
Appendix A

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CSIRO-BTF 18

About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

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

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Borehole and Test Pit Logs

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

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

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

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

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

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



Sampling

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

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

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

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low

reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

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

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:
4,6,7
N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:
15, 30/40 mm

Sampling Methods

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.



Description and Classification Methods

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

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 - 5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

Douglas Partners



Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U ₅₀	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough


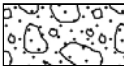
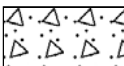

Other

fg	fragmented
bnd	band
qtz	quartz


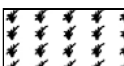
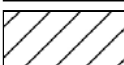
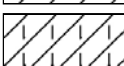
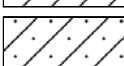
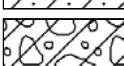
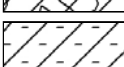

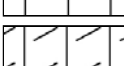
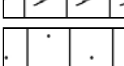

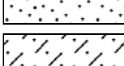
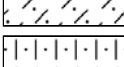
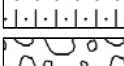
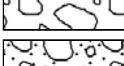
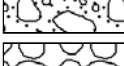

Symbols & Abbreviations

Graphic Symbols for Soil and Rock




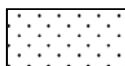
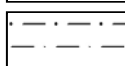
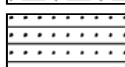
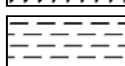
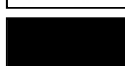
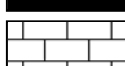
General

	Asphalt
	Road base
	Concrete
	Filling

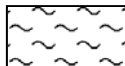
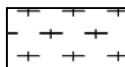

Soils

	Topsoil
	Peat
	Clay
	Silty clay
	Sandy clay
	Gravelly clay
	Shaly clay
	Silt
	Clayey silt
	Sandy silt
	Sand
	Clayey sand
	Silty sand
	Gravel
	Sandy gravel
	Cobbles, boulders
	Talus

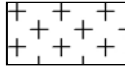
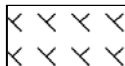
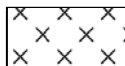
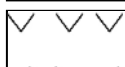
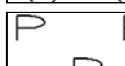
Sedimentary Rocks

	Boulder conglomerate
	Conglomerate
	Conglomeratic sandstone
	Sandstone
	Siltstone
	Laminite
	Mudstone, claystone, shale
	Coal
	Limestone

Metamorphic Rocks

	Slate, phyllite, schist
	Gneiss
	Quartzite

Igneous Rocks

	Granite
	Dolerite, basalt, andesite
	Dacite, epidote
	Tuff, breccia
	Porphyry



Rock Strength

Rock strength is defined by the Point Load Strength Index ($IS_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $IS_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $IS_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

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

Foundation Maintenance and Footing Performance: A Homeowner's Guide



PUBLISHING
BTF 18-2011
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslide; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpend).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay

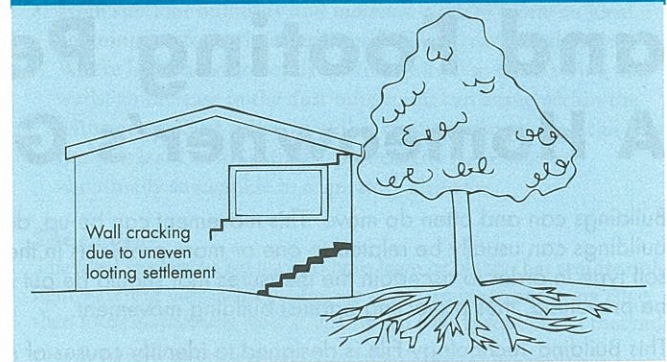
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the

Trees can cause shrinkage and damage



external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.

- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter

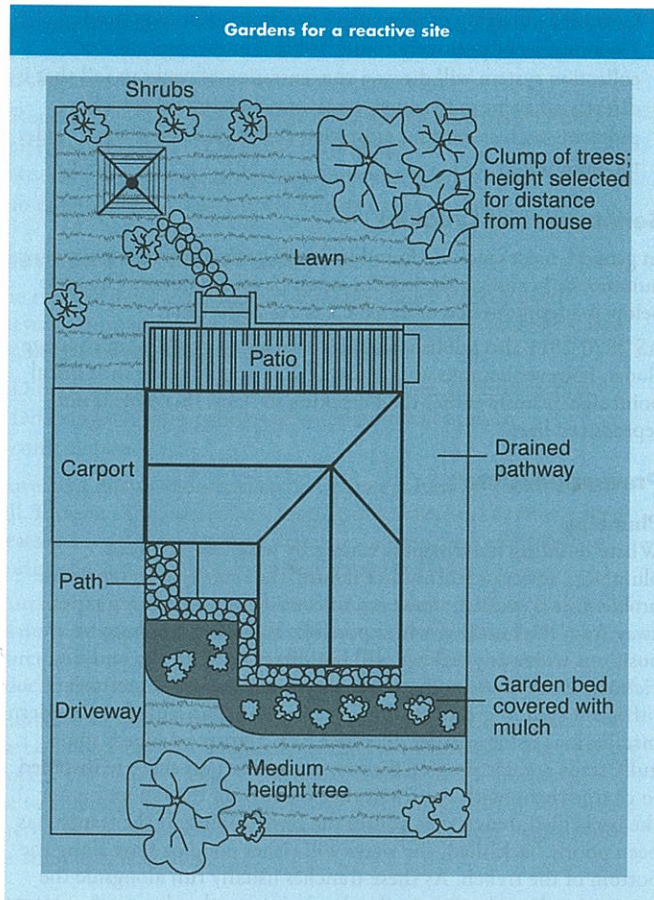
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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Appendix B

Test Pit Logs (Pits 301 to 321)
Results of Dynamic Penetrometer Tests
Borehole Logs (Bores 601 to 606 and 701 to 703)
Core Photoplates

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369334
NORTHING: 6374563

PIT No: 301
PROJECT No: 81719.01
DATE: 12/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		FILLING - Generally comprising a mixture of clayey sand and gravel with some cobbles (ripped fine to medium sandstone and carbonaceous siltstone)		D	0.5								
1					1.0								
				B									
				D	1.3								
	1.9	SANDSTONE - Extremely low strength, extremely weathered, friable, orange and grey sandstone		D	1.95								
2	2.0	SANDSTONE - Low strength, moderately weathered yellow and grey, fine to medium grained sandstone		D	2.05								
	2.1	Pit discontinued at 2.1m, limit of investigation											

RIG: 5.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369333
NORTHING: 6374563

PIT No: 301a
PROJECT No: 81719.01
DATE: 12/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		FILLING - Generally comprising a mixture of clayey sand and gravel with some cobbles of fine to medium grained sandstone (rippled sandstone and carbonaceous siltstone), moist		B	0.5								
					0.7								
1	1.0	Pit discontinued at 1.0m, limit of investigation		D	1.0								
2													

RIG: 5.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Stockpile adjacent Pit 301

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	>	Water seep	S	Standard penetration test
E	Environmental sample	≡	Water level	V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369317
NORTHING: 6374487

PIT No: 302
PROJECT No: 81719.01
DATE: 12/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		FILLING - Dark grey gravelly sand filling, comprising fine to medium grained sand and medium to coarse sized gravel (ripped sandstone and carbonaceous siltstone) with some clay, damp		D	0.5								
	1			D	1.0								
		From 1.5m, damp to moist		D	1.5								
	2			D	2.0								
				D	2.5								
	2.7			D	2.75								
	2.8	SANDSTONE - Very low to low, highly weathered, orange, fine grained sandstone (thinly bedded)											
		Pit discontinued at 2.8m, limit of investigation											

RIG: 5.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369305
NORTHING: 6374607

PIT No: 303
PROJECT No: 81719.01
DATE: 12/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.15	FILLING - Generally comprising light grey silty sand filling	[Cross-hatched pattern]	D	0.2								
	0.25	FILLING - Generally comprising black coal (silty sand)											
	0.9	FILLING - Generally comprising brown, fine to medium grained clayey sand, damp to moist		D	0.5								
1	0.9	SANDSTONE - Very low to low strength, highly weathered, orange, fine to medium grained sandstone	[Dotted pattern]	B	0.9								
	1.1	Pit discontinued at 1.1m, refusal		D	1.0								
	1.1				1.1								
	2												

RIG: 5.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369253
NORTHING: 6374484

PIT No: 304
PROJECT No: 81719.01
DATE: 12/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.15	FILLING - Generally comprising firm, light grey silt filling		D	0.1								
	0.4	FILLING - Generally comprising dark brown clayey sand with some gravel (reworked natural/ripped siltstone)		D	0.3								
	0.4	SILTSTONE - Extremely low to very low strength, extremely weathered dark grey siltstone		D	0.5								
		From 0.7m, some iron staining		D	0.75								
		From 0.8m to 0.9m, carbonaceous siltstone with coal lenses		D	0.85								
	0.95	SANDSTONE - Low strength, highly weathered, orange, fine grained sandstone (thinly bedded)		D	1.0								
	1.1	Pit discontinued at 1.1m, refusal											

RIG: 5.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369302
NORTHING: 6374626

PIT No: 305
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.05	FILLING - Generally comprising light grey silt filling, dry		D	0.0								
		FILLING - Generally comprising black coal (fine to medium grained sand)		D	0.05								
	0.2	FILLING - Generally comprising brown-grey, fine to medium grained sandy clay filling with some gravel		D	0.1								
	0.35	FILLING - Generally comprising brown, fine to medium grained clayey sand filling with some gravel		D	0.2								
	0.5	SANDSTONE - Very low to low strength, highly weathered orange and light grey fine to medium grained sandstone		D	0.3								
	0.7	Pit discontinued at 0.7m, refusal on low to medium strength sandstone		D	0.4								
1													
2													

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369281
NORTHING: 6374619

PIT No: 306
PROJECT No: 81719.01
DATE: 12/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)										
				Type	Depth	Sample	Results & Comments		5	10	15	20							
	0.15	TOPSOIL - Generally comprising light grey fine grained silty sand topsoil with abundant rootlets		D	0.1														
	0.6	CARBONACEOUS SANDY CLAY - Black carbonaceous fine to medium grained sandy clay, (extremely weathered coal with soil like properties) with interbedded bands of grey clayey silt, (thinly bedded), M>Wp		U ₅₀ D	0.3 0.5 0.6														
	1.1	SANDY CLAY - (Stiff) brown fine to medium grained sandy clay interbedded with grey clayey silt (thinly bedded), M>Wp		U B D	0.6 0.7 0.9 1.0														
	1.85	SILTSTONE - Extremely low to very low strength, extremely weathered light grey siltstone		D	1.1 1.2 1.6 1.8														
		From 1.7m, low to medium strength		D															
	1.85	Pit discontinued at 1.85m, refusal																	

RIG: 5.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2




SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369191
NORTHING: 6374403

PIT No: 307
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		TOPSOIL - Dense, grey, fine to medium grained silty sand topsoil with abundant rootlets, dry to humid		D	0.1								
	0.3	SANDY CLAY - Very stiff to hard, brown, orange and light grey, fine to medium grained sandy clay, M>Wp At 0.4m, tree roots		U ₅₀	0.3								
				D	0.45								
		SANDSTONE - Extremely low to very low strength, highly weathered, orange and light grey, fine to medium grained sandstone		D	0.6								
	0.9			D	1.0								
	1.2	Pit discontinued at 1.2m, refusal on low strength sandstone		D	1.15								

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369134
NORTHING: 6374489

PIT No: 308
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.3	CLAYEY SILT - Soft to firm, grey mottled brown clayey silt with trace fine grained sand, M>Wp		D	0.2		pp = 80						
	0.6	SANDY SILT - Stiff to very stiff, orange mottled light grey, fine to medium grained sandy silt, slightly clayey, M>Wp		D	0.5		pp = 130-150						
	0.8	SANDSTONE - Very low to low strength, moderately weathered, orange and light grey, fine to coarse grained sandstone	D	0.75								
	0.8	Pit discontinued at 0.8m, refusal											

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369144
NORTHING: 6374417

PIT No: 309
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.1	SILTY SAND - Dense, grey fine grained silty sand with some rootlets, dry to humid	----	D	0.1								
	0.3	SANDY CLAY - Very stiff to hard orange mottled grey, fine to coarse grained sandy clay, $M \gg W_p$ At 0.5m, tree roots	////	D	0.5		pp >300-400						
	0.75	SANDSTONE - (Low to medium strength) highly weathered orange and light grey fine to coarse grained sandstone Pit discontinued at 0.75m, refusal	----										
1													
2													

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369203
NORTHING: 6374465

PIT No: 310
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)					
				Type	Depth	Sample	Results & Comments		5	10	15	20		
		FILLING - Brown, clayey gravelly sand filling, comprising fine to medium grained sand and fine to medium sized gravel (mixture of coal, carbonaceous siltstone and sandstone) with some silt, trace cobbles of sandstone and trace bricks At 0.3m to 0.6m, tree roots At 0.5m, golf ball At 0.6m to 1.1m, boulder At 0.8m, evidence of sulphidic (yellow) staining		D	0.5									
1				D	0.8									
	1.2	CLAYEY SAND - (Dense) orange-red and light grey fine to medium grained clayey sand (extremely low strength extremely weathered sandstone with soil like properties)		D	1.3									
	1.4	SANDSTONE - Very low strength, highly weathered, orange-red and light grey, fine to medium grained sandstone		D	1.6									
	1.65	Pit discontinued at 1.65m, refusal on low to medium strength sandstone												
	2													

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	≧	Water seep
E	Environmental sample	≧	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369082
NORTHING: 6374330

PIT No: 311
PROJECT No: 81719.01
DATE: 14/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.3	SANDY SILT - Brown, fine grained sandy silt with some rootlets and tree roots, dry to humid		D	0.1								
	0.3	SILTY CLAY - Very stiff to hard, red-brown mottled grey silty clay with some fine to medium grained sand, M>Wp		D	0.3		pp = 250-350						
	0.4												
	0.6												
	0.66			B									
	0.66			U ₅₀									
	0.7			D	0.66		pp = 400-450						
	0.7	Pit discontinued at 0.7m, refusal on low to medium strength sandstone			0.7								
	1												
	2												

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2





SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369223
NORTHING: 6374340

PIT No: 312
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.3	SILTY CLAY - Very stiff to hard, light grey silty clay with trace gravel and fine grained sand, M<Wp		D	0.2		pp >400						
	0.3	SILTY CLAY - Very stiff to hard, orange-brown mottled red silty clay with some fine grained sand, M>Wp		D	0.4								
	0.55			U ₅₀	0.55		pp >400						
	0.95	SILT - Very stiff, light grey silt (extremely low strength, extremely weathered siltstone with soil like properties)											
	1			D	1.5								
	1.8	SILTSTONE - Very low strength, highly weathered, light grey siltstone		D	1.9								
	2.0	Pit discontinued at 2.0m, refusal											

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369319
NORTHING: 6374304

PIT No: 313
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.15	SILTY SAND - Medium dense, brown fine grained silty sand with some rootlets, damp	---	D	0.1								
		SANDY CLAY - Very stiff, brown, fine to medium grained sandy clay, with some silt, $M \gg W_p$	///	D	0.3								
	0.5	CLAYEY SILT - Very stiff, orange and brown clayey silt, with some fine grained sand, $M \gg W_p$		D	0.6								
		From 0.8m, pale grey and orange		D	0.85								
	0.9	SILTSTONE - Low to medium strength, highly weathered, fractured, red and pale grey siltstone	---	D	0.9								
	1.2	Pit discontinued at 1.2m, refusal	---	B	1.1								
			---	D	1.2								

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	∇	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test $I_s(50)$ (MPa)
		PL(D)	Point load diametral test $I_s(50)$ (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369428
NORTHING: 6374335

PIT No: 314
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		FILLING - Dark brown gravel filling comprising fine to coarse sized subangular gravel (coal and some carbonaceous siltstone) with some fine to medium grained sand and clay with some cobbles (carbonaceous siltstone) up to 300mm in diameter, trace brick and evidence of sulphidic (yellow) staining		D	0.3								
				D	0.6								
	0.7	SANDSTONE - Low to medium strength, moderately weathered, orange and grey, fine to medium grained sandstone		D	0.75								
	0.8	Pit discontinued at 0.8m, refusal on medium strength sandstone											
1													
2													

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Sandstone had been backed and backfilled at 0.35m

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369469
NORTHING: 6374328

PIT No: 315
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		FILLING - Brown, silty sand filling comprising fine to medium grained sand, slightly fine to coarse sized gravelly (ripped sandstone with some siltstone) with some clay, trace bricks and coal		D	0.5								
1	1.0	FILLING - Grey, silty sand filling, comprising fine to medium grained sand and slightly fine to medium sized gravelly (sandstone and siltstone)		D	1.3								
	1.6	FILLING - Brown, sandy gravel filling comprising fine to medium grained sand, fine to medium sized subangular gravel (ripped sandstone) with bricks		D	2.1								
	2.4	Pit discontinued at 2.4m, slow progress											

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2




SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test 1s(50) (MPa)
		PL(D)	Point load diametral test 1s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369375
NORTHING: 6374427

PIT No: 316
PROJECT No: 81719.01
DATE: 14/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		CARBONACEOUS SILTSTONE - Low strength, moderately weathered, grey carbonaceous siltstone (highly fractured)		D	0.1								
	0.3	COAL - Very low strength, highly weathered, highly fractured, black coal From 0.3m to 0.4m, yellow sulphur staining		D	0.35								
	0.6	SILTSTONE - Low strength, slightly weathered grey siltstone (thinly bedded)		D	0.5								
	1			D	1.0								
	1.1	Pit discontinued at 1.1m, refusal in low to medium strength siltstone											
	2												

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369530
NORTHING: 6374414

PIT No: 317
PROJECT No: 81719.01
DATE: 13/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.3	FILLING - Generally comprising dark brown clayey silt filling with black coal fines (comprising silt to fine grained sand, with trace fine to medium sized gravel), damp (possibly natural)		D	0.1								
	0.6	SILTSTONE - Extremely low to very low strength, highly weathered, grey siltstone with some bands of fine to medium grained sandstone		D	0.4								
	0.6	Pit discontinued at 0.6m, refusal on low to medium strength siltstone		D	0.55								

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2





SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369590
NORTHING: 6374432

PIT No: 318
PROJECT No: 81719.01
DATE: 14/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		FILLING - Grey, gravelly silty clay filling comprising fine to medium sized gravel with some bricks											
	0.4	FILLING - Generally comprising soft, brown mottled red silty clay with brick fragments, fine to medium grained sand, fine to medium sized gravel, some sandstone cobbles and trace coal/carbonaceous siltstone		D	0.6								
	0.8	SILTY CLAY - Hard, brown-grey silty clay with some carbonaceous siltstone fragments											
1	1.05	CARBONACEOUS SILTSTONE - Low to medium strength, moderately weathered, grey, carbonaceous siltstone		D	1.1								
	1.2	Pit discontinued at 1.2m, refusal											
	2												

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Free groundwater observed at 0.3m

REMARKS: Sediment pond

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	▷	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369555
NORTHING: 6374508
DIP/AZIMUTH: 90°/--

BORE No: 319
PROJECT No: 81719.01
DATE: 16/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
		FILLING - Generally comprising brown-grey, fine to medium grained sandy clay filling, trace coal fines	[Cross-hatched pattern]					▼					
	0.6 0.65	SANDY CLAY - Hard, grey, fine to medium grained sandy clay, M<Wp Bore discontinued at 0.65m, refusal (possible rock)	[Diagonal hatched pattern]										
	1												
	2												

RIG: Hand Auger **DRILLER:** Parkinson **LOGGED:** Parkinson **CASING:** Uncased
TYPE OF BORING: 80mm diameter hand auger
WATER OBSERVATIONS: Free groundwater observed at surface
REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	>	Water seep	S	Standard penetration test
E	Environmental sample	≡	Water level	V	Shear vane (kPa)


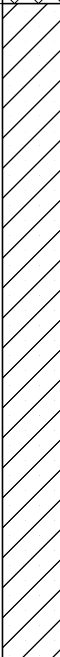


TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369670
NORTHING: 6374364

PIT No: 320
PROJECT No: 81719.01
DATE: 14/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm)					
				Type	Depth	Sample	Results & Comments		5	10	15	20		
	0.5	FILLING - Hard, grey mottled red, fine grained sandy clay filling with some silt, gravel and coal, M < Wp		D	0.2		pp >400							
	1.0	SANDY CLAY - Hard, red-brown and grey, fine grained sandy clay with some silt (possibly reworked natural)		D	0.7		pp >400							
	1.5	From 0.8m, trace fine sized gravel												
	1.8	From 1.5m, trace cobbles (sandstone)												
	1.8	At 1.7m, possible rock shelf (possible floater)		D	1.65									
	2.0	Pit discontinued at 1.8m, refusal												

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

TEST PIT LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 368996
NORTHING: 6374368

PIT No: 321
PROJECT No: 81719.01
DATE: 14/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 150mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
	0.1	SILTY SAND - Very dense, brown, fine grained silty sand with some rootlets, humid to dry	---	D	0.1								
	0.2	CLAY - Hard, brown mottled red and grey clay with some fine to medium grained sand and some silt, M>Wp	///	D	0.3		pp = 400						
	0.35			U ₅₀	0.35								
	0.55	From 0.55m, pale grey mottled orange and red	///	D	0.55		pp >400						
	0.6	Pit discontinued at 0.6m, refusal on low to medium strength sandstone		D	0.6								
1													
2													

RIG: 4.5 Tonne excavator with 450mm bucket

LOGGED: Fulham

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

- Sand Penetrometer AS1289.6.3.3
 Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

Results of Dynamic Penetrometer Tests

Client Health Infrastructure Pty Ltd
Project New Maitland Hospital
Location Metford Road, Metford

Project No. 81719.01
Date 20/10/2015
Page No. 1 of 1

Test Locations	304	307	308	309	312	313	317	319	322	
RL of Test (AHD)										
Depth (m)	Penetration Resistance Blows/150 mm									
0.00 – 0.15	2	9	2	8	8	5	5	0	0	
0.15 – 0.30	10	25	1	12	12	12	6	0	13	
0.30 – 0.45	18		5	12	8	7	6	1	12	
0.45 – 0.60	20		10	18	8	7	bouncing	10	15	
0.60 – 0.75			22	15	5	8		15		
0.75 – 0.90				25	5	10				
0.90 – 1.05					8					
1.05 – 1.20										
1.20 – 1.35										
1.35 – 1.50										
1.50 – 1.65										
1.65 – 1.80										
1.80 – 1.95										
1.95 – 2.10										
2.10 – 2.25										
2.25 – 2.40										
2.40 – 2.55										
2.55 – 2.70										
2.70 – 2.85										
2.85 – 3.00										
3.00 – 3.15										
3.15 – 3.30										
3.30 – 3.45										
3.45 – 3.60										

Test Method AS 1289.6.3.2, Cone Penetrometer
 AS 1289.6.3.3, Sand Penetrometer

Tested By MJP
Checked By

Remarks Ref = Refusal, 25/110 indicates 25 blows for 110 mm penetration

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 NEW MAITLAND HOSPITAL, METFORD
 BORE 601 PROJECT 81719.01 2015



1.10 m – 6.00 m

DOUGLAS PARTNERS PTY LTD
 NEW MAITLAND HOSPITAL, METFORD
 BORE 601 PROJECT 81719.01 2015



6.00 m – 8.17 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT:	81719.01
PLATE No:	1
REV:	0
DATE:	25-Nov-15

CLIENT: Health Infrastructure

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: 16.8m AHD* **BORE No:** 602
EASTING: 369340 **PROJECT No:** 81719.01
NORTHING: 6374598 **DATE:** 15/10/2015
DIP/AZIMUTH: 90°/-- **SHEET 1 OF 3**

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing							
			EW	HW	MW	SW		FS	FR	Ex Low	Very Low	Low			Medium	High	Very High	Ex High	B - Bedding	J - Joint	Type	Core Rec. %	RQD %	Test Results & Comments
			S - Shear		F - Fault			0.01	0.05	0.10	0.50	1.00												
	0.8	FILLING - Brown-grey sandy clay filling, comprising fine to medium grained sand with some fine to medium sized gravel (coal, siltstone, sandstone and brick fragments)															A							
	1	SILTSTONE - Extremely low to very low strength, highly weathered brown siltstone															S			17,25/100 refusal				
	2	From 1.75m to 1.85m, extremely weathered coal/carbonaceous siltstone																						
	2.15	SANDSTONE - Low strength, moderately weathered, slightly fractured, light brown fine to medium grained sandstone												2.3m: P, 3°, pl, sm 2.4m: P, 5°, pl, sl						PL(A) = 0.3 PL(D) = 0.28				
	3	SILTSTONE - Low to very low strength, highly weathered, slightly fractured, pale grey and brown siltstone with carbonaceous lenses															C	100	56	PL(A) = 0.27 PL(D) = 0.09				
	3.11	SANDSTONE - Very low strength, highly weathered, unbroken brown, fine to medium grained sandstone with trace carbonaceous lenses up to 2mm thick																		PL(A) = 0.06 PL(D) = 0.07				
	3.59	From 4.26m to 4.65m, extremely low strength												4.57m: P, 2°, pl, sm						PL(A) = 0.04 PL(D) = 0.04				
	4	At 4.93m, low strength																		PL(A) = 0.08 PL(D) = 0.1				
	5	From 5.15m, fine grained																		PL(A) = 0.28 PL(D) = 0.25				
	5.13m													5.13m: P, 3°, pl, sm, Fe						PL(A) = 0.39 PL(D) = 0.25				
	5.59m													5.59m: P, 3°, pl, sm						PL(A) = 0.43 PL(D) = 0.27				
	6	SANDY SILTSTONE - Low strength, fresh stained, slightly fractured, fine grained sandy siltstone															C	100	90	PL(A) = 0.21 PL(D) = 0.2				
	6.03													6.56m: BP, 2°, pl, sm 6.74m: BP, 2°, pl, sm										
	7																			PL(A) = 0.3 PL(D) = 0.13				
	7.64	SANDSTONE - Low strength, slightly weathered, slightly fractured, fine to medium grained sandstone with trace carbonaceous lenses up to 2mm thick																		PL(A) = 0.24 PL(D) = 0.23				
	8													8.12m: P, 3°, un, sm						PL(A) = 0.28 PL(D) = 0.3				
	9	From 9.09m, medium strength, some low strength, moderately weathered bands															C	100	96	PL(A) = 0.41 PL(D) = 0.33				
														9.59m: P, sh, pl, sm, fe 9.76m: J, 65°, pl, ti, fe										

RIG: Explorer **DRILLER:** Ground Test (Simon) **LOGGED:** Fulham **CASING:** HQ to 1.1m

TYPE OF BORING: Solid flight auger to 1.25m, rock roller to 2.15m, NMLC to 21.85m

WATER OBSERVATIONS: Free groundwater obscured due to drilling methods

REMARKS: *Surface level provided by project surveyor

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PLD Photo ionisation detector (ppm)	PID Point load axial test Is(50) (MPa)
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	PL(D) Point load diametral test Is(50) (MPa)
BLK Block sample	U Tube sample (x mm dia.)	pp Pocket penetrometer (kPa)	gp Standard penetration test
C Core drilling	W Water sample	S Shear vane (kPa)	
D Disturbed sample	> Water seep		
E Environmental sample	≠ Water level		



DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 602 PROJECT 81719.01 2015



2.15 m – 7.00 m

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 602 PROJECT 81719.01 2015



7.00 m – 12.00 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT:	81719.01
PLATE No:	2
REV:	0
DATE:	25-Nov-15

CLIENT: Health Infrastructure

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: 16.8m AHD* **BORE No:** 602
EASTING: 369340 **PROJECT No:** 81719.01
NORTHING: 6374598 **DATE:** 15/10/2015
DIP/AZIMUTH: 90°/-- **SHEET 2 OF 3**

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing				
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium				High	Very High	Ex High	0.01	0.05
	11	SANDSTONE - Low strength, slightly weathered, slightly fractured, fine to medium grained sandstone with trace carbonaceous lenses up to 2mm thick (continued)													10.12m: J, 75°, pl, ti, fe	C	100	96	PL(A) = 0.3 PL(D) = 0.34		
	12	From 11.77m to 12.0m, some medium sized subrounded gravel																PL(I) = 0.13			
	13	From 13.75m, fine grained with some carbonaceous lenses												12.82m: BP, 2°, pl, sm, coal	C	100	100	PL(A) = 0.35 PL(D) = 0.38			
	14													13.36m: J, 40°, pl, sm, fe				PL(A) = 0.25 PL(D) = 0.24			
	15													14.49m: P, 2°, pl, sm, coal				PL(A) = 0.51 PL(D) = 0.38			
	15.04	SILTSTONE - Low strength, fresh, grey siltstone													C	82	62	PL(A) = 0.2 PL(D) = 0.1 PL(A) = 0.31 PL(D) = 0.21			
	15.54	COAL/CARBONACEOUS SILTSTONE - Low strength, fresh, black coal with bands of carbonaceous siltstone up to 40mm thick												15.54m to 16.0m, fractured				PL(A) = 0.56 PL(D) = 0.31			
	16.0	From 15.83m to 15.9m, medium strength												16m: CORE LOSS: 400mm				PL(A) = 0.15 PL(D) = 0.07			
	16.4	CORE LOSS - 0.4m in probable coal													C	66	17	PL(A) = 0.23 PL(A) = 0.48			
	16.8	COAL/CARBONACEOUS SILTSTONE - Very low strength, fresh, black coal with some bands of high strength carbonaceous siltstone												16.8m: CORE LOSS: 200mm				PL(A) = 0.06			
	17.0	CORE LOSS - 0.20m, in probable coal												17.13m to 18.0m, P, 3°, pl, sm at 140mm spacings	C	85	25	PL(A) = 0.11 PL(D) = 0.03 PL(A) = 0.52 PL(D) = 0.24			
	18	COAL/CARBONACEOUS SILTSTONE - Very low strength, fresh black coal with interbedded carbonaceous siltstone bands												18.1m: 3 x J, sv, pl, sm				PL(A) = 0.51 PL(D) = 0.17			
	18.62	CORE LOSS - 0.28m												18.32m: P, sh, pl, sl				PL(I) = 1.42			
	18.9	COAL - Low to medium strength, fresh, fragmented, black coal												18.62m: CORE LOSS: 280mm	C	100	0				
	19.0	CORE LOSS - 0.79m, in probable coal												18.90m to 19.0m, fragmented							
	19.79													19m: CORE LOSS: 790mm	C	6	0				
														19.79m to 20m,	C	100	60				

RIG: Explorer **DRILLER:** Ground Test (Simon) **LOGGED:** Fulham **CASING:** HQ to 1.1m

TYPE OF BORING: Solid flight auger to 1.25m, rock roller to 2.15m, NMLC to 21.85m

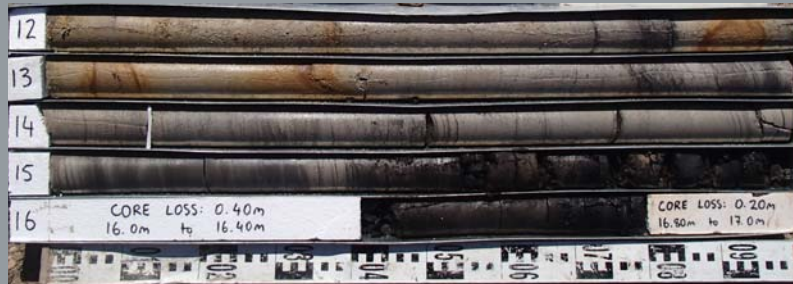
WATER OBSERVATIONS: Free groundwater obscured due to drilling methods

