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job St. James C.E. Primary School, Greenacrest, Chatburn BB7 4ED

made by: date: 13.10.2021 job no: 3528 sheet no: 1/1

Area 1

Flood Zone 3 all of site area - west of water course.

Gross Area - 4160 m²

Building -

Hard Play Area -

Total Permeable - 1522 m²

Total Impermeable - 2638 m²

Ex. Bldg - ~~796~~ m²

Increase - 1842 m².

Gross Area - 1200

~~Hard Play - 873~~

Grass 163
93
66
1522 m²

Ex. 1869 m² Impermeable Area.

Proposed 2638 m² " "

STORAGE VOLUME 1/100 year - 158.27 m³. (or 117 m³)

If, using uplift Impermeable Area of (2638 - 1869) 769 m²

Storage System - Polystorm-R Modular Cell 95% storage capacity.

∴ $\frac{117}{0.95} = 123 m^3$ 0.5m cover required (pedestrian)

$\frac{159}{0.95} = 167 m^3$

Assumed overall depth of 2.5m excavation

Area = $\frac{123}{2} = 61.5 m^2$

$\frac{167}{2} = 83.5 m^2$

Observe Tree Root Zone Protection distances.

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job St Johns CE Primary School. Chatburn BB7 4ED

made by: date: 20-10-2021 job no: 3578 sheet no: 1/1

Area 2 - East side of Watercourse.

Site Area. - 3944m²

Exs. Impermeable Area. - 1187m²

Proposed Impermeable Area - 3944m².

Increase - 2757m².

STORAGE VOLUME - 1/100 year return. 264.97m³. for 100% site area

Actual volume required using storage system.

$\frac{265}{0.95} = 279m^3$

Assumed overall depth ≯ 2.5m. excavation.

Area = $\frac{279}{2} = 139.5m^2$.

Tedds
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Project				Job no.	
St James C.E. Primary School, Greenacre St, Clitheroe BB7				3518	
Calcs for				Start page no./Revision	
SW Attenuation West side of watercourse				1	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
PH	19/10/2021				

ATTENUATION DESIGN

In accordance with CIRIA publication C697 - The SUDS Manual

Tedds calculation version 1.0.01

EA_Defra method

Site characteristics

Location	Manchester
Hydrological region	10
Soil type (Wallingford Procedure W.R.A.P map)	4
Standard percentage runoff	SPR = **0.47**
Average annual rainfall	SAAR = **880** mm
5 year return period rainfall of 60 minute duration	M5_60min = **18.0** mm
Ratio 60-minute to 2 day rainfalls of 5 year return	r = **0.36**
Rainfall intensity increase due to global warming	$p_{climate}$ = **30%**
Impervious area req. attenuation storage	α = **100.0** %

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%)	Impermeable. area (ha)
1	School buildings and play area	0.42	63.0	0.26
	Total	0.42	63.0	0.26

Greenfield runoff rates

Catchment area	AREA = **50.00** hectare
Greenfield runoff rate (50 hectare site)	$\bar{Q}_{rural}$ = 0.00108m^3/s × (AREA/1km^2)$^{0.89}$ × (SAAR/1mm)$^{1.17}$ × SPR$^{2.17}$ = **315.5** l / s
Greenfield runoff rate	$\bar{Q}$ = $\bar{Q}_{rural}$ / AREA × A = **2.6** l / s
Greenfield runoff rate per unit area	$\bar{Q}_A$ = $\bar{Q}$ / A = **6.3** l / s / hectare

Estimated site discharges

FSR growth rate (1 year)	FSR_{1yr} = **0.87**
Discharge (1 year)	Q_{1yr} = $\bar{Q}$ × FSR_{1yr} = **2.3** l/s
FSR growth rate (30 year)	FSR_{30yr} = **1.70**
Discharge (30 year)	Q_{30yr} = $\bar{Q}$ × FSR_{30yr} = **4.5** l/s
FSR growth rate (100 year)	FSR_{100yr} = **2.08**
Discharge (100 year)	Q_{100yr} = $\bar{Q}$ × FSR_{100yr} = **5.5** l/s

Estimated attenuation volume - 1 year

Attenuation storage vol (fig A7.1 - A7.8)	$Uvol_{1yr}$ = **60.4** m^3 / hectare
Basic storage volume	BSV_{1yr} = $Uvol_{1yr}$ × α × A = **25.11** m^3
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF_{1yr} = **1.00**
Storage volume ratio (fig A8.1 - A8.8)	SVR_{1yr} = **1.44**
Adjusted storage volume	ASV_{1yr} = SVR_{1yr} × BSV_{1yr} = **36.13** m^3
Hydrological regional volume ratio (fig A9.1)	HR_{1yr} = **1.00**
Final estimated attenutation storage	Vol_{1yr} = HR_{1yr} × ASV_{1yr} = **36.17** m^3

Estimated attenuation volume - 30 year

Attenuation storage vol (fig A7.1 - A7.8)	$Uvol_{30yr}$ = **150.1** m^3 / hectare
Basic storage volume	BSV_{30yr} = $Uvol_{30yr}$ × α × A = **62.46** m^3

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Project	Job no.
St James C.E. Primary School, Greenacre St, Clitheroe BB7	3518
Calcs for	**Start page no./Revision**
SW Attenuation West side of watercourse	2

Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
PH	19/10/2021				

FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF_{30yr} = **0.95**
Storage volume ratio (fig A8.1 - A8.8)	SVR_{30yr} = **1.55**
Adjusted storage volume	$ASV_{30yr} = SVR_{30yr} \times BSV_{30yr}$ = **96.81** m^3
Hydrological regional volume ratio (fig A9.1)	HR_{30yr} = **1.11**
Final estimated attenutation storage	$Vol_{30yr} = HR_{30yr} \times ASV_{30yr}$ = **107.32** m^3

Estimated attenuation volume - 100 year

Attenuation storage vol (fig A7.1 - A7.8)	$Uvol_{100yr}$ = **196.7** m^3 / hectare
Basic storage volume	$BSV_{100yr} = Uvol_{100yr} \times \alpha \times A$ = **81.84** m^3
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF_{100yr} = **0.90**
Storage volume ratio (fig A8.1 - A8.8)	SVR_{100yr} = **1.67**
Adjusted storage volume	$ASV_{100yr} = SVR_{100yr} \times BSV_{100yr}$ = **136.94** m^3
Hydrological regional volume ratio (fig A9.1)	HR_{100yr} = **1.16**
Final estimated attenutation storage	$Vol_{100yr} = HR_{100yr} \times ASV_{100yr}$ = **158.27** m^3

Attenuation storage required

Vol. increase due to head-discharge relationship	p_{hydro} = **1.25**
Maximum attenuation storage required	$V_{req\_max} = Vol_{30yr} \times p_{hydro}$ = **134.1** m^3

Interception storage

Interception rainfall depth	d_{int} = **5** mm
Volume of interception storage required	$V_{int\_req} = 0.8 \times A_{imp} \times d_{int}$ = **10.48** m^3

Long term storage

Proportion of paved area draining in to network	α = **1.0**
Proportion of pervious area draining in to network	β = **0.5**
Rainfall depth for 100years, 6 hour event	RD = M100_360 = **74.1** mm
Extra runoff vol of dev.runoff over greenfield runoff	Vol_{xs} = max(RD × A × (PIMP × α × 0.8 + ((1 - PIMP) × β × SPR) - SPR), 0m^3) = **37.31** m^3

Treatment volume

Treatment volume (assume 80% runoff)	T_{vol} = 0.8 × A × 15mm × PIMP = **31.45** m^3

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ATTENUATION DESIGN

In accordance with CIRIA publication C697 - The SUDS Manual

Tedds calculation version 1.0.01

EA_Defra method

Site characteristics

Location	Manchester
Hydrological region	10
Soil type (Wallingford Procedure W.R.A.P map)	4
Standard percentage runoff	SPR = **0.47**
Average annual rainfall	SAAR = **880** mm
5 year return period rainfall of 60 minute duration	M5_60min = **18.0** mm
Ratio 60-minute to 2 day rainfalls of 5 year return	r = **0.36**
Rainfall intensity increase due to global warming	$p_{climate}$ = **30%**
Impervious area req. attenuation storage	α = **100.0** %

Catchment details

Subcatchment	Name	Area (ha)	PIMP (%)	Impermeable. area (ha)
1	School buildings and play area	0.39	100.0	0.39
	Total	0.39	100.0	0.39

Greenfield runoff rates

Catchment area	AREA = **50.00** hectare
Greenfield runoff rate (50 hectare site)	$\bar{Q}_{rural} = 0.00108 m^3/s \times (AREA/1km^2)^{0.89} \times (SAAR/1mm)^{1.17} \times SPR^{2.17}$ = **315.5** l / s
Greenfield runoff rate	$\bar{Q} = \bar{Q}_{rural} / AREA \times A$ = **2.5** l / s
Greenfield runoff rate per unit area	$\bar{Q}_A = \bar{Q} / A$ = **6.3** l / s / hectare

Estimated site discharges

FSR growth rate (1 year)	FSR_{1yr} = **0.87**
Discharge (1 year)	$Q_{1yr} = \bar{Q} \times FSR_{1yr}$ = **2.2** l/s
FSR growth rate (30 year)	FSR_{30yr} = **1.70**
Discharge (30 year)	$Q_{30yr} = \bar{Q} \times FSR_{30yr}$ = **4.2** l/s
FSR growth rate (100 year)	FSR_{100yr} = **2.08**
Discharge (100 year)	$Q_{100yr} = \bar{Q} \times FSR_{100yr}$ = **5.2** l/s

Estimated attenuation volume - 1 year

Attenuation storage vol (fig A7.1 - A7.8)	$Uvol_{1yr}$ = **124.3** m^3 / hectare
Basic storage volume	$BSV_{1yr} = Uvol_{1yr} \times \alpha \times A$ = **48.99** m^3
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF_{1yr} = **1.00**
Storage volume ratio (fig A8.1 - A8.8)	SVR_{1yr} = **1.42**
Adjusted storage volume	$ASV_{1yr} = SVR_{1yr} \times BSV_{1yr}$ = **69.40** m^3
Hydrological regional volume ratio (fig A9.1)	HR_{1yr} = **1.00**
Final estimated attenutation storage	$Vol_{1yr} = HR_{1yr} \times ASV_{1yr}$ = **69.47** m^3

Estimated attenuation volume - 30 year

Attenuation storage vol (fig A7.1 - A7.8)	$Uvol_{30yr}$ = **284.7** m^3 / hectare
Basic storage volume	$BSV_{30yr} = Uvol_{30yr} \times \alpha \times A$ = **112.16** m^3

FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF_{30yr} = **0.95**
Storage volume ratio (fig A8.1 - A8.8)	SVR_{30yr} = **1.52**
Adjusted storage volume	$ASV_{30yr} = SVR_{30yr} \times BSV_{30yr}$ = **171.02** m^3
Hydrological regional volume ratio (fig A9.1)	HR_{30yr} = **1.08**
Final estimated attenutation storage	$Vol_{30yr} = HR_{30yr} \times ASV_{30yr}$ = **184.55** m^3

Estimated attenuation volume - 100 year

Attenuation storage vol (fig A7.1 - A7.8)	$Uvol_{100yr}$ = **364.7** m^3 / hectare
Basic storage volume	$BSV_{100yr} = Uvol_{100yr} \times \alpha \times A$ = **143.68** m^3
FEH rainfall factor (figs A11.1, A6.1.1 - A6.3.4)	FF_{100yr} = **0.90**
Storage volume ratio (fig A8.1 - A8.8)	SVR_{100yr} = **1.64**
Adjusted storage volume	$ASV_{100yr} = SVR_{100yr} \times BSV_{100yr}$ = **236.34** m^3
Hydrological regional volume ratio (fig A9.1)	HR_{100yr} = **1.12**
Final estimated attenutation storage	$Vol_{100yr} = HR_{100yr} \times ASV_{100yr}$ = **264.93** m^3

Attenuation storage required

Vol. increase due to head-discharge relationship	p_{hydro} = **1.25**
Maximum attenuation storage required	$V_{req\_max} = Vol_{30yr} \times p_{hydro}$ = **230.7** m^3

Interception storage

Interception rainfall depth	d_{int} = **5** mm
Volume of interception storage required	$V_{int\_req} = 0.8 \times A_{imp} \times d_{int}$ = **15.76** m^3

Long term storage

Proportion of paved area draining in to network	α = **1.0**
Proportion of pervious area draining in to network	β = **0.5**
Rainfall depth for 100years, 6 hour event	RD = M100_360 = **74.1** mm
Extra runoff vol of dev.runoff over greenfield runoff	Vol_{xs} = max(RD × A × (PIMP × α × 0.8 + ((1 - PIMP) × β × SPR) - SPR), 0m^3) = **96.40** m^3

Treatment volume

Treatment volume (assume 80% runoff)	T_{vol} = 0.8 × A × 15mm × PIMP = **47.28** m^3

Polystorm-R Modular Cell

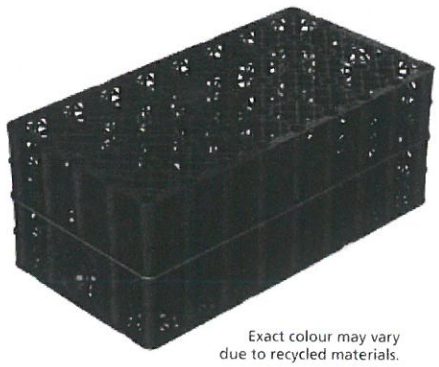
Data Sheet

PRODUCT INFORMATION P1 ISSUE 4 - SEPT 2017

Product code: PSM1A

The Polystorm-R modular cell is ideally suited for loaded applications at greater depths, such as housing, commercial and infrastructure projects and has a compressive strength of up to 61 tonnes/m². It offers all the proven performance of the Polystorm cell, with the added benefits of being manufactured from over 90% recycled material content.

Wherever performance criteria and standards allow, we will always maximise the sustainability of our products by using post consumer plastics in their manufacture. By sourcing and carefully controlling the quality of the recycled material we use our precision injection moulding. Therefore we are able to guarantee consistent quality in our recycled plastic, giving you the confidence and the performance levels you expect from the market leader.



Exact colour may vary due to recycled materials.

Key Benefits

- Made from specially selected and controlled recycled materials
- Environmentally friendly, sustainable solution
- Has undergone stringent testing to ensure product performance
- Compressive strength of 61 tonnes/m²
- Ideal for retention, attenuation and infiltration applications with a suitable geomembrane or geotextile
- BBA approved
- Allow flexibility of shape - ideal for shallow excavation systems, narrow strips or use in restricted areas
- Can be used as part of a value engineered hybrid system with Polystorm, Polystorm Lite and Polystorm Xtra
- Integrated inlet and outlet
- 3D flow throughout the structure
- 95% void ratio
- Light weight yet robust - excellent Health and Safety and installation benefits
- 60 years creep limited life expectancy

Technical Support

Detailed guidance and assistance is available.
For further information, please contact our Technical Team on **+44 (0) 1509 615100** or email **civils@polypipe.com**

BBA BRITISH BOARD OF AGREMENT CERTIFICATE No. 06/4297

ELEMENT	VALUE
PHYSICAL PROPERTIES	
Length	1m
Width	0.5m
Depth	0.4m
Total volume	0.2m³
Unit weight	9kg (approx)
Unit storage volume	0.19m³ (190 litres)
Void ratio	95%
SHORT TERM COMPRESSIVE STRENGTH	
Vertical	610 kN/m² **
Lateral	63 kN/m² **
SHORT TERM DEFLECTION	
Short-term vertical deflection	60 kN/m² per mm
LONG TERM DEFLECTION	
Estimated long term vertical deflection (creep)	0.2798 Ln (design life in hrs) +0.485 [Based on an applied test load = 162 kN/m²] Creep data limit 60 years
Estimated long term lateral deflection (creep)	1.0192 Ln (design life in hrs) -3.864 [Based on an applied test load = 30.8 kN/m²] Creep data limit 60 years

Note: Polystorm-R is ideal for use in trafficked and pedestrian applications subject to a structural design check and suitable installation conditions

* Each unit includes 4 Clips and 2 Shear Connectors.

** Compressive strength at yield, maximum recommended value for design purposes.

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Polypipe

Polystorm-R Modular Cell

Data Sheet

RECOMMENDED MAXIMUM DEPTH OF INSTALLATION (to cell invert) [m]

TYPICAL SOIL TYPE	TYPICAL ANGLE OF SHEAR RESISTANCE	SOIL WEIGHT kN/m³	WITHOUT GROUNDWATER (below base of cells) NORMAL CASE		WITH GROUNDWATER AT 1M BELOW GROUND LEVEL AND UNITS WRAPPED IN GEOMEMBRANE	
			Pedestrian	Trafficked (cars) <3000kg GVW	Pedestrian	Trafficked (cars) <3000kg GVW
Stiff over consolidated clay e.g. London clay	24	20.0	2.2	1.9	1.8	1.6
Normally consolidated silty sandy clay e.g. alluvium, made ground	26	19.0	2.4	2.2	1.9	1.7
Loose sand and gravel	30	18.0	3.0	2.7	2.0	1.9
Medium dense sand and gravel	33	19.0	3.2	2.9	2.0	1.9
Dense sand and gravel	38	20.0	3.7	3.5	2.1	2.0

Note:
1) Stated depths based on the calculation methodology detailed within CIRIA C680 (2008)
2) Assuming water density = 10.0kN/m³
3) Assumed ultimate limit state (ULS) partial factor of safety applied to: Material = 2.75 Lateral pressure = 1.35

Durability

The polymer material used in the manufacture of the Polystorm-R unit has an adequate resistance to attack from the type and quantities of chemicals that may be expected to naturally occur in uncontaminated soils and rainwater runoff. When installed in accordance with our recommendations, it is expected that the Polystorm-R unit will have a design life in excess of 60 years*. The installer of a proposed geocellular structure should ensure that an appropriate design check has been undertaken, in accordance with the recommended methodology and factors of safety given in CIRIA C680 (2008), Structural Design of Modular Geocellular Drainage Tanks, prior to the commencement of construction activities.

* Derived from long term extrapolated creep testing

Notes

1. Unless stated, all values are nominal and may vary within normal production tolerances.
2. The characteristic unit parameters stated have been based on Polypipe BBA certificate N° 06/4297, sheet 3.
3. Polypipe reserve the right to change product specifications without prior notice.
4. This document is uncontrolled and updates will not be issued automatically.

RECOMMENDED MINIMUM COVER LEVELS [m]

LIVE LOAD CONDITIONS	PEDESTRIAN	LIGHT TRAFFICKED	
		Car park with vehicle mass <GVW	
Minimum cover depth required (m)	0.50	<3000kg 0.50	<9000kg 0.65

Note
1) Stated depths based on the calculation methodology detailed within CIRIA C680 (2008)
2) Assumed serviceability limit state (SLS) partial factor of safety applied to: Material = 1.5 Live load = 1.0 Dead load = 1.0
3) Shallower minimum burial depths may be applicable subject to an assessment of the specific site conditions. For further details please consult our Technical Team on 01509 615100.

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