GEOTECHNICAL INVESTIGATION:

New Unit Block at **12-14 Ponsonby Parade, Seaforth**

1. Proposed Development

1.1 Demolish the existing structures on both properties and construct a new two-storey unit block with basement parking by excavating to a maximum depth of ~4.5m into the slope.

1.2 Details of the proposed development are shown on 8 drawings prepared by Gartner Trovato Architects, Project number 2029, drawings numbered DA02 to 09, revision P08-WIP, dated 10/12/20.

2. Site Description

2.1 The site was inspected on the 17th November, 2020, and previously on the 16th October, 2017.

2.2 These residential properties have dual access. They are on the high side of Ponsonby Parade and on the low side of Ross Street. The properties have a S aspect. They are located on the gently graded upper middle reaches of a hillslope. Medium Strength Sandstone outcrops on the uphill side of 12 Ponsonby Parade. The slope above the property continues at increasing angles for ~250m to the crest of the slope. The slope below the property continues for ~125m at similar gentle angles before the slope falls steeply to Middle Harbour.

2.3 **12 Ponsonby Parade –** The cut for Ponsonby Parade is supported by a stable brick retaining wall reaching ~1.1m high (Photo 1). Between the road frontage and the house is a gently sloping lawn (Photo 2). Another gently sloping lawn extends off the uphill side of the house to the road frontage with Ross Street (Photo 3). Competent Medium Strength Sandstone outcrops through this lawn in the NW corner of the property (Photo 4). A brick garage extends off the road frontage to Ross Street in the NE corner of the property (Photo 5). The garage and house (Photo 6) will be demolished and the site will be cleared as part of the proposed works.

2.4 14 Ponsonby Parade - The cut for Ponsonby Parade is supported by a stable brick retaining wall reaching ~1.1m high (Photo 7). Between the road frontage to Ponsonby Parade and the house is a gently sloping lawn (Photo 8). Another gently sloping lawn extends off the uphill side of the house to the road frontage with Ross Street (Photo 9). A concrete driveway runs from the road frontage to a fibreboard clad garage (Photo 10). At the NE corner of the property is a fibreboard outbuilding and an adjacent brick toilet (Photo 11). The house (Photo 12), garage, outbuilding, and toilet will be demolished and the site will be cleared as part of the proposed works.

3. Geology

The Sydney 1:100 000 Geological sheet indicates the site is underlain by Hawkesbury Sandstone. It is described as a medium to coarse grained quartz sandstone with very minor shale and laminite lenses.

4. Subsurface Investigation

One hand Auger Hole (AH) was put down to identify the soil materials. Nine Dynamic Cone Penetrometer tests (DCP) were put down to determine the relative density of the overlying soil and the depth to bedrock. The locations of the tests are shown on the site plan attached. 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. However, excavation and foundation budgets should always allow for the possibility that the interpreted ground conditions in this report vary from those encountered during excavations.

See the appended "Important information about your report" for a more comprehensive explanation. The results are as follows:

AUGER HOLE 1 (~RL68.5) **–** AH1 (Photo 13)

Depth (m)	**Material Encountered**
0.0 to 0.3	**TOPSOIL**, sandy soil, grey brown, medium dense to dense, fine grained with fine trace organic matter and trace silt.
0.3 to 0.7	**SANDY SOIL**, brown, medium dense, fine to medium grained with fine trace organic matter.
0.7 to 0.9	**VERY LOW STRENGTH SANDSTONE**, grey, medium grained with sugary texture.

End of hole @ 0.9m in Very Low Strength Sandstone. No water table encountered.

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** (~RL66.7)	**DCP 2** (~RL66.5)	**DCP 3** (~RL68.4)	**DCP 4** (~RL68.6)	**DCP 5** (~RL67.6)	**DCP 6** (~RL69.4)	**DCP 7** (~RL68.6)	**DCP 8** (~RL67.3)	**DCP 9** (~RL65.1)
0.0 to 0.3	13	14	14	5	12	Rock Exposed at Surface	3F	5	6
0.3 to 0.6	8	24	40	7	20		14	8	13F
0.6 to 0.9	8	12	#	14	13		#	9	1
0.9 to 1.2	10	#		#	#			17	#
1.2 to 1.5	#							#	
	Refusal on Rock @ 1.0m	Refusal on Rock @ 0.7m	Refusal @ 0.6m	Refusal on Rock @ 0.9m	Refusal on Rock @ 0.7m		Refusal on Rock @ 0.5m	Refusal on Rock @ 1.0m	Refusal on Rock @ 0.7m

