Sixth Line Road, Oakville, Ontario - Residential Development
Modified Rational Method Analysis

5 Year Pre-Development Condition

[A_{PRE}] Pre-Development Area	=	1.5037	ha	
[C] Pre-Development Site runoff Co-efficient	=	0.35		**Pre. Dev. 'C' = 0.35, however, 'C' can only be a maximum of 0.5**
[t_d]Time of concentration	=	10	min	
[i] Average Rainfall Intensity	=	114.21	mm/hr	**A = 1170, b = 5.8, and c = 0.843 for Town of Oakville**
[$Q_{allowable}$] Peak Run-off Rate for 5 yr Storm Event	=	166.99	L/sec	** Q = 2.778CIA **

100 Year Post-Development Condition

[A_{POST}] Post-Development Area	=	1.5037	ha	
[$A_{c, TOT.}$] Total Controlled Area	=	1.4566	ha	
[A_{un}] Un-controlled Site Area	=	0.0471	ha	
[C_{un}] Uncontrolled Post-Development Site Runoff Co-efficient	=	0.35		
[C] Controlled Post-Development Site Runoff Co-efficient	=	0.63		
[tc]Time of concentration	=	10	min	
[i] Average Rainfall Intensity	=	200.80	mm/hr	**A = 2150, b = 5.7, and c = 0.861 for Town of Oakville**
[$Q_{Un-controlled}$] Peak Run-off Rate for 100 yr Storm Event	=	9.19	L/sec	** Q = 2.778CIA **

$[Q_{controlled}] = [Q_{allowable}] - [Q_{Un-controlled}]$

$[Q_{controlled}] = 157.80$ L/sec

$[Q_{in}] = CIA/360$

Time [T_c]	Intensity [i]	Inflow [Q_{in}]	Inflow Volumes [V_{in}]	Outflow [$Q_{controlled}$]	Outflow Volume [V_{out}]	Storage
(min)	(mm/hr)	(m^3/sec)	(m^3)	(m^3/sec)	(m^3)	(m^3)
5.0	279.34	0.71	213.62	0.15780	47.34	166.28
10.0	200.80	0.51	307.11	0.15780	94.68	212.43
11.0	190.41	0.49	320.33	0.15780	104.15	216.19
12.0	181.11	0.46	332.39	0.15780	113.62	218.77
13.0	172.74	0.44	343.44	0.15780	123.08	220.36
14.0	165.16	0.42	353.64	0.15780	132.55	221.09
15.0	158.27	0.40	363.09	0.15780	142.02	221.07
16.0	151.97	0.39	371.87	0.15780	151.49	220.39
17.0	146.18	0.37	380.08	0.15780	160.95	219.13
18.0	140.86	0.36	387.78	0.15780	170.42	217.36
19.0	135.93	0.35	395.01	0.15780	179.89	215.12
20.0	131.37	0.33	401.83	0.15780	189.36	212.48
21.0	127.12	0.32	408.28	0.15780	198.83	209.46
22.0	123.16	0.31	414.40	0.15780	208.29	206.10
23.0	119.45	0.30	420.20	0.15780	217.76	202.44
REQUIRED STORAGE = 222 m3						

Proposed Total Storage = 289 m^3

ORIFICE PLATE SIZING

Q = CA V2gh or A = Q / (C*V2gh)

[Q] Allowable Discharge	=	157.80	L/s
[C] Orifice Entrance Co-efficient	=	0.82	Constant (0.63 for plate, 0.82 for tube)
[g] Acceleration due to Gravity	=	9.81	m/s^2
[h] (1:100 Year Storage Elevation - Center of Outlet)	=	1.24	m (1:100 year water level based on 222m^3 of required storage / 290m^3 provided storage = 108.66m)
[A] Area of Orifice	=	0.03894	m^2
[r] Radius of Orifice	=	0.111	m

ORIFICE DIAMETER = 223 mm

****Since orifice tubes come in nominal sizes, use 200mm orifice tube and recalcuate required storage and outflow based on this revised size****

ORIFICE TUBE SIZING

Q = CA V2gh or A = Q / (C*V2gh)

[C] Orifice Entrance Co-efficient	=	0.82	Constant (0.63 for plate, 0.82 for tube)
[g] Acceleration due to Gravity	=	9.81	m/s^2
[h] (1:100 Year Storage Elevation - Center of Outlet)	=	1.22	m (1:100 year water level based on 222m^3 of required storage / 290m^3 provided storage = 108.66m)
[r] Radius of Orifice	=	0.100	m
[A] Area of Orifice	=	0.03142	m^2

[Q] Revised Allowable Discharge = 126.04 L/s

Time [T_c]	Intensity [i]	Inflow [Q_{in}]	Inflow Volumes [V_{in}]	Outflow [$Q_{controlled}$]	Outflow Volume [V_{out}]	Storage
(min)	(mm/hr)	(m^3/sec)	(m^3)	(m^3/sec)	(m^3)	(m^3)
5.0	279.34	0.71	213.62	0.12604	37.81	175.81
10.0	200.80	0.51	307.11	0.12604	75.62	231.49
11.0	190.41	0.49	320.33	0.12604	83.18	237.15
12.0	181.11	0.46	332.39	0.12604	90.75	241.64
13.0	172.74	0.44	343.44	0.12604	98.31	245.14
14.0	165.16	0.42	353.64	0.12604	105.87	247.77
15.0	158.27	0.40	363.09	0.12604	113.43	249.65
16.0	151.97	0.39	371.87	0.12604	120.99	250.88
17.0	146.18	0.37	380.08	0.12604	128.56	251.53
18.0	140.86	0.36	387.78	0.12604	136.12	251.66
19.0	135.93	0.35	395.01	0.12604	143.68	251.33
20.0	131.37	0.33	401.83	0.12604	151.24	250.59
21.0	127.12	0.32	408.28	0.12604	158.80	249.48
22.0	123.16	0.31	414.40	0.12604	166.37	248.03
23.0	119.45	0.30	420.20	0.12604	173.93	246.27
REVISED REQUIRED STORAGE = 252 m3						

Proposed Total Storage = 289 m^3

Pre-Development Site Area 'C' (Areas From Figure 2)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	1.2947	0.25	0.861	0.220
Hard Landscape	0.1128	0.90	0.075	0.070
Roof	0.0962	0.90	0.064	0.060
Permeable Pavers	0.0000	0.80	0.000	0.000
	1.5037			**0.35**

Area A1 (From STM-1) - Uncontrolled				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0326	0.25	1.0000	0.25
Hard Landscape	0.0000	0.90	0.0000	0.00
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0326			**0.25**

Area A2 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0080	0.25	0.4378	0.11
Hard Landscape	0.0102	0.90	0.5622	0.51
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0182			**0.62**

Area A3 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0029	0.25	0.3702	0.09
Hard Landscape	0.0050	0.90	0.6298	0.57
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0079			**0.66**

Area A4 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.1003	0.25	0.9914	0.25
Hard Landscape	0.0009	0.90	0.0086	0.01
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.1012			**0.26**

Area A5 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0132	0.25	0.9612	0.24
Hard Landscape	0.0005	0.90	0.0388	0.03
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0137			**0.27**

Area A6 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0129	0.25	0.1213	0.03
Hard Landscape	0.0499	0.90	0.4692	0.42
Roof	0.0436	0.90	0.4095	0.37
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.1064			**0.82**

Area A7 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0194	0.25	0.1575	0.04
Hard Landscape	0.0540	0.90	0.4378	0.39
Roof	0.0500	0.90	0.4047	0.36
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.1235			**0.79**

Area A8 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0013	0.90	0.1328	0.12
Roof	0.0087	0.90	0.8672	0.78
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0100			**0.90**

Area A9 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0013	0.90	0.1509	0.14
Roof	0.0075	0.90	0.8491	0.76
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0088			**0.90**

Area A10 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0038	0.90	0.1577	0.14
Roof	0.0205	0.90	0.8423	0.76
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0243			**0.90**

Area A11 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0038	0.90	0.1575	0.14
Roof	0.0205	0.90	0.8425	0.76
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0243			**0.90**

Area A12 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0271	0.25	0.6760	0.17
Hard Landscape	0.0130	0.90	0.3240	0.29
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0401			**0.46**

Area A13 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0039	0.90	0.1583	0.14
Roof	0.0205	0.90	0.8417	0.76
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0244			**0.90**

Area A14 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0040	0.90	0.1625	0.15
Roof	0.0205	0.90	0.8375	0.75
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0245			**0.90**

Area A15 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0037	0.90	0.1516	0.14
Roof	0.0205	0.90	0.8484	0.76
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0241			**0.90**

Area A16 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0049	0.90	0.1951	0.18
Roof	0.0203	0.90	0.8049	0.72
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0252			**0.90**

Area A17 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0037	0.90	0.2102	0.19
Roof	0.0139	0.90	0.7898	0.71
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0176			**0.90**

