

LAWTIG Seminar : What it takes to build a landfill

Landfill Construction Process

10 April 2019

Reon Pienaar, PrEng

JPCE

Specialist Consulting Engineers

60 Bracken Street, Brackenfell, 7560

P O Box 931, Brackenfell, 7561

Tel: +27 (0) 21 982 6570

Fax: +27 (0) 21 981 0868

e-mail: info@jpce.co.za

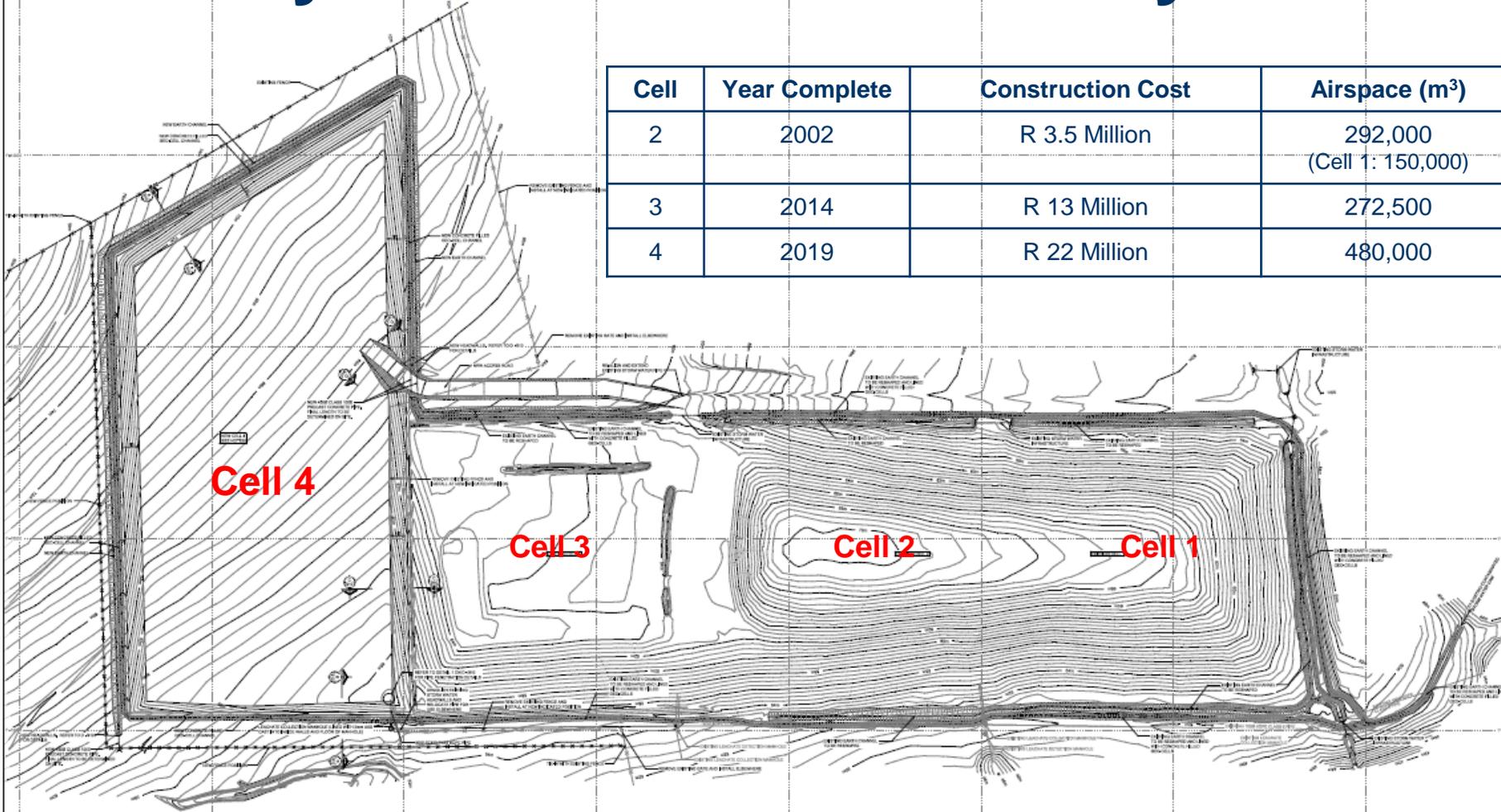
Karwyderskraal Landfill - Location



Karwyderskraal Landfill - Layout



Cell	Year Complete	Construction Cost	Airspace (m ³)
2	2002	R 3.5 Million	292,000 (Cell 1: 150,000)
3	2014	R 13 Million	272,500
4	2019	R 22 Million	480,000



DRAWING STATUS	
FOR APPROVAL	DATE
TENDERS ONLY	
ORDERED FOR CONSTRUCTION	DATE
AS SUB Y	

Date	By	For

OVERBERG DISTRICT MUNICIPALITY
 PROJECT
 KARWYDERSKRAAL CELL 4
 GENERAL LAYOUT


 SPURRIER CONSULTING ENGINEERS
 ENGINEERS AND ARCHITECTS
 117-2017/18

Karwyderskraal Landfill – Cell 4 Scope of Works

General

- 1) Establishment of camp and plant on site.
- 2) Accommodation of supervisory staff.
- 3) Discovery, exposing and demarcation of existing services to be protected and/or relocated.
- 4) Setting out of the works.
- 5) Expose edge of existing Cell 3 where new Cell 4 will tie in.

Construct new Cell 4

- 1) Earthworks to shape new cell
- 2) Four 150mm thick compacted clay layers from excavated material
- 3) Leachate collection system and pipe work - (150mm thick stone layer with 53mm crushed stone)
- 4) 1,5mm HDPE geomembrane installation
- 5) Construct leachate drainage manhole
- 6) Tie into the existing leachate drainage system

Roadworks

- 1) Extension of existing access road,
- 2) Import and place gravel wearing course and G5 sub-base layer
- 3) Move existing fence
- 4) Construct storm water cut off channels and associated infrastructures

To construct Cell 4 will require the excavation of 130 000m³ of clay and will cover an area of approximately 45 000m² (4,5ha). The new Cell 4 is approximately 3 – 4m deep and will have airspace capacity of 480 000m³ of waste which will give this cell a lifetime of approximately 6 - 8 years depending on disposal rates.