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

DCP Notes:

DCP1 – Refusal on rock @ 1.0m, DCP bouncing off rock surface, clean dry tip.
DCP2 – Refusal on rock @ 0.7m, DCP bouncing off rock surface, white impact dust on dry tip.
DCP3 – Refusal @ 0.6m, DCP thudding, clean dry tip.
DCP4 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, white sand on dry tip.
DCP5 – Refusal on rock @ 0.7m, DCP bouncing off rock surface, clean dry tip.
DCP6 – Rock exposed at surface.
DCP7 – Refusal on rock @ 0.5m, DCP bouncing off rock surface, white, orange, and maroon sandstone fragments on dry tip.
DCP8 – Refusal on rock @ 1.0m, DCP bouncing off rock surface, brown clay on wet tip.
DCP9 – Refusal on rock @ 0.7m, DCP bouncing off rock surface, white, orange, and brown sandstone fragments on damp tip.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the outcropping and underlying sandstone bedrock that steps up the property forming sub-horizontal benches between the steps. Where the grade is steeper, the steps are larger and the benches narrower. Where the slope eases, the opposite is true. The rock is overlain by sandy soils and sandy clays that fill the bench step formation. In the test locations, the depth to rock ranged between 0.5 to 1.0m below the current surface, being slightly deeper due to the stepped nature of the underlying bedrock. The outcropping sandstone on the property is estimated to be medium strength and similar strength rock is expected to underlie the entire site. See Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

Normal ground water seepage will move over the buried surface of the rock and through the cracks. Due to the slope and elevation of the block, the water table is expected to be many metres below the base of the proposed excavation.

7. Surface Water

No evidence of significant surface flows were observed on the property during the inspection. Normal sheet wash from the slope above will be intercepted by the street drainage system for Ross Street above.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below, or beside the property. The vibrations from the proposed excavations are a potential hazard (**Hazard One**). A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process is a potential hazard (**Hazard Two**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The vibrations produced during the proposed excavation impacting on the surrounding structures.	A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (20%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.3×10^{-7}/annum	8.4×10^{-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.	This level of risk to life and property is 'UNACCEPTABLE'. 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

The fall is to Ponsonby Parade. 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 ~4.5m is required to install the proposed basement level of the unit block. The excavation is expected to be through sandy soils and firm to stiff sandy clays with Medium Strength Sandstone expected at a maximum depth of ~1.0m below the surface.

It is envisaged that excavations through sandy soil and sandy clays can be carried out with a bucket and excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

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

It is expected most of the excavation will be through Medium Strength Sandstone or better. Excavations through rock should be carried out to minimise the potential to cause vibration damage to the E neighbouring house and garage, NW neighbouring house, and SW neighbouring house. The E neighbouring house will be as close as ~5.0m, the E neighbouring garage will be as close as ~7.5m, the NW neighbouring house will be as close as ~5.5m, and the SW neighbouring house will be as close as ~7.2m from the edges of the excavation. 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 600kg 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 house and neighbouring properties.

13. Excavation Support Requirements

Allowing for drainage, the entire excavation will be sufficiently set back from the property boundaries.

The excavation through soil and clay is to be scraped back from the excavation line at least 0.5m and battered at 1.0 Vertical to 1.7 Horizontal (30°) prior to the excavation through rock commencing. Excavations through Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. Unsupported cut batters through soil and clay are to be covered to prevent access of water in wet weather and loss of moisture in dry weather. The covers are to be tied down with metal pegs or other suitable fixtures so they can’t blow off in a storm. The materials and labour to construct the retaining walls are to be organised so on completion of the excavations they can be constructed as soon as possible. The excavations are to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast.

During the excavation process, the geotechnical consultant is to inspect the cut faces in 1.5m intervals as they are lowered or after encountering softer sections of rock, while the machine is on site to ensure the ground materials are as expected and no wedges or other geological defects are present that could require additional support. Should any weak sections of rock be encountered, works are to stop until temporary or permanent support such as rock anchors, bolts, sprayed concrete, or similar support designed by the structural engineer is installed in consultation with the geotechnical consultant.

