Ackermans DC

Erf 3865, formerly Portion 9 erf 441, Hagley, Cape Town

Stormwater Management Plan

Revision A
October 2022

Prepared for:

Ackermans
Kuils River
Cape Town
7579

Prepared by:

KLS Consulting Engineers
13 Pasita Street
Rosenpark
7550
Author: Jaco Schoeman
Email: jaco@kls.co.za
Tell: 021 812 5300

CONTENTS:

1. INTRODUCTION

KLS Consulting Engineers has been appointed by Ackermans (Pty) Ltd to compile compile the Stormwater Management Report for the proposed Distribution Centre development on Erf 3865, Hagley, Cape Town.

The purpose of this report is to address stormwater issues generated from the development and to discuss the general stormwater management measures to be implemented.

Please note that this report and calculations is based on the whole developed site including all future phases. Some of the drawings, however, only indicates Phase 1. Please refer Site Development Plan for all phases.

The effective management of stormwater run-off generated from the development site will ensure that downstream water courses and ecosystems are protected while also implementing critical measures to ensure that the development is protected against events of abnormal rainfall and flooding.

The following guidelines have been used in the stormwater design and management implementation of this development:

- TOPOGRAPHICAL SURVEY OF THE PROPOSED DEVELOPMENT SITE COMPILED BY DH+A PROFESSIONAL LAND SURVEYORS
- SITE DEVELOPMENT PLAN COMPILED BY TC RPV ARCHITECTS
- GEOTECHNICAL REPORT COMPILED BY R.A. BRADSHAW & ASSOCIATES
- THE STANDARD STORMWATER GUIDELINES FOR RESIDENTIAL DEVELOPMENTS AS GIVEN IN THE "GUIDELINES FOR HUMAN SETTLEMENT PLANNING AND DESIGN" *(CSIR "RED BOOK")*
- THE ROADS DRAINAGE MANUAL PUBLISHED BY THE SOUTH AFRICAN NATIONAL ROADS AGENCY
- RAINFALL DATA AS PROVIDED BY THE SOUTH AFRICAN WEATHERBOARD
- GEORGIAN STORMWATER MANUAL VOLUME 2

2 DESCRIPTION OF THE PRE-DEVELOPMENT SITE

2.1 Locality

The existing and proposed development is situated on Erf 3865, Hagley, Cape Town. The property is located between Blackheath (East) and Kuils River (West) with the M12 to the North.

The total size of the proposed development is approximately 6.8 ha. *Refer to figure 1 for the locality plan*.

Figure 1 - Locality Plan (Google Earth)

2.2 Topography

The topographical layout plan *(refer to **Appendix A.1**)* indicates that the site is relative flat with a low area in the middle south of the site. General levels vary between 44,5m AMSL and 42.5m AMSL over the site.

2.3 Climate

The site falls within a winter rainfall region. The closest rainfall station to the site is Kuils River rainfall station *(SAWS no:* 021326W*)*. Kuils River rainfall station is situated ±3km from the site.

Weather Services Station	Kuils River					
Weather Station number	021326 W					
MAP	566mm					
Coordinates	33° 56' ; 18° 41'					
Duration (Days)	**Return Period (years)**					
	2	**5**	**10**	**20**	**50**	**100**
1	38mm	51mm	60mm	70mm	84mm	95mm

Table 1: Kuils River Rainfall Station Details

All stormwater run-off calculations are based on rainfall data derived from the longitude and latitude coordinates, as well as the Intensity-Duration-Frequency *(IDF)* curve for the Cape Town region.

The mean annual precipitation is 566mm.

*Refer to **Appendix B** for the **Stormwater Run-off and Attenuation Calculations**.*

2.4 Cover Type

The site is already developed, the existing building and hardstand areas will be demolished for the proposed development. Pre-Development cover will be assumed to be the same as undeveloped areas located in the region. This will be used as the base to align the SWMP to best practice principles and practices as required.

2.5 Soil permeability and subsurface water

A geotechnical investigation was conducted by R.A Bradshaw & Associates in June 2022 (refer to Appendix D for the geotechnical investigation report). The presence of various structures, services and materials limited the positions where trial pits could be excavated. Twelve trial pits were excavated with a backacter loader, with depths roughly between 0.5m and 2m. Concrete was encountered below the surfacing materials in TP7, TP8, TP9 and near TP4.

The natural soil profile comprises an assemblage of sandy soils overlying the residual soils and weathered bedrock of the Malmesbury Group at depth. The natural soils are overlain by gravelly and concrete surfacing and imported fill materials.

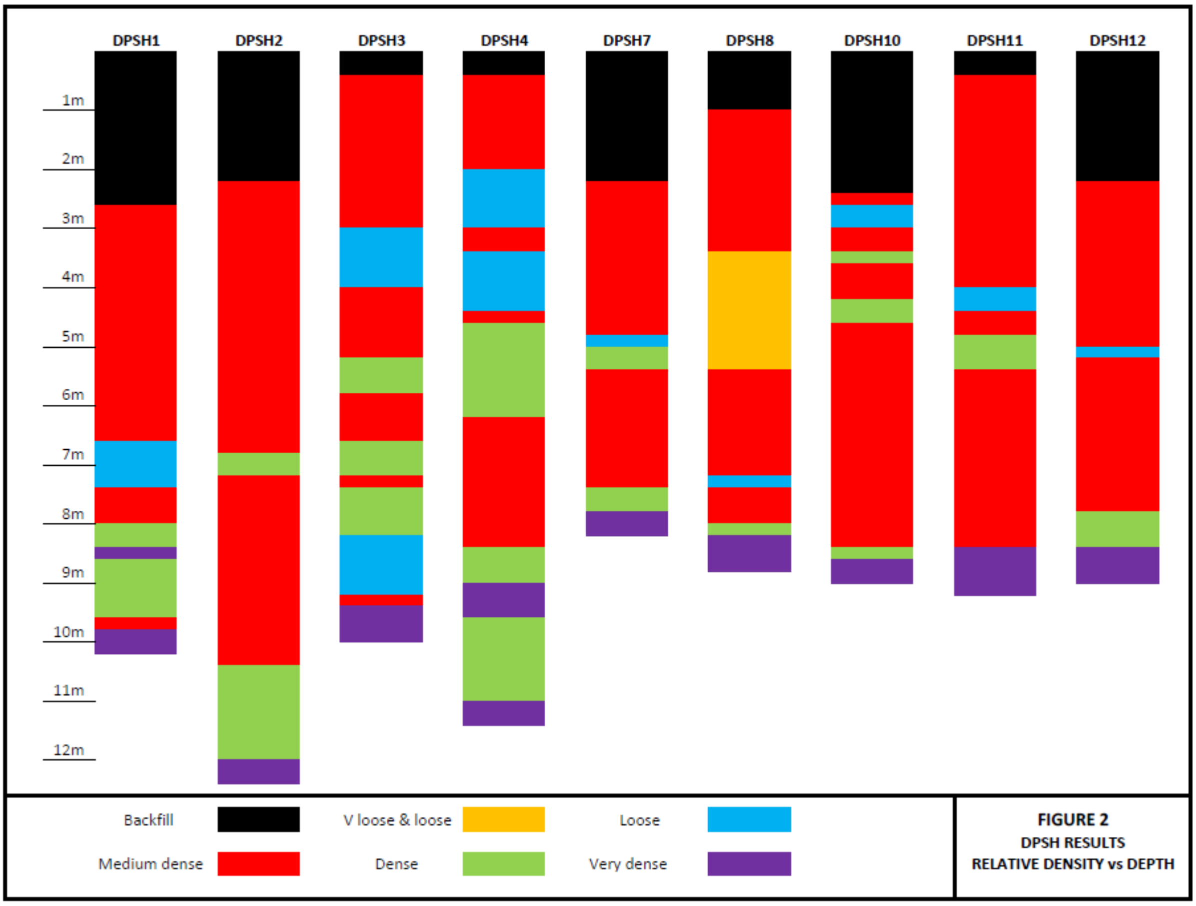


Figure 2: Soil profile from test pits

No groundwater was encountered in any of the trial pits as well as on the DCP probe when it was withdrawn from the ground. The groundwater at the time of the investigations is therefore occurring at depths greater than 3m. The Kuilsrivier lies relatively close to the site and experience elsewhere in the area has shown that perched water can occur at depths significantly shallower than 3m.

No evidence, such as the occurrence of ferricrete or staining of the shallow soils, was observed in the exposures in the trial pits to indicate the occurrence of seasonal shallow water. Provision of shallow subsurface drainage is therefore not anticipated.

2.6 Management of 1: 100-year flood from adjacent properties

The 1: 100-year flood line falls outside of the development site and should not adversely affect the development. During a 1: 100-year rainfall event, the normal overland flow routes and drainage patterns will not apply as the run-off will be too big for the normal flow routes, channels, and even roads.

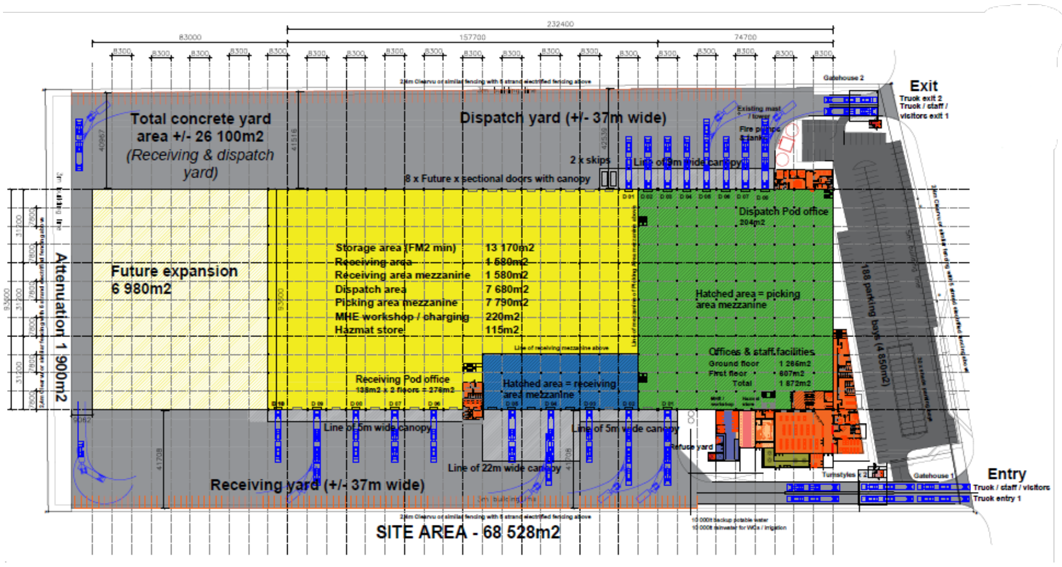
Given the natural fall of the land surrounding the site it is anticipated that no overland run-off from the erven and roadways bounding the site, will enter the site.

The 1: 100-year run-off generated from the development site will also not have an adverse effect on any adjacent properties as the run-off will be released in the western section of the site, which will ultimately discharge run-off into the Kuilsriver (Eerste).

3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

The proposed development comprises of the construction of the following distribution centre (refer to Appendix C for the detailed Site Development Plan):

ACKERMANS WAREHOUSE :	34 603m2
Storage area (FM2 min)	13 170m2
Receiving area	1 580m2
Receiving area mezzanine	1 580m2
Dispatch area	7 680m2
Picking area mezzanine	7 790m2
Office / staff facilities	1 872m2 (2 x floors)
Receiving pod office	317m2 (2 x floors)
Dispatch pod office	204m2
Gatehouse 1 & 2	34m2 (excl. canopy)
Refuse yard & pump house	41m2
MHE workshop / charging	220m2
Hazmat store	115m2



4. STORMWATER MANAGEMENT

4.1 Design philosophy

The standard stormwater principles, as set out by the guidelines mentioned in section 1 of this document, was employed for the design of the internal stormwater system.

The stormwater detail design made allowance for the creation of low and high points to the roads, parking areas and marshalling yards, to make provision for adequate cross falls and longitudinal slopes to meet the minimum standards for effective stormwater drainage.

The following minimum specifications were implemented in the stormwater infrastructure design:

- Box Culverts
- Minimum velocity - 0.7m/s
- Maximum spacing between manholes/inlets/catch pits – 90m

Refer to ***Appendix A.3****:* ***Roads & Stormwater Layout.***

4.2 Subsoil Drainage

The geotechnical investigation stated that no groundwater was encountered in any of the trial pits excavated.

The possible subsoil network at the permeable paved parking area will consist of 110mm diameter perforated pipes connecting to the stormwater system.

The discharge volume and flow-rate of the subsurface water into the subsoil drains will not be significant and will not have an impact on the sizing of the stormwater pipelines nor the attenuation volumes.

4.3 Minor Flows (1:10 year and smaller rainfall events)

The development will create relatively large impervious areas that will substantially increase the stormwater run-off from the site. Stormwater run-off, however, will be concentrated in certain areas, for example at low points in the parking areas and marshalling yards.

Stormwater run-off from the impervious areas will be routed to low points with inlets towards the underground stormwater network into the attenuation facilities, located on the western boundary of the site.

The internal stormwater system consists mainly of an underground gravity culvert network, permeable paving in the parking area and inlet structures which drains the roads and marshalling yards. This system was designed to have sufficient capacity to convey a 1:10-year rainfall event *(this is defined as a rainstorm which has a 10% chance to occur)*.

4.4 Major Flows (Larger than 1:10-year rainfall events)

During rainfall events with a return period larger than 1:10-years, the proposed roads, marshalling yards, parking areas will act as overland flow routes which will channel, attenuate and ultimately discharge the surface run-off via predetermined escape routes into the attenuation facilities. The design of these dams will make allowance to adequately manage the 1:50-year rainfall event. (refer to ***Appendix A.4*** *for the* ***Overland Flow- and Emergency Escape Route Layout****)*.

4.5 Attenuation

A stormwater attenuation facility/dam will be constructed on the western boundary of the site and will operate as dry extended detention facility.

The main purpose of these facilities will be to retain the difference between a 1:10-year pre-development and 1: 50-year post-development flood. The attenuation dam is classified as a dry dam, with extended storage available to effectively attenuate large floods (up to a 1: 50-year flood).

This facility will effectively manage stormwater run-off up to 1: 100-year rainfall events and attenuate up to 1: 50-year rainfall events. The outlet structure of the attenuation facility will govern the outflow to not exceed the 1: 10-year pre-development flow for the overall development.

After conducting dam sizing calculations with reference to the South African Drainage Manual, a minimum storage volume of 486m^3 is required.

- Attenuation Dam **A** (Theoretical)
    - Catchment Area: 68 000m^2
    - Pre-development run-off (1:10 year): 0.534 m^3/s
    - Post-development run-off (1:50 year): 1.405 m^3/s

- Storage volume required: *486 m^3*
- **Storage volume Provided: 1300 m^3**

The attenuation dam has an emergency overflow which has the capacity to discharge the run-off generated from rainfall events larger than 1:50 years, up to a maximum of a 1:100-year rainfall event. The emergency outflow will release excess run-off as surface discharge onto the surrounding area which discharges into the existing open stormwater canal to the south-east of the site.

The total attenuation volume provided on site will be 1300m^3. This satisfies the minimum requirement as calculated by making use of the Rational Method. (South African Drainage Manual) (486m^3).

4.6 Outlet Structures – Inlets into the Attenuation Facility

The stormwater from the underground culvert network will discharge through 4 separate outlet structures directly into the attenuation dams.

4.7 Outlets into the Municipal Stormwater Network

The attenuation dam outlets will be discharging to the westerly direction of the site. The outlet capacity of the attenuation dam will be capped at 350l/s by limiting the outlet sizing @ 41.5m Invert level to reduce run-off.
*(Refer to **Appendix B** for the **Stormwater Run-off Calculations**).*

5. CONCLUSION

The planning and design of stormwater elements is a holistic process which incorporates much more than the infrastructure elements required in adequately dealing with stormwater run-off.

Our stormwater design and management plan were based on standard stormwater design principles as set out by the guidelines mentioned in section 1 of this document. We have generally strived to comply with the design requirements of the City of Cape Town Municipality, and we are confident that the proposed stormwater design and management plan achieves and satisfies the requirements.

KLS will be actively involved with construction supervision to ensure that all elements conform to our design specifications.

<u>APPENDIX A – LAYOUT DRAWINGS</u>

A.1 – Topographical Survey
A.2 – Pavement Design
A.3 – Stormwater Layout
A.4 – Overland Flow- and Emergency Escape-Routes

TOPOGRAPHICAL SURVEY
ERF 3856 HAGLEY

Situate in the City of Cape Town
Administrative District of Stellenbosch
Province of Western Cape

NOTES

1. 43.52 denotes lidar data
2. 44.13 denotes surveyed data
3. Buildings have been taken from aerial imagery

SITE DATA

SIDES Metres		ANGLES OF DIRECTION	CO-ORDINATES Y System WG 19° X		
		CONSTANTS		0,00	+3 700 000,00
AB	360,03	271 14 00	A	+30 653,29	+58 944,11
BC	50,45	348 07 00	B	+30 293,34	+58 951,86
CD	44,63	350 59 20	C	+30 282,95	+59 001,23
DE	91,01	351 34 00	D	+30 275,96	+59 045,31
EF	394,61	91 35 50	E	+30 262,61	+59 135,34
FA	180,26	181 11 50	F	+30 657,06	+59 124,33

BENCH MARKS - WG19

NAME	CO-ORDINATES Y Constant 0.00	X +3 700 000.00	HEIGHT (msl)	DESCRIPTIONS
WP8	+30 444.76	+59 124.93	42.46	12mm drill hole in concrete
WP1	+30 384.29	+58 958.36	43.70	roofing screw in concrete
WP3	+30 446.63	+58 969.69	42.94	roofing screw in concrete

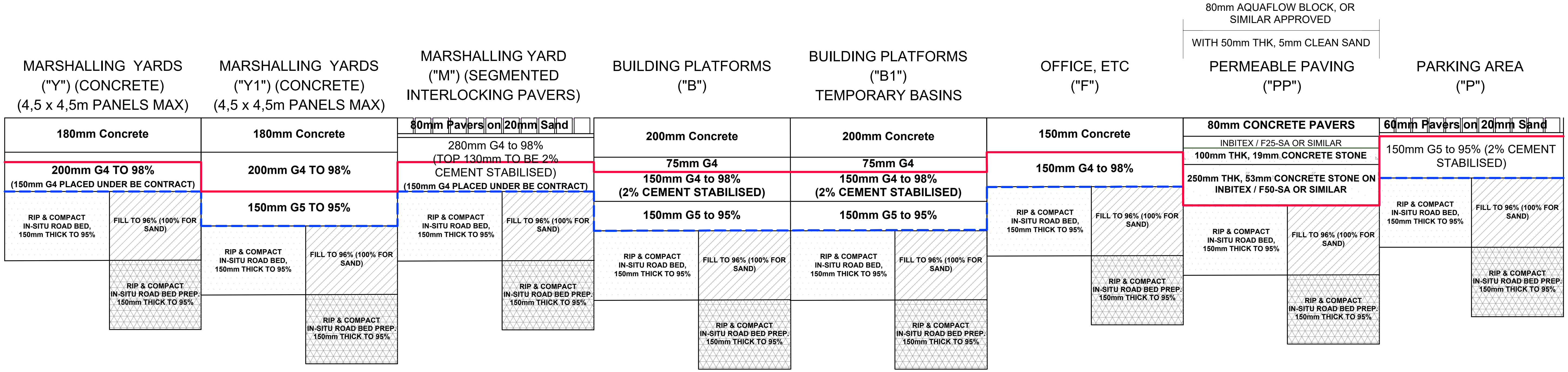
HEIGHT DATUM : MEAN SEA LEVEL
HEIGHTS ARE LINKED TO TOWN SURVEY MARK 49DC24

date	03 June 2022
scale	1 / 400 (A0)
drawing ref & no.	L12919/Topo Plan (fa)

david hellig+abrahamse
professional land surveyors
2nd floor wale street chambers
38 wale street, cape town
Tel : +27 021 426 2613
info@dhaa.co.za www.dhale.co.za

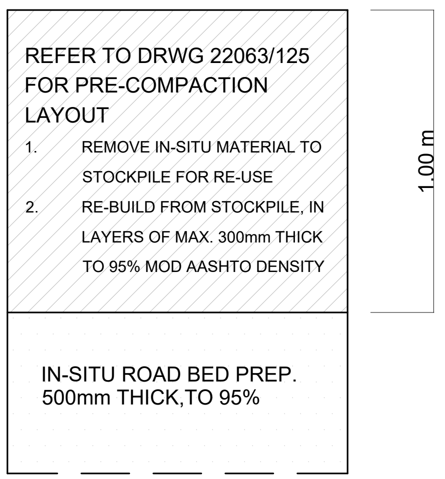
NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRWG NO 22063/150 SERIES
2. BALANCE OF BULK EARTHWORKS FOOTPRINT TO BE PAVING/VEGETATION/LANDSCAPING, BY OTHERS
3. SURFACE BED DETAILS TO BE IN ACCORDANCE WITH STRUCTURAL ENG's DETAILS
4. ALLOWABLE LEVEL TOLERANCE ON ALL LAYERWORKS: +-15mm



TYPICAL CROSS SECTION THROUGH LAYERWORKS

PRE-COMPACTION ("A")



PRE-COMPACTION (EXTEND 3m BEYOND BUILDING FOOTPRINT)

1. PRE-COMPACTION OF INSITU ROADBED IN FILL: AREA IN FILL TO BE COMPACTED PRIOR TO FILLING BY MEANS OF 10 PASSES WITH A 20 TON ROLLER TO ACHIEVE PROPER COMPACTION OF INSITU MATERIAL
2. PRE-COMPACTION OF INSITU ROADBED IN CUT: AREA IN CUT TO BE COMPACTED AFTER REACHING FINAL CUT LEVEL BY MEANS OF 10 PASSES WITH A 20 TON ROLLER TO ACHIEVE PROPER COMPACTION OF INSITU MATERIAL

EXTENT OF BULK EARTHWORKS CONTRACT

BULK EARTHWORKS DESIGN LEVEL (SETTING OUT "Z" HEIGHT)

No. Nr.	REVISION / WYSIGING	DATE DATUM	AUTHOR OUTEUR
A	FOR INFORMATION	14/07/2022	T.M.D

ACKERMANS DISTRIBUTION CENTRE, ERF 3865, HAGLEY

PAVEMENT DESIGN TYPICAL X-SECTIONS

kls CONSULTING ENGINEERS progress delivered
2nd Floor Avanti South Block
35 Carl Cronje Drive
Tygervalley 7536
Cape Town: +27(0)21 948 0900
Gauteng: +27(0)12 346 1672
Website: www.kls.co.za
e-mail: info@kls.co.za

DRAWN GETEKEN	T. Mac Donald
CHECKED NAGESIEN	J. Malherbe
DATE DATUM	JULY 2022
SCALE SKAAL	NTS (A3)
DRG. No. TEK. Nr.	22063/160
REVISION No. WYSIGING Nr.	A

B1	**BUILDING PLATFORM** - FUTURE PHASE
B	**BUILDING PLATFORM** - NEW
F	**OFFICE PLATFORM** - NEW
Y	**MARSHALLING YARDS** - 4.5X4.5m PANELS MAX
PP	**PERMEABLE PAVING** - 80mm AQUAFLOW BLOCK/SIMILAR

NOTES:

1. REFER TO TYPICAL DETAILS DRWG's No: 22063/160 FOR PAVEMENT DESIGN X-SECTIONS

No. Nr.	REVISION / WYSIGING	DATE DATUM	AUTHOR OUTEUR
B	UPDATED SERVICES LAYOUTS	11/10/2022	JS
A	FOR MEASUREMENT	14/07/2022	C.S

kls CONSULTING ENGINEERS
progress delivered
13 Pasita Street
Rosenpark, Cape Town 7550
Cape Town: +27(0)21 948 0900
Gauteng: +27(0)12 346 1672
Website: www.kls.co.za
e-mail: info@kls.co.za

PAVEMENT DESIGN LAYOUT

APPROVED BY | SIGNATURE | PROF. NUMBER | DATE

ACKERMANS DISTRIBUTION CENTRE,
ERF 3865, HAGLEY

DRAWN GETEKEN	C.A.S.	CHECKED NAGESIEN	J.M.M.	DATE DATUM	14/07/2022
DRG. No. TEK. Nr.	22063/150			SCALE SKAAL	1:500 (A1)
				REVISION No. WYSIGING Nr.	B

K:\22063_Ackermans DC\2_Siviel\2i_Autocad\22063_Meester_2022-10-11.dwg

LEGEND

- STORMWATER LINE (uPVC CLASS 34) 375mm Ø / BOX CULVERT (UNLESS OTHERWISE SHOWN)
- SW16 / 65.418 / 63.842 / 1.576 — SW MANHOLE (NUMBER, COVER- , INVERT LEVEL & DEPTH)
- SW OUTLET STRUCTURE
- DOUBLE GRID INLET
- DOUBLE KERB INLET
- R.E. — PRIMARY SUBSOIL (160mm Ø) WITH 500mm FIN & RODDING EYE
- FOULSEWER (uPVC Heavy Duty class 34) 160mm Ø (UNLESS OTHERWISE SHOWN)
- FS7 / 64.242 / 63.200 / 1.042 — FOULSEWER MANHOLE 750mm DIA (NUMBER, COVER - , INVERT LEVEL & DEPTH)
- 110 DIA uPVC CLASS 12 WATERLINES (UNLESS OTHERWISE SHOWN)
- 100mm BULK WATER METER (AS PER CoCT SPECIFICATIONS)
- GATE VALVE & CHAMBER (AS PER CoCT STANDARD DETAIL W1)
- GATE VALVE WITH HAND WHEEL IN CHAMBER
- FH — FIRE HYDRANT & CHAMBER (AS PER CoCT STANDARD DETAIL W2)
- FIRE BOOSTER CONNECTION
- NON RETURN VALVE

GENERAL NOTES:

ALL WORK TO BE IN ACCORDANCE WITH SABS 1200

REFER TO DRWG's No:

122063/110 FOR TOPOGRAPHICAL SURVEY AND SERVICES LAYOUT

22063/150 - SERIES FOR PAVEMENT DESIGN LAYOUT

22063/160 FOR PAVEMENT DESIGN TYPICAL X-SECTIONS

22063/200 FOR ROADS AND SERVICES LAYOUT

CONTRACTOR TO APPLY AND OBTAIN WAYLEAVES BEFORE CONSTRUCTION MAY COMMENCE AND MUNICIPAL SERVICES ARE EXPOSED OR CONNECTED TO.

ALL EXISTING SERVICES IN THE VICINITY OF THE WORKS TO BE EXPOSED, LOCATION AND DETAILS RECORDED, REPORTED TO ENGINEER FOR APPROVAL, PRIOR TO START OF ANY EXCAVATION IN THE VICINITY OF SERVICES.

SPECIAL CARE TO BE TAKEN TO AVOID THE TRAPPING OF RAIN WATER, BY PLANNING THE WORKS PROPERLY, AND BY INSTALLING TEMPORARY CUT-OFF DRAINS IF REQUIRED, ETC.

SERVICES SETTING OUT COORDINATES REFER TO CENTRE OF MANHOLE, CENTRE OF KERB INLET OR CENTRE OF GRID INLET IF NOT AGAINST KERB.

SEWER BUILDING CONNECTIONS TO BE AT 1:60 SLOPE.

SEWER MANHOLES SHALL BE FIBRE CEMENT SOLID SHAFT AND BASE TYPE MANHOLES AS PER DETAIL S2. (PRECAST CONCRETE RING MANHOLES ARE NOT ALLOWED)

ALL COVERS AND FRAMES TO BE HEAVY DUTY DUCTILE IRON WITH HINGED COVER IN COMPLIANCE WITH EN124-D400.

WHERE CONNECTION TO AN EXISTING SEWER MANHOLE IS TO BE MADE, FLEXIBLE uPVC COUPLING SHALL BE BUILT INTO EXISTING MANHOLE (SEALED WITH EPOXY), THE MANHOLE BENCHING MODIFIED ACCORDINGLY, EXISTING SEWAGE FLOW HANDLED/MAINTAINED AND FOREIGN MATERIAL PREVENTED FROM ENTERING THE SEWAGE SYSTEM AT ALL TIMES.

MINIMUM COVER TO WATER PIPES TO BE 800mm

BEDDING C2 IN ACCORDANCE WITH TYPICAL DETAIL DRWG No. GEN-2, TO APPLY TO ALL UNDERGROUND SERVICES, UNLESS OTHERWISE SHOWN

STEP IRONS MUST BE INSTALLED WHERE MANHOLES ARE DEEPER THAN 1m (ON DOWNSTREAM SIDE)

MIN COVER ON SLEEVES TO BE 600mm IN WALKWAYS AND LANDSCAPING AREAS AND 800mm IN ROADWAYS

REFER A4 BOOKLET FOR TYPICAL DETAILS

No. Nr.	REVISION / WYSIGING	DATE DATUM	AUTHOR OUTEUR
D	FIREWATER RETICULATION MAIN ADDED	25/10/2022	JS
C	UPDATED SERVICES LAYOUTS & DESIGN CONTOURS	19/10/2022	JS
B	UPDATED SERVICES LAYOUTS	11/10/2022	JS
A	FOR MEASUREMENT	14/07/2022	C.S

kls CONSULTING ENGINEERS
progress delivered

13 Pasita Street
Rosenpark, Cape Town 7550

Cape Town: +27(0)21 948 0900
Gauteng: +27(0)12 346 1672
Website: www.kls.co.za
e-mail: info@kls.co.za

ROADS & SERVICES

APPROVED BY | SIGNATURE | PROF. NUMBER | DATE

ACKERMANS DISTRIBUTION CENTRE, ERF 3865, HAGLEY

DRAWN GETEKEN	J.S.	CHECKED NAGESIEN	J.R.	DATE DATUM	14/07/2022
DRG. No. TEK. Nr.	22063/200			SCALE SKAAL	1:500 (A1)
				REVISION No. WYSIGING Nr.	C

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OVERLAND FLOW PATH

EMERGENCY OVERLAND ESCAPE

GENERAL NOTES:

ALL WORK TO BE IN ACCORDANCE WITH SABS 1200

REFER TO DRWG's No:
122063/110 FOR TOPOGRAPHICAL SURVEY AND SERVICES LAYOUT
22063/150 - SERIES FOR PAVEMENT DESIGN LAYOUT
22063/160 FOR PAVEMENT DESIGN TYPICAL X-SECTIONS
22063/200 FOR ROADS AND SERVICES LAYOUT

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A	FOR MEASUREMENT	14/07/2022	C.S

kls CONSULTING ENGINEERS
progress delivered
13 Pasita Street
Rosenpark 7550
Cape Town: +27(0)21 812 5300
Gauteng: +27(0)12 346 1672
Website: www.kls.co.za
e-mail: info@kls.co.za

ROADS & SERVICES

ACKERMANS DISTRIBUTION CENTRE, ERF 3865, HAGLEY

DRAWN GETEKEN: C.A.S.	CHECKED NAGESIEN: J.M.M.	DATE DATUM: 14/07/2022	SCALE SKAAL: 1:500 (A1)
DRG. No. TEK. Nr.: 22063/200		REVISION No. WYSIGING Nr.: A	

APPENDIX B – STORMWATER CALCULATIONS

B.1 – Rainfall Intensity Calculations
B.2 – Run-off Coefficient Calculations
B.3 – Attenuation Capacity Calculations
B.3 – Attenuation Capacity Calculations – Capping outflow

22063 ACKERMANS
STORMWATER RAINFALL INTENSITY CALCULATIONS

Sep-22

Weather Services Station	Kuilsrivier					
Weather Station number	021326 W					
MAP	566 mm					
Coordinates	33º 56' ; 18º 41'					
Duration (Days)	**Return Period (years)**					
	2	**5**	**10**	**20**	**50**	**100**
1	38	51	60	70	84	95

1. Time of Concentration:

$$T_c = 0.604\left(\frac{rL}{S^{0.5}}\right)^{0.467} \qquad T_c = \left(\frac{0.87L^2}{1000S_{av}}\right)^{0.385} \qquad S_{av} = \left(\frac{H_{0.85L} - H_{0.1L}}{(1000)(0.75L)}\right)$$

		Pre - Dev	**Post-Development**
Roughness Coeffisient		0.47	0.89
Longest Watercourse	m	200	350
$L_{0.75}$	m	N/A	263
$H_{0.85}$	m		43.4
$H_{0.10}$	m		42.8
S_{avg}	m/m	0.0100	0.0025

Time of Concentration	hours	0.59	0.30

**SANRAL drainage manual prescribes 15min as minimum Time of Concentration*

Adjusted Time of Concentration	hour	0.59	0.30
	min	35.24	17.87

2. Modified Herschfield Formula:

$$P^t_T = 1.13 \times (0.41 + 0.64\ln T) \times (-0.11 + 0.27\ln t) \times (0.79M^{0.69} \times R^{0.2})$$

		10 year	**50 year**
P^t_T	*Precipitation Depth (mm)*	21.955	26.651
T	*Recurrence intervall in years*	10	50
t	*Rainfall duration (minutes)*	35.24	17.87
M	*Mean 24 hour maximum rainfall (1:2)*	38	38
R	*Mean number of thunder days per annum*	3	3

3. Point Intensity:

$$I_T = \frac{P^t_T}{T_c}$$

		Mod. Hers	**IDF**	**Rainfall**	**KLS**
		Rational	DF Malan	SANRAL	Chosen
I_{10} =	mm/hour	37.4	46	52	50.0
I_{50} =	mm/hour	89.5	81	72.4	80.0

22063 Ackermans DC
STORMWATER RUN-OFF COEFFICIENT CALCULATIONS

1. Pre-Development Run-Off Coeffisient

$$C_{pre} = (C_s + C_p + C_v) \times D_F \times F_t$$

		Factor	%	C
Surface Slope - Cs	Vleis and Pans (<3%)	0.01	100%	0.010
	Flat Areas (3 to 10%)	0.06	0%	
	Hilly (10 to 30%)	0.12	0%	
	Steep Areas (>30%)	0.22	0%	
Permeability - Cp	Very Permable	0.03	0%	0.201
	Permeable	0.06	0%	
	Semi Permeable	0.12	10%	
	Impermeable	0.21	90%	
Vegetation - Cv	Thick Bush and Plantation	0.03	0%	0.260
	Light Bush and Farmlands	0.07	0%	
	Grasslands	0.17	0%	
	No vegetation	0.26	100%	
			$C_s + C_p + C_v$ =	0.47

Area Adjustment Factor	F_t for flat and permeable catchments (1:10)	1.00
	C_{pre} =	**0.47**

2. Post-Development Run-Off Coeffisient

		Factor	%	C
Lawns	Sandy, Flat (<2%)	0.10	0%	0.003
	Sandy Steep (>7%)	0.20	0%	
	Heavy Soil, Flat (<2%)	0.17	2%	
	Heavy Soil, Steep (>7%)	0.35	0%	
Residential	Houses	0.50	0%	0.000
	Flats	0.70	0%	
Industrial	Light Industry	0.80	0%	0.882
	Heavy Industry	0.90	98%	
Business	City Centre	0.95	0%	0.000
	Suburban	0.70	0%	
	Streets	0.95	0%	
	Maximum Flood	1.00	0%	

Area Adjustment Factor	F_t for impermeable catchments (1:50)	1.00
	C_{post} =	**0.89**

kls CONSULTING ENGINEERS progress delivered

PROJECT 22063 ACKERMANS **Sep-22**

STORMWATER ATTENUATION FACILITY CALCULATIONS

Catchment Area	m²	68000
Time of Concentration (tc)	minutes	15
Rainfall Intensity - 10 year	mm/hour	60
Rainfall Intensity - 50 year		84
Pre-Dev Run-Off Coeff	*incl A R F*	0.47
Post-Dev Run-Off Coeff		0.89

$$Q = \frac{C \times I \times A}{3600}$$

		Dam
Pre-Development Peak Discharge	$Q_{10\ pre}$ (m^3/s)	0.534
Post Development Peak Discharge	$Q_{50\ post}$ (m^3/s)	1.405

1. DAM SIZING USING ABT GRIGG METHOD (1:50 year flood)

$$V_{st} = 60\left(\frac{1+m}{2}\right) q_{pa} t_{ca} (1-a)^2$$

Ratio of Hydrograph Recession Time =	m	**1**
Post-development Peak Discharge (1:50) =	q_{pa} (in $m^3/_{sec}$)	**1.405**
Post-development Time of Concentration =	t_{ca} (in min)	**15**
Outflow Peak Discharge (1:10) Pre-Dev =	q_{pb} (in $m^3/_{sec}$)	**0.534**
q_{pb}/q_{pa} =	*a*	**0.380**
Storage Volume Required V_{st} =	**V_{st} (in m^3)**	**486**

2. TOTAL RUN-OFF VOLUME FOR A 1:50 year flood (ASSUMING 100% Blockage)

$$V = Q \times tc$$

		Dam A
Post-development Time of Concentration =	t_{ca} (in min)	15
Post-development Peak Discharge (1:50) =	Q (in $m^3/_{sec}$)	1.405
Total Volume Required V_{st} =	**V_{st} (in m^3)**	**1264**

kls CONSULTING ENGINEERS progress delivered

PROJECT 22063 ACKERMANS

Oct-22

STORMWATER ATTENUATION FACILITY CALCULATIONS - CAPPING OUTFLOW

Catchment Area	m²	68000
Time of Concentration (tc)	minutes	15
Precipitation Depth - 5 year	millimetre	11.3
Precipitation Depth - 50 year	millimetre	18.6

Rainfall Intensity - 10 year	mm/hour	60
Rainfall Intensity - 50 year		84

Pre-Dev Run-Off Coeff	*incl A R F	0.47
Post-Dev Run-Off Coeff		0.89

$$Q = \frac{C \times I \times A}{3600}$$

		Dam
Pre-Development Peak Discharge	$Q_{10\ pre}$ (m³/s)	0.534
Post Development Peak Discharge	$Q_{50\ post}$ (m³/s)	1.405

1. DAM SIZING USING ABT GRIGG METHOD (1:50 year flood)

$$V_{st} = 60 \left(\frac{1+m}{2}\right) q_{pa} t_{ca} (1-a)^2$$

Ratio of Hydrograph Recession Time =	m	**1**
Post-development Peak Discharge (1:50) =	q_{pa} (in $m^3/_{sec}$)	**1.405**
Post-development Time of Concentration =	t_{ca} (in min)	**15**
Outflow Peak Discharge (1:10) Pre-Dev =	q_{pb} (in $m^3/_{sec}$)	**0.350**
q_{pb}/q_{pa} =	a	**0.249**
Storage Volume Required V_{st} =	**V_{st} (in m^3)**	**713**

2. TOTAL RUN-OFF VOLUME FOR A 1:50 year flood (ASSUMING 100% Blockage)

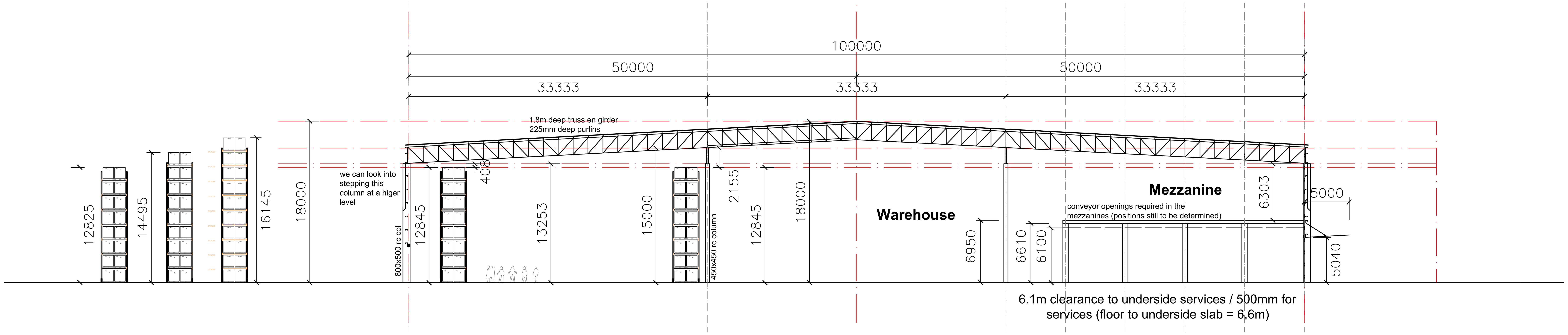
$$V = Q \times tc$$

		Dam A
Post-development Time of Concentration =	t_{ca} (in min)	15
Post-development Peak Discharge (1:50) =	Q (in $m^3/_{sec}$)	1.405
Total Volume Required V_{st} =	**V_{st} (in m^3)**	**1264**

Appendix C – Attenuation Dam Details

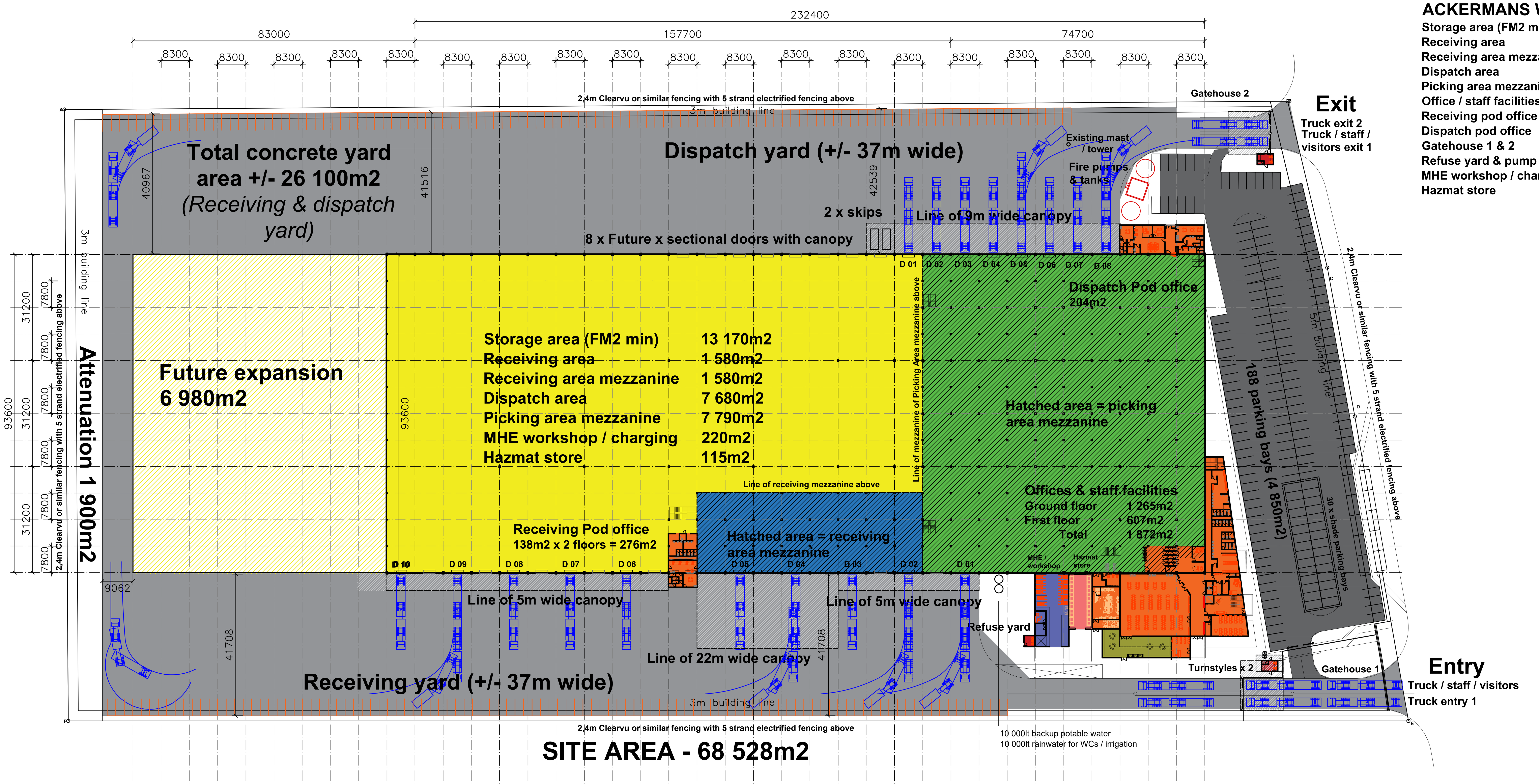
C.1 – SDP

C.2 – Attenuation Dam Layout & Section



Site Section A-A

Scale 1 : 250



Ground Storey

Scale 1 : 750

ACKERMANS WAREHOUSE : 34 603m2

Storage area (FM2 min)	13 170m2
Receiving area	1 580m2
Receiving area mezzanine	1 580m2
Dispatch area	7 680m2
Picking area mezzanine	7 790m2
Office / staff facilities	1 872m2 (2 x floors)
Receiving pod office	317m2 (2 x floors)
Dispatch pod office	204m2
Gatehouse 1 & 2	34m2 (excl. canopy)
Refuse yard & pump house	41m2
MHE workshop / charging	220m2
Hazmat store	115m2

SITE INFORMATION:

Address:	36 Nooiensfontein Road Hagley	
Site:	ERF 3865 (formerly as: Ptn 9 ERF 441)	
Zoned:	General Industrial 1	
Proposed usage:	Warehouse DC	
Occupancy:	J1	
Height Restriction:	18m	
Prop. Height:	TBC	
Building Lines:		
Front (road):	5m	
Side & Rear:	3m	
Site area:	**68 528m²**	
Allowable Coverage:	51 396m²	(75%)
Proposed Coverage:	25 875m²	(56%)
Total Coverage:	**25 521m²**	**(56%)**
Coverage in Hand:	**25 521m²**	**(19%)**
Allowable FAR:	102 792m²	(1.5)
Total FAR:	**37 201m²**	**(0.55)**
FAR in Hand:	**65 591m²**	**(0.45)**
Parking required:	=	**375 bays**
Parking Provided:	=	**408 bays**

(188 actual parkings / 220 council bays (orange)

PLEASE NOTE:

GROSS LETTABLE AREAS

TO BE CONFIRMED SUBJECT TO ACCURATE DRAWINGS STILL BE GENERATED FOR DISCUSSION ONLY

GENERAL NOTES:

1.
THIS DRAWING IS TO BE READ IN CONJUCTION WITH DRAWINGS ISSUED BY CONSULTANTS OF VARIOUS DISCIPLINES, IN PARTICULAR STRUCTURAL, ELECTRICAL, MECHANICAL AND WET SERVICES ENGINEERS.
2.
ANY DISCREPANCIES BETWEEN DRAWING LAYOUTS ARE TO BE BROUGHT TO THE ATTENTION OF THE ARCHITECTS PRIOR TO ANY WORK BEING PUT IN HAND.
3.
FIGURED DIMENSIONS ARE TO BE TAKEN IN PREFERENCE TO SCALED MEASUREMENTS AND LARGE SCALE DETAIL DRAWINGS WILL SUPERSEDE SMALL SCALE GENERAL LAYOUT DRAWINGS.
4.
CONTRACTOR AND SUBCONTRACTORS TO CHECK ALL DIMENSIONS AND LEVELS ON SITE PRIOR TO ANY WORK BEING PUT IN HAND.
5.
ALL WORK ON SITE IS TO CONFORM TO GOOD BUILDING PRACTICE AND ALL RELEVENT NATIONAL BUILDING CODES AND STANDARDS.

REVISIONS

No.	DATE	DESCRIPTION	SIGNED	APPRV.
01	2022-05-16	1. Issued for comments & discussion.	PT	PT
02	2022-07-04	1. Issued for comments & discussion.	PT	PT
03	2022-07-08	1. Gatehouse adjusted to allow for staging.	PT	PT
04	2022-07-21	1. General update of areas and adjusted design for costing.	PT	PT
05	2022-08-11	1. Changed paving to concrete hardstand for future expansion.	PT	PT
06	2022-09-09	1. Adjusted layout based on clients brief.	PT	PT
07	2022-09-13	1. Adjusted layout based on clients brief.	PT	PT
08	2022-10-04	1. Adjusted layout based on clients brief.	PT	PT
09	2022-10-04	1. Adjusted areas as per clients brief.	PT	PT
10	2022-10-06	1. Minor adjusted areas to offices and staff facilities only.	PT	PT

KEY PLAN

TC RPV ARCHITECTS
Reg. number 1997/020737/07
1 Richeford Circle,
Ridgeside Office Park, Lower Level
Umhlanga
4319
Tel +27 31 502 3625
www.tcrpv.co.za
E-mail philip@tcrpv.co.za

PROJECT No.	DRAWING No.	STATUS	REVISION
000	001	Sk	10

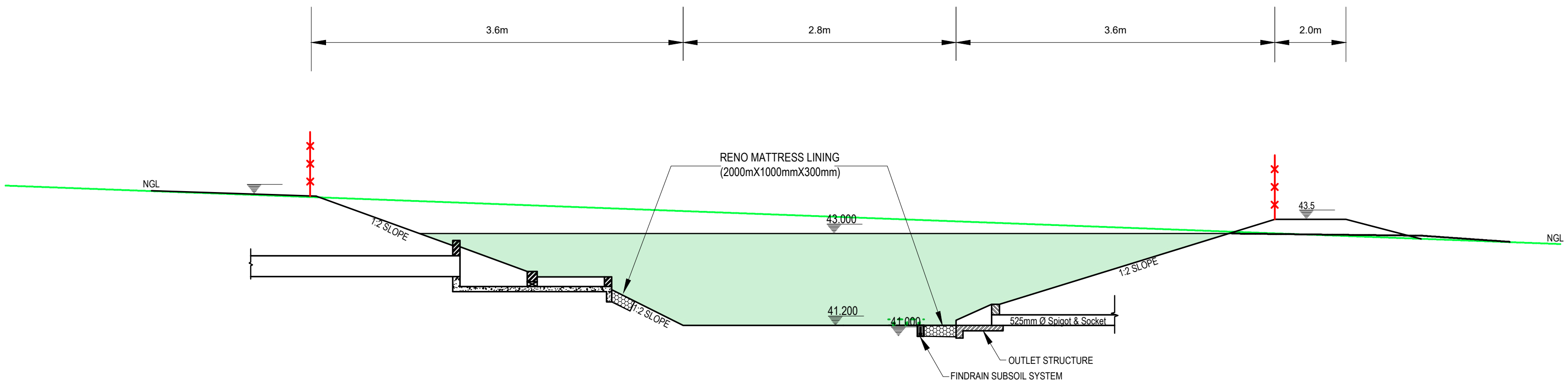
DRAWING TITLE

Site Development Plan

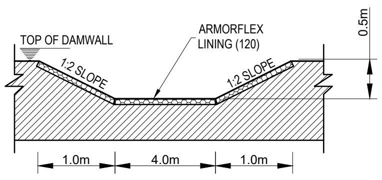
SCALE	DATE	DRAWN BY
as shown	2022-05-16	PT

PROJECT TITLE

Proposed DC Warehouse at
36 Nooiensfontein Road, Hagley
For Ackermans, Cape Town



TYPICAL SECTION THROUGH DAM WALL
SCALE: N.T.S



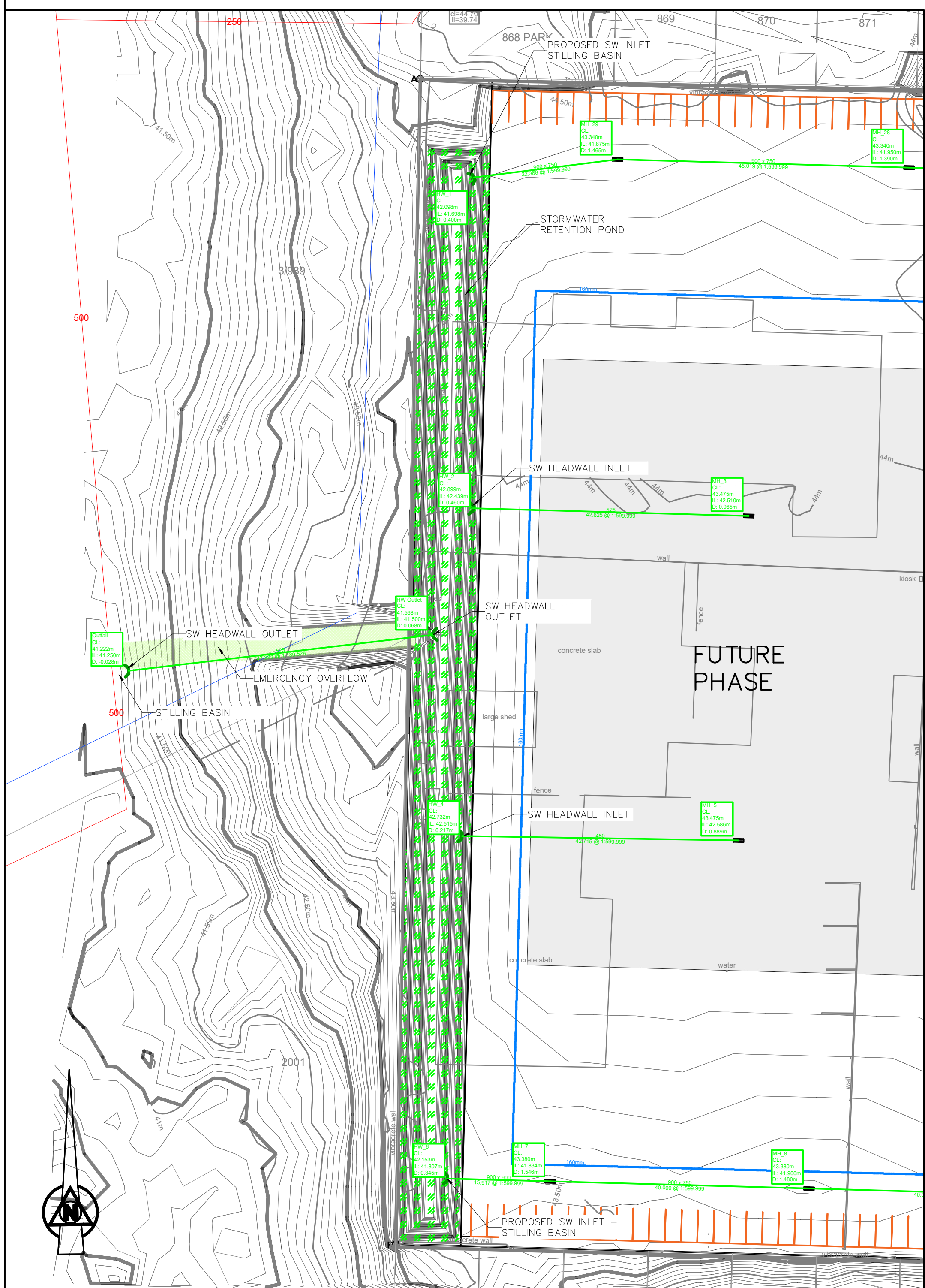
SECTION THROUGH EMERGENCY OVERFLOW
SCALE N.T.S

Dam volumes per depth Increment
================================

Surface: Dam

Level	Area (m2)	Interv. Vol. (m3)	Cumul. Vol. (m3)
43.000	1331.587	252.787	1311.066
42.800	1196.282	225.854	1058.279
42.600	1062.261	199.178	832.425
42.400	929.523	172.759	633.246
42.200	798.068	146.597	460.487
42.000	667.897	120.691	313.891
41.800	539.010	95.042	193.200
41.600	411.407	69.649	98.158
41.400	285.087	28.509	28.509
41.200	0.000	0.000	0.000

		1311.066	



ACKERMANS DISTRIBUTION CENTRE,
ERF 3865, HAGLEY

STORMWATER ATTENUATION DAM

kls CONSULTING ENGINEERS
progress delivered

13 Pasita Street
Rosenpark, Cape Town 7550

Cape Town: +27(0)21 948 0900
Gauteng: +27(0)12 346 1672
Website: www.kls.co.za
e-mail: info@kls.co.za

B	UPDATED CAPACITY	25/10/2022	JS
A	FOR INFORMATION	22/09/2022	JS
	REVISION / WYSIGING	*DATE DATUM*	*AUTHOR OUTEUR*

APPROVED BY	SIGNATURE	PROF. NUMBER	DATE

DRAWN GETEKEN	J.S.	*CHECKED NAGESIEN*	J.R.	*DATE DATUM*	22/09/2022

DRG. No. TEK. Nr. **22063/530**

SCALE SKAAL **1:1000 (A3)**

REVISION No. WYSIGING Nr. B

APPENDIX D – GEOTECHNICAL INVESTIGATION REPORT

ERF 3865

HAGLEY

REPORT ON

GEOTECHNICAL INVESTIGATIONS

REF. 1-179022
6 June 2022

R. A. BRADSHAW
& ASSOCIATES cc
Consulting Engineering
Geologists

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R.A. BRADSHAW & ASSOCIATES CC Reg. No. CK 99/12774/23

Consulting Engineering Geologists

17 Midwood Avenue
Newlands 7708
SOUTH AFRICA
Tel . +27 +21 671-1995
Fax +27 +21 671-0991
e-mail: rab@intekom.co.za

Ref. 1-179022

6 June 2022

ERF 3865
HAGLEY

REPORT ON
GEOTECHNICAL INVESTIGATIONS

1. INTRODUCTION

Planning for the proposed new distribution centre for Ackermans on Erf 3865 Hagley is currently in progress and the Consulting Civil and Structural Engineers will be appointed shortly.

Geotechnical data will be required for civil and structural designs and for contract documentation and Mr F de Villiers of KLS Consulting Engineers therefore approached R.A. Bradshaw & Associates cc to quote for a geotechnical investigation at the site.

The following scope of works was provided by KLS:

- Trial pitting and DCP and laboratory testing
- Determination of the shallow soil profile
- Determination of groundwater conditions
- Earthworks requirements including excavation conditions, use of on-site materials for construction purposes and measures for construction of the engineered fill
- Drainage requirements
- Assessment of founding conditions and optimum foundation layout(s)
- Assessment of subgrade conditions for surface beds and for roads and yard areas

A proposal and quotation were forwarded via a letter dated 3 May 2022 to KLS and authorisation to proceed with the investigations was received from CDJ Services the following day.

This report presents the results of the site investigations that were undertaken on 17 and 18 May and the associated laboratory testing. In addition to addressing the items in the scope of works described above, the report describes the site and the development and the investigations that were undertaken.

2. INFORMATION PROVIDED

A drawing of the topographic survey was provided by David Hellig & Associates after site investigations had been completed. The drawing was not titled or dated.

A preliminary site development plan was shown to the Author prior to the commencement of the site investigations but no electronic or hard copy of this drawing was provided.

3. DESCRIPTION OF THE SITE AND THE DEVELOPMENT

3.1. The Site

Erf 3865 Hagley is an approximately rectangular parcel of land that is 6.86Ha in extent.

The property is bounded to both the east and west by small residential erven with vibracrete walls along the site's boundaries with the erven. The southern boundary faces onto vacant ground and the northern boundary abuts the road reserve of Nooiensfontein Road.

It is understood that a concrete works originally occupied the site, but this has not been confirmed and no other details of the history of the site have been obtained.

Numerous buildings currently stand on the site and various businesses are active throughout the property. A pre-cast concrete manufacturer, a vehicle servicing business and a manufacturer of styrofoam insulation panels occupy the southern end of the site. Styrofoam panels have been stacked in many places in and around the manufacturer's building.

A company refurbishing gas cylinders, a manufacturer of concrete products, a scaffolding supplier and renovator and a workshop occupy buildings and yards in the central part of the site.

GoBid car auctioneers occupy a large area in the northeastern corner of the property and numerous vehicles are parked in their lot.

Imperial trucking have a yard area in the northwestern corner and another yard area, undercover parking and a double-storey building stand immediately to the south of Imperial's yard.

Entrance to the property is via an access road along the northern part of the western boundary with the road leading to a security office.

Many of the buildings and smaller structures have asbestos roof sheeting and some buildings have asbestos sheet cladding. Metal sheet cladding is attached to other buildings.

Open areas around and near buildings are either covered by concrete surface beds or a G5-type gravelly surfacing. Old concrete surface beds also underlie the gravel surfacing in many areas..

The topographic survey shows that the site is almost flat-lying with less than 1m fall and generally less than 0.5m fall for over the entire site. However, the ground immediately to the south of the site falls southwards at gradients of approximately 1:4 to 1:13.

Various sewer and stormwater lines with their associated manholes are present on the site and water meters on water lines are also present. Subsurface cabling and associated manholes also occur on the site. Because the manholes were either secured or they were filled, the topographic survey provided little or no information on the depth and invert levels of the various subsurface services.

A cellphone mast stands next to the entrance road near the northwestern corner of the site.

3.2. The Development

The site development plan has not been finalised, but it is understood that the new distribution centre will comprise a 35 000m^2 rectangular building located approximately centrally on the site.

High stack loads are anticipated on the surface beds.

Local double-storey office or possibly plant rooms will probably be constructed in or next to the distribution centre.

Yard areas will be provided together with on-site parking for staff and visitors.

4. OUTLINE OF THE INVESTIGATIONS

The field investigations comprised trial pitting and DCP and DPSH testing, supplemented with laboratory testing.

4.1. Trial Pitting

Twelve trial pits were excavated with a digger/loader at the positions shown on Figure 1.

The presence of various structures, services and materials limited the positions where trial pits could be excavated.

Concrete surface beds were present in many places and no attempt was made to excavate through them

The sidewalls of many trial pts collapsed or collapse was imminent when the pitting extended to depths below 2m and, in these circumstances, the pitting was stopped to prevent further disturbance.

Hard material (see Section 5.1), which prevented deep excavation, was encountered at shallow depth in TP4 and TP6.

The soils exposed in the sidewalls of the trial pits were described according to standard South African practice and the descriptions are presented on the soil profile sheets in Appendix A.

The pits were backfilled with excavated soils and the backfill was nominally compacted using the bucket and finally the back wheels of the digger/loader.

4.2. DCP Testing

DCP testing was undertaken from ground surface next to and in the following trial pits: TP1, TP2, TP3, TP7 and TP11 and this testing provided a profile of relative density to a depth of approximately 3m.

DCP tests were conducted only from ground surface next to TP4, TP6 and TP10. Hard material at shallow depth prevented meaningful testing in the first two pits and collapsing fill material prevented staff from entering TP10.

Hard or very hard/dense layers were encountered at surface in TP5, TP8, TP9 and TP12 and hence shallow, purpose-excavated pits were excavated through the hard layer so that DCP tests could be conducted directly into the underlying in-situ sand.

The plots of DCP penetration rates versus depth are presented on the soil profile sheets in Appendix A.

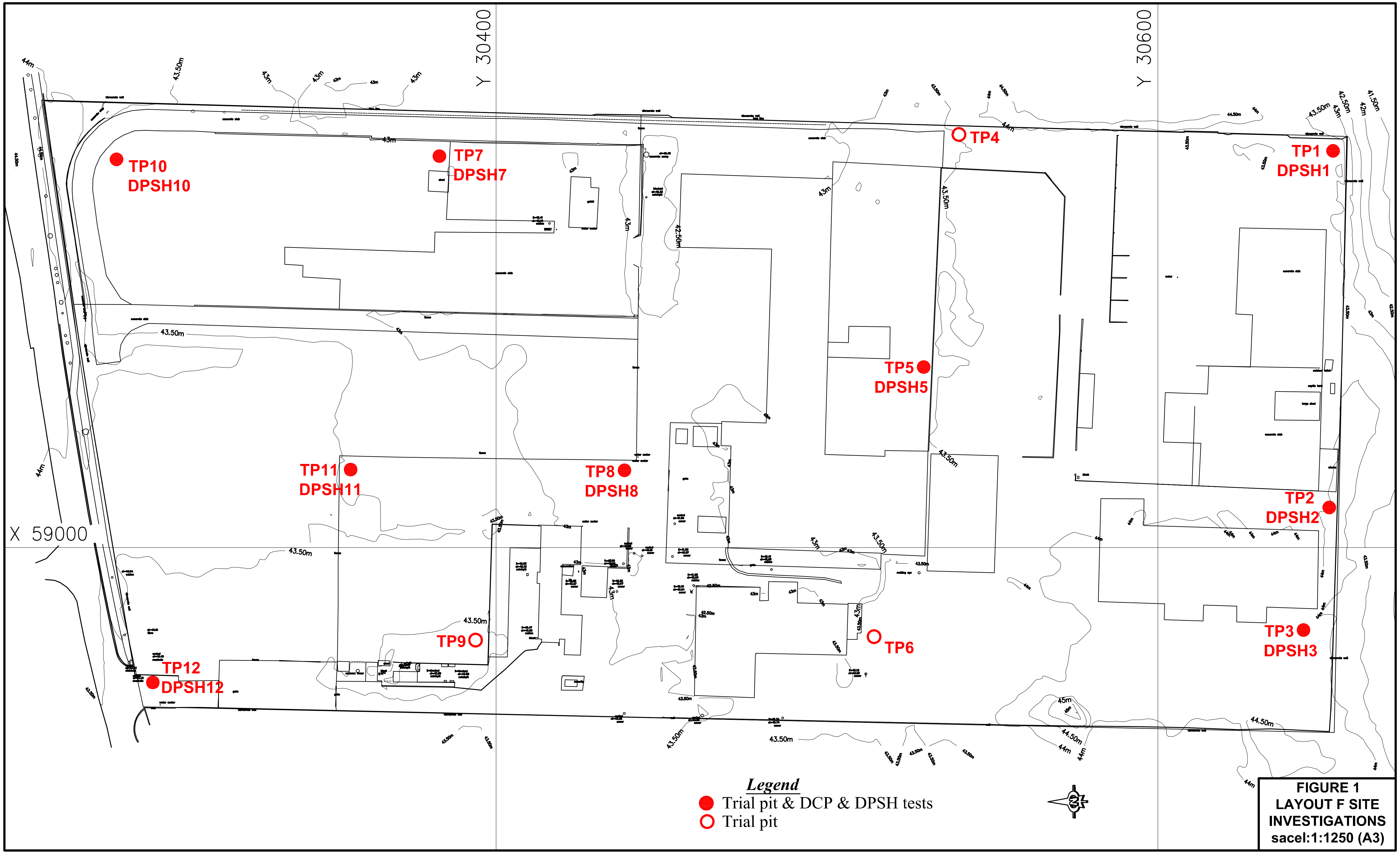


FIGURE 1
LAYOUT F SITE
INVESTIGATIONS
sacel:1:1250 (A3)

4.3. DPSH Tests

DPSH testing was conducted over two days with the objective of determining the relative densities of the soils with depth.

Because of the presence of hard or very hard surficial layers or concrete or coarse fill near surface, the following DPSH tests were conducted through the backfill in the trial pits: DPSH 1, 5, 7, 10 and 12. Tests were also conducted through shallow, purpose-excavated pits next to TP3, TP8 and TP11.

The graphs of blows per 100mm penetration and equivalent SPT N-values versus depth are presented in Appendix B. The equivalent SPT N-values shown on the graphs are taken as the number of blows for the Raymond spoon to penetrate 300mm and no correction factor was used.

4.4. Laboratory Testing

Bulk disturbed samples were taken for laboratory testing from seven of the trial pits.

Roads indicator (sieve analysis and Atterberg Limits) and CBR tests were conducted on four samples and grading analyses and CBR tests were conducted on the other three samples.

The laboratory test sheets are presented in Appendix C.

5. RESULTS OF THE INVESTIGATIONS

5.1. The Soil Profile and Its Engineering Properties

The natural soil profile comprises an assemblage of sandy soils overlying the residual soils and weathered bedrock of the Malmesbury Group at depth. The natural soils are overlain by gravelly and concrete surfacing and imported fill materials.

The distribution and composition of the various materials encountered in the trial pits are described in detail on the soil profile sheets in Appendix A and the information is summarised below.

- **Surfacing and concrete surface beds:** Although a discussion on concrete surface beds appears misplaced in this section of the report, the gravelly surfacing and concrete surface beds commonly occur together as outlined below and a discussion here is therefore relevant.

  Surfacing covers many of the open areas on the site. Its composition includes a formal pre-mix surfacing over slabs of concrete, ferricrete sub base, very slightly clayey sand with gravel, crushed pre-mix, cemented sand, gravelly sub base, G5-type sub base gravel, cemented gravel and ferricrete gravel.

  Large areas such as those in the Imperial yard and the adjacent plot to the south of it are covered with a black, crushed pre-mix and piles of the crushed materials are also present.

  The thickness of the surfacing also varies considerably with a range between 150mm and 450mm observed in the trial pits.

  Concrete surface beds and, in a few places, remnants of concrete surface beds are visible in areas between buildings and in other open areas. They, of course, also occur in in all buildings.

Surface beds also occur below the surfacing in many areas and, with the surfacing masking them, it is difficult to assess exactly their locations and extent. Concrete was encountered below the surfacing materials in TP7, TP8, TP9 and near TP4.

Cemented material was also encountered in TP4 and TP6. Initially, it was interpreted as a naturally occurring calcrete, but it appears to be old layered mortar slush and excess cementitious material from the old concrete works. The thickness of this material and its exact distribution are unknown.

- **Fill materials:** Fill materials were encountered below the surfacing and concrete beds in TP1, TP2, TP3, TP5, TP7, TP9, TP10 and TP12. As a generalisation, the fill comprises a fine to medium sandy matrix with variable quantities and types of extraneous material. The extraneous materials include fragments of concrete and brick. Wire, rebar, gravel, wood and pieces of cement pipe variously occur in more limited quantities and distribution. The size of the concrete fragments vary from coarse gravel to cobble-size and locally coarser.

  The results of DCP testing in the fill material indicated that, where tested, the fill was generally dense, but the occurrence of coarser particles might have skewed the results in places.

  The thickness of the fill was 1.45m and 1.5m respectively in TP1 and TP10 but generally less than 0.5m elsewhere.

- **In-situ sands:** In-situ sand of mainly aeolian (windblown) origin underlies the fill and other surfacing. However, the Kuilsrivier is currently located some 500m to the west of the site and it could have meandered through the site in the geological past in which case alluvial soils including clayey soils might also be present at depth.

  The sands are fine to medium grained and the grading moduli of the samples of sand vary from 1.08 to 1.16.

  The results of DCP testing indicated that the sands to depths of approximately 3m are generally medium dense, but marginal loose layers are present e.g. DCP 7.

  DCP tests undertaken in the trial pits display looser ground at the same level that tests from ground surface show denser soil. This is partially explained by the reduction in overburden stress in the soil immediately below the trial pit as a result of removal of the overburden, and possibly by some loosening of soil in the base of the pit.

  The results of DPSH tests are shown schematically in Figure 2 and the following information is evident from the figure:

  - Loose backfill in which penetration rates are meaningless was encountered in all trial pits.

  - Soils were generally medium dense, but layers of loose and dense soil were also recorded.

  - A layer of very loose to loose soil was encountered between depths of approximately 3.4m and 5.4m in the DPSH 8.

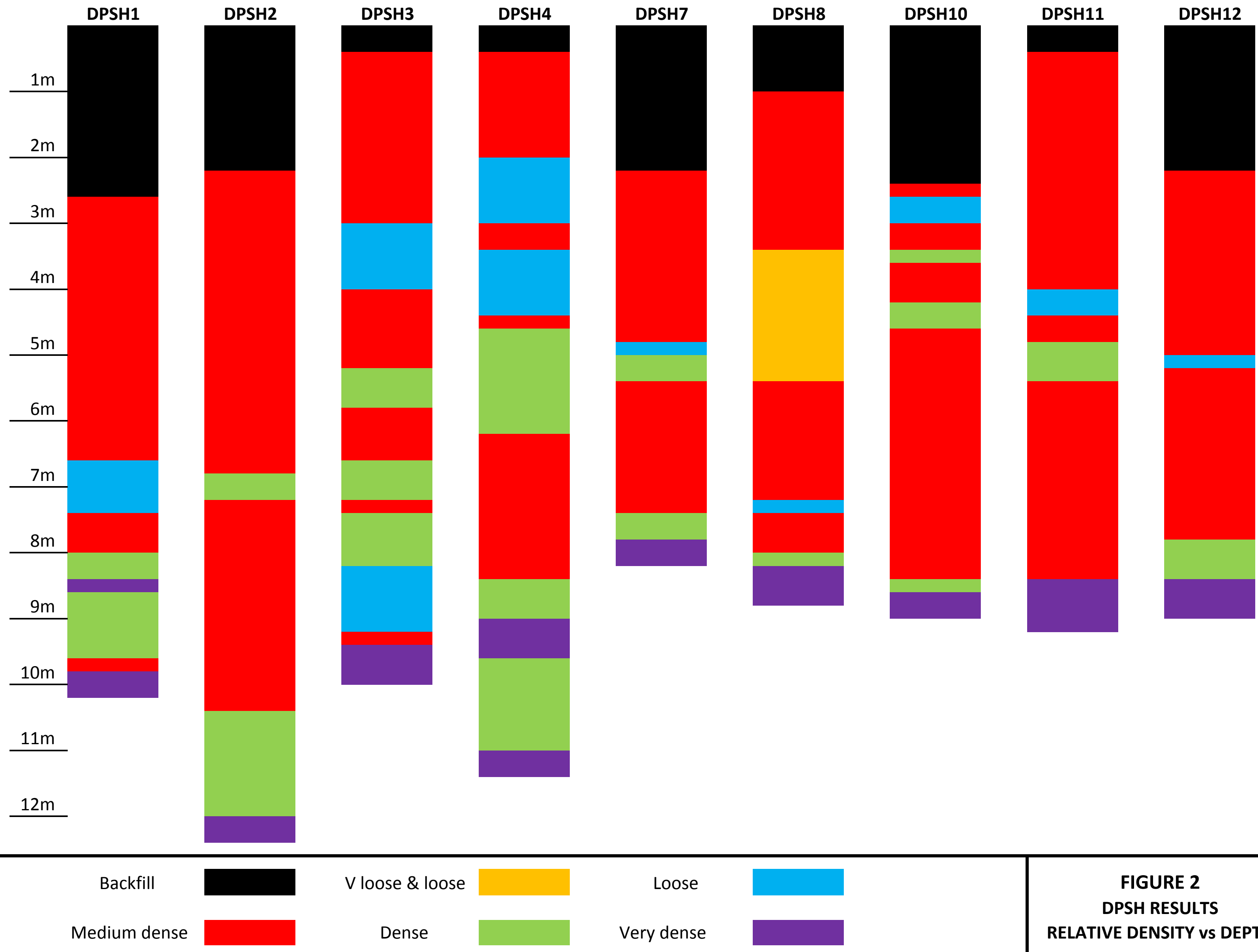


FIGURE 2
DPSH RESULTS
RELATIVE DENSITY vs DEPTH

- DPSH refusal (more than 100 blows to penetrate 300mm) occurred at depths ranging from approximately 8m to 12m.
- There is no gross correlation of relative densities between test positions with the possible exception of DPSH 7 to DPSH 12 where refusal occurred between depths of approximately 8m and 9m.

The information in Figure 2 should be viewed in conjunction with the graphs in Appendix D. The reason is that, in several cases, the equivalent SPT N-values vary within the ranges of relative density shown on Figure 2 and in some cases the N-values only just fall within a range. For example, for DPSH 3, the classification in Figure 3 is medium dense to a depth of approximately 4m, but the N-values are 10 or marginally above 10 which is at the extreme lower end for medium dense sand for which the range of N-values is 10 to 30.

The composition of the material on which the DPSH probe refused at depth is unknown. It is possible that it is either very stiff/hard, residual Malmesbury soil or weathered bedrock.

5.2. Groundwater

No groundwater was encountered in any of the trial pits nor was water observed on the DCP probe when it was withdrawn from the ground.

The groundwater at the time of the investigations therefore occurred at depths greater than 3m.

This was an unexpected result, particularly as the Kuilsrivier lies relatively close to the site and experience elsewhere in the area has shown that perched water can occur at depths significantly shallower than 3m.

6. GEOTECHNICAL ASSESSMENT

6.1. Site Clearance and Preparation

Site clearance and preparation on this degraded site will be extensive and will include, but not necessarily be limited to the following:

- The positions of the trial pits should be identified and the coordinates of the pits plotted om the drawing showing the foundation layout. The loose soil should be removed from the pits and the pits backfilled with approved soil that is compacted to at least 98% of mod AASHTO maximum dry density wherever the footings are located close to a pit or that the loosened soil in the pit would results in poor subgrade conditions of surface beds and layerworks in the yard and road areas.

  This remedial work should be undertaken before any site clearance or other works commence on the site.

- Demolition and removal of the existing buildings and their footings.

- Demolition and removal of surface beds. Concrete surface beds are hidden below the surfacing in several parts of the site and the extent of concrete surface beds that must be removed is currently not possible to predict.

- Many structures are clad and/or roofed with asbestos sheeting. Special measures and specialist contractors will be required for its removal and its appropriate disposal.

- Existing plant, manufactured goods and possibly abandoned material will also have to be collected and disposed.
- The cell phone mast and its subsurface connections must be removed.
- The electrical and water connections onto the site must be identified and cut off.

6.2. Earthworks

The topographic survey has indicated that, with the exception of local steps and extremely shallow gradients, the current ground surface is remarkably flat-lying.

No earthworks design has been undertaken to date, but slight reshaping will be required to ensure that the distribution centre is located on a level platform and also to facilitate stormwater drainage.

Dock levellers will not be provided and raising or lowering parts of the site will therefore not be required for levellers. However, the demolition and removal of structures and their footings and even surface beds will disturb the ground and lead to both loosened soil and an irregular ground profile. A significant focus of the earthworks program must therefore comprise making good and densifying the disturbed ground to ensure acceptable subgrade for future surface beds and yard areas and founding conditions for footings.

6.2.1. Initial Measures

The excavations and disturbed ground that will result from the demolition and removal of the structures and their footings and surface beds will probably be loosely backfilled and/or smoothed over by the demolition contractor and loose spots and areas will occur under the buildings and in the yard areas.

Special measures are therefore required to ensure uniform relatively dense conditions in the subgrade and for footings and these are described below.

<u>*Footprint areas*</u>
Ideally, excavations should not be backfilled during the demolition contract, but this is probably impractical and/or difficult to control.

Because the existing major structures only cover a relatively small percentage of the site, a recommended option is to remove all the soil material from within the footprint areas of the buildings, plus a 3m wide strip around them, to a depth of 1m.

The excavated soil should be stockpiled temporarily, the exposed base of the excavations compacted to at least 93% of mod AASHTO maximum dry density with smooth drum vibratory roller. The excavated soil, scalped of extraneous material coarser than 75mm, can then be placed in 200mm thick layers in the excavations and compacted to at least 98% of mod density. Watering with a bowser and working the water into the fill material will be necessary to ensure that the soil moisture is within 2% of optimum moisture content.

The measures described above are considered more appropriate than attempting to identify loose, disturbed areas after the demolition contractor has completed his contract.

Areas outside the footprints of buildings

Ground disturbance will also occur to a greater or lesser extent in areas outside the footprints of the existing buildings when, for example, surface beds are removed.

The depth of disturbance is expected to be less than that in the footprints of the buildings and re-compaction of the disturbed ground from ground surface will be required. Compaction should again be undertaken with a smooth drum vibratory roller with the ground compacted to at least 93% of mod density.

6.2.2. Placement of Engineered Fill

Where filling is required, imported approved soil (preferably G7 quality clean sand or calcareous sand from the Macassar area) should be placed in 200mm thick layers, moistened to within 2% of optimum moisture content and compacted to at least 98% of mod density.

6.2.3. Use of On-site Materials for Construction Purposes

The majority of material that will be excavated on the site will comprise gravelly surfacing, existing fill and possibly in-situ sand.

The results of CBR tests on seven samples of soil from the site are presented in Table 1

TABLE 1 RESULTS OF CBR TESTS

Soil Type	*Trial Pit*	*Depth (m)*	*Mod A.A.S.H.T.O. Data*		*C.B.R. at*					*Maximum Swell (%)*	*COLTO Classification*
			M.D.D. (kg/m^3)	**O.M.C. (%)**	**100%**	**98%**	**95%**	**93%**	**90%**		
Fill	TP1	0.15-1.1	1885	10.5	157	78	27	13	4	0.3	G6
Surfacing	TP2	0-0.45	2406	8.9	64	59	50	45	39	0.3	G5
In-situ sand	TP3	0.6-1.8	1750	12.5	17	13	8	5	3	0.1	<G9
In-situ sand	TP5	0.7-1.3	1724	7.6	14	9	6	4	3	0	<G9
Fill & surfacing	TP6	0-0.55	2070	11.2	108	90	57	41	28	0	G5
Surfacing	TP9	0-0.2	2067	5.8	36	24	14	8	4	0.4	G9
Fill	TP12	0.2-0.55	1701	20.4	55	39	22	17	9	0.7	G7

The results in Table 1 indicate variable CBR within the different soil types, but surfacing is G5 and G9 quality material. Much of it could be re-used with specific controls as sub base or in a selected layer.

Table 1 also suggests that the sandy fill is a G7 or a G6 or possibly G5 quality material. Intuitively, these classifications appear optimistic and, with its sandy matrix, the fill material is expected to be no better than G7 or G8 quality. It can be used for engineered fill provided that the coarse, extraneous material is scalped.

The in-situ sands have very low, wet CBR and are worse than G9 quality. However, they could be used for bulk engineered fill, but high compaction is required to achieve high CBR.

A large quantity of concrete and brick will be produced during the demolition of the buildings and surface beds and consideration should be given to crushing these materials on the site for use as G5 sub base material. The extent of reinforcement in the surface beds and footings is unknown but, if extensive, it might affect the viability of crushing this material.

6.2.4. Excavation Conditions

Excavation in some of the denser surficial materials would be classified as Intermediate Excavation Class according to SANS 1200 D.

Excavation in the cemented soils encountered in TP4 and TP6 and which presumably occur in other areas would also be classified as Intermediate Excavation Class.

Excavation in the underlying fill and the in-situ sands would be classified as Soft Excavation Class.

In order to prevent disagreements regarding classification and measurement, it is recommended that Soft and Intermediate Excavation Classes should be combined into one excavation class for this project. All material that can be excavated with a twenty-tonne excavator shall be deemed to fall within the project-specific class.

It is assumed that measurement and payment for excavation and breaking up of existing footings and surface beds would be measured and paid for under other items in the Bill of Quantities.

6.2.5. Stability of Excavations

Ensuring the safety of workers in the excavations shall be the responsibility of the contractor. If necessary, they should employ professionals to assist in the design of safe slopes.

Issues to be considered include, but are not necessarily limited to the following:

- The materials in the cut slopes of the excavations are generally cohesionless.
- No surcharging of the cut slopes by excavated material, construction material, plant or vehicles shall be allowed.
- Special measures will be required if water occurs in the trenches.
- Routine inspection of the stability of the side slopes should be considered.

6.2.6. Compaction Testing

Provision should be made for a combination of troxler and DCP tests to check the compaction of the engineered fill and the compacted subgrade.

Samples should be taken from the positions of troxler tests to determine a laboratory dry density value or values with which to compare field densities.

The DCP penetration rate should be less than 25mm per blow.

6.2.7. Ground Vibrations

Ground vibrations from compaction equipment could cause damage to the houses abutting the western and eastern boundaries. Damage is most likely when compacting ground near these boundaries.

It is therefore recommended that dilapidation surveys are conducted on these houses before any demolition or construction occurs on the site. Vibration monitoring during compaction should also be considered.

In addition, advice should be sought from the manufactures of the compaction equipment as to measures to minimise or preferably obviate vibration damage.

6.3. Founding Conditions

The following engineering properties of the soil profile will significantly affect founding conditions and therefore the foundation layout and associated measures:

- **The composition and relative density of the gravelly surfacing:** The gravelly surfacing is thinly developed and relatively dense. The surfacing might be selectively excavated for use as sub base and hence it would not affect subgrade or founding conditions. Even if it is left in place, it is too thin to affect founding conditions for footings, but it would provide fair subgrade for surface beds in its undisturbed state.

- **The composition and relative density of the existing fill:** The existing fill generally comprises a sandy matrix with extraneous material such as fragments of concrete and brick with minor occurrences of other materials. Unless the composition of the fill changes and/or compressible or decomposable material is encountered, the composition of the existing fill will not be a significant factor affecting foundation layout.

  Based on the results of DCP tests and the slow rate of excavation in the existing fill, the fill is generally medium dense or dense. In that condition, it would provide suitable subgrade for surface beds and layerworks and founding conditions for footings.

- **The loose backfill in the trial pits:** As described in Section 5.1, the loose backfill in the trial pits will not provide suitable subgrade or founding conditions and it should be removed and replaced with approved compacted fill. Footings must be founded at adequate depth such that a 45° slope from the bottom edge of the footing does not project into a trial pit even when it is backfilled.

- **The relative density of disturbed ground:** This material will not provide suitable subgrade or founding and measures to re-work and compact it are described in Section 6.2.1 and footings should still be founded below it.

- **The relative density of new engineered fill:** Provided that the new engineered fill comprises adequately compacted approved soils, new engineered fill will provide adequate subgrade and founding conditions.

- **The composition and relative density of the in-situ soils:** With one major exception and the local presence of thin loose layers, the results of the DPSH and DCP tests indicate that the sands are generally medium dense and would provide fair founding for footings.

As far as can be ascertained from the results of the current investigations, the soil profile to a depth of at least 8m comprises in-situ sandy soils. However, it is possible, particularly because of the proximity of the Kuilsriveir, that clayey soils might occur within the soil profile. Depending on their stiffness and consolidation history, some consolidation settlement could occur in them but, if present, the clayey layers are apparently thinly developed and consolidation settlement of clayey soils is not considered a significant issue.

- **The occurrence of groundwater:** Current information indicates that groundwater occurs at depth and it will therefore not significantly affect founding conditions or construction.

6.4. Bearing Capacity

The bearing capacity of pad and strip footings can be analysed using the Terzaghi-Buismann formula and assuming various geotechnical parameters.

For an assumed bulk density of 1725 kg/m^3 and a friction angle of 30° and the water table at 4m depth, the safe bearing pressure against shear failure with a Factor of Safety of 2.5 can be determined from the following equations:

Square footings $Qs = 203D + 47B$

Strip footings $Qs - 129D + 78B$

Where

Qs = safe bearing pressure (kPa)
D = depth of founding (m)
B = width of footing (m)

6.5. Settlement

Settlement of strip and pad footings can be estimated using the method of Schmertmann and converting the equivalent N-values measured during DPSH testing into cone resistances using the relationship N=400Cr were Cr = cone resistance in kPa.

Settlements are estimated for the loosest soil profile as intersected by DPSH 8 and for one of the denser profiles using DPSH 2. A constant founding depth of 0.8m below platform level is assumed for the calculations.

Graphs of settlement versus footing width for different bearing pressures are presented in Appendix D.

The following is apparent from the graphs:

- Large settlements are predicted for large footings founded on the loosest soil conditions (Analysis 1). For example, a 3m square footing with a bearing pressure of 125kPa has an estimated settlement of 37mm.

- Strip footings in the loosest conditions have an estimated settlement of 6mm for a 1m wide footing and a bearing pressure of 125kPa (Analysis 2).

- Square footings founded in the denser sol condition have an estimated settlement of 21mm for a 3m wide footing with a bearing pressure of 125kPa (Analysis 3).

- Strip footings in the denser conditions have an estimated settlement of 8mm for a 1m wide footing with the bearing pressure of 125kPa (Analysis 4).

- Settlements will be elastic (immediate) and a significant portion of the settlement would be built out as the structure is constructed and footings are loaded.

- For wide column spacings, angular distortions due to possible differential settlement are likely to be with tolerable amounts.

- The amount of settlement for a given footing configuration is partly influenced by the stress distribution below the footings and partly the location and thickness of loose layers within the profile. This gives rise to the apparently anomalous situation where the estimated settlement for the strip footing in the loosest conditions (Analysis 2) is 6mm but 8mm in the denser condition (Analysis 4).

- The profile of relative density used in Analyses 3 and 4 is similar to the profile in many of the other locations tested and hence the estimated settlement from these analyses could be regarded as typical for the site in general.

6.6. Foundation Layout

Based on the descriptions in Section 4.1 and the assessments in Section 6.5, the following general foundation layout is considered appropriate for this project:

Foundation type:	strip and pad footings
Founding depth:	minimum 800mm
Bearing pressure:	maximum 150kPa
Reinforcement:	reinforcement of strip footings is recommended

The following issues should be addressed and other measures adopted to supplement the general foundation layout:

- Two-metre DCP tests should be undertaken in each foundation excavation. The DCP penetration rates shall not exceed 30mm per blow from a depth of 300mm below the base of the excavation.

- All foundation excavations shall be inspected by a competent person to ensure that the ground conditions are acceptable and that the foundation layout is appropriate for the conditions encountered.

- Investigations have revealed that the ground conditions are variable. Ad hoc changes or modifications to the general foundation design and layout might therefore be required in places. These measures might include deepening the foundations or possibly other measures. Changes or modifications would result in additional costs and affect the programme.

- Tip-up columns are planned for the distribution centre. Because the columns are pre-cast and have a fixed length, the top of the base of the footing must be cast at a fixed design level. If deepening of the foundation excavation is required because of poor ground conditions, extra mass concrete or possibly cement-stabilised and will be required to raise the footing to the design level. A provision should be made in the contract documentation and costing for up to 25% of the bases to require additional mass concrete or stabilised sand.

- The effect of backfilled service trenches and trial pits close to footings must be considered. Preferably, services and their trenches shall be located at positions and levels such that the stressed soil below and adjacent to footings does not extend into these trenches. The '45° rule' shall therefore apply whereby a theoretical line drawn from the base of the footing shall not intersect the service trench or ground disturbed by the trenching. If this is not possible, deeper founding will be required.

- The concept described above shall also apply to trial pits. The loose backfill in the pits should have been removed and replaced with compacted fill as described in Section 6.1. Irrespective of how well the backfill is compacted, the '45° rule' shall apply and deeper founding of individual basis with an associated requirement should be expected for mass concrete or cement stabilised soil.

- Gutters should be provided on the roof and stormwater from downpipes must be formally directed away from the building. Surface beds should be sloped away from the buildings to ensure no ponding of stormwater occurs against the building.

- Large, costly footings will be required to counter uplift. Piling could therefore be considered as an alternative foundation layout with the piles designed for both static loading and tension to counter uplift. Geotechnically, piling could provide an acceptable layout, but the costs of constructing large conventional bases need to be compared with those of piling and probable provision of pile caps. Issues such as program and ease of construction must also be considered to assess the financial viability of piling.

6.7. Drainage

Groundwater currently occurs at depths of more than 3m and no evidence, such as the occurrence of ferricrete or staining of the shallow soils, was observed in the exposures in the trial pits to indicate the occurrence of seasonal shallow water. Provision of shallow subsurface drainage is therefore not anticipated.

The site is almost flat-lying and shaping it will be required to ensure and facilitate surface drainage, particularly as the site will be effectively be hard surfaced.

Surface water would presumably be vented into an existing stormwater line in Nooiensfontein Road. However, no manhole or stormwater line has been identified in the road by the Surveyors and manholes, which might be related to on-site drainage lines, are blocked. The manner in which stormwater is disposed must therefore be investigated by the civil engineer.

6.8. Surface Beds

The subgrade for surface beds will comprise one or more of the existing fill, new engineered fill, in-situ sands and possibly existing surfacing materials. Because no earthworks design has been undertaken to date, the exact future distribution of these materials in the subgrade is unknown.

Most of the existing subgrade will be disturbed by the demolition and removal of buildings, footings and existing surface beds and measures to prepare the subgrade are discussed in Section 6.2.1.

The engineering properties of the existing fill, new engineered fill and in-situ sand will influence the design of layerworks for surface beds. Although the limited testing to date indicates that the existing fill could, at least in places, be of G6 quality, it comprises predominantly sand and hence a maximum of a G8 designation should be considered.

The in-situ sands are worse than G9 quality and unless the imported material for new engineered fill is calcareous, it too will probably be of G8 or G9 quality.

Consequently, the design of layerworks should assume a poor quality subgrade and the layerworks in the distribution centre will probably therefore comprise subbase and base course layers and/or a cement stabilised layer.

6.9. Roads and Yard Areas

The subgrade for roads and yard areas is likely to comprise the same subgrade materials or combinations of subgrade materials that were described for surface beds in Section 6.8.

Similar preparation of the subgrade will be required and the layerworks design must reflect the poor quality subgrade.

7. CONCLUSIONS AND RECOMMENDATIONS

a) The natural soil profile comprises an assemblage of sandy soils overlying the residual soils and weathered bedrock of the Malmesbury Group at depth. The natural soils are overlain by gravelly and concrete surfacing and imported fill materials.

b) Surfacing of a variable but generally gravelly composition covers many of the open areas on the site.

c) Concrete surface beds and remnants of concrete surface beds occur in the buildings and between buildings and in other open areas. Surface beds also occur below the surfacing in many areas and, with the surfacing masking them, it is difficult to assess exactly the locations and extent of the concrete surface beds.

d) Site clearance and preparation on this degraded site will be extensive and will include, inter alia, measures such as remediating trial pits, demolition and removal of buildings, footings and surface beds and specialised removal and disposal of asbestos roof sheeting and cladding.

e) The current ground surface is remarkably flat-lying with the exception of local steps and extremely shallow gradients. Consequently the earthworks will probably comprise mainly remediation of disturbed ground and some reshaping of the ground profile.

f) In respect of the disturbed ground, special measures are required to ensure uniform relatively dense conditions in the subgrade and for footings.

g) The special measures should include excavating the soils to a depth of 1m in the footprint plus 3m of the existing buildings, temporarily stockpiling the excavated soil, compacting the newly exposed base of the excavations and re-using the excavated soils as engineered fill in the excavated areas. These measures are considered more appropriate than attempting to identify loose, disturbed areas after the demolition contractor has completed his contract.

h) Provision should be made in the contract documentation for compaction testing of the subgrade and the engineered fill.

i) Ground vibration from compaction equipment could damage neighbouring structures and a dilapidation survey, monitoring ground vibrations and professional assistance to specify the type of compaction equipment and compaction methods to minimise the risk of damage are required.

j) Much of the existing surfacing materials could be re-used with specific controls as sub base or in a selected layer. Consideration could also be given to on-site crushing of concrete and brick for use as G5 sub base material. The extent of reinforcement in the surface beds and footings is unknown but, if extensive, it might affect the viability of crushing this material.

k) Founding conditions for the structures are generally fair, but local, loose ground will be experienced in places.

l) A general foundation layout comprising strip and pad footings is considered appropriate for this project.

m) Local adverse ground conditions will inevitably be encountered and ad hoc changes or modifications to the general foundation design and layout might therefore be required in places. These measures might include deepening the foundations or possibly other measures. Changes or modifications would result in additional costs and affect the programme.

n) Tip-up columns are planned for the distribution centre and footings must be cast at a fixed design level. If deepening of the foundation excavation is required because of poor ground conditions, extra mass concrete or possibly cement-stabilised and will be required to raise the footing to the design level. A provision should be made in the contract documentation and costing for up to 25% of the bases to require additional mass concrete or stabilised sand.

o) The subgrade for surface beds and yard areas and roads will comprise one or more of the existing fill, new engineered fill, in-situ sands and possibly existing surfacing materials. The engineering properties of each of these materials vary and, depending on the remnant soil profile after remediation and re-shaping of the site has occurred, poor subgrade conditions might be present.

p) The design of layerworks for surface beds and yard areas and roads should therefore assume a poor quality subgrade

R.A. Bradshaw Pr.Sci.Nat.
R.A. BRADSHAW & ASSOCIATES cc

APPENDIX A

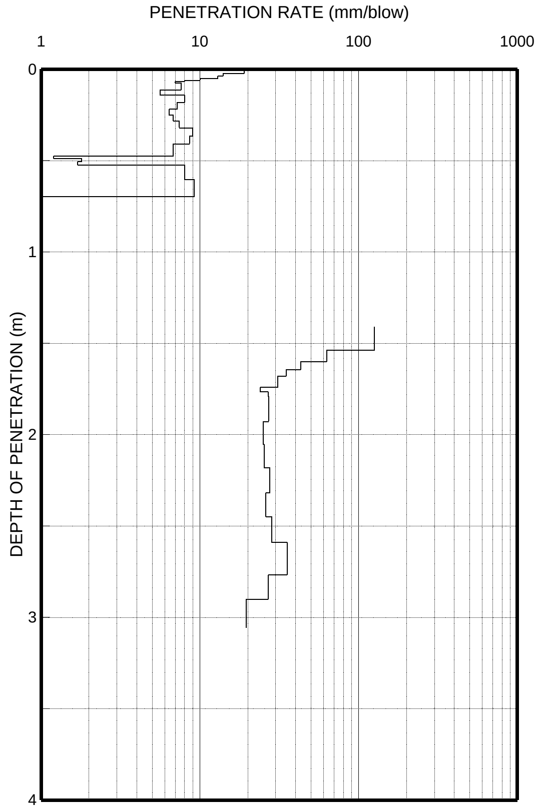
**DESCRIPTIONS OF SOIL PROFILES IN TRIAL PITS
AND
RESULTS OF DCP TESTS**

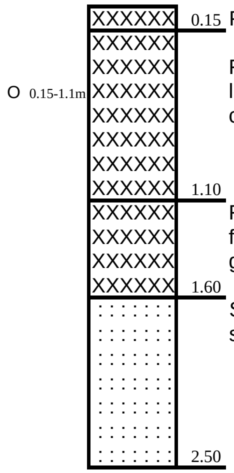
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY | **PROJECT NO:** 179022 | **DATE :** 17/5/2022

TEST NO: DCP1 | **STARTING DEPTH:** Ground surface and in TP1 at 1.15m depth | **ELEVATION:**

TRIAL PIT NO: TP1 | **METHOD OF INVESTIGATION :** Digger/loader





0.15 Premix surfacing and slabs of concrete.

FILL Slightly moist, light greyish brown, locally layered, dense fill l comprising mainly fine to medium sand with scattered fragments of concrete and rare pieces of wire and rebar.

1.10 FILL Slightly moist, light brown, medium dense fill comprising mainly fine to medium sand with scattered aggregate and rare coarse gravel-size fragments of concrete.

1.60 SAND Slightly moist, light brownish grey, medium dense, fine to medium sand becoming light brown with depth. Aeolian.

2.50

NOTE: Sidewalls of pit collapsing.

Sandy Materials: (mm/blow)			**Clayey Materials:** (mm/blow)		
	Very loose	>75		Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

¥ PERCHED WATER TABLE

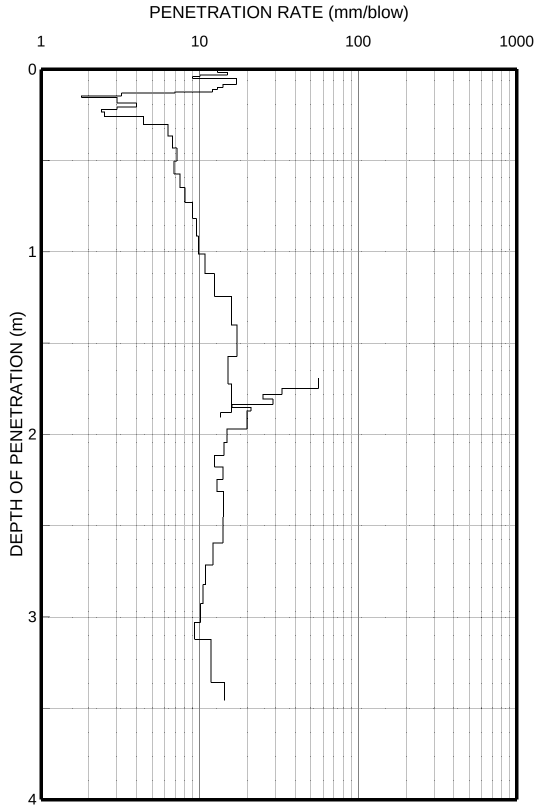
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

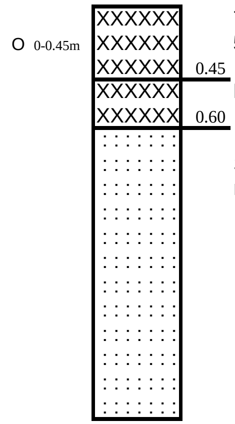
PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP2 **STARTING DEPTH:** Ground surface and in TP2 at 1.55m depth

ELEVATION:

TRIAL PIT NO: TP2 **METHOD OF INVESTIGATION :** Digger/loader





70mm premix over sandy ferricrete gravel sub base over, in places, 50mm of premix.

FILL Slightly moist, dark greyish brown, dense fill comprising fine to medium sand and scattered medium coarse gravel.

SAND Slightly moist, light brown, dense to medium dense, fine to medium sand. Aeolian.

NOTE: Sidewalls of pit collapsing.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

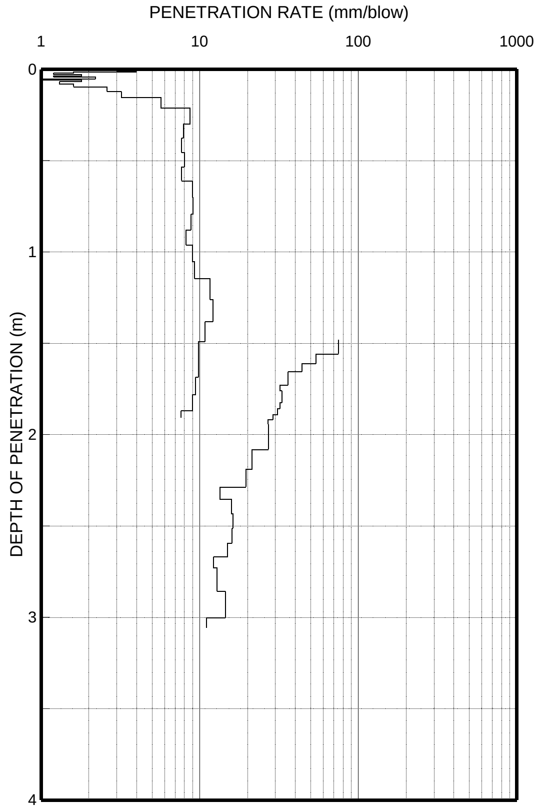
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP3 **STARTING DEPTH:** Ground surface and in TP3 at 1.15m depth

ELEVATION:

TRIAL PIT NO: TP3 **METHOD OF INVESTIGATION :** Digger/loader



0.25	FILL Dry, streaked brownish grey and brown, very dense fill comprising very slightly clayey, fine to medium sand with scattered gravel.
0.60	FILL Slightly moist, khaki brown, dense fill comprising fine to medium sand with scattered aggregate..
1.80	SAND Slightly moist, brown, dense and medium dense, fine to medium sand. Aeolian.
2.20	SAND Slightly moist, light yellowish brown, medium dense, fine to medium sand. Aeolian.

NOTE: Sidewalls of pit collapsed.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

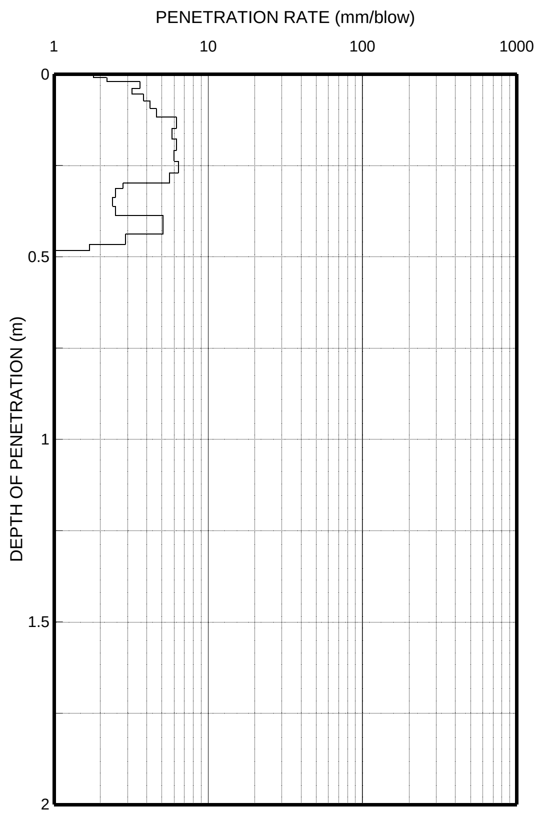
¥ PERCHED WATER TABLE

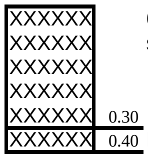
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP 4 **STARTING DEPTH:** Ground surface **TRIAL PIT NO:** TP4 **METHOD OF INVESTIGATION :** Digger/loader

ELEVATION:





60mm of reworked premix over dense fill comprising gravelly calcareous sand with fragments of concrete and plastic bag. Dense.

MADE GROUND Slightly moist, layered light brown and dark grey, weakly to strongly cemented sand. Interpreted as cement infused sand from old concrete plant but has the appearance of calcrete.

NOTE: Machine refused at 0.4m depth.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE V WATER TABLE

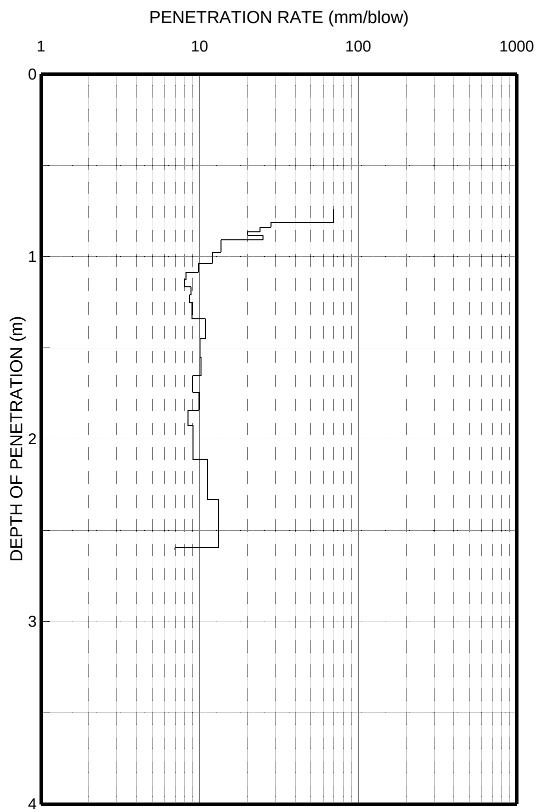
[] UNDISTURBED SAMPLE ¥ PERCHED WATER TABLE

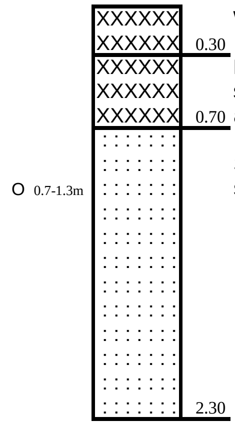
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY | **PROJECT NO:** 179022 | **DATE :** 17/5/2022

TEST NO: DCP5 | **STARTING DEPTH:** In TP5 at 0.7m depth. | **TRIAL PIT NO:** TP5 | **METHOD OF INVESTIGATION :** Digger/loader

ELEVATION:





Weakly cemented sand and layers of strongly cemented sand.

FILL Slightly moist, dark orange brown, dense fill comprising very slightly clayey sand with scattered fragments of concrete and brick and one piece of rebar.

SAND Slightly moist to moist, light greyish brown, dense, fine to medium sand. Aeolian.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

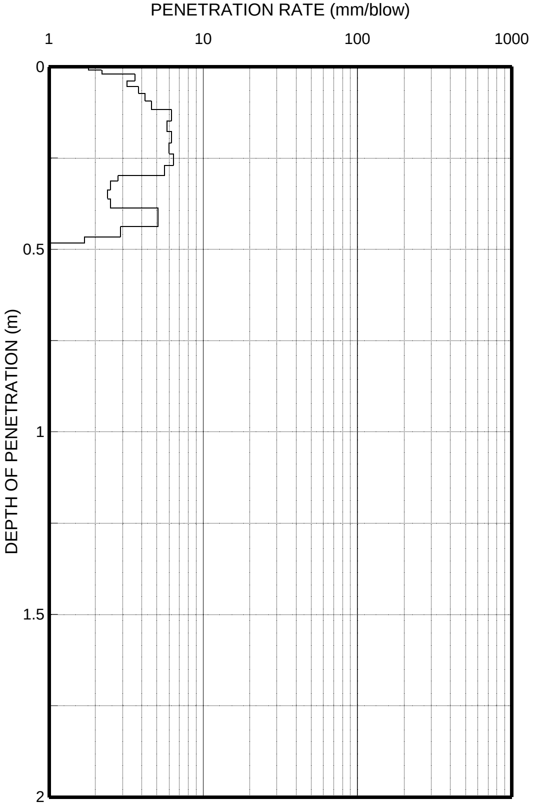
O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

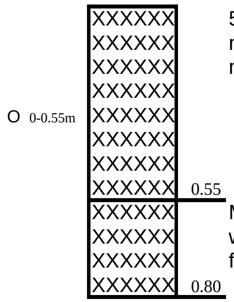
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP6 **STARTING DEPTH:** Ground surface **TRIAL PIT NO:** TP6 **METHOD OF INVESTIGATION :** Digger/loader

ELEVATION:





50mm of sub base gravel over slightly moist, dense fill comprising numerous coarse gravel-size fragments of concrete in a minor sandy matrix. Scattered fragments of wood, one cement pipe and rare wire.

MADE GROUND Slightly moist, layered light brown and dark grey, weakly to strongly cemented sand. Interpreted as cement infused sand from old concrete plant but has the appearance of calcrete.

NOTE: Machine refused at 0.8m depth.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

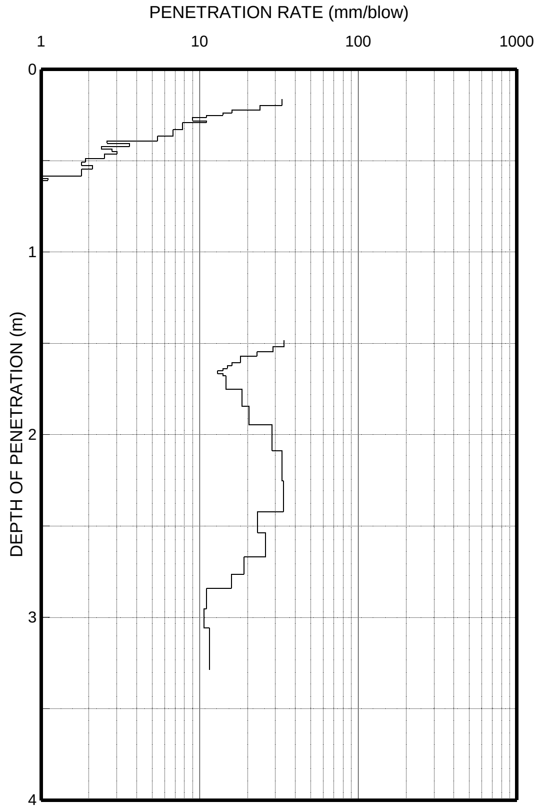
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

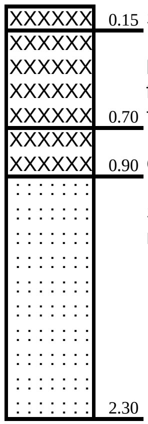
PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP7 **STARTING DEPTH:** Ground surface and in TP7 at 1.3m depth.

ELEVATION:

TRIAL PIT NO: TP7 **METHOD OF INVESTIGATION :** Digger/loader





0.15 Surfacing G5 type gravel. Very dense.

FILL Slightly moist, layered light yellow brown and greyish brown, dense, fill comprising fine to medium sand and scattered coarse gravel-size
0.70 fragments of concrete and one tabular block.

0.90 Concrete surface bed at western end of pit.

SAND Slightly moist, brownish grey, medium dense and locally marginal loose, fine to medium sand. Aeolian.

2.30

NOTE: Collapse of lower sidewalls of pit.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

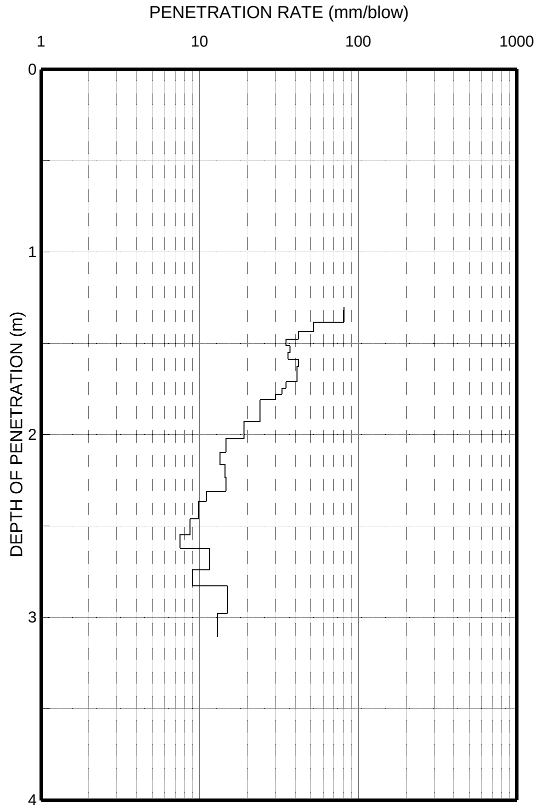
O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

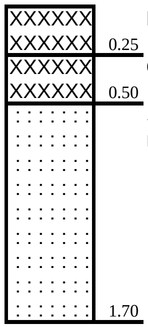
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP8 **STARTING DEPTH:** In TP8 at 1.15m depth. **TRIAL PIT NO:** TP8 **METHOD OF INVESTIGATION :** Digger/loader

ELEVATION:





FILL Strongly cemented gravel.

Concrete surface bed.

SAND Slightly moist, light brownish grey, loose to medium dense, fine to medium sand. Aeolian.

NOTE: Extremely difficult excavating through the upper 0.5m.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

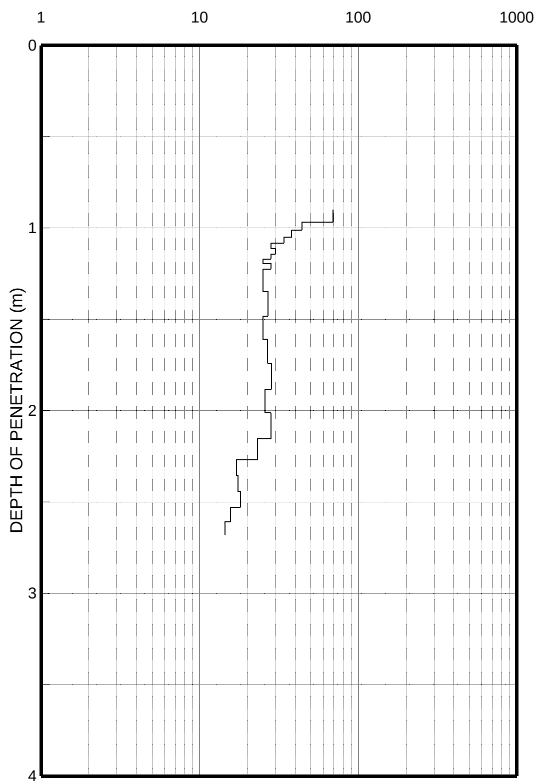
¥ PERCHED WATER TABLE

DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

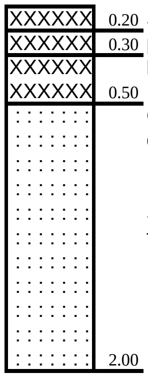
PROJECT: ERF 3865, HAGLEY | **PROJECT NO:** 179022 | **DATE :** 17/5/2022

TEST NO: DCP9 | **STARTING DEPTH:** In TP5 at 0.7m depth | **TRIAL PIT NO:** TP9 | **METHOD OF INVESTIGATION :** Digger/loader

ELEVATION:



O 0-0.2m



Surfacing comprising Malmesbury G5 type material over 100mm of premix.

FILL Moist, khaki brown, dense fill comprising very slightly clayey fine to medium sand and scattered small brick fragments.

Concrete surface bed between 0.m and 0.5m with broken fragments of cement brick at its base.

SAND Slightly moist, light brownish grey and cream, medium dense, fine to medium sand. Aeolian.

NOTE: Massive collapse of sidewalls of pit.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE | V WATER TABLE

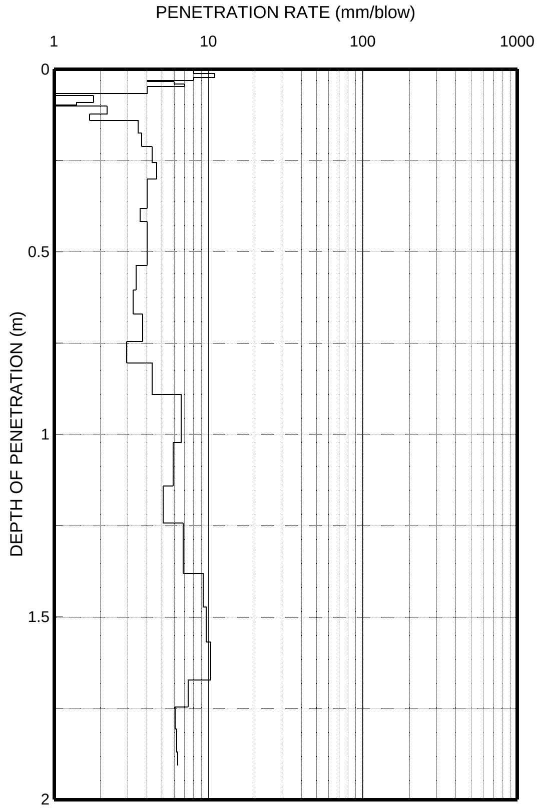
[] UNDISTURBED SAMPLE | ¥ PERCHED WATER TABLE

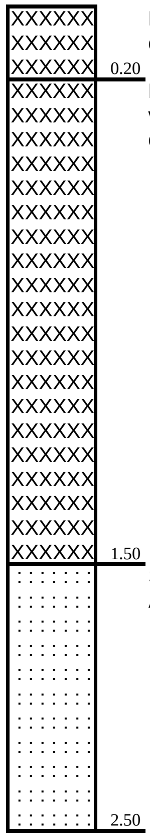
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP10 **STARTING DEPTH:** Ground surface **TRIAL PIT NO:** TP10 **METHOD OF INVESTIGATION :** Digger/loader

ELEVATION:





FILL Slightly moist, light brownish grey, dense and very dense fill comprising fine to medium sand and scattered fragments of concrete.

FILL Slightly moist, medium brownish grey and light orange brown, very dense and dense, layered fine to mediumsandy fill with scattered coarse gravel-size and cobble-size fragments of concrete.

SAND Slightly moist, light brownish grey, dense, fine to medium sand Aeolian.

NOTE: Collapse of lower sidewalls of pit.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

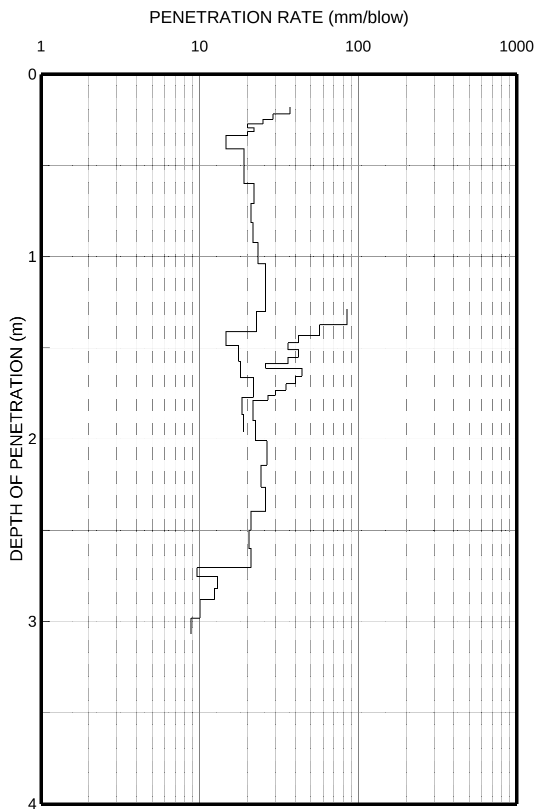
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

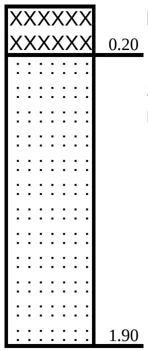
PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP11 **STARTING DEPTH:** Ground surface and in TP11 at 1.1m depth.

ELEVATION:

TRIAL PIT NO: TP11 **METHOD OF INVESTIGATION :** Digger/loader





FILL Dry, orange brown, meedium dense fill comprising ferricrete gravel in a very slightly clayey sandy matrix. Surfacing.

SAND Slightly moist, light brownish grey, medium dense, fine to medium sand. Aeolian.

NOTE: Massive collapse of sidewalls of pit.

Sandy Materials: (mm/blow)	Very loose	>75	**Clayey Materials:** (mm/blow)	Very Soft	>110
	Loose	30 - 75		Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

O DISTURBED SAMPLE

[] UNDISTURBED SAMPLE

V WATER TABLE

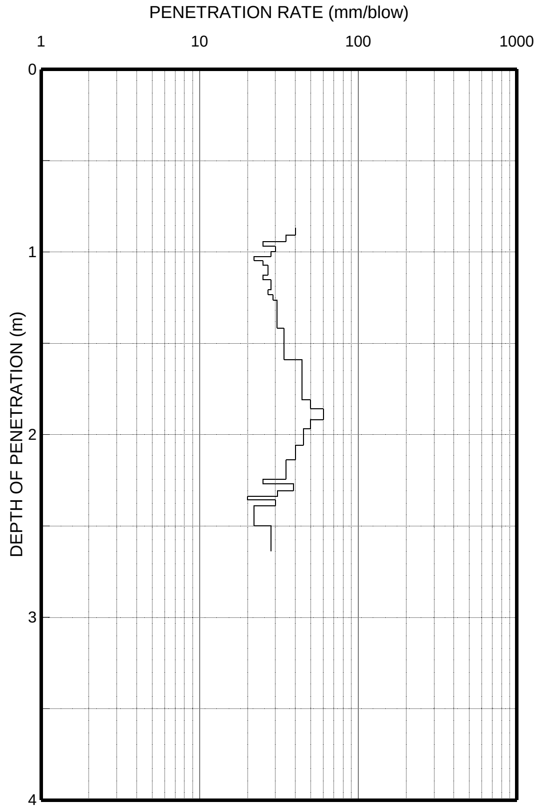
¥ PERCHED WATER TABLE

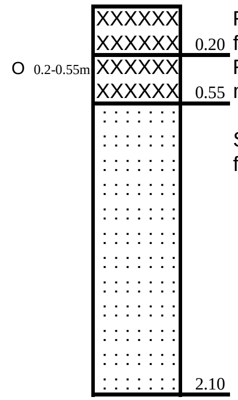
DYNAMIC CONE PENETRATION TEST AND SOIL PROFILE

PROJECT: ERF 3865, HAGLEY **PROJECT NO:** 179022 **DATE :** 17/5/2022

TEST NO: DCP12 **STARTING DEPTH:** In TP 12 at 0.65m depth. **TRIAL PIT NO:** TP12 **METHOD OF INVESTIGATION :** Digger/loader

ELEVATION:





FILL Slightly moist, brownish grey, medium dense fill comprising fine to medium sand with tabular fragments of concrete.

FILL Slightly moist, dark orange brown, dense fill comprising medium and coarse gravel in a very slightly clayey sandy matrix.

SAND Slightly moist to moist, grey, medium dense and loose, fine to medium sand. Aeolian.

NOTE: Massive collapse of sidewalls of pit.

Sandy Materials:	Very loose	>75	**Clayey Materials:**	Very Soft	>110
(mm/blow)	Loose	30 - 75	(mm/blow)	Soft	55 - 110
	Medium Dense	12.5 - 30		Firm	30 - 55
	Dense	5 - 12.5		Stiff	15 - 30
	Very Dense	2 - 5		Very Stiff	7 - 15

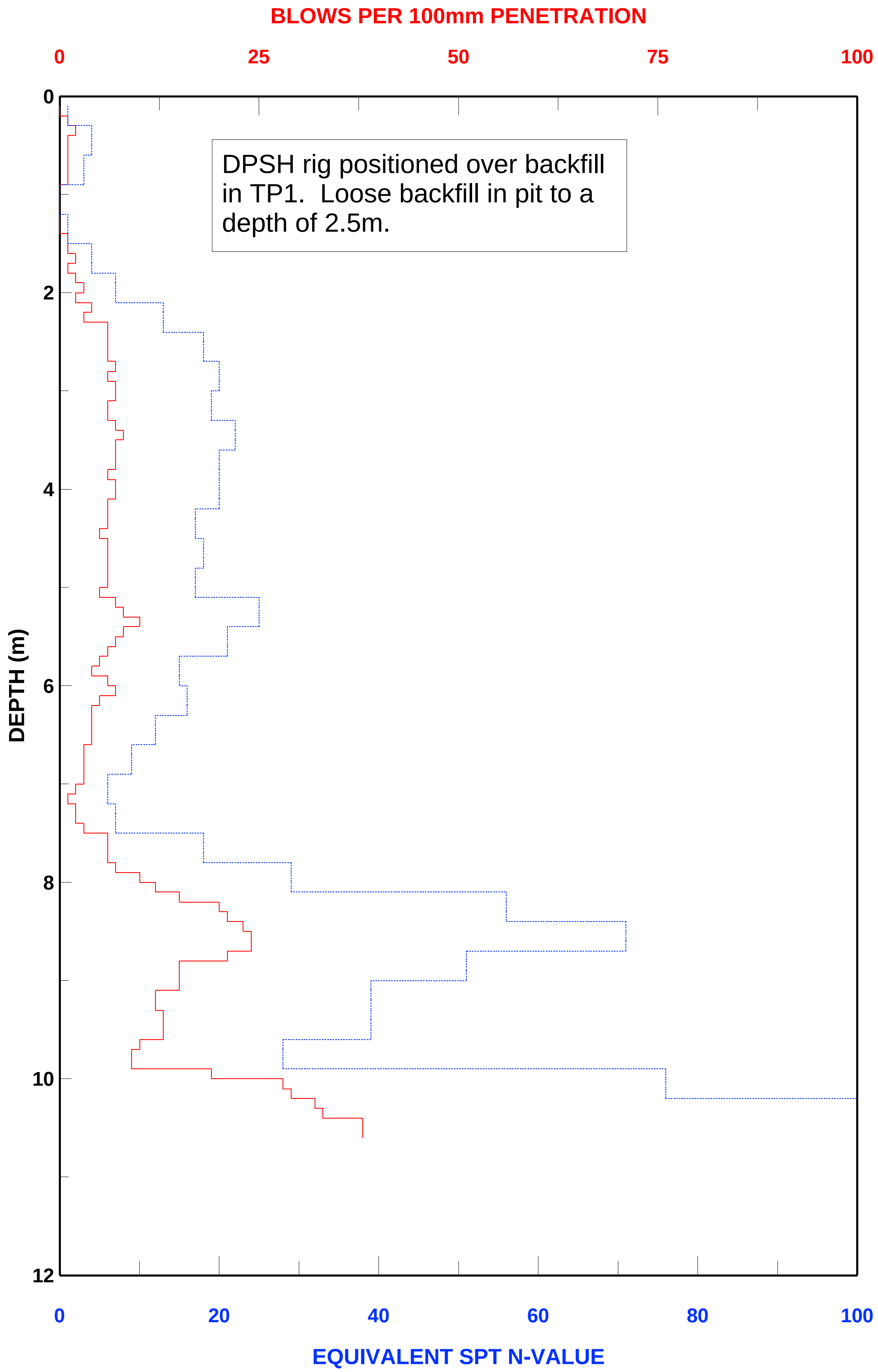
O	DISTURBED SAMPLE	V	WATER TABLE
[]	UNDISTURBED SAMPLE	¥	PERCHED WATER TABLE

APPENDIX B

RESULTS OF DPSH TESTS

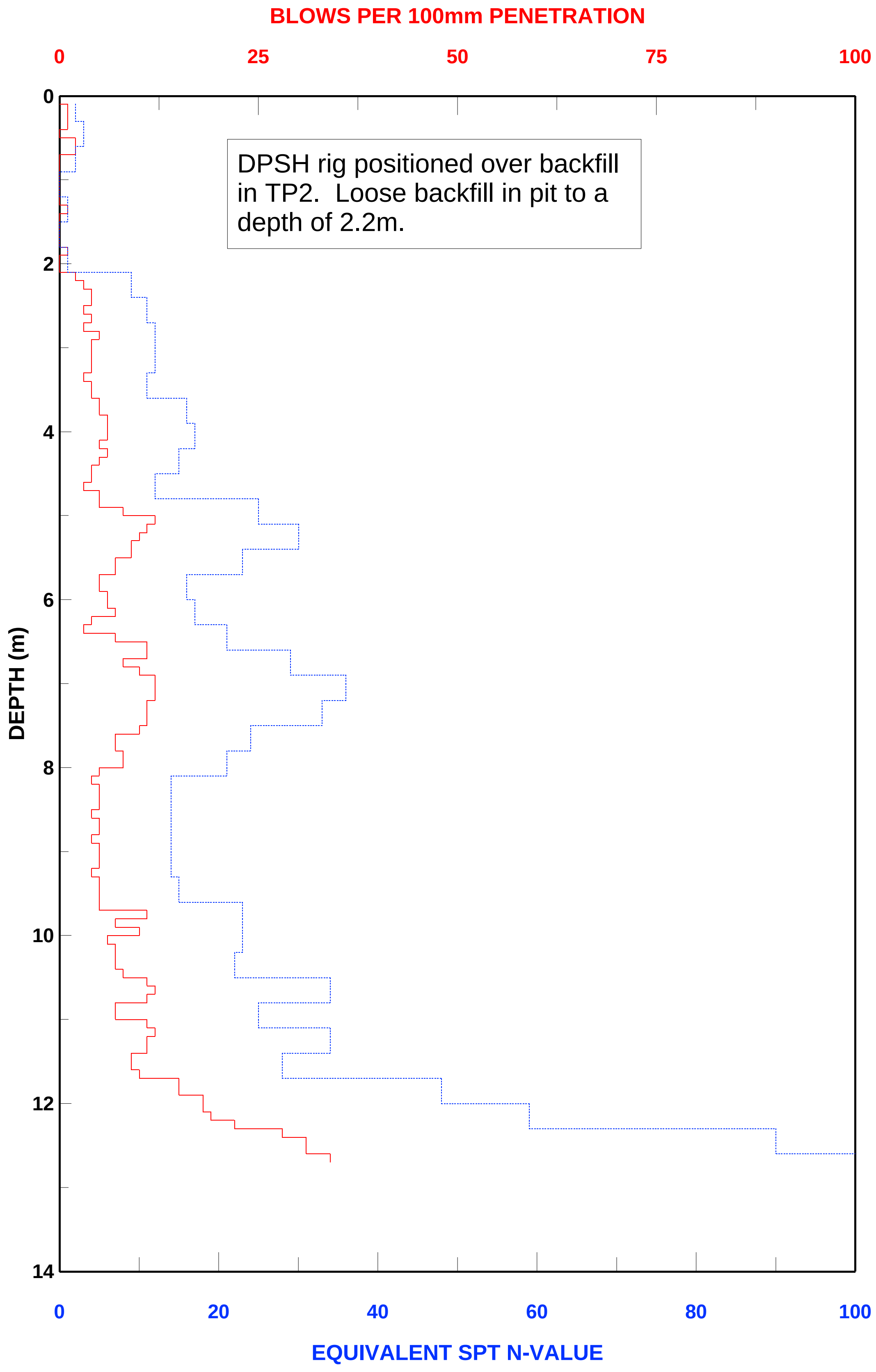
PROJECT: ERF 3865, HAGLEY **PROBE NO:** DPSH1

REF NO: 179022 **ELEVATION:** **DATE:** 18/5/2022



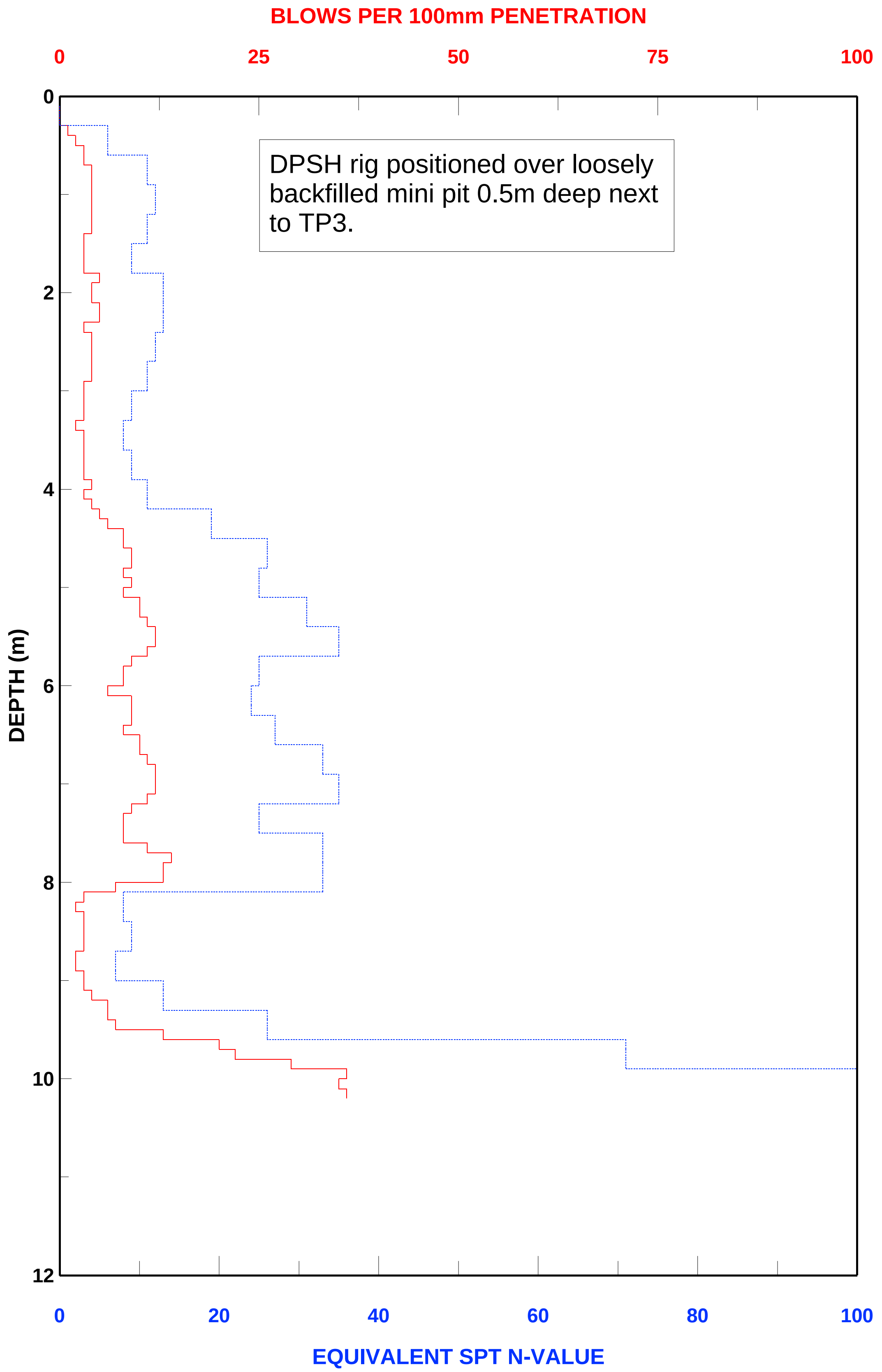
PROJECT: ERF 3865, HAGLEY **PROBE NO:** DPSH2

REF NO: 179022 **ELEVATION:** **DATE:** 18/5/2022



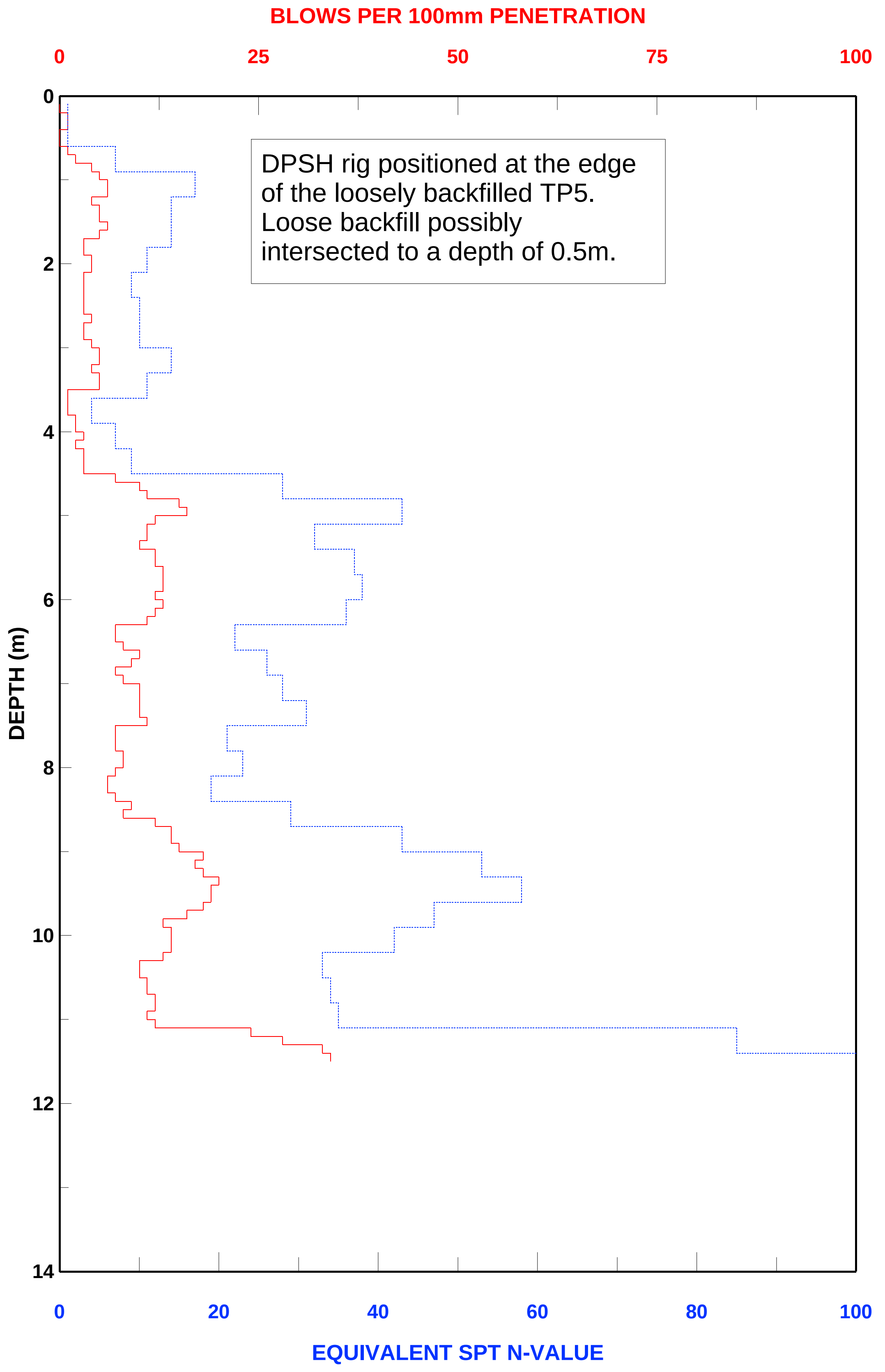
PROJECT: ERF 3865, HAGLEY **PROBE NO:** DPSH3

REF NO: 179022 **ELEVATION:** **DATE:** 18/5/2022



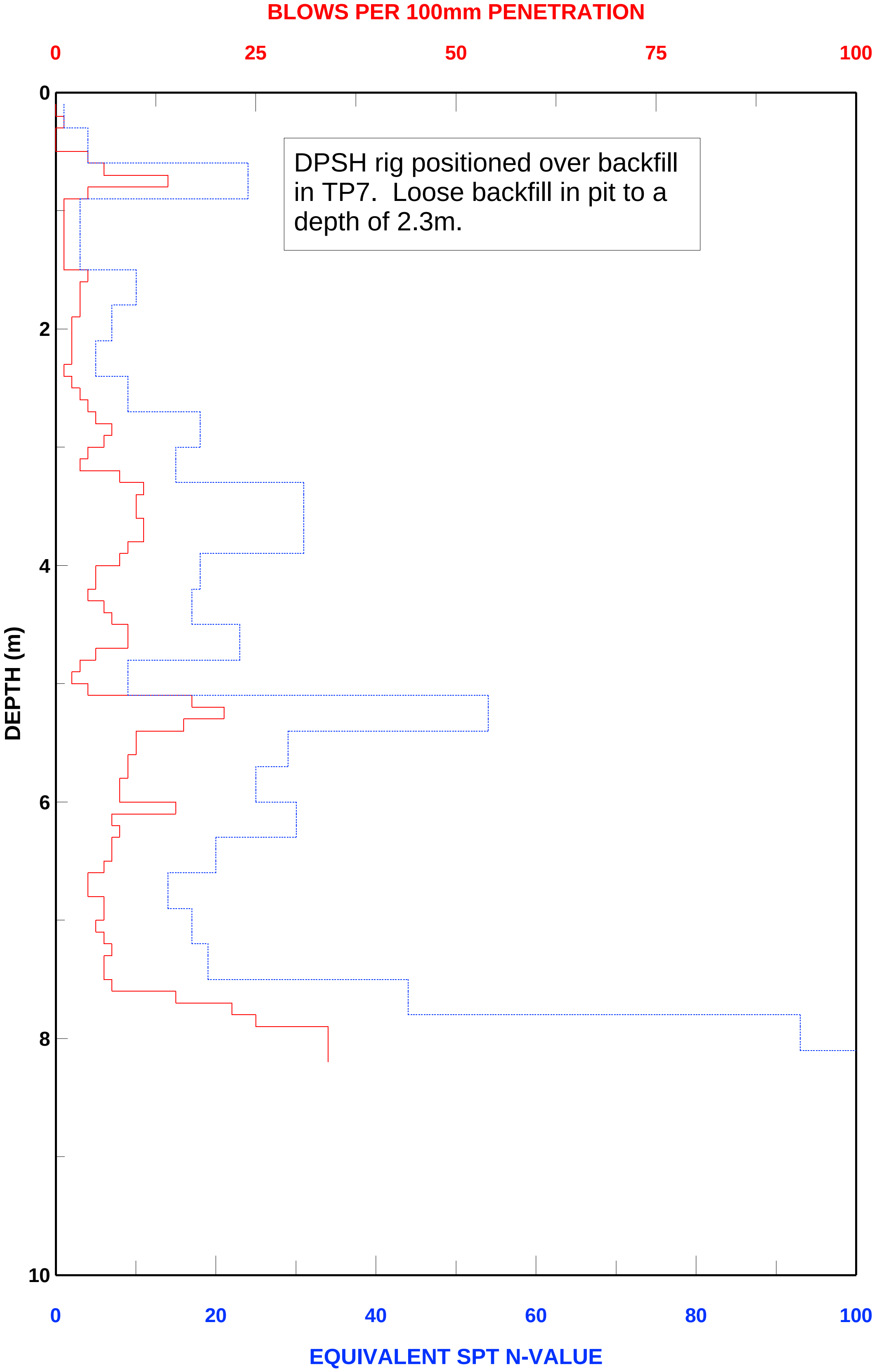
PROJECT: ERF 3865, HAGLEY **PROBE NO:** DPSH5

REF NO: 179022 **ELEVATION:** **DATE:** 18/5/2022



PROJECT: ERF 3865, HAGLEY **PROBE NO:** DPSH7

REF NO: 179022 **ELEVATION:** **DATE:** 18/5/2022

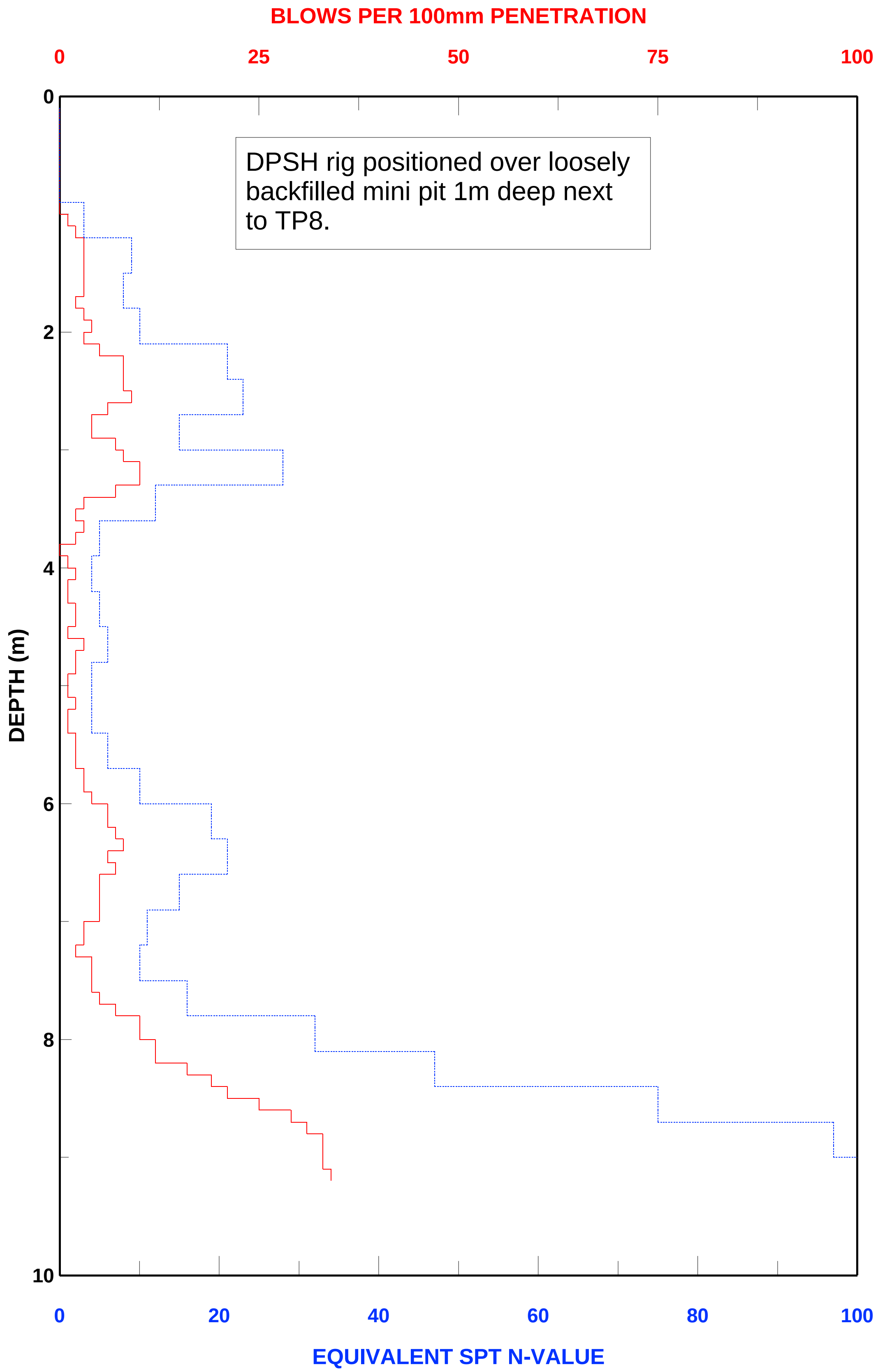


PROJECT: ERF 3865, HAGLEY

PROBE NO: DPSH8

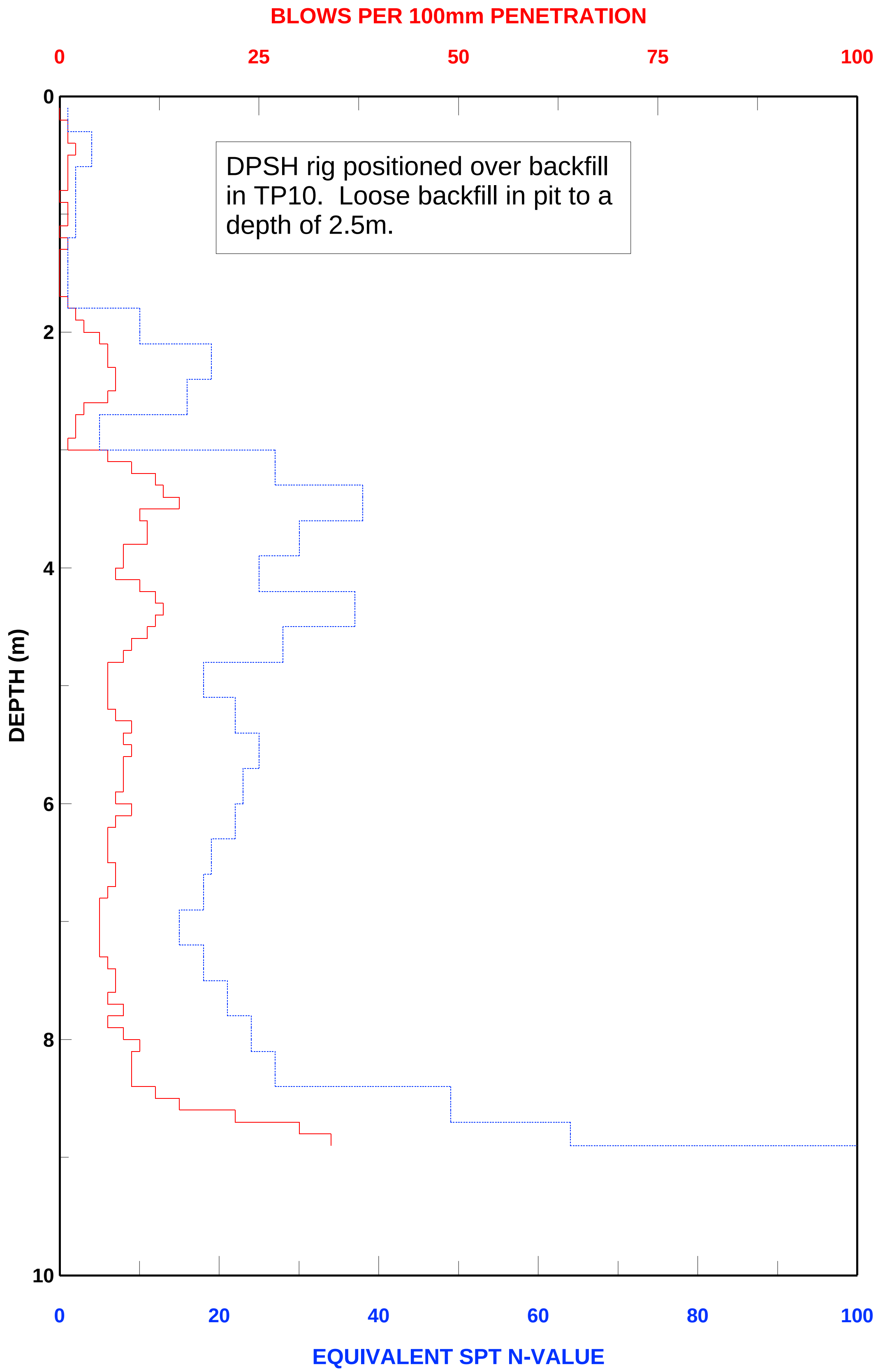
REF NO: 179022 **ELEVATION:**

DATE: 18/5/2022

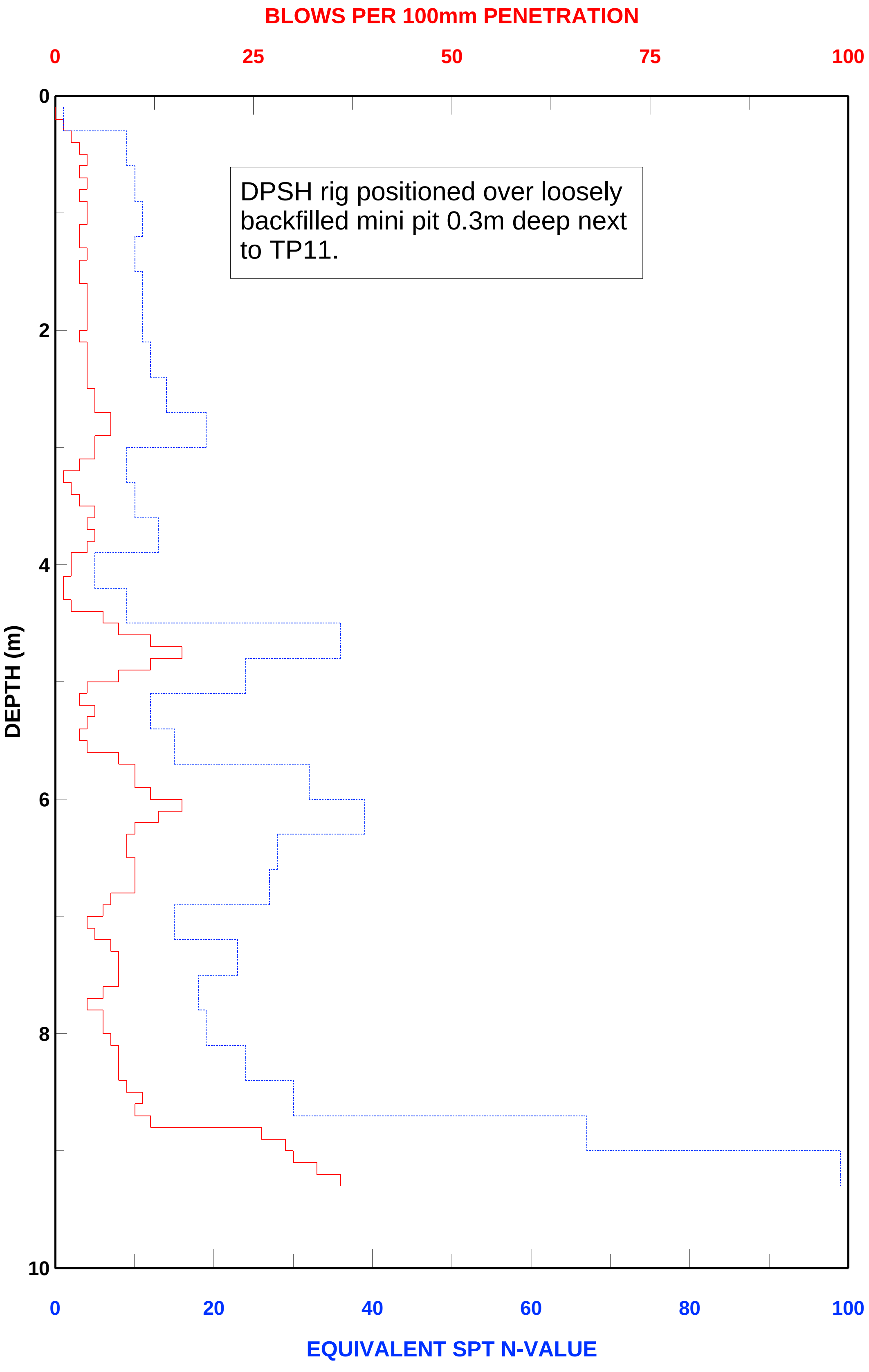


PROJECT: ERF 3865, HAGLEY **PROBE NO:** DPSH10

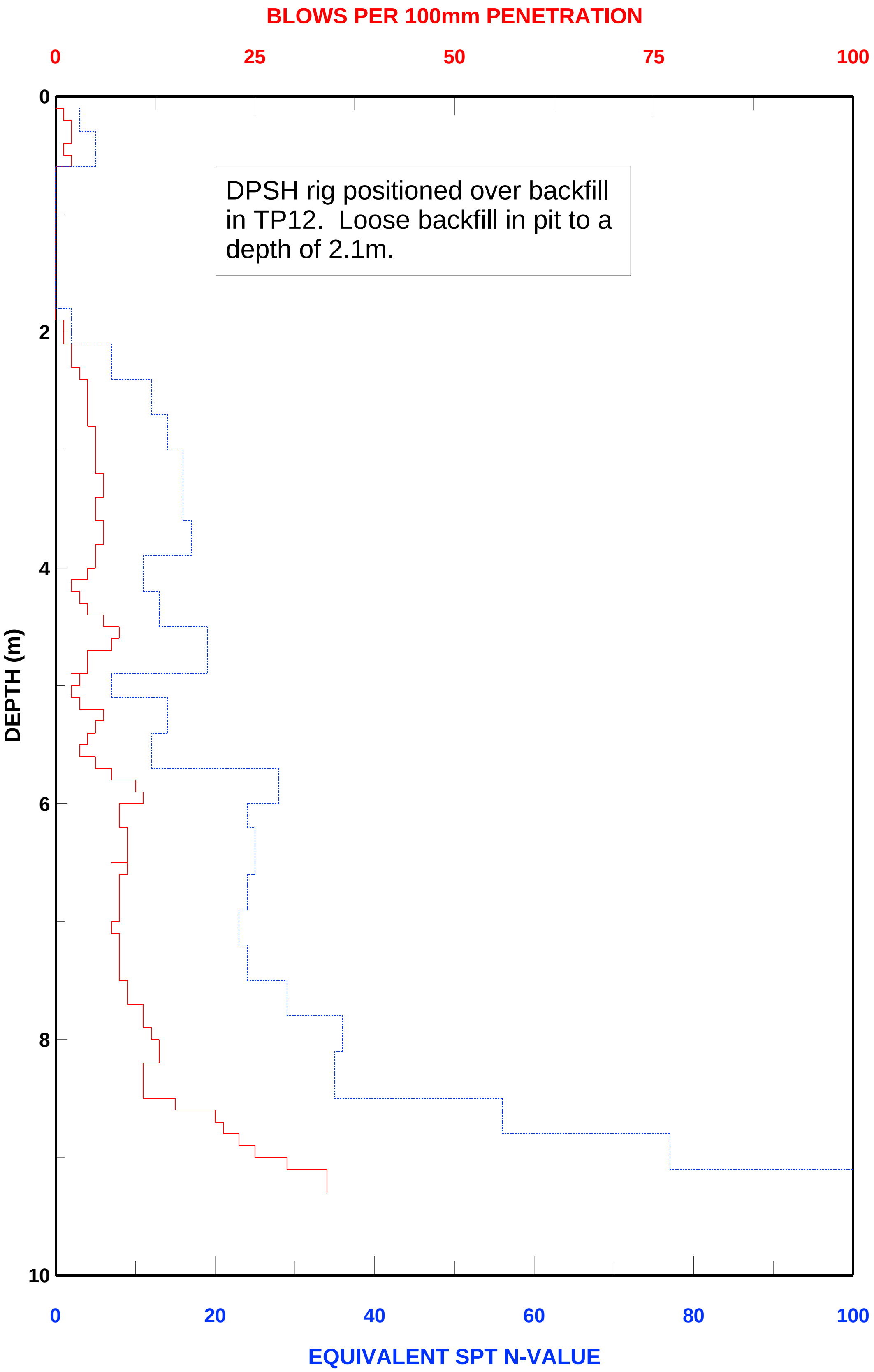
REF NO: 179022 **ELEVATION:** **DATE:** 18/5/2022



PROJECT:	ERF 3865, HAGLEY	**PROBE NO:**	DPSH11
REF NO:	179022 **ELEVATION:**	**DATE:**	18/5/2022



PROJECT:	ERF 3865, HAGLEY	**PROBE NO:**	DPSH12
REF NO:	179022 **ELEVATION:**	**DATE:**	18/5/2022



APPENDIX C

RESULTS OF LABORATORY TESTS

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7 Milan Street, Airport Industria, Cape Town, 7490
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Email: geosci@mweb.co.za

EAST LONDON
Unit 4 Kelly Court, Schafli Road, Kwelera, 5259
Tel: 0833102193/ 0842774444
Email: mlproudfoot@geosciences.co.za

CLIENT: RA Bradshaw & Associates **PROJECT:** Erf 3865 Hagley

ATT: Dick Bradshaw **REF. NO:** L220528

SAND GRADING RESULT SUMMARY

SAMPLE NO: 34564

CLIENT SAMPLE NO.

SAMPLE DESCRIPTION lt brown gvl sand

SAMPLE POSITION TP 1 @ 0,15-1,10m

GRADING MODULUS 1,72

SIEVE ANALYSIS

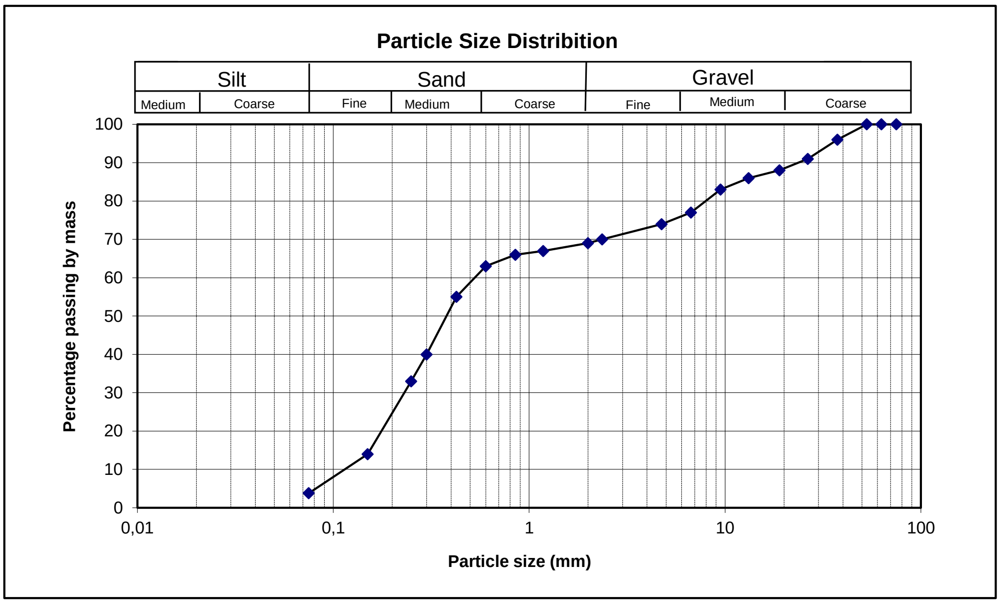
Sieve mm	Percentage Passing	Sieve mm	Percentage Passing
75		2,36	70
63		2,00	69
53	100	1,18	67
37,5	96	0,850	66
26,5	91	0,600	63
19	88	0,425	55
13,2	86	0,300	40
9,50	83	0,250	33
6,70	77	0,150	14
4,750	74	0,075	3,8

ATTERBERG LIMITS

Liquid Limit	
Plastic Index	
Linear Shrinkage %	

MOD / CBR

MOD	1885
O.M.C.	10,5
100%	157
98%	78
95%	27
93%	13
90%	4
Max Swell	0,3



Technical Signatory: M Hofman

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Email: geosci@mweb.co.za

EAST LONDON
Unit 4 Kelly Court, Schafli Road, Kwelera, 5259
Tel: 0833102193/ 0842774444
Email: mlproudfoot@geosciences.co.za

CLIENT:	RA Bradshaw & Associates 17 Midwood Avenue Newlands 7700	**PROJECT:**	Erf 3865 Hagley
		DATE:	30-05-2022
ATT:	Dick Bradshaw	**REF:**	L220528

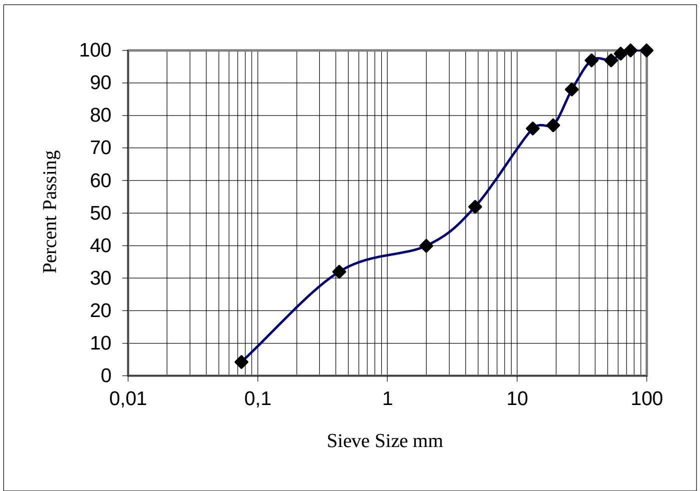
ROAD INDICATOR TEST SUMMARY

Client Ref. No.:		*Sample Number:*	34565
Client Sample Ref.:		*Sample Position:*	TP 2
Client Sample Ref.:		*Depth:*	0-0.45m
Client Sample Ref.:		*Sample Description:*	dark br Fe gvl

TMH 1 Method A1

Sieve Analysis

Sieve Size (mm)	% Passing
75	100
63	99
53	97
37,5	97
26,5	88
19	77
13,2	76
4,75	52
2,00	40
0,425	32
0,075	4,3

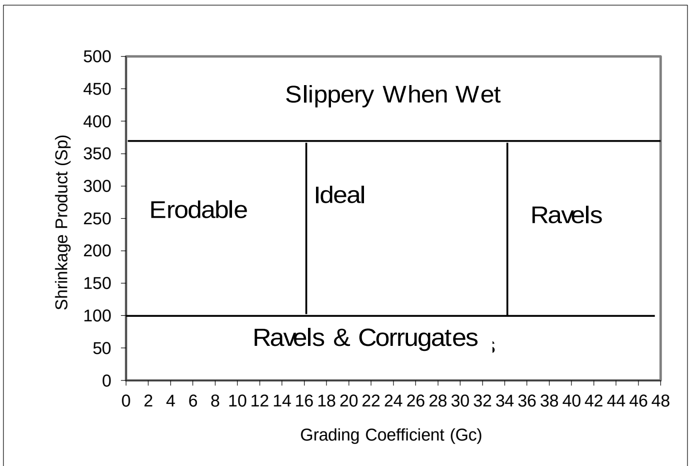


SANS 3001- GR10

Atterberg limits

Liquid Limit	
Plastic Index	S-P
Linear Shrinkage	

Grading Modulus (GM)	2,24
Oversized Index (Io)	
Shrinkage Product (Sp)	
Plastic Product (Pp)	
Grading Coefficient (Gc)	
Maximum size (mm)	



Maximum Dry Den.	OMC	Percentage Compaction.	100%	98%	95%	93%	90%
2406	8,9	CBR Values	64	59	50	45	39
						Max. %Swell	0,3

Technical Signatory: M Hofman

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Email: geosci@mweb.co.za

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Unit 4 Kelly Court, Schafli Road, Kwelera, 5259
Tel: 0833102193/ 0842774444
Email: mlproudfoot@geosciences.co.za

CLIENT: RA Bradshaw & Associates **PROJECT:** Erf 3865 Hagley

ATT: Dick Bradshaw **REF. NO:** L220528

SAND GRADING RESULT SUMMARY

SAMPLE NO: 34566

CLIENT SAMPLE NO.

SAMPLE DESCRIPTION: dark brown sand

SAMPLE POSITION: TP 3 @ 0,6-1,80m

GRADING MODULUS: 1,16

SIEVE ANALYSIS

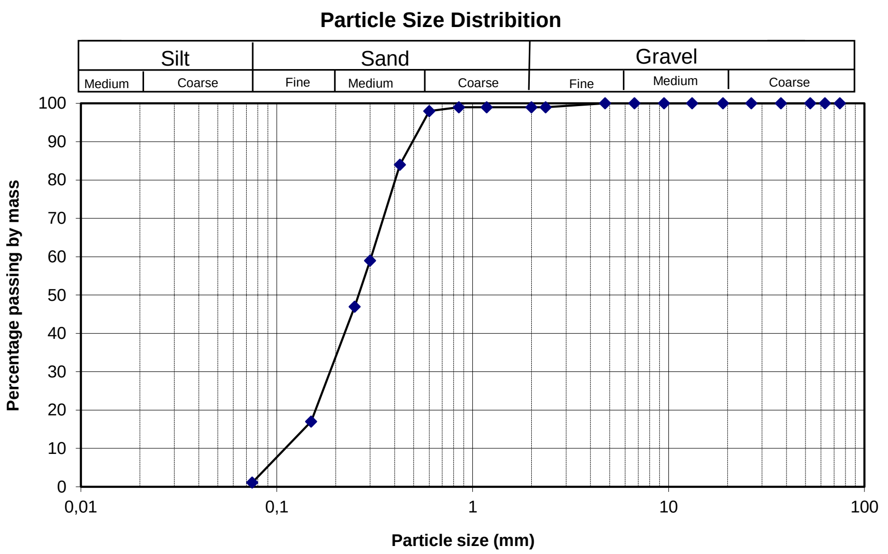
Sieve mm	Percentage Passing	Sieve mm	Percentage Passing
75		2,36	99
63		2,00	99
53		1,18	99
37,5		0,850	99
26,5		0,600	98
19		0,425	84
13,2		0,300	59
9,50		0,250	47
6,70		0,150	17
4,750	100	0,075	1,1

ATTERBERG LIMITS

Liquid Limit	
Plastic Index	
Linear Shrinkage %	

MOD / CBR

MOD	1750
O.M.C.	12,5
100%	17
98%	13
95%	8
93%	5
90%	3
Max Swell	0,1



Technical Signatory: M Hofman

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Email: geosci@mweb.co.za

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Unit 4 Kelly Court, Schafli Road, Kwelera, 5259
Tel: 0833102193/ 0842774444
Email: mlproudfoot@geosciences.co.za

CLIENT: RA Bradshaw & Associates **PROJECT:** Erf 3865 Hagley

ATT: Dick Bradshaw **REF. NO:** L220528

SAND GRADING RESULT SUMMARY

SAMPLE NO: 34567

CLIENT SAMPLE NO.

SAMPLE DESCRIPTION brown sand

SAMPLE POSITION TP 5 @ 0,7-1,30m

GRADING MODULUS 1,08

SIEVE ANALYSIS

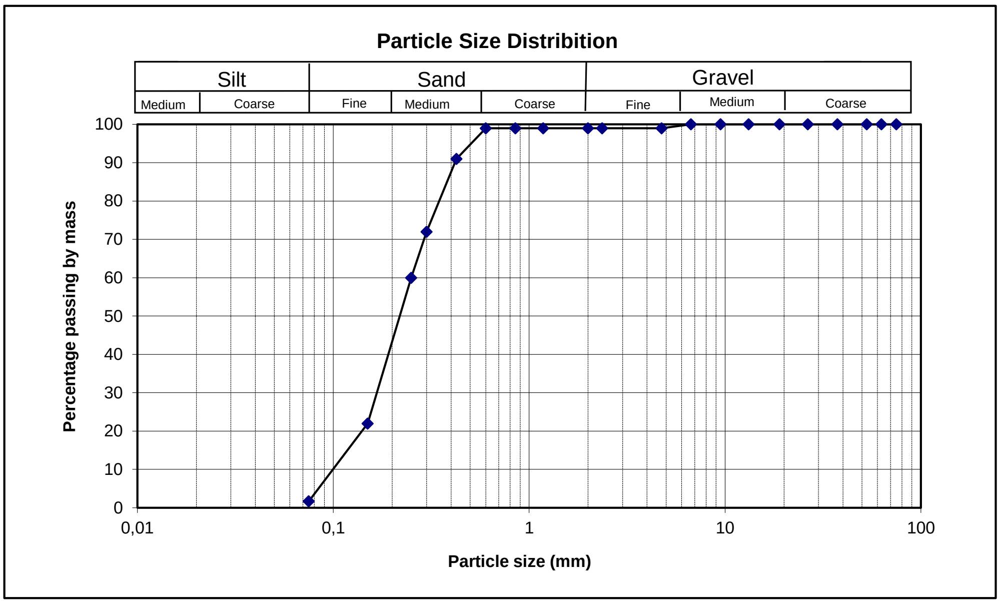
Sieve mm	Percentage Passing	Sieve mm	Percentage Passing
75		2,36	99
63		2,00	99
53		1,18	99
37,5		0,850	99
26,5		0,600	99
19		0,425	91
13,2		0,300	72
9,50		0,250	60
6,70	100	0,150	22
4,750	99	0,075	1,7

ATTERBERG LIMITS

Liquid Limit	
Plastic Index	
Linear Shrinkage %	

MOD / CBR

MOD	1724
O.M.C.	7,6
100%	14
98%	9
95%	6
93%	4
90%	3
Max Swell	0



Technical Signatory: M Hofman

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Email: geosci@mweb.co.za

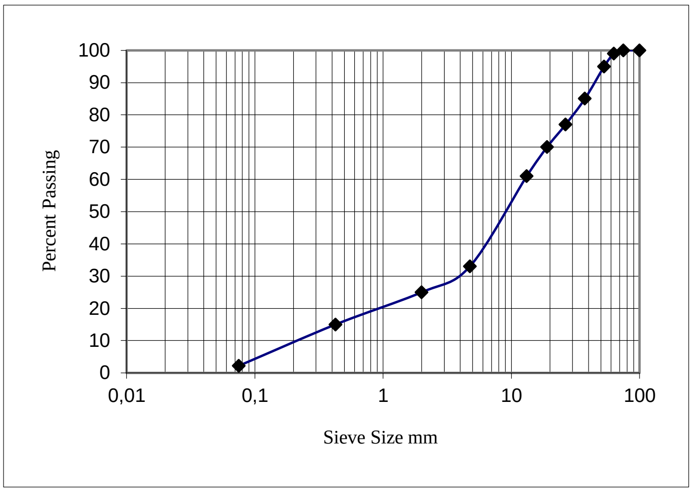
EAST LONDON
Unit 4 Kelly Court, Schafli Road, Kwelera, 5259
Tel: 0833102193/ 0842774444
Email: mlproudfoot@geosciences.co.za

CLIENT:	RA Bradshaw & Associates 17 Midwood Avenue Newlands 7700	**PROJECT:**	Erf 3865 Hagley
		DATE:	30-05-2022
ATT:	Dick Bradshaw	**REF:**	L220528

ROAD INDICATOR TEST SUMMARY

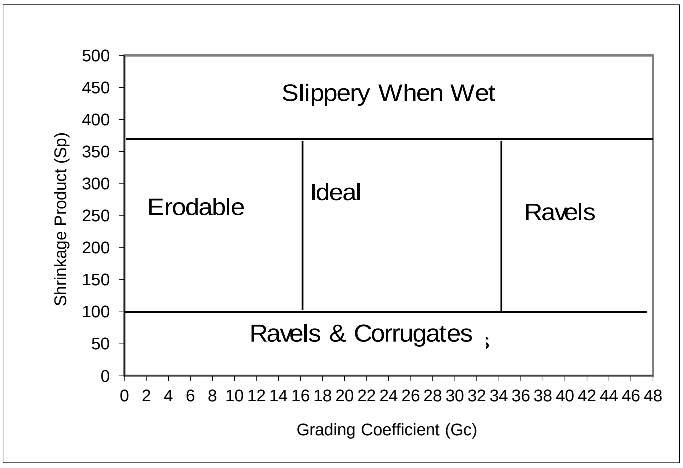
Client Ref. No.:		*Sample Number:*	34568
Client Sample Ref.:		*Sample Position:*	TP 6
Client Sample Ref.:		*Depth:*	0-0.55m
Client Sample Ref.:		*Sample Description:*	grey sand & concrete

TMH 1 Method A1		
Sieve Analysis		
Sieve Size (mm)	% Passing	
75		
63	99	
53	95	
37,5	85	
26,5	77	
19	70	
13,2	61	
4,75	33	
2,00	25	
0,425	15	
0,075	2,2	



SANS 3001- GR10	
Atterberg limits	
Liquid Limit	
Plastic Index	N-P
Linear Shrinkage	

Grading Modulus (GM)	2,58
Oversized Index (Io)	
Shrinkage Product (Sp)	
Plastic Product (Pp)	
Grading Coefficient (Gc)	
Maximum size (mm)	



Maximum Dry Den.	OMC	Percentage Compaction.	100%	98%	95%	93%	90%
2070	11,2	CBR Values	108	90	57	41	28
						Max. %Swell	0

Technical Signatory: M Hofman

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING AND GEOTECHNICAL SERVICES, INVESTIGATIONS & LABORATORY TESTING

CAPE TOWN
7 Milan Street, Airport Industria, Cape Town, 7490
Tel: (021) 934 1114/ 0731894619
Email: geosci@mweb.co.za

EAST LONDON
Unit 4 Kelly Court, Schafli Road, Kwelera, 5259
Tel: 0833102193/ 0842774444
Email: mlproudfoot@geosciences.co.za

CLIENT: RA Bradshaw & Associates
17 Midwood Avenue
Newlands
7700

ATT: Dick Bradshaw

PROJECT: Erf 3865 Hagley

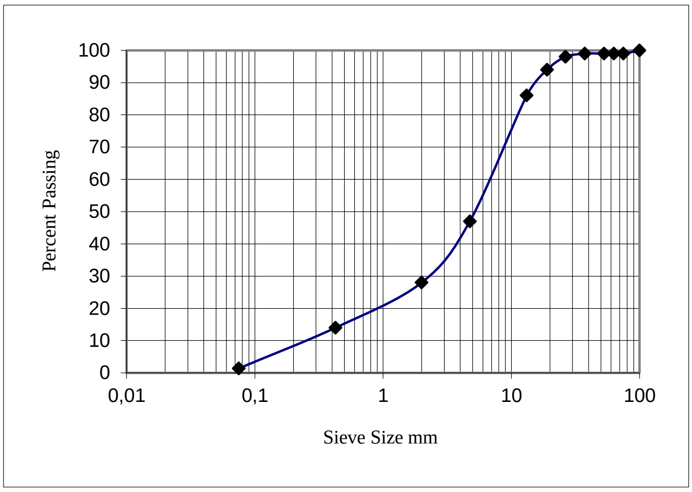
DATE: 30-05-2022

REF: L220528

ROAD INDICATOR TEST SUMMARY

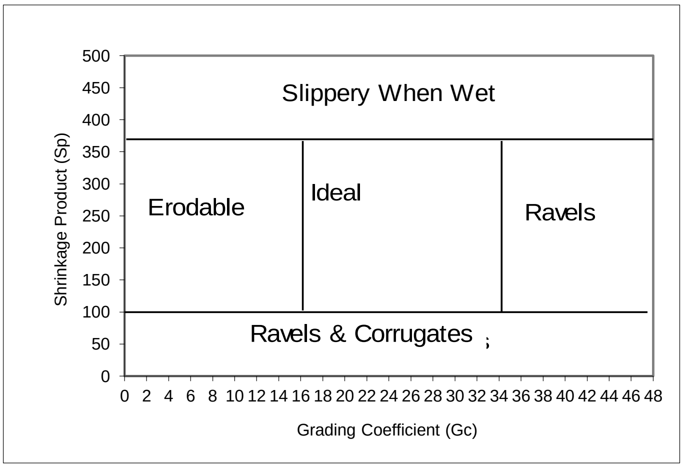
Client Ref. No.:		*Sample Number:*	34569
Client Sample Ref.:		*Sample Position:*	TP 9
Client Sample Ref.:		*Depth:*	0-0.2m
Client Sample Ref.:		*Sample Description:*	dark grey gvl sand

TMH 1 Method A1 Sieve Analysis	
Sieve Size (mm)	% Passing
75	99
63	99
53	99
37,5	99
26,5	98
19	94
13,2	86
4,75	47
2,00	28
0,425	14
0,075	1,4



SANS 3001- GR10 Atterberg limits	
Liquid Limit	
Plastic Index	N-P
Linear Shrinkage	

Grading Modulus (GM)	2,57
Oversized Index (Io)	
Shrinkage Product (Sp)	
Plastic Product (Pp)	
Grading Coefficient (Gc)	
Maximum size (mm)	



Maximum Dry Den.	OMC	Percentage Compaction.	100%	98%	95%	93%	90%
2067	5,8	CBR Values	36	24	14	8	4
						Max. %Swell	0,4

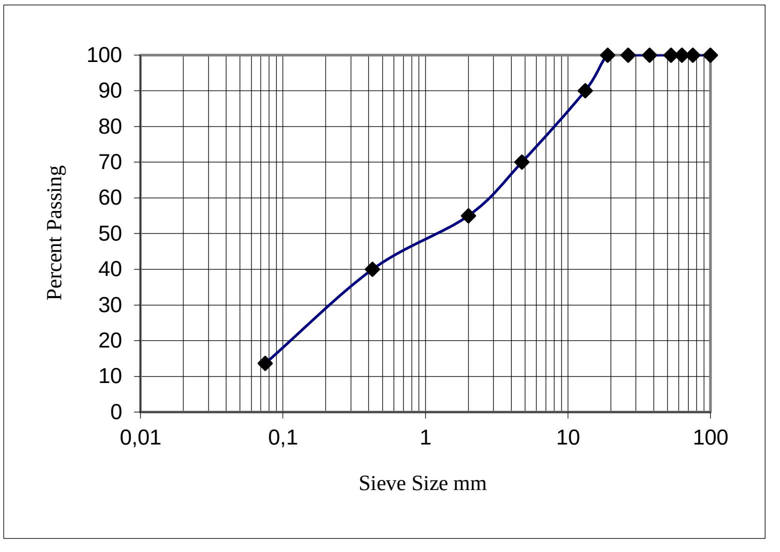
Technical Signatory: M Hofman

CLIENT:	RA Bradshaw & Associates 17 Midwood Avenue Newlands 7700	**PROJECT:**	Erf 3865 Hagley
		DATE:	30-05-2022
ATT:	Dick Bradshaw	**REF:**	L220528

ROAD INDICATOR TEST SUMMARY

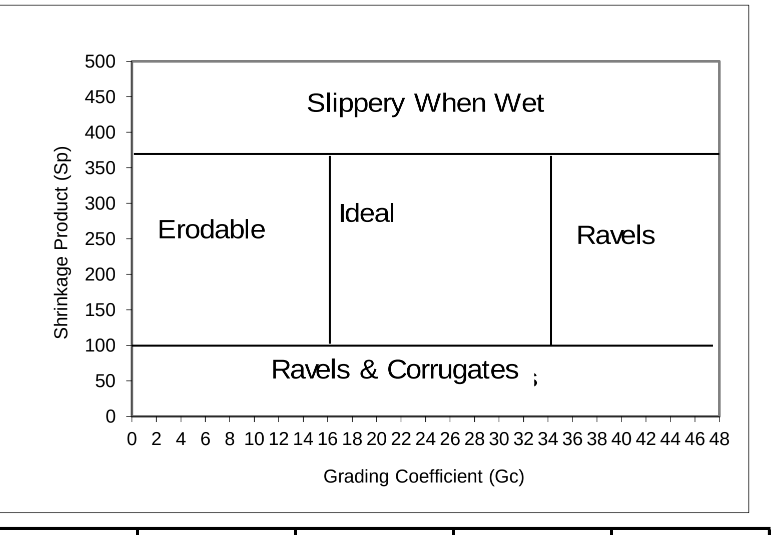
Client Ref. No.:		*Sample Number:*	34570
Client Sample Ref.:		*Sample Position:*	TP 12
Client Sample Ref.:		*Depth:*	0.2-0.55m
Client Sample Ref.:		*Sample Description:*	dark yel br silty sand

TMH 1 Method A1		
Sieve Analysis		
Sieve Size (mm)	**% Passing**	
75		
63		
53		
37,5		
26,5		
19	100	
13,2	90	
4,75	70	
2,00	55	
0,425	40	
0,075	13,6	



SANS 3001- GR10	
Atterberg limits	
Liquid Limit	21
Plastic Index	6
Linear Shrinkage	3,0

Grading Modulus (GM)	1,91
Oversized Index (Io)	
Shrinkage Product (Sp)	
Plastic Product (Pp)	
Grading Coefficient (Gc)	
Maximum size (mm)	



Maximum Dry Den.	OMC	Percentage Compaction.	100%	98%	95%	93%	90%
1701	20,4	CBR Values	55	39	22	17	9
						Max. %Swell	0,7

Technical Signatory: M Hofman

APPENDIX D

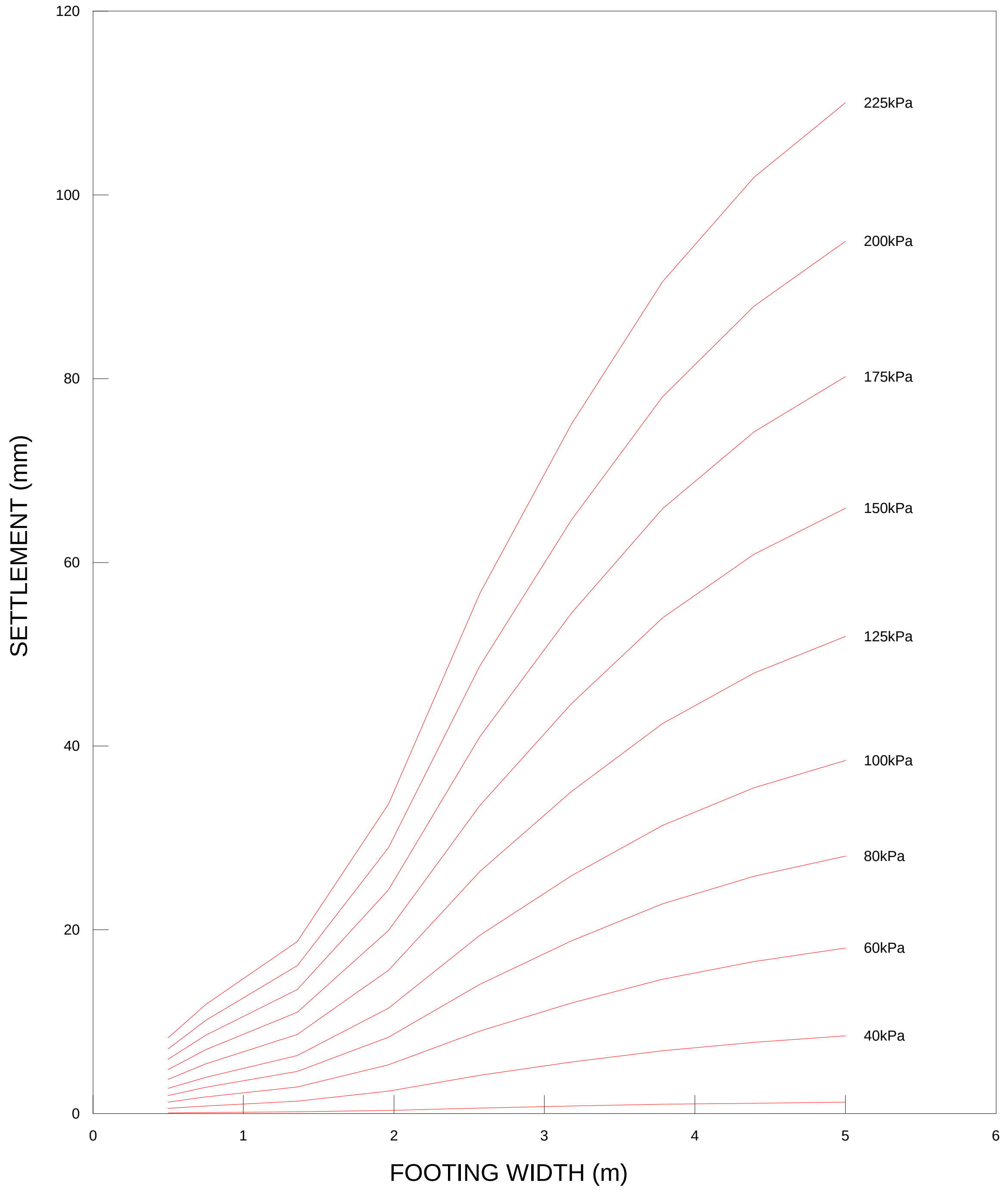
RESULTS OF SETTLEMENT ANALYSES

SETTLEMENT ANALYSIS

PROJECT :	ERF 3865 HAGLEY	DATE :	05/06/2022
DESCRIPTION :	Settlement of square footings - loosest conditions		
REF. NO : 179022	ANALYSIS : 1	FILE NO :	17902201

ANALYSIS USES TEST NO. :	DPSH8		
GROUND ELEVATION (m)	N/A	SOIL DEPTH TO BEDROCK (m)	20
FOOTING SHAPE	SQUARE	DEPTH TO FOUNDING LEVEL(m)	0.8

SETTLEMENT ANALYSIS USING SCHMERTMANN (1978) METHOD

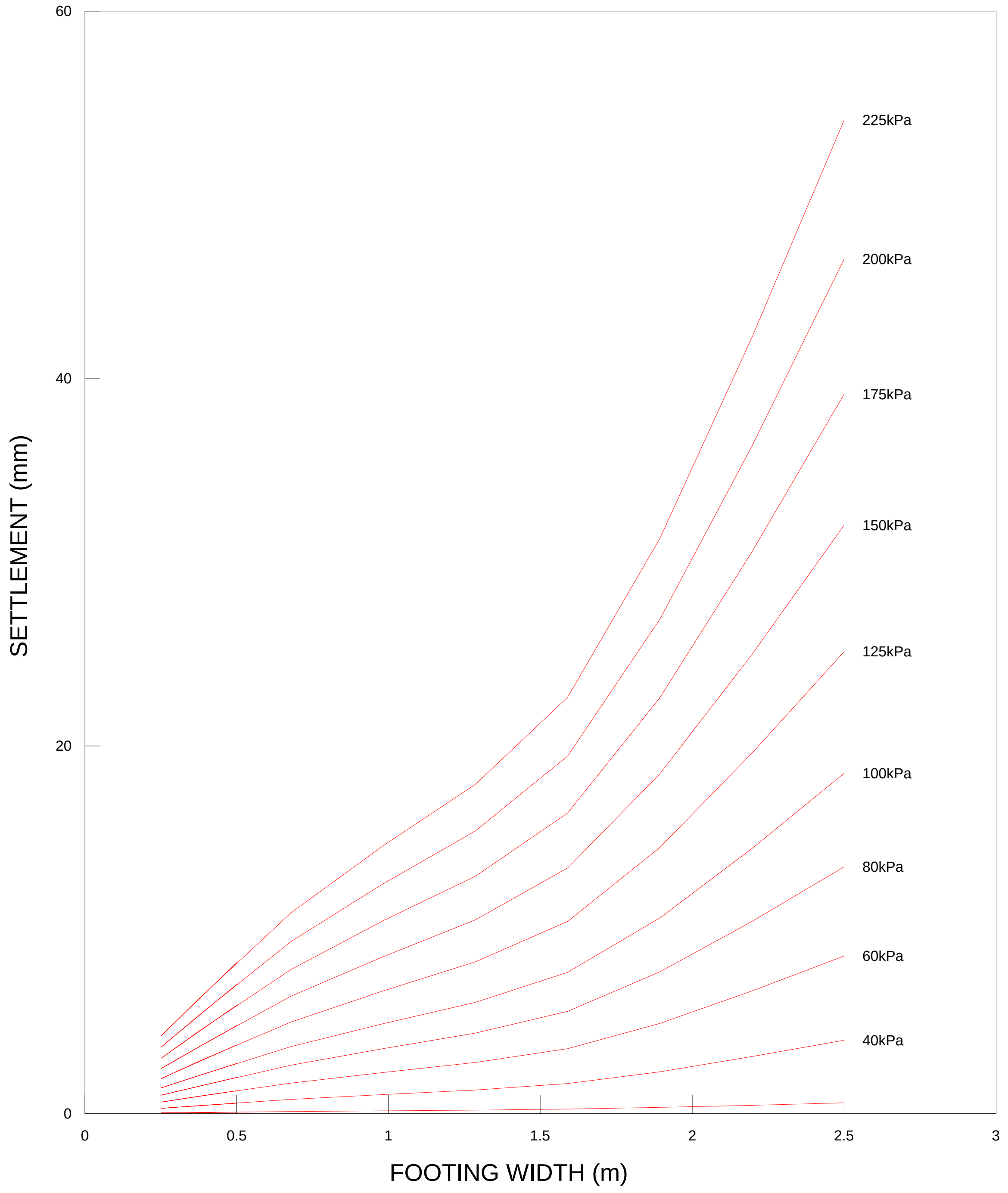


SETTLEMENT ANALYSIS

PROJECT :	ERF 3865 HAGLEY	DATE :	05/06/2022
DESCRIPTION :	Settlement of strip footings - loosest conditions		
REF. NO : 179022	ANALYSIS : 2	FILE NO :	17902202

ANALYSIS USES TEST NO. :	DPSH8		
GROUND ELEVATION (m)	N/A	SOIL DEPTH TO BEDROCK (m)	20
FOOTING SHAPE	SQUARE	DEPTH TO FOUNDING LEVEL(m)	0.8

SETTLEMENT ANALYSIS USING SCHMERTMANN (1978) METHOD

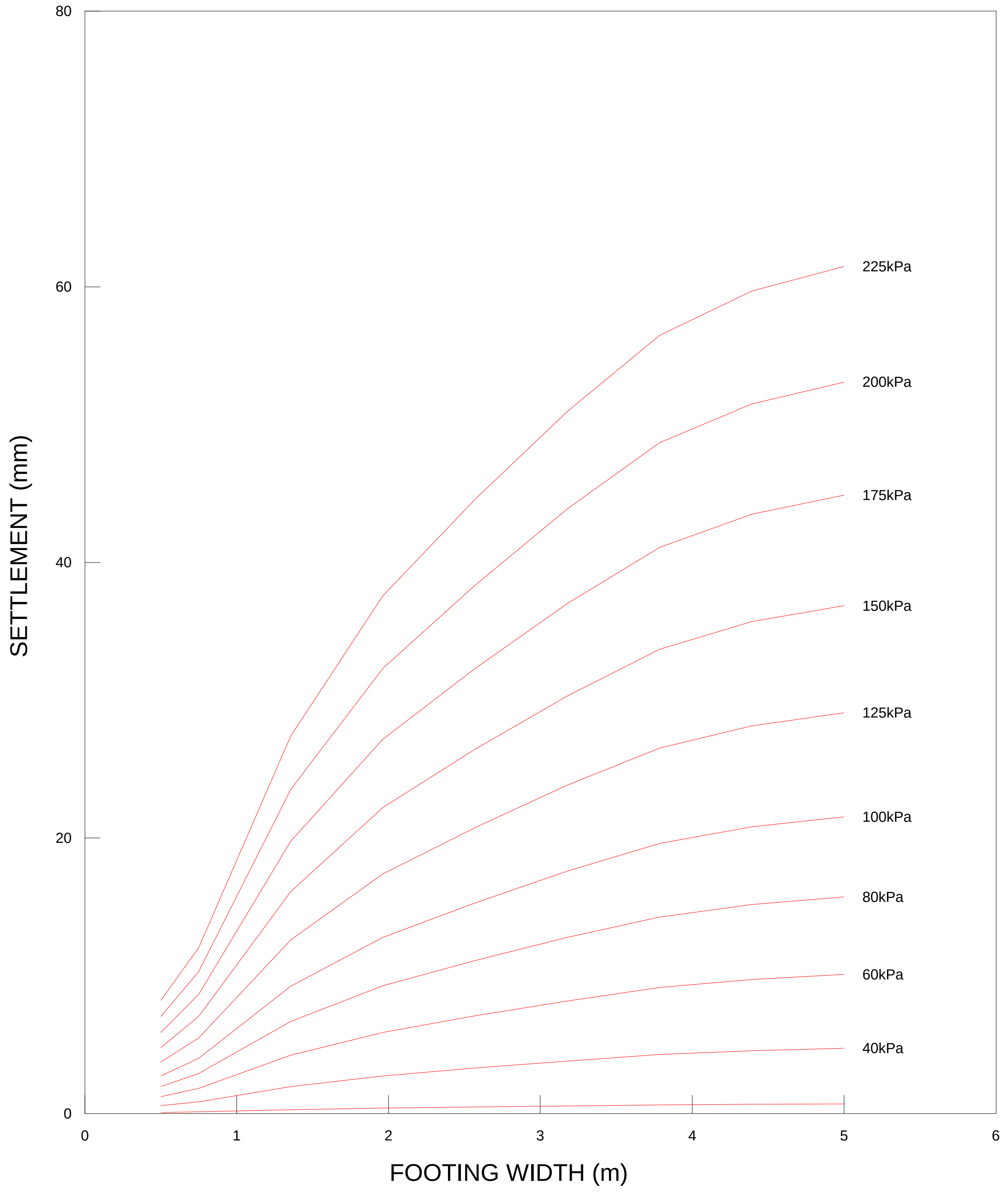


SETTLEMENT ANALYSIS

PROJECT :		ERF 3865 HAGLEY		DATE :	05/06/2022
DESCRIPTION :		Settlement of square footings - densest conditions			
REF. NO :	179022	ANALYSIS :	3	FILE NO :	17902203

ANALYSIS USES TEST NO. :	DPSH10		
GROUND ELEVATION (m)	N/A	SOIL DEPTH TO BEDROCK (m)	20
FOOTING SHAPE	SQUARE	DEPTH TO FOUNDING LEVEL(m)	0.8

SETTLEMENT ANALYSIS USING SCHMERTMANN (1978) METHOD



SETTLEMENT ANALYSIS

PROJECT :	ERF 3865 HAGLEY	DATE :	05/06/2022
DESCRIPTION :	Settlement of strip footings - densest conditions		
REF. NO : 179022	ANALYSIS : 4	FILE NO :	17902204

ANALYSIS USES TEST NO. :	DPSH10		
GROUND ELEVATION (m)	N/A	SOIL DEPTH TO BEDROCK (m)	20
FOOTING SHAPE	SQUARE	DEPTH TO FOUNDING LEVEL(m)	0.8

SETTLEMENT ANALYSIS USING SCHMERTMANN (1978) METHOD