

Report on GEOTECHNICAL STUDY PROPOSED DEBIE RESIDENCE 118 COONDAREE PARADE, UPPER SWAN

Submitted to:

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1. INTRODUCTION

This report presents the outcomes of Galt Geotechnics Pty Ltd's (Galt's) geotechnical study for the proposed Debie residence at 118 Coondaree Parade, Upper Swan (the "site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

The study was authorised by Daniel Baines on behalf of ISMART Building Group for Emerald Building Solutions Pty Ltd (EBS) in an email dated 20 February 2017.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Number 118 is roughly triangular in plan with an area of about 27.1 ha. The ground surface slopes up from about RL 35.0 m AHD in the western corner from Coondaree Parade to greater than RL 100 m AHD (limit of supplied survey plan) to the east of the proposed residence. The proposed residence is to be located part-way up the slope in the north-western part of the lot.

The site of the proposed residence comprises generally open ground covered with low vegetation, trees and numerous boulders/rock outcrops at the surface.

Supplied information shows that the ground surface in the area of the proposed residence slopes from about RL 76.5 m AHD in the south eastern corner to about RL 68.5 m AHD in the north-west corner.

Based on drawings provided, we understand that the residence is to be about 41 m long by 20 m wide in plan, with the longest side aligned in a north west to south east direction. Other details of the proposed residence are as follow:

- consists of a single storey structure supported on a steel framed structure; and
- it is elevated up to about 4.0 m to 4.5 m above the ground surface.

We assume the residence will be supported on a system of steel columns founded on shallow pad footings.

Drawings provided are presented in Appendix A, Supplied Drawings.

3. PROJECT OBJECTIVES

The objectives of the study were to:

- assess subsurface soil and groundwater conditions across the site;
- provide recommendations on suitable footing systems for the proposed development;
- provide a site classification(s) in accordance with AS 2870-2011 "Residential Slabs and Footings";
- provide recommendations and geotechnical design parameters for earth retaining structures; and
- recommend appropriate site preparation procedures including excavation, fill, drainage and compaction criteria.

4. FIELDWORK

Fieldwork was carried out on 28 February 2017 and comprised:

- a site walkover, including taking photographs of the site;
- excavation of test pits at six locations (TP01 to TP06), extending to depths of between 0.4 m and 2.4 m; and
- collection of samples for inspection and possible laboratory testing.



General

A geotechnical engineer from Galt positioned the tests, conducted the site walkover, observed the test pitting, logged the materials encountered in the test pits, and collected samples for inspection and possible laboratory testing.

Photographs of the site are presented in Appendix B, Site Photographs.

Test locations were selected and positioned using a handheld GPS accurate to about 5 m in the horizontal plane. The approximate test locations are shown on Figure 1, Site and Location Plan.

Details of the tests are summarised in Table 1: Summary of Tests.

Table 1: Summary of Tests

Test Name	Test Depth (m)	Depth to Groundwater ¹ (m)	Reason for Termination	Stratigraphy
TP01	2.2	GNE	Target depth	Silty SAND/Clayey SAND overlying
TP02	2.0	GNE	Refusal	Sandy CLAY/CLAY overlying Sandy
TP03	2.4	GNE	Refusal	CLAY/Clayey SAND
TP04	0.4	GNE	Refusal	Silty SAND overlying Gravelly Clayey
TP04A	0.5	GNE	Refusal	SAND
TP05	1.8	GNE	Refusal	Silty SAND/Clayey SAND overlying
TP06	2.0	GNE	Target depth	Sandy CLAY/CLAY overlying Sandy CLAY/Clayey SAND

Notes: 1. GNE: Groundwater not encountered.

Test Pits

Test pits were excavated using an 8 tonne, JCB 3CX tractor mounted backhoe equipped with a 0.6 m rock bucket, supplied and operated by ANH Contracting. Test pit reports are presented in Appendix C, Test Pit Reports, along with a method of soil description and a list of explanatory notes and abbreviation used on the reports. A photograph of the spoil recovered from each test pit is included on each test pit report.

5. LABORATORY TESTING

Laboratory testing was undertaken by Liquid Labs WA in their NATA accredited laboratory. The testing comprised determination of:

- particle size distribution on two samples; and
- Atterberg limits and linear shrinkage on two samples.

Laboratory test results along with the test methods followed are presented in Appendix D, Laboratory Test Results and summarised in Table 2: Summary of Laboratory Test Results.

Table 2: Summary of Laboratory Test Results

Test Location	Depth (m)	Unified Soils Classification	% Gravel	% Sand	% Fines	LL (%)	PL (%)	PI (%)	LS (%)
TP01	0.7 – 0.9	СН	8	27	65	69	17	52	16.0
TP06	0.8 – 1.0	СН	1	29	70	75	17	58	15.0

Notes: LL: Liquid Limit PL: Plasticity Limit PI: Plasticity Index LS: Linear Shrinkage



6. SITE CONDITIONS

6.1 Geology

The Perth sheet of the 1:50,000 scale Environmental Geology series map indicates that the area of the residence is underlain by GRANITE described as "mesocratic, fine to coarse-grained, ranges in composition from granodiorite to granite, adamellite being commonest variety".

6.2 Surface Conditions

A significant area of relatively steeply sloped ground is present at the rear of the proposed residence. It appears that cobble and boulder sized rock fragments have and are still gravitating down the slope. Numerous cobble and boulder sized rock fragments were noted to be present across the site. The gravitation process is likely to be assisted by sheet flows over the surface following a rain event.

6.3 Subsurface Conditions

Based on the soils encountered in the test pits, we have interpreted the subsurface conditions to be broadly consistent across the site, and the generalised subsurface conditions to comprise:

- TOPSOIL: Silty SAND, fine to medium grained, grey/brown, trace roots, present from the surface to depths ranging from about 0.1 m to 0.2 m; overlying
- Silty SAND/Clayey SAND (SM/SC), fine to coarse grained, brown/grey, with gravel, cobbles and boulders, extending to depths of between about 0.4 m to 0.6 m; overlying
- Sandy CLAY/CLAY (CI/CH), medium to high plasticity, brown/orange mottled grey, trace gravel, extending to depths of between about 1.2 m to 1.6 m; overlying
- Sandy CLAY/Clayey SAND (CI/CH/SC), extremely to highly weathered rock, medium to high plasticity fines, fine to coarse grained, brown/orange/grey, with pockets of high plasticity clay, with dark grey lens, with highly to moderately weathered rock fragments (with rock structure), extending to the maximum depth investigated of 2.4 m.

6.4 Groundwater

We are not aware of any groundwater information that is available for the site as the Perth Groundwater Atlas (1997 & 2004 editions) do not extend to the site. However, given the elevation of the site we expect the groundwater table to be located at a significant depth. Notwithstanding this, we note that shallow perched water may develop on top of the clayey strata during and following periods of rainfall.

We did not encounter groundwater during the investigation.

We do not expect the static groundwater table to impact the proposed development, however, surface water run-off from the higher elevations and perched water on site must be taken into account for the proposed development.

7. GEOTECHNICAL ASSESSMENT

7.1 Site Classification

We consider that the proposed building envelope is geotechnically suitable for the proposed development, provided that the recommended site preparation measures are undertaken.



We have assessed the proposed building envelope in accordance with AS 2870-2011 "Residential Slabs and Footings" which defines the site classes as such in Table 3, Summary of Site Classifications (AS 2870-2011).

Table 3: Summary of Site Classifications (AS 2870-2011)

Class	Description	Characteristic Surface Movement (y _s)
А	Most sand and rock site with little or no ground movement from moisture change	Not Defined (typically <5 mm)
S	Slightly reactive clay sites with only slight ground movement from moisture changes	0 – 20 mm
M	Moderately reactive clay sites, which may experience moderate ground movements from moisture change	20 – 40 mm
H1	Highly reactive sites, which may experience high ground movements from moisture change	40 – 60 mm
H2	Highly reactive sites, which may experience very high ground movements from moisture change	60 – 75 mm
E	Extremely reactive sites, which may experience extreme ground movements from moisture change	>75 mm
Р	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise	Not Defined

We have assessed the site in accordance with AS 2870-2011 "Residential Slabs and Footings". We consider that a site classification of "Class H1" is appropriate provided that the site preparation measures in Section Error! Reference source not found. are undertaken.

Improvement of the building envelope to "Class M" is possible with importation and placement of inert sand (or gravel) fill to produce a total thickness of 0.6 m (*in situ* sand and inert fill) overlying clayey material.

Note: AS 2870 is limited to single to double storey residential structures with normal shallow footings with a maximum bearing pressure of 100 kPa. This must be taken into account by the structural designers.

7.2 Site Preparation

Clayey soils can perform poorly (with respect to bearing capacity, settlement under load and trafficability) when wet. The site preparation measures outlined below are aimed at preparation of the building envelope prior to construction of structures including on-ground slabs, shallow footings, retaining walls and pavement subgrades. Landscaped areas (if any) will not require this preparation.

The following site preparation measures must be followed:

- Strip and remove all vegetation and topsoil including removal of roots, loose boulders and cobbles from the building envelope and dispose of off-site.
- Excavate to the required level. Stockpile suitable excavated material for potential re-use as fill (see Section 7.6) and remove unsuitable or excess material off-site. Excavations should be battered in accordance with Section 7.7.
- Shape the site surface to drain away from building structures and prevent ponding with a minimum cross-fall slope of 1%. On the high side of the site, install cut off drains or sub-surface drainage to capture subsurface flows and dispose of clear of buildings. Water should be directed to discharge into an on-site drainage basin or the local authority's drainage system (subject to approval from the local authority).



- Moisture condition and compact *in situ* soil in accordance with and to the requirements of Section 7.5 to a minimum depth of 0.9 m below the base of the excavation (sandy soils) or 0.45 m (clayey soils). No compaction is required where rock is exposed. Any wet or soft areas not responding to the compaction should be excavated and replaced with approved clayey material compacted to the requirements of Section 7.5. Under no circumstances should a free draining granular material be used to backfill depressions in the clay surface as these are likely to fill with water and soften the surrounding clayey soil.
- Excavate for pad and strip footings and compact the exposed bases to achieve the level of compaction specified in Section 7.5 to a depth of at least 0.9 m below all footings (or 0.45 m for clayey soils). Remove, replace and compact as required any zone not achieving the level of compaction specified in Section 7.5.
- Any areas of loose, soft or unsuitable material must be removed and replaced with approved fill as outlined in Section 7.6.
- Where fill is required to build up levels, use approved fill (see Section 7.6), placed and compacted in layers of no greater than 300 mm loose thickness.

Compaction and trafficking of the clayey areas of the site must not be attempted when the site is wet (i.e. following rainfall or if the site has been over-wetted during moisture conditioning). It will be necessary to let the site dry out or trim wet soil off to expose underlying drier material. Attempting to traffic or compact the wet clayey soils is likely to result in soil disturbance and significant softening of the clayey soils.

Where excavation into the underlying soils occur, shaping of the clay must be done to grade the surface to collection points (perimeter ditches draining to a temporary sump) to help prevent standing water on the surface. A grade of at least 1% is recommended.

Note: The removal and/or breaking of large boulders is expected to be difficult.

7.3 Drainage Control

In addition to the site preparation measures outlined in Section 7.2, we recommend that measures should be made to control surface water flows and lessen the impact of water ingress on the clayey soils. These measures include:

- Any exposed clayey soils should be graded to drain away from structures and prevent standing water over the clayey soils. A grade of at least 1% is recommended.
- Pavements should be sealed to minimise water ingress.
- Stormwater should be disposed of into swales or similar located at least 10 m away from buildings, retaining walls and pavements.
- Runoff from upslope of the proposed residencemust either be collected and discharged via pipes into discrete locations (via swales or soakage basins) at least 10 m away from structures and pavements or alternatively discharged over a wide area, but not allowed to collect and discharge into concentrated areas near structures and pavements.

Note: The use of soak wells for the disposal of stormwater is NOT recommended unless at least 1.2 m of imported granular fill is placed on top of the clayey material.

7.4 Impact of Slope

As stated earlier cobble and boulder sized rock fragments can be expected to gravitate down the relatively steep slope behind the proposed residence. This process is likely to be exacerbated by surface sheet water flows occurring after a rain event. Gravitation of these rocks could potentially impact on the residence. We consider that measures should be put in place to capture any rock fragments upslope of the proposed residence.



A suitable measure would be to excavate a deep cut off trench across the slope. The material excavated should be placed on the downslope side of the trench to form a bund wall. The trench and bund wall should be at least 20 m upslope of the proposed residence and extend laterally to 10 m beyond the edges of the proposed residence.

7.5 Compaction

7.5.1 Granular Soils

Approved granular fill must be compacted using suitable compaction equipment to achieve a dry density ratio (DDR) of at least 95% MMDD (maximum modified dry density) as determined in accordance with AS 1289.5.2.1 at a moisture content within 2% of optimum moisture content (OMC).

Granular fill must be placed in horizontal layers of not greater than 300 mm loose thickness. Each layer must be compacted by suitable compaction equipment (such as a self-propelled vibrating roller or large (>800 kg) plate compactor), and carefully controlled to ensure even compaction over the full area and depth of each layer.

Where clean sand (<5% gravel, <5% fines) is used as fill, a Perth sand penetrometer (PSP) may be used for compaction control in accordance with AS 1289.6.3.3. The following minimum PSP blow counts may be assumed to correspond to a dry density ratio of 95% MMDD:

Depth range 0.0 m to 0.15 m: SET
Depth range 0.15 m to 0.45 m: 8 blows
Depth range 0.45 m to 0.75 m: 10 blows

Depth range 0.75 m to 1.05 m: 12 blows (or 0.75 m to 0.9 m: 6 blows)

If difficulties are experienced recording the required blow counts, a site-specific PSP correlation should be carried out to determine the PSP blow count correlating to a DDR of 95% MMDD. The correlation must:

- be done on site;
- use the nuclear density gauge (NDG) to determine density at a minimum of 5 points with varying density to a depth of 300 mm below surface;
- use a calibrated PSP to determine the PSP blow count from 150 mm to 450 mm at each of the NDG test points; and
- be plotted on a chart of PSP blow count vs DDR.

If gravel is used as fill, compaction testing must be done using a nuclear density gauge (NDG) in accordance with AS 1289.5.8.1.

7.5.2 Clayey Soils

The *in situ* clayey soils must be moisture conditioned to within 2% of OMC and compacted using suitable compaction equipment to a minimum dry density ratio of 95% SMDD (standard maximum dry density) as determined in accordance with AS 1289.5.1.1.

A nuclear density gauge should be used for compaction control of clayey soils in accordance with AS 1289.5.8.1.



The *in situ* clayey soils will require careful moisture conditioning so that the moisture content of the material is between optimum moisture content (OMC) and 2% wet of OMC at the time of placement and compaction. We note that compaction to 95% SMDD can be difficult to achieve for the clayey in situ material when not appropriately moisture conditioned.

Surficial clayey soils are likely to soften and become saturated during and following rainfall. This commonly leads to weaving and rutting of the surface when trafficked by earthmoving equipment. It will also be difficult to compact the clayey soil in this condition. Where this occurs, we recommend the following prior to compaction:

- remove the soft saturated clayey soil to waste to expose a competent clay base; or
- wait until the soils have dried to at or near their optimum moisture content for compaction.

We note that regardless of the compaction of clayey soils, they are still likely to perform poorly with regard to strength, rutting, etc. when wet.

The clayey soils on the site will drain poorly when inundated during the wetter times of the year and result in saturated conditions that may inhibit compaction of the soil. To reduce the risk associated with this, we recommend that earthworks are carried out during the summer months when little if any groundwater flow is expected. Earthworks should not be carried out within 1-2 weeks following heavy rainfall. Shaping of clay subgrade areas must always be done to promote run-off and prevent ponding of water, which will rapidly lead to strength loss in the clayey soils.

If difficulties are encountered during compaction due to water, further advice should be sought from a geotechnical engineer.

7.5.3 General

Over-excavation and replacement of loose/soft materials must be done where the minimum dry density ratio cannot be achieved.

Fill must be placed in horizontal layers of not greater than 0.3 m loose thickness for granular material and 0.2 m loose thickness for cohesive material. Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

Care will need to be taken when compacting in the vicinity of existing services and structures. This is particularly important if vibratory compaction is being carried out. Tynan (1973)¹ provides assistance with the selection of compaction equipment for use adjacent to structures.

Large compaction equipment (self-propelled vibrating rollers, etc.) must not be used within 2 m behind retaining walls. Hand compaction plant must be used.

Test Frequency

After compaction, verify that the required level of compaction has been achieved by testing at the base of excavation and through the full depth of any fill, to minimum depth of 0.9 m (or 0.45 m for *in-situ* clayey soils)::

- on each lift of fill at the rate of 1 test per 500 m³;
- at each spread footing location;
- at 5 m centres along gravity retaining wall footings and strip footings (where present); and
- at 21 m centres below on-ground slabs and pavements.

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¹ Tynan (1973) Ground Vibration and Damage Effects on Buildings, Australia Road Research Board, Special Report No. 11.



Further to this, we recommend footings be inspected by a geotechnical engineer prior to blinding.

If difficulties are encountered during compaction due to water, further advice should be sought from a geotechnical engineer.

7.6 Approved Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments". Sand fill must comprise clean sand that is free of organic matter and have a fines content of less than 5%.

The *in situ* clayey material is not considered to be suitable for re-use as inert structural fill, but may be used to make good over-excavations in clayey material.

Any sand containing oversize (>100 mm) or putrescible demolition rubble or rubbish is not suitable for re-use as structural fill.

Any organic-rich sand or sand containing significant proportions of fines (material less than 0.075 mm in size) must not be used.

Where doubt exists, a geotechnical engineer must be engaged to inspect and approve the use of potential fill materials.

7.7 Excavations and Slopes

Based on the soil profile encountered, we consider that excavation of the material (comprising clayey soils and boulders and rock outcrops) will require large earthmoving equipment (i.e. 15 tonne or larger excavator), equipped with a toothed bucket and hydraulic rock breaker. The possible presence of obstructions such as granite outcrops (or large boulders and cobbles) and cemented layers must be taken into account when selecting excavation equipment.

Care must be exercised in such excavations and appropriate safety measures adopted where necessary, particularly in the vicinity of existing structures and infrastructure.

Excavations in sand must be battered at slopes no steeper than 1V:2H for temporary slopes and 1V:3H for permanent slopes, and excavation in clayey soils must be battered at slopes no steeper than 1V:1H for temporary slopes and 1V:2H for permanent slopes where no external restraint is provided to the slope (suitable for slope heights up to 2 m with no surcharge (machinery, stockpiles, etc) at the crest of the slope). Even at these slope angles erosion and rilling may occur. Where steeper slopes are required, temporary or permanent slope retention must be employed.

Surcharges (such as structures, plant and soil stockpiles) must not be placed at or close to the crest of unsupported excavations.

The presence of clayey soils at relatively shallow depth is expected to restrict groundwater movement. Shallow perched groundwater may occur during wetter months and following heavy rainfall. For temporary excavations, we recommend grading of the clayey soil to promote subsurface drainage such that water is directed to a sump from which it can be pumped.

A geotechnical engineer must be consulted where there is any doubt regarding the stability or safety of unsupported excavations.



7.8 Foundations

We consider the proposed structure may be founded on shallow pad and strip footings placed within the clayey soils encountered across the building envelope, provided the site preparation recommendations outlined in Section 7.2 are followed.

Table 4 and Table 5 give allowable bearing pressures and estimated settlements for isolated pad footings and strip footings founded at embedment depths of 0.5 m and 1.0 m below the existing ground surface level. **Note:** the estimated settlements do not include heave movements due to moisture changes in the clayey strata.

Table 4: Pad Footing Allowable Bearing Pressures and Estimated Settlements

Min. Footing Embedment (m)	Minimum Footing Dimension (m)	Allowable Bearing Pressure (kPa)	Estimated Settlement (mm)
	0.5	100	<5
0.5	1.0	100	5-10
0.3	1.5	100	5-10
	2.0	100	10-15
	0.5	100	<5
1.0	1.0	100	5-10
1.0	1.5	100	5-10
	2.0	100	10-15

Table 5: Strip Footing Allowable Bearing Pressures and Estimated Settlements

Min. Footing Embedment (m)	Footing Width (m)	Allowable Bearing Pressure (kPa)	Estimated Settlement (mm)
	0.5	100	5-10
0.5	1.0	100	5-10
0.3	1.5	100	10-15
	2.0	100	15-20
	0.5	100	5-10
1.0	1.0	100	5-10
1.0	1.5	100	10-15
	2.0	100	15-20

Allowable bearing pressures for footings of intermediate plan dimensions to those tabulated can be interpolated. Footings that have a plan dimension either smaller or larger than those covered by the tables above will need to be considered individually along with other embedment depths.

An allowable working bearing pressure of 100 kPa is considered to be an upper limit for shallow footings at this site to limit total and differential settlements. Footings carrying significant eccentric loading, such as below retaining walls, must be assessed separately.



The settlement of the proposed structure will depend upon a number of factors including the applied pressures, footing size and base preparation. The estimates of settlement provided above are based on the assumption that the site preparation measures detailed in Section 7.2 have been completed. The estimated settlements are for the working bearing pressure values shown. Differential settlements of up to half of the total estimated settlement values are likely between footings of similar sizes, loads and elevations. Differential settlement may also occur between footings located above and adjacent to old buried footings.

If footings are to be constructed during wet weather, footing bases in clayey soil must be excavated (using an excavator equipped with a flat-edged bucket to minimise soil disturbance), compacted (to tighten any loose soil on the base), checked for soft spots and blinded prior to further rainfall.

About 50% of the settlement and differential settlement is expected to occur during construction.

All foundation excavations must be assessed by a competent person prior to blinding.

7.9 **Earth Retaining Structures**

Retaining structures may be designed in accordance with AS 4678-2002 "Earth-Retaining Structures". We recommend that all retaining walls at the site be backfilled with free-draining fill, e.g. sand (imported free draining sand fill with less than 5% fines).

For the design of retaining structures, the parameters in Table 6 are considered appropriate for compacted sand backfill behind retaining walls.

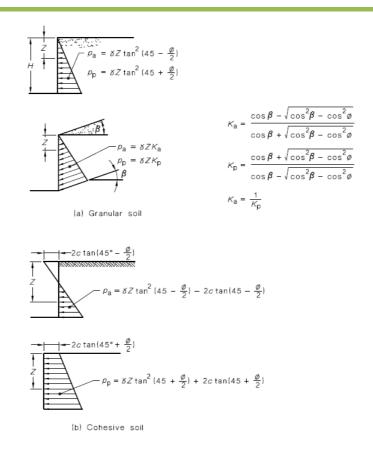
		Undrained cohesion, c (kPa)	Angle of Internal Friction (deg.)	Wall Fri	ction = 0°	Wall Friction = 0.5Ф	
Soil Type	Bulk Density (kN/m³)			Coefficient of Active Earth Pressure, K _a	Coefficient of Passive Earth Pressure, K _p	Coefficient of Active Earth Pressure, K _a	Coefficient of Passive Earth Pressure, K _p
Compacted sand fill	18	-	34	0.28	3.5	0.25	5.7
Stiff clayey strata	18	100	-	-	-	-	-

Table 6: Retaining Wall Geotechnical Design Parameters

- Notes: 1. Earth pressure coefficients are provided in this table for conditions of zero friction between the wall and the soil and with wall friction of $0.5\Phi'$.
 - 2. The retaining wall designer should make an independent assessment of the parameters appropriate to the construction method to be used, including alternative values of wall friction.
 - 3. A horizontal ground surface behind the wall has been assumed.

The effective strength parameters should be used for analysis of free-draining granular soils and the long term stability of clayey soils. The formulae for active and passive pressures are shown below for granular soil and cohesive soil





Unless a suitable drainage layer is placed behind the wall such that a build-up of pore pressure is prevented, the retaining wall must be designed to accommodate water pressure behind the wall (10 kPa per metre height).

Retaining walls must be backfilled with at least 300 mm width of free-draining granular fill. A slotted drain (wrapped in a geotextile) should be used at the base of the granular backfill to collect seepage and direct it to a collection point (either discharging away from the basement, or collecting at a sump which must be fitted with an automatic pump system to ensure that it remains dry).

Compaction plant can augment the lateral earth pressure acting on retaining walls. Hand operated compaction equipment is recommended within 2 m of any retaining walls to minimise compaction pressures.

It is important to note that some ground movement will occur behind any soil retaining system, including gravity retaining walls.

Retaining walls can move and rotate under imposed soil loading resulting in settlement behind the wall. This must be considered during the design and construction of the retaining walls in order that adjacent properties are not adversely affected. Particular care should be exercised when forming excavations so as not to affect neighbouring properties. Account must be taken of the effect of both temporary and permanent works on neighbouring properties. Anchoring or strutting of retaining walls may be required.

Detailed design of retaining structures should be undertaken using methods appropriate to the proposed retention system.

8. CLOSURE

We draw your attention to Appendix J of this report, "Understanding your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. Guidance is also provided on



how to minimise risks associated with groundworks for this project. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD

Blake Luff CPEng

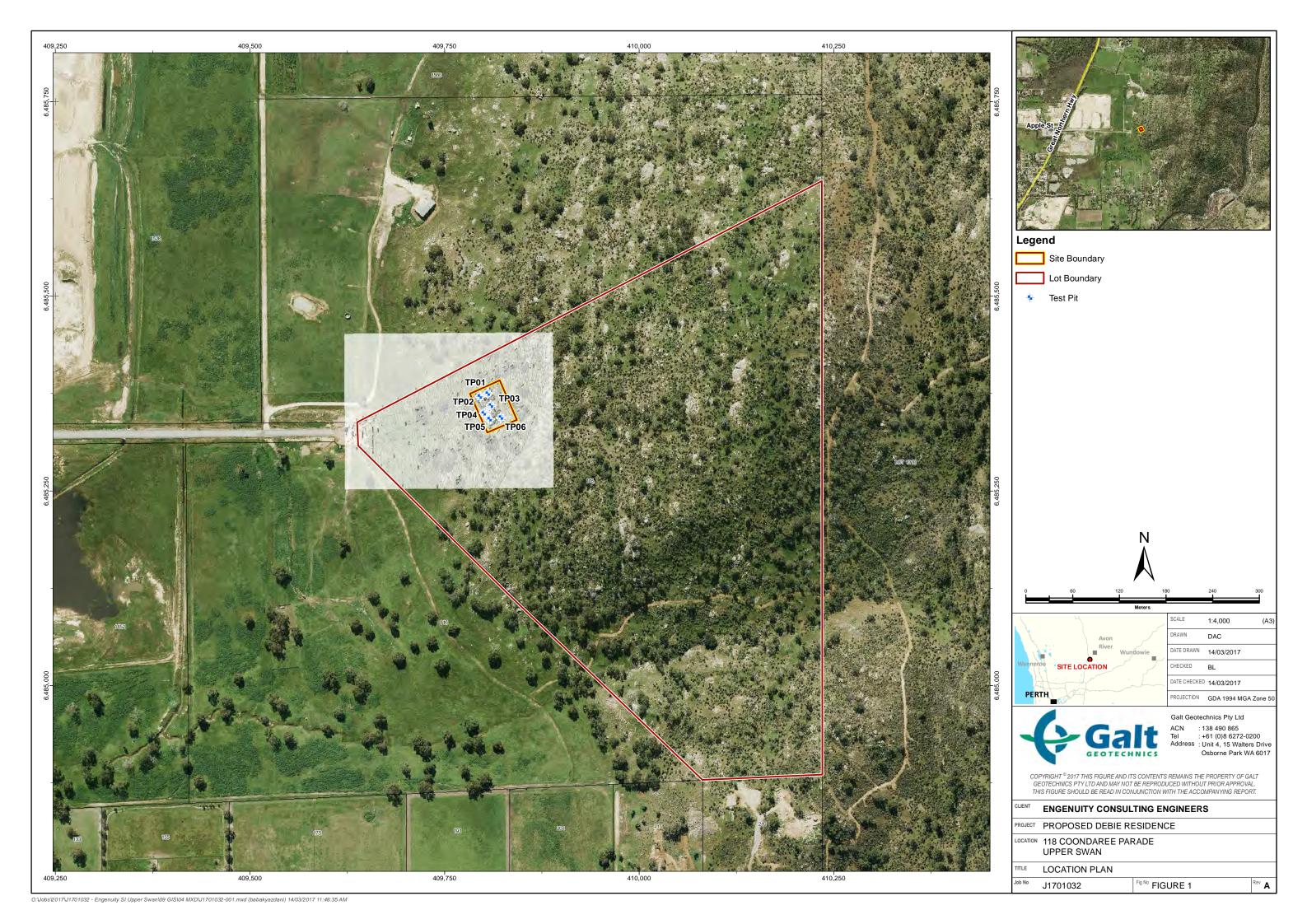
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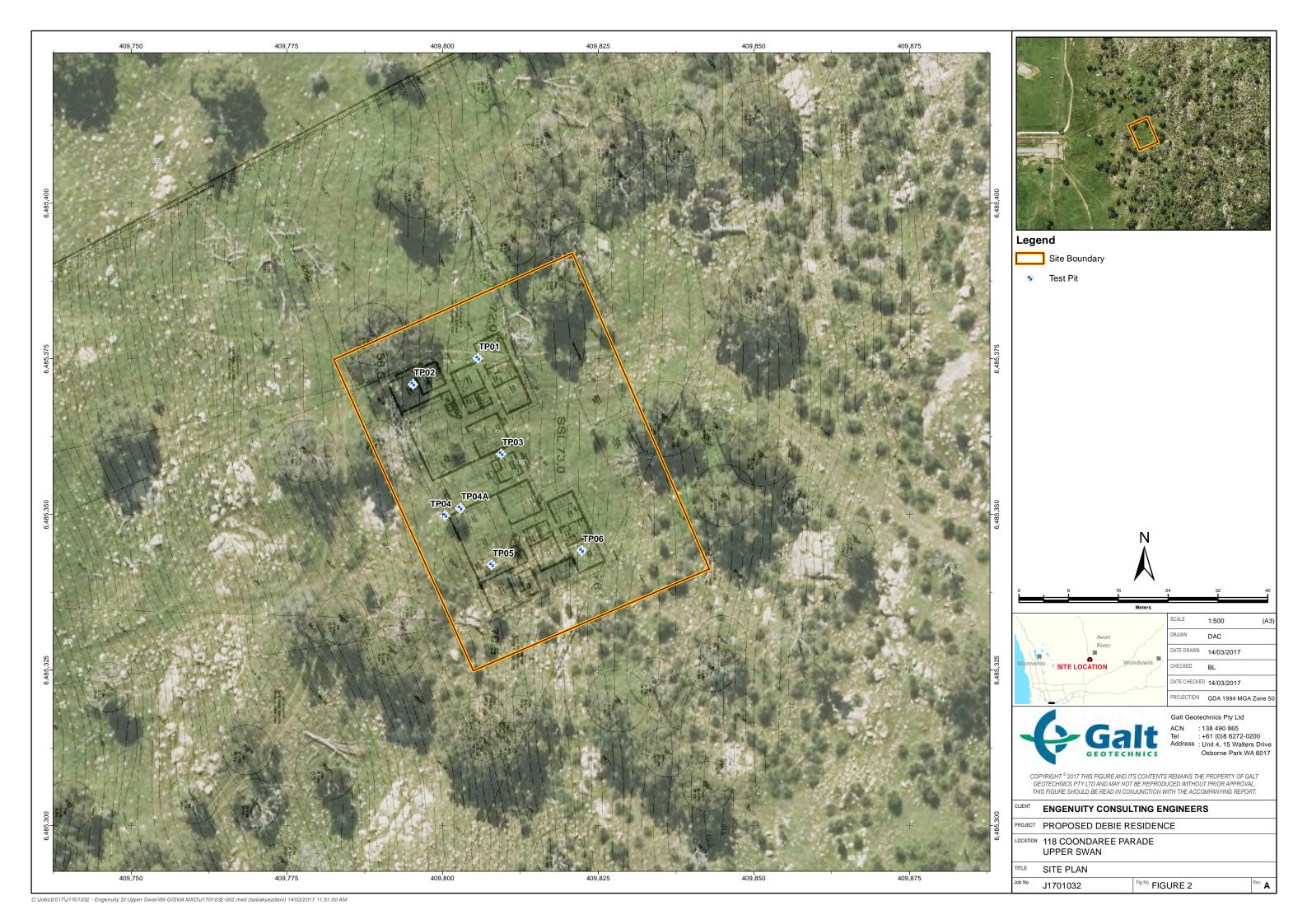
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Fred