Upon completion of the excavations, it is recommended all cut faces be supported with retaining walls to prevent any potential future movement of joint blocks in the cut faces that can occur over time, when unfavourable jointing is obscured behind the excavation faces. Additionally, retaining walls will help control seepage and to prevent minor erosion and sediment movement.

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 IS ON THE NEXT PAGE

Table 1 – Likely Earth Pressures for Retaining Walls

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	**'Active' K_a**	**'At Rest' K_0**
Sandy Soil and Residual Clay	20	0.40	0.55
Medium Strength Sandstone	24	0.00	0.10

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 structure, do not account for any surcharge loads and assume retaining walls are fully drained. Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

All retaining walls are to have sufficient back-wall drainage and be backfilled immediately behind the wall with free-draining material (such as gravel). This material is to be wrapped in a non-woven Geotextile fabric (i.e., Bidim A34 or similar), to prevent the drainage from becoming clogged with silt and clay. If no back-wall drainage is installed in retaining walls, the likely hydrostatic pressures are to be accounted for in the structural design.

15. Foundations

A concrete slab supported directly off Medium Strength Sandstone is a suitable footing for the proposed unit block. This ground material is expected to be exposed across the entire base of the excavation for the basement level. A maximum allowable bearing pressure of 1000kPa can be assumed for footings on Medium Strength Sandstone.

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.

16. Inspections

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

- During the excavation process, the geotechnical consultant is to inspect the cut faces in 1.5m intervals as they are lowered to ensure ground materials are as expected and that there are no wedges or other defects present in the rock that may require additional support.
- All footings are to be inspected and approved by the geotechnical consultant while the excavation equipment is still onsite and before steel reinforcing is placed or concrete is poured.

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

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 41

Photo 12

Photo 13: AH1 – Downhole is from top to bottom.

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.

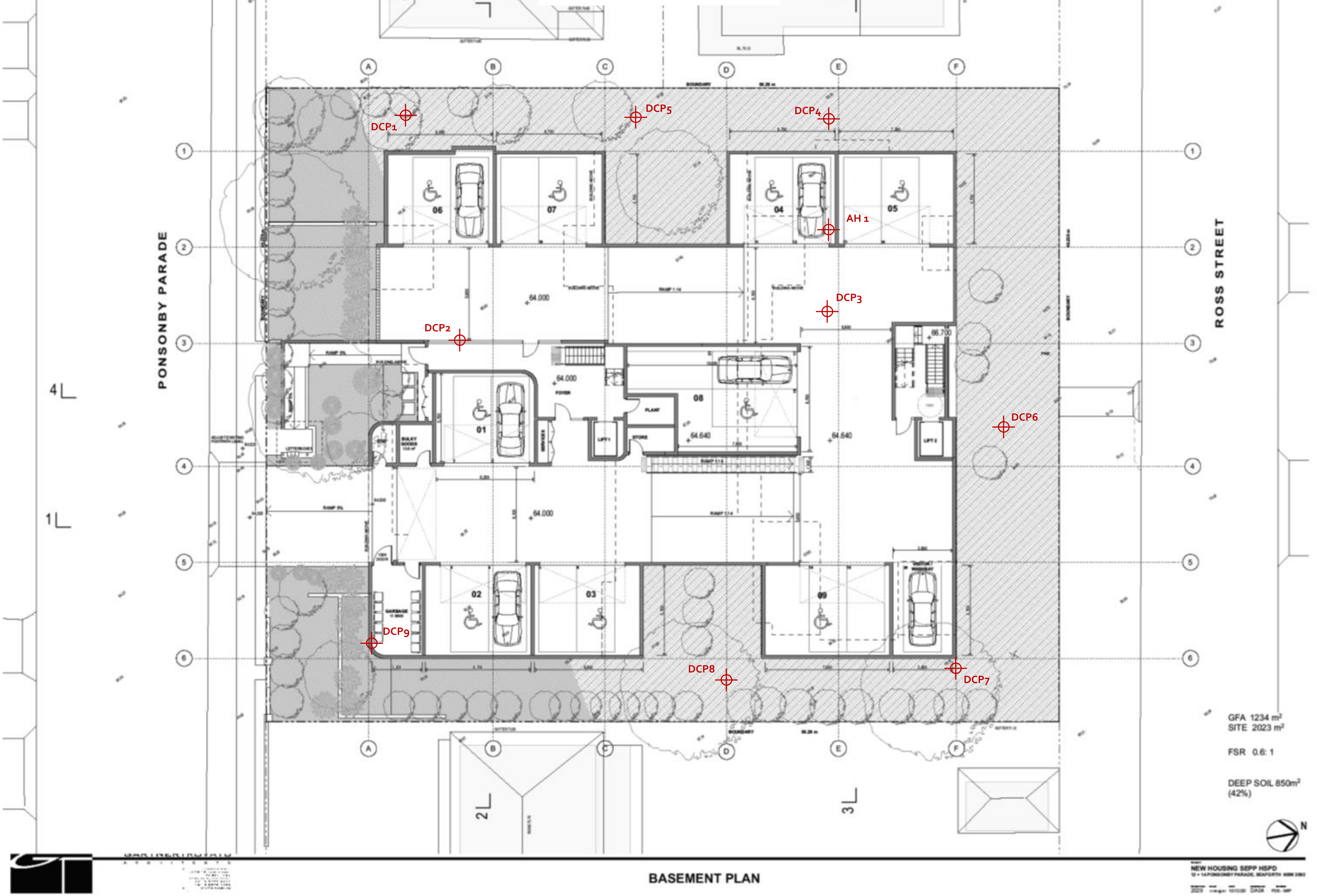
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

