GEOTECHNICAL INVESTIGATION:

Proposed Unit Block at **17-19 Anzac Avenue, Collaroy**

1. Proposed Development

1.1 Demolish the existing warehouse and construct a new part three-storey unit block with two car stackers by excavating to a maximum depth of ~3.4m into the slope.

1.2 Details of the proposed development are shown on 10 drawings prepared by Gartner Trovato Architects, Project number 1931, drawings numbered DA-01 to 10, Revision 01, dated 30/3/20.

2. Site Description

2.1 The site was inspected on the 18th March, 2020.

2.2 This commercial property is level with the road and has an E aspect. It is located on the gently graded lower reaches of a hillslope. The slope rises across the site at an average angle of <5°. The slope above and below the property continues at similar angles.

2.3 At the road frontage to Anzac Avenue, a concrete driveway runs to a parking area on the S side of the property (Photo 1). The single-storey brick warehouse encompasses the remainder of the property (Photo 2). The warehouse has been structurally compromised in a fire and will be demolished as part of the proposed works (Photo 3).

3. Geology

The Sydney 1:100 000 Geological sheet indicates the site is underlain by the Newport Formation of the Narrabeen Group. It is possible there is a band of sandstone underlying the property that extends through the otherwise shale-dominated profile.

4. Subsurface Investigation

Two auger holes were put down to identify the soil materials. Four Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and the depth to weathered rock. The locations of the tests are shown on the site plan. It should be noted that a level of caution should be applied when interpreting DCP test results. The test will not pass through hard buried objects so in some instances it can be difficult to determine whether refusal has occurred on an obstruction in the profile or on the natural rock surface. This is not expected to be an issue for the testing on this site and the results are as follows:

AUGER HOLE 1 (~RL13.3) **–** AH1 (Photo 4)

Depth (m)	Material Encountered
0.0 to 0.1	**CONCRETE SLAB**.
0.1 to 0.6	**FILL**, disturbed sandy soil, dark brown, brown, and white, medium dense to very dense, medium to coarse grained with fine trace organic matter.

Refusal @ 0.6m on unknown obstruction. No watertable encountered.

AUGER HOLE 2 (~RL12.9) **–** AH2 (Photo 5)

Depth (m)	Material Encountered
0.0 to 0.2	**FILL**, gravel, grey, loose to medium dense, dry, coarse grained.
0.2 to 1.0	**SAND**, dark brown, medium dense, damp, coarse grained with fine trace organic matter.
1.0 to 1.3	**CLAYEY SAND**, grey, medium dense, wet, coarse grained with sugary texture.
1.3 to 1.5	**CLAY**, Very Low Strength Sandstone, grey and mottled orange, very stiff, damp, fine grained with sugary texture.

End of hole @ 1.5m in Very Low Strength Sandstone. Groundwater seepage observed.

DCP TEST RESULTS – Dynamic Cone Penetrometer				
Equipment: 9kg hammer, 510mm drop, conical tip.			Standard: AS1289.6.3.2 - 1997	
Depth(m) Blows/0.3m	**DCP 1** (~RL13.3)	**DCP 2** (~RL13.4)	**DCP 3** (~RL12.9)	**DCP 4** (~RL13.8)
0.0 to 0.3	25	8	9	18
0.3 to 0.6	45	20	13	9
0.6 to 0.9	24	32	22	6
0.9 to 1.2	43	31	11	8
1.2 to 1.5	60	40	16	10
1.5 to 1.8	#	#	20	19
1.8 to 2.1			30	35
2.1 to 2.4			30	#
2.4 to 2.7			#	
	End of Test @ 1.5m	End of Test @ 1.4m	End of Test @ 2.2m	End of Test @ 2.1m

#refusal/end of test. F=DCP fell after being struck showing little resistance through all or part of the interval.

DCP Notes:

DCP1 – Cored through concrete with core drill, slab ~0.1m thick. End of test @ 1.5m, DCP still very slowly going down, brown grey sand on wet tip.

DCP2 – Cored through concrete with core drill, slab ~0.1m thick. End of test @ 1.4m, DCP still very slowly going down, brown grey sand on wet tip.

DCP3 – End of test @ 2.2m, DCP still very slowly going down, wet muddy tip, grey sand in collar above tip.

DCP4 – End of test @ 2.1m, DCP still very slowly going down, wet muddy tip, maroon and grey sand in collar above tip.

5. Geological Observations/Interpretation

The site is underlain by manmade fill across the property over sands and clayey sands. The property has been levelled with manmade filling to a maximum depth of ~0.8m. The fill overlies loose to dense sands and clayey sands to a maximum depth of ~1.3m. In AH2, Very Low Strength Sandstone was encountered at ~1.3m below the current surface. It is likely each of the DCP tests encountered this layer of Very Low Strength Sandstone as none of the tests refused on rock. We were informed by the neighbour of the property that there is likely a natural seepage path underlying the property. This has been confirmed on work we have carried out on properties immediately upslope and during the testing as each of the DCP tests produced a wet tip upon extraction and water was observed to be pooling at the base of AH2. The groundwater seepage runs over the buried clay and rock and has likely contributed to the interpreted weathering in the sandstone that underlies the property. Thus, it is possible Medium Strength Sandstone underlies the property beyond the weathered layer of Very Low Strength Sandstone. See the Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

As discussed above, a natural seepage path likely flows under the property. The groundwater runs over the buried surface of the clays and rock. This will have implications for the excavations. See the recommendations in **Section 13**.

7. Surface Water

No evidence of surface flows were observed on the property during the inspection. It is expected that normal sheet wash will move onto the site from above the property during heavy down pours.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below, or beside the property. The vibrations from the proposed excavation are a potential hazard (**Hazard One**). The proposed excavation is a potential hazard until the retaining walls are in place (**Hazard Two**).

RISK ANALYSIS SUMMARY ON NEXT PAGE

Geotechnical Hazards and Risk Analysis - Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The vibrations produced during the proposed excavation impacting on the surrounding structures.	The excavation for the car stackers collapsing onto the work site and impacting on the N and E neighbouring properties before retaining walls are in place.
LIKELIHOOD	‘Possible’ (10^{-3})	‘Likely’ (10^{-3})
CONSEQUENCES TO PROPERTY	‘Medium’ (15%)	‘Medium’ (35%)
RISK TO PROPERTY	‘Moderate’ (2×10^{-4})	‘High’ (2×10^{-3})
RISK TO LIFE	5.3×10^{-7}/annum	$6.1 \text{ X } 10^{-4}$/annum
COMMENTS	This level of risk to property is ‘UNACCEPTABLE’. To move risk to ‘ACCEPTABLE’ levels, the recommendations in **Section 12** are to be followed.	‘UNACCEPTABLE’ level of risk to life and property. To move risk to ‘ACCEPTABLE’ levels, the recommendations in **Section 13** are to be followed.

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

9. Suitability of the Proposed Development for the Site

The proposed development is suitable for the site. No geotechnical hazards will be created by the completion of the proposed development provided it is carried out in accordance with the requirements of this report and good engineering and building practice.

10. Stormwater

There is fall to Anzac Avenue. Roof water from the proposed development is to be piped to the street drainage system through any tanks that may be required by the regulating authorities.

11. Excavations

An excavation to a maximum depth of ~3.4m will be required to install the car stackers. The excavations are expected to be through ~0.8m of manmade fill over loose to dense sands, clayey sands, and Very Low Strength Sandstone. Medium Strength Sandstone may be encountered near the base of the excavation. It is envisaged that excavations through fill, sand, clay, and Very Low Strength Sandstone can be carried out with an excavator and bucket and excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

Possible vibrations generated during excavations through fill, sandy soils and sandy clays will be below the threshold limit for building damage.

Medium Strength Sandstone may be encountered towards the base of the proposed excavation. Excavations through rock should be carried out to minimise the potential to cause vibration damage to the neighbouring houses to the N and E. The edges of the excavation will be set back ~8.0m from the N neighbouring house, and ~1.0m from the E neighbouring house. Close controls by the contractor over rock excavation are recommended so excessive vibrations are not generated.

Excavation methods are to be used that limit peak particle velocity to 5mm/sec at the property boundaries. Vibration monitoring will be required to verify this is achieved.

If a milling head is used to grind the rock, vibration monitoring will not be required. Alternatively, if rock sawing is carried out around the perimeter of the excavation boundaries in not less than 1.0m lifts, a rock hammer up to 300kg could be used to break the rock without vibration monitoring. Peak particle velocity will be less than 5mm/sec at the property boundaries using this method provided the saw cuts are kept well below the rock to broken.

It is worth noting that vibrations that are below thresholds for building damage may be felt by the occupants of the neighbouring properties.