Davenport CPEng

Geotechnical Engineer

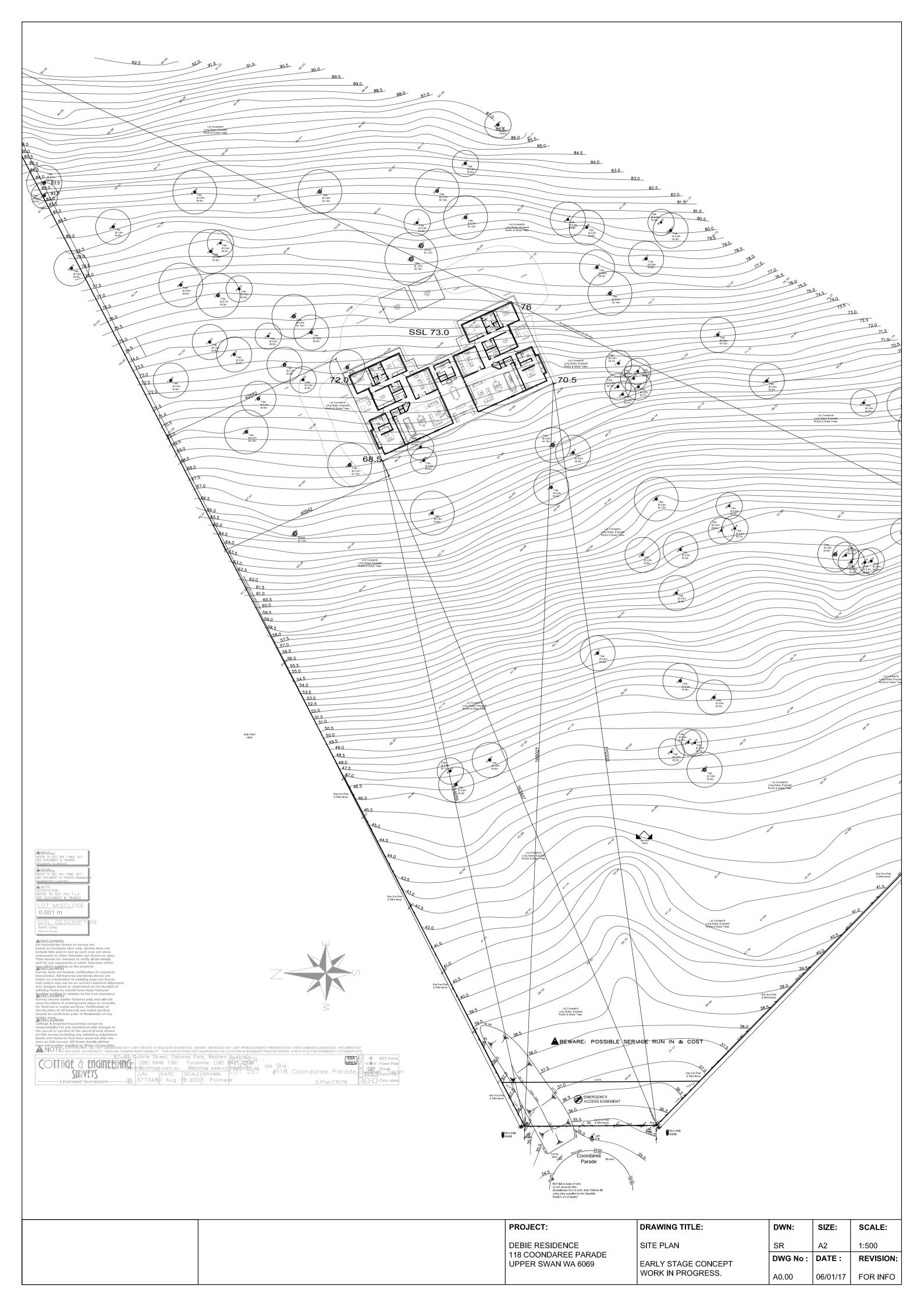
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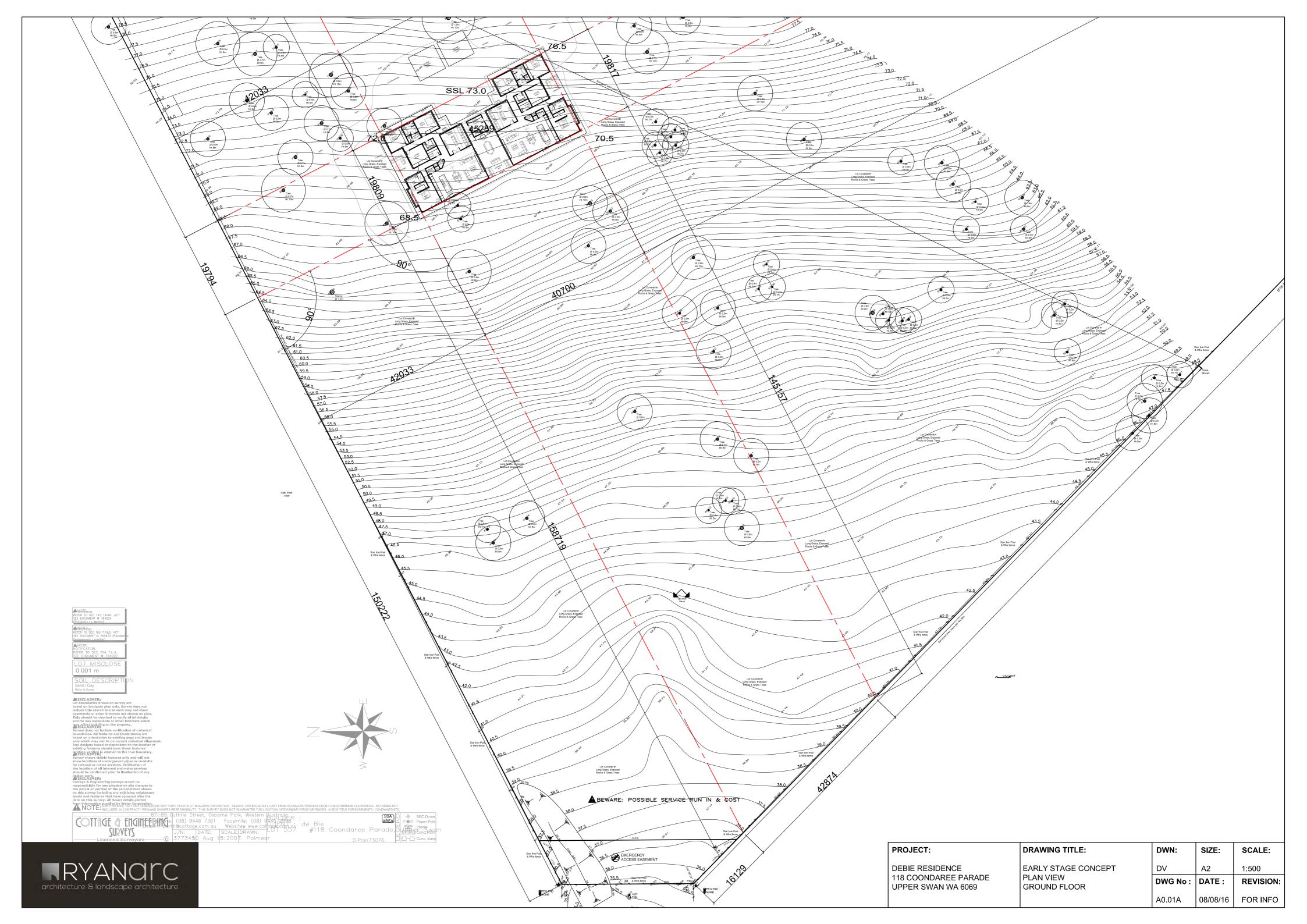


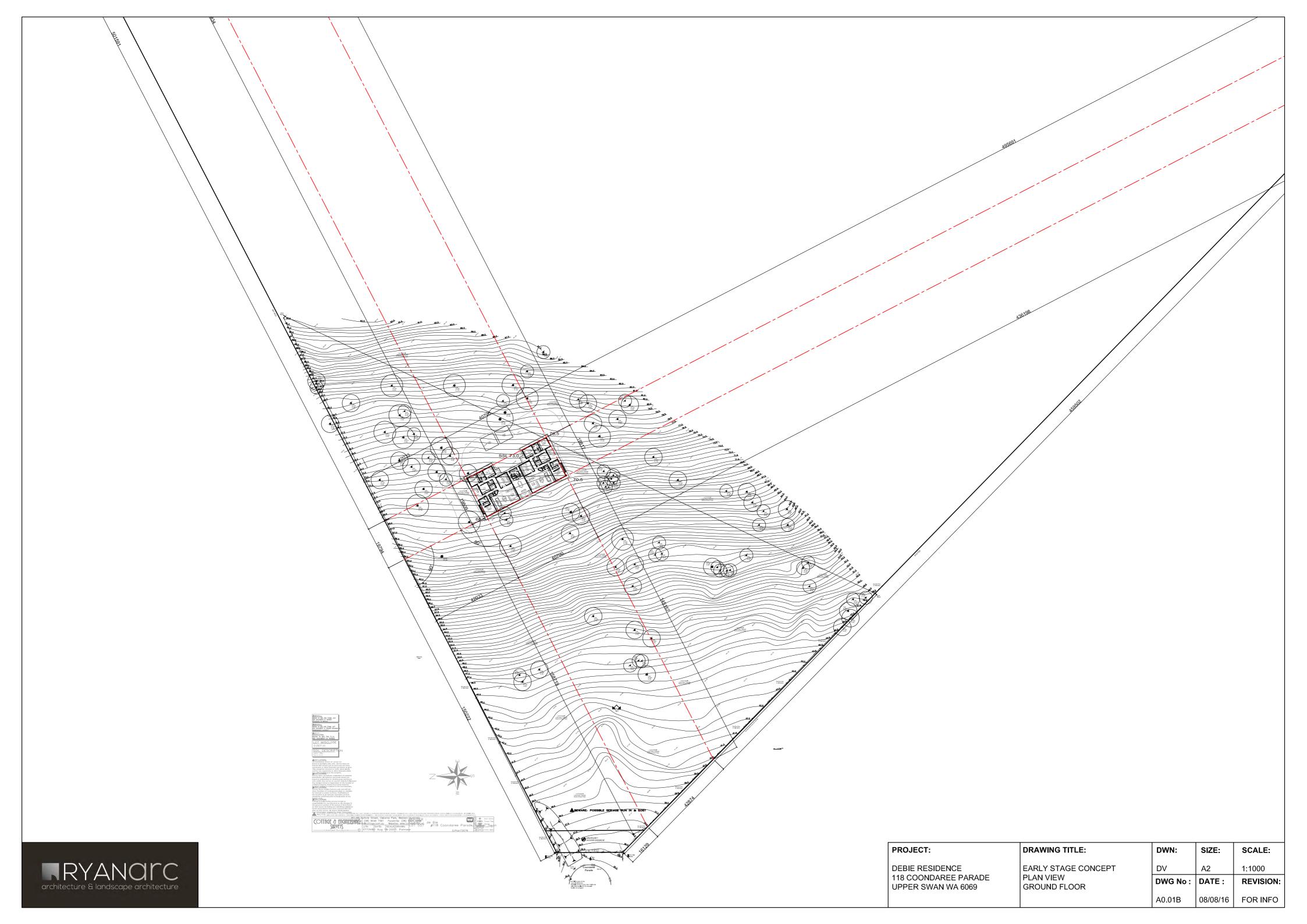


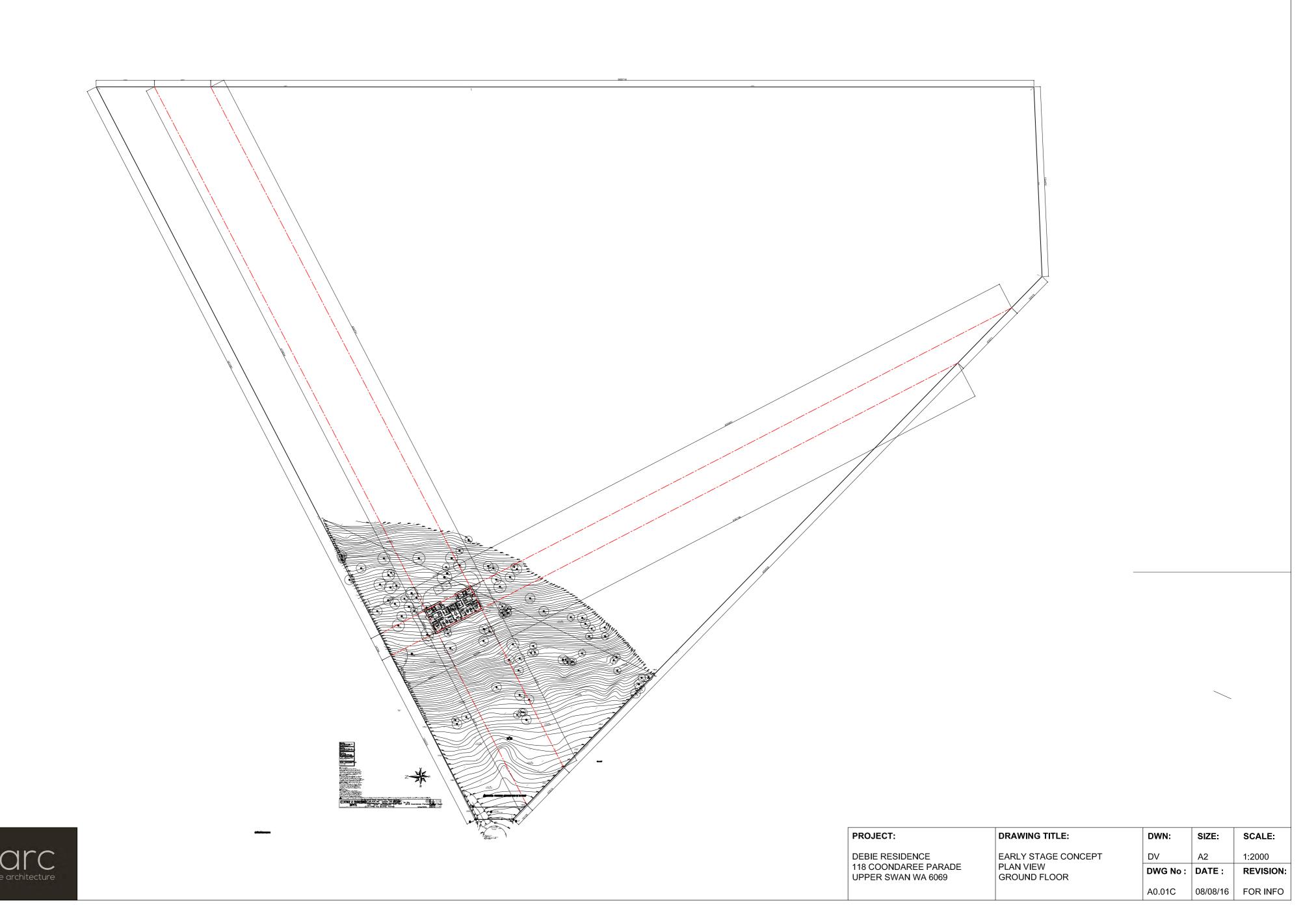
Appendix A: Supplied Drawings

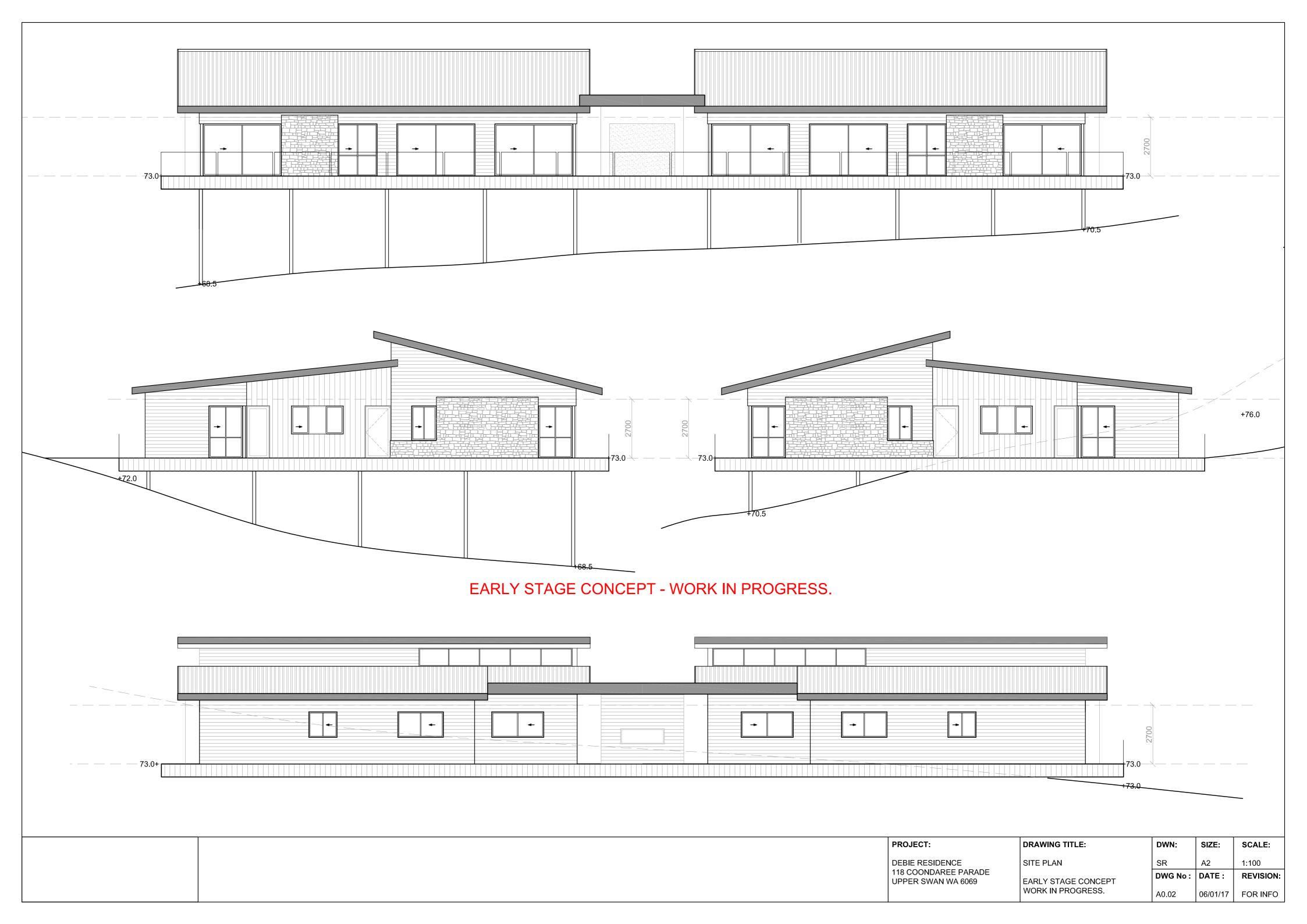














Appendix B: Site Photographs





Photograph 1: Looking east from the base of the slope towards the proposed residence site



Photograph 2: Typical boulders and rock outcropping across the site surface





Photograph 3: Looking south-east across the proposed residence site



Photograph 4: Looking east across the proposed residence site





Photograph 5: Looking north across the proposed residence site



Photograph 6: Typical vegetation to the east of the proposed residence site





Photograph 7: Looking west across the proposed residence site



Photograph 8: Typical vegetation across the proposed residence site



Appendix C: Test Pit Reports

EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS



Existing Excavation

METHOD	NETHOD OF DRILLING OR EXCAVATION							
AC	Air Core	Е	Excavator	PQ3	PQ3 Core Barrel			
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube			
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper			
AT	Air Track	HMLC	HMLC Core Barrel	RR	Rock Roller			
В	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig			
ВН	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT			
СТ	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore			

Push Probe

DT SUPPORT

T Timbering

Diatube

PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	Ε	Easy	F	Firm
Н	Hard	VH	Very Hard		

WATER

	Water Inflow	•	Water Level

	water Loss (complete)
\sim	Water Loss (partial)

SAMPLING AND TESTING

MIVIF LII	NG AND TESTING		
В	Bulk Disturbed Sample	Р	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
С	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

ROCK CORE RECOVERY

TCR = Total Core Recovery (%) =
$$\frac{CRL}{TCL} \times 100$$

SCR = Solid Core Recovery (%)
$$=\frac{CCR}{TCL} \times 100$$

RQD = Rock Quality Designation (%)
$$= \frac{ALC > 100}{TCL} \times 100$$

ALC>100 Total Length of Axial Lengths of Core Greater than 100 mm Long

METHOD OF SOIL DESCRIPTION BOREHOLE AND TEST PIT REPORTS



GRAPHIC LOG & UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) SYMBOLS

Graphic	USCS	Soil Name
		FILL (various types)
000		COBBLES
XX		BOULDERS
0000	GP	GRAVEL (poorly graded)
3000	GW	GRAVEL (well graded)
\$ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	GC	Clayey GRAVEL
	SP	SAND (poorly graded)
7.77.77 7.77.77 7.77.77	SW	SAND (well graded)
	SC	Clayey SAND

303/311	363/311110063				
Graphic	USCS	Soil Name			
× · · · × · · · · · · · · · · · · · · ·	SM	Silty SAND			
H >	ML	SILT (low liquid limit)			
× × × × × × × × × × × × × × × × × × ×	МН	SILT (high liquid limit)			
6:5:5:5 6:5:5:5 6:5:5:5	CL	CLAY (low plasticity)			
	CI	CLAY (medium plasticity)			
:	СН	CLAY (high plasticity)			
25 25 25 5 25 25 25 25 25	OL	Organic SILT (low liquid limit)			
0000	ОН	Organic SILT (high liquid limit)			
33	Pt	PEAT			

RESISTANCE TO EXCAVATION

Symbol	Term	Description
VE	Very easy	
E	Easy	
F	Firm	
Н	Hard	
VH	Very hard	

All resistances are relative to the selected method of excavation

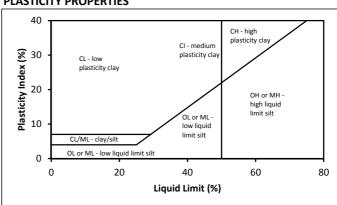
SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726-1993, Appendix A. Material properties are assessed in the field by visual/tactile methods in combination with field testing techniques (where used).

PARTICLE	SIZE
----------	------

Soil	Name	Particle Size (mm)				
BOU	LDERS	>200				
COE	BLES	63 to 200				
	Coarse	20 to 63				
GRAVEL	Medium	6 to 20				
	Fine	2 to 6				
	Coarse	0.6 to 2.0				
SAND	Medium	0.2 to 0.6				
	Fine	0.075 to 0.2				
FINES	SILT	0.002 to 0.075				
TINES	CLAY	<0.002				
· · · · · · · · · · · · · · · · · · ·						





MOISTURE CONDITION AS1726-1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery.
М	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

		Undrained Shear		DCP blows
Symbol Term		Strength (kPa)	SPT "N"	per 100 mm
VS	Very Soft	0 to 12	0 to 2	<1
S	Soft	12 to 25	2 to 4	<1
F	Firm	25 to 50	4 to 8	1 to 2
St	Stiff	50 to 100	8 to 15	3 to 4
VSt	Very Stiff	100 to 200	15 to 30	5 to 10
Н	Hard	>200	>30	>10

AS1726-1993 and HB160-2006

		Density		DCP blows	PSP Blows			
Symbol Term		Index (%)	SPT "N"	per 100 mm	per 300 mm			
VL Very Loose		<15	0 to 4	<1	0 to 2			
L Loose		15 to 35	4 to 10	1 to 2	2 to 6			
MD Medium Dense		35 to 65	10 to 30	2 to 3	6 to 8			
D	Dense	65 to 85	30 to 50	4 to 8	8 to 15			
VD Very Dense		>85	>50	>8	>15			
Note: PSP	Note: PSP correlations only valid to 450 mm depth							

Consistency and density may also be inferred from excavation performance and material behaviour.

ROCK STRENGTH, WEATHERING AND DEFECTS



STRENGTH

SYMBOL	STRENGTH	PLI, I _{s(50)}	Typical UCS	TYPICAL DESCRIPTORS	
EL	Extremely Low	≤0.03	≤0.7	Easily remoulded by hand to form a soil	
VL	Very Low	0.03-0.1	0.7-2.4	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut triaxial samples by hand. Pieces up to 30 mm thick can be broken by finger pressure	
L	Low	0.1-0.3	2.4-7	Easily scored with a knife; indentations 1-3 mm show in the specimen with firm blows of the pick point; has dull thud under hammer. A piece of core 150 mm long x 50 mm dameter may be broken by hand. Sharp edges of core may be friable and break during handling	
М	Medium	0.3-1.0	7-24	Readily scored with a knife; a piece of core 150 mm long x 50 mm diameter can be broken by hand with difficulty	
Н	High	1.0-3.0	24-70	A piece of core 150 mm long x 50 mm diameter cannot be broken by hand but can be broken by a pick with a single blow; rock rings under hammer	
VH	Very High	3.0-10.0	70-240	Hand specimen breaks with pick after more than 1 blow; rock rings under hammer	
EH	Extremely High	≥10.0	≥240	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer	

PLI: Point Load Index (MPa)

UCS: Uniaxial Compressive Strength (MPa)

Note: Rock strength is defined in accordance with PLI. The relationship between PLI and UCS varies depending on rock type, weathering, etc. UCS is typically 24 x I_{s(50)} (may range from 10-30 x I_{s(50)} but possibly lower for carbonate rocks)

WEATHERING

SYMBOL	TERM	TYPICAL DESCRIPTORS
RS	Residual Soil	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; the soil has not been significantly transported.
EW	Extremely Weathered	The rock has weathered to such an extent that it has 'soil' properties i.e. it either disintegrates or can be remoulded in water. Fabric of original rock still evident.
HW	Highly Weathered	Rock strength is changed by weathering. The whole of the rock mass is discoloured, usually by iron staining or bleaching such that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
MW	Moderately Weathered	The whole of the rock mass is discoloured, usually by iron staining or bleaching such that the colour of the original rock is not recognisable.
SW	Slightly Weathered	Rock is slightly discoloured but shows little or no change of strength from fresh rock
Fr	Fresh	Rock shows no sign of decomposition or staining

Note: The terms HW and MW are not used by AS 1726. The standard uses the term Distinctly Weathered instead to cover this range of weathering.

ROCK DEFECTS

SYMBOL	DESCRIPTION	COATIN	G / INFILLING	R	OUGHNESS	PLANARITY	
J	Joint	Cn	Clean	SI	Slickensided	Pl	Planar
В	Bedding	St	Stained	Sm	Smooth	Cr	Curved
F	Foliation	Vn	Veneer	Ro	Rough	Un	Undulating
С	Contact	Ct	Coating	VR	Very rough	St	Stepped
Cl	Cleavage					Ir	Irregular
SZ	Shear Zone						
V	Vein						
IS	Infilled seam						
DI	Drilling induced break						

CORE RUN DETAILS

SYMBOL	DESCRIPTION	SYMBO	L DESCRIPTION	SYMBOL	DESCRIPTION
TCR SCR	Total Core Recovery Solid Core Recovery	RQD	Rock Quality Designation	TOR BOR	Top of Run Bottom of Run

METHOD OF CEMENTATION CLASSIFICATION **BOREHOLE AND TEST PIT REPORTS**



ementation Classification	Description
Incemented	No cementation present
ery weakly Cemented	Near uncemented sand
Jeakly Cemented	Very low strength rock, fragments can be crushed between fingers
Noderately Cemented	Low strength rock, easily scratched, generally friable, rock core can be broken by hand
Vell Cemented	Medium strength rock, can be scratched with thumbnail, requires substantial hand effort to break core
ery well cemented	Typically high strength rock, cannot be scratched easily, core can be broken with blow from hammer



Sheet 1 OF 1

Contractor: ANH Contracting 28/02/2017 Job Number: J1701032 Date:

Client: **ENGenuity Consulting Engineers** Machine: JCB 3CX Logged: BL Project: Proposed Debie Residence Operator: Neil Checked Date: 09/03/2017 . 118 Coondaree Parade, Upper Swan Location: Bucket: 0.6 m rock Checked By: FAD

STRUCTURE AND ADDITIONAL OBSERVATIONS STRUCTURE AND ADDITIONAL OBSERVATIONS SILY SAND: fine to medium grained, grey/brown, trace Sily SAND: fine to coarse grained, brown, with The structure and the structur		E	cavat	ion		Sampling				Field Material Desc	•		
F 1.0— B(TP01-1) CI-CH-CH-CH-CH-CH-CH-CH-CH-CH-CH-CH-CH-CH-	METHOD	EXCAVATION RESISTANCE	WATER		<i>DEPTH</i> RL	FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
Hole terminated at 2.20 m Target depth Groundwater not encountered	Ш	F		1.0 —		B(TP01-1)		× × × ×	SM-SC C-CH	Sandy CLAY / Clayey SAND: fine to coarse grained, brown, with gravel, cobbles and boulders Sandy CLAY / CLAY: medium to high plasticity, brown/orange, trace gravel Sandy CLAY / Clayey SAND: (extremely to highly weathered rock), medium to high plasticity fines, fine to coarse grained, brown/orange mottled grey, with highly to moderately weathered rock fragments Hole terminated at 2.20 m Target depth		MD	

Sketch & Other Observations



Comments:



Sheet 1 OF 1

Contractor: ANH Contracting Job Number: J1701032 Date: 28/02/2017

Client: **ENGenuity Consulting Engineers** Machine: JCB 3CX Logged: BL Project: Proposed Debie Residence Operator: Neil Checked Date: 09/03/2017 118 Coondaree Parade, Upper Swan Location: Bucket: 0.6 m rock Checked By: FAD

	ı	Excava	ition		Sampling				Field Material Desc	· ·					
METHOD	EXCAVATION	RESISTANCE WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS			
ш	F	-	0.0—			>	* * * * * * * * * * * * * * * * * * *	SM SM-SC	TOPSOIL: Silty SAND: fine to medium grained, grey/brown, trace roots Silty SAND / Clayey SAND: fine to coarse grained, brown, with boulders up to 600 mm diameter, trace roots Sandy CLAY / CLAY: medium to high plasticity, brown/orange mottled grey, trace gravel Sandy CLAY: medium to high plasticity, brown/orange Sandy CLAY: medium to high plasticity, brown/orange	M	MD F/St				
). GALL 1:01 201 G-02-21	н	1	-2.0 					CH- CH- SC	Sariny CLAT / Clayey SANUT. (extremitely to fight) weathered rock), medium to high plasticity fines, fine to coarse grained, pale brown/orange, with dark grey lenses, pockets of high plasticity CLAY, with highly to moderately weathered rock fragments Hole terminated at 2.00 m Refusal Groundwater not encountered			- - - - - - - -			

Sketch & Other Observations



Comments:



Sheet 1 OF 1

Job Number: J1701032

Client: **ENGenuity Consulting Engineers** Project: Proposed Debie Residence . 118 Coondaree Parade, Upper Swan Location:

Contractor: ANH Contracting Machine: JCB 3CX

Operator: Neil Bucket: 0.6 m rock

28/02/2017 Date: Logged: BL

Checked Date: 09/03/2017 Checked By: FAD

Excavation	Sampling	Field Material Desc	ription			
EXCANATION RESISTANCE WATER DEPTH (metres)	RECOVERED CRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION CONSISTENCY	STRUCTURE AND ADDITIONAL OBSERVATIONS		
0.0—	\(\frac{\fracc}\frac{\frac{\frac{\frac{\fir}}}}}{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\f	roots Silty SAND / Clayey SAND: fine to coarse grained, brown/grey, with gravel and cobbles, boulders Sandy CLAY / CLAY: medium to high plasticity, brown/orange mottled grey Sandy CLAY / Clayey SAND: medium to high plasticity, fine to	ME F/S			
2.0 —		carse grained, brown/orange mottled grey, with dark grey fissures Clayey SAND: (extremely to highly weathered rock), fine to coarse grained, medium to high plasticity fines, pale brown/orange, with dark grey lenses, with gravel and boulders, pockets of high plasticity CLAY, with highly to moderately weathered rock fragments Hole terminated at 2.40 m Refusal	-			