Karwyderskraal Cell 4 Construction

- Important Construction Documents
 - Contract Specifications
 - Contract Document
 - Construction Drawings
 - CQA Plan
 - EMP
 - OHS Specification

**March 2018
Before Cell 4 Construction**

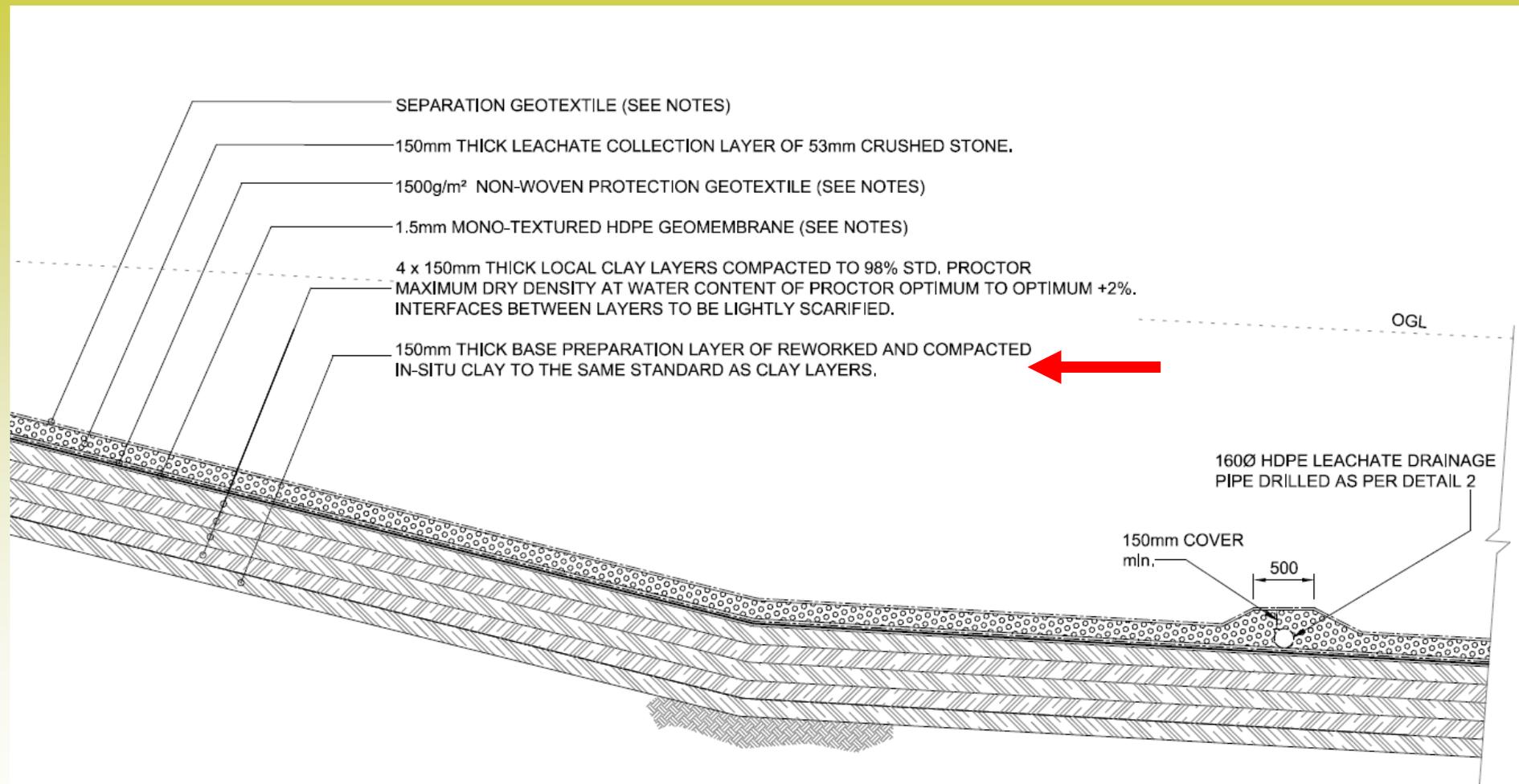


July 2018

Construction Commencement



Layerworks Design



**August 2018
Bulk Excavations**



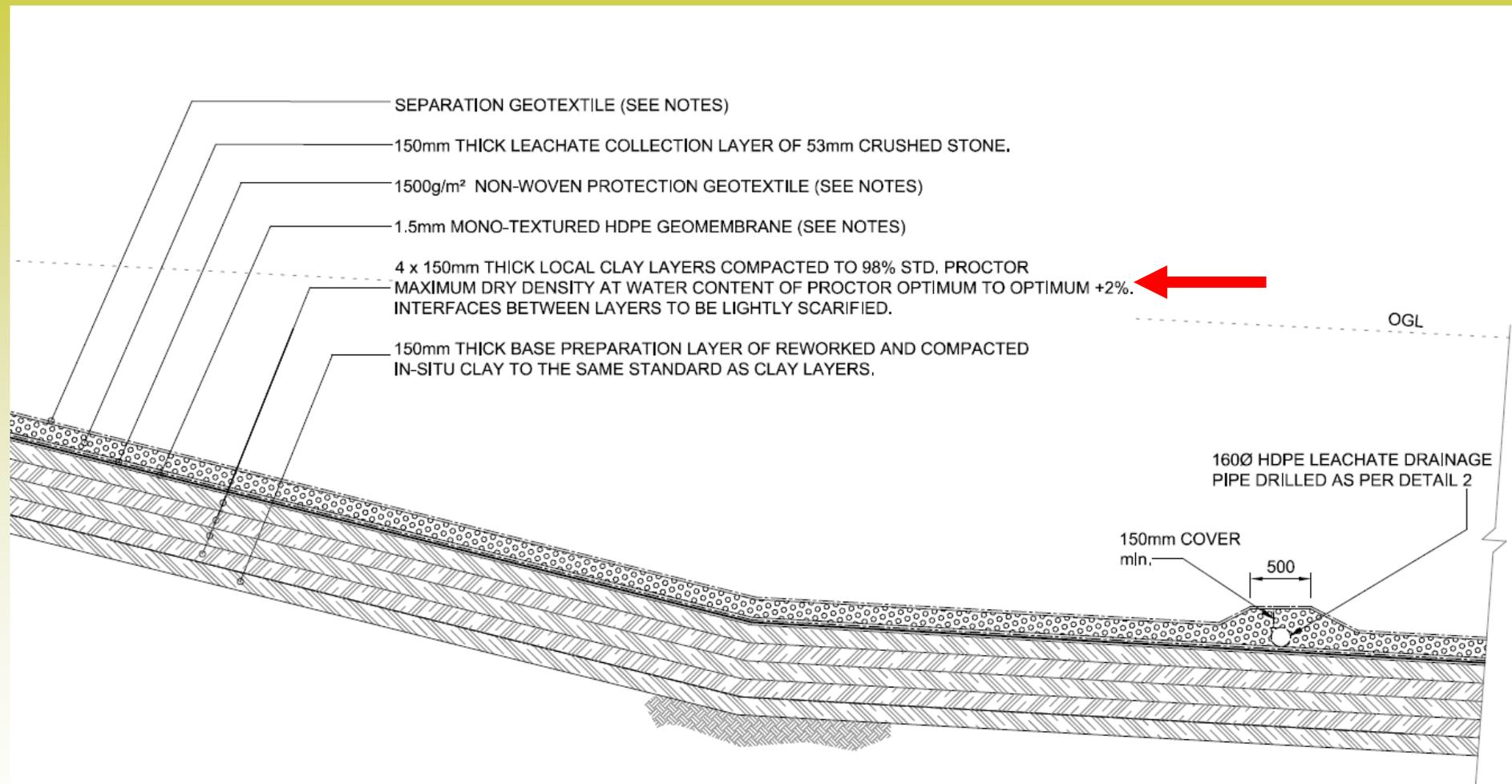
August 2018

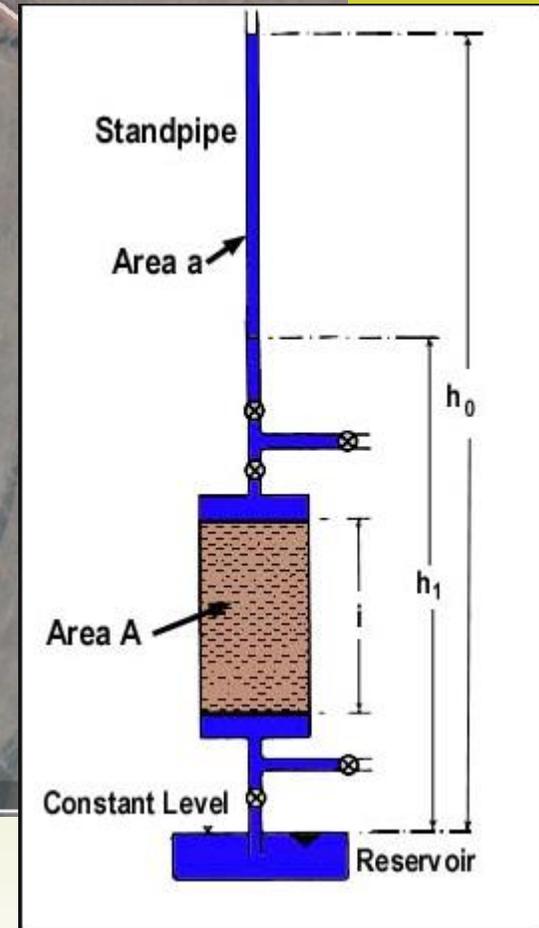
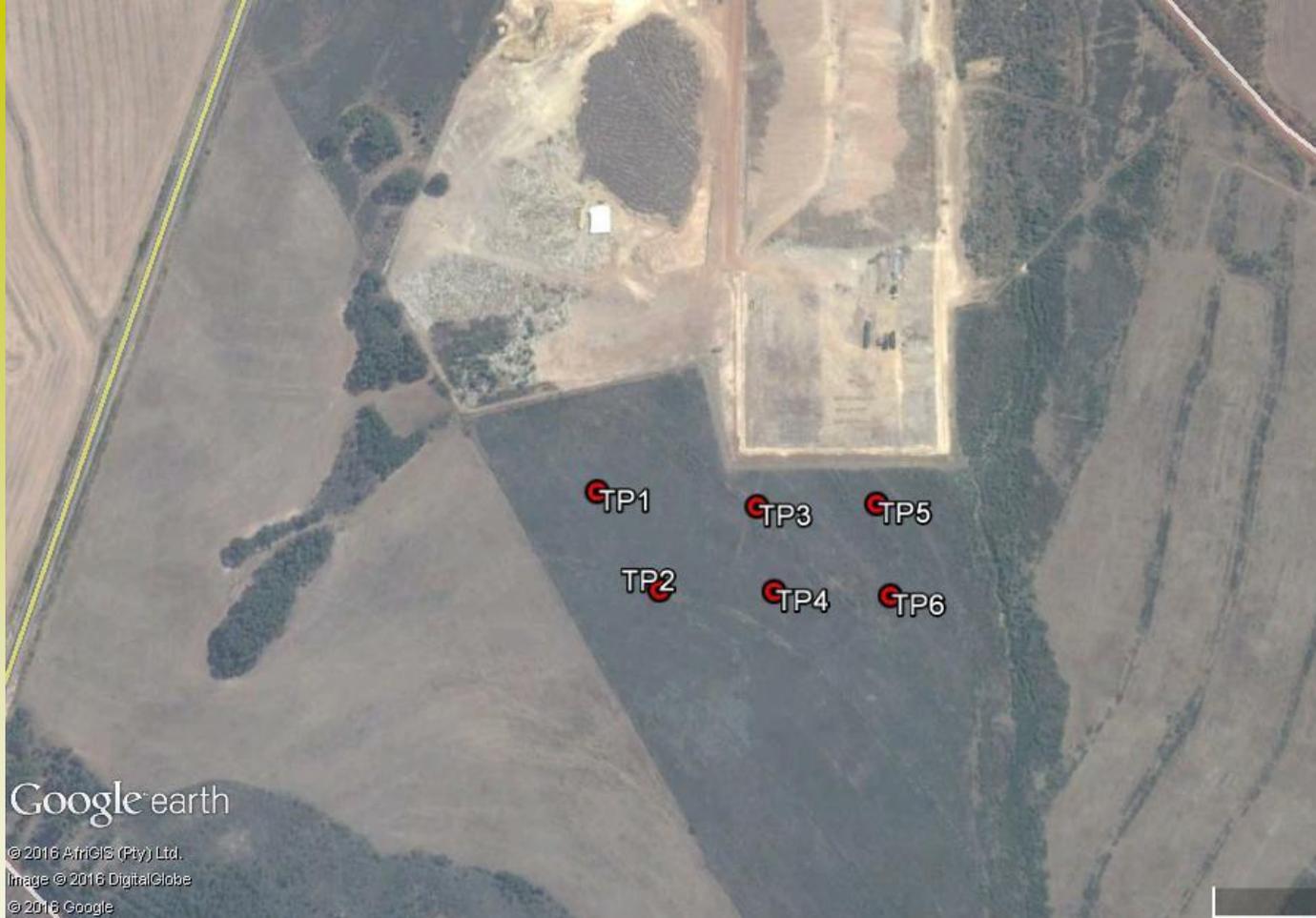


August 2018



Layerworks Design





- Clay permeability needs to be 1×10^{-6} cm/s or less
- Six test pits sampled and tested
- Compaction specified at 98% Standard Proctor at OMC +2%
- Lab results for Falling Head Permeability Test showed all samples $> 1 \times 10^{-6}$ cm/s

Karwyderskraal Cell 4 – Clay Layer Spec.

Material Classification

c) *4 x 150mm Thick local clay layers.*

Material for these layers shall consist of selected cohesive material from the stockpiles of excavated on-site materials.

The material shall have a minimum plasticity index (PI) of 8%. All material placed within this layer shall be well graded with a minimum of 60% finer than 0,075mm. The material shall be free from roots and organic matter and shall contain no clods or pebbles greater than 10mm.

It will be necessary to scarify and grid roll the material in order to meet the above grading criteria.

In-situ permeability tests using double ring infiltrometers must be carried out on every compacted layer and documented in detail. The tests shall log at least 48 hours per test. The diameter of the inner ring of such an infiltrometer must be at least 600mm, while the diameter of the outer ring must be twice that of the inner ring. The infiltrometer must be covered and sealed with plastic sheeting to prevent the evaporation loss of moisture.

Placing and Compaction

b) *4 x 150mm Thick local clay layers*

Material for these layers shall be spread in layers of maximum thickness 150mm and compacted to a minimum of 98% Standard Proctor Density at a water content of Proctor optimum to optimum +2%. All clay placed shall be immediately rolled to prevent penetration by rainwater. Permeability of clay shall not exceed 1×10^{-8} cm/s where possible.

The frequency of the permeability tests on the clay layers shall be at least **three tests per hectare per layer**. The cost of the tests shall be included in the rate for placing and compaction.

Compaction and water content tests must be done at a frequency of at least **three tests per hectare per layer**. The cost of the tests shall be included in the placing and compaction rate.

September 2018



November 2018



November 2018



January 2019

LAWTIG Seminar – What it takes to build a landfill



January 2019

LAWTIG Seminar – What it takes to build a landfill



January 2019

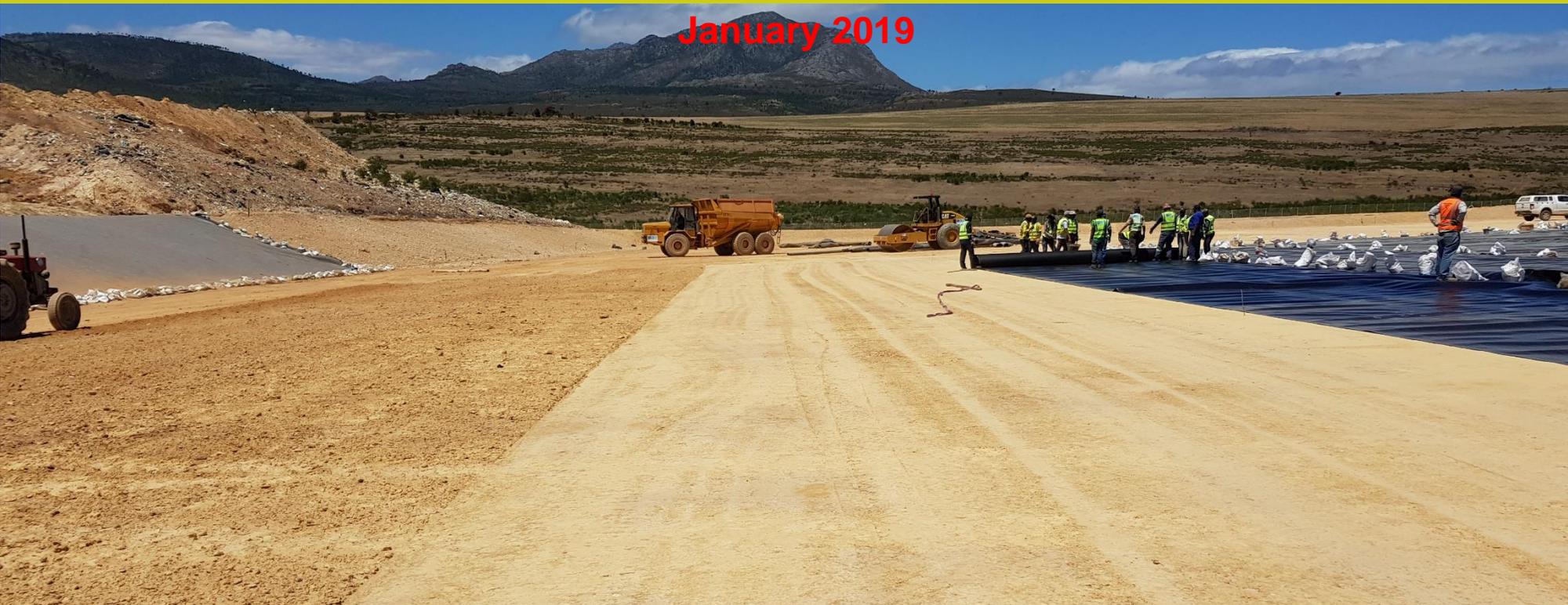
LAWTIG Seminar – What it takes to build a landfill



January 2019



January 2019



February 2019



February 2019





QA/QC – On site compaction and moisture content testing using Troxler testing apparatus

(Photo not from Karwyderskraal Construction)

Compaction and water content tests must be done at a frequency of at least three tests per hectare per layer. The cost of the tests shall be included in the placing and compaction rate.



STEYN-WILSON
LABORATORIES

CIVIL ENGINEERING TESTING LABORATORIES



11 Gooderson Road Blackheath
PO Box 58 Blackheath 7581
Tel: 021 905 0435
Fax: 086 499 9482
Email: admin@steynwilson.co.za
Web: www.steynwilson.co.za

JOB NO	SW02197	YOUR REF.	1869 - 97	DATE	06.11.18
CLIENT:	JVZ Construction (Pty) Ltd P.O. Box 37 Wellington 7654	PROJECT	Karwyderskraal	TROXLER SR NO	Troxler 3411B (8440)
ATTENTION:	Mr Louden Faro	MS/DS.	462-1663	BALANCE NO	AC1 - 0015
		OVEN NO	AB1 - 0010		

IN-PLACE DENSITY AND MOISTURE CONTENT OF SOIL AND GRAVEL BY NUCLEAR METHOD SANS 3001 : NG5 / GR20

SECTION 1

Date	03.11.18	03.11.18	03.11.18	03.11.18					
Road Name / Section	TP 7	TP 8	TP 9	TP 10					
SV	Y: 14980 - X: 3801320	Y: 15040- X: 3801360	Y: 15080 - X: 3801400	Y: 15080 - X: 3801360					
Layer	Clay Layer 4	Clay Layer 4	Clay Layer 4	Clay Layer 4					
Depth Tested (mm)	0-150mm	0-150mm	0-150mm	0-150mm					
Actual Depth of Layer (mm)	-	-	-	-					
Offset/Lane	-	-	-	-					

Example of Compaction Test Results

DENSITY MEASUREMENT

Average Moisture Content (%)	14,5	13,5	13,4	14,5					
Average Wet Density (kg/m ³)	2014	2012	2009	2070					
Average Dry Density (kg/m ³)	1759	1773	1772	1808					

LABORATORY MOISTURE CONTENT SANS 3001 GR20

Actual Moisture content	12,8	12,1	12,0	13,6					
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COMPACTION DATA

Dry Density (kg/m ³)	1785	1795	1794	1822					
PROCTOR (Kg/m ³)	1776	1776	1776	1776					
O.M.C.	10,8%	10,8%	10,8%	10,8%					
Relative Compaction (%)	100,5	101,1	101,0	102,6					



QA/QC – On site permeability testing using double ring infiltrometer testing apparatus

(Photo not from Karwyderskraal Construction)

The frequency of the permeability tests on the clay layers shall be at least **three tests per hectare per layer**. The cost of the tests shall be included in the rate for placing and compaction.



JOB No.: SWL02143 Ref No.: - DATE: 09/10/2018

CLIENT: JVZ Construction
P.O.Box 2859
PAARL
7620

PROJECT: Karwyderskraal Landfill

ATTENTION: Mr LLEWELLYN REESBERG

DOUBLE RING INFILTROMETER ASTM D3385-03

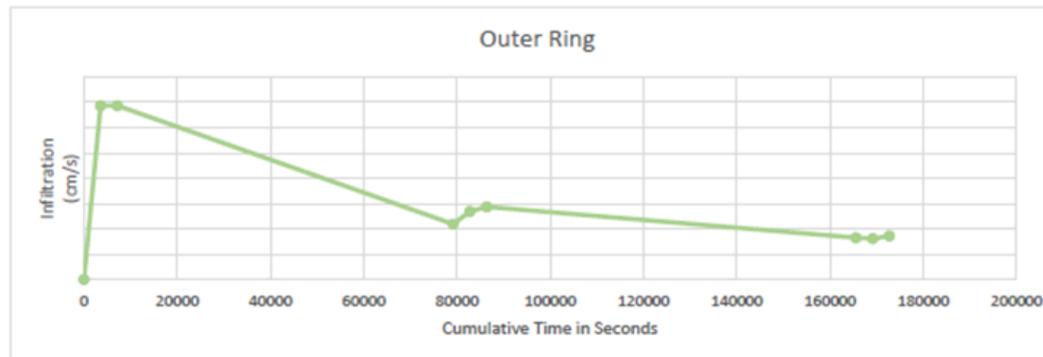
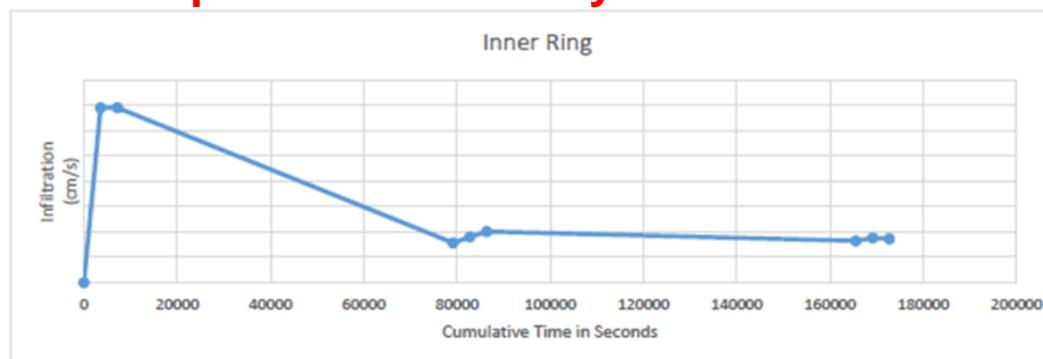
TEST Position: TP3 : Y-14900,000; X3801360,000
Layer: Clay Layer 1

TEST Ring Set No.: CLU3-0004

Example of Permeability Test Results

Inner Ring			
Time in Hours	Cumulative time in Seconds	Level Reading (cm)	Infiltration (cm/s)
0	0	4,8	0
1	3600	4,9	3,45E-07
2	7200	5,0	3,45E-07
22	79200	5,3	7,85E-08
23	82800	5,4	9,01E-08
24	86400	5,5	1,01E-07
46	165600	5,9	8,26E-08
47	169200	6,0	8,82E-08
48	172800	6,0	8,63E-08

Outer Ring			
Time in Hours	Cumulative time in Seconds	Level Reading (cm)	Infiltration (cm/s)
0	0	5,5	0
1	3600	5,6	1,37E-07
2	7200	5,7	1,37E-07
22	79200	6,2	4,37E-08
23	82800	6,4	5,37E-08
24	86400	6,5	5,72E-08
46	165600	6,6	3,28E-08
47	169200	6,6	3,21E-08
48	172800	6,7	3,43E-08



Mr. R.Wilson
Technical Signatory



STEYN-WILSON
LABORATORY

CIVIL ENGINEERING TESTING LABORATORY

11 Gooderson Road Blackheath
PO Box 58 Blackheath 7581
Tel: 021 905 0435
Fax: 086 499 9482
Email: admin@steyn-wilson.co.za
Web: www.steyn-wilson.co.za

JOB No.: SWL02143

CLIENT: JVZ Construction
P.O.Box 2859
PAARL
7620

ATTENTION: Mr LLEWELLYN REESBERG

TEST Position: TP3 : Y-14900,000; X3801370
Layer: Clay Layer 1

DATE: 09/10/2018

PROJECT: Karwyderskraal Landfill

Testing Set No.: CLU3-0004

Permeability Test Results

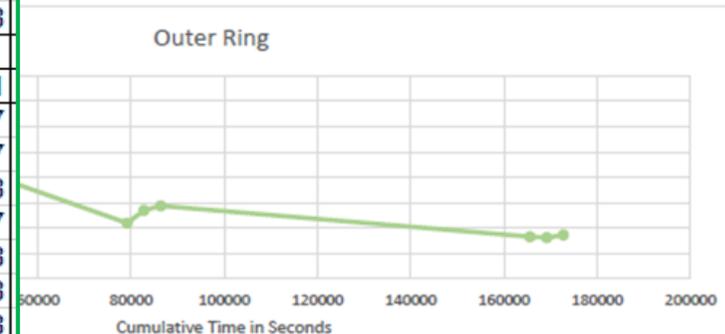
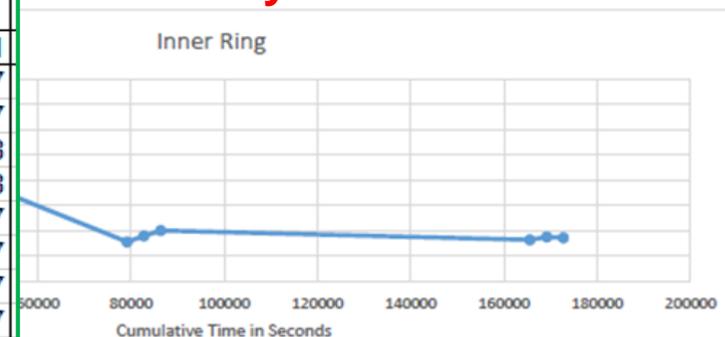
Inner Ring		
Time in Hours	Cumulative time in Seconds	Level Reading (cm)
0	0	4,9
1	3600	4,9
2	7200	5,0
22	79200	5,0
23	82800	5,0
24	86400	5,0
46	165600	5,0
47	169200	6,0
48	172800	6,0

Outer Ring		
Time in Hours	Cumulative time in Seconds	Level Reading (cm)
0	0	5,0
1	3600	5,0
2	7200	5,0
22	79200	6,0
23	82800	6,0
24	86400	6,0
46	165600	6,0
47	169200	6,0
48	172800	6,0

Base Preparation Layer		Permeability	
Y	X	Specified	Measured
-14825.697	3801333.225	1.00E-06	4.39E-07
-14954.452	3801412.697	1.00E-06	3.45E-07
-14858.979	3801411.654	1.00E-06	3.31E-07
-15071.147	3801404.754	1.00E-06	4.61E-07
-14895.497	3801348.546	1.00E-06	2.30E-07
-15000.185	3801384.930	1.00E-06	2.59E-07
-14890.243	3801427.260	1.00E-06	3.09E-07
-15046.815	3801342.859	1.00E-06	2.45E-07
-14897.352	3801393.507	1.00E-06	3.31E-07
-14925.102	3801374.504	1.00E-06	2.37E-07

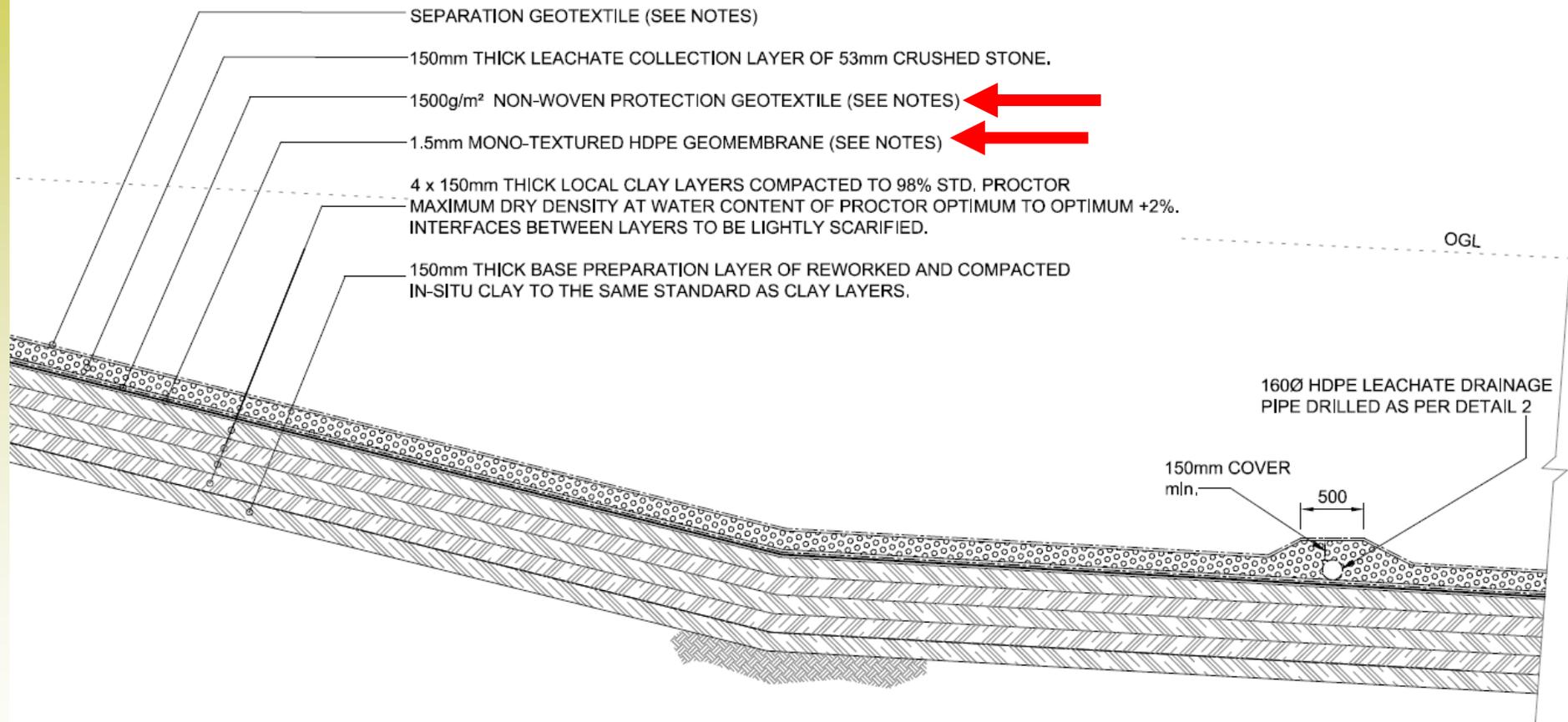
Layer 1		Permeability	
Y	X	Specified	Measured
-14840.000	3801370.000	1.00E-06	1.15E-07
-14900.000	3801400.000	1.00E-06	1.01E-07
-14900.000	3801360.000	1.00E-06	8.63E-08
-14900.000	3801320.000	1.00E-06	8.63E-08
-14980.000	3801420.000	1.00E-06	2.23E-07
-14980.000	3801380.000	1.00E-06	1.73E-07
-14980.000	3801340.000	1.00E-06	1.15E-07
-15060.000	3801400.000	1.00E-06	1.94E-07
-15060.000	3801360.000	1.00E-06	8.63E-08
-15060.000	3801360.000	1.00E-06	8.63E-08

Layer 2		Permeability	
Y	X	Specified	Measured
-14820.000	3801340.000	1.00E-06	1.08E-07
-14860.000	3801400.000	1.00E-06	1.01E-07
-14940.000	3801420.000	1.00E-06	7.20E-08
-14920.000	3801380.000	1.00E-06	1.15E-07
-14900.000	3801340.000	1.00E-06	9.35E-08
-15000.000	3801400.000	1.00E-06	9.35E-08
-14980.000	3801360.000	1.00E-06	8.63E-08
-14960.000	3801320.000	1.00E-06	1.73E-07
-15080.000	3801420.000	1.00E-06	1.08E-07
-15020.000	3801340.000	1.00E-06	1.15E-07



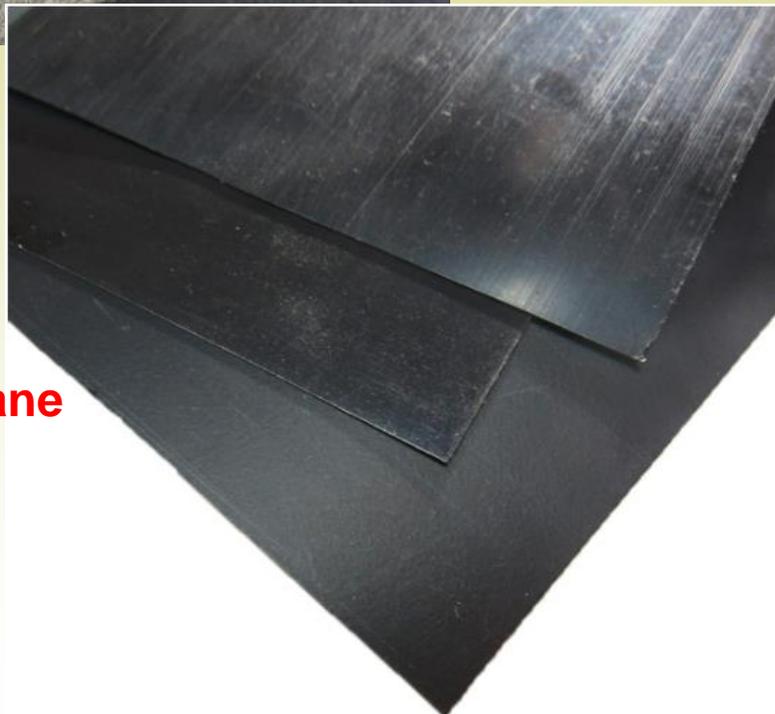
Mr. R. Wilson
Technical Signatory

Layerworks Design





Geotextile



HDPE Geomembrane

1. HDPE GEOMEMBRANES

- 1.1 THICKNESS TO BE MINIMUM, NOT NOMINAL
- 1.2 MINIMUM ASPERITY HEIGHT 0,6mm AS PER ASTM D7466 UNLESS OTHERWISE SHOWN ON DRAWINGS
- 1.3 TEXTURING TO BE EMBOSSED UNLESS OTHERWISE SHOWN ON THE DRAWINGS
- 1.4 BREAK ELONGATION FOR TEXTURED GEOMEMBRANES TO BE MINIMUM 400% AS PER ASTM D6693 TYPE IV
- 1.5 PUNCTURE RESISTANCE FOR TEXTURED GEOMEMBRANES TO BE MINIMUM 450 N FOR 1,5mm AND 600 N FOR 2mm AS PER ASTM D4833
- 1.6 STANDARD OIT TO BE 200 MINUTES AS PER ASTM D3895
- 1.7 HP OIT TO BE 600 MINUTES AS PER ASTM D5885
- 1.8 STRESS CRACK RESISTANCE TO BE MIN. 1000hrs AS PER ASTM D5397
- 1.9 THE FOLLOWING CONFORMANCE TESTS TO BE DONE AND APPROVED PRIOR TO SHIPMENT AND ALSO ON ARRIVAL OF MATERIAL ON SITE:

PARAMETER METHOD

THICKNESS:
SMOOTH ASTM D5199
TEXTURED ASTM D5994

DENSITY	ASTM D1505
CARBON BLACK CONTENT	ASTM D1603
CARBON BLACK DISPERSION	ASTM D5596
STRESS CRACK RESISTANCE	ASTM D5397 (Mod.)
TENSILE PROPERTIES	ASTM D6693
MODIFIED TENSILE TEST DONE AT A STRAIN RATE OF 300mm / min TO CONFIRM NO SIP DELAMINATION	
OXIDITIVE INDUCTION TIME (OIT)	ASTM D3895
HIGH PRESSURE OIT	ASTM D5885
ASPERITY HEIGHT	ASTM D7466

- 1.10 THE FOLLOWING DURIBILITY TESTS TO BE CONDUCTED AS SOON AS MATERIAL IS MANUFACTURED:

OVEN AGING AT 85° (ASTM D5721)
STANDARD OIT 55% RETAINED AFTER 90 DAYS (ASTM D3895)

OVEN AGING AT 85° (ASTM D5721)
HIGH PRESSURE OIT 80% RETAINED AFTER 90 DAYS (ASTM D5885)

UV RESISTANCE HIGH PRESSURE OIT 50% RETAINED AFTER 1600 HRS (ASTM D5885)

2. GEOTEXTILES

SEPARATION GEOTEXTILES TO CONFORM TO GRI-GT13 CLASS 2

PROTECTION GEOTEXTILES TO CONFORM TO:
- 1500g/m² GRI-GT12(a)

CONFORMANCE TESTING AS INDICATED IN TABLE 1b (GRI-GT12) AND TABLE 2b (GRI-GT13) TO BE DONE AND APPROVED DURING MANUFACTURING AND ALSO ON ARRIVAL ON SITE.

January 2019



February 2019



February 2019



February 2019

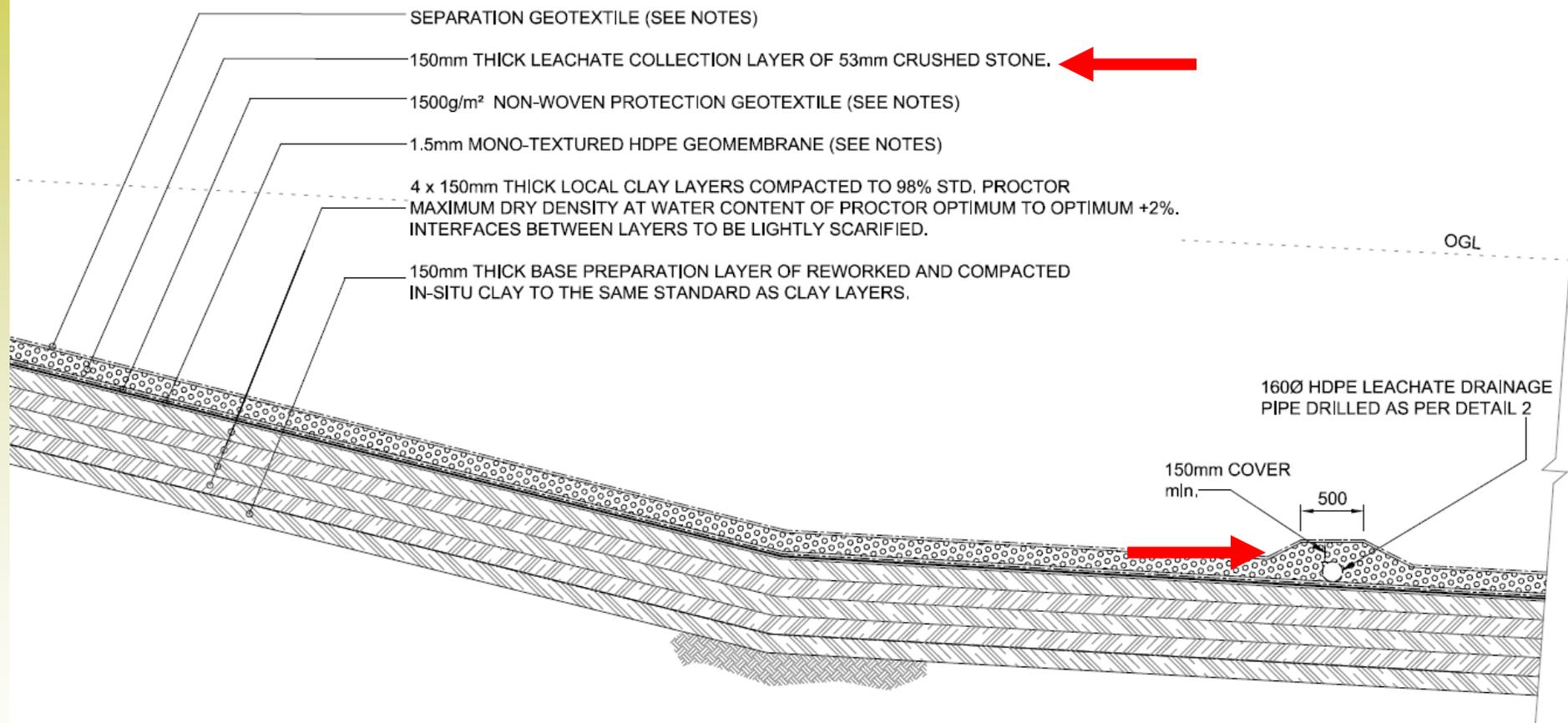


February 2019

HDPE Welding (Extrusion and Wedge)



