION

ITEM	CONTROL	CHECKED/OK	
1	Are all finished surface levels being topsoiled and stabilised as works progress and as soon as possible after finished surface levels are achieved?	YES	NO
2	Is the disturbance to existing ground cover being managed to minimise the time from exposure to finished level and stabilisation?	YES	NO
3	Is rubbish being contained onsite using acceptable methods?	YES	NO
4	Are controls free of damage and not being displaced by stormwater, wind or raindrop impact?	YES	NO
5	Are all stockpile locations still adequate?	YES	NO
6	Are the batter slopes and heights of stockpiles in accordance with relevant authorities (slope usually 2:1 and height less than 3m)?	YES	NO
7	Are the surfaces of “long term” stockpiles protected from erosion?	YES	NO
8	Are temporary covers applied to stockpiles where there is a high erosion risk and are the covers working satisfactorily?	YES	NO
9	Are disturbed areas being stabilised within the required time frame?	YES	NO
10	Are control measures being applied to all disturbed areas?	YES	NO
11	Are controls installed prior to new areas being cleared or exposed?	YES	NO
12	Where possible have exposed surface areas been roughened to allow water penetration and reduce run-off?	YES	NO
13	Are measures in place to accommodate new surface drainage patterns?	YES	NO
14	Are all drains, chutes, batter coverage, water crossings, inlets and outlets working?	YES	NO

SEDIMENT

ITEM	CONTROL	CHECKED/OK	
1	Are site accesses/shaker grids and approaches clear of excessive sediment? (Are the rocks being replaced and any captured sediment removed periodically)	YES	NO
2	Is all sediment laden runoff being contained on site?	YES	NO
3	Is any collected sediment being disposed of in an appropriate manner?	YES	NO
4	Are all drains working? If not should drains be added, amended or improved to suit changing site topography	YES	NO

SEDIMENT BASIN

It is assumed the sediment basin will be constructed and used to accommodate runoff from sites containing fine material particles (Type D & F soils) that will require chemical flocculation prior to release.

ITEM	CONTROL	CHECKED/OK	
1	Is the basin inlet and outlet in good working order and adequate to accommodate flows?	YES	NO
2	Does the basin have the capacity to capture a design rainfall event considering the changing site conditions?	YES	NO
3	Does the basin still have the correct depth to allow for settling and sediment storage?	YES	NO
4	Is the basin being desilted to retain sufficient storage capacity?	YES	NO
5	Is any silt removed from the basin being disposed of correctly?	YES	NO
6	Are the inlet and outlets at the correct levels?	YES	NO
7	Is the maintenance vehicle access adequate for treatment purposes?	YES	NO
8	Is public safety satisfactory and access by unauthorised persons being limited?	YES	NO
9	Is the pumping system including the intake pipe in good working order?	YES	NO
10	If treated water is being released from the basin using a self draining outlet system, is the system free of sediment and debris and in good working order?	YES	NO
11	Are the flow rates from the outlet arms of the self draining system adequate?	YES	NO
12	Is the self draining system free of sediment and debris?	YES	NO

TOPSOIL

ITEM	CONTROL	CHECKED/OK	
1	Is the topsoil being tested to ensure no adjustments are required to achieve good revegetation (pH, nutrients etc.)?	YES	NO
2	Is any topsoil laid free of debris, rocks etc.?	YES	NO
3	Is the subsoil surface being conditioned prior to the application of topsoil?	YES	NO
4	Is the subsoil being scarified to break up surface and allow keying of both soils?	YES	NO
5	Is the topsoil moist and not being respread wet?	YES	NO
6	Is the topsoil being spread at an adequate depth and coverage of the exposed areas?	YES	NO
7	Is the topsoil being lightly compacted and roughened to allow moisture infiltration and reduce potential runoff?	YES	NO

COVERAGE

ITEM	CONTROL	CHECKED/OK	
1	Is the stabilisation providing adequate cover?	YES	NO
2	Do drainage channels have adequate cover and anchorage to suit changing site conditions (consider flow velocity)?	YES	NO
3	Is landscaping be undertaken and managed as the job progresses?	YES	NO
4	Are grass seeded areas achieving strike?	YES	NO
5	Are grass seeded areas developing sufficient ground cover?	YES	NO
6	Is the proposed watering program working?	YES	NO
7	Are areas with no strike achieved being reseeded to achieve cover?	YES	NO
8	Are turf strips being laid adjacent to newly constructed impervious surfaces (footpaths, back of kerb etc.)?	YES	NO
9	Has turf taken root to areas where laid?	YES	NO
10	Has turf been laid at a level low enough to ensure overland flows are not impeded?	YES	NO
11	Has turf been re-laid to areas where required?	YES	NO
12	Has cover been established to all exposed areas?	YES	NO

Comments:

Accepted by the Principal Contractor **YES NO**

Signed: **Date:**

Reviewer signed: **Date:**

7.0 NON-CONFORMANCE REPORT

Project Name: ***Job No:***

Location of Project:

Principal Contractor:

Principal Contractor Representative:

Reviewer: ***Date:***

The Non-conformance report should be completed by the reviewer and any items identified actioned as soon as possible. The report should be kept with the relevant inspection checklist and filed as part of the on-site register.

Details of non-conformance items:

Preventative action to be taken:

Date Non-conformance was resolved:

Comments:

Accepted by the Principal Contractor **YES NO**

Signed: **Date:**

Reviewer signed: **Date:**

APPENDIX E

Stamped Approved Drawings from MP08_0194 (as modified)

Prepared by Mortons Urban Solutions

NSW GOVERNMENT
Planning

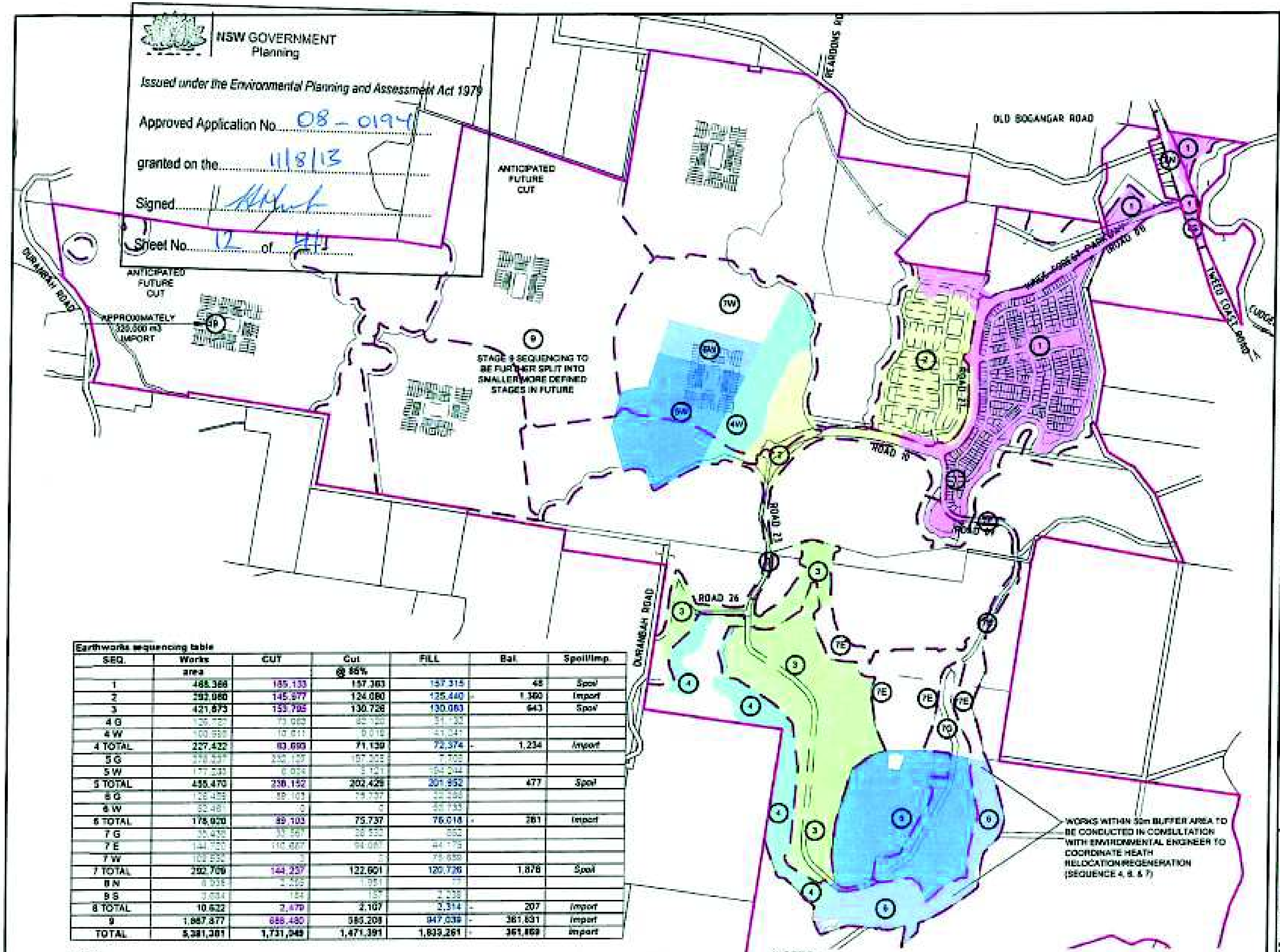
Issued under the Environmental Planning and Assessment Act 1979

