

6 September 2018

NettCorp
 Att: David De Angelis
 By email

Dear David,

RE: PROPOSED CEMETERY - WALLACIA MEMORIAL PARK AT WALLACIA GOLF COURSE, 13-15 PARK ROAD, WALLACIA, NSW.

1.0 Overview

This letter provides an interim summary of groundwater level monitoring undertaken at the above site by Martens and Associates Pty Ltd (MA). The letter should be read in conjunction with MA's preliminary geotechnical, groundwater and salinity assessment report for the site (Ref: P1706171JR01V01, October 2017) and MA's first interim groundwater summary and response letter to Council's letter dated 23, February 2018 (REF: P1706171JC01V01).

2.0 Groundwater Monitoring Locations

On 22 September 2017, Boreholes (BHs) BH102, BH104, BH105, BH107, BH117 and BH119 were drilled on the site and completed as groundwater monitoring wells (MW102, MW104, MW105, M107, MW117 and MW119). The BHs were drilled for geotechnical and hydrogeological characterisation purposes. Refer to Attachment A for BH/MW locations, Attachment B for borehole and groundwater monitoring well logs and Table 1 for a summary of monitoring well details.

Table 1: MW details.

MW	Approximate Surface Level (mAHD) ¹	Depth of MW (mBGL) ²	Approximate Base of MW (mAHD)	Screened Material
MW102	40	4.00	36	Clay
MW104	45	4.00	41	Sandy clay
MW105	45	3.00	42	Clay
MW107	53	3.00	50	Clay
MW117	49	3.00	46	Clay
MW119	38	4.00	34	Shale

Notes:

¹ Levels approximated based on survey plan – MWs not surveyed.

² mBGL – metres below ground level.

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2.0 Monitoring Period

The groundwater monitoring period covered by this letter is from 22 September 2017 to 30 August 2018 (inclusive), which is a period of 343 days. The monitoring was undertaken at six monitoring wells as noted in Table 1 with a measurement frequency of 15 minutes. It is noted that during monitoring period, data loggers at MW105, MW107, MW117 and barometric data logger experienced data logging errors over a 2-3 week period from the end of May to the middle of June, 2018. These data loggers were restarted and/or replaced on 18 June, 2018, however data was not recorded during this time.

4.0 Groundwater Level Monitoring Results

Groundwater levels obtained by dip meter are summarised in Table 2. Groundwater levels obtained by data logger are summarised below:

- MW102 data logger values No response to rainfall was recorded, all manual measurements were dry or <100mm of water, likely associated with sump at bottom of well of approximately which cannot free drain.
- MW104 data logger values – MW04 has had a declining standing water level with all manual measurements recorded as dry since 16 April, 2018. Data recorded does not shown any response to rainfall events, other than event noted in P1706171JC01V01.
- MW105 data logger values – No response to rainfall, all manual measurements were recorded as dry or <30 mm of water, likely associated with sump at bottom of well of approximately which cannot free drain.
- MW107 data logger values – No response to rainfall, all manual measurements recorded as dry or 100-150 mm of water, likely associated with sump at bottom of well of approximately which cannot free drain.
- MW117 data logger values – MW117 has constantly contained groundwater of monitoring period. The well had some response to rainfall during monitoring period including 150 - 200 mm response to March rainfall events and 50-100 mm response to rainfall events since then. The trend of the standing water level (SWL) in monitoring well has been declining since the well installation.
- MW119 data logger values – No response to rainfall, all manual measurements were recorded as dry or <30 mm of water, likely associated with sump at bottom of well which cannot free drain.

Table 1: Summary of groundwater levels from manual dip measurements.

Date	Groundwater Level (mBGL/mAHD)					
	MW102	MW104	MW105	MW107	MW117	MW119
22/09/2017	3.4 ¹	NM ²	NM ²	NM ²	NM ²	3.93 ¹
29/09/2017	Dry	2.35	Dry	Dry	2.05	Dry
10/10/2017	3.92	2.47	Dry	D	2.02	Dry
23/10/2017	3.9	2.59	Dry	D	1.7	Dry
22/12/2017	4.0 ³	3.15	Dry	2.88 ³	2.06	Dry
25/01/2018	4.0 ³	3.46	Dry	2.87 ³	2.03	Dry
2/03/2018	3.9 ³	3.78	2.98 ³	2.85 ³	2.07	Dry
16/04/2018	Dry	Dry	Dry	2.87 ³	2.11	Dry
18/06/2018	Dry	Dry	2.97 ³	2.88 ³	2.34	Dry
12/07/2018	Dry	Dry	2.98 ³	2.88 ³	2.43	Dry
30/08/2018	Dry	Dry	Dry	Dry	2.51	Dry

Notes:

¹ Levels assumed to represent levels of drilling water which was not completely purged from boreholes, not groundwater level.

² Not measured (NM).

³ Dry or effectively dry MW (MWs have a small sump at bottom of well of approximately 100 mm which cannot free drain).

⁴ Detailed survey of the groundwater well locations and elevation levels to be provided by client to obtain more accurate groundwater data.

5.0 Rainfall

Rainfall over the groundwater monitoring period is provided in Figure 1. Throughout the monitoring period there were 22 days with rain of equal to or greater than 5 mm, 16 days with rain of equal to or greater than 10 mm and 3 days with rain of equal to or greater than 20 mm. Maximum daily rainfall was 53 mm.

A cumulative monthly residual rain mass analysis was completed to assess recent rainfall trends during and leading up to the groundwater monitoring period. The analysis was based on observed rainfall data from Badgerys Creek AWS BOM Station (as it had a full recent record) and long term average rainfall from Badgerys Creek McMasters F.Stn BOM Station (as it had a long record). The analysis indicated generally below average rainfall from March 2017 onwards. Groundwater level trends often follow cumulative residual rain mass trends and therefore groundwater levels in the region are likely to have been generally declining over the monitoring period.