Layerworks Design



Karwyderskraal Cell 4 – Stone Layer Spec.

a) 150mm thick leachate collection layer of 53mm crushed stone.

The material for this layer shall consist of clean 53mm gap graded stone with fines <5% and with low carbonate content.



a) 150mm thick leachate collection layer of 53mm crushed stone

Material for use as a leachate collection layer shall be placed by carefully damping the material. No compaction is required but trimming will be necessary to produce the specified thickness and tolerances. **NOTE: All stone placed on the 1:3 side slopes to be placed from the bottom to the top of the slope.**

February 2019



March 2019



March 2019



March 2019



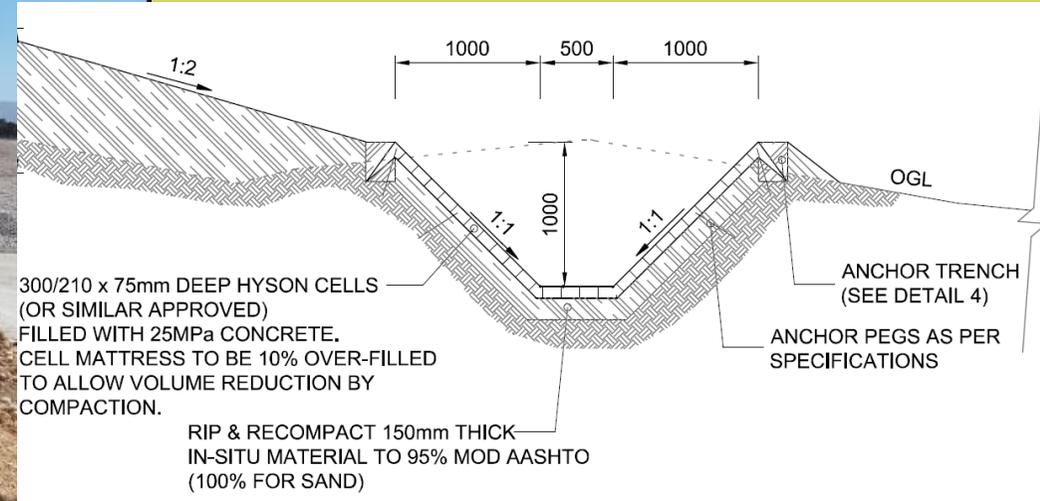
March 2019



Non-Layerworks Construction Photos

March 2019

Storm Water Channels



March 2019

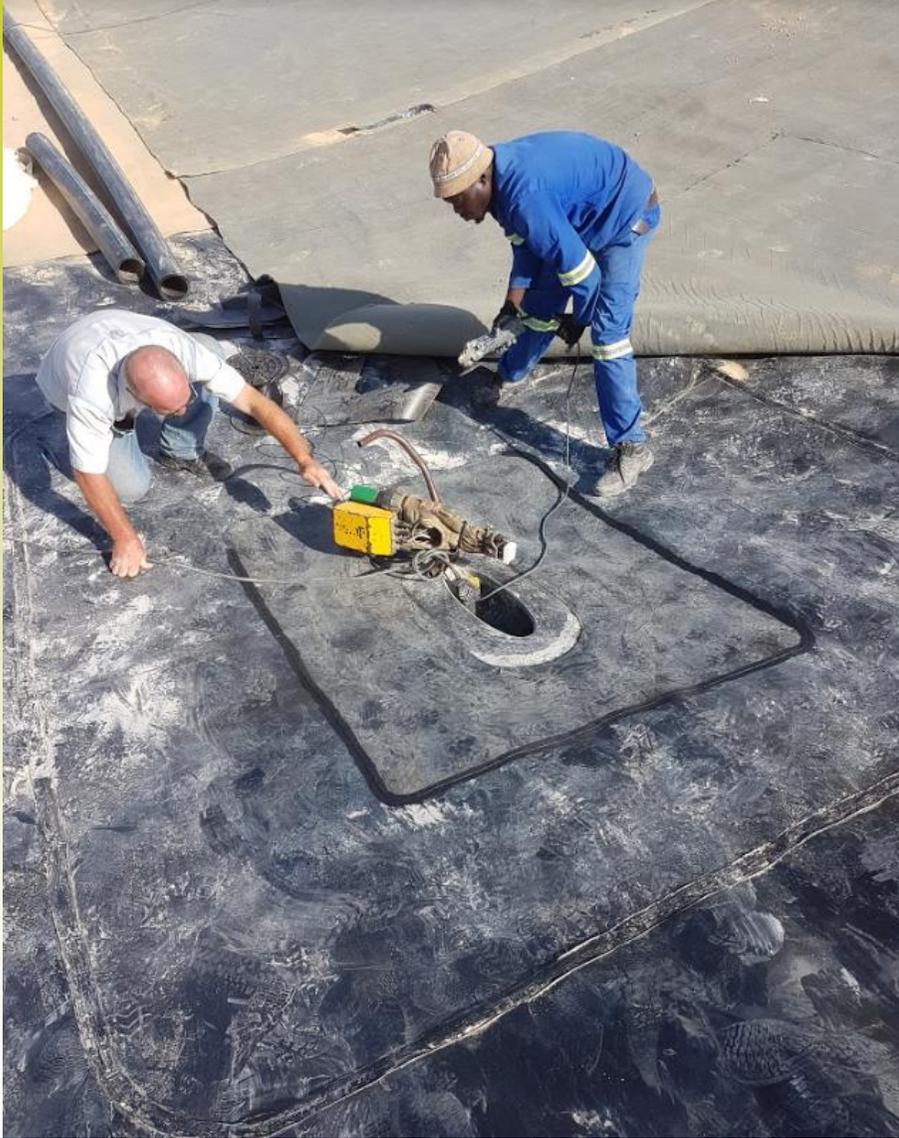


Leachate Manhole and Pipe Penetration



March 2019

Leachate Manhole and Pipe Penetration



End and Drone Videos

Thank You !