13. Excavation Support Requirements

The excavation for the proposed car stackers will reach a maximum depth of ~3.4m and will be taken close to flush with the N and E common boundaries. The excavation will be taken close to flush with a fibro shed on the N neighbouring property (Photo 6) and will be set back ~1.0m from the E neighbouring house (Photo 7). Thus, the N and E property boundaries, N neighbouring fibro shed, and E neighbouring house will be within the zone of influence of the proposed excavations. In this instance, the zone of influence is the area above a theoretical 30° line from the base of the excavation towards the surrounding structures or boundaries. Heavy ground support is recommended due to the presence of manmade fill and sand, groundwater, and the proximity to the N and E neighbouring structures/properties.

The proposed excavation requires support installed along all sides before excavations commence. In this instance, due to the manmade fill, sand, and groundwater encountered secant or contiguous piers are suitable support. Secant piers are the preferred option but if contiguous piers are used, the gaps between the piers are to be grouted closed as the excavation is lowered so no sand moves through the wall. The piers can be temporarily supported by embedment below the base of the excavation and/or propping but are to be tied into the floor and ceiling slabs of the garage structure during construction.

It is recommended a piling rig capable of drilling through Medium Strength Rock be used for this job as Very Low Strength Sandstone was encountered and the ground testing did not extend to the likely required depth of the piles. Additionally, the rig will need to be a CFA rig (capable of grout injection during the drilling process due to the presence of groundwater seepage in sand - wet sand). Alternatively, exploration drilling is to be carried out prior to the structural design.

The geotechnical consultant is to inspect the drilling process of the entire first pile and the ground materials at the base of all the piers before any steel or concrete is placed.

All excavation spoil is to be removed from site following the current Environmental Protection Agency (EPA) waste classification guidelines.

14. Retaining Walls

For cantilever or singly-propped retaining walls, it is suggested the design be based on a triangular pressure distribution of lateral pressures using the parameters shown in Table 1.

Table 1 – Likely Earth Pressures for Retaining Walls

Unit	Earth Pressure Coefficients			
	Unit weight (kN/m^3)	**'Active' K_a**	**'At Rest' K_0**	**Passive**
Fill, Sandy Soil, and Residual Clays	20	0.40	0.55	N/A
Rock Up to Low Strength Rock - Jointed	24	0.25	0.35	K_p = 2.5
Medium Strength Rock	24	0.00	0.10	2.0MPa "Ultimate"

For rock classes refer to Pells et al "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region". Australian Geomechanics Journal 1978.

It is to be noted that the earth pressures in Table 1 assume a level surface above the wall, do not account for any surcharge loads and assume retaining walls are fully drained. It should be noted that passive pressure is an ultimate value and should have an appropriate safety factor applied. No passive resistance should be assumed for the top 0.4m to account for any disturbance from the excavation. Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

It should be noted normal seepage will move into the bulk excavation for the proposed basement. We expect this seepage can be removed with a conventional sump and pump system. The bulk excavation is to be periodically inspected by the Geotechnical Consultant to monitor ground water movements into the bulk excavation.

As the basement is to be embedded ~3.0m below the current surface, it is suggested the basement be tanked to minimise the use of pumps over the life of the building. Tanking the basement will also result in less impact on soil moisture levels around the development.

15. Foundations

The entirety of the proposed unit block will need to be supported on piers taken to the same material that will be encountered at the base of the proposed car stacker excavations. This is expected to be Low to Medium Strength Sandstone. A maximum allowable bearing pressure of 600kPa can be assumed for footings on this material.

Naturally occurring vertical cracks (known as joints) commonly occur in sandstone. These are generally filled with soil and are the natural seepage paths through the rock. They can extend to depths of several metres and are usually relatively narrow but can range between 0.1 to 0.8m wide. If a footing falls over a joint in the rock, the construction process is simplified if with the approval of the structural engineer the joint can be spanned or alternatively the footing can be repositioned so it does not fall over the joint.

NOTE: If the contractor is unsure of the footing material required, it is more cost-effective to get the geotechnical consultant on site at the start of the footing excavation to advise on footing depth and material. This mostly prevents unnecessary over-excavation in clay-like shaly-rock but can be valuable in all types of geology

REQUIRED INSPECTIONS ARE ON THE NEXT PAGE

16. Inspections

The client and builder are to familiarise themselves with the following required inspections as well as council geotechnical policy. We cannot provide certification for the regulating authorities if the following inspections have not been carried out during the construction process.

