SUDS Design

STINGRAY ENVIRONMENTAL ENGINEERING
Protect Our Water

Reference Number: SEE-S343
Register Reference: SD21B/0589
Site: Tig Mhuire, Old Bridge Road, Templeogue, D16, D16W6F4, X312821, Y228559
Name: Brian and Lauren Monaghan

February 2022

STINGRAY ENVIRONMENTAL ENGINEERING LTD
Authored by: Waldemar Debowski
M:00353857215590
T:0035316949174
Email: info@stingrayenvironmental.ie
Company Registration No:639965
www.stingrayenvironmental.ie

Disclaimer

Although every effort has been made to ensure the accuracy of information contained in this report, complete correctness cannot be guaranteed. The author does not accept any legal liability or responsibility for the accuracy, completeness, or usefulness of any information on product or process disclosed in this report. All or part of this report may be reproduced without further permission, provided the source is acknowledged.

GDPR

The new data protection laws, GDPR, effective 25th May 2018.

A main principle of our data protection policy:

- Personal data will be processed lawfully, fairly and in a transparent manner in relation to the data subject.
- Personal data will be collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes.
- Personal data will be adequate, relevant, and limited to what is necessary in relation to the purposes for which they are processed.
- Personal data will be accurate and where necessary kept up to date.
- Personal data will be kept in a from which permits identification of data subjects for no longer than is necessary for the purposes for which the personal date is processed.
- Personal data will be processed in a manner that ensures appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction, or damage, using appropriate technical or organisational measures.

We would like to continue to correspond with you by email and text. If you wish to continue, you need take no further action. Otherwise simply forward the email, letter or text message and confirm if you no longer wish to receive correspondence via email or SMS.

Table of Contents

Introduction

This design report is based on the findings of a soil infiltration test as per BRE Digest 365, carried out by David Ryan on the 12th of November 2021.

As required by South Dublin County Council, this report provides recommendations for the SUDS design in line with the requirements of *BRE365*.

1. Site Specific Information

Information supplied by client /architect.

- Total Impermeable Area Feeding SuDS:
    - **300 msq (proposed roof area dwelling and gym)**
- Inlet drain: **DN150 UPVC Wavin**

Rainfall information

- Site Location: **Tig Mhuire, Old Bridge Road, Templeogue, D16, D16W6F4, X312821, Y228559**
- Return period: **100 years**
- Storm Duration: **4h**
- Rainfall Depth (incl. 20% Climate Change):**0.08316m**

Fig 1. Site Location D16W6F4

2. Infiltration Test BRE Digest 365

- Dimensions of the infiltration test pit A: L 1200mm x W 800mm x D 1100mm
- Effective Depth adopted: ED 400mm

Cillron Limited
Newtowermoyaghy, Kilcock, Co. Kildare.
www.percolationtests.ie
Tel: 087 6636757

BRE Digest 365 Test

		Revision	1.00
Job No:	101	Page:	C/01
Section: Tig Mhuire, Old Bridge Road, Templeogue	Prepared By: DR	Date:	12/11/2021

ALTERNATIVE SOAKAWAY SIZES

	Trench soakaways		
width of trench [mm]:	450	600	900
required trench length [m]:	22.72	18.51	13.48
	Ring soakaways		
diameter of ring [mm]:	1500	2130	2400
required pit diameter [m]:	2.18	2.18	2.18

* Based on effective depth and number of pits as in Soakaway Code table

SUMMARY OF CALCULATIONS

critical design rainfall duration t_{cd} =	360	min
required storage volume V_{req} =	10.56	m^3
provided storage volume V_{prov} =	10.64	m^3
utilisation factor =	0.99	OK
required time to discharge 50% t_{50} =	5.86	hours
utilisation factor =	0.39	OK

GENERAL DATA

site location: [redacted] Ireland
soakaway type: infilled pit or trench

impermeable area drained to soakaway 'A' [m^2] =	800
60 min rainfall depth of 5 year return period 'R' [mm] =	16
M5-60 to M5-2d rainfall ratio 'r' =	0.28
allowance for climate change:	20%

SOAKAWAY DATA

soakaway width 'W' [m] =	1.68
soakaway length 'L' [m] =	4.66
total depth from ground level 'D_g' [m] =	1.10
depth to drain invert level 'D_d' [m] =	0.38
soakaway effective depth 'D_{eff}' [m] =	0.80
free volume in infill aggregate [%] =	95

SOIL INFILTRATION DATA

allowance for infiltration through soakaway base:	50%
available on-site infiltration test results:	(●) Yes ( ) No
use soakage trial pit table below	
internal surface area of trial pit 'a_{p50}' [m^2] =	1.76
storage volume between 75-25% 'V_p' [m^3] =	0.19
time for water to fall from 75-25% 't_p' [min] =	110.00
soil infiltration rate 'f' [m/s] =	1.65E-05

SOAKAGE TRIAL PIT DATA

soakage trial pit width 'W' [m] =	0.80
soakage trial pit length 'L' [m] =	1.20
total depth from ground level 'D_g' [m] =	1.10
depth to pipe invert level 'D_d' [m] =	0.70
soakage trial pit effective depth 'D_{eff}' [m] =	0.40
free volume in infill aggregate [%] =	100

NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION

rainfall duration [min]	rainfall factor Z1	M5-D rainfalls [mm]	M30-D Z2	M30-D rainfalls [mm]	M30-D inflow [m^3]	Ignore Z2	Ignore rainfalls [mm]	Ignore inflow [m^3]	Ignore Z2	Ignore rainfalls [mm]	Ignore inflow [m^3]	outflow from soakaway [m^3]	required storage [m^3]
5	0.33	5.21	1.44	9.02	2.71							0.06	2.64
10	0.48	7.57	1.47	13.31	3.99							0.13	3.86
15	0.58	9.14	1.48	16.24	4.87							0.19	4.68
30	0.76	11.96	1.48	21.41	6.42							0.39	6.04
60	1.00	15.70	1.48	28.09	8.42							0.77	7.65
120	1.27	19.88	1.47	35.15	10.55							1.55	9.00
240	1.63	25.53	1.46	44.67	13.40							3.09	10.31
360	1.86	29.20	1.46	50.67	15.20							4.64	10.56
600	2.22	34.79	1.43	59.66	17.90							7.74	10.16
1440	3.05	47.86	1.38	79.36	23.81							18.57	5.24

* Z2 is a growth factor from M5 rainfalls

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

water level measurement No:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time [min] =	0	90	185																
	depth to water [m] =	0.70	0.80	0.90																
Soakage Trial 2	time [min] =	0	90	190																
	depth to water [m] =	0.70	0.80	0.90																
Soakage Trial 3	time [min] =	0	100	210																
	depth to water [m] =	0.70	0.80	0.90																

Spreadsheet provided by www.YourSpreadsheets.co.uk — calculations are based on BRE Guidelines (Digest 365)

Fig 2. BRE 365 by David Ryan 12-11-2021.

3. Sustainable Drainage System SuDS Design

Due to the relatively large, proposed catchment area (300msq), restricted space on site, proximity of the river and moderate infiltration rates (f=1.65 E-05), the traditional soakaway system would not be suitable for stormwater disposal on proposed site. Accordingly, the developer shall instead implement an alternative approved Sustainable drainage system (SuDS) as per requirements of the GDSDS (Greater Dublin Strategic Drainage study) Regional Drainage Policies Volume 2 New Development, August 2005.

The proposed storm water system will drain to the ground via 1No. separate Cultec stormwater management system (underground attenuation system) designed for 100years + 20% increase for climate change.

For details, please refer to Appendix A and B (Drawings 645-C01, 645-C02)

For full design details refer to section below:

a). Infiltration rates calculated as per BRE 365

f=0.0000165m/sec

b). Cultec Stormwater Management System (underground attenuation system)

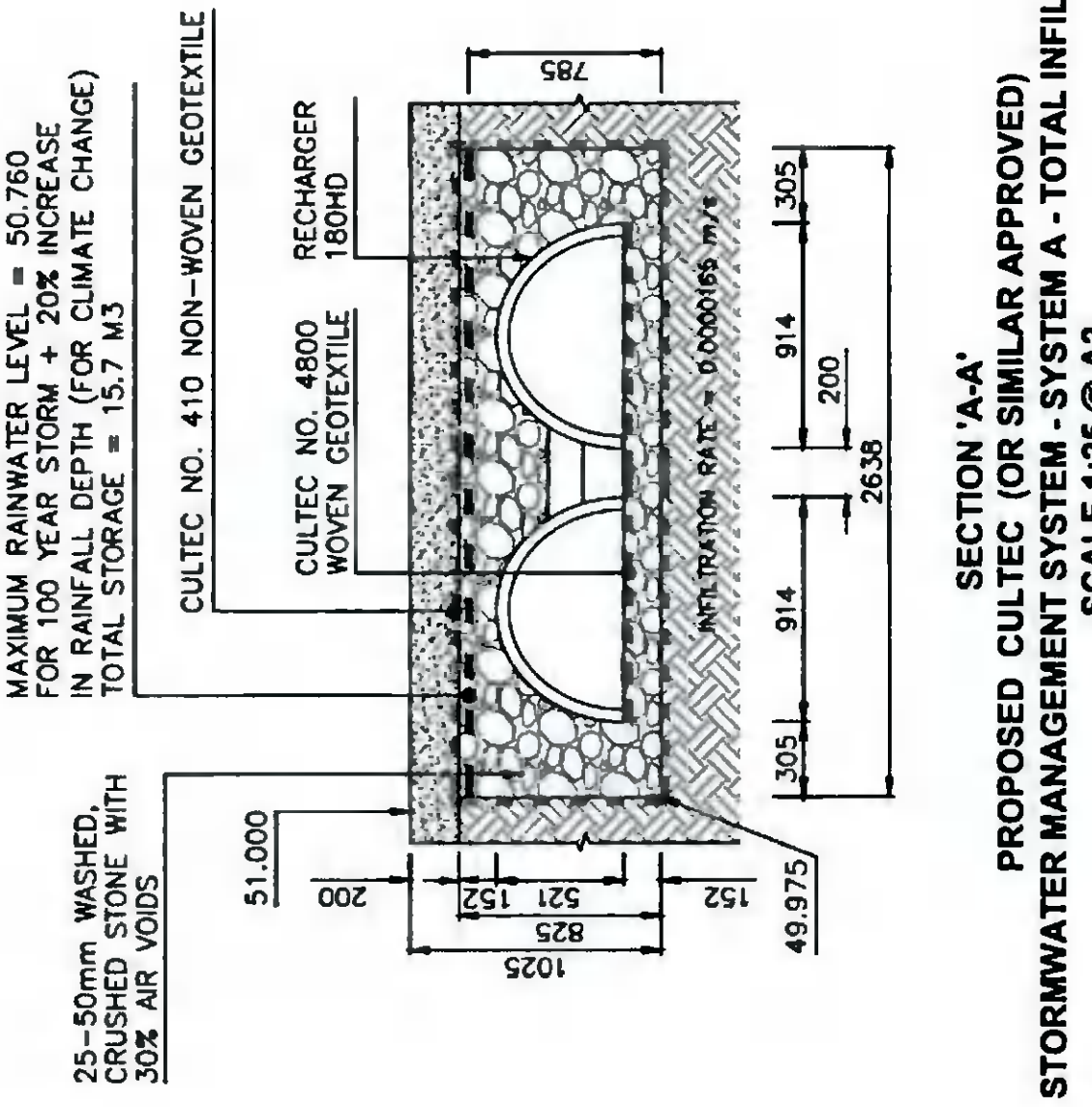


Fig 3. Cultec Storm attenuation system Cross Section.

HYDRAULIC CALCULATIONS FOR PROPOSED CULTEC (OR SIMILAR APPROVED) STORM WATER MANAGEMENT SYSTEM A WITH TOTAL INFILTRATION

Infiltration value: 0.0000165 m / sec = 0.0594 m / h

n - porosity of fill material (voids volume/total volume): 0.60

q - infiltration coefficient: 0.0594000 m / h

A_D - area to be drained: 300.0 m^2

R - Run-off Co-efficient: 0.90

A_b - base area of infiltration system: 31.7 m^2

R - drainage ratio = A_D/A_b 8.52

$H_{max} = (D \times (R \times I - q))/n$

D - storm duration	Rainfall (100 year storm + 20% increase in rainfall depth for climate change) Return Period Rainfall Depths for sliding Durations Irish Grid: Easting: 312 821, Northing: 228 559	i - rainfall intensity	H_{max} - maximum depth of water in storm water management system
[h]	[m]	[m/h]	[m]
0.0833	0.02172	0.2606	0.300
0.1667	0.03024	0.1814	0.413
0.2500	0.03552	0.1421	0.479
0.5000	0.04404	0.0881	0.576
1.0000	0.05436	0.0544	0.673
2.0000	0.06720	0.0336	0.756
3.0000	0.07608	0.0254	0.783
4.0000	0.08316	0.0208	0.785
6.0000	0.09408	0.0157	0.742
9.0000	0.10656	0.0118	0.622
12.0000	0.11640	0.0097	0.464
18.0000	0.13176	0.0073	0.088
24.0000	0.14388	0.0060	- 0.334
48.0000	0.16080	0.0034	- 2.469
72.0000	0.17496	0.0024	- 4.644
96.0000	0.18744	0.0020	- 6.843
144.0000	0.20904	0.0015	- 11.289
192.0000	0.22776	0.0012	- 15.775
240.0000	0.24468	0.0010	- 20.287
288.0000	0.26028	0.0009	- 24.817
384.0000	0.28860	0.0008	- 33.919
480.0000	0.31428	0.0007	- 43.059
600.0000	0.34368	0.0006	- 54.521

From table above, H_{max} is: 0.785 m

Max.water depth = 785 mm is less than proposed minimum 825 mm deep Cultec stormwater management system. For details please refer to drawing 645-C02 Section 'A-A'

Fig 4. Design Calculations

c). Surface Water Network Design

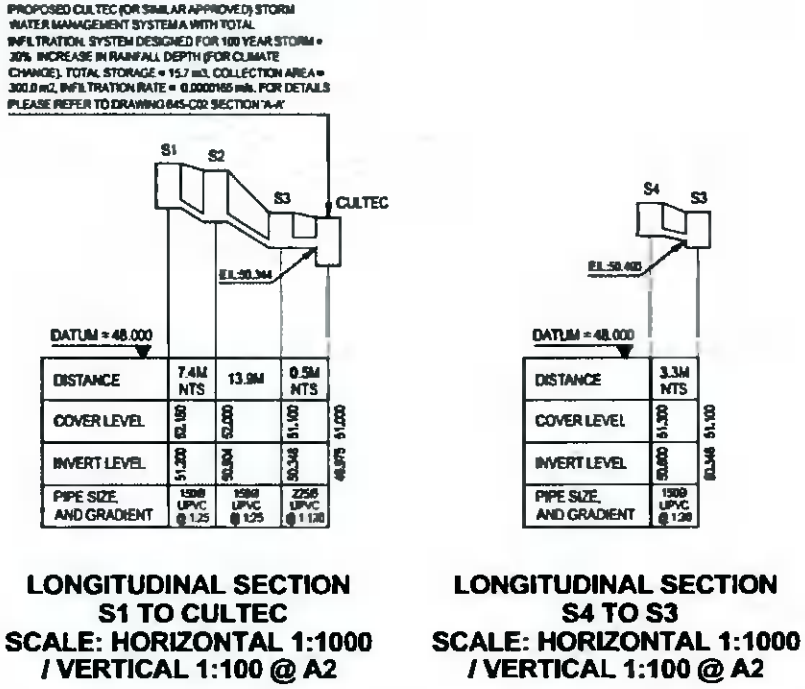
Rainfall Intensity roof = 75 mm/hr
Rainfall Intensity paved = 50 mm/hr
Storm Return Period = 5 years
Self cleansing Velocity = 0.8-3 m/s
Roof Vol. run-off coeffiecient = 1.0
Paved Vol. run-off coeffiecient = 1.0
Pipe Roughness K_s = 0.6 mm

Pipe No.	Impermeable Area (A_p)		Gradient	Diameter	Actual Rate of Flow	Accumulative Rate of Flow	Discharge Velocity	Capacity Full bore flow	Full Bore Velocity	Proportional flow	Discharge Velocity	Proportional Depth
	Roof (A_{p1})	Paved (A_{p2})			Q	Q_i	v	Q_p	v_p	Q/Q_p		
P	m^2	m^2	1 in	mm	l/s	l/s	m/s	l/s	m/s	OK?	OK?	OK?
S1-S2	90.0		25	150	1.9	1.9	1.08	35.68	2.02	OK	OK	OK
S2-S3	174.0		25	150	3.6	3.6	1.31	35.68	2.02	OK	OK	OK
S3-CULTEC	300.0		120	225	6.3	6.3	0.83	47.32	1.19	OK	OK	OK
S4-S5	126.0		30	150	2.6	2.6	1.12	32.55	1.84	OK	OK	OK

Fig 5. Surface Water Network Design-Calculations

S1	52.150		51.200				0.950
S2	52.000	50.904	50.904	7.4	25	150	1.096
S3	51.100	50.348	50.348	13.9	25	150	0.752
CULTEC	51.000	50.344	49.975	0.5	120	225	1.025
S4	51.300		50.600				0.700
S3	51.100	50.490	50.348	3.3	30	150	0.752

Fig 6. Surface Water Network Design-Levels



LONGITUDINAL SECTION S1 TO CULTEC SCALE: HORIZONTAL 1:1000 / VERTICAL 1:100 @ A2

LONGITUDINAL SECTION S4 TO S3 SCALE: HORIZONTAL 1:1000 / VERTICAL 1:100 @ A2

Fig 7. Surface Water Network Design-Level

4. SuDS System Location

The location and configuration of the underground storm attenuation system will depend on the topography, the presence of underground services, planning conditions, and on or other factors, whether existing, planned, or anticipated. The separation distances tabulated below are provided as a guide. Separation distances should be such that any excavation work required for the stormwater disposal system does not undermine adjacent features, such as buildings, roads, or walls.

Features	Required	Proposed Storm Management system
Sewage system	10m	14m Cultec to FPS
Building/Structure	5m	5m Cultec to dwelling
Road Boundary	5m	25m Cultec to road boundary
Site Boundary	3m	3m Cultec to site boundary
Watercourse	10m	7.9m Cultec to river Dodder*

Fig 8. Separation distances. * Due to a site space restrictions, minimum recommended separation distance for standard soakaway cannot be met. The advanced Cultec Storm Water Management SuDS system has been proposed as more advanced alternative. Collected storm water will be polished and discharged into ground with no direct connection to waterbody, thus protecting receiving waters to the best available standard.

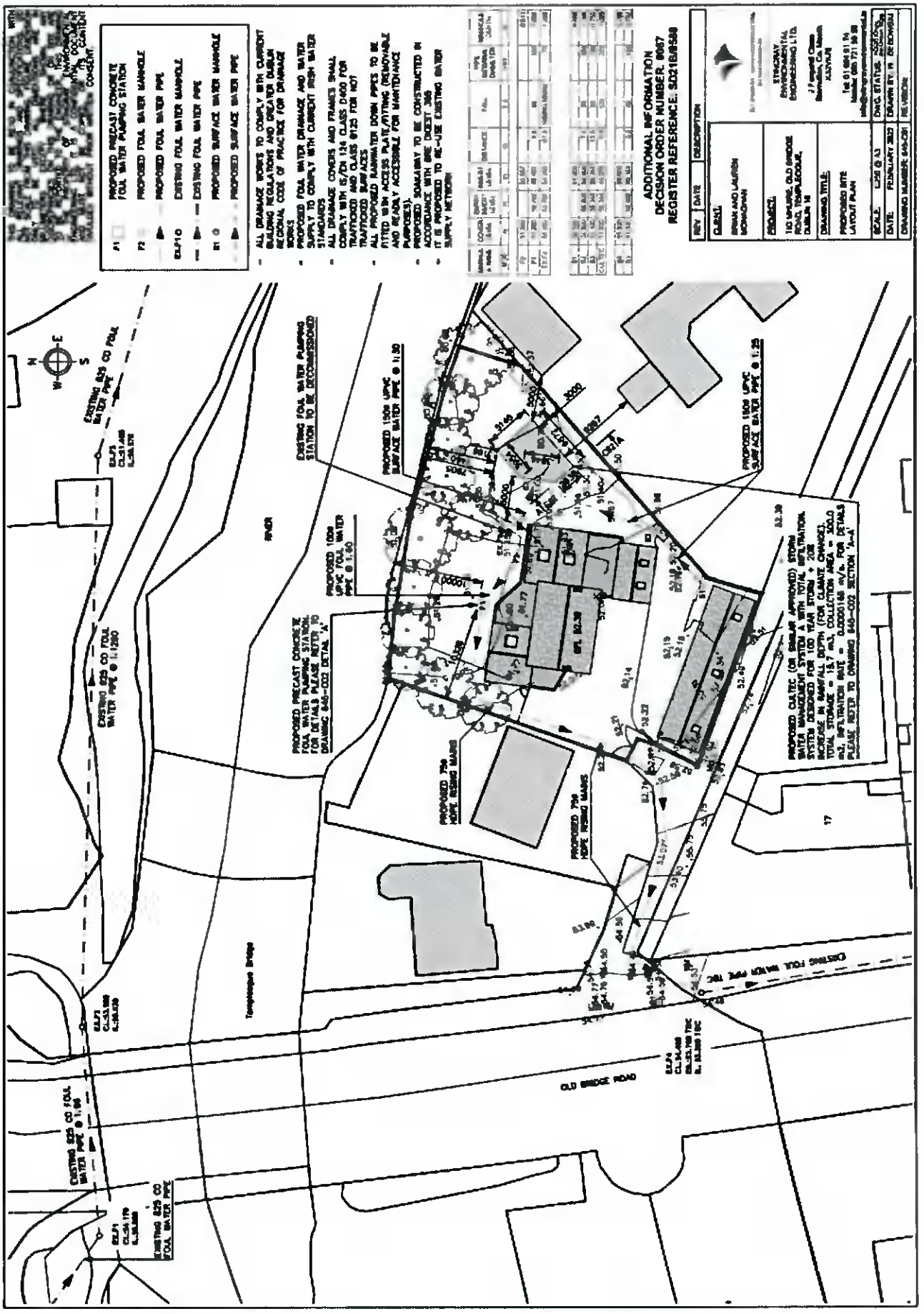


Fig 9. Proposed Drainage Layout

5. Recommendation

- It is the responsibility of the Project Supervisor (i.e., Engineer, Architect, or other competent person) to ensure that the stormwater management system is located and installed in accordance with planning conditions, SuDS and BRE 365 requirements.
- All elements of the attenuation system should be effectively maintained by qualified service technicians/engineers.

6. Important note

- The percentage run-off is taken as 100% from the drained area. No reduction is made to the design run-off volume discharged to the Cultec for loses due to surface wetting or the filling of puddles during the storm.
- No allowance is made for the time taken for run-off to discharge to the Cultech system. The required storage volume is calculated based on instantaneous discharge to the storm attenuation system.
- The outflow from the Cultec system is underestimated. Higher infiltration rates occur at the greater depths of storage in practice, than are adopted in design, and because the outflow is calculated of the rainfall duration rather than of run off duration. The latter maybe considerably longer depending on the size and length of drains.
- This report is only valid on the time of site inspection. The author cannot be responsible for any changes that could occur as result of construction, remediation, adjustment works completed afterwards.

7. Summary

- The effective storage of Cultec storm attenuation system filled with granular material (30% void) is 15.7m3.
- Strom attenuation system with minimum dimensions as per Drw.645-C01 & 645-C02 to be constructed. The sizing of the storm attenuation system can be further reduced if rainwater collection system or additional sustainable drainage systems will be installed.

Signed: *Waldemar Debowski* Date: 7 February 2022

Qualifications: B.Eng. P.Grad.Dips. FETAC Cert MIEI MIAH