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

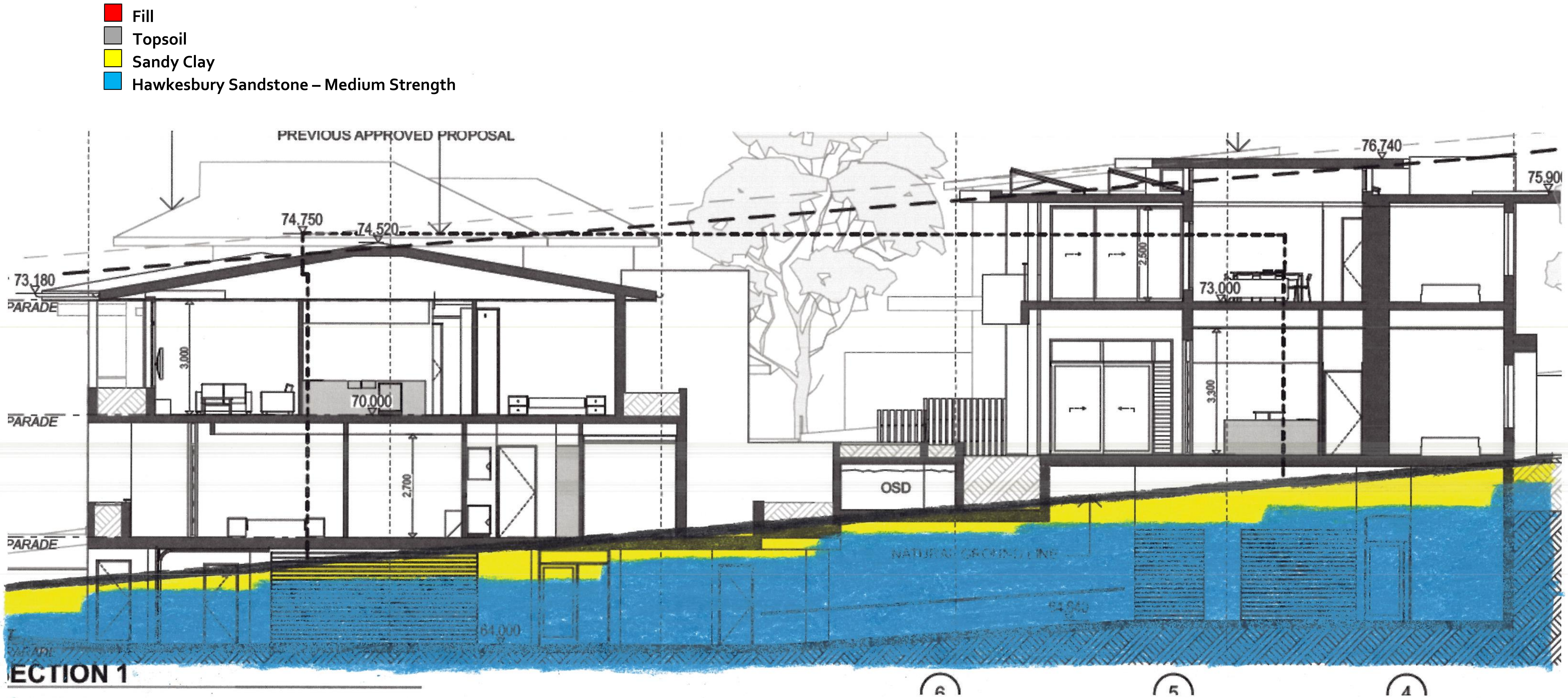
- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

- 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.

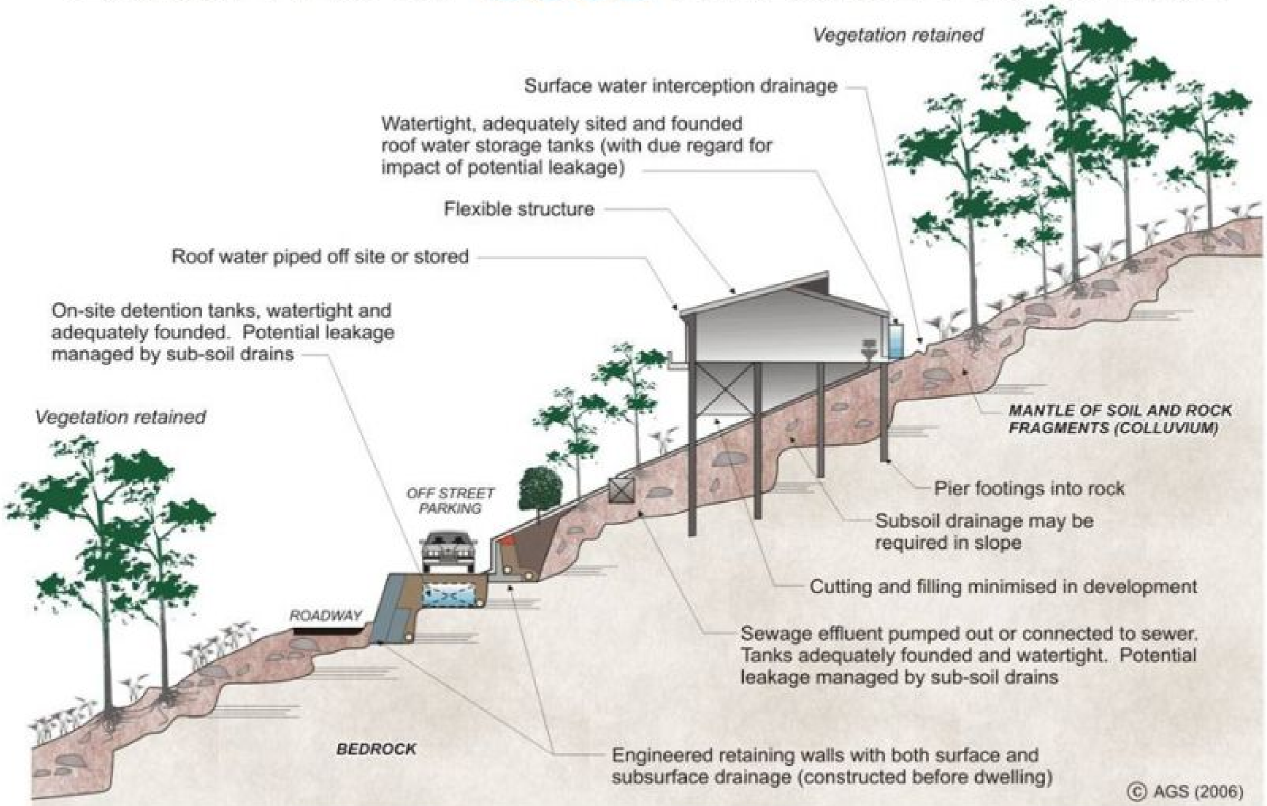
SITE PLAN – showing test locations



TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE