SUDS Maintenance Plan

Re: SD22A/0124
Citywise Science & Language Centre,
Durkan Centre,
Fortunestown Way,
Tallaght,
Dublin,
A94 YX22.

Client: Citywise Education

Date: 19th October 2021

MSW & Associates
Unit B19, KCR Estate,
Ravensdale Park,
Kimmage, Dublin 12.
E: info@mswconsulting.ie
W: www.mswconsulting.ie

REV	DESCRIPTION	DATE	BY	APPROVED	DOCUMENT
A	General Revisions				

1.0 Introduction:

With reference to Condition No.7 of the Grant of Permission, regarding the details of the Sustainable Drainage Systems (SUDS), and storm water management to be included in the proposed development.

The existing Citywise Education site is 0.44ha, has an existing building used for education purposes, with a footprint area of 800m^2.

The west side of this area of the campus site is affected by the proposed development is 1940m^2. The new development has impermeable roof area of 750m^2 and pavement area of 360m^2. The stormwater runoff from the new roof area and the new pavement area are to be managed as parts of the SUDs plan for the new development.

All proposed developments must ensure that SUDS are incorporated into the development. SUDS requires that post development run-off rates be maintained at the equivalent to, or lower than, the predevelopment run-off levels. Thus, the development must be able to retain, within its boundaries, storm water volumes from extreme storm events up to and including a design for a 1 in 100year storm event, also expressed as a 1.0% AEP (Annual Exceedance Probability), while also allowing for climate change factors (+CC). Any new development must have physical capacity to retain storm water volumes as directed under the Greater Dublin Strategic Drainage Study (GDSDS) and, if necessary, release this attenuated surface water runoff before it enters a natural watercourse or into a public sewer, which ultimately discharges to a water body. This is to ensure the highest possible standard of storm water quality.

All new hardstanding contributing areas (i.e. pavement and flat roof) for this new development are to be served by the proposed SUDS measures.

2.0 SUDS & Storm water:

Sustainable Urban Drainage Systems (SUDS) have been developed and are in use to alleviate the detrimental effects of traditional urban storm water drainage practice that typically consisted of piping rainwater runoff from developments to the nearest watercourse. Storm water drainage methods that take account of the quantity, quality and amenity issues associated with the management of the stormwater are referred to as Sustainable Urban Drainage Systems. These systems include one or more structures that manage the surface/storm water run-off in a way that minimises the negative impacts on the quantity and quality of stormwater runoff, while maximising the benefits to the amenity and biodiversity for people and the surrounding environment. These systems are particularly effective at achieving the above objectives with the use of 'nature based solutions'.

Nature-based solutions (NBS) are structures used to replicate the management of stormwater as would be done without urban intervention. The use of these systems aids biodiversity and ecosystems, mitigates the risk of floods and also improves water quality, and prevents erosion. NBS uses trees and plants reduce water run-off in extreme rain events, taking pressure off the urban drainage system.

For this proposed development it is proposed that nature-based solutions will be employed within the SUDS networks where suitable.

3.0 Site Characteristics:

The site is predominantly level/flat, with raised berms at parts of the south and south-west boundaries. The extent of the development site is quite small, approximately 1940m^2 (0.194Ha), of which the footprint of the new building having an approximate plan area of 750m^2.

The surface water drainage is currently serviced by a 300mm diameter public storm sewer which runs adjacent to the front/north boundary of the site, and a 225mm diameter public storm sewer to the rear/south-east of the site in Bawnlea Close. The invert levels of both the surface water manholes are relatively shallow, 0.75m and 0.84m below ground level.

4.0 Site Specific Design:

4.1 To assess the properties of the underlying soils on the site to ensure suitable site-specific SUDS components are employed for this development.
A trial pit was excavated, and the existing sub-soil conditions were exposed.
The exposed soil conditions appeared to be a silty sandy loam composition.
The trial pit excavation was carried out to the south-west of the of the site and was excavated to a depth of 1.5m below ground level.

4.2 The presence of ground water was noted at the base of the excavation and was recorded at 1.5m below ground level.

4.3 For the assessment of the underlying soil for infiltration of the stormwater runoff, Percolation tests were carried out in accordance with the procedure described in BRE Digest 365. This test was carried out from the 27th to the 30th of July 2022.
An infiltration rate (f) of 2.8x10^{-6}m/s was calculated*, and was deemed satisfactory for infiltration SUDs components to be employed as per CIRIA C753 SUDS Manual Table 25.1. See Appendix A.4 for attached Infiltration Calculation sheet. [* Trial pit was already empty after third fill when inspection of the -30th July 2022, therefore f value calculated is believed to be conservative].

4.4 With reference to CIRIA C753 SUDS Manual, a Factor of Safety of 2.5 was applied to give an Adjusted Soil Infiltration Rate (q) of 1.12x10^{-6}m/s, which was used for hydraulic calculations associated with the SUDS elements.

4.5 Stormwater Runoff Outflow Limits:

To assess the required attenuation volumes and flow control requirements the maximum runoff from the site has to be ascertained This was done using the following references:

4.5.1 **$Q_{bar\ (rural)}$** – which is the estimation of equivalent Flow for Mean Annual Flood, reference CIRIA C753 SUDS Manual Equation 24.3.

$Q_{bar\ (rural)}$ - Site Specific Calculation:
Hydrological Characteristics of the Site:

Standard Area Average Rainfall [SAAR] [Ref. Met Eireann].	822mm
Soil Index/Factor (see appendix A.5)	0.387
$Q_{bar(rural)}$ (mean annual flood flow rate) (see appendix A.5 for calculation sheet)	**3.8 L/s/Ha**

4.5.2 **Greater Dublin Regional Code of Practice** – Runoff discharge rate equal to 1-year greenfield site peak runoff rate or **2 l/s/ha**, whichever is the greater.

5.0 Site Specific SUDs Measures:

Sustainable Urban Drainage Systems (SUDS) were considered for the site, in line with recommendations of *Greater Dublin Strategic Drainage Strategy (GDSDS)*, *CIRIA Report 753 The SUDs Manual*, and *Sustainable Drainage Explanatory Deign & Evaluation Guide 2022*. Particular consideration was given to employing Nature Based SUDS Solutions (NBS) which replicate the natural characteristics of rainfall runoff from any site.

It is proposed that there will two SUDS treatment trains to address the rainwater run-off from the impermeable roof surface of the new development, and that a single treatment stage (permeable paving) for the new hardstand pavement areas. See attached plan drawing D-01 Rev E and Section drawing D-03 Rev A, documenting the proposed drainage layout, and longitudinal section of the proposed SUDS treatment trains.
It is noted that the SUDS components proposed for this development are typically 'shallow' systems. This is due to the observed level of the ground water table in this location and that the stormwater outfalls servicing the site are also relatively shallow/close to the surface.
It is for these reasons that ***Bio- Retention Tree pits*** have **not** been included in this proposal, due to the risk of inundation of their specialised root systems/structure, that typically require a low-level drain which on this site would fall below our Storm Sewer outfall level.

The following SUDS measures are the elements that make up the proposed SUDS treatment trains for this development:

- Surface Channel/Rill conveyance element.
- Bio- Retention Swales/ Rainwater Gardens (both with Type A – infiltration), both using soakaway media to increase volume storage and infiltration.
- Attenuation Flow control outlet/chamber.

5.1 Surface Channels/Rills:

The first component of the SUDS treatment train is the use of Surface Channels. Surface Channels and/or rills are used for conveying rainwater have a positive presence in the urban

environment, creating unique spaces that can be enjoyed. The use of rills/surface channels with other nature based solutions connects people, nature and water.
Surface channels in this case are proposed to convey the collected rainwater from the new building's roof to the next SUDS component in the train. See drawing D-03 Rev C for proposed detail.

5.2 Bio-Retention Swale:

The next component in each SUDS train is the use of a Bio Retention swale. Swales are based on open channel design for conveyance, but also provide a means runoff volume control with infiltration, and attenuation. We have included 2no. vegetated swales (one in each treatment train), which we believe will improve the amenity space of this recreation area. These bio retention swales are also under drained with a length of modular geo-cellular units (which have a high void ratio) to increase below ground runoff storage capacity. Typically the swales will have suitable ground cover plants to the lower level, with suitable trees to the perimeter, (both plant and trees specifications as advised by the Landscape Architect). These swales have a maximum attenuation depth of 150mm, before conveying to the next element. See drawing D-03 Rev C for proposed details and composition.

5.3 Bio Retention Rainwater Garden:

Both swales, from each SUDS treatment train convey their overflows to a single Bio Retention Rainwater Garden which is located at the south end of the site. The Bio Retention Rainwater Garden is a shallow landscaped depression that is used to intercept and manage the stormwater runoff. Rainwater Gardens typically are attractive landscape features that improve the amenity space. Like the bio retention swale, it offers full infiltration in this case and is also under drained with modular geo-cellular units, but to the full plan area to increase runoff storage capacity. See detail drawing D-03 Rev C for proposed details and composition. Like the previous swales, the Rainwater Garden will have suitable ground cover plants to the lower level, with suitable trees planted to the perimeter, (both plant and trees specifications as advised by the Landscape Architect). These Rainwater Garden will also have a maximum attenuation depth of 150mm, and an overflow outlet.

5.4 Attenuation Chamber with Flow Control Device:

The overflow from the Bio Retention Rainwater Garden drains to a small attenuation chamber which contains a simple overflow device. As a means of controlling the outflow from the development, a Perforated Riser is the proposed control structure to restrict the overflow from the SUDS treatment trains. From our rainwater attenuation calculations, the flow control chamber will only be utilised for the greater storm event; i.e. 100 year- 6 hour storm.
The Perforated Riser located within a small attenuation chamber downstream of the proposed SUDS measures, has been designed in accordance with SUDS Handbook CIRIA C753 28.5.3 to restrict the outflow and have a Total Flow Capacity of 3.8L/sec/ha when connected to the existing stormwater sewer within the site. See Appendix A.11 calculation sheet for the Perforated design calculations

5.5 Permeable/Pervious Paving:

Outside the above SUDS treatment trains, it is also proposed to use a Type A [Total Infiltration] Permeable Pavement to receive the run-off from all of the new paved areas.

Permeable pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers, and also attenuates the rainwater beneath the overlying surface before infiltration. Permeable pavements are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. See attached plan drawing D-01 Rev E and details drawing D-02 Rev C for proposed extent and section of the permeable pavement.

6.0 Stormwater Quantity Design;

6.1 The extreme storm event, 100year – 6hour storm, defines the stormwater volumes that are to be managed for at the new development. It is proposed to use two SUDS treatment trains to manage the stormwater run-off from the impermeable areas (roofs) of the new development. These treatment trains will attenuate all of the stormwater runoff from a 100year – 6 hr. storm event. These treatment trains will also maintain within the site curtilage 89% of the stormwater runoff from a 100year – 6 hr. storm event .

6.2 The attenuated runoff is stored for infiltration, with the estimated excess (2.8m^3) released via the perforated riser flow control device to the existing stormwater outfall. This release rate 1.87L/sec/Ha is significantly less than the maximum allowable outfall rate (Qbar or the GDRCP rate 2L/sec/Ha); see attached calculation sheet, Appendix A.11.

6.3 Storage Components of the Treatment Trains:

Treatment Train AC: Bio-Ret. Swale A + Bio-Ret. Rainwater Garden C (50%)
Treatment Train BC: Bio-Ret. Swale B + Bio-Ret. Rainwater Garden C (50%)

6.4 Attenuation Volume Design:

(See Appendix A.6-A.10 attached calculation sheets):

Design Parameters:		**Ref.**
Max Run-off Rate:	3.8L/s/ha	See $Q_{bar(rural)}$ above
Storm Return Periods :	10yr.; **100yr.**	
Storm Duration:	60 min.; **6 hour**	
Max Rainfall for Extreme Rainfall Return for Storm Periods:	20.9mm; **68mm**	MetEireann (Casement)
Impermeable area :	750m^2	
Climate Change Factor :	20%	

6.5 100 Year – 6Hr Storm: Runoff & Storage Quantities Recap:

100year – 6Hr Storm Recap	
Total Inflow (m^3)	71.7
Less Treatment Train AC storage Volume (m^3)	29.7
Less Treatment Train BC storage Volume (m^3)	34.1
Less Infiltration during Storm Duration Volume (m^3)	5.2
Net Excess inflow over Storage Capacity (m^3)	2.7

See attached SUDS calculation sheet and Summary sheet for 10year and 100year storm events calculations, Appendix A.6-A.10.

Signed:______________________________Date:______

Marty Wardick
Chartered Engineer
MSW

Appendix A

1. Storm Drainage Layout Plan - Drawing D-01 Rev E
2. Storm Drainage Details – Drawing D-02 Rev C
3. Storm Drainage – Long. Sections D-03 Rev A
4. Infiltration Rate Calculation Sheet
5. Mean Annual Flood Flow Calculation [$Q_{bar(rural)}$]
6. SUDS Train A-C Calculation Sheet–10 Year 60min Storm
7. SUDS Train A-C Calculation Sheet–100 Year 6 Hr. Storm
8. SUDS Train B-C Calculation Sheet–10 Year 60min Storm
9. SUDS Train B-C Calculation Sheet–100 Year 6 Hr. Storm
10. Summary of SUDS Soakaway & Attenuation water volumes
11. Perforated Riser Flow Control Calculation Sheet

Soil Infiltration Rate Calculation:
Project: *New Citywise Science & Language Centre*
Location: *Durkan Centre, Fortunstown Way, Tallaght, Dublin 24.*

Trial Pit
Dimensions:

Length (l) =	0.6	m	1st filling:	27-Jul-22
Width (w) =	0.875	m	2nd filling:	28-Jul-22
Hole Depth=	1.5	m	3rd filling:	29-Jul-22
Depth of water (d1) =	0.520	m	15.35 pm	29-Jul-22
Depth of water (d2) =	0.00	m	12.30 pm	30-Jul-22
Depth delta =	0.52	m	[use 24hr clck]	
Initial Volume of Water	0.273	m3		
Final Volume of Water	0	m3		

Soil Infiltration Rate (f) = Vp(100-0) / Ap50 x tp(100-0)
as per BRE 365

tp (100-0)
Time delta = 1257 minutes 20.95 hrs
75420 secs

Vp(100-0) 0.273 m3
Volume delta

50% percolation in 24hrs test
percentage drop in volume of water in 24 hours
100.00%
OK percolation voumne greater than 50% in24hrs

Ap50= 1.292 m2
Ap50= [(l+w) x2 x delta d] + [l x w]

Soil Infiltration Rate (f) = 2.80E-06 m/s
0.01008593 m/hr
Safety Factor (1.5 - 10) 2.5 Ref SUDS Manual C697 4-30
Adjusted Soil Infitration Rate (q) 1.1207E-06 m/s
0.00403437 m/hr

1: Mean Annual Flood Outflow Calculation (for Greenfield site) $Q_{bar(rural)}$

Project: Citywise, Fortunestown Lane

		0.5 km^2	50 ha
Catchment Area =	1940 m^2	0.00194 km^2	0.194 Ha
Standard Area Average Rainfall (**SAAR**) =	822 mm	Citywise, Tallaght	Ref. Met Eireann
Soil Type 1 =	0 %		
Soil Type 2 =	10 %		
Soil Type 3 =	60 %		
Soil Type 4 =	30 %		
Soil Type 5 =	0 %		
Total =	100 %		
SPR (Soil Index: Per-centage Run-off)	**0.387**		

Soil = 0.1 [Soil1] + 0.3 [Soil2] + 0.37 [Soil3] + 0.47 [Soil4] + 0.53 [Soil5]

$$Q_{bar} = 0.00108 \times (AREA)^{0.89} \times SAAR^{1.17} \times SPR^{2.17}$$

Mean Annual Flood Flow Rate ($Q_{bar(rural)}$) =	**191.1**	litres/sec	for Area = 50Ha
Greenfield Peak Run-off	**0.1911**	m^3/sec	Ref. Eqn. 24.3 Ciria C753 The Suds Manual

$Q_{bar(rural)}$ for 50 Ha = 191.1 litres/sec = **3.8 litres/sec/Ha**

$Q_{bar(rural)}$ for .194 Ha = **0.74 litres/sec**

This is the Maximum Allowable Discharge from the Development Site

Area = Area of Catchment (km^2)
SAAR= Standard Area Average Rainfall (mm)
SPR = Standard Percentage Run-off (also known as Soil Index)
Qbar = The peak rate of flow from a catchment for the mean annual flood (a return period of approx 1:2.3 years)

Project: *New Citywise Science & Language Centre*
Location: *Durkan Centre, Fortunstown Way, Tallaght, Dublin 24.*

Total Area of Site 1940 m2 SUDS CHAIN A-C (See Section A-C)

Area Data:	Area		Impermeability [%]	Effective Area [m2]
Impermeable area	750 m2	New Roof Area	50%	375 m2
Partial permable area	31 m2	Swale A plan area	100%	31 m2
Other: Landscaped, green roof	26 m2	Swale C plan area (50%)	50%	26 m2
	807 m2			
			Eff. Area drained to Soakway	518 m2
				incl 20% CCA

Return Period Rainfall Depths [Ref. Met Eireann]
Location: Casement Aerodrome Dublin
10 year Return Period - 60 min duration 20.9 mm

Design Rainfall [R10-60MIN]:
10 year storm - 60 min duration:
Inflow to Soakway [A x R10-60]: 10.8 m^3 Inflow

SUDS MEASURE #1
Proposed Infiltration Structure - Dims: **BIO-RET. SWALE #A**

Area	31.25 m2				
Perimeter	31 m				
Depth of filter layer 1:	0.45 m	STONE	Infiltration		
Depth of filter layer 2:	0.4	CELLS	Infiltration	Length of Cells	11 m
Dept of Retained water	0.15 m		Attenuation	Width of Cells	1 m

Total Volume of Soakway 18.46 m^3 — 30% STONE
Net Volume of Soakway 8.40 m^3 — Free volume % — 95% CELLS
[95% for 'Aquacells'; 30% for stone]

Attenuation Surface Storage 4.69 m^3

Outflow from Soakaways during storm (O) O=As50 x f x D **BIO-RET. SWALE**

As50=	44.43 m2	Internal surface area of Swale to 50% effective depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	3600 secs	Duration of storm

Outflow = 0.31 m^3

SUDS MEASURE #2
Proposed Infiltration Structure - Dims: **BIO-RET. RAINWATER GRDN #C** 50%

Area	26 m2		
Perimeter	15 m		
Depth of filter layer 1:	0.35 m	STONE	Infiltration
Depth of filter layer 2:	0.4 m	CELLS	Infiltration
Dept of Retained water	0.15 m		Attenuation

Total Volume of Soakway 19.13 m^3 — 30% STONE
Net Volume of Soakway 12.37 m^3 — Free volume % — 95% CELLS
[95% for 'Aquacells'; 30% for stone]

Attenuation Surface Storage 3.825 m^3

Outflow from Soakaways during storm (O) O=As50 x f x D **BIO-RET. RAINWATER GRDN #C**

As50=	31.13 m2	Internal surface area (excl. base area) of soakway to 50% eff. depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	3600 secs	Duration of storm

Outflow = 0.13 m^3

Inflow - Outflow = Storage Required [I-O=S] 10.40 m^3 **Storage Required**

Total Swale #A & RWG #C (50%) Filter Layer Storage Vol = 20.8 m^3
Total Swale #A & RWG #C (50%) Surface Storage Vol = 8.5 m^3
29.28 m^3 **Storage available**
18.88 m^3 Surplus

Adequate Attenuation volume; greater than inflow

Project: *New Citywise Science & Language Centre*
Location: *Durkan Centre, Fortunstown Way, Tallaght, Dublin 24.*

Total Area of Site 1940 m2 — SUDS CHAIN A-C (See Section A-C)

Area Data:	Area		Impermeability [%]	Effective Area [m2]
Impermeable area	750 m2	New Roof Area	50%	375 m2
Partial permable area	31 m2	Swale A plan area	100%	31 m2
Other: Landscaped, green roof	26 m2	Swale C plan area (50%)	50%	26 m2
	807 m2			

Eff. Area drained to Soakway 518 m2 (incl 20% CCA)

Return Period Rainfall Depths [Ref. Met Eireann]
Location: Casement Aerodrome Dublin
100 year Return Period - 6hr duration: 68 mm

Design Rainfall [R100-6HR]:
100 year storm - 6hr duration:
Inflow to Soakway [A x R10-60]: 35.2 m^3 Inflow

SUDS MEASURE #1

Proposed Infiltration Structure - Dims: **BIO-RET. SWALE #A**

Area	31.25 m2				
Perimeter	31 m				
Depth of filter layer 1:	0.45 m	STONE	Infiltration		
Depth of filter layer 2:	0.40 m	CELLS	Infiltration	Length of Cells	12 m
Dept of Retained water	0.15 m	Surface Attenuation		Width of Cells	1 m

Total Volume of Soakway	18.86 m^3		30%	STONE
Net Volume of Soakway	8.78 m^3	Free volume %	95%	CELLS

[95% for 'Aquacells'; 30% for stone]

Attenuation Surface Storage 4.69 m^3

Outflow from Soakaways during storm (O) O=As50 x f x D — **BIO-RET. SWALE**

As50=	44.43 m2	Internal surface area of Swale to 50% effective depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	21600 secs	Duration of storm

Outflow = 1.08 m^3

SUDS MEASURE #2

Proposed Infiltration Structure - Dims: **BIO-RET. RAINWATER GRDN #C** 50%

Area	26 m2		
Perimeter	15 m		
Depth of filter layer 1:	0.35 m	STONE	Infiltration
Depth of filter layer 2:	0.4 m	CELLS	Infiltration
Dept of Retained water	0.15 m		Attenuation

Total Volume of Soakway	19.13 m^3		30%	STONE
Net Volume of Soakway	12.37 m^3	Free volume %	95%	CELLS

[95% for 'Aquacells'; 30% for stone]

Attenuation Surface Storage 3.825 m^3

Outflow from Soakaways during storm (O) O=As50 x f x D — **BIO-RET. RAINWATER GRDN #C**

As50=	31.13 m2	Internal surface area of Swale to 50% effective depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	21600 secs	Duration of storm

Outflow = 0.75 m^3

Inflow - Outflow = Storage Required [I-O=S] 33.40 m^3 **Storage Required**

Total Swale #A & RWG #C (50%) Filter Layer Storage Vol = 21.1 m^3
Total Swale #A & RWG #C (50%) Surface Storage Vol = 8.5 m^3

29.66 m^3 **Storage available**
3.74 m^3 Storage Deficit

Attenuation volume exceeded

MSW Associates
www.mswconsulting.ie
info@mswconsulting.ie

Project: *New Citywise Science & Language Centre*
Location: *Durkan Centre, Fortunstown Way, Tallaght, Dublin 24.*

Total Area of Site 1940 m2 SUDS CHAIN B-C (See Section B-C)

Area Data:	Area		Impermeability [%]	Effective Area [m2]
Impermeable area	750 m2	New Roof Area	50%	375 m2
Partial permable area	47 m2	Swale B plan area	100%	47 m2
Other: Landscaped, green roof	26 m2	Swale C plan area (50%)	50%	26 m2
	823 m2			
			Eff. Area drained to Soakway	537 m2
				incl 20% CCA

Return Period Rainfall Depths [Ref. Met Eireann]
Location: Casement Aerodrome Dublin
10 year Return Period - 60 min duration 20.9 mm

Design Rainfall [R10-60MIN]:
10 year storm - 60 min duration:
Inflow to Soakway [A x R10-60]: **11.2 m^3 Inflow**

SUDS MEASURE #1
Proposed Infiltration Structure - Dims: **BIO-RET. SWALE #B**

Area	47 m2				
Perimeter	29 m				
Depth of filter layer 1:	0.45 m	STONE	Infiltration		
Depth of filter layer 2:	0.4 m	CELLS	Infiltration	Length of Cells	11 m
Dept of Retained water	0.15 m		Attenuation	Width of Cells	1 m

Total Volume of Soakway	25.55 m^3		30%	STONE
Net Volume of Soakway	**10.525 m^3**	Free volume %	95%	CELLS
			[95% for 'Aquacells'; 30% for stone]	

Attenuation Surface Storage **7.050 m^3**

Outflow from Soakaways during storm (O) O=As50 x f x D **BIO-RET. SWALE**

As50=	59.33 m2	Internal surface area of Swale to 50% effective depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	3600 secs	Duration of storm

Outflow = 0.43 m^3

SUDS MEASURE #2
Proposed Infiltration Structure - Dims: **BIO-RET. RAINWATER GRDN #C** 50%

Area	26 m2		
Perimeter	15 m		
Depth of filter layer 1:	0.35 m	STONE	Infiltration
Depth of filter layer 2:	0.4 m	CELLS	Infiltration
Dept of Retained water	0.15 m		Attenuation

Total Volume of Soakway	19.13 m^3		30%	STONE
Net Volume of Soakway	**12.37 m^3**	Free volume %	95%	CELLS
			[95% for 'Aquacells'; 30% for stone]	

Attenuation Surface Storage **3.825 m^3**

Outflow from Soakaways during storm (O) O=As50 x f x D **BIO-RET. RAINWATER GRDN #C**

As50=	31.13 m2	Internal surface area (excl. base area) of soakway to 50% effective depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	3600 secs	Duration of storm

Outflow = 0.13 m^3

Inflow - Outflow = Storage Required [I-O=S] **10.67 m^3 Storage Required**

Total Swale #B & RWG #C (50%) Filter Layer Storage Vol =	22.9 m^3	
Total Swale #B & RWG #C (50%) Surface Storage Vol =	10.88 m^3	
	33.77 m^3	**Storage available**
	23.10 m^3	Surplus

Adequate Attenuation volume; greater than Inflow

MSW Associates
www.mswconsulting.ie
info@mswconsulting.ie

Project: *New Citywise Science & Language Centre*
Location: *Durkan Centre, Fortunstown Way, Tallaght, Dublin 24.*

Total Area of Site 1940 m2 SUDS CHAIN B-C (See Section B-C)

Area Data:	Area		Impermeability [%]	Effective Area [m2]
Impermeable area	750 m2	New Roof Area	50%	375 m2
Partial permable area	47 m2	Swale B plan area	100%	47 m2
Other: Landscaped, green roof	26 m2	Swale C plan area	50%	26 m2
	823 m2			
			Eff. Area drained to Soakway	537 m2
				incl 20% CCA

Return Period Rainfall Depths [Ref. Met Eireann]
Location: Casement Aerodrome Dublin
100 year Return Period - 6 hour duration 68 mm

Design Rainfall [R100-6HR]:
100 year storm - 6Hr. duration:
Inflow to Soakway [A x R10-60]: 36.5 m^3 Inflow

SUDS MEASURE #1

Proposed Infiltration Structure - Dims: **BIO-RET. SWALE #B**

Area	47 m2				
Perimeter	29 m				
Depth of filter layer 1:	0.45 m	STONE	Infiltration		
Depth of filter layer 2:	0.4 m	CELLS	Infiltration	Length of Cells	12 m
Dept of Retained water	0.15 m		Surface Attenuation	Width of Cells	1 m

Total Volume of Soakway	25.95 m^3		30%	STONE
Net Volume of Soakway	10.91 m^3	Free volume %	95%	CELLS

[95% for 'Aquacells'; 30% for stone]

Attenuation Surface Storage 7.050 m^3

Outflow from Soakaways during storm (O) O=As50 x f x D **BIO-RET. SWALE**

As50=	59.33 m2	Internal surface area of Swale to 50% effective depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	21600 secs	Duration of storm

Outflow = 2.57 m^3

SUDS MEASURE #2

Proposed Infiltration Structure - Dims: **BIO-RET. RAINWATER GRDN #C** 50%

Area	26 m2		
Perimeter	15 m		
Depth of filter layer 1:	0.35 m	STONE	Infiltration
Depth of filter layer 2:	0.4 m	CELLS	Infiltration
Dept of Retained water	0.15 m		Attenuation

Total Volume of Soakway	19.13 m^3		30%	STONE
Net Volume of Soakway	12.37 m^3	Free volume %	95%	CELLS

[95% for 'Aquacells'; 30% for stone]

Attenuation Surface Storage 3.825 m^3

Outflow from Soakaways during storm (O) O=As50 x f x D **BIO-RET. RAINWATER GRDN #C**

As50=	31.13 m2	Internal surface area (excl. base area) of soakway to 50% effective depth
f=	1.12E-06 m/s	Calculated Adjusted Infiltration Rate (FOS)
D=	21600 secs	Duration of storm

Outflow = 0.75 m^3

Inflow - Outflow = Storage Required [I-O=S] 33.19 m^3 **Storage Required**

Total Swale #B & RWG #C (50%) Filter Layer Storage Vol = 23.3 m^3
Total Swale #B & RWG #C (50%) Surface Storage Vol = 10.9 m^3
34.15 m^3 **Storage available**
0.96 m^3 Surplus

Adequate Attenuation volume: greater than inflow

MSW Associates
www.mswconsulting.ie
info@mswconsulting.ie

CITYWISE EDUCATION, FORTUNESTOWN LANE, DUBLIN 24.
SUMMARY RECAP OF STORAGE & ATTENUATION CAPACITIES

10 year storm - 60 min duration:			
SUDS CHAIN **A-C** INFLOW	10.8	m^3	
SUDS CHAIN **B-C** INFLOW	11.2	m^3	
TOTAL Inflow	**22.1**	m^3	
SUDS CHAIN **A-C** below Ground Void/Soakaway Volume	21.15	m^3	
SUDS CHAIN **B-C** below Ground Void/Soakaway Volume	23.27	m^3	
SUDS CHAIN **A-C** Above Ground Attenuation Volume	8.51	m^3	
SUDS CHAIN **B-C** Above Ground Attenuation Volume	10.88	m^3	
TOTAL Storage & Attenuaton	**63.81**	m^3	
Excess Storage/Attenuation over Inflow	**41.75**	m^3	
100 year storm - 6Hour duration:			
SUDS CHAIN **A-C** INFLOW	35.2	m^3	
SUDS CHAIN **B-C** INFLOW	36.5	m^3	
TOTAL Inflow	**71.7**	m^3	
INFILTRATION DURING STORM			
SUDS CHAIN **A-C** INFILTRATION	1.8	m^3	
SUDS CHAIN **B-C** INFILTRATION	3.3	m^3	
Less TOTAL Infiltration during Storm	**5.2**	m^3	
SUDS CHAIN **A-C** below Ground Void/Soakaway Volume	21.15	m^3	
SUDS CHAIN **B-C*** below Ground Void/Soakaway Volume	23.27	m^3	
SUDS CHAIN **A-C** Above Ground Attenuation Volume	8.51	m^3	
SUDS CHAIN **B-C*** Above Ground Attenuation Volume	10.88	m^3	
Less TOTAL Storage & Attenuaton	**63.81**	m^3	89% of Total inflow
Excess Net Inflow over Storage/Attenuation	**2.78**	m^3	
*= 50% above and below volume of Rain Garden C used in this calculation			

MSW Associates
www.mswconsulting.ie
info@mswconsulting.ie

Project:	*New Citywise Science & Language Centre*							
Location:	*Durken Centre, Fortunstown Way, Tallaght, Dublin 24.*							
	Total Flow Capacity of **<u>Perforated Riser</u>**	Q=Cp.2Ap.(2g)^1/2.(H^3/2)/ 3Hs	m3/s				Ref.: CIRIA C753 28.5.3	
		Q=	0.000164932	m3/sec	(using input below in blue)			
			1.65E-04	**m3/sec =**	0.165	L/sec	1.87	L/sec/Ha
	Q= discharge, m3/s		=					
	Cp= discharge coeff (0.61 for perforations)		=	0.61				
	Ap=Cross sectional area for all holes, m2		=	0.00076302	m2			
		radius of holes	=	4.5	mm	0.0045	m	
		no of holes per row	=	4	no.			
		no. of rows	=	3	no.			
		Total no. of holes	=	12	no.			
	g= gravity		=	9.81	m/s2			
	Hs= Distance from S/2 below the lowest row of holes to S/2 above the top row,m		=	225	mm	0.225	m	
	S= distance between holes, m		=	75	mm	0.075	m	
	H= effective head, m		=	90	mm	0.090	m	
		Allowable flow=	2	L/s/ha=	0.0000002	m3/s/m2		
		Catchment area served =	880	m2 =	0.088	ha		
		Impermeable & permeable areas served by SUDs measures on treatment chains with overflow to Flow Control Chamber						
		Allowable flow for Area=		0.000176	m3/sec			
				1.76E-04	**m3/sec**			
				0.176	L/sec			
				OK Perforated Riser Outflow < Max Allowable Flow for Area				