Appendix I. Geotechnical Investigation (Tonkin, 2021)

Geotechnical Investigation Report

Buronga Landfill Expansion

Wentworth Shire Council

11 June 2021
Ref: 202597R02A

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Building exceptional
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Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
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Client: Wentworth Shire Council
Ref: 202597R02A

Appendices

1 Introduction

Wentworth Shire Council (Council) has identified that the predicted volume of waste requiring disposal at their Buronga Landfill is likely to increase in the future beyond the current approved limit. Therefore, Council is seeking regulatory approval to increase the waste disposal limit and expand the landfill to areas north of the existing footprint.

Tonkin has been engaged to undertake a soil/geotechnical investigation prior to commencing the landfill conceptual site design as the information from these investigations will inform the landfill design scope.

This report presents the results of the geotechnical investigation undertaken including:

- Summary of the subsurface conditions encountered;
- Borehole logs for each investigation location;
- Results from selected geotechnical and environmental laboratory testing; and
- Discussion and recommendations on geotechnical properties for design of project elements.

2 Field Investigation

2.1 Fieldwork

The field investigation undertaken on 16 to 18 February 2021 was directed by a senior geotechnical engineer from Tonkin and included the following:

- Work Health and Safety Hazzard Assessment;
- Undertaking dial before you dig search to assess potential underground service conflicts;
- Drilling twelve boreholes (H1 to H12) to a maximum depth of 10 m below the existing surface level or drilling refusal across the proposed landfill expansion area;
- Logging and classifying soils and materials encountered using visual tactile techniques;
- Recording groundwater and soil moisture observations;
- Obtaining selected soil samples for potential laboratory environmental and geotechnical testing.

Logs of the boreholes are presented in Appendix A.

Photographs of each borehole and selected sites were taken. A selection of these is provided in Appendix B.

2.2 Borehole Methodology

The boreholes were drilled using a Rockmaster drill rig on a Toyota Landcruiser 4WD, provided and operated by In Depth Drilling Pty Ltd, using a combination of push tube and solid auger (including rock tip) techniques. Bulk samples were retrieved from auger flights.

Boreholes were located to provide a broad coverage of potential soil conditions across the site, whilst also being directed by access restrictions.

Borehole locations are presented on Figure 1.1 below.


ARUMPO ROAD
H01
H02
H03
H04
H05
H06
H07
H08
H09
H10
H11
H12
Legend
Borehole Locations
tonkin
0 100 200 300 400 m
N
Job Number: 202597
Filename: 202597GQ00
Revision: Rev 0
Date: 2021-03-31
Drawn: WG
Data Acknowledgement:
Primary Imagery from ESRI, 2021
Wentworth Shire Council
Buronga Landfill Expansion
Hydrogeological Investigations
Borehole Location Plan
Figure 1.1

2.3 Laboratory Testing

2.3.1 Geotechnical Testing

Bulk samples were retrieved at random locations and depths from the boreholes and sent to CivilTest for geotechnical laboratory analysis. CivilTest is a NATA-accredited laboratory for the analyses requested. The scope of testing was intended to provide classification of representative samples and to target samples that will potentially be included in capping or base liners, or other potential on reuses on site. The laboratory testing requested included the following:

- Particle Size Distribution (PSD) x 18
- Atterberg Limits (AL) x 18
- Emerson Class x 18

The geotechnical laboratory test reports reference number 3210195-1 issue 1 dated 8/4/21 are presented in Appendix C.

2.3.2 Environmental Testing

Representative samples, mostly targeting surface soils, were retrieved at random depths from the boreholes and sent to Australian Laboratory Services (ALS) for environmental laboratory analysis. ALS is a NATA-accredited laboratory for the analyses requested. The scope of testing was intended to provide a broad classification of the potential contamination status of the soils on site. The laboratory testing requested included the following:

- Heavy metals x 18
- Organochlorine Pesticides (OCPs)/ Organophosphorus Pesticides (OPPs) x 10
- National Environment Protection Measure (NEPM) Screen x 13

The environmental laboratory test report reference EM2102930 and associated QA/QC reports are presented in Appendix D.

3 Results

3.1 Site Description

The general topography of the site is undulating, with overall grade towards the west. The River Murray Valley is south west of the site.

The southern area of the site has been disturbed as it abuts the current landfill operations. The south western portion has been disturbed significantly with material being removed in various locations for landfill cover or construction. Borehole H5 was drilled in this area. The central area is also highly disturbed through likely material sourcing for various Council operations. The eastern area is relatively undisturbed and well vegetated.

3.2 Geological Information

Based on the 1:250,000 scale Geological Map Series Sheet SI 54-11 entitled Mildura, Edition 2 dated May 1997, the geology within the site is likely to consist of:

- Woorinen Formation including aeolian red brown sand with carbonaceous silt; and
- Coonambidgal Formation which contains fluvial and lacustrine sand, sandy clay, and clay likely associated with Lake Gol Gol located east of the site.

3.3 Subsurface Conditions

The subsurface conditions observed were in general accordance with those expected from the geological maps.

Fill was only encountered in borehole H3 to a depth of 0.2m below the surface.

Topsoil was mostly non-existent apart from a sandy surface layer observed in most boreholes.

Generally, sand and clayey sand materials were observed in the upper layer, underlain by clays and sandy clays of low to medium plasticity, further underlain by silty clayey sand and sand often containing groundwater. The upper sands and clayey sand layers were more predominant in the western boreholes (H1 to H6, H11 and H12), with the eastern boreholes (H7 to H9) encountering clays near the surface.

Rock or rock strength materials were not encountered in the boreholes, although some materials provided high resistance to drilling due to being hard and dry.

Groundwater was observed in all boreholes apart from H1 and H5. Groundwater was observed at between 6.8 m (H7) and 9.7m (H11) below the surface with standing water level measured in eth open boreholes after approximately one day stabilisation at between 5.9m (H7) and 9.5m (H2) below the surface in the boreholes that did not collapse.

A summary of the soils encountered is provided below in Table 4.1.

Table 4.1 – Soil Profile Summary (depth intervals are m below surface)

Soil Description	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12
FILL, Clayey Sand (FILL)			0 - 0.2									
SAND, fine to coarse grained, red brown and pale brown (UNIT 1)	0 - 1.2	0 – 0.8	0.2 – 1.7	0 – 0.4		0 – 0.6				0 – 0.4	0 – 0.5	0 – 1.2
Clayey Gravelly SAND/Clayey SAND, fine to coarse grained, pale orange/brown, pale brown and white, fine to coarse gravel, low plasticity fines (UNIT 2A)	1.2-6.4	0.8 – 2.0	1.7 – 2.6	0.4 – 2.4	0 – 2.0	0.6 – 3.0				0.4 – 1.8	0.5 – 2.2	1.2 – 3.0
SAND/Clayey SAND, fine to coarse grained, pale brown, orange/brown and orange, low plasticity fines (UNIT 2B)	6.4 – 10.0	2.0 – 5.2	2.6 – 5.2		2.0 – 4.0	3.0 – 7.1					2.2 – 6.4	3.0 – 4.2
Clayey SAND, fine to coarse grained, grey/brown, low plasticity fines (UNIT 3A)				2.4 – 3.5	4.0 – 4.6				0 – 0.05			
Sandy CLAY/CLAY, medium plasticity, grey, grey/brown, yellow brown, red, fine to coarse sand (UNIT 3B)		5.2 – 10.0	5.2 – 9.0	3.5 – 8.0	4.6 – 7.5	7.1 – 8.1	0 – 6.8	0 – 9.3	0.05 – 6.5	1.8 - 8.1	6.4 – 8.2	4.2 – 8.2
Clayey SAND/Silty SAND, fine to coarse grained, yellow brown, grey, low plasticity fines (UNIT 4A)			9.0 – 10.0	8.0 – 10.0	7.5 – 10.0		6.8 – 10.0		6.5 – 8.0	8.1 – 10.0	8.2 – 10.0	8.2 – 10.0
SAND, fine to coarse grained, grey (UNIT 4B)								9.3 – 10.0	8.0 – 10.0			

Table 4.2 - Laboratory Result Summary

Sample Location	Depth (mbsl)	Soil Description	Particle Size Distribution (% passing)					Atterberg Limits (%)			Emerson Class
			19mm	2.36mm	0.6mm	0.3mm	75um	LL	PI	LS	
UNIT 1											
BS2/1	0 – 0.5	Clayey SAND (SC)	100	100	98	77	22	NO	NP	NO	4
UNIT 2A											
BS1/2	1.2 – 1.7	Clayey SAND (SC)	100	99	98	78	27	NO	NP	NO	4
BS3/1	2.0 – 2.5	Clayey SAND (SC)	100	99	97	81	23	18	4	0.5	5
BS5/1	0 – 0.5	Clayey SAND (SC)	100	74	71	63	24	NO	NP	NO	4
BS6/1	2.0 – 2.5	Clayey SAND (SC)	100	99	98	88	45	26	15	2.5	2
BS11/1	1.5 – 2.0	Clayey SAND (SC)	100	90	86	64	27	21	6	2.0	4
UNIT 3B											
BS2/3	6.0 – 6.5	Sandy CLAY (CI)	100	100	98	90	70	38	26	8.0	2
BS4/2	3.5 – 4.0	Sandy CLAY (CI)	100	100	99	94	61	36	25	8.5	5
BS5/2	5.0 – 5.5	CLAY, with sand (CI)	100	100	99	94	74	37	25	9.0	5
BS7/1	3.0 – 3.5	Sandy CLAY (CI)	100	99	89	80	57	42	29	11.0	4
BS8/1	0.5 – 1.0	Sandy CLAY (CI)	100	100	94	87	61	39	24	10.0	6
BS8/3	5.0 – 5.5	CLAY (CI) with sand	100	99	96	92	74	45	30	12.0	5
BS9/2	4.0 – 4.5	Sandy CLAY (CL)	100	100	95	87	50	29	17	6.5	4

BS10/1	2.5 – 3.0	Sandy CLAY (CI)	100	98	96	89	59	35	22	10.0	4
BS10/2	5.5 – 6.0	Sandy CLAY (CI)	100	100	93	84	65	36	24	11.0	5
BS12/2	4.2 – 4.7	Sandy CLAY (CL)	100	100	98	87	56	30	17	4.0	4
UNIT 4A											
BS4/4	8.5 – 9.0	Clayey SAND (SC)	100	93	29	17	14	22	11	4.0	5
BS7/3	7.0 – 7.5	Clayey SAND (SC)	100	97	64	37	22	27	13	6.0	2

LL – Liquid Limit PI – Plasticity Index LS – Linear Shrinkage

3.4 Environmental Testing

3.4.1 Assessment Criteria

Based on NSW EPA definitions, the samples material can be classified as Virgin Excavated Natural Material (VENM) as it is natural material which is not contaminated. However, to confirm that the material is free of contaminants a qualitative review of the results was undertaken against the NSW EPA Excavated Natural Material (ENM) criteria:

- NSW 2014 Excavated Natural Material (Absolute Max)
- NSW 2014 Excavated Natural Material (Max Average)

In addition, the samples were also assessed with reference to the ASC NEPM commercial/ industrial investigation levels to account for the soils remaining or being re-used on site:

- Health Investigation Level (HIL) Level D – Commercial/ Industrial
- Ecological Screening Level (ESL) – Commercial/ Industrial
- Ecological Investigation Level (EIL) – Commercial/ Industrial
- Management Levels for TPH Fractions – Commercial/ Industrial

3.4.2 Results

Laboratory report and complete tables of analytical results compared against relevant criteria are provided in Appendix D and summarised below.

Quality Control

Precision of analytical results is measured by the Relative Percentile Difference (RPDs) between the duplicate results. RPDs are generally considered acceptable if they are less than 30% (ASC NEPM). However, when both results are less than 10 times the laboratory limit of report (LOR), where actual difference are minor, higher RPDs are not considered to affect the interpretation of results.

Two inter-laboratory duplicate samples were collected and submitted for laboratory analysis. There were no RPDs observed to be elevated above the acceptable range between the primary samples (H1/1 & H6/1) and the duplicate samples (DUP1 & DUP2).

The laboratory quality control reports (Appendix D) were reviewed and did not report any method blank, duplicate, laboratory control or surrogate recovery outliers. Two matrix spike recovery outliers occurred for organic matter and total organic carbon. The recovery was less that the lower data quality objective. Analysis holding times occurred for pH which only has a holding time of 6 hours which is not achievable due to the delivery time to the laboratory. The laboratory results are considered acceptable for the purposes of this investigation.

NSW EPA ENM

There were no reported exceedances of the ENM criteria.

Assessment of Risk to Human Health & Environment (NEPM)

There were no reported exceedances of the relevant NEPM criteria.

3.4.3 Conclusions

The sampling and analysis undertaken at the proposed Buronga Landfill expansion area has provided an indicative classification of the soil material across the site. The analytical results indicate that the natural material across the site is not contaminated.

4 Assessment

4.1 Excavatability

All soils are expected to be readily excavated with machinery typically used during similar construction projects such as an excavator of notional 20 tonne capacity. Whilst drilling difficulty was experienced in places due to the hard nature and low moisture content of the soils in a bulk excavation this is not considered to be an issue with the expected excavation equipment proposed.

Based on observations of the existing borrow pits the materials appear to be readily excavated with site equipment similar to that mentioned above.

4.2 Stability

The boreholes generally remained open during and after drilling to approximately groundwater level. Based on that and our other observations we generally expect the soils will be self-supporting for short periods after excavation, assuming the weather is dry. It may be possible to work in excavations without support for short periods after excavation, subject to any construction regulations, although it would be prudent to inspect the walls of the excavations prior to accessing them as there may be fissuring or cracking of the soils that will affect their stability but would not have been apparent in our boreholes.

If excavations are required to remain open for more than a couple of days at most, they will require support or battering or stepping back to maintain acceptable stability. The stability of excavations will also be affected by rainfall or runoff, so it will be important to maintain appropriate stormwater management on site.

If there are permanent slopes, for ponds or embankments, we expect these to be acceptably stable at slopes no steeper than 1V to 2.5H in the soils observed.

It is noted that existing borrow areas appear to be preforming suitably with benched walls of approximately 2m height and 2m bench width.

It is recommended that excavations remain 2m above the groundwater level to reduce potential softening of subgrade materials that may impact slope stability.

4.3 Material Reuse

Generally, it is expected that the site materials (apart from units 4A and 4B) will be suitable for use as general engineered fill for bulk earthworks, subject to appropriate moisture conditioning. Prior to reuse, site-won materials will need to be significantly moisture conditioned (water added) to achieve a moisture content suitable for construction.

4.3.1 Water Detention Characteristics

The soils encountered within unit 3B are considered suitable for use in water retaining structures if placed and compacted at a suitable standard, due to their fine-grained nature and low to medium plasticity. However, no permeability testing was undertaken as part of this scope.

Emerson Classification values varied across the samples from 2, 4, 5 and 6. Generally samples with an Emerson class of 2 would show signs of dispersion, as identified in sample BS2/3. However, based on the majority of results within Unit 3B we would expect that these soils would not be dispersive.

4.3.2 Pipe Bedding

Based on the results the sand and clayey sand materials observed would not be suitable for reuse as pipe embedment material.

4.3.3 Pavement Materials

Whilst gravel sized particles were observed in some Unit 2A materials, based on the results these soils are unlikely to be suitable for reuse as pavement materials for sheeting internal roads.

5 Limitations

The contents of the report are for the sole use of the client and no responsibility or liability to any third party will be accepted. Data or opinions contained within the report may not be used in other contexts or for any other purposes without Tonkin's prior review and agreement.

The recommendations in this report are based on data collected at specific locations and by using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific financial and technical requirements of our Proposal and the Brief, and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the assumed model.

Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

It is strongly recommended that any plans and specifications prepared by others and relating to the content of this report, or amendments to the original plans and specifications, are reviewed by Tonkin Consulting to verify that the intent of our recommendations is properly reflected in the design.

During construction Tonkin requests the opportunity to review our interpretations if the exposed site conditions are significantly different from those inferred in this report.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

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Appendix A – Borehole Logs

Appendix B – Photographs

Photo 1 – H1 Location

Photo 2 – H1 0 – 6m bsl

Photo 3 – H1 6m – 10m bsl

Photo 4 – H2 Location

Photo 5 – H2 0 – 6m bsl

Photo 6 – H2 6m – 10m bsl

Photo 7 – H3 Location

Photo 8 – H3 0 – 6m bsl

Photo 9 – H3 6m – 10m bsl

Photo 10 – H4 location

Photo 11 – H4 0 – 6m bsl

Photo 12 – H4 6m - 10m bsl

	
Photo 13 – H5 Location	Photo 14 – H5 0 – 6m bsl
	
Photo 15 – H5 6m – 10m bsl	Photo 16 – H6 location
	
Photo 17 – H6 0 – 6m bsl	Photo 18 – H6 6m - 10m bsl

Photo 19 – H7 Location

Photo 20 – H7 0 – 6m bsl

Photo 21 – H7 6m – 8m bsl

Photo 22 – H8 location

Photo 23 – H8 0 – 6m bsl

Photo 24 – H8 6m – 10m bsl

Photo 25 – H9 Location

Photo 26 – H9 0 – 6m bsl

Photo 27 – H9 6m – 10m bsl

Photo 28 – H10 location

Photo 29 – H10 0 – 6m bsl

Photo 30 – H10 6m – 10m bsl

	
Photo 31 – H11 Location	Photo 32 – H11 0 – 6m bsl
	
Photo 33 – H11 0 – 6m bsl	Photo 34 – H12 location
	
Photo 35 – H12 0 – 6m bsl	Photo 36 – H12 6m – 10m bsl

Appendix C – Geotechnical Lab Test Certificates

Appendix D – Environmental Results Tables and Lab Test Certificates