Comments:



Sheet 1 OF 1

Contractor: ANH Contracting 28/02/2017 Job Number: J1701032 Date:

Client: **ENGenuity Consulting Engineers** Machine: JCB 3CX Logged: BL Project: Proposed Debie Residence Operator: Neil Checked Date: 09/03/2017 . 118 Coondaree Parade, Upper Swan Location: Bucket: 0.6 m rock Checked By: FAD

	Excavation Sampling Field Material Description											
_	EX.	cavat	IUN		Sampling				rieia Materiai Desc			
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
Ī	F		0.0	Γ			71.7	SM	TOPSOIL: Silty SAND: fine to medium grained, grey/brown, trace			
ш	VH		-					SC	roots Gravelly Clayey SAND: fine to coarse grained, brown, medium to high plasticity fines, with gravel, cobbles and boulders, up to 1m in diameter	М	MD	
			0.5 —						Hole terminated at 0.40 m Refusal on rock Groundwater not encountered			
			1.0 —									
			-									
			1.5 —									
			=									
			2.0 —									
			2.5—									
			2.5 —									

Sketch & Other Observations



Comments:



TEST PIT: TP04A

Sheet 1 OF 1

Job Number: J1701032

Client: **ENGenuity Consulting Engineers** Project: Proposed Debie Residence 118 Coondaree Parade, Upper Swan Location:

Contractor: ANH Contracting Machine: JCB 3CX

Operator: Neil Bucket: 0.6 m rock

28/02/2017 Date: Logged: BL

Checked Date: 09/03/2017 Checked By: FAD

	Excavation Sampling Field Material Description												
	Ex	cavat	ion		Sampling				Field Material Desc	•			
МЕТНОБ	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	
	F		0.0				17 7 17 71 17 71	SM	TOPSOIL: Silty SAND: fine to medium grained, grey/brown, trace roots			-	
ш	VH	-	-					sc	Gravelly Clayey SAND: fine to coarse grained, brown, medium to high plasticity fines, with gravel, cobbles and boulders, up to 1m in diameter		MD	-	
			0.5 - -						Hole terminated at 0.50 m Refusal on rock Groundwater not encountered			-	
			1.0									-	
			1.5 —									- - -	
			2.0 —									- - -	
GAL 1 1.01 2013-02-21			2.5 —									- - - -	
-02-21 F1J.									Sketch & Other Observations				



Comments:



Sheet 1 OF 1

Job Number: J1701032

Client: **ENGenuity Consulting Engineers** Project: Proposed Debie Residence 118 Coondaree Parade, Upper Swan Location:

Contractor: ANH Contracting Machine: JCB 3CX

Operator: Neil Bucket: 0.6 m rock

28/02/2017 Date: Logged: BL

Checked Date: 09/03/2017 Checked By: FAD

	Ex	cavat	ion		Sampling				Field Material Desc			
МЕТНОВ	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0				71 71	SM	TOPSOIL: Silty SAND: fine to medium grained, grey/brown, trace roots			
			-				× × × × × × × × × × × × × × × × × × ×	SM- SC	Silty SAND / Clayey SAND: fine to coarse grained, brown/grey, with gravel and cobbles, boulders up to about 1mm diameter, trace roots		MD	
			0.5 —						Sandy CLAY / CLAY: medium to high plasticity, brown/orange with gravel, cobbles and boulders up to about 0.5 diameter			Large boulder in side of test pit from 0.5 m
	F		_									depth to 1.8 m depth
ш			-					CI- CH		М		
			1.0 —								F/St	
		-	-						Sandy CLAY / Clayey SAND: (extremely to highly weathered rock), medium to high plasticity fines, fine to coarse grained, pale brown/grey, with pockets of high plasticity CLAY, with dark grey	-		
	Н		-					CI-	brown/grey, with pockets of high plasticity CLAY, with dark grey lenses, with highly to moderately weathered rock fragments (with rock structure)			
	"		1.5 —					CH- Sc	Took structure)			
	Hole terminated at 1.80 m											
2.0 — Refusal Groundwater not encountered												
			-									
			-									
			2.5 —									
			-									
					-::				Sketch & Other Observations			
				というという							ラインにはいい	





Comments:



Sheet 1 OF 1

Contractor: ANH Contracting 28/02/2017 Job Number: J1701032 Date:

Client: **ENGenuity Consulting Engineers** Machine: JCB 3CX Logged: BL Project: Proposed Debie Residence Operator: Neil Checked Date: 09/03/2017 118 Coondaree Parade, Upper Swan Location: Bucket: 0.6 m rock Checked By: FAD

	Ex	cavat	ion		Sampling				Field Material Desc			
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	<i>DEPTH</i> RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ш	F		0.0 —		B(TP06-1)		× × × × × × × × × × × × × × × × × × ×	SM-SC	TOPSOIL: Silty SAND: fine to medium grained, grey/brown, trace roots Silty SAND / Clayey SAND: fine to coarse grained, brown, with boulders up to about 0.6 m diameter Sandy CLAY / CLAY: medium to high plasticity, brown/orange, with boulders up to about 0.5 m diameter	М	MD F/St	-
	Н		- - - - -2.0					CI- CH- SC	Sandy CLAY / Clayey SAND: (extremely to highly weathered rock), medium to high plasticity fines, fine to coarse grained, pale brown/grey, with pockets of high plasticity CLAY, with dark grey lenses, with highly to moderately weathered rock fragments (with rock structure) Hole terminated at 2.00 m Target depth			
21 Ptj: GALT 1.01 2013-02-21			2.5 —						Groundwater not encountered Sketch & Other Observations			



Comments:

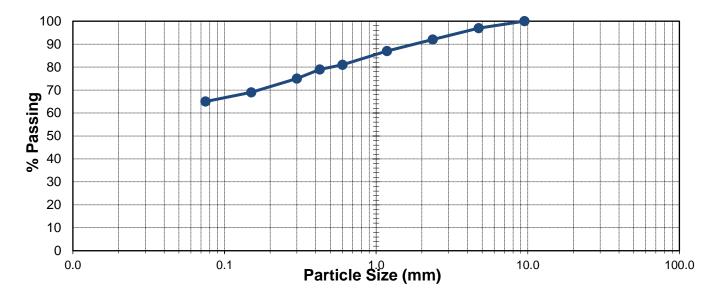


Appendix D: Laboratory Test Results



Galt Geotechnics Client: **Ticket No:** S351 **Project: Proposed Residence Report No:** LLS17/468_1 118 Coondaree Parade, Upper Swan Location: Sample No: LLS17/468 Sample ID: TP01 0.7-0.9m **Issue Date:** 08-March-2017

Sampling Procedure: Tested as Received



SIEVE ANALYSIS	AS 1289.3.6.1	Atterberg Limits Te	ests	
Sieve Size (mm)	% Passing	AS 1289		
75.0				
37.5		Liquid Limit 3.1.1	69	%
19.0				
9.5	100	Plastic Limit 3.2.1	17	%
4.75	97			
2.36	92	Plasticity Index 3.3.1	52	%
1.18	87			
0.600	81	Linear Shrinkage 3.4.1	16.0	%
0.425	79			
0.300	75			
0.150	69	Cracked		
0.075	65			
		Curled	√	

Client Address: 4/15 Walters Dr, Osborne Park WA 6017

Comments:



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Approved Signature:

Name: Matt van Herk **Function** Laboratory Manager

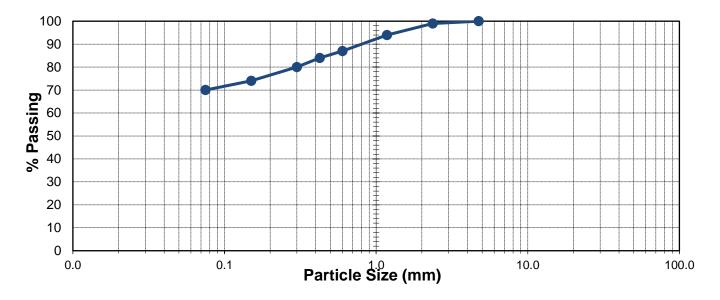
08-March-2017 Date:



Particle Size Distribution & Atterberg Limits Test Report

Galt Geotechnics Client: Ticket No: S351 **Project: Proposed Residence Report No:** LLS17/469_1 Location: 118 Coondaree Parade, Upper Swan Sample No: LLS17/469 Sample ID: **Issue Date:** 08-March-2017 TP06 0.8-1.0m

Sampling Procedure: Tested as Received



SIEVE ANALYSIS	AS 1289.3.6.1	Atterberg Limits Te	ests	
Sieve Size (mm)	% Passing	AS 1289		
75.0				
37.5		Liquid Limit 3.1.1	75	%
19.0				
9.5		Plastic Limit 3.2.1	17	%
4.75	100			
2.36	99	Plasticity Index 3.3.1	58	%
1.18	94			
0.600	87	Linear Shrinkage 3.4.1	15.0	%
0.425	84			
0.300	80			
0.150	74	Cracked	J	
0.075	70			
		Curled	J	

Client Address: 4/15 Walters Dr, Osborne Park WA 6017

Comments:



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Approved Signature:

Name: Matt van Herk **Function** Laboratory Manager

08-March-2017 Date:



Appendix E: Understanding Your Report



UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev2

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- the project objectives as we understood them and as described in this report;
- the specific site mentioned in this report; and
- the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- the report was not written for you;
- the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.



SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.