Approved Application No. 08 – 0194

granted on the 11/8/13

Signed [signature]

Sheet No. 12 of 44



Earthworks sequencing table

SEQ.	Works area	CUT	Cut @ 85%	FILL	Bal.	Spoil/Imp.
1	468,368	185,133	157,363	157,315	48	Spoil
2	292,080	145,977	124,080	125,440	- 1,360	Import
3	421,873	153,795	130,726	130,083	643	Spoil
4 G	126,727	73,083	62,120	31,133		
4 W	100,695	10,611	9,019	41,241		
4 TOTAL	227,422	83,693	71,139	72,374	- 1,234	Import
5 G	278,237	232,127	197,308	7,708		
5 W	177,233	6,024	5,121	194,244		
5 TOTAL	455,470	238,152	202,429	201,952	477	Spoil
6 G	126,439	89,103	75,737	32,283		
6 W	52,481	0	0	43,735		
6 TOTAL	178,920	89,103	75,737	76,018	- 281	Import
7 G	35,436	33,567	28,532	852		
7 E	144,720	110,687	94,087	44,175		
7 W	102,552	3	3	75,699		
7 TOTAL	282,709	144,237	122,601	120,726	1,876	Spoil
8 N	6,938	2,295	1,951	77		
8 S	3,684	184	157	2,238		
8 TOTAL	10,622	2,479	2,107	2,314	- 207	Import
9	1,867,877	688,480	585,208	947,039	- 361,831	Import
TOTAL	5,381,381	1,731,049	1,471,391	1,833,261	- 361,869	Import

Notes:

- Cut and fill figures subject to detail design including stripping, trenching and boxing
- Full site trenching and boxing used to adjust sequence 9 cut / fill figures for overall earthwork calculation purposes
- Earthworks sequence 9 requires import of approximately 320,000m3 and site cut of approximately 42,000m3

NOTES:

1. EARTHWORKS ARE TO BE PREFORMED IN ACCORDANCE WITH THE RELEVANT APPROVED MANAGEMENT PLANS TO ENSURE PROTECTION OF SEPP14 WETLANDS AND PROTECTED ABORIGINAL SITES.
2. CONTRACTOR TO ENSURE ANY PROTECTED AREAS ARE FENCED IN ACCORDANCE WITH APPROVED MANAGEMENT PLANS AND INSPECTED ON A DAILY BASIS.
3. SEQUENCING OF EARTHWORKS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE APPROVED BULK EARTHWORKS SEQUENCING DIAGRAM 12301-ALL-041 (B) TO ENSURE THE MINIMUM AREA OF DISTURBANCE OCCURS.

PROJECT NAME

KINGS FOREST

BULK EARTHWORKS PRECINCTS, & ESTATE MAJOR ACCESS WORKS

REAL PROPERTY DESCRIPTION
Lot 7 on DP875447, Part of Lot 6 on DP875446,
Lot 1 on DP781633, Lot 40 on DP7482,
Lot 2 on DP819015, Lot 1 on DP128737,
Lot 37A, 38A &39B ON DP3727,
Lot 1 on DP706497, Lot 76, 303, 372,
96 & 326 on DP755701
PARISH OF CUDGEN, COUNTY OF ROUS

CLIENT

PROJECT 28 PTY LTD

NORTH

0 750 1500 2250 3000 3750m
Scale 1:75000 - A1 (1:150000 - A3)

ISSUES	DATE	
TENDER		
STATE AUTHORITY		
CONSTRUCTION		

REV	DATE	AMENDMENT
B		[illegible]
A		[illegible]

ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH 001-NOTES AND 002-LEGEND

ASSOCIATED CONSULTANTS

LANDSURV Pty. Ltd.
TWEED HEADS NSW

GILBERT+SUTHERLAND
agricultural and environmental scientists

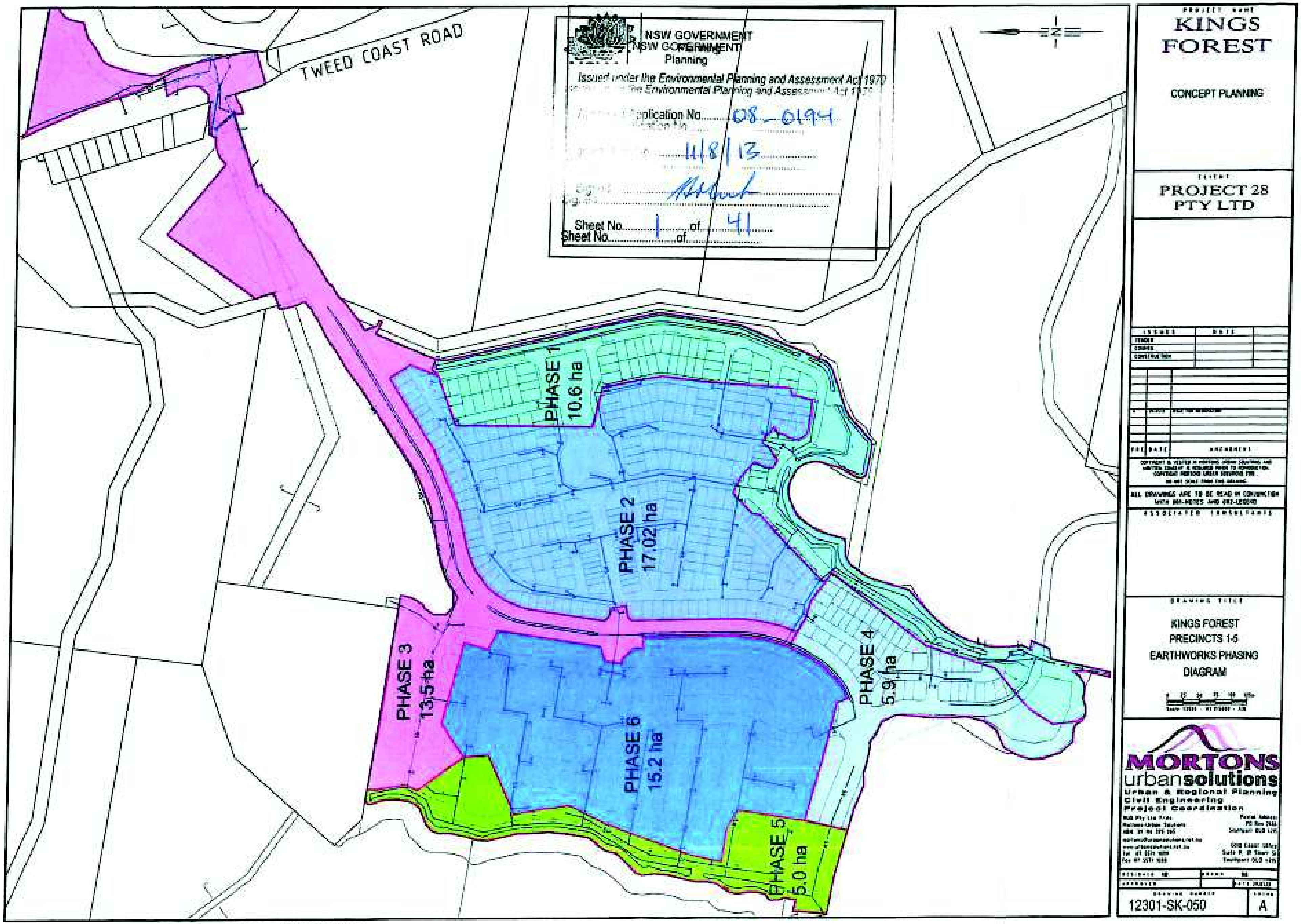
DRAWING TITLE

BULK EARTHWORKS SEQUENCING DIAGRAM

MORTONS urbansolutions
Urban & Regional Planning
Civil Engineering
Project Coordination

DRAWING NUMBER
12301-ALL-041

AMEND
B


TWEED COAST ROAD
NSW GOVERNMENT
Planning
Issued under the Environmental Planning and Assessment Act 1979
Application No. 08_0194
11/8/13
Sheet No. 1 of 41
PHASE 1
10.6 ha
PHASE 2
17.02 ha
PHASE 3
13.5 ha
PHASE 4
5.9 ha
PHASE 5
5.0 ha
PHASE 6
15.2 ha
KINGS FOREST
CONCEPT PLANNING
PROJECT 28
PTY LTD
ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH GRI-NOTES AND GRI-LEGEND
KINGS FOREST
PRECINCTS 1-5
EARTHWORKS PHASING
DIAGRAM
MORTONS
urbansolutions
Urban & Regional Planning
Civil Engineering
Project Coordination
12301-SK-050
A