Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Acid Sulfate Soil Management Plan

Huntington
35 Honeysuckle Drive, Newcastle

Prepared for
Lee 4 Pty Ltd

Project 91303.00
June 2018

Document History

Document details

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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- Floor Plan Basement 02, Drawing No.DA-A-0201 Rev 03
- Floor Plan Basement 01 Drawing No.DA-A-0202 Rev 03
- Building Sections – Sheet 1, Drawing No.DA-A-0601 Rev 03
- Building Sections – Sheet 2, Drawing No. DA -A- 0602 Rev 03

Detail and Contour Survey – De Witt Consulting (8215 – DET – 14.02.18)

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1. Introduction

1.1 Purpose

This Aacid sulfate soil management plan (ASSMP) has been prepared for the Huntington development at 35 Honeysuckle Drive, Newcastle. The work was commissioned in an email dated 4 April 2018 by Chris Farrington of Lee 4 Pty Ltd and was undertaken with reference to Douglas Partners' Pty Ltd (DP) proposal NCL180001 dated 11 January 2018.

It is understood that the development of the site will include the construction of two seven-storey residential towers with two basement levels across the site. (see further details below).

This ASSMP has been prepared to provide a framework for achieving environmental objectives to minimise the risk of harm to human health and the environment during and following the above mentioned works. This ASSMP provides the following:

- Acid sulfate soil (ASS) management strategies;
- Monitoring program for soil and water quality;
- Contingency procedures.

The management procedures outlined in this ASSMP are based on the results of previous investigations undertaken at the site which included subsurface investigation, sampling and testing for the assessment of ASS conditions.

This ASSMP has been prepared with reference to the “Acid Sulfate Soils Manual” (Ref 3) published by the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC) and the “Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines” (Ref 6) published by the Queensland Acid Sulfate Soil Investigation Team (QASSIT).

1.2 Proposed Development

It is understood that the development of the site will include:

- Two seven-storey residential towers, with two basement levels across the site below both towers;
- Existing ground levels range from about RL 2.3 to 2.9 AHD. The proposed level of the basement is about RL -3.1 AHD. Localised deeper excavations (about 1 m below basement level) are anticipated for lift pit and services construction.

Reference should be made to the architectural drawings provided in Appendix C showing the proposed development.

2. Site Description

The site is known as 35 Honeysuckle Drive. The development site is roughly rectangular in shape (120 m long by 46 m to 50 m wide) and has an approximated plan area of 4700 m^2. The site is bounded to the south by Honeysuckle Drive, to the east by 21 Honeysuckle Drive and to the north and west by undeveloped land. Newcastle Harbour lies about 5 m to 10 m to the north of the site.

It is almost fully occupied by a bitumen-sealed area which is currently disused. The location and aerial view of the site is shown in Figure 1.

Figure 1: Site Location - 35 Honeysuckle Drive, Newcastle (Photo dated 7 April 2018, nearmap)

3. Regional Geology and Acid Sulfate Soil Risk Mapping

The regional geology at the site is shown on the 1:100,000 scale regional geology map for Newcastle (Newcastle Coalfield Regional Geology, Sheet 9321, NSW Department of Mineral Resources). This map indicates that site is underlain by Quaternary Alluvium (Qa), comprising gravel, sand, silt and clay deposits.

The natural soils in this area are typically overlain by man-made fill materials to varying depths, related to reclamation, historical industrial usage, infrastructure and commercial development.

Reference to the Newcastle Acid Sulphate Soil Risk Map published by the Department of Land and Water Conservation indicates that the site has a high probability of acid sulphate soil conditions occurring between 1 m and 3 m depth. The mapping is shown in Figure 2.

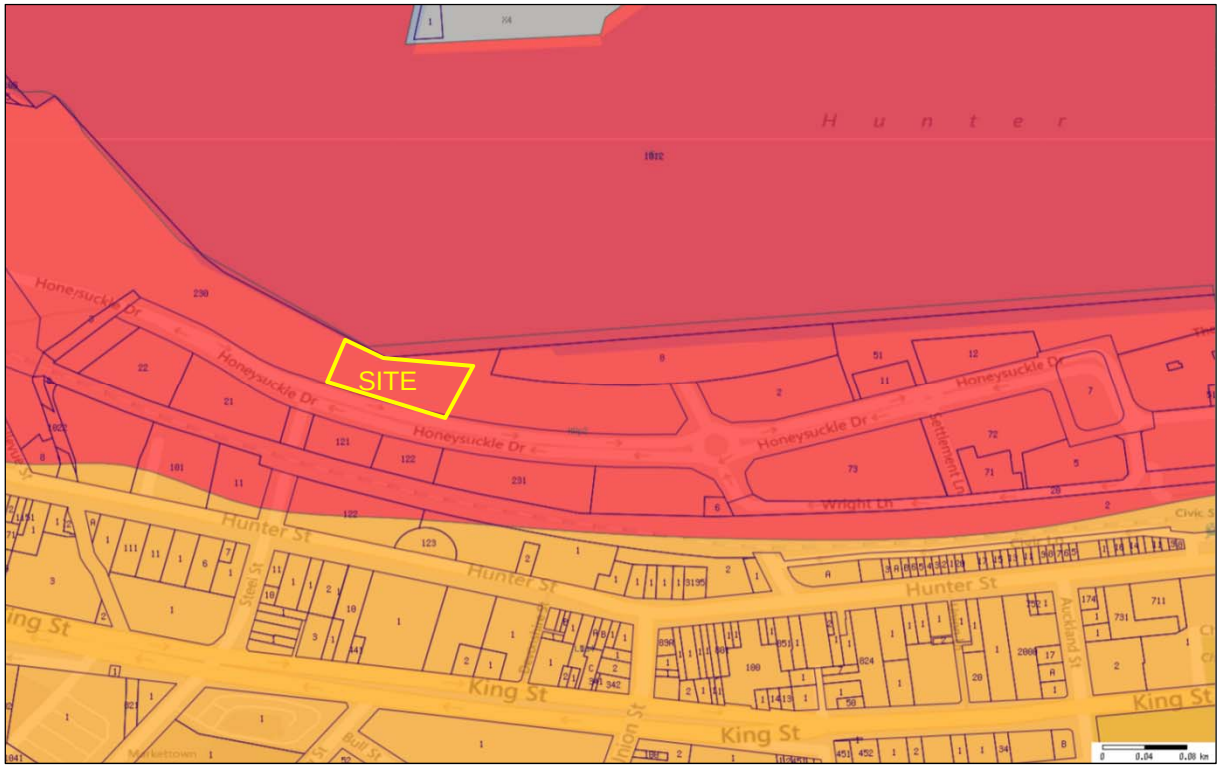

Figure 2: Acid Sulphate Risk Mapping (DLWC)

4. Previous Investigations

4.1 Introduction

A number of investigations including geotechnical, contamination and waste classification assessments have been conducted at the site and adjacent sites.

An ASS assessment was conducted at the site in conjunction with Reference 1 and comprised the following:

- Sampling from nine test bores (Bores DP1-BH, DP2-BH, DP4-BH DP6-BH, DP14-BH, DP16-BH to DP18-BH and DP20-BH) using a Geoprobe drilling rig fitted with a 100 mm continuous tube sampler, to depths ranging from 7.0 m to 7.3 m within the area requiring bulk excavation for basement construction;
- ASS screening tests and detailed ASS laboratory testing on selected soil samples to assess ASS conditions;
- Sampling and analysis of groundwater from three locations (DP4-BH, DP14-BH and DP20-BH);

Approximate test locations are shown on Drawing 2 in Appendix C.

The Newcastle foreshore area has been extensively modified by fill associated with land reclamation. It is understood that localised remediation of contaminated soils within upper fill materials has previously been recommended but not yet undertaken at the site.

4.2 Geotechnical Subsurface Profile

A generalised geotechnical model of the site subsurface conditions was presented in the DP reports (Ref 1 and 2). For the purposes of the ASSMP, the subsurface conditions are summarised in Table 1.

Table 1: Summary of Geotechnical Subsurface Profile

Unit	Description	Range at Base of Stratum[1]	
		Depth (m)	RL (AHD)
1.1	Upper Fill: pavement materials, gravelly sand, rubble	0.32 to 1.0	2.58 to 1.9
1.2	Lower Fill: sand, silty sand, some gravelly sand	0.51 to 4.0	2.39 to -1.10
2	SILTY CLAY/CLAYEY SILT – soft to firm (CPTs 5, 6 & 9 only)	5.07 to 6.44 [2]	-2.17 to -3.54
3.1	SAND / SILTY SAND – typically medium dense, loose in parts	6.75 to 15.57	-3.85 to -12.67
3.2	SAND - medium dense to dense, very dense in parts	10.10 to 11.84	-7.20 to -8.94
4	CLAY - stiff to hard, some interbedded sand layers	19.00 to 30.69	-16.10 to -27.79
5	CPT refusal in Weathered Rock (inferred)	29.68 to 31.54 – limit of investigation	

Notes to Table 1:

1. Layers vary in base depth across the site (i.e. not level) hence a range is given.
2. Unit 2 (soft to firm clay) is commonly encountered in alluvial areas of Newcastle but is not continuous over this site.

The borehole logs are provided in Appendix B. The logs should be read in conjunction with the accompanying explanatory notes that define classification methods and terms used to describe the soils.

4.3 Groundwater and Surface Water Conditions

4.3.1 Groundwater

Table 2 presents the groundwater parameters recorded at the time of groundwater well development on 4 May 2018 groundwater sampling on 10 May 2018.

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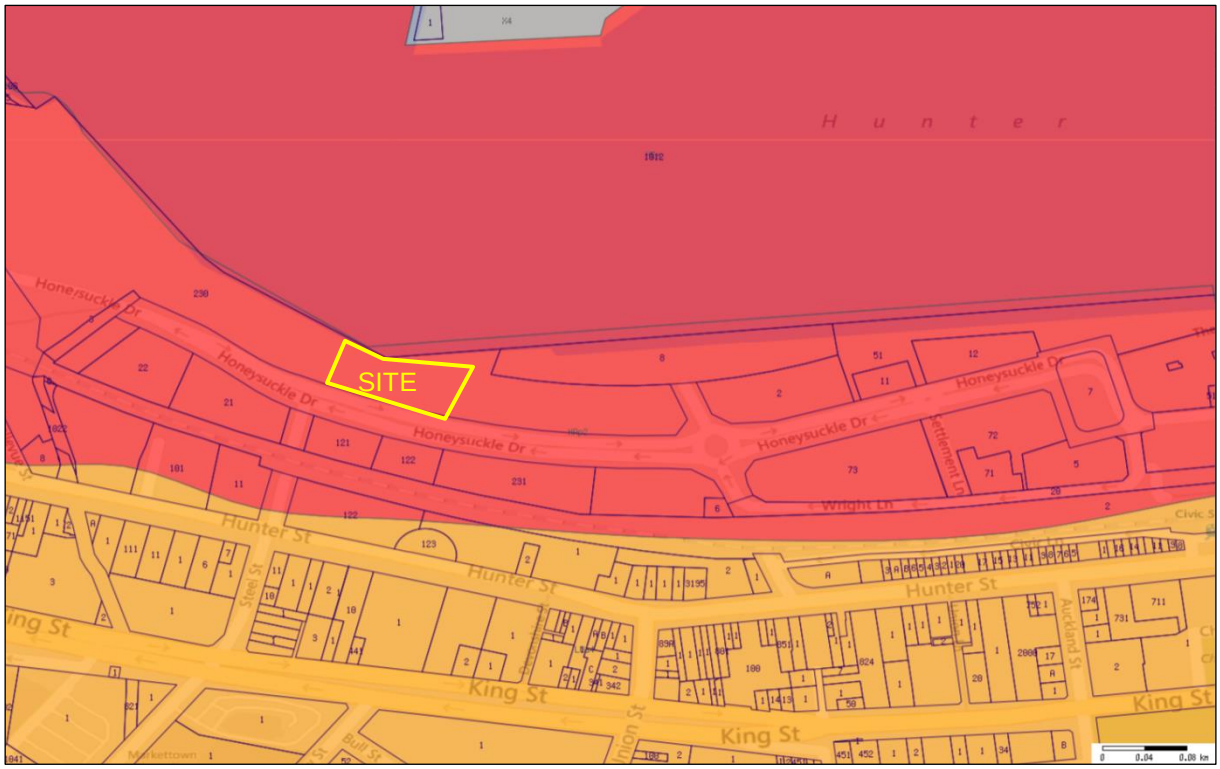

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Table 2: Field Measurements of Groundwater at Time of Sampling

Parameter (Units)	DP4-BH		DP14-BH		DP20-BH	
	04/05/2018	10/05/2018	4/05/2018	10/05/2018	4/05/2018	10/05/2018
Reduced Level of Well Collar (AHD)	2.06		1.84		2.07	
Depth to Groundwater below Well Collar (m)	2.08	1.94	2.00	1.97	1.99	1.74
Depth to Groundwater below Ground Level (m)	2.18	2.04	2.07	2.04	2.03	1.78
Reduced Level of Groundwater (AHD)	-0.02	0.12	-0.16	-0.13	0.08	0.328
PID Well Headspace (ppm)	-	<1	-	<1	-	<1
Thickness of free product (mm)	<1	<1	<1	<1	<1	<1
pH	7.7	5.6	7.5	7.0	7.4	7.2
Electrical Conductivity (mS/cm)	0.638	0.734	.512	.601	0.01	0.01
Redox, Eh (mV)	-63	28	48	54	-75	-47
Colour	Turbid/ Grey	Moderate Turbidity/ Grey	Very Turbid/ Grey	Very Turbid/ Brown	Very Turbid/ Dark Brown	Extremely Turbid/ Brown

The results of groundwater field testing indicated the following:

- Groundwater is generally slightly alkaline (i.e. pH 7.0 to 7.7) with a single test indicating slight acidity in Bore DP4-BH on the 10/05/2018;
- Groundwater is brackish;
- Reducing conditions were encountered (i.e. Redox potential -47 to -75);
- The results of PID screening on groundwater headspace suggest the absence of volatile hydrocarbon impacts (i.e. <1 ppm); and
- Floating product was not detected visually or by the interface meter (i.e. <1 mm).

The groundwater samples collected did not exhibit any obvious indications of gross contamination (e.g. staining or odours).

4.3.2 Groundwater Level Monitoring

The groundwater levels were recorded manually on the 4 May 2018 and 10 May 2018 and have been summarised in Table 2 above. Long term groundwater monitoring was not possible following the installation of groundwater wells given the site was being utilised for the reconstruction of the adjacent wharf embankments.

Groundwater monitoring was undertaken as part of the investigation for the adjacent site (50 Honeysuckle Drive) over the period 20 December 2016 to 23 January 2017 (34 days).

The results indicate the following:

- Water levels at the subject site were about 3 m to 4 m above the proposed bulk excavation level. Dewatering will therefore be required during construction;
- There were two moderate rainfall events of about 30 mm during the monitoring period for the adjacent site. There was no noticeable response in water level as a result of the rainfall. This is most likely due to the majority of the site being paved; and
- A subdued tidal response in the order of 0.2 m amplitude was apparent, having a time-lag of about 3 to 4 hours relative to the tide.

It is noted that during construction, while the ground is open to rainfall and runoff, there would likely be a more direct groundwater response to rainfall.

It should be noted that groundwater levels are affected by factors such as climatic conditions, soil permeability and tidal movements and will therefore vary with time.

4.3.3 Surface Water

The field measurements made on 19 December 2016 for surface water within the adjacent Newcastle Harbour are shown in Table 3.

Table 3: Field Measurements of Surface Water at Time of Sampling

Parameter (Units)	HR1[(1)]
Date	19/12/2016
pH	7.5
Electrical Conductivity (mS/cm)	44.9
Redox, Eh (mV)	+56
Colour	Clear

HR1 – Collected within Newcastle Harbour at the bend in the Wharf adjacent to 35 Honeysuckle Drive.

The results of harbour surface water field testing indicated the following:

- The harbour water sampled is slightly alkaline (i.e. pH 7.1 to 7.5);
- The harbour water is saline;
- Oxidising conditions were encountered (i.e. Redox potential +56);

- The results of PID screening on surface water headspace suggests the absence of volatile hydrocarbon impacts (i.e. <1 ppm).

4.3.4 Water Quality Testing

The results of groundwater testing from the three wells are shown in Table 4.

Table 4: Laboratory Results of Groundwater Testing

	Units	PQL	ANZECC 2000 FW 95%	ANZECC 2000 MW 95%	NEPM 2013 Table 1C GILs, Fresh Waters	NEPM 2013 Table 1C GILs, Marine Waters	NEPM 2013 Table 1C GILs, Drinking Water	**Sample ID**	D1	DP14	DP20	DP4
								Date Sampled	5/10/2018	5/10/2018	5/10/2018	5/10/2018
Inorganics												
pH (Lab)	pH_Units	0.1	6.5-7.5|8|6.5-8|6.5-8	7-8.5					7.2	7.7	7.7	6
Electrical Conductivity	uS/cm	1							2100	410	2000	510
Turbidity (Lab)	NTU	0.1	6 - 50	0.5 - 10					110	440	97	15
Chloride	mg/L	1							1600	22	1500	54
Nitrogen (Total)	mg/L	0.1	0.25|0.35	0.3					1.6	0.8	1.5	0.9
Sulphate	mg/L	1					500		250	32	250	59
Metals												
Arsenic (Filtered)	mg/L	0.001	0.013	0.0023			0.01		<0.001	0.003	<0.001	<0.001
Beryllium (Filtered)	mg/L	0.0005	0.00013				0.06		<0.0005	<0.0005	<0.0005	<0.0005
Boron (Filtered)	mg/L	0.02	0.37		**0.37**		4		**0.38**	0.1	**0.38**	0.25
Cadmium (Filtered)	mg/L	0.0001	0.0002	0.0007	**0.0002**	0.0007	0.002		<0.0001	<0.0001	<0.0001	<0.0001
Chromium (III+VI) (Filtered)	mg/L	0.001	0.001	0.0044					<0.001	<0.001	0.001	0.001
Copper (Filtered)	mg/L	0.001	0.0014	0.0013	**0.0014**	0.0013	2		0.001	**0.045**	**0.041**	**0.02**
Iron (Filtered)	mg/L	0.01							1.4	0.018	1.4	0.15
Lead (Filtered)	mg/L	0.001	0.0034	0.0044	**0.0034**	0.0044	0.01		<0.001	0.003	0.003	0.002
Manganese (Filtered)	mg/L	0.005	1.9	0.08	**1.9**		0.5		0.14	0.065	0.14	0.038
Mercury (Filtered)	mg/L	0.00005	0.00006	0.0001	**0.00006**	0.0001	0.001		<0.00005	<0.00005	<0.00005	<0.00005
Nickel (Filtered)	mg/L	0.001	0.011	0.007	**0.011**	0.007	0.02		**0.019**	0.01	**0.02**	**0.012**
Phosphorus	mg/L	0.05	0.01|0.02|0.025	0.03					0.2	0.2	0.2	0.2
Selenium (Filtered)	mg/L	0.001	0.005	0.003	**0.005**		0.01		<0.001	<0.001	<0.001	<0.001
Zinc (Filtered)	mg/L	0.001	0.008	0.015	**0.008**	0.015			0.006	**0.059**	**0.066**	**0.079**
TPH												
C10-C16	mg/L	0.05							<0.05	<0.05	<0.05	<0.05
C16-C34	mg/L	0.1							<0.1	<0.1	<0.1	<0.1
C34-C40	mg/L	0.1							<0.1	<0.1	<0.1	<0.1
F2-NAPHTHALENE	mg/L	0.05							<0.05	<0.05	<0.05	<0.05
C6 - C9	mg/L	0.01							<0.01	<0.01	<0.01	<0.01
C10 - C14	mg/L	0.05							<0.05	<0.05	<0.05	<0.05
C15 - C28	mg/L	0.1							<0.1	<0.1	<0.1	<0.1
C29-C36	mg/L	0.1							<0.1	<0.1	<0.1	<0.1
C6-C10 less BTEX (F1)	mg/L	0.01							<0.01	0.011	<0.01	<0.01
C6-C10	mg/L	0.01							<0.01	0.016	<0.01	<0.01
BTEX												
Benzene	mg/L	0.001	0.95	0.5	**0.95**	0.5	0.001		<0.001	<0.001	<0.001	<0.001
Ethylbenzene	mg/L	0.001	0.08	0.005			0.3		<0.001	<0.001	<0.001	<0.001
Toluene	mg/L	0.001	0.18	0.18			0.8		<0.001	0.006	<0.001	<0.001
Xylene (m & p)	mg/L	0.002							<0.002	<0.002	<0.002	<0.002
Xylene (o)	mg/L	0.001	0.35	0.35	**0.35**				<0.001	<0.001	<0.001	<0.001
PAH/Phenols												
Total Positive PAHs	mg/L								0.002	0.00044	0.00036	0.0005
Acenaphthene	mg/L	0.0001							<0.0001	<0.0001	<0.0001	<0.0001
Acenaphthylene	mg/L	0.0001							<0.0001	<0.0001	<0.0001	<0.0001
Anthracene	mg/L	0.0001	0.00001	0.00001					<0.0001	<0.0001	<0.0001	<0.0001
Benz(a)anthracene	mg/L	0.0001							0.0001	<0.0001	<0.0001	<0.0001
Benzo(a) pyrene	mg/L	0.0001	0.0001	0.0001			0.00001		0.0001	<0.0001	<0.0001	<0.0001
Benzo[b+j]fluoranthene	mg/L	0.0002							0.0003	<0.0002	<0.0002	<0.0002
Benzo(g,h,i)perylene	mg/L	0.0001							0.0002	<0.0001	<0.0001	<0.0001
Chrysene	mg/L	0.0001							0.0002	<0.0001	<0.0001	<0.0001
Dibenz(a,h)anthracene	mg/L	0.0001							<0.0001	<0.0001	<0.0001	<0.0001
Fluoranthene	mg/L	0.0001	0.001	0.001					0.0005	0.0002	0.0002	0.0002
Fluorene	mg/L	0.0001							<0.0001	<0.0001	<0.0001	<0.0001
Indeno(1,2,3-c,d)pyrene	mg/L	0.0001							0.0001	<0.0001	<0.0001	<0.0001
Naphthalene	mg/L	0.0002	0.016	0.05	**0.016**	0.05			<0.0002	<0.0002	<0.0002	<0.0002

4.4 Results of Acid Sulfate Tests

Selected soil samples of the filling and underlying natural soils were subject to ASS screening tests in DP's laboratory. Selected soil samples were tested for pH in distilled water and pH following oxidation in peroxide. Table 5 presents the screening test results.

Based on the screening test results, six samples were sent to Envirolab Services Pty Ltd for detailed testing, comprising the Chromium suite. The results are also summarised in Table 5.

Table 5: Results of Acid Sulfate Screening and Laboratory Tests

Fill UNIT	Sample ID	Sample Depth [a] (m)	Sample Description	Screening Test Results				Comments	Laboratory Results							
				pH			Strength of Reaction [b]		pH_{KCL}	S_{KCL}	Scr %S	s-TAA %S	S_{NAS} %S	$s\text{-}ANC_{BT}$ %S	Net Acidity[c] %S	Exisiting and Potential Acidity %S
				pH_F	pH_{FOX}	pH_F - pH_{FOX}										
1.2	DP1-BH	0.6	Filling - light brown sand, trace shells	7.9	7.9	0	1	V H B								
		0.75	Filling - light brown sand, trace shells	7.4	7.4	0	4	V H B								
		1	Filling - light brown sand, trace shells	7.9	7.5	0.4	4	V H B								
		1.25	Filling - light brown sand, trace shells	8.3	7.6	0.7	4	V H B								
		1.5	Filling - light brown sand, trace shells	8.3	7.6	0.7	3	V H								
		1.75	Filling - light brown sand, trace shells	8.3	7.8	0.5	4	V H B								
		2	Filling - light brown sand, trace shells	8.5	7.7	0.8	4	V H B								
		2.25	Filling - light brown sand, trace shells	8.2	7.7	0.5	4	V H B								
		2.5	Filling - light brown sand, trace shells	8.2	7.2	1	4	V H B								
		2.75	Filling - light brown sand, trace shells	8.3	7.4	0.9	3	V H B								
3.1		3	Brown sand, trace shells	8.4	7.9	0.5	3	V H B								
		4	Dark grey sand, some gravel and shells	8.4	7.1	1.3	2	H B								
		4.25	Dark grey sand, some gravel and shells	8.4	7.1	1.3	2	B								
		4.5	Dark grey sand, some gravel and shells	7.5	7.2	0.3	2	B								
		4.75	Brown sand, trace shell & gravel	7.4	7.3	0.1	2	B								
		5.25	Dark grey sand, some gravel and shells	7.6	7.3	0.3	2	B								
		5.5	Dark grey sand, some gravel and shells	7.3	7.3	0	2	B								
		5.75	Dark grey sand, some gravel and shells	7.3	7.3	0	3	B H								
		6	Dark grey sand, some gravel and shells	7.4	7.4	0	1	-								
		6.25	Dark grey sand, some gravel and shells	7.4	7.3	0.1	1	-								
		6.5	Dark grey sand, some gravel and shells	7.4	7.2	0.2	3	H B								
		6.75	Dark grey sand, some gravel and shells	7.5	7.3	0.2	3	B H								
		7	Dark grey sand, some gravel and shells	7.3	7	0.3	3	B H								
1.2	DP2 - BH	1	Filling - Light brown sand	8	5.7	2.3	3	B H								
		1.5	Filling - Light brown sand	8	6.3	1.7	2	B								
3.1		2	Filling - Light brown sand	8	6.4	1.6	2	B								
		2.75	Brown sand, abundant shells	7.8	6.3	1.5	1	-								
		3	Brown sand, abundant shells	7.8	6.4	1.4	1	-								
		3.5	Brown sand, abundant shells	7.7	6.2	1.5	1	-								
		4	Dark grey/brown sand, trace shells	7.8	6.1	1.7	2	B								
		4.5	Dark grey/brown sand, trace shells	8	6.5	1.5	2	B								
		5	Dark grey/brown sand, trace shells	8.1	6.5	1.6	2	B								
		5.75	Dark grey/brown clayey silty sand, trace shells	8.2	6.5	1.7	2	B	9.4	0.048	0.29	<0.01	<0.005	1.4	<0.005	0.29
		6	Dark grey/brown clayey silty sand, trace shells	8.2	6.3	1.9	2	B								
		6.5	Dark grey/brown clayey silty sand, trace shells	8.1	6.6	1.5	2	B								
		7	Dark grey/brown clayey silty sand, trace shells	8.3	6.6	1.7	2	B								
1.2	DP4 - BH	1.5	Filling - light brown sand, trace shells	8.9	6.9	2	2	B								
		2	Filling - light brown sand, trace shells	8.8	7.2	1.6	2	B								
		2.5	Filling - light brown sand, trace shells	8.6	7.1	1.5	2	B								
		3	Filling - light brown sand, trace shells	8.4	7.3	1.1	2	B								
3.1		3.5	Light brown/grey sand with abundant gravel and shells	8.6	7.1	1.5	2	B								
		4	Light brown/grey sand with abundant gravel and shells	8.8	7	1.8	2	B								
		4.5	Light brown/grey sand with trace gravel and shells	8.8	6.9	1.9	2	B								
		5	Light brown/grey sand with trace gravel and shells	8.9	7	1.9	2	B								
		55	Light brown/grey sand with trace gravel and shells	8.8	6.6	2.2	2	B								
		6.5	Light brown/grey sand with trace gravel and shells	8.1	7.5	0.6	2	B								
		7	Light brown/grey sand with trace gravel and shells	8.1	2.8	5.3	2	B, colour change	8.2	0.013	0.06	<0.01	<0.005	0.13	<0.005	0.06
1.2	DP6 - BH	1	Filling - light brown sand	7.7	6.8	0.9	2	trace shells								
		1.5	Filling - light brown sand	8.3	7.5	0.8	2	-								
		2	Filling - light brown sand	8.4	7.5	0.9	2	-								
		2.5	Filling - light brown sand	8.6	7.6	1	2	-								
		3	Filling - light brown sand	8.5	7.7	0.8	2	-								
3.1		3.5	Brown and grey clayey silty sand	8.3	3.5	4.8	3	B H	8.4	0.036	0.27	<0.01	<0.005	0.38	0.012	0.27
		4	Brown and grey clayey silty sand	8.2	3.6	4.6	3	B H								
		4.5	Brown and grey clayey silty sand	8	5.9	2.1	2	-								
		5	Brown and grey clayey silty sand	8.4	5.6	2.8	2	Trace shells								
		5.5	Dark grey Sand	8.5	6.7	1.8	2	Trace shells	9.9	0.006	0.04	<0.01	<0.005	0.46	<0.005	0.04
		6	Brown and grey clayey silty sand	8.7	6.9	1.8	2	Trace shells								
		6.25	Brown and grey clayey silty sand	8.6	6.9	1.7	2	Trace shells								
		7	Brown and grey clayey silty sand	8.7	7.1	1.6	2	Trace shells								

Table 5: Results of Acid Sulfate Screening and Laboratory Tests (continued)

Fill UNIT	Sample ID	Sample Depth [a] (m)	Sample Description	Screening Test Results				Comments	Laboratory Results							
				pH			Strength of Reaction [b]		pH_{KCL}	S_{KCL}	Scr %S	s-TAA %S	S_{NAS} %S	s-ANC_{BT} %S	Net Acidity[c] %S	Exisiting and Potential Acidity %S
				pH_F	pH_{FOX}	pH_F - pH_{FOX}										
1.2	DP14-BH	1	Filling - light brown sand	7.9	7.9	0	2	-								
		1.5	Filling - light brown sand	8.2	8.2	0	2	-								
		2	Filling - light brown sand	8.4	8.4	0	2	Trace shells								
		2.5	Filling - light brown sand	8.2	7.9	0.3	2	-								
3.1		3	Dark brown clayey silty sand	8.6	7.9	0.7	2	-								
		3.5	Dark brown silty sand	8.5	7.6	0.9	2	-								
		4	Dark brown silty sand	8.5	7.3	1.2	2	-								
		4.5	Dark brown silty sand	8.5	7.3	1.2	2	-								
		5	Dark brown silty sand	8.6	4.3	4.3	3	B H	9.5	0.017	0.09	<0.01	<0.005	0.22	<0.005	0.086
		5.5	Dark brown clayey silty sand	8.7	4.5	4.2	4	B H								
		6	Dark brown silty sand	8.8	3.8	5	3	B H								
		6.5	Dark brown silty sand	8.8	5.9	2.9	2	B H								
		7	Dark brown silty sand	8.8	6.6	2.2	2	-								
1.2	DP16-BH	1.5	Filling - light brown sand	7.6	7.6	0	2	-								
		2	Brown clayey sand/sandy clay	7.8	7.8	0	1	-								
		3	Brown clayey sand/sandy clay	8.1	8	0.1	1	-								
		3.5	Brown clayey sand/sandy clay	8.3	7.6	0.7	1	-								
		4	Brown clayey sand/sandy clay	8.2	7.2	1	1	-								
		4.5	Brown clayey sand/sandy clay	8.6	7.1	1.5	1	-								
		5	Brown clayey sand/sandy clay	8.7	6.6	2.1	2	B H								
		5.5	Brown clayey sand/sandy clay	8.8	6.8	2	2	-								
		6	Brown clayey sand/sandy clay	8.9	6.9	2	2	-								
		6.5	Brown clayey sand/sandy clay	8.9	6.9	2	2	-								
		7	Brown clayey sand/sandy clay	9	7.4	1.6	2	-								
1.2	DP17-BH	1	Filling - light brown sand	6.7	6.7	0	2	Trace shells								
		1.25	Filling - light brown sand	6.3	6.3	0	2	Trace shells								
		1.5	Filling - light brown sand	6.3	6.3	0	2	Trace shells								
		1.75	Filling - light brown sand	6.3	6.3	0	2	Trace shells								
		2	Filling - light brown sand	6.5	6.5	0	2	Trace shells								
		2.25	Filling - light brown sand	6.5	6.5	0	2	Trace shells								
		2.5	Dark grey clayey sand	6.6	6.5	0.1	2	Trace shells								
3.1		2.75	Dark grey clayey sand	7.4	6.9	0.5	2	Trace shells								
		3	Dark grey clayey sand	8.8	7.5	1.3	2	Trace shells								
		3.25	Dark grey clayey sand	8.5	7.2	1.3	2	Trace shells								
		3.5	Dark grey sand	8.8	7.2	1.6	2	Trace shells								
		4	Dark grey sand	8.8	7.2	1.6	2	Trace shells								
		4.75	Dark grey sand	8.9	7.3	1.6	2	Trace shells								
		5.25	Dark grey sandy clay	8.9	7.3	1.6	2	Trace shells								
		6	Dark grey sandy clay	9	7.2	1.8	2	Trace shells								
		6.5	Dark grey sand	8.9	7.7	1.2	2	Trace shells								
		7	Dark grey sand	8.9	7.7	1.2	2	Trace shells								
1.2	DP18-BH	1.5	Filling - light brown sand	7.4	7.4	0	2	Trace shells								
		2	Filling - light brown sand	7.8	7.8	0	2	Trace shells								
		2.5	Filling - light brown sand	7.7	7.7	0	2	Trace shells								
3.1		3	Dark brown clayey sand	7.8	7.5	0.3	2	Trace shells								
		3.5	Dark brown clayey sand	8.2	7.6	0.6	2	Trace shells								
		4.25	Dark brown clayey sand	8.2	7.3	0.9	2	Trace shells								
		4.5	Dark brown clayey sand	8.4	7.2	1.2	2	Trace shells								
		5	Dark brown clayey sand	8	7.2	0.8	2	Trace shells								
		5.5	Dark brown clayey sand	8.5	5.5	3	3	Trace shells	9.2	0.026	0.08	<0.01	<0.005	0.19	<0.005	0.084
		6	Dark brown clayey sand	8.5	6.5	2	2	Trace shells								
		6.5	Dark brown clayey sand	8.6	7	1.6	2	Trace shells								
		7	Dark brown clayey sand	8.6	7	1.6	2	Trace shells								
1.2	DP20-BH	1	Filling - light brown sand	8.2	8.2	0	2	Trace shells								
		1.5	Filling - light brown sand	8.3	7.2	1.1	2	Trace shells								
3.1		2.05	Brown and grey sand	8.5	7.3	1.2	2	Trace shells								
		2.5	Brown and grey sand	8.2	6.8	1.4	2	Trace shells								
		3	Brown and grey sand	8.1	6.7	1.4	2	Trace shells								
		3.5	Brown and grey sand	8.1	8.1	0	2	Trace shells								
		4	Brown and grey sand	8	6.1	1.9	2	Trace shells								
		4.5	Brown and grey sand	7.9	6.2	1.7	2	Trace shells								
		5	Brown and grey sand	7.9	5.9	2	2	Trace shells								
		5.5	Brown and grey sand	7.7	5.8	1.9	2	Trace shells, B H								
		6	Brown and grey sand	8.6	7.2	1.4	2	Trace shells, B H								0
		6.5	Brown and grey sand	8.4	7.2	1.2	2	Trace shells								0
		7	Brown and grey sand	8.5	7.2	1.3	2	Trace shells								0
	Guideline		Coarse sands, poorly buffered	<4[d]	<3.5[e]	≥1[e]	-	Coarse sands, poorly buffered								0.01
			Coarse sands to loamy sands and peats					Coarse sands to loamy sands and peats								0.03
			Medium sandy loams to light clays					Medium sandy loams to light clays								0.06[f]/0.03[g]
			Fine medium to heavy clays & silty clays					Fine medium to heavy clays & silty clays								0.1[f]/0.03[g]

Notes to Table 5:

a Depth below ground surface

b Strength of Reaction
- 1 denotes no or slight reaction
- 2 denotes moderate reaction
- 3 denotes high reaction
- 4 denotes very vigorous reaction
- F denotes bubbling/frothy reaction indicative of organics
- V denotes vapours generated
- B denotes bubbles generated
- H denotes heat generated

c Calculated by the laboratory based on the ABA equation in ASS Laboratory Methods Guidelines (Ref 15)

d For actual acid sulphate soils (ASS)

e Indicative value only for Potential Acid Sulphate Soils (PASS)

f QASSIT Action Criteria for disturbance of 1-1000 tonnes of material

g QASSIT Action Criteria for disturbance of more than 1000 tonnes of material

Bold results indicative of ASS

Shaded results indicate an exceedence of QASSIT action criteria (Ref 14)

pH_F - Soil pH Test (1:5 soil:distilled water)

pH_{FOX} - Soil Peroxide pH Test (1:4 soil:distilled water following oxidation of soil with 30% hydrogen peroxide (H_20_2))

*Laboratory methods used to quantify ANC are likely to overestimate environmental effectiveness

The results of the ASS assessment indicated the following:

- Absence of ASS conditions within upper filling (Unit 1.1 and Unit 1.2 sand fill);
- Presence of ASS conditions in Unit 3.1 natural 'sand / silty and clayey sand' soils, as encountered in Bore DP2-BH, DP4-BH, DP6-BH, DP14-BH and DP18-BH;

ASS conditions were generally prevalent within underlying natural silty and clayey soils. However, underlying natural sands also exhibited some propensity to generate acid upon oxidation.

An Acid Sulfate Soil Management Plan (ASSMP) will be required for the proposed development due to the likely disturbance of ASS during construction (i.e. excavations and dewatering).

An Excavation Management Plan and Dewatering Management Plan were also recommended to facilitate the proposed development at the site.

5. Potential to Oxidise Acid Sulfate Soils

The following activities may expose acid sulfate soils to oxidising conditions during construction:

- Excavations for construction including basement excavations, service trenches, lift pits / wells, which extend into natural clayey soils;
- Installation of piles and subsequent generation of spoil at the surface;
- Dewatering of excavations, as required during the construction works;

The recommended management option for excavated ASS is neutralisation by full lime treatment and oxidation.

6. Management Strategy

6.1 Soil Treatment

Neutralisation of acid sulfate soils (ASS) should be undertaken in accordance with this ASSMP which has been prepared with reference to the ASSMAC (Ref 5) and QASSIT (Ref 6) guidelines. It will be necessary to prepare suitable treatment area(s) on site, as described below.

The treatment methodology applies to natural sand, silty and clayey sand soils at the site which are ASS. Where upper filling is intermixed with underlying natural clayey soils (e.g. spoil generation from pile installation), the materials should be considered as ASS.

The excavated ASS material or generated pile spoil should be segregated from non-ASS and contained within suitably bunded area(s) prepared as follows. Based on recent experience, it is recommended (where practical) that the natural sands are also segregated, and tested to confirm requirements for treatment, considering that the natural silty / clayey soils exhibited a greater propensity to generate acid upon oxidation:

- Construct perimeter bunding around the treatment area(s) to prevent run-off or run-on (minimum height of 300 mm depending on the size of the treatment area and volume of material to be treated). If on-site soils are utilised for the bunding, they should also be lime treated at the rates as discussed below;
- Strip surface vegetation within area(s) to be used for treatment/stockpiling of ASS;
- Where sandy or highly permeable surface soils are present, place appropriate low permeability soils or low permeability membrane over the surface of the treatment area(s);
- Broadcast a guard layer of agricultural lime over the ground surface to be used for treatment/stockpiling (1 kg/m^2). Re-application of lime may be required if this guard layer is disturbed or removed during treatment of soils;

- Construct a catch drain/sump at the lowest point on the inside of the bund to collect run-off / leachate from the treatment area. The base of the sump should be inspected and must comprise low permeability (i.e. clayey) soils. If low permeability soils are not present the sump should be lined with a low permeability layer or membrane. The surface of the sump/catch drain should also be limed with 1 kg/m^2 of agricultural lime;
- Install appropriate erosion and sediment control measures for the perimeter of the treatment area(s).

It is noted that the above recommendations for the preparation of the treatment area rely on ASS treatment being conducted as soon as practical (i.e. within 24 hours of excavation for clayey soils).

The location of the bunded area(s) should be selected in order to minimise the potential for impact on nearby sensitive receptors. Any leachate produced in the bunded area should be contained for monitoring and treatment (if required) as discussed below.

Suitable neutralising agents for actual acid sulfate or potential acid sulfate soils include agricultural lime ($CaCO_3$), calcined magnesia (MgO or $Mg(OH)_2$), and dolomite ($MgCO_3.CaCO_3$).

An assessment of the dosing rate for lime treatment can be calculated from the results of detailed laboratory testing, using the following equation, which includes a factor of safety.

Alkali Material Required (kg)

$$\textit{per unit volume of soil } (m^3) = \left(\frac{\%S \times 623.7}{19.98}\right) \times \frac{100}{ENV(\%)} \times D \times FOS$$

Where: *%S = net acidity (% S units);*
623.7 = % S to mol H^+/t;
19.98 = mol H^+/t to kg $CaCO_3$/t;
D = Bulk density of soil (t/m^3);
FOS = safety factor (usually 1.5);
ENV = Effective Neutralising Value (e.g. 80% for Grade 1 Agricultural lime).

Note:
The ENV is calculated based on the molecular weight, particle size and purity of the neutralising agent and should be assessed for proposed materials in accordance with ASSMAC (Ref 5).

It is recommended that Grade 1 agricultural lime is used for the neutralisation of potential acid sulfate soils excavated during the construction.

The following liming/monitoring procedures for the treatment of ASS are recommended:

- All excavated ASS should be contained within the suitably bunded area(s) and kept moist to minimise oxidation, prior to treatment with lime. Progressive neutralisation will minimise the area required for bunding;
- Based on the laboratory results of detailed ASS testing, recommended liming rates vary from 4 to 30 kg/m^3 of soil with an average rate of 15 kg/m^3 soil. Stockpiled sand and silty/clayey sand should be limed at an initial rate of 10 kg/m^3 soil. It appears that the deeper coarse sands with lower silt/clay content have a lower net acidity. Thus a lower initial liming rate should be considered for natural sands;
- The neutralising agent and acid sulfate soils should be thoroughly mixed and aerated using, for example, an agricultural lime spreader and excavator or rotary hoe. The soil should be treated in layers up to 300 mm thick to encourage aeration;
- The actual lime rate required will depend on the results of monitoring during neutralisation. Additional lime will be required if monitoring results indicate that appropriate neutralisation has not been achieved. Conversely the liming rate may decrease if monitoring suggests over-liming has occurred;
- Sampling and testing should be undertaken in accordance with Section 7.1 to verify the neutralisation treatment. The acceptance criteria are discussed in Section 7.2. Depending on the results of testing, reapplication of lime may be necessary to gain adequate neutralisation. Care should be taken to avoid over-liming of soils;
- Upon verification of treatment, the neutralised acid sulfate soils could be reused on site. The geotechnical suitability of the treated soils should be confirmed prior to reuse. Alternatively, treated ASS could be disposed at a licensed landfill following confirmation of the waste classification by an appropriate qualified consultant. It is noted that ASS must be appropriately neutralised prior to off-site landfill disposal in accordance with NSW EPA "Waste Classification Guidelines - Part 4: Acid Sulfate Soils" (Ref 7).

6.2 Neutralising Leachate

Leachate water collected from the bunded area(s) should be neutralised as necessary before disposal. Calcined magnesia (magnesium hydroxide, burnt magnesite, or magnesia) is the recommended neutralising agent as it produces a two-step reaction, which proceeds rapidly at acidic pH and slows down as higher pH is approached, and hence reduces the potential for over neutralisation to occur.

The amount of neutraliser required to be added to the leachate can be calculated from the following equation:

$$\textit{Alkali Material Required (kg)} = \frac{M_{Alkali} \times 10^{-pH\ initial}}{2 \times 10^{3}} \times V$$

Where: pH initial = initial pH of leachate

V = volume of leachate (litres)

M_{Alkali} = molecular weight of alkali material (g/mole)

Note: molecular weight of calcined magnesia (M_{MgO}) = 40 g/mole.

The alkali should be added to the leachate as slurry. Mixing of the slurry is best achieved using an agitator.

Notwithstanding regulatory authority requirements, the leachate should consider the water quality criteria presented in Section 7.2 prior to discharge.

Regular monitoring of leachate should be conducted as discussed in Section 7.1.2.

6.3 Dewatering

Options for the management/disposal of extracted groundwater during dewatering include the following:

- Re-injection of groundwater at a location away from the dewatered excavation;
- Overland discharge and infiltration, or infiltration from a detention basin;
- Disposal to sewer.

Dewatering activities should be conducted under the appropriate licence and regulatory requirements (i.e. NSW Office of Water, Council requirements).

The following procedure is recommended in order to minimise potential adverse impacts resulting from excavation and dewatering of acid sulfate soils during construction:

- Minimise the dewatering depth required for installation (i.e. as close as practicable to the invert level of the excavation);
- Minimise the time and volume of exposed acid sulfate soils (i.e. stage excavation and dewatering);
- If re-injection is proposed, periodic monitoring of reinjected water should be conducted to assess potential impacts from the dewatering process;
- For discharge/infiltration methods, extracted groundwater should be collected in a suitably sized multi stage sedimentation tank or on-site detention structures and neutralised as necessary prior to disposal;
- The extracted groundwater could then be discharged to a bunded area or constructed pond away from the dewatering site (i.e. re-injected or evaporation/infiltration) or discharged overland or to sewer, subject to regulatory requirements;
- The pH of the extracted water should be monitored prior to discharge. Neutralisation should be undertaken, as discussed below, if discharge water pH falls below natural background levels (re-injection/evaporation/infiltration) or outside regulatory requirements (sewer disposal);
- Dose the base of temporary excavations (i.e. pier holes, service trenches, basement floor levels, lift wells etc) at a rate of approximately 1 kg/m^2 of agricultural lime in order to counteract the generation of acidic leachate following groundwater recovery;
- Treat ASS excavated during construction as discussed in Section 6.1;
- Undertake monitoring as recommended in Section 7.

The following procedure is recommended for neutralising groundwater if required:

- The neutralising agent (e.g. agricultural lime or calcined magnesia) should be added as a slurry at the first stage of a multi-stage sedimentation tank or detention structure to allow the lime to mix with the extracted groundwater prior to discharge;
- The neutralising agent should be added at a constant rate during dewatering. The rate of dosing should be minimal initially and be monitored and adjusted based on the results of regular monitoring of the treated extracted groundwater.

7. Monitoring Strategies

7.1 Procedures

7.1.1 Soil Neutralisation / Management

It is recommended that the following inspections and monitoring be undertaken when excavating ASS materials (i.e. clayey natural soils), based on guidelines presented in the ASSMAC (Ref 5) and QASSIT (Ref 6) manuals:

- Daily inspection of liming operations during initial excavation, to be reviewed following establishment of liming procedures;
- Sampling and testing after lime treatment (i.e. measurements of soil pH in distilled water and pH following oxidation with peroxide) should initially be undertaken at a frequency of at least one sample per 20 m^3 excavated soil to verify the neutralisation treatment. The frequency of testing could be reviewed as treatment progresses. A lower frequency of testing could be considered, subject to consistent results, soil conditions and treatment procedures;
- Analysis of one sample per 50 m^3 for Chromium Suite analysis by a NATA accredited laboratory to confirm appropriate neutralisation;
- Check testing should also be conducted on natural soils during excavation works to confirm ASS conditions and requirements for treatment.

7.1.2 Leachate Management

Leachate collected within the treatment bunded area(s) should be temporarily stored and neutralised as necessary. The pH of the leachate should be monitored daily and prior to discharge. The leachate could be discharged overland (i.e. re-injection evaporation/infiltration) or discharged to sewer, subject to regulatory requirements and licences.

Neutralisation should be undertaken if leachate water pH falls below natural background groundwater levels (evaporation/infiltration) or outside regulatory requirements (sewer discharge).

A contingency procedure should be in place to allow lime dosing and monitoring to confirm neutralisation prior to discharge.

7.1.3 Dewatering

Extracted groundwater should be temporarily stored, and neutralised as necessary. The pH of extracted water associated with areas of acid sulfate soils should be monitored twice daily (am, pm) prior to discharge. The groundwater could be reinjected, discharged overland (i.e. evaporation / infiltration) as discussed in Section 6.3, or discharged to sewer subject to regulatory requirements and licences.

Neutralisation should be undertaken if discharge water pH falls below natural background groundwater levels (re-injection/evaporation/infiltration) or outside regulatory requirements (sewer discharge). Current natural groundwater pH should be confirmed at the commencement of dewatering.

A contingency procedure should be in place to allow for lime dosing and monitoring confirming that neutralisation has been achieved prior to discharge.

Monitoring for ASS conditions should be incorporated with the Dewatering Management Manual.

7.1.4 Surface Water Monitoring

A surface water monitoring program should be established due to the proximity of the receiving water (i.e. Hunter River). The monitoring program should include pH and EC testing of surface waters upstream, downstream and adjacent to the site within the Hunter River.

Monitoring should be conducted at an initial daily frequency during construction. A reduced frequency could be conducted subject to consistent daily results and consistent construction activities.

The monitoring program should be developed prior to the commencement of construction with consideration to the staging of excavation and dewatering works.

7.1.5 Reporting

A record of treatment of acid sulfate soil and leachate should be maintained by the contractor and should include the following details:

- Date;
- Location;
- Time of excavation and reuse or disposal (i.e. time stockpile has been exposed);
- Neutralisation process undertaken;
- Lime rate utilised;
- Results of monitoring of soil, leachate, surface water and groundwater.

A record of water monitoring and any treatment and discharge activities should also include the following:

- Background surface water pH and EC monitoring within the Hunter River, upstream and downstream of the site/discharge area;
- Daily monitoring at the point of discharge of any waters (i.e. on-site discharge point).

A record should also be maintained confirming contingency measures and additional treatment if undertaken. Monitoring should be commensurate with licencing and regulatory requirements.

A final report should be issued upon completion of the works presenting the monitoring regime and results to confirm that no adverse environmental impact has occurred during the works.

7.2 Acceptance Criteria

7.2.1 Water

Notwithstanding regulatory requirements, it is recommended that the pH of discharge waters from dewatering or leachate are within measured background groundwater pH levels, and that the ANZECC (2000) Guidelines for Fresh and Marine Water Quality (Ref 4) be considered before discharging any waters to the environment. The ANZECC (2000) guidelines trigger value range of pH 7.0 to pH 8.5 for estuarine environments is considered to be appropriate, rather than the marine or fresh water criteria, given the close proximity of the site to the Hunter River.

The background pH levels in groundwater should be confirmed prior to commencement of works.

7.2.2 Soil

Further treatment of soils may be required if monitoring of the material reveals any of the following properties:

- pH of soil in water is less than background values (to be confirmed at the commencement of works;
- pH of soil in water minus pH of soil in hydrogen peroxide is greater than 1 and pH in water is less than background values;
- pH of soil in hydrogen peroxide is greater than background (i.e. potential for over-liming).

Depending on the results of testing, reapplication of lime may be necessary to gain adequate neutralisation. Care should be taken to ensure over-liming does not occur.

The background pH levels in soils should be confirmed at the commencement of works.

8. Contingency Plan

Remedial action will be required if the standards or acceptance criteria outlined above are not being achieved. Remedial action shall comprise mixing of additional lime through the excavated material and neutralisation of leachate (if under-liming has occurred). If monitoring indicates that over-liming has occurred, additional ASS or leachate should be mixed with soils and leachate respectively to reduce pH to acceptable levels. The required mixing rate to treat the soil or leachate should be confirmed by on-site monitoring tests.

Where overland discharge or sewer discharge of extracted groundwater is proposed, a contingency plan should be in place to allow neutralisation and confirmation monitoring prior to discharge if pH levels are low or fall below natural background levels.

During periods of heavy or prolonged rainfall, stockpiling of acid sulfate soils should be appropriately contained/bunded to collect leachate for testing and neutralisation (if required) prior to disposal (see Section 6.2). Alternatively, temporary backfilling of acid sulfate soils could be undertaken to prevent the migration of leachate.

Sufficient lime should be stored on site during construction for the neutralisation of acid sulfate soils and contingency measures.

The development should be conducted with due regard to erosion and sediment controls to minimise potential impacts to nearby sensitive receptors.

Site development should be conducted in accordance with a site specific Construction Environmental Management Plan (CEMP). The CEMP should incorporate mitigation measures for soil and water management including those recommended for the management of ASS. Details should be provided in the CEMP by the contractor, in conjunction with the recommended Excavation Management Plan and Dewatering Management Plan.

9. References

1. Douglas Partners Pty Ltd, 'Report on Waste Classification and Groundwater Quality Assessment, 35 Honeysuckle Drive, Newcastle, Project 91303.00, Report 91303.00.R.003.Rev1, June 2018.
2. Douglas Partners Pty Ltd, 'Report on Geotechnical Investigation, 35 Honeysuckle Drive, Newcastle, Project 91303.00, Report 91303.00.R.001.Rev1, June 2018.
3. Ahern CR, Sullivan LA and McElnea AE, "Acid Sulfate Soils Laboratory Methods Guidelines" in "Queensland Acid Sulfate Soil Technical Manual", Department of Natural Resources and Mines, June 2004.
4. ANZECC (2000), 'Australian Water Quality Guidelines for Fresh and Marine Waters', November 2000.
5. ASSMAC, "ASSMAC Acid Sulfate Soil Manual", New South Wales Acid Sulfate Soil Management Advisory Committee, August 1998.
6. Dear SE, Moore NG, Dobos SK, Watling KM and Ahern CR, "Soil Management Guidelines" in "Queensland Acid Sulfate Soil Technical Manual" (QASSIT), Department of Natural Resources and Mines, November 2002.
7. NSW EPA "Waste Classification Guidelines, Part 4: Acid Sulfate Soils", Department of Environment and Climate Change, November 2014.
8. Department of Mineral Resources (DMR), Newcastle Coalfields Regional Geology 1:100 000 Sheet.

9. NHMRC (2011), 'National water quality management strategy, Australian Drinking Water Guidelines', National Health and Medical Research Council and National Resource Management Ministerial Council, Australia.

