AUSTRALIAN GEOTECHNICAL

GEOTECHNICAL & ENVIRONMENTAL SERVICES

ACID SULFATE SOIL ASSESSMENT

Prepared For: Rawson Homes Pty Ltd
Address: 42 Gondola Road, North Narrabeen, NSW, 2101
Job No: AG-432_1
Date: 04-04-19

Australian Geotechnical Pty Ltd
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1.0 INTRODUCTION AND PROPOSED SITE USE

Australian Geotechnical Pty Ltd have undertaken an Acid Sulfate Soils Assessment at the proposed residential development located at Lot 262 (42) Gondola Road, North Narrabeen, 2101. It is understood that the project will comprise of a new double storey, four (4) bedroom residential dwelling with associated garage.

Based on the drawings prepared by Rawson Homes Pty Ltd, c/o – Residential Engineering Pty Ltd (Reference: Job number A009002 dated 19-12-18, Drawing 03, issue B) we understand that approximately 350mm of site cut and 300mm of site filling is required to achieve subgrade levels for the new residential dwelling. The deepest point of excavation is anticipated to be reduced level 4.085m within the south western portion of the site.

2.0 OBJECTIVES AND SCOPE OF WORK

The objectives of the work are outlined below:

- Summarise the relevant environmental characteristics of the site that may impact Acid Sulfate Soils (ASS) and result in the release of acidity and the potential leaching and transport of contaminants;
- Outline potential environmental impacts associated with the proposed works;
- Summarise the presence or the absence Actual Acid Sulfate Soil (AASS) and Potential Acid Sulfate Soils (PASS).

The scope of work includes the following:

- Review of soils and geological maps;
- A Preliminary soil sampling and analysis program to investigate the presence and distribution of AASS and PASS within the site;
- Assessment of the results of the chemical analysis against the appropriate guidelines to assess if management is required so as to minimise potential environmental impacts caused by the disturbance of ASS; and
- Provide recommendations for the need to undertake an ASS assessment and ASS Management Plan.

3.0 SITE IDENTIFICATION

The subject site is known as Lot 262 (42) Gondola Road, North Narrabeen, 2101. The site is approximately rectangular in shape encompassing an area of 575m^2. The site is bound by low density residential dwellings to the north, south-east and north-west with Gondola Road situated to the south-west of the subject site.

4.0 SOIL & HYDROGEOLOGY

4.1 Soil Profile

A total of four (4) boreholes were augered in accordance with the NSW Acid Sulfate Assessment Guidelines close to the building envelope of the proposed development. The sub-surface soil profile for each borehole has been summarised in Appendix A. (Refer to Appendix A for bore logs) However, a general interpretation of the sub-surface soil profile based on the information obtained is summarised as follows:

- (0.0 – 0.3m): Fill– Grass cover underlain by Silty Sand, Dark Grey grading pale Grey and Brown, Humid, appears loose.

- (0.3 – 1.4m): Natural – Sand trace of Silt, brown/pale brown, moist becoming slightly wet in parts.

Groundwater was not encountered during augering of boreholes, however, no long term monitoring was carried out as part of our assessment. A search of the NSW Department of Primary Industries Office of Water registered groundwater bores was undertaken by AG, with a search radius of 500m around the site. Seven (7) registered groundwater bores, used for domestic and monitoring purposes were identified within the search radius. The groundwater bores indicated a standing water level of between 1.0m and 2.0m below existing surface level. Groundwater bore summary reports are provided in Appendix A.

4.2 Geology

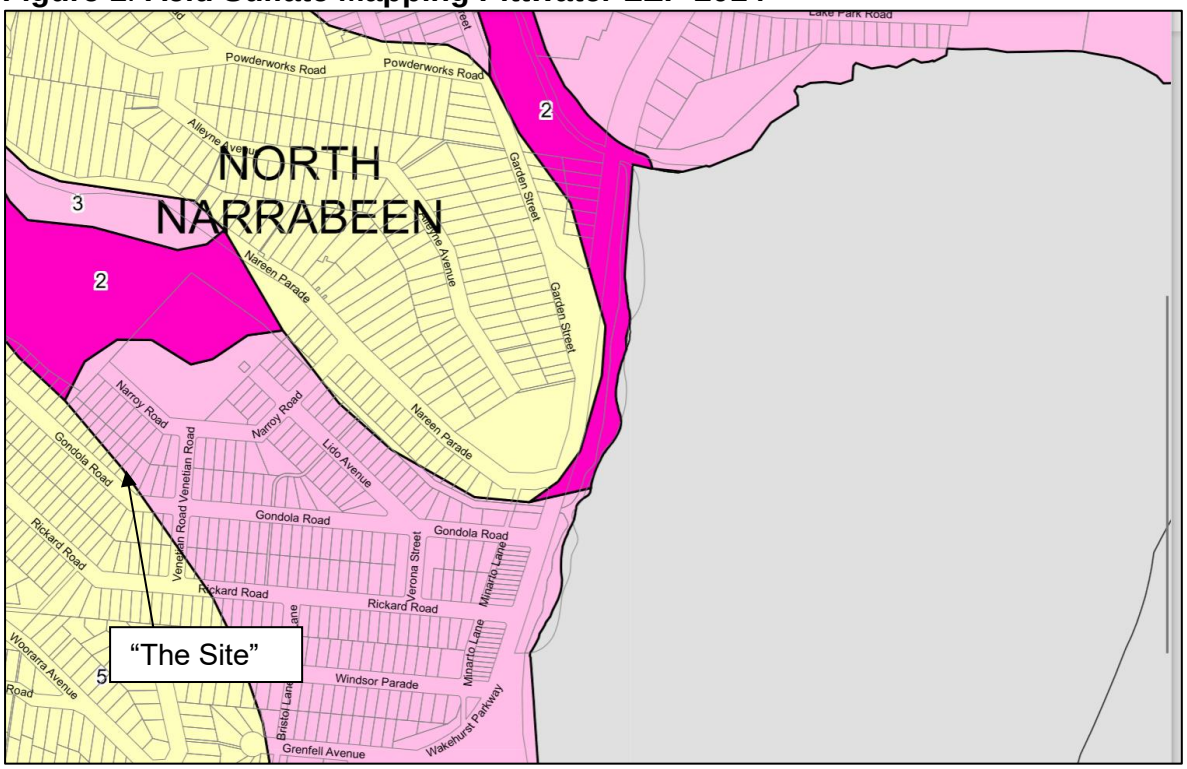
The Soil Landscape Map of Sydney (Soil Landscape Series Sheet 9130wa and 9130bt, Scale 1:100,000, 2002), prepared by the Soil Conservation Service of NSW, indicates that the site is located at the border the Warriewood and WataganLandscapes, described as including *Holocene silty to peaty quartz sand. Medium to fine marine sand with podzols and the Narrabeen Group of sediments. Mostly interbedded laminite and shale with quartz to lithic quartz sandstone. Minor red claystones occur north of the Hawkesbury River. Clay pellet sandstone occurs south of the Hawkesbury River (Herbert, 1983).*

4.3 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring and usually form in low lying coastal areas, creeks, rivers and flood plains. The sulphates present in the soil are stable when in the saturated/waterlogged state, but react to form sulphuric acid when disturbed and exposed to oxygen.

The Acid Sulfate Soil Maps published by Pittwater Local Environmental Plan 2014 has indicated that the site is located at the border a Class 5 and Class 3 risk zone. Class 3 acid sulfate risk areas affect works more than 1 metre below the natural ground surface and works by which the watertable is likely to be lowered more than 1 metre below the natural ground surface. Refer to figure 1 below.

Figure 1: **Acid Sulfate Mapping Pittwater LEP 2014**



It should be noted that land management is generally affected by acid sulfate materials, however, highly localised occurrences may be found, especially near boundaries with a highly probable occurrence. Disturbance of these soil materials will result in an environment risk that will vary with elevation and depth of disturbance. Any works below natural ground surface or affecting the water table has a risk of being contaminated with acid sulfate soils or is potential acid sulfate soils.

5.0 SAMPLING & ANALYSIS PLAN AND SAMPLING METHODOLOGY

Sampling and analysis was undertaken in order to assess the presence or absence, location and likely distribution of any AASS or PASS present at the subject site in the area of the proposed development.

5.1 Sampling

A soil sampling program was undertaken in accordance with the Acid Sulfate Soil Assessment Guidelines. Four (4) boreholes were augered across the site in the area of the proposed residential dwelling as part of the sampling program (Refer to figure 2 – for the borehole locations).

Boreholes were terminated at a depth of between 1.4m below existing surface level (greater than 1 metre below final depth of the proposed excavation). Soil samples were recovered at every 0.5m down the soil profile in boreholes. A total of twelve (12) soil samples were collected in total.

Samples assigned for laboratory analysis were sampled directly into labelled clean zip lock bags and were placed on ice until delivery to the laboratory for testing. All analyses were performed by a NATA registered laboratory using NATA accredited test methods.

6.0 ACID SULFATE SOILS ASSESSMENT

6.1 Laboratory Test Results

Samples were screened at the laboratory analysis to assess for the possible presence of actual acid sulfate soil (AASS) or potential acid sulfate soil (PASS). These results were compared against the NSW Acid Sulphate Soils Management Advisory Committee (ASSMAC) Acid Sulphate Soils Assessment Guidelines (1998) guidance indicators, namely:

- $pH_f \leq 4$ strongly indicates oxidation has occurred in the past and that AASS are likely to be present;

- $pH_{fox} < 3.5$ (but preferably $pH_f < 3$), plus preferably one or more of a pH_{fox} reading at least one pH unit below the corresponding pH_f, a strong reaction with peroxide, change in soil colour from grey tones to brown tones or release of sulphurous gases, strongly indicates the presence of PASS.

6.2 Results of pHf and pHfox Testing

Results will provide guidance to identification of potential PASS/ASS issues. Refer to table 1 below for test results.

Table 1: **Summary of Test Results**

Sample (m)	pH_f	pH_{fox}	Difference
BH1-0.0	6.6	4.5	2.1
BH1-0.5	6.5	4.6	1.9
BH1-1.0	6.3	4.9	1.4
BH2-0.0	6.6	4.4	2.2
BH2-0.5	6.5	4.7	1.8
BH2-1.0	6.3	5.1	1.2
BH3-0.0	6.5	4.7	1.8
BH3-0.5	5.5	3.5	2.0
BH3-1.0	5.0	3.0	2.0
BH4-0.0	7.4	5.4	2.0
BH4-0.5	7.2	5.8	1.4
BH4-1.0	7.0	5.3	1.7
Guidelines	**<4**	**<3.5**	**Greater than 1**

Notes: The values that exceed the action criteria are highlighted bold.
pH_f = non-oxidised pH.
pH_{fox} = oxidised pH.

6.3 Discussion of pHf and pHfox test results

All of the samples collected are within the guideline values for material of coarse and medium texture with the absence of grey to brown tones or release of sulphurous gases with the exception of BH2-0.0m and BH3-0.5m which achieved a drop of 2.2 and 2.0 to a final pH 4.4 and pH 3.0 respectively with a slight reaction to peroxide recorded.

On the basis of the pH testing, selected ‘worst case’ samples were submitted to SGS for SPOCAS (Peroxide Oxidation Combined Acidity and Sulphate) testing. The results of analysis are summarised in Table 3 and compared with action criteria specified in ASSMAC Acid Sulphate Soils Assessment Guidelines (1998). Guidelines values extracted from the NSW ASSMAC guidelines are provided in table 2 below.

Two samples were selected and analysed for SPOCAS to confirm the presence or absence of ASS or PASS in the soil. The samples were dispatched to SGS Environmental services for the quantitative analysis for Suspension Peroxide Oxidation Combined Acidity & Sulphate (SPOCAS).

6.4 Assessment Criteria for Acid Sulfate Soils (Laboratory)

The results of analysis for the soils are compared to the below ASSMAC assessment criteria. It is assumed that <1000 tonnes of material would be disturbed hence the action criteria for less than 1000 tonnes have been applied.

Table 2: **ASSMAC Action Criteria**

Type of Material Texture	Approx Clay Content (% <0.002mm)	Action Criteria <1000 tonnes Sulfur Trail Spos%	Action Criteria <1000 tonnes Acid Trail TPA mole H+/t
Coarse e.g. sands	> 5	0.03	18
Sandy loams/light clays	5 – 40	0.06	36
Fine clays/silts	> 40	0.1	62

6.5 SPOCAS Test Result

Table 3: **SPOCAS Test Results**

Sample	pH_{ox}	pH_{fox}	TPA/TSA/TAA pH 6.5 moles H+/tonne	Spos/S_{KCL}/S_P %w/w
BH2-0.0**	6.6	4.4	<5	0.043
BH3-0.5*	5.0	3.0	<5	<0.005

Note: The values that exceed the action criteria are highlighted bold.

6.6 Discussion of Results of SPOCAS tests

There is no specific method to interpret the results of the SPOCAS test results. However results from SPOCAS testing will provide guidance to identification of potential ASS or PASS issues. Results in table 3 above indicates that the site is not affected by acid sulfate soils at the proposed excavation depth.

Notes:

TAA	Total Actual Acidity
TPA	Total Potential Acidity
TSA	Total Sulphidic Acidity (TPA-TAA)
SKCl	KCl extractable sulphur
SP	peroxide oxidation sulphur
SPOS	Peroxide oxidisable sulphur
*	ASSMAC Action Criteria for disturbance of 1 – 1000 tonnes of coarse textured material i.e. sands to loamy sands
**	ASSMAC Action Criteria for disturbance of 1 – 1000 tonnes of medium textured material i.e. sandy loams to light clay
^ pHf	non-oxidised pH
pHfox	oxidised pH

7.0 CONCLUSIONS AND RECOMMENDATIONS

Australian Geotechnical Pty Ltd has undertaken a Acid Sulfate Soils Assessment for the proposed residential development as requested by Rawson Homes Pty Ltd. Our site investigation included on site observation of the soil retrieved from the borehole sites and sampling of soil for field and laboratory testing. Upon completion of our investigation and laboratory analysis the following conclusions/discussions are made:

- From the above findings, it can be stated that potential or actual Acid Sulfate Soil is not present below surface level at the proposed excavation depth (approximate reduced level 4.085m) therefore an Acid Sulfate Management Plan is not required for the site based on the current scope of work/depth of excavation.

This report is based on a limited sampling and testing regime. It is possible that ASS/PASS soils and differing ground conditions may be present between sampling locations, or in the remainder of the site not intrusively investigated.

Should you have any queries, please do not hesitate to contact the undersigned.

For and on behalf of
Australian Geotechnical Pty Ltd

N. Smith
Principal

A. Smith
Environmental Consultant
B.Sc

8.0 REFERENCES

- Stone, Y, and Hopkins G (1998). Acid Sulfate Soils Planning Guidelines. Published by the Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia;

- Ahern C R, Stone, Y, and Blunden B (1998). *Acid Sulfate Soils Assessment Guidelines* Published by the Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia;

- Google Earth Viewer;

- NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au; and

- Geological Series Sheet Map of the Sydney region, scale 1:100,000.

9.0 LIMITATIONS

This document was prepared by Australian Geotechnical Pty Ltd (AG) for the sole use of Provincial Homes Pty Ltd, the only intended beneficiary of our work. Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current to the date of this document. Any other party should satisfy themselves that the scope of work conducted and reported herein meets their specific needs before relying on this document. AG cannot be held liable for any third party reliance on this document, as AG is not aware of the specific needs of the third party. No other party should rely on the document without the prior written consent of AG, and AG undertakes no duty to, nor accepts any responsibility to, any third party who may rely upon this document.

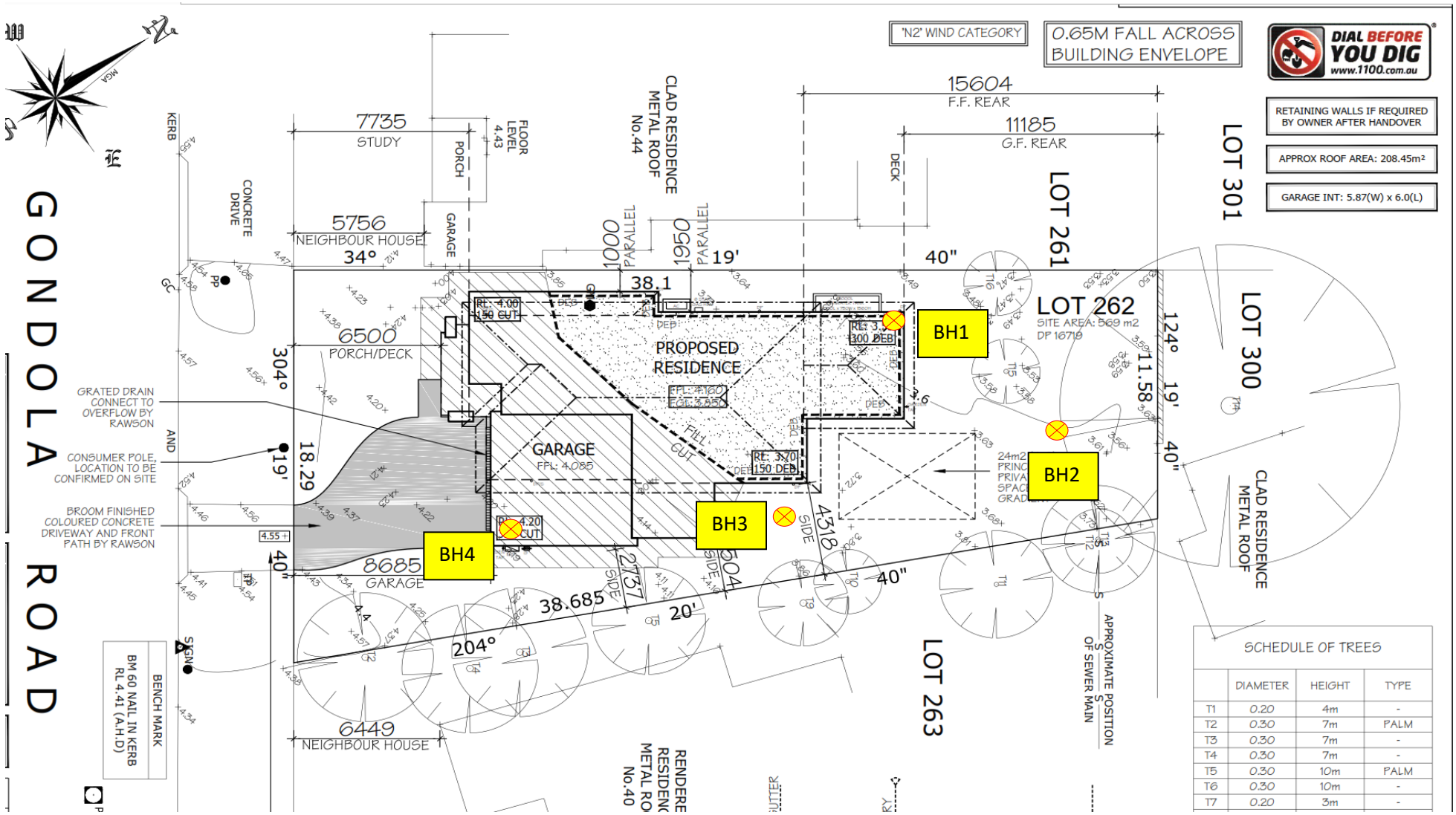
This document was prepared for the specific purpose described in the our fee proposal for the project. From a technical perspective, the subsurface environment at any site may present substantial uncertainty. It is a heterogeneous, complex environment, in which small subsurface features or changes in geologic conditions can have substantial impacts on water and chemical movement. Uncertainties may also affect source characterisation assessment of chemical fate and transport in the environment, assessment of exposure risks and health effects, and remedial action performance.

AG's professional opinions are based upon its professional judgement, experience, and training. These opinions are also based upon data derived from the testing and analysis described in this document. It is possible that additional testing and analysis might produce different results and/or different opinions. AG has limited its investigation to the scope agreed upon with its client. AG believes that its opinions are reasonably supported by the testing and analysis that have been done, and that those opinions have been developed according to the professional standard of care for the environmental consulting profession in this area at the date of this document. That standard of care may change and new methods and practices of exploration, testing, analysis and remediation may develop in the future, which might produce different results. AG's professional opinions contained in this document are subject to modification if additional information is obtained, through further investigation, observations, or validation testing and analysis during remedial activities.

Figures

Figure 2 – Site Location and Borelog Location Plan

Drawing Source: Job number Job number A009002 dated 19-12-18, Drawing 03, issue B prepared by Rawson Homes Pty Ltd



AUSTRALIAN GEOTECHNICAL	Approximate Borehole Locations	**Rawson Homes Pty Ltd** Lot 262 (42) Gondola Road, North Narrabeen, 2101		Job No	AG-432_1
				Drawing No	AG-432-1DWG
		Drawn By	NS	Ref No	
		Approved By	NS	Scale	Not to scale

Appendices

Appendix A – Borelogs and Supporting Information

AUSTRALIAN GEOTECHNICAL

SITE LOCATION: Lot 262 (42) Gondola Road, North Narrabeen, 2101

Borehole No 1

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	Sample	Odours	REMARKS
NIL		SM	Sandy Silt, fine to medium grain sand dark grey, low plasticity, dry, grass rootlets		NIL	Fill
	0.5	SM	Sand trace of Silt, grey, high plasticity fine to medium grained sand, humid wet in part			Natural
	1					
			End Bore 1.2m			
	1.5					
	2					
	2.5					
	3					
	3.5					

Method: *Hand Auger*
Date : *22/03/2019*
Logged By: *NS*

AUSTRALIAN GEOTECHNICAL

SITE LOCATION: Lot 262 (42) Gondola Road, North Narrabeen, 2101

Borehole No 2

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	Sample	Odours	REMARKS
NIL		SM	Sandy Silt, fine to medium grain sand dark grey, low plasticity, dry, grass rootlets		NIL	Fill
	0.5	SM	Sand trace of Silt, grey, high plasticity fine to medium grained sand, humid wet in part grades dark grey			Natural
	1					
	1.5		End Bore 1.4m			
	2					
	2.5					
	3					
	3.5					

Method: *Hand Auger*
Date : *22/03/2019*
Logged By: *NS*

AUSTRALIAN GEOTECHNICAL

SITE LOCATION: Lot 262 (42) Gondola Road, North Narrabeen, 2101

Borehole No 3

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (*SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY*)	Sample	Odours	REMARKS
NIL		SM	Sandy Silt, fine to medium grain sand dark grey, low plasticity, dry, grass rootlets		NIL	Fill
	0.5	SM	Sand trace of Silt, grey, high plasticity fine to medium grained sand, humid wet in part			Natural
	1		grades dark grey			
	1.5		End Bore 1.4m			
	2					
	2.5					
	3					
	3.5					

Method: *Hand Auger*
Date : *22/03/2019*
Logged By: *NS*

AUSTRALIAN GEOTECHNICAL

SITE LOCATION: Lot 262 (42) Gondola Road, North Narrabeen, 2101

Borehole No 4

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	Sample	Odours	REMARKS
NIL		SM	Sandy Silt, fine to medium grain sand dark grey, low plasticity, dry, grass rootlets		NIL	Fill
	0.5	SM	Sand trace of Silt, grey, high plasticity fine to medium grained sand, humid wet in part			Natural
			grades dark grey			
	1		grades pale grey			
	1.5		End Bore 1.4m			
	2					
	2.5					
	3					
	3.5					

Method: *Trailer mounted solid flight auger drilling rig*
Date : *22/03/2019*
Logged By: *NS*

WaterNSW
Work Summary

GW109109

Licence:		**Licence Status:**	
		Authorised Purpose (s):	
		Intended Purpose(s):	DOMESTIC
Work Type:	Spear		
Work Status:			
Construct.Method:			
Owner Type:	Private		
Commenced Date:		**Final Depth:**	6.00 m
Completion Date:	23/07/2008	**Drilled Depth:**	
Contractor Name:	(None)		
Driller:	Michael Peter Sprouster		
Assistant Driller:			
Property:		**Standing Water Level (m):**	1.000
GWMA:		**Salinity Description:**	
GW Zone:		**Yield (L/s):**	0.900

Site Details

Site Chosen By:

		County	**Parish**	**Cadastre**
		Form A:		
		Licensed:	CUMBERLAND	NARRABEEN	291//16719
Region:	10 - Sydney South Coast	**CMA Map:**		
River Basin:	- Unknown	**Grid Zone:**		**Scale:**
Area/District:				
Elevation:	0.00 m (A.H.D.)	**Northing:**	6269051.000	**Latitude:**	33°42'24.3"S
Elevation Source:	Unknown	**Easting:**	341810.000	**Longitude:**	151°17'34.7"E
GS Map:	-	**MGA Zone:**	56	**Coordinate Source:**	Unknown

***** End of GW109109 *****

WaterNSW
Work Summary

GW109675

Licence:		**Licence Status:**	
		Authorised Purpose(s):	
		Intended Purpose(s):	DOMESTIC
Work Type:	Bore		
Work Status:			
Construct.Method:			
Owner Type:	Private		
Commenced Date:		**Final Depth:**	4.00 m
Completion Date:	01/01/2005	**Drilled Depth:**	
Contractor Name:	SELF DRILLED		
Driller:	Unkown Unknown		
Assistant Driller:			
Property:		**Standing Water Level (m):**	1.500
GWMA:		**Salinity Description:**	
GW Zone:		**Yield (L/s):**	

Site Details

Site Chosen By:

	County	**Parish**	**Cadastre**
Form A:			
Licensed:	CUMBERLAND	NARRABEEN	27//16212

Region:	10 - Sydney South Coast	**CMA Map:**			
River Basin:	- Unknown	**Grid Zone:**		**Scale:**	
Area/District:					
Elevation:	0.00 m (A.H.D.)	**Northing:**	6268835.000	**Latitude:**	33°42'31.3"S
Elevation Source:	Unknown	**Easting:**	341784.000	**Longitude:**	151°17'33.5"E
GS Map:	-	**MGA Zone:**	56	**Coordinate Source:**	Unknown

Remarks

18/12/2008: Yield: Intermittently, 4 litres/minute.
Casing: PVC 100mm.

***** End of GW109675 *****

WaterNSW
Work Summary

GW111041

Licence: | **Licence Status:**

Authorised Purpose (s):
Intended Purpose(s): MONITORING BORE

Work Type: Well
Work Status:
Construct.Method: Auger - Hollow Flight
Owner Type: Private

Commenced Date: | **Final Depth:** 5.00 m
Completion Date: 11/05/2010 | **Drilled Depth:** 5.00 m

Contractor Name: Numac Drilling Services Pty Ltd
Driller: Stewart Michael
Assistant Driller:

Property: | **Standing Water Level (m):** 2.000
GWMA: | **Salinity Description:**
GW Zone: | **Yield (L/s):**

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:			
Licensed:	CUMBERLAND	NARRABEEN	1//838462

Region: 10 - Sydney South Coast | **CMA Map:**
River Basin: - Unknown | **Grid Zone:** | **Scale:**
Area/District:

Elevation: 0.00 m (A.H.D.) | **Northing:** 6268965.000 | **Latitude:** 33°42'27.2"S
Elevation Source: Unknown | **Easting:** 342110.000 | **Longitude:** 151°17'46.3"E

GS Map: - | **MGA Zone:** 56 | **Coordinate Source:** Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.00	200			Auger - Hollow Flight
1		Annulus	Waterworn/Rounded	1.50	5.00				Graded
1	1	Casing	Pvc Class 18	0.00	2.00	60	50		Seated on Bottom, Other
1	1	Opening	Slots - Horizontal	2.00	5.00	60		0	Casing - Machine Slotted, PVC Class 18, Other, SL: 40.0mm, A: 3.80mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
4.00	5.00	1.00	Unknown	2.00					

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	FILL	Fill	
1.00	3.00	2.00	SAND DARK BROWN,MOIST	Sand Grains (Lithic)	
3.00	5.00	2.00	SAND SATURATED,DARK BROWN	Sand Grains (Lithic)	

***** End of GW111041 *****

WaterNSW
Work Summary

GW111043

Licence: | **Licence Status:**

Authorised Purpose (s):
Intended Purpose(s): MONITORING BORE

Work Type: Well
Work Status:
Construct.Method: Auger - Hollow Flight
Owner Type: Private

Commenced Date: | **Final Depth:** 5.00 m
Completion Date: 11/05/2010 | **Drilled Depth:** 5.00 m

Contractor Name: (None)
Driller: Stewart Michael
Assistant Driller:

Property: | **Standing Water Level (m):** 2.000
GWMA: | **Salinity Description:**
GW Zone: | **Yield (L/s):**

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:			
Licensed:	CUMBERLAND	NARRABEEN	1//838462

Region: 10 - Sydney South Coast | **CMA Map:**
River Basin: - Unknown | **Grid Zone:** | **Scale:**
Area/District:

Elevation: 0.00 m (A.H.D.) | **Northing:** 6268954.000 | **Latitude:** 33°42'27.6"S
Elevation Source: Unknown | **Easting:** 342119.000 | **Longitude:** 151°17'46.6"E

GS Map: - | **MGA Zone:** 56 | **Coordinate Source:** Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.00	200			Auger - Hollow Flight
1		Annulus	Waterworn/Rounded	2.00	5.10				Graded
1	1	Casing	Pvc Class 18	0.00	2.60	60	50		Seated on Bottom, Other
1	1	Opening	Slots - Horizontal	2.60	5.10	60		0	Casing - Machine Slotted, PVC Class 18, Other, SL: 40.0mm, A: 3.80mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)		Duration (hr)	Salinity (mg/L)

							Hole Depth (m)		
3.00	5.00	2.00	Unknown	2.00					

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	FILL	Fill	
1.00	3.00	2.00	SAND, DARK BROWN,MOIST	Sand	
3.00	5.00	2.00	SAND SATURATED,DARK BROWN	Sand Grains (Lithic)	

***** End of GW111043 *****

WaterNSW
Work Summary

GW114585

Licence:
Licence Status:
Authorised Purpose (s):
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method: Auger - Solid Flight
Owner Type: Private

Commenced Date:
Completion Date: 04/04/2011
Final Depth: 4.00 m
Drilled Depth: 4.00 m

Contractor Name: Numac
Driller: Unkown Unknown
Assistant Driller:

Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:			
Licensed:	CUMBERLAND	NARRABEEN	1//838462

Region: 10 - Sydney South Coast
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6268983.000
Easting: 342122.000
Latitude: 33°42'26.7"S
Longitude: 151°17'46.7"E

GS Map: -
MGA Zone: 56
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	4.00	0			Auger - Solid Flight
1	1	Casing		0.00	1.50				

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.25	0.25	CONCRETE	Fill	
0.25	0.50	0.25	SAND,MINOR GRAVEL	Sand	
0.50	1.00	0.50	SAND M/GRAINED,LOOSE,MOIST,DARK BROWN	Sand	

1.00	3.00	2.00	SAND,M/GRAINED,LOOSE,MOIST TO WET	Sand	
3.00	4.00	1.00	SAND,M/GRAINED LOOSE SATURATED BROWN BLACK	Sand	

***** End of GW114585 *****

Appendix B – Laboratory Test Results

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Nathan Smith
Client	AUSTRALIAN GEOTECHNICAL PTY LTD
Address	2 SHIRLEY STREET ROSEHILL NSW 2144
Telephone	(Not specified)
Facsimile	(Not specified)
Email	nathan@austgeo.com.au
Project	**AG432**
Order Number	**AG432_1**
Samples	12

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE190709 R0**
Date Received	22/3/2019
Date Reported	27/3/2019

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Dong Liang
Metals/Inorganics Team Leader

Field pH for Acid Sulphate Soil [AN104] Tested: 25/3/2019

PARAMETER	UOM	LOR	Surface 0.1m - BH1 SOIL - 22/3/2019 SE190709.001	0.5m - BH1 SOIL - 22/3/2019 SE190709.002	1.0m - BH1 SOIL - 22/3/2019 SE190709.003	Surface 0.1m - BH2 SOIL - 22/3/2019 SE190709.004	0.5m - BH2 SOIL - 22/3/2019 SE190709.005
pHf	pH Units	-	6.6	6.5	6.3	6.6	6.5
pHfox	pH Units	-	4.5	4.6	4.9	4.4	4.7
Reaction*	No unit	-	x	x	x	x	x
pH Difference*	pH Units	-10	2.1	1.9	1.4	2.1	1.7

PARAMETER	UOM	LOR	1.0m - BH2 SOIL - 22/3/2019 SE190709.006	Surface 0.1m - BH3 SOIL - 22/3/2019 SE190709.007	0.5m - BH3 SOIL - 22/3/2019 SE190709.008	1.0m - BH3 SOIL - 22/3/2019 SE190709.009	Surface 0.1m - BH14 SOIL - 22/3/2019 SE190709.010
pHf	pH Units	-	6.3	6.5	5.5	5.0	7.4
pHfox	pH Units	-	5.1	4.7	3.5	3.0	5.4
Reaction*	No unit	-	x	x	x	x	x
pH Difference*	pH Units	-10	1.2	1.9	2.0	2.0	2.0

PARAMETER	UOM	LOR	0.5m - BH4 SOIL - 22/3/2019 SE190709.011	1.0m - BH4 SOIL - 22/3/2019 SE190709.012
pHf	pH Units	-	7.2	7.0
pHfox	pH Units	-	5.8	5.3
Reaction*	No unit	-	x	x
pH Difference*	pH Units	-10	1.4	1.6

METHOD	METHODOLOGY SUMMARY
AN104	pHF is determined on an extract of approximately 2g of as received sample in approximately 10 mL of deionised water with pH determined after standing 30 minutes.
AN104	pHFox is determined on an extract of approximately 2g of as received sample with a few mLs of 30% hydrogen peroxide (adjusted to pH 4.5 to 5.5) with the extract reaction being rated from slight to extreme, with pH determined after reaction is complete and extract has cooled. Referenced to ASS Laboratory Methods Guidelines , method 23Af-Bf, 2004. X Slight Reaction XX Moderate Reaction XXX Strong/High Reaction XXXX Extreme/Vigorous Reaction (gas evolution and heat generation)

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been perfomed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/ Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

STATEMENT OF QA/QC PERFORMANCE

SE190709 R0

CLIENT DETAILS

Contact	Nathan Smith
Client	AUSTRALIAN GEOTECHNICAL PTY LTD
Address	2 SHIRLEY STREET ROSEHILL NSW 2144
Telephone	(Not specified)
Facsimile	(Not specified)
Email	nathan@austgeo.com.au
Project	**AG432**
Order Number	**AG432_1**
Samples	12

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE190709 R0**
Date Received	22 Mar 2019
Date Reported	27 Mar 2019

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

HOLDING TIME SUMMARY

SE190709 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS “Field Sampling Guide for Containers and Holding Time” (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Field pH for Acid Sulphate Soil — **Method: ME-(AU)-[ENV]AN104**

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
Surface 0.1m - BH1	SE190709.001	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
0.5m - BH1	SE190709.002	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
1.0m - BH1	SE190709.003	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
Surface 0.1m - BH2	SE190709.004	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
0.5m - BH2	SE190709.005	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
1.0m - BH2	SE190709.006	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
Surface 0.1m - BH3	SE190709.007	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
0.5m - BH3	SE190709.008	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
1.0m - BH3	SE190709.009	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
Surface 0.1m - BH14	SE190709.010	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
0.5m - BH4	SE190709.011	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019
1.0m - BH4	SE190709.012	LB169911	22 Mar 2019	22 Mar 2019	19 Apr 2019	25 Mar 2019	19 Apr 2019	26 Mar 2019

SURROGATES

SE190709 R0

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

No method blanks were required for this job.

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Field pH for Acid Sulphate Soil — **Method: ME-(AU)-[ENV]AN104**

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE190709.006	LB169911.013	pHf	pH Units	-	6.3	6.3	30	0
		pHfox	pH Units	-	5.1	5.0	30	2
SE190709.012	LB169911.020	pHf	pH Units	-	7.0	6.9	30	0
		pHfox	pH Units	-	5.3	5.2	30	2

LABORATORY CONTROL SAMPLES

SE190709 R0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Sample Number	Parameter	Units	LOR

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to Analytical Report comments for further information.

SAMPLE RECEIPT ADVICE

SE190709A

CLIENT DETAILS

Contact	Nathan Smith
Client	AUSTRALIAN GEOTECHNICAL PTY LTD
Address	2 SHIRLEY STREET ROSEHILL NSW 2144
Telephone	(Not specified)
Facsimile	(Not specified)
Email	nathan@austgeo.com.au
Project	**AG432 Additional**
Order Number	**AG432_1**
Samples	12

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Thu 28/3/2019
Report Due	Tue 2/4/2019
SGS Reference	**SE190709A**

SUBMISSION DETAILS

This is to confirm that 12 samples were received on Thursday 28/3/2019. Results are expected to be ready by COB Tuesday 2/4/2019. Please quote SGS reference SE190709A when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	Client	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	2 Soil
Date documentation received	28/3/2019@9:06am	Type of documentation received	Email
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	N/A	Sample temperature upon receipt	7.4°C
Sufficient sample for analysis	Yes	Turnaround time requested	Three Days

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SPOCAS subcontracted to SGS Cairns, 2/58 Comport St, Portsmith QLD 4870, NATA Accreditation Number: 2562, Site Number: 3146.