REMARKS: *Surface level provided by project surveyor

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

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 NEW MAITLAND HOSPITAL, METFORD

BORE 602 PROJECT 81719.01 2015



12.00 m – 17.00m

DOUGLAS PARTNERS PTY LTD
 NEW MAITLAND HOSPITAL, METFORD

BORE 602 PROJECT 81719.01 2015



17.00 m – 21.85 m



Core Photoplates
 New Maitland Hospital, Metford

PROJECT: 81719.01

PLATE No: 3

REV: 0

CLIENT: Health Infrastructure

DATE: 25-Nov-15

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: 16.8m AHD* **BORE No:** 602
EASTING: 369340 **PROJECT No:** 81719.01
NORTHING: 6374598 **DATE:** 15/10/2015
DIP/AZIMUTH: 90°/-- **SHEET 3 OF 3**

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing																	
			EW	HW	MW	SW	FS		FR	Ex	Low	Very Low	Low			Medium	High	Very High	Ex	High	0.01	0.05	0.10	0.50	1.00	B - Bedding	J - Joint	S - Shear	F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments		
	20.28	CARBONACEOUS SILTSTONE - Very low strength, fresh, black to dark brown carbonaceous siltstone (continued)																																	PL(A) = 0.13 PL(D) = 0.07
	20.65	SILTSTONE - Fresh, slightly fractured, grey siltstone																															PL(A) = 0.11 PL(D) = 0.11		
	21	SANDSTONE - Low strength, fresh, unbroken grey fine grained sandstone with laminations of siltstone																							C	100	60					PL(A) = 0.24 PL(D) = 0.14			
	21.85	Bore discontinued at 21.85m																															PL(A) = 0.22 PL(D) = 0.23		
	22																																		
	23																																		
	24																																		
	25																																		
	26																																		
	27																																		
	28																																		
	29																																		

RIG: Explorer **DRILLER:** Ground Test (Simon) **LOGGED:** Fulham **CASING:** HQ to 1.1m
TYPE OF BORING: Solid flight auger to 1.25m, rock roller to 2.15m, NMLC to 21.85m
WATER OBSERVATIONS: Free groundwater obscured due to drilling methods
REMARKS: *Surface level provided by project surveyor

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	Δ	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: 18.4m AHD* **BORE No:** 603
EASTING: 369326 **PROJECT No:** 81719.01
NORTHING: 6374480 **DATE:** 16/10/2015
DIP/AZIMUTH: 90°/-- **SHEET 1 OF 1**

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing										
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding	J - Joint	S - Shear	F - Fault	Type
	1	FILLING - Generally comprising grey-brown, fine to medium grained, gravelly sand filling, sandstone gravel, possible sandstone cobbles, trace clay																						S				10,19,18 N = 37
	2.2	SANDSTONE - (Low strength) grey, fine grained sandstone, some silt																						C	100	100	PL(A) = 0.2 PL(D) = 0.3	
	2.47	SANDSTONE - Low strength, slightly weathered, slightly fractured, grey, fine grained sandstone, some silt, some carbonaceous bands up to 1mm thick, horizontally bedded																		2.82m: J, 10°, pl, sm, stn, fe								PL(A) = 0.23 PL(D) = 0.13
	3																			3.28m: J, 10°, ir, ro, stn, fe								
	3.8	SANDSTONE - Medium strength, slightly weathered, slightly fractured, pale grey, medium grained sandstone, some carbonaceous bands, horizontally bedded																		3.71m: J, 10°, pl, ro, cbs					C	100	100	PL(A) = 0.29 PL(D) = 0.26
	4	At 4.30m, 30mm carbonaceous band																		4.17m: P, sh, pl, ro, cbs								PL(A) = 0.36 PL(D) = 0.34
	5	At 4.73m, 10mm carbonaceous band																		4.51m: J, 20°, ir, ro, cbs								
	6																			5.07m: J, 80°, ir, ro, stn, fe								PL(A) = 0.51 PL(D) = 0.56
	7																			5.54m: Cs, sh, pl, 5mm clay					C	100	98	
	8																			7.16m to 7.22m, Cs, sh, pl, 5mm clay spaced generally 20mm								PL(A) = 0.32 PL(D) = 0.3
	8.07	SILTSTONE - Low strength, slightly weathered, grey siltstone, some fine grained sand																		7.78m: P, sh, pl, ro, stn, fe								PL(A) = 0.17 PL(D) = 0.13
	8.2	Bore discontinued at 8.2m, limit of investigation																		8m: J, 10°, pl, ro, stn, fe								
	9																											

RIG: Ground Test **DRILLER:** Ground Test (Simon) **LOGGED:** Parkinson **CASING:** HQ to 2.47m

TYPE OF BORING: Solid flight auger TC bit to 2.47m, NMLC core to 8.20m

WATER OBSERVATIONS: Observations obscured by drilling fluids below 2.47m

REMARKS: *Surface level provided by project surveyor

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 603 PROJECT 81719.01 2015



2.47 m – 7.00 m

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 603 PROJECT 81719.01 2015



7.00 m – 8.20 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT:	81719.01
PLATE No:	4
REV:	0
DATE:	25-Nov-15

CLIENT: Health Infrastructure

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 604 PROJECT 81719.01 2015



1.20 m – 6.00 m

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 604 PROJECT 81719.01 2015



6.00 m – 8.60 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT: 81719.01

PLATE No: 5

REV: 0

CLIENT: Health Infrastructure

DATE: 25-Nov-15

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: 24.3m AHD*
EASTING: 369257
NORTHING: 6374488
DIP/AZIMUTH: 90°/--

BORE No: 605
PROJECT No: 81719.01
DATE: 22/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing										
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding	J - Joint	S - Shear	F - Fault	Type
	0.05	FILLING - Generally comprising light grey silt filling, humid																										
	0.4	FILLING - Brown gravelly sand filling, comprising fine to medium grained sand and fine to medium sized gravel (ripped sandstone, siltstone and coal)																										
	1																											
	1.2	SILTSTONE - Very low strength, highly weathered, brown and grey siltstone																										
	2	SANDSTONE - Extremely low strength, slightly weathered, slightly fractured, pale grey, fine to medium grained sandstone																										
	3	From 2.31m to 2.87m, very low strength																										
	3.67																											
	3.87	CORE LOSS - 0.2m (3.67m to 3.87m) in probable extremely weathered sandstone																										
	4																											
	4.47	SANDSTONE - Extremely low strength, extremely weathered, friable, brown, fine to medium grained sandstone (with soil like properties)																										
	5	SANDSTONE - Low strength, slightly weathered, slightly fractured, grey, fine to medium grained sandstone with wisps of dark grey siltstone																										
	6	From 4.72m, fresh																										
	6.2	LAMINATE - Low strength, fresh, slightly fractured, grey, interbedded siltstone and fine grained sandstone																										
	7																											
	7.1	SANDSTONE - Medium strength, fresh, unbroken, grey, medium grained sandstone																										
	8																											
	7.98	Bore discontinued at 7.98m, limit of investigation																										
	9																											

RIG: DT25 **DRILLER:** Ground Test (Kerny-Enn) **LOGGED:** Fulham **CASING:** HQ to 1.2m

TYPE OF BORING: Solid flight auger to 1.2m, NMLC core to 7.98m

WATER OBSERVATIONS: Free groundwater obscured by drilling methods

REMARKS: *Surface level provided by project surveyor

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 605 PROJECT 81719.01 2015



1.20 m – 6.00 m

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 605 PROJECT 81719.01 2015



6.00 m – 7.98 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT:	81719.01
PLATE No:	6
REV:	0
DATE:	25-Nov-15

CLIENT: Health Infrastructure

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369285
NORTHING: 6374363
DIP/AZIMUTH: 90°/--

BORE No: 606
PROJECT No: 81719.01
DATE: 22/10/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing										
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	0.01	0.05	0.10	0.50	1.00	B - Bedding	J - Joint	S - Shear	F - Fault	Type
	1	FILLING - Brown, gravelly sand filling comprising fine to medium grained sand and fine to medium sized gravel (ripped sandstone and siltstone, trace coal) trace cobbles and tree roots																										
	2.2	SANDSTONE - Very low strength, extremely weathered, friable, brown and orange, fine to medium grained sandstone																										PL(D) = 0.04
	2.7	SANDSTONE - Low strength, highly weathered, unbroken, brown, fine to medium grained sandstone with bands of extremely low strength, moderately weathered pale grey sandstone																										PL(A) = 0.11
	3																											PL(A) = 0.02
	4																											PL(A) = 0.11
	5																											PL(A) = 0.13
	5.18	CORE LOSS - 0.06m (5.18m to 5.24m)																										PL(D) = 0.14
	5.24																											PL(A) = 0.04
	5.45	LAMINATE - Very low strength, extremely weathered, friable, orange-brown and pale grey interbedded fine to medium sandstone and siltstone																										PL(A) = 0.05
	6	LAMINATE - Low to medium strength, moderately weathered, slightly fractured, grey and brown fine grained sandstone interbedded with siltstone																										PL(A) = 0.1
	7	CARBONACEOUS SILTSTONE - Low strength, highly weathered, dark brown siltstone																										PL(A) = 0.24
	7.04	From 7.2m, very low strength, extremely weathered																										PL(A) = 0.23
	7.42	SANDSTONE - Medium strength, slightly weathered, slightly fractured brown and grey, fine to medium grained sandstone																										PL(A) = 0.25
	8	Bore discontinued at 8.2m, limit of investigation																										PL(D) = 0.05
	8.2																											PL(A) = 0.09
	9																											PL(D) = 0.07
																												PL(A) = 0.38
																												PL(D) = 0.45

RIG: DT25 **DRILLER:** Ground Test (Kerny-Enn) **LOGGED:** Fulham **CASING:** HW to 1.2m, HQ to 2.2m
TYPE OF BORING: Solid flight auger to 2.2m, NMLC core to 8.2m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Surface level not recorded

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 606 PROJECT 81719.01 2015



2.20 m – 7.00 m

DOUGLAS PARTNERS PTY LTD
NEW MAITLAND HOSPITAL, METFORD
BORE 606 PROJECT 81719.01 2015



7.00 m – 8.20 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT:	81719.01
PLATE No:	7
REV:	0
CLIENT:	Health Infrastructure
DATE:	25-Nov-15

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369315
NORTHING: 6374543
DIP/AZIMUTH: 90°/--

BORE No: 702
PROJECT No: 81719.01
DATE: 11 - 12/7/2017
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering					Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing										
			EW	HW	MW	SW	FS		FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	B - Bedding	J - Joint	S - Shear	F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments		
	1	FILLING - Generally comprising grey brown gravelly sandy clay filling, fine to medium grained sand, gravel ripped sandstone medium to boulder sized, abundant silt, trace coal, humid																										
	2	From 2.0m, brown, moist																										
	3																											
	3.8	CARBONACEOUS SANDSTONE - Extremely low strength, extremely weathered, grey black, fine to medium grained carbonaceous sandstone																										
	4	Start coring at 4.4m																										
	4.4	SANDSTONE - Low strength, moderately weathered, grey stained orange, medium grained sandstone, slightly fractured to unbroken																										

RIG: Isuzu Mounted TD101

DRILLER: Total Drilling

LOGGED: Parkinson

CASING: HWt to 4.4m

TYPE OF BORING: Solid flight auger v-bit to 4.4m, NMLC from 4.4m to 11.55m

WATER OBSERVATIONS: Observations obscured below 4.4m due to drilling fluids

REMARKS: Backfilled at completion

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PL(D)	Point load axial test Is(50) (MPa)
		PL(A)	Point load axial test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)
		PID	Photo ionisation detector (ppm)

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369315
NORTHING: 6374543
DIP/AZIMUTH: 90°/--

BORE No: 702
PROJECT No: 81719.01
DATE: 11 - 12/7/2017
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing					
			EW	HW	SW	FS		FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	B - Bedding	J - Joint	S - Shear	F - Fault	Type
		SANDSTONE - Low strength, moderately weathered, grey stained orange, medium grained sandstone, slightly fractured to unbroken (continued)																	C	100	100	
	6	From 6.25-6.4m, extremely low strength, extremely weathered From 6.4-6.75m, medium strength												5.66m: J, 10°, pl, ro, stn fe 5.81m: P, sh, pl, ro, stn fe								PL(A) = 0.17
		From 6.75-7.08m, extremely low strength, extremely weathered												6.3m: Cz, sh, pl, ro 6.57m: J, 10°, pl, ro, stn fe 6.67m: P, sh, pl, ro								PL(A) = 0.56 PL(D) = 0.46
	7	From 7.08m, very low strength, slightly weathered												7.08m: P, sh, pl, ro, stn fe				C	100	78		PL(A) = 0.05
	7.25	SANDSTONE - Low to medium strength, slightly weathered, grey, fine grained sandstone, some horizontal carbonaceous bands 1-2mm thick, slightly fractured																				PL(A) = 0.34
	8	From 8.55m to 8.68m, extremely low to very low strength												7.92m: P, sh, pl, cbs								PL(A) = 0.27
	8.68	SANDSTONE - Medium strength, slightly weathered, grey stained orange in parts, medium to coarse grained sandstone, slightly fractured												8.7m: P, sh, pl, ro, stn fe								PL(A) = 0.45 PL(D) = 0.4
	9													9.4m: P, sh, pl, he 9.55m: P, sh, pl, ro, stn fe				C	100	89		PL(A) = 0.42 PL(D) = 0.42

RIG: Isuzu Mounted TD101 **DRILLER:** Total Drilling **LOGGED:** Parkinson **CASING:** HWt to 4.4m
TYPE OF BORING: Solid flight auger v-bit to 4.4m, NMLC from 4.4m to 11.55m
WATER OBSERVATIONS: Observations obscured below 4.4m due to drilling fluids
REMARKS: Backfilled at completion

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		gp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369315
NORTHING: 6374543
DIP/AZIMUTH: 90°/--

BORE No: 702
PROJECT No: 81719.01
DATE: 11 - 12/7/2017
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing							
			EW	HW	MW	SW		FS	FR	Ex	Low	Very Low			Low	Medium	High	Very High	Ex	High	B - Bedding	J - Joint	Type	Core Rec. %
		SANDSTONE - Medium strength, slightly weathered, grey stained orange in parts, medium to coarse grained sandstone, slightly fractured (continued)																						
	10.73	SANDSTONE - Low strength, slightly weathered, grey, fine to medium grained sandstone, some horizontal carbonaceous bands 1-2mm thick, slightly fractured																						
	11	From 11.35-11.55m, very low strength																						PL(A) = 0.12
	11.55	Bore discontinued at 11.55m, limit of investigation																						PL(A) = 0.03
	12																							
	13																							
	14																							

RIG: Isuzu Mounted TD101 **DRILLER:** Total Drilling **LOGGED:** Parkinson **CASING:** HWt to 4.4m
TYPE OF BORING: Solid flight auger v-bit to 4.4m, NMLC from 4.4m to 11.55m
WATER OBSERVATIONS: Observations obscured below 4.4m due to drilling fluids
REMARKS: Backfilled at completion

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	≻	Water seep
E	Environmental sample	≻	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		gp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369291
NORTHING: 6374511
DIP/AZIMUTH: 90°/--

