GIST Barnsley

DRAINAGE CALCULATIONS

7442-HBPW-XX-XX-CA-D-0001

Aug 2023

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DOCUMENT HISTORY SHEET

Issue	Status	Purpose/Description	Originator	Checker	Date
P01	S4	Initial Issue	DPS	MDT	09.08.23
P02	S4	Second Issue	DPS	MDT	18.08.23

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1 DRAINGE METHODOLOGY

HBPW have been tasked with designing a drainage system for GIST-owned car park located in Barnsley. The existing operational car park on site covers an area of approximately 2650m^2. There is currently no drainage system in place. The existing carpark consist of a mixture of impermeable tarmac (1268m^2) and permeable stone surfacing (1487m^2) with the later making up around 54% of the total area.

HBPW have commissioned a soil percolation test to determine the permeability of the subgrade. The test revealed a mean permeability of 0.213m/hr (5.91x10^{-5} m/s), therefore, the site is suitable for System A as described in *Permeable Pavements* guide by Interpave. For full output please refer to 7442-HBPW-XX-XX-RP-C-0020 - Soakaway Test Report.

The existing surface will be stripped and fully replaced by a permeable tarmac, therefore, given high permeability of the ground, no further drainage is required.

From Microdrainage interactive map: M5-60 =19mm & r = 0.36 for Barnsley.

From figure 1-1, the required min permeable sub-base thickness is 240mm. The ground investigation found in Appendix 1, reveals granular conditions continue for a minimum of six metres before encountering sandstone layer. Long term surface water storage is therefore not considered to be critical.

Figure 1-1 Extract from Interpave Permeable Pavements

For System A (infiltration) Table 6 can be used.

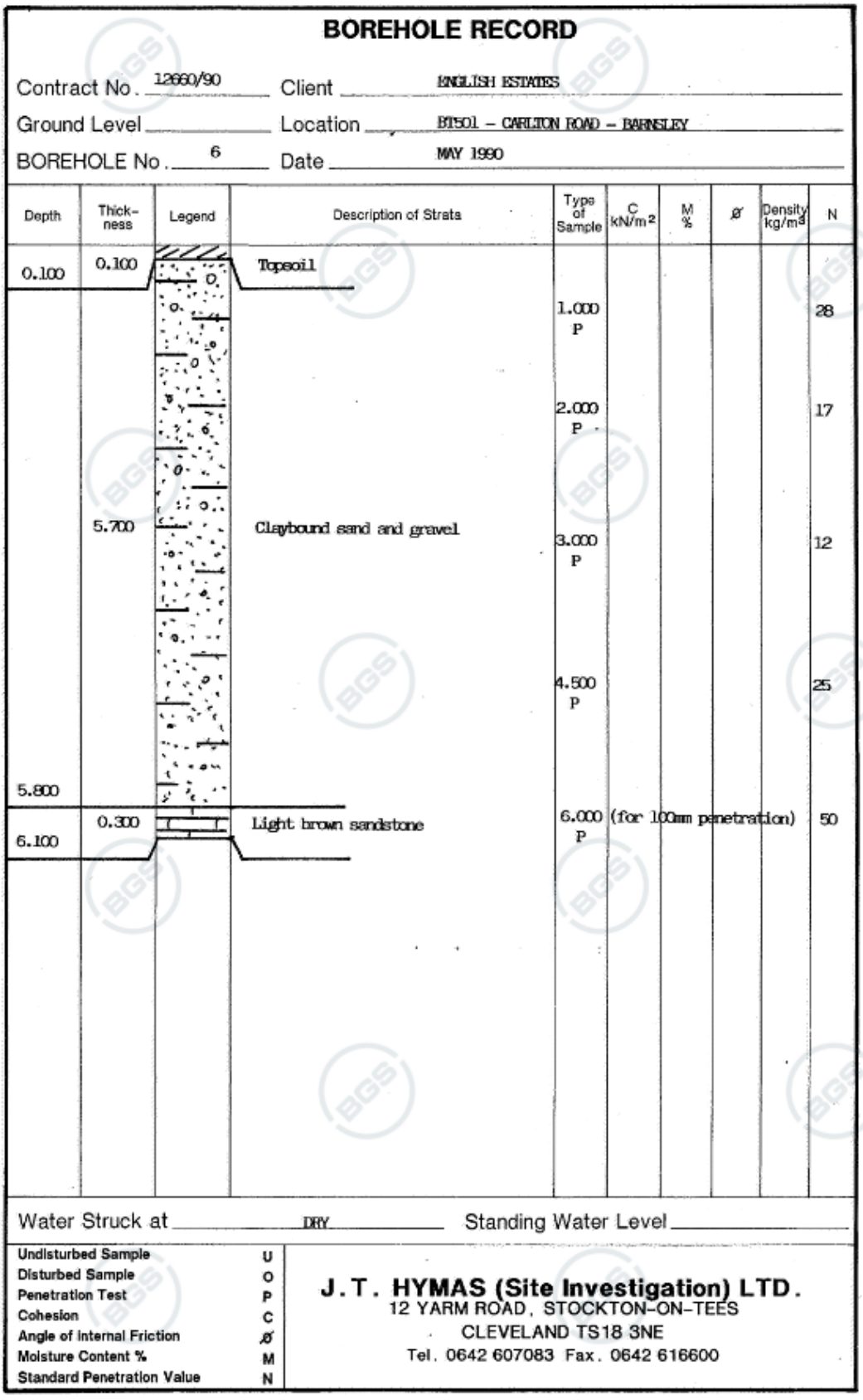
Rainfall data	r	Required permeable sub-base thickness (mm)		
		1 in 30 year design event	1 in 100 year event	1 in 100 year event plus 20% climate change
M_5-60 = 20mm	0.4	230	340	450
	0.3	240	360	480
	0.2	260	400	530
M_5-60 = 17mm	0.4	190	270	360
	0.3	190	280	380
	0.2	200	320	440
M_5-60 = 14mm	0.4			
	0.3	140	210	290
	0.2	140	230	330

