iSTRUCT CONSULTING ENGINEERS

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Surface Water Management Report

for Site of Proposed New House at

64A, Monastery Drive, Clondalkin.

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For and on behalf of iStruct Consulting Engineers

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1) Surface Water Management Plan Overview

1.1 Overview

The aim was to limit the discharge of surface water from the site by installing a number of SuDS features.

Design guidance has been taken primarily from S.D.C.C.'s Sustainable Drainage Design and Evaluation Guide (2022), The Greater Dublin Strategic Drainage Study (2005) and the SuDS Manual (C753, CIRIA, 2015), among other sources.

In designing the SuDS systems consideration was given to the following factors:

- Environmental aspects (e.g. minimising discharge to the public drainage infrastructure)
- Cost
- Logistical considerations.

Within the SuDS approach there is a hierarchy of preferred discharge methods for rainfall as indicated below and outlined in section 7.4.8 of S.D.C.C.'s Sustainable Drainage Design and Evaluation Guide (2022):

- Rainwater harvesting
- Infiltration
- Watercourse
- Surface Water Sewer
- Combined Sewer

Taking into consideration all the above factors it is proposed to adopt the infiltration methods of a soakaway and permeable paving to manage the surface water incident on the site. These methods both involve infiltration to the ground and ultimately recharging of the water table, in a way that resembles the natural slow process of water table recharge that occurs in greenfield areas. The rainfall directed towards the soakaway and incident on the permeable paving areas is to be discounted from any runoff discharge for the proposed development, subject to there being no expected overflows to the surface water drainage network from either.

It is also proposed to install water butts at the rear downpipes. Water butts represent a form of rainwater harvesting (for reuse to water the garden etc.) and are thus at the top of the preferred hierarchy of discharge methods. The water butts are not accounted for in the calculations for the inflow to the soakaway (as it must be assumed that the water butts may be full at the onset of any storm).

Reference should be made to the proposed drainage and SuDS details drawings, drawings 1910 – PG – 1.15 and 1.16 while reading the following sections.

Details of the site infiltration test, soakaway design and permeable paving design calculations are included in the appendices.

1.2 Soakaway Design and Location

Locating the soakaway to the front of the house is not considered feasible due to the presence of existing and proposed services and so as not to locate it beneath permeable paving. It was therefore decided to locate the soakaway in the back garden.

The soakaway was designed in line with the principles outlined in BRE Digest 365 but incorporating adjustments to reflect current good practice and the guidance contained in the more recent reference documents. This included applying a 20% climate change allowance to the design rainfall figures and designing for the 1 in 100 year rather than the 1 in 10 year rainfall event.

To minimise the soakaway size, modular soakaway units (soakaway crates) with a 'porosity' of 95% were assumed for the design. The soakaway was sized so as to handle the 100 year rainfall event of critical duration with no overflow being produced (though an overflow pipe will be provided for safety in line with S.D.C.C policy).

While the limiting factor of achieving 5m separation from buildings has been achieved, the requirement sometimes stipulated by S.D.C.C. to 'generally' achieve 3m separation from the boundary to neighbouring properties cannot readily be achieved. We note however that this 3m requirement is understood to have originated with older 'point' type soakaways and that S.D.C.C. have shown flexibility on this requirement in the past.

Achieving a 3m separation distance from boundaries would rule out a soakaway and most likely necessitate the installation of an attenuation tank with controlled discharge to the surface water sewer system.

Somewhat improved separation distances to boundaries could be achieved by designing a more compact soakaway with a designed (rather than mechanically controlled) overflow rate for the 100 year rainfall event to not exceed the greenfield runoff rate.

However from a SuDS perspective both of these alternatives are less favourable than the full-infiltration design chosen.

1.3 Permeable Paving

Permeable paving is proposed for all paved areas. As the infiltration rate established for the site is adequate, the system proposed can be a full-infiltration system. A high level overflow will nonetheless be provided as a precaution (in line with the advice in Section 6.8.4 of the GDSDS, Vol. 2) in the form of a gulley at the lowest point of the driveway.

Design calculations are included in the appendices and show that the design will satisfy the temporary storage requirements produced but the critical-5duration 1 in 100 year rainfall event.

To help prevent silt runoff from inward-sloping front lawn clogging the joints in the permeable paving a pebbled silt-trap margin is proposed between the lawn and the driveway.