- The geotechnical consultant is to inspect the ground materials while the first pile for the pile wall is being dug to assess the ground strength and to ensure it is in line with our expectations. All finished pier holes are to be inspected and measured before concrete is placed.

- All footings are to be inspected and approved by the geotechnical professional before concrete is placed while the excavation equipment is still onsite and before steel reinforcement is installed.

White Geotechnical Group Pty Ltd.

Ben White M.Sc. Geol.,
AusIMM., CP GEOL.
No. 222757
Engineering Geologist

Photo 1

Photo 2

Photo 3

Photo 4: AH1 – Downhole is from left to right

Photo 5: AH2 – Downhole is from top to bottom

Photo 6

Photo 7

Important Information about Your Report

It should be noted that Geotechnical Reports are documents that build a picture of the subsurface conditions from the observation of surface features and testing carried out at specific points on the site. The spacing and location of the test points can be limited by the location of existing structures on the site or by budget and time constraints of the client. Additionally, the test themselves, although chosen for their suitability for the particular project, have their own limiting factors. The testing gives accurate information at the location of the test, within the confines of the test's capability. A geological interpretation or model is developed by joining these test points using all available data and drawing on previous experience of the geotechnical consultant. Even the most experienced practitioners cannot determine every possible feature or change that may lie below the earth. All of the subsurface features can only be known when they are revealed by excavation. As such, a Geotechnical report can be considered an interpretive document. It is based on factual data but also on opinion and judgement that comes with a level of uncertainty. This information is provided to help explain the nature and limitations of your report.

With this in mind, the following points are to be noted:

- If upon the commencement of the works the subsurface ground or ground water conditions prove different from those described in this report, it is advisable to contact White Geotechnical Group immediately, as problems relating to the ground works phase of construction are far easier and less costly to overcome if they are addressed early.

- If this report is used by other professionals during the design or construction process, any questions should be directed to White Geotechnical Group as only we understand the full methodology behind the report's conclusions.

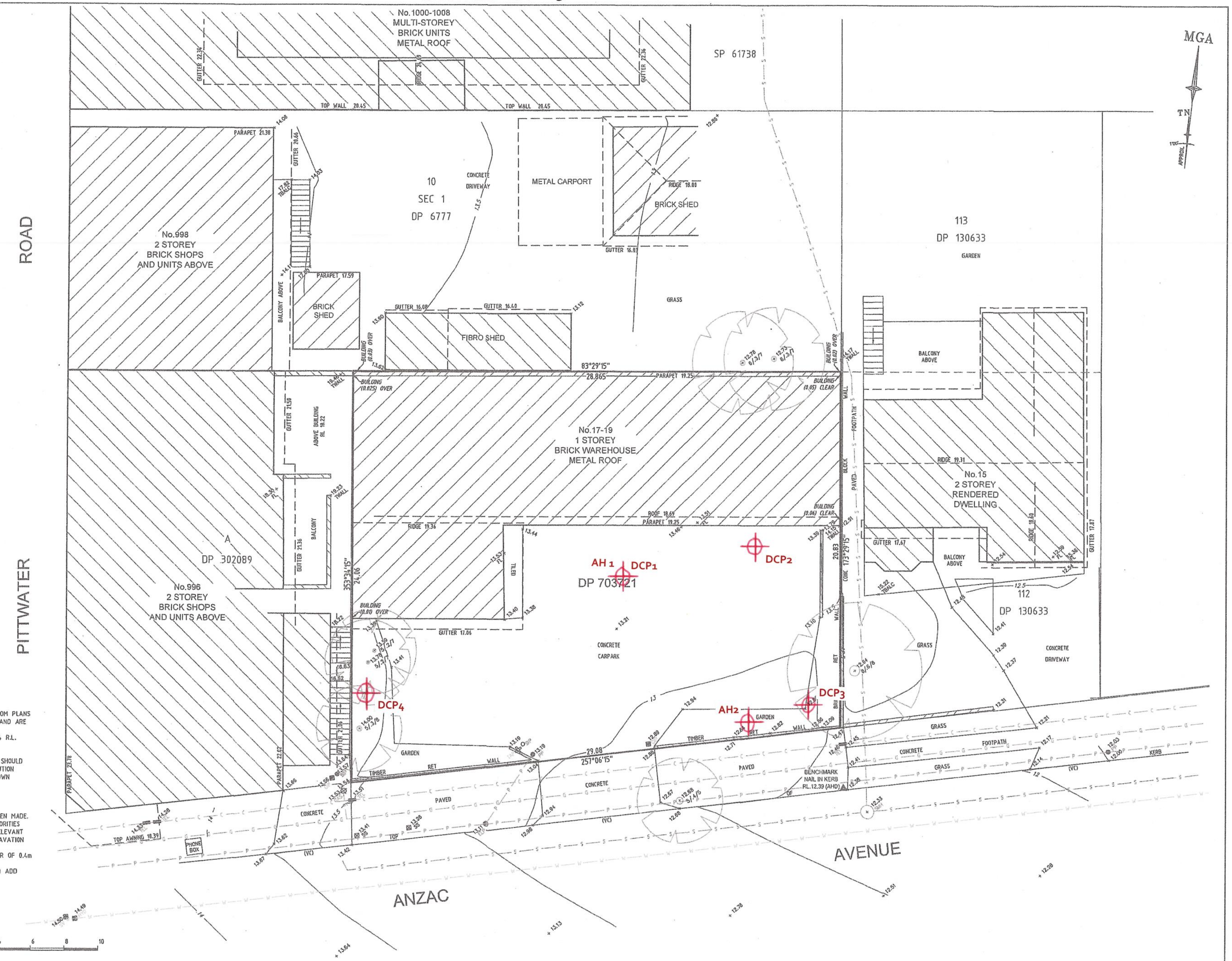
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- This report should not be applied to any other project other than that outlined in section 1.0.

- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

- It is common for the design and construction process to be adapted as it progresses (sometimes to suit the previous experience of the contractors involved). If alternative design and construction processes are required to those described in this report, contact White Geotechnical Group. We are familiar with a variety of techniques to reduce risk and can advise if your proposed methods are suitable for the site conditions.

SITE PLAN – showing test locations



LEGEND

BENCH MARK	▲
TELSTRA PIT	TEL
ELECTRIC LIGHT POLE	ELP
POWER POLE	PP
STREET SIGN	SS
GRATED INLET PIT	GIP
KERB INLET PIT	KIP
SEWER INSPECTION POINT	SIP
SEWER MANHOLE	SMH
STOP VALVE	SV
HYDRANT	HYD
WATER TAP	TAP
GAS VALVE	GAS
VEHICLE CROSSING	(VC)
WINDOW	W
DOOR	D
HEAD/SILL	H/S
GAS (DBYD)	— G —
TELSTRA (DBYD)	— C —
WATER (DBYD)	— W —
SEWER (DBYD)	— S —
ELECTRICITY (OVERHEAD)	— P —

NOTES

1. THE BOUNDARIES HAVE NOT BEEN MARKED
2. ALL AREAS AND DIMENSIONS HAVE BEEN COMPILED FROM PLANS MADE AVAILABLE BY NSW LAND REGISTRY SERVICES AND ARE SUBJECT TO FINAL SURVEY
3. ORIGIN OF LEVELS ON A.H.D. IS TAKEN FROM PM 10114 R.L. 11.422 (A.H.D.) IN ANZAC AVENUE
4. CONTOUR INTERVAL 0.5 m
5. CONTOURS ARE INDICATIVE ONLY. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION
6. KERB LEVELS ARE TO THE TOP OF KERB UNLESS SHOWN OTHERWISE
7. FLOOR LEVELS SHOWN ARE THRESHOLD LEVELS. NO INVESTIGATION OF INTERNAL FLOOR LEVELS HAS BEEN UNDERTAKEN
8. NO INVESTIGATION OF UNDERGROUND SERVICES HAS BEEN MADE. SERVICES HAVE BEEN PLOTTED FROM RELEVANT AUTHORITIES INFORMATION AND HAVE NOT BEEN SURVEYED. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE
9. 8/.4/7 DENOTES TREE SPREAD OF 8m, TRUNK DIAMETER OF 0.4m & APPROX HEIGHT OF 7m
10. BEARINGS SHOWN ARE MGA (MAP GRID OF AUSTRALIA) ADD APPROX. 1°00' FOR TRUE NORTH

DIAL BEFORE YOU DIG www.1100.com.au

REFER TO NOTES AND LEGEND

0 2 3 4 6 8 10
SCALE 1:100 @ A1

Revision	Date	Description	Reference	Revision	Date	Description	Reference	Revision	Date	Description	Reference
L	00/00/00	–	00	H	00/00/00	–	00	D	00/00/00	–	00
K	00/00/00	–	00	G	00/00/00	–	00	C	00/00/00	–	00
J	00/00/00	–	00	F	00/00/00	–	00	B	00/00/00	–	00
I	00/00/00	–	00	E	00/00/00	–	00	A	00/00/00	–	00

