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Consulting Engineers

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2 March 2018
Our ref: AB/S1033

David Black
Via email: david_black@rooksalinger.com

Proposed Driveway Rehabilitation + Pool – 63 Gordon Street, Clontarf, NSW

Geotechnical Assessment

1 Introduction

At the request of David Black, Fortify Geotech Pty Ltd carried out a geotechnical assessment of a failing driveway pavement at 63 Gordon Street in Clontarf, NSW. The top section of the driveway is in good condition and consists of an asphaltic concrete pavement. The bottom half of the existing driveway is currently paved with loose rocks and is to be reconstructed. It appears to comprise a wearing course of sandstone pavers, underlain by a silty fill material. It is understood that the client intends to replace the sandstone pavers with asphaltic concrete to match the top section of the driveway. It is understood that this driveway is used for light vehicles only. The aim of the assessment is to identify the cause(s) of the pavement failure, and provide advice to remediate the pavement and/or subgrade

Future works include a pool in the backyard and it has been requested that the geotechnical work for the pool is to be done at this time. A site classification, footing recommendations as well as excavation conditions and use of excavated material is included in this report for the proposed pool.

2 Investigation Results

2.1 SUBSURFACE CONDITIONS

The 1:100,000 Sydney Geology map indicates the area to be underlain by Triassic age, Triassic age, Wianamatta Group, Hawkesbury Sandstone bedrock which includes medium to coarse-grained quartz sandstone, very minor shale and laminate lenses. Figure 1 is a recent aerial photograph showing the approximate borehole locations as designated by the client.

2.1.1 Subsurface Conditions - Driveway

The subsurface conditions of the driveway location were investigated by two boreholes designated 1A to 2A. The borehole logs in Appendix A can be referred to for more detail. Investigation boreholes at the driveway site found the subsurface profile to comprise:

Geological Profile	**Depth Interval**	**Description**
SANDSTONE PAVERS	0m to 0.03m/0.04m	Sandstone Pavers.
FILL	0.03m/0.04m to 0.3m/0.33m	SILTY SAND & SANDY SILT; fine to coarse and coarse sand, grey, dark grey, dark brown, some sandstone gravels to 5mm/10mm size, trace anthropogenic material (tile, brick), dry to moist, loose – medium dense.
RESIDUAL & SANDSTONE BOULDERS	0.3m/0.33m to >0.4m/1.01m	SILTY SAND, SAND & SANDSTONE BOULDERS; highly weathered (HW) sandstone boulders, fine to coarse grained sandstone, pale orange, dark brown, white, pale pink, brown, some plant roots, dry and dry to moist, dense.

2.1.2 Subsurface Conditions – Proposed Pool Location

The subsurface conditions of the proposed pool location were investigated by one borehole designated 3A. The borehole log in Appendix A can be referred to for more detail. Investigation boreholes at the driveway site found the subsurface profile to comprise:

Geological Profile	**Depth Interval**	**Description**
TOPSOIL FILL & FILL	0m to 0.5m	SANDY SILT, SILT & SILTY SAND; fine sand, Dark brown, trace sub-angular gravels to 5mm size, some roots, trace anthropogenic material (plastic), dry, loose and medium dense to dense.
SANDSTONE / SANDSTONE BOULDER	0.5m to 0.6m	SANDSTONE; highly weathered (HW), pale orange, fine to medium grained, dry. Push-tube refusal occurred at 0.6m depth in HW sandstone rock.

2.2 GROUNDWATER

Groundwater was not encountered during the investigation, however, it is expected that seasonal perched seepages could be present in the upper soils following periods of rain.

2.3 LABORATORY TEST RESULTS

The results of the standard compaction and soaked CBR laboratory test performed on the subgrade soils are summarised in Table 5. The CBR test specimen was compacted to a nominal 98% StdMDD at about at about optimum moisture content, and soaked for four days prior to testing. The NATA test certificates are presented in Appendix C.

TABLE 2 – Laboratory Test Results Summary – Subgrade

Sample No	1A/1D
Depth Interval	0.03m to 0.3m
Material Description	**Fill;** SILTY SAND & SANDY SILT; fine to coarse and coarse sand dark grey, some sandstone gravels to 5mm/10mm size, medium dense to dense, dry.
USCS (visually assessed)	SM & ML
Modified Compaction	
Std. Max Dry Density (t/m^3)	1.82
Opt. Moisture Content (%)	12.5
Soaked CBR	
Placement Moisture Content (%)	4.3
Placement Density Ratio (%)	98.0
Post-Soak Density Ratio (%)	98.0
Swell After Soak (%)	0
CBR Value (4-day soak) (%)	25
Remarks	

5 DISCUSSION & RECOMMENDATIONS – DRIVEWAY

5.1 CAUSE(S) OF PAVEMENT DISTRESS/FAILURE

It is assessed that the main cause of the pavement distress is due to areas of loose – medium dense, uncompacted fill under the pavement as well as insufficient subsurface drainage.

5.2 PAVEMENT REMEDIATION

Given the loose to medium dense, uncompacted subgrade conditions, we have recommended replacing the failed/distressed pavers with a reinforced concrete groundslab. If the pavement is not remediated, the failures and distress will become worse over time.

A properly designed and constructed groundslab will be able to bridge over the areas of loose/soft subgrade. The concrete slab construction process is summarised below:

1) Remove the existing pavers, and strip the subgrade surface to design subgrade level.

2) The exposed surface should then be proof-rolled using a vibratory, smooth-drum pavement roller to identify and soft spots that require further removal. The Geotechnical Engineer should inspect the foundation and witness the proof-rolling (hold point – Fortify Geotech).

3) The groundslab must be designed by a structural/civil engineer to support the anticipated traffic loads.If required for design of ground slabs, a modulus of subgrade reaction of 50kPa/mm and soaked CBR value of 10% can be assumed for the subgrade.

Alternatively, if a asphaltic concrete wearing course is preferred, the existing fill would have to be removed to at least 500mm below design subgrade level, and replaced with controlled fill.

5.3 DRAINAGE

Suitable surface drainage should be provided to ensure rainfall run-off or other surface water cannot pond against buildings or pavements. Subsoils drains should be installed along the upslope side of road pavements. It is also recommended that all drainage and water supply pipes be checked to ensure there are no water leaks into the driveway subgrade.

6 DISCUSSION & RECOMMENDATIONS – POOL

6.1 SITE CLASSIFICATION

Due to the presence of uncontrolled fill materials to at least 0.5m depth, the site is designated as Class “P” (problem) site in accordance with AS2870 “Residential Slabs & Footings”. If the fill is removed, or if footings are founded in the natural soils below the fill, or if the fill is removed and replaced with controlled fill, a Class “M” (highly reactive) category can be used in design of new footings (Ys is estimated to be between 20mm and 30mm).

Deemed-to-comply footing designs provided by AS2870 are applicable specifically to residential-style one and two-storey structures, or buildings with similar loads and superstructure stiffness.

6.2 FOOTINGS

AS2870 provides “deemed-to-comply” footing/slab designs, which for a class “M” site includes stiffened rafts, stiffened footing slabs, waffle rafts, and strip and/or pad footings with above ground floors. Footings and slabs should be in accordance with the principles of AS2870.

Footings including thickened sections of slabs forming footings should be taken below the topsoil and fill material and founded in the bouldery residual soils or sandstone bedrock. A footing depth of up to ~0.5m depth below existing surface levels may be required.

It is recommended that footings are inspected by a geotechnical engineer prior to the pouring of concrete to ensure that footings are founded in adequate material.

6.3 EXCAVATION CONDITIONS & USE OF EXCAVATED MATERIAL

Pool excavations could extend to 2.4m depth. The excavations will be through topsoil, existing fill, bouldery residual soil and potentially MW sandstone bedrock. The fill and residual soils are readily diggable by backhoe and medium sized excavator to at least ~0.5m depth. However, medium strong and strong rock may be encountered below ~0.5m depth, and would require heavy excavator or bulldozer ripping and rock hammering. Care should be taken when rock hammering to avoid ground vibrations that could damage nearby structures. Pre-cutting the perimeter of the excavation with a diamond saw would also aid excavation.

The low/medium plasticity residual soils can be used in controlled fill construction of building platforms. Topsoil and existing uncontrolled fill material should not be used in controlled fill construction, however, it can be used for landscaping.

If imported fill is required, a suitable select fill material would include a low or medium plasticity soil such as clayey sand or gravelly clayey sand, containing between 25% and 50% fines less than 0.075mm size (silt and clay), and no particles greater than 75mm size.

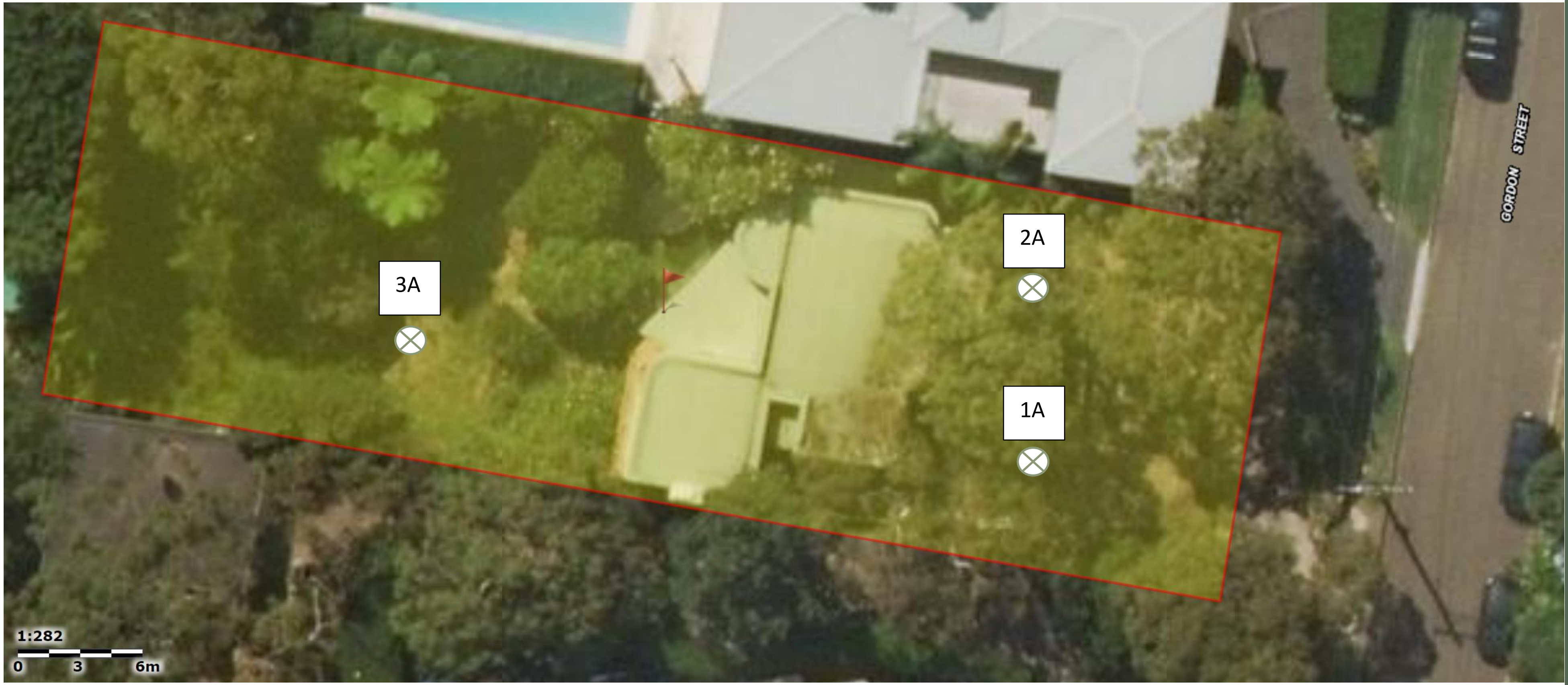
Should you require any further information, please contact our office.

Yours faithfully,

Fortify Geotech Pty Ltd

ARBaillie

Allison Baillie
Geotechnical Engineer



Legend:

Borehole Location - ⊗

AERIAL PHOTOGRAPH AND BOREHOLE LOCATION	S1033	FIGURE 1

FORTIFY GEOTECH

Borehole No.
BH1
Page 1 of 1

Engineering Log - Borehole

Project No.: S1033

Client:	David Black	Commenced:	06/02/2018
Project Name:	Driveway Remediation + Proposed Pool	Completed:	06/02/2018
Hole Location:	63 Gordon Street, Clontarf, NSW	Logged By:	
Hole Position:		Checked By:	

Drill Model and Mounting:		Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:		Bearing:		Datum:	AHD	Operator:	

Drilling Information								Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
								▨		SANDSTONE PAVERS				ROAD SURFACE
								▨	SM	SILTY SAND/SANDY SILT; fine to coarse sand, dark grey, some sandstone gravels to 10mm size, trace anthropogenic materials (brick, tile)	D to M	MD		FILL
							0.2	▨	SM	SILTY SAND; coarse sand, grey, some sandstone gravels to 5mm size.		MD to D		
								⁘		SANDSTONE BOULDER? coarse grained, pale orange.	D			RESIDUAL SOIL
							0.4			Hole Terminated at 0.40 m Refusal				
							0.6							
							0.8							
							1.0							
							1.2							
							1.4							

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
⊻ Level (Date)
▷ Inflow
◁ Partial Loss
◀ Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

FORTIFY 1.00 LIB.GLB Log IS AU BOREHOLE 1 S1033.GPJ <<DrawingFile>> 27/02/2018 15:00 10.0.000 Datgel Lab and In Situ Tool - DGD | Lib: Fortify 1.00 2017-04-15 Prj: Fortify 1.00 2017-04-15

FORTIFY
GEOTECH

Borehole No.
BH2
Page 1 of 1

Engineering Log - Borehole

Project No.: S1033

Client:	David Black	Commenced:	06/02/2018
Project Name:	Driveway Remediation + Proposed Pool	Completed:	06/02/2018
Hole Location:	63 Gordon Street, Clontarf, NSW	Logged By:	
Hole Position:		Checked By:	

Drill Model and Mounting:	Inclination:	-90°	RL Surface:	No survey		
Hole Diameter:	Bearing:		Datum:	AHD	Operator:	

Drilling Information								Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
										SANDSTONE PAVERS				ROAD SURFACE
							0.2		SM	SILTY SAND; fine to coarse sand, dark brown-grey, some sandstone gravesl to 10mm size. trace roots	D to M	MD		FILL
										HW SANDSTONE BOULDER; coarse grained, pale orange.				ROCK
							0.4		SW	SAND; coarse, pale orange. brown		L to MD		RESIDUAL SOIL
							0.6			HW SANDSTONE BOULDER; fine to coarse grained, pink				ROCK
							0.8		SM	SILTY SAND; fine to coarse, dark brown, some plant roots.		D		RESIDUAL SOIL
							1.0			HW SANDSTONE BOULDER; coarse grained, pale orange	D			ROCK
										Hole Terminated at 1.01 m Refusal				
							1.2							
							1.4							

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
▽ Level (Date)
▷ Inflow
◁ Partial Loss
◀ Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
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Plastic Limit
< PL
= PL
< PL

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VS - Very Soft
S - Soft
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VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

FORTIFY
GEOTECH

Borehole No.
BH3
Page 1 of 1

Engineering Log - Borehole

Project No.: S1033

Client:	David Black	Commenced:	06/02/2018
Project Name:	Driveway Remediation + Proposed Pool	Completed:	06/02/2018
Hole Location:	63 Gordon Street, Clontarf, NSW	Logged By:	
Hole Position:		Checked By:	

Drill Model and Mounting:	Inclination: -90°	RL Surface:	No survey		
Hole Diameter:	Bearing:	Datum:	AHD	Operator:	

Drilling Information								Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
									ML	SANDY SILT/ SILT; fine sand, dark brown, some roots.	D	L		FILL
							0.2 0.4		SM	SILTY SAND / SANDY SILT; fine sand, dark brown, trace sub-angular gravels to 5mm size, trace anthropogenic materials (plastic).		MD to D		
										HW SANDSTONE; pale orange, fine to medium grained, weak rock				ROCK
							0.6 0.8 1.0 1.2 1.4			Hole Terminated at 0.60 m Refusal				

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
⧖ Level (Date)
▷ Inflow
◁ Partial Loss
◀ Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Plastic Limit
< PL
= PL
< PL

Consistency/Relative Density
VS - Very Soft
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VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

FORTIFY 1.00 LIB.GLB Log IS AU BOREHOLE 1 S1033.GPJ <<DrawingFile>> 27/02/2018 15:01 10.0.000 Datgel Lab and In Situ Tool - DGD | Lib: Fortify 1.00 2017-04-15 Prj: Fortify 1.00 2017-04-15

J & A GEOTECH TESTING PTY LTD

Unit 2/25 Dacre Street Mitchell ACT 2911

Certificate No 254761

Test Certificate - California Bearing Ratio - CBR

Client	**FORTIFY GEOTECH**	Job No	**2165**
Principal		Date Tested	19.02.18
Project	63 Gordon Street	Tested By	D.J
Location	Clontarf NSW	Date Checked	20.02.18
Test Procedures		Checked By	S.M

[•] AS 1289 6.1.1 [•] AS 1289 2.1.1 [•] AS 1289 2.1.4 [•] AS 1289 5.1.1 [ ] AS 1289 5.2.1

[ ] RMS T102 – CAn = ___ [ ] RMS T111 [ ] RMS T112 [ ] RMS T117 [ ] RMS T120 [ ] RMS T180 [ ] RMS 130 [ ] RMS T132

Sample Location		BH1/1D	-	-	-
Level at Test Taken	BFL	0.03m-0.3m	-	-	-
Remoulding Parameters		**98%SMDD@OMC**	-	-	-
Compactive Effort		Standard	-	-	-
Maximum Particle Size	mm	19.0	-	-	-
Percentage Oversize of Material	%	0.0	-	-	-
Oversize Material Included in Sample		[ ] Yes [•] No	[ ] Yes [ ] No	[ ] Yes [ ] No	[ ] Yes [ ] No
Maximum Dry Density	t/m^3	1.86	-	-	-
Optimum Moisture Content	%	12.5	-	-	-
Dry Density Before Soak	t/m^3	1.82	-	-	-
Dry Density After Soak	t/m^3	1.82	-	-	-
Dry Density Ratio Before Soak	%	98.0	-	-	-
Dry Density Ratio After Soak	%	98.0	-	-	-
Moisture Ratio Before Soak	%	100.0	-	-	-
Moisture Content Before Soak	%	12.4	-	-	-
Soaking					
Period of Soak days		4	-	-	-
Surcharge kg		4.5	-	-	-
Swell%		0.0	-	-	-
Penetration Test					
Sample Moisture Content	%	4.3	-	-	-
Top 30 mm	%	15.0	-	-	-
Whole Sample	%	13.2	-	-	-
CBR Value		**25**	**-**	**-**	**-**
Penetration at Which CBR Determined mm		5.0	-	-	-
Material Classification: Sampled by client received on 08.02.18		**Sandy clay brown colour**	-	-	-

NATA

ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

20.02.18
Laboratory Manager/Date
Scott Miller

NATA Accredited Laboratory Number: 19979