1.4 Water Butts

Water butts will be located to the rear of the proposed house to take approximately 85% of the rainfall runoff from the roof with any unused excess overflowing to the soakaway.

1.5 Limiting Site Runoff to Pre-developed Greenfield Levels

If the runoff rate from each surface type is no greater than greenfield runoff levels, it follows that the runoff rate for the site as a whole will be no greater than the site greenfield runoff rate. For that reason no detailed calculation of the greenfield runoff rates is required. Each surface type is now considered in turn.

Roof Area Rainfall to Soakaway: The proposed soakaway will reduce runoff discharge levels to zero for the roof area rainfall for the design 1 in 100 year return period. By definition this is an improvement on the greenfield runoff rate for that part of the site.

Permeable Paving:
Similarly, as the permeable paving design will reduce runoff discharge levels from all areas of permeable paving to zero for the roof area rainfall for the design 1 in 100 year return period. Again, by definition this is an improvement on the greenfield runoff rate for those areas.

Grassed Areas:
The front grassed area will require minimal landscaping and to the rear the back garden will be re-contoured as necessary using the existing subsoil and topsoil. By definition therefore post-development runoff rates for grassed areas should be similar to pre-development runoff rates.

Conclusion:
As post-development runoff rates for the roof area, the permeable paving and the grassed areas will individually be either zero or no worse than pre-development runoff rates the nett runoff rate for the site will in fact be less than the pre-development runoff rate for the site.

Appendix A:

Infiltration Test Report

Test Carried out at 64 Monastery Drive, Clondalkin on 21 and 22 February 2002 by Roger O'Dwyer (B.Eng)

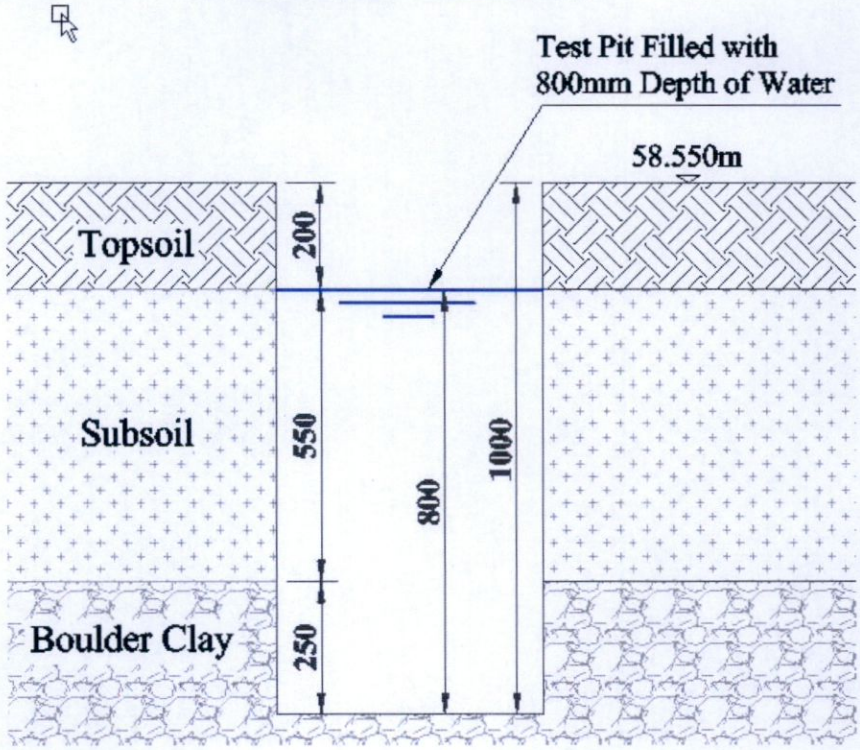
Test Procedure

A test pit was marked out close to the proposed soakaway location in the back garden. The test pit location is shown on the revised proposed drainage and site services drawing.

The test pit depth was set at 1m below ground level. As the current ground level in this location is approximately 300mm below the proposed floor level of the new house (with the garden to be built up accordingly), the pit base level represents a level of approximately 1.3m below proposed finished floor level of the new house. This corresponds to the anticipated approximate depth of the soakaway.

A depth of 800mm of water was used in the test. The top water level therefore corresponds to an inlet level 500mm below proposed finished floor level. Details of the test pit and observed soil profile are shown below.

Test Pit Details



The test procedure outlined in BRE digest 365 was followed. The pit was filled with water to the required level and the depth of remaining water and elapsed time were recorded as the pit emptied by infiltration into the surrounding ground. This procedure was repeated three times and the results of the third test were used for calculations. For convenience a marked yardstick was set up so that elapsed time could be recorded at fixed depths of water, including the key depths for calculation corresponding to a 25% drop in water level and a 75% drop in water level.

Results and Calculations

Test Pit Dimensions	
Length, L (m)	1.2
Width, W (m)	0.5
Effective Depth, D (m)	0.8

	Test 1		Test 2		Test 3	
	Date:	21-Feb-23	Date:	22-Feb-23	Date:	22-Feb-23
	Start Time:	15.15	Start Time:	9.38	Start Time:	13.46
	Finish Time:	17.28	Finish Time:	12.45	Finish Time:	17.44
Reading No.	Depth of Water (mm)	Elapsed Time (min)	Depth of Water (mm)	Elapsed Time (min)	Depth of Water (mm)	Elapsed Time (min)
1	800	0	800	0	800	0
2	600	13.5	600	26	600	36
3	400	35	400	64	400	82
4	200	74	200	121	200	155
5	0	138	0	187	65	238

Infitration Rate Calculations

Effective storage volume between 75% full and 25% full (equivalent to half the initial water volume):

V_{p75-25} = (L x W x D)/2 = 0.24 m^3

Internal surface area of trial pit up to 50% effective depth and including the base area:

a_{p50} = ((2L + 2W) x D/2) + (L x W) = 1.96 m^2

Time to reach 75% depth = 36 min

Time to reach 25% depth = 155 min

Time for the water level to fall from 75% to 25% effective depth:

t_{p75-25} = 155 -36 = 119 min

= 7140 s

Soil Infiltration rate: $f = V_{p75-25}/(a_{p50} \times t_{p75-25})$ = 0.00001715 m/s

= 1.715E-05 m/s

Observations

The infiltration rate is moderate and should facilitate a soakaway design for the site.

No sign of infiltration into the pit from the water table was observed in the pit after leaving it open over-night between tests 1 and 2 and after then leaving it open for a further 7 days.

Photographs

Test Pit

Depth of Test Pit

Arisings from Test Pit

Infiltration Test in Progress

Appendix B:

Soakaway Design Calculations

Design of Soakaway in line with BRE Digest 365 and Best Practice

Basic Inputs

Catchment Details		
Catchment (Roof) Area, A	91.6	m^2
Runoff Coefficient	100	%
Design Return Period	100	years
Climate Change Allowance	20	%

Ground Information

Infiltration Rate, f	1.71497E-05	m/s

Soakaway Design using Proprietary Soakaway Crates

Soakaway Shape	As Required, Square/Rectangular	
Number of Soakaways	1	
Length	3	m
Width	2	m
Effective Depth	1.1	m
Porosity (% Free Volume)	95	%
Storage Volume Provided	6.27	
Factor of Safety for Infiltration	1	
Base Infiltration Factor	0	

Storm Duration, D		Base Rainfall (mm)*	Design Rainfall (mm)	Inflow, I (m3)	Outflow, O (m3)	Storage Required, S	% Surplus Storage Provided
Mins	Hours						
5		16.9	20.28	1.858	0.028	1.829	243
10		23.6	28.32	2.594	0.057	2.538	147
15		27.8	33.36	3.056	0.085	2.971	111
30		34.5	41.40	3.792	0.170	3.622	73
60	1	42.8	51.36	4.705	0.340	4.365	44
120	2	53.1	63.72	5.837	0.679	5.158	22
180	3	60.2	72.24	6.617	1.019	5.598	12
240	4	65.9	79.08	7.244	1.358	5.885	7
360	6	74.7	89.64	8.211	2.037	6.174	2
540	9	84.8	101.76	9.321	3.056	6.265	0
720	12	92.7	111.24	10.190	4.075	6.115	3
1080	18	105.2	126.24	11.564	6.112	5.451	15
1440	24	115	138.00	12.641	8.150	4.491	40
2880	48	126.6	151.92	13.92	16.299	0.000	Huge

Notes

* Rainfall data obtained from Met Eireann rainfall model data for Ireland available at www.met.ie/climate/services/rainfall-return-periods.

Site Coordinates entered: IG, E:307607, N: 231414

Design Rainfall = Base Rainfall x Climate Change Allowance of 1.2 (i.e. 20%)

I = A x R x Runoff Coefficient/100 = A x R (Runoff coeffiecient taken to be 100)

$O = a_{s50} \times (f/\text{Factor of Safety}) \times D$

a_{s50} = ((length +width) x 2) x 0.5 X effective depth = 5.500 m

Nb. A_{s50} is the internal surface area of the soakaway to 50% effective depth

S = I - O

Time of Emptying 50% = Storage Volume Provided x 0.5 / (a_{s50} x f) = 9.232 hrs

Is T_{e50} less than 24hrs?: YES

Conclusion: T_{e50} is Acceptable

Design Methodology: The length, width and effective depth were selected by trial and error and bearing in mind practical considerations until a satisfactory Storage Volume Provided was achieved for the resultant Storage Required for he critical storm duration.

Appendix C:

Permeable Paving Design Calculations

Permeable Paving Structural Design

With reference to Chapter 20 of the CIRIA SuDS Manual 2015, for domestic driveways a traffic load category of 2 can be assumed. This load category requires a coarse graded aggregate sub-base depth of 150mm. Checking this sub-base (i.e. storage) depth against hydraulic requirements resulted in insufficient storage within the permeable paving sub-base. Therefore the proposed sub-base depth has been increased to 175mm and the hyrdaulic results are satisfactory as can be seen below.

Permeable Paving Sub-Base Hydraulic Depth Assessment

Basic Inputs

Rainfall Factors		
Design Return Period	100	years
Climate Change Allowance	20	%
Porosity of sub-base, n (fraction of void space)	0.3	
Factor of Safety for Infiltration	1.5	

Ground Information

Infiltration Rate, f, as determined in soakaway test pit	1.7150E-05	m/s
Max Depth of Water in Soakpit Test, H	0.8	m
Assumed Depth of Sub-base Layer, h	0.175	m
Adjusted Infiltration Rate to Reflect Reduced Head of Water in Sub-base Layer, = f *(h/H)	3.7515E-06	m/s
Design Infiltation coefficient, q, with factor of safety applied,	0.00900	m/hr

Storm Duration, D		Base Rainfall (mm)*	Design Rainfall (mm)	Design Rainfall, D (m)	Intensity, i (m/hr)	h_{max} (m)
Mins	Hours					
5	0.083	16.9	20.28	0.0203	0.2434	0.065
10	0.167	23.6	28.32	0.0283	0.1699	0.089
15	0.250	27.8	33.36	0.0334	0.1334	0.104
30	0.500	34.5	41.40	0.0414	0.0828	0.123
60	1	42.8	51.36	0.0514	0.0514	0.141
120	2	53.1	63.72	0.0637	0.0319	0.152
180	3	60.2	72.24	0.0722	0.0241	0.151
240	4	65.9	79.08	0.0791	0.0198	0.144
360	6	74.7	89.64	0.0896	0.0149	0.119
540	9	84.8	101.76	0.1018	0.0113	0.069
720	12	92.7	111.24	0.1112	0.0093	0.011
1080	18	105.2	126.24	0.1262	0.0070	0.000
1440	24	115	138.00	0.1380	0.0058	0.000
2880	48	126.6	151.92	0.1519	0.0032	0.000

* Rainfall data for the site as per that used in the soakaway design (see Appendix D)
Design Rainfall = Base Rainfall x Climate Change Allowance of 1.2 (i.e. 20%)

Max. depth of sub-base needed for storage = Inflow Volume from Rain - Volume Infitrated into the Sub-grade for the Storm Event Duration
$h_{max} = (D \times (i - q))/n$ where:
D is the storm duration (hr)
i is the rainfall intensity (m/hr)
q is the infiltration coefficient, adjusted by the factor of safety
n is the porosity of the sub-base fill material (voids volume/total volume)

Time of Emptying 50% = $(n \times h_{max})/2q$ ....(i.e. half the water storage volume/infiltration rate)
T_{e50} = 2.539 hrs

Is T_{e50} less than 24hrs?: YES
Conclusion: T_{e50} is Acceptable

Comments:
* An adjusted approximated infiltration rate has been used in the permeable paving design to reflect the reduced depth (head) of water in the permeable paving storage layer as opposed to that used in the soakaway infiltation test hole. The infiltration rate has been reduced in linear proportion to the ratio of the two depths.
** H_{max} is satisfactory as it it does not exceed the storage depth provided by the sub-base layer.

Appendix D:

Site-Specific Met Eirean Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 307607, Northing: 231414,

	Interval		Years											
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,
5 mins	2.3,	3.5,	4.1,	5.1,	5.8,	6.3,	8.1,	10.2,	11.6,	13.6,	15.5,	16.9,	19.2,	21.0,
10 mins	3.2,	4.8,	5.7,	7.1,	8.0,	8.8,	11.3,	14.2,	16.2,	19.0,	21.6,	23.6,	26.8,	29.3,
15 mins	3.8,	5.7,	6.7,	8.3,	9.4,	10.3,	13.3,	16.7,	19.0,	22.4,	25.4,	27.8,	31.5,	34.5,
30 mins	5.0,	7.4,	8.7,	10.7,	12.1,	13.2,	16.8,	21.0,	23.9,	27.9,	31.6,	34.5,	39.0,	42.5,
1 hours	6.7,	9.7,	11.3,	13.8,	15.5,	16.9,	21.4,	26.5,	30.0,	34.9,	39.3,	42.8,	48.1,	52.4,
2 hours	8.8,	12.6,	14.7,	17.8,	20.0,	21.6,	27.1,	33.4,	37.6,	43.6,	48.9,	53.1,	59.5,	64.5,
3 hours	10.3,	14.7,	17.1,	20.7,	23.1,	25.0,	31.2,	38.3,	43.0,	49.7,	55.6,	60.2,	67.4,	72.9,
4 hours	11.6,	16.4,	19.0,	22.9,	25.6,	27.7,	34.5,	42.2,	47.3,	54.5,	60.9,	65.9,	73.5,	79.5,
6 hours	13.6,	19.2,	22.2,	26.6,	29.6,	32.0,	39.6,	48.3,	54.0,	62.0,	69.2,	74.7,	83.2,	89.9,
9 hours	16.0,	22.4,	25.8,	30.9,	34.3,	36.9,	45.6,	55.3,	61.7,	70.7,	78.6,	84.8,	94.2,	101.6,
12 hours	18.0,	25.0,	28.7,	34.3,	38.0,	40.9,	50.3,	60.9,	67.8,	77.5,	86.1,	92.7,	102.9,	110.8,
18 hours	21.2,	29.2,	33.4,	39.8,	44.0,	47.3,	57.8,	69.7,	77.4,	88.3,	97.8,	105.2,	116.5,	125.2,
24 hours	23.8,	32.6,	37.3,	44.2,	48.8,	52.3,	63.9,	76.7,	85.1,	96.8,	107.1,	115.0,	127.2,	136.5,
2 days	29.7,	39.7,	44.9,	52.5,	57.5,	61.4,	73.7,	87.2,	96.0,	108.0,	118.5,	126.6,	138.8,	148.2,
3 days	34.5,	45.4,	51.0,	59.2,	64.6,	68.7,	81.7,	95.8,	104.9,	117.4,	128.2,	136.5,	148.9,	158.5,
4 days	38.7,	50.4,	56.4,	65.0,	70.7,	75.0,	88.6,	103.4,	112.8,	125.6,	136.7,	145.2,	157.9,	167.6,
6 days	46.0,	59.1,	65.7,	75.1,	81.3,	86.0,	100.6,	116.3,	126.3,	139.9,	151.5,	160.3,	173.6,	183.6,
8 days	52.5,	66.7,	73.8,	83.9,	90.5,	95.5,	111.1,	127.6,	138.1,	152.2,	164.4,	173.5,	187.2,	197.6,
10 days	58.4,	73.6,	81.2,	91.9,	98.9,	104.1,	120.5,	137.8,	148.7,	163.4,	176.0,	185.4,	199.5,	210.2,
12 days	63.9,	80.1,	88.0,	99.4,	106.6,	112.1,	129.2,	147.2,	158.5,	173.7,	186.6,	196.3,	210.9,	221.8,
16 days	74.2,	91.9,	100.6,	112.9,	120.8,	126.7,	145.1,	164.3,	176.2,	192.3,	205.9,	216.2,	231.4,	242.8,
20 days	83.7,	102.8,	112.2,	125.4,	133.8,	140.1,	159.5,	179.7,	192.3,	209.1,	223.4,	234.0,	249.9,	261.7,
25 days	94.8,	115.5,	125.6,	139.7,	148.7,	155.4,	176.1,	197.5,	210.8,	228.4,	243.4,	254.5,	271.0,	283.3,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf