Douglas Partners
Geotechnics / Environment / Groundwater

Report on
Geotechnical Investigation

Proposed Low-Density Residential Development
146 Vimiera Road, Marsfield

Prepared for
Winston Langley Pty Limited

Project 213200.00
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Integrated Practical Solutions

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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.

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1. Introduction

This report presents the results of a preliminary geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) at 146 Vimiera Road, Marsfield (currently Eastwood Rugby Club). The work was commissioned by Winston Langley Pty Limited (WL) and was carried out in accordance with DP's proposal 213200.P.001.Rev0 dated 21 February 2022.

The investigation was initially undertaken in May 2018 for a different development and client at this site. It is understood that the current planning proposal for the site contemplates construction of two-storey residential terraces and townhouses with no basement levels. The geotechnical advice within this report has been updated for the current proposed development.

The field work for the investigation was undertaken in conjunction with a preliminary contamination investigation and a hazardous materials building survey, both of which have been updated and reported separately (Ref: Reports 213200.R.002.Rev0 and 213200.R.003.Rev0).

The objective of the geotechnical investigation was to provide information on subsurface conditions for preliminary planning and design purposes.

2. Site Description

The site is occupied by TG Millner Sports Ground with grassed playing fields, buildings and asphaltic concrete (AC) roads and car parks. Rows of mature trees extend around the site boundaries and within the central area. The site is bounded by residential lots to the north-east, south-east and south-west, and Vimiera Road to the north-west. It is understood that the Epping-Chatswood Rail Line (ECRL) tunnels extend below the site at the approximate alignment shown on Drawing 1 in Appendix B.

The ground surface slopes down to the south-west, with levels ranging from approximately reduced level (RL) 90 m relative to Australian Height Datum (AHD) at the north-eastern corner to RL 78 m at the south-western corner. The lower and upper playing fields, as well as the central club house and car park, are terraced into the sloping hillside with 3 - 4 m high batter slopes between these areas.

The Epping to Chatswood Railway Line (ECRL) tunnels run below the site, about 40 m below the lower part of the site. Based on drawings prepared by Maunsell Australia Pty Ltd (see Appendix E), the crowns of the rail tunnels are at approximately RL 35 m to RL 38 m and the top of the support zone extends to about 10 m above the rail tunnel crown. The "second reserve" extends 20 m horizontally beyond the "first reserve". Details of the location of the rail tunnels should be confirmed by a registered surveyor prior to detailed design and construction.

3. Regional Geology

The Sydney 1:100,000 Sydney Soil Landscape Sheet and Geological Series Sheet indicates that the site is underlain by Ashfield Shale. Ashfield Shale typically comprises dark grey to black shale and laminite, which usually weather to form reactive residual clays.

The geological map shows that the boundary to the underlying Hawkesbury Sandstone is about 100 m to the west of Vimiera Road, which means that deeper boreholes may intersect this rock unit below the shale. Hawkesbury Sandstone typically comprises medium to coarse grained quartz sandstone with occasional shale and laminite bands

The geotechnical investigation confirmed the presence of Ashfield Sale below the site with Hawkesbury Sandstone at depth.

4. Field Work

4.1 Methods

The geotechnical investigation completed in May 2018 included:

- drilling of five rock-cored boreholes (BH1 to BH5) to depths of 9.0 m and 9.4 m. The boreholes were drilled using spiral flight augers in the soil and NMLC (50 mm diameter) diamond core drilling techniques in the rock. Standard penetration tests were undertaken within the soil strata to assess the in situ strength of the soil;
- drilling of twelve shallow boreholes (BH6 to BH17) to depths of between 0.7 m and 2.2 m using augers;
- excavations of two trenches (TP1 and TP2) about 50 m in length to depths of between 0.6 m and 1.0 m. The trenches were excavated using a 13 tonne excavator fitted with a 900 mm wide bucket. At TP1 Chainage 0 m the excavation was deepened to 5.0 m for the preliminary contamination assessment;
- installation of one groundwater well to 9.3 m depth in BH1 to allow for subsequent measurement of the water level (and sampling of groundwater for the preliminary contamination investigation). Groundwater observations were also made during auger drilling of the boreholes; and
- co-ordination of field work and collection of soil/rock samples by a geotechnical engineer.

The locations of the boreholes and trenches are shown on Drawing 1 in Appendix B.

4.2 Field Work Results

Details of the subsurface conditions encountered in the boreholes and trenches are provided in the logs in Appendix C, together with notes explaining descriptive terms and classification methods.

The subsurface materials encountered in the boreholes are described as follows:

PAVEMENT:	Asphaltic concrete underlain by roadbase gravel (or similar) in BH3, BH6 and BH7 up to 0.3 m depth;
FILLING:	Silty sand, silty clay and sandy clay filling in all boreholes to depths of between 0.2 m and 0.7 m. Predominantly silty clay filling was encountered to 1.7 m depth in BH12. Deeper depths of filling may exist near BH16 and BH17 given that auger refusal occurred in filling at 0.7 m and 0.8 m, respectively;
NATURAL SOIL: (Residual Clay)	Stiff to hard, silty clay and sandy clay extending to the top of rock at depths of between 0.5 m and 4.1 m;
BEDROCK:	Initially extremely low to low strength, sandstone, laminite and shale to depths of between 3.3 m and 6.0 m becoming low to medium strength then medium and high strength sandstone, laminite and shale. Boreholes BH3 to BH5, BH9 to BH11 and BH14 are located at higher levels within the eastern part of the site, and encountered shale and/or laminite bedrock overlying sandstone. Boreholes BH1 and BH2 are located on the lower side of the site and encountered sandstone bedrock (no shale). The bedrock was predominantly fragmented to slightly fractured with some unbroken sandstone within BH1 and BH4 below depths of 7.2 m and 7.6 m, respectively.

No free groundwater was observed whilst auger drilling the boreholes. Groundwater was measured on 28 March 2018 at a depth of 6.6 m (RL 72.1 m) within the sandstone bedrock at the well installed in BH1.

The subsurface materials encountered in the trenches are described as follows:

FILLING:	Silty clay filling to depths of between 0.2 m and 0.4 m with a 50 – 100 mm thick layer of asphaltic concrete below a depth of about 0.3 m in some sections of the trenches. Sand filling was encountered in TP2 Chainage 40 m at 0.4 - 0.6 m depth;
NATURAL SOIL: (Residual Clay)	Silty clay extending to the base of the trench in all sections except at TP2 Chainage 0 m, 40 m and 50 m, where natural soil was absent (i.e. filling directly over bedrock);
BEDROCK:	Extremely low shale at 5.0 m in TP1 Chainage 0 m and at TP2 Chainage 0 m, 40 m and 50 m at depths of 0.2 m to 0.6 m.

No free groundwater was observed during the excavation of the trenches.

5. Laboratory Test Results

Two soil samples were analysed to assess the aggressivity of the soil to buried steel and concrete structures. A summary of the results is provided in Table 1. The detailed laboratory test report is included in Appendix D.

Table 1: Summary of Soil Aggressivity Test Results

Borehole	Soil Type	Depth (m)	pH (pH units)	EC (µS/cm)	Chloride (mg/kg)	Sulphate (mg/kg)
BH3	Silty Clay	2.5 – 2.95	4.9	21	<10	24
BH4	Silty Clay	1.0 – 1.45	5.0	63	28	58

Notes: EC = electrical conductivity; All samples mixed at a ratio of 1(soil):5(water) prior to testing

Selected samples of the rock core were tested in the laboratory to determine the Point Load Strength Index (Is_{50}) values to assist with the rock strength classification. The results of the testing are shown on the borehole logs at the appropriate depth. The Is_{50} values for the rock ranged from approximately 0.2 MPa to 2.6 MPa, indicating that the rock samples tested were low strength to high strength.

6. Geotechnical Model

The subsurface profile at this site includes filling and natural clay overlying extremely low to low and medium strength bedrock, grading to medium and high strength sandstone and shale with depth. The site is likely to have undergone significant cutting and filling to form the near-level playing fields. Therefore, the depth of filling at the test locations is highly variable. At borehole BH11 and within parts of the trench TP2 the filling extended to the top of bedrock and residual clay was absent.

Five geotechnical cross-sections showing the interpreted subsurface profile across the site are shown on Drawings 2 to 6 in Appendix B. The sections show the interpreted geotechnical boundaries for the filling, natural soil and underlying rock. These profiles are accurate at the borehole locations only and variations must be expected away from the boreholes. The strata units or layers have been shown on the cross-sections by inferred strata boundaries only. The cross-sections indicate that variable extremely low to low strength shale and sandstone overlies more consistent medium and high strength sandstone at about RL 75 m to RL 78 m. In the higher areas at the north-eastern corner of the site, medium and high strength shale is expected below about RL 83.5 m.

Groundwater was measured on 28 March 2018 at a depth of 6.6 m (RL 72.1 m) within the sandstone bedrock at the well installed in BH1. The measured groundwater is expected to be seepage rather than a regional water table. Seepage is expected at the soil/rock interface and through rock defects and water levels will fluctuate and temporarily rise following periods of extended rainfall.

7. Comments

7.1 Proposed Development

It is understood that the proposed development includes about 136 two-storey residential buildings with no basement levels. Internal access roads, multipurpose sport and leisure courts, a public park and landscaping are also proposed. It is also understood that the development will generally follow the existing ground levels, and excavations for bulk earthworks are anticipated to be about 0.5 m to 1 m deep. Localised, detailed excavations for in-ground services, stormwater tanks, lift pits and building footings may extend to greater depths. .

Figure 1: Master Plan of Proposed Development

7.2 Earthworks

7.2.1 Excavation Conditions

Excavations for the bulk earthworks and subgrade preparation for roads and building platforms are anticipated to be less than about 0.5 m to 1 m deep and are likely to be in filling, natural clays and possibly extremely low and very low strength rock which should be readily removed using conventional earthmoving equipment such as excavators.

Excavation of any low strength or stronger rock, if encountered (possibly near the crests of the hills), would generally require ripping by a bulldozer or an excavator with a tyne attachment. Alternatively, hydraulic rock hammers could be used to break up any low strength or stronger rock.

7.2.2 Groundwater

Groundwater was encountered at about 6.6 m (RL 72.1 m) in BH1. The permanent groundwater table is expected to be well below the anticipated depths of excavations. Seepage however should be expected to enter any excavations through the soils, along the soil/rock interface and through rock joints and defects, particularly after periods of rainfall.

During construction and in the long term, it is anticipated that any seepage could be managed by grading levels downslope to discharge into a stormwater management system or by a sump-and-pump system. Generally, water collected from construction operations should be suitable for disposal by pumping to stormwater drains subject to confirmation testing of groundwater quality and approval from regulatory authorities.

Previous experience indicates that the water within Ashfield Shale can also have moderate concentrations of dissolved solids including iron. Once groundwater comes into contact with the atmosphere, precipitation of iron oxides is likely to occur and provision should be made for the periodic filtering and/or cleaning of this precipitate from subsoil drains, sumps, pumps and other fittings where excavations intersect shale bedrock.

Reference should be made to DP’s preliminary contamination investigation (Ref: Report 213200.R.002.Rev0) for preliminary advice on groundwater chemistry.

7.2.3 Disposal of Excavated Material

All excavated materials to be removed from site will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the Waste Classification Guidelines (EPA, 2014). Reference should be made to DP’s contamination report (Ref. 213200.R.002.Rev0) for details on the preliminary contamination status of the soils.

7.2.4 Acid Sulphate Soils

Reference to the Acid Sulphate Soil (ASS) Risk Map indicates that the site is not in an area of known potential risk for acid sulphate soils.

Acid sulphate soils are typically encountered in low-lying (generally below RL 5 m AHD), water-logged, estuarine or marine soil deposits of recent Holocene Age, and can include organic deposits.

Given the site topography (i.e. above RL 78 m) and the residual soils encountered, and DP’s experience in the area, it is extremely unlikely that there would be any ASS at the site.

7.2.5 Dilapidation Surveys

Dilapidation (building condition) reports should be undertaken on surrounding properties that may be affected by the proposed construction works prior to commencing work on the site to document any existing defects so that any claims for damage due to construction related activities can be accurately assessed.

7.2.6 Vibrations

As most of the proposed development is expected to be within filling and soils, vibrations caused by excavations in rock are unlikely to be an issue at this site. Nevertheless, it will be necessary to use appropriate methods and equipment to keep ground vibrations at adjacent buildings and structures within acceptable limits. The level of acceptable vibration is dependent on various factors including the type of building structure (e.g. reinforced concrete, brick, etc.), its structural condition, the frequency range of vibrations produced by the construction equipment, the natural frequency of the building and the vibration transmitting medium.

A ground vibration limit of 8 mm/sec vector sum peak particle velocity (VSPPV) is commonly adopted at the foundation level of existing buildings and structures for both architectural and human comfort considerations, although this vibration limit may need to be reduced if there are sensitive buildings, structures or equipment in the area. It is noted that vibration levels above 2 - 3 mm/sec may be strongly perceptible to occupants of adjacent buildings.

In relation to rail tunnels below the site, further advice on the vibration criteria and any requirement for vibration monitoring will need to be sought from Transport for NSW (TfNSW). The *Development Near Rail Tunnels* standard prepared by TfNSW (Ref T HR CI 12051 ST, dated 14 November 2016) indicates that developments within a horizontal distance of 25 m from the “first reserve” shall consider vibrations on the rail tunnels with an assessment criteria of maximum peak particle velocity (PPV) of 15 mm/s at the tunnel lining for brick or mass concrete in good condition or maximum PPV of 20 mm/s at the tunnel lining for cast iron, steel or concrete segment lining. These vibration limits are unlikely to be an issue for the proposed development due to the depth of the tunnels below the site and as any excavations in rock are expected to be localised and minimal.

7.3 Excavation Support

7.3.1 Batter Slopes

Temporary and permanent batter slopes for unsupported excavations up to a maximum height of 3 m are shown in Table 2. Deeper excavations and/or steeper batters will require further geotechnical review and input.

Table 2: Recommended Safe Batter Slopes for Exposed Material

Exposed Material	Maximum Temporary Batter Slope (H : V)	Maximum Permanent Batter Slope (H : V)
Filling and Natural Soil	1 : 1	2 : 1
Variable Extremely Low to Very Low Strength Bedrock	0.75 : 1	1 : 1

The rock is expected to deteriorate and break down in the long-term if left exposed to the weather. It is therefore recommended that all excavation slopes exposing soil, and shale or laminite be protected against erosion. This could comprise mesh reinforced shotcrete pinned to the face with steel dowels for steeper slopes. Alternatively the permanent slopes could be flattened to 3H:1V or flatter and vegetation established.

7.3.2 Retaining Walls

The preliminary design of cantilevered or gravity-type retaining walls may be based on the parameters provided in Table 3, with a triangular earth pressure distribution (i.e. with zero pressure at the ground surface) calculated using an active earth pressure coefficient (k_a) where some wall movement is acceptable, or an "at-rest" earth pressure coefficient (k_o) where wall movement is to be reduced. The pressure coefficients in Table 3 assume a level ground surface behind the top of the walls.

Table 3: Recommended Earth Pressure Coefficients and Bulk Unit Weights

Material	Earth Pressure Coefficient		Bulk Unit Weight (kN/m^3)
	Active (K_a)	At Rest (K_o)	
Filling or Natural Soil	0.4	0.6	20
Extremely Low to Very Low Strength Bedrock	0.2	0.3	22

All surcharge loads should be allowed for in the retaining wall design including building footings, inclined slopes behind the wall, traffic and construction related activities.

Retaining walls should be designed for full hydrostatic pressures unless appropriate drainage systems are implemented in the design.

7.3.3 Excavation Adjacent to Rail Infrastructure

As outlined in Section 2 of this report, the ECRL tunnels and rail reserves 1 and 2 extend below the site. Specific details on the tunnel locations, depths and rail reserves will need to be confirmed with TfNSW for the development at this site.

Requirements for developments are outlined in the ECRL Underground Infrastructure Protection Guidelines Report No. 20007300/PO-4532", prepared by Transport Infrastructure (2008). The TfNSW Standard (2016) provides further comments in regard to engineering assessment design and construction requirements. It is understood that where there are differences, the TfNSW Standard (2016) supersedes the Transport Infrastructure (2008) report. Relevant extracts from these two reports are provided in Appendix E.

The TfNSW standard indicates that no excavation is allowed within the "first reserve". Shallow excavations less than 2 m depth are allowed within the "second reserve" without assessment. Excavations greater than 2 m depth in the "second reserve" require assessment. In general, any works within the “first reserve” should be avoided. This is unlikely to be an issue on this site for the proposed development given the significant depths of the ECRL tunnels below the site.

If proposed excavations will be greater than 2 m depth within the “second reserve” boundary then numerical modelling of the proposed excavation adjacent to the rail infrastructure may be required to assess potential ground movements and to satisfy TfNSW requirements outlined in the TfNSW Standard (2016). As the tunnels are expected to be some 40 m below the basements and formed within competent sandstone bedrock, it is considered that the proposed development would have no significant impact on the tunnels. The proposed development however will ultimately need to be reviewed and approved by TfNSW.

7.4 Foundations

7.4.1 Site Classification

The existing fill on the site is highly variable and in areas is greater than 0.4 m thick. The existing fill is considered to be ‘uncontrolled’ fill, that is, it has not been placed and compacted in a controlled manner with the details of the materials and compaction recorded. If any footings were to be founded within the uncontrolled fill with a thickness greater than 0.4 m, they would have to be designed for a Site Classification of ‘Class P’ in accordance with “AS 2870-2011 Design of residential slabs and footings. For a Class P site classification, the design of footings is based on engineering principles.

The residual clays are expected to be moderately to highly reactive and are expected to be highly susceptible to shrink-swell movements due to changes in moisture content. Further investigation should include laboratory testing to assess the soil reactivity across the site. For footings founded on the residual clays, due to the variable depth of the underlying bedrock across the site, the site classification may range from a Class S (Slightly Reactive) to Class H1 (Highly Reactive), depending on the location of the structure. Further assessment of the soil reactivity and the depth to rock is required to delineate areas of various site classifications.

Additional ground surface movement may also occur due to the soil-suction effects induced by trees in proximity to the building footings and this should be further assessed once the building locations have been confirmed.

7.4.2 Footing Design

It is expected that the building footing excavations are likely to expose a combination of filling, residual clay and shale, laminite and/or sandstone bedrock of variable strength. All footings should be founded on a consistent foundation material to minimise differential settlements.

Shallow pad or strip footings founded within the residual clay or deeper bored piles founded in the underlying bedrock are suitable for this development. In areas where deep filling is present, temporary or sacrificial casing may be required to prevent the fill from collapsing into the pile hole.

Preliminary design of footings may be based on the parameters provided in Table 4, but will need to be confirmed across the site at the proposed locations of buildings and structures. If higher bearing capacities are required, then additional rock-cored boreholes would be necessary to confirm the level and strength of the rock.

Table 4: Preliminary Design Parameters for Foundation Design

Foundation Stratum	Maximum Allowable Pressure		Maximum Ultimate Pressure		Young's Modulus (MPa)
	End Bearing (kPa)	Shaft Adhesion (kPa)	End Bearing (kPa)	Shaft Adhesion (kPa)	
Stiff to Very Stiff Residual Clay	200	-	500	-	35
Extremely Low to Very Low Strength Bedrock	700	50	1,500	75	70

Footings should be founded below a 45 degree line drawn up from the toe of any adjacent excavations and retaining walls.

Foundations proportioned on the basis of the allowable bearing pressure in Table 4 would be expected to experience total settlements of less than 1% of the footing width or pile diameter under the applied working load, with differential settlements between adjacent columns expected to be less than half of this value.

All footings should be inspected by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters.

7.4.3 Footings Above ECRL Rail Tunnels

The TfNSW Standard (2016) indicates that shallow footings located above the second reserve should have a maximum footing load of 500 kPa. For piles located within the second reserve, their effects on the underground infrastructure including the effects of construction method should be assessed. As a guide, it is suggested that footings above the tunnel should be founded at least 1.5 times the tunnel diameter above the tunnel crown, which should not be an issue given the depth of the tunnels. Depending on the final structural loads, detailed numerical modelling may be required during the detailed design stage and footings would require review and approval by TfNSW.

7.5 Soil Aggressivity

The laboratory test results for soil aggressivity were compared with the exposure classifications outlined in Australian Standard AS 2159 – 2009 Piling – Design and installation. The results indicate that the soils tested are 'mild' to buried concrete elements and 'non-aggressive' to buried steel elements.

7.6 Seismic Design

In accordance with Australian Standard AS 1170 - 2007 Structural Design Actions, Part 4:Earthquake Actions in Australia, based on the current information, a site subsoil Class C_e (Shallow Soil Site) is considered to be appropriate given the depth to very low strength or stronger rock is typically greater than 3 m. AS 1170 nominates a hazard factor (Z) of 0.08 for Sydney.

7.7 Slabs and Pavements

Depending upon the proposed subgrade levels for buildings and access roads, the subgrade may vary from clayey filling or natural clayey soil to extremely low to low strength rock.

From a geotechnical perspective, the high silt content of topsoil on the existing playing fields is highly susceptible to softening with only slight changes in the moisture content and is likely to be difficult to compact. It is therefore recommended that the topsoil is not re-used as engineered fill and instead used for landscaping purposes only.

The residual clay is likely to be suitable for re-use as engineered fill provided that it is free of any oversize particles (>100 mm diameter) and deleterious material. As the residual soils are likely to be moderately to highly reactive it will also be important to control the moisture content of the highly plastic residual soils during compaction.

If fill is imported to the site, then the engineering properties (e.g. plasticity, reactivity, CBR etc.) should ideally be equivalent, or superior, to the existing materials on site.

The re-use of material should also consider the contamination status of the soil and may require further environmental assessment.

If uncontrolled filling is exposed within slab and pavement footprints then good engineering practice involves removal and replacement of the uncontrolled filling as engineered filling, compacted to a minimum dry density ratio of 98% (for building slabs) and 100% (for pavements) relative to Standard compaction, with moisture conditions within 2% of the optimum moisture content.

In areas where deep filling is present, it may not be practical to remove and replace all of the filling. The construction of a bridging layer comprising a crushed, durable rock may be used to reduce (although not eliminate) the risk of long-term settlement of the underlying uncontrolled filling. The suitability of this approach to subgrade preparation would require further testing and advice by a geotechnical engineer.

Preliminary design of slabs and pavements may be based on a California bearing ratio (CBR) of 3% for natural clayey soil.

It is recommended that laboratory testing be undertaken to assess the CBR value for slab and pavement design at a later stage once subgrade levels are confirmed.

7.8 Further Investigations

Once details and locations of the residential buildings, roads and any ancillary structures are known, it is recommended that further geotechnical investigation including boreholes as well as laboratory testing for soil reactivity (i.e. site classification purposes) and California bearing ratio values (for design of pavements) be carried to confirm the subsurface conditions and to refine the geotechnical design parameters and comments provided in this report.

8. Limitations

Douglas Partners (DP) has prepared this report for this project at 146 Vimiera Road, Marsfield in accordance with DP's proposal 213200.P.001.Rev0 dated 21 February 2022 and acceptance received from David Hynes of Winston Langley Pty Limited (Services Order dated 22 February 2022). The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Winston Langley Pty Limited for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP.

Douglas Partners Pty Ltd

Appendix A

About This Report

Introduction

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

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

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

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

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

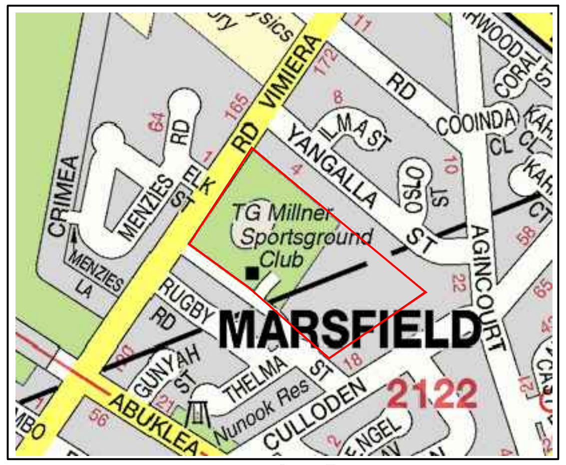
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate 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.

Appendix B

Drawings



Locality Plan

NOTE:
1: Base image from MetroMap (Dated 09.02.2022)
2: Test locations are approximate only and are shown with reference to existing features.

0 5 10 15 20 30 40 60m
1:600 @ A3

LEGEND
- ⊕ Rock cored borehole
- ⊕ Augered borehole
- W Groundwater well
- ▬ Test pit
- A A' Geotechnical Cross Section A-A'

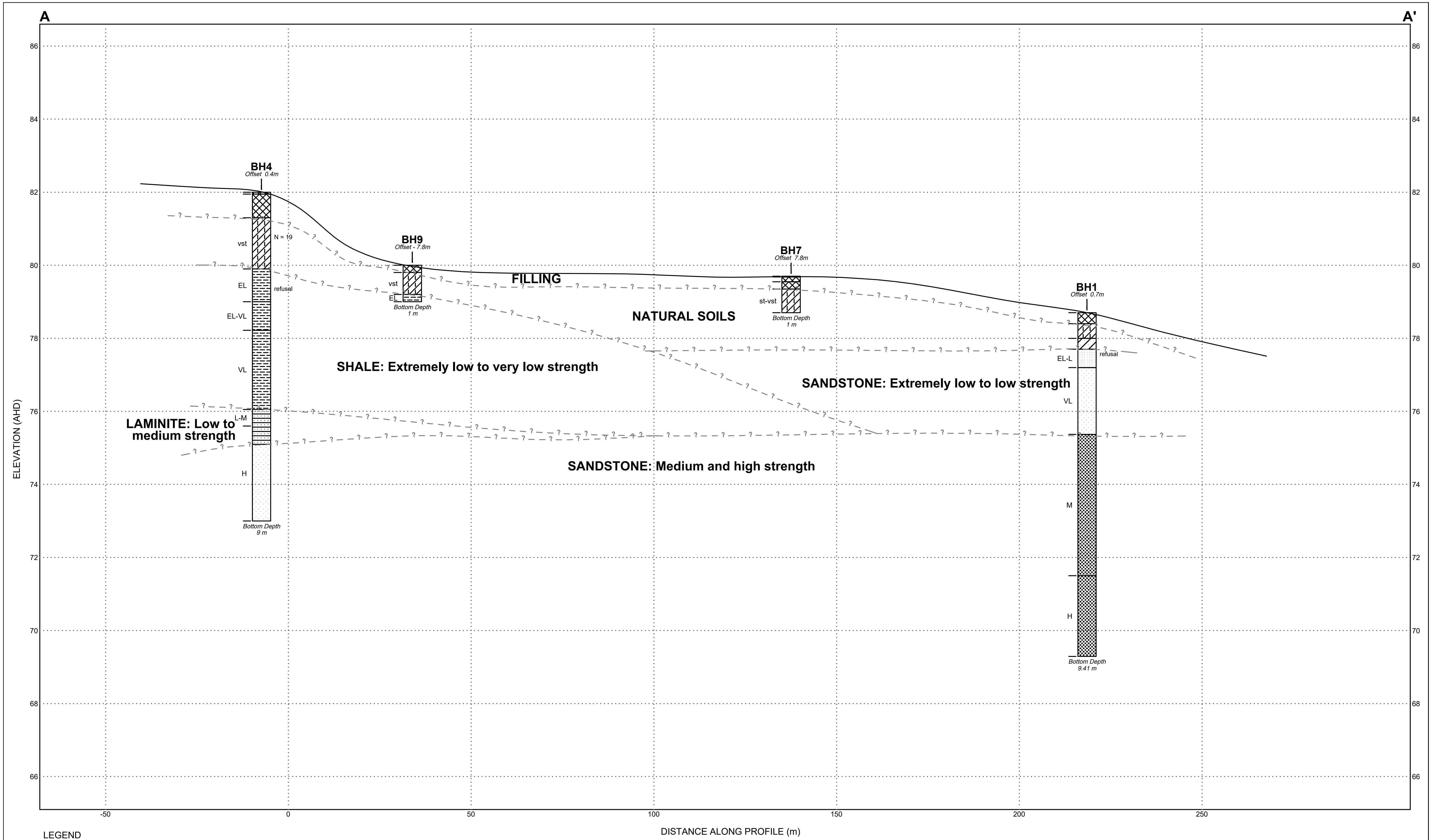
Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Winston Langley Pty Limited
OFFICE: Sydney
DRAWN BY: MG
SCALE: 1:600 @ A3
DATE: 04.03.2022

TITLE: **Location of Tests**
Proposed Low-Density Residential Development
146 Vimiera Road, MARSFIELD

N

PROJECT No: 213200.00
DRAWING No: 1
REVISION: 0



LEGEND

▨	Filling	☐	Sandstone fine grained	■	Asphaltic Concrete
▨	Silty Clay	▩	Sandstone coarse grained		
▨	Sandy Clay	▤	Shale		
☐	Sandstone	▤	Laminite		

NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard

TESTS / OTHER
N - Standard penetration test value
▽ - Water level

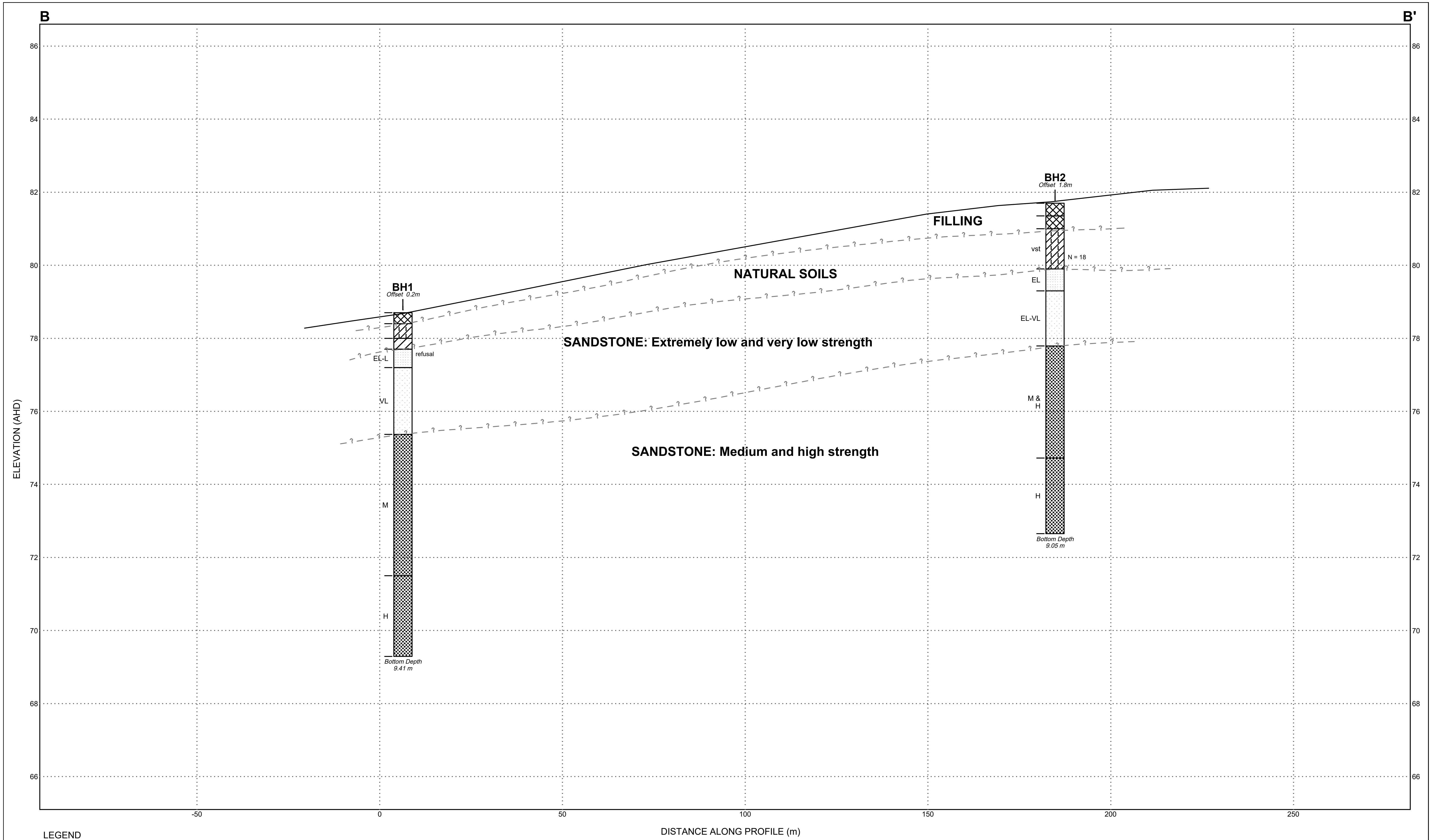
0 20
Horizontal Scale (metres)
Vertical Exaggeration = 10.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Winston Langley Pty Limited
OFFICE: Sydney
DRAWN BY: MG
SCALE: 1:1000 (H) 1:100 (V) @ A3
DATE: 04.03.2022

TITLE: **Interpreted Geotechnical Cross Section A-A'**
Proposed Low-Density Residential Development
146 Vimiera Road, MARSFIELD

PROJECT No: 213200.00
DRAWING No: 2
REVISION: 0



LEGEND

▩ Filling	☐ Sandstone fine grained
▨ Silty Clay	▦ Sandstone coarse grained
▨ Sandy Clay	
☐ Sandstone	

NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
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TESTS / OTHER
N - Standard penetration test value
▽ - Water level

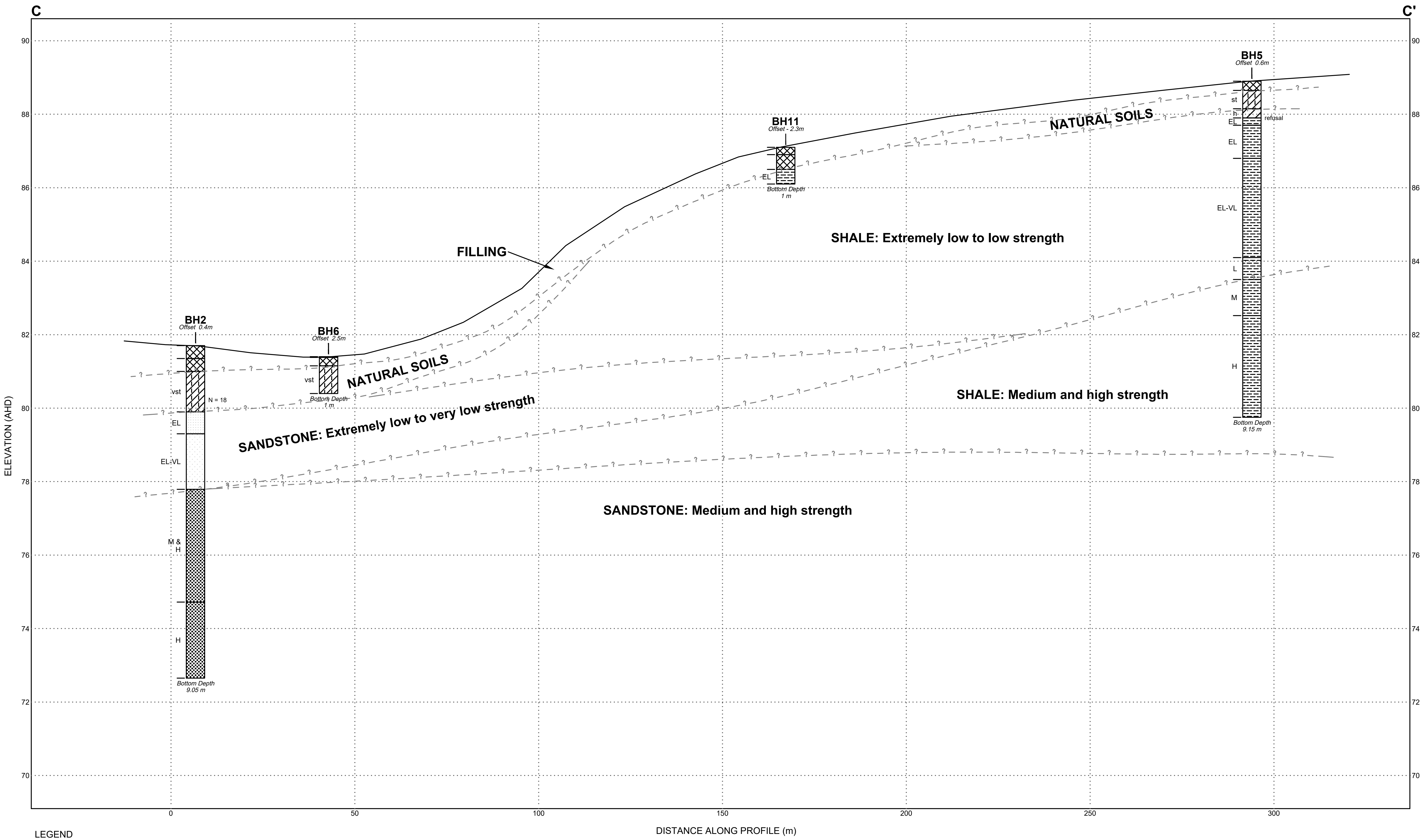
0 20
Horizontal Scale (metres)
Vertical Exaggeration = 10.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Winston Langley Pty Limited
OFFICE: Sydney
DRAWN BY: MG
SCALE: 1:1000 (H) 1:100 (V) @ A3
DATE: 04.03.2022

TITLE: **Interpreted Geotechnical Cross Section B-B'**
Proposed Low-Density Residential Development
146 Vimiera Road, MARSFIELD

PROJECT No: 213200.00
DRAWING No: 3
REVISION: 0



LEGEND

- ▨ Filling
- ▤ Shale
- ▨ Silty Clay
- ░ Sandstone
- ☐ Sandstone fine grained
- ▩ Sandstone coarse grained
- ▧ Sandy Clay
- ■ Asphaltic Concrete

NOTE:

1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

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SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard

TESTS / OTHER
N - Standard penetration test value
⊻ - Water level

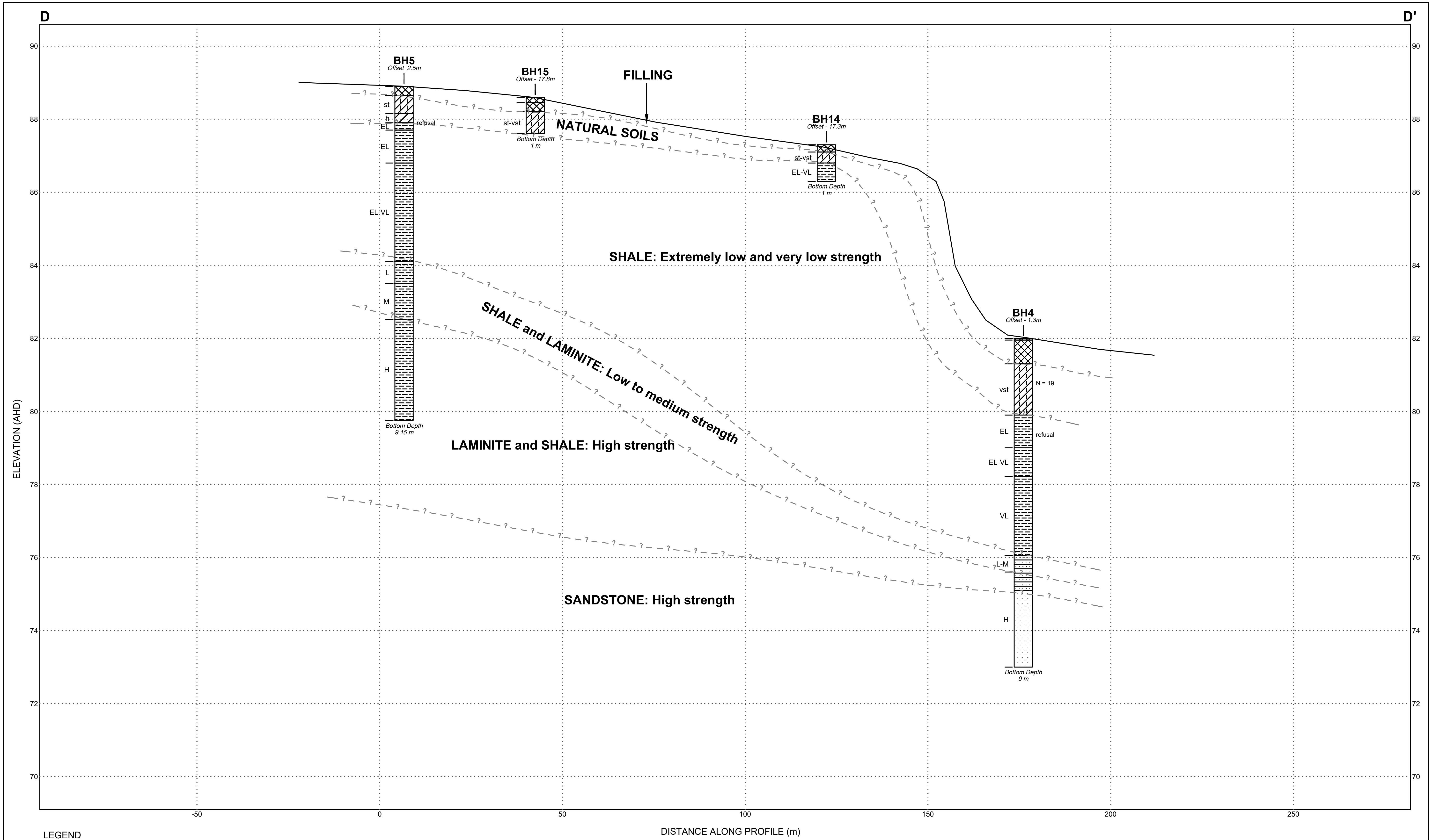
0 20
Horizontal Scale (metres)
Vertical Exaggeration = 10.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Winston Langley Pty Limited
OFFICE: Sydney
DRAWN BY: MG
SCALE: 1:1000 (H) 1:100 (V) @ A3
DATE: 04.03.2022