BORE No: 703
PROJECT No: 81719.01
DATE: 12/7/2017
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength					Water	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing			
			EW	HW	MW	SW		FS	FR	Ex Low	Very Low	Low			Medium	High	Very High	Ex High	B - Bedding	J - Joint
	5.08	SANDSTONE - Medium strength, slightly weathered, grey, medium to coarse grained sandstone, unbroken															C	100	74	PL(A) = 0.32 PL(D) = 0.29
	6.5	SANDSTONE - Low strength, slightly weathered, grey, medium to coarse grained sandstone, unbroken															C	100	100	PL(A) = 0.22 PL(A) = 0.11 PL(A) = 0.2 PL(D) = 0.16
	7.65															7.65m: Handling break				
	9.4															9.4m: Pt, sh, pl, ro	C	98	98	PL(A) = 0.36 PL(D) = 0.22
	9.67															9.67m: J, 40°, ir, inf cbs				
	9.9															9.9m: J, 10°, pl, ro, inf				PL(D) = 0.13

RIG: Isuzu Mounted TD101 **DRILLER:** Total Drilling **LOGGED:** Parkinson **CASING:** HWt to 1.3m
TYPE OF BORING: Solid flight auger v-bit to 1.3m, NMLC from 1.3m to 12.0m
WATER OBSERVATIONS: Observations obscured below 1.3m due to drilling fluids
REMARKS: Well installed at completion

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		gp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369291
NORTHING: 6374511
DIP/AZIMUTH: 90°/--

BORE No: 703
PROJECT No: 81719.01
DATE: 12/7/2017
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering				Graphic Log	Rock Strength						Water	Fracture Spacing (m)	Discontinuities			Sampling & In Situ Testing								
			EW	HW	MW	SW		FS	FR	Ex Low	Very Low	Low	Medium			High	Very High	Ex High	B - Bedding	J - Joint	S - Shear	F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments	
	10.23	SANDSTONE - Low strength, slightly weathered, grey, medium to coarse grained sandstone, unbroken (continued)																									
	10.28	CORE LOSS - 0.05m, probable sandstone																									
	10.78	SANDSTONE - Low strength, slightly weathered, grey, medium to coarse grained sandstone, some siltstone inclusions																									
	11	SILTSTONE - Low strength, slightly weathered, grey siltstone, slightly fractured																									PL(A) = 0.11
	11.71	CORE LOSS - 0.19m, probable coal																									PL(A) = 0.1 PL(D) = 0.16
	11.9	COAL - Medium strength, slightly weathered, black coal																									PL(A) = 0.33
	12	Bore discontinued at 12.0m, limit of investigation																									
	13																										
	14																										

RIG: Isuzu Mounted TD101 **DRILLER:** Total Drilling **LOGGED:** Parkinson **CASING:** HWt to 1.3m
TYPE OF BORING: Solid flight auger v-bit to 1.3m, NMLC from 1.3m to 12.0m
WATER OBSERVATIONS: Observations obscured below 1.3m due to drilling fluids
REMARKS: Well installed at completion

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PLD	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	gp	Pocket penetrometer (kPa)
D	Disturbed sample	>	Water seep	S	Standard penetration test
E	Environmental sample	≡	Water level	V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369291
NORTHING: 6374511
DIP/AZIMUTH: 90°/--

BORE No: 703
PROJECT No: 81719.01
DATE: 12/7/2017
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction	
				Type	Depth	Sample		Results & Comments	Stickup = 0.88m
	0.3	FILLING - Generally comprising brown, fine grained silty sand filling, trace coal fines and rootlets, moist (slope wash)	[Cross-hatch pattern]						
	0.7	CARBONACEOUS CLAY - Hard, black carbonaceous clay with some fine to medium grained sand, M<Wp	[Diagonal lines]						
	1.0	CARBONACEOUS SILTSTONE - Extremely low strength, extremely weathered, black carbonaceous siltstone, some coal bands (soil like properties)	[Horizontal lines]	S	1.0		pp = 400 8,25/50 refusal		
	1.3	Start coring at 1.3m			1.2				
	1.35	CARBONACEOUS SILTSTONE - Extremely low strength, extremely weathered, black carbonaceous siltstone, some coal bands (soil like properties)	[Horizontal lines]		1.3				
	2.0	SANDSTONE - Medium strength, moderately weathered, grey stained orange, fine to medium grained sandstone, slightly fractured	[Dotted pattern]	C	1.75		PL(A) = 0.49 PL(D) = 0.47		
		From 2.0m, low strength			2.3		PL(A) = 0.11 PL(D) = 0.08		
		From 2.58m to 3.25m, very low strength, highly weathered			2.5				
					2.8		PL(A) = 0.08	Backfill, 0.5-5.0m	
	3.35	SANDSTONE - Low strength, slightly weathered, grey, fine grained sandstone, some horizontal carbonaceous bands 1-3mm thick, unbroken	[Dotted pattern]	C	3.7		PL(A) = 0.15 PL(D) = 0.12	50mm diameter blank PVC from 0.0-6.0m	
	4.5				4.5		PL(A) = 0.29 PL(D) = 0.16		

RIG: Isuzu Mounted TD101 **DRILLER:** Total Drilling **LOGGED:** Parkinson **CASING:** HWt to 1.3m
TYPE OF BORING: Solid flight auger v-bit to 1.3m, NMLC from 1.3m to 12.0m
WATER OBSERVATIONS: Observations obscured below 1.3m due to drilling fluids
REMARKS: Well installed at completion

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369291
NORTHING: 6374511
DIP/AZIMUTH: 90°/--

BORE No: 703
PROJECT No: 81719.01
DATE: 12/7/2017
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details		
				Type	Depth	Sample	Results & Comments				
	5.08	SANDSTONE - Medium strength, slightly weathered, grey, medium to coarse grained sandstone, unbroken	[Dotted Pattern]	C	5.5		PL(A) = 0.32 PL(D) = 0.29		Bentonite, 5.0-5.4m	[Hatched Pattern]	
	6										
	6.5	SANDSTONE - Low strength, slightly weathered, grey, medium to coarse grained sandstone, unbroken	[Dotted Pattern]	C	6.6		PL(A) = 0.22		Specialised Sand, 5.4-12.0m	[Dotted Pattern]	
	7										
	7.4						PL(A) = 0.11				
	8										
					8.42		PL(A) = 0.2 PL(D) = 0.16				
					8.55						
	9			C	9.2		PL(A) = 0.36 PL(D) = 0.22		50mm diameter machine slotted PVC from 6.0-12.0m	[Vertical Line Pattern]	
					9.95		PL(D) = 0.13				

RIG: Isuzu Mounted TD101 **DRILLER:** Total Drilling **LOGGED:** Parkinson **CASING:** HWt to 1.3m
TYPE OF BORING: Solid flight auger v-bit to 1.3m, NMLC from 1.3m to 12.0m
WATER OBSERVATIONS: Observations obscured below 1.3m due to drilling fluids
REMARKS: Well installed at completion

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Proposed Maitland Hospital
LOCATION: Metford Road, Metford

SURFACE LEVEL: --
EASTING: 369291
NORTHING: 6374511
DIP/AZIMUTH: 90°/--

BORE No: 703
PROJECT No: 81719.01
DATE: 12/7/2017
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	10.23	SANDSTONE - Low strength, slightly weathered, grey, medium to coarse grained sandstone, unbroken (continued)		C						
	10.28	CORE LOSS - 0.05m, probable sandstone								
		SANDSTONE - Low strength, slightly weathered, grey, medium to coarse grained sandstone, some siltstone inclusions		C	10.95		PL(A) = 0.11			
	10.78	SILTSTONE - Low strength, slightly weathered, grey siltstone, slightly fractured								
	11			C	11.5 11.55		PL(A) = 0.1 PL(D) = 0.16			
	11.71	CORE LOSS - 0.19m, probable coal								
	11.9	COAL - Medium strength, slightly weathered, black coal		C	11.95		PL(A) = 0.33		12 End Cap	
	12.0	Bore discontinued at 12.0m, limit of investigation								
	12									
	13									
	14									

RIG: Isuzu Mounted TD101 **DRILLER:** Total Drilling **LOGGED:** Parkinson **CASING:** HWt to 1.3m
TYPE OF BORING: Solid flight auger v-bit to 1.3m, NMLC from 1.3m to 12.0m
WATER OBSERVATIONS: Observations obscured below 1.3m due to drilling fluids
REMARKS: Well installed at completion

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



DOULGAS PARTNERS PTY LTD...
NEW MAITLAND HOSPITAL METFORD
Bore 701 PROJECT 81719.01 2017



1.50 m to 6.0 m

DOULGAS PARTNERS PTY LTD...
NEW MAITLAND HOSPITAL METFORD
Bore 701 PROJECT 81719.01 2017



6.0 m to 8.55 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT:	81719.01
PLATE No:	1
REV:	0
DATE:	18-Aug-17

CLIENT: Health Infrastructure

DOULGAS PARTNERS PTY LTD...
NEW MAITLAND HOSPITAL METFORD
Bore 702 PROJECT 81719.01 2017



4.40 m to 9.0 m

DOULGAS PARTNERS PTY LTD...
NEW MAITLAND HOSPITAL METFORD
Bore 702 PROJECT 81719.01 2017



9.0 m to 11.55 m



Core Photoplates
New Maitland Hospital, Metford

PROJECT:	81719.01
PLATE No:	2
REV:	0
DATE:	18-Aug-17

CLIENT: Health Infrastructure

DOULGAS PARTNERS PTY LTD...
NEW MAITLAND HOSPITAL METFORD
Bore 703 PROJECT 81719.01 2017



1.30 m to 6.0 m

DOULGAS PARTNERS PTY LTD...
NEW MAITLAND HOSPITAL METFORD
Bore 703 PROJECT 81719.01 2017



6.0 m to 11. m



Core Photoplates
New Maitland Hospital, Metford


PROJECT:	81719.01
PLATE No:	3
REV:	0
DATE:	18-Aug-17

CLIENT: Health Infrastructure

DOULGAS PARTNERS PTY LTD...
NEW MAITLAND HOSPITAL METFORD
Bore 703 PROJECT 81719.01 2017



11.0 m to 12.0 m

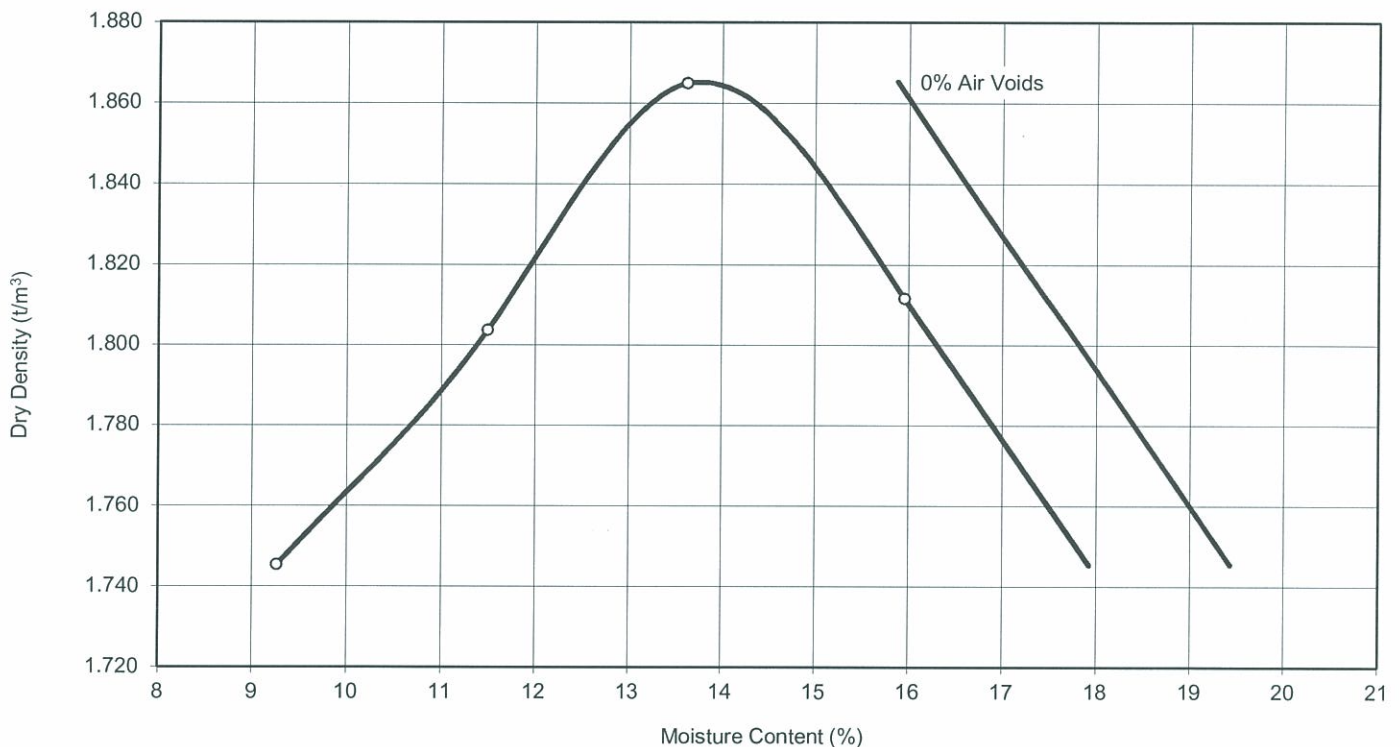
 Douglas Partners <i>Geotechnics Environment Groundwater</i>	Core Photoplates New Maitland Hospital, Metford	PROJECT: 81719.01
		PLATE No: 4
	REV: 0	
	CLIENT: Health Infrastructure	DATE: 18-Aug-17

Appendix C

Laboratory Test Results

Results of Compaction Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_1
Location :	Metford Road, Metford	Report Date :	20.11.2015
		Date of Test:	04.11.2015
		Page:	1 of 1



Sample Details: Location: 301
Depth: 1.0 - 1.3m

Particles > 19mm: 0%

Description: FILLING: Clayey SAND - Brown
(Ripped Sandstone)

Maximum Dry Density:	1.87 t/m³
Optimum Moisture Content:	14.0 %

Remarks:

Test Methods: AS 1289.5.1.1, AS1289.2.1.1

Sampling Methods: Sampled by DP Engineering Department

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FORM R016 REV 8 APRIL 2013



NATA Accredited Laboratory Number: 828
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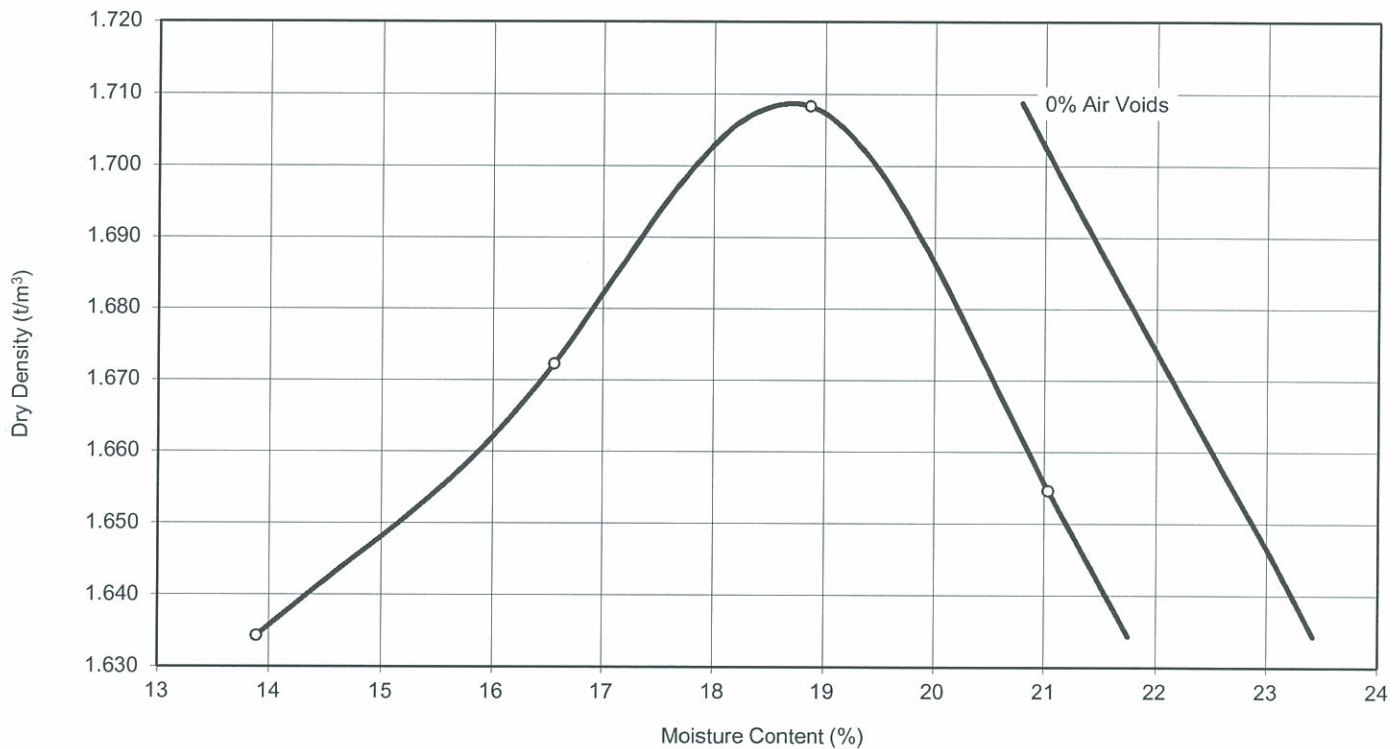
Tested:	MM
Checked:	DM



Dave Millard
Laboratory Manager

Results of Compaction Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_2
Location :	Metford Road, Metford	Report Date :	20.11.2015
		Date of Test:	04.11.2015
		Page:	1 of 1



Sample Details: Location: 301A
Depth: 0.5 - 0.7m

Particles > 19mm: 0%

Description: FILLING: Clayey SAND - Brown
(Ripped Sandstone)

Maximum Dry Density:	1.71 t/m³
Optimum Moisture Content:	18.5 %

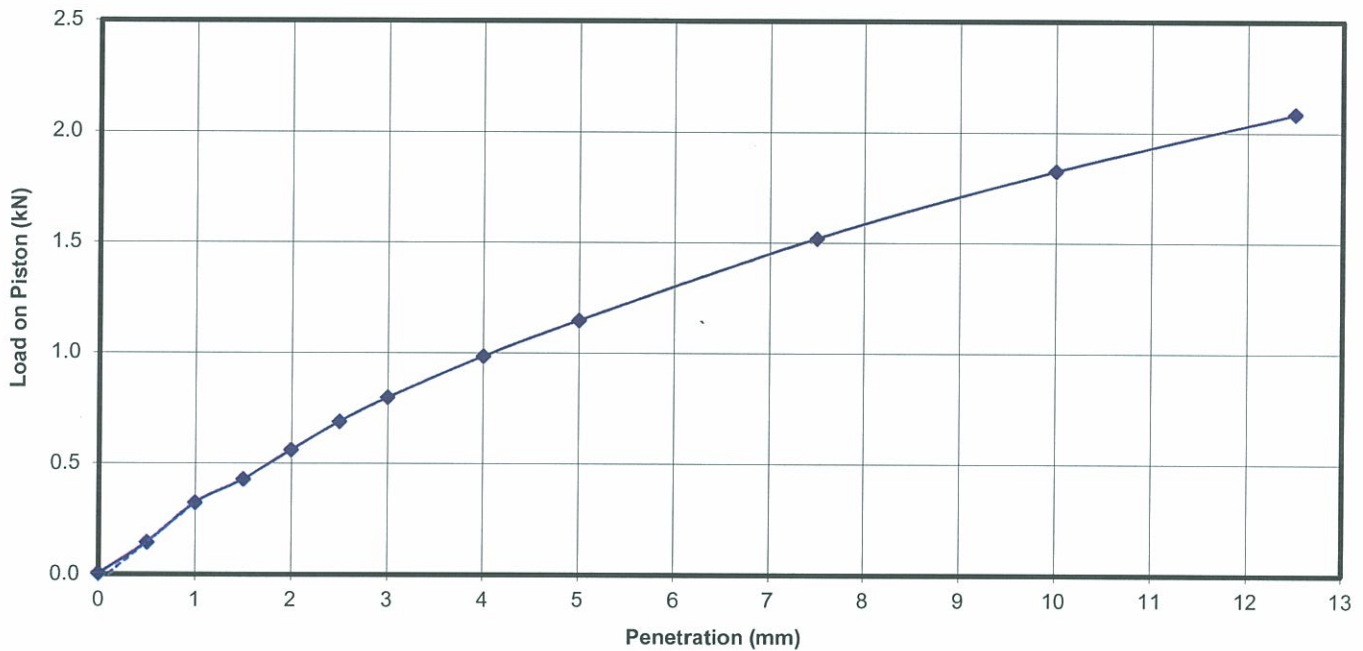
Remarks:

Test Methods: AS 1289.5.1.1, AS1289.2.1.1

Sampling Methods: Sampled by DP Engineering Department

Result of California Bearing Ratio Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_3
Location :	Metford Road, Metford	Report Date :	20.11.2015
Test Location :	301A	Date Sampled :	12-14.10.15
Depth / Layer :	0.5 - 0.7m	Date of Test:	05.11.2015
		Page:	1 of 1



Description: FILLING: Clayey SAND - Brown (Ripped Sandstone)

Sampling Method(s): Sampled by DP Engineering Department

Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Remarks:

Percentage > 19mm: 0.0%

LEVEL OF COMPACTION: 100% of STD MDD

SURCHARGE: 4.5 kg

SWELL: 1.2%

MOISTURE RATIO: 100% of STD OMC

SOAKING PERIOD: 4 days

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m ³
At compaction	18.5	1.71
After soaking	20.6	1.69
After test	Top 30mm of sample	-
	Remainder of sample	-
Field values	16.5	-
Standard Compaction (OMC/MDD)	18.5	1.71

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0mm	6



NATA Accredited Laboratory Number: 828

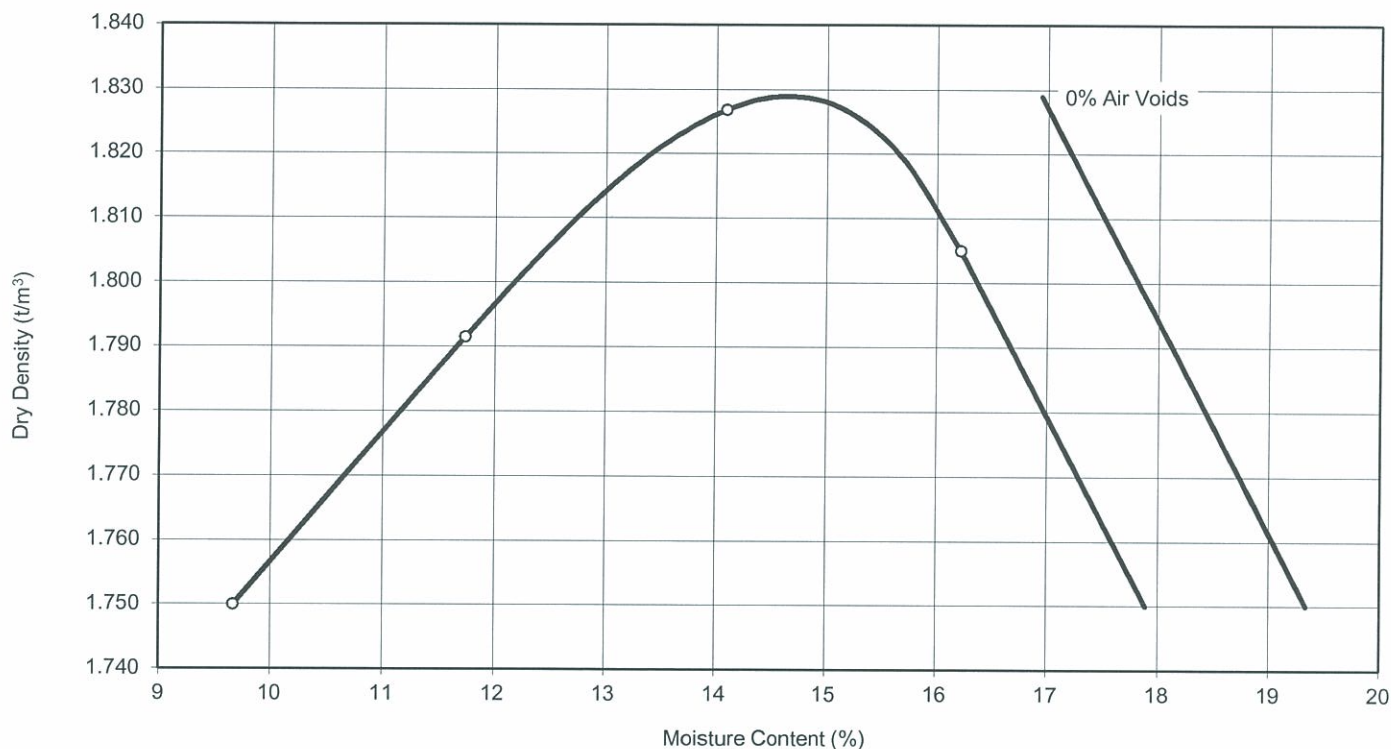
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Tested: JH
Checked: DM


Dave Millard
Laboratory Manager

Results of Compaction Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_4
Location :	Metford Road, Metford	Report Date :	20.11.2015
		Date of Test:	04.11.2015
		Page:	1 of 1



Sample Details: Location: 303
 Depth: 0.9 - 1.1m

Particles > 19mm: 0%

Description: SANDSTONE - Brown

Maximum Dry Density:	1.83 t/m³
Optimum Moisture Content:	14.5 %

Remarks:

Test Methods: AS 1289.5.1.1, AS1289.2.1.1

Sampling Methods: Sampled by DP Engineering Department

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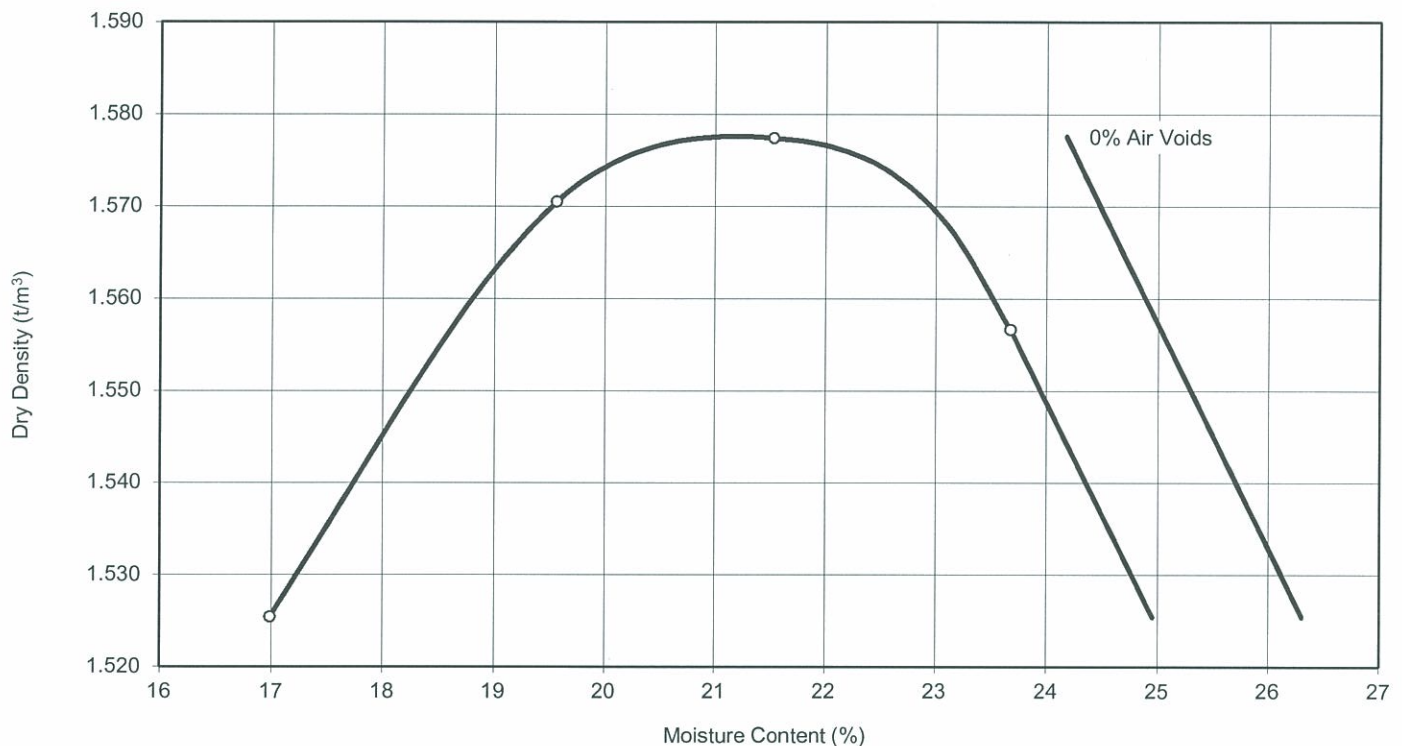
NATA Accredited Laboratory Number: 828
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Tested:	MM
Checked:	DM


 Dave Millard
 Laboratory Manager

Results of Compaction Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_5
Location :	Metford Road, Metford	Report Date :	20.11.2015
		Date of Test:	03.11.2015
		Page:	1 of 1



Sample Details: Location: 306
Depth: 0.9 - 1.1m

Particles > 19mm: 0%

Description: Sandy CLAY - Brown

Maximum Dry Density:	1.58 t/m³
Optimum Moisture Content:	21.0 %

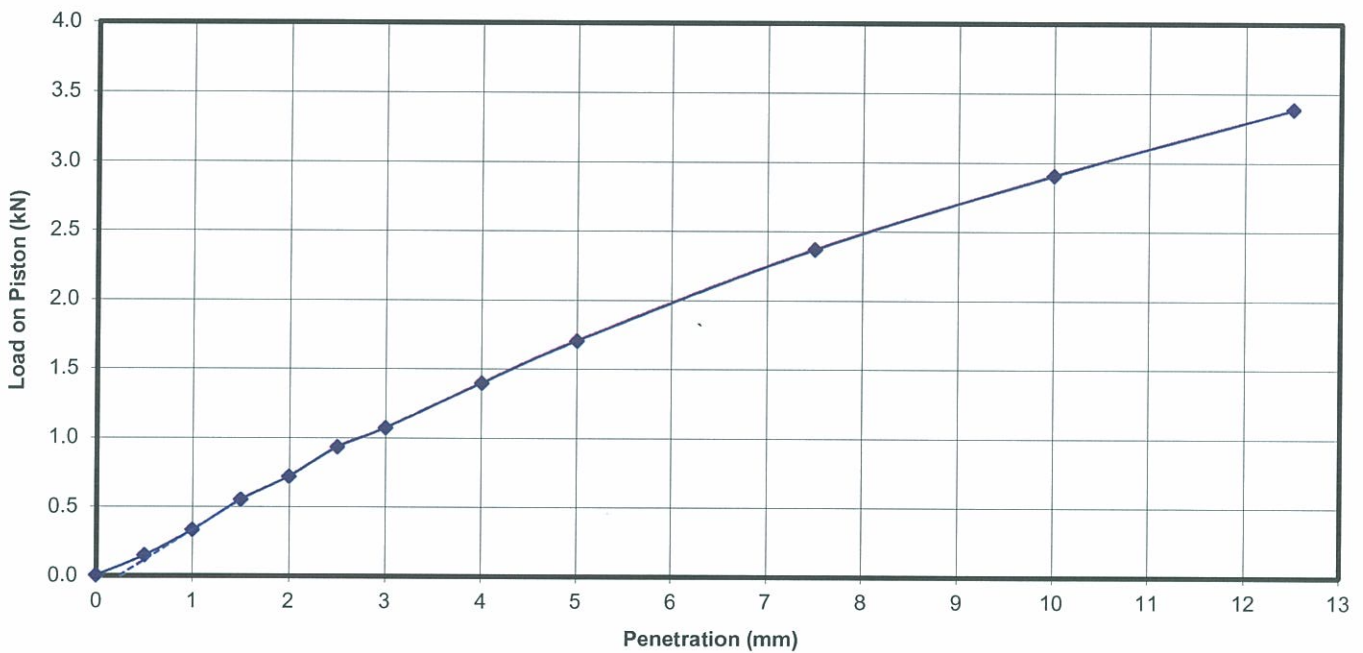
Remarks:

Test Methods: AS 1289.5.1.1, AS1289.2.1.1

Sampling Methods: Sampled by DP Engineering Department

Result of California Bearing Ratio Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_6
Location :	Metford Road, Metford	Report Date :	20.11.2015
Test Location :	306	Date Sampled :	12-14.10.15
Depth / Layer :	0.7 - 1.1m	Date of Test:	05.11.2015
		Page:	1 of 1



Description: Sandy CLAY - Brown
Sampling Method(s): Sampled by DP Engineering Department
Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Remarks:

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 100% of STD OMC
Percentage > 19mm: 0.0%
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.6%

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m ³
At compaction	21.1	1.58
After soaking	23.9	1.57
After test		
Top 30mm of sample	22.5	-
Remainder of sample	21.2	-
Field values	21.5	-
Standard Compaction (OMC/MDD)	21.0	1.58

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0mm	9

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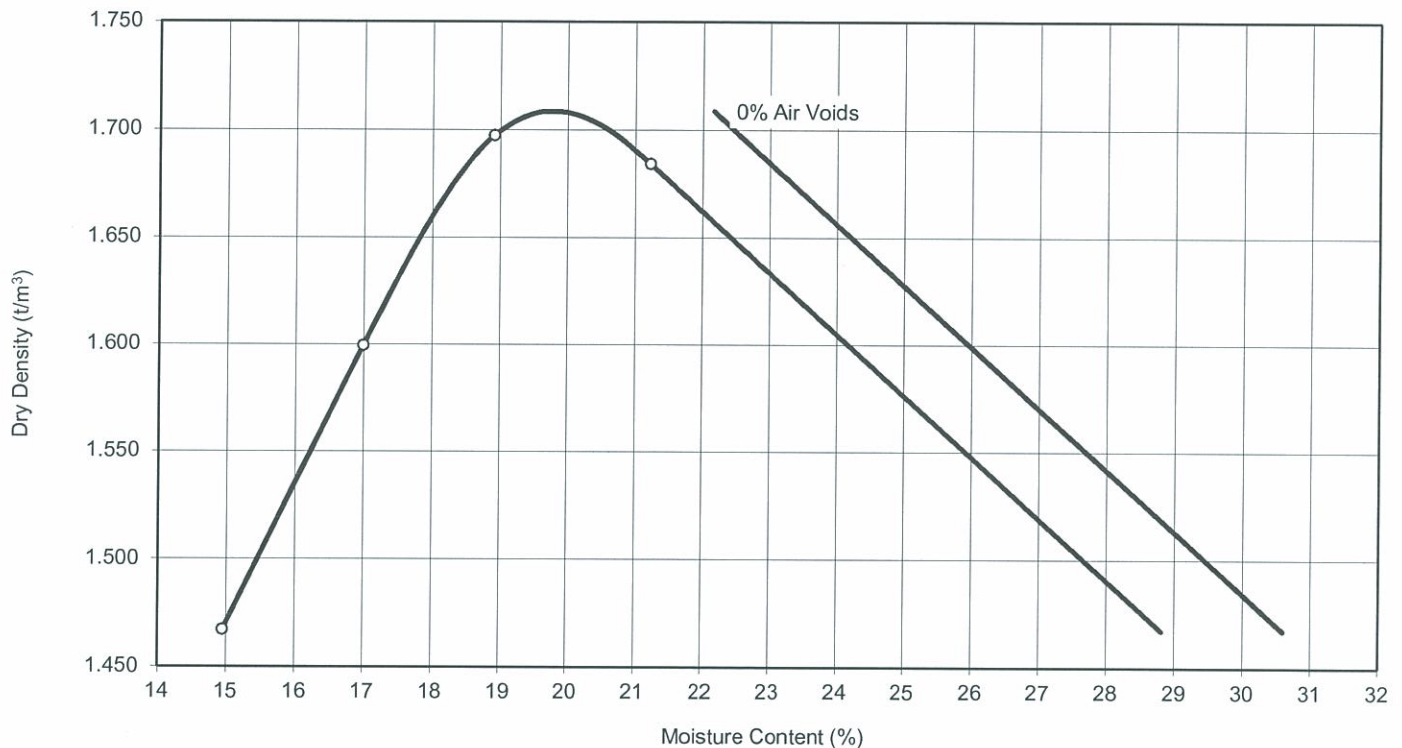
NATA Accredited Laboratory Number: 828
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 Accredited for compliance with ISO/IEC 17025

Tested: JH
 Checked: DM


 Dave Millard
 Laboratory Manager

Results of Compaction Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_7
Location :	Metford Road, Metford	Report Date :	20.11.2015
		Date of Test:	03.11.2015
		Page:	1 of 1



Sample Details: Location: 311
 Depth: 0.3 - 0.7m

Particles > 19mm: 0%

Description: Silty CLAY - Red brown / grey

Maximum Dry Density:	1.71 t/m³
Optimum Moisture Content:	20.0 %

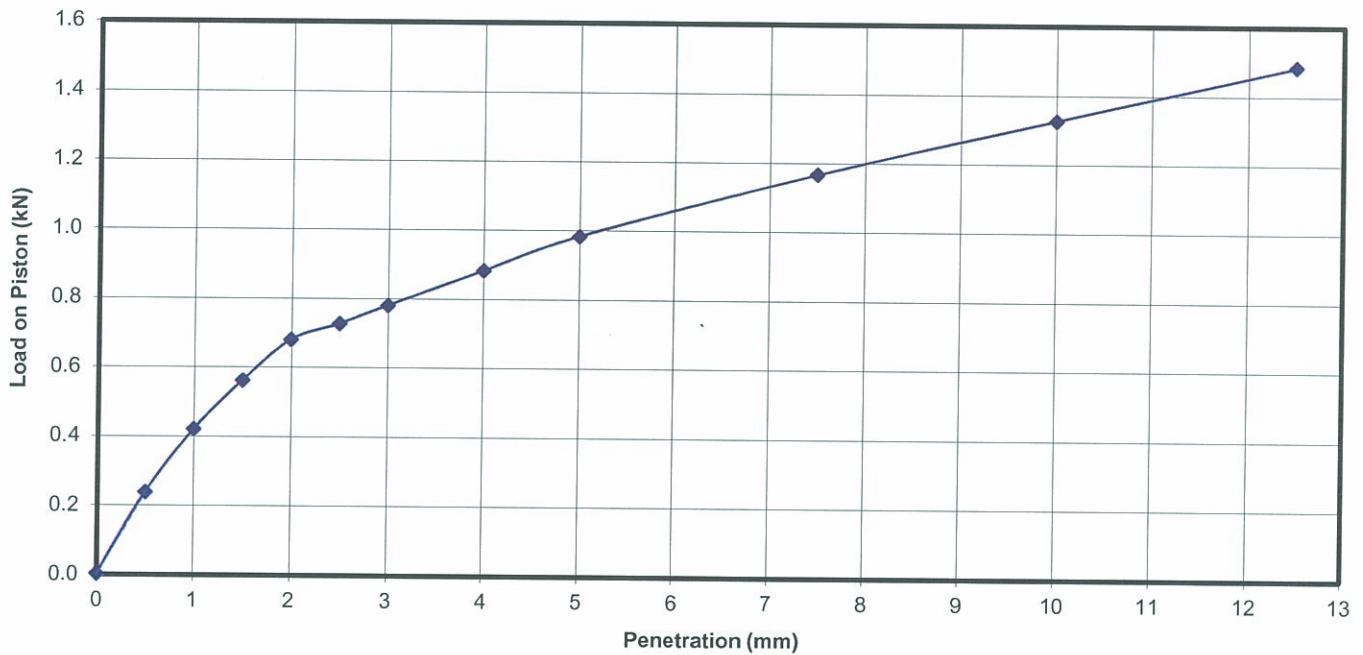
Remarks:

Test Methods: AS 1289.5.1.1, AS1289.2.1.1

Sampling Methods: Sampled by DP Engineering Department

Result of California Bearing Ratio Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_8
Location :	Metford Road, Metford	Report Date :	20.11.2015
Test Location :	311	Date Sampled :	12-14.10.15
Depth / Layer :	0.3 - 0.7m	Date of Test:	05.11.2015
		Page:	1 of 1



Description: Silty CLAY - Red brown / grey
Sampling Method(s): Sampled by DP Engineering Department
Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Remarks:

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 100% of STD OMC
Percentage > 19mm: 0.0%
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.8%

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m ³
At compaction	20.0	1.71
After soaking	21.0	1.69
After test	Top 30mm of sample	-
	Remainder of sample	-
Field values	18.9	-
Standard Compaction (OMC/MDD)	20.0	1.71

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	2.5mm	5



NATA Accredited Laboratory Number: 828

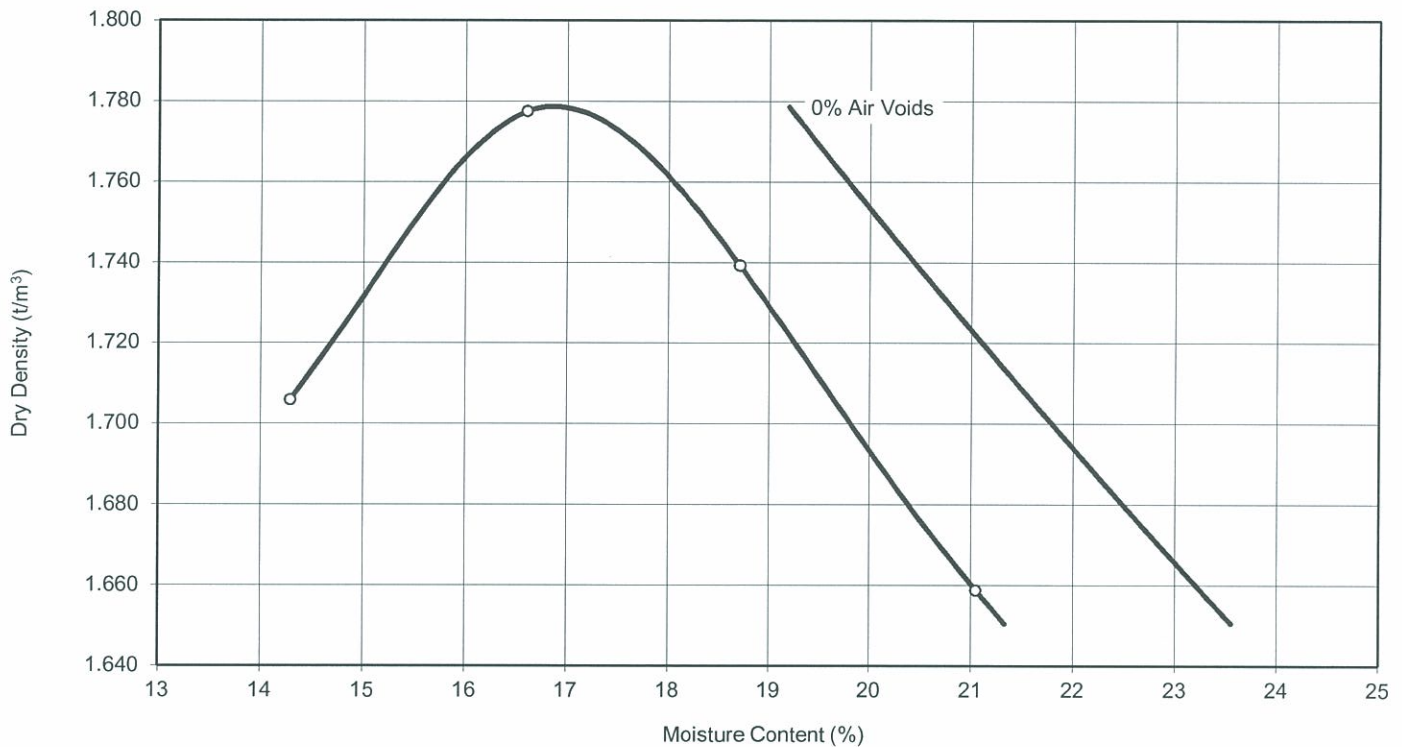
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Tested: JH
 Checked: DM


 Dave Millard
 Laboratory Manager

Results of Compaction Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_9
Location :	Metford Road, Metford	Report Date :	20.11.2015
		Date of Test:	03.11.2015
		Page:	1 of 1



Sample Details: Location: 313
Depth: 0.9 - 1.2m

Particles > 19mm: 0%

Description: Gravelly Silty CLAY - Brown (Siltstone)

Maximum Dry Density:	1.78 t/m³
Optimum Moisture Content:	17.0 %

Remarks:

Test Methods: AS 1289.5.1.1, AS1289.2.1.1

Sampling Methods: Sampled by DP Engineering Department

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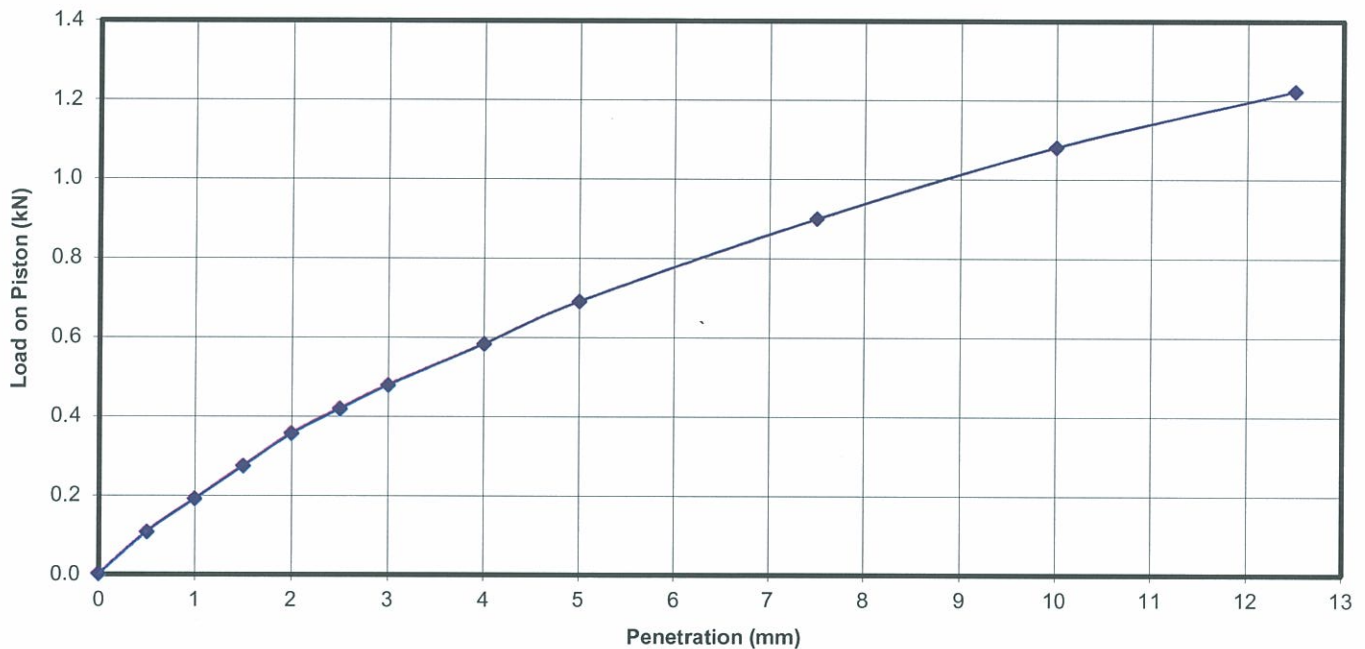
Tested:	MM
Checked:	DM



Dave Millard
Laboratory Manager

Result of California Bearing Ratio Test

Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_10
Location :	Metford Road, Metford	Report Date :	20.11.2015
Test Location :	313	Date Sampled :	12-14.10.15
Depth / Layer :	0.9 - 1.2m	Date of Test:	05.11.2015
		Page:	1 of 1



Description: Gravelly Silty CLAY - Brown (Siltstone)

Sampling Method(s): Sampled by DP Engineering Department

Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Remarks:

Percentage > 19mm: 0.0%

LEVEL OF COMPACTION: 100% of STD MDD

SURCHARGE: 4.5 kg

SWELL: 1.6%

MOISTURE RATIO: 100.5% of STD OMC

SOAKING PERIOD: 4 days

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m ³
At compaction	17.1	1.78
After soaking	19.4	1.75
After test	Top 30mm of sample	-
	Remainder of sample	-
Field values	16.6	-
Standard Compaction (OMC/MDD)	17.0	1.78

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0mm	3.5



NATA Accredited Laboratory Number: 828

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Tested: JH
Checked: DM


Dave Millard
Laboratory Manager

Result of Shrink-Swell Index Determination

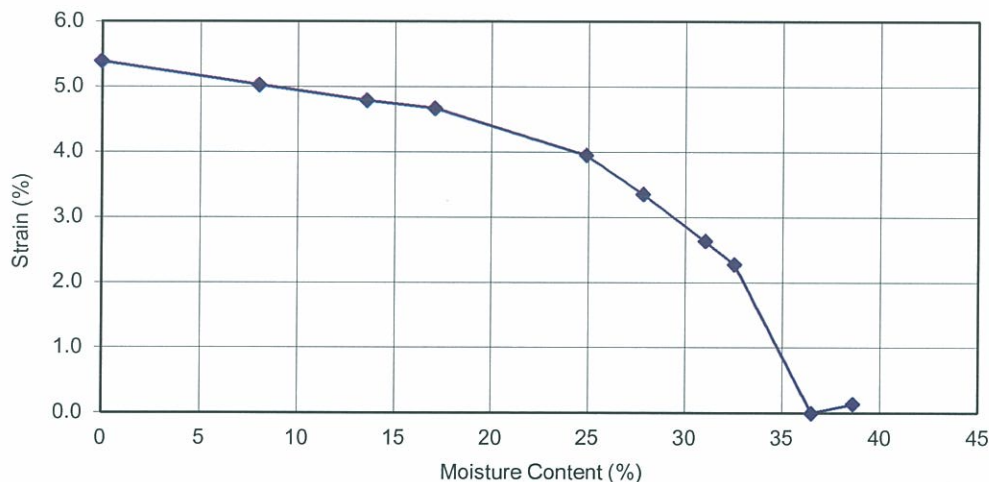
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Project :	Proposed Maitland Hospital	Report No. :	N15-223_11
Location :	Metford Road, Metford	Report Date :	20.11.2015
Test Location :	306	Date Sampled :	12-14.10.15
Depth / Layer :	0.3 - 0.7m	Date of Test:	02.11.2015
		Page:	1 of 1

CORE SHRINKAGE TEST

Shrinkage - air dried	5.0 %
Shrinkage - oven dried	5.4 %
Significant inert inclusions	0.0 %
Extent of cracking	SC
Extent of soil crumbling	0.0 %
Moisture content of core	36.5 %

SWELL TEST

Pocket penetrometer reading at initial moisture content	150 kPa
Pocket penetrometer reading at final moisture content	130 kPa
Initial Moisture Content	34.8 %
Final Moisture Content	38.6 %
Swell under 25kPa	-0.1 %



SHRINK-SWELL INDEX I_{ss} 3.0% per Δ pF

Description:	Carbonaceous Sandy CLAY - Dark grey	
Test Method(s):	AS 1289.7.1.1, AS 1289.2.1.1	
Sampling Method(s):	Sampled by Newcastle Engineering Department	
Extent of Cracking:	UC - Uncracked SC - Slightly cracked MC - Moderately cracked	HC - Highly cracked FR - Fractured
Remarks:	Slight consolidation	

Note that NATA accreditation does not cover the performance of pocket penetrometer readings



NATA Accredited Laboratory Number: 828
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Tested:	DR
Checked:	DM



Dave Millard
 Laboratory Manager

Result of Shrink-Swell Index Determination

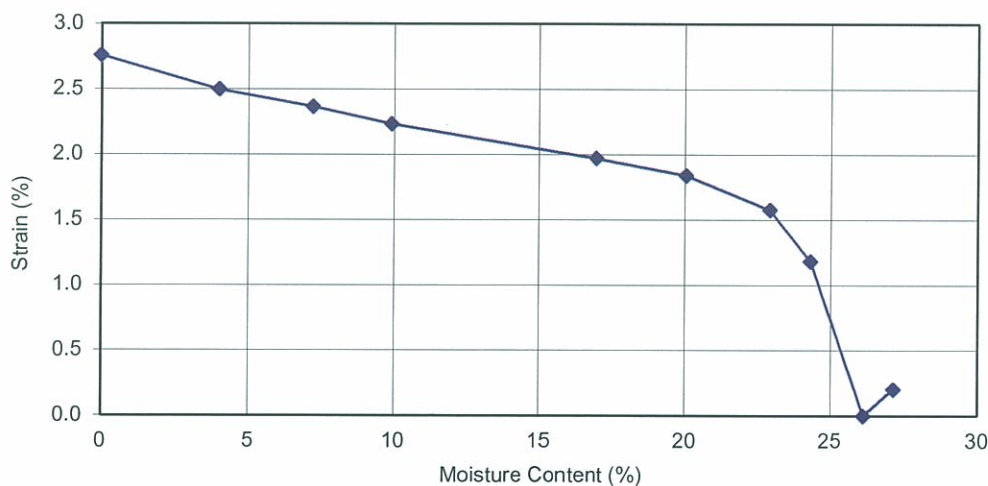
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Project :	Proposed Maitland Hospital	Report No. :	N15-223_12
Location :	Metford Road, Metford	Report Date :	20.11.2015
Test Location :	306	Date Sampled :	12-14.10.15
Depth / Layer :	0.6 - 1.0m	Date of Test:	02.11.2015
		Page:	1 of 1

CORE SHRINKAGE TEST

Shrinkage - air dried	2.5 %
Shrinkage - oven dried	2.8 %
Significant inert inclusions	0.0 %
Extent of cracking	MC
Extent of soil crumbling	0.0 %
Moisture content of core	26.1 %

SWELL TEST

Pocket penetrometer reading at initial moisture content	150 kPa
Pocket penetrometer reading at final moisture content	130 kPa
Initial Moisture Content	24.2 %
Final Moisture Content	27.1 %
Swell under 25kPa	-0.2 %



SHRINK-SWELL INDEX I_{ss} 1.5% per ΔpF

Description:	Sandy CLAY - Grey brown	
Test Method(s):	AS 1289.7.1.1, AS 1289.2.1.1	
Sampling Method(s):	Sampled by Newcastle Engineering Department	
Extent of Cracking:	UC - Uncracked SC - Slightly cracked MC - Moderately cracked	HC - Highly cracked FR - Fractured
Remarks:	Slight consolidation	

Note that NATA accreditation does not cover the performance of pocket penetrometer readings



NATA Accredited Laboratory Number: 828
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Tested:	DR
Checked:	DM


 Dave Millard
 Laboratory Manager

Result of Shrink-Swell Index Determination

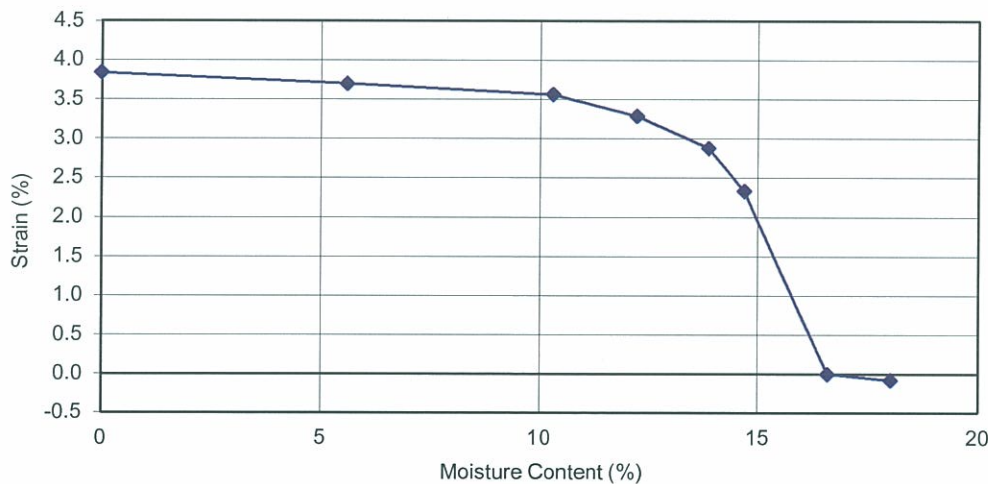
Client :	Health Infrastructure	Project No. :	81719.01
Project :	Proposed Maitland Hospital	Report No. :	N15-223_13
Location :	Metford Road, Metford	Report Date :	20.11.2015
Test Location :	311	Date Sampled :	12-14.10.15
Depth / Layer :	0.40 - 0.66m	Date of Test:	02.11.2015
		Page:	1 of 1

CORE SHRINKAGE TEST

Shrinkage - air dried	3.7 %
Shrinkage - oven dried	3.8 %
Significant inert inclusions	0.0 %
Extent of cracking	SC
Extent of soil crumbling	0.0 %
Moisture content of core	16.6 %

SWELL TEST

Pocket penetrometer reading at initial moisture content	450 kPa
Pocket penetrometer reading at final moisture content	380 kPa
Initial Moisture Content	15.4 %
Final Moisture Content	18.0 %
Swell under 25kPa	0.1 %



SHRINK-SWELL INDEX I_{ss} 2.2% per ΔpF

Description:	CLAY - Orange brown	
Test Method(s):	AS 1289.7.1.1, AS 1289.2.1.1	
Sampling Method(s):	Sampled by Newcastle Engineering Department	
Extent of Cracking:	UC - Uncracked SC - Slightly cracked MC - Moderately cracked	HC - Highly cracked FR - Fractured
Remarks:	Slight consolidation	

Note that NATA accreditation does not cover the performance of pocket penetrometer readings



NATA Accredited Laboratory Number: 828
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Tested:	DR
Checked:	DM


 Dave Millard
 Laboratory Manager

Results of Moisture Content, Plasticity and Linear Shrinkage Tests

Client:	Health Infrastructure	Project No:	81719.01
Project:	Proposed Maitland Hospital	Report No:	N15-233_14
Location:	Metford Road, Metford	Report Date:	20.11.2015
		Date Sampled:	12-14.11.15
		Date of Test:	09.11.2015
		Page:	1 of 1

Test Location	Depth (m)	Description	Code	W _F %	W _L %	W _P %	PI %	*LS %
307	0.30 – 0.45	Sandy CLAY – Light brown	2,5	12.2	36	14	22	8.5

Legend:

W_F Field Moisture Content
 W_L Liquid limit
 W_P Plastic limit
 PI Plasticity index
 LS Linear shrinkage from liquid limit condition (Mould length 125mm)

Test Methods:

Moisture Content: AS 1289 2.1.1
 Liquid Limit: AS 1289 3.1.2 , 3.1.1
 Plastic Limit: AS 1289 3.2.1
 Plasticity Index: AS 1289 3.3.1
 Linear Shrinkage: AS 1289 3.4.1

Code:

Sample history for plasticity tests

1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests

5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Methods: Sampled by DP Engineering Department

Remarks:



NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested: MF
 Checked: DM


 Dave Millard
 Laboratory Manager



Preliminary Report

Final Report

Client:

Douglas Partners pty Ltd

Project Description:

Combustibility Testing

Client Order Number

Branch reference number

MKY15-08010

SGS Mackay

Energy Minerals

SGS Australia Pty Ltd

13 Interlink Court

Paget Qld 4740

Australia

Phone: +61 (07) 4957 5444

Fax: +61 (0) 7 4952 5434

This document is issued by SGS Australia Pty Ltd under a contract between SGS Australia Pty Ltd and the relevant ("Client").

Any holder of this document is advised that information contained hereon reflects SGS Australia Pty Ltd's findings at the time of its intervention only and within the limits of Client's instructions, if any.

The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS Australia Pty Ltd
13 Interlink Court
Mackay QLD 4740
Tel: (07) 49515 444
Fax: (07) 49525 434



ANALYSIS REPORT

REPORT ON: Douglas Partners
SAMPLE: Soil Samples - Combustibility Testing

SGS REFERENCE: MKY15-08010

ELECTRONIC COPY TO: Michael Gawn

REQUESTED BY: Michael Gawn

DATE SAMPLE RECEIVED: 8/09/2015


AUTHORISATION TO COMMENCE: 9/11/2015

DATE PRELIMINARY RESULT ISSUED: 17/11/2015

This report supersedes any preliminary report which may have been issued.

REPORT PREPARED BY: Katrina Dreger

DATE FINAL REPORTED: 17/11/2015

FINAL REPORTED BY: 
Katrina Dreger
Projects Assistant

This Document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

A member of the SGS Group

Client ID: Douglas Partners
Sample ID: Soil Samples -
Combustibility Testing

REF: MKY15-08010
Reported by: Katrina Dreger

Date Received: 08-Sep-15
Report Date: 17-Nov-15

REPORTED TO: Michael Gawn

ANALYSIS RESULTS

Job Number:	MKY15-08010.001	MKY15-08010.002	MKY15-08010.003	MKY15-08010.004	MKY15-08010.005	MKY15-08010.006	MKY15-08010.007
Sample ID:	TP303/0.2	TP305/0.1	TP310/0.4	TP314/0.3	TP316/0.6	Stockpile 1	Stockpile 2
<u>Air Dry Basis unless otherwise stated</u>							
Moisture (air dried)	(%)	3.8	2.8	2.5	3.2	2.8	4.4
Ash	(%)	34.1	76.8	69.8	65.7	11.9	79.7
Volatile Matter	(%)	29.0	9.9	13.5	15.4	34.0	9.9
Fixed Carbon	(%)	33.1	10.5	14.3	15.8	51.4	7.6
Total Sulfur	(%)	0.64	0.17	0.23	0.54	1.72	0.24
Gross Calorific Value (corrected)	(MJ/kg)	19.69	5.56	8.16	9.29	29.34	3.81
Gross Calorific Value (corrected)	(kcal/kg)	4703	1329	1950	2219	7007	910
							3357

	LABORATORY					AS	ISO	ASTM	BS
	GLD	MKY	MUS	NCL	WOL				
Coal - Total Moisture	x	x	x	x	x	*AS1038.1-2001	ISO589	D3302M-10	BS1016.1
% Solids	x	x	x	x	x	SGS in-house method			
Coke - Total Moisture		x		x	x	AS1038.2	ISO579	-	BS ISO579
Coal and Coke - Proximate Analysis	x	x	x	x	x	*AS1038.3-2000	ISO17246	D3172-07a	-
Coal - Proximate Analysis - Air Dried Moisture	x	x	x	x	x	*AS1038.3-2000	ISO11722	D3173-11	BS ISO11722
Coal - Proximate Analysis - Ash	x	x	x	x	x	*AS1038.3-2000	ISO1171	D3174-11	BS ISO1171
Coal - Proximate Analysis - Volatile Matter	x	x	x	x	x	*AS1038.3-2000	ISO562	D3175-11	BS ISO562
Coke - Proximate Analysis - Air Dried Moisture		x			x	*AS1038.3-2000	ISO687	D3173-11	BS ISO11722
Coke - Proximate Analysis - Ash		x			x	*AS1038.3-2000	ISO1171	D3174-11	BS ISO1171
Coke - Proximate Analysis - Volatile Matter		x			x	*AS1038.3-2000	ISO562	D3175-11	BS ISO562
Coal and Coke - Calorific Value	x	x	x	x	x	*AS1038.5-1998	ISO1928	D5865-10a	BS ISO1928
Coal and Coke - Total Sulfur - IR Method	x	x	x	x	x	AS1038.6.3.3	ISO19579	D5016-08e1	BS ISO19579
Coal and Coke - Carbon/Hydrogen/Nitrogen - Instrumental	x	x		x		AS1038.6.4	ISO29541	D5373-08	BS ISO29541
Coal and Coke - Chlorine - Eschka Method		x				AS1038.8.1	ISO587	D2361-95	BS1016.106.6.1
Coal and Coke - Chlorine by XRF				x		SGS in-house method			
Coal and Coke - Phosphorus - Ash Digestion - Phosphomolybdovanadate Method		x				AS1038.9.3	ISO622	-	BS1016.9
Coal - Forms of sulfur		x				AS1038.11	ISO157	D2492-02	BS1016.106.5
Coal - Forms of Sulfur by ICP				x		SGS in-house method			
Coal - Crucible swelling number	x	x	x	x	x	*AS1038.12.1-2002	ISO501	D720-91	BS ISO501
Coal - Gray-King coke type	x	x			x	AS1038.12.2	ISO502	-	BS1016.107.2
Coal - Dilatation	x	x		x	x	*AS1038.12.3-2002	ISO23873	D5515-97	BS1016.107.3
Coal - Audibert-Arnu Dilatometer Test	x	x				-	ISO349	-	-
Coal - Gieseler fluidity - Continuous Torque	x	x		x	x	*AS1038.12.4.1-1996	ISO10329	D2639-08	BS ISO10329
Coke - Tests specific to coke		x			x	AS1038.13	-	-	-
Coal and Coke Ash - Ash Elemental Analysis - XRF		x		x		AS1038.14.3	-	D4326-04	-
Coal and Coke Ash - Ash Fusibility	x	x		x		*AS1038.15-1995	ISO540	D1857M-04	BS ISO540
Coal - Moisture Holding Capacity (Equilibrium Moisture)	x			x		AS1038.17	ISO1018	-	BS1016.21
Coke - Size Analysis	x	x			x	AS1038.18	ISO2325/ISO728	D2393-93	-
Coal - Abrasion Index	x			x	x	AS1038.19	ISO12900	-	BS1016-111
Coal - Hardgrove Grindability Index	x	x	x	x	x	AS1038.20	ISO5074	D409M-11	BS1016.112
Coal and Coke - Relative Density - Bottle Method	x	x	x	x		AS1038.21.1.1	ISO1014 (Coke)	-	-
Coal and Coke - Relative Density - Volumetric Method			x		x	AS1038.21.1.2	-	-	-
Coal and Coke - Carbonate Carbon		x		x		AS1038.23	ISO925	D1756-02	BS1016.106.7
Coal and Coke - Apparent Relative Density	x	x	x	x		AS1038.26	-	-	-
Fluorine		x		x		-	-	D3761-96	-
Guide to the technical evaluation of higher rank coal deposits						AS2519	-	-	-
Sampling From Coal Seams		x	x			AS2617	-	-	-
Coal - Maceral Analysis **		x				AS2856.2	ISO7404.3	D2799-11	BS ISO7404.3
Coal - Reflectance of Coal Macerals **		x				AS2856.3	ISO7404.5	D2798-09a	BS ISO7404.5
Coal - Size analysis	x	x	x	x	x	*AS3881-2002	ISO1953	D4749-87	BS1016.109
Coal and Coke - Bulk Density		x	x			AS3899	ISO23499	-	BS ISO23499
Coal - Float and Sink Testing	x	x	x	x		AS4156.1	ISO7936	D4371-06	BS7067
Coal - Magnetism By Davis Tube	x	x	x	x		AS4156.3	-	-	-
Coal - Froth Flotation - Basic Test	x	x		x		AS4156.2.1	ISO8858-1	D5114-90	BS7530-1
Coal - Froth Flotation - Sequential Procedure	x	x		x		AS4156.2.2	ISO8858-2	-	BS7530-2
Coal - Sampling Procedures	x	x	x	x	x	AS4264.1	ISO13909-1-4	D2234M-10	BS ISO13909-1-4
Coke - Sampling Procedures	x	x	x	x	x	AS4264.2	ISO13909-5 & 6	D346-04	-
Coal and Coke - Sampling - Determination of Precision and Bias		x	x		x	AS4264.4	ISO13909-7	D2013M-09	BS ISO13909-7
Coal - Caking G Index	x	x		x		-	ISO15585	-	BS ISO15585
Trace Elements in Coal using ICP/Microwave Digestion				x		SGS in-house methods			

* Australian Standards withdrawn, however used for specific contract requirements according to the year stated above.

** Petrographic examinations carried out at SGS Mackay unless otherwise indicated on the analysis page.

LEGEND: GLD - Gladstone MKY - Mackay MUS - Muswellbrook NCL - Newcastle WOL - Wollongong



CERTIFICATE OF ANALYSIS

136666

Client:

Douglas Partners Newcastle
Box 324 Hunter Region Mail Centre
Newcastle
NSW 2310

Attention: Michael Gawn

Sample log in details:

Your Reference: **81719.01. Metford**
No. of samples: 5 Soils
Date samples received / completed instructions received 30/10/15 / 30/10/15

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date: 6/11/15 / 3/11/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:


Jacinta Hurst
Laboratory Manager

Misc Inorg - Soil						
Our Reference:	UNITS	136666-1	136666-2	136666-3	136666-4	136666-5
Your Reference	-----	TP302	TP302	TP303	TP307	TP312
Depth	-----	1.0	2.0	0.5	0.6	0.4
Date Sampled		12/10/2015	12/10/2015	12/10/2015	13/10/2015	13/10/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/11/2015	02/11/2015	02/11/2015	02/11/2015	02/11/2015
Date analysed	-	02/11/2015	02/11/2015	02/11/2015	02/11/2015	02/11/2015
pH 1:5 soil:water	pH Units	9.0	8.9	7.8	5.5	4.8
Electrical Conductivity 1:5 soil:water	µS/cm	430	430	340	370	200
Chloride, Cl 1:5 soil:water	mg/kg	390	350	55	330	130
Sulphate, SO4 1:5 soil:water	mg/kg	260	300	570	280	190

MethodID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.

Client Reference: 81719.01. Metford

QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Misc Inorg - Soil						Base II Duplicate II %RPD		
Date prepared	-			02/11/2015	136666-1	02/11/2015 02/11/2015	LCS-1	02/11/2015
Date analysed	-			02/11/2015	136666-1	02/11/2015 02/11/2015	LCS-1	02/11/2015
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	136666-1	9.0 9.0 RPD: 0	LCS-1	101%
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	136666-1	430 420 RPD: 2	LCS-1	102%
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	136666-1	390 380 RPD: 3	LCS-1	104%
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	136666-1	260 260 RPD: 0	LCS-1	116%

Report Comments:

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test
NR: Test not required
<: Less than

PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than

NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.


In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Project Name: Mefford
 Project No: 81719-01 DP Order No:
 DP Contact Person: Michael Gawn
 Prior Storage: esky / fridge / freezer / shelved (circle)

To: Envirolab Services Pty Ltd.....
 12 Ashley Street.....
 CHATSWOOD NSW 2067
 Ph: (02) 9910 6200.....
 Attn: Jacinta Hurst

Sample ID	Date Sampled	Sample Type S-soil W-water	Lab ID	Analytes								Notes	
				pH	EC	SO ₄	Cl						
TP302/1.0	12/10/15	S	1	✓	✓	✓	✓						 Envirolab Services 12 Ashley St Chatswood NSW 2067 Ph: (02) 9910 6200 Job No: <u>136666</u> Date Received: <u>30/10</u> Time Received: <u>9:43</u> Received by: <u>PH</u> Temp: Cool/Ambient Cooling: Ice/Icepack Security: Intact/Broken/None
TP302/2.0	12/10/15		2	✓	✓	✓	✓						
TP303/0.5	12/10/15		3	✓	✓	✓	✓						
TP307/0.6	13/10/15		4	✓	✓	✓	✓						
TP312/0.4	13/10/15	↓	5	✓	✓	✓	✓						
PQL (S)		mg/kg											
PQL (W)		mg/L											

PQL = practical quantitation limit *As per Laboratory Method (Detection Limit)
 # - Metals to Analyse (Please circle): As Cd Cr Cu Pb Zn Hg Ni Other
 Date relinquished: 29/10/15
 Total number of samples in container: 5
 Results required by:
 TAT (Circle): Standard 72 hr 48hr 24hr

SAMPLES RECEIVED
 Please sign and date to acknowledge receipt of samples and return by fax
 Signature: [Signature]
 Date: 30/10 Lab Ref: ELS

Send results to:
 Douglas Partners Pty Ltd
 Address:
 BOX 324 Hunter Region Mail Centre
 NSW 2310
 Fax: (02) 4960 9601



CERTIFICATE OF ANALYSIS

137281

Client:

Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Michael Gawn

Sample log in details:

Your Reference:	81719.01, Proposed Maitland Hospital
No. of samples:	1 Water
Date samples received / completed instructions received	12/11/2015 / 12/11/2015

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data. Samples were analysed as received from the client. Results relate specifically to the samples as received. Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date: 19/11/15 / 16/11/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:


Jacinta Hurst
Laboratory Manager

Miscellaneous Inorganics		
Our Reference:	UNITS	137281-1
Your Reference	-----	BH602
Date Sampled	-----	1/10/2015
Type of sample		Water
Date prepared	-	12/11/2015
Date analysed	-	12/11/2015
pH	pH Units	6.9
Electrical Conductivity	µS/cm	9,200
Chloride, Cl	mg/L	3,000
Sulphate, SO ₄	mg/L	250

MethodID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.

Client Reference: 81719.01, Proposed Maitland Hospital

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Miscellaneous Inorganics						Base II Duplicate II %RPD		
Date prepared	-			12/11/2015	[NT]	[NT]	LCS-W1	12/11/2015
Date analysed	-			12/11/2015	[NT]	[NT]	LCS-W1	12/11/2015
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-W1	101%
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	LCS-W1	104%
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	LCS-W1	105%
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	LCS-W1	110%

Report Comments:

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

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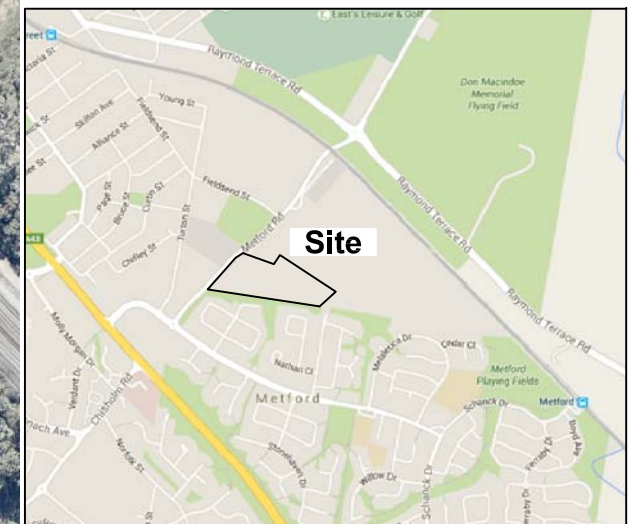
In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

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Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Appendix D

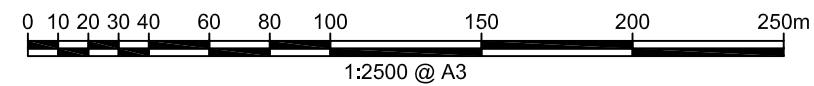
Drawing 1 – Test Location Plan
Drawing 2 – Site Features



Locality Plan

NOTES

1. Drawing adapted from plan by Nearmap Image dated 6.5.15.
2. Test locations are approximate only and were located using Hand-held GPS.



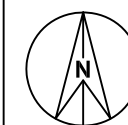
LEGEND

- Borehole Location (current investigation)
- Borehole Location (previous investigation)
- Test Pit Location (previous investigation)
- Dynamic Penetrometer Test Location (previous investigation)
- Site
- Terrain Areas
- Approximate Alignment of Drainage Gully

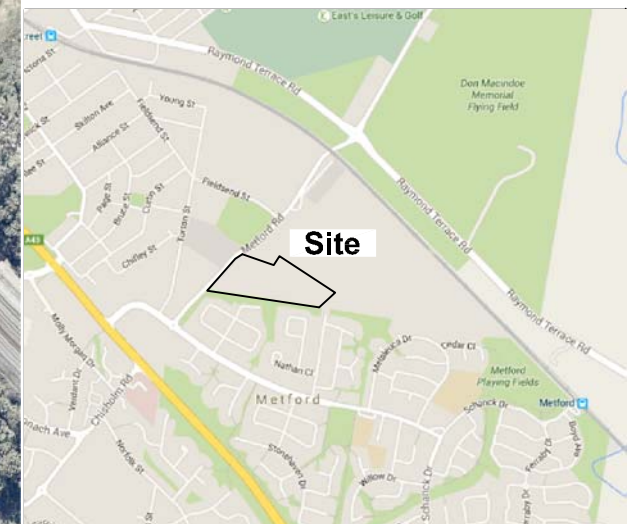


CLIENT: Health Infrastructure	
OFFICE: Newcastle	DRAWN BY: PLH
SCALE: 1:2500@A3 Sheet	DATE: 25.07.2017

TITLE: **Test Location Plan**
New Maitland Hospital - Enabling Works
Metford Road, Metford



PROJECT No:	81719.03
DRAWING No:	1
REVISION:	0



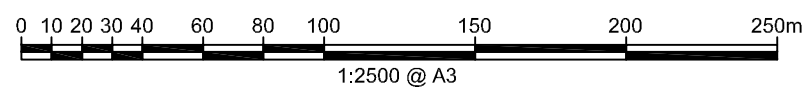
Locality Plan

NOTES

1. Drawing adapted from plan by Nearmap Image dated 6.5.15.
2. Test locations are approximate only and were located using Hand-held GPS.

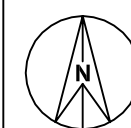
LEGEND

- Borehole Location
- Test Pit Location
- Dynamic Penetrometer Test Location
- Site Boundary
- Terrain Areas
- Approximate Alignment of Drainage Gully



CLIENT: Health Infrastructure	
OFFICE: Newcastle	DRAWN BY: PLH
SCALE: 1:2500@A3 Sheet	DATE: 24.11.2015

TITLE: **Site Features**
New Maitland Hospital
Metford Road, Metford



PROJECT No:	81719.01
DRAWING No:	2
REVISION:	0