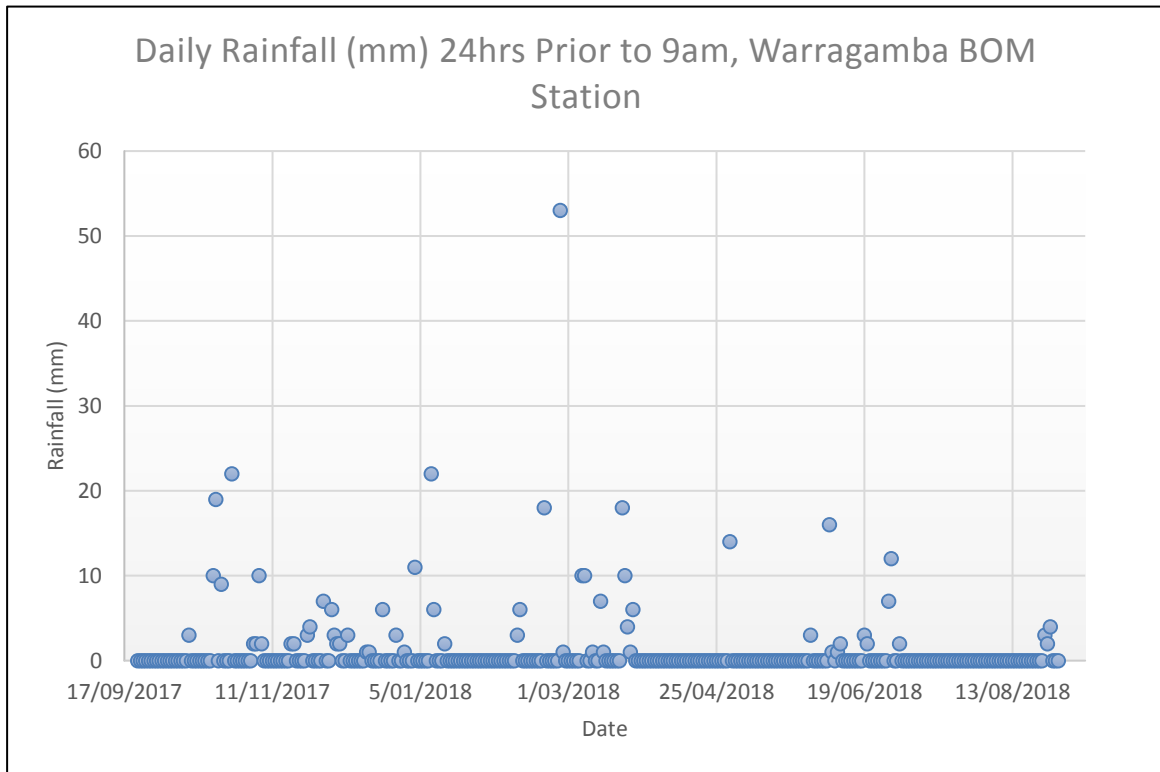


Figure 1: Rainfall over groundwater monitoring period (September 2017 to August 2018).

6.0 Conclusion

In light of the obtained groundwater level data coinciding with a declining cumulative residual rain mass trend and constant groundwater only recorded at MW117 in this monitoring period, we recommend extending the groundwater monitoring period for an additional three months. After which point the data will be assessed and this letter updated accordingly. We consider this necessary, as it is possible that higher than monitored groundwater levels will occur during periods which are wetter than that which have occurred during the current monitoring period.

Due to limited areas of the site that are considered to have shallow groundwater, we don't see the benefit in creating a groundwater model at this stage. Additionally creating a groundwater model based on the current information we have for this site (i.e. only 2 locations with groundwater since monitoring began) will likely be very difficult, have poor calibration, and therefore unreliable and hence unusable. Furthermore, these types of saturated and unsaturated shallow systems do not lend themselves to being modelled.

If burial plots are proposed in the vicinity of MW104 and MW117 then we recommend additional groundwater wells and monitoring to better determine groundwater levels in these areas.

Following completion of monitoring and analysis of additional rain events, the above results, advice and recommendations shall be updated accordingly.

If you require any further information please contact our office.

For and on behalf of

MARTENS & ASSOCIATES PTY LTD



MATTHEW VAUGHAN

BSc

Engineering Scientist

References

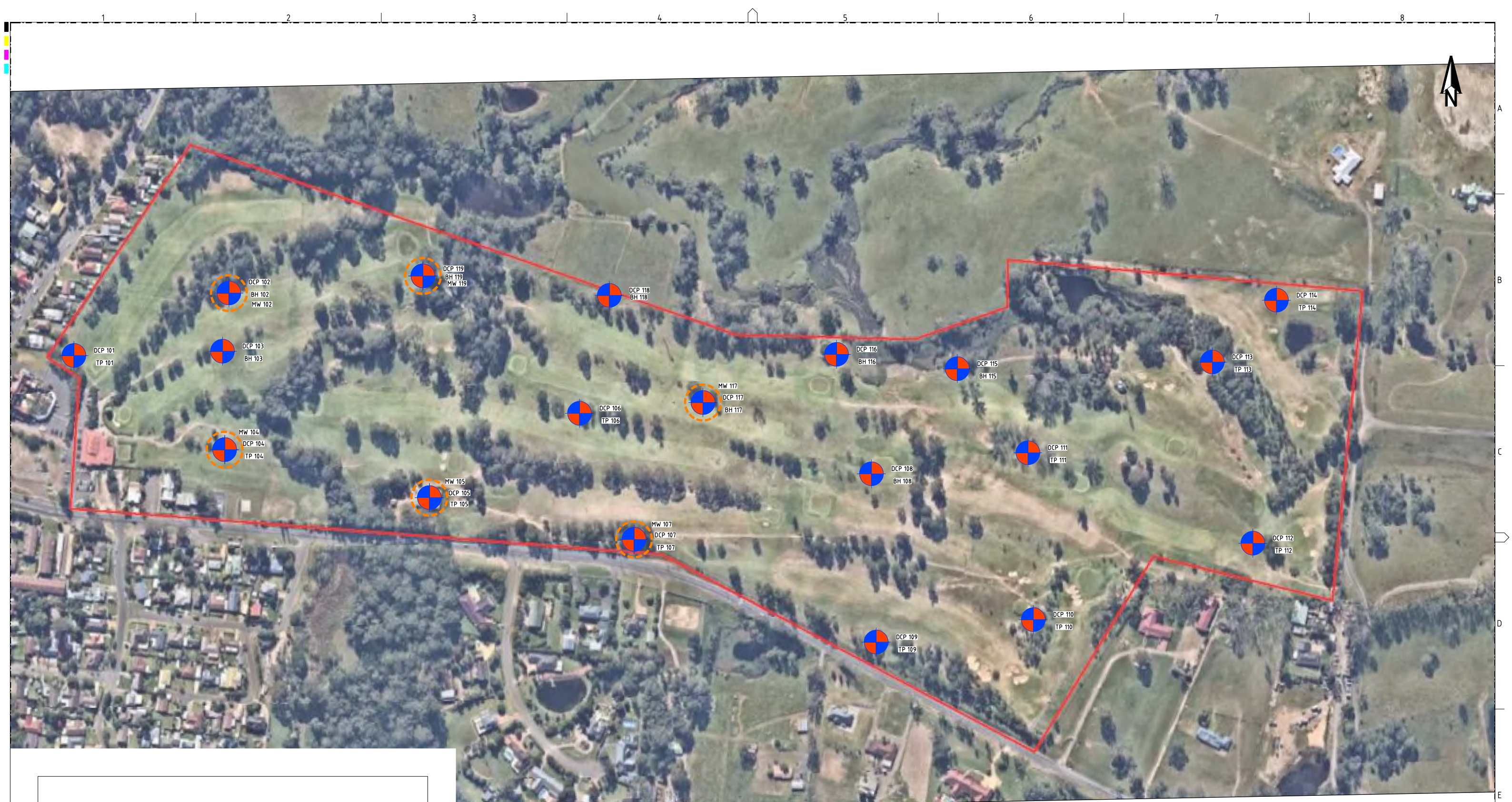
- Martens and Associates Pty Ltd (2017) – P1706171JR01V01, October 2017 – *Preliminary Geotechnical, Groundwater and Salinity Assessment: Proposed Wallacia Cemetery, Wallacia, NSW*
- Martens and Associates Pty Ltd (2018) – P1706171JC01V01, February 2018 – *WALLACIA MEMORIAL PARK – 13-15 PARK ROAD, WALLACIA, NSW: RESPONSE TO COUNCILS LETTER DATED 23 FEBRUARY 2018 (REF:DA17/1092 ECM:8063701)*

Attachments


Attachment A – Borehole/Monitoring Well Locations


Attachment B – Borehole/Monitoring Well Logs

Attachment A – Borehole/Groundwater Monitoring Well Locations



KEY:

GROUNDWATER MONITORING WELL 

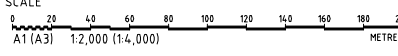
INDICATIVE BORE HOLE / DCP / TEST PIT LOCATION 

SOURCE:
DOUGLAS PARTNERS, PROJECT 76652.01 (JUNE 2017)

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
A	INITIAL RELEASE	25/10/2017	KW	OT	GT	

SCALE



0 20 40 60 80 100 120 140 160 180 200 METRES

A1 (A3) 1:2,000 (1:4,000)

GRID

DATUM

PROJECT MANAGER
GT

CLIENT
CATHOLIC METRO. CEMETERIES TR.

PROJECT NAME/PLANSET TITLE
PROPOSED CEMETERY
GEOTECHNICAL GROUNDWATER AND SALINITY MAPPING

WALLACIA GOLF COURSE, PARK ROAD,
WALLACIA, NSW

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DRAWING TITLE
GEOTECHNICAL SITE INVESTIGATION LOCATIONS
(AERIAL IMAGE)


PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1706171	PS01	R01	PS01-J100	A

Attachment B – Borehole/Groundwater Monitoring Well Logs

CLIENT	Catholic Metropolitan Cemeteries Trust	COMMENCED	22/09/2017	COMPLETED	22/09/2017	REF MW102	
PROJECT	Prelim. geotechnical, groundwater & salinity assessment	LOGGED	OT	CHECKED	RE	Sheet 1 OF 1	
SITE	Proposed Cemetery, Wallacia, NSW	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1706171	
EQUIPMENT	4WD ute-mounted hydraulic drill rig	EASTING		RL SURFACE	40 m	DATUM	AHD
EXCAVATION DIMENSIONS	Ø75 mm x 4.00 m depth	NORTHING		ASPECT	Northeast	SLOPE	10%

Drilling			Sampling		Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
				40.00			ML	TOPSOIL: SILT, low liquid limit, brown, with some clay, trace gravel.				TOPSOIL
				0.60								
				39.40			CH	Sandy CLAY, high plasticity, orange, brown.				RESIDUAL SOIL
	M		1	1.00			CH	CLAY, high plasticity, red, grey, with some sand, trace gravel.				
				39.00								
			2	2.00				From 2.0 m: More grey.				
				38.00						M		
			3									
	H											
			4	4.00				Hole Terminated at 4.00 m (Target depth reached)				
			5									

EXCAVATION LOG TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS


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MARTENS 2.00 LIB.GLB Log MARTENS BOREHOLE P1706171/BH102/BH103/BH108/BH110/BH115/BH116/BH117/BH118/BH119/TP101/TP105/TP105/TP107/TP109/TP111/TP113/V01.GPJ <<Drawingfile>> 24/10/2017 14:15 8.30.04 Diagam Lab and in Situ Tool - DGD | Lib: Martens 2.00 2016-11-19 Ppt: Martens 2.00 2016-11-13

CLIENT	Catholic Metropolitan Cemeteries Trust	COMMENCED	22/09/2017	COMPLETED	22/09/2017	REF MW104	
PROJECT	Prelim. geotechnical, groundwater & salinity assessment	LOGGED	OT	CHECKED	RE	Sheet 1 OF 1	
SITE	Proposed Cemetery, Wallacia, NSW	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1706171	
EQUIPMENT	4WD ute-mounted hydraulic drill rig	EASTING		RL SURFACE	45 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø75 mm x 4.00 m depth	NORTHING		ASPECT	North	SLOPE	5%

Drilling			Sampling			Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
L			45.00					ML	TOPSOIL: SILT, low liquid limit, dark brown, with some clay.	D	St		TOPSOIL
			0.20										
M			44.80					CH	Sandy CLAY, high plasticity, red brown, with some gravel.				RESIDUAL SOIL
ADV			1								VSt and H		
H			2	2.00					From 2.0 m: Red and grey.	M			
				43.00									
			3								H		
			4	4.00					Hole Terminated at 4.00 m (Target depth reached)				
			5										

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MARTENS 2.00 LIB.GLB Log MARTENS BOREHOLE P1706171BH102-BH103-BH108-BH110-BH115-BH116-BH117-BH118-BH119-TP101-TP105-TP106-TP107-TP109-TP111-TP113-V01.GPJ <<DrawingFile>> 24/10/2017 14:49 8:30:04 D:\g\Lab and In Situ Tool - DGD [Lib. Martens 2.00 2016-11-13 Pj] Martens 2.00 2016-11-13

CLIENT	Catholic Metropolitan Cemeteries Trust	COMMENCED	22/09/2017	COMPLETED	22/09/2017	REF MW105	
PROJECT	Prelim. geotechnical, groundwater & salinity assessment	LOGGED	OT	CHECKED	RE	Sheet 1 OF 1	
SITE	Proposed Cemetery, Wallacia, NSW	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1706171	
EQUIPMENT	4WD ute-mounted hydraulic drill rig	EASTING		RL SURFACE	45 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø75 mm x 3.00 m depth	NORTHING		ASPECT	North	SLOPE	5%

Drilling				Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	SAMPLE OR FIELD TEST	RECOVERED	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			45.00							
	M		1.00			ML	FILL: SILT, with fine sand, light brown, concrete rubble (<20mm).	D		FILL
		Not Encountered	44.00			CH	CLAY, high plasticity, red brown, trace silt.		H	RESIDUAL SOIL
	H		3.00				Hole Terminated at 3.00 m (Target depth reached)	M		
			4							
			5							

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MARTENS 2.00 LIB.GLE LOG MARTENS BOREHOLE P170617/BH102/BH103, BH108, BH110, BH115, BH116, BH117, BH118, BH119, TP100, TP105, TP106, TP107, TP109, TP111, TP113, V01, GP1 <<Drawingfile>> 24/10/2017 14:16 8:30:04 D:\pel Lab and in Situ\Tool - DGD [Lib: Martens 2.00 2016-11-19 Pdf: Martens 2.00 2016-11-19]

CLIENT	Catholic Metropolitan Cemeteries Trust	COMMENCED	22/09/2017	COMPLETED	22/09/2017	REF MW107	
PROJECT	Prelim. geotechnical, groundwater & salinity assessment	LOGGED	OT	CHECKED	RE	Sheet 1 OF 1	
SITE	Proposed Cemetery, Wallacia, NSW	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1706171	
EQUIPMENT	4WD ute-mounted hydraulic drill rig	EASTING		RL SURFACE	53 m	DATUM	AHD
EXCAVATION DIMENSIONS	ø75 mm x 3.00 m depth	NORTHING		ASPECT	North	SLOPE	5%

Drilling			Sampling		Field Material Description								
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADV	M	Not Encountered	53.00					ML	TOPSOIL: SILT, low liquid limit, brown.				TOPSOIL
			0.20					CH	CLAY, high plasticity, red with grey mottled, with some gravel.				RESIDUAL SOIL
			52.80										
			1	1.00					Grey and red.				
				52.00									
			2										
			3	3.00									
			4						Hole Terminated at 3.00 m (Target depth reached)				
			5										

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MARTENS 2.00 LIB.GLE LOG MARTENS BOREHOLE P170617/BH102-BH103, BH108, BH110, BH115, BH116, BH117, BH118, BH119, TP100, TP105, TP106, TP107, TP109, TP111, TP113, V01, GP1 <<DrawingFile>> 24/10/2017 14:16 8:30:04 D:\pel Lab and in Situ\Tool - DGD [Lib: Martens 2.00 2016-11-19 P1: Martens 2.00 2016-11-19 P1: Martens 2.00 2016-11-13

CLIENT	Catholic Metropolitan Cemeteries Trust	COMMENCED	22/09/2017	COMPLETED	18/09/2017	REF MW117	
PROJECT	Prelim. geotechnical, groundwater & salinity assessment	LOGGED	OT	CHECKED	RE	Sheet 1 OF 1	
SITE	Proposed Cemetery, Wallacia, NSW	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1706171	
EQUIPMENT	4WD ute-mounted hydraulic drill rig	EASTING		RL SURFACE	49 m	DATUM	AHD
EXCAVATION DIMENSIONS	Ø75 mm x 3.00 m depth	NORTHING		ASPECT	North	SLOPE	15%

Drilling			Sampling		Field Material Description								
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	L		49.00					MH	TOPSOIL: Clayey SILT, high liquid limit, dark brown, trace gravel.	D			TOPSOIL
			0.20				CH	CLAY, high plasticity, grey, red, trace gravel.	F				RESIDUAL SOIL
			48.80										
M			1	1.00				From 1.00 m: More grey.					
			48.00										
H			2	2.30				From 2.30 m: Dark grey.					
			46.70										
AD/T			3	2.80				SHALE, dark grey, inferred low strength, distinctly weathered.					WEATHERED ROCK 2.80: V-bit refusal.
				3.00				Hole Terminated at 3.00 m (Target depth reached)					3.00: TC-bit refusal on inferred medium strength shale. Well and diver installed for groundwater monitoring.
			4										
			5										

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MARTENS 2.00 LUB GLE Log MARTENS BOREHOLE P170617/BH102/BH103/BH108/BH110/BH115/BH116/BH117/BH118/BH119/TP100/TP101/TP105/TP106/TP107/TP109/TP111/TP113/VP1 GPJ <<DrawingFile>> 24/10/2017 14:16 6.30.004 Dagele Lab and in Situ Tool - DGD | Lib: Martens 2.00 2016-11-19 Proj: Martens 2.00 2016-11-13

