Douglas Partners
Geotechnics / Environment / Groundwater

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Report on
Preliminary Geotechnical Investigation

Proposed Industrial Subdivision
59 - 63 Abbotts Road, Kemps Creek

Prepared for
ESR Australia

Project 92352.00
August 2019

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	92352.00	Document No.	R.002.Rev0
Document title	Report on Preliminary Geotechnical Investigation Proposed Industrial Subdivision		
Site address	59 - 63 Abbotts Road, Kemps Creek		
Report prepared for	ESR Australia		
File name	92352.00.R.002.Rev0.docx		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Draft A	Konrad Schultz	Michael J Thom	30 July 2019
Revision 0	Konrad Schultz	Michael J Thom	19 August 2019

Distribution of copies

Status	Electronic	Paper	Issued to
Draft A	1	0	Riley Sampson, ESR Australia
Revision 0	1	0	Riley Sampson, ESR Australia

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		19 August 2019
Reviewer		19 August 2019

bsi. ISO 9001 Quality Management
FS 604853

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1. Introduction

This report presents the results of a preliminary geotechnical investigation undertaken prior to the purchase of the site for a proposed industrial subdivision at 59 - 63 Abbotts Road, Kemps Creek. The investigation was commissioned in an email dated 25 June 2019 by Mr Riley Sampson on behalf of ESR Australia(ESR) and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal MAC190137 dated 20 May 2019.

It is understood that if acquired the development of the site will include the creation of five near level industrial lots. The construction of the building platforms at levels in the range of RL 58 mAHD to RL 80 mAHD will require cut and fill earthworks on the site in the order of 8 m depth. Abbots Road will be extended along the northern boundary then turn south to access the two lot on the southern boundary.

The aim of the subsurface investigation was to provide preliminary information on the subsurface conditions for pre-purchase due diligence purposes and conceptual planning including:

- Subsurface conditions including groundwater if encountered;
- Likely site classification in accordance with AS 2870;
- Excavations, batter slopes and retaining wall design parameters;
- Site preparation and earthworks
- Suitable footing types and tentative design parameters for high level footings and piles;
- Flexible pavement subgrade design parameters;
- Earthquake site factor in accordance with AS 1170.4;
- Potential for soil salinity and aggressivity to buried structures; and
- Anticipated land use difficulties and potential solutions.

The investigation included borehole drilling, the excavation of test pits and in-situ testing followed by laboratory testing of selected samples. The details of the field and laboratory work are presented in this report, together with preliminary comments relating to design and construction practice.

The work was carried out in conjunction with a preliminary site investigation (PSI) for contamination with limited sampling which has been reported separately (Project 92352.00.R.001.Rev1 dated 18 July 019).

2. Site Description and Regional Geology

The site, known as Lots 11 and 12 in DP 253503, is a near triangular shape with maximum plan dimensions of some 600 m by 600 m with an area 20.3 ha. The site is accessed from the eastern end of Abbots Road and is bounded to the north, south west and partially to the east by rural lots similar to the subject site. The southern portion of the eastern boundary is bounded by residential acreages.

The site surface generally falls from east to west with the maximum height near the south eastern corner at approximately RL 93 m relative to the Australian Height Datum (AHD) falling to RL 52 mAHD near Abbots Road in the west. The topography is defined by three ridge lines running near east-west and located near the centre of the site and to the north and south. Drainage paths, each with two or three farm dams are located in the gullies either side of the central ridge. Two dams are also located near the lowest part of the site at the western boundary. The general grades near the eastern part of the site are relatively steep at up to 2.5(H):1(V) flattening to the west to about 5(H):1(V).

At the time of the investigation the site comprises rural residential and agricultural land, (pastoral and market gardens). There were three residences, a pump shed and two storage sheds with approximately two thirds of the site occupied by fields; with the majority of gardens on Lot 11 and grazing paddocks on Lot 12.

Reference to the Penrith 1:100 000 Geological Series Sheet indicated that the site is underlain by Middle Triassic Period Bringelly Shale of the Wianamatta Group. Bringelly Shale formation typically comprising shale, carbonaceous claystone, laminite, fine to medium grained lithic sandstone with some coal bands and tuff.

Reference to The Penrith 1:100 000 Soil Landscape Series Sheet indicates that the site is mostly underlain by Luddenham soils, possibly with Blacktown soils in the northwest portion.

The Luddenham Soil Landscape is an erosional soil group characterised by undulating to rolling low hills on Wianamatta Group shales and often associated with Minchinbury Sandstone. Local relief is between 50 – 80 m and slopes from 5 - 20%. Typical landscape features include narrow ridges, hillcrests and valleys. The unit comprises three soil horizons that range from shallow dark podzolic soils to massive earthy clays on crests and moderately deep red podzolic soils on upper slopes. These soils are typically moderately reactive, with a high soil erosion hazard, and localised impermeable highly plastic subsoil.

The Blacktown Soil Landscape is a residual soil group associated with the gently undulating slopes and broad rounded crests and ridges on the Wianamatta Group in the eastern part of the site. The unit comprises up to four soil horizons that range from shallow red-brown hard-setting sandy clay soils on crests and upper slopes to deep brown to yellow sand and clay soils overlying grey plastic mottled clay on mid to lower slopes. These soils are typically of low fertility, are moderately reactive and have a generally low bearing strength when wet.

3. Field Work Methods

3.1 Methods

The field work comprised a site walkover inspection by a geotechnical engineer and the excavation of 22 test pits (TP1 to TP22) and five boreholes (BH1 to BH5, with BH3 incomplete due to limited accessibility).

Most of the test pits (TP1 to TP20) were excavated using a Hyundai 60CR-9 excavator fitted with a with a 450 mm wide bucket. A grid of 11 pits were excavated across (TP1, TP6, TP8 to TP11, TP13, TP14, TP17 TP18 and TP20) for both the geotechnical investigation and PSI. These pits were excavated to depth of up to 3 m or prior refusal. For the PSI, a further nine pits (TP2 to TP5, TP7, TP12, TP15, TP16 and TP19) were excavated with the excavator at targeted locations to depths of up to 1.3 m. Two additional PSI pits (TP21 and TP22) were also excavated using hand tools to depths of up to 0.4 m.

Adjacent to the geotechnical test pit locations, dynamic cone penetrometer (DCP) tests were carried out to depths of up to 1.2 m to provide an indication of the penetration resistance of the near-surface soils.

The test pits were logged on site by a geotechnical or environmental engineer who collected disturbed and 'undisturbed' (in 50 mm diameter thin-walled tubes) for laboratory testing and to assist in strata identification. Following logging, testing and sampling, all test pits were backfilled and the ground surface reinstated to its previous level.

The boreholes were located near the high points of each lot tops of the ridges which, with rain, created difficult access conditions. To provide an information on the soil profile and an indication of the rock depth at each borehole locations, test pits were initially excavated using the excavator. Once the locations were accessible, four of the boreholes (BH1, BH2, BH4 and BH5) were drilled using a Commachio Geo 205 track mounted drilling rig and a Scout truck mounted drilling to depths of 8 m to 10.4 m. The proposed BH3 location could not be accessed by the support vehicles, hence a test pit only was excavated to the top of rock. All boreholes were advanced through the overburden soils with 150 mm spiral flight augers to refusal of the TC-bit at depths in the range 2.7 – 3 m and then continued into the rock using NMLC (50 mm diameter) diamond coring equipment to the termination depths of 5.9 m and 7.4 m.

The test pit and borehole locations were nominated by DP and located on site prior to the investigation. The surface levels to Australian Height Datum (AHD) and coordinates to Map Grid of Australia (MGA) were obtained using a differential GPS with a nominal accuracy of 0.1 m is typical and the locations are shown on Drawing 1 in Appendix A.

3.2 Results

3.2.1 Site Inspection

Relevant observations during the site walkover are summarised below:

- Virtually all the site has been previously cleared of natural vegetation primarily for use as market gardens and grazing paddocks;

- The major earthworks on the site appear to be associated with roadways, farm dams and the existing building platforms;
- The dam walls appear to have been constructed using uncontrolled clay fill won from the impoundment areas;
- no evidence of deep seated slope instability was observed on the site, however there are some localised near vertical erosion scarps in the drainage channels
- no salt efflorescence or scalding was observed.

3.2.2 Subsurface Investigation

The results of the test pit and borehole are included in the logs in Appendix A, together with notes defining classification methods and descriptive terms.

Relatively uniform conditions were encountered underlying the site with the general succession of strata broadly summarised as follows:

TOPSOIL FILL and FILL:	silty clay filling in TP1, TP2, TP3, TP5, TP16, TP16DW and TP19 to depths of up to 2.3 m (TP1) near the western residence and along the northernmost creek line including: plastic, porcelain and construction and demolition rubble (TP1); bricks (TP2), charcoal (TP3); building rubble, asbestos containing material (ACM), ceramic tiles and brick (TP16); and brick, terracotta, plastic, metal and ACM (TP19).
TOPSOIL:	silty clay with and rootlets in all test pits and boreholes with the exception of the pits detailed above, to depths in the range 0.1 – 0.6 m;
RESIDUAL SOIL:	stiff brown silty clay/clay of medium – high plasticity below topsoil and/or fill to depths of more than 2.5 m in most test pits other than TP1, TP16DW and TP19; and sandy clay to depths of greater than 3 m in TP9, TP10, TP11 and TP15 in the south east and east of the site.
BEDROCK:	initially very low to low strength weathered shale, siltstone and sandstone in Pits TP6, TP8 TP10. TP13 and TP20, and boreholes BH1, BH2, BH3, BH4, and BH5, from depths of 0.7 m. The rock generally increased in strength with depth to medium or high strength, with variable strength layers of extremely low to low strength. In BH 4 was typically low strength with some medium or high strength layers

Perched groundwater was observed in TP1 at 2.2 m depth and contained a nutrient ‘sewage’ like odour. With the exception of TP1, no free groundwater was observed in the pits or boreholes during excavation for the short time that they were left open. It is noted, however, that the pits and boreholes were immediately backfilled following excavation which precluded longer term assessment of any permanent groundwater that might be present. Groundwater levels are affected by factors such as soil site works and weather conditions and will vary with time.

4. Laboratory Testing

Four bulk samples were tested in the laboratory for measurement of field moisture content, compaction properties and California bearing ratio (CBR). The CBR tests were carried out on samples compacted to approximately 100% dry density ratio relative to Standard compaction at standard optimum moisture content. The samples were then soaked for four days under surcharge loadings of 4.5 kg. The detailed laboratory test report sheets are given in Appendix B, with the results summarised in Table 1.

Table 1: Results of CBR Testing

Test No	Depth (m)	FMC (%)	OMC (%)	MDD (t/m^3)	Swell (%)	CBR (%)	Material
TP6	0.5	26.8	26.0	1.55	0.5	5.0	Silty Clay
TP11	0.5	18.3	20.5	1.68	1.0	5.0	Silty Clay
TP17	0.5	11.7	13.5	1.89	2.0	2.0	Silty Clay
TP20	0.5	13.9	17.0	1.78	2.0	4.0	Silty Clay

Where FMC = Field moisture content OMC = Optimum moisture content
MDD = Maximum dry density

The results of the field moisture content tests indicate the soil samples ranged between approximately 0.8% wet to 3.1% dry of Standard optimum moisture content (SOMC).

Disturbed samples were tested for measurement of plasticity, moisture content and dispersion. The detailed laboratory test report sheets are given in Appendix B, with the results summarised in Table 2.

Table 2: Results of Plasticity and Dispersion Testing

Test No	Depth (m)	LL (%)	PL (%)	PI (%)	LS (%)	ECN	Material
TP6	0.5	-	-	-	-	3	Silty Clay
TP17	0.5	67	24	43	17.0	-	Silty Clay
TP17	1.5	-	-	-	-	2	Silty Clay
BH1	0.5	57	22	35	14.5	-	Silty Clay
BH2	0.5	61	23	38	16.0	-	Silty Clay
BH4	0.5	62	25	37	16.5	-	Silty Clay
BH5	0.5	62	22	40	16.5	-	Silty Clay

Where LL = Liquid limit PL = Plastic limit PI = Plasticity Index LS = Linear shrinkage
ECN = Emerson Class number

The test results indicate that the natural clays are of high plasticity and as such, would be susceptible to shrinkage and swelling with changes in soil moisture content. The results of the Emerson crumb tests indicate that the soils tested are dispersive.

'Undisturbed' samples were recovered for measurement of field moisture content and Shrink-swell Index. The detailed laboratory test report sheets are given in Appendix B, with the results summarised in Table 3.

Table 3: Results of Shrink Swell Testing

Test No	Depth (m)	Iss (%/ΔpF)	Material
TP6	0.5	2.9	Silty Clay
TP11	0.4	2.5	Silty Clay
TP20	0.5	0.6	Silty Clay

Where Iss = Shrink-swell Index

The Shrink-swell Index (Iss) test results also indicate that the natural clays are of moderate shrink-swell potential.

4.1 Aggressivity

Samples from the test pits were also tested in the laboratory for determination of aggressivity to concrete and steel. The detailed laboratory test report sheets are given in Appendix B and summarised in Table 4.

Table 4: Results of Laboratory Testing – Chemical

Test No	Depth (m)	pH	Electrical Conductivity (µS/cm)	Chlorides (%)	Sulfates (%)	Material
TP6	0.5	7.2	75	-	-	Silty Clay
TP10	1.5	6.7	210	160	90	Silty Clay
TP13	2.5	5.9	230	-	-	Silty Clay
TP17	1.5	8.2	260	-	-	Silty Clay
TP20	3.0	8.1	590	610	28	Sandstone

The results for clay rich soils above the water table (exposure classification B) indicate that samples ere non aggressive for concrete piles and non-aggressive to mildly aggressive for steel piles.

