



# **Douglas Partners**

*Geotechnics | Environment | Groundwater*

**Integrated Practical Solutions**

Remediation Action Plan

Site B  
Castle Towers Expansion Project – P11 Scheme  
Castle Street, Castle Hill

Prepared for  
QIC Limited

Project 84335.03  
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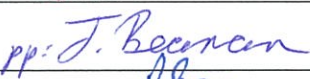

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## List of Abbreviations

ABC	ambient background concentration
AC	asbestos cement
ACL	added contaminant limits
ACM	asbestos containing materials
ADWG	NHMRC/NRMMC National Water Quality Management Strategy Australian Drinking Water Guidelines (2011)
AEC	area of environmental concern
AF	asbestos fines
AHD	Australian height datum
ANZECC	Australian and New Zealand Environmental & Conservation
AS	Australian Standard
As	arsenic
AST	above ground storage tank
BaP	benzo(a)pyrene
BaP TEQ	benzo(a)pyrene toxic equivalent
BG&E	BG&E
bgl	below ground level
BH	borehole
BTEX	benzene, toluene, ethylbenzene, xylenes
BTEXN	benzene, toluene, ethylbenzene, xylenes, naphthalene
Cd	cadmium
CEC	cation exchange capacity
CEMP	construction environmental management plan
CLM Act	Contaminated Land Management Act 1997
CN	cyanide
COC	chain of custody
COPC	Contaminants of potential concern
Cr	chromium
Cr(III)	chromium with oxidation state III (stable in normal environments)
Cr(VI)	chromium with oxidation state VI (typically not stable in normal environments)
CRC Care	Co-operative Research Centre for Contamination Assessment and Remediation of the Environment
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSM	conceptual site model
CT	contaminant threshold
Cu	copper

Cx	equivalent to “x” number of carbon atoms in TRH/TPH groups
DA	development application
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DECC	NSW Department of Environment and Climate Change (now superseded)
DECCW	NSW Department of Environment, Climate Change and Water (now superseded)
DIPNR	NSW Department of Infrastructure Planning and Natural Resources (now superseded)
DLWC	NSW Department of Land and Water Conservation (now superseded)
DNAPL	dense non-aqueous phase liquid
DNR	NSW Department of Natural Resources (now superseded)
DP	Douglas Partners
D.P.	Deposited Plan
DPI	NSW Department of Primary Industries
DQI	data quality indicator
DQO	data quality objective
DSI	detailed site (contamination) investigation
DWE	NSW Department of Water and Energy (now superseded)
Eh	redox potential
EIL	ecological investigation levels
ELS	EnviroLab Services Pty Ltd
ENM	excavated natural material (in accordance with the EPA The excavated natural material order 2014, or superseding documents)
EOS	emulsified oil substrate
EPA	Environment Protection Authority
ESL	ecological screening level
F1	TPH fraction C <sub>6</sub> -C <sub>10</sub> (less BTEX)
F2	TPH fraction >C <sub>10</sub> -C <sub>16</sub> (less naphthalene)
F3	TPH fraction >C <sub>16</sub> -C <sub>34</sub>
F4	TPH fraction >C <sub>34</sub> -C <sub>40</sub>
FA	friable asbestos
Fe	iron
FID	flame ionisation detector
FPD	flame photometric detector
GC-MS	gas chromatography-mass spectrometry
GIL	groundwater investigation level
GPR	ground penetrating radar

GW	groundwater
Hg	mercury
HI	hazard index
HIL	health investigation level
HMTV	hardness modified trigger value
HSL	health screening level
LNAPL	light non-aqueous phase liquid
LOD	limit of detection
LOR	limit of reporting
MAH	monocyclic aromatic hydrocarbons
MGT	Eurofins mgt (MGT), a NATA accredited laboratory
MTBE	methyl tert-butyl ether
MW	monitoring well
N/A	not applicable
NATA	National Association of Testing Authorities
ND(nd)	not detected above the practical quantitation limit
NHMRC	National Health and Medical Research Council
NEPC	National Environment Protection Council
NEPM	National Environmental Protection (Assessment of Site Contamination) Measure
Ni	nickel
NL	not limiting
NRMMC	National Resource Management Ministerial Council
OCP	organochlorine pesticides
OPP	organophosphate pesticides
OEH	NSW Office of Environment and Heritage
PAH	polycyclic aromatic hydrocarbons
Pb	lead
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
pH	unit measure of acidity/ alkalinity
PID	photoionisation detector
POEO Act	Protection of the Environment Operations Act 1997
PSI	preliminary site investigation
PSH	phase separated hydrocarbons
PQL	practical quantitation limit
QA	quality assurance
QA/QC	quality assurance/ quality control
QC	quality control

QIC	QIC Limited
RAP	remediation action plan
RL	reduced level
RPD	relative percentage difference
SAC	site assessment criteria
SAQP	sampling and analysis quality plan
SCC	specific contaminant concentration
SD	standard deviation
SEPP 55	State Environmental Planning Policy No. 55 – Remediation of Land
SWL	standing water level
SWMS	safe work method statement
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
TRH	total recoverable hydrocarbons
TSS	total suspended solids
UCL	upper confidence limit
UPSS	underground petroleum storage system
UST	underground storage tank
VENM	virgin excavated natural material
VOC	volatile organic compounds
WA DoH	Western Australia Department of Health
WHO	World Health Organisation
WHS	work health and safety
Zn	zinc

#### Mathematical

ha	hectares
KL	kilolitre (1000 litres).
km	kilometre
L	litre
m	metre
mm	millimetre
m <sup>2</sup>	square metre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
µg/L	microgram per litre
µS/cm	microSiemens per centimetre

ppb	parts per billion
ppm	parts per million
%	percent
<	less than
≤	equal to or less than
>	greater than
≥	equal to or greater than



## Remediation Action Plan

### Castle Towers Expansion Project – P11 Scheme Site B

#### Castle Street, Castle Hill

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## 1. Introduction

### 1.1 Background and Purpose

Douglas Partners Pty Ltd (DP) has been commissioned by QIC Limited (QIC), in conjunction with the project structural engineers BG&E Pty Ltd (BG&E), to prepare this Remediation Action Plan (RAP) which outlines the methodology for remediating asbestos contamination discovered on the Site B portion of the subject project known as the Castle Towers Expansion Project – P11 Scheme. The work was undertaken in accordance with the agreed scope, as outlined in DP's fee proposals (Ref. SYD140368, dated 27 May 2014, SYD141521.Rev2, dated 6 March 2015 and SYD151436 dated 30 October 2015) and recommendations provided by DP in the Detailed Site Investigation conducted on the site and detailed in the report titled *Report on Detailed Site Investigation for Contamination, Castle Towers Expansion Project – P11 Scheme, Castle Street, Castle Hill*, Project 84335.03, April 2016 (DP, 2016b)

Site investigations were carried out in several work stages over a period of 21 months over 2015 and 2016 to provide information on the subsurface conditions with respect to potential contamination relative to the proposed development and waste classification for off-site disposal of surplus soils.

The location of Site B (herein referred to interchangeably as “the site”) within the bounds of Precinct 11 is shown on Drawing 1, Appendix A.

Asbestos containing materials in the form of asbestos cement fragments have been identified in filling materials at the site. No loose asbestos fibres or respirable asbestos fibres have been detected. The proposed development includes bulk excavation and off-site disposal of the majority of filling materials at the site, including asbestos impacted soils.

The purpose of the RAP is to describe the works required to safely manage, excavate and dispose of asbestos contamination soils identified at the site in accordance with applicable legislation. This RAP also covers the requirements to undertake waste classification and disposal of all filling materials from the site.

The adopted remediation strategy outlined herein involves the excavation and removal of “hot spots” and emu picking asbestos fragments from the otherwise suitable fill. Whilst the total site area is 3.2 hectares, the adopted remediation strategy only applies to approximately 2.6 hectares, which excludes:

- The embankment / batter slope along the site boundary where exposed shale is evident on Showground Road and Pennant Street (approximately 0.1 hectares); and
- The drip lines / tree root zone across the site, which will only be subjected to near surface raking (approximately 0.5 hectares).

## 1.2 Proposed Development

It is understood that the proposed redevelopment of Castle Towers will include a significant expansion to the existing Castle Towers Shopping Centre and adjacent infrastructure, with the development proposal known as the “P11 Scheme” as summarised in Section 5. Drawings 1 and 2, Appendix A show the boundaries of the Castle Towers sub-sites including Site B and the P11 Scheme Site.

Site B is approximately 3.2 ha.

The development in Site B is limited to the construction of new site entry and exit roads passing through the site to and beneath Pennant Street and connecting into the new basement carparks below the existing footprint of the shopping centre.

## 1.3 Objectives

The objective of the RAP is to provide a methodology for identified asbestos in soil to be handled, removed and disposed in an acceptable manner, with minimal environmental impact and to a condition suitable for the proposed development within the site. The strategy therefore aims to:

- Minimises impacts from the site on the environment and on public health and safety during asbestos removal works;
- Maximises the protection of workers involved with asbestos removal works, and other workers who may be present at the site during asbestos removal works;
- Renders the site safe for the proposed land use, in terms of asbestos impact; and
- Minimises asbestos related impacts on the local environment.

## 1.4 Risks Associated with Asbestos

Asbestos has been linked to a number of conditions as discussed below. Health risks from asbestos are associated with inhalation of asbestos fibres. Management of emission of and/or inhalation of asbestos fibres is therefore the most appropriate method to manage health impacts from asbestos.

The following information is sourced from the Safe Work Australia document: *Asbestos-related Disease Indicators*, August 2010

*“Asbestosis and other asbestos-related diseases usually only occur following lengthy periods of exposure to high levels of asbestos fibres; mesothelioma, on the other hand, can develop from short or lengthy periods of low or high concentrations of asbestos, although exposure to asbestos fibres does not make the development of the disease inevitable.”*

*“It can take up to 40 years or more after initial asbestos exposure for disease caused by asbestos to become evident. Each asbestos-related disease differs in the extent of exposure to asbestos fibres and time between exposure and the onset of disease.”*

- “Benign pleural disease takes at least seven years to develop following exposure to asbestos fibres and is only evident on chest x-rays. It generally causes no symptoms and does not require any treatment other than cessation of smoking and regular check ups with a health professional;
- Asbestosis usually takes around 10 years or more to develop following heavy and prolonged exposure to asbestos before the disease advances to a stage where symptoms become apparent. Although it is a chronic rather than a fatal disease, it is a serious condition that can lead to death from other causes such as respiratory or cardiac failure. Ongoing medical treatment is necessary to maintain good quality of life and to reduce the burden it places on the body’s vital organs. People with asbestosis have a greater risk of developing lung cancer or mesothelioma than other people who have been exposed to asbestos fibres;
- Lung cancer can take 20 years or more before the cancer develops and asbestos is only one of many agents linked to its development. It is reported to occur only following levels of exposure similar to those for asbestosis and is strongly associated with workplace exposure to asbestos fibres. It is much more likely to occur in people who smoke and/or who have asbestosis
- Mesothelioma has the longest latency of any asbestos-related disease, usually taking between 20 and 40 years or more to develop. Symptoms of the disease usually only become evident when the disease has progressed to an advanced stage when treatment is ineffective and necessarily focussed at maintaining good quality of life for as long as possible.”

## 2. Site Identification and Description

### 2.1 Site Identification

Site B is located at Castle Hill in the local government authority of The Hills Shire Council. The boundary and locality plan is shown on Drawings 1 and 2, Appendix A.

Table 1 below, details the Lot and Deposited Plans (D.P.) for Site B (the site). The table also comments on the previous investigation accessibility. Current accessibility has not been determined.

**Table 1: Lot and Deposited Plan Identification**

Castle Towers Site	P11 Scheme Site	Comment
Lots 6 to 9 and 11 to 13 in Section 3 of D.P. 2496	<b>Site B</b> Lots 31 & 32 DP 515782 Sec 3 DP 2486, Lot 12 Sec 3 DP 2496, Lot 13 Sec 3 DP 2496, Lot 1 DP 137044, ‘ Lot 8&9 DP 28135, Lots 1-9 DP 135596, Lot 10 DP135699, Lot 111 DP 880469, Lot 10 DP20028 and part of Lot 121 DP1180956	Lot 11 and north western portion of Lots 12 and 13 not accessible

### 2.2 Nomenclature

Table 2 below shows alternate/ previous nomenclature for the Site B.

**Table 2: Alternate and Pervious Nomenclature**

<b>Current Nomenclature</b>	<b>Alternate / Previous Nomenclature</b>
Site B	Stage B Site B, Stage 3

### 2.3 Site Description and Current Land Use

Site B comprises the irregular shaped parcel of land bounded by Pennant Street to the east, Showground Road to the south, Kentwell Avenue to the west and Castle Street to the north excluding the existing Castle Grand public library and residential tower at its north eastern corner. The majority of Site B, at the time of conducting the 2016 contamination investigations, was vacant land separated from Site A by Pennant Street. The north western edge of Site B was occupied by residential houses (not accessible for investigation).

The area of the site shown on Drawing 1, Appendix A is 3.2 hectares.

The southern portion of Site B was previously occupied by a school. A number of buildings and sporting facilities were present at the time of DP (2006a) investigation; however, this part of Site B was vacant at the time of the more recent investigation in 2016 and covered with grass, scattered trees, and areas of remnant asphalt paving, concrete slabs and light posts. At the time of the 2016 investigation the south eastern area was fenced to preclude public access. It was understood from site personnel at the time that this area was used as a staff carpark during the Christmas period.

### 2.4 Adjacent Land Uses

Land uses adjacent to Site B comprise:

- North: road intersection and then residential;
- North east: Castle Road and then police station and residential;
- East: Castle Grand public library and residential tower on the same block as Site B, then road intersection and then Zones 1 to 3 ;
- South east: Pennant Street and then Site A;
- South: road intersection and then Castle Hill Baptist Church and McDonalds;
- South west: Showground Road and then residential and Castle Hill Baptist Church
- West: road intersection and then residential; and
- North west: Kentwell Avenue and then residential.

The identified potential significant off-site sources of potential contamination based on the above are:

- The dry cleaners to the south west of Site A. However this is considered to be cross-gradient from the site, reducing its potential to impact the site. One groundwater well, Well 701 was placed previously to assess the potential for contamination from this source; and
- The Telstra exchange and Australia Post sites adjacent to Site A. DP has previously identified two underground storage tanks (USTs) on the Telstra site, with the potential for contamination from the USTs to impact Site A investigated as part of DP (2015a). No contamination of concern was recorded associated with the USTs.

## 2.5 Previous Reports

DP has previously completed a number of reports (relating to contamination) on various parts of the Castle Towers site, with the following reports being the most pertinent to the RAP:

- *Ian Jack Castle Hill Public School and Former Police Station* (Jack, 2004);
- *Report on Preliminary Contamination Assessment, Corner of Old Northern Road and Showground Road, Castle Hill*, Project 43863A, June 2006 (DP, 2006a);
- *Report on Preliminary Waste Classification, Corner of Old Northern Road and Showground Road, Castle Hill*, Project 43863A, June 2006 (DP, 2006b) [attached as Appendix L];
- *Report on Supplementary Contamination Assessment, Castle Towers Shopping Centre, Corner of Showground Road and Old Northern Road, Castle Hill*, Project 72386, June 2011 (DP, 2011a);
- *Report on Remediation Action Plan, Castle Towers Shopping Centre, Corner of Showground Road and Old Northern Road, Castle Hill*, Project 72386, June 2011 (DP, 2011b);
- *Report on Detailed Site Investigation, 1 Castle Place and 4 Castle Street, Castle Hill*, Project 84339.01, January 2015 (DP, 2015a); and
- *Provisional In Situ Waste Classification, Footpaths Adjacent to Castle Towers Shopping Centre, Castle Hill*, Project 84335.03, May 2015 (DP, 2015b);

And three reports prepared concurrently,

- *Report on Geotechnical Investigation Castle Towers Expansion Project*, Project 84335.00, April 2016 (DP, 2016a);
- *Report on Detailed Site Investigation for Contamination, Castle Towers Expansion Project – P11 Scheme, Castle Street, Castle Hill*, Project 84335.03, April 2016 (DP, 2016b); and
- *Estimated General Solid Waste Volumes by Separable Portions Castle Towers Expansion Project*, Project 84335.03, April 2016 (DP, 2016c) (prepared based on the results of this investigation).

In addition, a number of geotechnical investigations have been undertaken across the Castle Towers site and adjacent infrastructure areas from 1972 onwards. The findings of these reports are summarised in DP (2016a).

A summary of the latest round of testing in 2015-2016 is provided below.

The investigation included:

- A review of site history information, previous reports and regional topography, geology and hydrogeology;
- A site inspection;
- Collection of soil samples from 80 borehole and test pit locations for general identified contaminants of potential concern (COPC);
- Sampling and field testing from 73 test pits in Site B for a detailed, quantitative, asbestos investigation;
- Construction and development of eight groundwater wells. Collection of groundwater samples from each well following stabilisation of field parameters;
- Laboratory analysis at a NATA accredited laboratory for various combinations of the identified contaminants of concern in soil and groundwater samples. Asbestos was also tested for in a number of fibre cement fragments;
- Assessment of the results in general accordance with NEPC (2013)<sup>1</sup> based on the proposed shopping centre use; and
- Preparation of a DSI report in general accordance with EPA (2011)<sup>2</sup>.

A detailed asbestos investigation was conducted at Site B, and the sampling density was devised to comply with National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in 2013)* (NEPM, 2013) and the WA Department of Health *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*, May 2009 (WA DoH 2009) on which the NEPC (2013) approach is based. The number of sampling locations was approximately double that recommended in the NSW EPA (1995) *Sampling Design Guidelines* and the locations were placed on a general grid-based pattern over the investigation area.

The sample locations for Precinct B are shown on Drawing 14 in Appendix A (extracted from the previous DSI). The site boundary shown on this site plan has since been amended and therefore Drawing 1 provided in Appendix A should be read in conjunction with the extracted site plan.

The previous investigations (i.e. prior to 2016) identified asbestos contamination in the area of the former school at Site B. Based on the desktop review, the contaminants of potential concern (COPC) were identified as heavy metals, TPH, BTEX, PAH, phenols, PCB, OCP, VOC and asbestos. In the previous testing in 2011, ACM was positively identified in the previous investigation at location 210. ACM was also observed in the filling during the current investigation at TP313. Both locations are in the north of the former primary school, where the filling profile is more significant. Additional test pits were excavated in both locations with a view to determining the extent of the asbestos contamination. Test pits TP310 to TP313, TP 310A and TP313A-TP313C, TP313E, and TP313G to TP313H were found to contain ACM fragments. Given the sporadic nature of asbestos and the number of pits in

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<sup>1</sup> National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended 2013*

<sup>2</sup> NSW Environment Protection Authority 2011, *Contaminated sites. Guidelines for consultants reporting on contaminated sites*



which the ACM fragments were observed, it is likely that the filling in this portion of the site is generally contaminated with the asbestos. It is noted that no fibres were detected in any of the soil samples. Furthermore, no fibres were detected in the residual soils underlying the filling. These locations (TP210 and TP313) are shown on Drawing 2 – hotspot locations in Appendix A.

The average filling depth encountered in the 2016 investigations across the site was approximately 0.3 to 0.1 m bgl, although a localised filling depth of up to 1.6 m was encountered. The filling was underlain by natural clays, laminite, siltstone, shale and sandstone bedrock. Asbestos cement was observed in filling in Site B. The majority of filling in other areas of the site appeared to be reworked natural materials, though some areas had filling with inclusions of building debris, which can be indicative of asbestos.

Groundwater depths encountered in the 2016 investigation were between 121.7 m AHD (4.1 m bgl) and 132.7 m AHD (6.1 m bgl). The shallow groundwater was encountered in Well 411 at 2.1 m bgl (125.3 m AHD). Previous investigations (2006) encountered groundwater between 115.1 m AHD (3.0 m bgl) and 133.3 m AHD (6.5 m bgl).

No chemical contaminants of concern were identified above the adopted site assessment criteria (SAC). No asbestos was identified at sample locations at Zones 1 to 3 or Site A.

In Site B, ACM, in the form of asbestos cement, was detected in 12 of the 72 test pits screened on site using the 7 mm sieve. The levels of ACM detected in the field screening exercise ranged from 0.01% to 0.05% in the samples where ACM was detected (i.e. where it exceeded 7 mm by 7 mm in size). The calculated levels of asbestos were within the adopted SAC of 0.05% in 11 of the 12 samples assessed, with TP603 recording 0.05% of asbestos. However, TP613 and TP622 were observed to have significant amounts of asbestos cement sheeting, which was not collected due to the significant volume of asbestos (likely to be in the kilograms) and was considered at the time of the investigation unsafe to disturb and put through the sieving process. As such TP613 and TP622 should also be considered to exceed the adopted SAC.

Laboratory analysis for asbestos fines and fibrous asbestos detected no levels of asbestos fibres above the limit of reporting in any sample from across the 73 test pit locations.

Groundwater results included some metal concentrations above the adopted groundwater investigation levels (GIL) however the detected concentrations of these metals were relatively low and within expected background levels for urban areas. The laboratory results for organic analytes in groundwater were within the assessment criteria, however some low level detections of petroleum related compounds (TRH, toluene and xylenes), PAH and chloroform were recorded.

The preliminary waste classification results for soils at the site were Special Waste Asbestos-General Solid Waste (non-putrescible) for filling in Site B; and virgin excavated natural excavated material (VENM) for natural soils and rock. Given that the testing was conducted *in situ*, and that limited access was available in some areas, these preliminary classifications were subject to inspection of the material and further testing as required. All materials must be appropriately classified, managed and disposed in accordance with the POEO Act.

Based on the field and analytical results presented in the previous reports, it is concluded that, from a contamination standpoint, Site B can be rendered suitable, subject to the recommendations in Table 3, which includes remediation/ management of asbestos.

**Table 3: Recommendations and Suggested Timing**

<b>Short Term</b>
<ul style="list-style-type: none"> <li>Prepare an asbestos management plan/ site management plan for asbestos contamination detected in Site B;</li> </ul>
<b>Prior to Development</b>
<ul style="list-style-type: none"> <li>Prepare a Remediation Action Plan (RAP) for asbestos in Site B;</li> <li>Develop an “unexpected finds” protocol for the entire site to be incorporated into the construction environmental management plan(s) (CEMP) during excavation and earthworks;</li> <li>Undertake another round of groundwater monitoring to assess water quality prior to any dewatering;</li> </ul>
<b>During Development</b>
<ul style="list-style-type: none"> <li>Implementation of an “unexpected finds” protocol incorporated into the CEMP(s);</li> <li>Remediation of asbestos in the redevelopment areas (as expected in Site B);</li> <li>Removal of grease traps and any associated infrastructure and contaminated soils. Validation of the resulting excavation for in-ground grease traps;</li> <li>Final waste classification of filling for off-site disposal and/ or classification of filling (where appropriate), soils and rock for re-use; and</li> <li>Additional intrusive investigations in areas of the site not currently accessible (e.g. beneath existing buildings). The investigations should be aimed at assessing the waste classification of the fill, and any issues of potential environmental concern.</li> </ul>

This RAP has been prepared to address the recommendations provided in Table 3 above.

### 3. Subsurface Conditions

The principal strata sequentially encountered beneath the surface of the site comprised:

- Pavement** – Comprising asphalt and base course in Bores 113, 208 and 504 to depths of between 0.2 m and 0.5 m and concrete in Bore 111 to a depth of 0.15 m;
- Filling** – encountered in all locations except TP15, to depths of between 0.05 m and 2.05 m bgl. Refusal in filling was encountered in six locations at depths of up to 1.6 m. Generally the filling comprised brown silty clays, sandy clays, clays, ripped shale, gravelly sands, silty sand, sandy gravel with some building rubble including asbestos cement fragments as discussed below. TP682 encountered grey ash filling between 0.7 m and 1 m bgl; and
- Clays, silty clays, shaly clays, weathered shale** – Clays, silty clays and shaly clays ranging in colour from grey to orange brown.

Suspected asbestos-containing material (ACM) was observed in 12 of the 73 test pits assessed as part of the detailed asbestos investigation. On the basis of the field screening and/or observations three locations were assessed to have concentrations of equal to or greater than the bonded ACM

HSL (0.05%), and are therefore considered to represent “hotspots”, namely Pits TP603, TP613 and TP622.

No visible evidence of unnatural staining or odours was observed in any of the test pits or at the ground surface.

PID screening results were all below 5 parts per million, considered to be consistent with background ranges for Australian soils.

Free groundwater was observed during the auger drilling of Bore 408 only at a depth of 2.3 m. No free groundwater was observed in other test location, including the pavement bores, test pits and the various test locations drilled during DP's 2006 investigation (DP 2006a) with the exception of TP651 in Site B, where an inflow of water was observed at 0.8 m, likely to be perched water in the clay. The use of water as a drilling fluid during diamond core drilling of the bedrock precluded any observations of groundwater inflow in cored bores during the investigation.

No signs of contamination concern were noted during groundwater well development or sampling. No phase separated hydrocarbons (PSH) were observed or detected by the interface meter.

## 4. Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

### 4.1 Identified Contamination

Based on the investigations discussed in Section 2.5, the following contamination has been identified.

- S1 – Asbestos in filling. Filling in hotspot areas (locations TP603, TP613 and TP622, as shown on Drawing 2, Appendix A): significant amounts of asbestos cement sheeting, which was not collected due to the significant volume of asbestos (likely to be in the kilograms); possible ACM in other fill at the site; and
- S2 – Other contaminants associated with the filling.

## 4.2 Potential Receptors

### Human Health Receptors:

- R1 – Construction and maintenance workers;
- R2 – End users (residential); and
- R3 – Adjacent users (residential).

### Environmental receptors:

- R4 – Terrestrial Ecology.

## 4.3 Potential Pathways

- P1 – Inhalation of dust and/or vapours.
- P2 – Direct contact

## 4.4 Summary of CSM

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm being caused to the identified receptors from contamination sources on or in the vicinity of the site, via exposure pathways (complete pathways). The possible pathways between the above sources and receptors are provided in Table 4 below.

**Table 4: Conceptual Site Model**

Source	Transport Pathway	Receptor	Risk Management Action Recommended
S1 – Asbestos in filling	P1: Inhalation of dust and/or vapours; P2: Direct contact	R1: Construction and maintenance workers	Remediation of asbestos and other contaminants (if found) in the fill in accordance with this RAP.  Implementation of appropriate work health and safety (WHS) controls during remediation works
		R2: End users (residential)	
S2 – Other contaminants in filling.		R3: Adjacent users (residential)	

## 5. Remediation and Management Options and Adopted Remediation Strategy

The following options for remediation of the asbestos in fill could be applied to the site.

- Excavation and off-site disposal of all asbestos impacted filling;
- Excavation and off-site disposal of asbestos hotspots only, and covering of remaining asbestos impacted filling below a cap of clean soil;
- On-site containment of all asbestos impacted filling, which would require a legally enforceable long term management plan; and
- Sort/ remove asbestos from filling with lower percentages of asbestos, and keeping filling which can be “cleared” of asbestos on site and disposing of other materials off-site.

A combination of the above for different portions of the site may be optimised.

The above options are discussed further in the below sections.

### 5.1 Option 1: Removal of All Asbestos Impacted Soils

This option comprises removal of all asbestos impacted filling from the site. Based on current results it is recommended that it is assumed that all filling contains ACM, although if some “clean” looking materials were observed during excavation they could be separated for clearance for asbestos.

The volume of impacted filling is expected to be in the order of 12,000 m<sup>3</sup>, based on the boundary shown on Drawing 1, and an average fill depth of 1 m.

The main advantage of this option is the complete removal of filling with asbestos impacts, removing future liability associated with asbestos, and negating the need for consideration / management of asbestos for future works in Site B.

The main disadvantage of this option is the cost, as it is expected to be the most expensive option. This option is also the least sustainable based on the volume of waste that will be disposed of to landfill.

### 5.2 Option 2: Removal of Asbestos Hotspots Only

This option comprises removal of the identified ‘hotspots’ of asbestos, whilst retaining other asbestos impacted filling on the site. As asbestos is currently present in surface soils in some areas, a clean imported surface soil layer in the order of 100 mm to 300 mm, or a hard cover, will need to be placed over the remaining asbestos impacted filling. The depth will depend on the future use and expected potential for erosion/ wearing of the surface, for example if the area is to be fully fenced with foot traffic only then a 100 mm surface cover would generally be sufficient, however if vehicles will be driving over the area then a 300 mm surface cover is likely to be required to sufficiently reduce the risk of future exposure of asbestos.

If it is assumed that each identified hotspot (TP603, TP613, TP622) is approximately 2 m by 2 m in extent, the approximate volume of asbestos hotspot material could be in the order of 25 m<sup>3</sup>. However, the identified hotspots could extend beyond these dimensions, resulting in higher impacted volumes. Also further hotspots may be encountered during future works.

This satisfies the commercial land use criteria which requires no visible asbestos in “surface soil”, less than 0.001% friable asbestos in all soils and less than 0.05% bonded ACM. Having said this, the risk of other, unidentified, hotspots remains, which could be encountered at a future date. If this occurred, they would need to be remediated when encountered.

This option is likely to be much cheaper than Option 1, and would not require a legally enforceable asbestos management plan like Option 3.

However, the presence of ACM in the remaining filling would impact future subsurface works, including requiring an asbestos licenced contractor, and disposing of soils as Special Waste (Asbestos). The potential presence of unrecorded asbestos hotspots would remain, and could require further work/management in the future. To allow future works to be managed, the presence of ACM would need to be noted on the site asbestos register, and a protocol would need to be in place that triggered asbestos management requirements for any proposed subsurface works at Site B.

Also, the addition of 100 mm to 300 mm of surface cover could potentially significantly increase the volume of ACM impacted soils during future site remediation/ excavation works, as separation of this layer may be difficult to achieve and/ or demonstrate during excavation.

### **5.3 Option 3: On-Site Containment**

This option comprises retaining all asbestos impacted filling on-site, including the hotspots, capping the impacted filling, and having a legally enforceable asbestos management plan (AMP). A capping layer would normally comprise of pavement or 0.5 m of compacted clean soil.

The advantage of this option is that disposal costs could potentially be avoided (or postponed), although some materials may still need to be disposed off-site to achieve final design levels following construction of the capping layer.

The disadvantages are the need for ongoing management of the capped asbestos, the notification of the AMP on title, and the need to import soil to cap the asbestos impacted filling.

### **5.4 Option 4: Emu Picking, Raking and Selective Off-Site Disposal**

This option comprises removal by “emu picking” and “raking” of the ACM from the filling with low frequency ACM. For “emu picking”, this process requires the filling to be excavated and spread out in thin layers for hand removal of ACM.

For “raking”, the process involves inspection, scarification and loosening of the soil using the teeth of an excavator or hand tools and hand removal of ACM in situ with minimal disturbance.



Once no more ACM could be seen, the filling would be turned and the process repeated until there was confidence that no ACM remained. The filling would then be validated for asbestos, which would generally require additional turning and inspection of the material and on-site and laboratory analysis.

Hotspots of asbestos would normally be disposed off-site in their entirety as emu picking of the ACM is likely to be highly time consuming and could take many ACM removal iterations.

The main advantage of this is the practical removal of asbestos from the site whilst reducing the volume, and therefore costs, of materials disposed off-site. There is, however, a higher risk of some asbestos being missed and remaining on site than under Option 1. Ongoing management of asbestos would not be required.

The main disadvantage is the time and cost for the asbestos removal works. These would be expected to be significant based on the site area. The costs of the removal work can vary significantly, and will depend on the time taken for the removal. This will be impacted by the soil type and amount of ACM present, as well as by the experience of the contractor. Much of the filling on Site B was logged as being clayey, which is more difficult and time consuming for asbestos removal than sandy filling.

## **5.5 Adopted Remediation Strategy (Option 4)**

Option 4 is the adopted remediation strategy for the site based on the cost benefit, timing and site access/area available for remediation works. The sequence and methodology is detailed in Section 9.

## **6. Assessment Criteria**

### **6.1 Remediation Acceptance Criteria**

(NEPC; 2013) defines the various asbestos types as follows:

- Bonded ACM: Asbestos-containing material which is in sound condition, bound in a matrix of cement or resin, and cannot pass a 7 mm x 7 mm sieve;
- FA: Fibrous asbestos material including severely weathered cement sheet, insulation products and woven asbestos material. This material is typically un-bonded or was previously bonded and is now significantly degraded and crumbling;
- AF: Asbestos fines including free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve.

The asbestos Health Screening Levels (HSL) in Table 5 will be adopted in validating the suitability of fill soils to be retained within the site.

**Table 5: Health Screening Levels for Asbestos Contamination in Soil (% w/w)**

Form of Asbestos	HSL (% w/w)
	Residential (HSL D) (commercial / industrial)
Bonded ACM	0.05%
FA and AF	0.001 %
All Forms of Asbestos	No visible asbestos for surface soil

### 6.1.1 Aesthetic Considerations

Aesthetic issues relate to the presence of low-concern odours, staining, and non-hazardous inert foreign material (refuse) in soils resulting from human activity and include fragments such as concrete, metal, bricks, pottery, glass, trivial amounts of bonded ACM, bitumen, ash, green waste, rubber, plastics and a wide variety of other waste materials (NEPC, 2013). For this RAP the asbestos HSL in Section 6.1 take precedence over the requirements of these aesthetic considerations.

Whilst there are no specific numeric aesthetic guidelines, NEPC (2013) calls for a balanced consideration of the quantity, type and distribution of foreign material or odours in relation to the land use and sensitivity. This includes consideration of small quantities of inert material and low odour residues which may decrease over time, and inert materials that present no health hazard such as brick fragments and cement wastes.

The following characteristics are examples that would trigger further assessment:

- Highly malodorous soils or extracted groundwater (e.g. strong residual petroleum hydrocarbon odours, hydrogen sulphide in soil or extracted groundwater, organosulfur compounds);
- Hydrocarbon sheen on surface water;
- Discoloured chemical deposits or soil staining with chemical waste other than of a minor nature;
- Large monolithic deposits of otherwise low-risk material, e.g. gypsum as powder or plasterboard, cement kiln dust;
- Presence of putrescible refuse including material that may generate hazardous levels of methane such as deep-fill profile of green waste or large quantities of timber waste; and
- Soils containing residue from animal burial (e.g. former abattoir sites).

## 6.2 Classification Assessment for Off-Site Disposal

All wastes will be assessed in accordance with the NSW *Protection of the Environment Operations Act* 1997 (POEO Act). For disposal to landfill, this will comprise assessment in accordance with the NSW Environment Protection Authority (EPA) *Waste Classification Guidelines* (2014).

## 7. Roles and Responsibilities

### 7.1 Principal

The Principal is responsible for the environmental performance of the proposed remediation works, including implementation of acceptable environmental controls during all site works. The Principal will retain the overall responsibility for ensuring this RAP is appropriately implemented. The Principal is to nominate a representative (the Principal's Representative - PR), who is responsible for overseeing the implementation of this RAP. The actual implementation of the RAP will, however, be conducted by the Principal Contractor on behalf of the Principal.

The Principal is responsible for providing appropriate information to the Contractor to allow them to safely plan the required works.

### 7.2 Principal Contractor

The Principal Contractor ('the Contractor') will be the party responsible for daily implementation of this RAP and shall fulfil the responsibilities of the Contractor as defined by SafeWork NSW. It is noted that the Contractor may appoint appropriately qualified sub-contractors or sub-consultants to assist in fulfilling the requirements of the RAP. The Contractor will appoint a Site Manager.

In addition to the implementation of the RAP it will be the Contractor's responsibility to:

- Obtain specific related approvals as necessary to implement the earthworks including permits for asbestos works, SafeWork NSW notification etc.;
- Develop or request and review any site plans to manage the works to be conducted;
- Ensure that all site works and other related activities are undertaken in accordance with this RAP;
- Maintain all site records related to the implementation of this RAP;
- Ensure sufficient information is provided to engage or direct all required parties, including sub-contractors, to implement the requirements of the RAP other than those that are the direct responsibility of the Contractor;
- Manage the implementation of any recommendation made by those parties in relation to work undertaken in accordance with the RAP;
- Inform, if appropriate, the relevant regulatory authorities of any non-conformances with the procedures and requirements of the RAP in accordance with the procedures outlined in this document;
- Retain records of any contingency actions;
- On completion of the project, to review the RAP records for completeness and update as necessary; and
- Recommend any modification to general documentation which would further improve the environmental outcomes of this RAP.

### 7.3 Asbestos Contractor

The Asbestos Contractor will be responsible for undertaking all asbestos work involving any asbestos impacted filling and will hold a Class B licence for the removal of non-friable asbestos (issued by SafeWork NSW). Should friable asbestos be encountered at any stage during the remediation process, a Class A licence will be required for the remediation works.

The Asbestos Contractor can be the same entity as the Principal Contractor.

### 7.4 Sub-contractors

All sub-contractors will be inducted onto the site, informed of their responsibilities in relation to this RAP. Where necessary, sub-contractors will also be trained in accordance with the requirements of this document. All sub-contractors must conduct their operations in accordance with the RAP as well as all applicable regulatory requirements.

### 7.5 Environmental Consultant

The Environmental Consultant will provide advice on implementing the RAP. The Environmental Consultant will be responsible for:

- Undertaking any required assessments where applicable (e.g. waste classification, validation);
- Providing advice and recommendations arising from monitoring and/or inspections; and
- Notifying their client with any results of assessments, and any observed non-conformances.

### 7.6 Occupational Hygienist

The Occupational Hygienist will provide advice on Work Health and Safety (WHS) issues related to the asbestos works.

The Occupational Hygienist will hold an Asbestos Assessor Licence in accordance with the WHS Regulations.

The Occupational Hygienist will be responsible for:

- Preparing any WHS plans and advice requested by the Contractor;
- Undertaking airborne asbestos monitoring;
- Undertaking clearance inspections;
- Providing advice and recommendations arising from monitoring and/or inspections; and
- Notifying their client with the results of any assessments and any observed non-conformances in a timely manner.

The Environmental Consultant and Occupational Hygienist can be the same entity.

## 7.7 Site Workers

All workers on the site are responsible for observing the requirements of this RAP and other management plans. These responsibilities include the following:

- Being inducted on the site and advised of the general nature of the remediation/environmental issues at the site;
- Being aware of the requirements of this plan;
- Wearing appropriate personal protective equipment (PPE) as required by this plan;
- Only entering restricted areas when permitted;
- Requesting clarification when unclear of requirements of this or any other plans (e.g. safe work method statements - SWMS); and
- Reporting observations as required by the Unexpected Finds Protocol (Section 12).

## 8. Regulatory Requirements and Relevant Standards

### 8.1 Regulatory Framework

In New South Wales (NSW), occupational health and safety is regulated under the NSW Work Health and Safety Act 2011 (WHS Act) and the NSW Work Health and Safety Regulation 2017 (WHS Regulation).

The WHS Act and the WHS Regulation place a broad range of responsibilities on key stakeholders to promote and secure the safety and health of persons in the workplace. The WHS Regulation also outlines an array of requirements pertaining to the identification, assessment and control of asbestos and ACM in the workplace.

In addition to the WHS Act and WHS Regulation there are a range of National Codes of Practice and Guidance Notes, Australian Standards and other guidelines relating to the management of asbestos and ACM in the workplace.

Safe Work Australia (SWA) has issued the following codes of practice that have been adopted in NSW:

- Code of Practice: *How to Safely Remove Asbestos*, Safe Work Australia, 2016 (SWA, 2016a);
- Code of Practice: *How to Manage and Control Asbestos in the Workplace*, Safe Work Australia, 2016 (SWA, 2016b); and
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* 2nd Edition [NOHSC:3003(2005)].

These codes and guidance note detail the requirements for the identification, assessment and management of ACM in the workplace, including the specific controls required for asbestos and ACM removal. Electronic copies of these documents are available on the SWA website ([www.safeworkaustralia.gov.au](http://www.safeworkaustralia.gov.au)).

Asbestos waste is regulated under the *Protection of the Environment Operations* (POEO) Act 1997 and POEO (Waste) Regulation 2014, which are administered by the Environment and Protection Authority (EPA).

Wastes, including those containing asbestos, must be classified for disposal in accordance with the NSW EPA *Waste Classification Guidelines, Part 1: Classifying Waste*, November 2014 (EPA, 2014)

The Dangerous Goods (Road and Rail Transport) Regulation 2008 adopts uniform national requirements for the transport of dangerous goods (e.g. asbestos) including the requirements of the Australian Dangerous Goods Code.

Asbestos transporters and facilities receiving asbestos waste must report the movement of asbestos waste to the EPA. Entities involved with the transport or disposal of asbestos waste in NSW, or arranging the transport of asbestos waste in NSW, must use the EPA's online tool, WasteLocate.

All works must be conducted in accordance with the development consent conditions.

All works must be also undertaken in accordance with the relevant regulatory criteria, including *inter alia*;

- NSW *Work Health and Safety Act* 2011 (WHS Act);
- NSW *Work Health and Safety Regulation* 2011 (WHS Regulation);
- NSW *Environmental Planning and Assessment Act* 1979;
- NSW *Environmental Protection and Biodiversity Conservation Act* 1999;
- NSW *Environmental Offences and Penalties Act* 1996;
- NSW *Environmentally Hazardous Chemicals Act* 1985;
- NSW *Protection of the Environment Operations Act* 1997 (POEO Act);
- NSW *Contaminated Land Management Act* 1997;
- NSW *Dangerous Goods (Road and Rail Transport) Act* 2008; and
- NSW *Dangerous Goods (Road and Rail Transport) Regulation* 2009.

Reference to relevant Codes of Practice, Australian Standards and industry standards should also be made in determining appropriate safe work practices. These include, *inter alia*:

- National Occupational Health and Safety Commission (NOHSC) *Code of Practice for the Safe Removal of Asbestos* [2002(2005)];
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition* [NOHSC:300392005];
- NOHSC *Code of Practice for the Management and Control of Asbestos in the Workplace* [NOHSC:2018(2005)];
- NOHSC *Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:3008 (1995)] 3rd edition;
- AS/NZS 1715:2009 *Selection, Use and Maintenance of Respiratory Protective Devices*;



- AS/NZS 1716:2012 *Respiratory Protective Devices*;
- AS/NZS 1716:2003/Amdt 1:2005: *Respiratory protective devices*;
- WorkCover NSW: *Working with Asbestos: Guide 2008*;
- WorkCover NSW: *How to manage and control asbestos in the workplace: Code of practice*; and
- WorkCover NSW: *How to safely remove asbestos: Code of practice*.

## 9. Excavation Works

### 9.1 Sequence

The actual sequence of works will depend on the programme of the Contractor, however it is foreseen to include the sequence below. All works with asbestos containing materials must be undertaken by the Asbestos Contractor.

Given the residential nature of some of the surrounding properties, asbestos air monitoring will take place during the remediation works as discussed in Section 11.2.9.

The proposed sequence of works comprises:

#### 9.1.1 Removal of hotspot material (TP603, TP613 and TP622):

Hotspots of asbestos are to be disposed off-site in their entirety. The identified “hot spots” to date are shown on Drawing 2, Appendix A.

The proposed sequence of works comprises:

- a. Excavation by the Asbestos Contractor of the hotspot locations identified above, plus any other hot spots as may be identified by the Environmental Consultant during the planned civil works and/or emu picking (refer Unexpected Finds Protocol, Section 13. The excavation should remove the full depth of the filling layer containing the exceedance (based on visual observation). The horizontal extent has not been determined but an initial excavation in the order of 2 m by 2 m would be appropriate, to be confirmed or instructed for extension by the Environmental Consultant;
- b. Stockpiling by the Asbestos Contractor for waste classification confirmation, by the Environmental Consultant;
- c. Visual validation by the Environmental Consultant of the resulting excavation pit to confirm the removal of soils with considerable ACM impacts;
- d. Disposal of the excavated soils to a landfill facility licensed to receive the soils under the classification assigned by the Environmental Consultant. At a minimum the soils will classify as Special Waste (Asbestos) under EPA (2014); and
- e. Preparation of a memorandum by the Environmental Consultant that the identified hot spots of ACM impacted soils have been excavated and removed from the site.

### 9.1.2 Emu Picking and Selective Off-Site Disposal

- a. Designation by the PR and preparation by the Contractor/ Asbestos Contractor of an Asbestos Treatment Area (ATA) for treatment of the asbestos impacted soils. The ATA must have sufficient space for stockpiling and treatment of the asbestos impacted filling as described below. The surface of the ATA must be cleared of all structures/ vegetation and levelled/ compacted to provide a platform where soils can be easily spread and inspected.

The ATA must be managed in accordance with the general site management requirements provided in Section 11, including fencing to prevent unauthorised access, implementation of a dust management system, suitable locations selected for asbestos air monitoring, and provision of an asbestos decontamination area.

The ATA must also be managed to prevent filling being removed from the ATA by water runoff or wind. Surface water runoff must be appropriately redirected, managed, collected and treated to prevent egress of asbestos in surface water runoff;

- b. Progressive excavation by the Asbestos Contractor of manageable volumes of filling and placement in the ATA for treatment. This can be conducted in stages to prevent over-filling of the ATA;
- c. Visual validation by the Environmental Consultant of the resulting excavation to confirm that ALL fill has been removed from the nominated area. This area will be demarcated to prevent cross contamination with un-treated soils;
- d. Treatment by the Asbestos Contractor and validation by the Environmental Consultant of the asbestos impacted filling in the ATA as detailed below:
- The Asbestos Contractor will spread a “treatment batch” of asbestos impacted soils out in the ATA in a layer no thicker than 0.1 m;
  - The Asbestos Contractor will inspect the layered soil by walking on a 1 m transect grid. Observed ACM will be removed by hand, double bagged and stored on site in the secure designated ACM waste storage area;
  - The Asbestos Assessor/ Environmental Consultant will inspect the soil and mark any observed ACM. The marked ACM will be removed by the Asbestos Contractor;
  - Following the inspection and any additional required ACM removal, the Asbestos Contractor will re-work the inspected material and repeat items (a) to (c) above;
  - Steps (a) to (d) will be repeated until no ACM is observed during three consecutive inspections / passes;
- e. The Asbestos Contractor will stockpile the treated material in approximate 10-25 m<sup>3</sup> stockpiles, in an area separate from the treatment area;
- f. The Asbestos Assessor/ Environmental Consultant will:
- assign each treatment batch a unique material tracking ID;
  - record the number of passes and number of asbestos finds per pass for each treatment batch;
  - record the date(s) of the asbestos removal works for each treatment batch; and
  - The Asbestos Assessor/ Environmental Consultant will undertake validation assessment of each stockpile comprising:

- Inspection of the stockpile surface for visible ACM;
  - Collection of one ~10 L bulk sample per 10 m<sup>3</sup> stockpile, comprising five composited sub-samples, and assess for ACM in accordance with WA DoH (2009);
  - Collection of one ~500 ml sample per 10 m<sup>3</sup> stockpile, comprising five composited sub-samples, and obtain \ laboratory analysis of asbestos fines (AF) and fibrous asbestos (FA) in accordance with WA DoH (2009); and
  - Assessment of the results with reference to the RAC provided in Section 6.
- g. Based on the above assessment, the Asbestos Assessor/ Environmental Consultant will categorise each stockpile into one of the following categories, and advise the Contractor/ Asbestos Contactor of the category for each stockpile:
- Category A - Suitable for Reuse (burial on-site) – ACM is below the RAC and AF and FA are not detected, This will only be possible after suitable analysis of samples<sup>3</sup>;
  - Category B - Suitable for Reuse (burial on-site below 0.5 m below likely future excavation/ disturbance) – ACM, FA and AF are below the RAC but AF and FA are detected;
  - Category C - Suitable for further Remediation – ACM exceeds the RAC but FA and AF are below the RAC; or
  - Category D - Requiring Disposal off-site to landfill – FA / AF exceed the RAC.

Material will be handled according to these categories.

### **9.1.3 In Situ Remediation (Minimal Disturbance) Around Existing Trees (inside tree drip lines)**

Remediation within existing tree root zone (also known as the tree drip zone) will involve scraping back material to a depth agreed by the arborist (minimum of 0.1- 0.15 m below ground level if possible) for stockpiling and remediation.

Where existing root systems make this difficult, the remaining soil is to be remediated using undisturbed methods. These areas will be inspected, scarified and loosened (raking) using the teeth of an excavator or hand tools and remediation of the material will be undertaken *in situ* according to Section 9.1.2.

The area will then be reinstated with material deemed suitable.

Based on the current site layout DP considers the approximate area to be remediated *in situ* via undisturbed methods is estimated to cover an area of approximately 0.5 hectares.

No remediation is proposed for the embankment in close proximity to the site boundaries on Showground and Pennant Streets. This is considered to cover 0.1 hectares. The embankment has

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<sup>3</sup> Category A material will be considered suitable for reuse on site. For surplus material requiring off-site disposal a separate waste classification investigation with appropriate sampling and analysis of samples will be required to determine the appropriate waste classification category as outlined in Section 9.3. This will be required for GSW and materials proposed for disposal to a licensed recycling facility.

been formed through excavation in the past, with shale and natural soil is exposed (i.e. no fill or potential asbestos impact).

The remaining area to be subject to the adopted remediation strategy (Section 5.3) occupies approximately 2.6 hectares.

## **9.2 Stockpiling of Contaminated Material**

Any stockpiles placed on the site must be managed to minimise the risk of dust generation, erosion and leaching. The measures required to achieve this will depend on the stockpiled material and the amount of time the stockpile remains on site. Measures should include:

- Restriction of the height of stockpiles (less than 3 m) to reduce dust generation;
- Implementation of control measures for sediment and erosion;
- Stockpiles of asbestos impacted soil should be covered at the end of each day to prevent wind or water erosion; and
- Temporary stockpiles should be kept moist by using water spray (where required).

## **9.3 Off-site Disposal of Soil/ Rock**

All spoil to be disposed off-site will be classified, managed and disposed in accordance with the POEO Act and Section 10.3. In particular,

- a. Materials of the same spoil category will be carefully excavated and placed as separate stockpiles at demarcated and contained locations. The categorisation would be done on the basis of on-site observations and the contaminant exceedances detected;
- b. Stockpiles of excavated materials will be appropriately banded with hay bales/sandbags and covered with anchored geotextile or impermeable plastic sheeting, or alternatively placed in an appropriate container e.g. waste skip, with appropriate cover. Materials considered to have the potential to produce contaminated leachate will be stockpiled in an area with an appropriate leachate collection system;
- c. Where required, sampling and analysis of segregated stockpiles will be conducted to determine the concentrations of the target parameters in the excavated materials (e.g. leachability of the contaminants of concern, treatability studies); and
- d. Approvals for the proposed treatment and disposal method will be obtained from the EPA prior to the removal of the waste from the site.

## **9.4 Importation of Soil**

Any soil to be imported onto the site will be certified and provided by an appropriately licenced supplier. Prior to importation appropriate documentation confirming that the soil can be legally imported onto the site and meets the SAC (as outlined in Section 6) is to be provided to the Environmental Consultant for review. The Environmental Consultant may require additional

information (including additional sampling and analysis) to provide a final determination on the suitability of the soil to be accepted by the site.

The material must be inspected during importation by the Contractor and any materials not meeting the description given in the provided documentation or displaying signs of contamination will be rejected. The Environmental Consultant will also conduct inspection(s) during and/ or following importation to check the same.

Confirmatory testing of the imported material, where required, will be undertaken by the Environmental Consultant.

Imported material also needs to be suitable for its proposed purpose from a geotechnical/ horticultural perspective as relevant. This is beyond the scope of this RAP.

## 9.5 Unexpected Finds

Should unexpected occurrences be identified during clearing, excavation or construction phases of the works (such as unidentified buried tanks or unexpected contaminants), the following general approach should be adopted:

- Foreman will barricade the impacted area, and stop all works which are potentially impacted by or which will potentially impact the issue/ area of concern;
- The Contractor will notify the PR and Environmental Consultant of the occurrence;
- The Environmental Consultant will assess the identified issue/ area of concern, and provide advice to the PR regarding potential remedial/ management options;
- The PR will instruct the Environmental Consultant of the preferred remedial/ management strategy;
- The Environmental Consultant will prepare a plan detailing the works required for the preferred remedial/ management option;
- The PR/ Contractor will obtain any necessary approvals for undertaking the remedial/ management works; and
- The Contractor will undertake the remedial/ management works in accordance with the provided plan upon instruction by the PR.

## 10. Validation Assessment

### 10.1 Data Quality Objectives (DQO)

The validation assessment will be conducted broadly in accordance with the 7 step data quality objective process, as defined in NEPC (2013). The DQO process is outlined as follows:

#### (a) State the Problem

The problem is the potential for health impacts associated with the identified contamination at the site.

**(b) Identify the Decision**

The decision is to determine if the site is suitable for the proposed land use.

**(c) Identify Inputs to the Decision**

The inputs into the decision include the following:

- Site inspection results;
- Remediation outcomes;
- Validation results; and
- Details of the proposed development.

**(d) Define the Boundary of the Assessment**

The boundary of the assessment is defined by the boundary of the site, as described in Section 2 and shown on Drawing 1, Appendix A.

**(e) Develop a Decision Rule**

The decision rule is the Remediation Acceptance Criteria provided in Section 6.

**(f) Specify Acceptable Limits on Decision Errors**

There are two types of error:

( $\alpha$ ) Deciding that the site is acceptable when it actually is not.

( $\beta$ ) Deciding that the site is unacceptable when it is not.

In accordance with EPA (1995)<sup>4</sup> the limit for above errors in the investigation will be set at a 5% probability of type ( $\alpha$ ) error and 20% probability of type ( $\beta$ ) error, based on a null hypothesis that 'the site is not suitable for the proposed development'.

**(g) Optimise the Design for Obtaining Data**

Sampling procedures and sample densities will be with reference to EPA endorsed guidelines and current industry practice. National Association of Testing Authorities (NATA) accredited analytical laboratories will be used to conduct sample analysis.

The data collected for the validation assessment will be collected and assessed with reference to the following quality control measures:

- Documentation completeness;
- Data completeness;
- Data comparability;
- Data representativeness; and

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<sup>4</sup> NSW Environmental Protection Authority (EPA) *Contaminated Sites: Sampling Design Guidelines* (1995)

- Precision and accuracy for sampling and analysis.

## 10.2 Validation Assessment Requirements

The following site validation work will be required:

- Field assessment by the Environmental Consultant comprising:
  - Visual inspection, including taking photographs for record purposes; and
  - Collecting validation samples from asbestos removal areas, the walls and base of remediation excavations and from treated asbestos impacted filling in accordance with Section 10.5;
- Laboratory analysis of all validation samples for, as a minimum:
  - The identified contaminant(s) of concern for the location; and
  - QA/QC samples in accordance with Section 10.7;
- Comparison by the Environmental Consultant of the laboratory results with the RAC (refer to Section 6); and
- When all results confirm the complete removal of the contamination, preparation by the Environmental Consultant of a Validation Report.

## 10.3 Waste Classification

The Environmental Consultant will classify all soil and rock to be disposed off-site in accordance with the POEO Act.

### 10.3.1 Classification of Filling for Disposal to Landfill

Waste classification will be undertaken in general accordance with the EPA *Waste Classification Guidelines* 2014.

The proposed scope of works for general waste classification purposes is as follows:

- Review of previous applicable results which can be included in the waste classification;
- Sampling from across the subject materials at various depths / locations to ensure collection of characteristic samples;
- Analysis of primary samples at a rate in accordance with Section 9.5 and as discussed below; and
- Quality assurance/ quality control (QA/QC) sampling and analysis in accordance with Section 9.7.

The analytical regime adopted will depend on the previous results available for the material, but should include the following approximate frequencies (including previous testing results):

- Asbestos for the number of samples recommended in Section 10.5, unless asbestos is clearly present and the material is assumed to be Special Waste (asbestos);



- Heavy metals, TRH, benzene, toluene, ethylbenzene and total xylenes (BTEX) and polycyclic aromatic hydrocarbons (PAH) (including BaP TEQ and BaP) from the number of samples recommended in Section 10.5;
- Phenols, polychlorinated biphenyls (PCB) and organochlorine pesticides (OCP) from a third of the number of samples recommended in Section 10.5;
- Additional analysis for any specific issues of concern (e.g. odorous or stained material); and
- Toxicity characteristic leaching procedure (TCLP) analysis as required based on total concentration results.

### **10.3.2 Classification of Filling for Re-Use Off Site**

If required, this will be conducted in accordance with the appropriate resource recovery order issued by EPA under the *Protection of the Environment Operations (Waste) Regulation 2014*.

### **10.3.3 Natural Materials**

Natural materials will initially be assessed to determine if they meet the virgin excavated natural material (VENM) criteria. As a minimum this will involve:

- Inspection of the material for signs of concern;
- Analysis of at least three samples per material or area being assessed; and
- QA/QC sampling and analysis in accordance with Section 10.7.

Samples will be analysed for the following:

- Every sample will be analysed for heavy metals, TRH, BTEX, PAH and asbestos; and
- Additional analysis will be conducted if required to address any issue of potential concern.

If any natural materials do not meet the VENM thresholds, they can be assessed as for disposal or re-use as filling.

## **10.4 Field Records**

Field records will be prepared and provided in the relevant report(s). These will include:

- Inspection records, including photographs and information required in Section 9 and 10.2;
- Records of treatment batch a unique material tracking ID, record the number of passes and number of asbestos finds per pass for each treatment batch; record the date(s) of the asbestos removal works for each treatment batch; and assign each stockpile a unique ID linked to its source treatment batch, and use to record its location and validation sampling records as required in Section 9.1.2.
- Sample locations;
- Borehole logs or test pit logs (where appropriate) with sampling dates, descriptions of the drilling/ excavation methods, encountered strata, sampling depths and logger/ sampler; and



- Record of samples (for surface and stockpile samples), including sampling date, material description and sampler.

## 10.5 Sample Collection and Analysis Requirements

### 10.5.1 Soil Sampling Frequencies

The sampling frequency will depend on the volume or area to be assessed and the previous results. The following general sampling frequencies will be used.

#### Visual Inspections and Signs of Environmental Concern

All areas to be assessed and validated will first be subject to a visual inspection.

If any signs of environmental concern (e.g. odours, staining) are observed in the area/material being tested, targeted sampling will be conducted as required to assess the contamination potentially associated with the observed sign of concern. This may require additional samples to those required by the testing frequencies given below.

#### Validation of excavations and surface asbestos removal areas:

##### Small to medium excavations/ removal areas (base <500 m<sup>2</sup>):

- Base of excavation/ ground surface: one sample per 25 m<sup>2</sup> to 50 m<sup>2</sup> or part thereof; and
- Sides of excavation: one sample per 10 m length or part thereof. Additional samples will be collected at depths of concern where there is more than one depth of concern, with a minimum of one sample per 1.5 m depth.

##### Large excavations/ removal areas (base ≥500 m<sup>2</sup>):

- Base of excavation/ ground surface: sampling on a grid at a density in accordance with the EPA (1995) or a minimum of 10 samples. In sub-areas with any specific signs of concern, a higher sampling density may be required; and
- Sides of excavation: one sample per 20 m length or part thereof. Additional samples will be collected at depths of concern where there is more than one depth of concern, with a minimum of one sample per 1.5 m depth.

#### Stockpiles / *In situ* Filling Classification

Samples will be collected from stockpiles/ *in situ* filling at various depths to characterise the full depth of the material.

Assessment of soils (note actual frequency will be determined based on volume, contamination risk and homogeneity of the material):

- Volume ≤250 m<sup>3</sup>: one sample per 25 m<sup>3</sup> or a minimum of three samples;
- Volume 250 m<sup>3</sup> to 1,000 m<sup>3</sup>: one sample per 50 m<sup>3</sup> to 100 m<sup>3</sup>, or a minimum of 10 samples; and

- Volume  $>1,000 \text{ m}^3$ : one sample per  $100 \text{ m}^2$  to  $250 \text{ m}^3$ , or a minimum of 10 samples.

A sampling regime will be determined by the Environmental Consultant in the event that the subject material has a volume significantly greater than  $1,000 \text{ m}^3$ .

Where contaminated soils are stored or treated on bare soils, the footprint of the stockpile will require validation following removal of the contaminated soils.

### **Natural Soils**

Sampling as discussed in Section 10.3.3. This comprises a minimum of three primary samples per material or area being assessed.

### **Imported Materials**

The amount of sampling and analysis for imported soils will depend on the material type, risk of contamination and previous assessment.

This will be determined on an as-needs basis by the Environmental Consultant.

## **10.5.2 Field Methods**

The following general sampling methodology is to be implemented for all sampling:

- Preparing record of samples, including sample date, location, description, signs of concern, and any field results;
- Sampling using disposable or stainless steel sampling equipment;
- Decontaminating all re-useable sampling equipment prior to collecting each sample using a 3% solution of phosphate free detergent (Decon 90) and distilled water;
- Screening of samples using a calibrated photoionisation detector (PID) if volatile contaminants are a potential issue of concern;
- Collection of rinsate blank samples where re-used sampling equipment is used;
- Transferring 500 mL samples into a sealable plastic bag, and then placement in a second plastic bag (i.e. double bagging) (for asbestos analysis);
- Transferring samples into laboratory-prepared glass jars with Teflon-lined lid, and capping immediately (for chemical analytes);
- Labelling sample containers with individual and unique identification, including project number and sample number;
- Collection of at least 10% replicate samples. These samples will be collected from the same location and material as the primary sample and placed in a separate sample container with a unique sample number which does not include the sample location or depth. The sample will not be homogenised with the original sample to prevent the loss of volatiles;
- Placing the plastic bags for asbestos into a sealed container for transport to the laboratory;

- Placing the glass jars for chemical analysis into a cooled, insulated and sealed container for transport to the laboratory; and
- Use of chain-of-custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory.

For on-site quantitative ACM assessment, the following general procedure will be followed:

- Collection of 10 L sample and weighed using pre calibrated scales;
- Manually screen sample on site using a 7 mm sieve (where soils are of suitable consistency) or visual inspection by spreading in thin (<7 mm) layer on a colour contrast tarpaulin or plastic sheet including breaking of clods; and
- Collection of all fragments of suspected ACM of 7 mm and larger and weighing using a calibrated balance to 0.001 g accuracy.

## 10.6 Laboratory Analysis

Laboratory analysis of samples will be undertaken by laboratories with national associated of testing authorities (NATA) accreditation for the analyte(s) being tested and with appropriate QA/QC assessment to meet the requirements of Section 10.7. The exception to this is trace analysis of AF/FA asbestos to a PQL of 0.001% w/w, which will be undertaken in accordance with NEPC (2013) requirements, but may not be NATA accredited.

Samples will be analysed for the contaminants of concern identified for the sampling purpose.

## 10.7 Quality Control and Quality Assurance

QA/QC procedures will be adopted to assess the repeatability and reliability of the results.

Field QA/QC testing will include the following:

- 5% sample inter-laboratory analysis, analysed for the same suite as primary sample;
- 5% sample intra-laboratory analysis, analysed for the same suite as primary sample;
- Rinsate samples (where re-useable sampling equipment is used), analysed for the suite of analytes analysed by the majority of the primary samples;
- Trip spike samples (analysed for BTEX) (one per batch of samples tested for volatile contaminants are of concern); and
- Trip blank samples (analysed for BTEX) (one per batch of samples tested for volatile contaminants are of concern).

The laboratory will undertake analysis in accordance with its accreditation, including in-house QA/QC procedures. These may include:

- Reagent blanks;
- Spike recovery analysis;

- Laboratory duplicate analysis;
- Analysis of control standards;
- Calibration standards and blanks; and
- Statistical analysis of QC data including control standards and recovery plots.

The quality control analytical results will be assessed using the following criteria:

- Sampling location rationale meet the sampling objective;
- Standard operating procedures are followed;
- Appropriate QA/QC samples are collected/prepared and analysed;
- Samples are stored under secure, temperature controlled conditions;
- Chain of custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory;
- Conformance with specified holding times;
- Accuracy of spiked samples within the laboratory's acceptable range (typically 70-130% for inorganic contaminants and greater for some organic contaminants);
- Field and laboratory duplicates and replicate samples will have a precision average of +/- 30% relative percentage difference (RPD) for inorganic analytes and +/- 50% RPD for organic analytes; and
- Rinsate samples will show that any re-used sampling equipment is free of introduced contaminants, i.e. the analytes show that the rinsate sample is within the normal range for deionised water.

## 10.8 Reporting and Documentation

The following documents will be prepared/ obtained by the relevant party, and provided to other parties (the PR, Contractor, Environmental Consultant and/ or Asbestos Assessor) as required. Documentation should be provided by the relevant parties in a timely manner to allow the works to be conducted efficiently.

### 10.8.1 PR

The PR will prepare/ obtain the following documents:

- Any Licences and Approvals required for the Works which are not the responsibility of the Contractor to provide.

### 10.8.2 Contractor

The Contractor will prepare/ obtain the following documents:

- Any Licences and Approvals required for the Works which are the responsibility of the Contractor to provide;

- Excavation and Stockpiling Records: these will record the source of any stockpiled material, the date of excavation and any issues of concern;
- Transportation Record: this will comprise a record of all truck loads of soil entering or leaving the site, including truck identification (e.g. registration number), date, time, load characteristics (i.e. classification, on-site source, destination);
- Tip dockets: these comprise dockets of receipt provided by the receiving waste facility. Where the receiving site is not a waste facility (e.g. if VENM from the site is accepted for re-use on another site), a record of receipt from the receiving site will be supplied (i.e. the receiving sites Transportation Record); and
- Incident Reports: any WHS or Environmental Incidents which occur during the works will be documented and the PR and appropriate regulatory authority will be informed in accordance with regulatory requirements.

### **10.8.3 Environmental Consultant**

The Environmental Consultant will prepare the following documents:

- Waste Classification reports (if required);
- Advice on the suitability of soil proposed to be imported onto the site (if required); and
- Validation Report prepared in general accordance with EPA (2011)<sup>5</sup> including records the remediation and validation work undertaken, and the results of the work.

### **10.8.4 Asbestos Assessor**

The Asbestos Assessor will prepare the following documents:

- Airborne asbestos monitoring records; and
- Visual clearance of asbestos removal.

## **11. Work Health and Safety**

### **11.1 General**

A site specific work health and safety (WHS) Plan is to be prepared by the Contractor and submitted to the Principal for approval. The plan will be prepared with reference to the WHS Act and Regulation. The following protocols are to be observed during the works and are to be incorporated into the Contractors' plan.

- Site Induction. As part of the site induction, site workers are to be advised on:
  - The contamination status of the site including the location, nature, type and concentration of contaminants present;

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<sup>5</sup> NSW Office of Environment and Heritage (OEH) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (reprinted 2011)

- The location and the methods of field identification of potential issues of environmental concern;
- The worker health and safety monitoring to be undertaken;
- The occupational health and safety controls to mitigate the risks (including PPE and air monitoring);
- Responsibilities under the Unexpected Finds Protocol;
- Requirements related to toolbox talks;
- PPE required to be worn by site workers;
- All earthworks plant to be used in remediation works to incorporate air-conditioned cabs and:
  - Cabs to be enclosed at all times during operation in contaminated soils;
  - Cabs to be cleaned daily to remove accumulated dust and dirt;
  - Appropriate personal PPE to be available within the cab;
- Personnel hygiene to be adopted when working in contaminated areas/ potentially contaminated areas. These will include, as a minimum, observing a no eating when working in areas of contamination, and washing hands and face before eating etc; and
- Work to cease immediately when odours, unusual discolouration or unexpected asbestos-based materials found within the filling. When asbestos, odours or other indicators of environmental concern are noted, the Site Manager must be informed immediately. He/ she will assess the situation and implement the Unexpected Finds Protocol (Section 13) as appropriate.

## **11.2 Specific Requirements for Asbestos**

The WHS Act and associated Regulation has specific requirements for asbestos works. The Asbestos Assessor is responsible for providing advice on Regulatory requirements for asbestos works and the Asbestos Contractor is responsible for implementing these requirements. A summary of the WHS requirements with respect to asbestos is provided below.

### **11.2.1 Provision of Asbestos Register**

The Principal or Contactor will provide the Asbestos Contractor and Asbestos Assessor with a copy of the Asbestos Register (if applicable) for the site prior to commencement of asbestos removal work.

### **11.2.2 Notification**

SafeWork NSW must be notified by the Asbestos Contractor five days in advance of any licensable asbestos works.

The Asbestos Contractor must, before commencing the licensed asbestos removal work, inform the person with management or control of the workplace that asbestos removal works are to be conducted and the date the work will commence.

The person with management or control of the workplace must then ensure the following are informed:

- The person's workers and any other persons at the workplace;
- The person who commissioned the asbestos removal work; and
- Any person conducting a business or undertaking or occupying a premises at or adjacent to the workplace.

### **11.2.3 Asbestos Assessor**

An Asbestos Assessor who is independent of the Asbestos Contractor is to be engaged by the Principal or Principal Contractor to provide WHS advice, air monitoring and asbestos clearances.

### **11.2.4 WHS Plans**

The Asbestos Contractor will prepare, retain and provide the following plans complying with Regulatory requirements, including the WHS Regulation (2011), the Code of Practice 'How to Safely Remove Asbestos' and SafeWork NSW requirements:

- Safe Works Method Statement (SWMS): which will be specific to individual tasks undertaken at the site; and
- Asbestos Removal Control Plan (ARCP) which must be prepared for all licensable asbestos removal works.

These plans must be provided to the person who commissioned the work.

### **11.2.5 Licensed Contractor and Training**

Asbestos removal works must be undertaken by an Asbestos Contractor with a Class A License (friable works) or Class B Licence (non-friable works) issued by SafeWork NSW.

All asbestos workers at the site must be appropriately trained and certified in asbestos removal works in accordance with the WHS Regulation 2011. In addition they must be provided with specific training for the project, the risks associated with the asbestos removal work, the health monitoring requirements and any other site-specific requirements.

The licensed asbestos removalist must keep records of all training works in accordance with the requirements of the WHS Regulation 2011.

### **11.2.6 Fencing and Signage**

Prior to the commencement of the asbestos works, the area will be delineated by erecting barricades and affixing warning signs. The type of barricade should be in keeping with the risk and warning signs shall be specific to asbestos removal hazards and be clearly placed at all main entry points.

### **11.2.7 Restriction of Access**

Access to the asbestos works area will be restricted to:

- Workers engaged in asbestos removal work;
- Other persons associated with the asbestos removal work; and
- Anyone allowed under the WHS Regulation or another law to be in the asbestos removal area.

### **11.2.8 Removal Methodology**

The asbestos removal methodology will be detailed in the ARCP and approved by the Asbestos Assessor.

### **11.2.9 Airborne Asbestos Monitoring**

The Asbestos Assessor will design and undertake a monitoring programme for airborne asbestos fibres.

### **11.2.10 Personal Protective Equipment**

The personal protective equipment (PPE) will be detailed in the ARCP and approved by the Asbestos Assessor.

### **11.2.11 Decontamination and Asbestos Waste Disposal**

The Asbestos Contractor must set up decontamination facilities that are appropriate for the specific works to be undertaken and prior to the commencement of the works. The facilities must be provided to decontaminate:

- The asbestos removal area;
- The asbestos treatment area;
- Any plant used in the asbestos removal area;
- Workers carrying out asbestos removal work; and
- Other persons who have access to the asbestos removal area.

The Asbestos Contractor must ensure that Asbestos Waste, including used PPE, is managed and disposed in accordance with the WHS Regulation 2011 and this RAP.

### **11.2.12 Clearance Inspection and Certificate**

Upon completion of all asbestos removal works, the Asbestos Assessor is to undertake a visual clearance inspection. When they are satisfied the works area and immediate surrounding areas are free from any visible asbestos contamination (and any air monitoring results are below 0.01f/ml) then a final clearance certificate is issued.



## 12. Environmental Management

A project specific construction environmental management plan (CEMP) shall be prepared by the Contractor as part of their site management plan documents. As a minimum, the site specific CEMP shall detail the following:

- Works sequence and timeline;
- Health and Safety Protocols;
- Dust minimisation measures;
- Noise minimisation measures;
- Environment protection measures;
- Equipment to be used;
- Nominated landfill(s);
- Truck movements / site access / site egress; and
- Measures to prevent cross contamination between areas being remediated.

The remediation works shall be undertaken with all due regard to the minimisation of environmental effects and to meet all statutory requirements. The Contractor shall have in place the site specific CEMP such that work on the site complies with the requirements as laid down in relevant legislation, guidelines and codes.

The Contractor shall also be responsible to ensure that the site works comply with the following conditions:-

- Fugitive dust leaving the confines of the site is minimised;
- No water containing any suspended matter or contaminants leaves the site in a manner which could pollute the environment;
- Vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas; and
- Noise and vibration levels at the site boundaries comply with the legislative requirements.

A dust management plan will be submitted separately.

Given that there is no shallow groundwater and no proposed deep excavations, a water management plan is not considered to be necessary for the project. With regards to site run-off, ground surfaces should be graded towards the centre of the site (i.e. away from boundary lines) to prevent off-site discharge of water that may be affected by ACM. Internally collected run-off should be managed and tested during the remediation period to ensure it is appropriately evaporated on-site or discharged after environmental testing. Stockpiled materials yet to be remediated should be kept away from areas of the site that have had remediated soils reinstated to prevent run-off from washing potentially ACM onto remediated ground.

## 13. Unexpected Finds Protocol and Contingency Plan

### 13.1 Unexpected Finds Protocol

All site personnel are to be inducted into their responsibilities under this Unexpected Finds Protocol (UFP), which should be included or referenced in the Contractors Site Management Plan.

All site personnel are required to report unexpected signs of environmental concern to the Site Manager if observed during the course of their works e.g. presence of unexpected ACM, petroleum, or other chemical odours, unnatural staining, potential contamination sources (such as buried drums or tanks) or chemical spills.

Should signs of concern be observed, the Site Manager, as soon as practical, will:

- Stop work in the affected area and ensure the area is barricaded to prevent unauthorised access;
- Notify authorities needed to obtain emergency response for any health or environmental concerns (e.g. fire brigade);
- Notify the PR of the occurrence;
- Notify any of the authorities that the Contractor is legally/ contractually required to notify (e.g. EPA, Council); and
- Notify the Environmental Consultant.

The PR is to notify any of the authorities which the Principal is legally/ contractually required to notify (e.g. EPA, Council).

Following the immediate response in the UFP a contingency plan is to be implemented.

### 13.2 Contingency Plan

The contingency plan for the site is as follows:

- The Environmental Consultant will inspect the issue of concern and determine the nature of the issue, whether it comprises an area of environmental concern (AEC), and the appropriate approach to assessing or (if appropriate) managing the issue;
- The Environmental Consultant will undertake an assessment considered necessary to determine the management strategy for the AEC;
- If contamination is found and remediation action is considered necessary, a remediation strategy for the AEC will be prepared by the Environmental Consultant and provided to the PR for approval;
- If the AEC or proposed remediation strategy is significantly different than that detailed in the RAP, the Consent Authority or Private Certifier (as applicable) will be provided notification of the proposed works; and

- The Contractor will implement the proposed remediation strategy (if required) in accordance with the above advice and any approvals/ requirements of the Consent Authority/ Private Certifier.

## 14. Conclusions

It is considered that conformance with this RAP will minimise the potential impacts on human health and the environment during the remediation works and render the site suitable for the proposed development.

## 15. Limitations

Douglas Partners (DP) has prepared this report for this project at Castle Towers Shopping Centre, Castle Street, Castle Hill in accordance with DP's fee proposals (Ref. SYD140368, dated 27 May 2014, SYD141521, Rev2, dated 6 March 2015 and SYD151436 dated 30 October 2015), as amended during the subsequent field investigations, and the acceptances received from Mr Tony Growse of QIC Limited. The work was carried out under the agreed terms of the Consultancy Agreement between QIC and Douglas Partners (Contract No. aibb A0131404478v12 120473187, dated 11 November 2015).

This report is provided for the exclusive use of QIC Limited for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints (as discussed above), or to parts of the site being inaccessible and not available for inspection/sampling or to vegetation preventing visual inspection and reasonable access. It is therefore considered possible that hazardous building materials, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

Division 4, Section 45, of *The Protection of the Environment Operations (Waste) Regulation 2014* states that it is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that the waste is disposed of appropriately. DP does not accept liability for the unlawful disposal of waste materials from any site. DP accepts no responsibility for the material tracking, loading, management, transport or disposal of waste from the site. Before disposal of the material to a licensed landfill is undertaken, the waste producer will be required to obtain prior consent from the landfill.

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**Douglas Partners Pty Ltd**

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## Appendix A

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About this Report

Drawings

# 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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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

## 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.

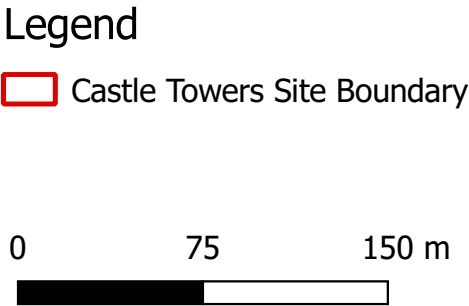
## **Information for Contractual Purposes**

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.

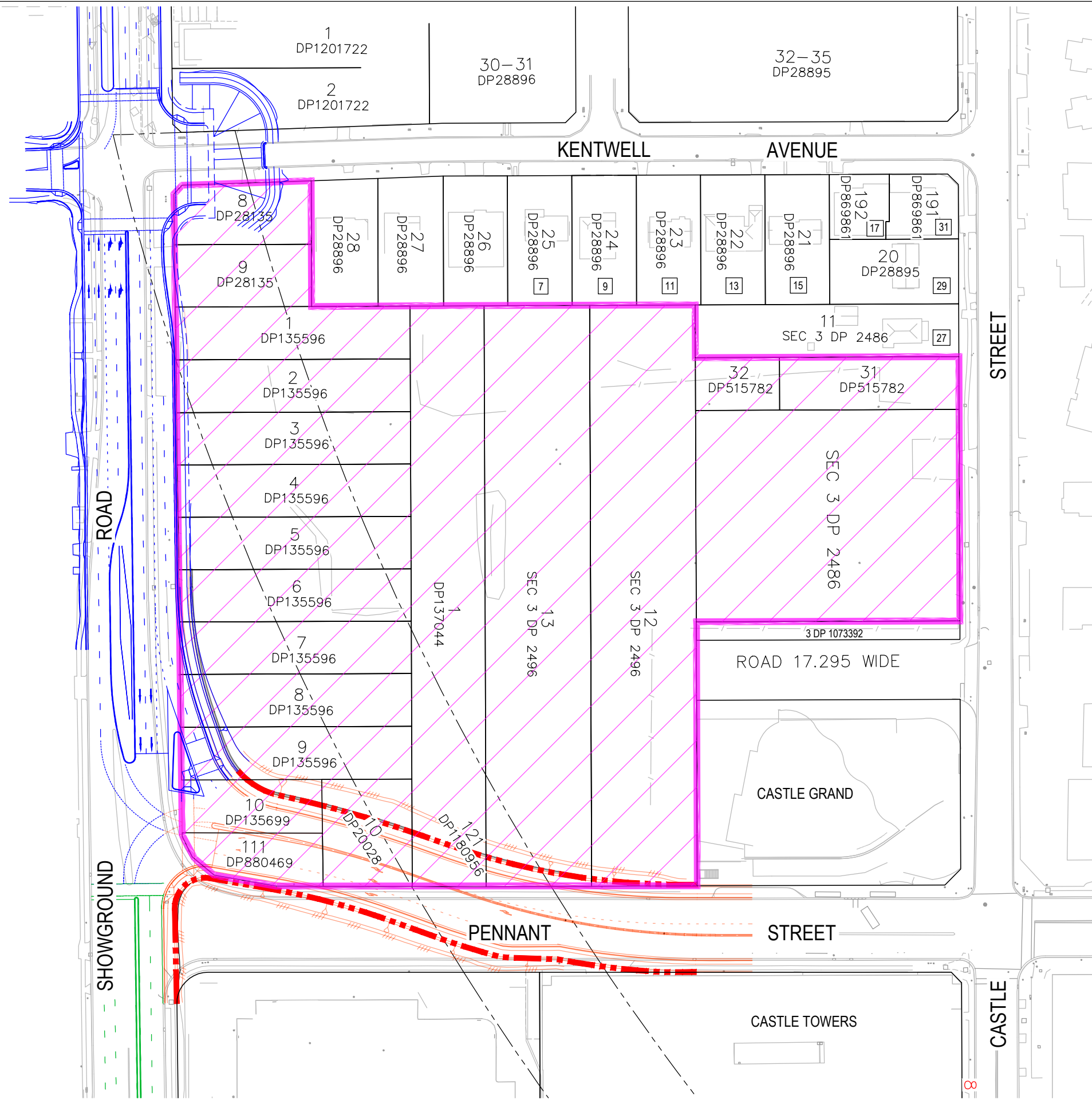






THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL



LEGEND

- EXISTING ROAD RESERVE/CADASTRAL BOUNDARY
- NWRL STRATA
- FUTURE PENNANT STREET ROADWORKS - 5A
- PROPOSED SHOWGROUND ROAD ROADWORKS (BY OTHERS)
- ADDITIONAL SHOWGROUND ROAD ROADWORKS - 5E
- AREA = 32118 m<sup>2</sup>
- PROPOSED ROAD RESERVE
- PROPERTY LOT AND DP NUMBER
- HOUSE STREET ADDRESS

NOTES

- UNDERTAKE DETAILED CONTAMINATION INVESTIGATION AND ASSESSMENT TO SUPPLEMENT AND VALIDATE PRELIMINARY SITE INVESTIGATION. UNDERTAKE CONTAMINATION REMEDIATION ON OTHER CONTAMINANTS IDENTIFIED WITHIN SITE-B OUTLINED IN DOUGLAS PARTNERS REPORT 84335.01 DATED NOVEMBER 2016
- REFER TO DOUGLAS PARTNER ADVICE 84335.03.R.004. CONTAMINATION CLEARANCE CERTIFICATE TO BE PROVIDED ON COMPLETION.

Drawing 1A

NOT FOR CONSTRUCTION

DRAWING FILE LOCATION / NAME Victor\dfs01\Projects\BGE\SYD\13111\100 Draw\100.2 Civil\AutoCAD\SITE B ACCESS RD\SKETCHES\13111-SK-PW-1102.dwg			DESIGN LOT CODE		DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING		PLOT DATE / TIME 3/10/2018 4:17:39 PM		PLOT BY tanjim.alam	CLIENT Global Real Estate   QIC		THE HILLS SHIRE COUNCIL AREA CASTLE TOWERS REDEVELOPMENT - SITE B SCHEDULE 3B INDICATIVE PLAN OF PROPOSED REMEDIATION OF SITE B		A3
EXTERNAL REFERENCE FILES			WVR No.	APPROVAL	SCALES ON A3 SIZE DRAWING		TITLE		NAME	DATE	PREPARED FOR QIC	SITE B AND KENTWELL AVENUE		PART
							DRAWN		T.ALAM	04.10.18		RMS REGISTRATION No. DSxxxx/xxxxxx		1
							DRG CHECK		C. PELAEZ	04.10.18		ISSUE STATUS		ISSUE
							DESIGN					SKETCH ONLY		4
							DESIGN CHECK					S13111-EW5		
							DESIGN MNGR					SHEET No. SK-PW-1102		
							PROJECT MNGR							

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EXTERNAL REFERENCE FILES

REV	DATE	AMENDMENT / REVISION DESCRIPTION
1	17.05.2018	ISSUED FOR INFORMATION
2	23.05.2018	REMEDIATION AREAS REVISED
3	24.05.2018	REMEDIATION AREAS AND NOTES REVISED
4	04.10.2018	REMEDIATION AREAS AND NOTES REVISED

DESIGN LOT CODE

WVR No.

APPROVAL

CB  
CB  
CB  
TA

SCALES ON A3 SIZE DRAWING

DRAWINGS / DESIGN PREPARED BY

Sydney Office—  
L2, 8 Windmill St, Sydney NSW 2000  
P / +61 2 9770 3300  
E / info@bgeeng.com  
bgeeng.com—

SCALE 1:1250

CO-ORDINATE SYSTEM  
MGA ZONE 56

HEIGHT DATUM  
AHD

PLOT DATE / TIME  
3/10/2018 4:17:39 PM

PLOT BY  
tanjim.alam

TITLE

NAME

DATE

DRG CHECK

C. PELAEZ

04.10.18

DESIGN

DESIGN CHECK

DESIGN MNGR

PROJECT MNGR

CLIENT  
Global Real Estate | QIC

PREPARED FOR  
QIC

THE HILLS SHIRE COUNCIL AREA  
CASTLE TOWERS REDEVELOPMENT - SITE B  
SCHEDULE 3B INDICATIVE PLAN  
OF PROPOSED REMEDIATION OF SITE B

SITE B AND KENTWELL AVENUE

RMS REGISTRATION No. DSxxxx/xxxxxx

ISSUE STATUS  
SKETCH ONLY

S13111-EW5

SHEET No. SK-PW-1102

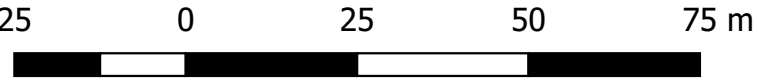
PART  
1

ISSUE  
4





- Legend
- Possible asbestos hotspot
  - Asbestos hot spots
  - Site B Boundary









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## Appendix B

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Field Results  
With Descriptive Notes



## 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 1726-1993, 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.





## 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 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approximate 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  $Is_{(50)}$ . It should be noted that the UCS to  $Is_{(50)}$  ratio varies significantly for different rock types and specific ratios should be determined for each site.

## 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 longer 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

# 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 <sub>50</sub>	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

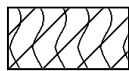


Concrete



Filling

### Soils



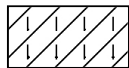
Topsoil



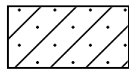
Peat



Clay



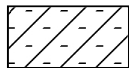
Silty clay



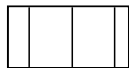
Sandy clay



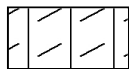
Gravelly clay



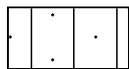
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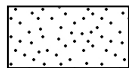
Silt



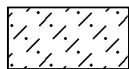
Clayey silt



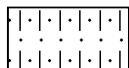
Sandy silt



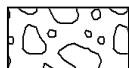
Sand



Clayey sand



Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

### Sedimentary Rocks



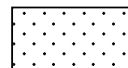
Boulder conglomerate



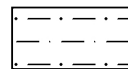
Conglomerate



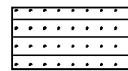
Conglomeratic sandstone



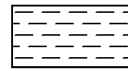
Sandstone



Siltstone



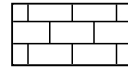
Laminite



Mudstone, claystone, shale

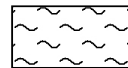


Coal

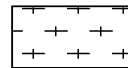


Limestone

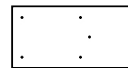
### Metamorphic Rocks



Slate, phyllite, schist

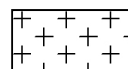


Gneiss

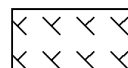


Quartzite

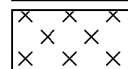
### Igneous Rocks



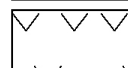
Granite



Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia





Porphyry

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314964.3517  
**NORTHING:** 6265916.566

**PIT No:** TP601  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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
	0.0	FILLING - grey, gravelly (basalt) sand filling		D/^ 500ml	0.0							
	0.1	FILLING - brown, silty clay filling with some fine gravel		D/^ 500ml	0.1							
	0.3	SILTY CLAY - orange-brown, silty clay			0.3							
	0.5			D	0.5							
	0.7	Pit discontinued at 0.7m - target depth reached			0.7							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** \*BD1A/BD13 taken from 0.1m to 0.3m. ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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	W <sub>s</sub>	Water seep	S	Standard penetration test
E	Environmental sample	W <sub>L</sub>	Water level	V	Shear vane (kPa)





**Douglas Partners**  
 Geotechnics | Environment | Groundwater

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314999.1493  
**NORTHING:** 6265895.38

**PIT No:** TP602  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 clay filling with some large roots		D/A 500ml	0.0							
	0.3	SHALY CLAY - light grey, shaly clay		D	0.3							
					0.5							
	0.8	Pit discontinued at 0.8m - target depth reached			0.8							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>1</sub> 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	W Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314947.8682  
**NORTHING:** 6265901.918

**PIT No:** TP603  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 - grey, silty clay filling with some shale gravel and shale cobbles and bricks										
					0.2		0.0-0.5m: ^500ml *ACM collected					
				D*	0.4							
	0.5	SILTY CLAY - brown, silty clay with trace fine gravel										
					0.9							
				D								
	1.1	Pit discontinued at 1.1m - target depth reached			1.1							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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


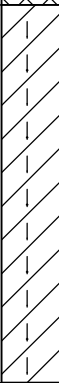
SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U <sub>s</sub>	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample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

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314969.8434  
**NORTHING:** 6265888.311

**PIT No:** TP604  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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, sandy clay with rootlets		D/ <sup>^</sup> 500ml	0.0							
	0.2	SILTY CLAY - brown-orange, silty clay			0.2							
					0.5							
	0.7	Pit discontinued at 0.7m - target depth reached			0.7							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>L</sub>	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)


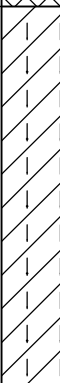


# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314992.8659  
**NORTHING:** 6265875.234

**PIT No:** TP605  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 clay filling with some gravel and rootlets		D/A 500ml	0.0							
	0.3	SILTY CLAY - orange-brown, silty clay		D	0.3							
		- becomes grey from 0.6m			0.5							
					0.7							
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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


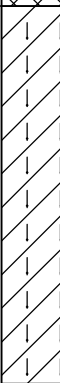
SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U <sub>s</sub>	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample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

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314937.9319  
**NORTHING:** 6265881.513

**PIT No:** TP606  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 clayey sand filling with some gravel, tile fragments and whole bricks			0.1		0.0-0.4m: ^500ml					
	0.4	SILTY CLAY - orange-brown, silty clay		D	0.4							
					0.7							
	0.9	Pit discontinued at 0.9m - target depth reached		D	0.9							
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314957.0293  
**NORTHING:** 6265872.874

**PIT No:** TP607  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 with some clay and rootlets		D/^ 500ml	0.0							
	0.2	SILTY CLAY - orange-brown, silty clay			0.2							
					0.5							
	0.7	Pit discontinued at 0.7m - target depth reached		D	0.7							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314983.713  
**NORTHING:** 6265858.487

**PIT No:** TP608  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 clayey sand filling with rootlets and trace gravel		D/ <sup>^</sup> 500ml	0.0							
	0.2	SILTY CLAY - orange-brown, silty clay			0.2							
					0.5							
	0.7	Pit discontinued at 0.7m - target depth reached			0.7							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>L</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314923.5428  
**NORTHING:** 6265857.967

**PIT No:** TP609  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 - light brown, silty sand with some sandstone gravel and cobbles										
					0.2		0.0-1.0m: ^500ml					
				D								
					0.6							
1	1.0	SILTY CLAY - orange-brown, silty clay										
					1.1							
				D								
	1.4	Pit discontinued at 1.4m - target depth reached			1.4							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314948.6598  
**NORTHING:** 6265844.36

**PIT No:** TP610  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 with some gravel, brick fragments and metal pipe, fibre cement fragments observed										
					0.2		0.0-0.6m: ^500ml ACM sample collected					
				D								
					0.4							
	0.6	SILTY CLAY - orange-brown, silty clay										
					0.8							
				D								
1	1.0	Pit discontinued at 1.0m - target depth reached			1.0							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>1</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314951.5376  
**NORTHING:** 6265821.075

**PIT No:** TP611  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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, gravelly (river pebble and concrete) sand filling		D/^ 500ml	0.0							
	0.2	SILTY CLAY - orange-brown, silty clay		D	0.2							
					0.5							
					0.7							
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314995.4881  
**NORTHING:** 6265792.56

**PIT No:** TP612  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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, sandy gravel (crushed aggregate) filling		D/^ 500ml	0.0							
	0.3	SILTY CLAY - orange-brown, silty clay		D	0.3							
	0.7	Pit discontinued at 0.7m - target depth reached			0.7							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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	W <sub>s</sub>	Water seep	S	Standard penetration test
E	Environmental sample	W <sub>L</sub>	Water level	V	Shear vane (kPa)




# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314906.0121  
**NORTHING:** 6265828.143

**PIT No:** TP613  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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
	0.03	ROADBASE										
		FILLING - brown, clayey sand filling with some gravel and fibre cement fragment (100mm x 100mm, numerous fragments bonded)			0.1		0.0-0.4m: ^500ml ACM collected					
				D								
	0.4	Pit discontinued at 0.4m - due to the presence of significant amounts of ACM			0.4							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314923.279  
**NORTHING:** 6265815.056

**PIT No:** TP614  
**PROJECT No:** 84335.03  
**DATE:** 15/4/2015  
**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 with some gravel		D/^ 500ml	0.0							
	0.1	FILLING - brown, sandy clay filling with some gravel and sandstone cobbles			0.1		0.1-0.7m: ^500ml					
					0.4							
				D	0.6							
	0.7	SILTY CLAY - orange-brown, silty clay, damp										
					1.0							
				D	1.1							
	1.1	Pit discontinued at 1.1m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314940.282  
**NORTHING:** 6265804.338

**PIT No:** TP615  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 with some gravel and concrete, sandstone cobbles		D/Λ 500ml	0.0							
	0.3	SILTY CLAY - brown, silty clay		D	0.3							
	0.6				0.6							
	0.8	Pit discontinued at 0.8m - target depth reached			0.8							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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


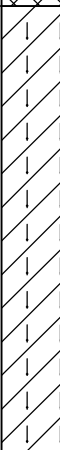
SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314955.4626  
**NORTHING:** 6265792.56

**PIT No:** TP616  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 - grey, sandy gravel (crushed aggregate) filling		D/^ 500ml	0.0							
	0.4	SILTY CLAY - grey, silty clay		D*	0.4							
		- becoming orange-brown from 0.6m			0.6							
					0.8							
1	1.0	Pit discontinued at 1.0m - target depth reached		D	1.0							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** \*BD1A and BD1B taken from 0.4m to 0.6m. ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314974.2962  
**NORTHING:** 6265781.833

**PIT No:** TP617  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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, sandy gravel filling		D/^ 500ml	0.0							
	0.15	SILTY CLAY - brown-orange, silty clay		D	0.15							
					0.4							
	0.6	Pit discontinued at 0.6m - target depth reached			0.6							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314884.8202  
**NORTHING:** 6265804.598

**PIT No:** TP618  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 with some whole bricks			0.1							
				D/^ 500ml	0.3							
	0.4	SILTY CLAY - orange-brown, silty clay			0.5							
				D	0.7							
	0.9	LAMINITE - grey laminite with some clay bands										
	1											
	1.05	Pit discontinued at 1.05m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	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)


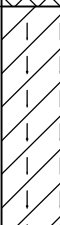


# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314906.5398  
**NORTHING:** 6265805.638

**PIT No:** TP619  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 with trace gravel and rootlets		D/A 500ml	0.0							
	0.3	SILTY CLAY - orange-brown, silty clay		D	0.3							
					0.4							
	0.6	Pit discontinued at 0.6m - target depth reached			0.6							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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	W <sub>s</sub>	Water seep	S	Standard penetration test
E	Environmental sample	W <sub>L</sub>	Water level	V	Shear vane (kPa)

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314938.7152  
**NORTHING:** 6265762.996

**PIT No:** TP620  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 with trace terracotta and plastic		D/^ 500ml	0.0							
	0.15	FILLING - orange-brown, silty clay			0.15							
				D	0.4							
	0.6	Pit discontinued at 0.6m - target depth reached			0.6							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314964.8794  
**NORTHING:** 6265752.798

**PIT No:** TP621  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 with some clay, gravel and terracotta fragments		D/^ 500ml	0.0							
	0.35	FILLING - orange-brown, silty clay filling (trench backfill)			0.35							
				D	0.4							
					0.6							
	0.8	- terracotta pipe at 0.8m Pit discontinued at 0.8m - services encountered										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>t</sub>	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	W <sub>s</sub>	Water seep	S	Standard penetration test
E	Environmental sample	W <sub>l</sub>	Water level	V	Shear vane (kPa)

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314984.7602  
**NORTHING:** 6265751.229

**PIT No:** TP622  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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, gravelly sand filling with some whole bricks		D/Λ	0.0							
	0.3	FILLING - brown, silty gravelly sand filling with some broken glass and fibre cement fragments			0.3		0.3-0.8m: Λ500ml					
				D	0.5		ACM sample taken					
					0.7							
	0.8	SILTY CLAY - orange-brown, silty clay			0.9							
				D								
	1.1	Pit discontinued at 1.1m - target depth reached			1.1							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ΛSample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>L</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314872.0061  
**NORTHING:** 6265765.356

**PIT No:** TP623  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 with roots and rootlets										
					0.2		0.0-0.8m: ^500ml					
				D								
					0.5							
	0.8	SILTY CLAY - light brown, silty clay, damp										
					0.9							
				D								
	1.1	SHALE - grey, highly weathered shale										
					1.1							
	1.3	Pit discontinued at 1.3m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314893.9814  
**NORTHING:** 6265752.538

**PIT No:** TP624  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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 clayey sand filling with rootlets		D/ <sup>^</sup> 500ml	0.0							
	0.25	SILTY CLAY - orange mottled grey, silty clay		D	0.25							
					0.4							
					0.6							
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314916.2205  
**NORTHING:** 6265739.191

**PIT No:** TP625  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 clayey sand with large roots		D/^ 500ml	0.0							
	0.4	SILTY CLAY - brown-orange, silty clay with some ironstone gravel, damp		D	0.4							
	0.8				0.8							
1	1.0	Pit discontinued at 1.0m - target depth reached			1.0							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>1</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314929.5623  
**NORTHING:** 6265729.773

**PIT No:** TP626  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 with building rubble (concrete, tiles, terracotta, brick, metal pipe)		D/^ 500ml	0.0							
	0.4	SILTY CLAY - brown, silty clay		D	0.4							
					0.8							
1	1.0	Pit discontinued at 1.0m - target depth reached			1.0							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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	W <sub>s</sub>	Water seep	S	Standard penetration test
E	Environmental sample	W <sub>L</sub>	Water level	V	Shear vane (kPa)

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314949.9626  
**NORTHING:** 6265715.646

**PIT No:** TP627  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 with some brick and tile fragments		*D/A 500ml	0.0							
					0.3							
	0.4	SILTY CLAY - orange-brown, silty clay		D	0.4							
	0.6	Pit discontinued at 0.6m - target depth reached			0.6							
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** \*BD1A taken from 0.0m to 0.3m. ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314859.4477  
**NORTHING:** 6265736.842

**PIT No:** TP628  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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
	0.02	TOPSOIL - brown, slightly sandy, clayey silt topsoil with rootlets, humid		D/^	0.0							
		FILLING - orange-brown then brown, silty clay filling with some rootlets and a trace of fine to medium gravel (ironstone) and charcoal and roots, humid		500ml	0.05							
					0.4							
	0.5	SILTY CLAY - very stiff to hard, orange-brown, silty clay with bands of medium to high strength siltstone, humid		D/^								
				500ml								
	0.6	Pit discontinued at 0.6m			0.6							

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314879.0728  
**NORTHING:** 6265723.234

**PIT No:** TP629  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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
	0.0	TOPSOIL - brown, slightly sandy, clayey silt topsoil with rootlets, humid		D/^ 500ml	0.0							
	0.05				0.05							
	0.1	FILLING - brown, silty clay filling with some fine to coarse gravel (ironstone and shale), rootlets and a trace of roots, humid										
	0.4				0.4							
	0.5	SILTY CLAY - very stiff to hard, orange-brown, silty clay with some fine to coarse gravel (ironstone) and medium to high strength, brown-orange siltstone bands, humid		D/^ 500ml								
	0.6				0.6							
	0.7	Pit discontinued at 0.7m										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** KM

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314900.5204  
**NORTHING:** 6265709.367

**PIT No:** TP630  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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
	0.08	TOPSOIL - brown, slightly sandy, clayey silt topsoil with rootlets, humid										
		FILLING - brown, silty clay filling with some rootlets, fine to coarse gravel (ironstone), a trace of cobbles (shale), roots and charcoal, humid		D	0.1		0.0-0.5m: ^500ml					
					0.3							
	0.5	SHALY CLAY - stiff to hard, orange-brown, shaly clay with a trace of rootlets, fine to medium gravel (ironstone, charcoal and medium to high strength siltstone bands), humid		D	0.6							
					0.8							
	0.85	Pit discontinued at 0.85m										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** KM

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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



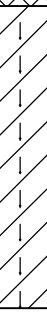

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket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

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314924.0623  
**NORTHING:** 6265696.55

**PIT No:** TP631  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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
	0.1	TOPSOIL - brown, slightly sandy, clayey silt topsoil with rootlets, humid		D/^ 500ml	0.0							
	0.1	FILLING - brown, silty clay filling with some fine to medium gravel (ironstone and shale) and rootlets and a trace of charcoal, tile (up to 100mm fragments) and brick (up to 250mm fragments), humid		D/^ 500ml	0.1							
	0.4	SILTY CLAY - very stiff to hard, brown mottled grey, silty clay with some rootlets and a trace of fine to medium gravel (ironstone) and roots, humid			0.4							
	0.8	SHALE - extremely low and very low strength, grey shale with some rootlets and low to medium strength bands and a trace of roots		D	0.8							
	0.95	Pit discontinued at 0.95m			0.95							
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** KM

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314943.9431  
**NORTHING:** 6265684.252

**PIT No:** TP632  
**PROJECT No:** 84335.03  
**DATE:** 16/4/2015  
**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
	0.1	TOPSOIL - brown, slightly sandy, silty clay topsoil with rootlets and a trace of medium gravel (concrete), humid		D/^ 500ml	0.0							
	0.1	FILLING - brown, silty clay filling with some rootlets and a trace of roots, fine to medium gravel (concrete, ironstone and shale), concrete (up to 90mm fragments) and charcoal, humid		D/^ 500ml	0.1							
	0.6	SHALE - extremely low to low strength, grey shale with some high strength ironstone bands		D	0.6							
	0.7	Pit discontinued at 0.7m			0.7							
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** KM

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314957.8127  
**NORTHING:** 6265930.693

**PIT No:** TP633  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 with some clay and rootlets		D/^ 500ml	0.0							
	0.25	SHALY CLAY - grey shaly clay, moist			0.25							
	0.6	Pit discontinued at 0.6m										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314986.3269  
**NORTHING:** 6265913.946

**PIT No:** TP634  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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
	0.0	FILLING - grey-brown, gravelly sand filling with some sandstone and whole bricks			0.0		ACM sample collected					
	1.0	SHALE - extremely weathered, grey shale with some clay			1.0							
	1.1	Pit discontinued at 1.1m										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>l</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 315012.2272  
**NORTHING:** 6265897.729

**PIT No:** TP635  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 with some clay and rootlets		D/ <sup>^</sup> 500ml	0.0							
	0.25	SHALY CLAY - grey, shaly clay			0.25							
	0.6	Pit discontinued at 0.6m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314981.3547  
**NORTHING:** 6265905.318

**PIT No:** TP636  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 - grey, gravelly sand filling with some silt and shale cobbles			0.0							
	0.5	SILTY CLAY - orange-brown, silty clay			0.5							
	0.9	Pit discontinued at 0.9m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>L</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 315008.3022  
**NORTHING:** 6265884.912

**PIT No:** TP637  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 with whole bricks and pipe		D	0.0		ACM Sample collected					
	0.5	SHALY CLAY - orange mottled grey, shaly clay			0.5							
	0.7	Pit discontinued at 0.7m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314962.0016  
**NORTHING:** 6265897.729

**PIT No:** TP638  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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, clayey sand filling with some gravel		D/^ 500ml	0.0		ACM sample collected					
	0.15	SHALY CLAY - grey, shaly clay			0.15							
	0.5	Pit discontinued at 0.5m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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


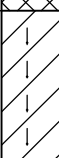
SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket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

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314927.7317  
**NORTHING:** 6265879.153

**PIT No:** TP639  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 clayey sand filling with some ripped shale and bricks			0.0		ACM sample recovered					
				D/^ 500ml								
	0.9	SILTY CLAY - orange-brown, silty clay			0.9							
	1.1	Pit discontinued at 1.1m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314952.8404  
**NORTHING:** 6265883.342

**PIT No:** TP640  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 clayey sand filling with whole bricks		D/^ 500ml	0.0							
	0.4	SILTY CLAY - orange-brown, silty clay, moist			0.4							
1	1.0	Pit discontinued at 1.0m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314974.8157  
**NORTHING:** 6265869.215

**PIT No:** TP641  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 with rootlets		D/^ 500ml	0.0							
	0.15	SILTY CLAY - brown, silty clay			0.15							
	0.5	Pit discontinued at 0.5m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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


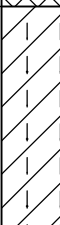
SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314948.6598  
**NORTHING:** 6265862.416

**PIT No:** TP642  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 with some clay and rootlets		D/A 500ml	0.0							
	0.3	SILTY CLAY - orange-brown, silty clay			0.3							
	0.6	Pit discontinued at 0.6m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>L</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314978.2212  
**NORTHING:** 6265837.821

**PIT No:** TP643  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 - grey, gravelly (rippled shale) sand filling with some fibre cement fragments		D/A 500ml	0.0 0.05		ACM sample collected					
	0.3	SILTY CLAY - orange-brown, silty clay										
	0.7	Pit discontinued at 0.7m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314936.3652  
**NORTHING:** 6265851.169

**PIT No:** TP644  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 clayey sand filling with some rootlets		D/^ 500ml	0.0							
	0.35	SILTY CLAY - orange-brown, silty clay with some ironstone gravel			0.35							
	0.7	Pit discontinued at 0.7m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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	W <sub>s</sub>	Water seep	S	Standard penetration test
E	Environmental sample	W <sub>L</sub>	Water level	V	Shear vane (kPa)

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314963.0488  
**NORTHING:** 6265835.472

**PIT No:** TP645  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 with some clay and gravel			0.0							
	0.45	SILTY CLAY - orange-brown, silty clay			0.45							
1	1.0	Pit discontinued at 1.0m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314971.6822  
**NORTHING:** 6265818.205

**PIT No:** TP646  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - grey, sandy gravelly (crushed aggregate: concrete, basalt) filling		D/^ 500ml	0.0		ACM fragment found in surface soils					
	0.2	FILLING - brown, gravelly sandy clay filling		D/^ 500ml	0.2							
	0.4	FILLING - brown, clayey sand filling - fabric layer at 0.4m		D/^ 500ml	0.4							
	0.6	SILTY CLAY - orange-brown, silty clay			0.6							
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 315009.3494  
**NORTHING:** 6265791.521

**PIT No:** TP647  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - grey, sandy gravel (crushed aggregate) filling			0.0							
				D/^								
					500ml							
	0.45	FILLING - dark grey, silty sand filling			0.45		0.45-0.7m: ^500ml					
				D	0.5							
	0.7	FILLING - brown mottled grey, silty clay filling with some ripped shale and ironstone gravel, damp			0.7		0.7-1.6m: ^500ml					
				D	1.0							
					1.2							
	1.6	Pit discontinued at 1.6m - on large diameter pipe, suspected sewer										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Sewer pipe at 1.6m. ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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)



**Douglas Partners**  
 Geotechnics | Environment | Groundwater

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314990.5158  
**NORTHING:** 6265807.737

**PIT No:** TP648  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - grey, sandy gravel filling (crushed aggregate, concrete, basalt, brick)		D/^ 500ml	0.0							
	0.15	FILLING - brown, silty sand filling with some gravel and brick fragments		D/^ 500ml	0.15							
	0.6	SILTY CLAY - light brown, silty clay			0.6							
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314936.3652  
**NORTHING:** 6265823.694

**PIT No:** TP649  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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, gravelly (shale and ironstone) sandy clay filling with some sandstone cobbles and bricks			0.0							
	0.6	SILTY CLAY - brown, silty clay with some sand			0.6							
	1.1	Pit discontinued at 1.1m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314961.4739  
**NORTHING:** 6265806.168

**PIT No:** TP650  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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, gravelly (brick, concrete) sand filling			0.0		ACM sample collected					
	0.4	SANDY CLAY - brown, sandy clay			0.4							
	0.6	SILTY CLAY - orange mottled grey, silty clay										
	0.9	Pit discontinued at 0.9m - target depth reached										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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


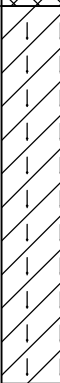
SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test Is(50) (MPa)	
C Core drilling	W Water sample	pp Pocket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

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314966.4461  
**NORTHING:** 6265785.242

**PIT No:** TP651  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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			0.0							
				D/^ 500ml								
	0.4	SILTY CLAY - orange-brown, silty clay			0.4							
		- high inflow of water seepage at 0.8m						▽				
	0.9	Pit discontinued at 0.9m - target depth reached										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** Seepage observed at 0.8m

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314983.7047  
**NORTHING:** 6265795.71

**PIT No:** TP652  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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 - grey, sandy gravel (crushed aggregate) filling		D/^ 500ml	0.0							
	0.2	FILLING - grey, gravelly (ripped shale) clay filling		D/^ 500ml	0.2							
	0.4	FILLING - brown, clayey sand filling - fabric layer at 0.4m		D/^ 500ml	0.4							
	0.9	SILTY CLAY - orange-brown, silty clay			0.9							
1	1.0	Pit discontinued at 1.0m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314986.0713  
**NORTHING:** 6265776.614

**PIT No:** TP653  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - grey, sandy gravel (crushed aggregate) filling		D/^\n500ml	0.0							
	0.2	FILLING - brown, silty sand filling with some ripped shale gravel		D/^\n500ml	0.2							
	0.9	SILTY CLAY - orange-brown, silty clay			0.9							
	1.1	Pit discontinued at 1.1m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>l</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314927.4679  
**NORTHING:** 6265799.889

**PIT No:** TP654  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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 with some gravel, brick fragments and rootlets		D/A 500ml	0.0							
	0.3	SILTY CLAY - orange-brown, silty clay			0.3							
	0.5	Pit discontinued at 0.5m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314952.0571  
**NORTHING:** 6265783.412

**PIT No:** TP655  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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, sandy silty clay filling with some gravel		D/^ 500ml	0.0							
	0.4	SILTY CLAY - orange-brown, silty clay			0.4							
1	1.0	Pit discontinued at 1.0m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** Water seepage observed at 0.8m

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314964.6155  
**NORTHING:** 6265773.724

**PIT No:** TP656  
**PROJECT No:** 84335.03  
**DATE:** 27/4/2015  
**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
	0.0	FILLING - grey, silty sand filling		D/^ 500ml	0.0							
	0.1	FILLING - orange-brown, silty clay filling with trace brick		D/^ 500ml	0.1							
	0.4	SANDY CLAY - brown, sandy clay with some silt			0.4							
	0.6	SILTY CLAY - orange-brown, silty clay										
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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



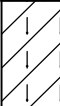
SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>l</sub>	Water level
		PID	Photo ionisation detector (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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314975.8629  
**NORTHING:** 6265766.666

**PIT No:** TP657  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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, gravelly (ripped shale, ironstone) sandy filling with some clay		D/^ 500ml	0.0							
	0.35	SILTY CLAY - brown, silty clay with some sand			0.35							
	0.65	SILTY CLAY - orange-brown, silty clay with some ironstone gravel										
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314989.9963  
**NORTHING:** 6265737.631

**PIT No:** TP658  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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 with rootlets		D/^ 500ml	0.0							
	0.2	SILTY CLAY - orange-brown, silty clay			0.2							
	0.75	Pit discontinued at 0.75m - on grey shaly clay - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314974.2962  
**NORTHING:** 6265737.361

**PIT No:** TP659  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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 with some clay and rootlets		D/A 500ml	0.0							
	0.3	SILTY CLAY - orange-brown, silty clay with trace sand			0.3							
	0.7	Pit discontinued at 0.7m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

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


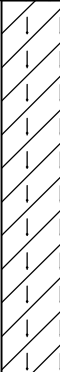
SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U <sub>s</sub>	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample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

# TEST PIT LOG

**CLIENT:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314952.8404  
**NORTHING:** 6265734.752

**PIT No:** TP660  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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 clayey sand filling with roots		D/^ 500ml	0.0							
	0.15	FILLING - brown, gravelly silty clay filling		D/^ 500ml	0.15							
	0.5	SILTY CLAY - brown mottled grey, silty clay			0.5							
1	1.0	Pit discontinued at 1.0m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>1</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314935.3179  
**NORTHING:** 6265746.78

**PIT No:** TP661  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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 with large roots, rootlets and trace shale gravel		D/A 500ml	0.0							
	0.3	FILLING - brown, silty clay with some ironstone gravel			0.3							
	0.5	SHALY CLAY - grey, shaly clay with some ironstone gravel										
	0.9	Pit discontinued at 0.9m - target depth reached										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314926.4206  
**NORTHING:** 6265782.362

**PIT No:** TP662  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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 with two large concrete pieces and rootlets		D/ <sup>^</sup> 500ml	0.0							
	0.3	SILTY CLAY - orange-brown, silty clay			0.25							
	0.7	Pit discontinued at 0.7m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>1</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314909.9371  
**NORTHING:** 6265779.223

**PIT No:** TP663  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 with trace clay and rootlets		D/ 500ml	0.0							
	0.25	SILTY CLAY - light brown, silty clay			0.25							
	0.7	SHALY CLAY - grey, shaly clay										
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314901.8314  
**NORTHING:** 6265795.18

**PIT No:** TP664  
**PROJECT No:** 84335.03  
**DATE:** 8/5/2015  
**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, sandy silty clay filling with some gravel		D/A 500ml	0.0							
	0.2	SILTY CLAY - orange-brown, silty clay			0.2							
	0.4	Pit discontinued at 0.4m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>1</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314887.1785  
**NORTHING:** 6265772.154

**PIT No:** TP665  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - grey, sandy gravel (crushed aggregate) filling		D/^ 500ml	0.0							
	0.2	FILLING - brown, silty clayey sand filling with some gravel (concrete, brick, metal)		D/^ 500ml	0.2							
	0.5	SILTY CL AY - orange-brown, silty clay			0.5							
	0.6	Pit discontinued at 0.6m - target depth reached										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314875.6673  
**NORTHING:** 6265781.313

**PIT No:** TP666  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 with slight clay and rootlets, trace gravel		D/A 500ml	0.0							
	0.3	SILTY CLAY - brown, silty clay, damp			0.3							
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>L</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314854.4754  
**NORTHING:** 6265761.177

**PIT No:** TP667  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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
	0.04	FILLING - brown, gravelly sand (crushed aggregate) filling										
		FILLING - brown, silty clayey sand filling with some gravel, fibre cement fragments and a trace of metal			0.05		ACM fragment collected					
				D/^ 500ml								
	0.35	SILTY CLAY - brown, silty clay			0.35							
1	1.0	Pit discontinued at 1.0m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>1</sub> 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314880.6395  
**NORTHING:** 6265754.628

**PIT No:** TP668  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 with some gravel and trace clay and rootlets		D/^ 500ml	0.0							
	0.4	SILTY CLAY - light brown, silty clay			0.4							
	0.8	Pit discontinued at 0.8m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314881.159  
**NORTHING:** 6265733.442

**PIT No:** TP669  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - sandy gravelly (crushed aggregate) filling		D/^ 500ml	0.0							
	0.2	FILLING - brown, silty sand filling with some gravel and brick/concrete cobbles		D/^ 500ml	0.2							
	0.6	SILTY CLAY - orange-brown, silty clay			0.6							
	0.7	Pit discontinued at 0.7m - target depth reached										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314896.3397  
**NORTHING:** 6265719.575

**PIT No:** TP670  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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
	0.0	FILLING - grey, sandy gravelly filling		D/^ 500ml	0.0							
	0.1	FILLING - brown, gravelly silty sand filling (including tile and concrete)		D/^ 500ml	0.1							
	0.3	SILTY CLAY - orange-brown, silty clay			0.3							
	0.5	Pit discontinued at 0.5m - target depth reached										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314919.6178  
**NORTHING:** 6265705.188

**PIT No:** TP671  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - grey, sandy gravel filling		D/^ 500ml	0.0							
	0.15	FILLING - brown, silty clay filling with some gravel and trace wood		D/^ 500ml	0.15							
	0.3	SILTY CLAY - orange-brown, silty clay			0.3							
	0.5	Pit discontinued at 0.5m - target depth reached										
	1											

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314940.8097  
**NORTHING:** 6265691.061

**PIT No:** TP672  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 - grey, sandy gravelly (crushed aggregate: concrete, basalt, brick, tile) filling		D/^ 500ml	0.0							
	0.15	FILLING - brown, silty clayey sand filling with some gravel		D/^ 500ml	0.15							
	0.35	SILTY CLAY - light brown, silty clay			0.35							
	0.45	Pit discontinued at 0.45m - target depth reached										

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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 <sub>s</sub>	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W <sub>s</sub>	Water seep
E	Environmental sample	W <sub>L</sub>	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:** QIC Pty Ltd  
**PROJECT:** Castle Towers Expansion Project  
**LOCATION:** Site B, Castle Hill

**SURFACE LEVEL:** --  
**EASTING:** 314957.5571  
**NORTHING:** 6265681.113

**PIT No:** TP673  
**PROJECT No:** 84335.03  
**DATE:** 17/4/2015  
**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 clayey sand filling with some gravel and whole bricks		D/A 500ml	0.0							
	0.3	SILTY CLAY - brown, silty clay			0.3							
	0.4	SHALY CLAY - grey, shaly clay										
	0.5	Pit discontinued at 0.5m - target depth reached										
1												

**RIG:** 3.5 tonne Excavator with 450mm bucket

**LOGGED:** MW

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** ^Sample type '500ml' indicates 500ml samples collected for analysis to 0.1g/kg as adopted in NEPC (2013) from WA DoH (2009)

☐ 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)