TITLE: **Interpreted Geotechnical Cross Section C-C'**
Proposed Low-Density Residential Development
146 Vimiera Road, MARSFIELD

PROJECT No: 213200.00
DRAWING No: 4
REVISION: 0



LEGEND

▨ Filling	☐ Sandstone fine grained
▨ Silty Clay	▨ Sandy Clay
▤ Shale	
▤ Laminite	

NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

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H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard

TESTS / OTHER
N - Standard penetration test value
▽ - Water level

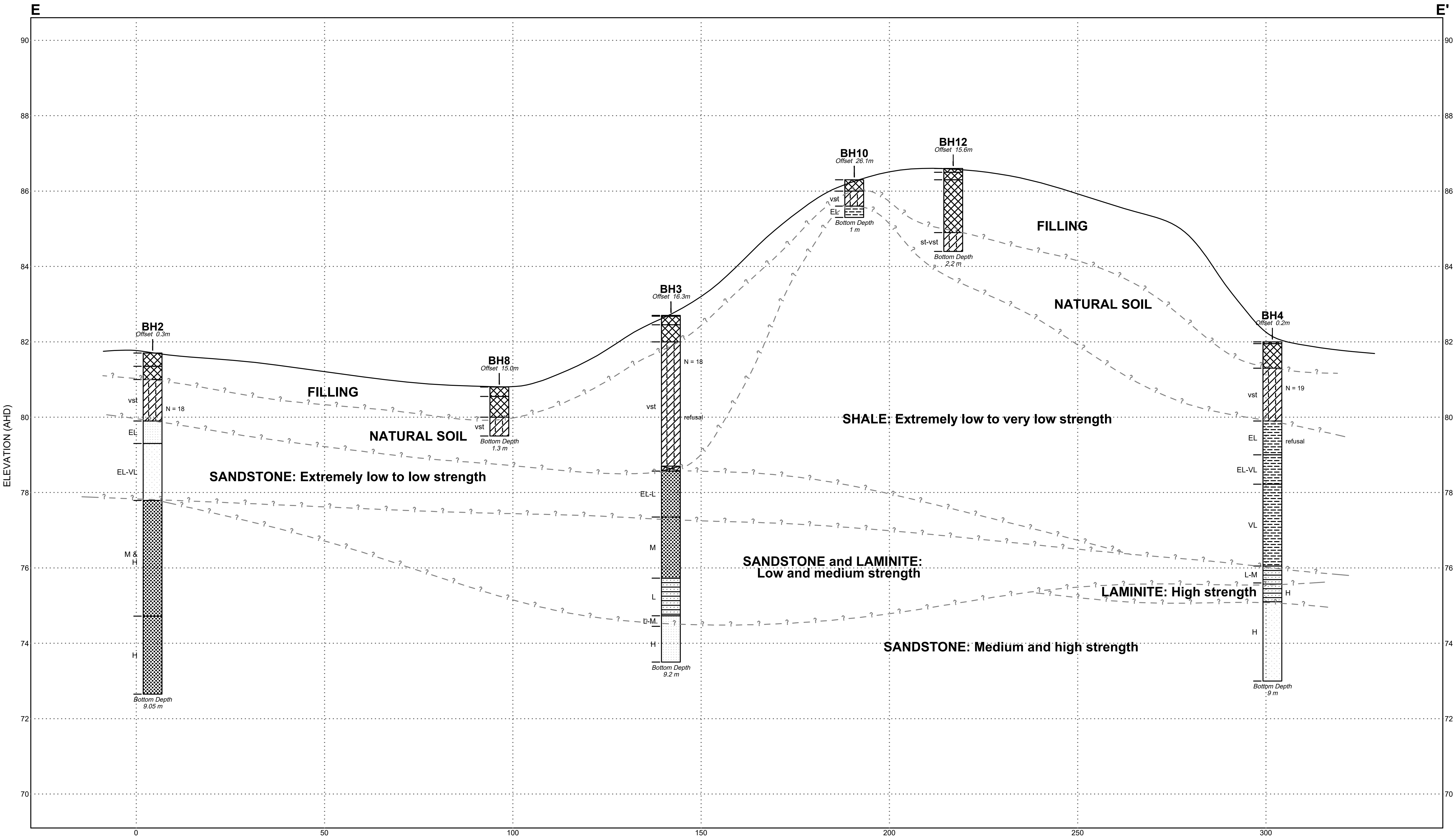
0 20
Horizontal Scale (metres)
Vertical Exaggeration = 10.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Winston Langley Pty Limited
OFFICE: Sydney
DRAWN BY: MG
SCALE: 1:1000 (H) 1:100 (V) @ A3
DATE: 04.03.2022

TITLE: **Interpreted Geotechnical Cross Section D-D'**
Proposed Low-Density Residential Development
146 Vimiera Road, MARSFIELD

PROJECT No: 213200.00
DRAWING No: 5
REVISION: 0



DISTANCE ALONG PROFILE (m)

LEGEND

☒	Core Loss	☐	Sandstone	▨	Silty Clay
■	Asphaltic Concrete	▩	Sandstone coarse grained		
▩	Filling	☐	Sandstone fine grained		
▤	Laminite	▤	Shale		

NOTE:
1. Subsurface conditions are accurate at the borehole locations only and variations may occur away from the borehole locations.
2. Strata layers and rock classification shown are generalised and each layer can include bands of lower or higher strength rock and also bands of less or more fractured rock.
3. Summary logs only. Should be read in conjunction with detailed logs.

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L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard

TESTS / OTHER
N - Standard penetration test value
≚ - Water level

0 20
Horizontal Scale (metres)
Vertical Exaggeration = 10.0

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Winston Langley Pty Limited		TITLE: **Interpreted Geotechnical Cross Section E-E'**	PROJECT No: 213200.00
OFFICE: Sydney	DRAWN BY: MG	**Proposed Low-Density Residential Development**	DRAWING No: 6
SCALE: 1:1000 (H) 1:100 (V) @ A3	DATE: 04.03.2022	**146 Vimiera Road, MARSFIELD**	REVISION: 0

Appendix C

Borehole Logs

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 Descriptions

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:

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

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

May 2017

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

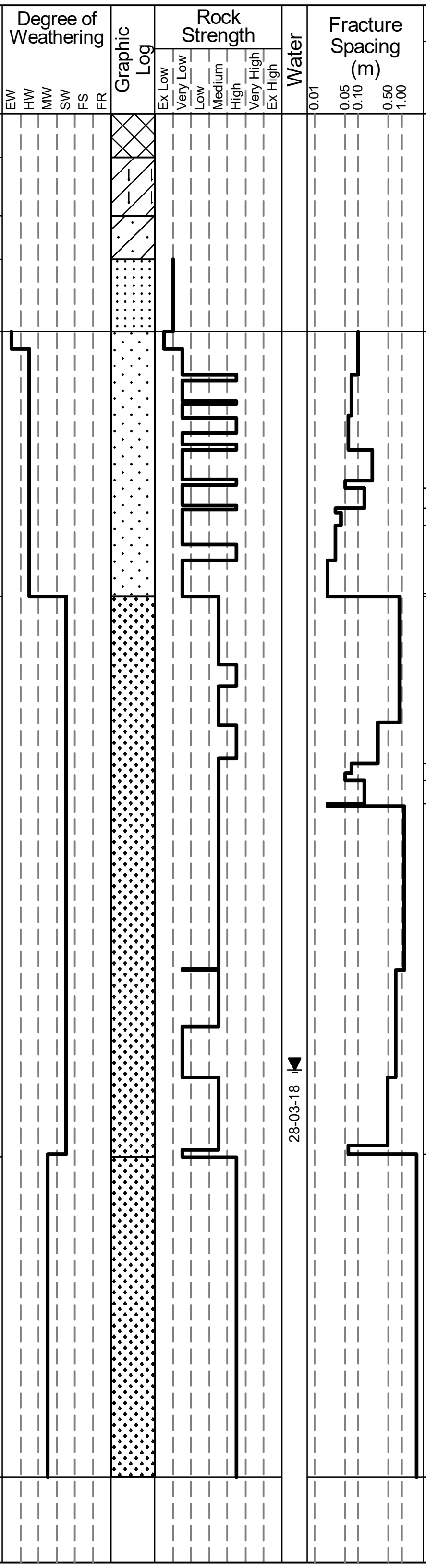
▨	Granite
▨	Dolerite, basalt, andesite
▨	Dacite, epidote
▨	Tuff, breccia
▨	Porphyry

BOREHOLE LOG

CLIENT: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 78.7 AHD
EASTING: 323833
NORTHING: 6260949
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 1 OF 1



RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
	0.3	FILLING - dark brown silty sand (topsoil) filling with some rootlets, humid		E			PID<1
78	0.7	SILTY CLAY - brown silty clay, moist	Unless otherwise stated rock is fragmented along planar bedding, dipping 0-10°	E			PID<1
	1.0	SANDY CLAY - red brown sandy clay with some ironstone gravel, moist		E			PID<1
	1.5	SANDSTONE - extremely low to low strength, extremely weathered grey and red brown sandstone		S			15,25 refusal
77 76	3.33	SANDSTONE - very low strength fractured and slightly fractured pale grey and red brown, fine grained sandstone with some medium and high strength iron-cemented bands	1.5 to 1.8m: B(x3), 0-5°, fe, cly 1.8 to m2.08m: B(x4) 0-5°, fe, cly 2.08 to 2.32m: B(x4), 0°, ro, pl, fe, cly 2.53m: B0°, ro, pl, fe, cly 2.58m: B18°, pl, fe, cly 2.72m: B5°, pl, fe, cly 2.84m: B0°, pl, fe, cly 2.84 to 3.08m: B(x7), 0-5°, pl, fe, cly 3.31m: B0°,pl, cly vn 3.33m: B0°, pl, cly	C	100	0	PL(A) = 2.4 PL(A) = 2.4
75 74 73 72	7.2	SANDSTONE - medium strength, slightly weathered, slightly fractured and unbroken, light grey to red brown medium grained sandstone	4.2m: B0°, pl, cly 4.41m: B5°, pl, ro, cly vn 4.48 to 4.55m: Ds 4.6m: B20°, pl, ro, cly vn 4.76 to 4.78m: B20°, pl, ro, fe, cly vn 5.9 to 5.93m: Ds 6.65 to 6.7m: J30°, ro, un, cly 5mm 7.12m: B15°, ro, pl, cly 3mm 7.18m: B15°, ro, pl, cly 5mm	C	100	85	PL(A) = 0.4 PL(A) = 1 PL(A) = 0.7 PL(A) = 0.8
71 70	9.41	SANDSTONE - high strength, moderately weathered, unbroken brown, medium to coarse grained sandstone		C	100	98	PL(A) = 1.6 PL(A) = 1.2 PL(A) = 0.8
69		Bore discontinued at 9.41m Limit of Investigation					

RIG: Comacchio GEO 305 **DRILLER:** LC **LOGGED:** RB/SI **CASING:** HW to 1.2m

TYPE OF BORING: Solid flight auger 0-1m (TC bit); Rotary 1-1.5m; NMLC Coring 1.5m-9.41m

WATER OBSERVATIONS: Free groundwater observed at 6.6m on 28 March 2018

REMARKS: Standpipe installed to 9.3m; Gravel 1.8-9.3m; Bentonite 0.7-1.8m; Machine slotted screen 1.5-9.3m

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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BORE: 1 PROJECT: MARSFIELD MARCH 2018

1.5 – 6.0m

BORE: 1 PROJECT: MARSFIELD MARCH 2018

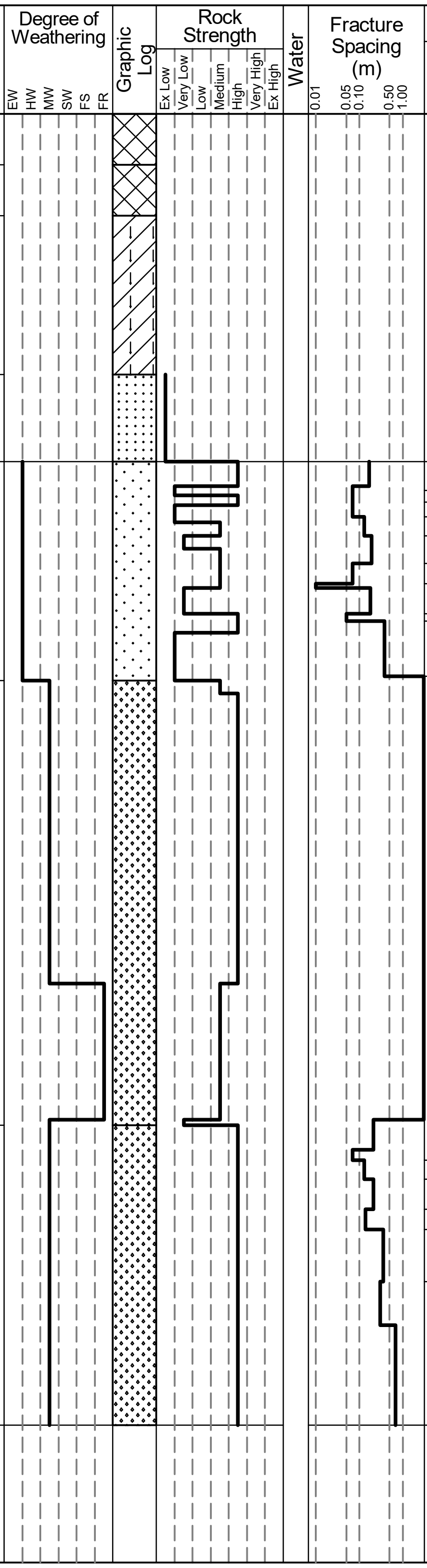
6.0 – 9.41m

BOREHOLE LOG

CLIENT: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 81.7 AHD
EASTING: 323937
NORTHING: 6261094
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 213200.00
DATE: 14/3/2018
SHEET 1 OF 1



Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
0.35	FILLING - dark brown sandy clay filling with some sandstone gravel, moist		E			PID<1
0.7	FILLING - dark brown silty clay filling with some sand and sandstone gravel, moist		E			PID<1
1.8	SILTY CLAY - very stiff grey and red brown silty clay with some ironstone sand, moist	Unless otherwise stated rock is fragmented along rough planar bedding, dipping 0-10°	E S			PID<1 8,7,11 N = 18
2.4	SANDSTONE - extremely low strength, extremely weathered grey and red brown sandstone with some ironstone gravel bands					
3.91	SANDSTONE - extremely low to very low strength, extremely to highly weathered, fractured and slightly fractured, light grey and red brown, fine grained sandstone with some medium and high strength iron-cemented bands	2.57m: B5°, fe 2.6 to 2.63m: Cs 2.68m: J45°, pl, ro, fe, cly 2.78m: B5°, fe, cly 2.91 to 2.95m: Ds 3.1 to 3.2m: J 710°, pl, ro, fe 3.24 to 3.27m: fg, fe 3.45m: B10°, fe, cly 3.5 to 3.58m: J 85°, un, ro, cly partially healed 3.88 to 3.91m: Cs	C	100	30	PL(A) = 1.2
6.98	SANDSTONE - medium and high strength, moderately weathered then fresh unbroken, brown then light grey, medium grained sandstone		C	100	100	PL(A) = 1 PL(A) = 1.1 PL(A) = 1.2 PL(A) = 0.8
9.05	SANDSTONE - high strength, moderately weathered, fractured to slightly fractured brown medium grained sandstone	6.94 to 6.98m: Ds 7.15m: J 25° & 75°, st, ro, cln partially healed 7.22 to 7.3m: J45° &070°, st, ro, fe, partially healed 7.3 to 7.6m: J075°, un, ro, fe 7.56m: J 45°, & 80°, st, ro, partially healed 7.7 to 7.95m: J 75°, pl, ro, fe 8.06 and 8.36m: B 10°, fe, cly vn	C	10	98	PL(A) = 1.7 PL(A) = 2.4 PL(A) = 1.3
	Bore discontinued at 9.05m Limit of Investigation					

RIG: Scout 1 **DRILLER:** SS **LOGGED:** RB/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC bit) to 2.4m; NMLC Coring to 9.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD2 taken at 0.05-0.1m

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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BORE: 2 PROJECT: MARSFIELD MARCH 2018

2.4 – 6.0m

BORE: 2 PROJECT: MARSFIELD MARCH 2018

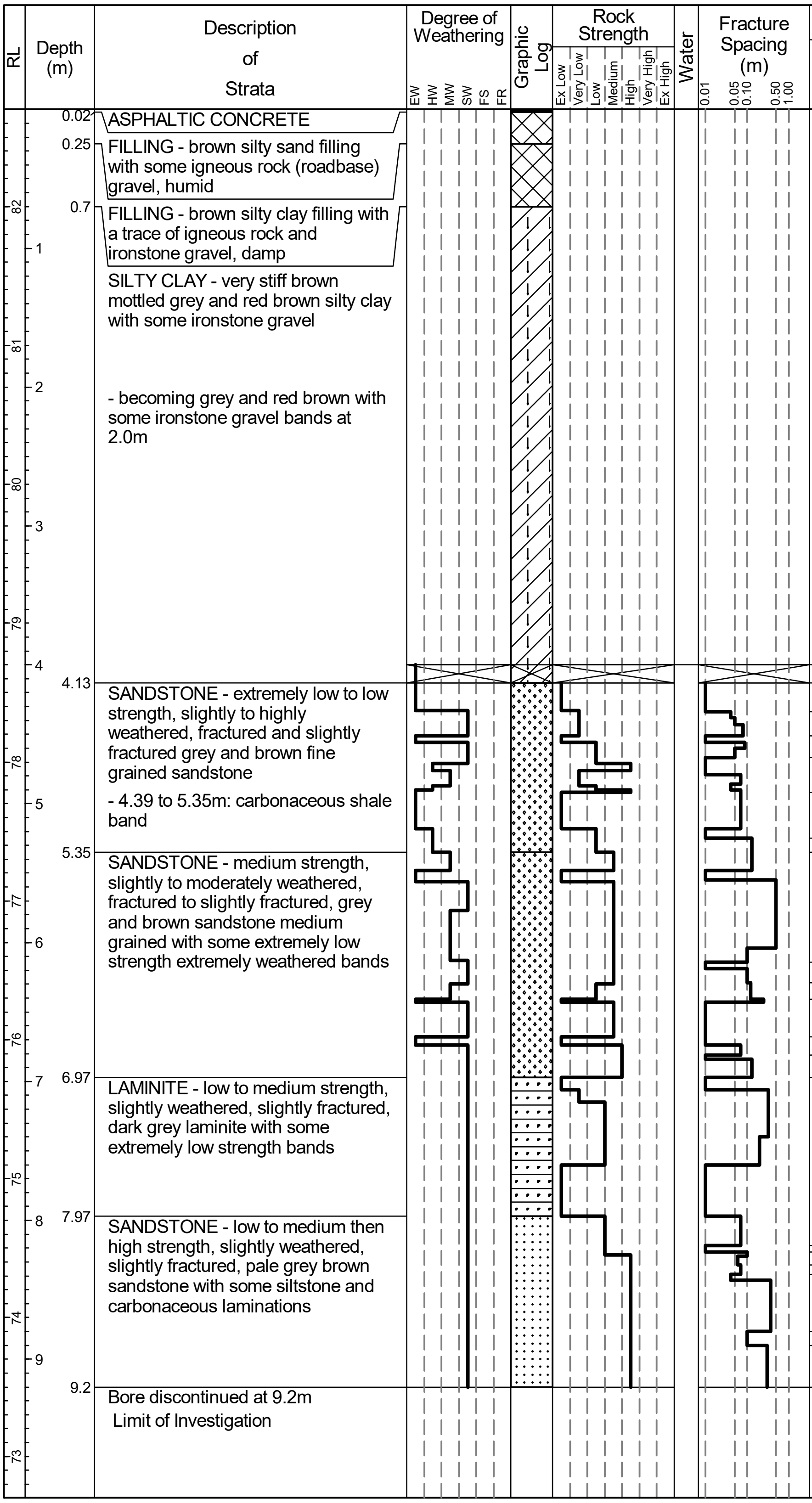
6.0 – 9.05m

BOREHOLE LOG

CLIENT: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 82.7 AHD
EASTING: 323985
NORTHING: 6260964
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 213200.00
DATE: 14/3/2018
SHEET 1 OF 1



Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
0.02	ASPHALTIC CONCRETE		E			PID<1
0.25	FILLING - brown silty sand filling with some igneous rock (roadbase) gravel, humid		*E			PID<1
0.7	FILLING - brown silty clay filling with a trace of igneous rock and ironstone gravel, damp		E			PID<1
	SILTY CLAY - very stiff brown mottled grey and red brown silty clay with some ironstone gravel		S			4,9,9 N = 18
	- becoming grey and red brown with some ironstone gravel bands at 2.0m	Unless otherwise stated rock is fragmented along planar bedding, dipping 0-10°	S			8,14,15/100mm refusal
4.13	SANDSTONE - extremely low to low strength, slightly to highly weathered, fractured and slightly fractured grey and brown fine grained sandstone - 4.39 to 5.35m: carbonaceous shale band	4m: CORE LOSS: 130mm 4.13 to 4.33m: Ds 4.34 to 4.49m: J 80° cly 4.51 to 56m: Ds 4.67 to 4.79m: B(x7) 4.86m: B 0°, cly ct 20mm 4.92 to 5.18m: Ds 5.25 to 5.34m: J70°	C	94	30	PL(A) = 1.4
5.35	SANDSTONE - medium strength, slightly to moderately weathered, fractured to slightly fractured, grey and brown sandstone medium grained with some extremely low strength extremely weathered bands	5.35m: B 0°, cly cr 10mm 5.48 to 5.55m: Ds 6.04m: B 0°, cly cr 10mm 6.14 to 6.15m: B(x3) 6.29m: B 15° fe 6.41 to 6.43m: Ds 6.68 to 6.74m: Ds 6.81 to 6.84m: B(x3)				PL(A) = 1
6.97	LAMINITE - low to medium strength, slightly weathered, slightly fractured, dark grey laminite with some extremely low strength bands	6.97 to 7.06m: Ds 7.6 to 7.97m: Ds	C	100	60	PL(A) = 1 PL(A) = 0.2 PL(A) = 0.5
7.97	SANDSTONE - low to medium then high strength, slightly weathered, slightly fractured, pale grey brown sandstone with some siltstone and carbonaceous laminations	8.11m: B 0°, pl, ro, cly 1mm 8.18m: B 0°, pl, ro, cly 5mm 8.23 to 8.26m: B(x3) 0°, pl, fe, cly 1-5mm 8.32m: B 15°, pl, ro, fe, cly 5mm 8.39m: B 0°, pl, ro, cly 5mm 8.8m: B 0°, pl, ro cly 10mm 8.9m: B °, pl, ro, cly 4mm				PL(A) = 0.2 PL(A) = 1.7
9.2	Bore discontinued at 9.2m Limit of Investigation					

RIG: Scout 1 **DRILLER:** SS **LOGGED:** RB **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger (TC bit) to 2.5; Rotary 2.5-4.0m; NMLC Coring 9.2m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: *BD1 taken at 0.0-0.6m

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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BORE: 3 PROJECT: MARSFIELD MARCH 2018

4.0 – 8.0m

BORE: 3 PROJECT: MARSFIELD MARCH 2018

8.0 – 9.2m

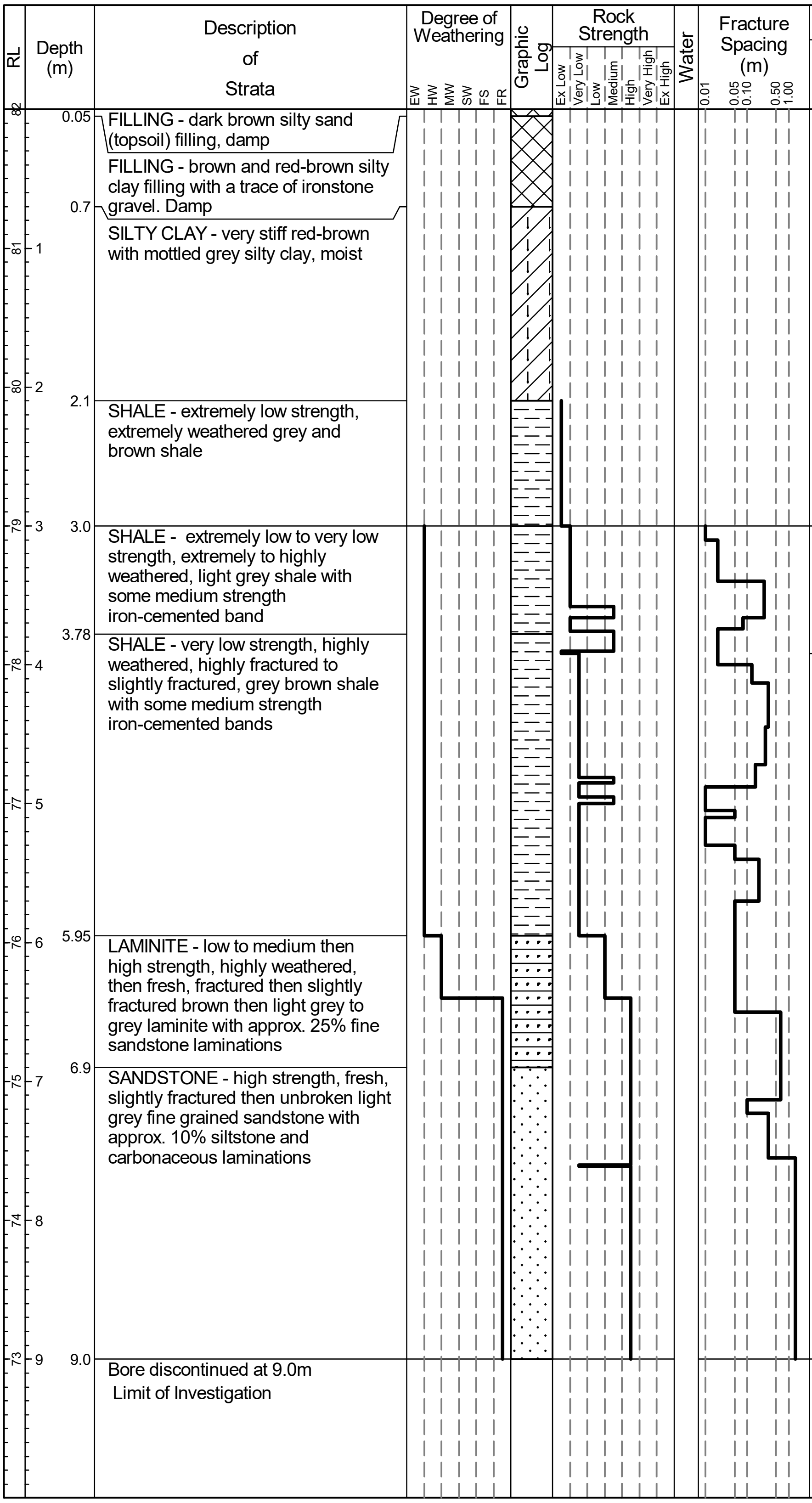
BOREHOLE LOG

CLIENT: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 82.0 AHD
EASTING: 324007
NORTHING: 6260805
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
82	0.05	FILLING - dark brown silty sand (topsoil) filling, damp		E			PID<1
	0.7	FILLING - brown and red-brown silty clay filling with a trace of ironstone gravel. Damp		E			PID<1
	2.1	SILTY CLAY - very stiff red-brown with mottled grey silty clay, moist	Unless otherwise stated rock is fragmented along planar bedding, dipping 0-10°	E S			PID<1 5,8,11 N = 19
	3.0	SHALE - extremely low strength, extremely weathered grey and brown shale		S			20,25/130 refusal
	3.78	SHALE - extremely low to very low strength, extremely to highly weathered, light grey shale with some medium strength iron-cemented band	3.4m: J 80°, un, ro, cly 3.66 and 3.74m: Cs, 15mm 3.92m: J 80°, pl, ro, fe	C	100	0	PL(A) = 0.7
	5.95	SHALE - very low strength, highly weathered, highly fractured to slightly fractured, grey brown shale with some medium strength iron-cemented bands	4.13m: J 45°, pl, sm, fe 4.45m: J 30°, pl, ro, fe, cly 5.12 to 5.3m: st, ro, cly 5.4 to 5.5m: B 0°, fe 5.7m: J 45°, pl, ro, fe				
	6.9	LAMINITE - low to medium then high strength, highly weathered, then fresh, fractured then slightly fractured brown then light grey to grey laminite with approx. 25% fine sandstone laminations	5.95 to 6.4m: B's 0°, fe, cly 6.45, 6.5m: & 7.2m: B(x3) 0°, cly co	C	100	48	PL(A) = 0.3 PL(A) = 2.1
	9.0	SANDSTONE - high strength, fresh, slightly fractured then unbroken light grey fine grained sandstone with approx. 10% siltstone and carbonaceous laminations	7.55m: B 0°, fg, cly 10mm	C	100	99	PL(A) = 2.6 PL(A) = 2.6
		Bore discontinued at 9.0m Limit of Investigation					



RIG: Scout 1 **DRILLER:** SS **LOGGED:** RB/SI **CASING:** HW to 2.5m
TYPE OF BORING: Solid flight auger (TC bit) to 2.5m; Rotary 2.5-3.0m; NMLC Coring to 9.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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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BORE: 4 PROJECT: MARSFIELD MARCH 2018

3.0 – 7.0m

BORE: 4 PROJECT: MARSFIELD MARCH 2018

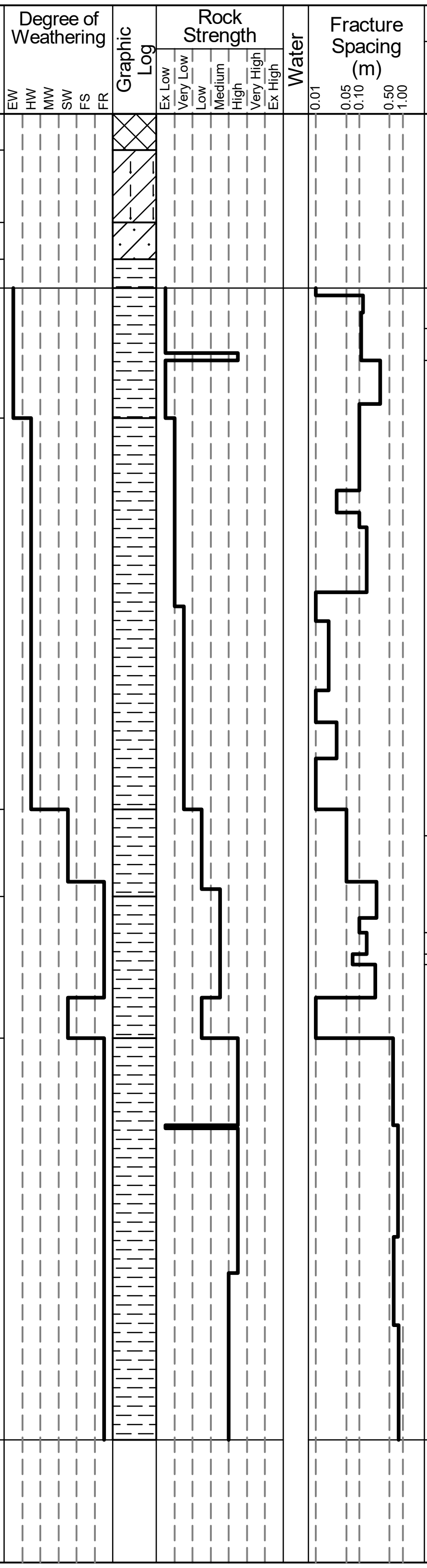
8.0 – 9.0m

BOREHOLE LOG

CLIENT: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 88.9 AHD
EASTING: 324148
NORTHING: 6260899
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 1 OF 1



RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
	0.25	FILLING - dark brown silty clay filling with some sand and rootlets with grass cover, moist	Unless otherwise stated rock is fragmented along rough planar bedding, dipping 0-10°	E			PID<1
	0.75	SILTY CLAY - stiff brown silty clay with some sand and gravel, damp		E			PID<1
88	1 / 1.0	SANDY CLAY - hard light grey sandy clay, damp		E S			PID<1 25/90 refusal
	1.2	SHALE - extremely low strength, light grey shale					
87	2 / 2.1	SHALE - extremely low strength, extremely weathered, light grey shale 1.65m: high strength iron cemented band	1.2 to 1.25m: fg 1.37 to 1.45m: J80°, un, ro, cln 1.48m: J 45°, pl, ro, cln 1.7m: B 0°, fe, cly 2m: J 60°, un, ro, cln	C	100	0	PL(A) = 2.1
86 85	3 4 4.8	SHALE - extremely low to very low strength, highly weathered, fragmented and highly fractured grey brown to dark grey-brown shale with some fine sandstone laminations	2.6 to 2.75m: B's 0-5°, fe 3.3 to 3.5m: fg, fe 3.5 to 3.98m: B's 0°, fe, he 4.1 to 4.15m: Cs 4.45 to 4.8m: fg, fe	C C C	100 100 100	0 0 34	
84	5 5.4	SHALE - low strength, slightly weathered, fragmented to fractured grey brown shale	4.85 to 5.3m: B(x10) 0°, fe 3.98 to 4.0m: Cs				PL(A) = 0.2 PL(A) = 0.5
83	6 6.38	SHALE - medium strength, fresh, highly fractured to slightly fractured, dark grey shale	5.55m: J 30°, pl, ro, fe 5.65m: J 45°, pl, ro, cln 5.8m: J 30°, pl, sm, cln 5.87m: B 020, fg, 10mm 6.1 to 6.38m: fg				PL(A) = 0.9
82 81 80	7 8 9 9.15	SHALE - high, then medium to high strength, fresh, slightly fractured dark grey shale	6.38m: J 70°, pl, ro, cln 6.98m: B 0°, cly 7.75m: B 0°, cly 5mm 8.36m: J 70°, pl, ro, cln	C	100	90	PL(A) = 1.9 PL(A) = 1.6 PL(A) = 0.8 PL(A) = 1.1
79		Bore discontinued at 9.15m Limit of Investigation					

RIG: Scout 1 **DRILLER:** SS **LOGGED:** RB/SI **CASING:** HW to 1.0m
TYPE OF BORING: Solid flight auger (TC bit) to 1.0m; Rotary 1.0-1.2m; NMLC Coring to 9.15m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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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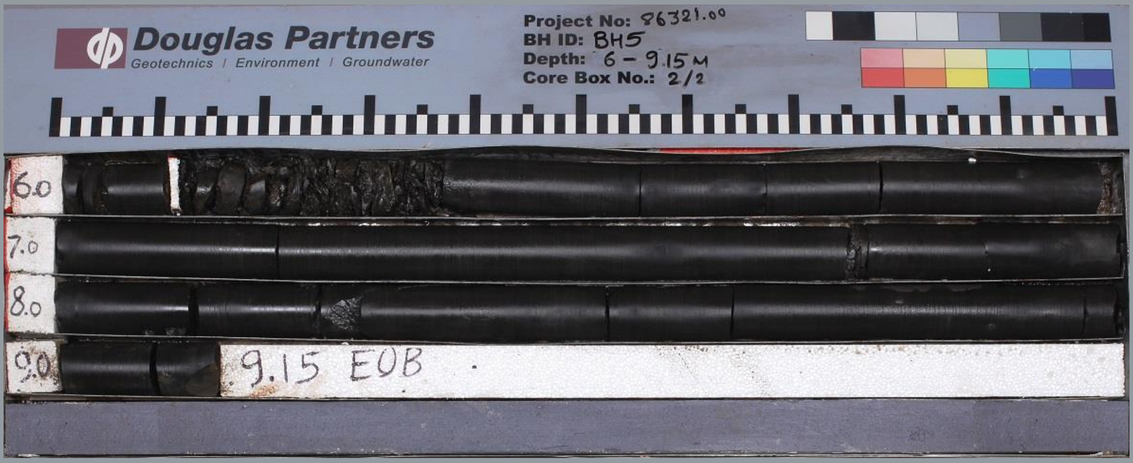
BORE: 5 PROJECT: MARSFIELD MARCH 2018

1.2 – 6.0m

BORE: 5 PROJECT: MARSFIELD MARCH 2018



6.0 – 9.15m

BOREHOLE LOG

CLIENT: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 81.4 AHD
EASTING: 323965
NORTHING: 6261071
DIP/AZIMUTH: 90°/--

BORE No: BH6
PROJECT No: 213200.00
DATE: 16/3/2018
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
	0.018	ASPHALTIC CONCRETE										
		FILLING - brown silty sand filling with some igneous rock gravel, moist										
	0.25	SILTY CLAY - very stiff brown mottled grey and red brown silty clay with some ironstone gravel, moist							E			PID<1
									E			PID<1
81												
		-0.7m: becoming mottled red brown										
	1 1.0	Bore discontinued at 1.0m Limit of Investigation										
80												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil

TYPE OF BORING: Solid flight auger (TC bit) to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 79.7 AHD
EASTING: 323900
NORTHING: 6260903
DIP/AZIMUTH: 90°/--

BORE No: BH7
PROJECT No: 213200.00
DATE: 16/3/2018
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
	0.02	ASPHALTIC CONCRETE		■								
	0.15	FILLING - brown sandy (roadbase) gravel, damp		▨					E			PID<1
	0.35	FILLING - brown and grey silty clay filling with some sand and gravel, damp		▨					*E			PID<1
79	1.0	SILTY CLAY - stiff to very stiff brown silty clay with some ironstone gravel, damp - becoming grey mottled red-brown at 0.6m		▧					E			PID<1
78	1	Bore discontinued at 1.0m Limit of Investigation										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil

TYPE OF BORING: Solid flight auger (TC bit) to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD4 taken at 0.2-0.3m

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 80.8 AHD
EASTING: 323973
NORTHING: 6261008
DIP/AZIMUTH: 90°/--

BORE No: BH8
PROJECT No: 213200.00
DATE: 16/3/2018
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
		FILLING - brown silty clay (topsoil) filling with some rootlets, with trace of plaster and glass with grass cover, damp							E			PID<1
	0.25	FILLING - brown silty clay filling, moist							*E			PID<1
80	0.8	SILTY CLAY - very stiff brown mottled red brown and grey silty clay, moist							E			PID<1
	1											
	1.3	Bore discontinued at 1.3m Limit of Investigation										
79												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil

TYPE OF BORING: Solid flight auger (TC bit) to 1.3m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD3 taken at 0.4-0.5m

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 80.0 AHD
EASTING: 323970
NORTHING: 6260825
DIP/AZIMUTH: 90°/--

BORE No: BH9
PROJECT No: 213200.00
DATE: 16/3/2018
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
80		FILLING - brown silty sand filling with some igneous rock gravel and a trace of concrete rubble, damp							E			PID<1
	0.2	SILTY CLAY - very stiff brown mottled grey silty clay with some ironstone gravel, damp							E			PID<1
	0.8	SHALE - extremely low strength, extremely weathered grey and brown shale										
79	1 1.0	Bore discontinued at 1.0m Limit of Investigation										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil
TYPE OF BORING: Solid flight auger (TC bit) to 1.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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

BOREHOLE LOG

CLIENT: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.3 AHD
EASTING: 324006
NORTHING: 6260919
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 213200.00
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Test Results & Comments
	0.0	FILLING - brown medium grained silty sand (topsoil) filling with some rootlets and grass cover, damp	E	PID<1
86	0.3	SILTY CLAY - very stiff, grey mottled red-brown silty clay with some ironstone gravel, damp	E	PID<1
	0.7	SHALE - extremely low strength, grey and brown shale with some ironstone bands		
	1.0	Bore discontinued at 1.0m Limit of Investigation		
85				

Degree of Weathering: EW HW MW SW FS FR

Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High

Fracture Spacing (m): 0.01 0.05 0.10 0.50 1.00

Discontinuities: B - Bedding J - Joint S - Shear F - Fault

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil

TYPE OF BORING: Solid flight auger (TC bit) to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 87.1 AHD
EASTING: 324053
NORTHING: 6260983
DIP/AZIMUTH: 90°/--

BORE No: BH11
PROJECT No: 213200.00
DATE: 16/3/2018
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
87		FILLING - brown silty clay (topsoil) filling with some rootlets and grass cover, damp		☒					E			PID<1
	0.2	FILLING - brown and grey silty clay filling with some sand and ironstone gravel, damp		☒					E			PID<1
	0.6	SHALE - extremely low strength, grey and brown shale with some low to medium strength bands		☰					E			PID<1
86	1 1.0	Bore discontinued at 1.0m Limit of Investigation										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil
TYPE OF BORING: Solid flight auger (TC bit) to 1.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.6 AHD
EASTING: 324002
NORTHING: 6260891
DIP/AZIMUTH: 90°/--

BORE No: BH12
PROJECT No: 213200.00
DATE: 21/3/2018
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
	0.1	FILLING- brown silty clay (topsoil) filling with some sand and rootlets with grass cover, damp							E			PID<1 PID<1
	0.3	FILLING - grey sandy igneous rock gravel filing, damp							E			
86		FILLING - brown and grey silty clay filling with a trace of igneous rock and ironstone gravel, damp							E			PID<1
	1											
85									E			PID<1
	1.7	SILTY CLAY - stiff to very stiff grey mottled brown and red brown silty clay with some ironstone gravel, damp										
	2								A			PID<1
	2.2	Bore discontinued at 2.2m Limit of Investigation										
84												
	3											
83												
	4											
82												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil
TYPE OF BORING: Solid flight auger (TC bit) to 2.2m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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:	Winston Langley Pty Limited	**SURFACE LEVEL:**	87.7 AHD	**BORE No:**	BH13
PROJECT:	Proposed Low-Density Residential Development	**EASTING:**	324055	**PROJECT No:**	213200.00
LOCATION:	146 Vimiera Road, Marsfield	**NORTHING:**	6260940	**DATE:**	21/3/2018
		DIP/AZIMUTH:	90°/--	**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
		FILLING - brown silty clay (topsoil) filling with some sand, and rootlets with grass cover, damp							E			PID<1
	0.15	FILLING - brown silty clay filling with some sand and ironstone gravel, damp							E*			PID<1
	0.4	FILLING - brown and red brown silty clay filling with a trace of sand and ironstone gravel, damp							E			PID<1
87	0.5	SILTY CLAY - stiff to very stiff grey mottled red brown silty clay with some ironstone gravel, damp										
86	1 1.0	Bore discontinued at 1.0m Limit of Investigation										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil

TYPE OF BORING: Solid flight auger (TC bit) to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD1 taken at 0.2-0.3m

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 87.3 AHD
EASTING: 324042
NORTHING: 6260849
DIP/AZIMUTH: 90°/--

BORE No: BH14
PROJECT No: 213200.00
DATE: 21/3/2018
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
		FILLING - brown silty clay (topsoil) filling with some rootlets and grass cover, damp							E			PID<1
87	0.2	SILTY CLAY - stiff to very stiff silty clay with some ironstone gravel, damp							E			PID<1
	0.5	SHALE - extremely low to very low strength, light grey shale										
	1 1.0	Bore discontinued at 1.0m Limit of Investigation										
86												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil

TYPE OF BORING: Solid flight auger (TC bit) to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 88.6 AHD
EASTING: 324107
NORTHING: 6260895
DIP/AZIMUTH: 90°/--

BORE No: BH15
PROJECT No: 213200.00
DATE: 21/3/2018
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
		FILLING - brown silty clay (topsoil) filling with some rootlets and grass, damp		▩					E			PID<1
	0.15	FILLING - brown medium grained sand filling, damp		▩								
	0.4	SILTY CLAY - stiff to very stiff, grey mottled red brown silty clay with some ironstone gravel, damp		▨					E			PID<1
88												
	1 1.0	Bore discontinued at 1.0m Limit of Investigation							A			
87												

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil
TYPE OF BORING: Solid flight auger (TC bit) to 1.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 79.6 AHD
EASTING: 323890
NORTHING: 6260957
DIP/AZIMUTH: 90°/--

BORE No: BH16
PROJECT No: 213200.00
DATE: 23/3/2018
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
		FILLING- brown medium grained sand (topsoil) filling with some rootlets and grass cover, damp										
	0.3	FILLING - brown and grey medium to coarse grained sand filling, moist							E			PID<1
79	0.5	FILLING - grey coarse igneous rock gravel filling with some brown medium grained sand, damp							E			PID<1
78	0.7 1	Bore discontinued at 0.7m - Refusal of hand auger in filling										

RIG: Scout 1 **DRILLER:** SS **LOGGED:** JS **CASING:** Nil
TYPE OF BORING: Hand auger to 0.7m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 79.7 AHD
EASTING: 323914
NORTHING: 6260995
DIP/AZIMUTH: 90°/--

BORE No: BH17
PROJECT No: 213200.00
DATE: 23/3/2018
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
		FILLING - brown silty sand (topsoil) filling with some rootlets and grass cover, damp		▨					E			PID<1
	0.25	FILLING - brown medium grained filling, damp to moist		▨					E			PID<1
	0.5	FILLING - grey coarse igneous rock gravel filling with some brown medium grained sand, damp		▨								
79												
	0.8	Bore discontinued at 0.8m - Refusal of hand auger in filling										
	1											
78												

RIG: Hand auger **DRILLER:** JS **LOGGED:** JS **CASING:** Nil
TYPE OF BORING: Hand auger to 0.8m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 85.9 AHD
EASTING: 323972
NORTHING: 6260872

PIT No: TP1 CH0
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - dark brown silty clay (topsoil) filling with some rootlets, with a trace of sandstone gravel, damp							
				D	0.2		PID<1		
	0.3	ASPHALTIC CONCRETE		S	0.3		PID<1		
	0.4	SILTY CLAY - red mottled grey silty clay with some ironstone gravel with trace of charcoal and rootlets, damp			0.4				
85				D	0.9		PID<1		
	1				1.0				1
84									
	2								2

RIG: 13 T Excavator, 900 mm wide bucket
LOGGED: NW
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 85.9 AHD
EASTING: 323972
NORTHING: 6260872

PIT No: TP1 CH0
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Sampling & In Situ Testing: Depth	Sampling & In Situ Testing: Sample	Sampling & In Situ Testing: Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		SILTY CLAY - red mottled grey silty clay with some ironstone gravel with trace of charcoal and rootlets, damp *(continued)*							
83	3								3
82	4			D	3.9 4.0		PID<1		4
81	5.0	- bucket refusal on extremely low strength shale							
		Pit discontinued at 5.0m							

RIG: 13 T Excavator, 900 mm wide bucket

LOGGED: NW

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.0 AHD
EASTING: 323989
NORTHING: 6260871

PIT No: TP1 CH10
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Sampling & In Situ Testing: Depth	Sampling & In Situ Testing: Sample	Sampling & In Situ Testing: Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
86		FILLING - dark brown silty clay (topsoil) filling with some rootlets and igneous gravel, damp	▩	D	0.2		PID<1		
	0.3	ASPHALTIC CONCRETE	■	D*	0.3		PID<1		
	0.4	SILTY CLAY - red, mottled grey, silty clay with some ironstone gravel, damp	▨		0.4				
				D	0.9		PID<1		
85	1 1.0	Pit discontinued at 1.0m Limit of Investigation			1.0				1
84	2								2

RIG: 13 T Excavator, 900 mm wide bucket
LOGGED: NW
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD1/20180315 taken at 0.2-0.3m

☐ 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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.3 AHD
EASTING: 323998
NORTHING: 6260869

PIT No: TP1 CH20
PROJECT No: 213200.00
DATE: 15/3/2018
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) 5 10 15 20
		FILLING - dark brown silty clay (topsoil) filling with some rootlets and igneous gravel, damp	▨						
			▨	D	0.2 0.3		PID<1		
86			▨						
	0.4	SILTY CLAY - red mottled grey silty clay with some ironstone gravel and shale gravel, damp	▨						
			▨	D	0.9 1.0		PID<1		
	1 1.0	Pit discontinued at 1.0m Limit of Investigation							1
85									
	2								2
84									

RIG: 13 T Excavator, 900 mm wide bucket

LOGGED: NW

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.4 AHD
EASTING: 324005
NORTHING: 6260861

PIT No: TP1 CH30
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Sampling & In Situ Testing: Depth	Sampling & In Situ Testing: Sample	Sampling & In Situ Testing: Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING - dark brown silty clay (topsoil) filling with some igneous gravel and rootlets, damp		D	0.2 0.3		PID<1		
86	0.4	SILTY CLAY - red, mottled grey silty clay with some ironstone gravel and shale gravel, damp		D	0.9 1.0		PID<1		
	1 1.0	Pit discontinued at 1.0m Limit of Investigation							1
85									
	2								2
84									

RIG: 13 T Excavator, 900 mm wide bucket

LOGGED: NW

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.5 AHD
EASTING: 324013
NORTHING: 6260849

PIT No: TP1 CH40
PROJECT No: 213200.00
DATE: 15/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
				Type	Depth	Sample	Results & Comments		
		FILLING - dark brown silty clay (topsoil) filling with some igneous gravel, damp			0.2 0.3		PID<1		
86	0.4	SILTY CLAY - red, mottled grey silty clay with some shale gravel and ironstone gravel, damp			0.9 1.0		PID<1		
	1 1.0	Pit discontinued at 1.0m Limit of Investigation							1
85									
	2								2

RIG: 13 T Excavator, 900 mm wide bucket

LOGGED: NW

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.6 AHD
EASTING: 324022
NORTHING: 6260841

PIT No: TP1 CH50
PROJECT No: 213200.00
DATE: 15/3/2018
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) 5 10 15 20
		FILLING - dark brown silty clay (topsoil) filling with some rootlets and igneous gravel, damp		D	0.2 0.3		PID<1		
86	0.4	SILTY CLAY - red, mottled grey silty clay with some ironstone gravel and shale gravel		D	0.9 1.0		PID<1		
	1 1.0	Pit discontinued at 1.0m Limit of Investigation							1
85									
	2								2

RIG: 13 T Excavator, 900 mm wide bucket
LOGGED: NW
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 86.8 AHD
EASTING: 324014
NORTHING: 6260917

PIT No: TP2 CH0
PROJECT No: 213200.00
DATE: 26/3/2018
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) 5 10 15 20
		FILLING - dark brown silty clay (topsoil) filling with some ironstone gravel and grass rootlets, damp		D*	0.2 0.3		PID<1		
86	0.4	SHALE - extremely low strength, grey shale with some ironstone bands, damp		D	0.9 1.0		PID<1		
	1 1.0	Pit discontinued at 1.0m Limit of Investigation							1
85	2								2

RIG: 9 T Excavator, 450 mm wide bucket **LOGGED:** NW **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD1/20180326 taken from 0.2 - 0.3m

☐ 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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 87.0 AHD
EASTING: 324022
NORTHING: 6260911

PIT No: TP2 CH10
PROJECT No: 213200.00
DATE: 26/3/2018
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) 5 10 15 20
87		FILLING - dark brown silty clay (topsoil) filling with some grass rootlets, ironstone gravel, damp	▨	D	0.2 0.3		PID<1		
	0.3	ASPHALTIC CONCRETE	■						
	0.35	SILTY CLAY - red, mottled grey silty clay with some ironstone gravel, damp	▨	D	0.9 1.0		PID<1		
86	1 1.0	Pit discontinued at 1.0m Limit of Investigation							1
85	2								2

RIG: 9 T Excavator, 450 mm wide bucket **LOGGED:** NW **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 87.1 AHD
EASTING: 324032
NORTHING: 6260900

PIT No: TP2 CH20
PROJECT No: 213200.00
DATE: 26/3/2018
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) 5 10 15 20
		FILLING - dark brown silty clay (topsoil) filling with some grass rootlets, ironstone gravel, damp							
87									
				D	0.2		PID<1		
	0.3	ASPHALTIC CONCRETE			0.3				
	0.35	SILTY CLAY - red, mottled grey silty clay with some ironstone gravel, with a trace of rootlets, damp							
				D	0.8		PID<1		
	0.9	Pit discontinued at 0.9m Limit of Investigation			0.9				
	1								1
86									
	2								2
85									

RIG: 9 T Excavator, 450 mm wide bucket
LOGGED: NW
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 87.2 AHD
EASTING: 324049
NORTHING: 6260896

PIT No: TP2 CH30
PROJECT No: 213200.00
DATE: 26/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
87		FILLING - dark brown silty clay (topsoil) filling with some grass rootlets, damp		D	0.2 0.3		PID<1		
	0.3	ASPHALTIC CONCRETE							
	0.35	SILTY CLAY - grey, mottled red silty clay with some ironstone gravel, damp		D	0.8 0.9		PID<1		
	0.9	Pit discontinued at 0.9m Limit of Investigation							
86	1								1
85	2								2

RIG: 9 T Excavator, 450 mm wide bucket

LOGGED: NW

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 87.4 AHD
EASTING: 324056
NORTHING: 6260880

PIT No: TP2 CH40
PROJECT No: 213200.00
DATE: 26/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
				Type	Depth	Sample	Results & Comments		
		FILLING - dark brown silty clay (topsoil) filling with some grass rootlets and sand, damp	▩	D*	0.2 0.3		PID<1		
87	0.4	FILLING - light brown sand filling	▩	D	0.5 0.6		PID<1		
	0.6	SHALE - grey shale with some ironstone bands	▤	D	0.8 0.9		PID<1		
	0.9	Pit discontinued at 0.9m Limit of Investigation							
	1								1
86									
	2								2
85									

RIG: 9 T Excavator, 450 mm wide bucket **LOGGED:** NW **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD2/20180326 taken from 0.2 - 0.3m

☐ 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: Winston Langley Pty Limited
PROJECT: Proposed Low-Density Residential Development
LOCATION: 146 Vimiera Road, Marsfield

SURFACE LEVEL: 87.5 AHD
EASTING: 324063
NORTHING: 6260878

PIT No: TP2 CH50
PROJECT No: 213200.00
DATE: 26/3/2018
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) 5 10 15 20
		FILLING - dark brown silty clay (topsoil) filling with some grass rootlets, damp	⊠	D	0.1 0.2		PID<1		
	0.2	SHALE - extremely low strength, grey shale with some ironstone bands	☰	D	0.4 0.5		PID<1		
87									
	0.6	Pit discontinued at 0.6m Limit of Investigation							
	1								1
86									
	2								2

RIG: 9 T Excavator, 450 mm wide bucket **LOGGED:** NW **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	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

Appendix D

Laboratory Test Results

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 187860

Client Details

Client	Douglas Partners Pty Ltd
Attention	accounts email, Peter Valenti
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86321.00, Eastwood**
Number of Samples	2 Soil
Date samples received	22/03/2018
Date completed instructions received	22/03/2018

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.