5. Proposed Development

It is understood that the site will be developed for commercial or industrial purposes. Preliminary concept master plans indicate that the proposed development will likely include five warehouse structures constructed on separate building platforms. Based on the information provided, excavation and filling to maximum depths of 8 m respectively will required to create a series of near-level benches

ranging from RL58 mAHD to RL80 mAHD. Although detailed design is yet to be undertaken, similar developments have required advice regarding earthworks, foundations, retaining walls and pavements.

Due to the aim of this investigation is for 'due-diligence' purposed prior to purchase, the information must be considered as being preliminary in nature. As conceptual designs proceed, it is recommended that DP reassesses the designs with respect to the information given within this report to determine if revisions or additional investigations are required.

6. Comments

6.1 General

The following comments are based on the surface and subsurface profiles encountered in the test locations. Comments are provided in the following sections on development constraints related to geotechnical and geological factors to assist in the conceptual planning and design of the proposed subdivision. Notwithstanding this, further investigation, analysis and reporting will be required as conceptual planning and development of the subdivision and specific proposal on each allotment progresses.

6.2 Geotechnical Model

Based on the results of the investigation, the inferred subsurface geotechnical model underlying the site comprises:

- localised FILL to depths of greater than 2 m over parts of the site, primarily dam walls , building platforms , roads and landfill;
- TOPSOIL typically to depths in the range 0.1 – 0.6 m;
- residual CLAY, typically of stiff to hard consistency, to depths in the range 0.1 to greater than 3.0 m;
- bedrock (siltstone, shale and sandstone) initially very low to low strength becoming low to high strength with depth, although with variable strength layers.
- Perched groundwater at a depth of 2.2 m in Pit TP1 during excavation possibly being controlled by the nearby dams.

6.3 Site Classification

Classification of individual allotments within the site (if required) should comply with the requirements of AS2870:2011 Residential Slabs and Footings. Based on the subsurface conditions encountered and previous experience in similar geological settings, the subsurface profiles would most likely range from Class M (moderately reactive) to H1 (highly reactive), with the final classifications dependent on fill quality, fill depth, soil reactivity, soil strength and rock depth.

It is noted however, that the classification is appropriate for the undeveloped site and is independent of proposed development. Furthermore, reference to Clause 3.1.1 of the Code indicates that the footing details given are not appropriate for buildings longer than 25 m and as such the classifications above

are indicative only. The main requirement for this project therefore, is for design to be undertaken by a suitably qualified engineer using appropriate engineering principles which take into consideration the site conditions.

The site would currently be classified as Class P due to the presence of uncontrolled filling deeper than 0.4 m (in parts). It must be noted that to allow for reclassification of filling from Class P to conventional classifications, all filling must be undertaken under Level 1 control.

6.4 Earthworks

6.4.1 Excavation

All topsoil, uncontrolled filling, natural soils and bedrock up to very low to low strength should be readily removed using an elevating scraper or a conventional medium sized excavator with a toothed bucket with some light ripping, or a D6 or equivalent dozer.

Medium strength rock and possibly higher strength rock, is expected in the areas of deepest cut in the eastern section of the site, will require, as a minimum a D9 or equivalent dozer with some heavy ripping. However, larger plant may provide greater excavation efficiency. Pneumatic assistance will be required for detailed excavation (such as footings and service trenches).

Anticipated plant required for rock removal is given as a guide only as excavatability depends on the size of the plant and the skills of the operator, as well as the rock strength and the degree of jointing.

Vibration issues may become a concern where excavation is undertaken within 20 m of neighbouring structures (such as along the southern boundary), the northern boundary. However, this will need to be determined once the details of the proposed excavations and equipment are known.

Reference must be made to the individual logs which are included in Appendix A. The contractor must make its own assessment of excavation conditions as the information given on the test pit logs are preliminary only. Additional investigation may be required as the design of the subdivision progress.

6.4.2 Site Preparation

To prepare the site for the proposed commercial/industrial lots and pavements, the following procedures are suggested:

- Strip vegetation and organic topsoil and uncontrolled filling (including existing dwelling platforms). The organic topsoil could be separately stockpiled for use in landscaping or removed off site. Clay fill free of deleterious material would be re-used subject to geotechnical inspection and environmental protocols;
- Compact of the exposed surface with at least 6 passes of a 12 tonne (minimum dead weight) roller, followed by test rolling in the presence of a geotechnical engineer;
- Soft or unstable areas that are identified during test rolling should generally be treated by excavation to a stiff stratum and replaced with engineered fill (refer Section 6.3.5). If this exceeds 500 mm, a bridging layer may be required; and

- Site drainage should be maintained at all times by adopting appropriate cross-falls within the site. Surface drainage should be installed as soon as is practicable in order to capture and remove surface flows to prevent erosion and softening of the exposed soils and weathered bedrock.

Any filling delivered to site must be approved by the geotechnical and environmental consultant before use.

Site observations have indicated low lying areas susceptible to water logging and subsurface material predominantly consists of silty clays which could potentially be affected by inclement weather and result in difficult trafficability conditions. As a result, surface drainage that directs runoff away from work areas should be installed prior to construction, possibly in conjunction with the designation of construction equipment haul routes to minimise trafficking of stripped areas.

Conventional sediment and erosion control measures should be implemented during the earthworks operation, with final surfaces to be topsoiled and vegetated as soon as practicable following the completion of earthworks.

6.4.3 Desilting of Farm Dams

The existing farm dams will need to be drained and filled to design level. The following general procedure is recommended:

- Pump out existing water across land at a minimum distance of 50 m from any existing waterways;
- Strip all vegetation and other deleterious material (such as saturated silt and clay) to expose the underlying stiff clay/weathered rock;
- Excavate the existing uncontrolled filling from the dam wall;
- Bench the exposed surface to facilitate near-horizontal fill placement;
- Test roll the surface to receive filling with six passes of a 12 tonne dead weight roller operating in static mode, with final pass undertaken in the presence of a geotechnical engineer in order to identify areas requiring remedial work;
- Place and compact approved filling as per Section 6.3.5;
- Saturated ‘organic’ soils from the pond base can be spread out and dried. Once dried the material can be blended with stockpiled topsoils and spread across the finished surface of lots;
- Any saturated ‘non-organic’ soils can be spread out and dried. Once moisture conditioned the materials can be reused as engineered filling (refer Section 6.3.5) subject to inspection and approval.

Prior to discharging, an assessment of the pond water should be undertaken to confirm the suitability of the above disposal method, particularly with regard to erosion. The assessment should include (as a minimum) pH and turbidity testing to in accordance with Penrith City Council requirements.

6.4.4 Reuse of Excavated Materials

Generally, the majority of natural soils and clayey filling encountered during the investigation will be suitable for reuse as engineered filling within the site provided that any pre–treatment (moisture conditioning, removal of oversize and deleterious material etc), is carried out prior to fill placement. The

material should not contain any particle sizes greater than 150 mm as these may cause inadequate compaction. It is expected that bedrock of very low strength or less should breakdown to a suitable size beneath the construction plant used for placement. Low and higher strength rock will require the use of a crushing plant to create a homogeneous material appropriate for compaction.
Consideration should be given to the high dispersion potential of the clay soils. Care should be exercised to ensure dispersive soils are covered with a layer of topsoil.

Regarding reuse of existing filling, reference should be made to DP's preliminary site investigation for contamination (Project 92352.00.R.001.Rev1).

6.4.5 Engineered Fill

Controlled fill for support of structures should be placed in near-horizontal layers of maximum loose thickness of 250 mm and compacted to minimum density ratio of 98% relative to Standard maximum dry density (SMDD) with a moisture content within 2% Standard optimum moisture content.

Earthworks quality control inspections and testing must be carried out to confirm the placement of filling to the required standard and in accordance with AS 3798:2007 Guidelines on Earthworks for Commercial and Residential Developments.

Where filling is placed as pavement subgrade, the upper 0.5 m depth of fill (ie: to subgrade level) must be compacted to a density ratio of at least 100% relative to SMDD with a moisture content within 2% Standard optimum moisture content.

During wet weather or if the site is to be left unattended for an extended period, the upper surfaces of fill should be crowned and if possible blinded by smooth wheeled plant. Any stockpiles should be blinded to allow water to run off.

Where building construction is delayed following completion of earthworks, the allotments will need to be revegetated promptly in order to minimise the effects of erosion and to prevent drying of the site soils.. A minimum topsoil thickness of 100 mm is suggested. Alternatively, the subgrades are to be tyned, moisture conditioned and re-compacted immediately before building construction. The allotments must also be graded to a minimum of 1% to prevent ponding.

6.4.6 Batter Slopes

While cut slopes within the stiff clays may often stand vertically unsupported (provided no nearby structures are present) for short periods of time, they will rapidly lose strength upon exposure to weather. A maximum batter slope of 2(H):1(V) is recommended for permanent slopes in stiff clays and temporary slopes (with no surcharge) in filling, provided that the slopes are no more than 4 m in height and they are protected against surface erosion and local slumping.

Where the slopes are to be vegetated and maintained to prevent erosion, a maximum batter slope of 3(H):1(V) is recommended. It should be noted, however, that Council may require slopes of the order of 4(H):1(V).

If batters greater than 4 m in height are required, the inclusion of a 3 m wide intermediate bench every 4 m in vertical height is recommended to reduce the effects of scour and erosion. Detailed slope stability analysis would be required for batters over 4 m in height

Where filling batters are formed, similar parameters to those recommended for cut slopes can be adopted. However, it is recommended that whilst the slope is being formed the batters should be over-filled in near-horizontal lifts and cut back to form the design grades.
All other excavations and fill should be supported by engineer-designed retaining walls.

6.4.7 Geotechnical Inspections and Testing

It is recommended that the site be inspected by a geotechnical engineer following stripping of vegetation, topsoils and uncontrolled filling and during the test rolling undertaken prior to the placement of filling. Geotechnical testing should be carried out in accordance with AS 3798:2007 (Standards Australia, 2007). As a minimum, placement of filling on future lots should be to a Level 1 standard as described in AS:3798 whilst Level 2 standard is considered appropriate for pavement construction and backfilling of service trenches, unless otherwise specified by the designer. It is also recommended that the Geotechnical Inspection and Testing Authority (GITA) should be engaged directly on behalf of the Principal and not by the earthworks contractor.

6.5 Retaining Walls

Where engineer-designed retaining walls are proposed, the following measures should be incorporated into the design:

- Backfilling of the void between the wall and the slope using imported, free draining granular material connected into a drainage pipe at the base of the wall;
- Capping of the backfill (where exposed) with compacted clay or concrete to prevent surface runoff entering the backfill;
- Provision of an open drain to collect and divert surface runoff from ponding above the wall;
- For horizontal backfill or retained soils, design based on an average bulk unit weight for retained material of 20 kN/m^3 and on a triangular earth pressure distribution based on an active earth pressure coefficient of (Ka) 0.3 for compacted filling and natural clay where no movement sensitive structures are located within a horizontal distance of 2H (where H is the vertical height of the retained zone) of the rear of the wall; and
- Where there are movement sensitive structures located within the abovementioned critical zone, an at rest pressure coefficient (K_0) of 0.6 should be adopted.

If a drainage medium is not provided behind the retaining wall, then hydrostatic pressures must be incorporated within the design and soil densities must be reduced to the buoyant values.

6.6 Footings

Design of footings for proposed structures can only be undertaken once detailed investigation has been undertaken. As a guide however and based on the results of the subsurface investigation and the range of soils encountered, preliminary footing design could be based on the parameters presented in Table 5.

Table 5: Preliminary Footing Design Parameters

Material	Allowable Base Bearing Pressures (kPa)
Stiff clay or controlled filling	150
Very stiff to hard clays or stronger	200 – 250
Very low strength rock	500
Low to medium strength rock	1200

Footings on clay will likely only be feasible for column loads up to, say, 400 kN. As a guide, settlements under column loads of 400 kPa would be in the range 5 – 10 mm. Notwithstanding this, due to large footprints of the proposed warehouses and the variable subgrade conditions that will probably occur following site works (that could include weathered rock through residual clays and controlled filling), consideration must be given to differential movements that would result. In this regard, differential settlements could approach the total estimated settlements.

If estimated settlements are beyond tolerable limits or higher loads are proposed, footings-to-rock systems would be required. The principal advantage of footings-to-rock systems would be that settlements (both total and differential) will be minimal.

6.7 Pavements

6.7.1 Preliminary Pavement Thicknesses

Based on the results of laboratory testing and previous experience in the area, it is expected that most of the clay subgrades will generally comprise clays with CBR values in the range of 2 – 5%. A CBR value of 7% could be adopted for rock subgrades.

Where weak clay subgrades with a CBR 2% or below (such as near Pit TP17), subgrade improvement in the form of lime stabilisation or replacement with a select material such as crushed rock (CBR of at least 15%) will be required. As an example, where material with CBR of 2% is encountered at subgrade level, an effective design CBR of 4% may be achieve by liming or subgrade replacement to a depth of 300 mm. In addition to localised subgrade improvement required where weak subgrades are encountered, overall pavement thickness design may be optimised by the inclusion of a select subgrade following detailed subgrade investigation.

The preliminary flexible pavement thickness designs given in Table 6 are based on the design traffic loading requirements of Penrith Council, Austroads – 2018 and a range of likely CBR values. Additional investigations, sampling and laboratory testing will need to be undertaken at the appropriate time to provide a final pavement thickness design.

Table 6: Preliminary Flexible Pavement Thickness Design

Road	Traffic Loading (ESA)[1]	Design CBR[2] (%)	Total Granular Pavement Thickness (mm)[3]
Industrial	5×10^6	2	745
		4	520
		7	380
Heavy Industrial	1×10^7	2	790
		4	555
		7	405

Notes: (1) To be confirmed by Council prior to construction;
(2) Indicative CBR values, need to be confirmed by further investigation at the completion of earthworks;
(3) Excluding wearing course thickness

Notwithstanding the above, detailed subgrade investigation should be undertaken prior to pavement construction in order to provide optimised subgrade strength and design parameters.

6.7.2 Materials and Compaction

Suggested material quality and compaction requirements are given in Table 7 (following page).

Whilst the use of lesser quality pavement materials than that detailed in Table 7 may be feasible, some compromise in either performance and/or pavement life must be anticipated and accepted.

The pavements should be placed and compacted in layers no thicker than 150 mm, with control exercised over placement moisture contents. If layer thicknesses greater than 150 mm are proposed, it may be necessary to test the top and bottom of the layer to ensure that the minimum level of compaction has been achieved through the layer.

Table 7: Pavement Material Quality and Compaction

Layer	Material Quality	Minimum Compaction
Wearing Course	To conform to Austroads requirements	To conform to Austroads requirements
Base Course	To conform to Austroads requirements Soaked CBR > 80%, PI < 6%	Minimum dry density ratio of 98% Modified (AS 1289 Test 5.2.1)
Sub-base Course	To conform to APRG requirements Soaked CBR > 50%, PI < 12%	Minimum dry density ratio of 95% Modified (AS 1289 Test 5.2.1)
Subgrade Replacement	Soaked CBR > 15%	Minimum dry density ratio of 100% Standard (AS 1289 Test 5.1.1)
Subgrade	-	Minimum dry density ratio of 100% Standard (AS 1289 Test 5.1.1)

Where: PI = Plasticity Index
CBR = California bearing ratio

Whilst the use of lesser quality pavement materials than that detailed in Table 7 may be feasible, some compromise in either performance and/or pavement life must be anticipated and accepted.

The pavements should be placed and compacted in layers no thicker than 150 mm, with control exercised over placement moisture contents. If layer thicknesses greater than 150 mm are proposed, it may be necessary to test the top and bottom of the layer to ensure that the minimum level of compaction has been achieved through the layer.

6.7.3 Pavement Drainage

Surface and subsurface drainage should be provided to prevent moisture ingress into the pavement materials. It is suggested that subsurface drains, constructed with an invert level at least 0.5 m below subgrade level. As a minimum, subsurface drainage should be incorporated along the cut sides of all roads, on both sides of roads with minimal grade and around both sides of all intersections. This aspect and the need for additional subsurface drainage should be reviewed on site during construction and should take into consideration the significance of other engineered drainage work proposed for the project. Guidelines on the arrangements of subsurface drainage are given on Page 20 of ARRB – SR41 (ARRB, 1989). It should be noted that if the sub-base is of lower permeability relative to the base layer, then the subsurface drain should intersect all pavement layers as shown in ARRB – SR41.

Additional subsurface drainage may also be required within development lots in footslope locations abutting where water logging forms a constraint to development. Within these areas, filling and/or deep drainage is likely to be required to permit trafficability during construction and subsequent lot development.

Erosion and sedimentation control measures should be installed maintained for the duration of the construction. Furthermore, adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding except where ponding forms part of a planned erosion and sedimentation control system.

6.8 Seismic Classification

When assessed in accordance with AS 1170.4 - 2007 Structural design actions Part 4: Earthquake Actions in Australia', the depth of soil (>3 m) suggests a classification of Ce – Shallow soil is appropriate. As extensive cut and fill construction is likely at may be feasible to isolate parts of the site with shallow rock to areas with a lower classification.

6.9 Aggressivity to Buried Structures and Soil Salinity

The results of the testing suggest that the site soils will be non-aggressive to mildly aggressive to buried steel and concrete structural elements. The results also suggest that some saline soils, typical of the area, will be present on the site and additional investigation and testing will be required during the detailed design phase.

7. Summary

The report presents the findings of preliminary due-diligence investigation for a proposed new industrial subdivision. The preliminary geotechnical assessment has indicated that the site is geotechnically suitable for the proposed development.

The geotechnical investigation undertaken to date has indicated that most of the site will be suitable for commercial/industrial development, with comments given on geotechnical limitations, development guidelines, likely site classification, stability considerations and indicative pavement thicknesses. Conceptual comments on design and construction aspects are also given in the report.

Detailed geotechnical investigation and assessment will be required as the design of the development proceeds and as such, this report must be considered as being preliminary in nature. Specific geotechnical investigation would include (but not necessarily be limited to):

- Detailed salinity investigation and management plan;
- Detailed geotechnical investigations for determination of pavement thickness design and individual building construction.
- Routine inspections and earthworks monitoring during construction;

8. References

AS 3798:2007 Guidelines on Earthworks for Commercial and Residential Developments (Standards Australia, 2007).

AS 2870:2011 Residential Slabs and Footings (Standards Australia, 2007).

Australian Road Research Board (1989), A Structural Design Guide for Flexible Residential Street Pavements, Special Report No 41.

AUSTROADS (2018), "Guide to Pavement Technology – Part 2: Pavement Structural Design".

NSW Department of Minerals and Energy (1991), Geology of 1:100 000 Penrith Geological Series Sheet 9030 (Edition 1)

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 59-63 Abbotts Road Kemps Creek in accordance with DP's proposal dated MAC190137 dated 20 May 2019 and emailed acceptance received from ESR Australia dated 27 June 2019. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of ESR Australia for this project only and for the purposes as described in the report. It should not be used for other projects or purposes 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.

This report must be read in conjunction with all of the attachments 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 scope for work for this report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site, however the work was carried out in conjunction with a PSI and reference should be made to that report for guidance on the contamination status of the site.

Asbestos has been detected by observation and by laboratory analysis in filling materials at a test location sampled and analysed. Building demolition materials, such as concrete, brick, tile etc were located in previous below-ground filling and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

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 [where appropriate], or to vegetation preventing visual inspection and reasonable access [where appropriate]. It is therefore considered possible that HBM, 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.

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 the Comments section of 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.

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Appendix A

About This Report
Results of Field Work
Drawing 1

About this Report

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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.

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

Sampling Methods

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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

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 generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. 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	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

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

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

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
Friable	Fr	-

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	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

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;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it 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 Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

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

* 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
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

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 occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or stronger. 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_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

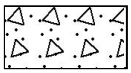
Symbols & Abbreviations

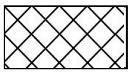
Graphic Symbols for Soil and Rock

General

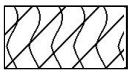

Asphalt

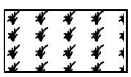

Road base

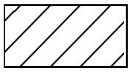

Concrete

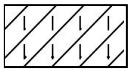

Filling

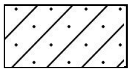
Soils


Topsoil

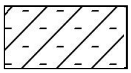

Peat

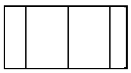

Clay

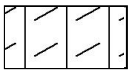

Silty clay

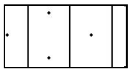

Sandy clay

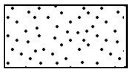

Gravelly clay

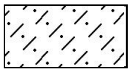

Shaly clay

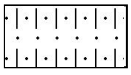

Silt


Clayey silt


Sandy silt

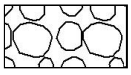

Sand

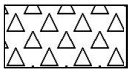

Clayey sand


Silty sand


Gravel

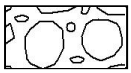

Sandy gravel


Cobbles, boulders

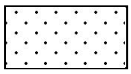

Talus

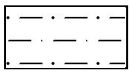
Sedimentary Rocks

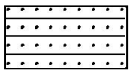

Boulder conglomerate

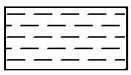

Conglomerate


Conglomeratic sandstone

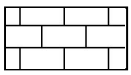

Sandstone


Siltstone

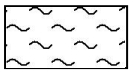

Laminite

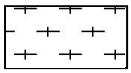

Mudstone, claystone, shale

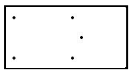

Coal


Limestone

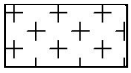
Metamorphic Rocks

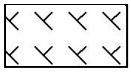

Slate, phyllite, schist

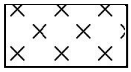

Gneiss

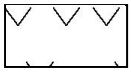

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 54.3 mAHD
EASTING: 296168
NORTHING: 6251420

PIT No: TP1
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
54	0.1	TOPSOIL - dark brown silty clay with rootlets and a trace of terracotta (fill)		D/E	0.1		PID<1		
	0.4	FILL - red and grey clay with a trace of rootlets		D/E/B	0.5		PID<1		
53	1	FILL - brown silty clay with a trace of domestic refuse comprising plastic and porcelain and building rubble comprising bricks and terracotta		D/E	1.0		PID<1		
					1.5		PID<1		
	2				2.0		PID<1		
52	2.3	- becoming grey, domestic and building refuse comprising, timber, plastic and bricks, strong organic/sewage odour, MC>LL at 2.2m		D*	2.3		PID<1	01-07-19	
		Pit discontinued at 2.3m - refusal on building rubble and pit collapsing							
51	3								
50	4								
49	5								
48	6								
47	7								
46	8								
45	9								
44	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: Perched groundwater observed at 2.2m

REMARKS: * Replicate sample BD3/010719 collected; Prior tip site; MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 57.6 mAHD
EASTING: 296214
NORTHING: 6251379

PIT No: TP2
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
57	0.01	TOPSOIL - dark brown clayey silt with rootlets		D	0.1				
	0.4	FILL - brown silty clay with gravel and bricks, MC<PL		D	0.5				
	0.8	SILTY CLAY - very stiff, orange brown silty clay with a trace of small ironstone gravel, MC<PL							
56	1	Pit discontinued at 0.8m - limit of investigation							
55	2								
54	3								
53	4								
52	5								
51	6								
50	7								
49	8								
48	9								
47	10								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 57.6 mAHD
EASTING: 296191
NORTHING: 6251365

PIT No: TP3
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
57	0.1	TOPSOIL - brown silty clay with rootlets and a trace of plastic		E	0.05				
	0.6	FILL - brown, orange and red silty clay with charcoal, MC<PL		D	0.5				
	0.9	SILTY CLAY - very stiff, pale orange mottled pale grey silty clay, MC<PL		D	0.8				
56	1	Pit discontinued at 0.9m - limit of investigation							
55	2								
54	3								
53	4								
52	5								
51	6								
50	7								
49	8								
48	9								
47	10								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 58.6 mAHD
EASTING: 296224
NORTHING: 6251341

PIT No: TP4
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
58	0.1	TOPSOIL - dark brown silty clay with rootlets		D	0.1				
		SILTY CLAY - firm, pale orange mottled grey silty clay, MC<PL		D	0.5				
		- becoming brown mottled grey, extremely weathered with fine grained brown and grey sandstone gravel		D	0.9				
	1.0	Pit discontinued at 1.0m - limit of investigation							

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Test pit excavated over fence due to access, appears to have been cut to make lot flat; MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 58.1 mAHD
EASTING: 296245
NORTHING: 6251373

PIT No: TP5
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
58	0.05	TOPSOIL - dark brown silty clay with rootlets		D	0.1				
	0.25	FILL - brown and orange silty clay, MC~PL (reworked natural)		D	0.5				
	0.7	SILTY CLAY - stiff, brown mottled orange silty clay with a trace of rootlets, MC~PL							
57	1	Pit discontinued at 0.7m - limit of investigation							
56	2								
55	3								
54	4								
53	5								
52	6								
51	7								
50	8								
49	9								
48	10								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 67.1 mAHD
EASTING: 296396
NORTHING: 6251335

PIT No: TP6
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
67	0.3	TOPSOIL - dark brown clayey silt with a trace of plastic and rootlets to 0.1m		D/E	0.1				
		SILTY CLAY - soft, orange brown silty clay, MC~PL		D/E/U.B	0.5				
	0.8	CLAY - firm, light brown mottled grey clay with a trace of sandstone gravel and rootlets, MC~PL		D/E	1.0				
66	1			D/E	1.5				
	1.7	CLAY - stiff, light grey mottled grey and light orange brown clay with fine grained sand and a trace of sandstone gravel, MC<PL (extremely weathered)							
65	2								
	2.2	SANDSTONE - low strength, highly weathered, brown, dark brown and grey fine grained sandstone		D/E	2.2				
		Pit discontinued at 2.2m - limit of investigation							
64	3								
63	4								
62	5								
61	6								
60	7								
59	8								
58	9								
57	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 60.6 mAHD
EASTING: 296341
NORTHING: 6251199

PIT No: TP7
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
60.6	0.3	TOPSOIL - grey brown silty clay with rootlets to 0.1m		D*	0.1		PID<1		
		SILTY CLAY - firm, orange mottled pale brown silty clay, MC~PL		D	0.5		PID<1		
59.6	1.0	Pit discontinued at 1.0m - limit of investigation							

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Replicate sample BD2/020719 collected; Stagnant water on surface; MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 68.4 mAHD
EASTING: 296474
NORTHING: 6251161

PIT No: TP8
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
68	0.3	TOPSOIL - very dark brown silty clay with rootlets to 0.1m, MC~PL		D/E	0.1				
		SILTY CLAY - firm, orange brown mottled pale brown silty clay with a trace of rootlets, MC~PL		D/E	0.5				
67	1	- becoming pale orange brown mottled pale grey below 0.8m		D/E	1.0				
		- becoming stiff, grey mottled orange brown, MC<PL (extremely weathered) below 1.3m		D/E	1.5				
	1.8	SILTSTONE - low strength, highly weathered, dark grey, orange and brown siltstone with a trace of fine grained sand		D/E	2.0				
66	2.5	Pit discontinued at 2.5m - limit of investigation		D/E	2.5				
65	3								
64	4								
63	5								
62	6								
61	7								
60	8								
59	9								
58	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 67.9 mAHD
EASTING: 296463
NORTHING: 6251099

PIT No: TP9
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
67	0.0	TOPSOIL - dark grey brown silty clay with rootlets to 0.2m		D/E	0.1				
				D/E U_{50}	0.5				
	0.6	SILTY CLAY - stiff, orange brown mottled grey silty clay with a trace of ironstone gravel, MC<PL							
	1			D/E/B	1.0				
66				D/E	1.5				
	2	- becoming very stiff, grey mottled red, MC<PL		D/E	2.0				
	2.3	SANDY CLAY - stiff, brown mottled grey fine grained sandy clay with low strength sandstone gravel layers, MC<PL (extremely weathered sandstone)		D/E	2.5				
65	3			D/E	3.0				
	3.0	Pit discontinued at 3.0m - limit of investigation							
64	4								
63	5								
62	6								
61	7								
60	8								
59	9								
58	10								
57									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 77.3 mAHD
EASTING: 296635
NORTHING: 6251043

PIT No: TP10
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
77	0	TOPSOIL - dark brown clayey silt with rootlets to 0.15m		D/E	0.1				
				D/E	0.5				
	0.6	SILTY CLAY - stiff, brown silty clay with a trace of rootlets, MC<PL							
76	1			D/E	1.0				
		- becoming very stiff, pale orange and pale grey below 1.3m		D/E	1.5				
	1.9								
	2	SANDY CLAY - hard, grey mottled orange fine grained sandy clay, MC<PL (extremely weathered sandstone)							
75	2.1			D/E	2.2				
	2.2	SANDSTONE - low to medium strenth, weathered, dark grey, orange and brown fine grained sandstone							
		Pit discontinued at 2.2m - refusal on low to medium strength sandstone							
74	3								
73	4								
72	5								
71	6								
70	7								
69	8								
68	9								
67	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 74.5 mAHD
EASTING: 296616
NORTHING: 6251131

PIT No: TP11
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
74	0.0	TOPSOIL - dark brown clayey silt with rootlets to 0.2m		D/E	0.1				
				U_{50}	0.4				
	0.5	SILTY CLAY - firm, brown and red silty clay with a trace of small ironstone gravel, MC<PL		D/E/B	0.5				
	0.8	SILTY CLAY - firm, pale red mottled pale brown silty clay with a trace of ironstone gravel and fine grained sand, MC<PL		D/E/B	1.0				
73	1			D/E	1.5				
	2			D/E	2.0				
	2.3	SANDY CLAY - firm, pale grey and pale orange fine grained sandy clay, MC~PL		D/E	2.5				
72	2.8	SILTY CLAY - soft, grey mottled brown silty clay, MC~PL (extremely weathered)		D/E	3.0				
	3	Pit discontinued at 3.0m - limit of investigation							
71	4								
70	5								
69	6								
68	7								
67	8								
66	9								
65	10								
64									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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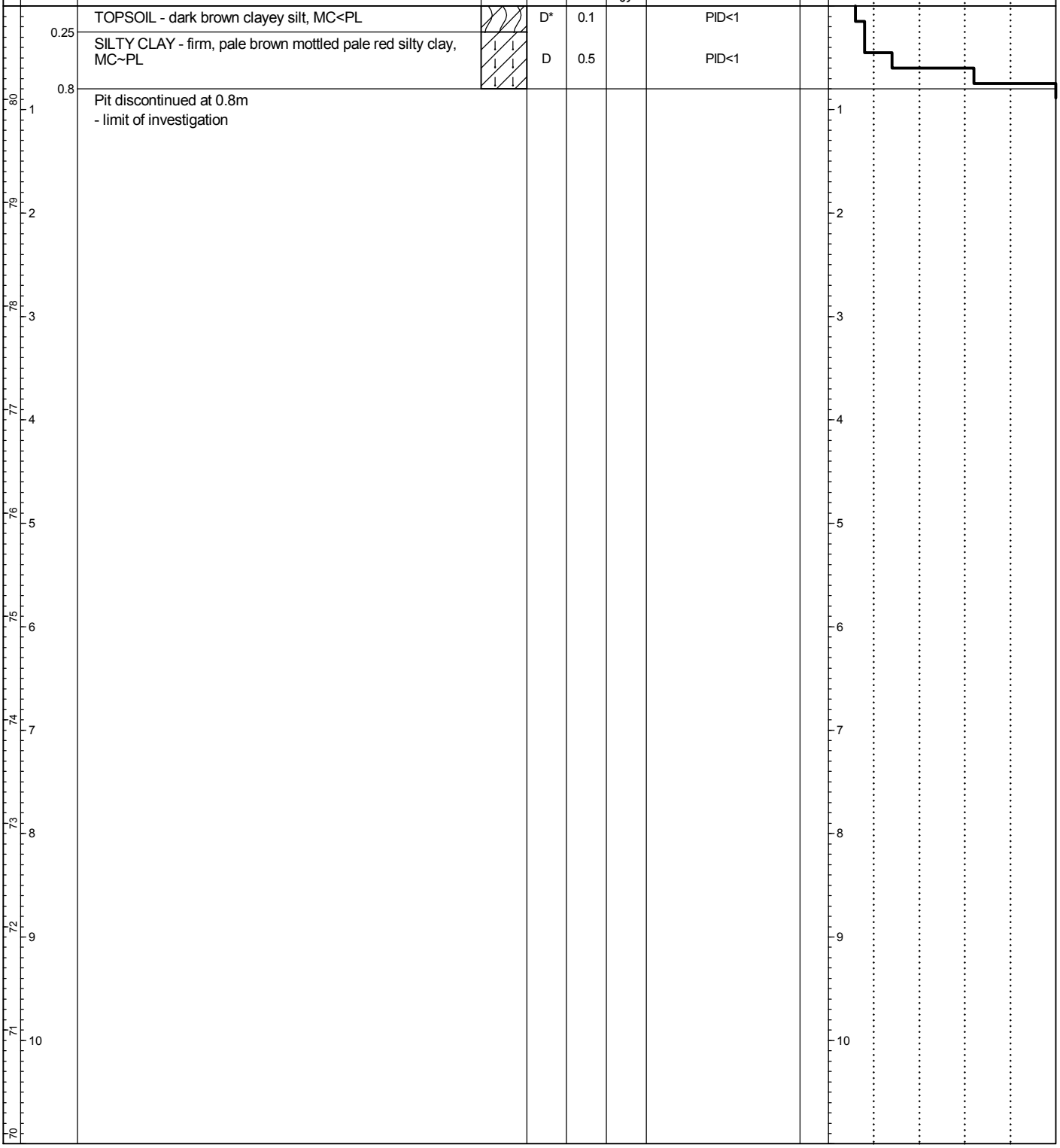
TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 80.9 mAHD
EASTING: 296508
NORTHING: 6251231

PIT No: TP12
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
80.9	0.25	TOPSOIL - dark brown clayey silt, MC<PL		D*	0.1		PID<1		
		SILTY CLAY - firm, pale brown mottled pale red silty clay, MC~PL		D	0.5		PID<1		
80.1	0.8	Pit discontinued at 0.8m - limit of investigation							



RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Replicate sample BD1/020719 collected; MC = moisture content; PL = plastic limit

☐ 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_x	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)

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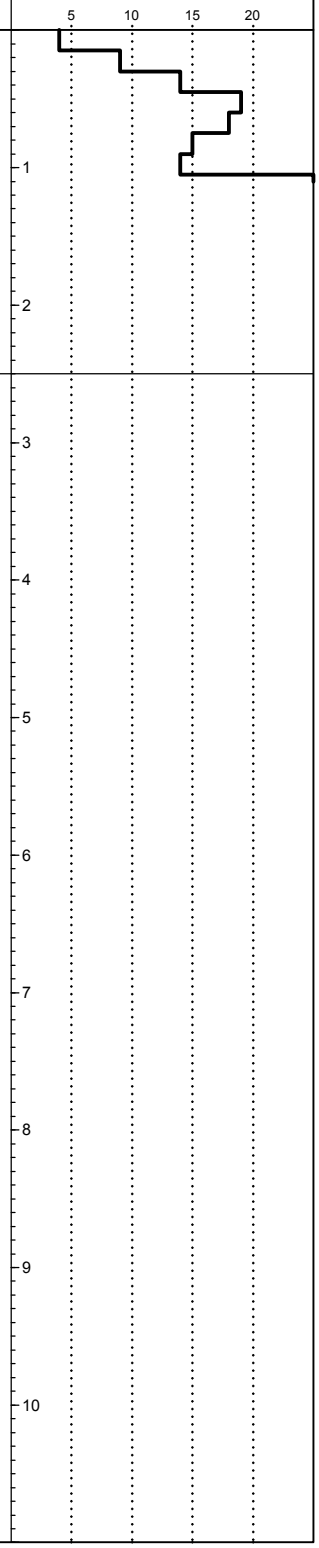
TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 76.4 mAHD
EASTING: 296661
NORTHING: 6251324

PIT No: TP13
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
76	0.2	TOPSOIL - dark brown clayey silt with rootlets		D/E	0.1				
		SILTY CLAY - hard, red brown silty clay with a trace of ironstone gravel and rootlets, MC<PL		D/E	0.5				
	0.7	SILTY CLAY - brown and grey with brown and dark grey fine grained sandstone gravel, MC<PL (extremely weathered)		D/E	1.0				
75	1			D/E	1.5				
	2			D/E	2.0				
74	2.5	Pit discontinued at 2.5m - refusal on low strength sandstone gravel		D/E	2.5				
73	3								
72	4								
71	5								
70	6								
69	7								
68	8								
67	9								
66	10								



RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 67.7 mAHD
EASTING: 296543
NORTHING: 6251351

PIT No: TP14
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
67	0.1	TOPSOIL - dark brown silty clay with rootlets, MC<PL		D/E	0.1				
		SILTY CLAY - hard, brown silty clay with ironstone gravel, MC<PL		D/E	0.5				
	1			D/E	1.0				
66		- becoming stiff, red mottled brown with a trace of fine grained sandstone gravel, MC~PL below 1.5m		D/E	1.5				
	2	- becoming firm, orange brown mottled grey with a trace of fine grained sandstone gravel below 2.0m		D/E	2.0				
65		- becoming red mottled grey below 2.5m		D/E	2.5				
	3	3.0 Pit discontinued at 3.0m - limit of investigation		D/E	3.0				
64	4								
63	5								
62	6								
61	7								
60	8								
59	9								
58	10								
57									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 73.2 mAHD
EASTING: 296611
NORTHING: 6251406

PIT No: TP15
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
73	0.1	TOPSOIL - dark brown silty clay with rootlets and a trace of grey gravel, MC<PL		D/E*	0.1		PID<1		
				E	0.3		PID<1		
	0.4	SILTY CLAY - hard, red brown silty clay with a trace of rootlets, MC<PL							
72	1.0	SANDY CLAY - light brown and orange fine grained sandy clay with fine grained sandstone gravel							
	1.2	SILTY CLAY - hard, grey and brown silty clay with grey siltstone gravel, MC<PL (extremely weathered)							
		Pit discontinued at 1.2m - limit of investigation							

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Replicate sample BD1/010719 collected; MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 66.3 mAHD
EASTING: 296557
NORTHING: 6251452

PIT No: TP16
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
66	0.0	FILL - brown to dark brown clayey silt with rootlets (to 0.1m) and building rubble (including asbestos, ceramic tiles and bricks)		D	0.1		PID<1		
				D	0.5		PID<1		
	0.6	SILTY CLAY - soft, grey mottled red and orange silty clay with a trace of rootlets, MC~PL		D	1.0		PID<1		
65	1.4	Pit discontinued at 1.4m - limit of investigation							
64	2								
63	3								
62	4								
61	5								
60	6								
59	7								
58	8								
57	9								
56	10								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Test pit excavated on creek bed next to dam wall due to building rubble observed; MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 66.3 mAHD
EASTING: 296557
NORTHING: 6251452

PIT No: TP16DW
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
66	0.4	FILL - brown mottled dark brown silty clay, MC~PL		D	0.1		PID<1		
		Pit discontinued at 0.4m - limit of investigation							
65	1								
64	2								
63	3								
62	4								
61	5								
60	6								
59	7								
58	8								
57	9								
56	10								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 77.3 mAHD
EASTING: 296645
NORTHING: 6251501

PIT No: TP17
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
77	0.3	TOPSOIL - dark brown silty clay with rootlets to 0.15m, MC<PL		D/E	0.1				
		SILTY CLAY - hard, red and brown silty clay with a trace of ironstone gravel and rootlets, MC<PL		D/E/B/U50	0.5				
76	1	- becoming grey brown with a trace of rootlets, Mc<PL below 0.8m		D/E	1.0				
		- becoming brown and orange with a trace of ironstone gravel and rootlets below 1.3m		D/E	1.5				
75	2			D/E	2.0				
	2.8			D/E	2.5				
74	3	SILTY CLAY - very stiff, light grey mottled orange silty clay, MC<PL		D/E/B	3.0				
	3.0	Pit discontinued at 3.0m - limit of investigation							
73	4								
72	5								
71	6								
70	7								
69	8								
68	9								
67	10								

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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
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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 68.0 mAHD
EASTING: 296455
NORTHING: 6251508

PIT No: TP18
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
68	0	TOPSOIL - dark brown silty clay with rootlets to 0.15m		D/E	0.1				
	0.45	SILTY CLAY - hard, orange brown silty clay with dark grey ironstone gravel, MC<PL		D/E	0.5				
67	1	- becoming brown mottled orange below 1.0m		D/E	1.0				
				D/E	1.5				
66	2			D/E	2.0				
	2.2	SILTY CLAY - hard, grey mottled orange silty clay with a trace of dark red small claystone gravel, MC<PL		D/E	2.5				
65	3			D/E	3.0				
	3.0	Pit discontinued at 3.0m - limit of investigation							
64	4								
63	5								
62	6								
61	7								
60	8								
59	9								
58	10								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 63.7 mAHD
EASTING: 296473
NORTHING: 6251431

PIT No: TP19
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
63	0.0	FILL - building rubble (comprising bricks, terracotta, plastic, metal and asbestos) with brown silty fine to medium grained sand		D	0.5		PID<1		
	1.3	Pit discontinued at 1.3m - pit collapsing							

RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Asbestos on surface surrounding test pit; MC = moisture content; PL = plastic limit

☐ 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_x	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
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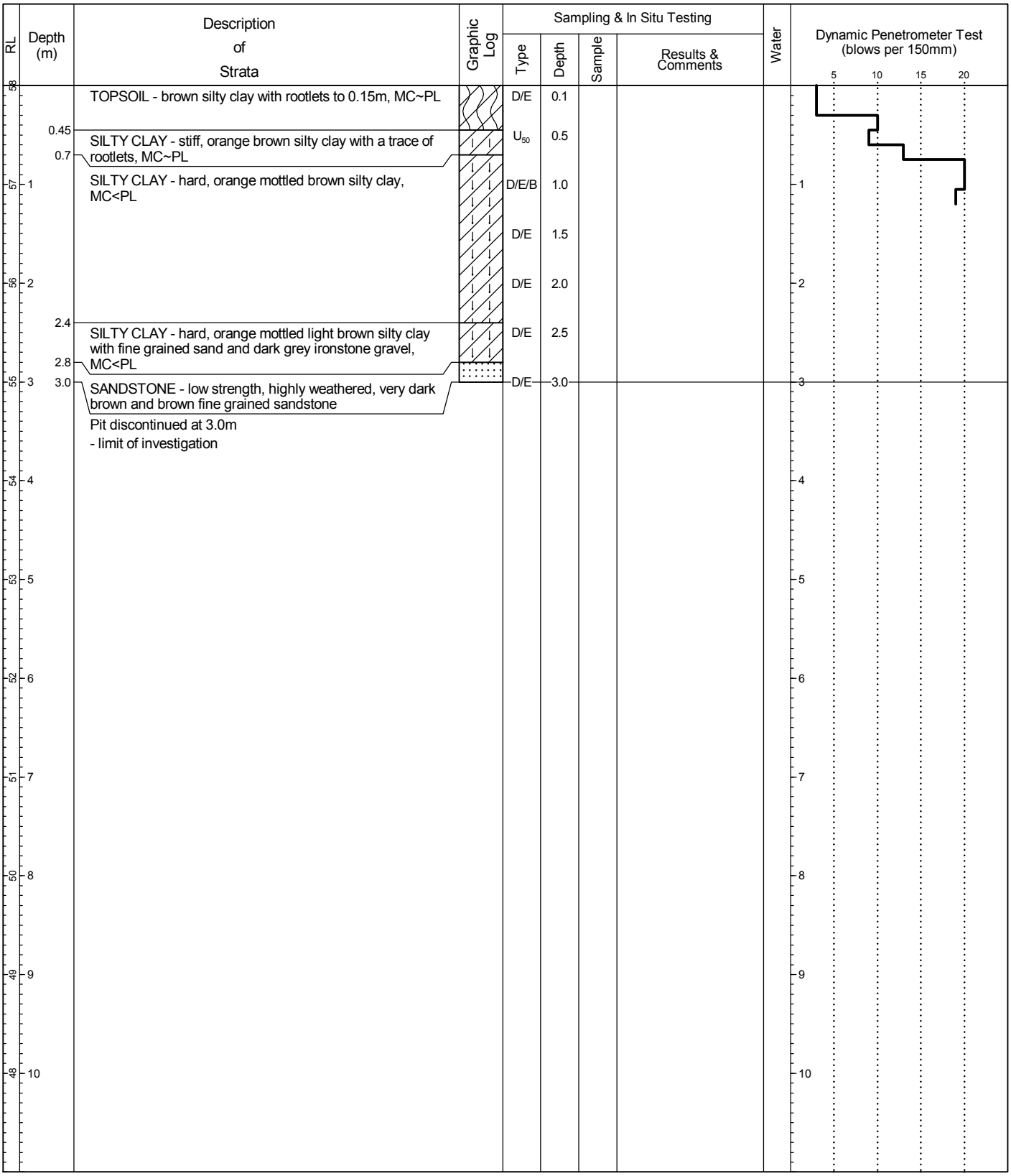
TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 58.0 mAHD
EASTING: 296316
NORTHING: 6251471

PIT No: TP20
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1



RIG: Hyundai 60CR-9 6 tonne excavator - 450mm toothed bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 56.8 mAHD
EASTING: 296269
NORTHING: 6251429

PIT No: TP21
PROJECT No: 92352.00
DATE: 1/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
56	0.1	TOPSOIL - dark brown silty clay with rootlets		D*	0.1		PID<1		
	0.2	SILTY CLAY - firm, orange brown silty clay with a trace of rootlets, MC~PL							
		Pit discontinued at 0.2m - limit of investigation							
55	1								
54	2								
53	3								
52	4								
51	5								
50	6								
49	7								
48	8								
47	9								
46	10								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hand tools

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Replicate sample BD2/010719 collected; MC = moisture content; PL = plastic limit

☐ 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_x	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)

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TEST PIT LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 69.1 mAHD
EASTING: 296432
NORTHING: 6251333

PIT No: TP22
PROJECT No: 92352.00
DATE: 2/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
69	0.35	TOPSOIL - brown to dark brown silty clay with rootlets to 0.1m, MC<PL		D/E	0.1				
		Pit discontinued at 0.35m - limit of investigation							
68	1								
67	2								
66	3								
65	4								
64	5								
63	6								
62	7								
61	8								
60	9								
59	10								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hand tools

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: MC = moisture content; PL = plastic limit

☐ 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_x	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

BOREHOLE LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 88.4 mAHD
EASTING: 296725
NORTHING: 6251528
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 92352.00
DATE: 3 - 19/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
88	0.1	TOPSOIL - brown clayey silt with rootlets, moist							D			
	0.8	SILTY CLAY - hard, red and brown silty clay, high plasticity MC<PL (extremely weathered shale)										
87	1	SANDSTONE - very low strength, highly weathered, grey sandstone							D			
86	2											
	2.7	INTERBEDDED SHALE AND SANDSTONE - medium to high strength, highly to slightly weathered, fractured, grey shale interbedded with sandstone							C	100	0	
85	3							3.2m: Cs 120mm 3.44m: Cs 180mm 3.81m: J, 80°, sv, pl, ro, fe stn 40mm	C	100	52	PL(A) = 0.31
84	4											PL(A) = 1.04
83	5							5.31m: Cs 20mm 5.34m: J, 85°, sv, pl, ro, cln 5.46m: Cs 80mm	C	100	52	PL(A) = 0.46
82	6							6.22m: fg, clay inf 30mm	C	100	26	PL(A) = 0.35
81	7							6.82m: J, v, un, ro, clay stn				PL(A) = 0.64
80	8								C	100	0	PL(A) = 0.75
79	9							8.7m: J, v, pl, ro, he 45mm 9.28m: J, 86°, sv, pl, ro, fe stn 90mm	C	100	73	PL(A) = 1.85
	10											PL(A) = 1.31
78	10.35	Bore discontinued at 10.35m - refusal on low strength sandstone										

RIG: Comacchio Geo 205 **DRILLER:** Numac Drilling Services **LOGGED:** ABB **CASING:** HW to 2.7m

TYPE OF BORING: SFA to 2.7m, NMLC coring to 10.35m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Approximately 10% circulation fluid loss between 4.2m and 5.7m; MC = moisture content; PL = plastic limit

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_x	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
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DOUGLAS PARTNERS PTY LTD

ESR CIP
PROPOSED INDUSTRIAL SUBDIVISION, KEMPS CREEK

BORE: 1 DEPTH: 2.70 – 10.35m PROJECT: 92352.00 July 2019

End of Bore at 10.35 m

BOREHOLE LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 88.9 mAHD
EASTING: 296681
NORTHING: 6251232
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 92352.00
DATE: 4/7/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
88	0.1	TOPSOIL - brown silty clay with rootlets, dry										
		SILTY CLAY - stiff, brown silty clay, high plasticity, MC<PL							D			
	0.7	- becoming hard below 0.5m										
	1	SHALE - very low strength, highly weathered, grey shale							D			
		- becoming low strength below 1.5m							D			
87	2											
	2.7	SHALE - extremely low to medium strength, extremely to moderately weathered, slightly fractured, brown shale, iron stained						2.92m: Cs 100mm				PL(A) = 0.28
86	3							3.26m: J, 45°, cu, ro, fe stn				
								3.43m: J, 60°, cu, sm, fe stn 70mm				PL(A) = 0.31
85	4							3.92m: B, sh, pl, sm, fe stn	C	100	51	
								4.06m: B, sh, pl, sm, fe stn				
								4.11m: B, sh, pl, sm, fe stn				PL(A) = 1.88
84	5							4.15m: J, sv, un, ro, fe stn				
								4.25m: B, sh, pl, sm, fe stn				
								4.29m: B, sh, pl, sm, fe stn				PL(A) = 0.25
83	6							4.32m: J, 80°, cu, ro, fe stn 130mm				
								4.51m: B, sh, pl, sm, clay inf				PL(A) = 0.53
								4.58m: B, sh, pl, sm, fe stn				
82	7							4.75m: B, sh, pl, sm, fe stn	C	100	39	
								4.87m: J, 45°, cu, sm, cln				PL(A) = 0.24
								5.09m: B, sh, pl, sm, fe stn				PL(A) = 0.37
								5.17m: J, 45°, cu, sm, cln				
81	8	- becoming dark grey below 7.92m						5.32m: fg 30mm				
								5.51m: J, 45°, cu, sm, cln				PL(A) = 0.04
								5.62m: fg 40mm				
								5.77m: B, sh, pl, sm, fe stn				
80	9							5.82m: B, sh, pl, sm, fe stn				
								5.89m: B, sh, un, sm, cbs co	C	100	69	
								5.92m: B, sh, un, sm, cbs co				PL(A) = 0.32
								6.16m: B, sh, pl, sm, fe stn				
79	10							6.21m: B, sh, pl, sm, fe stn				PL(A) = 0.44
								6.41m: J, 45°, cu, ro, cln				
	10.24	Bore discontinued at 10.24m						6.67m: Cs 90mm				
		- limit of investigation						7.24m: J, 45°, cu, ir, cln				
78								7.38m: fg 30mm				
								7.48m: Cs 50mm				

RIG: Scout **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.7m

TYPE OF BORING: SFA to 2.7m, NMLC coring to 2.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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_x	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

DOUGLAS PARTNERS PTY LTD

ESR CIP
PROPOSED INDUSTRIAL SUBDIVISION, KEMPS CREEK

BORE: 2 DEPTH: 2.70 – 10.24m PROJECT: 92352.00 July 2019

End of Bore at 10.24 m

BOREHOLE LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 88.9 mAHD
EASTING: 296681
NORTHING: 6251232
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 92352.00
DATE: 4/7/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW, HW, MW, SW, FS, FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
77	12							7.54m: fg 320mm 7.89m: Cs 30mm 8.39m: Cs 190mm 8.64m: J, 80°, un, ro, cln 230mm 8.91m: B, sh, pl, sm, clay co 9m: J, 80°, un, ro, cln 160mm 9.12m: Cs 30mm 9.58m: B, sh, pl, sm, clay co 9.75m: B, sh, pl, sm, clay co				
76	13											
75	14											
74	15											
73	16											
72	17											
71	18											
70	19											
69	20											
68	21											
67												

RIG: Scout **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.7m

TYPE OF BORING: SFA to 2.7m, NMLC coring to 2.7m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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_x	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)

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BOREHOLE LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 77.1 mAHD
EASTING: 296437
NORTHING: 6251277
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 92352.00
DATE: 3 - 18/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
77	0.1	TOPSOIL - pale brown silty clay with rootlets, moist							D			
		SILTY CLAY - very stiff, brown silty clay, medium plasticity, MC~PL										
	0.8	SHALE - very low strength, highly weathered, grey shale							D			
76	1	- with low strength, highly weathered, shale bands below 1.4m							D			
75	2								D			
	2.8	SHALE - very low to high strength, highly to moderately weathered, fractured, brown shale						3m: Cs 20mm 3.15m: Cs 10mm 3.16m: J, 80°, sv, ir, ro, clay stn 50mm 3.21m: Cs 30mm 3.29m: Cs 90mm 3.4m: fg 80mm	C	100	0	PL(A) = 0.16
74	3								C	100	35	PL(A) = 0.21 PL(A) = 1.39
73	4	- with medium grained sandstone band between 3.8 - 4.16m						4.16m: Cs 10mm 4.27m: Cs 25mm 4.32m: J, 81°, sv, pl, ro, he, clay inf 80mm 4.64m: J, 50°, sv, pl, ro, fe stn 4.65m: J, 55°, sv, pl, ro, clay stn 40mm 4.92m: J, 86°, sv, ir, ro, clay stn	C	100	72	PL(A) = 0.16 PL(A) = 0.2 PL(A) = 0.14
72	5											
71	6							5.85m: Cs 110nn 6.16m: J, 80°, sv, pl, ro, fe stn 50mm 6.52m: Cs 30mm	C	100	29	PL(A) = 0.22
70	7							6.74m: Cs 20mm 6.77m: J, 35°, sv, pl, ro, clay inf 25mm 7.07m: J, 80°, sv, pl, ro, he, fe & clay stn 70mm 7.15m: J, v, pl, ro, fe stn 7.52m: Cs 20mm				PL(A) = 0.77
69	8							7.91m: Cs 40mm	C	100	47	PL(A) = 0.12
	8.8							8.47m: Cs 35mm				
68	9	Bore discontinued at 8.8m - limit of investigation										
67	10											

RIG: Comacchio Geo 205 **DRILLER:** Numac Drilling Services **LOGGED:** ABB **CASING:** HW to 2.8m

TYPE OF BORING: SFA to 2.8m, NMLC coring to 8.8m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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_x	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)

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ESR CIP
PROPOSED INDUSTRIAL SUBDIVISION, KEMPS CREEK

BORE: 4 DEPTH: 2.80 – 8.80m PROJECT: 92352.00 July 2019

End of Bore at 8.80 m

BOREHOLE LOG

CLIENT: ESR CIP
PROJECT: Proposed Industrial Subdivision
LOCATION: 59 - 63 Abbotts Road, Kemps Creek, NSW

SURFACE LEVEL: 67.0 mAHD
EASTING: 296316
NORTHING: 6251291
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 92352.00
DATE: 4/7/2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
67	0.1	TOPSOIL - pale brown silty clay with rootlets, dry										
		SILTY CLAY - hard, red and brown silty clay, medium plasticity, MC<PL							D			
66	1	- becoming grey and brown weathered shale below 0.9m							D			
	1.1	SHALE - very low strength, highly weathered, grey shale							D			
65	2								D			
64	3											
63	4											
	4.3	SHALE - very low to medium strength, highly to moderately weathered, slightly fractured, brown shale interbedded with siltstone and fine grained sandstone with clay seams						4.49m: J, 45°, cu, ro, fe stn 4.54m: J, 45°, cu, ro, fe stn	C	100	78	PL(A) = 0.36
62	5							4.56m: J, 60°, cu, ro, clay co 120mm 4.66m: J, sv, un, very ro, cln 180mm	C	100	19	PL(A) = 0.04
61	6	- with iron nodules at 6.16m						4.97m: J, 60°, cu, ro, fe stn 160mm 5.13m: Cs 30mm 5.25m: Cs 10mm 5.6m: Cs 10mm 5.75m: Cs 30mm 5.95m: J, 60°, cu, ro, cln 80mm 6.37m: J, 60°, cu, sm, cln 50mm 6.67m: B, sh, pl, ro, clay co 7.21m: J, 60°, cu, ro, cln 150mm	C	100	100	PL(A) = 0.22 PL(A) = 0.44 PL(A) = 0.41
60	7											
59	8											
	8.0	Bore discontinued at 8.0m - limit of investigation										
58	9											
57	10											

RIG: Comacchio GEO 305 **DRILLER:** Terratest **LOGGED:** JHB **CASING:** HQ to 3.0m

TYPE OF BORING: SFA to 3.0m, wash boring to 4.3m, NMLC coring to 8.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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_x	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)

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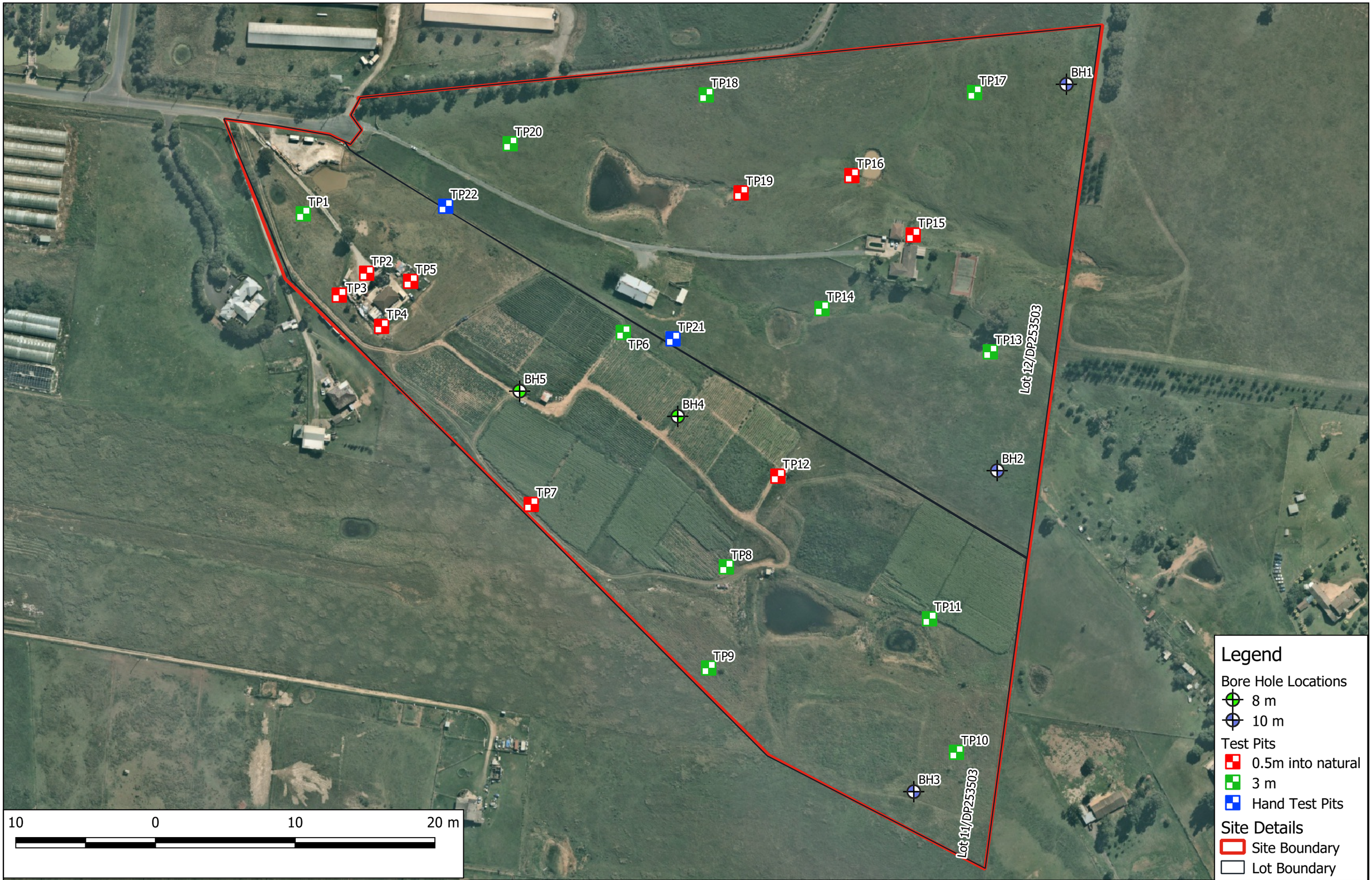
ESR CIP
PROPOSED INDUSTRIAL SUBDIVISION, KEMPS CREEK

BORE: 5 DEPTH: 4.30 – 8.00m PROJECT: 92352.00 July 2019

End of Bore at 8.00 m



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: ESR CIP Constructions (NSW) Pty Ltd		
OFFICE: Macarthur	DRAWN BY: LOC	
SCALE: As shown	DATE: 28.06.2019	

TITLE: **Test Pit and Bore Location Plan**
Preliminary Site Investigation for Contamination
59 - 63 Abbotts Road, Kemps Creek, NSW

PROJ. #:	92352.00
DRAWING No:	3
REVISION:	0

Appendix B

Results of Laboratory Testing

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

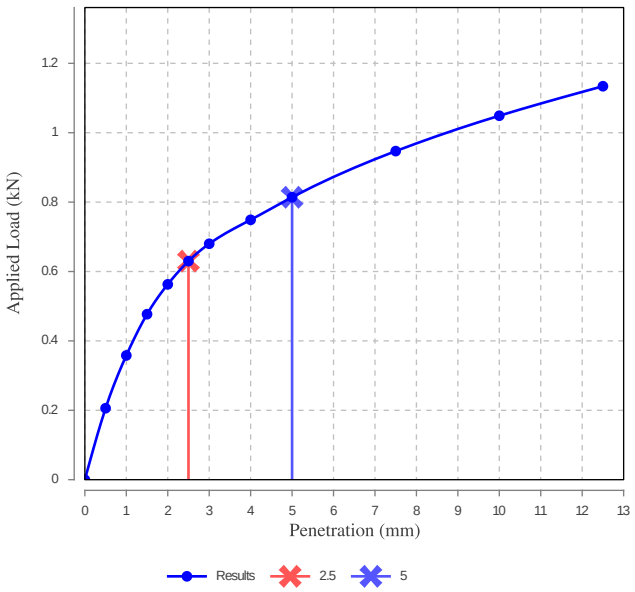
Approved Signatory: Tim White
Lab manager

NATA Accredited Laboratory Number: 828

Report Number: **92352.00-3**
Issue Number: 1
Date Issued: 30/07/2019
Client: ESR CIP
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 950
Sample Number: 19-950B
Date Sampled: 03/07/2019
Dates Tested: 04/07/2019 - 15/07/2019
Sampling Method: AS1289 1.2.1 6.4 - Sampling from layers in earthworks or pavement - uncompacted/compacted
Sample Location: **TP6 (0.5 m)**

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**5.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.55		
Optimum Moisture Content (%)	26.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.54		
Field Moisture Content (%)	26.8		
Moisture Content at Placement (%)	26.1		
Moisture Content Top 30mm (%)	29.0		
Moisture Content Rest of Sample (%)	27.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	48		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



Material Test Report

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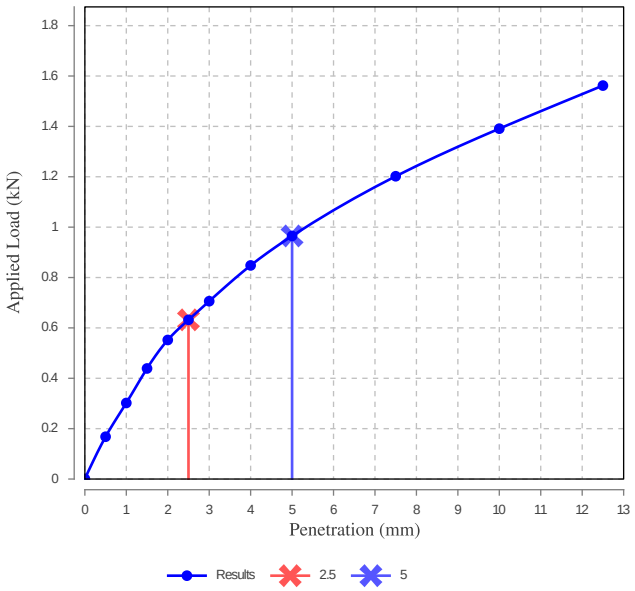
Issue Number: 1
Date Issued: 30/07/2019
Client: ESR CIP
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 950
Sample Number: 19-950D
Date Sampled: 03/07/2019
Dates Tested: 04/07/2019 - 15/07/2019
Sampling Method: AS1289 1.2.1 6.4 - Sampling from layers in earthworks or pavement - uncompacted/compacted
Sample Location: **TP11 (0.5 m)**
Material: SILTY CLAY - pale red mottled pale brown, trace irostone gravels, trace fine grained sand

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**5.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.68		
Optimum Moisture Content (%)	20.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.66		
Field Moisture Content (%)	18.3		
Moisture Content at Placement (%)	20.2		
Moisture Content Top 30mm (%)	24.0		
Moisture Content Rest of Sample (%)	21.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	48		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



Material Test Report

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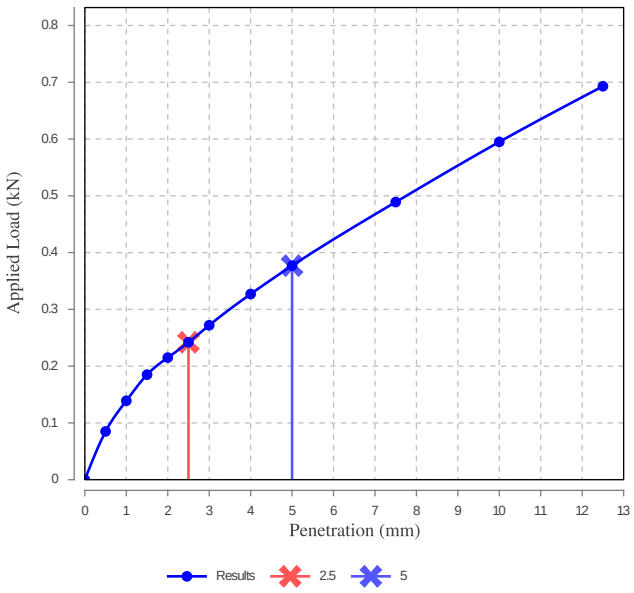
Date Issued: 30/07/2019
Client: ESR CIP
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 950
Sample Number: 19-950F
Date Sampled: 03/07/2019
Dates Tested: 04/07/2019 - 15/07/2019
Sampling Method: AS1289 1.2.1 6.4 - Sampling from layers in earthworks or pavement - uncompacted/compacted
Sample Location: **TP17 (0.5 m)**
Material: SILTY CLAY - pale grey mottled orange

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.89		
Optimum Moisture Content (%)	13.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.86		
Field Moisture Content (%)	11.7		
Moisture Content at Placement (%)	13.5		
Moisture Content Top 30mm (%)	18.9		
Moisture Content Rest of Sample (%)	15.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	48		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



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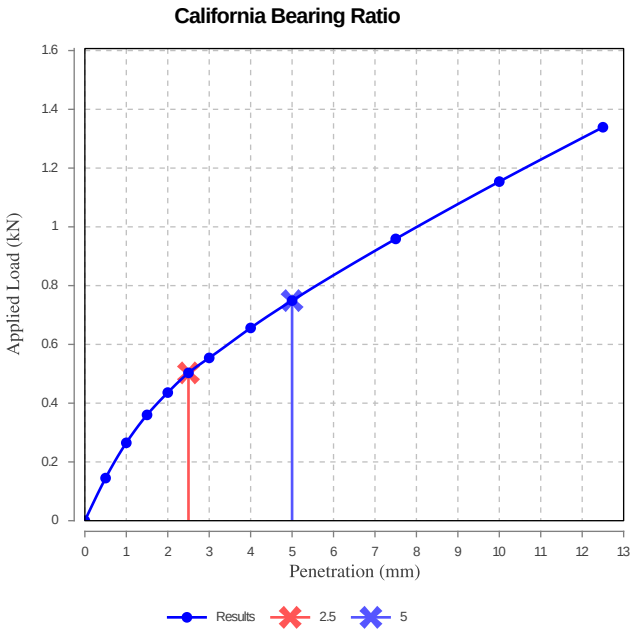
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 950
Sample Number: 19-950H
Date Sampled: 03/07/2019
Dates Tested: 04/07/2019 - 19/07/2019
Sampling Method: AS1289 1.2.1 6.4 - Sampling from layers in earthworks or pavement - uncompacted/compacted
Sample Location: **TP20 (0.5 m)**
Material: SILTY CLAY - Orange brown

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**4.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.78		
Optimum Moisture Content (%)	17.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.75		
Field Moisture Content (%)	13.9		
Moisture Content at Placement (%)	16.7		
Moisture Content Top 30mm (%)	21.7		
Moisture Content Rest of Sample (%)	18.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	144		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



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Issue Number: 1
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Client: ESR CIP
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 950
Date Sampled: 03/07/2019
Dates Tested: 04/07/2019 - 04/07/2019
Sampling Method: AS1289 1.2.1 6.5.1 - Sampling from hand excavated pit or trench

Shrink Swell Index AS 1289 7.1.1 & 2.1.1			
Sample Number	19-950A	19-950C	19-950G
Sampling Method	AS1289 1.2.1 6.5.1	AS1289 1.2.1 6.5.1	AS1289 1.2.1 6.5.1
Date Sampled	03/07/2019	03/07/2019	03/07/2019
Date Tested	04/07/2019	04/07/2019	04/07/2019
Material Source	U50 push tube	U50 push tube	U50 push tube
Sample Location	TP6 (0.5m)	TP11 (0.4 m)	TP20 (0.5 m)
Inert Material Estimate (%)	0	0	0
Pocket Penetrometer before (kPa)	150	375	>600
Pocket Penetrometer after (kPa)	140	180	280
Shrinkage Moisture Content (%)	27.9	23.2	15.8
Shrinkage (%)	**5.2**	**4.1**	**0.8**
Swell Moisture Content Before (%)	28.3	23.5	16.1
Swell Moisture Content After (%)	28.4	26.3	20.2
Swell (%)	**0.0**	**0.7**	**0.7**
Shrink Swell Index Iss (%)	**2.9**	**2.5**	**0.6**
Visual Description	SILTY CLAY - Orange brown silty clay	SILTY CLAY - pale red mottled pale brown, trace ironstone gravels, trace fine grained sand	SILTY CLAY - Orange brown silty clay
Cracking	Slightly Cracked	Moderately Cracked	Moderately Cracked
Crumbling	No	No	No
Remarks	**	**	**

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
NATA Accreditation does not cover the performance of pocket penetrometer readings.

Material Test Report

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Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 950
Sample Number: 19-950E
Date Sampled: 03/07/2019
Dates Tested: 04/07/2019 - 08/07/2019
Sampling Method: AS1289 1.2.1 6.5.1 - Sampling from hand excavated pit or trench
Remarks: Field moisture content = 18.9%
Sample Location: **TP17 (0.5 m)**
Material: SILTY CLAY - red brown, with trace ironstone gravels

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	67		
Plastic Limit (%)	24		
Plasticity Index (%)	**43**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	17.0		
Cracking Crumbling Curling	Curling		

Material Test Report

Douglas Partners
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NATA WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92352.00-2**
Issue Number: 1
Date Issued: 16/07/2019
Client: ESR CIP
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 972
Sample Number: 19-972A
Date Sampled: 03/07/2019
Dates Tested: 10/07/2019 - 12/07/2019
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 18.3%
Sample Location: **BH 1 (0.5m)**
Material: SILTY CLAY - red and brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	57		
Plastic Limit (%)	22		
Plasticity Index (%)	**35**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	14.5		
Cracking Crumbling Curling	Curling		

Material Test Report

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Date Issued: 16/07/2019
Client: ESR CIP
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 972
Sample Number: 19-972B
Date Sampled: 03/07/2019
Dates Tested: 10/07/2019 - 12/07/2019
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 17.4%
Sample Location: **BH 2 (0.5m)**
Material: SILTY CLAY - brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	61		
Plastic Limit (%)	23		
Plasticity Index (%)	**38**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	16.0		
Cracking Crumbling Curling	Curling		

Material Test Report

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Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 972
Sample Number: 19-972C
Date Sampled: 03/07/2019
Dates Tested: 10/07/2019 - 12/07/2019
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 21.3%
Sample Location: **BH 4 (0.5m)**
Material: SILTY CLAY - brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	62		
Plastic Limit (%)	25		
Plasticity Index (%)	**37**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	16.5		
Cracking Crumbling Curling	Curling		

Material Test Report

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Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 972
Sample Number: 19-972D
Date Sampled: 03/07/2019
Dates Tested: 10/07/2019 - 12/07/2019
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 18.9%
Sample Location: **BH 5 (0.5m)**
Material: SILTY CLAY - brown mottled orange brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	62		
Plastic Limit (%)	22		
Plasticity Index (%)	**40**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	16.5		
Cracking Crumbling Curling	Curling		

Material Test Report

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Report Number: **92352.00-1**
Issue Number: 1
Date Issued: 09/07/2019
Client: ESR CIP
Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 962
Sample Number: 19-962A
Date Sampled: 02/07/2019
Dates Tested: 09/07/2019 - 09/07/2019
Sampling Method: Sampled by Engineering Department
Sample Location: **TP 6 (0.5 m)**
Material: SILTY CLAY - red silty clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	As above		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	24		

Material Test Report

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Suite 59, 26-32 Pirrama Road, PYRMONT NSW 2009
Contact: Paul Jewiss
Project Number: 92352.00
Project Name: Proposed Industrial Subdivision
Project Location: 59 - 63 Abbotts Road, KEMPS CREEK
Work Request: 962
Sample Number: 19-962B
Date Sampled: 01/07/2019
Dates Tested: 09/07/2019 - 09/07/2019
Sampling Method: Sampled by Engineering Department
Sample Location: **TP 17 (1.5 m)**
Material: SILTY CLAY - dark brown silty clay

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	24		

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 221119

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Lachlan Clement, Emily McGinty
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**92352.00, Kemps Creek**
Number of Samples	30 Soil, 1 Material
Date samples received	05/07/2019
Date completed instructions received	05/07/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	12/07/2019
Date of Issue	12/07/2019

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Asbestos Approved By
Analysed by Asbestos Approved Identifier: Aida Marner
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
Diego Bigolin, Team Leader, Inorganics
Jaimie Loa-Kum-Cheung, Metals Supervisor
Lucy Zhu, Senior Asbestos Analyst
Priya Samarawickrama, Senior Chemist
Steven Luong, Organics Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		221119-21	221119-22	221119-23	221119-24	221119-25
Your Reference	UNITS	TP6	TP10	TP13	TP17	TP20
Depth		0.5	1.5	2.5	1.5	3.0
Date Sampled		02/07/2019	02/07/2019	01/07/2019	01/07/2019	01/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Date analysed	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
pH 1:5 soil:water	pH Units	7.2	6.7	5.9	8.2	8.1
Electrical Conductivity 1:5 soil:water	µS/cm	75	210	230	260	590
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	160	[NA]	[NA]	610
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	90	[NA]	[NA]	28

Moisture						
Our Reference		221119-1	221119-2	221119-3	221119-4	221119-5
Your Reference	UNITS	TP1	TP2	TP3	TP4	TP5
Depth		2.3	0.1	0.05	0.1	0.1
Date Sampled		01/07/2019	02/07/2019	02/07/2019	02/07/2019	02/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Date analysed	-	09/07/2019	09/07/2019	09/07/2019	09/07/2019	09/07/2019
Moisture	%	30	7.7	22	12	15

Moisture						
Our Reference		221119-6	221119-7	221119-8	221119-9	221119-10
Your Reference	UNITS	TP6	TP7	TP8	TP9	TP10
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		02/07/2019	02/07/2019	02/07/2019	02/07/2019	02/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Date analysed	-	09/07/2019	09/07/2019	09/07/2019	09/07/2019	09/07/2019
Moisture	%	18	14	23	16	20

Moisture						
Our Reference		221119-11	221119-12	221119-13	221119-14	221119-15
Your Reference	UNITS	TP11	TP12	TP13	TP14	TP15
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		02/07/2019	02/07/2019	01/07/2019	01/07/2019	01/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Date analysed	-	09/07/2019	09/07/2019	09/07/2019	09/07/2019	09/07/2019
Moisture	%	20	19	14	16	16

Moisture						
Our Reference		221119-16	221119-17	221119-18	221119-19	221119-20
Your Reference	UNITS	TP16	TP17	TP18	TP19	TP20
Depth		0.1	0.1	0.1	0.5	0.1
Date Sampled		01/07/2019	01/07/2019	01/07/2019	01/07/2019	01/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Date analysed	-	09/07/2019	09/07/2019	09/07/2019	09/07/2019	09/07/2019
Moisture	%	26	17	17	6.4	18

Moisture				
Our Reference		221119-26	221119-28	221119-30
Your Reference	UNITS	TB	BD2 020719	TP21
Depth		-	-	0.1
Date Sampled		01/07/2019	02/07/2019	01/07/2019
Type of sample		Soil	Soil	Soil
Date prepared	-	08/07/2019	08/07/2019	09/07/2019
Date analysed	-	09/07/2019	09/07/2019	10/07/2019
Moisture	%	21	15	18

Asbestos ID - soils						
Our Reference		221119-1	221119-2	221119-3	221119-4	221119-5
Your Reference	UNITS	TP1	TP2	TP3	TP4	TP5
Depth		2.3	0.1	0.05	0.1	0.1
Date Sampled		01/07/2019	02/07/2019	02/07/2019	02/07/2019	02/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Sample mass tested	g	Approx. 35g	Approx. 35g	Approx. 20g	Approx. 35g	Approx. 30g
Sample Description	-	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		221119-6	221119-7	221119-8	221119-9	221119-10
Your Reference	UNITS	TP6	TP7	TP8	TP9	TP10
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		02/07/2019	02/07/2019	02/07/2019	02/07/2019	02/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Sample mass tested	g	Approx. 50g	Approx. 45g	Approx. 40g	Approx. 55g	Approx. 20g
Sample Description	-	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils						
Our Reference		221119-11	221119-12	221119-13	221119-14	221119-15
Your Reference	UNITS	TP11	TP12	TP13	TP14	TP15
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		02/07/2019	02/07/2019	01/07/2019	01/07/2019	01/07/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Sample mass tested	g	Approx. 25g	Approx. 40g	Approx. 50g	Approx. 35g	Approx. 20g
Sample Description	-	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils					
Our Reference		221119-17	221119-18	221119-19	221119-20
Your Reference	UNITS	TP17	TP18	TP19	TP20
Depth		0.1	0.1	0.5	0.1
Date Sampled		01/07/2019	01/07/2019	01/07/2019	01/07/2019
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	08/07/2019	08/07/2019	08/07/2019	08/07/2019
Sample mass tested	g	Approx. 45g	Approx. 30g	Approx. 30g	Approx. 30g
Sample Description	-	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils NEPM		
Our Reference		221119-16
Your Reference	UNITS	TP16
Depth		0.1
Date Sampled		01/07/2019
Type of sample		Soil
Date analysed	-	08/07/2019
Sample mass tested	g	337.63
Sample Description	-	Brown coarse-grained soil & rocks
Asbestos ID in soil (AS4964) >0.1g/kg	-	Chrysotile asbestos detected Amosite asbestos detected Crocidolite asbestos detected Organic fibres detected
Trace Analysis	-	No asbestos detected
Total Asbestos[#1]	g/kg	44.7872
Asbestos ID in soil <0.1g/kg*	-	See Above
ACM >7mm Estimation*	g	15.1215
FA and AF Estimation*	g	–
FA and AF Estimation*#2	%(w/w)	<0.001

Asbestos ID - materials		
Our Reference		221119-29
Your Reference	UNITS	TP1/PACM
Depth		0.1
Date Sampled		01/07/2019
Type of sample		Material
Date analysed	-	08/07/2019
Mass / Dimension of Sample	-	60x30x4mm
Sample Description	-	Grey compressed fibre cement material
Asbestos ID in materials	-	Chrysotile asbestos detected Amosite asbestos detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
ASB-001	Asbestos ID - Identification of asbestos in soil samples using Polarised Light Microscopy and Dispersion Staining Techniques. Minimum 500mL soil sample was analysed as recommended by "National Environment Protection (Assessment of site contamination) Measure, Schedule B1 and "The Guidelines from the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia - May 2009" with a reporting limit of 0.1g/kg (0.01% w/w) as per Australian Standard AS4964-2004. Results reported denoted with * are outside our scope of NATA accreditation. **NOTE** #1 Total Asbestos g/kg was analysed and reported as per Australian Standard AS4964 (This is the sum of ACM >7mm, <7mm and FA/AF) **NOTE** #2 The screening level of 0.001% w/w asbestos in soil for FA and AF only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres. Estimation = Estimated asbestos weight Results reported with "--" is equivalent to no visible asbestos identified using Polarised Light microscopy and Dispersion Staining Techniques.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.

Method ID	Methodology Summary
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-2
Date extracted	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			09/07/2019	1	09/07/2019	09/07/2019		09/07/2019	09/07/2019
TRH C_6 - C_9	mg/kg	25	Org-016	<25	1	<25	<25	0	95	98
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	1	<25	<25	0	95	98
Benzene	mg/kg	0.2	Org-016	<0.2	1	<0.2	<0.2	0	103	105
Toluene	mg/kg	0.5	Org-016	<0.5	1	<0.5	<0.5	0	103	98
Ethylbenzene	mg/kg	1	Org-016	<1	1	<1	<1	0	89	95
m+p-xylene	mg/kg	2	Org-016	<2	1	<2	<2	0	90	97
o-Xylene	mg/kg	1	Org-016	<1	1	<1	<1	0	90	97
naphthalene	mg/kg	1	Org-014	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	99	1	76	78	3	93	93

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	221119-28
Date extracted	-			[NT]	11	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			[NT]	11	09/07/2019	09/07/2019		09/07/2019	09/07/2019
TRH C_6 - C_9	mg/kg	25	Org-016	[NT]	11	<25	<25	0	102	100
TRH C_6 - C_{10}	mg/kg	25	Org-016	[NT]	11	<25	<25	0	102	100
Benzene	mg/kg	0.2	Org-016	[NT]	11	<0.2	<0.2	0	101	90
Toluene	mg/kg	0.5	Org-016	[NT]	11	<0.5	<0.5	0	103	95
Ethylbenzene	mg/kg	1	Org-016	[NT]	11	<1	<1	0	104	107
m+p-xylene	mg/kg	2	Org-016	[NT]	11	<2	<2	0	100	104
o-Xylene	mg/kg	1	Org-016	[NT]	11	<1	<1	0	105	108
naphthalene	mg/kg	1	Org-014	[NT]	11	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	[NT]	11	83	85	2	99	93

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	20	08/07/2019	08/07/2019		[NT]	[NT]
Date analysed	-			[NT]	20	09/07/2019	09/07/2019		[NT]	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	[NT]	20	<25	<25	0	[NT]	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	[NT]	20	<25	<25	0	[NT]	[NT]
Benzene	mg/kg	0.2	Org-016	[NT]	20	<0.2	<0.2	0	[NT]	[NT]
Toluene	mg/kg	0.5	Org-016	[NT]	20	<0.5	<0.5	0	[NT]	[NT]
Ethylbenzene	mg/kg	1	Org-016	[NT]	20	<1	<1	0	[NT]	[NT]
m+p-xylene	mg/kg	2	Org-016	[NT]	20	<2	<2	0	[NT]	[NT]
o-Xylene	mg/kg	1	Org-016	[NT]	20	<1	<1	0	[NT]	[NT]
naphthalene	mg/kg	1	Org-014	[NT]	20	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	[NT]	20	80	69	15	[NT]	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-2
Date extracted	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			09/07/2019	1	09/07/2019	09/07/2019		09/07/2019	09/07/2019
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	1	<50	<50	0	100	108
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	1	<100	<100	0	78	73
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	1	<100	<100	0	71	70
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	1	<50	<50	0	100	108
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	1	<100	<100	0	78	73
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	1	<100	<100	0	71	70
Surrogate o-Terphenyl	%		Org-003	88	1	88	82	7	119	106

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	221119-28
Date extracted	-			[NT]	11	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			[NT]	11	09/07/2019	09/07/2019		09/07/2019	09/07/2019
TRH C_{10} - C_{14}	mg/kg	50	Org-003	[NT]	11	<50	<50	0	104	116
TRH C_{15} - C_{28}	mg/kg	100	Org-003	[NT]	11	<100	<100	0	95	109
TRH C_{29} - C_{36}	mg/kg	100	Org-003	[NT]	11	<100	<100	0	100	91
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	[NT]	11	<50	<50	0	104	116
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	[NT]	11	<100	<100	0	95	109
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	[NT]	11	<100	<100	0	100	91
Surrogate o-Terphenyl	%		Org-003	[NT]	11	95	94	1	111	106

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	20	08/07/2019	08/07/2019		[NT]	[NT]
Date analysed	-			[NT]	20	09/07/2019	09/07/2019		[NT]	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	[NT]	20	<50	<50	0	[NT]	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	[NT]	20	<100	<100	0	[NT]	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	[NT]	20	<100	<100	0	[NT]	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	[NT]	20	<50	<50	0	[NT]	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	[NT]	20	<100	<100	0	[NT]	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	[NT]	20	<100	<100	0	[NT]	[NT]
Surrogate o-Terphenyl	%		Org-003	[NT]	20	89	82	8	[NT]	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-2
Date extracted	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			09/07/2019	1	09/07/2019	09/07/2019		09/07/2019	09/07/2019
Naphthalene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	114	120
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	102	108
Phenanthrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	100	104
Anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	100	103
Pyrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	102	107
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	102	105
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	1	<0.05	<0.05	0	104	108
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	103	1	125	96	26	98	99

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			[NT]	11	08/07/2019	08/07/2019		08/07/2019	[NT]
Date analysed	-			[NT]	11	09/07/2019	09/07/2019		09/07/2019	[NT]
Naphthalene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	122	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	108	[NT]
Phenanthrene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	106	[NT]
Anthracene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	104	[NT]
Pyrene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	108	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	106	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	[NT]	11	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	[NT]	11	<0.05	<0.05	0	110	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	[NT]	11	92	94	2	103	[NT]

QUALITY CONTROL: PAHs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	20	08/07/2019	08/07/2019		[NT]	[NT]
Date analysed	-			[NT]	20	09/07/2019	09/07/2019		[NT]	[NT]
Naphthalene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Phenanthrene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Anthracene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Pyrene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	[NT]	20	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	[NT]	20	<0.05	<0.05	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	[NT]	20	91	110	19	[NT]	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-2
Date extracted	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			09/07/2019	1	09/07/2019	09/07/2019		09/07/2019	09/07/2019
HCB	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	86	81
gamma-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	83	77
Heptachlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	78	74
delta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	84	80
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	84	80
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	1	0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	85	78
Dieldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	99	94
Endrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	81	76
pp-DDD	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	71	64
Endosulfan II	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	91	86
Methoxychlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	88	1	89	85	5	83	82

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			[NT]	11	08/07/2019	08/07/2019		08/07/2019	[NT]
Date analysed	-			[NT]	11	09/07/2019	09/07/2019		09/07/2019	[NT]
HCB	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	83	[NT]
gamma-BHC	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	81	[NT]
Heptachlor	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	71	[NT]
delta-BHC	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	84	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	84	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	83	[NT]
Dieldrin	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	99	[NT]
Endrin	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	80	[NT]
pp-DDD	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	71	[NT]
Endosulfan II	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	77	[NT]
Methoxychlor	mg/kg	0.1	Org-005	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	[NT]	11	85	85	0	82	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	20	08/07/2019	08/07/2019		[NT]	[NT]
Date analysed	-			[NT]	20	09/07/2019	10/07/2019		[NT]	[NT]
HCB	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
gamma-BHC	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
delta-BHC	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Dieldrin	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Endrin	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Endosulfan II	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Methoxychlor	mg/kg	0.1	Org-005	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	[NT]	20	85	85	0	[NT]	[NT]

QUALITY CONTROL: Organophosphorus Pesticides						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-2
Date extracted	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			09/07/2019	1	09/07/2019	09/07/2019		09/07/2019	09/07/2019
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	98	105
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	98	101
Dimethoate	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	92	93
Fenitrothion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	106	104
Malathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	102	99
Parathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	112	107
Ronnel	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	93	99
Surrogate TCMX	%		Org-008	88	1	89	85	5	88	87

QUALITY CONTROL: Organophosphorus Pesticides						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			[NT]	11	08/07/2019	08/07/2019		08/07/2019	[NT]
Date analysed	-			[NT]	11	09/07/2019	09/07/2019		09/07/2019	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	103	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	99	[NT]
Dimethoate	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	92	[NT]
Fenitrothion	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	116	[NT]
Malathion	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	96	[NT]
Parathion	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	110	[NT]
Ronnel	mg/kg	0.1	Org-008	[NT]	11	<0.1	<0.1	0	99	[NT]
Surrogate TCMX	%		Org-008	[NT]	11	85	85	0	87	[NT]

QUALITY CONTROL: Organophosphorus Pesticides					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	20	08/07/2019	08/07/2019		[NT]	[NT]
Date analysed	-			[NT]	20	09/07/2019	10/07/2019		[NT]	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Dimethoate	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Fenitrothion	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Malathion	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Parathion	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Ronnel	mg/kg	0.1	Org-008	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-008	[NT]	20	85	85	0	[NT]	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-2
Date extracted	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			09/07/2019	1	09/07/2019	09/07/2019		09/07/2019	09/07/2019
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	97	95
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	88	1	89	85	5	88	87

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date extracted	-			[NT]	11	08/07/2019	08/07/2019		08/07/2019	[NT]
Date analysed	-			[NT]	11	09/07/2019	09/07/2019		09/07/2019	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	[NT]	11	<0.1	<0.1	0	98	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	[NT]	11	85	85	0	87	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	20	08/07/2019	08/07/2019		[NT]	[NT]
Date analysed	-			[NT]	20	09/07/2019	10/07/2019		[NT]	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	[NT]	20	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	[NT]	20	85	85	0	[NT]	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-2
Date prepared	-			09/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			09/07/2019	1	09/07/2019	09/07/2019		09/07/2019	09/07/2019
Arsenic	mg/kg	4	Metals-020	<4	1	9	10	11	111	97
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	103	81
Chromium	mg/kg	1	Metals-020	<1	1	20	19	5	114	96
Copper	mg/kg	1	Metals-020	<1	1	31	33	6	110	105
Lead	mg/kg	1	Metals-020	<1	1	92	78	16	110	94
Mercury	mg/kg	0.1	Metals-021	<0.1	1	0.2	0.1	67	89	98
Nickel	mg/kg	1	Metals-020	<1	1	10	8	22	107	82
Zinc	mg/kg	1	Metals-020	<1	1	170	190	11	108	73

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date prepared	-			[NT]	11	08/07/2019	08/07/2019		08/07/2019	[NT]
Date analysed	-			[NT]	11	09/07/2019	09/07/2019		09/07/2019	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	11	12	13	8	107	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	11	<0.4	<0.4	0	100	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	11	15	16	6	108	[NT]
Copper	mg/kg	1	Metals-020	[NT]	11	24	25	4	106	[NT]
Lead	mg/kg	1	Metals-020	[NT]	11	22	22	0	105	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	11	<0.1	<0.1	0	88	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	11	16	16	0	104	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	11	45	46	2	106	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	16	08/07/2019	08/07/2019		[NT]	[NT]
Date analysed	-			[NT]	16	09/07/2019	09/07/2019		[NT]	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	16	9	8	12	[NT]	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	16	1	2	67	[NT]	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	16	20	20	0	[NT]	[NT]
Copper	mg/kg	1	Metals-020	[NT]	16	26	25	4	[NT]	[NT]
Lead	mg/kg	1	Metals-020	[NT]	16	31	40	25	[NT]	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	16	0.1	0.2	67	[NT]	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	16	13	13	0	[NT]	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	16	950	1300	31	[NT]	[NT]

QUALITY CONTROL: Misc Soil - Inorg						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	221119-3
Date prepared	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Date analysed	-			08/07/2019	1	08/07/2019	08/07/2019		08/07/2019	08/07/2019
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	1	<5	<5	0	102	104

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	[NT]
Date prepared	-			08/07/2019	[NT]	[NT]	[NT]	[NT]	08/07/2019	[NT]
Date analysed	-			08/07/2019	[NT]	[NT]	[NT]	[NT]	08/07/2019	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	107	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	87	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	88	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Report Comments

Asbestos: Excessive sample volumes were provided for asbestos analysis.
A portion of the supplied samples were sub-sampled according to Envirolab procedures.
We cannot guarantee that these sub-samples are indicative of the entire sample.
Envirolab recommends supplying 40-50g (50mL) of sample in its own container as per AS4964-2004.
Note: Samples 221119-1 to 15, 17 to 20 were sub-sampled from bags provided by the client.

Note: All samples analysed as received. However, sample 221119-16 is below the minimum 500mL sample volume as per National Environment Protection (Assessment of Site Contamination) Measure, Schedule B1, May 2013.