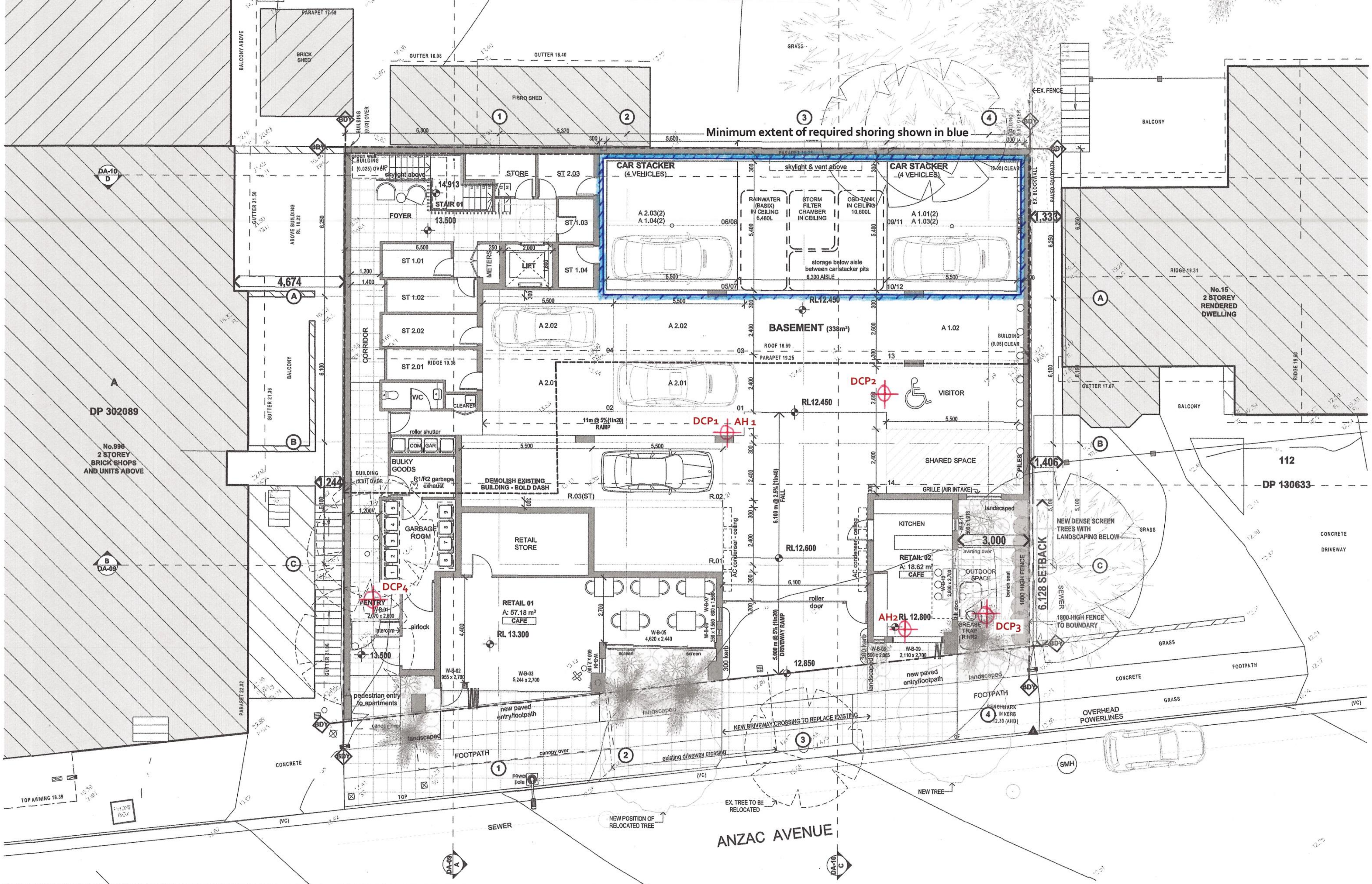
LTS CONFIDENCE TOGETHER
www.ltsl.com.au | P 1300 587 000

THIS IS THE PLAN REFERRED TO IN MY LETTER
DATED:
Registered Surveyor NSW

Client 17 AVE PTY LTD
Drawing title
PLAN OF DETAIL AND LEVELS OVER LOT 51 IN DP 703721
KNOWN AS 17-19 ANZAC AVENUE, COLLAROY

datum AHD
site Area 648.3m²
LGA NORTHERN BEACHES
reference number 50875 001DT
scale 1:100 @A1
date of survey 25/11/2019
SHEET 1 OF 2

SITE PLAN – showing test locations



Issue Date	Rev	Description	Drawn	Checked
30/03/2020	01	ISSUE FOR DA	JR	SG

GARTNERTROVATO ARCHITECTS
A PITTWATER PLACE L1/13 10 PARK STREET
PO BOX 1122
MONA VALE, NSW 2103
P +61 2 9979 4411
F +61 2 9979 4422
E GTA@G-T.COM.AU

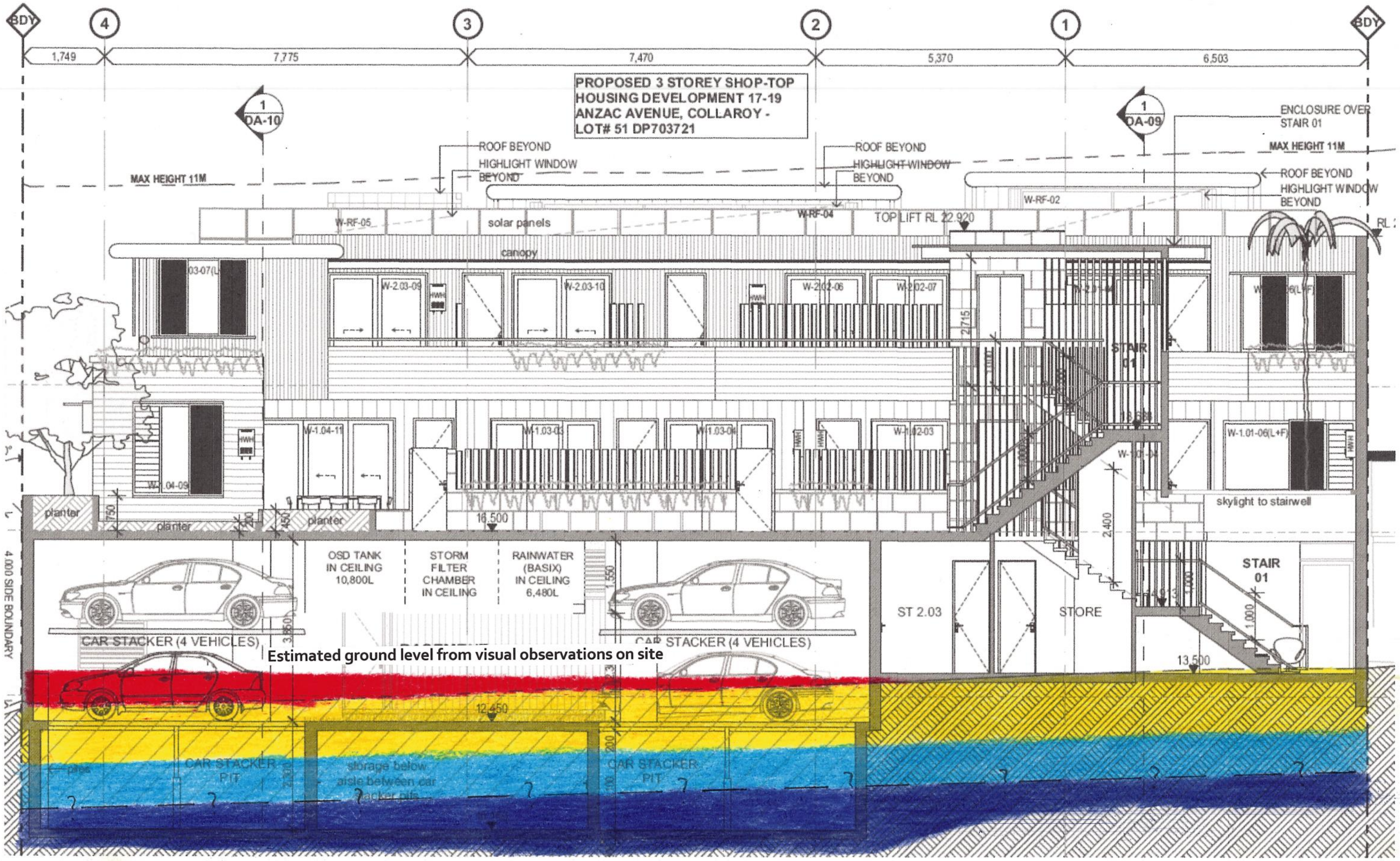
PROJECT: **LONG REEF SHOP-TOP**
PROPOSED 3 STOREY SHOP-TOP HOUSING DEVELOPMENT
17-19 ANZAC AVENUE, COLLAROY NSW
LOT No. 51 DP No. 703721
FOR B SANDVOSS

DRAWING TITLE: BASEMENT + CARPARK PLAN

SCALE	DRAWN BY	CHECKED BY	PLOT DATE
1:100 @ A2	JR	SG	30/03/2020

PROJECT NO.	DRAWING NO.	REVISION
1931	DA-02	01

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



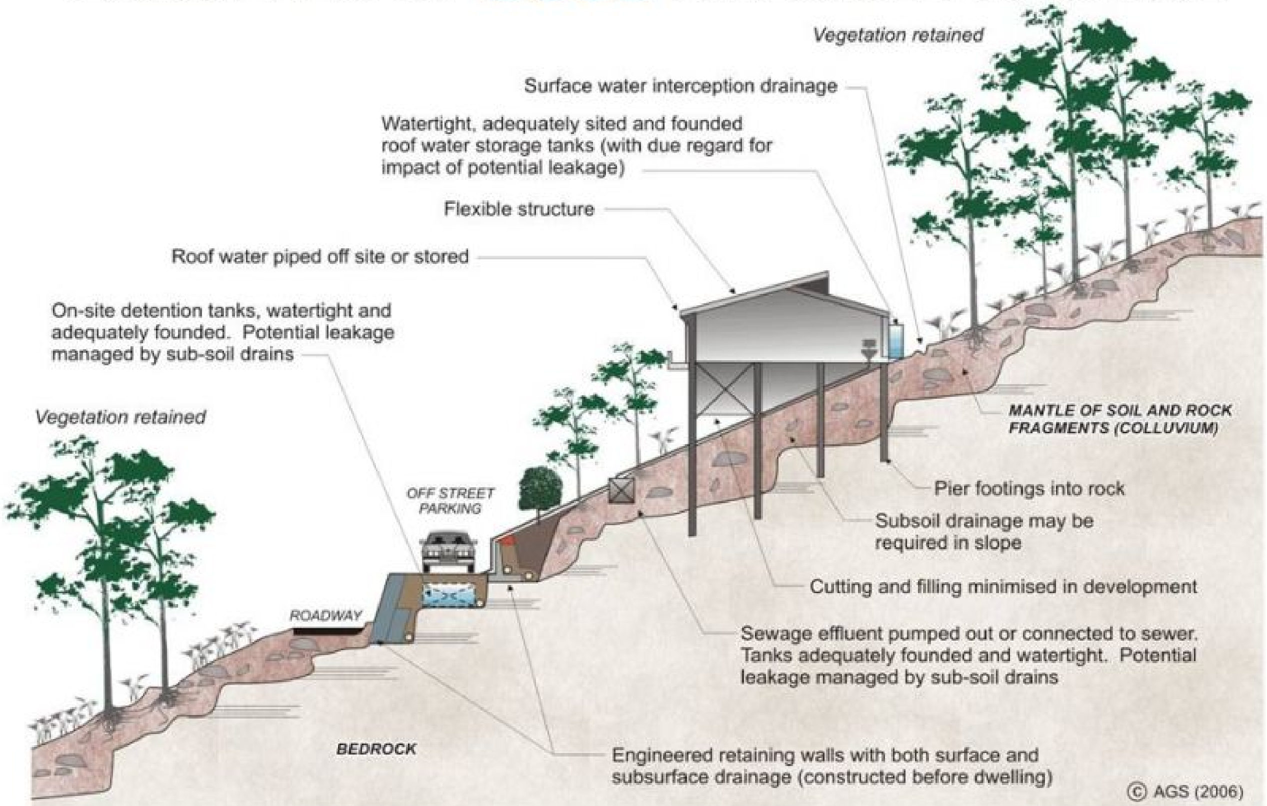
Fill

Sands and Clayey Sands

Very Low Strength Sandstone

Possible Low to Medium Strength Sandstone Band through Narrabeen Group Rocks – Depth to rock not known.

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE