

KEN RUSH ASSOCIATES

STRUCTURAL & CIVIL ENGINEERS

Drainage Submission For Planning Condition Release/
Conditions 5(2e) & 9.

For

New Dwelling at 170a
Harefield Road, Uxbridge,
UB8 1PP

For

Bchitecture / Toast Developments

Job No. 21-7018

August 2021

Ken Rush Associates
Bowman House
191 South Street
Braintree
Essex
CM7 3QB

Tel: 01376 326789
Fax: 01376 342711
engineer@krusha.co.uk
info@krusha.co.uk
www.kenrush.co.uk



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6. Outline Maintenance Schedule.
7. Crate Type Soakaway – Recommended Suppliers Technical Data.
8. Water Efficiency Outline Data.

1. Extract From Hillingdon Planning Department Conditions



Jim Biek
Architecture
11a Beresford Road
London
N2 8AT

Application Ref:
23469/APP/2020/3612

TOWN AND COUNTRY PLANNING ACT 1990 (AS AMENDED)
GRANT OF PLANNING PERMISSION

The Council of the London Borough of Hillingdon as the Local Planning Authority within the meaning of the above Act and associated Orders **GRANTS** permission for the following:-

Description of development:

Erection of a 3-bed detached bungalow with habitable roofspace involving parking and amenity space

Location of development: 170 Harefield Road Uxbridge

Date of application: 19 November 2020

Plan Numbers: See attached Schedule of plans

Permission is subject to the condition(s) listed on the attached schedule:-

Head of Planning, Transportation and Regeneration

Date: 5 August 2021

- NOTES:
- (i) Please also see the informatives included in the Schedule of Conditions.
 - (ii) Should you wish to appeal against any of the conditions please read the attached sheet which explains the procedure.
 - (iii) This decision does not convey any approval or consent which may be required under any by-laws, building regulations or under any Act other than the Town and Country Planning Act 1990 (as amended).

SCHEDULE OF CONDITIONS

- 5 Prior to the occupation of the development hereby approved, a landscape scheme shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall include: -

1. Details of Soft Landscaping

- 1.a Planting plans (at not less than a scale of 1:100),
- 1.b Written specification of planting and cultivation works to be undertaken,
- 1.c schedule of plants giving species, plant sizes, and proposed numbers/densities where appropriate

2. Details of Hard Landscaping

- 2.a Refuse Storage
- 2.b Cycle Storage
- 2.c Means of enclosure/boundary treatments
- 2.d Car Parking Layouts (including one 'active' and one 'passive' electric vehicle charging points)
- 2.e Hard Surfacing Materials
- 2.f External Lighting

4. Details of Landscape Maintenance

- 4.a Landscape Maintenance Schedule for a minimum period of 5 years.
- 4.b Proposals for the replacement of any tree, shrub, or area of surfing/seeding within the landscaping scheme which dies or in the opinion of the Local Planning Authority becomes seriously damaged or diseased.

5. Schedule for Implementation

Thereafter the development shall be carried out and maintained in full accordance with the approved details.

REASON

To ensure that the proposed development will preserve and enhance the visual amenities of the locality and provide adequate facilities in compliance with policies DMHB 11, DMHB 12, DMHB 14, DMEI 1 and DMT 2 of the Hillingdon Local Plan Part 2 (2020).

- 6 Notwithstanding the provisions of the Town and Country Planning (General Permitted Development)(England) Order 2015 (or any order revoking and re-enacting that Order with or without modification), no additional windows, doors or other openings shall be constructed in the walls or roof slopes of the development hereby approved.

REASON

To prevent overlooking to adjoining properties in accordance with policy DMHB 11 of the Hillingdon Local Plan Part 2 (2020).

SCHEDULE OF CONDITIONS

- 9 . No development approved by this permission shall be commenced until a scheme for the provision of sustainable water management and water efficiency has been submitted to and approved in writing by the Local Planning Authority. The scheme shall:
- i. Provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;
 - ii. Include a timetable for its implementation; and
 - iii. Provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.

The scheme shall also demonstrate the use of methods to minimise the use of potable water through water collection, reuse and recycling and will:

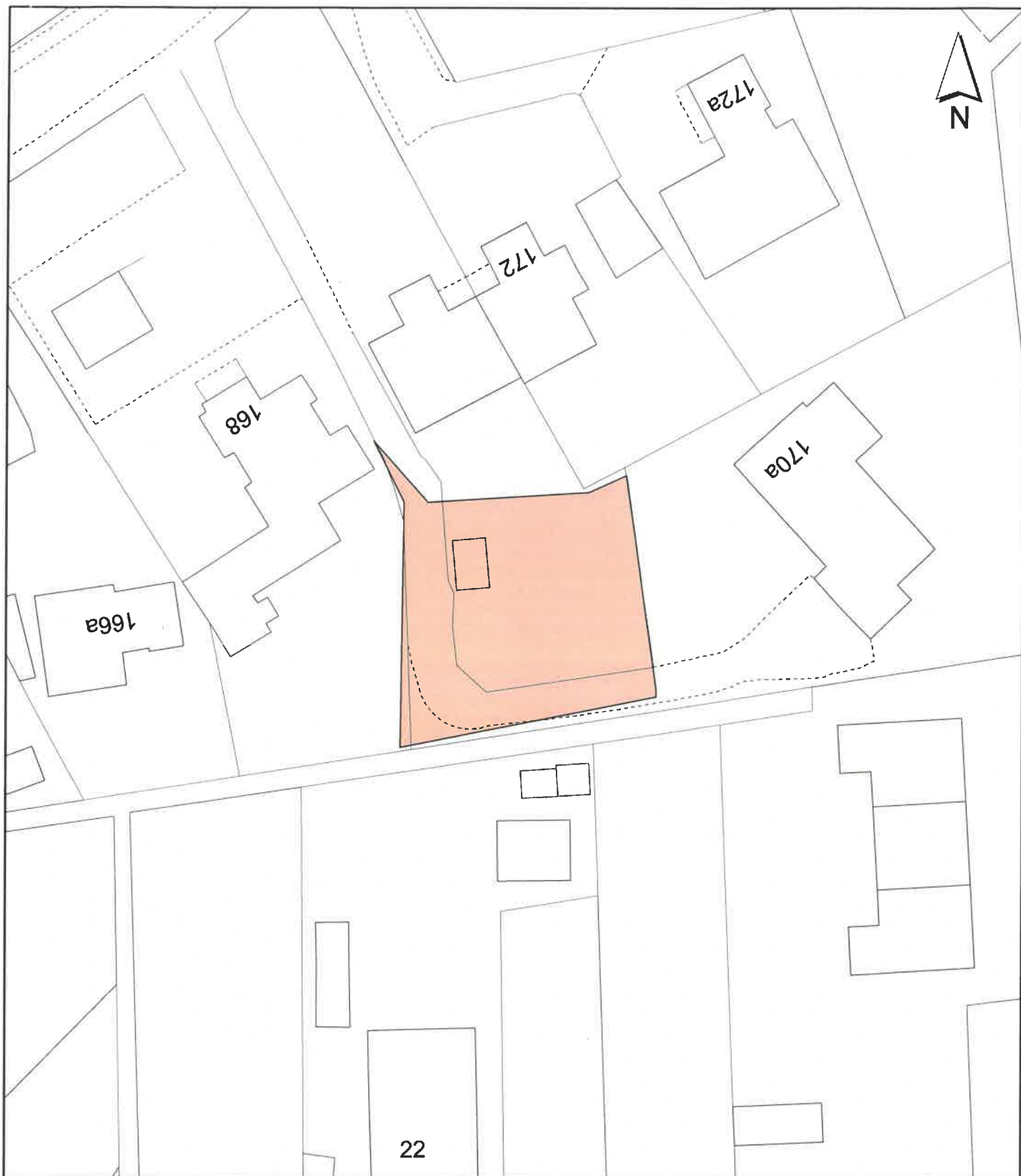
- iv. Provide details of water collection facilities to capture excess rainwater;
- v. Provide details of how rain and grey water will be recycled and reused in the development.
- vi. Details of how the dwelling will achieve a water efficiency standard of no more than 110 litres per person per day maximum water consumption (to include a fixed factor of water for outdoor use of 5 litres per person per day in accordance with the optional requirement defined within Approved Document G of the Building Regulations).

Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence.

REASON

To ensure the development does not increase the risk of flooding in accordance with Policy DME1 10 of the Hillingdon Local Plan Part 2 (2020) and Policies SI2 and SI 13 of the London Plan (2021).

2. Existing and Proposed Architectural Site Layouts.



Notes:

 Site boundary

For identification purposes only.

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Site Address:

170 Harefield Road

Planning Application Ref:

23469/APP/2020/3612

Scale:

1:500

Planning Committee:

Central & South

Date:

June 2021

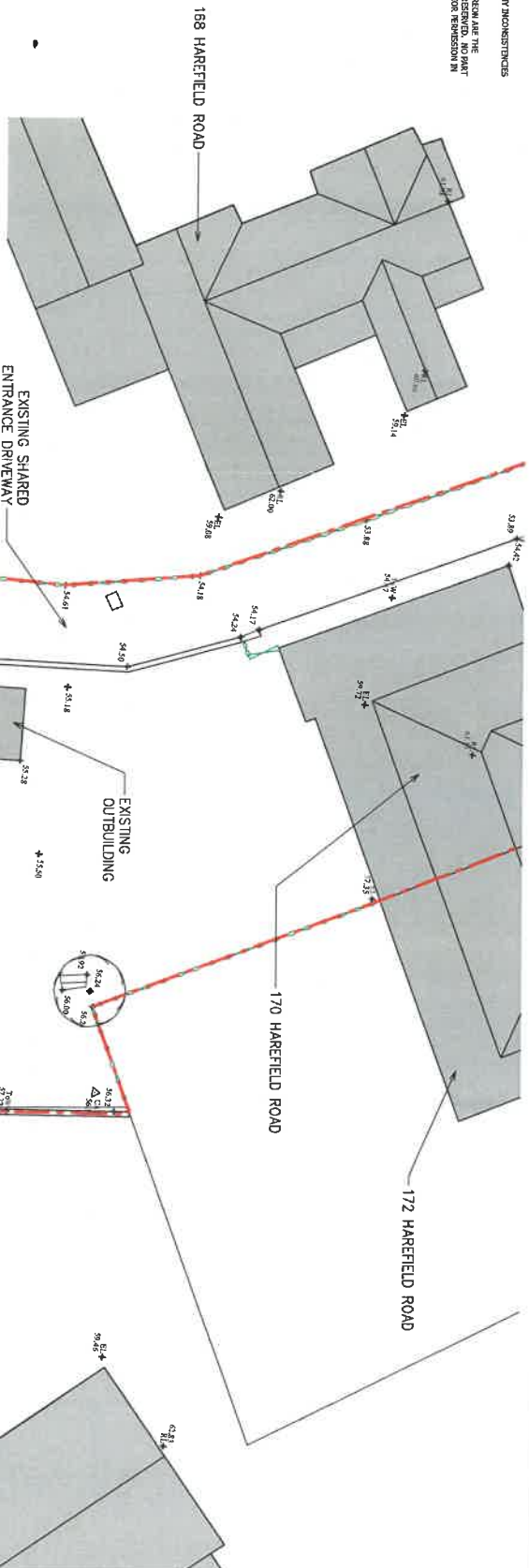
**LONDON BOROUGH
OF HILLINGDON**
**Residents Services
Planning Section**

Civic Centre, Uxbridge, Middx. UB8 1UW
Telephone No.: Uxbridge 01895 250111



HILLINGDON
LONDON

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1 SITE PLAN
1 : 1500



2 EXISTING SITE PLAN
1 : 250



DATE	2009	SCALE	1:1500 1:250 @A3	DATE	Oct 2020	LOCATION PLAN & SITE PLAN	DRAWING TITLE	Land to the Rear of 170 Harefield Rd Uxbridge UB8 1PP	LOCATION	Bchitecture 11A Beresford Road London N2 8AT t:07932 796 407 e:Bchitecture@gmail.com
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168 HAREFIELD ROAD

170 HAREFIELD ROAD

2M HIGH CLOSE BOARDED
 FENCING NEW SIDE & REAR
 BOUNDARIES TO REAR
 GARDEN OF NO. 170

EXISTING SHARED
 ENTRANCE DRIVEWAY

BINS

140M² Private
 Assembly Garden

27metres

BIKE STORE IN SHED

SIDE BOUNDARY LINE MOVED TO
 INCREASE WIDTH OF SHARED
 ENTRANCE ROAD

RETAINED REAR GARDEN TO
 NO. 170

172A HAREFIELD ROAD

170A HAREFIELD ROAD

PLANTING TO BOUNDARIES
 TO ENHANCE PRIVACY

28metres

28metres

NEW BUILD DWELLINGS ON
LAND TO THE REAR OF 15,
16 & 17 NORTH COMMON RD

— PRIVATE AMENITY SPACE TO
PROPOSED DWELLING

2.8metres

170A HAREFIELD ROAD

62.7%
H.L. +

59.46%
H.L. +

RIES

BIKE STORE IN SHED

RETAINED REAR GARDEN TO
NO. 170

SIDE BOUNDARY LINE MOVED TO INCREASE WIDTH OF SHARED

PROPOSED SITE PLAN
1 : 200

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2009	1.200 @A3	Oct 2020
------	--------------	----------

ERIC NO./REV
101/C

EXISTING EVERGREEN
HEDGING TO BOUNDARIES OF
20 & 22 NORTH COMMON
ROAD

PROPOSED DWELLING

EXISTING SITE LEVEL
LOWERED AND LEVELLED

NO. 168 HAREFIELD ROAD
BEYOND

NO. S 170 & 172 HAREFIELD
ROAD

EXISTING CLOSE BOARDED
BOUNDARY TO DRIVEWAY TO
170A HAREFIELD ROAD

NO. 168 HAREFIELD ROAD

NO. 5, 170 & 172 HAREFIELD ROAD

PROPOSED NEW DWELLING

EXISTING CLOSE BOARDED
BOUNDARY FENCE

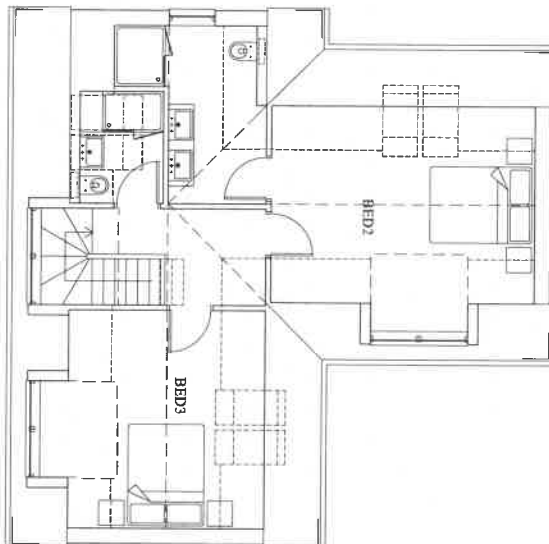
NO. 170A HAREFIELD ROAD

Dimensions: 10.00, 59.68, 35.13, 4.5, 11.17, 10.00, 56.49, 32.74, 55.10, 6.13, 56.42, 6.13

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1
PROPOSED GROUND FLOOR PLAN
1 : 100



2
PROPOSED FIRST FLOOR PLAN
1 : 100



LOCATION

Bchitecture
11A Beresford Road London N2 8AT
t 07932 796 407 e Bchitecture@gmail.com

Land to the Rear of
170 Harefield Rd
Uxbridge UB8 1PP

DRAWING TITLE

PROPOSED GROUND &
FIRST FLOOR PLANS

DATE

Oct 2020

SCALE

1:100
@A3

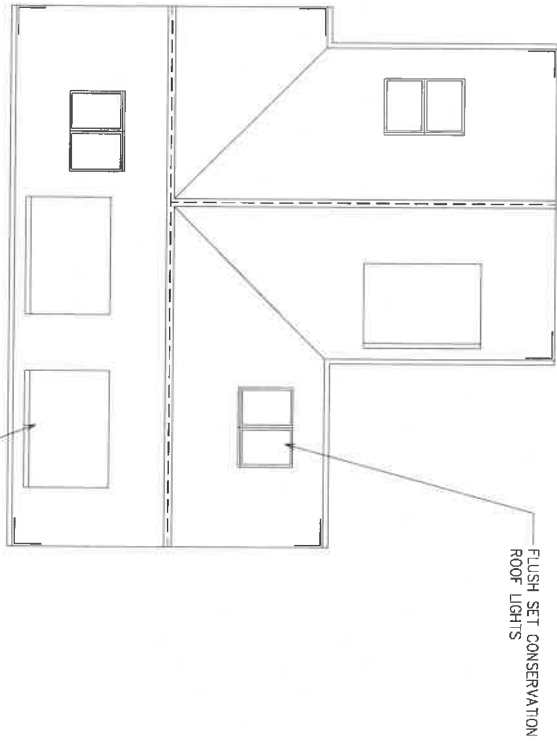
DATE

2009

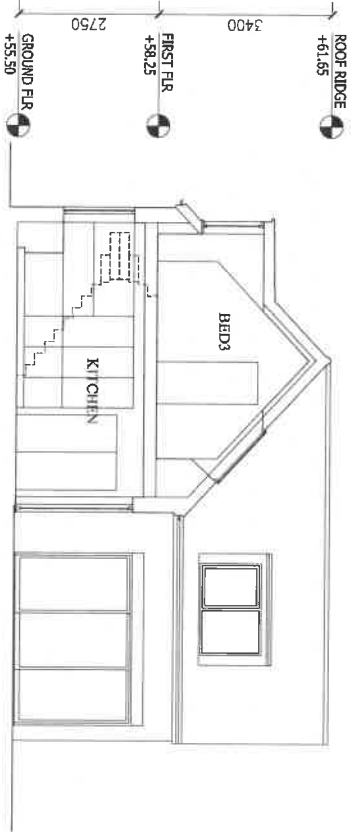
DWG NO.

103/A

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1
PROPOSED ROOF PLAN
1 : 100



2
PROPOSED SECTION A-A
1 : 100



LOCATION

Land to the Rear of
170 Harefield Rd
Uxbridge UB8 1PP

DRAWING TITLE

PROPOSED ROOF PLAN
& SECTION A-A

DATE

Oct 2020

SCALE

1:100
@A3

APP NO

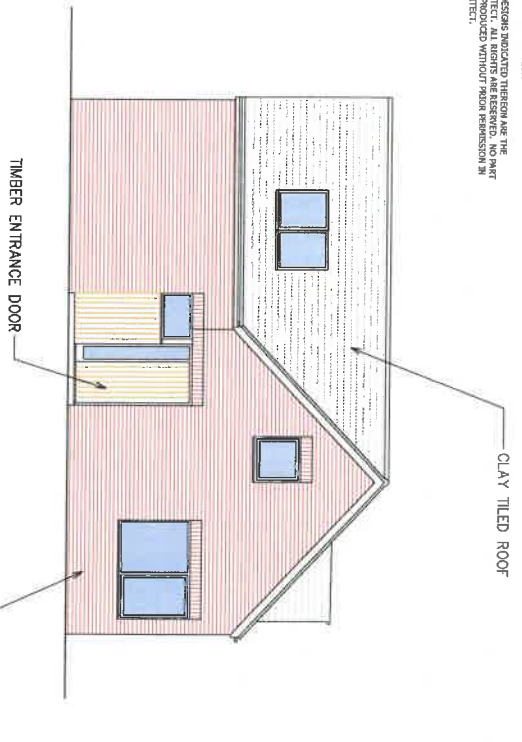
2009

DWG NO/REV

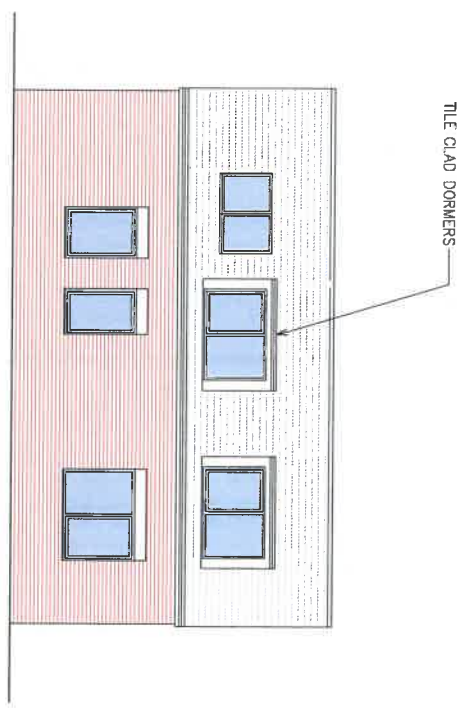
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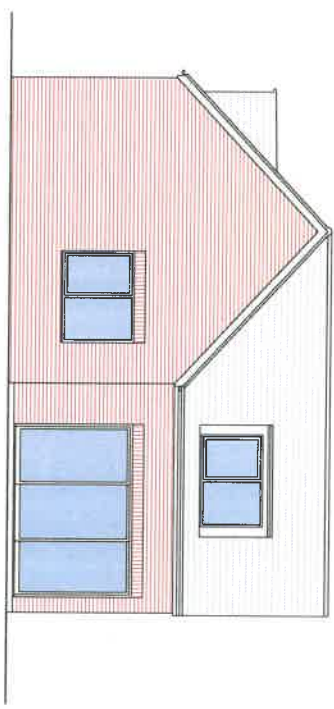
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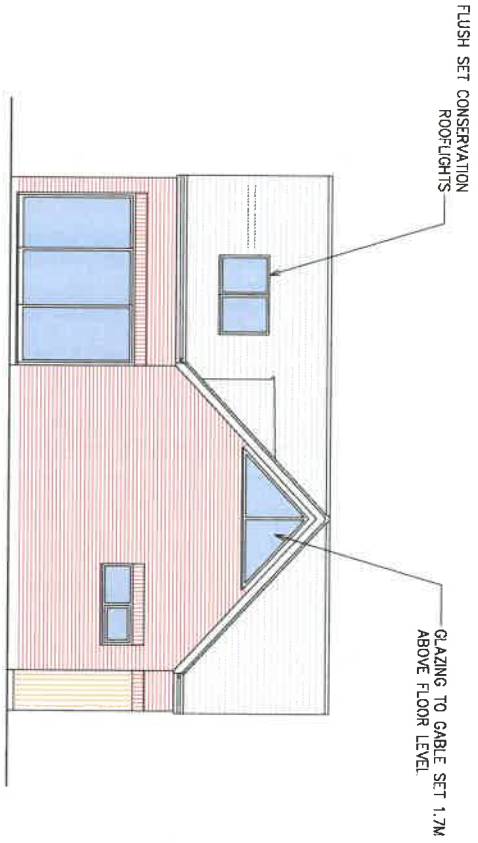
1
PROPOSED WEST ELEVATION
1 : 100



2
PROPOSED SOUTH ELEVATION
1 : 100



3
PROPOSED EAST ELEVATION
1 : 100



4
PROPOSED NORTH ELEVATION
1 : 100



LEFT TO RIGHT OPERATIONS ONLY.
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CONSTRUCTION COMPOUND
 TO FRONT OF No. 170 TO
 PROVIDE PARKING, STORAGE
 & VEHICLE TURNING

172a

172

170

168

ROADWAY WIDTH INCREASED
 ALONG No. 170 WITH NEW
 PASSING SPACE

143M2 Private
 Assembly Garden

170A

28metres

27metres

1

PROPOSED SITE ACCESS PLAN

1 : 250

106/-

2009

1:250
 @A3

Feb 2021

PROPOSED SITE ACCESS
 PLAN

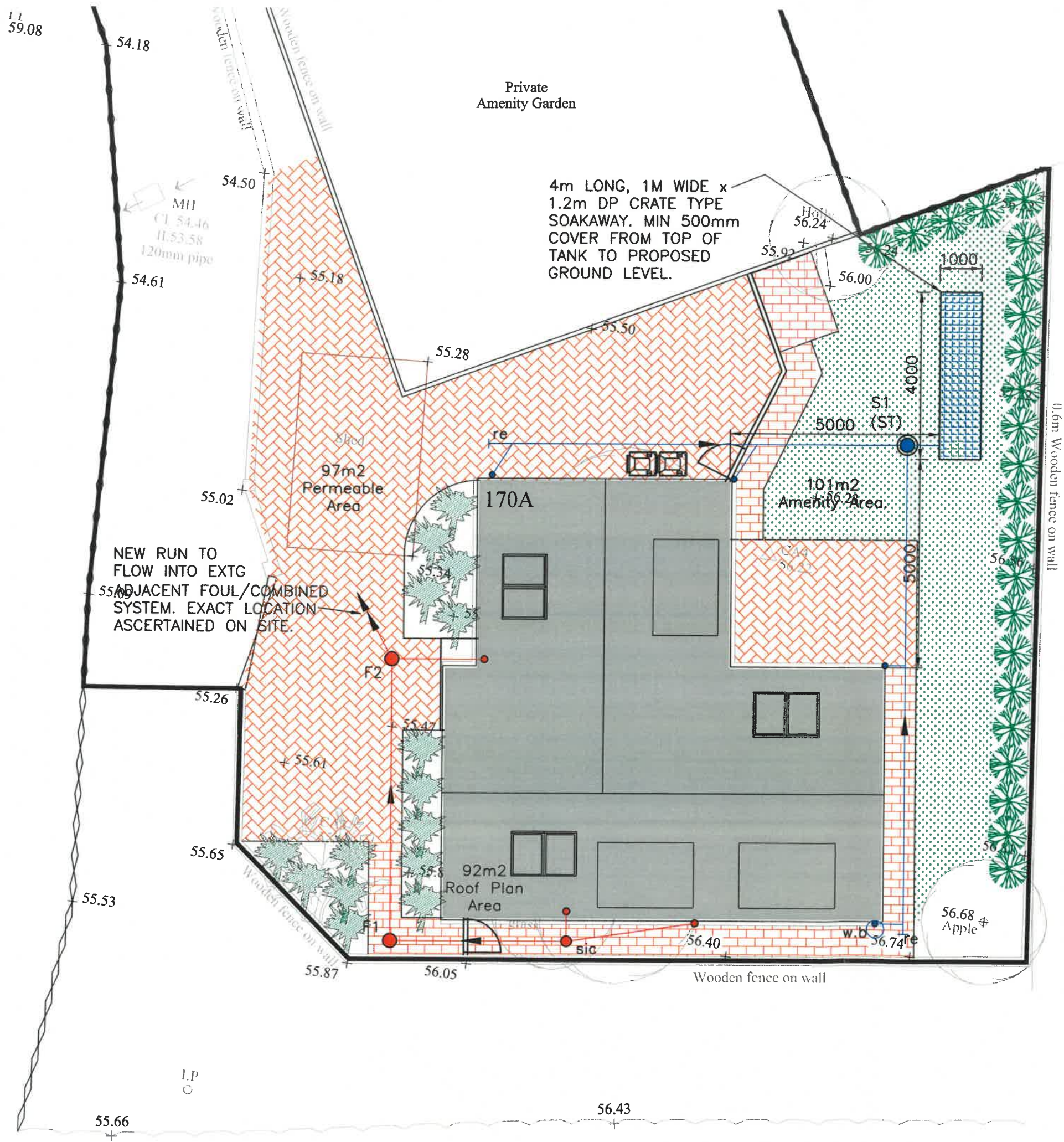
Land to the Rear of
 170 Harefield Rd
 Uxbridge UB8 1PP

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3. Proposed Drainage Strategy Plan, Typical Soakaway and Permeable Drive Construction Details.

1:1
59.08



LEGEND

- F1 NEW FOUL MANHOLES (MH)/ INSPECTION CHAMBERS (IC).
- sic NEW SHALLOW INSPECTION CHAMBER
- NEW SOIL VENT PIPE / STUB STACK/BACK INLET GULLY POSITION.
- NEW FOUL DRAINAGE RUNS
- sic NEW SHALLOW INSPECTION CHAMBER
- S1 NEW STORM MANHOLES (MH)/ INSPECTION CHAMBERS (IC).
- (ST) NEW STORM CHAMBER WITH SILT TRAP.
- NEW STORM/SURFACE WATER DRAINAGE RUNS
- NEW RAINWATER PIPE POSITION.
- re NEW RODDING EYE POSITION.
- w.b NEW WATER BUTT.
- EXTENT OF FULL INFILTRATION PERMEABLE PAVING.
- EXTENT OF PAVING TO NEW DWELLING PERIMETER.

FOR EXTERNAL WORKS LAYOUT AND EXTENT OF SURFACE FINISHES REFER TO ARCHITECTS DRAWINGS.

EDGINGS TO PRIVATE DRIVES TO BE TYPE "EF" UNLESS NOTED OTHERWISE

FOR LANDSCAPING DETAILS REFER TO SPECIALISTS PLAN AND PLANTING SCHEDULE.

NOTES

- DO NOT SCALE FROM THIS DRAWING USE FIGURED DIMENSIONS ONLY.
- ALL NEW DRAINS ARE uPVC TO BS EN 13598-1:2010 OF 100 OR 150 DIA.
ANY PIPED LAID UNDER ADOPTED ROAD/DRIVE AREAS TO BE CLAYWARE.
- WHERE PIPES ARE LAID LESS THAN 900mm BELOW WEARING SURFACE OF THE ROAD OR HARDSTANDING LAY 200mm THK CONCRETE SLAB (GEN 3) ON TOP OF GRANULAR SURROUND FOR FULL WIDTH OF TRENCH
WHERE PIPES ARE LAID BELOW ROAD/PARKING AREAS TRENCH BACKFILL SHALL BE TYPE 2 SUB-BASE MATERIAL CONSOLIDATED IN 150mm MAX LAYERS.
- ALL INSPECTION CHAMBERS (IC, DEPTH NOT EXCEEDING 1200mm) TO BE 450 DIA FROM PREFORMED PLASTIC CHAMBERS TO BS EN13598-2010.
ALL NON ENTRY INSPECTION CHAMBERS (NIC, DEPTH 1200-3000) TO BE 500 DIA FROM PREFORMED PLASTIC CHAMBERS TO BS EN13598-2010.
ALL SHALLOW INSPECTION CHAMBERS (SIC) TO BE 300 DIA x 600 DP FROM PREFORMED PLASTIC CHAMBERS TO BS EN13598-2010.
UNLESS OTHERWISE NOTED PIPE DIAMETERS FOR STORM DRAINS TO BE 100mm. LAID AT 1:100 IN uPVC UNLESS NOTED OTHERWISE.
UNLESS OTHERWISE NOTED PIPE DIAMETERS FOR FOUL DRAINS TO BE 100mm LAID AT 1:40 IN uPVC.

FOR EXACT LOCATION OF RWP, SS & SVP'S REFER TO ARCH'S DRAWINGS.

ALL EXISTING INVERT LEVELS TO BE CHECKED AND CONFIRMED AGAINST THAT NOTATED WITHIN THESE DRAWINGS PRIOR TO ANY COMMENCEMENT OF WORKS ON SITE

REVISIONS. BY. CHD. DATE.

KEN RUSH ASSOCIATES

STRUCTURAL & CIVIL ENGINEERS
Bowman House, 191 South Street,
Braintree, Essex, CM7 3CB.
Tel: (01376) 326789

ARCHITECT / CLIENT

Bchitecture/Toast Developments.

PROJECT
**RESIDENTIAL DEVELOPMENT AT
170A HAREFIELD ROAD,
UXBRIDGE, UBB 1PP.**

TITLE
**PROPOSED DRAINAGE STRATEGY
PLAN FOR RELEASE OF
PLANNING CONDITION.**

SCALE 1:50 @ A1

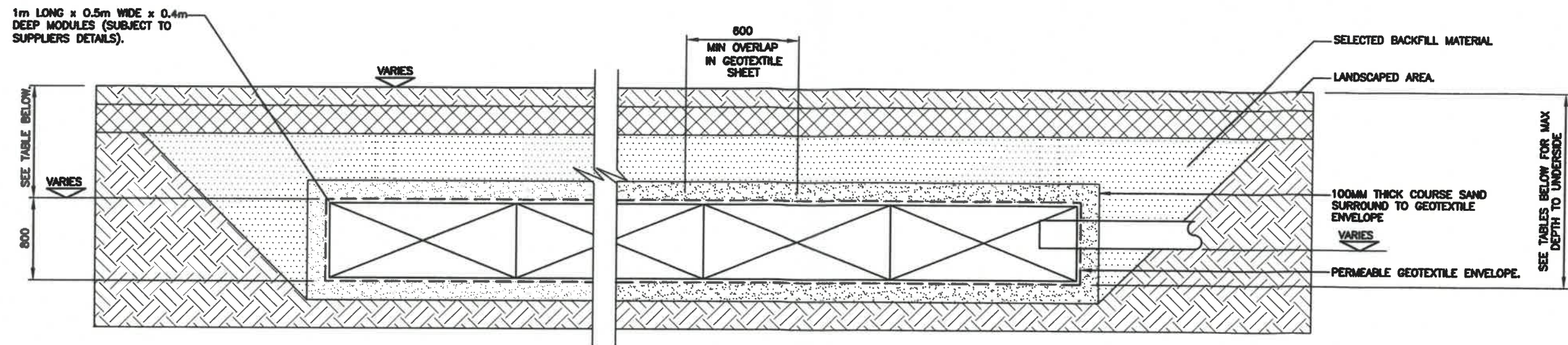
DRAWN AS DATE AUGUST 2021

DESIGNED AS CHECKED SM

JOB No. 21-7018 DRS. No. 300

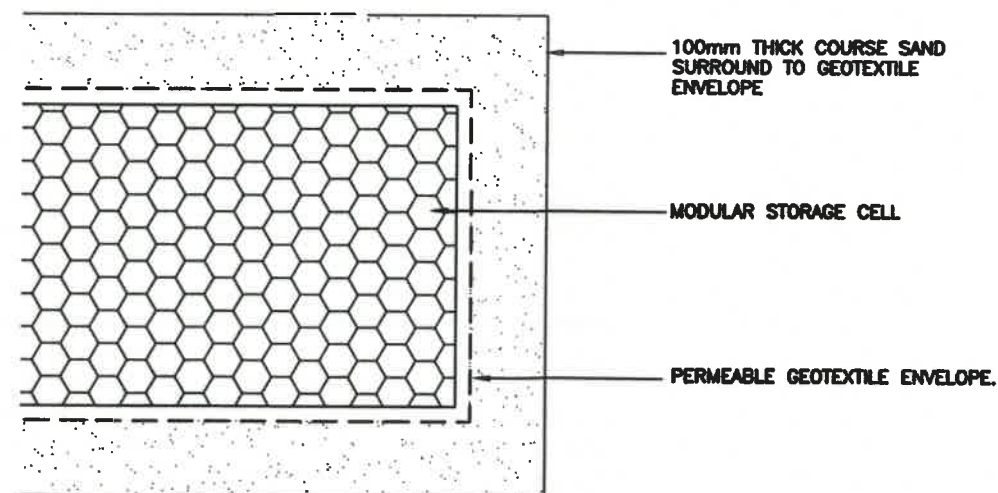
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TYPICAL SECTION THRU SOAKAWAY WITH CELLS.

MINIMUM COVER TO CELLS.	
IN LANDSCAPED AREAS	500mm
IN TRAFFICKED AREAS	750mm



ENLARGED DETAIL

NOTES

1. ALL DRAWINGS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS DRAWINGS & SPECIFICATIONS.
2. DO NOT SCALE. WORK TO FIGURED DIMENSIONS ONLY.

KEN RUSH ASSOCIATES



STRUCTURAL & CIVIL ENGINEERS

Bowman House, 191 South Street,
Braintree, Essex, CM7 3QB.

Tel: (01376) 326789 Fax: (01376) 342711

ARCHITECT / CLIENT

Bchitecture/Toast Developments.

PROJECT

RESIDENTIAL DEVELOPMENT AT
170A, HAREFIELD ROAD, UXBRIDGE.

TITLE

TYPICAL CRATED TYPE SOAKAWAY DETAIL.

SCALE 1:25, 1:10 • A3

DRAWN AS

DATE AUGUST 2021

DESIGNED AS

CHECKED SM

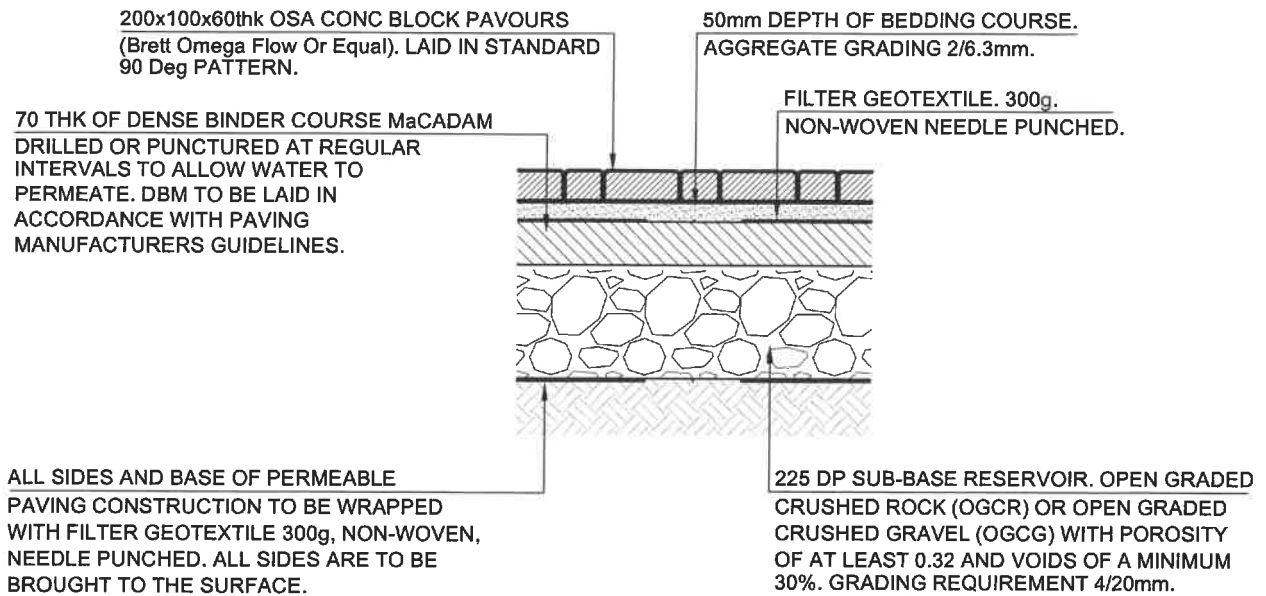
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DRG. No. 301

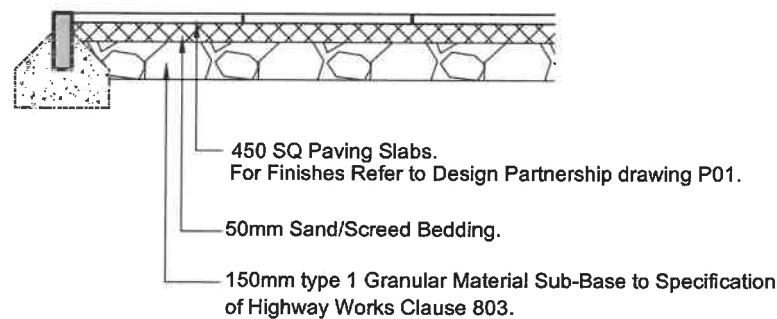
REVISION

REVISIONS.

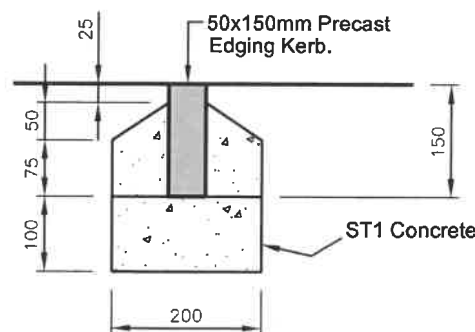
BY. CHKD. DATE.



TYPICAL PERMEABLE PAVED AREAS FOR PRIVATE PARKING AREAS.



TYP FOOTPATH CONSTRUCTION. (Around Dwellings)



"EF" P.C.C EDGING DETAIL

SCALE 1:10

 STRUCTURAL & CIVIL ENGINEERS Bowman House, 191 South Street, Braintree, Essex, CM7 3QB. Tel: (01376) 326789	PROJECT 170A HAREFIELD ROAD, UXBRIDGE.			
	SKETCH TITLE TYPICAL PERMEABLE PAVING CONSTRUCTION.			
	DATE AUG' 2021	SCALE 1:10, 1:20.	JOB No. 21-7018	SKETCH No. 302
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4. Ken Rush Associates Tedds Calculations For Soakaway & Permeable Paving Area.

SOAKAWAY DESIGN**In accordance with BRE Digest 365 - Soakaway design**

Tedd's calculation version 2.0.04

Design rainfall intensity

Location of catchment area London
 Impermeable area drained to the system $A = 92.0 \text{ m}^2$
 Return period Period = 100 yr
 Ratio 60 min to 2 day rainfall of 5 yr return period
 5-year return period rainfall of 60 minutes duration
 Increase of rainfall intensity due to global warming

$$r = 0.440$$

$$M5_{60\text{min}} = 20.0 \text{ mm}$$

$$p_{\text{climate}} = 40 \%$$

Soakaway / infiltration trench details

Soakaway type Rectangular
 Minimum depth of pit (below incoming invert) $d = 1200 \text{ mm}$
 Width of pit $w = 1000 \text{ mm}$
 Length of pit $l = 4000 \text{ mm}$
 Percentage free volume $V_{\text{free}} = 95 \%$
 Soil infiltration rate $f = 44.0 \times 10^{-6} \text{ m/s}$
 Wetted area of pit 50% full $a_{s50} = l * d + w * d = 6000000 \text{ mm}^2$

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	0.39;	10.8;	1.92;	20.8;	1.92;	0.08;	1.84
10	0.54;	15.0;	1.99;	29.9;	2.75;	0.16;	2.59
15	0.65;	18.1;	2.01;	36.5;	3.36;	0.24;	3.12
30	0.82;	22.9;	2.02;	46.2;	4.25;	0.48;	3.77
60	1.00;	28.0;	1.99;	55.6;	5.12;	0.95;	4.17
120	1.19;	33.4;	1.94;	64.9;	5.97;	1.90;	4.07
240	1.39;	39.0;	1.90;	74.0;	6.81;	3.80;	3.01
360	1.53;	42.8;	1.87;	80.0;	7.36;	5.70;	1.66
600	1.70;	47.6;	1.83;	87.1;	8.01;	9.50;	0.00
1440	2.07;	58.1;	1.76;	101.9;	9.37;	22.81;	0.00

Required storage volume

$$S_{\text{req}} = 4.17 \text{ m}^3$$

CALCULATION SHEET

CONTRACT:-

170A Harefield Road,
Uxbridge

Drainage Strategy -
Stormwater Soakaway to
BRE 365

DATE:- 26/08/2021



STRUCTURAL & CIVIL ENGINEERS

Job No:- 21-7018

Designed by:- AS

Checked by:-

SHEET No. 2

Soakaway storage volume

$$S_{act} = l * d * w * V_{free} = 4.56 \text{ m}^3$$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume

$$t_{s50} = S_{req} * 0.5 / (a_{s50} * f) = 2\text{hr } 11\text{min } 38\text{s}$$

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

CALCULATION SHEET
 CONTRACT:-
 New Dwelling at 170A
 Harefield Road, Uxbridge
 SUDS Permeable
 Paving Drive Area
 DATE:- 31/08/2021

Job No:- 21-7018
 Designed by:- AS
 Checked by:-
 SHEET No. 1

PLANE INFILTRATION SYSTEM DESIGN

In accordance with CIRIA C753 SUDS

Tedds calculation version 2.0.04

Design rainfall intensity

Location of catchment area London
 Impermeable area drained to the system $A = 100.0 \text{ m}^2$
 Return period Period = 100 yr

Ratio 60 min to 2 day rainfall of 5 yr return period

$r = 0.440$

5-year return period rainfall of 60 minutes duration

$M5_{60\text{min}} = 20.0 \text{ mm}$

Increase of rainfall intensity due to global warming

$p_{\text{climate}} = 40 \%$

Infiltration pavement details

Base area of pavement $A_b = 100.0 \text{ m}^2$
 Porosity $n = 0.3$
 Drainage ratio $R = A / A_b = 1.0$
 Soil infiltration rate $f = 1.67 \times 10^{-6} \text{ m/s}$

Table equations

Rainfall intensity $i = M100 / D$
 Minimum depth required (Eq. 25.1) $H = D / n * (R * i - f)$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Intensity, i (mm/hr)	Depth (mm)
5	0.39;	10.8;	1.92;	20.8;	249.87;	68;
10	0.54;	15.0;	1.99;	29.9;	179.44;	96;
15	0.65;	18.1;	2.01;	36.5;	145.93;	117;
30	0.82;	22.9;	2.02;	46.2;	92.31;	144;
60	1.00;	28.0;	1.99;	55.6;	55.61;	165;
120	1.19;	33.4;	1.94;	64.9;	32.46;	176;
240	1.39;	39.0;	1.90;	74.0;	18.51;	167;
360	1.53;	42.8;	1.87;	80.0;	13.33;	147;
600	1.70;	47.6;	1.83;	87.1;	8.71;	90;
1440	2.07;	58.1;	1.76;	101.9;	4.25;	0;

Min depth of pavement req'd $H_{\text{max}} = 176 \text{ mm}$

Time to empty blanket to half volume - Eq.25.6(1) $t_{50} = n * H_{\text{max}} / (2 * f) = 4\text{hr } 24\text{min } 34\text{s}$

PASS - Infiltration system discharge time less than or equal to 24 hours

**5. Historical Borehole Logs From Nearby Sites (Presence of Gravel).
Information Derived From Open Source Via The British Geological Survey (BGS)
Website Data**

Contract Name		UXBRIDGE		0555 8476		Borehole No. 4		Sheet 1 of 1	
Method of boring		Shell and Auger		Ground level		43.10 m OD			
Diameter		200 mm nominal		Start		15.8.78			
				Finish		18.8.78			
Daily progress	Water levels	In-situ tests	Samples	Depth (m)	Reduced level (m O.D.)	Thickness (m)	Description of Strata		
15/8				0.20	42.90	0.20	Tarmac	Made	
				0.50	42.60	0.30	Concrete, bricks, and clays	ground	
15/8		N=57	B	1.50	41.60	1.00	Medium to fine gravel	1	
15/8		N=64	B			1.90	Very dense coarse to medium gravel	2	
				3.40	39.70	0.70	Dense coarse to medium gravel with a trace of brown sand	3	
16/8		N=31	B	4.10	39.00			4	
16/8		N=69	B			3.90	Very dense coarse to medium gravel with occasional cobbles	5	
	▽	N=56	B					6	
	17/8	N=58	B					7	
		N=55	B					8	
17/8				8.00	35.10		Bottom of Borehole		
17/8								9	
								10	
Notes Surface broken out by pneumatic breaking tools Noticeable water loss during boring through granular soils Water level observation tubing installed to 8.00 m									
Terresearch Limited				Report No. S.28/586			Appendix 1 Sheet 4		

Contract Name		UXBRIDGE		0559 8484		Borehole No. 5	
						Sheet 1 of 1	
Method of boring		Shell and Auger		Ground level		42.45 m OD	
Diameter		200 mm nominal		Start		11.8.78	
				Finish		15.8.78	

Daily progress	Water levels	In-situ tests	Samples	Depth (m)	Reduced level (m OD)	Thickness (m)	Description of Strata
	12/8			0.55	41.90	0.55	Brown and black sandy clay with bricks
							Made ground
11/8		N=64	B			2.75	Very dense coarse to medium gravel
11/8							1
		N=68	B				2
							3
	14/8	N=35	B	3.30 3.40	39.15 39.05	0.10	Soft brown sandy clay with some coarse to fine gravel
	14/8					2.20	Dense coarse to medium gravel with a little brown sand
							4
12/8							5
12/8			U	5.60	36.85	0.60	Firm brown sandy silty clay (London Clay)
				6.20	36.25	0.70	Firm dark grey sandy silty clay with pockets of blue silty clay and yellow-brown fine sand and some shell fragments (London Clay)
			U	6.90 7.00	35.55 35.45	0.10	Firm grey sandy silty clay (London Clay)
14/8							Bottom of Borehole
							7
							8
							9
							10

Notes	Surface broken out by pneumatic breaking tools Noticeable water loss to 3.30 m during boring through granular soil
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Terresearch Limited	Report No. S.28/586	Appendix 1 Sheet 5
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6. Outline Maintenance Schedule

General Maintenance Schedule

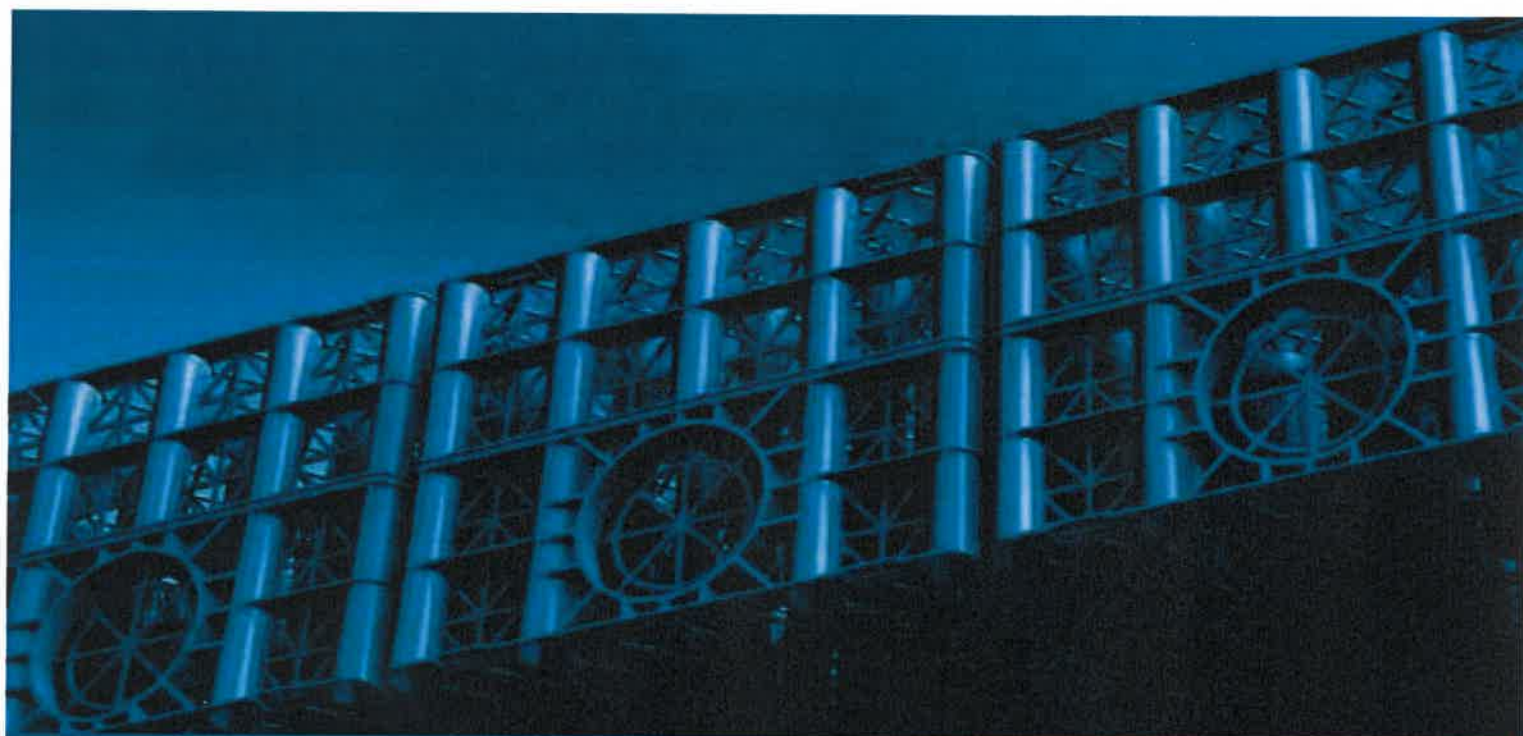
21-718 – Development at 170A Harefield Road, Uxbridge.

Element	Action	Frequency
General Hard Standing Areas	Litter and leaf Collection	Monthly
	Surface Sweeping	Half yearly
Manholes	Inspection	Half yearly
	Cleaning	Half yearly
	Replacement	As required
Pipe Work	Jetting/Rodding	As required
	Replacement	As required
Channels	Removal of Silt etc.	Half yearly/As required
	Replacement	As required
Road Gullies	Inspection	Half yearly
	Jetting/Rodding	As required
	Replacement	As required
Flow Control	Inspection	quarterly
	Cleaning/ removal of silt	Half yearly/ as required
	Replacement	As required
Attenuation Tanks & Soakaways	Inspection	Monthly for First 3 months, Annually after 3 months
	Removal of Sediment from Inlets etc.	Annually/As required
	Repair/Replacement	As required
	Internal Sediment Removal	Five (5) Yearly/As required
Petrol interceptor	Servicing	6 monthly (or as required by the manufacturer) by experienced personnel
Silt Traps	Inspection	Quarterly
	Cleaning	Half yearly/As required

7. Crate Type Soakaway – Recommended Suppliers Technical Data.
Note: Alternative suppliers/products can be adopted, providing the required total volume of attenuation is provided to match design requirements.

Polystorm & Polystorm Lite

Technical Guide

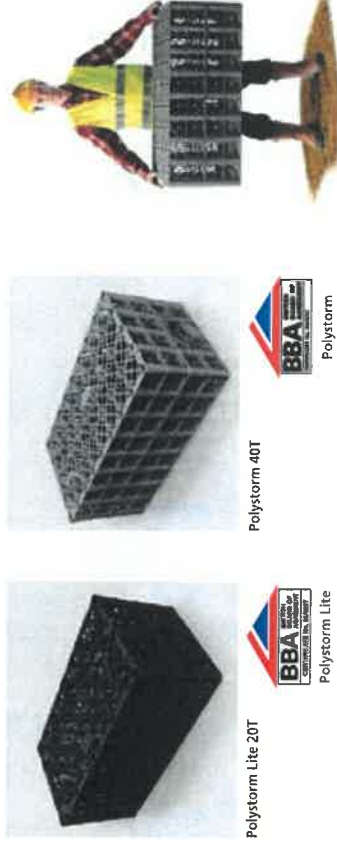
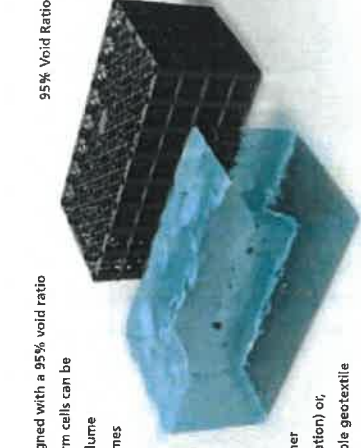


Water Management Solutions
Design, planning, specification and installation guidelines

2.1 Polystorm modular cell system - three types of Polystorm cells

2.1.1 The Polystorm principles

The Polystorm range of modular cell systems are designed with a 95% void ratio to retain large volumes of water run-off. The Polystorm cells can be designed and built to a specific size to a total void volume requirement dependent upon the water run-off volumes required on a particular project (i.e. car park, road or building). The Polystorm range of water storage cells are structurally strong, individual modular cells which can be built up to form a structure of any shape or size. The structure is wrapped in a non permeable, geomembrane which can receive rainwater collected from the roof gutter system or surface drains and either releases the water within set discharge limits (attenuation) or, where soil conditions allow, be wrapped in a permeable geotextile and slowly release the water back into the surrounding soil (soakaway).



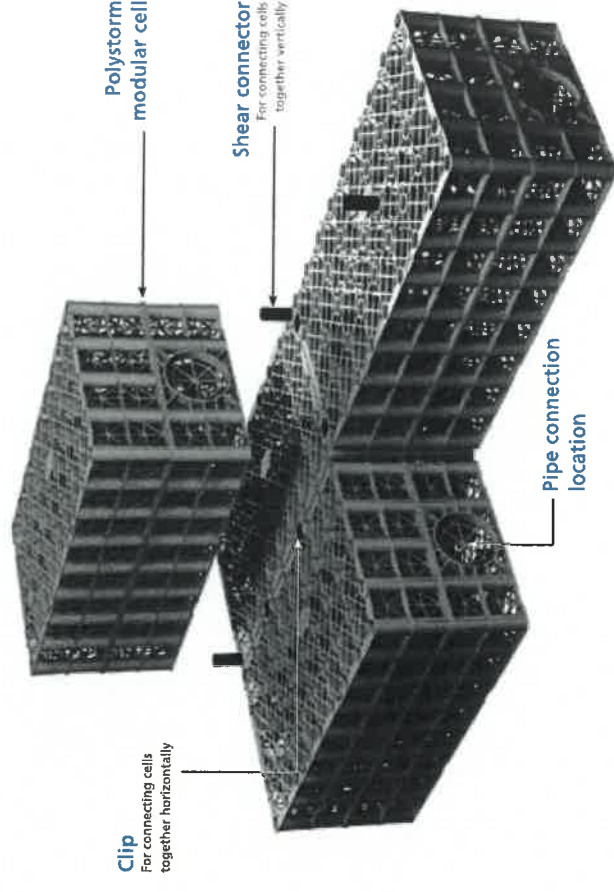
Key benefits

- **95% void ratio:** Providing greater water storage capacity and reduced excavation and disposal costs
- **Modular units:** Allow flexibility of shape - ideal for shallow excavation systems, narrow strips or use in restricted areas
- **Light weight yet robust:** Excellent Health and Safety and installation benefits
- **Easy to handle:** Unique rounded corners for ease of handling and reduces likelihood of punctures to membranes
- **Cost effective:** Especially when used as a hybrid, value engineered system
- **Recyclable:** 100% recyclable at the end of its useful life
- **Range:** Spans from 20 tonnes per square metre load bearing capacity up to a maximum of 80 tonnes per square metre load bearing capacity
- The range can be designed for nontrafficked, trafficked or heavy trafficked applications
- Suitable for both attenuation and soakaway systems
- 50 year design life
- BBA Approved
- Hybrid Solutions

There are three different types of Polystorm cells which are Polystorm Lite, Polystorm and Polystorm Xtra. Each Polystorm cell type has a different surface load specification.

- Polystorm Lite is designed for use in landscaped pedestrian or other non-loaded applications
- Polystorm is designed for use in light trafficked and loaded applications

The Polystorm Technical Manual is available to download at:
www.polypipewms.co.uk/downloads



2.2 Polystorm Lite

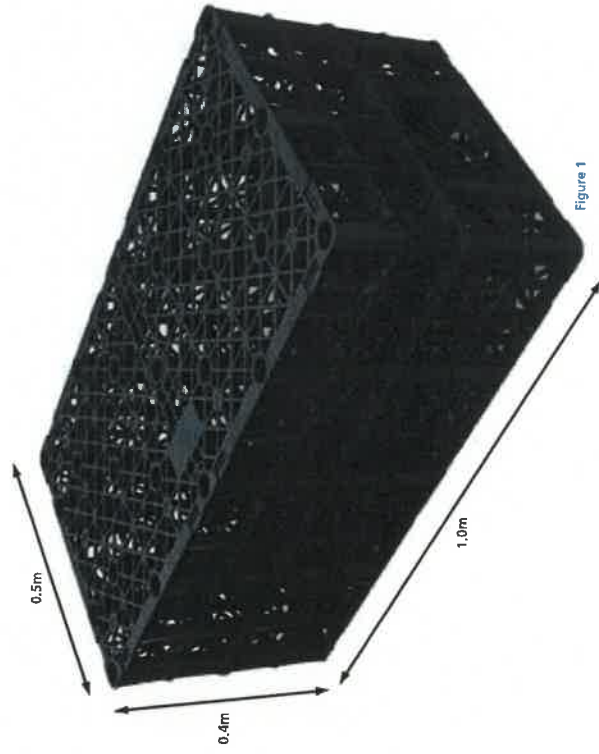


Figure 1

Designed for use in landscaped, pedestrian or other non-loaded applications with a load bearing capacity of:

20 tonnes

Technical specification overview

Unit type	Polystorm Lite
Product code	PSM2**
Dimensions	1m x 0.5m x 0.4m high
Total volume	0.2m per cube
Unit weight	7kg ^{***}
Cube storage volume	0.19m ³ (190 litres)
Surface area	55% perforated
Compressive strength	Maximum 20 tonnes per sq metre
Maximum burial depth	2.5m ^{***}

* Each unit includes 4 clips and 2 shear connectors. Please note that brick bond connector may be required at additional cost.

** Pallet weight dependent upon order quantity and transport type.

*** In weak clay soil conditions the maximum burial depth is 1.5 metres. Polystorm Lite should not be installed below the water table.

Table 1

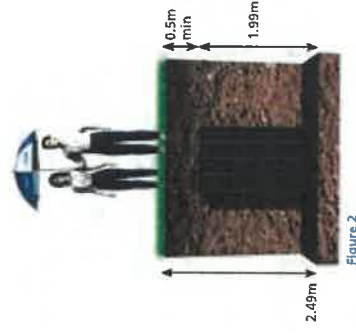


Figure 2

Polystorm Lite has been specifically designed for non-trafficked applications. With a 20 tonne per square metre compressive strength it will however take general maintenance vehicles such as grass cutters. Polystorm Lite can be used for both attenuation and soakaway applications. The modular structure receives rainwater collected from roofs or surface drains ready to release within a set drainage limit. Polystorm Lite can be used typically for landscaped areas, pedestrian or public open spaces such as underneath playgrounds.

Polystorm Lite		
Description	Code	Pack quantity
Polystorm Lite cell 1000 x 500 x 400mm	PSM2	15
Polystorm Lite flow control unit	PSMFC150/30	1
Brick bond shear connector	PSMBPSC	30
Clips	PSMCLIP	60
Shear connector	PSMSC	30
ENT401 flange adaptor - 110mm	PSMFA110	1
Ridgidrain flange adaptor - 150mm	PSMFA150	1
ENT401 flange adaptor - 160mm	PSMFA160	1
Basic silt trap	PSMST160	1
Advanced silt trap - 15 litres/sec	PSMSTA160/15	1
Mini silt trap for Polystorm Lite	PSMST110	1
Cover & frame (round)	UG501	1
Cover & frame (square)	UG502	1
450mm silt trap lid & frame	UG512	1
460mm lockable plastic cover & frame	UG511	1
Polypropylene cover & frame	ICDC1	1
Chamber riser section	ICDF1	1
Silt trap sealing ring	UG488	1

Table 2

Note: Minimum cover and burial depths may vary depending on load and ground conditions. Please contact Polystorm WMS for further information. All grades of Polystorm units may be used in situations outside of those recommended above, through the use of the appropriate protective measure designed to reduce the imposed loading on the proposed Polystorm structures.



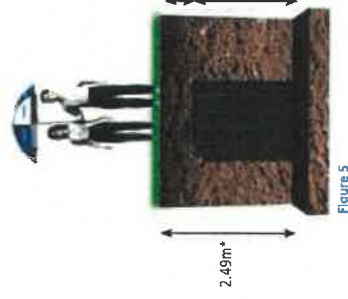
2.4 Hybrid - Polystorm range of modular cells creating a cost-effective hybrid construction

The following illustrations indicate maximum burial depths for Polystorm Lite and Polystorm modular cell systems.

Polystorm Lite and Polystorm

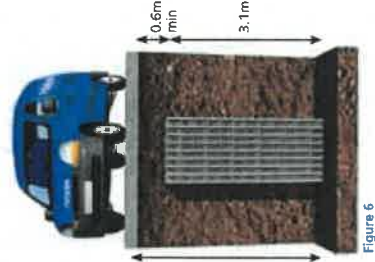
POLYSTORM Lite
20 tonnes

Pedestrian



POLYSTORM
40 tonnes

Light Traffic



Note: * Based on ground conditions being dense sand and gravel.

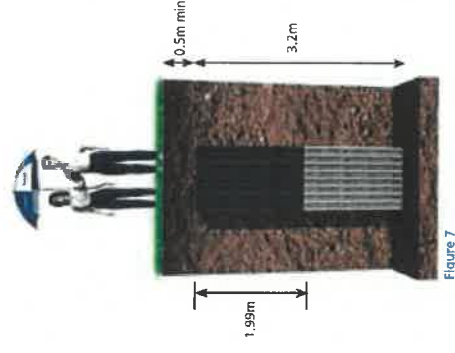
Minimum cover and burial depths may vary depending on load and ground conditions.

Please contact Polypipe WMS for further information. All grades of Polystorm units may be used in situations outside of those recommended above, through the use of the appropriate protective measures, designed to reduce the imposed loading on the proposed Polystorm structures.

Hybrid Solution VALUE ENGINEERED STRUCTURES

POLYSTORM Lite
POLYSTORM

Pedestrian



Value engineered structures

Polypipe are the only manufacturer who can offer a complete value engineered hybrid system utilising Polystorm Lite or Polystorm cells to create a bespoke solution based on the load requirements and burial depths for any given project.

When integrated as a hybrid structure, a complete value engineered solution can be adopted for any given project. To reduce costs, it's possible to construct a hybrid tank, which contains all types of cells, the stronger Polystorm cells at the bottom and Polystorm Lite cells at the top. For further details contact Polypipe WMS technical support team. Refer to tables 8, 9 and 10 (page 39) for burial depths in different soil conditions.

3.0 Testing and certification - laboratory testing and protocol

At Polypipe WMS we pride ourselves on providing a consistently high level of product quality. All our products undergo stringent testing and quality control and where possible, are covered by third party certification. Our manufacturing processes are also accredited to ISO 9001:2008. There are two quality control labs in operation 12 hours a day.



Testing and certification

Contents

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Testing and certification	3.1 26 - 27
Summary of test results	3.2 28 - 29

4.1 Detail design protocol

4.1.1 Structural design

4.1.1.1 Structural design

When designing plastic geocellular structure for soakaway or attenuation tanks care has to be taken to ensure the finished system is safe to carry the loads they will be subject to. The diagram below outlines a safe route to the design and installation of Polystorm modular stormwater tanks.

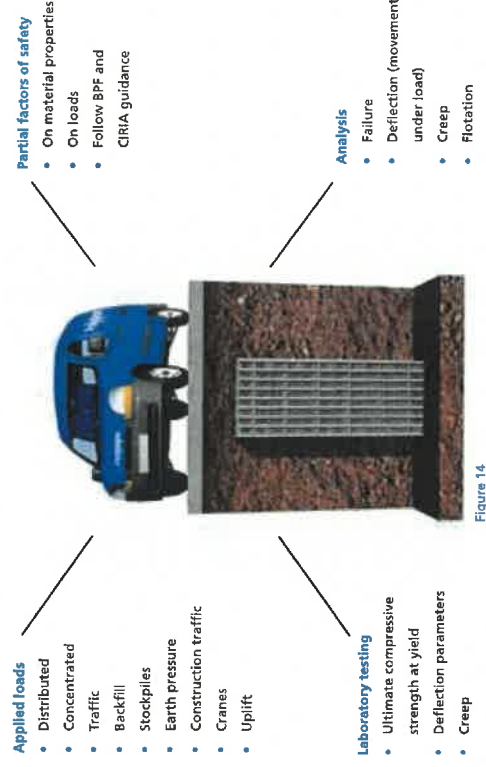


Figure 14

Listed below are the four main reasons for failure of the system:

1. Structural failure or collapse - when the structure cannot support the applied loads.
2. Excessive deflection or movement when vehicles passing over the tank cause movement and the surface above may crack or displace.
3. Creep - excessive movement or loss of strength over a period of time which can occur under a constant load.
4. Flotation: Constructing a tank below the groundwater table can create uplift.

4.1.2 Limit state design, 4.1.3 Industry standards,

4.1.4 Factors of safety

4.1.2 Limit state design

In the design of any load carrying system, there needs to be factors of safety to allow for any variation in either the applied load or cellular unit strength. Limit state design does not use a single overall factor of safety; the method looks at 'limit states' and applies partial factors of safety to the various design parameters depending on the consequences of the limit state being exceeded. In the case of Polystorm drainage tanks the two limit states to be considered are:

• Ultimate limit state (ULS)

This is when the strength of the cell is exceeded by the applied loads and the tank collapses. This is obviously serious and the partial factors of safety used in this assessment are chosen to ensure there is a negligible risk of a collapse occurring.

• Serviceability limit state (SLS)

This considers the operational behaviour of a tank to ensure that the installation remains serviceable. For the structural calculations this means that deflections are not excessive and do not cause damage to overlying surfaces (such as asphalt) or cause a significant reduction in the storage volume of the tank. The Polystorm Lite cell is recommended for use in landscaped areas, where deflections would have a negligible effect. SLS would therefore not play a significant role in Polystorm Lite structural design.

4.1.3 Industry standards

There are currently no design standards or guides specific to generic modular plastic stormwater tanks, with each manufacturer within the marketplace providing their own guidelines that tend to be specific to their own cells. However, a generic design method has been developed that can be applied to most types of cells, using basic structural design theory and relevant British Standards. In particular the loading on plastic tanks may be considered to be the same as a buried concrete or steel tank and so the loads and partial factors of safety for loads have been taken from the following:

1. British Standards Institution (1997). British Standard BS8110, Part 1: 1997; Structural use of concrete: Code of practice for design and construction. BSI
2. British Standards Institution (1996). British Standard BS 6399: Part 1: 1996: British Standard Loadings for Buildings. Part 1 Code of Practice for dead and imposed loads. BSI

The only available guidance relating to plastic materials in similar situations to buried cellular tanks is that for plastic geosynthetics in soil strengthening and reinforcement. The information in the following British Standard has been used as a guide to the choice of partial material factors used for the design:

1. British Standards Institution (1995). British Standard BS8006: 1995: Code of practice for strengthened/reinforced soils and other fills. BSI

4.1.4 Factors of safety

To ensure that the risk of exceeding the limit states is minimal, factors of safety are applied to the cellular unit's ultimate compressive strength and to any applied loads; these are known as partial factors of safety.



4.1.5 Material factors

4.1.5.1 Material factors

The ultimate compressive strength of the Polystorm cells has been obtained from laboratory testing on samples. To take account of other factors such as variations due to manufacturing processes, variability and uncertainties in material strength (e.g. due to extrapolation of data), damage during installation and environmental effects, a design strength is derived by dividing the cell's characteristic strength by a material partial factor of safety (f_m), appropriate to the material and limit state. There is no guidance on the choice of material factors for plastic storage tanks.

Partial material factors of safety: Polystorm Lite & Polystorm	
Limit state	f_m
Ultimate limit state	2.75
Serviceability limit state	1.5

Table 6

The partial factor f_m is made up of several components:

f_{m11}

This is applied to the characteristic strength of Polystorm. It covers possible reductions in strength from the control test specimens and inaccuracies in the assessment of the resistance of a structural element resulting from modelling errors. For tightly controlled Polystorm production f_{m11} would normally be between 1.05 and 1.1. Because a limited number of compression tests have been undertaken on the Polystorm cells in addition to this property not being measured as part of the quality control program, a conservative value has been adopted. Compression tests were undertaken at points judged by inspection to be the weakest however the cell is a complex three dimensional structure, therefore an allowance must be made for this. In view of the preceding factors and the conservative choice of design parameters already undertaken, a value of $f_{m11}=1.20$ has been adopted for the ULS and 1.1 for the SLS. This can be reviewed if the compressive strength is measured as part of the manufacturing quality control procedure.

f_{m12}

This is applied to take account of the extrapolation of creep test data. It is also used in the case of the Polystorm cells to allow for the absence of fatigue testing. A suggested value of f_{m12} is given by $\ln g_{td} = \ln g_{td} + \ln g_{td}$ where td = design life, t is duration of creep test. This gives a value for the ULS, with a design life of 20 years, of $f_{m12} = 1.9$. Although the cells will be under compressive loads and appear to fail in compression at the internal columns, they are complex structures. Some of the elements will be acting in tension and when polypropylene is subject to creep under long term tensile loads it can lose strength over time. Therefore the values taken from reinforced earth applications are considered reasonable. For serviceability, which is not so critical, a value of 1.25 is adopted.

f_{m21}

This is applied to take account of damage during installation. The Polystorm cells are robust and not particularly susceptible to damage and therefore, in the absence of specific damaged strength testing, a factor of 1.1 for the ULS and 1.0 for the SLS has been used.

f_{m22}

This is applied to take account of environmental conditions. The polypropylene used in the manufacture of the Polystorm units is resistant to all contaminants that are naturally found in soil and rainwater. No specific test results are available and so a value of f_{m22} for both ULS and SLS of 1.1 has been adopted; which is the minimum value recommended for reinforced earth applications by Ingold. With the total value of $f_m = f_{m11} \times f_{m12} \times f_{m21} \times f_{m22}$ Therefore, for the following limit state, f_m will equate to:

Ultimate limit state:	Serviceability limit state:
$1.2 \times 1.9 \times 1.1 \times 1.1 = 2.75$	$1.1 \times 1.25 \times 1.0 \times 1.1 = 1.5$

The use of conservative factors also allows for synergistic effects (i.e. the combined effect of construction damage, environmental effects and lower than expected cell strength) that may result in a greater combined effect than the three factors acting individually. These factors are only applicable for temperate climate conditions such as in the UK. Although the strength of polypropylene varies with temperature, this will not be significant for installation in the UK where the temperature in the ground (at the typical depth of installation) remains between 0°C and 20°C with a mean value of around 10°C.

4.1.6 Applied loads and load factors

4.1.6.1 Applied loads and load factors

Loads that may be imposed on a cellular storage structure such as Polystorm, can be broken down into the following types:

• Dead Loads

Permanent loads applied to the cells, including the weight of backfill material placed over the top and lateral (horizontal) earth and water pressure loads acting on the side of the system.

• Live Loads

Loads due to pedestrian, vehicle and construction traffic that are not permanent. Traffic wheel loads are normally given as static loads, with a factor applied to allow for dynamic effects (a moving wheel will impose more force on the ground than a static one).

A design load is obtained by applying a partial factor of safety to the estimated characteristic load. This allows for unforeseen variations of loading and also the severity of the consequences of the limit state occurring. The loads on cellular units will be similar to loads applied in the design of structures using rigid materials such as concrete and therefore the partial safety factors for loads that are appropriate to the design of plastic storage systems are taken from British Standard BS 8110.

Partial factors of safety for applied loads			
Limit state	Imposed vertical dead load f_{m1}	Imposed earth pressure dead load f_{m2}	Imposed live load f_{m3}
Ultimate limit state	1.40	1.40	1.60
Serviceability limit state (Polystorm only)	1.0	1.0	1.0

Table 7

Thermal expansion of the cells will be negligible because temperature variations that are likely to occur in the ground should not be significant. These loads are therefore not considered in this design.



4.2 Distributed loads

4.2.1 Example of calculation methods

The structural design of the cells needs to consider a number of different loads and their effects.

What load is applied to the tank?

1. Dead (permanent) loads such as the weight of soil placed over the top of the cells or long term stockpiles of containers or materials (anything that will be applying load for a lengthy period of time).
2. Surcharge loads. From stored materials or to allow for traffic.

How is this analysed?

The weight of the fill material is calculated from the depth of soil and its cell weight. The traffic loads that are typically used are: Car Parks - 2.5kPa. HGV Loading - 10kPa.

Example: 1.5m cover depth over the top of Polystorm - Car Park.

Design against collapse (ultimate limit state)

Weight of soil = $1.5\text{m} \times 20\text{kN/m}^3$.

Partial factor of safety = 1.4.

Surcharge = 2.5 kPa. Partial factor of safety = 1.6.

Total design load = $(1.5 \times 20 \times 1.4) + (2.5 \times 1.6) = 46\text{kPa}$.

Polystorm ultimate compressive strength at yield = 440kPa.

Partial factor of safety = 2.75.

Design strength of Polystorm = $440/2.75 = 160\text{kPa}$.

Design strength is greater than factored loads so the design is ok.

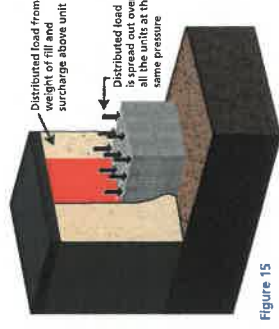


Figure 15

Check deflection (serviceability limit state)

Partial factor on load = 1.0.

Design load = $(1.5 \times 20 \times 1.0) + (2.5 \times 1.0) = 32.5\text{kPa}$.

Deflection of Polystorm = 1mm per 83kPa load.

Partial factor of safety = 1.5.

So elastic deflection of Polystorm = $32.5 \times 1.5/83 = 0.6\text{mm}$.

Most of the deflection is due to the permanent load and so it will be acceptable.

Check creep (serviceability limit state)

Long term creep deflection = 0.2794Ln (design life in hours).

For a load less than 100kPa.

So if design life is 20 years

Creep = 0.2794Ln ($20 \times 365 \times 24$) = 3.4mm.

What load is applied to the tank?

3. Concentrated loads for example those from:

- Wheels of cars or trucks
- Container feet
- Construction vehicles
- Crane spreader plates or legs

How is this analysed?

The load from the wheel is spread out through the soil or pavement materials over the top of the tank.

The heavier the load the greater the thickness of material that is required over the top of the tank. However there is a practical minimum of about 0.5m in most cases to avoid damage to the tank during installation and after construction.

Example:

Polystorm is to be used under a car park that may be occasionally crossed by delivery trucks or refuse collection lorries (maximum gross vehicle weight 31,000 kg).

Polystorm is covered by 1.2m of Type 1 sub-base and asphalt pavement construction.

Design against collapse (ultimate limit state)

Load from wheel = 35kN.

Assume contact patch is 0.135m by 0.275m.

Trucks will be moving slowly but turning therefore dynamic factor = 1.5.

Cover depth of soil is 1.2m and assume a 26.6° load spread.

Contact area on top of tank is:

$0.275 + 1.2 \text{ by } 0.135 + 1.2 = 1.97\text{m}^2$.

Applied pressure from wheel is $35 \times 1.5/1.97 = 26.6\text{kPa}$.

Factor of safety = 1.6

and factored pressure = $26.6 \times 1.6 = 42.6\text{kPa}$.

Pressure from soil is $1.2\text{m} \times 20\text{kN/m}^3 = 24\text{kPa}$.

Factor of safety = 1.4

and factored pressure = $24 \times 1.4 = 33.6\text{kPa}$.

Total pressure = $42.6 + 33.6 = 76.2\text{kPa}$.

As in previous example design strength of

Polystorm = 160kPa and this is greater than the applied load and so it is acceptable.

4.3 Lateral loading - calculation example

4.3.1 Check deflection (serviceability limit state)

In this case we are interested in the continuous and repeated deflections under wheel loads only.

Partial factor on load = 1.0.

Applied pressure from wheel (above) is 26.6kPa.

Design pressure = $26.6 \times 1.0 = 26.6\text{kPa}$.

Deflection of Polystorm = 1mm per 83kPa load.

Partial factor of safety = 1.5.

So elastic deflection of Polystorm = $26.6 \times 1.5/83 = 0.5\text{mm}$.

This will be repeated each time a wheel passes over the tank. This is acceptable for an asphalt pavement.

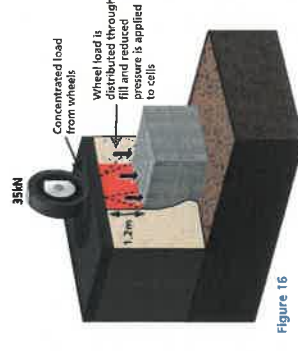


Figure 16

What load is applied to the tank?

4. Earth and groundwater pressure from the surrounding ground. Note that account must be taken of sloping ground, pre-existing shear planes and groundwater. If in doubt obtain expert advice from Polypipe WMS technical support team.

How is this analysed?

The earth pressure applied to the side of the tank by the soil and groundwater. The weaker the soil the greater the pressure it applies to the side of the tank. Water also applies pressure to the side of a tank. The calculations are based on standard earth pressure theory.

Example

The bottom of a modular tank is located 2.5m below ground level. The excavation is surrounded by medium dense sand and gravel with an angle of friction of 34°.

The groundwater is below the base of the tank. Allow for a 10kN/m² surcharge.

To allow for load distribution on the side of the tank, the design uses the earth pressure at a depth of 0.25m above the base of the tank.

Therefore; Design depth = $2.5 - 0.25 = 2.25\text{m}$.

For an angle of friction of 34° the coefficient of active earth pressure is 0.282.

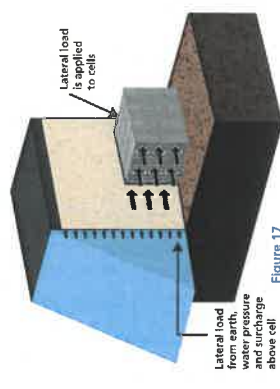


Figure 17

Design against collapse (ultimate limit state)

Partial factor of safety for earth pressure = 1.35.

Partial factor of safety for earth pressure = 1.5.

The applied pressure from the soil is given by;

Applied pressure =

$0.282 \times 2.25\text{m} \times 20\text{kN/m}^3 \times 1.35 + 0.282 \times 10\text{kN/m}^2 \times 1.5$.

Applied pressure = 21.4kN/m².

Polystorm ultimate strength at yield for lateral loading = 63kN/m².

Material partial factor of safety = 2.75.

Design strength = $63/2.75 = 22.9\text{kN/m}^2$.

This is greater than the applied load and so it is acceptable.

Deflections can be estimated using the same approach as for the vertical loads with a partial load factor of 1.0 in all cases.

Note: Where groundwater is present the submerged density must be used to calculate the earth pressure on the side of the tank from the soils below the groundwater table.

4.3 Lateral loading - calculation example



What load is applied to the tank?

5. Uplift pressure from groundwater of the tank is constructed below the groundwater table.

How is this analysed?

A tank is constructed 1m below the groundwater table and has a soil cover over the top of 0.8m.
Will uplift occur?

Design against floatation

Uplift pressure equals weight of water displaced by tank.

Partial factor safety on uplift force = 1.5.

Uplift pressure = $1 \times 10 \times 1.5 = 15\text{kN/m}^2$.

Weight of soil resisting uplift

Partial factor of safety = 0.95.

Weight = $0.8 \times 20 \times 0.95 = 15.2\text{kN/m}^2$.

The weight of soil is sufficient to prevent uplift.

Note: An assessment would need to be made of the risk of ground levels being reduced or groundwater levels rising after completion of construction.

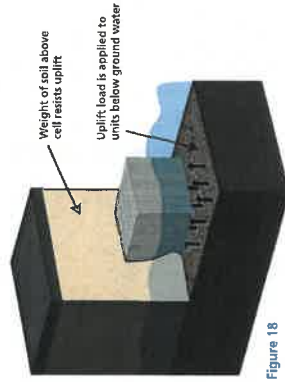


Figure 18

4.4 Maximum burial depths

4.4.1 Recommended maximum installation depths

Polystorm Lite and Polystorm cells can be buried to the maximum depths detailed below. Actual maximum burial depths will depend on soil conditions applicable, however in some circumstances both Polystorm Lite and Polystorm can be buried to greater depths when special measures are carried out. For examples of such measures please refer to page 40.

Polystorm Lite - maximum depth of installation (to base of cells) (m)				
Typical soil type	Typical angle of shearing resistance ϕ	Without groundwater (below base of cells) normal case	Non-trafficked	Trafficked (cars only)
Stiff over consolidated clay e.g. London Clay	24	1.49	1.41	1.41
Normally consolidated silty sandy clay e.g. Alluvium, Made Ground	26	1.60	1.48	1.48
Loose sand and gravel	30	1.77	1.60	1.60
Medium dense sand and gravel	33	2.05	1.69	1.69
Dense sand and gravel	36	2.49	1.83	1.83

Table 8

Polystorm - maximum depth of installation (to base of cells) (m)				
Typical soil type	Typical angle of shearing resistance ϕ	Without groundwater (below base of cells) normal case	Trafficked (cars only)	Non-trafficked
Stiff over consolidated clay e.g. London Clay	24	2.1	2.2	1.5
Normally consolidated silty sandy clay e.g. Alluvium, Made Ground	26	2.3	2.4	1.5
Loose sand and gravel	30	2.5	2.7	1.6
Medium dense sand and gravel	33	3.0	3.1	1.7
Dense sand and gravel	36	3.7	3.8	1.8

Table 9

Polystorm Lite & Polystorm - minimum cover levels (to top of cells) (m)		
Live load conditions	Field (Polystorm Lite & Polystorm)	Light trafficking (Polystorm only)
Minimum cover depth required (m)	0.50	0.60

Table 10

Please note that the maximum burial depths above are based on the partial factors of safety derived during consultation with the British Board of Agrément (BBA) prior to the publication of CIRIA C680. The BBA has used higher partial factors of safety than CIRIA C680. For further information of the design method detailed in CIRIA C680 please contact our technical support team.

4.8.2 Infiltration Calculation principles

There are two approaches, either of which may be adopted: the Construction Industry Research and Information Association (CIRIA) Report 156 Infiltration Drainage - Manual of Good Practice or BRE Digest 365 Soakaway Design. A simplified approximate approach can be used on a very small site (i.e. a single house development) where detailed site infiltration rate information may not be required nor available (see table below). Approved document H3 (refer to 1.1, page 10) allows a storage volume equal to the area to be drained multiplied by 10mm for areas up to 25m². Beyond this size, design should be carried out in accordance with BS EN 752-4 : 1998 or BRE Digest 365, BS EN 752-4 : 1998 suggests a storage volume equal to 20mm multiplied by the area to be drained.

Guidance on soakaway for single house development ⁽¹⁾			
Number of units	Storage volume (m ³)	Max area to be drained (m ²)	
1	0.15	19.0 ⁽²⁾	
2	0.38	25.0 ⁽²⁾	
3	0.57	28.5 ⁽²⁾	
4	0.76	38.0 ⁽²⁾	
5	0.95	47.5 ⁽²⁾	
6	1.14	57.0 ⁽²⁾	

Table 13

- (1) When doubt exists over suitability of ground for infiltration permeability figures should be derived by test (see BRE Digest 365).
- (2) In accordance with Approved Document H3 (refer to 1.1 page 10).
- (3) In accordance with BS EN 752-4 : 1998, Clause HG 2.4.

When the BRE or CIRIA approach is used, the design volumes and areas for trench or cuboid type installations can be found from Tables 14 and 15.

Volumetric data per linear metre for one cell (0.5m) wide trench configuration			
Number of cells high	Storage volume (m ³)	Side areas (m ²)	Base area (m ²)
1	0.19	0.8	0.5
2	0.38	1.6	0.5
3	0.57	2.4	0.5

Table 14

Volumetric data for 3D usage - two cells high									
Cells long (1m side)	2 wide (0.5m side)		4 wide (0.5m side)		8 wide (0.5m side)				
	Vol m ³	Side m ²	Base m ²	Vol m ³	Side m ²	Base m ²	Vol m ³	Side m ²	Base m ²
1	0.76	3.2	1.6	1.52	4.8	2.0	3.04	9.6	4.0
2	1.52	4.8	2.0	3.04	6.4	4.0	6.08	9.6	8.0
4	3.04	8.0	4.0	6.08	9.6	8.0	12.16	12.8	16.0
8	6.08	14.4	8.0	12.16	16.0	16.0	24.32	19.2	32.0
10	7.60	17.6	10.0	15.20	19.2	20.0	30.40	22.4	40.0
100	76.00	161.6	100.0	152.00	163.2	200.0	304.00	166.4	400.0

Table 15

Concrete ring converter

Table 16 enables the conversion of a specified nominal diameter pre-cast concrete ring soakaway volume into the equivalent number of Polystorm Lite and Polystorm cells.

Concrete Ring conversion											
Depth of soakaway	900	1050	1200	1300	1500	1800					
0.25	1	2	2	2	3	4					
0.50	2	3	4	4	5	7					
0.75	3	4	5	6	8	11					
1.00	4	5	7	8	10	14					
1.25	5	6	8	10	12	17					
1.50	6	8	10	12	15	21					
1.75	7	9	11	14	17	24					
2.00	7	10	13	16	20	27					
2.25	8	10	13	16	20	29					
2.50	8	11	14	18	22	31					
2.75	9	12	16	20	24	34					
3.00	11	14	18	21	28	41					

Table 16

Product code: PVT51000

Polystorm Soakaway Geotextile PVT51000 is a UV stabilized, polypropylene continuous filament needle-punched non-woven geotextile, designed to complement our existing Polystorm modular geocellular system.



Applications

Polystorm Soakaway Geotextile is suitable for use as part of our Polystorm geocellular system for infiltration applications, and can also be incorporated into drainage trenches.

Key Benefits

- Excellent filtration properties, including high water permeability and optimum soil retention capability
- Offers quick and efficient draining of soil
- Resistant to all chemical and biological media that usually occur in surrounding soils and construction materials
- High mechanical resistance
- 100 year material design life

Installation

Polystorm Soakaway Geotextile will be laid to suit site specific requirements. Overlaps shall be joined together with double sided jointing tape. Ensure geotextile is clean and debris free before installing Polystorm.

Technical Support

Detailed guidance and assistance is available.

For further information, please contact our Technical Team on **+44 (0) 1509 615 100** or email civils@polypipe.com or visit www.polypipe.com/civils-technical-hub

APPLICATION	PRODUCT
LOADING OVER TANK	TS1000
Landscape (min cover 0.5m)	✓
Car parks (min cover 0.6-1.0m+)	✓
HGV (min cover 1.0m+)	X

ELEMENT	VALUE
PHYSICAL PROPERTIES	
Nominal Thickness	0.8mm
Weight	105g/m ²
Roll Width	4.5m
Roll Length	100m
Opening Size	0.12mm
MECHANICAL PROPERTIES	
Tensile Strength (Machine direction)	8kN/m ²
Tensile Strength (Cross direction)	8kN/m ²
Elongation at max. load (Machine direction)	90%
Elongation at max. load (Cross direction)	75%
Puncture Resistance (CBR)	1500N
Dynamic Puncture Resistance (Cone drop)	26mm
HYDRAULIC PROPERTIES	
Water Permeability (Vertical)	130 l/m ² s

Polystorm Soakaway Geotextile can be utilised in these SuDS techniques

TECHNIQUES													
Blue-Green roofs	Podium Decks	Trees	Sports Pitches	Cycle Paths	Permeable Paving (sub base & podium)	Bioretention & Rain Gardens	Attenuation Storage Tanks	Infiltration	Swales	Filter Drains	Detention Basins	Ponds & Wetlands	Filter Strips
								✓	✓	✓	✓		

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8. Water Efficiency Outline Data

The following outline data is provided by KRA as a guide only. The developer may apply varying specifications providing the maximum consumption is not exceeded. It is the developer's responsibility to ensure that the respective constraints are achieved.

The Water Calculator Methodology

This online calculator uses the Government's methodology for assessing the whole house water efficiency of new dwellings. The calculation method is to be used to assess compliance against the water performance targets in Building Regulations Part G. It is not a design tool for water supply and drainage systems. It is also not capable of calculating the actual water consumption of a new dwelling. Behaviour and changing behaviour can also have an effect on the amount of potable water used throughout a home.

Performance target	Maximum Consumption (litres/person/day)
Part G Compliance	125

The calculation method requires the use of water consumption figures provided from manufacturers product details. Before the assessment can be carried out, figures will need to be collected from manufacturers' product information to determine the consumption of each terminal fitting.

There is a separate tab for each terminal fitting. Figures from manufacturers' product details should be entered into the table on the relevant appliance tab. These data will be used to populate the 'Water Calculator' table with the consumption of each fitting in litres per person per day. Specific data requirements and instructions are provided alongside each fitting's data entry table.

Note, flow rates of external taps are not included in the calculation as a fixed allowance of five litres per person per day is assumed for external water use in Part G.


<http://www.thewatercalculator.org.uk/>

Congratulations

You are within your target maximum consumption of potable water (125 litres per person per day).

Total water consumption from your calculation	92.12	litres per person per day
Total including external water use (17.K Compliance [Building Regulations Part G])	97.12	litres per person per day

This calculator is intended to inform design choices by demonstrating the likely impact of specification changes on total water consumption. Results can only be used to demonstrate compliance with Building Regulations when the calculations have been verified by a Building Control Officer.

Calculation summary

Installation type	Unit of measure	Capacity / flow rate	Use factor	Fixed use	Litres / person / day
WCs (single flush)	Flush volume (litres)	4.5	4.42	0	20.24
WCs (dual flush)	Average effective flushing volume (litres)	4.66			
Taps (excl. kitchen/utility room)	Flow rate (litres / minute)	3.7	1.58	1.58	7.43
Bath (shower also present)	Capacity to overflow (litres)	155	0.11	0	17.05
Shower (bath also present)	Flow rate (litres / minute)	5.1	4.37	0	22.29
Kitchen/utility room sink taps	Flow rate (litres / minute)	5	0.44	10.36	12.56
Washing machine	Litres / kg dry load	8.17	2.1	0	17.16
Dishwasher	Litres / place setting	1.25	3.6	0	4.5
Waste disposal unit	Litres / use	☐	3.08	0	
Water softener	Litres / person / day	☐	1	0	
Contribution from Grey Water					undefined
Contribution from Rain Water					undefined
Normalisation factor					$\Sigma \times 0.91$

