Appendix D

Previous borehole logs with explanation sheets

GLOSSARY OF SYMBOLS

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This standard sheet should be read in conjunction with all test hole log sheets and any idealised geological sections prepared for the investigation report.

GENERAL

Symbol	Description	Symbol	Description
D	Disturbed Sample	R	Rising Head Permeability Test
B	Bulk Sample	F	Falling Head Permeability Test
U(50)	Undisturbed Sampled (suffixed by sample size or tube diameter in mm if applicable)	PBT	Plate Bearing Test
CS	Core Sample (suffixed by diameter in mm)		Water Inflow (make)
ES	Soil sample for environmental sampling		Water Outflow (loss)
PID	Photoionisation Detector		Temporary Water Level
SPT	Standard Penetration Test (with blows per 0.15m)		Final Water Level
N	SPT Value		Point Load Test (axial)
HB/HW	SPT Hammer Bouncing/Hammer Weight		Point Load Test (diametric)
PP/HP	Pocket/Hand Penetrometer (suffixed by value kPa)	PL	Point Load (kPa)
PK	Packer Test (kPa)	IMP	Impression Device Test
PZ	Piezometer Installation	PM	Pressuremeter Test
SV/VS	Shear Vane Test (suffixed by value in kPa)		

SOIL SYMBOLS

Main Components				Minor Components			
SAND		FILL		sandy		vegetation, roots	
GRAVEL		SILT		gravelly		silty	
CLAY		TOPSOIL		clayey	*Note: Natural soils are generally a combination of constituents, e.g. sandy CLAY*		

ROCK SYMBOLS

Sedimentary						Igneous			
SANDSTONE		SILTSTONE		CONGLOMERATE		GRANITIC ROCK		IGNEOUS DYKE	
CLAYSTONE		SHALE		COAL		BASALTIC ROCK			

Note: Additional rock symbols may be allocated for a particular project

NATURAL DEFECTS *(Coding)*

Defect Type		Orientation					
Jt	Joint	For vertical non-oriented core ... “Dip” angle (eg. 5°) measured relative to horizontal.					
Pt	Parting	For inclined non-oriented core ... “Angle” measured relative to core axis.					
SS	Sheared Surface	For inclined oriented core ... “Dip” angle and “Dip Direction” angle (eg. 45°/225° mag.).					
WSm	Weathered Seam	**Orientation (con’t)**		**Roughness**		**Coating**	
SSm	Sheared Seam	VT	Vertical	Pol	Polished	Cn	Clean
CSm	Crushed Seam	HZ or 0°	Horizontal	So	Smooth	Sn	Stained
ISm	Infilled Seam	d / °	Degrees	Rf	Rough	Ve	Veneer
SZ	Sheared Zone			VR	Very Rough	Co	Coating
VN	Vein			Slk	Slickensided		
Shape				**Infilling / Common Materials**			
Pln	Planar	St	Stepped	CLAY	Clay	Mi	Micaceous
Cu	Curved	Ir	Irregular	Ca	Calcite	Mn	Manganese
Un	Undulating	Dis	Discontinuous	X	Carbonaceous	Py	Pyrite
Others				Kt	Chlorite	Qz	Quartz
OP	Open	CL	Closed	Ti	Tight	Fe	Iron Oxide	MU	Unidentified Mineral

Ref: DS6.5.3 Rev 1 Date : 25/09/2019

SOIL DESCRIPTION AND CLASSIFICATION

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Soil is described in general accordance with Australian Standard AS 1726-2017 (Geotechnical Site Investigations) in terms of visual and tactile properties, with potential refinement by laboratory testing. AS 1726 defines soil as particulate materials that occur in the ground and can be disaggregated or remoulded by hand in air or water without prior soaking. Classification of the soil is undertaken following description.

SOIL DESCRIPTION

The soil description includes a) Composition, b) Condition, c) Structure, d) Origin and e) Additional observations. 'FILL', 'TOPSOIL' or a 'MIXTURE OF SOIL AND COBBLES / BOULDERS' (with dominant fraction first) is denoted at the start of a soil description where applicable.

a) Soil Composition (soil name, colour, plasticity or particle characteristics, secondary and then minor components)

Soil Name: A soil is termed a *coarse grained soil* where the dry mass of sand and gravel particles exceeds 65% of the total. Soils with more than 35% fines (silt or clay particles) are termed *fine grained soils*. The soil name is made up of the primary soil component (in BLOCK letters), prefixed by applicable secondary component qualifiers. Minor components are applied as a qualifiers to the soil name (using the words 'with' or 'trace').

Particles are differentiated on the basis of size. 'Boulders' and 'cobbles' are outside the soil particle range, though their presence (and proportions) is noted. While individual particles may be designated as silt or clay based on grain size, fine grained soils are characterised as silt or clay based on tactile behaviour or Atterberg Limits, and not the relative composition of silt or clay sized particles.

Colour: The prominent colour is noted, followed by (spotted, mottled, streaked etc.) then secondary colours as applicable. Roughly equally proportioned colours are prefixed by (spotted, mottled, streaked etc.). Colour is described in its moist condition, though both wet and dry colours may also be provided if appropriate.

Plasticity: Fine grained soils are designated within standard ranges of plasticity based on tactile assessment or laboratory assessment of the Liquid Limit.

Particle Characteristics: The particle shape, particle distribution and particle size range within a coarse grained soil is described using standard terms. Particle composition may be described using rock or mineral names, with specific terms for carbonate soils.

Secondary and Minor Components: The primary soil is described and modified by secondary and minor components, with assessed ranges as tabulated.

Carbonate Soils: Carbonate content can be assessed by use of dilute '10%' HCl solution. Resulting clear sustained effervescence is interpreted as a *Carbonate soil* (approximately >50% carbonate), while weak or sporadic effervescence indicates *Calcareous soil* (< 50% carbonate). No effervescence is interpreted as a non-calcareous soil.

Organic and Peat Soils: Where identified, organic content is noted. *Organic soil* (2% to 25% organic matter) is usually identified by colour (usually dark grey/black) and odour (i.e. 'mouldy' or hydrogen sulphide odour). *Peat* (>25% organic matter) is identified by a spongy feel and fibrous texture. Peat soils' decomposition may be described as '*fibrous*' (little / no decomposition), '*pseudo-fibrous*' (moderate decomposition) or '*amorphous*' (full decomposition).

Fraction	Components		Particle Size (mm)
Oversize	BOULDERS		> 200
	COBBLES		63 - 200
Coarse grained soil particles	GRAVEL	Coarse	19 - 63
		Medium	6.7 -19
		Fine	2.36 - 6.7
	SAND	Coarse	0.6 - 2.36
		Medium	0.21 - 0.6
		Fine	0.075 - 0.21
Fine grained soil particles	SILT		0.002 - 0.075
	CLAY		< 0.002

Plasticity Terms (Fine Grained Soils)		Laboratory Liquid Limit Range
Silt	**Clay**	
N/A	N/A	(Non Plastic)
Low Plasticity	*Low Plasticity*	≤ 35%
	Medium Plasticity	> 35% and ≤ 50%
High Plasticity	*High Plasticity*	> 50%

Particle Distribution Terms (Coarse Grained Soils)	
Well graded	good representation of all particle sizes
Poorly graded	one or more intermediate sizes poorly represented
Gap graded	one or more intermediate sizes absent
Uniform	essentially of one size

Particle Shape Terms (Coarse Grained Soils)		
Rounded	*Sub-angular*	*Flaky or Platy*
Sub-rounded	*Angular*	*Elongated*

Secondary and Minor Components for Coarse Grained Soils			
Fines (%)	**Modifier** (as applicable)	**Accessory coarse (%)**	**Modifier** (as applicable)
≤ 5	*'trace silt / clay'*	≤ 15	*'trace sand / gravel'*
> 5, ≤ 12	*'with clay / silt'*	> 15, ≤ 30	*'with sand / gravel'*
> 12	*prefix 'silty / clayey'*	> 30	*prefix 'gravelly / sandy'*

Secondary and Minor Components for Fine Grained Soils	
% Coarse	**Modifier** (as applicable)
≤ 15	add *"trace sand / gravel"*
> 15, ≤ 30	add *"with sand / gravel"*
> 30	prefix soil *"sandy / gravelly"*

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b) Soil Condition (moisture, relative density or consistency)

Moisture: Fine grained soils are described relative to plastic or liquid limits, while coarse grained soils are assessed based on appearance and feel. The observation of seepage or free water is noted on the test hole logs.

Moisture - Coarse Grained Soils

Term		Tactile Properties
Dry	*('D')*	Non-cohesive, free running
Moist	*('M')*	Feels cool, darkened colour, tends to stick together
Wet	*('W')*	Feels cool, darkened colour, tends to stick together, free water forms when handling

Moisture - Fine Grained Soils

Term		Tactile Properties
Moist, dry of plastic limit	*('w < PL')*	Hard and friable or powdery
Moist, near plastic limit	*('w ≈ PL')*	Can be moulded
Moist, wet of plastic limit	*('w > PL')*	Weakened, free water forms on hands with handling
Wet, near liquid limit	*('w ≈ LL')*	Highly weakened, tends to flow when tapped
Wet, wet of liquid limit	*('w > LL')*	Liquid consistency, soil flows

Relative Density (Non Cohesive Soils): The Density Index is inherently difficult to assess by visual or tactile means, and is normally assessed by penetration testing (e.g. SPT, DCP, PSP or CPT) with published correlations. Assessment may be affected by moisture and *in situ* stress conditions. Density Index assessment may be refined by combination of *in situ* density testing and laboratory reference maximum and minimum density ranges.

Consistency (Cohesive Soils): May be assessed by direct measurement (shear vane, CPT etc.), or approximate tactile correlations. Cohesive soils include fine grained soils, and coarse grained soils with sufficient fine grained components to induce cohesive behaviour. A 'design shear strength' must consider the mode of testing, the *in situ* moisture content and potential for variations of moisture which may affect the shear strength.

Relative Density (Non-Cohesive Soils)

Term and (Symbol)		Density Index (%)
Very Loose	*(VL)*	≤ 15
Loose	*(L)*	> 15 and ≤ 35
Medium Dense	*(MD)*	> 35 and ≤ 65
Dense	*(D)*	> 65 and ≤ 85
Very Dense	*(VD)*	> 85

Consistency assessment can be influenced by moisture variation.

Consistency (Cohesive Soils)

Term and (Symbol)		Tactile Properties	Undrained Shear Strength
Very Soft	*(VS)*	Extrudes between fingers when squeezed	< 12 kPa
Soft	*(S)*	Can be moulded by light finger pressure	12 - 25 kPa
Firm	*(F)*	Can be moulded by strong finger pressure	25 - 50 kPa
Stiff	*(St)*	Cannot be moulded by fingers	50 - 100 kPa
Very Stiff	*(VSt)*	Can be indented by thumb nail	100 - 200 kPa
Hard	*(H)*	Can be indented with difficulty by thumb nail	> 200 kPa
Friable	*(Fr)*	Easily crumbled or broken into small pieces by hand	-

c) Structure (zoning, defects, cementing)

Zoning: The *in situ* zoning is described using the terms below. *'Intermixed'* may be used for an irregular arrangement.

'layer' (a continuous zone across the exposed sample)

'lens' (a discontinuous layer with lenticular shape)

'pocket' (an irregular inclusion of different material).

'interbedded' or *"interlaminated'* (alternating soil types)

Defects: Described using terms below, with dimension orientation and spacing described where practical.

'parting' (an open or closed surface or crack sub parallel to layering with little / no tensile strength - open or closed)

'fissure' (as per a parting, though not parallel or sub parallel to layering – may include desiccation cracks)

'sheared seam' (zone of sub parallel near planar closely spaced intersecting smooth or slickensided fissures dividing the mass into lenticular or wedge shaped blocks)

'sheared surface' (a near planar, curved or undulating smooth, polished or slickensided surface, indicative of displacement)

'softened zone' (in clayey soils, usually adjacent to a defect with associated higher moisture content)

'tube' (tubular cavity, singly or one of a large number, often formed from root holes, animal burrows or tunnel erosion)

'tube cast' (an infilled tube – infill may vary from uncemented through to cemented or have rock properties)

'infilled seam' (sheet like soil body cutting through the soil mass, formed by infilling of open defects)

Cementation: Soils may be cemented by various substances (e.g. iron oxides and hydroxides, silica, calcium carbonate, gypsum), and the cementing agent shall be identified if practical. Cemented soils are described as:

'weakly cemented'	easily disaggregated by hand in air or water
'moderately cemented'	effort required to disaggregate the soil by hand in air or water

Materials extending beyond '*moderately cemented*' are encompassed within the rock strength range. Where consistent cementation throughout a soil mass is identified as a duricrust, it is described in accordance with duricrust rock descriptors. Where alternate descriptors of cementation development are applied for consistency with regional practices or geology, or client requirements, these are outlined separately.

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d) Origin

An interpretation is provided based on observations of landform, geology and fabric, and may further include assignment of a stratigraphic unit. The use of terms 'possibly' or 'probably' indicates a higher degree of uncertainty regarding the assessed origin or stratigraphic unit. Typical origin descriptors include:

Residual	Formed directly from in situ weathering with no visible structure or fabric of the parent soil or rock.
Extremely weathered	Formed directly from in situ weathering, with remnant and/or fabric from the parent rock.
Alluvial	Deposited by streams and rivers (may be applied more generically as transported by water).
Estuarine	Deposited in coastal estuaries, including sediments from inflowing rivers, streams, and tidal currents.
Marine	Deposited in a marine environment.
Lacustrine	Deposited in freshwater lakes.
Aeolian	Transported by wind.
Colluvial and Slopewash	Soil and rock debris transported down slopes by gravity (with or without assistance of water). Colluvium is typically applied to thicker / localised deposits, and slopewash for thinner / widespread deposits.
TOPSOIL	Surficial soil, typically with high levels of organic material. Topsoils buried by other transported soils are termed *'remnant topsoil'*. Tree roots within otherwise unaltered soil does not characterise topsoil.
FILL	Any material which has been placed by anthropogenic processes (i.e. human activity).

e) Additional Observations

Additional observations may be included to supplement the soil description. Additional observations may consist of notations relating to soil characteristics (odour, contamination, colour changes with time), inferred geology (with delineation of soil horizons or geological time scale) or notes on sampling and testing application (including the reliability, recovery, representativeness, or condition of samples or test conditions and limitations). If the material is assessed to be not representative, terms such as 'poor recovery', 'non-intact', 'recovered as' or 'probably' are applied.

SOIL CLASSIFICATION

Classification allocates the material within distinct soil groups assigned a two character Group Symbol:

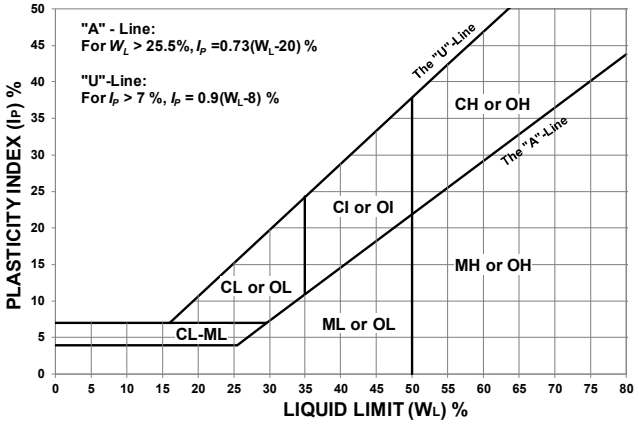
Coarse Grained Soils (sand and gravel: more than 65% of soil coarser than 0.075 mm)		
Major Division	**Group Symbol**	**Soil Group**
GRAVEL (more than half of the coarse fraction is > 2.36 mm)	GW	GRAVEL, well graded
	GP	GRAVEL, poorly graded
	GM	Silty GRAVEL
	GC	Clayey GRAVEL
SAND (more than half of the coarse fraction is < 2.36 mm)	SW	SAND, well graded
	SP	SAND, poorly graded
	SM	Silty SAND
	SC	Clayey SAND

Fine Grained Soils (silt and clay: more than 35% of soil finer than 0.075 mm)		
Major division	**Group Symbol**	**Soil Group**
SILT and CLAY (low to medium plasticity)	ML	SILT, low plasticity
	CL	CLAY, low plasticity
	CI	CLAY, medium plasticity
	OL	Organic SILT
SILT and CLAY (high plasticity)	MH	SILT, high plasticity
	CH	CLAY, high plasticity
	OH	Organic CLAY / SILT
Highly Organic	Pt	PEAT

Coarse grained soils with fines contents between 5% and 12% are provided a dual classification comprising the two group symbols separated by a dash, e.g. for a poorly graded gravel with between 5% and 12% silt fines (poorly graded 'GRAVEL with silt'), the classification is GP-GM.

For the purpose of classification, *poorly graded, uniform,* or *gap graded* soils are all designated as poorly graded. Soils that are dominated by boulders or cobbles are described separately and are not classified.

Classification is routinely undertaken based on tactile assessment with the soil description. Refinement of soil classification may be applied using laboratory assessment, including particle size distribution and Atterberg Limits. Atterberg Limits testing is applied to the sample portion finer than 0.425 mm. Fine grained soil components are assessed on the basis of regions defined within the Modified Casagrande Chart.



ROCK DESCRIPTION AND CLASSIFICATION

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Rock is described in general accordance with Australian Standard AS 1726-2017 (Geotechnical site investigations) in terms of visual and tactile properties, with potential refinement by laboratory testing. AS 1726 defines rock as any aggregate of minerals and/or organic materials that cannot be disaggregated by hand in air or water without prior soaking. The rock description and classification distinguishes between rock material, defects, structure and rock mass.

ROCK DESCRIPTION AND CLASSIFICATION

a) Description of rock material (rock name, grain size and type, colour, texture and fabric, inclusions or minor components, moisture content and durability)

Rock Name: Simple rock names are used to provide a reasonable engineering description rather than a precise geological classification. The rock name is chosen on the basis of origin, with common types summarised below. Additional, non-exhaustive, terminology is included in AS 1726. Rock names not described within AS 1726 may be adopted, with geological characteristics typically noted within accompanying text.

<table>
<tr><th rowspan="2">Grain Size (mm)</th><th colspan="4">Sedimentary</th><th colspan="2">Metamorphic</th><th colspan="3">Igneous</th></tr>
<tr><th colspan="2">Clastic or Detrital</th><th colspan="2">Carbonate</th><th rowspan="2">Pyroclastic</th><th rowspan="2">Foliated</th><th rowspan="2">Non-Foliated</th><th rowspan="2">Felsic</th><th rowspan="2">↔</th><th rowspan="2">Mafic</th></tr>
<tr><th>Low Porosity</th><th>Porous</th></tr>
<tr><td>>2.0</td><td colspan="2">CONGLOMERATE
(rounded grains in a finer matrix)

BRECCIA
(angular or irregular fragments in a finer matrix)</td><td rowspan="4">LIMESTONE
(Predominantly $CaCO_3$)

or

DOLOMITE
(Predominantly $CaMgCO_3$)</td><td>CALCIRUDITE</td><td>AGGLOMERATE
(rounded grains in a finer matrix)

VOLCANIC BRECCIA
(angular fragments in a finer matrix)</td><td>GNEISS</td><td>MARBLE
(carbonate)

QUARTZITE</td><td>GRANITE</td><td>DIORITE</td><td>GABBRO</td></tr>
<tr><td>2.0-0.06</td><td colspan="2">SANDSTONE</td><td>CALCARENITE</td><td>TUFF</td><td>SCHIST</td><td rowspan="3">SERPENTINITE

HORNFELS</td><td>MICRO-GRANITE</td><td>MICRO-DIORITE</td><td>DOLERITE</td></tr>
<tr><td>0.06-0.002</td><td rowspan="2">MUDSTONE
(silt and clay)</td><td>SILTSTONE
(mostly silt)</td><td>CALCISILTITE</td><td rowspan="2">Fine grained TUFF</td><td rowspan="2">PHYLLITE or SLATE</td><td rowspan="2">RHYOLITE</td><td rowspan="2">ANDESITE</td><td rowspan="2">BASALT</td></tr>
<tr><td><0.002</td><td>CLAYSTONE
(mostly clay)</td><td>CALCILUTITE</td></tr>
</table>

Reproduced with modification from Tables 15, 16 and 17, Clause 6.2.3.1, AS 1726-2017, Geotechnical site investigations.

Grain size: For rocks with predominantly sand sized grains the dominant or average grain size is described as follows:

Rock type	Coarse grained	Medium grained	Fine grained
Sedimentary rocks	Mainly 0.6 mm to 2 mm	Mainly 0.2 mm to 0.6 mm	Mainly 0.06 mm (just visible) to 0.2 mm
Igneous and metamorphic rocks	Mainly >2 mm	Mainly 0.06 mm to 2 mm	Mainly <0.6 mm (just visible)

Colour assists in rock identification and interpolation. Rock colour is generally described in a *"moist"* condition, using simple terms (e.g. grey, brown, etc.) and modified as necessary by *"pale"*, *"dark"*, or *"mottled"*. Borderline colours may be described as a combination of these colours (e.g. red-brown).

Texture refers to the arrangement of, or the relationship between, the component grains or crystals (e.g. porphyritic, crystalline or amorphous).

Fabric refers to visible grain arrangement along a preferential orientation or a layering. Fabric may be noted as *"indistinct"* (little effect on strength) or *"distinct"* (rock breaks more easily parallel to the fabric). Common terms include *"massive"* or *"flow banding"* (igneous), *"foliation"* or *"cleavage"* (metamorphic). Sedimentary layering is described as *"bedding"* or (where thickness < 20 mm) *"lamination"*. The typical orientation, spacing or thickness of these structural features can be described directly in millimetres and metres. Further quantification of bedding thickness applied by GHD is as follows:

Bedding Term	Thickness
Very thickly bedded	>2 m
Thickly bedded	0.6 to 2 m
Medium bedded	0.2 to 0.6 m
Thinly bedded	60 to 200 mm
Very thinly bedded	20 to 60 mm
Laminated	6 to 20 mm
Thinly laminated	<6 mm

Features, Inclusions and Minor Components are typically only described when those features could influence the engineering behaviour of the rock. Described features may include: gas bubbles in igneous rocks; veins of quartz, calcite or other minerals; pyrite crystals and nodules or bands of ironstone or carbonate; cross bedding in sandstone; clast or matrix support in conglomerates and breccia.

Moisture content may be described by the feel and appearance of the rock, as follows: *"dry"* (looks and feels dry), *"moist"* (feels cool, darkened in colour, but no water is visible on the surface), or *"wet"* (feels cool, darkened in colour, water film or droplets visible on the surface). The moisture content of rock cored with water may not represent in situ conditions.

Durability of rock samples is noted where there is an observed tendency of samples to crack, breakdown in water or otherwise deteriorate with exposure.

Ref: DS6.5.2.1 Issue 2.0 Date: 01/08/2019

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b) Classification of the rock material condition (strength, weathering and/or alteration)

Estimated Strength refers to the rock material and not the rock mass. The strength is defined in terms of uniaxial compressive strength (UCS), though is typically estimated by either tactile assessment or Point Load Strength Index ($Is_{(50)}$) (measured perpendicular to planar anisotropy). A correlation between $Is_{(50)}$ and UCS is adopted for classification, though is not intended for design purposes without appropriate supporting assessment. A field guide follows:

Term and (Symbol)		UCS (MPa)	$Is_{(50)}$ (MPa)	Field Guide
Very Low	*(VL)*	0.6 – 2	0.03 - 0.1	Material crumbles under firm blows with sharp end of geological pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm thick can be broken by finger pressure.
Low	*(L)*	2 - 6	0.1 - 0.3	Easily scored with knife; indentations 1 to 3 mm show in the specimen with firm blows of a geological pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	*(M)*	6 - 20	0.3 - 1.0	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
High	*(H)*	20 - 60	1 - 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a geological pick with a single firm blow; rock rings under hammer.
Very High	*(VH)*	60 - 200	3 -10	Hand specimen breaks with geological pick after more than one blow; rock rings under hammer.
Extremely High	*(EH)*	>200	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Based on Table 19, Clause 6.2.4.1, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Material with strength less than *"very low"* is described using soil characteristics, with the presence of an original rock texture or fabric noted if relevant.

Weathering and Alteration: The process of weathering involves physical and chemical changes to the rock resulting from exposure near the earth's surface. A subjective scale for weathering is applied as follows:

Weathering Term and (Symbol)		Description
Residual Soil	*(RS)*	Material has weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered	*(XW)*	Material has weathered to such an extent that it has soil properties. Mass structure, material texture and fabric of original rock are still visible.
Highly Weathered	*(HW)*	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered	*(MW)*	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered	*(SW)*	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	*(Fr)*	Rock shows no sign of decomposition of individual minerals or colour changes.

Modified based on Table 20, Clause 6.2.4.2, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Where physical and chemical changes to the rock are caused by hot gases or liquids at depth, the process is called alteration. Unlike weathering, the distribution of altered material may occur at any depth and show no relationship to topography. Where alteration minerals are identified the terms *"extremely altered" (XA)*, *"highly altered" (HA)*, *"moderately altered" (MA)* and *"slightly altered" (SA)* can be used to describe the physical and chemical changes described above.

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c) Description of defects (defect type, orientation, roughness and shape, coatings and composition of seams, spacing, length, openness and thickness, block shape)

Defects often control the overall engineering behaviour of a rock mass. AS 1726 defines a defect as “a discontinuity, fracture, break or void in the material or materials across which there is little or no tensile strength”. Describing the type, character and distribution of natural defects is an essential part of the description of many rock masses.

Commonly described characteristics of defects within a rock mass include type, orientation, roughness and shape, coatings and composition of seams, aperture, persistence, spacing and block shape.

The degree of detail required for defect descriptions depends on project requirements. All defects judged of engineering significance for the site and project are described individually. Where appropriate, generalised descriptions for less significant, or multiple similar, defects can be provided for delineated parts of rock core or exposures. A general description of delineated defect sets is provided when sufficient orientation data is available.

Defect Type is described using the terms summarised below. On core logs, only natural defects across which the core is discontinuous are described (i.e. inferred artificial fractures such as drill breaks are excluded). Incipient defects are described using the relevant texture or fabric terms. Healed defects (those that have been re-cemented by minerals such as chlorite or calcite) are described using the prefix “healed” (e.g. healed joint).

Type and (Symbol)		Description	Diagram
Parting	(Pt)	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.	
Joint	(Jt)	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or subparallel to layering or to planar anisotropy in the rock material. May be open or closed.	
Sheared Surface	(SS)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.	
Sheared Zone	(SZ)	Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
Sheared Seam	(SSm)	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
Crushed Seam	(CSm)	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.	
Infilled Seam	(ISm)	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1 mm thick may be described as a veneer or coating on a joint surface.	
Extremely Weathered Seam	(WSm)	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.	

Modified based on Table 22, Clause 6.2.5.2, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Defect Orientation is recorded as the “dip” (maximum angle of the mean plane, measured from horizontal) and the “dip direction” (azimuth of the dip, measured clockwise from true north). Dip and dip direction is expressed in degrees, with two-digit and three-digit numbers respectively, separated by a slash (e.g. 45/090). For vertical boreholes, the defect dip is measured as the acute angle from horizontal. Rock core extracted from vertical boreholes is generally not oriented, so the dip direction cannot be directly measured. For non-oriented inclined boreholes, a defect “alpha” (α) angle is measured as the acute angle from the core axis. For vertical and non-oriented inclined boreholes, the dip direction can sometimes be estimated from the relationship of the defect to a well-defined site structure such as fabric. For oriented inclined boreholes, the measurement of the defect orientation is carried out and recorded in a form suited to the particular device being used and later processed to report true dip and dip direction.

ROCK DESCRIPTION AND CLASSIFICATION

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Roughness and Shape of the defect surface combine to have significant influence on shear strength. Standard descriptions and abbreviations include:

Roughness and (Symbol)		Description
Very Rough	(VR)	Many large surface irregularities (amplitude generally more than 1 mm). Feels like, or coarser than very coarse sand paper.
Rough	(Rf)	Many small surface irregularities (amplitude generally less than 1 mm). Feels like fine to coarse sand paper.
Smooth	(So)	Smooth to touch. Few or no surface irregularities.
Polished	(Pol)	Shiny smooth surface.
Slickensided	(Slk)	Grooved or striated surface, usually polished.

Shape and (Symbol)		Description
Planar	(Pln	The defect does not vary in orientation.
Curved	(Cu)	The defect has a gradual change in orientation.
Undulating	(Un)	The defect has a wavy surface.
Stepped	(St)	The defect has one or more well defined steps.
Irregular	(Ir)	The defect has many sharp changes of orientation.

Although the surface roughness of defects can be described at small (10-100 mm) scales of observation, the overall shape of the defect surface can usually be observed only at medium (0.1-1 m) and large (>1 m) scale.

Where it is necessary to assess the shear strength of a defect, observations are generally made at multiple scales. Surface roughness may also be characterised by using the joint roughness coefficient (JRC) profiles established by Barton and Choubey (1977). Where large-scale observations are possible, further measurement of defect "waviness" (angle of the asperities relative to the overall dip angle of the plane) is made.

Coatings and Composition of Seams: Many defects have surface coatings, which can affect their shear strength. Standard descriptions include:

Coating and (Symbol)		Description
Clean	(Cn)	No visible coating.
Stained	(Sn)	No visible coating but surfaces are discoloured.
Veneer	(Ve)	A visible coating of soil or mineral substance, but too thin to be measured may be patchy.
Coating	(Co)	A visible coating up to 1 mm thick. Soil material greater than 1 mm thick is described using defect terms (e.g. infilled seam). Rock material greater than 1 mm thick is described as a vein (Vn).

Common Minerals and (Symbol)	
Clay	(CLAY)
Calcite	(Ca)
Carbonaceous	(X)
Chlorite	(Kt)
Iron Oxide	(Fe)
Micaceous	(Mi)
Manganese	(Mn)
Pyrite	(Py)
Quartz	(Qz)

The composition of seams are described using soil description terms as given on the SOIL DESCRIPTION AND CLASSIFICATION Standard Sheet. Where possible the mineralogy of coatings is identified. Common mineral coatings include:

Aperture: Defects across which there is little or no tensile strength can be either *"open"* (*Op*) or *"closed"* (*Cl*). For rock core, the width of the "open" defect is measured whilst still in the core barrel splits. The descriptor *"tight"* (*Ti*) can only apply to healed or incipient defects (i.e. veins, foliation, etc.).

Persistence and Spacing of defects is described directly in millimetres and metres. If the measurement of defect persistence is limited by the extent of the exposure, the end conditions are noted (i.e. 0, 1 or 2 defect ends observed). The spacing between defects of similar orientation (i.e. within a specific defect set) is recorded when possible.

The frequency of defects within rock core can be measured as either: the spacing between successive defects; or the "Fracture Index", which is the number of defects per metre of core.

Spacing Term	Thickness
Very wide	>2 m
Wide	0.6 to 2 m
Medium	0.2 to 0.6 m
Closely	60 to 200 mm
Very closely	20 to 60 mm
Extremely closely	6 to 20 mm

Block Shape: Where it is considered significant, block shape can be described using the subjective terms as follows:

Block Shape	Description
Polyhedral	Irregular discontinuities without arrangement into distinct sets, and of small persistence.
Tabular	One dominant set of parallel discontinuities, for example bedding planes, with other non-continuous joints; thickness of blocks much less than length or width.
Prismatic	Two dominant sets of discontinuities, approximately orthogonal and parallel, with a third irregular set; thickness of blocks much less than length or width.
Equidimensional	Three dominant sets of discontinuities, approximately orthogonal, with occasional irregular joints, giving equidimensional blocks.
Rhomboidal	Three (or more) dominant, mutually oblique, sets of joints giving oblique-shaped, equidimensional blocks.
Columnar	Several, usually more than three sets of continuous, parallel joints usually crossed by irregular joints; lengths much greater than other dimensions.

Modified based on Table 23, Clause 6.2.5.7, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Ref: DS6.5.2.1 Issue 2.0 Date: 01/08/2019

ROCK DESCRIPTION AND CLASSIFICATION

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d) Interpreted stratigraphic unit

Stratigraphic units may be interpreted and reported, in accordance with The Australian Stratigraphic Units Database (ASUD). The terms *"possibly"* or *"probably"* indicate increased uncertainty in this interpretation.

e) Geological structure

After describing the rock material and defects, an interpretation of the nature and configuration of rock mass defects may be presented in logs, charts, 2D sections and 3D models (e.g. dipping strata, folds, unconformities, weathering profiles, defect sets, geological faults, etc.).

PARAMETERS RELATED TO CORE DRILLING

Drill Depth and Core Loss: Drilling intervals are shown on GHD Core Log Sheets by depth increments and horizontal marker lines.

"Core loss", or its inverse "total core recovery" (TCR), is measured as a percentage of the core run. If the location of the core loss is known, or strongly suspected, it is shown in a region of the column bounded by dashed horizontal lines. If unknown, core loss is assigned to the bottom of a core run.

Rock Quality Designation (RQD), described by Deere et al. (1989), may be recorded on GHD Core Log Sheets.

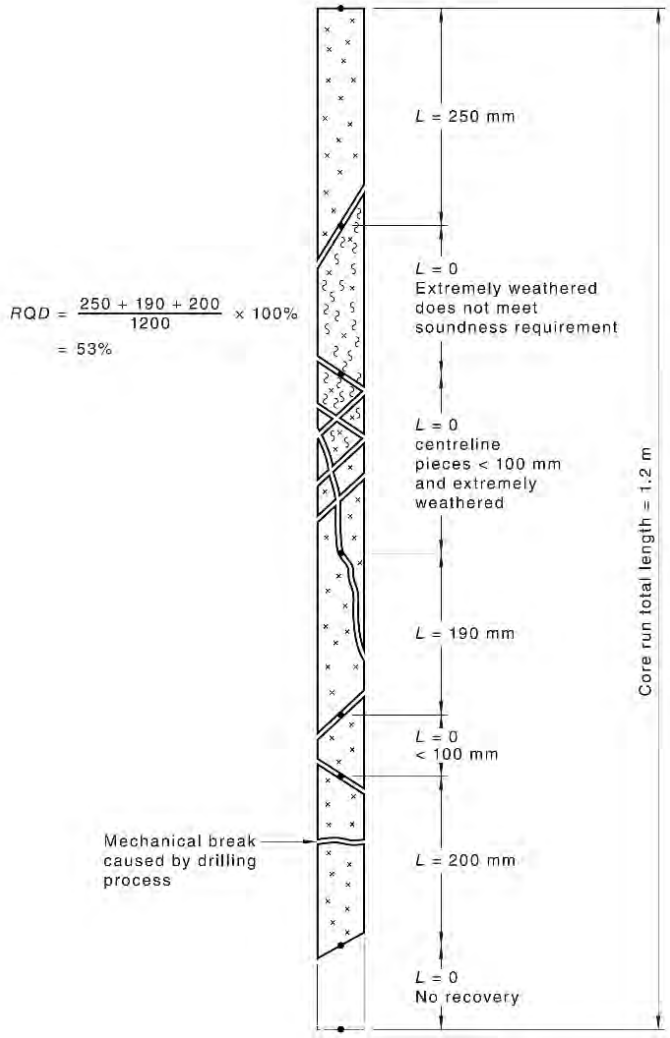
For certain projects, such as tunnelling or underground mining investigations, rock mass ratings or classifications can be required as part of the design process. The RQD forms a component of these rock mass ratings and provides a quantitative estimate of rock mass quality from rock core logs.

The rock core must be "N" sized (nominally 50 mm) or greater for derivation of RQD. The RQD is expressed as a percentage of intact rock core (excluding residual soil and extremely weathered rock) greater than 100 mm in length over the total selected core length.

Deere et al. (1989) recommends measuring lengths of core along the centreline, as shown right.

RQD is expressed as:

$$RQD = \frac{\sum Length\ of\ sound\ core\ pieces > 100\ mm\ in\ length}{Length\ of\ core\ run}\ x\ 100\%$$



RQD measurement procedure
(reproduced from Figure 13, Clause 6.2.9.4, AS 1726-2017, Geotechnical site investigations)

ROCK MASS CLASSIFICATION

Rock mass classification schemes may be used to represent the engineering characteristics of a rock mass. A large variety of classification schemes have been developed by various authors, ranging from simple to complex. All of the schemes are limited in their application and many rock mass classification systems assume that the rock mass is isotropic, which is rarely the case.

References

STANDARDS AUSTRALIA (2017). AS 1726-2017. GEOTECHNICAL SITE INVESTIGATIONS.
BARTON, N. AND CHOUBEY, V. (1977). THE SHEAR STRENGTH OF ROCK JOINTS IN THEORY AND PRACTICE. ROCK MECHANICS 10, 1-54. SPRINGER.
DEERE, D.U. AND DEERE, D.W. (1989). ROCK QUALITY DESIGNATION (RQD) AFTER TWENTY YEARS. CONTRACT REPORT GL-89-1. ARMY CORPS OF ENGINEERS. WASHINGTON DC, 1989.

DYNAMIC CONE PENETROMETER (DCP) TESTING

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SCOPE

The Dynamic Cone Penetrometer (DCP) test comprises the measurement of the soil resistance to a steel rod driven into the ground by a dropped weight.

The DCP test is a simple manual test used in both sandy and clayey soils. The test is a measure of the shear strength of the soil at relatively shallow depth.

EQUIPMENT AND METHOD

A general description of the dynamic penetrometer apparatus used by our firm is presented in Australian Standard AS 1289.6.3.2. The equipment utilises a 9 kg sliding weight with a drop height of 510 mm. It is fitted with a conical tip. The equipment can be adjusted for a fall of 600 mm and use of a blunt tip in accordance with AS 1289.6.3.3.

The test data are generally recorded as the number of blows (n) per 50 mm of penetration. For specific applications (such as pavement investigations), the data may be collected in the reverse form, i.e. as mm per blow. The results are presented either in tabular or graphic form for reporting purposes.

INTERPRETATION

The interpretation of the DCP results is generally based on the assumption that the measured resistance is a function of soil strength. A profile of soil strength (cohesive soils) or density index (cohesionless soils) can thus be established. The test often can be used to qualitatively indicate the presence of soft or loose zones within a soil profile.

The energy of the system per unit area is similar to that of the larger Standard Penetration Test (SPT). Thus, the common relationships of SPT and other parameters can be used as a means of estimating soil properties, after appropriate site specific consideration. The interpretations from the test are approximate only, and this is particularly pertinent to sand profiles where the magnitude of confinement stress is important in the assessment of the results.

Interpretation of the DCP penetration rate at depth must be conducted with due regard to rod friction effects. In particular, care must be exercised with soft clay profiles where rod resistance may have an unconservative impact on the results. Care must also be exercised with soil profiles containing larger particles such as gravels and cobbles where penetration rate can be affected if the DCP tip strikes or glances off such particles.

In-situ California Bearing Ratio (CBR) values of clay soil subgrades are sometimes interpreted directly from DCP test results for use in road pavement design. In this case, the correlation between DCP and CBR based on that published in AUSTROADS Pavement Structural Design guide (AGPT02-17 Part 2) may be applied. This correlation should be verified by site specific laboratory testing, where appropriate. In addition, the effects of moisture content variations (in-situ versus design conditions) must be considered, as the DCP test only reflects the shear strength of the soil at the time of testing. Further information can be found in AUSTROADS Geotechnical Investigation and Design guide (AGRD07-08 Part 7).

Ref: DS5.4.3 Rev 0 Date: 05/10/2018

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380 CRONULLACENTRE_STG2.GPJ GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH01

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** RCO
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 4/7/2019 | **Date Completed :** 4/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40 Recorded Blows	Comments/ Observations
	Diatube				0.01		-	TILE: pale grey, 15mm.	-	-		
					0.02		- -	BEDDING LAYER: stabilised sand, grey.				
					0.15		-	CONCRETE: dark grey, mixed aggregates up to 20mm. 0.13m, steel reinforcement.	M	L	DCP @ 0.2m: Refusal	
				ES/ D/ Q0003				FILL: Gravelly SAND: dark brown, fine to medium grained, fine to coarse sub-rounded to sub-angular gravel (volcanics and ironstone),			20 4 2	
					0.42		CH	trace silt (fill).	w ≈ PL	F	4	
				D				CLAY: red-brown, high plasticity, trace medium to coarse sub-angular to sub-rounded gravel (residual).			2	
											2	
								0.8m, becoming orange.		St	4	
											5	
				ES/ D				0.9m, becoming orange mottled red.			14	
1	Hand Auger	Nil	GNE							VSt	12	
					1.20		CI	CLAY: red mottled grey and brown, medium plasticity (residual).	w ≈ PL	VSt	14	
											10	
								1.4m, becoming grey mottled red.			12	
											8	
											8	
				ES/ D	1.70						9	
								End of Borehole at 1.7 metres. Refusal.			8	
											9	
2											DCP @ 2.0m: Terminated	

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-28380

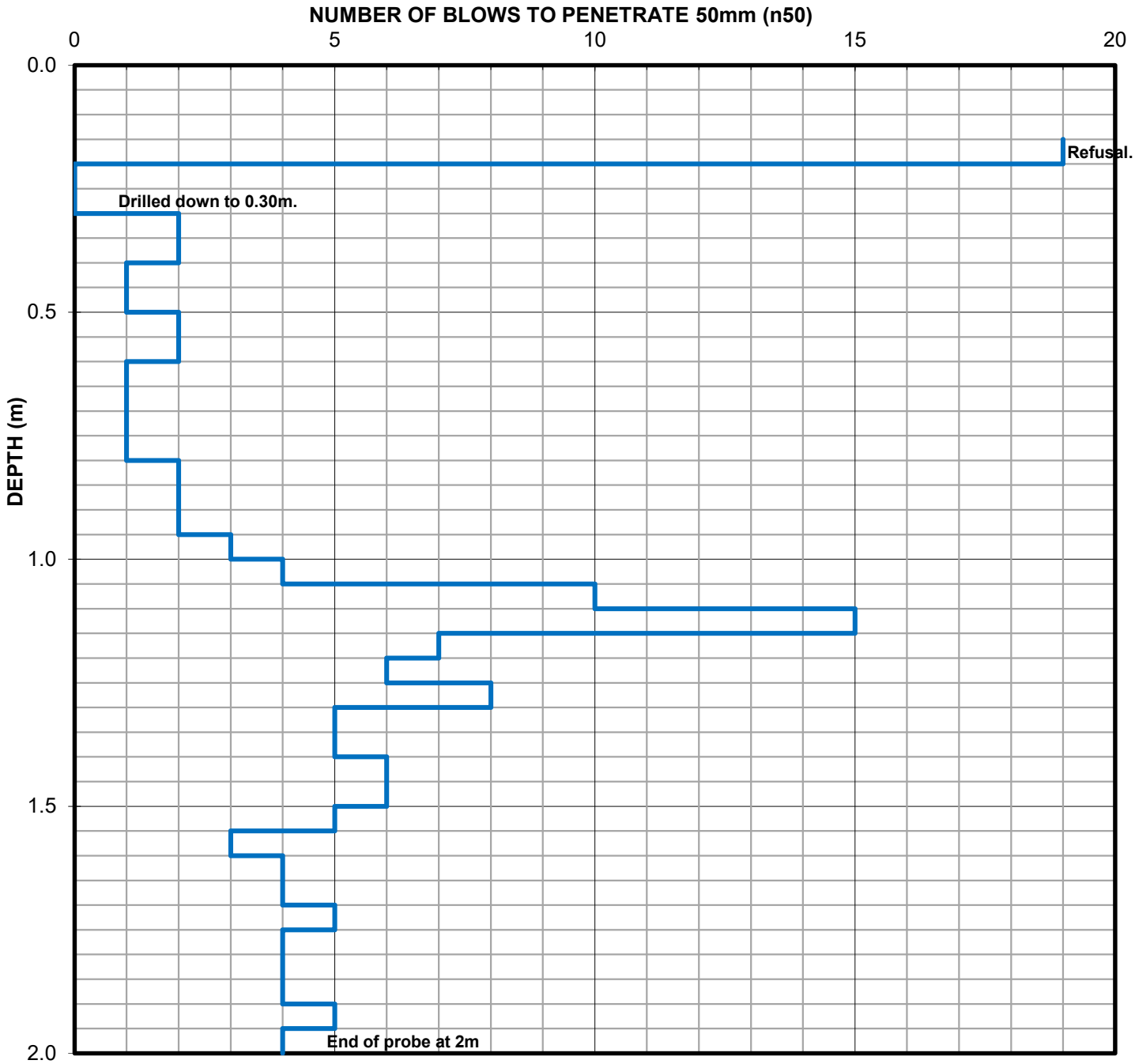
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP01

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	04/07/19
Adjacent Test Hole / Pit: BH01		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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GHD GEOTECHNICS

Job No. **2128380**

TP: BH01

DEPTH: 0.00 - 0.14

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH02

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** RCO
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 4/7/2019 | **Date Completed :** 8/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

DRILLING					MATERIAL						DCP	Note: * indicates signatures on original issue of log or last revision of log
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40 Recorded Blows	Comments/ Observations
	Diatube	Nil	GNE		0.06		-	CONCRETE: dark grey, mixed aggregates up to 15mm.	-	-		
							-	FILL: Sandy GRAVEL: dark brown, fine to coarse, sub-angular to sub-rounded, fine to coarse grained sand, trace silt (fill).	M	MD		
					0.17		-	CONCRETE: dark grey, mixed aggregates up to 15mm.	-	-	DCP @ 0.2m: Refusal 20	
	Hand Auger			ES/ D	0.38		-	FILL: Gravelly SAND: brown, fine to medium grained, fine to coarse sub-rounded to sub-angular gravel (sandstone), trace clay (fill).	M	MD	13	
				D	0.50		-	FILL: CLAY: dark brown, medium plasticity, with fine to coarse sub-rounded to sub-angular gravel (sandstone) (fill).	w = PL	VSt	12	
				D	0.62		CH	CLAY: brown mottled red, orange, high plasticity, with fine to coarse sub-angular to angular gravel (ironstone) (residual).	w = PL	VSt	10	
					0.81			0.71m, becoming orange mottled red, trace gravel (ironstone). End of Borehole at 0.81 metres. Refusal.			12 9	
1											12 11 8 16 14 12 17 18 18 15 9	
2											DCP @ 2.0m: Terminated	

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-28380

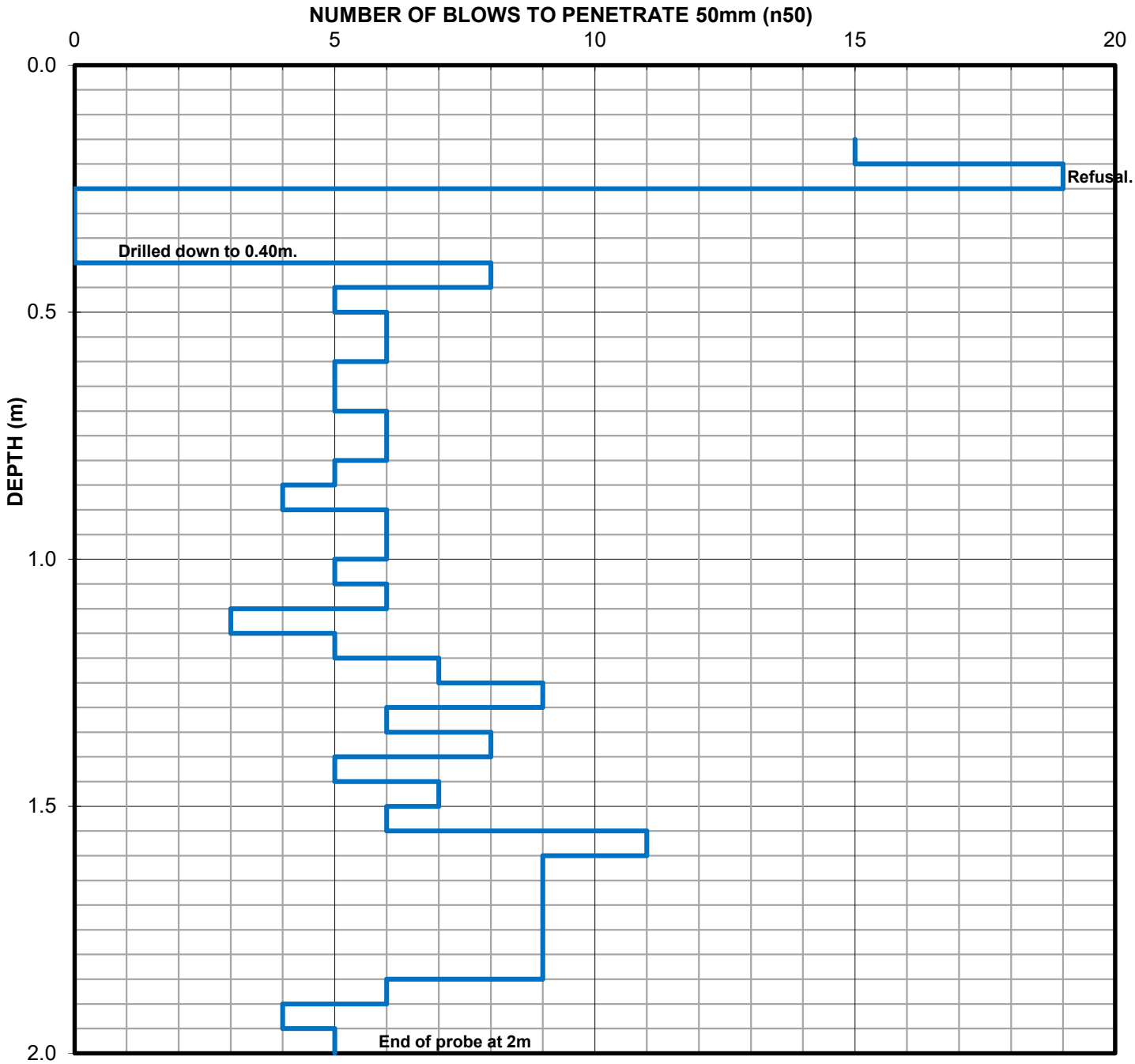
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP02

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	08/07/19
Adjacent Test Hole / Pit: BH02		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



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Job No. **2128380**

TP: BH02

DEPTH: 0.00 - 0.06m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

TP: BH02

DEPTH: 0.17 - 0.36m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH03

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** RCO
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 4/7/2019 | **Date Completed :** 4/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40	Recorded Blows
	Diatube	Nil	GNE				-	CONCRETE: dark grey, mixed aggregates up to 30mm.	-	-		
					0.12		-	FILL: Sandy GRAVEL: dark brown, fine to coarse, sub-rounded to sub-angular (sandstone and basalt), fine to coarse grained sand, trace silt (fill).	SM	MD		20
				D	0.33		-	CONCRETE: brown, mixed aggregates up to 25mm.	-	-	DCP @ 0.2m: Refusal	
					0.39		-	FILL: Sandy GRAVEL: brown, fine to medium, sub-rounded to sub-angular, fine to coarse grained sand, trace clay (fill).	SM	MD		13
	Hand Auger			D	0.50		CH	CLAY: brown mottled red, high plasticity, with fine to medium sub-angular to angular gravel (ironstone) (residual). 0.6m, becoming orange mottled red.	w = PL	VSt		12
				D	0.80			End of Borehole at 0.8 metres. Refusal.				10
												7
												10
												8
1												9
												10
												8
												13
												15
												13
												15
												21
												21
												29
2											DCP @ 2.0m: Terminated	

Note: * indicates signatures on original issue of log or last revision of log

Comments/ Observations

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-28380

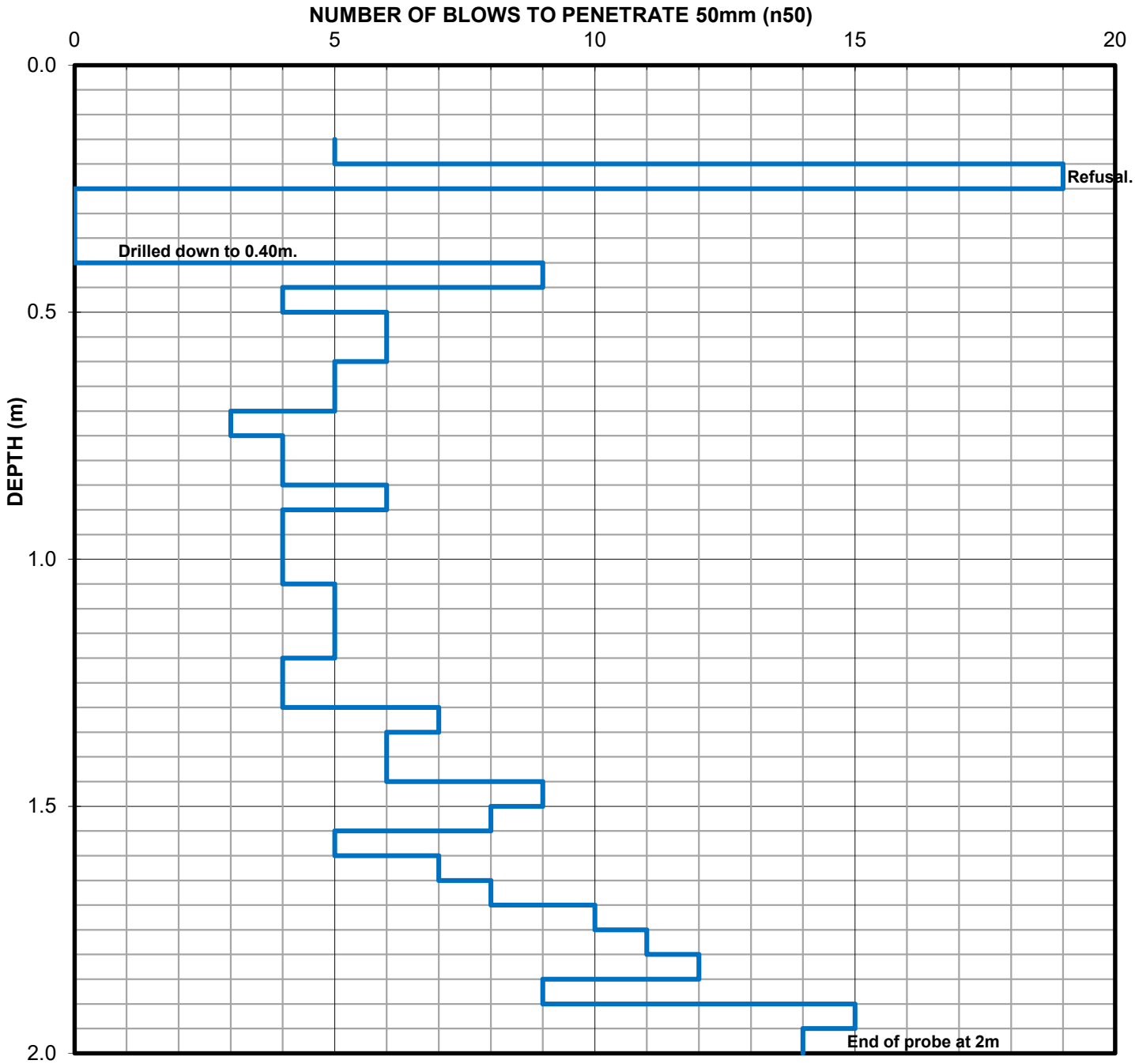
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP03

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	08/07/19
Adjacent Test Hole / Pit: BH03		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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Job No. **2128380**

TP: BH03

DEPTH: 0.00 - 0.12m

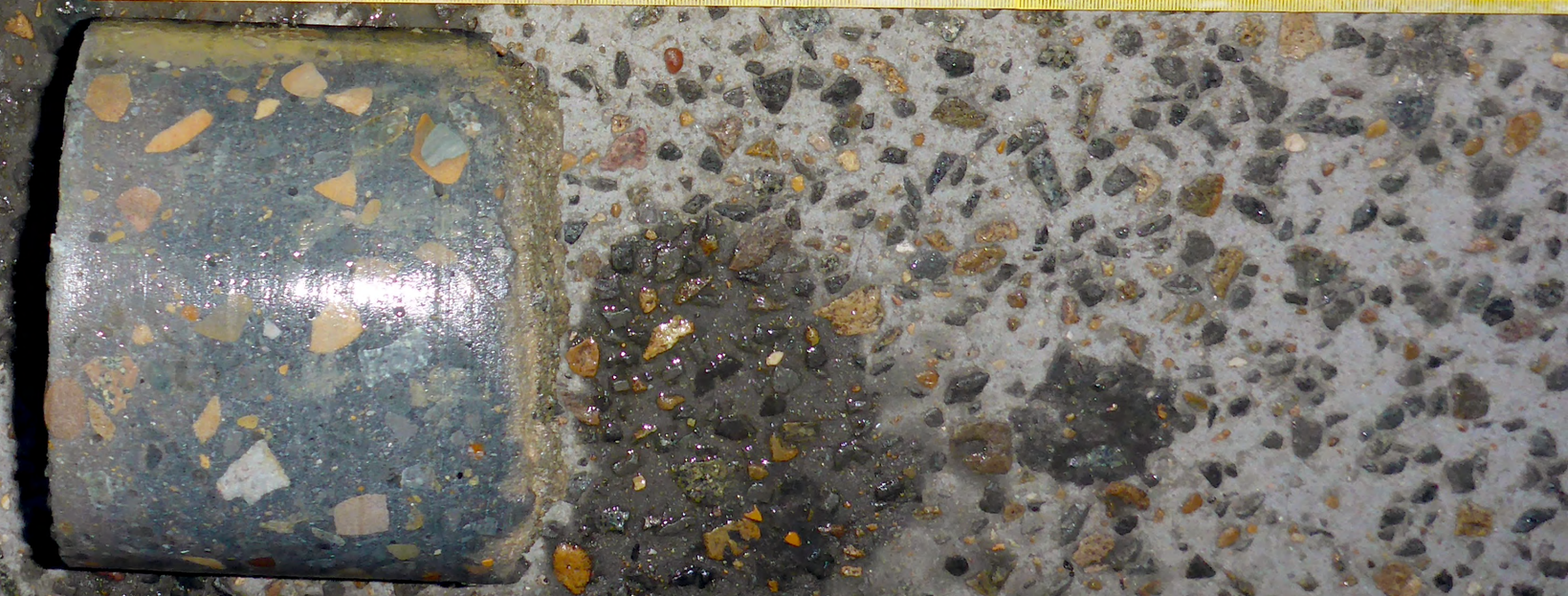
CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 4/7/19



BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH04

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** RCO
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 4/7/2019 | **Date Completed :** 8/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40) Recorded Blows	Comments/ Observations
	Diatube	Nil	GNE		0.01		-	TILE: grey, 15mm.	-	-		
					0.08		-	BEDDING LAYER: stabilised sand, grey.	-	-		
							-	CONCRETE: dark grey, mixed aggregates up to 20mm.	-	-	14	
	Hand Auger			D	0.24		-	FILL: Sandy GRAVEL: dark brown, fine to coarse, sub-rounded to sub-angular gravel (sandstone and basalt), fine to coarse grained sand, trace silt (fill).	M	MD	12	
				D	0.40		CH	CLAY: orange mottled red, high plasticity, trace fine to medium gravel (ironstone) (residual).	w ≈ PL	St	2	
					0.60			End of Borehole at 0.6 metres. Refusal.			3	
											4	
											6	
											9	
											7	
1											10	
											9	
											10	
											9	
											10	
											15	
											16	
											16	
											15	
											15	
2											11	DCP @ 2.0m: Terminated

See standard sheets for details of abbreviations & basis of descriptions

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-28380

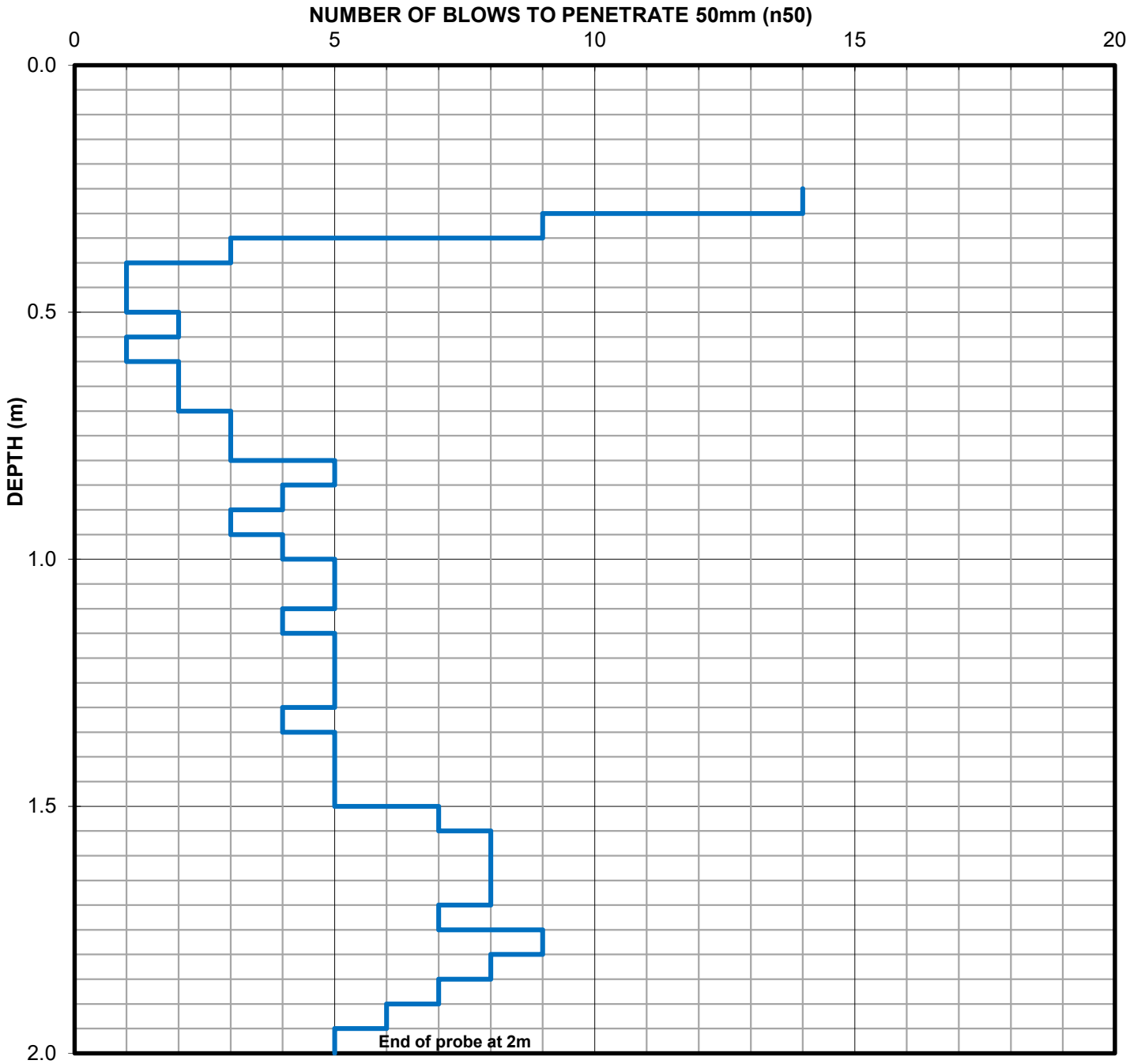
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP04

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	08/07/19
Adjacent Test Hole / Pit: BH04		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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Job No. **2128380**

TP: BH04

DEPTH: 0.00 - 0.24m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH05

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** RCO
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 4/7/2019 | **Date Completed :** 4/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40 Recorded Blows	Comments/ Observations
0	Diatube	Nil	GNE		0.02		-	TILE: pale grey, 20mm.	-	-		
					0.05		-	BEDDING LAYER: stabilised sand, grey.	-	-		
					0.14		-		-	-		
					0.17		-	CONCRETE: dark grey, mixed aggregates up to 20mm.	M	L		
							-		-	-		
					0.25		-	FILL: Sandy GRAVEL: brown, medium to coarse, sub-rounded to sub-angular (fill).	M	D		
				D				CONCRETE: brown, mixed aggregates up to 20mm.				
	Hand Auger				0.50		-	FILL: GRAVEL: black, fine to coarse, angular (asphaltic) (fill).	M	MD-D		
				D				FILL: SAND: yellow, fine to medium grained, trace roots and rootlets (fill).				
				D	0.90		CI	CLAY: grey mottled red, medium plasticity (residual).	w ≈ PL	H		
1					1.20							
								End of Borehole at 1.2 metres. Refusal.				
2												

DCP @.4m: Refusal — 20
DCP @1.2m: Refusal — 20

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Job No. 21-28380

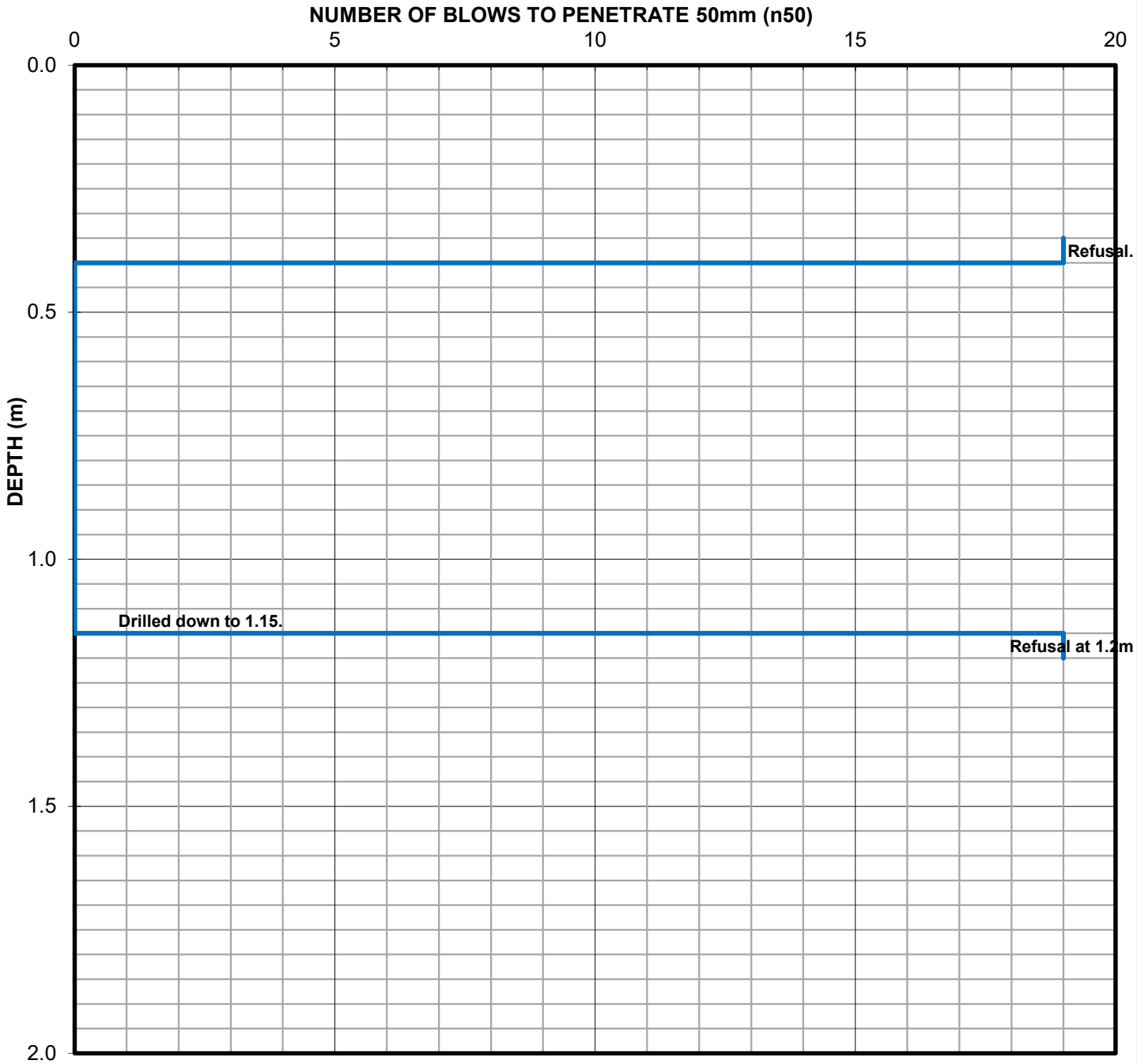
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP05

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	04/07/19
Adjacent Test Hole / Pit: BH05		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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GHD GEOTECHNICS

Job No. **2128380**

TP: BH06

DEPTH: 0.00 - 0.34m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH06

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** RCO
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 4/7/2019 | **Date Completed :** 4/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						DCP		
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40	Recorded Blows	Comments/ Observations
	Diatube	Nil	GNE		0.02		-	TILE: pale grey, 15mm.	-	-			
					0.04		-	BEDDING LAYER: stabilised sand, grey.	-	-			
					0.15		-	CONCRETE: beige, mixed aggregates up to 20mm.	-	-			
								CONCRETE: pale beige, mixed rounded aggregates up to 30mm. 0.15m, plastic lining.				10	
	Hand Auger			D	0.34		-		M	D		18	
					0.37		-	FILL: SAND: yellow, medium grained, with roots and rootlets (fill).	M	VD			
								FILL: Gravelly SAND: brown, fine to medium grained, sub-angular to sub-rounded, fine to medium gravel, trace clay (fill).			DCP @ 0.55m: Refusal	20	
					0.62			End of Borehole at 0.62 metres. Refusal.				18	
												6	
												9	
												11	
1												10	
												10	
												15	
												18	
												12	
												11	
												12	
												11	
												14	
												15	
2											DCP @ 2.0m: Terminated	15	

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Job No. 21-28380

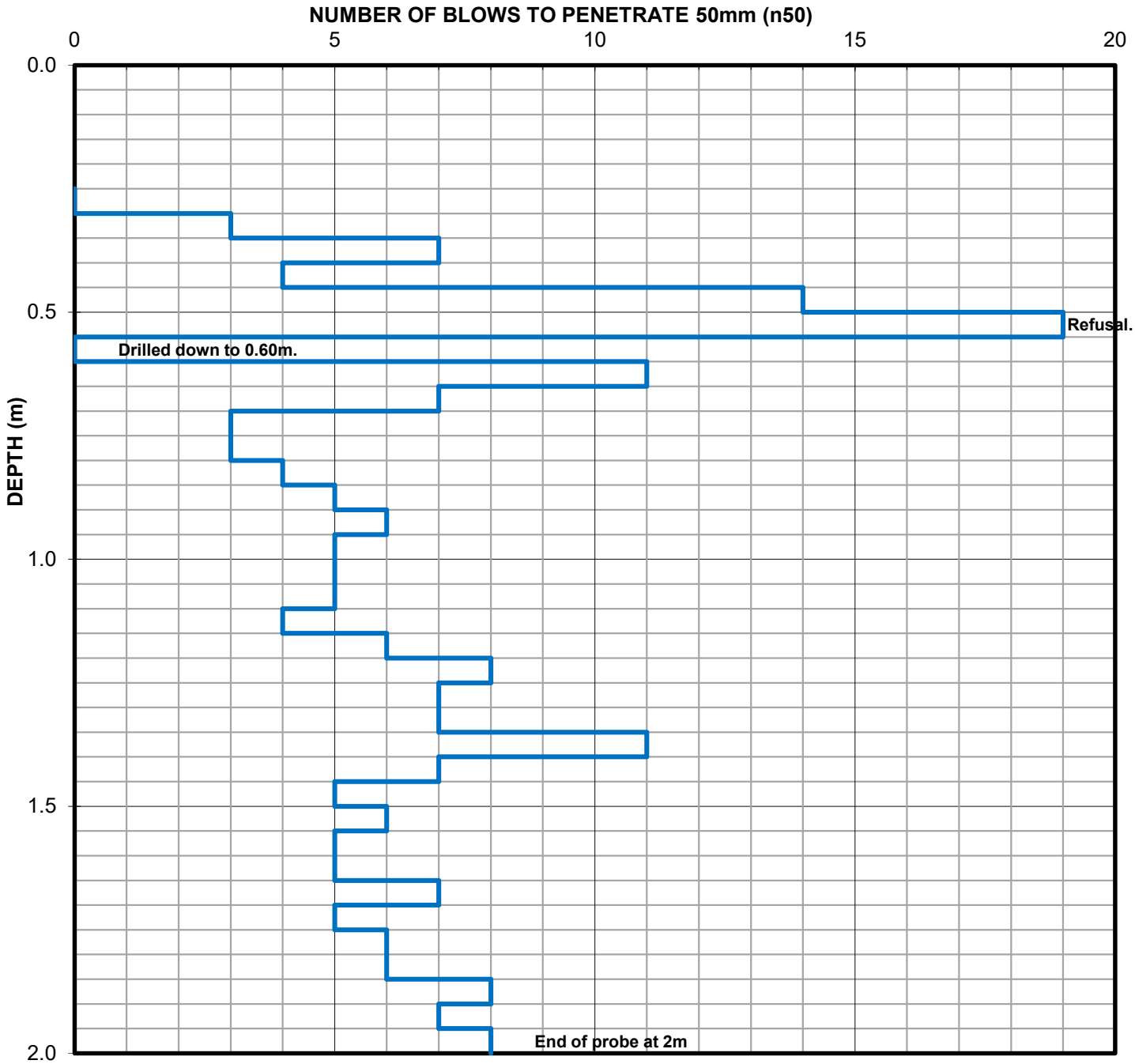
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP06

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	04/07/19
Adjacent Test Hole / Pit: BH06		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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Job No. **2128380**

TP: BH05

DEPTH: 0.00 - 0.25m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH07

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** RCO
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 4/7/2019 | **Date Completed :** 4/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40) Recorded Blows	Comments/ Observations
	Diatube	Nil	GNE		0.01		-	TILE: pale grey, 15mm.	-	-		
					0.05		-	BEDDING LAYER: stabilised sand, grey.	-	-		
							-		-	-		
					0.17		-	CONCRETE: grey, mixed aggregates up to 20mm. 0.13m, steel reinforcement.	-	-		
					0.34			CONCRETE: grey, mixed rounded aggregates up to 45mm.				
	Hand Auger			D			-	FILL: SAND: yellow-brown, fine to medium grained, with roots and rootlets (fill).	M	MD	14	
				D				0.4m, becoming brown, with fine to medium sub-rounded to sub-angular gravel (volcanics, ironstone and sandstone), with silt.			8	
					0.60						7	
				D			CH	0.5m, coarse gravel (sandstone and basalt).	w < PL	VSt	9	
								CLAY: brown mottled red, high plasticity, trace fine sub-rounded to sub-angular gravel, (ironstone), trace roots (residual).			11	
					0.90			0.85m, becoming grey mottled brown and red, no gravel.			11	
1								End of Borehole at 0.9 metres. Refusal.			15	
											17	
											12	
											16	
											19	
											23	
											19	
											17	
											20	
											19	
2											19	

DCP @ 2.0m: Terminated

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-28380

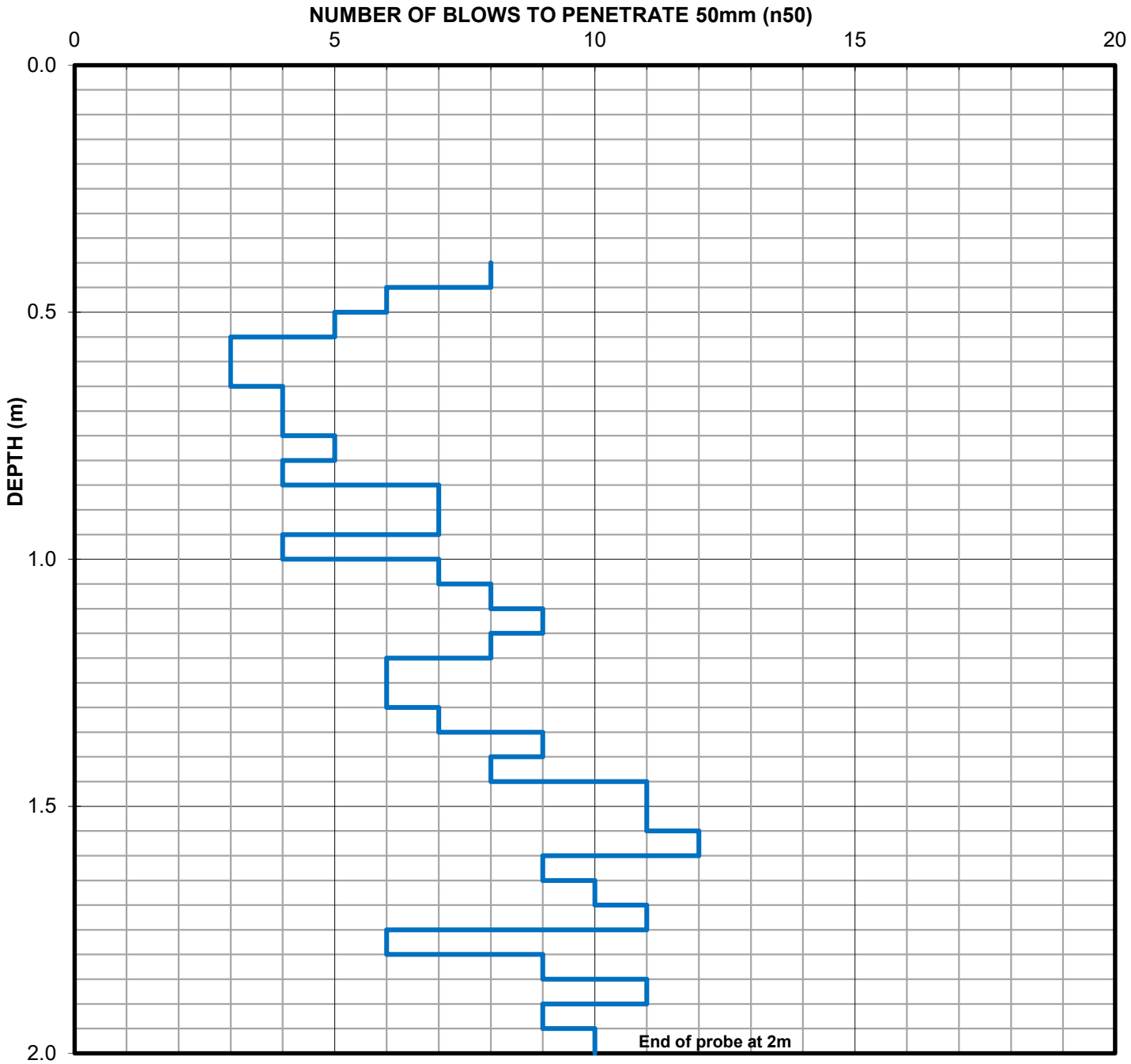
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP07

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	04/07/19
Adjacent Test Hole / Pit: BH07		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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GHD GEOTECHNICS

Job No. **2128380**

TP: BH07

DEPTH: 0.00 - 0.34m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 4/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH09

SHEET 1 OF 1

Position : Refer to test location plan		**Surface RL:** -	**Angle from Horiz. :** 90°		**Processed :** HAL
Rig Type : 150mm Diatube	**Mounting:** Stand	**Contractor :** Diacore	**Driller :** Noah		**Checked :** ICC
Date Started : 3/7/2019	**Date Completed :** 3/7/2019		**Logged by :** LCD/MG		**Date:** 1/8/19

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40 Recorded Blows	Comments/ Observations
	Diatube 100mm Ø				0.01		-	TILE: grey, 15mm.	-	-		
					0.05		-	BEDDING LAYER: stabilised sand, grey.	-	-		
							-		-	-		
					0.17		-	CONCRETE: dark grey, mixed aggregates up to 20mm, steel reinforcement between 0.12-0.55m.	M	L	1	
					0.25		-	FILL: Sandy GRAVEL: dark grey, fine, sub-rounded to sub-angular, medium grained sand (fill).	w ≈ PL	MD	4	
					0.37		Cl	FILL: SAND: yellow, medium to coarse grained (fill).	w ≈ PL	St	4	
								CLAY: brown, medium plasticity, trace fine gravels (residual).			9	
	Hand Auger	Nil	GNE	D							3	
											2	
								0.75m, becoming brown mottled yellow-red.	w < PL	VSt	9	
1											10	
											7	
											8	
								1.15m, becoming grey-mottled red, low to medium plasticity.			9	
											6	
					1.40						7	
								End of Borehole at 1.4 metres. Refusal.			7	
											12	
											13	
											10	
											13	
2											13	DCP @ 2.0m: Terminated

Note: * indicates signatures on original issue of log or last revision of log

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-28380

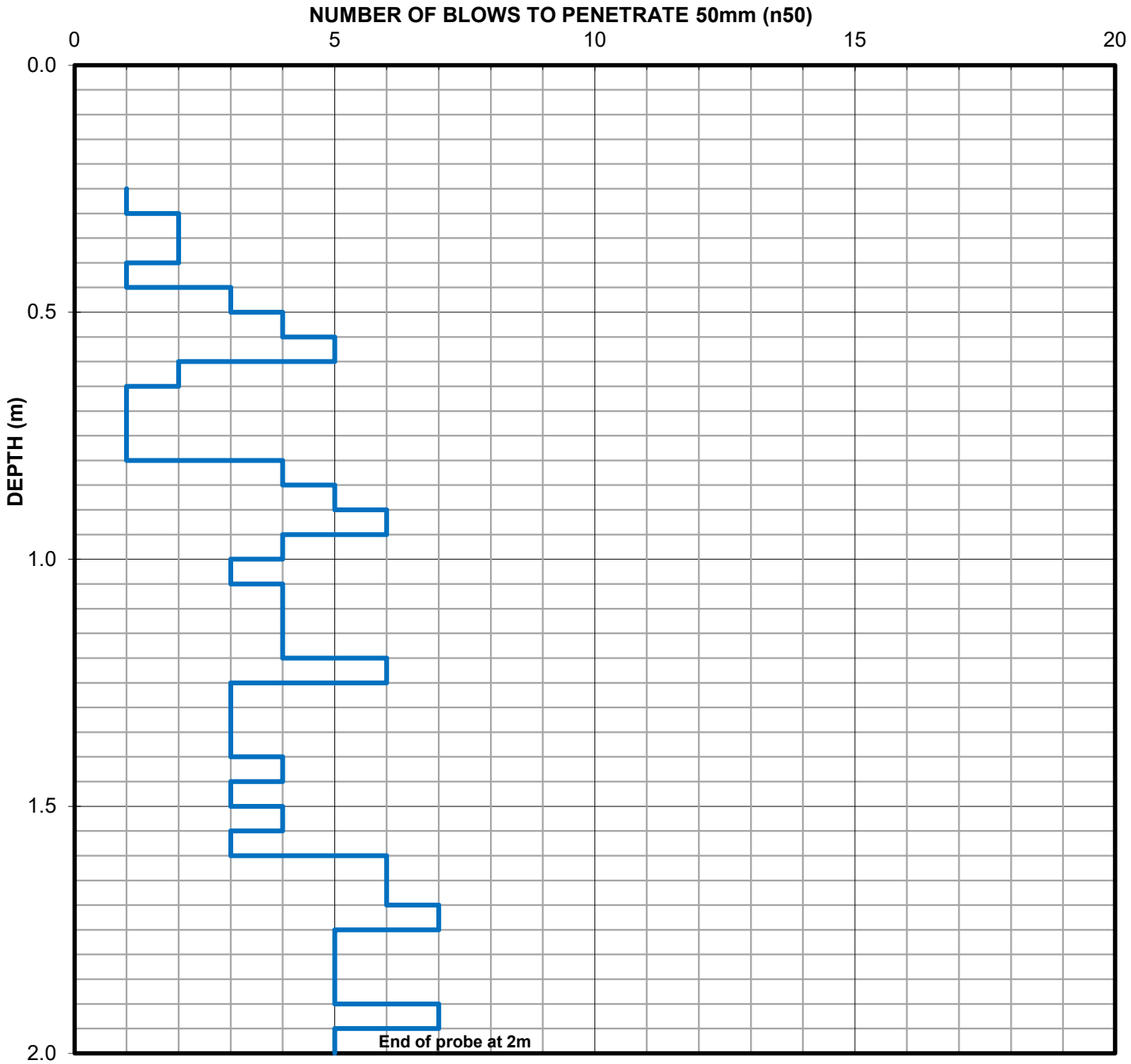
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP09

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	03/07/19
Adjacent Test Hole / Pit: BH09		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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GHD GEOTECHNICS

Job No. **2128380**

TP: BH09

DEPTH: 0.00 - 0.17m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH10

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** HAL
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 3/7/2019 | **Date Completed :** 3/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40) Recorded Blows	Comments/ Observations
	Diatube	Nil	GNE		0.01		-	TILE: grey, 15mm.	-	-		
					0.04		-	BEDDING LAYER: stabilised sand, grey.	-	-		
					0.15		-	CONCRETE: grey, mixed aggregates up to 20mm. 0.08-0.11m, steel reinforcement.	-	-		
					0.34		-	CONCRETE: grey, mixed rounded aggregates up to 30mm. 0.15m, plastic lining.	M	MD	9	
	Hand Auger			D	0.45		Cl	FILL: SAND: yellow brown, fine to medium grained, trace medium, sub-rounded gravel (fill).	w ≈ PL	VSt	15	
				D	0.50		Cl	CLAY: brown, medium plasticity, trace fine to medium, sub-angular to angular gravel (residual).	w ≈ PL	H	18	
				D	0.73			CLAY: brown mottled red, medium plasticity, with fine to coarse, angular gravel (ironstone) (residual).			27	
								End of Borehole at 0.73 metres. Refusal.			21	
1											20 15 11 10 10 9 13 15 12 10 13	
2											13 DCP @ 2.0m: Terminated	

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-28380

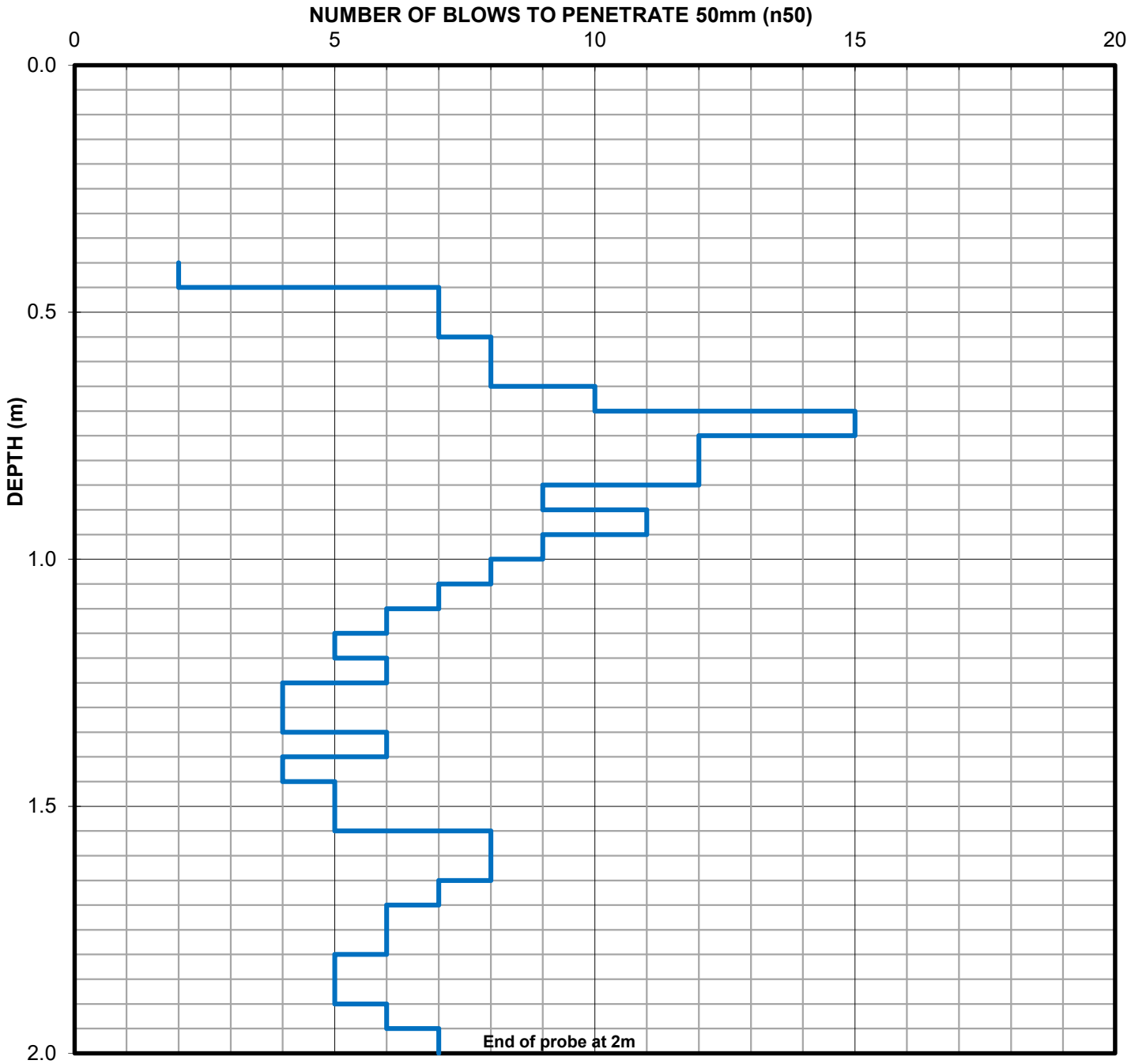
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP10

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	03/07/19
Adjacent Test Hole / Pit: BH10		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



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GHD GEOTECHNICS

Job No. **2128380**

GHD

TP: BH10

DEPTH: 0.00 - 0.35m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380_CRONULLACENTRE_STG2.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH11

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** HAL
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 3/7/2019 | **Date Completed :** 3/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40) Recorded Blows	Comments/ Observations
1	Diatube	Nil	GNE		0.01		-	TILE: grey, 15mm.	-	-		
					0.05		-	BEDDING LAYER: stabilised sand, grey.	-	-		
					0.17		-	CONCRETE: grey, mixed aggregates up to 20mm. 0.11m, steel reinforcement.	-	-		
					0.34		-	CONCRETE: grey, mixed rounded aggregates up to 25mm. 0.17m, plastic lining. 0.27m, steel reinforcement.	M	MD		
	Hand Auger			D	0.45		Cl	FILL: SAND: beige, fine to medium grained (fill).	w ≈ PL	St	6	
								CLAY: brown, medium to high plasticity, trace medium to coarse sub-rounded to sub-angular gravels (residual).			3 6 6	
					0.75		Cl	CLAY: mottled yellow-red, medium to high plasticity (residual). 0.85m, becoming grey mottled red.	w ≈ PL	VSt	8 10 8 7 10 9	
2					1.40			End of Borehole at 1.4 metres. Refusal.			12 15 12 10 13 13 13	DCP @ 2.0m: Terminated

See standard sheets for details of abbreviations & basis of descriptions

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-28380

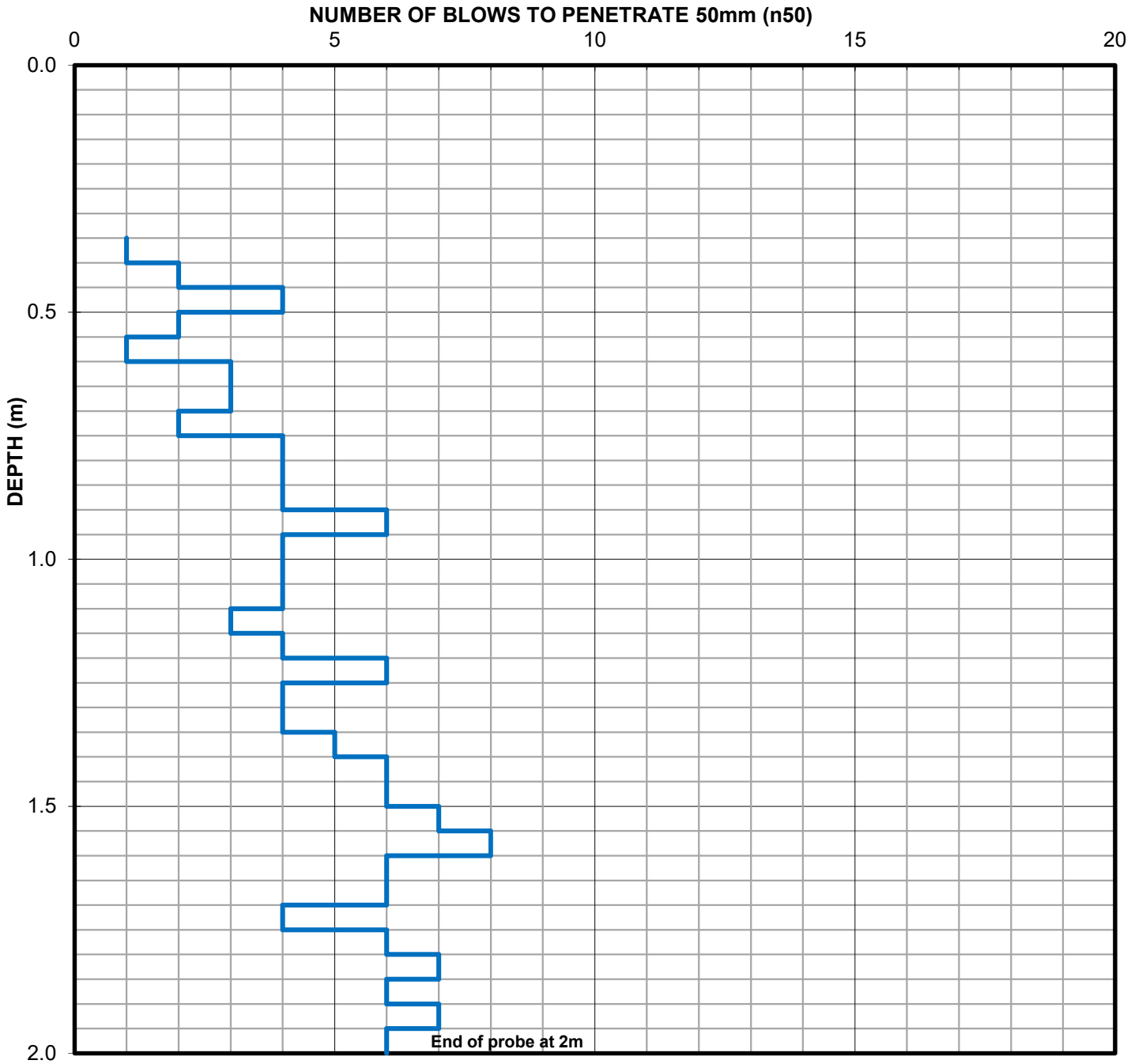
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP11

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	03/07/19
Adjacent Test Hole / Pit: BH11		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



Comments:

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Job No. **2128380**

TP: BH11

DEPTH: 0.00 - 0.34m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380 CRONULLACENTRE_STG2.GPJ GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH12

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** HAL
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 3/7/2019 | **Date Completed :** 3/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40	Recorded Blows	Comments/ Observations
1	Diatube	Nil	GNE	D	0.02		-	TILE: pale grey, 20mm.	-	-			
					0.06		-	BEDDING LAYER: stabilised sand, grey.	-	-			
					0.16		-	CONCRETE: grey, mixed aggregates up to 20mm. 0.12m, steel reinforcement.	-	-			From 0.16m, material crushed while drilling using diatube (recovered as rubble).
								ASPHALTIC CONCRETE: dark grey.				1	
	Hand Auger			D	0.35		CI	CLAY: brown mottled orange, medium plasticity, trace fine to medium sub-angular to sub-rounded gravel (residual).	w = PL	F		1	Indistinct odour detected.
				ES/ D/ QCOO2								1	
				D								2	
				D	0.70		CH	CLAY: grey mottled red-brown, high plasticity (residual).	w = PL	St		4	
				D								5	
												6	
								0.9m, becoming pale grey mottled red.	w < PL	VSt		6	
					1.30							9	
								End of Borehole at 1.3 metres. Refusal.				9	
												11	
												11	
												12	
												11	
												17	
												20	
2											DCP @ 2.0m: Terminated	17	

Note: * indicates signatures on original issue of log or last revision of log

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-28380

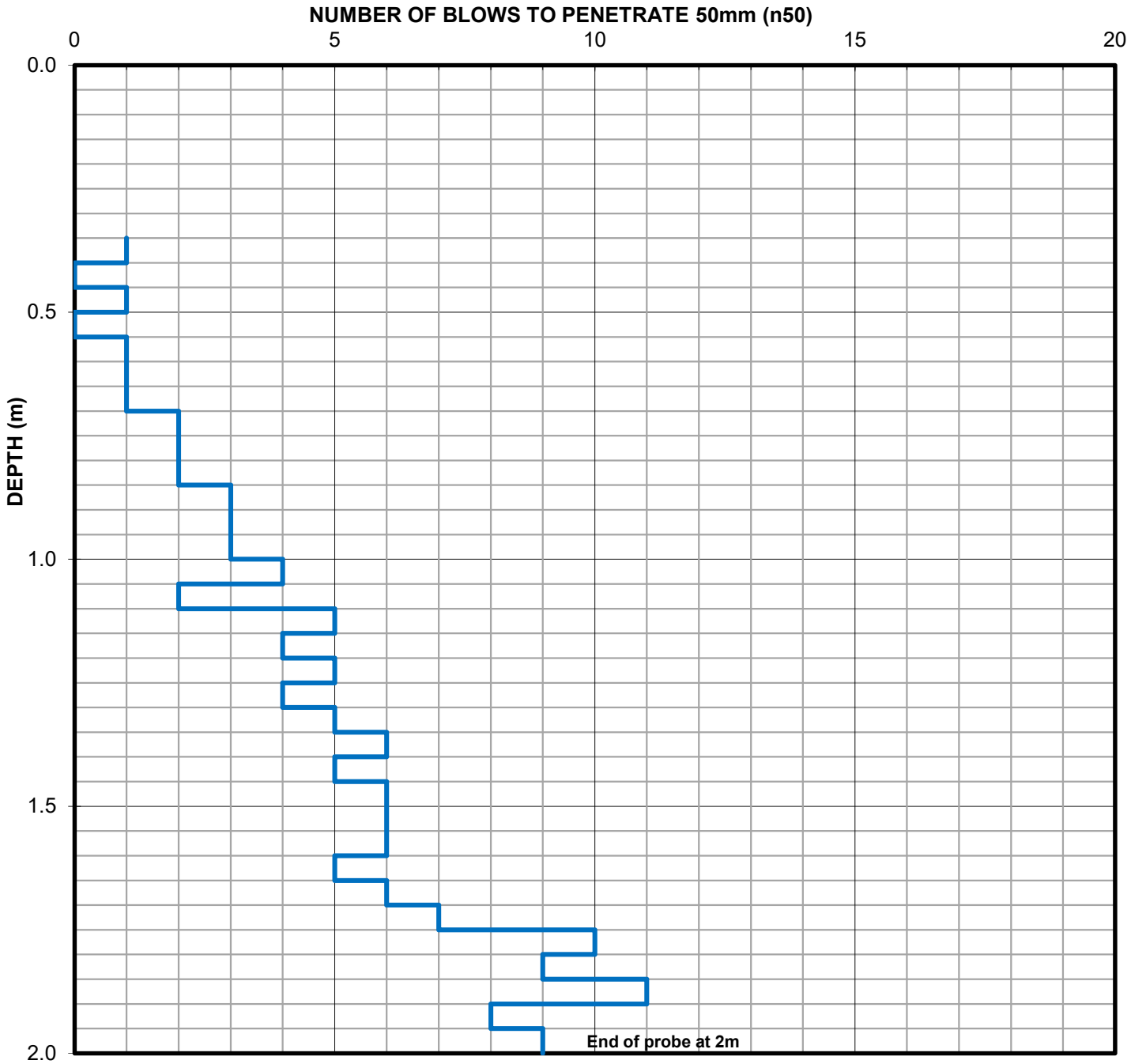
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP12

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	03/07/19
Adjacent Test Hole / Pit: BH12		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



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GHD GEOTECHNICS

Job No. **2128380**

TP: BH12

DEPTH: 0.00 - 0.16m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

GEO_BOREHOLE_DCP_AS1726_2017_21-28380 CRONULLACENTRE_STG2.GPJ GHD_GEO_TEMPLATE 2.00.GDT 2/8/19

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH13

SHEET 1 OF 1

Position : Refer to test location plan | **Surface RL:** - | **Angle from Horiz. :** 90° | **Processed :** HAL
Rig Type : 150mm Diatube | **Mounting:** Stand | **Contractor :** Diacore | **Driller :** Noah | **Checked :** ICC
Date Started : 3/7/2019 | **Date Completed :** 3/7/2019 | **Logged by :** LCD/MG | **Date:** 1/8/19

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments/ Observations
1	Diatube	Nil	GNE		0.02		-	TILE: pale grey, 20mm.	-	-		4	
					0.05		-	BEDDING LAYER: stabilised sand, grey.	-	-			
					0.17		-	CONCRETE: grey, mixed aggregates up to 20mm. 0.13m, steel reinforcement, becoming dark grey.	M	MD-D		12	
	Hand Auger			D				FILL: Gravelly SAND: brown, fine to medium grained, fine to medium sub-rounded to sub-angular gravel (predominantly igneous), trace clay (fill).				18	
					0.55			0.4m, becoming clayey.				8	
							CI-CH	CLAY: brown mottled red, medium to high plasticity, trace silt, trace rootlets (residual).	w < PL	VSt		8	
				D								9	
												11	
												9	
												8	
												9	
												10	
												14	
								1.2m, becoming pale grey mottled red, no rootlets.				11	
												15	
												17	
										H		18	
				D	1.76							12	
2								End of Borehole at 1.76 metres. Refusal.			DCP @ 1.9m: Terminated	30	

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Job No. 21-28380

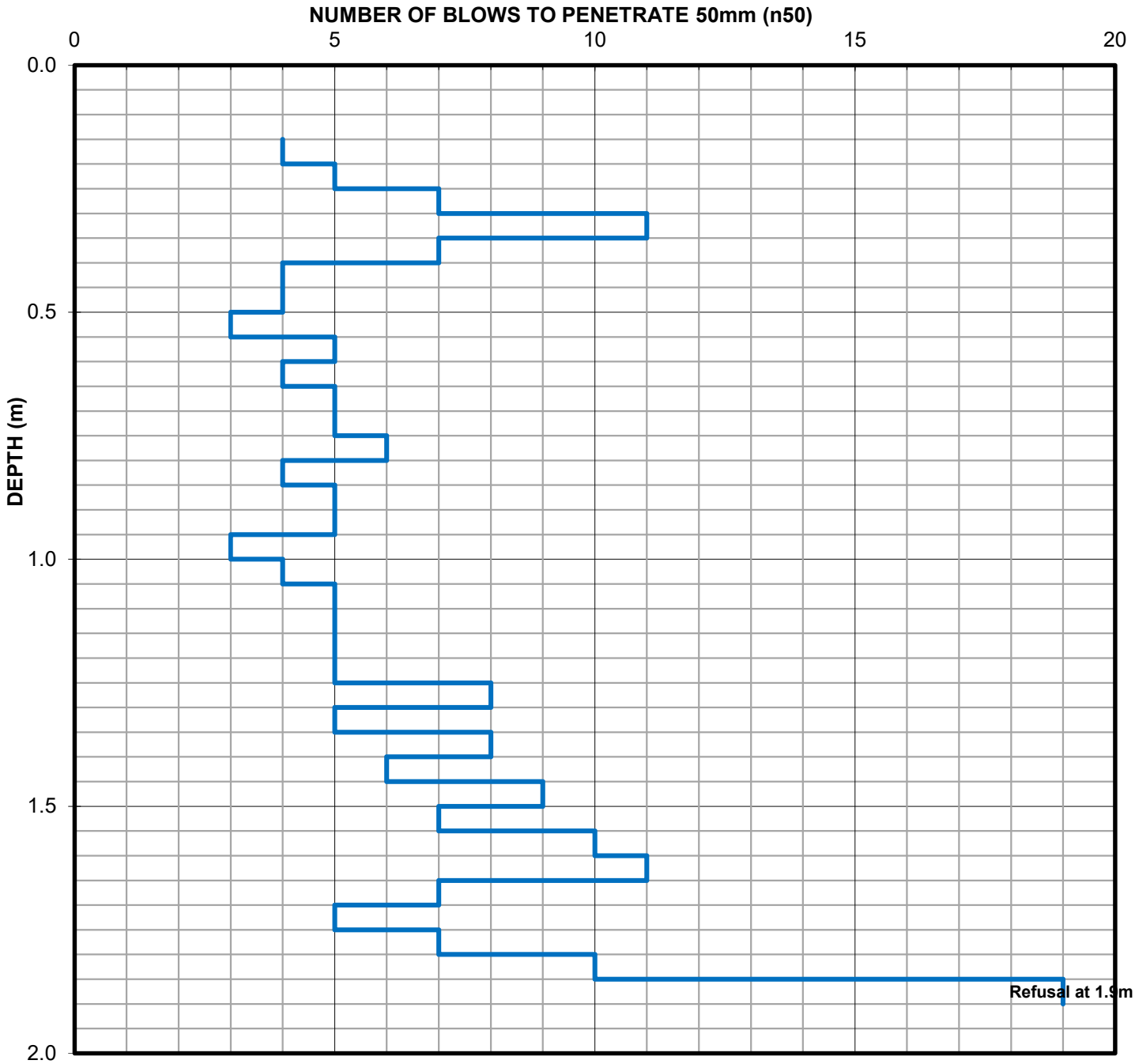
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP13

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	03/07/19
Adjacent Test Hole / Pit: BH13		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



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Job No. **2128380**

TP: BH13

DEPTH: 0.00 - 0.17m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19

BOREHOLE LOG SHEET

Client : Sutherland Shire Council
Project : Cronulla Town Centre - Design Stage 2
Location : Cronulla Mall, Cronulla NSW

HOLE No. BH14

SHEET 1 OF 1

Position : Refer to test location plan	**Surface RL:** -	**Angle from Horiz. :** 90°	**Processed :** HAL
Rig Type : 150mm Diatube	**Mounting:** Stand	**Contractor :** Diacore	**Driller :** Noah	**Checked :** ICC
Date Started : 3/7/2019	**Date Completed :** 3/7/2019	**Logged by :** LCD/MG	**Date:** 1/8/19

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DRILLING					MATERIAL						DCP	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description [COBBLES/BOULDERS/FILL/TOPSOIL] then SOIL NAME: colour, plasticity / primary particle characteristics, secondary and minor components, zoning (origin) and ROCK NAME: grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm 0 20 40	Recorded Blows	Comments/ Observations
1	Diatube	Nil	GNE		0.02		-	TILE: pale grey, 20mm.	-	-			
					0.05		-	BEDDING LAYER: stabilised sand, grey.	-	-			
					0.15		-	CONCRETE: grey, mixed aggregates up to 20mm.	-	-			
								CONCRETE: grey, mixed rounded aggregates up to 45mm.					
					0.34		-	0.15m, plastic lining. 0.25m, steel reinforcement (45mm length).	M	MD			
	Hand Auger			D	0.45		CH	FILL: SAND: yellow brown, medium to coarse grained (fill).	w ≈ PL	St			
				D				CLAY: brown, high plasticity, fine to medium sub-angular to angular gravel (residual).					
					0.70		CI-CH	CLAY: brown mottled red, medium to high plasticity (residual).	w ≈ PL	VSt			
				D				1.0m, becoming red mottled grey.					
				D	1.59								
2								End of Borehole at 1.59 metres. Refusal.			DCP @ 2.0m: Terminated		

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Job No. 21-28380

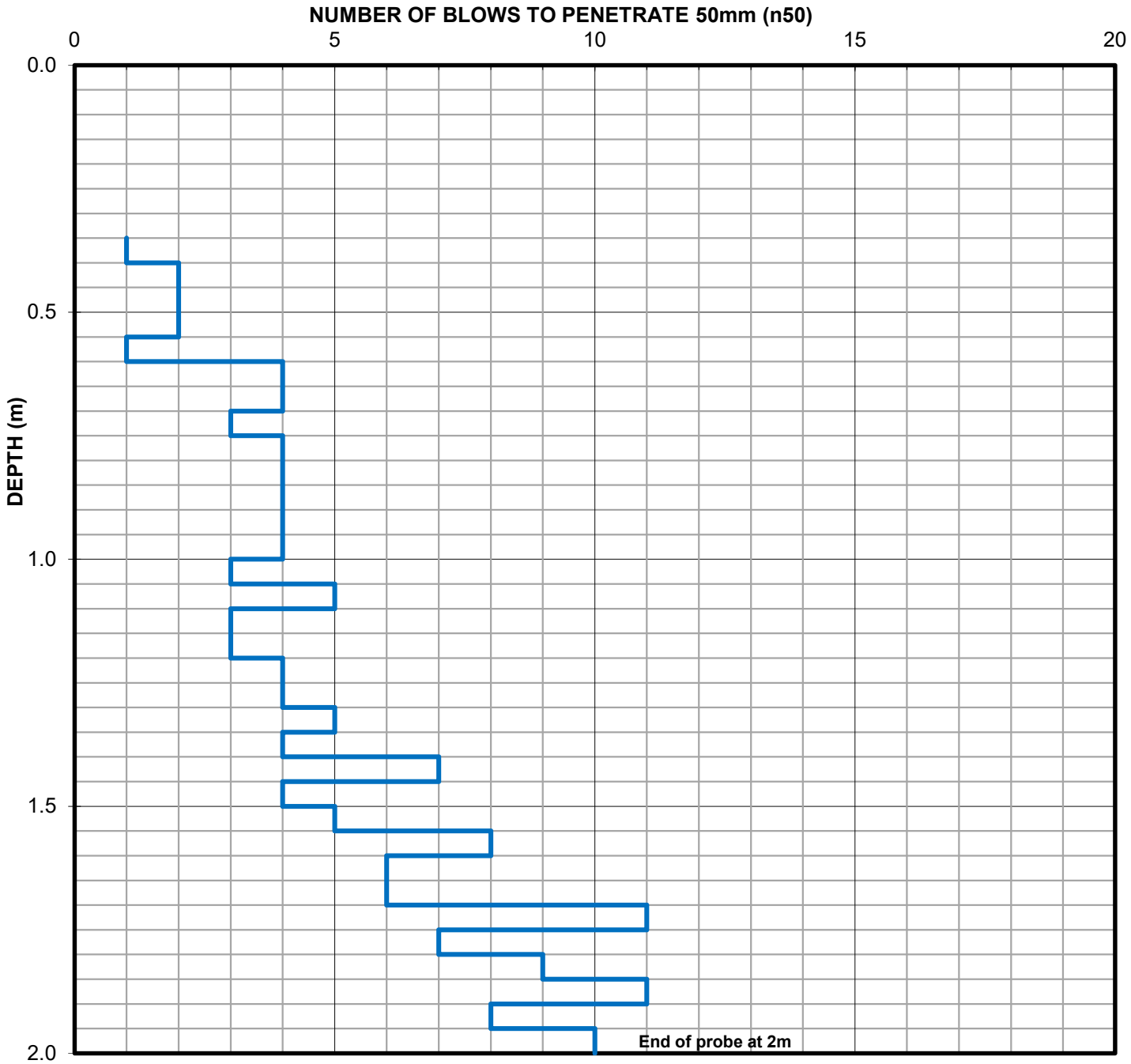
DYNAMIC CONE PENETROMETER LOG SHEET

Client: Sutherland Shire Council
Project: Cronulla Town Centre Design Stage 2
Location: Cronulla Mall, Cronulla, NSW

PROBE: DCP14

AS 1289.6.3.2-1997 (Cone Tip) 510 mm drop height.

Position:	**Chainage:** N/A	**Operator:**	LCD/MG
Elevation:	**Offset:** Refer Test Location Plan	**Date:**	03/07/19
Adjacent Test Hole / Pit: BH14		**Checked:**	ICC
Position Relative to Test Hole / Pit: On location		**Date:**	11/07/19



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Job No. **2128380**

TP: BH14

DEPTH: 0.00 - 0.34m

CLIENT: Sutherland Shire Council

PROJECT: Cronulla Town Centre Design

PROJECT NUMBER: 21 / 28380 /

LOCATION: Cronulla Town Center

DATE: 3/7/19