

PROPOSED DEVELOPMENT AT LOW GATE, GOSBERTON
DRAINAGE STRATEGY

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Introduction

A planning application is due to be submitted to South Holland District Council to construct approximately eighty dwellings and associated access roads off Low Gate and York Gardens, Gosberton, near Spalding. The planning authority requires a drainage strategy to be submitted with the application.

For all large developments (more than 10 dwellings) there is a requirement to apply sustainable drainage principles (SuDS) to the disposal of surface water from the site.

The CIRIA SuDS Manual 2015 explains the philosophy of SuDS in Chapter 1 of the manual as follows:

The philosophy of sustainable drainage systems is about maximising the benefits and minimising the negative impacts of surface water runoff from developed areas.

The SuDS approach involves slowing down and reducing the quantity of surface water runoff from a developed area to manage downstream flood risk, and reducing the risk of that runoff causing pollution. This is achieved by harvesting, infiltrating, slowing, storing, conveying and treating runoff on site and, where possible, on the surface rather than underground. Water then becomes a much more visible and tangible part of the built environment, which can be enjoyed by everyone.

The Technical Standards for Sustainable Drainage produced by the Local Authority SuDS Officer Organisation (LASOO) states that generally the aim for should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- 1) Into the ground (infiltration).
- 2) To a surface water body.
- 3) To a surface water sewer or highway drain.
- 4) To a combined sewer.

Site Investigation

A 2.0 metre deep trial hole was excavated on the site in August and this found the subsoil to be silty sand overlying clay, which was found in the bottom 200mm of the hole. No ground water was found. A percolation test was carried out on the site and the rate of fall of the water in the trial pit was very small. The infiltration rate was calculated using methods in BRE Digest 365 and the results are shown in Appendix A. The percolation rate was calculated to be 1.38×10^{-6} m/sec.

Design of Surface Water Disposal

It is concluded that it will be difficult to design suitable soakaways to dispose of the rainwater from the roofs of the proposed buildings on the development. The soakaways would not conform to all aspects of BRE365, particularly the clause requiring the water level in a soakaway to have reduced by 50% within 24 hours.

With regard to the drainage of the roads on the development, in order to comply with SuDS recommendations the option of using permeable block paving with surface water infiltration into the soil beneath the sub base was first considered. However because of the very low infiltration rates LCC would be unlikely to adopt the roads if this method of construction was used.

The following methods of disposal of the surface water are proposed:-

- a) The surface water from the roofs of the houses will discharge directly into the new surface water system. The new surface water system will discharge into a storage facility constructed of Polystorm units or similar which will be located under the public open space.
- b) It is proposed to construct the site access road with impermeable asphalt surfacing. The road immediately surrounding the public space will be cambered towards the swales around this area so surface water drains into these swales. Similarly the eastern end of the access road will flow into the swale on the eastern boundary of the site. The remaining section of road which is an extension of York Gardens will have traditional gullies which will discharge into the surface water system to be constructed under the roads on the site. The areas are shown on the plan below:



Sufficient storage capacity will be provided so that the volume of rainfall from a 1 in 100 year event with a 30% increase for climate change can be retained in the system and then discharged into the IDB watercourse at a rate of 5.0 litres/ second. This will then comply with the SuDS manuals and guidances that recommend that the surface water should be reduced as much as possible to manage downstream flood risk.

Welland and Deepingds IDb have been consulted on the proposed discharge into the dyke on the north western corner of the proposed development. The Board has stated

that there are no objections to the principal of discharging into the IDB system at the rate proposed subject to the following:

- a) The developer applies for discharge consent and pays the Board a development contribution.
- b) The developer agrees to pay the Board's costs to take over a short length of the dyke to allow the discharge to be made into a watercourse maintained by the Board.

A schematic layout of this is shown on page 4 of this report, and initial calculations are shown on pages 4 and 5.

Foul Water

It is assumed the foul water sewer will be located under the new site road which will connect into the existing Anglian Water system in Gosberton.

SCHEMATIC PLAN OF SURFACE WATER DISPOSAL OF ROOF WATER



CALCULATION OF VOLUMES OF ATTENUATION SCHEME

Total area of site = 3.75ha

The impermeable areas from which rainfall needs to be disposed are:

Roofs of 80 No buildings (including garages) 8380 sq m
 Impermeable Roads 6715 sq m
 Total impermeable area 15100 sq m

The volumes of rainfall for various storm durations in a 1 in 100 year event in 2115 can be calculated as follows:

Duration	M5_60min	Z1	M5-D	Z2	M100-D	Intensity mm/hour	Areal Factor	Areal Intensity mm/hour	Area (ha)	Volume cum/hr	Vol + 30% climate Change cum/hr	Total Volume cu m climate	Total Volume cu m	Volume litres/sec
15	24	0.64	15.36	1.98	30.41	121.65	0.94	114.35	1.51	1726.717	2244.73	561.2	431.68	479.644
30	24	0.81	19.44	1.97	38.30	76.59	0.95	72.76	1.51	1098.735	1428.36	714.2	549.37	305.204
60	24	1	24	1.93	46.32	46.32	0.96	44.47	1.51	671.455	872.89	872.9	671.45	186.515
120	24	1.2	28.8	1.89	54.43	27.22	0.97	26.40	1.51	398.633	518.22	1036.4	797.27	110.731
240	24	1.42	34.08	1.86	63.39	15.85	0.97	15.37	1.51	232.114	301.75	1207.0	928.46	64.476
360	24	1.57	37.68	1.83	68.95	11.49	0.98	11.26	1.51	170.065	221.08	1326.5	1020.39	47.240
600	24	1.74	41.76	1.81	75.59	7.56	0.98	7.41	1.51	111.852	145.41	1454.1	1118.52	31.070
1440	24	2.16	51.84	1.81	93.83	3.91	0.98	3.83	1.51	57.854	75.21	1805.1	1388.50	16.071
2880	24	2.5	60	1.81	108.60	2.26	0.98	2.22	1.51	33.480	43.52	2089.2	1607.06	9.300

If an outflow from the system of 5 litres/sec is taken then the volume of attenuation required can be calculated as follows:

Duration mins	Total Rainfall in Duration mm	Total Rainfall Volume cu m into storage facility	Area of Sides of Soakaway	Soil Infiltration Rate	Outflow in storm duration from Polystorm Units	Outflow into IDB Drain at 5 litres/sec	Total Storage Required	Total Time to empty Soakaway hours
15	0.0	561.18	115.2	0.00000138	0.07	4.50	556.61	31.18
30	0.0	714.18	115.2	0.00000138	0.14	9.00	705.03	39.68
60	0.0	872.89	115.2	0.00000138	0.29	18.00	854.60	48.49
120	0.0	1036.45	115.2	0.00000138	0.57	36.00	999.87	57.58
240	0.0	1206.99	115.2	0.00000138	1.14	72.00	1133.85	67.06
360	0.0	1326.50	115.2	0.00000138	1.72	108.00	1216.79	73.69
600	0.0	1454.07	115.2	0.00000138	2.86	180.00	1271.21	80.78
1440	0.0	1805.05	115.2	0.00000138	6.87	432.00	1366.19	100.28
2880	0.0	2089.18	115.2	0.00000138	13.74	864.00	1211.45	116.07

Therefore from the above table it can be seen that a total storage volume of 1370 cu metres is required to store the rainfall from a 1 in 100 year event with 30% increase for climate change.

It is proposed to provide this storage with Polystorm or similar crates under the public open space and by providing swales for the surface water.

The swales around the public open space will each have a top width of 7.0metres and a bed width of 1.0 metre and they will be 500mm deep and each will be 50.0metres in length. This will give a maximum storage volume of 100 cu metres for each swale length giving a total storage volume of 400 cu metres.

The swale on the eastern side of the site will be of similar dimensions to the one around the public open space giving an additional 100 cu metres of storage.

It is proposed that an area of 30 metres x 40 metres x 800mm deep.

A Polystorm unit is 500mm x 1000mm x 400mm deep and each one is capable of storing 0.19 cu m of water. Therefore 4800 units will be provided which will store 912 cu metres of water.

Therefore a total of $912 + 500 = 1412$ cu metres of storage is provided.

ADDITIONAL INFORMATION

- 1) An overflow should be built in to the eastern swale to discharge any excess water into the surface water system
- 2) Similarly an overflow should be built in to the set of four swales in the public open space to discharge into the storage facility.
- 3) The level of the public open space should if possible be 150mm below the level of the roads around this area to act as an emergency storage area in the event of an extreme storm.

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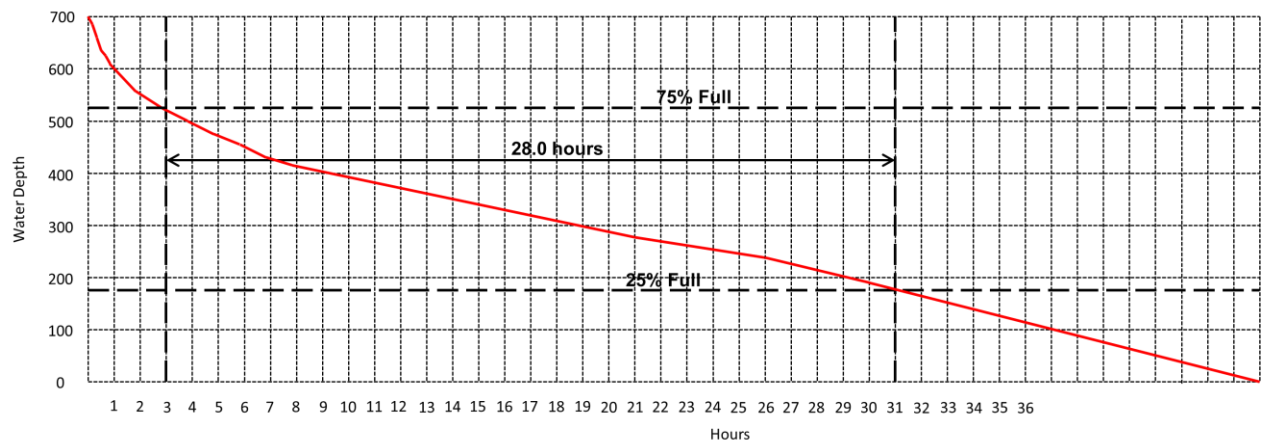
RESULTS OF PERCOLATION TEST

11th July 2016

Results

Hours	Time	Measurement	Water Depth
		mm	
0.00	10.10am	350	700
0.16	10.20am	365	685
0.33	10.30am	390	660
0.50	10.40am	415	635
0.67	10.50am	425	625
0.83	11.00am	440	610
1.83	12.00	493	557
2.83	13.00	525	525
3.83	14.00	550	500
4.83	15.00	575	475
5.83	16.00	595	455
6.83	17.00	620	430
7.83	18.00	635	415
21.00	7.00am	773	277
26.00	12.00	812	238
30.00	16.00	860	190
45.00	7.00am	1050	0

Graph of Water Level and Time



CALCULATION OF SOIL INFILTRATION RATE

On 31st August 2016 a trial hole was excavated to assess the depth of the ground water table on the site. This was excavated to a depth of 2.0 metres when a clay layer was found, but no ground water. On the same day one percolation tests to BRE 365 was carried out on the site. In this test a 1.3m long x 600mm wide hole was excavated 1.05 metres deep. This hole was filled and water soaked away completely in 45 hours. Referring to the graph of the results the time taken to drain between 75% and 25% of the depth filled was 28 hours.

The soil infiltration rate will be calculated as follows:

$$\text{Soil Infiltration Rate} = \frac{V_{p75-25}}{A_{p50} \times t_{p75-25}}$$

Volume outflowing between 75% and 25% effective depth:

$$V_{p75-25} = (0.525 - 0.175) \times 1.3 \times 0.65 = \underline{0.3 \text{ cu m}}$$

The mean surface area through which the outflow occurs, taken to be the pit sides to 50% effective depth and including the base of the pit:

$$A_{p50} = (1.3 \times 0.35 \times 2) + (0.65 \times 0.35 \times 2) + (1.3 \times 0.6) = \underline{2.15 \text{ s m}}$$

The time of outflow between 75% and 25% effective depth

$$t_{p75-25} = 28 \times 60 \times 60 = \underline{100,800}$$

$$\text{Soil Infiltration Rate} = \frac{0.3}{2.15 \times 100,800} = \underline{1.38 \times 10^{-6} \text{ m/sec}}$$