10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 35 Honeysuckle Drive, Newcastle in accordance with DP's proposal email dated 11 January 2018 and acceptance received from Chris Farrington dated 4 April 2018. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Lee 4 Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the (geotechnical / environmental / groundwater) components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Please note that Part 5.6, Section 143 of the Protection of the Environment Operations (POEO) Act 1997 states that it is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that the waste is disposed of appropriately. DP accepts no liability for the unlawful disposal of waste materials from any site.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Borehole Logs - Bores DP1-BH, DP2-BH, DP4-BH DP6-BH, DP14-BH, DP16-BH to DP18-BH and DP20-BH

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.2 AHD
EASTING: 384493
NORTHING: 6356304
DIP/AZIMUTH: 90°/--

BORE No: DP1-BH
PROJECT No: 91303.00
DATE: 23/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	ASPHALT - Slag aggregate and quarry gravel aggregate							
	0.32	FILLING - Generally comprising grey, brown, green and blue sand, gravel and cobble sized subangular slag filling up to 100mm diameter, damp							
	0.45								
	0.55	FILLING - Generally comprising grey / brown clayey fine to coarse grained sandy gravel filling (grey subangular quarry gravel up to 40mm diameter and grey, brown and green subangular slag gravel up to 50mm diameter) with trace bituminous subangular gravels with moderate PAH odour, damp		D, ASS	0.6		PID<1		
					0.75		PID<1		
				D, ASS	1.0		PID<1		
					1.25		PID<1		
		FILLING - Generally comprising medium to coarse grained sand filling with trace subangular grey slag gravel and subangular quarry gravel up to 50mm diameter, damp		D, ASS	1.5		PID<1		
				D, ASS	1.75		PID<1		
		FILLING - Generally comprising light brown medium to coarse grained sand filling with trace shell fragments and trace subrounded / subangular gravels up to 20mm diameter, damp		D, ASS	2.0		PID<1		
		From 1.6m, wet			2.25		PID<1		
		At 2.0m, trace brown staining		D, ASS	2.5		PID<1		
		At 2.2m, wet			2.75		PID<1		
	2.9	From 2.3m, wet, abundant shells		D, ASS	3.0		PID<1	▼	
		SAND - Light brown / grey medium to coarse grained sand, with shells, wet			3.25		PID<1	23-04-18	
		From 3.0m, saturated		D, ASS	3.5		PID<1		
		From 3.8m, dark grey, with trace to some subrounded gravels up to 4mm diameter, with trace shells							
	7.2	Bore discontinued at 7.2m, limit of investigation							

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.0m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.27 AHD
EASTING: 384493
NORTHING: 6356304
DIP/AZIMUTH: 90°/--

BORE No: DP2-BH
PROJECT No: 91303.00
DATE: 23/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.015	ASPHALT - Slag aggregate and quarry gravel aggregate							
	0.08								
	0.4	ASPHALT - Slag aggregate and quarry gravel aggregate							
	0.6	FILLING - Generally comprising grey brown and green sand, gravel and cobble sized subangular slag filling with trace light brown cemented slag, trace some subangular dark grey ballast up to 30mm diameter, trace subangular sandstone gravels and cobbles up to 200mm diameter, and trace subangluar bituminous gravels and cobbles with moderate PAH odour, damp							
		FILLING - Generally comprising grey / brown medium to coarse grained sand filling with trace subangular grey and brown slag gravels up to 30mm diameter, trace subangular brown cemented slag gravel up to 20mm diameter, trace subangular / subrounded sandstone gravels up to 40mm diameter and with trace shells, damp							
	2.3	FILLING - Generally comprising light brown / grey, medium to coarse grained sand with trace shell fragments, damp							
		SAND - Light brown / grey, medium to coarse grained sand, with trace shells, damp							
		From 2.3m, Wet, abundant shells							
		From 3.0m, saturated		D, ASS	3.25			23-04-18	
					3.5				
				D, ASS	3.75				
		From 4.0m, dark grey / brown, trace shells			4.0				
				D, ASS	4.25				
					4.5				
				D, ASS	4.75				
					5.0				
		From 5.3m, clayey silty dark grey / brown medium to coarse grained sand, abundant shells		D, ASS	5.25				
					5.5				
		From 5.6m, with trace shells		D, ASS	5.75				
					6.0				
				D, ASS	6.25				
					6.5				
		From 6.6m, dark grey / brown medium to coarse grained sand, some shells		D, ASS	6.75				
	7.0	Bore discontinued at 7.0m, limit of investigation			7.0				

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.0m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.3 AHD
EASTING: 384998
NORTHING: 6756313
DIP/AZIMUTH: 90°/--

BORE No: DP4-BH
PROJECT No: 91303.00
DATE: 24/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.08	ASPHALT - Slag aggregate and quarry gravel aggregate			0.19		PID<1		Gatic From 0-0.2m, concrete
	0.35	FILLING - Generally comprising grey, brown, green and blue sand, gravel and cobble sized subangular slag filling up to 100mm diameter, damp							From 0.2-0.5, bentonite
	0.5	FILLING - Generally comprising grey / brown clayey fine to coarse grained sandy gravel filling (grey subangular quarry gravel up to 40mm diameter and grey, brown and green subangular slag gravel up to 50mm diameter) with trace bituminous subangular gravel with moderate PAH odour, damp		D, ASS	0.9		PID<1		
	0.85	FILLING - Generally comprising medium to coarse grained sand filling with trace subangluar grey slag gravel and subangular quarry gravel up to 50mm diameter, damp		D, ASS	1.25		PID<1		
				D, ASS	1.5		PID<1		
					1.75		PID<1		
		FILLING - Generally comprising light brown, medium to coarse grained sand filling with trace shells, damp From 2.0m, wet From 2.2m, with some shells		D, ASS	2.0		PID<1		
					2.25		PID<1		
				D, ASS	2.5		PID<1		
					2.75		PID<1		
		From 3.0m, saturated		D, ASS	3.0		PID<1		
					3.25		PID<1		
	3.5	SAND - Light brown / grey medium to coarse grained sand and gravelly sand, subrounded gravels up to 5mm diameter and shells, saturated		D, ASS	3.5		PID<1		
					3.75		PID<1		From 0.5-7.2m, sand
					4.0		PID<1		
					4.25		PID<1		From 1.2m-7.2m, Class 18 PVC hand slotted PVC
		From 4.5m, with trace to some gravels and shells			4.5		PID<1		
					4.75		PID<1		
					5.0		PID<1		
					5.25		PID<1		
					5.5		PID<1		
					5.75		PID<1		
		From 6.1m, with trace shells and gravels			6.0		PID<1		
					6.25		PID<1		
					6.5		PID<1		
					6.75		PID<1		
					7.0		PID<1		
	7.2	Bore discontinued at 7.2m, limit of investigation							End cap

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.0m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.33 AHD
EASTING: 384516
NORTHING: 6356302
DIP/AZIMUTH: 90°/--

BORE No: DP6-BH
PROJECT No: 91303.00
DATE: 24/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.06	ASPHALT - Slag aggregate and quarry gravel aggregate							
	0.35	FILLING - Generally comprising grey, brown and green sand, gravel and cobble sized subangular slag filling with trace light brown cemented slag trace some subangular sandstone gravels up to 30mm diameter and trace bituminous gravel with moderate PAH odour, damp			0.5				
	0.45				0.75				
1					1.0				1
		FILLING - Generally comprising grey / brown clayey fine to coarse grained sandy gravel filling (grey subangular quarry gravel up to 40mm diameter and grey, brown and green subangular slag gravelly up to 50mm diameter) with trace bituminous subangular gravels with moderate PAH odour, damp		D	1.25	ASS	PID<1		
					1.5	ASS	PID<1		
				D	1.75	ASS	PID<1		
2		FILLING - Generally comprising light brown, medium to coarse grained sand with trace shells, damp			2.0	ASS	PID<1		2
				D	2.25	ASS	PID<1		
					2.5	ASS	PID<1		
		From 2.6m, wet		D	2.75	ASS	PID<1		
3					3.0	ASS	PID<1		3
	3.1	CLAYEY SILTY SAND / SANDY SILT - Dark grey / brown clayey silty medium to coarse grained sand / sandy silt with trace to some sandstone gravels up to 40mm diameter, saturated		D	3.25	ASS	PID<1		
					3.5	ASS	PID<1		
				D	3.75	ASS	PID<1		
4					4.0	ASS	PID<1		4
				D	4.25	ASS	PID<1		
					4.5	ASS	PID<1		
				D	4.75	ASS	PID<1		
5					5.0	ASS	PID<1		5
	5.2	SAND - Dark grey, medium to coarse grained sand with trace to some shells, saturated		D	5.25	ASS	PID<1		
					5.5	ASS	PID<1		
				D	5.75	ASS	PID<1		
6					6.0	ASS	PID<1		6
				D	6.25	ASS	PID<1		
					6.5	ASS	PID<1		
				D	6.75	ASS	PID<1		
7					7.0	ASS	PID<1		7
	7.2	Bore discontinued at 7.2m, limit of investigation							

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.0m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.33 AHD
EASTING: 384596
NORTHING: 6356287
DIP/AZIMUTH: 90°/--

BORE No: DP14-BH
PROJECT No: 91303.00
DATE: 23/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.08	ASPHALT - Slag aggregate and quarry gravel aggregate							Gatic
		FILLING - Generally comprising grey, brown, green and blue sand, gravel and cobble sized subangular slag filling up to 100mm diameter, damp							From 0-0.2m, concrete
	0.7	FILLING - Generally comprising light brown, medium to coarse grained sand with trace to some shells, damp		D	0.75	ASS			From 0.2-0.6m, bentonite
	1			D	1.0	ASS			
					1.25	ASS			
				D	1.5	ASS	PID<1		
					1.75	ASS	PID<1		
	2			D	2.0	ASS	PID<1		
					2.25	ASS	PID<1		
				D	2.5	ASS	PID<1		
	2.6	SAND - Dark brown / grey, medium to coarse grained sand with trace to some shells, wet		D	2.75	ASS	PID<1		
		From 2.85m - 3.05m, clayey silty sand							
	3	From 2.9m, saturated		D	3.0	ASS	PID<1		
					3.25	ASS	PID<1		
				D	3.5	ASS	PID<1		
					3.75	ASS	PID<1		
	4			D	4.0	ASS	PID<1		From 0.6-7.2m, sand
					4.25	ASS	PID<1		From 1.2m-7.2m, Class 18 PVC hand slotted PVC
					4.5	ASS	PID<1		
					4.75	ASS	PID<1		
	5			D	5.0	ASS	PID<1		
		From 5.1m - 6.0m, clayey silty medium to coarse grained sand			5.25	ASS	PID<1		
					5.5	ASS	PID<1		
					5.75	ASS	PID<1		
	6			D	6.0	ASS	PID<1		
					6.25	ASS	PID<1		
					6.5	ASS	PID<1		
					6.75	ASS	PID<1		
	7			D	7.0	ASS	PID<1		
	7.2	Bore discontinued at 7.2m, limit of investigation							End cap

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.0m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.2 AHD
EASTING: 389611
NORTHING: 6356293
DIP/AZIMUTH: 90°/--

BORE No: DP16-BH
PROJECT No: 91303.00
DATE: 23/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.08	ASPHALT - Slag aggregate and quarry gravel aggregate							
	0.28	FILLING - Generally comprising dark brown / grey fine to medium grained sandy gravel (subangular / subrounded gravel up to 60mm diameter) with subangular blue, green and brown slag up to 30mm diameter, with trace to some cobbles and boulders up to 400mm, damp		D	0.5	ASS	PID<1		
	0.45				0.75	ASS	PID<1		
		FILLING - Generally comprising orange / brown clayey fine to coarse grained sand with subangular / subrounded gravels up to 50mm diameter, damp							
		FILLING - Generally comprising light brown, medium to coarse grained sand filling with trace to some shells, damp			1.5	ASS	PID<1		
		From 1.9m, brown / grey clayey sand / sandy clay filling		D	2.0	ASS	PID<1		
		From 2.1m, dark brown / grey medium to coarse grained sand filling with trace to some shells, wet		D	2.25	ASS	PID<1		
				D	3.0	ASS	PID<1	▼	
		From 3.1m, saturated			3.5	ASS	PID<1		
				D	4.0	ASS	PID<1		
					4.5	ASS	PID<1		
					4.75	ASS	PID<1		
				D	5.0	ASS	PID<1		
					5.25	ASS	PID<1		
					5.5	ASS	PID<1		
					5.75	ASS	PID<1		
				D	6.0	ASS	PID<1		
					6.25	ASS	PID<1		
					6.5	ASS	PID<1		
					6.75	ASS	PID<1		
				D	7.0	ASS	PID<1		
	7.2	Bore discontinued at 7.2m, limit of investigation							

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.1m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.05 AHD
EASTING: 384597
NORTHING: 6356298
DIP/AZIMUTH: 90°/--

BORE No: DP17-BH
PROJECT No: 91303.00
DATE: 23/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.08	ASPHALT - Slag aggregate and quarry gravel aggregate							
	0.15								
	0.4	FILLING - Generally comprising brown sandy gravel filling (subangular gravel up to 40mm diameter and subangular green, blue and grey slag gravel up to 50mm diameter), damp		D	0.45	ASS			
				D	0.75	ASS	PID<1		
		FILLING - Generally comprising orange / brown clayey fine to coarse grained sandy gravel (subangular quarry rock up to 60mm diameter) with trace to some sandstone cobbles and boulders up to 450mm diameter, damp		D	1.0	ASS	PID<1		
					1.25	ASS	PID<1		
		FILLING - Generally comprising light brown, medium to coarse grained sand with trace shells, damp		D	1.5	ASS	PID<1		
					1.75	ASS	PID<1		
				D	2.0	ASS	PID<1		
					2.25	ASS	PID<1		
				D	2.5	ASS	PID<1		
	2.7	CLAYEY SAND - Dark grey silty clayey medium to coarse grained sand with trace shells, wet		D	2.75	ASS	PID<1		
		From 3.0m, saturated		D	3.0	ASS	PID<1		
					3.25	ASS	PID<1		
		From 3.5m, no clay component		D	3.5	ASS	PID<1		
					3.75	ASS	PID<1		
				D	4.0	ASS	PID<1		
					4.25	ASS	PID<1		
				D	4.5	ASS	PID<1		
					4.75	ASS			
	5.0	SANDY CLAY - Dark grey medium to coarse grained sandy clay, saturated		D	5.0	ASS			
					5.25	ASS			
				D	5.5	ASS			
					5.75	ASS			
				D	6.0	ASS			
	6.1	SAND - Dark grey medium to coarse grained sand with trace shells,saturated			6.25	ASS			
					6.5	ASS			
					6.75	ASS			
				D	7.0	ASS			
	7.3	Bore discontinued at 7.3m, limit of investigation							

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.1m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.86 AHD
EASTING: 384603
NORTHING: 6356271
DIP/AZIMUTH: 90°/--

BORE No: DP18-BH
PROJECT No: 91303.00
DATE: 23/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.15	FILLING - Generally comprising light grey / brown silty sand filling with some subangular to subrounded gravel up to 120mm diameter trace rootlets, humid							
	0.3	FILLING - Generally comprising brown / grey clayey sandy gravel (subangular to subrounded gravel up to 60mm diameter) with trace subangular grey and blue slag gravel up to 20mm diameter, with trace bituminous gravel up to 10mm diameter with moderate PAH odour, damp		D	0.65	ASS	PID<1		
	0.55			D	1.0	ASS	PID<1		
		FILLING - Generally comprising brown / orange silty clayey medium to coarse grained sand filling with some subangular to subrounded gravel up to 40mm diameter, damp		D	1.25	ASS	PID <1		
				D	1.5	ASS	PID<1		
		FILLING - Generally comprising light brown medium to coarse grained sand with trace shells, damp		D	1.75	ASS	PID<1		
				D	2.0	ASS	PID<1		
				D	2.25	ASS	PID<1		
				D	2.5	ASS	PID<1		
				D	2.75	ASS	PID<1		
	2.9	SAND - Dark brown grey medium to coarse grained sand with trace to some shells, wet		D	3.0	ASS	PID<1	▼	
		From 3m to 3.1m, clayey sand		D	3.25	ASS	PID<1		
				D	3.5	ASS	PID<1		
				D	3.75	ASS	PID<1		
				D	4.0	ASS	PID<1		
				D	4.25	ASS	PID<1		
				D	4.5	ASS	PID<1		
				D	4.75	ASS	PID<1		
				D	5.0	ASS	PID<1		
				D	5.25	ASS	PID<1		
				D	5.5	ASS	PID<1		
				D	5.75	ASS	PID<1		
				D	6.0	ASS	PID<1		
				D	6.25	ASS	PID<1		
				D	6.5	ASS	PID<1		
				D	6.75	ASS	PID<1		
				D	7.0	ASS	PID<1		
	7.2	Bore discontinued at 7.2m, limit of investigation							

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.1m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Lee 4 Pty Ltd
PROJECT: Huntington
LOCATION: 35 Honeysuckle Drive, Newcaslte

SURFACE LEVEL: 2.1 AHD
EASTING: 384551
NORTHING: 6356302
DIP/AZIMUTH: 90°/--

BORE No: DP20-BH
PROJECT No: 91303.00
DATE: 23/4/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	FILLING - Generally comprising grey brown and green sand, gravel and cobble sized subangular slag filling with trace light brown cemented slag, trace some subangular dark grey ballast up to 30mm diameter, trace subangular sandstone gravel and cobble up to 200mm diameter, and trace subangluar bituminous gravel and cobbles with moderate PAH odour, damp							Gatic From 0-0.2m, concrete From 0.2-0.5m, bentonite
	0.8			D	0.85	ASS	PID <1		
1		FILLING - Generally comprising grey / brown medium to coarse grained sand filling with trace subangular grey and brown slag gravel up to 30mm diameter, trace subangular brown cemented slag gravel up to 20mm diameter, trace subangular / subrounded sandstone gravel up to 40mm diameter and trace shells, damp		D	1.0	ASS	PID<1		1
				D	1.25	ASS	PID<1		
				D	1.5	ASS	PID<1		
		FILLING - Generally comprising light brown medium to coarse grained sand with trace to some shells, damp		D	1.75	ASS	PID<1		
2	2.0	At 1m to 1.1m, brown, medium to coarse grained sand with subangular gravel up to 30mm diameter		D	2.0	ASS	PID<1		2
		From 2m, brown-grey, wet		D	2.25	ASS	PID<1		
		SAND - Brown / grey, medium to coarse grained sand, with trace shells, damp		D	2.5	ASS	PID<1		
				D	2.75	ASS	PID<1		
3				D	3.0	ASS	PID<1	▼	3
		From 3.1m, saturated		D	3.25	ASS	PID<1		
				D	3.5	ASS	PID<1		
				D	3.75	ASS	PID<1		
4				D	4.0	ASS	PID<1		4 From 0.5-7.2m, sand
				D	4.25	ASS	PID<1		From 1.2m-7.2m, Class 18 PVC hand slotted PVC
				D	4.5	ASS	PID<1		
				D	4.75	ASS	PID<1		
5				D	5.0	ASS	PID<1		5
				D	5.5	ASS	PID<1		
6				D	6.0	ASS	PID<1		6
				D	6.5	ASS	PID<1		
7				D	7.0	ASS	PID<1		7
	7.2	Bore discontinued at 7.2m, limit of investigation							End cap

RIG: Geoprobe **DRILLER:** Terratest **LOGGED:** Abberton **CASING:** Drill Tube

TYPE OF BORING: 100mm continuous tube

WATER OBSERVATIONS: Free groundwater observed at 3.1m

REMARKS: Coordinates taken using hand held GPS typically accurate to ± logging of upper fill material based on conditions encountered in adjacent test pits

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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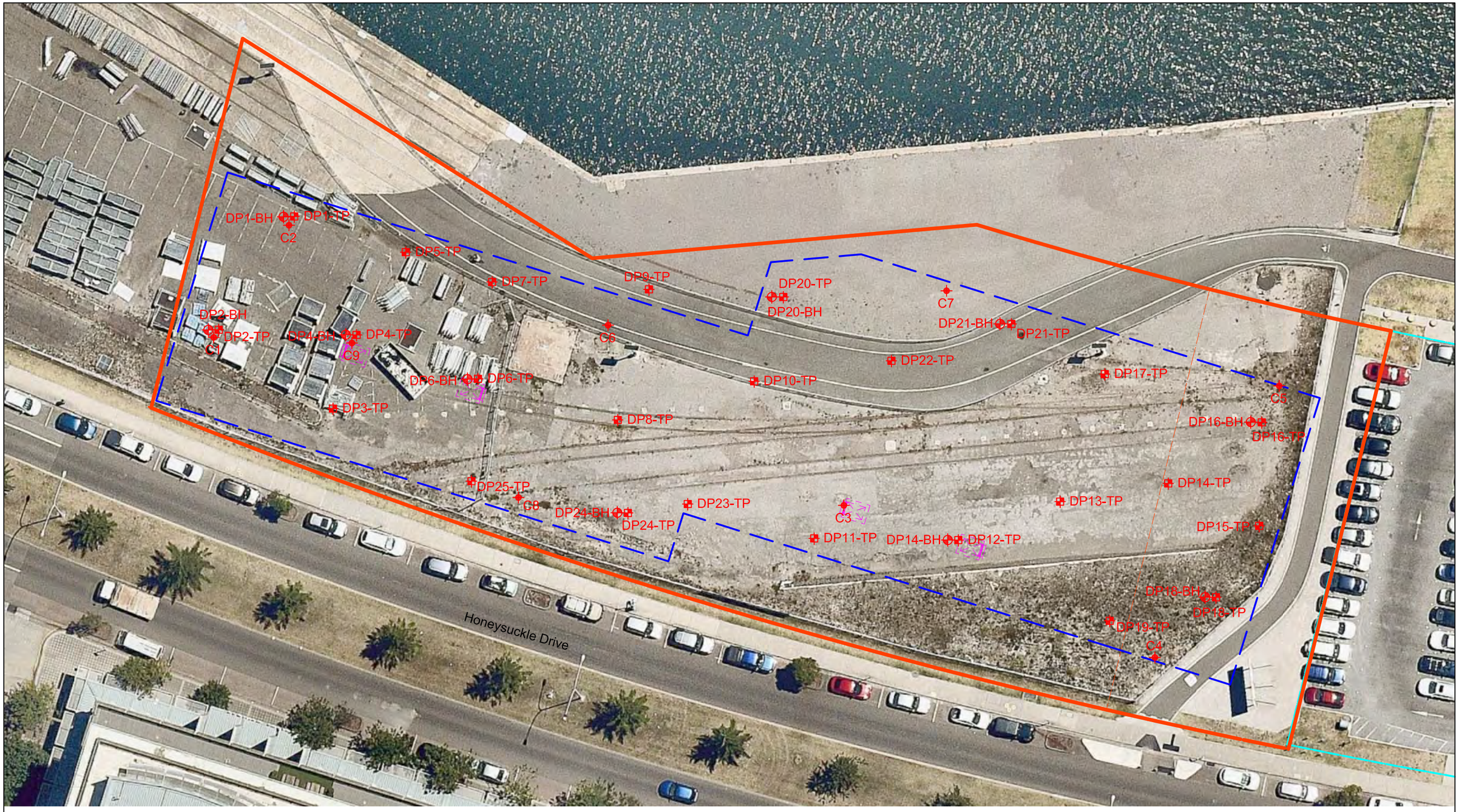
Appendix C

Drawing 2- Test Location Plan
Architectural Drawings (SJB Architects, Job No. 5711, dated 06.06.18):
Cover Sheet No. 0001 Rev03
Floor Plan Basement 02, Drawing No.DA-A-0201 Rev 03
Floor Plan Basement 01 Drawing No.DA-A-0202 Rev 03
Building Sections – Sheet 1, Drawing No.DA-A-0601 Rev 03
Building Sections – Sheet 2, Drawing No. DA -A- 0602 Rev 03
Detail and Contour Survey – De Witt Consulting (8215 – DET – 14.02.18)



NOTES

1. Drawing adapted from Nearmap Imaged dated 7 December 2017.
2. Test locations are approximate only and were located using hand-held GPS.

0 5 10 15 20 30 40 60 80m

1:800 @ A3

LEGEND

- Site Boundary
- Proposed Basement
- Borehole Location
- Test Pit Location
- CPT Location

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Lee 4 Pty Ltd		
OFFICE: Newcastle	DRAWN BY: PLH	
SCALE: 1:800@A3 Sheet	DATE: 01.06.2018	

TITLE: **Test Location Plan**
Huntington
35 Honeysuckle Drive, Newcastle

N

PROJECT No:	91303.00
DRAWING No:	2
REVISION:	0

SJB Architects

35 HONEYSUCKLE

35 Honeysuckle
35 Honeysuckle Drive
Newcastle, NSW 2300

SJB Architects
Level 2, 490 Crown Street
Surry Hills NSW
2010 Australia
T 61 2 9380 9911
F 61 2 9380 9922

Project Number:5711
Date: 06.06.18
Client: DOMA GROUP

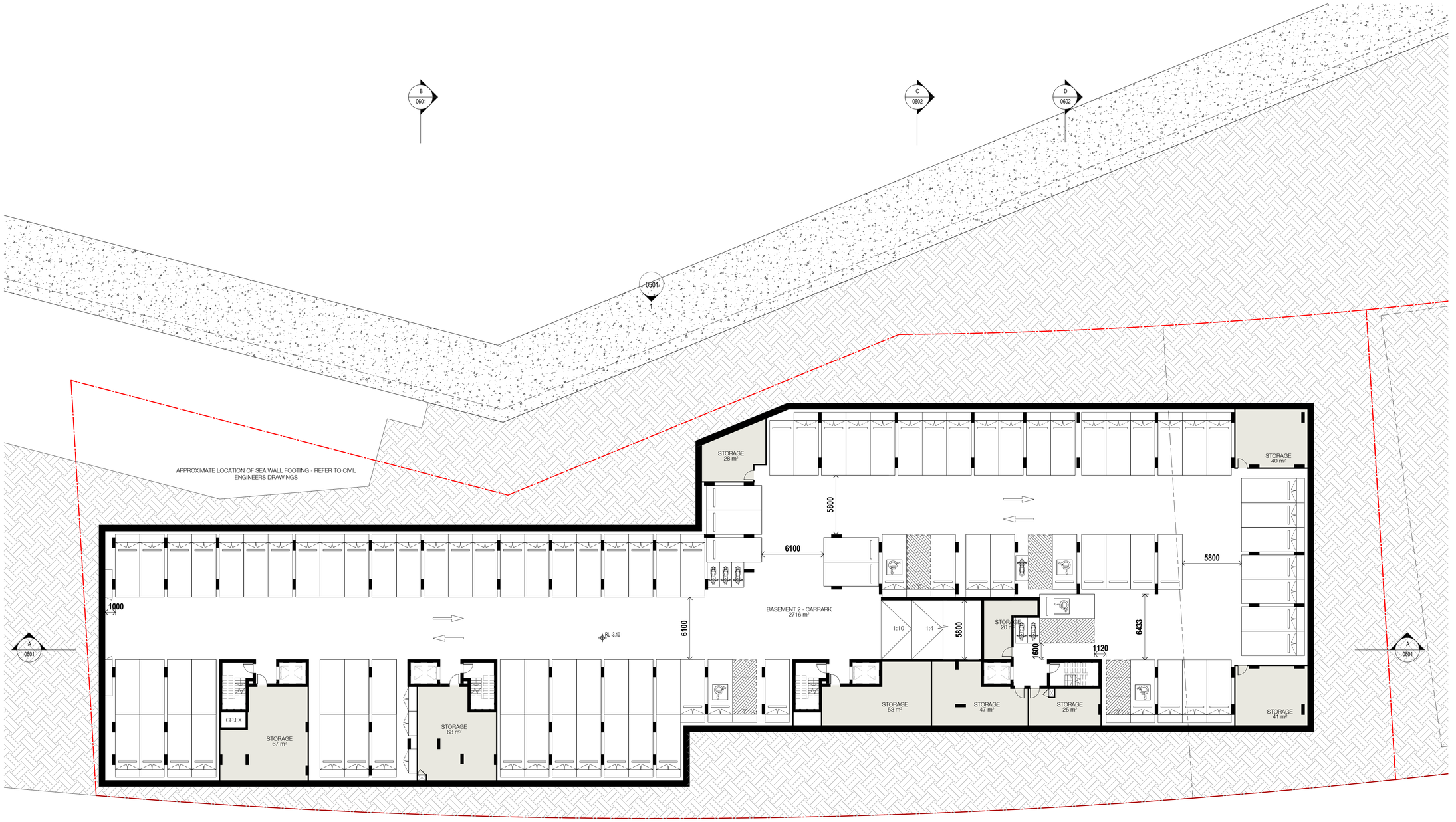
DRAWING LIST

Sheet No.	Sheet Name	Rev.	Date
0001	Cover	03	06.06.18
0101	Context Plan	03	06.06.18
0103	Site Plan / Site Analysis	03	06.06.18
0201	Floor Plan - Basement 02	03	06.06.18
0202	Floor Plan - Basement 01	03	06.06.18
0203	Floor Plan - Ground Floor	03	06.06.18
0204	Floor Plan - Level 01	03	06.06.18
0205	Floor Plan - Level 02	03	06.06.18
0206	Floor Plan - Level 03	03	06.06.18
0207	Floor Plan - Level 04-06	03	06.06.18
0210	Floor Plan - Level 07	03	06.06.18
0211	Roof Plan	03	06.06.18
0501	Elevations - Sheet 1	03	06.06.18
0502	Elevations - Sheet 2	03	06.06.18
0601	Building Sections - Sheet 1	03	06.06.18
0602	Building Sections - Sheet 2	03	06.06.18
1401	Apartment Plans - Sheet 1	03	06.06.18
1402	Apartment Plans - Sheet 2	03	06.06.18
1404	Apartment Plans - Adaptable	03	06.06.18
3001	Shadow Analysis - 9AM	03	06.06.18
3002	Shadow Analysis - 10AM	03	06.06.18
3003	Shadow Analysis - 11AM	03	06.06.18
3004	Shadow Analysis - 12PM	03	06.06.18
3005	Shadow Analysis - 1PM	03	06.06.18
3006	Shadow Analysis - 2PM	03	06.06.18
3007	Shadow Analysis - 3PM	03	06.06.18
3101	GFA Analysis	03	06.06.18
3201	SEPP 65 Analysis - Solar	03	06.06.18
3202	SEPP 65 Analysis - Ventilation	03	06.06.18
3203	SEPP 65 Analysis - Deep Soil	03	06.06.18
3204	SEPP 65 Analysis - Communal Space	03	06.06.18
4001	External Finishes	03	06.06.18
4005	Photomontage - Sheet 1	03	06.06.18
4006	Photomontage - Sheet 2	03	06.06.18

