



CONSULTING EARTH SCIENTISTS

PROGRESSIVE CAPPING PLAN
MANGROVE MOUNTAIN LANDFILL,
HALLARDS ROAD, CENTRAL MANGROVE, NSW.
PREPARED FOR VERDE TERRA PTY LTD

CES DOCUMENT REFERENCE: CES110703-VDT-FJ

Written by: S. Moore

Reviewed by: D. Lowe

Authorised by: Duncan Lowe

Client: Verde Terra Pty Ltd

78 Hallards Road

Central Mangrove

NSW 2250

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Suite 3, Level 1 • 55-65 Grandview Street • Pymble, NSW 2073 • Australia

Telephone: 02 8569 2200 • Fax: 02 9983 0582

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CES Document: CES110703-VDT-FJ	Issue: FJ	Page 1 of 7
Date: 16 June 2016	Controlled Document	Authorised by: D. Lowe

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CES Document: CES110703-VDT-FJ	Issue: FJ	Page 2 of 7
Date: 16 June 2016	Controlled Document	Authorised by: D. Lowe

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CONTENTS

1.	Introduction.....	4
2.	Landfill Waste Capping Design & Final Landform	4
3.	Staging Of Capping Construction	6
4.	Capping Construction Quality Assurance Program (CQA).....	6

Table 1 - Landfill Waste Capping - Preliminary Construction Quality Assurance Plan

PROGRESSIVE CAPPING PLAN
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CES DOCUMENT REFERENCE: CES110703-VDT-FJ

1. INTRODUCTION

Verde Terra Pty Ltd (Verde Terra) has engaged Consulting Earth Scientists Pty Ltd (CES) to prepare this Progressive Capping Plan (Capping Plan) with regard the final capping over General Solid Waste (non-putrescible) placed in the areas regulated under Environmental Protection License (EPL) 11395 (refer to Figure C of the Landfill Environmental Management Plan (LEMP 2014)).

This Progressive Capping Plan forms a sub-plan under the LEMP 2014. The objective of this Plan is to provide the purposed design and describe the progressive construction of the final waste capping to be constructed at the site to facilitate construction of the proposed Golf Course.

The purpose of the permanent site capping is to provide a barrier to the migration of water into the waste (thereby reducing the amount of leachate generated), to control emissions to water and the atmosphere and prevents hazards and protects amenity.

This Capping Plan shall periodically be reviewed and updated to consider the progress of the landfill works.

2. LANDFILL WASTE CAPPING DESIGN & FINAL LANDFORM

The proposed permanent capping will comply with the requirements of the NSW Environmental Protection Authority (EPA) publication “Environmental Guidelines: Solid Waste Landfill” (January 1996) Benchmark Techniques BT28 or alternative approved by the EPA. This Capping Plan also considers the requirements laid down in the Consent Orders and LEMP 2014.

For the avoidance of ambiguity, the capping designs described in this Capping Plan apply only to areas over which waste has been or will be deposited, that is to say the Regulated Area filled prior to mid-2011 and future landfill cells (which at the time of preparing this document were landfill Cells W, X, Y and Z). The location of these areas is shown in Figure D of LEMP 2014.

CES Document: CES110703-VDT-FJ	Issue: FJ	Page 4 of 7
Date: 16 June 2016	Controlled Document	Authorised by: D. Lowe

It should be noted that in accordance with the Consent Orders, 6 metres of waste from the fill mound on Area B shall be moved to Cell W and a permanent final capping placed to result in a maximum height for the final landform in Area B of RL341.4.

The contours for the finished level of closure of the landfill and the golf course are provided in the golf course design by McKay & Sons Pty Limited which are shown in Appendix III of LEMP 2014. The tolerance to the finished levels are plus 0.5 metres and minus 1.5 metres to enable best practice for the golf course design.

The final capping system shall comply with BT28 of the NSW EPA (1996) guidelines (or approved alternative), which prescribes the following five layers (layer closest to the waste listed first):

- 1) A seal-bearing surface - This is required to be properly designed and engineered layer of material.
- 2) A gas drainage layer - The gas drainage layer should have a minimum thickness of 30 centimetres (to be constructed if landfill gas is demonstrated to be present).
- 3) A sealing layer - A sealing layer should consist of a clay layer at least 50 centimetres thick and having a permeability less than $K = 10^{-8}$ metres/second.
- 4) An infiltration drainage layer – This should be not less than 30 centimetres deep.
- 5) A revegetation layer.

Layer 1) The seal-bearing layer shall comprise 300mm of crushed sandstone excavated from Cells X, Y and Z or other compactable fill material such as crushed recycled brick or approved waste materials. Layer 2) would be anticipated to comprise sandstone aggregate obtained and crushed on site from the excavation of cells X, Y and Z or other suitable aggregate such as crushed recycled brick or approved waste materials. This layer will be provided unless it can be demonstrated that landfill gas is not present in significant quantities or concentrations at the site. Layer 3) will require importation to the site and Layers 4) and 5) would be considered or amended to consider the requirements of the golf course designer.

Plants selected for revegetation shall have root systems which will not penetrate into the sealing layer and shall be proposed by the golf course designer.

Depending on site specific requirements and constraints, alternative final capping may be proposed during the progress of the works, as allowed under Section 3.3.2 of the Environmental Guidelines: Solid Waste Landfill. Alternative final capping would provide equivalent or better performance to that of the capping system prescribed under BT28. This could include the use of geosynthetic materials or alternative materials to those described above. The approval of the

CES Document: CES110703-VDT-FJ	Issue: FJ	Page 5 of 7
Date: 16 June 2016	Controlled Document	Authorised by: D. Lowe

NSW Environment Protection Authority (EPA) would be sought prior to construction of any alternative capping design.

3. STAGING OF CAPPING CONSTRUCTION

Construction of the final capping will occur progressively during the landfilling activities and in accordance with the Consent Orders as follows:

- The removal of 6m in height of waste from the mound on Area B and capping of the mound on Area B shall be completed no later than 31 August 2017 and otherwise in accordance with the LEMP.
- The capping of the mound in Area B shall occur sequentially in up to 9 stages, with each stage having a temporary capping of 500mm. The final capping shall be a further 1.9m consistent with the designs described in Section 2.
- In accordance with BT28, the landfill operator will commence capping of the completed filling areas within 30 days of completion of landfilling in that area, weather permitting.

4. CAPPING CONSTRUCTION QUALITY ASSURANCE PROGRAM (CQA)

The proposed Preliminary CQA plan for capping construction at the site is presented in Table 1. At the completion of construction, a set of “as executed” drawings will be prepared and included in a CQA report that will be prepared by a suitably qualified and experienced geotechnical practitioner.

CES Document: CES110703-VDT-FJ	Issue: FJ	Page 6 of 7
Date: 16 June 2016	Controlled Document	Authorised by: D. Lowe

Table 1
Landfill Waste Capping - Preliminary Construction Quality Assurance Plan

CES Document: CES110703-VDT-FJ	Issue: FJ	Page 7 of 7
Date: 16 June 2016	Controlled Document	Authorised by: D. Lowe

Table 1 - Landfill Waste Capping - Preliminary Construction Quality Assurance Plan

Capping Layers	CONSTRUCTION REQUIREMENTS	TESTING/ INSPECTION REQUIREMENTS	TESTING FREQUENCY	RESPONSIBILITY
Seal Bearing Layer	To comprise min. 300mm of crushed Sandstone or other compactable fill material such as crushed recycled brick or approved waste materials.	Source Description	1 test per 2500m ²	Geotechnical Practitioner
		Survey - Thickness requirement (min. 300mm)	Following placement of layer	Surveyor
	Compact fill to min. density ratio of 95% standard compaction as determined by AS1289 and/or by test rolling to AS3798-2007	>95% min. density ratio Areas which are assessed to deform excessively should be rectified and represented for rolling	1 test per 2500m ²	Geotechnical Practitioner/NATA Accredited Geotechnical Testing Laboratory
Gas Drainage Layer	Inert Gravel (ripped Sandstone) or crushed Sandstone or other suitable fill material such as crushed recycled brick and/or concrete with < 10% calcium carbonate by weight.	Particle Size Distribution (16 – 32mm particle size)	1 test per 2500m ²	NATA Accredited Geotechnical Testing Laboratory
		Calcium Carbonate Content (<10%)	1 test per 2500m ²	NATA Accredited Geotechnical Testing Laboratory
		Visual Inspection (Clean and reasonably rounded)	1 test per 2500m ²	Geotechnical Practitioner
		Survey – Thickness / Distribution	Following placement of material	Surveyor
Compacted Clay Seal	Min., 500 mm thick compacted clay seal tested to a permeability of less than K = 10 ⁻⁸ m/s and compacted to min. density ratio of 98% standard compaction as determined by AS1289.5.11	>98% min. density ratio and OMC +/- 2% AS 1289 5.8.1/ 5.5.1/ 5.3.1/ 5.3.2	1 test per 200mm thickness per 2500m ²	Geotechnical Testing Laboratory
		Permeability Testing (not greater than 10 ⁻⁸ m/s)	1 test per 2500m ³ to demonstrate that 98% relative compaction provides permeability of <10 ⁻⁸ m/s	
		Survey - Thickness requirement (min. 500mm)	Following placement of layer	Surveyor
		Inspection during installation and photographs	Regular intervals during construction	Geotechnical Practitioner

- At the completion of construction, a set of “as executed” drawings will be prepared by the surveyor showing that the cap was installed in accordance with the design and that the final landform and contour are consistent with the required Golf Course design.
- Depending on site specific conditions and constraints, alternative final capping may be proposed during the progress of the works, as allowed under Section 3.3.2 of the Environmental Guidelines: Solid Waste Landfill. If an alternative capping system is proposed, this CQA Plan will be revised and updated to consider the alternative capping scheme.