Area A18 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0000	0.25	0.0000	0.00
Hard Landscape	0.0017	0.90	0.1931	0.17
Roof	0.0071	0.90	0.8069	0.73
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0088			**0.90**

Area A19 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0140	0.25	0.6612	0.17
Hard Landscape	0.0072	0.90	0.3388	0.30
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0211			**0.47**

Area A20 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0003	0.25	0.0353	0.01
Hard Landscape	0.0085	0.90	0.9647	0.87
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0089			**0.88**

Area A21 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0043	0.25	0.1630	0.04
Hard Landscape	0.0221	0.90	0.8370	0.75
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0264			**0.79**

Area A22 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0084	0.25	0.1651	0.04
Hard Landscape	0.0274	0.90	0.5392	0.49
Roof	0.0150	0.90	0.2957	0.27
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0509			**0.80**

Area A23 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0481	0.25	0.8734	0.22
Hard Landscape	0.0070	0.90	0.1266	0.11
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0551			**0.33**

Area A24 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0512	0.25	1.0000	0.25
Hard Landscape	0.0000	0.90	0.0000	0.00
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0512			**0.25**

Area A25 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0142	0.25	0.1673	0.04
Hard Landscape	0.0282	0.90	0.3329	0.30
Roof	0.0424	0.90	0.4998	0.45
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0848			**0.79**

Area A26 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0559	0.25	1.0000	0.25
Hard Landscape	0.0000	0.90	0.0000	0.00
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0559			**0.25**

Area A27 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0093	0.25	0.1359	0.03
Hard Landscape	0.0306	0.90	0.4482	0.40
Roof	0.0284	0.90	0.4159	0.37
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0684			**0.80**

Area A28 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0583	0.25	1.0000	0.25
Hard Landscape	0.0000	0.90	0.0000	0.00
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0583			**0.25**

Area A29 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0250	0.25	0.2462	0.06
Hard Landscape	0.0473	0.90	0.4661	0.42
Roof	0.0292	0.90	0.2877	0.26
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.1016			**0.74**

Area A30 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0406	0.25	0.9647	0.24
Hard Landscape	0.0015	0.90	0.0353	0.03
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0421			**0.27**

Area A31 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0034	0.25	0.0818	0.02
Hard Landscape	0.0172	0.90	0.4136	0.37
Roof	0.0210	0.90	0.5046	0.45
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0416			**0.84**

Area A32 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0243	0.25	0.3775	0.09
Hard Landscape	0.0226	0.90	0.3516	0.32
Roof	0.0174	0.90	0.2709	0.24
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0644			**0.65**

Area A33 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0432	0.25	0.9481	0.24
Hard Landscape	0.0024	0.90	0.0519	0.05
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0456			**0.29**

Area A34 (From STM-1) - Uncontrolled				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0074	0.25	0.5115	0.13
Hard Landscape	0.0071	0.90	0.4885	0.44
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0145			**0.57**

Area A35 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0025	0.25	0.0523	0.01
Hard Landscape	0.0172	0.90	0.3603	0.32
Roof	0.0281	0.90	0.5874	0.53
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0478			**0.86**

Area A36 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0015	0.25	0.1172	0.03
Hard Landscape	0.0113	0.90	0.8828	0.79
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0128			**0.82**

Area A37 (From STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.0110	0.25	0.6482	0.16
Hard Landscape	0.0060	0.90	0.3518	0.32
Roof	0.0000	0.90	0.0000	0.00
Permeable Pavers	0.0000	0.80	0.0000	0.00
	0.0170			**0.48**

Total Uncontrolled Site Runoff Coefficient (See STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
A1	0.0326	0.25	0.6928	0.17
A34	0.0145	0.57	0.3072	0.18
	0.0471			**0.35**

Total Controlled Site Runoff Coefficient (See STM-1)				
Type	Area (ha)	C	Weighted Area (ha)	Weighted C
Soft Landscape	0.5993	0.25	0.4114	0.10
Hard Landscape	0.4223	0.90	0.2899	0.26
Roof	0.4350	0.90	0.2987	0.27
Permeable Pavers	0.0000	0.80	0.0000	0.00
	1.4566			**0.63**

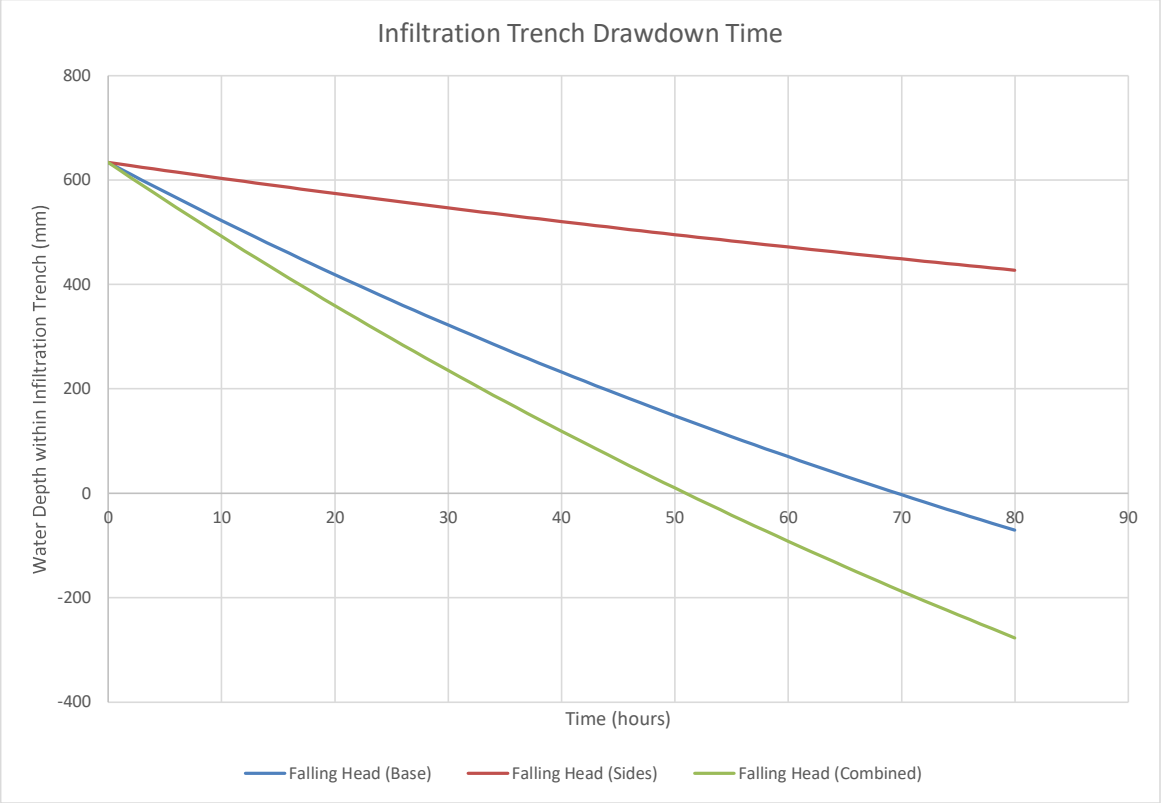
JSW+ associates

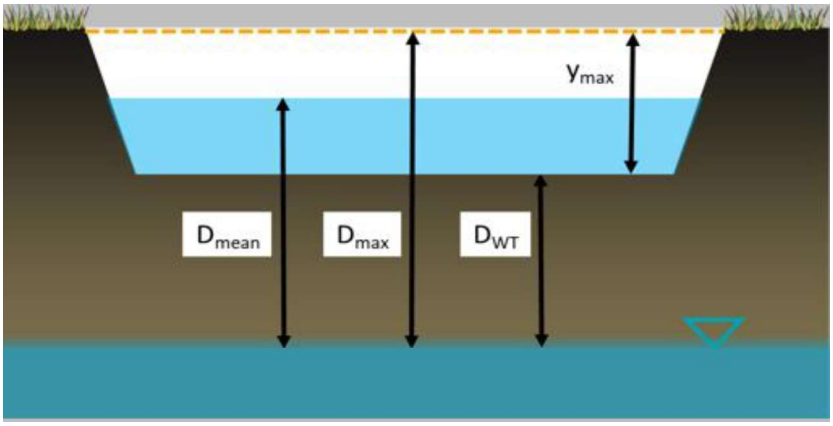
Darcy Method Infiltration Drawdown Calculations

1020, 1024, 1028, 1032, 1042 Sixth Line Road Residential Development				
Designed:	**S.S.**	Job No:	16-29	
Checked:	**M.M.**	Date:	4/11/2023	Sheet: 1 of 2

			Units	
Input	A_i =	**8649**	m^2	Catchment Impervious Area (Impervious Landscaping + Roof Area from entire site)
Input	K_V =	**7**	mm/hr	Vertical Hydraulic Conductivity of Native Soil
Input	K_H =	**0.5**		Ratio of Vertical to Horizontal Hydraulic Conductivity of Native Soil
Output	K_V =	14	mm/hr	Horizontal Hydraulic Conductivity of Native Soil
Input	y_{MAX} =	**0.66**	m	Storage reservoir depth
Input	n =	**0.96**		Porosity of storage reservoir fill material
Output	d_i =	633.6	mm	Infiltration water storage depth
Input	D_{WT} =	1	m	Depth to Water Table (>= 1m minimum depth permissible)
Output	D_{WT} =	1000	mm	Depth to Water Table (>= 1000mm minimum depth permissible)
Input	w =	**3.48**	m	Width of Reservoir
Input	L =	**16**	m	Length of Reservoir
Output	A_r =	55.68		Area of Reservoir
Output	V_r =	35.28	m^3	Water Storage Volume of Reservoir
Output	R =	155.33		I/P Ratio (Impervious Area [A_i] / Area of Reservoir [A_r])

Time	Falling Head (Base)	Falling Head (Sides)	Falling Head (Sides)	Falling Head (Combined)
(hours)	(mm)	(m^3)	(mm)	(mm)
0	634	35	634	634
2	611	35	627	605
4	588	35	621	576
6	566	34	615	548
8	544	34	609	520
10	522	34	603	492
12	501	33	597	465
14	480	33	591	438
16	459	33	586	411
18	439	32	580	385
20	419	32	574	359
22	399	32	569	334
24	379	31	563	309
26	360	31	557	284
28	341	31	552	259
30	322	30	547	235
32	304	30	541	211
34	285	30	536	188
36	267	30	531	165
38	250	29	526	142
40	232	29	520	119
42	215	29	515	97
44	198	28	510	75
46	181	28	505	53
48	165	28	500	31
50	148	28	495	10
52	132	27	491	-11
54	116	27	486	-31
56	101	27	481	-52
58	85	27	476	-72
60	70	26	472	-92
62	55	26	467	-111
64	40	26	462	-131
66	26	25	458	-150
68	11	25	453	-169
70	-3	25	449	-187
72	-17	25	445	-206
74	-30	25	440	-224
76	-44	24	436	-242
78	-57	24	432	-259
80	-71	24	427	-277


Infiltration Trench Drawdown Time
Water Depth within Infiltration Trench (mm)
800
600
400
200
0
-200
-400
0
10
20
30
40
50
60
70
80
90
Time (hours)
Falling Head (Base)
Falling Head (Sides)
Falling Head (Combined)


y_{max}
D_{mean}
D_{max}
D_{WT}

STORMCON
STORMWATER MANAGEMENT SOLUTIONS.

GreenStorm ST

Rigofill ST product by FRÄNKISCHE

Underground storage infiltration modules

www.stormcon.ca

Table of contents

*Rigofill ST product by FRÄNKISCHE

Storing stormwater with storage/infiltration systems

Basic element for underground water storage facilities

GreenStorm ST* are plastic tanks to be installed underground (storage/ infiltration modules) in which water is collected and stored. Storage/infiltration systems temporarily collect stormwater and discharge it later. In addition to infiltration using underdrained swale systems, pipe swales, and gravel swales common in the past, increasingly more storage/infiltration systems are being built today.

The storage space of the storage/ infiltration system consists of numerous GreenStorm ST* modules which can be combined three-dimensionally to form large systems.

The advantage of this method is that the void ratio is up to three times larger in these infiltration systems than in gravel swales which saves space and excavation work.

GreenStorm ST* is a modular system which is characterised by high flexibility, rapid installation and a high level of user-friendliness.

*Rigofill ST product by FRÄNKISCHE

Application – infiltration

Stormwater infiltration – giving back to nature

Large amounts of stormwater can reduce the performance of wastewater treatment systems. Infiltrating unpolluted stormwater nearby has therefore several advantages.

A constant growth in built-up areas and increase in impervious surfaces prevent natural infiltration of stormwater into the soil. Special infiltration systems are used in order to discharge it to the water cycle. In addition to infiltration using pipe swales, increasingly more storage/infiltration systems are being built.

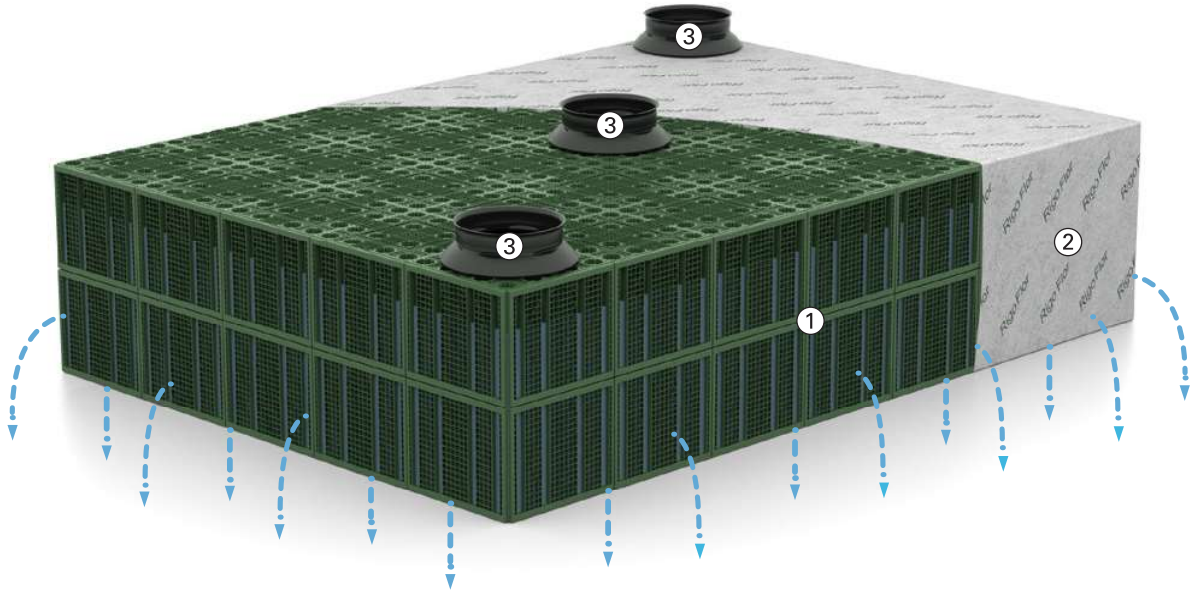
The advantage of this method is that the storage volume of the infiltration system is increased, and space and excavation are saved as compared to gravel swales. Stormwater is thus returned to the natural water cycle and can contribute to producing new groundwater. Infiltration systems are subject to very high requirements. Consequently, they have become an important component of urban drainage.

Storage/infiltration systems considerably increase the underground storage volume. High-performance storage/infiltration systems can be installed even in confined space.

In particular in urban construction no additional space is required and precious building ground is saved.

Légende

1. GreenStorm ST* storage /infiltration module
2. Geotextile
3. QuadroControl ST system shaft



*Rigofill ST product by FRÄNKISCHE

Application – retention

Retaining stormwater – instead of flooding

If subsoil conditions are unfavourable to infiltration, the goal is to retain the stormwater and ensure a retarded, timelagged discharge. Exposure to impulsive stress can be eliminated or reduced in sewer networks, wastewater treatment systems and waterbodies.

Stormwater retention systems retard the infiltration of stormwater. They are comprised of a watertight retaining element, an inlet and a vortex outlet.

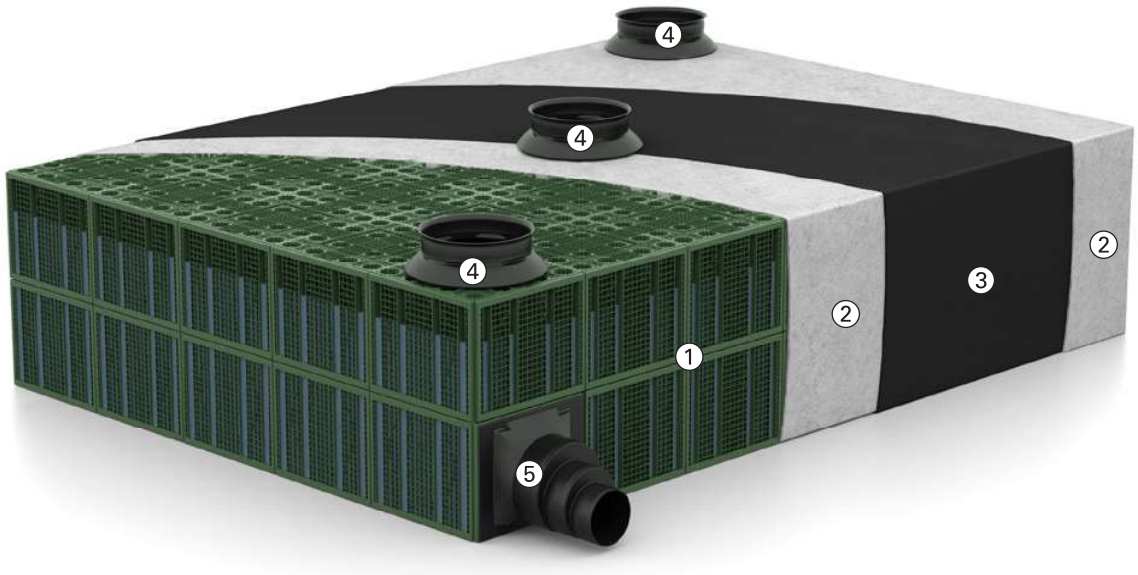
The stormwater distributes evenly in the system where it can be stored and is then discharged in a controlled manner through throttle shafts. If infiltration must be avoided or to prevent unintended discharge of groundwater or strata water (e.g., in case of contaminated soil), it is necessary to waterproof the retention system.

Stormwater runoff from impervious surfaces that cannot infiltrate naturally leads to peak loads in sewer systems.

Stormwater retention facilities collect stormwater in an underground storage tank and discharge it in a retarded manner but continuously. Their very short construction times make storage/ infiltration systems an inexpensive alternative to conventional retention facilities such as retention channels or underground concrete tanks.

Légende

1. GreenStorm ST* storage /infiltration module
2. Geotextile
3. Impermeable membrane
4. QuadroControl ST system shaft
5. Adapter



*Rigofill ST product by FRÄNKISCHE

Application – harvesting / fire water storage

Harvesting stormwater – saving drinking water

Water – particularly drinking water – is a priceless resource which should be treated responsibly and used sparingly. It is therefore wise to collect, store and use stormwater if the water must not necessarily be suitable for drinking purposes, instead of allowing the water to infiltrate into the soil unused or diverting it into the sewer system.

There are many examples: irrigation for greens, car wash, use in toilets, etc.

Water is diverted into a waterproof storage/infiltration system and can be supplied for use via a pumping system.

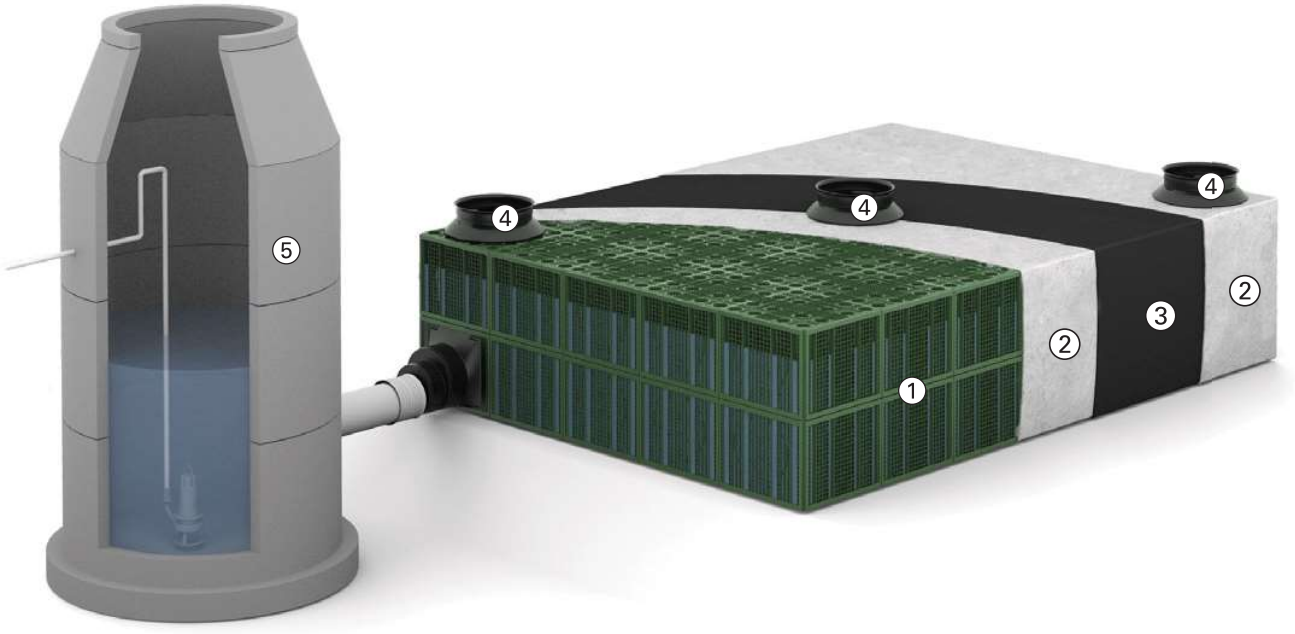
The use of the GreenStorm inspect system allows for finding solutions that fit project-specific requirements – even under the most difficult conditions such as very tight space, narrow conditions, low cover, high groundwater level, etc.

Stormwater harvesting systems provide water for different domestic and industrial water uses. They comprise a watertight retaining element, an inlet with upstream stormwater treatment system, a pump shaft and a system control.

Using GreenStorm ST* for fire water storage also saves water, since system checks can be made in a filled state and water does not have to be pumped out as is the case with conventional concrete tanks.

Légende

1. GreenStorm ST* storage/infiltration module
2. Geotextile
3. Impermeable membrane
4. QuadroControl ST system shaft
5. Tapping shaft (on-site)



*Rigofill ST product by FRÄNKISCHE

Modular design

Individual system geometries due to modular design

Sizes (length and width) of GreenStorm ST*orage/infiltration systems can be freely designed with hardly any limitations. The 800 mm cellular block type structure can easily be adapted to fit nearly any layout.

With heights of 660 mm (full block) and 350 mm (half block), systems can be built in various sizes to accommodate any single- or multi-layer combination. Therefore, the system can very easily be adapted to on-site requirements. Under high groundwater conditions or low permeability of backfill soil, for example, rather shallow depth systems are to be preferred.

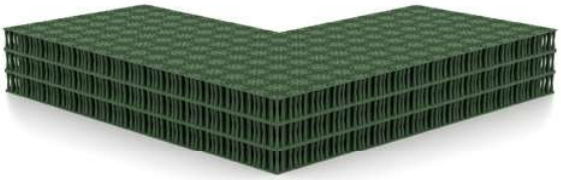
For soils with good permeability, however, high and compact systems are favourable and may be built accordingly. The maximum space available is used.

*Rigofill ST product by FRÄNKISCHE

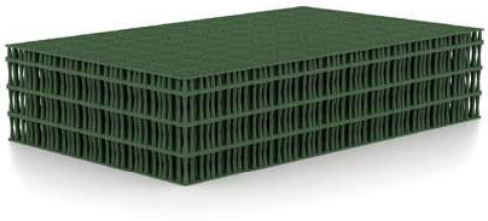
Possible system geometries

GreenStorm ST*
2-layer

GreenStorm ST*
1-layer



GreenStorm ST*
3-layer



GreenStorm ST*
3 1/2-layer

*Rigofill ST product by FRÄNKISCHE

Storage volume

Extremely high volume

The GreenStorm ST* full block provides a storage volume of 406 litres with a gross volume of 422 litres. With a storage volume of more than 96 %, it stores three times as much water as gravel swales.

The half block has a height of 350 mm and is used if shallow systems are required, e.g., in case of high groundwater levels. With a gross volume of 224 litres, it offers a storage volume of 212 litres.

Column void
The column void of the storage/infiltration module is 100 % available as storage space. Large openings at the column base and at the column connection allow unrestricted filling and emptying of the columns.

Storage/infiltration systems as compared to gravel swales

Pipe and gravel swales only use approx. 30 % of their volume to store water. Therefore, three times the required water storage volume must be provided by excavation. This requires lots of space which is frequently not available in urban areas.

GreenStorm ST* storage/infiltration systems save an enormous amount of space and excavation work. Thus, subsoil storage spaces for stormwater can be built in a very efficient and cost-saving way.

Storage/infiltration systems considerably increase the storage space. High-performance storage/infiltration systems can be installed even in confined space.

*Rigofill ST product by FRÄNKISCHE

Installation

Easy construction site handling

Requires little space for storage
The storage/infiltration modules are delivered in compact, stacked units with 17 modules per pallet.
The easy stackability of the GreenStorm ST* and ST-B modules allows them to be stored even in confined construction space, even outside the excavation pit.
This facilitates installation, since no additional storage space must be provided in the excavation pit. Installation is neither impeded nor constrained.

Pre-assembly
Depending on the requirements, GreenStorm
ST and GreenStorm ST*-B modules can be pre-assembled in no time at all, both outside and inside the excavation pit with just one easy move. Easy high tensile strength snap connections allow for combining two half elements to create a reliable unit in only a short period of time. This can easily be done by one person alone without requiring any additional tools. The moveable parts of the snap connection are recessed and thus protected from damage.

Easy assembly
There is no need to adhere to any complex installation pattern – the pre-assembled modules or half blocks can just as well be connected to create a single unit.
The low weight allows this to be done by one person only. Connectors establish firm connections between the individual modules. The surface can be accessed immediately without any risk of accidents, since the hole size of the columns is dimensioned respectively (< 100 mm).
Thus, no additional covers of column holes are required.

Montage dans la fouille

Up to

88 %

storage space saved as compared to unstackable storage/infiltration modules

*Rigofill ST product by FRÄNKISCHE

Inspection

CCTV inspection even when filled

Storage/infiltration systems are durable structures for urban drainage; they must work reliably for decades. Durability and reliability are essential requirements.
The best way to inspect the state of a system using state-of-the-art technology is CCTV inspection. Thus, a storage/infiltration system can be inspected excellently – for final acceptance or later. This provides safety for authorities, engineers, construction companies, customers, and operators.

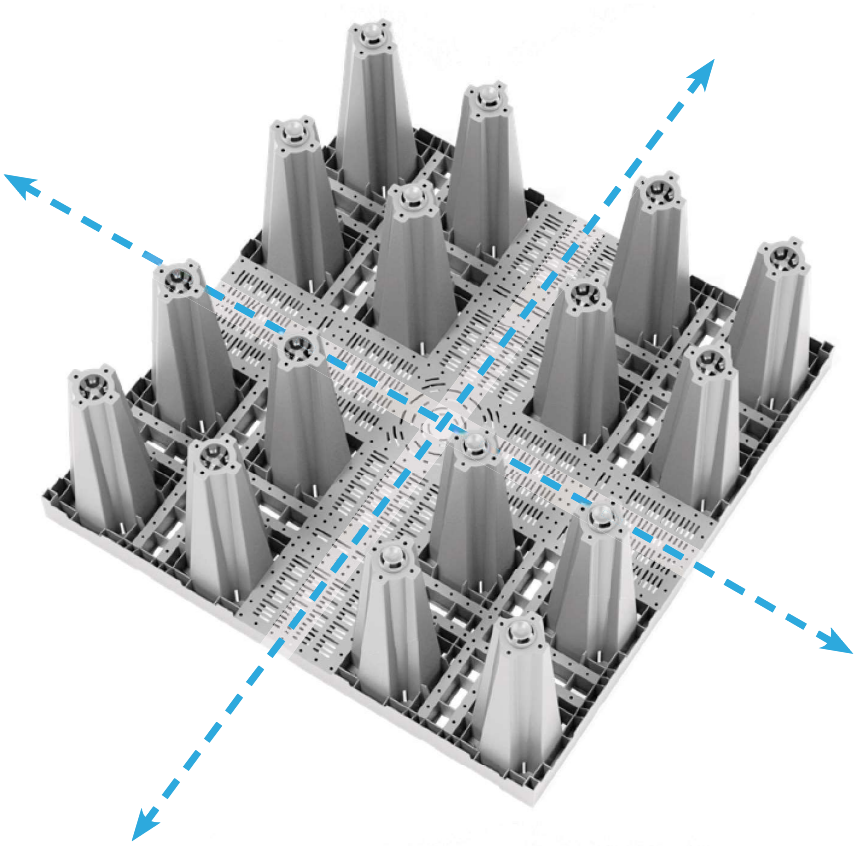
Cross-shaped inspection tunnel

GreenStorm ST* modules have a cross-shaped tunnel which makes the storage/infiltration system camera-accessible and flushable in two axes and thus in four dimensions.
The special and open design of the inspection tunnel allows for an unobstructed view of the entire interior and not only the inspection tunnel.

For example, the statically relevant load-bearing elements, the condition of the geotextile and the entire soil area can be viewed. GreenStorm ST* and GreenStorm ST*-B thus provide excellent options to control the “inner life” of a storage/infiltration system at any time.

The ideal, level and vibration-free running surface and the slim column structure allow for an unobstructed view of the entire module volume. The Quadro Control ST shaft for GreenStorm ST*, which can be integrated, allows for easy access of the automotive dolly for both professional final acceptance inspection and flushing technology.

100 %
inspectable



*Rigofill ST product by FRÄNKISCHE

Inspection

Recommended camera equipment

A standard sewer camera is sufficient for camera inspection.
A rotatable and height-adjustable camera head allows for an optimal view of the lateral soil area, a controllable carriage ensures a centred positioning, and high-performance optics together with lighting allow for a perfect picture.

Certified CCTV accessibility

GreenStorm ST* has been designed for the use of modern CCTV inspection technology.
The inspectability of the GreenStorm ST* and QuadroControl ST system unit has been tested and confirmed by leading manufacturers of pipe CCTV inspection technology!

Recommended: tender invitation for final acceptance inspection

Final acceptance of sewers using camera inspection has long since become a matter of course in sewer construction.
Also in the construction of storage/infiltration systems, the final acceptance inspection is important! Planning engineers should absolutely include this in their tender documents. For instructions on the professional system configuration of the CCTV inspection technology, please refer to **www.fraenkische.com**

Loading

GreenStorm ST* Heavy traffic

Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against impacting soil and traffic loads.

GreenStorm ST* storage/ infiltration systems are extremely strong and have been designed with various applications in mind:
While GreenStorm ST* has been designed in
particular for traffic loads of up to 13 tons axle load.

Certification CSTB

High resistance

When installed under traffic areas, relevant national guidelines must be observed.

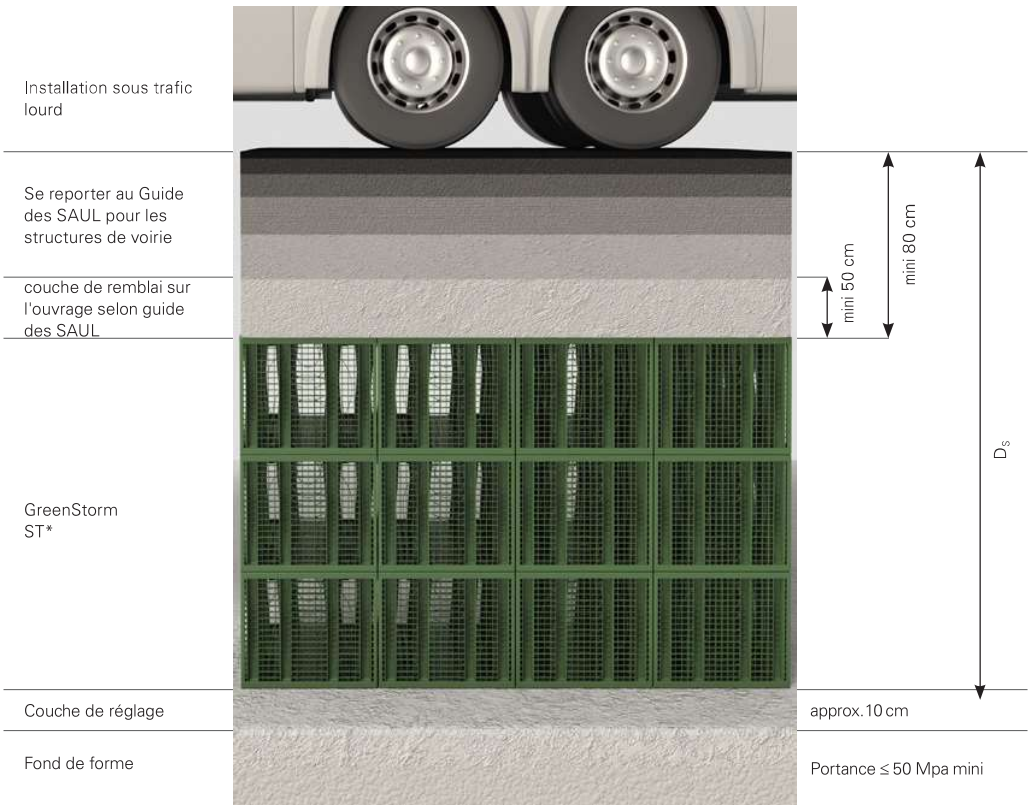
To build the planum for the road construction, an upper levelling layer must be provided. It should preferably be built as a gravel sub-base with a thickness of at least 350 mm, other materials usually result in larger covers.

Generally, a uniform modulus of deformation EV2 ≥ 45 MN/m² must be proven on the planum.

Installation under traffic area

The subsoil structures must have sufficient load-carrying capacity against impacting soil and traffic loads to ensure reliable stability.

This is why GreenStorm ST* is suitable for traffic loads of up to 15 tons axle load (20 tons possible, please refer to our technical department).



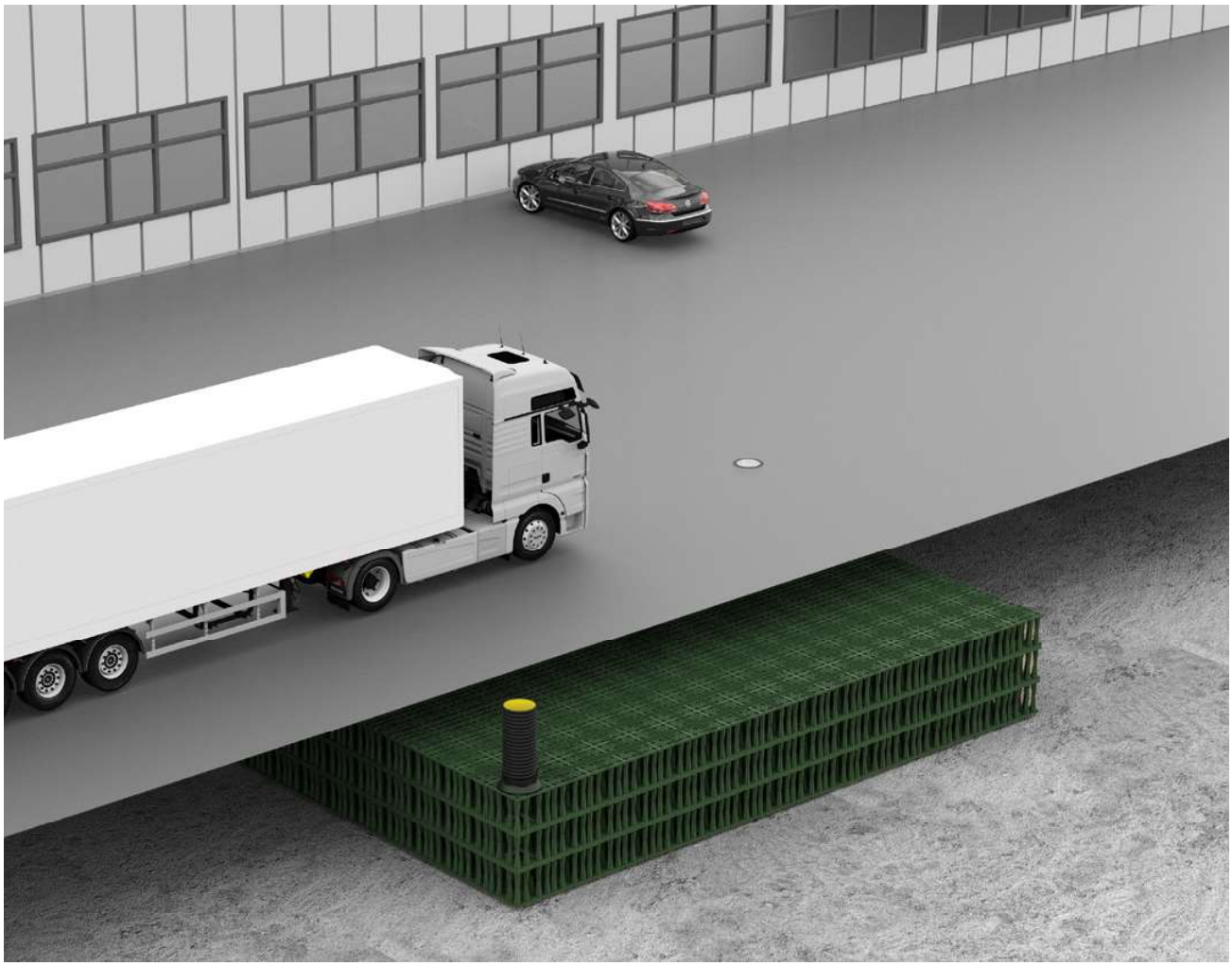
With conventional installation parameters*, depths of cover of DC 4 m and soil depths DSof 6 m are possible for infiltration systems. A project-specific stability analysis can be prepared by STORMCON.

*specific weight of soil 18 kN/m³
Mean soil temperature max. 23 °C,
6 m soil depth, = 0.3, 4-laye

*Rigofill ST product by FRÄNKISCHE

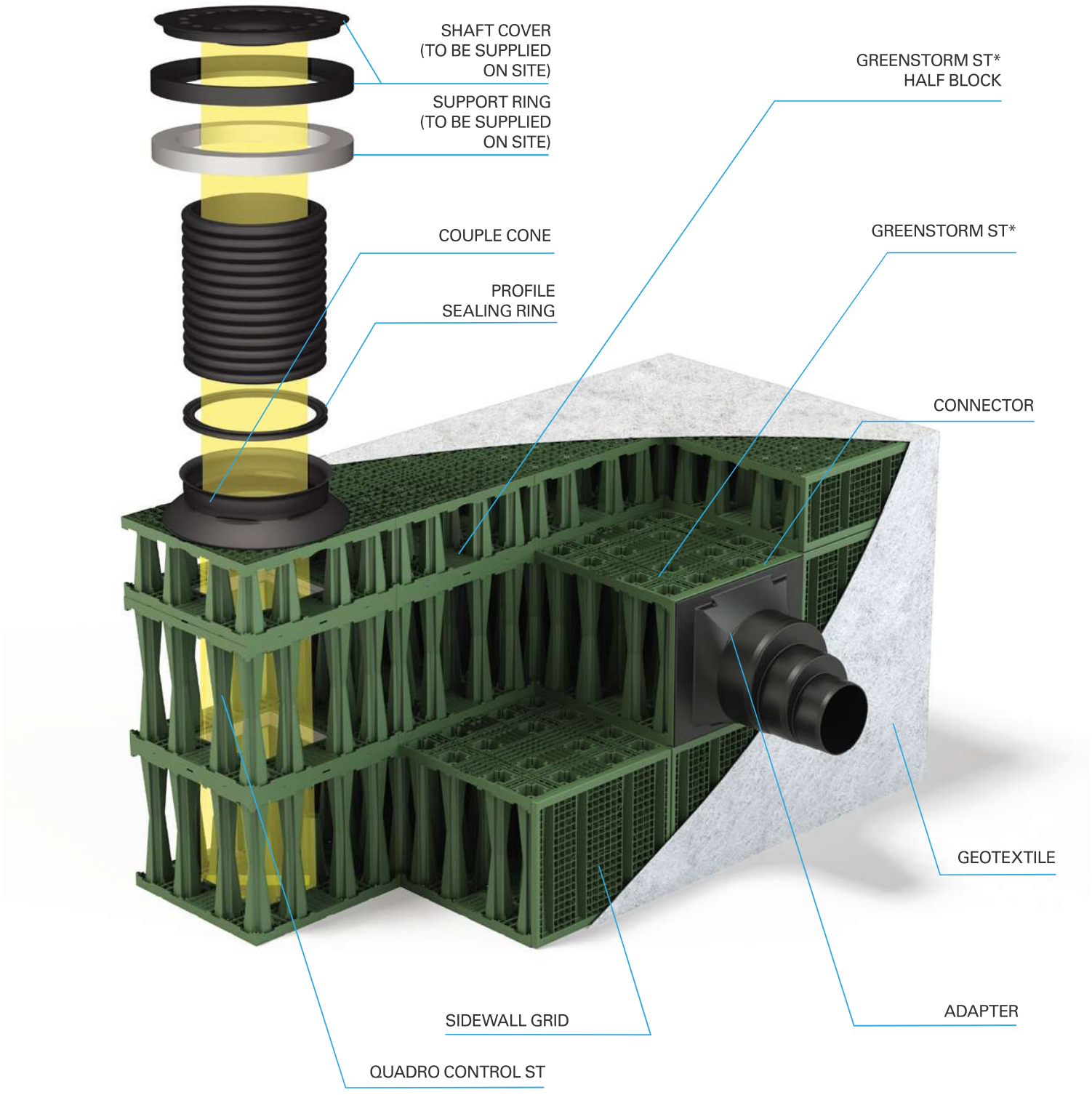
Example

GreenStorm ST* Heavy traffic



*Rigofill ST product by FRÄNKISCHE

Quadro® Control ST – system shaft



*Rigofill ST product by FRÄNKISCHE

Quadro® Control ST – system shaft

Integrated inspection shafts

Quadro® Control ST is a polypropylene inspection shaft which can be integrated in the storage/infiltration system.

It is square with a base of 800 x 800 mm and can be used in any position of the layout.

Its height results from the number of layers of the connected storage/infiltration system. The shaft allows for comfortable access to the inspection tunnel from aboveground. High-performance inspection and flushing equipment can easily be inserted into the inspection tunnel. The shaft is integrated in the storage/infiltration system and grows layer by layer as construction progresses. QuadroControl ST is delivered with all required components and will be assembled on site.

Structure

The shaft cone is the transition to the extension pipe. The length of the extension pipe is chosen depending on the installation depth.

The shaft is integrated in the storage/infiltration system and grows layer by layer as construction progresses.

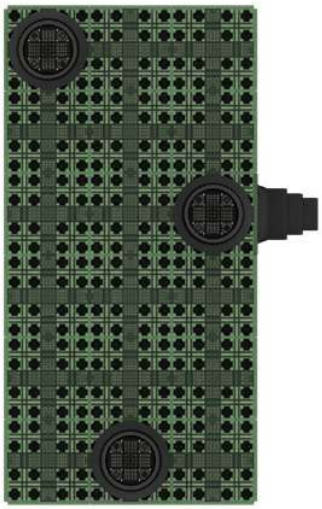
The shaft components are stackable and delivery includes the cone with all required components as shaft package.

Arrangement of inspection shafts

Number of and position in the system are above all determined by the size of the system, access, pipe connections and design of the outdoor facilities.

In order to ensure that flushing of the complete system is possible, each module should comprise at least one inspection shaft. In addition, the shafts should be positioned such that the shaft covers do not interfere with the design of the outdoor facilities, but can easily be accessed by vehicles for maintenance purposes.

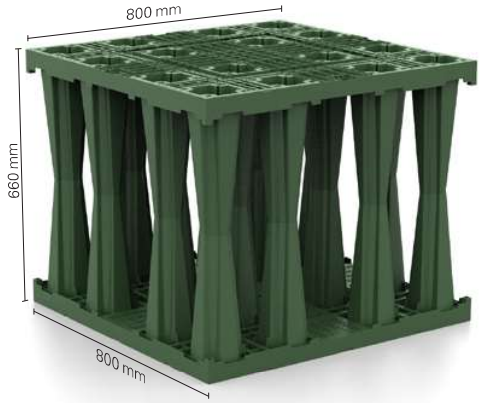
Adjacent shafts should be staggered in the layout.

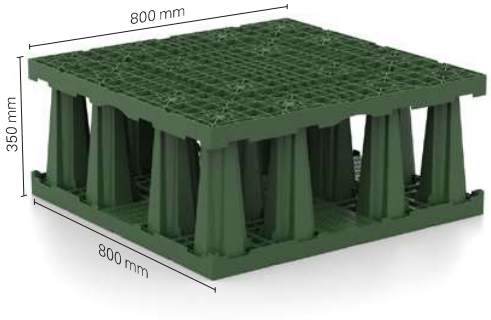


*Rigofill ST product by FRÄNKISCHE

GreenStorm ST* – Design-relevant dimensions

Dimensions





Sidewall grid connection options

Full block connection options
Dia 100 mm, 135 mm, 150 mm, 200 mm,
250 mm, 300 mm, 375 mm et 450 mm

This allows all available nominal diameters to be realised both at the top and the bottom of the module.

GreenStorm ST* – Design-relevant dimensions

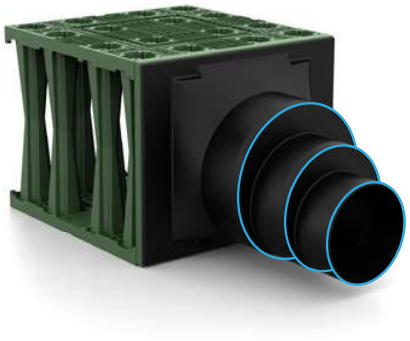
Sidewall grid connection options

Half block connection options
Dia 100 mm, 135 mm, 150 mm, 200 mm
et 250 mm

The side plates can be drilled to the height and desired position within the frame.

Adapter connection options

Connections:
Dia 300 mm, 450 mm
et 525 mm



Outside diameter 315 mm for a pipe diameter 300 mm PVC

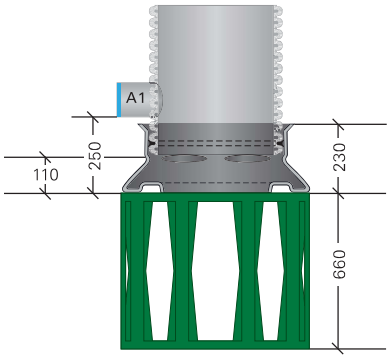
Outside diameter 400 mm for a pipe diameter 450 mm PVC. A flexible sleeve off center is required.

Outside diameter 500 mm for a pipe of diameter 525 mm. A flexible sleeve off center is required

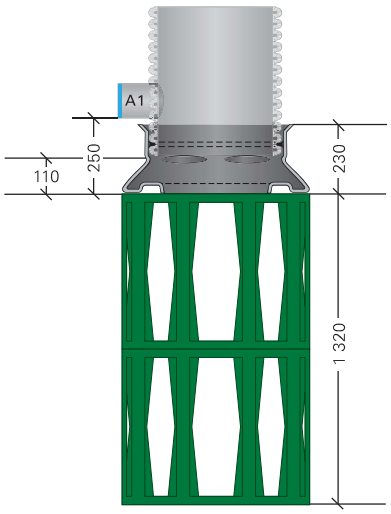
Quadro® Control ST – Design-relevant dimensions

Dimensions of Quadro® Control ST

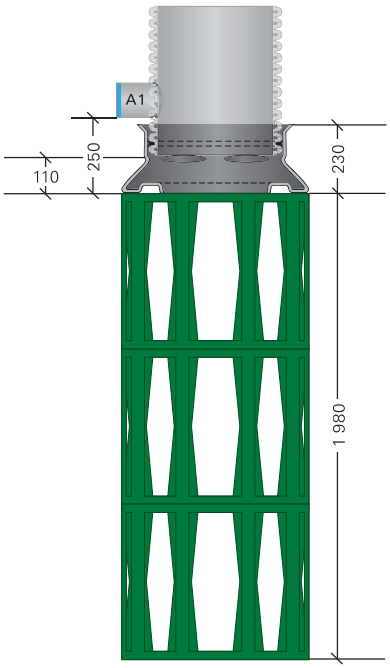
Connection options	
A1	DN/OD 200 or DN/OD 315 connection possible



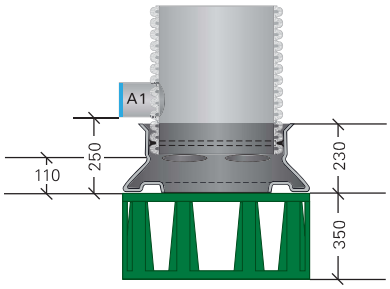
1-layer



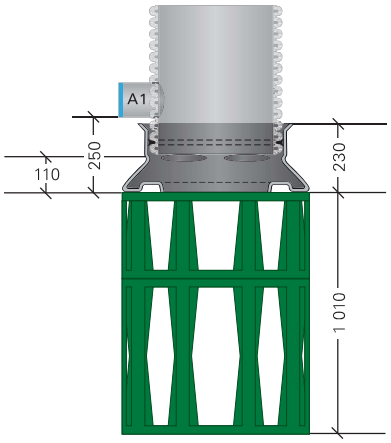
2-layer



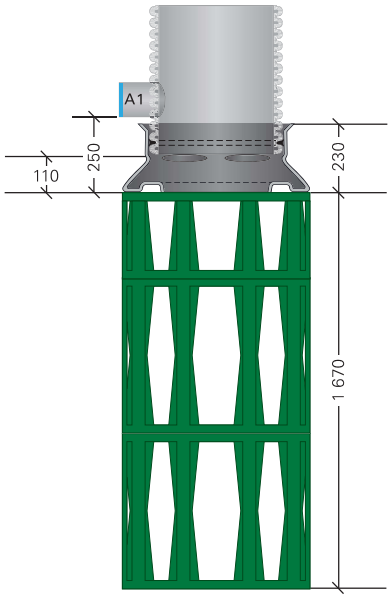
3-layer



1/2-layer



1 1/2-layer

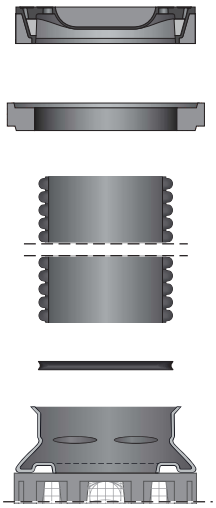


2 1/2-layer

Quadro® Control ST – Design-relevant dimensions

Shaft design of Quadro® Control ST

Structure of inspection shaft

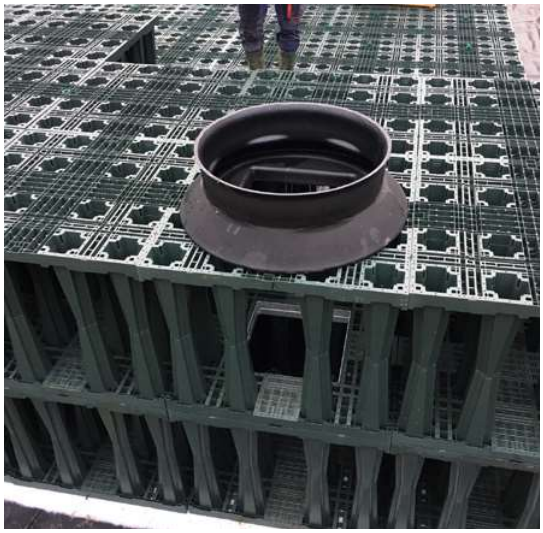


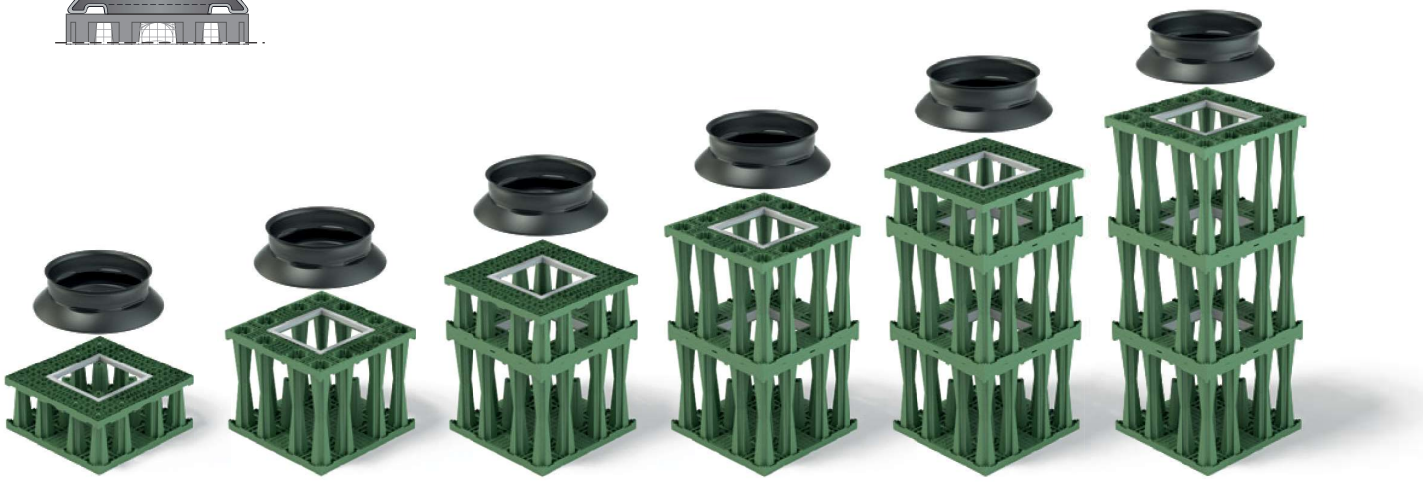
Class B or D
shaft cover acc. to DIN EN 124,
CW 610

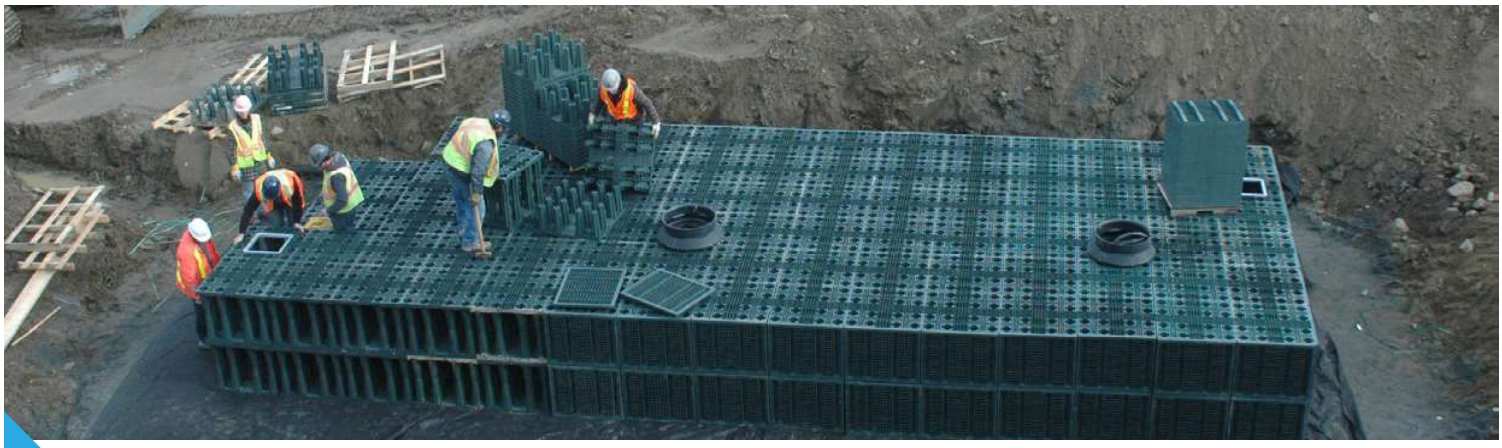
Support ring acc. to DIN 4034,
D_I = 625 mm

Extension pipe
D_O 600

Sealing ring







*Rigofill ST product by FRÄNKISCHE

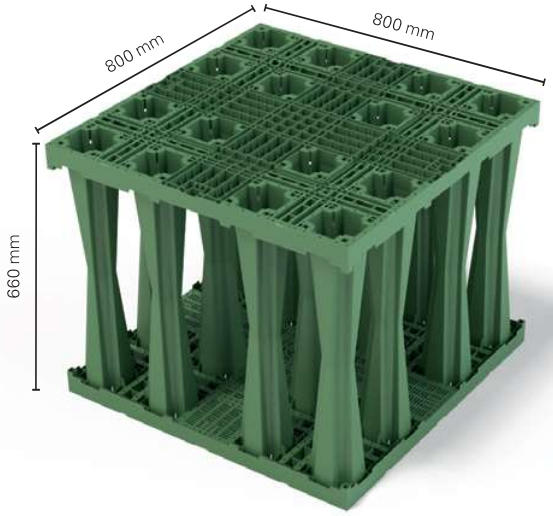
GreenStorm ST*

GreenStorm ST*

GreenStorm ST* IS highly durable and hard-wearing storage/infiltration module with a base of 800 x 800 mm and a height of 660 mm full blocks.

The polypropylene full block consists of two half elements to be installed on site and has a void ratio of more than 96 %. Water can flow through the module three-dimensionally almost without any obstacles. GreenStorm ST* allows for virtually any size and geometry of the systems.

The cross-shaped inspection tunnel in the storage/ infiltration modules has been designed for the use of automotive dollies. This allows the effective drainage surface and the entire system volume with all statically relevant bearing-type fixtures to be inspected.



GreenStorm ST* – half block

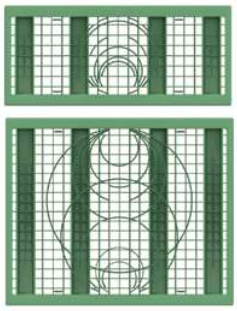
The GreenStorm ST* half block has a base of 800 x 800 mm and a height of 350 mm.

It consists of only one half element which must be assembled with a roof slab on site. This roof slab is only required for the half block. The GreenStorm ST* half block is used in particular for systems with shallow installation depths, e.g., in case of high groundwater levels.

Systems in various heights can be realised in 35 cm steps and adjusted to almost any layout in combination with the full block.

*Rigofill ST product by FRÄNKISCHE

GreenStorm ST* – Accessories



Différentes hauteurs de connexion (indépendamment du diamètre nominal) sont requises au-dessus du fond selon le nombre d'étages :

Nombre d'étages	Hauteur de raccord
0.5-layer	40 mm
1-layer	40 mm
1.5-layer	700 mm
2-layer	700 mm
2.5-layer	1 360 mm
3-layer	1 360 mm

Sidewall grid

The sidewall grids serve as external boundary.

They can be assembled easily using snap connections. The predefined position of the connections at the sidewall grids guarantees that the connections of inlet pipe and outlet pipe and the tunnel are same level. The sidewall grids can be assembled easily also outside the excavation pit.

The sidewall grid for the full block and Quadro® Control ST has a size of W x D x H = 800 x 30 x 660 mm and is suited for connecting lateral solid wall pipes DN 110, 125, 160, 200, 225, 250, 315, 400 and 500.

The sidewall grid for the half block or the half-layer shaft has a size of W x D x H = 800 x 30 x 350 mm and is suited for connecting lateral solid wall pipes DN 110, 125, 160, 200, 225 and 250. In storage/infiltration designs with inside corners, shortened sidewall grids are used at one side.

Adapter

The adapter for GreenStorm ST* has a length of 800 mm and a height of 660 mm and serves as an inlet and outlet connection.

It provides an inlet connection with an optimised flow design with diffusor effect for solid wall pipes DN 315, 400 and 500. It can be connected to GreenStorm ST* easily and quickly thanks to the snap connection.

The predefined position of the snap connection at the module guarantees that inlet pipe and outlet pipe and tunnel connect same level.

The adapter ensures a connection with the same crown, as it is installed turned by 180°.

STORMCON
STORMWATER MANAGEMENT SOLUTIONS

407 Deerhurst Dr. | Brampton | Ontario L6T 5K3 | CANADA
Tel. +1 647 463 9803 | sales@stormcon.ca | www.stormcon.ca