Nominated Architects: Adam Haddow-7188 | John Pradel-7004

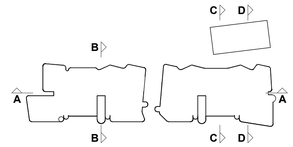
FOR APPROVAL

Rev	Date	Revision	By	Chk.
01	04.05.18	Issued to Consultants	MJL	EW
02	11.05.18	Issued to Consultants	MJL	EW
03	06.06.18	Issued for Approval	MJL	EW



Carparking Allocation - By Level

Basement 2	
Accessible 2400x5400	5
Standard 2400x5400	79
Standard 2400x5400 (Tandem)	14
	98
Basement 1	
Accessible 2400x5400	5
R = Retail Parking 2400x5400	22
Standard 2400x5400	37
Standard 2400x5400 (Tandem)	7
V = Visitor Parking 2400x5400	20
Visitor Accessible 2400x5400	1
	92
TOTAL	190



Structural Engineer
Northrop Consulting Engineers

Mechanical / Hydraulic Engineer
S4B / WPFD

Electrical Engineer
S4B

Fire Engineer
WPFD

Access Consultant
Phillip Chun

Basix
David Gradwell

Client

DOMAGROUP

Project
35 Honeysuckle

35 Honeysuckle Drive
Newcastle, NSW 2300

Drawing Name
Floor Plan - Basement 02

Date	Scale	Sheet Size
06.06.18	1 : 200	@ A1

Drawn	Chk.
MJL	EW

Job No.	Drawing No.	Revision
5711	DA-A-0201	/ 03

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Nominated Architects: Adam Haddow-7188 | John Pradel-7004

FOR APPROVAL

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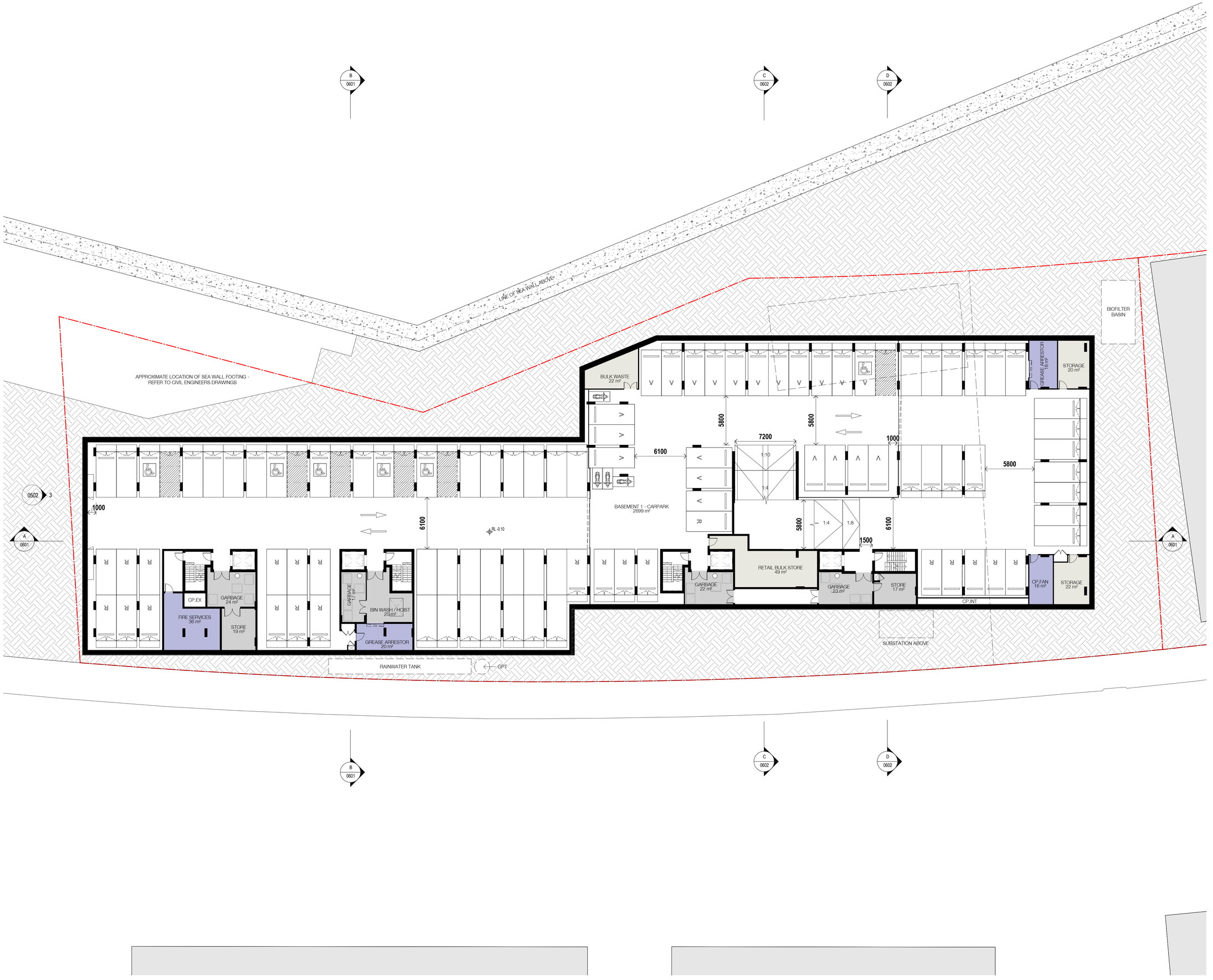
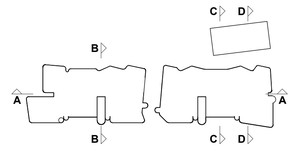
03	06.06.18	Issued for Approval	MJL	EW



Carparking Allocation - By Level

Basement 2	
Accessible 2400x5400	5
Standard 2400x5400	79
Standard 2400x5400 (Tandem)	14
	98
Basement 1	
Accessible 2400x5400	5
R = Retail Parking 2400x5400	22
Standard 2400x5400	37
Standard 2400x5400 (Tandem)	7
V = Visitor Parking 2400x5400	20
Visitor Accessible 2400x5400	1
	92
TOTAL	190



Structural Engineer
Northrop Consulting Engineers

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Electrical Engineer
S4B

Fire Engineer
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DOMAGROUP

Project
35 Honeysuckle

35 Honeysuckle Drive
Newcastle, NSW 2300

Drawing Name
Floor Plan - Basement 01

Date	Scale	Sheet Size
06.06.18	1 : 200	@ A1

Drawn	Chk.
MJL	EW

Job No.	Drawing No.	Revision
5711	DA-A-0202	/ 03

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Nominated Architects: Adam Haddow-7188 | John Pradel-7004

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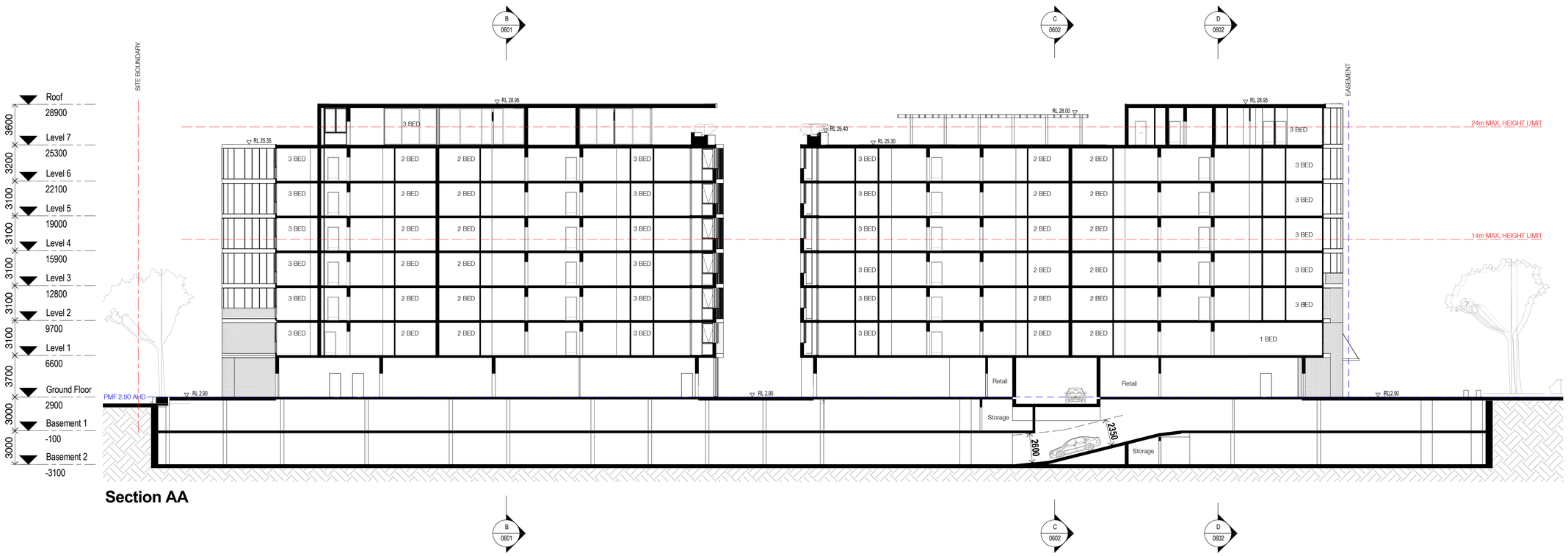
03	06.06.18	Issued for Approval	MJL	EW



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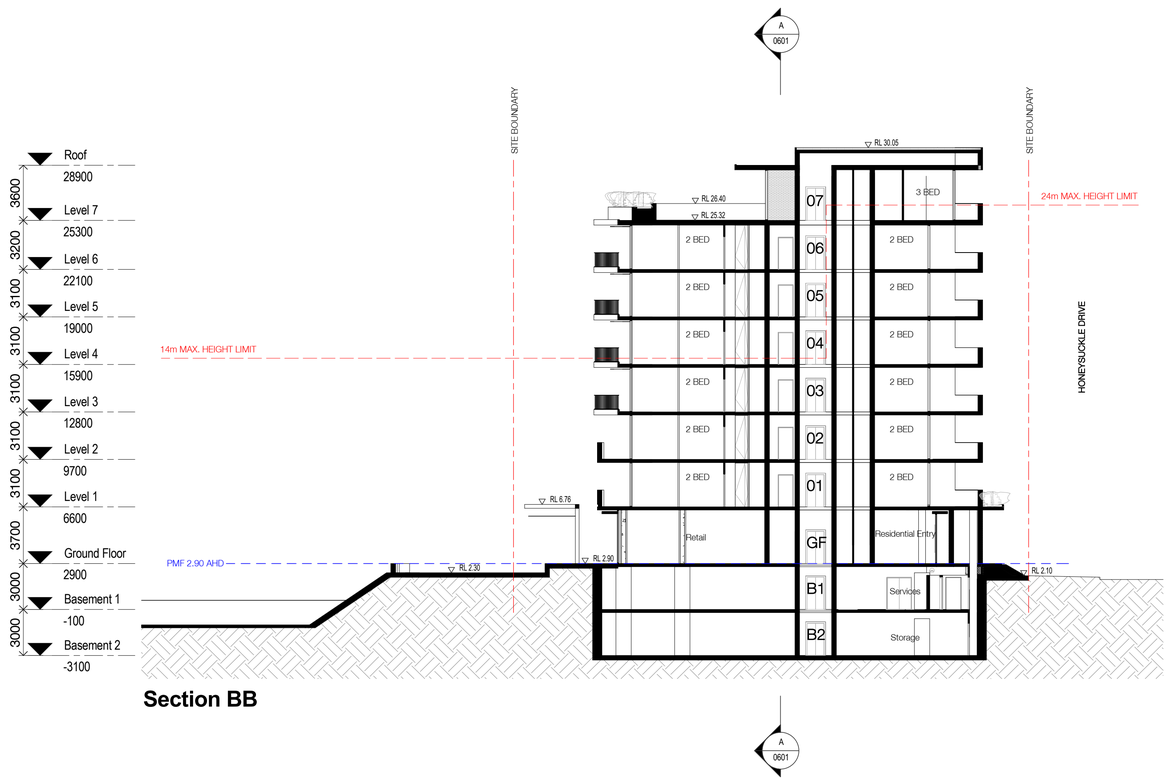

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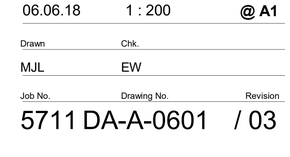

Structural Engineer
Northrop Consulting Engineers

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S4B / WPFD

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S4B

Fire Engineer
WPFD

Access Consultant
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David Gradwell

Client
DOMAGROUP

Project
35 Honeysuckle

35 Honeysuckle Drive
Newcastle, NSW 2300

Drawing Name
Building Sections - Sheet 1

Date	Scale	Sheet Size
06.06.18	1 : 200	@ A1

Drawn	Chk.
MJL	EW

Job No.	Drawing No.	Revision
5711	DA-A-0601	/ 03

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Nominated Architects: Adam Haddow-7188 | John Pradel-7004

FOR APPROVAL

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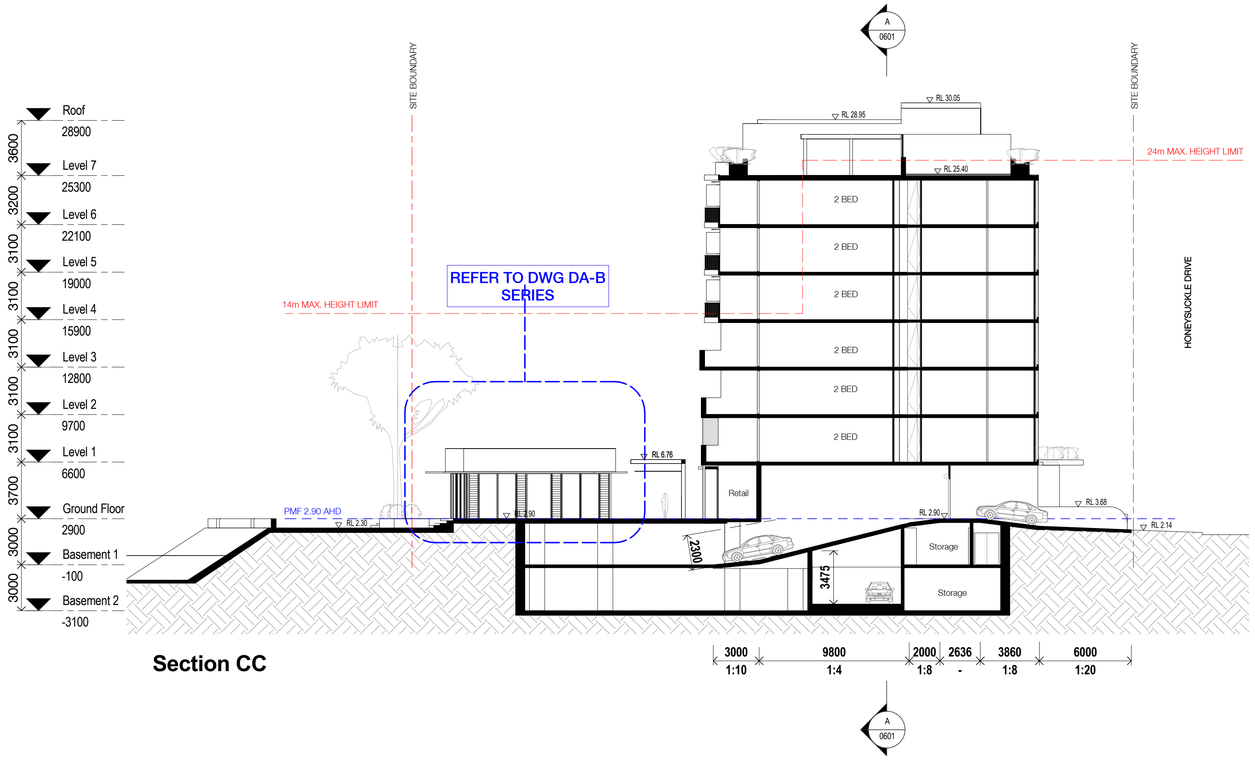
03	06.06.18	Issued for Approval	MJL	EW



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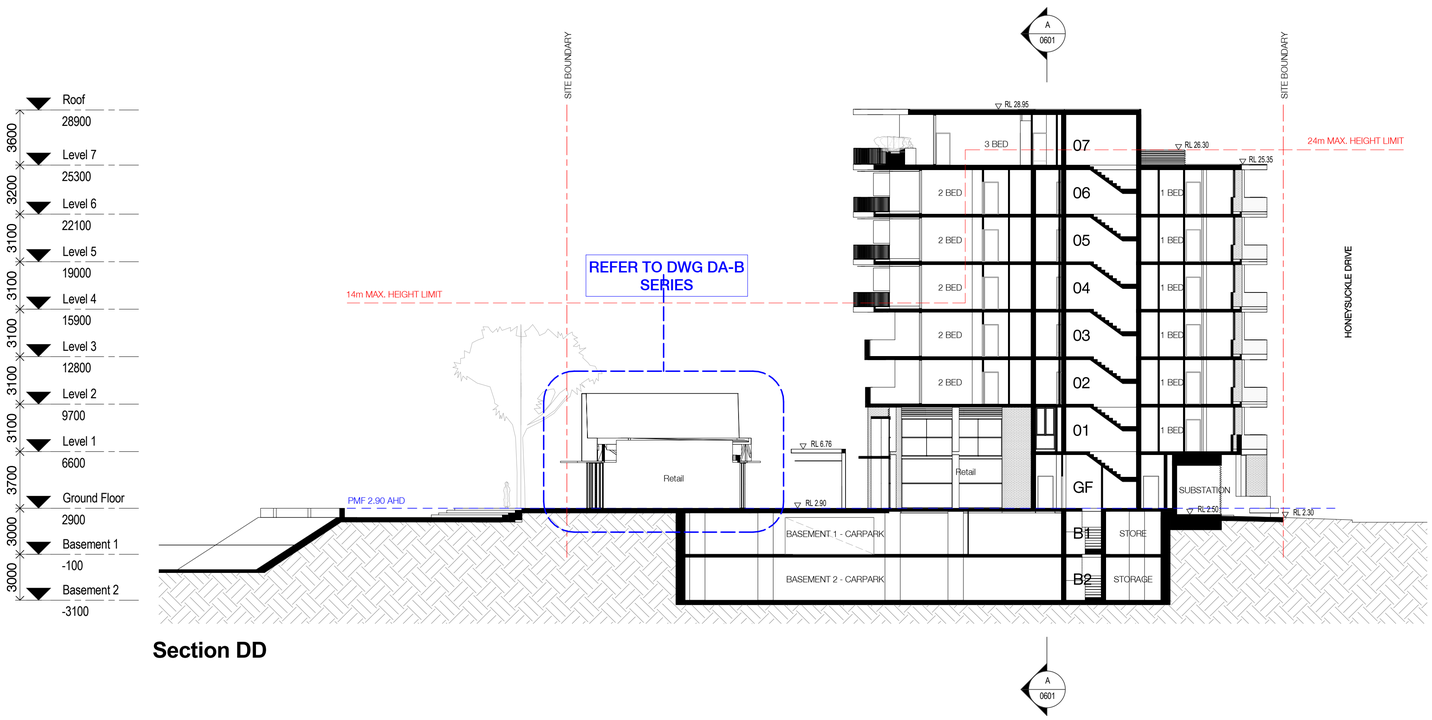

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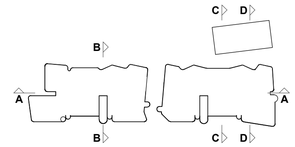

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Electrical Engineer
S4B

Fire Engineer
WPFD

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Client

DOMAGROUP

Project
35 Honeysuckle

35 Honeysuckle Drive
Newcastle, NSW 2300

Drawing Name
Building Sections - Sheet 2

Date	Scale	Sheet Size
06.06.18	1 : 200	@ A1

Drawn	Chk.
MJL	EW

Job No.	Drawing No.	Revision
5711	DA-A-0602	/ 03

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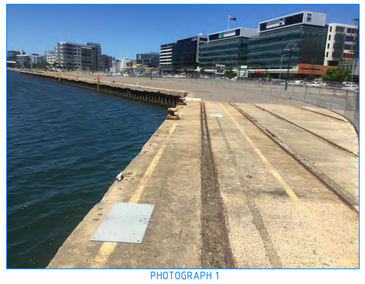
NOTES:

1. FEATURES SHOWN TO SCALE ACCURACY.
2. THIS PLAN IS SUITABLE FOR DETAILED PLANNING AND DESIGN AT THE SCALE/S STATED. THE PLAN MAY NOT BE SUITABLE FOR ANY OTHER PURPOSE OR FOR USE AT ANY OTHER SCALE/S.
3. SERVICE LINES SHOWN ON THIS PLAN HAVE BEEN SCALED FROM RELEVANT AUTHORITY PLANS. IT IS RECOMMENDED THAT THE LOCATION OF THESE SERVICES SHOULD BE PRECISELY DETERMINED BY POTHOLING PRIOR TO DESIGN & CONSTRUCTION
4. CONTOUR INTERVAL – 0.2m
5. THE BOUNDARIES SHOWN HAVE BEEN SURVEYED AND ARE ACCURATE.
6. DURING THE COURSE OF THIS SURVEY NO INVESTIGATION HAS BEEN UNDERTAKEN TO DETERMINE THE EXISTENCE OF ANY POSSIBLE SUBTERRANEAN ENCROACHMENTS.
7. THE SUBJECT PROPERTY IS AFFECTED BY A COVENANT. THE RELEVANT CONDITIONS OF THE COVENANT SHOULD BE CHECKED FOR COMPLIANCE PRIOR TO DESIGN & CONSTRUCTION. (D.P.1094812)


PHOTOGRAPH 1


PHOTOGRAPH 2

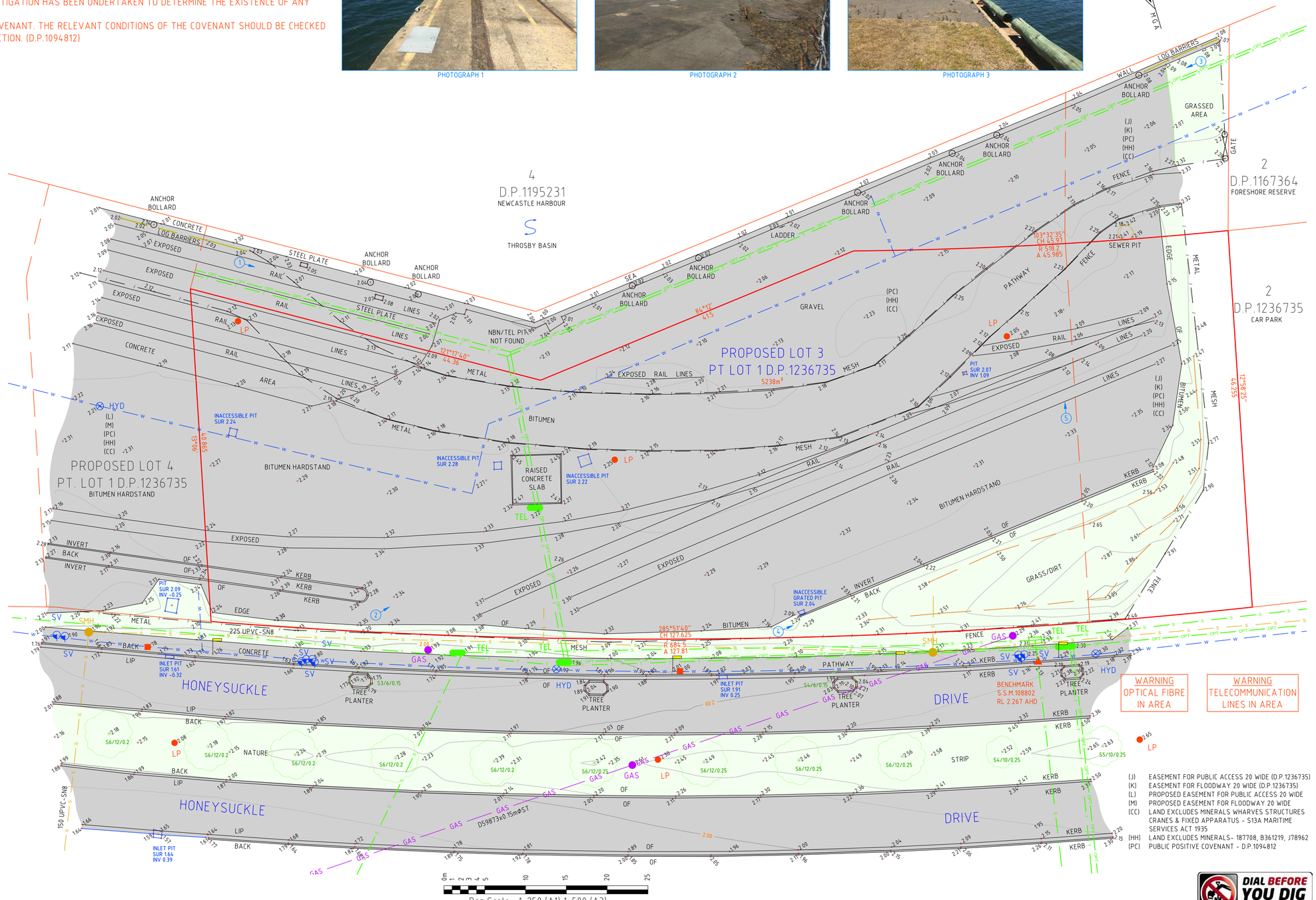

PHOTOGRAPH 3

LEGEND

- BOUNDARY LINE
- ADJACENT BOUNDARY
- MINOR CONTOUR LINE
- 10 MAJOR CONTOUR LINE
- EASEMENT
- FENCE LINE
- TOP & TOE OF BANKS
- W UNDERGROUND WATER LINE
- S UNDERGROUND OPTUS CABLE
- T UNDERGROUND TELSTRA LINE
- OPT UNDERGROUND OPTICAL FIBRE
- S UNDERGROUND SEWER LINE
- BENCH MARK
- LP LIGHT POLE
- PIT DRAINAGE PIT
- SV STOP VALVE
- HYD HYDRANT
- SMH SEWER MAN HOLE
- GAS NATURAL GAS MARKER
- TEL TELSTRA PIT
- DENOTES TREE — SS/10/0.6 spread radius/approx height/trunk diameter
- 2 PHOTOGRAPH LOCATION AND DIRECTION
- DENOTES SIGNAGE
- TICKET MACHINE


PHOTOGRAPH 4


PHOTOGRAPH 5



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TITLE

DETAIL AND CONTOUR SURVEY OF PROPOSED LOT 3

PART LOT 1 D.P.1236735

Ed.	Date	Amendment
H		
G		
F		
E		
D		
C		
B		
A	14.02.18	INITIAL ISSUE

JOB ADDRESS: HONEYSUCKLE DRIVE, NEWCASTLE

CLIENT: DCMA GROUP

PLAN No 001

JOB REF: 8215

SCALE: A1 1:250 A3 1:500

SURVEY DATE: 07.02.18

PLAN DATE: 14.02.18

DATUM: AHD

CAD REF: 8215-DE-180207

ORIGIN OF LEVELS S.S.M108802 RL 2.267

DRAWN CJ
SURVEYOR NS
CHECKED SW
APPROVED SW

SHEET No 1/1

DRAWING REF: 8215-DET-14.02.18