SAMPLE RECEIPT ADVICE

SE190709A

CLIENT DETAILS

Client AUSTRALIAN GEOTECHNICAL PTY LTD

Project AG432 Additional

SUMMARY OF ANALYSIS

No.	Sample ID	Sample Subcontracted
004	Surface 0.1m - BH2	1
008	0.5m - BH3	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

E-MAILED
22/3/19 @ C-18

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Page ____ of ____

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name:	Australian Geotechnical	Project Name/No:	AG-432
Address:	2 Shirley Street, Rose Hill, NSW	Purchase Order No:	AG-432_1 quote MMG3TN
		Results Required By:	**3 day TAT**
		Telephone:	
Contact Name:	Nathan Smith	Facsimile:	
		Email Results:	info@austgeo.com.au

Client Sample ID	Date Sampled	Lab Sample ID	WATER	SOIL	PRESERVATIVE	NO OF CONTAINERS	pHf and pHfox
Surface – BH1	22-03-19	1		x		1	X
0.5m – BH1	22-03-19	2		X		1	X
1.0m – BH1	22-03-19	3		X		1	X
Surface – BH2	22-03-19	4		X		1	X
0.5m – BH2	22-03-19	5		x		1	X
E6 – BH2	22-03-19	6		x		1	x
Surface – BH3	22-03-19	7		X		1	X
0.5m – BH3	22-03-19	8		X		1	X
1.0m – BH3	22-03-19	9		X		1	X
Surface – BH4	22-03-19	10		X		1	X
0.5m – BH4	22-03-19	11		x		1	x

SGS EHS Alexandria Laboratory
SE190709 COC
Received: 22 – Mar – 2019

Relinquished By: NS	Date/Time: 22-03-19	Received By: Nessa	Date/Time 22/3/19 1:05
Relinquished By:	Date/Time:	Received By:	Date/Time
Samples Intact: Yes/ No	Temperature: Ambient / Chilled	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No:
	Comments:		

E-MAILED
22/3/19

CHAIN OF CUSTODY & ANALYSIS REQUEST

Page ____ of ____

SGS Environmental Services
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Company Name:	Australian Geotechnical	Project Name/No:	AG-432
Address:	2 Shirley Street, Rose Hill, NSW	Purchase Order No:	AG-432_1 quote MMG3TN
		Results Required By:	**3 day TAT**
		Telephone:	
Contact Name:	Nathan Smith	Facsimile:	
		Email Results:	info@austgeo.com.au

Client Sample ID	Date Sampled	Lab Sample ID	WATER	SOIL	PRESERVATIVE	NO OF CONTAINERS	pHf and pHfox
1.0m – BH4	22-03-19	12		x		1	X

Relinquished By: NS	Date/Time: 22-03-19	Received By: Nessa	Date/Time 22/3/19 1:05
Relinquished By:	Date/Time:	Received By:	Date/Time
Samples Intact: Yes/ No	Temperature: Ambient / Chilled	Sample Cooler Sealed: Yes/ No	Laboratory Quotation No:
	Comments:		

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Nathan Smith	Manager	Anthony Nilsson
Client	AUSTRALIAN GEOTECHNICAL PTY LTD	Laboratory	SGS Cairns Environmental
Address	2 SHIRLEY STREET ROSEHILL NSW 2144	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	02 8594 0400	Telephone	+61 07 4035 5111
Facsimile	02 8594 0499	Facsimile	+61 07 4035 5122
Email	AU.Environmental.Sydney@sgs.com	Email	AU.Environmental.Cairns@sgs.com
Project	**AG_432_1 Additional**	SGS Reference	**CE138998 R0**
Order Number	**SE190709A**	Date Received	29 Mar 2019
Samples	2	Date Reported	03 Apr 2019

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146).

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Parameter	Units	LOR	Sample Number: CE138998.001 Sample Matrix: Soil Sample Date: 22 Mar 2019 Sample Name: Surface 0.1m - BH2	Sample Number: CE138998.002 Sample Matrix: Soil Sample Date: 22 Mar 2019 Sample Name: 0.5m- BH3
Moisture Content Method: AN002 Tested: 1/4/2019				
% Moisture	%w/w	0.5	**14**	**6.4**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 3/4/2019				
pH KCl	pH Units	-	**6.2**	**5.8**
Titratable Actual Acidity	kg H2SO4/T	0.25	<0.25	<0.25
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	<5	<5
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	<0.01
Sulphur (SKCl)	%w/w	0.005	<0.005	<0.005
Calcium (CaKCl)	%w/w	0.005	**0.17**	**0.011**
Magnesium (MgKCl)	%w/w	0.005	**0.011**	<0.005
TPA (Titratable Peroxide Acidity) Method: AN218 Tested: 3/4/2019				
Peroxide pH (pH Ox)	pH Units	-	**3.2**	**3.0**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25	<0.25	<0.25
TPA as moles H+/tonne	moles H+/T	5	<5	<5
TPA as S % W/W	%w/w S	0.01	<0.01	<0.01
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5	<5	<5
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25	<0.25	<0.25
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01	<0.01	<0.01
ANCE as % $CaCO_3$	% CaCO3	0.01	<0.01	<0.01
ANCE as moles H+/tonne	moles H+/T	5	<5	<5
ANCE as S % W/W	%w/w S	0.01	<0.01	<0.01
Peroxide Oxidisable Sulphur (Spos)	%w/w	0.005	**0.028**	<0.005
Peroxide Oxidisable Sulphur as moles H+/tonne	moles H+/T	5	**18**	<5
Sulphur (Sp)	%w/w	0.005	**0.030**	<0.005
Calcium (Cap)	%w/w	0.005	**0.21**	**0.014**
Reacted Calcium (CaA)	%w/w	0.005	**0.043**	<0.005
Reacted Calcium (CaA)	moles H+/T	5	**22**	<5
Magnesium (Mgp)	%w/w	0.005	**0.013**	<0.005
Reacted Magnesium (MgA)	%w/w	0.005	<0.005	<0.005
Reacted Magnesium (MgA)	moles H+/T	5	<5	<5
Net Acid Soluble Sulphur as % w/w	%w/w	0.005	-	-
Net Acid Soluble Sulphur as moles H+/tonne	moles H+/T	5	-	-
SPOCAS Net Acidity Calculations Method: AN220 Tested: 3/4/2019				
s-Net Acidity	%w/w S	0.01	**0.04**	<0.01
a-Net Acidity	moles H+/T	5	**22**	<5
Liming Rate	kg CaCO3/T	0.1	**1.7**	<0.1
Verification s-Net Acidity	%w/w S	-20	**0.01**	**0.00**
a-Net Acidity without ANCE	moles H+/T	5	**22**	<5
Liming Rate without ANCE	kg CaCO3/T	0.1	**1.7**	<0.1

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

TAA (Titratable Actual Acidity) **Method: ME-(AU)-[ENV]AN219**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH KCl	LB066217	pH Units	-	6.0	0 - 2%	101%
Titratable Actual Acidity	LB066217	kg H2SO4/T	0.25	<0.25	0%	NA
Titratable Actual Acidity (TAA) moles H+/tonne	LB066217	moles H+/T	5	<5	0%	92%
Titratable Actual Acidity (TAA) S%w/w	LB066217	%w/w S	0.01	<0.01	0%	92%
Sulphur (SKCl)	LB066217	%w/w	0.005	<0.005	0 - 1%	88%
Calcium (CaKCl)	LB066217	%w/w	0.005	<0.005	3 - 6%	97%
Magnesium (MgKCl)	LB066217	%w/w	0.005	<0.005	0 - 3%	90%

TPA (Titratable Peroxide Acidity) **Method: ME-(AU)-[ENV]AN218**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Peroxide pH (pH Ox)	LB066216	pH Units	-	6.2	0 - 2%	100%
TPA as kg H_2SO_4/tonne	LB066216	kg H2SO4/T	0.25	<0.25	0%	105%
TPA as moles H+/tonne	LB066216	moles H+/T	5	<5	0%	105%
TPA as S % W/W	LB066216	%w/w S	0.01	<0.01	0%	105%
ANCE as % $CaCO_3$	LB066216	% CaCO3	0.01	<0.01	0%	
ANCE as moles H+/tonne	LB066216	moles H+/T	5	<5	0%	
ANCE as S % W/W	LB066216	%w/w S	0.01	<0.01	0%	
Sulphur (Sp)	LB066216	%w/w	0.005	<0.005	2 - 5%	98%
Calcium (Cap)	LB066216	%w/w	0.005	<0.005	6%	101%
Magnesium (Mgp)	LB066216	%w/w	0.005	<0.005	0 - 8%	102%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN218	Soil samples are subjected to extreme oxidising conditions using hydrogen peroxide. Continuous application of heat and peroxide ensure all sulfide is converted to sulfuric acid. Excess peroxide is broken down by a copper catalyst prior to titration for acidity. Calcium, magnesium, and sulfur are determined by ICP-OES. Also included is a carbonate modification step which, depending on pH after the initial oxidation, gives a measure of ANC.
AN219	Dried pulped sample is extracted for 4 hours in a 1 M KCl solution. The ratio of sample to solution is 1:40. The extract is titrated for acidity. Calcium, magnesium, and sulfur are determined by ICP-AES.
AN220	SPOCAS Suite: Scheme for the calculation of net acidities and liming rates using a Fineness Factor of 1.5.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
		NVL	Not Validated

Unless it is reported that sampling has been perfomed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

Yin, Emily (Sydney)

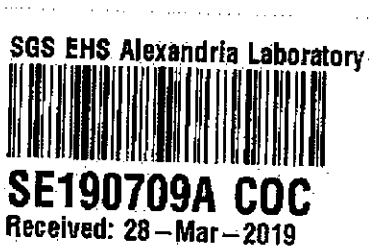
From: AU.Environmental.Sydney (Sydney)
Sent: Thursday, 28 March 2019 9:08 AM
To: AU.SampleReceipt.Sydney (Sydney)
Subject: FW: Report Job SE190709, your reference AG432, order number AG432_1

Please book this in for reporting Tuesday

Regards,

Paul Harley
Environment, Health & Safety
Client Manager

Phone: +61 (0)2 8594 0400
Direct: +61 (0)2 8594 0449
Mobile: +61 (0)4 0797 2867



-----Original Message-----
From: nathan@austgeo.com.au [mailto:nathan@austgeo.com.au]
Sent: Thursday, 28 March 2019 9:06 AM
To: AU.Environmental.Sydney (Sydney) <AU.Environmental.Sydney@sgs.com>
Subject: Re: Report Job SE190709, your reference AG432, order number AG432_1

3 days please

Quoting "AU.Environmental.Sydney (Sydney)" <AU.Environmental.Sydney@sgs.com>:

> Good morning Nathan
>
> Not a problem, Standard TAT?
>
> Regards,
>
> Paul Harley
> Environment, Health & Safety
> Client Manager
>
> Phone: +61 (0)2 8594 0400
> Direct: +61 (0)2 8594 0449
> Mobile: +61 (0)4 0797 2867
>
>
> -----Original Message-----
> From: nathan@austgeo.com.au [mailto:nathan@austgeo.com.au]
> Sent: Thursday, 28 March 2019 8:13 AM
> To: AU.Environmental.Sydney (Sydney) <AU.Environmental.Sydney@sgs.com>
> Subject: Re: Report Job SE190709, your reference AG432, order number
> AG432_1
>
> Hi

>
> Can I get SPOCAS for the following
>
> - Surface 0.1m - BH2 #4
> - 0.5m - BH3 #8
>
> Cheers
>
>
> Quoting AU.Environmental.Sydney@sgs.com:
>
>> Dear Nathan,
>>
>> Please find attached the report for SGS job SE190709, your reference
>> AG432, order number AG432_1.
>>
>>
>> -IMPORTANT INFORMATION ABOUT YOUR REPORT- To align with NEPM 1999
>> (2013), SGS Environmental has changed the way Silica Gel Clean-up of
>> TRH extracts is reported. TPH Silica Gel has now become TRH – Silica.
>> NEPM 1999(2013) seeks to clarify TRH and TPH in Schedule B3, 10.2.7.
>>
>> If you have any questions or concerns, please don't hesitate to
>> contact your SGS Client Services representative.
>>
>>
>> Regards,
>> Paul Harley
>> Information in this email and any attachments is confidential and
>> intended solely for the use of the individual(s) to whom it is
>> addressed or otherwise directed. Please note that any views or
>> opinions presented in this email are solely those of the author and
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>> recipient should check this email and any attachments for the
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>> caused by any virus transmitted by this email. All SGS services are
>> rendered in accordance with the applicable SGS conditions of service
>> available on request and accessible at
>> https://www.sgs.com/en/terms-and-conditions
>
>
> --
> Regards
>
> Nathan Smith
> Principal
>
> Australian Geotechnical Pty Ltd
> ACN 611 088 192
> 2 Shirley Street,
> Rose Hill, NSW, 2142
> nathan@austgeo.com.au
>
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