Note: thickness assumes permeable sub-base has a voids ratio of 30%.
Infiltration rate greater than 1 x 10^{-5} m/s. Maximum ratio of impermeable to permeable is 2 to 1.

Table 6: Permeable sub-base thickness for infiltration system (System A) collecting impermeable area.

The construction depth was confirmed with Tedds 2022 calculation found in Appendix 2.

APPENDIX 1 – GIR



BOREHOLE RECORD

Contract No. 12660/90 Client ENGLISH ESTATES

Ground Level _____ Location B1501 – CARLTON ROAD – BARNSLEY

BOREHOLE No. 6 Date MAY 1990

Depth	Thick-ness	Legend	Description of Strata	Type of Sample	C kN/m²	M %	ø	Density kg/m³	N
0.100	0.100		Topsoil						
				1.000 P					28
				2.000 P					17
	5.700		Claybound sand and gravel	3.000 P					12
				4.500 P					25
5.800									
6.100	0.300		Light brown sandstone	6.000 P	(for 100mm penetration)				50

Water Struck at DRY Standing Water Level _____

Undisturbed Sample	U
Disturbed Sample	O
Penetration Test	P
Cohesion	C
Angle of Internal Friction	ø
Moisture Content %	M
Standard Penetration Value	N

J.T. HYMAS (Site Investigation) LTD.
12 YARM ROAD, STOCKTON-ON-TEES
CLEVELAND TS18 3NE
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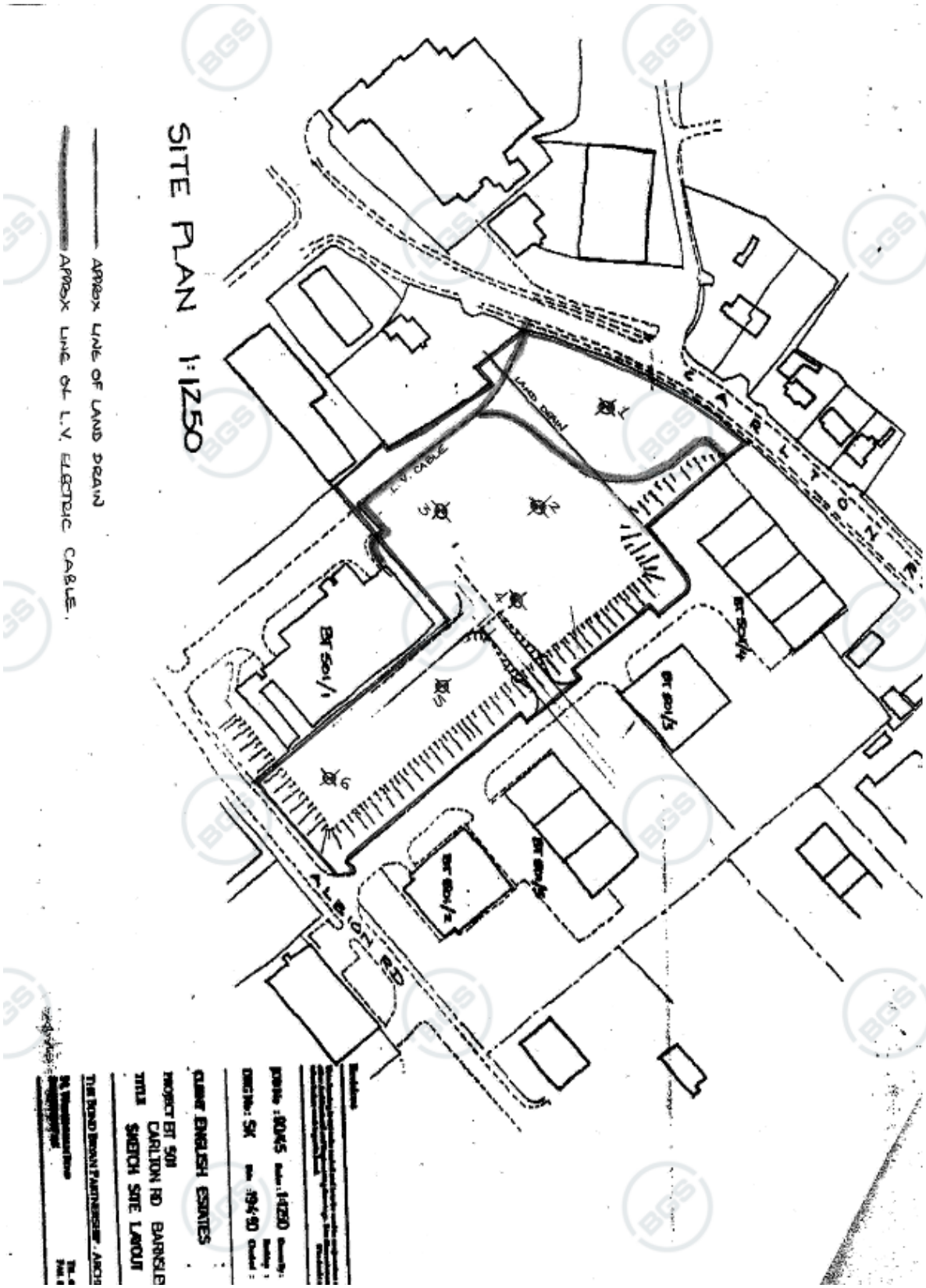

SITE PLAN 1:1250
APPROX LINE OF LAND DRAIN
APPROX LINE OF L.V. ELECTRIC CABLE.
L.V. CABLE
LAND DRAIN
BT SOL/1
BT SOL/2
BT SOL/3
BT SOL/4
CLARKE ENGLISH ESTATES
PROJECT BT 501
CARLTON RD BARNSLEY
SKETCH SITE LAYOUT

Norwest Holst Soil Engineering Ltd.

Borehole No. 3

BOREHOLE LOG

Contract No. F8790
Location Barnsley BOC
Client Burks Green & Partners
Method of Boring Percussion
Diameter of Borehole 150mm

436168
409426

Sheet 1 of 1
Chainage
Ground Level 67.4 m.A.O.D.
Date 29/3/90

Description of Strata	Legend	Depth Below G.L.(m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
MADE GROUND: dark grey clayey topsoil		0.50	66.9		0.50 (21)		
MADE GROUND: soft dark grey very sandy clay		1.00	66.4				
Medium dense to dense brown clayey very sandy GRAVEL					1.50	25	
					2.50	38	
					3.50	49	
					5.00	53	
					6.50	42	
		8.00	59.4		8.00	50 for 75mm*	
Weathered brown SANDSTONE		8.30	59.1		8.30	50 for 75mm*	

Type of Sample

Is	S.P.T.	■	Undisturbed
Ic	C.P.T.	x	Vane
0	Jar	△	Water
●	Bulk		Piezometer

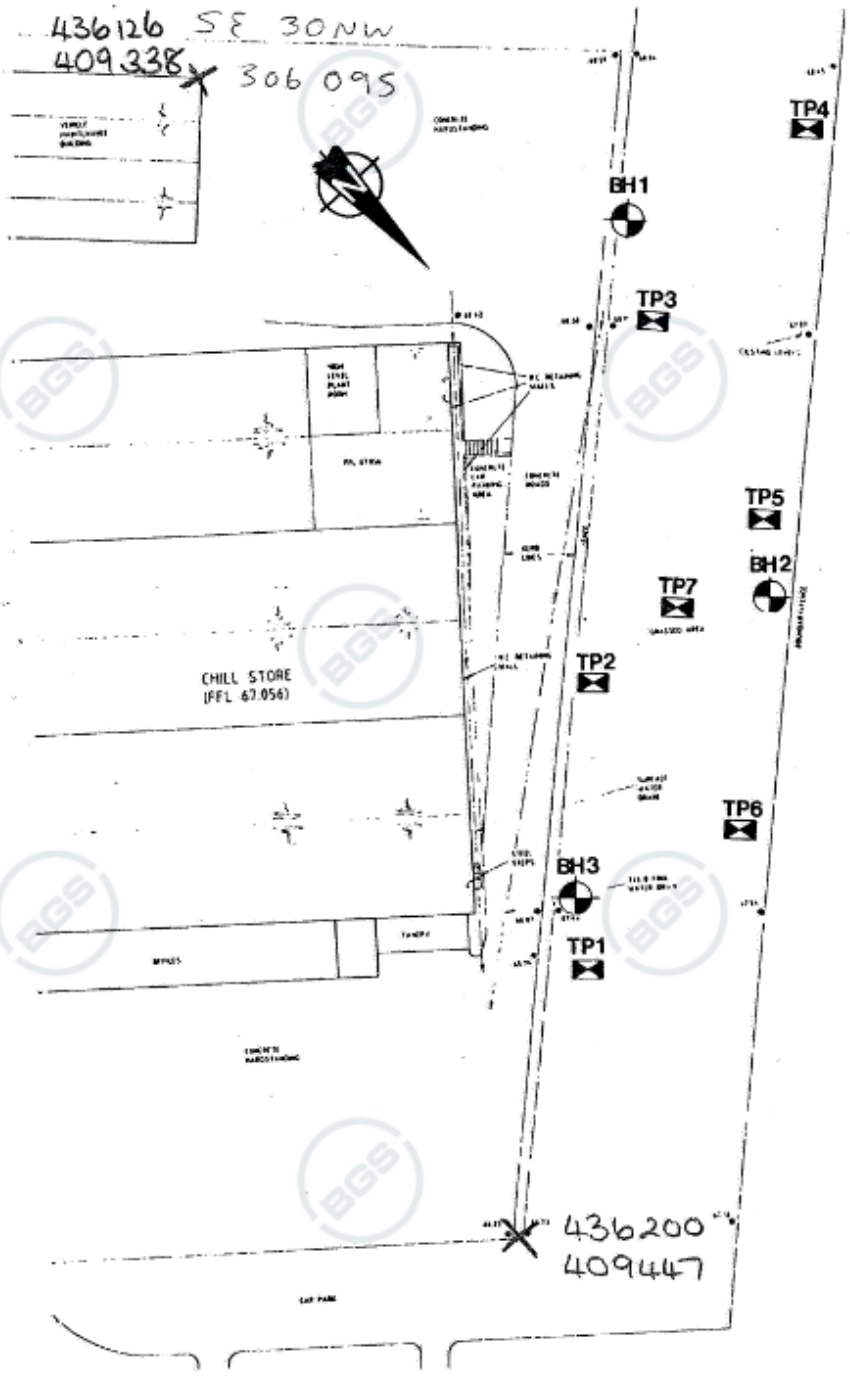
Remarks (Observations of Ground Water etc.) (-) U100 blows
* seating blows only

Groundwater not encountered
Chiselled Sandstone 8.00m to 8.30m - 1 hour

Norwest Holst Soil Engineering Ltd

GROUND INVESTIGATION

Client; *BURKS GREEN & PARTNERS.* Location; *PROPOSED EXTERNAL CHILL EXTENSION, BARNSLEY*



NB. Positions of Boreholes and/or Trial Pits are only indicative unless dimensioned.

Contract No; *F8790*	Title;	Fig;
Scale; *N.T.S.*	**BOREHOLE AND TRIAL PIT LOCATION PLAN**	**1**

REF-1003/99

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APPENDIX 2 – TEDDS CALCULATION

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.04

Design rainfall intensity

Location of catchment area	Sheffield
Impermeable area drained to the system	A = **2650.0** m^2
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.360**
5-year return period rainfall of 60 minutes duration	M5_60min = **19.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **40** %

Soakaway / infiltration trench details

Soakaway type	Rectangular
Minimum depth of pit (below incoming invert)	d = **238** mm
Width of pit	w = **51500** mm
Length of pit	l = **51500** mm
Percentage free volume	V_{free} = **30** %
Soil infiltration rate	f = **59.1×10^{-6}** m/s
Wetted area of pit 50% full	a_{s50} = l × d + w × d = **24554261** mm^2

Table equations

Inflow (cl.3.3.1)	I = M100 × A
Outflow (cl.3.3.2)	O = a_{s50} × f × D
Storage (cl.3.3.3)	S = I - O

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m^3)	Outflow (m^3)	Storage required (m^3)
5	0.36;	9.6;	1.90;	18.2;	48.21;	0.44;	47.78
10	0.51;	13.6;	1.97;	26.7;	70.72;	0.87;	69.84
15	0.62;	16.5;	2.00;	33.0;	87.49;	1.31;	86.19
30	0.79;	21.0;	2.03;	42.6;	112.82;	2.61;	110.21
60	1.00;	26.6;	2.00;	53.1;	140.78;	5.22;	135.56
120	1.22;	32.5;	1.95;	63.3;	167.73;	10.45;	157.28
240	1.48;	39.4;	1.90;	74.6;	197.70;	20.90;	176.81
360	1.67;	44.4;	1.85;	82.4;	218.32;	31.34;	186.98
600	1.90;	50.5;	1.81;	91.3;	241.92;	52.24;	189.68
1440	2.42;	64.4;	1.71;	110.2;	292.09;	125.38;	166.71

Required storage volume	S_{req} = **189.68** m^3
Soakaway storage volume	S_{act} = l × d × w × V_{free} = **189.68** m^3

PASS - Soakaway storage volume

Time for emptying soakaway to half volume	t_{s50} = S_{req} × 0.5 / (a_{s50} × f) = 18hr 9min 15s

PASS - Soakaway discharge time less than or equal to 24 hours

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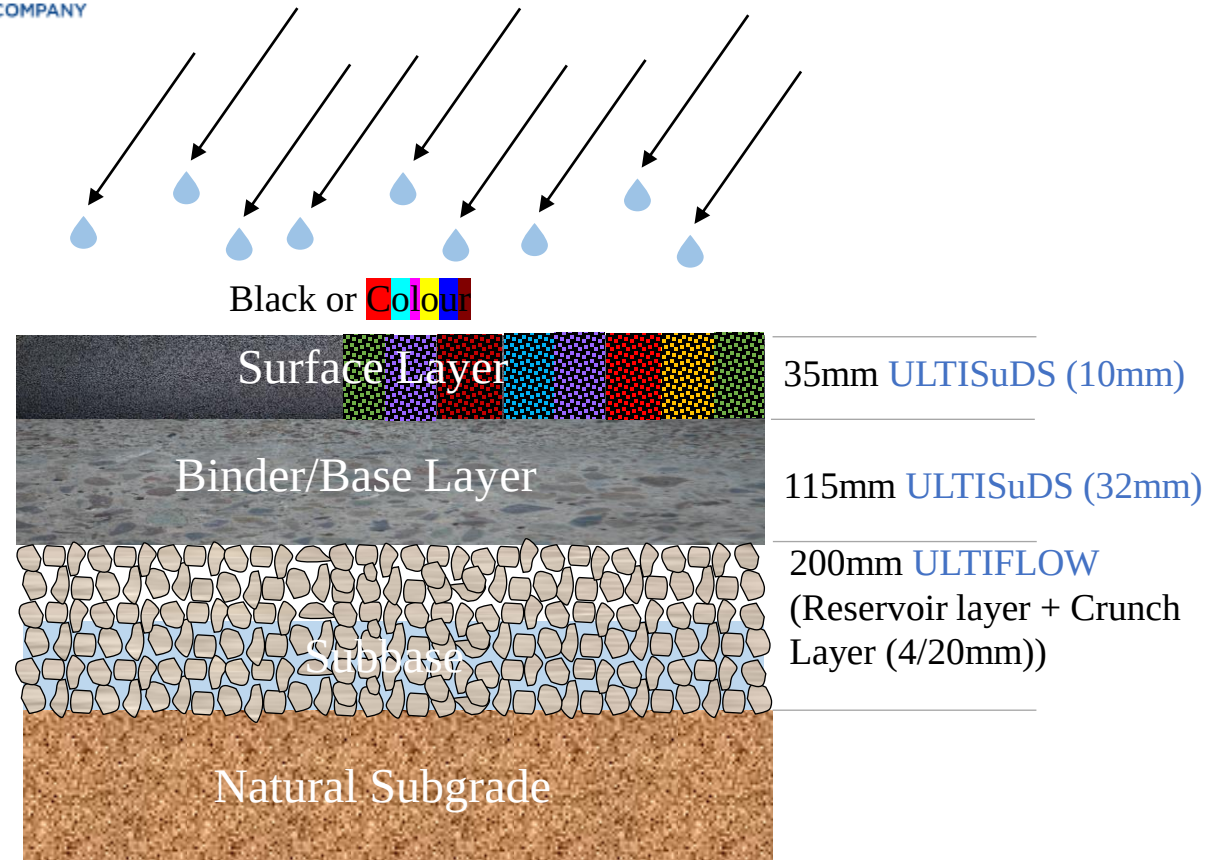
APPENDIX 3 - PERMEABLE PAVEMENT CONSTRUCTION

Public Car park

Typical Pavement Design*

*Subject to Approval



Notes:

- ❑ The subbase design will need to be checked by hydraulic/drainage design.
- ❑ Assumed min 5% Subgrade CBR.
- ❑ Infiltration geotextile/impermeable geomembrane based on the hydraulic/drainage design.
- ❑ Sweeping (cleaning) is recommended to maintain quality of performance in terms of permeability.