Report Details

Date results requested by	29/03/2018
Date of Issue	26/03/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

David Springer, General Manager

Misc Inorg - Soil			
Our Reference		187860-1	187860-2
Your Reference	UNITS	BH3	BH4
Depth		2.5-2.95	1.0-1.45
Date Sampled		14/03/2018	15/03/2018
Type of sample		Soil	Soil
Date prepared	-	23/03/2018	23/03/2018
Date analysed	-	23/03/2018	23/03/2018
pH 1:5 soil:water	pH Units	4.9	5.0
Electrical Conductivity 1:5 soil:water	µS/cm	21	63
Chloride, Cl 1:5 soil:water	mg/kg	<10	28
Sulphate, SO4 1:5 soil:water	mg/kg	24	58

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

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			23/03/2018	[NT]	[NT]	[NT]	[NT]	23/03/2018	[NT]
Date analysed	-			23/03/2018	[NT]	[NT]	[NT]	[NT]	23/03/2018	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	93	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	88	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	99	[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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

Appendix E

Extracts from ECRL Report 2008 and TfNSW Standard 2016

02 Apr 08 - 17:12

PRL_GD_02482.dwg

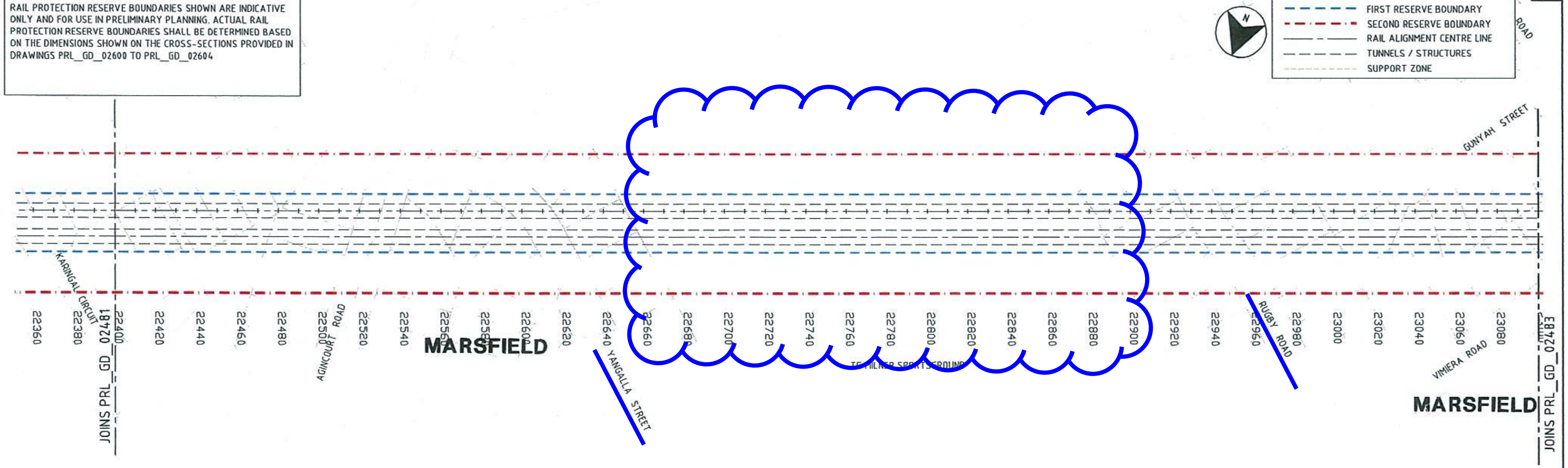
A3

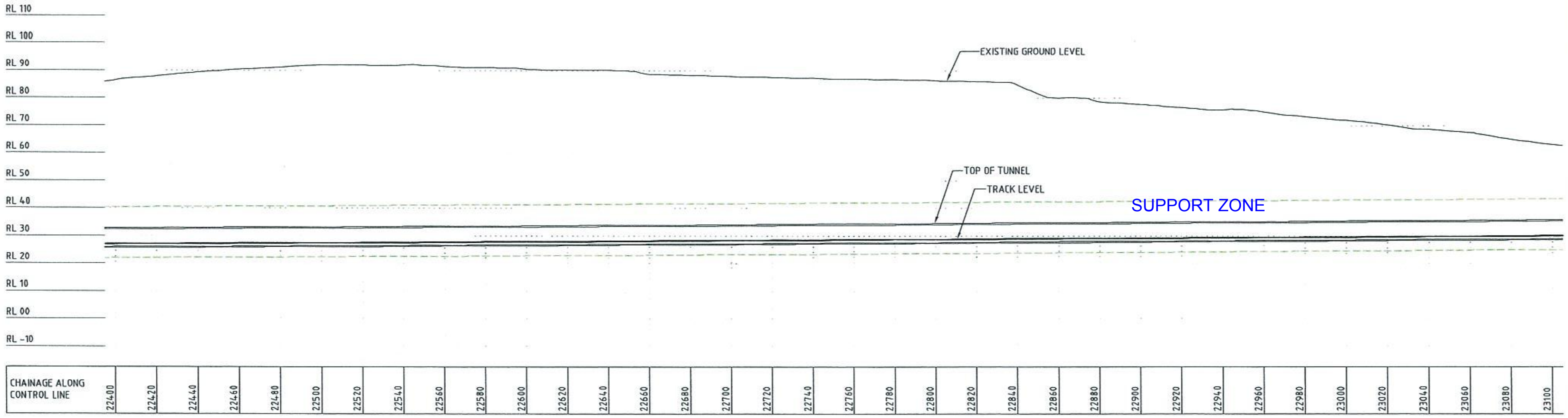
NOTE:

RAIL PROTECTION RESERVE BOUNDARIES SHOWN ARE INDICATIVE ONLY AND FOR USE IN PRELIMINARY PLANNING. ACTUAL RAIL PROTECTION RESERVE BOUNDARIES SHALL BE DETERMINED BASED ON THE DIMENSIONS SHOWN ON THE CROSS-SECTIONS PROVIDED IN DRAWINGS PRL_GD_02600 TO PRL_GD_02604

LEGEND

- FIRST RESERVE BOUNDARY
- SECOND RESERVE BOUNDARY
- RAIL ALIGNMENT CENTRE LINE
- TUNNELS / STRUCTURES
- SUPPORT ZONE





LONGITUDINAL SECTION DOWN TRACK DESIGN CENTRELINE

No.	BY	DATE	DESCRIPTION	APPD
B	DS	02.04.08	FINAL ISSUE	
A	PVM	21.12.07	DRAFT ISSUE FOR REPORT	

THE INFORMATION SHOWN ON THIS DRAWING IS FOR THE PURPOSES OF THE NORTH SYDNEY STATION UPGRADE PROJECT ONLY. NO WARRANTY IS GIVEN OR IMPLIED AS TO ITS SUITABILITY FOR ANY OTHER PURPOSE.

DESIGNED	AJL	CHECKED	JJA
DRAWN	PVM	CHECKED	AJL
APPROVED	AJL	DATE	

SCALES:

10 0 10 20 30 40 50m

1:2000 GENERAL SCALE FULL SIZE A3

7.5 0 7.5 15 22.5 30

1:1500 VERTICAL SCALE FOR LONG SECTION FULL SIZE A3

CONTRACTOR:

DESIGNER:

MAUNSELL | AECOM

Maunsell Australia Pty Ltd
A.B.N. 20 093 846 925

CLIENT:

Transport Infrastructure

RAILCORP EDMS ID --

ECRL DEVELOPMENT GUIDE LINES

RAIL PROTECTION RESERVES
PLAN
SHEET 16 OF 20

STATUS: FINAL

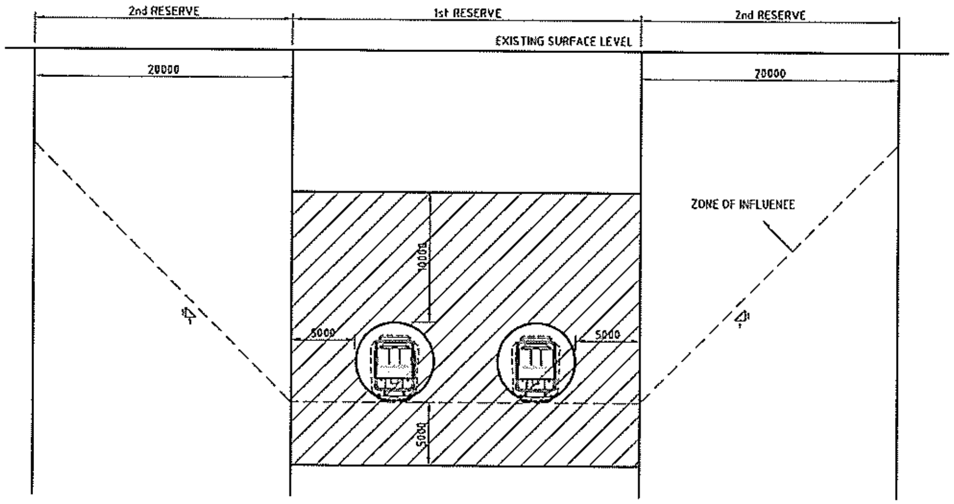
DRAWING NO: PRL GD 02482

REV: B

04 Apr 08 - 09:26

PRL_GD_02600Ev3

A3



LEGEND

▨ SUPPORT ZONE

B	DS	02.04.08	FINAL ISSUE	
A	PVH	21.12.07	DRAFT ISSUE FOR REPORT	
No.	BY	DATE	DESCRIPTION	APPD

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DESIGNED	A.R.	CHECKED	JJA
DRAWN	PVH	CHECKED	A.R.
APPROVED	A.R.	DATE	

SCALES:
2 0 2 4 6 8 10m
1:400 FULL SIZE A3

CONTRACTOR:

DESIGNER:
MAUNSELL | AECOM
Maunsell Australia Pty Ltd
A.B.N. 20 093 846 925

CLIENT:
Transport Infrastructure

RAILCORP EDMS ID --

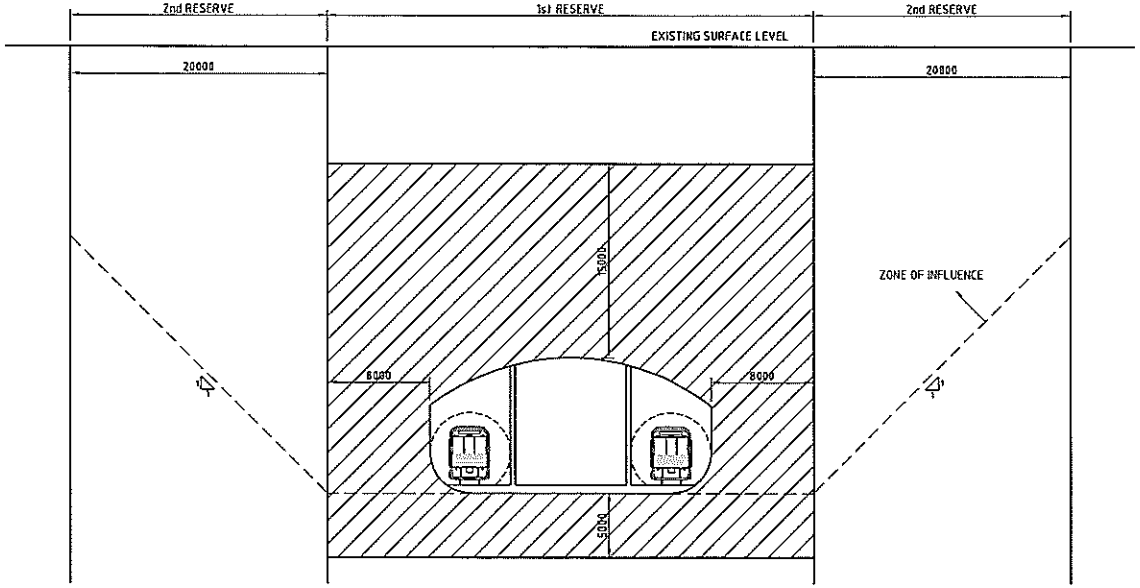
ECRL DEVELOPMENT GUIDE LINES

RAIL PROTECTION RESERVES
CROSS SECTION
RUNNING TUNNELS

STATUS: FINAL
DRAWING No: PRL_GD_02600
REV: B

PRL_GD_02601.dwg 04 Apr 08 - 09:26

A3



LEGEND

▨ SUPPORT ZONE

No.	BY	DATE	DESCRIPTION	APPD
B	DS	02.04.08	FINAL ISSUE	
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DESIGNED	AJL	CHECKED	JJA
DRAWN	PVH	CHECKED	AJL
APPROVED	AJL	DATE	

SCALES:
2 0 2 4 6 8 10m
1 : 400 FULL SIZE A3

CONTRACTOR:

DESIGNER:
MAUNSELL | AECOM
Maunsell Australia Pty Ltd
A.B.N. 20 093 846 925

CLIENT:
Transport Infrastructure

RAILCORP EDMS ID --

ECRL DEVELOPMENT GUIDE LINES

RAIL PROTECTION RESERVES
CROSS SECTION
CROSS OVER STRUCTURES

STATUS: FINAL
DRAWING No: PRL GD 02601
REV: B