

PROPOSED RESIDENTIAL DEVELOPMENT AT LAND OFF COLBEACH LANE SOUTH, SURFLEET, LINCOLNSHIRE FOR SEAGATE HOMES LTD

DRAINAGE STRATEGY

STUDIO 11
The Boathouse, Harbour Square, Nene Parade, Wisbech PE13 3BH

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00	S11	KB	28.02.2020	Information	Initial Issue
01	S11	KB	06.03.2020	Planning	Planning issue
02	S11	KB	21.09.2020	Planning	Planning update

Introduction
This drainage strategy report has been produced to accompany a planning application to South Holland District Council (SHDC) for a residential development on land off Colbeach Lane South, Surfleet. This document should be read in conjunction with the Concept Drainage Strategy drawing – 415-S11-00-SI-SK-C-9000, and also the Flood Risk Assessment (FRA) undertaken by S M Hemmings.

Site Description
The proposed site covers an area of approximately 2.3 hectares, and is a greenfield site. The proposal is to erect 60 dwellings on the site.

Drainage
For developments of 10 or more dwellings there is a requirement to apply sustainable drainage principles (SuDS) to the disposal of surface water from the site. Generally, the aim should be to discharge surface water 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.

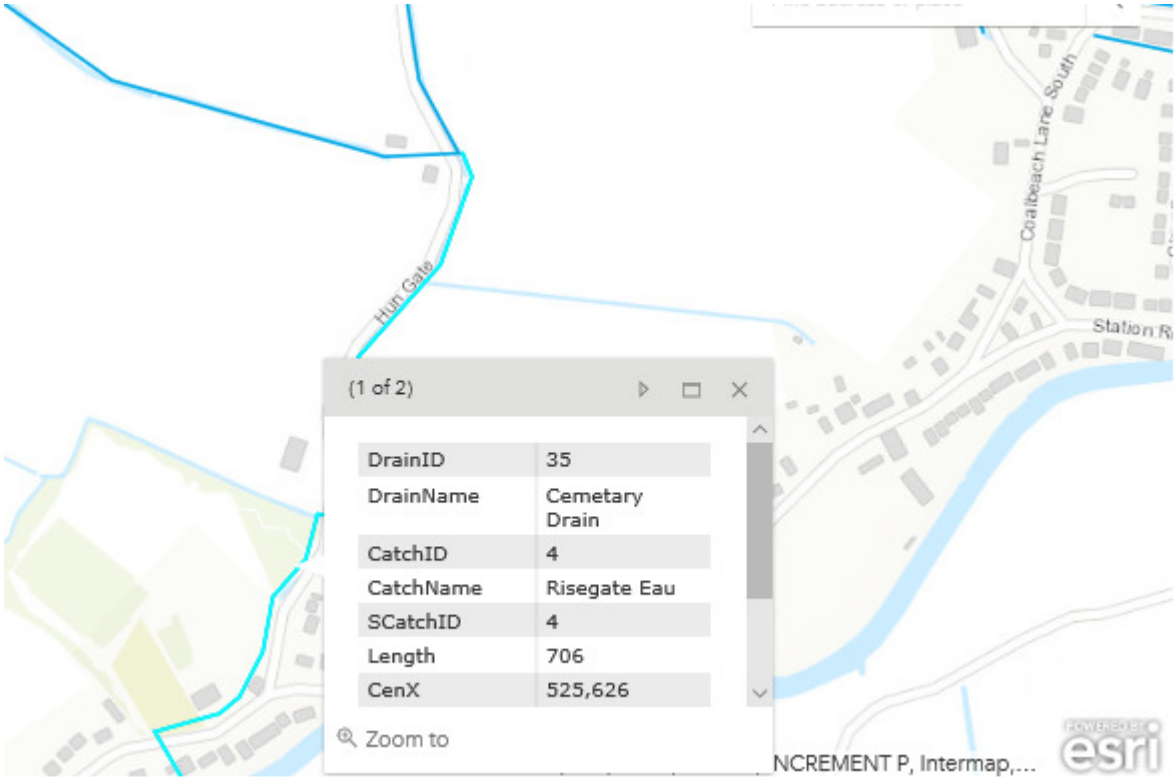
Infiltration
A ground investigation has been carried out by Ground Engineering, report reference No. C14949, and has been supplied as part of the overall planning application. The report notes that the ground water seepages were found up to 1.10m below the existing ground surface which is considered high - the technical requirement is that the water level should be a minimum of 1m below the base of infiltration devices.

Furthermore, the CBR values have been noted to be as low as 1% - typically porous paving would require a CBR of 3% to provide adequate support for the paving.

Lastly the boreholes generally describe the current ground conditions to be silt and clay, which generally provide no to very slow draining ground.

Given the above findings, infiltration has been ruled out on this site as it is not feasible.

Watercourses
There is an existing private shallow ditch which runs to the western perimeter of the site and then from the South West corner of the site through to the Welland and Deepings Internal Drainage Board (IDB) Drain – Cemetery Drain, which forms part of the Risegate Eau catchment. An extract of the IDB asset is shown overleaf.
The existing ditch is currently under riparian ownership and partly under stewardship of the current overall landowner. As part of the land sale, improvement works will be agreed to allow the site to be connect into this area.



Run-off Rates

In line with current guidelines, the developed site shall not exceed the pre-development greenfield run-off rate for the Q_{BAR} event - post development. The greenfield run-off for the site has been calculated in accordance with HR Wallingford's 'Greenfield runoff rate estimation', and their guidance has been followed when entering the data. The proposed run-off from the site will therefore be restricted to a maximum of 2.8l/s. An extract of the existing greenfield runoff is shown below, and the full calculation can be found in appendix A. An impermeable area plan has been provided as part of this application - 415-S11-00-SI-SK-C-9010.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	2.83	2.83
1 in 1 year (l/s):	2.46	2.46
1 in 30 years (l/s):	6.93	6.93
1 in 100 year (l/s):	10.08	10.08
1 in 200 years (l/s):	11.92	11.92

As the actual greenfield run-off from the site and the IDB rates for contribution differs, there will be the need to apply to the IDB for a consent to discharge surface water and pay for a development contribution.

Surface Water - Adopted Highway

As outlined previously, infiltration is not feasible for this site, therefore the SuDS strategy for the surface water highway drainage will be achieved using the provision of surface water conveyance, cleansing and attenuation. The site layout has been designed to provide a filter drain to one side of the carriageway in most cases, although the road will be designed to ensure that the entire carriageway drains to the filter drains. The filter drain will convey and treat the surface water run-off from the carriageways into the attenuation crates. Given the likely shallow gradient of the carriageway, it would be proposed that the filter drain will have an underdrain to provide adequate conveyance and to satisfy the requirements of Lincolnshire County Council (LCC). The filter drain will also provide additional attenuation within the voided stone when the system is surcharged, to lower the risk of flooding in storms of exceedance. As a requirement of LCC, the filter drain will undergo pre-treatment via a 'filter strip'.

Surface Water - Anglian Water Drainage

It is proposed that the general site drainage will be adopted by Anglian Water under a section 104 agreement, and will be designed and constructed to the latest design guidance. Where Anglian Water will not adopt areas of comunial drainage it is proposed that it will be transferred to a management company.

Surface Water - Roofs

Roof water will be collected through a traditional gutter system and discharge either into the permeable paving serving the property's driveways or piped into the proposed.

Surface Water - Private Drives

All private drives will be permeable construction with a voided permeable sub-base and tanked to prevent groundwater entry. At detailed design stage, the porous paving should be utilised to provide additional attenuation during period where the drainage systems water levels are high.

Attenuation Crates

Given the restricted run-off rate from the site of 2.8l/s, the surface water will need to be attenuated before it ultimately enters the IDB watercourse. Storage will be provided in the form of an attenuation crates to the south of the site which during dry periods will be empty. It would be proposed that the online attenuation crates and associated catchpits/manholes be put forward for adoption to Anglian Water during the detailed design stage and section 104 application – subject to meeting their design criteria. In the event that this is not deemed suitable for adoption, the crates and downstream infrastructure will need to be maintained by an appointed management company. Given the high-water levels and low infiltration potential the crates will need to be fully wrapped in impermeable membrane. The crates will need to be checked against floatation at detailed design.

The attenuation crates have been designed to store all storms, up to and including the 1 in 100 year + 40% climate change events. It is expected at detailed design, the engineer will allow for some above ground storage. As this is subject to detailed level design, this will only be possible to establish at detailed design. Preliminary drainage calculations can be found in appendix B.

Pump

As the proposed outfall is so shallow, and to allow the proposed site to drain under gravity, it is necessary for the attenuation crates to be pumped. The packaged pumping station will be maintained by a management company. Pump unit to be complete with dual pumps and high-level alarm.

Existing Ditch

The topographical survey of the existing ditch highlighted that improvement works would be required to ensure that the flow from the site is conveyed into the IDB drain. It is proposed that the existing ditch will be laid to a constant fall of 1:500 from the edge of the site through to the IDB drain. To accommodate this, the final 100m (approximately) of the existing top of bank will need to be widened to accommodate the extra depth. The sides of the re-profiled ditch will be no steeper than 1.5 (horizontal) in 1 (vertical) and incorporate a 500mm flat base.

Flood Routing

In the event of device or feature failure, it is proposed that an overland flow route, in the form of an informal shallow swale will be provided to link into the existing ditch being connected into. This will ensure that flooding will have a safe and managed route which will sit a sufficient distance below the proposed FFL's and surrounding land levels. It is recommended that the base of this will be set at roughly 3.000 AOD.

Water Quality

The methods of surface water disposal mentioned above have included provisions for water quality. In accordance with CIRIA C753, the pollution hazard features for the drainage areas are;

Residential roofs	- Very low
Individual property driveways	- Low
Private access	- Low
Adoptable cul-de-sac	- Low

To remove the pollution risks, CIRA have developed 'Pollution hazard indices' and the 'mitigation indices' that the SuDS components provide, further details of these are found in the tables below.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each containment type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ pollution hazard index
(for each contaminant type) (for each contaminant type)

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required where:

$$\textit{Total SuDS mitigation index} = \textit{mitigation index}_1 + 0.5\ (\textit{mitigation index}_2)$$

Where:

$$\textit{Mitigation index}_n = \textit{mitigation index for component } n$$

Provided the total SuDS mitigation index exceeds the pollution hazard indices, then sufficient water quality will be provided.

For the calculations below the hazards are represented by;
Total suspended solids = Red
Metals = Blue
Hydrocarbons = Green

Roofs

0.2 0.2 0.05 = Permeable Pavement (0.5 0.5 0.6)

It is proposed that roof water will discharge onto or through the permeable pavement and therefore sufficient mitigation has been achived.

Individual property driveways

0.5 0.4 0.4 = Permeable Pavement (0.7 0.6 0.7)

The mitigation provided by the permeable paving satisfies the mitigation index, therefore sufficient treatment has been provided.

Private accessways

0.5 0.4 0.4 = Permeable Pavement (0.7 0.6 0.7)

The mitigation provided by the permeable paving satisfies the mitigation index, therefore sufficient treatment has been provided.

Adopted Cul-de-sacs

0.5 0.4 0.4 = Filter strip (0.4 0.4 0.5) + Filter drain 0.5(0.2 0.2 0.2)-Combined mitigation = 0.5 0.5 0.6

The combined mitigation provided by the three treatment stages above comfortably exceeds the pollution indices, therefore sufficient treatment has been provided.

All the methods above provide enough water quality in accordance with CIRIA's C753 document. Further evidence will need to be provided at detailed design stage.

Finished Floor Levels

All finished floor levels are to be set at a minimum 3.70m AOD, or a minimum of 300mm above existing ground levels in accordance with the Flood Risk Assessment submitted as part of this application.

Foul Water

We have identified the closest Anglian Water foul water sewer which runs in Coalbeach lane South, an extract of the asset map is shown below.



The nearest manholes are 2801 and 2905 and interpolating between these levels gives and approximate invert level of 0.700 AOD at the preferred connection point. Given the sufficient depth of the foul sewer and the proposed FFL's, all foul water will be able to drain via. gravity sewers, subject to an accepted section 106 application from Anglian Water. Exact invert levels at the proposed connection point will need to be confirmed prior to detailed design.

Conclusion

The above drainage strategy demonstrates that the site can be drained appropriately including the use of a Sustainable Drainage System.

The run-off rate from the developed site will be no higher than 2.8l/s for all storm events.

Discharge from the site will ultimately be to a Welland and Deepings maintained drain.

A maintenance strategy will be developed at the detailed design stage.

A drainage sketch can be found on Studio 11's Concept Drainage Strategy drawing: 415-S11-00-SI-SK-C-9000.

As the run-off from the site is being restricted to greenfield run-off the risk of flooding as a result of the site's development will not increase.

Informal conversations have been held between Studio 11 and the Lead Local Flood Authority, and this strategy has been agreed in principle.

Appendices

Appendix A – Greenfield Run-off

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Studio 11
Site name:	Coalbeach Lane
Site location:	Surfleet

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.84539° N
Longitude:	0.12563° W
Reference:	1877469400
Date:	Feb 26 2020 21:47

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 2.0165

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	560	560
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	2.83	2.83
1 in 1 year (l/s):	2.46	2.46
1 in 30 years (l/s):	6.93	6.93
1 in 100 year (l/s):	10.08	10.08
1 in 200 years (l/s):	11.92	11.92

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix B - Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	80.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S1	0.062	5.00	3.400	1200	1.427
S2	0.062	5.00	3.400	1200	1.671
S3	0.063	5.00	3.400	1200	1.706
S4			3.400	1200	1.814
S5	0.043	5.00	3.400	1200	1.455
S6	0.043	5.00	3.400	1200	1.630
S7	0.028	5.00	3.400	1200	1.711
S8	0.028	5.00	3.400	1500	1.924
S9	0.028	5.00	3.400	1500	1.953
S10	0.118	5.00	3.400	1200	1.550
S11	0.043	5.00	3.400	1200	1.663
S12	0.043	5.00	3.400	1500	1.886
S13	0.048	5.00	3.400	1500	1.989
S14	0.049	5.00	3.400	1500	2.039
S15	0.046	5.00	3.400	1500	2.153
S16	0.046	5.00	3.400	1500	2.257
S17	0.045	5.00	3.400	1500	2.281
S18	0.056	5.00	3.400	1500	2.343
S19	0.095	5.00	3.400	1500	2.365
S20	0.095	5.00	3.400	1500	2.391
S21	0.095	5.00	3.400	1800	2.561
S22			3.400	1800	2.571
S23			3.400	1800	2.650
Pump			3.400	1800	2.667

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)
S1	3.400	1.427	1200
S2	3.400	1.671	1200
S3	3.400	1.706	1200

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Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)
S4	3.400	1.814	1200
S5	3.400	1.455	1200
S6	3.400	1.630	1200
S7	3.400	1.711	1200
S8	3.400	1.924	1500
S9	3.400	1.953	1500
S10	3.400	1.550	1200
S11	3.400	1.663	1200
S12	3.400	1.886	1500
S13	3.400	1.989	1500
S14	3.400	2.039	1500
S15	3.400	2.153	1500
S16	3.400	2.257	1500

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Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)
S17	3.400	2.281	1500
S18	3.400	2.343	1500
S19	3.400	2.365	1500
S20	3.400	2.391	1500
S21	3.400	2.561	1800
S22	3.400	2.571	1800
S23	3.400	2.650	1800
Pump	3.400	2.667	1800

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	40	0	0

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Node Pump Online Pump Control

Flap Valve	x	Design Depth (m)	1.200	Switch off depth (m)	0.000
Replaces Downstream Link	✓	Design Flow (l/s)	2.8		
Invert Level (m)	0.733	Switch on depth (m)	0.001		

Depth (m)	Flow (l/s)
1.200	2.800

Node S21 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	0.839
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	800.0	0.0	1.200	800.0	0.0	1.201	0.0	0.0

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Results for 2 year Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	2.056	0.083	11.3	0.0937	0.0000	OK
15 minute winter	S2	10	1.867	0.138	22.2	0.1565	0.0000	OK
15 minute winter	S3	10	1.845	0.151	33.5	0.1708	0.0000	OK
15 minute winter	S4	12	1.778	0.192	33.1	0.2171	0.0000	OK
15 minute winter	S5	10	2.011	0.066	7.8	0.0751	0.0000	OK
15 minute winter	S6	10	1.873	0.103	15.5	0.1169	0.0000	OK
15 minute winter	S7	11	1.815	0.126	20.1	0.1425	0.0000	OK
15 minute winter	S8	12	1.764	0.288	56.6	0.5094	0.0000	OK
15 minute winter	S9	12	1.752	0.305	60.1	0.5397	0.0000	OK
15 minute winter	S10	10	1.965	0.115	21.5	0.1300	0.0000	OK
15 minute winter	S11	11	1.873	0.136	29.0	0.1537	0.0000	OK
15 minute winter	S12	12	1.742	0.228	36.1	0.4034	0.0000	OK
15 minute winter	S13	12	1.739	0.328	99.0	0.5790	0.0000	OK
15 minute winter	S14	12	1.685	0.324	104.7	0.5723	0.0000	OK
15 minute winter	S15	12	1.585	0.338	110.4	0.5976	0.0000	OK
15 minute winter	S16	12	1.523	0.380	116.2	0.6706	0.0000	OK
15 minute winter	S17	12	1.493	0.374	122.0	0.6617	0.0000	OK
15 minute winter	S18	12	1.446	0.389	128.9	0.6880	0.0000	OK
15 minute winter	S19	12	1.411	0.376	141.6	0.6652	0.0000	OK
15 minute winter	S20	12	1.358	0.349	154.6	0.6165	0.0000	OK
1440 minute winter	S21	1410	1.222	0.383	10.7	291.7133	0.0000	OK
1440 minute winter	S22	1410	1.222	0.393	1.2	0.9990	0.0000	OK
1440 minute winter	S23	1410	1.222	0.472	1.1	1.2001	0.0000	OK
1440 minute winter	Pump	1410	1.222	0.489	1.1	1.2434	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	10.9	0.849	0.275	0.3725	
15 minute winter	S2	1.001	S3	22.0	0.654	0.308	0.2849	
15 minute winter	S3	1.002	S4	33.1	0.872	0.464	1.0629	
15 minute winter	S4	1.003	S8	31.9	0.813	0.446	0.4279	
15 minute winter	S5	2.000	S6	7.7	0.560	0.193	0.4090	
15 minute winter	S6	2.001	S7	15.2	0.762	0.383	0.2811	
15 minute winter	S7	2.002	S8	19.9	0.954	0.501	0.2533	
15 minute winter	S8	1.004	S9	55.3	0.662	0.481	0.8089	
15 minute winter	S9	1.005	S13	58.8	0.617	0.511	1.0581	
15 minute winter	S10	3.000	S11	21.2	0.771	0.297	0.7450	
15 minute winter	S11	3.001	S12	28.7	0.930	0.403	1.1382	
15 minute winter	S12	3.002	S13	33.1	0.503	0.220	1.5621	
15 minute winter	S13	1.006	S14	97.3	0.989	0.847	1.5156	
15 minute winter	S14	1.007	S15	103.9	1.039	0.904	3.5326	
15 minute winter	S15	1.008	S16	109.7	1.132	0.954	0.8868	
15 minute winter	S16	1.009	S17	115.6	0.828	0.724	1.4065	
15 minute winter	S17	1.010	S18	120.9	0.846	0.757	3.6058	
15 minute winter	S18	1.011	S19	128.1	0.897	0.802	1.2638	
15 minute winter	S19	1.012	S20	141.1	1.031	0.884	1.4341	
15 minute winter	S20	1.013	S21	152.6	1.311	0.956	4.4701	
1440 minute winter	S21	1.014	S22	1.2	0.232	0.005	0.8005	
1440 minute winter	S22	1.015	S23	1.1	0.156	0.004	3.7216	
1440 minute winter	S23	1.016	Pump	1.1	0.060	0.005	1.7551	
1440 minute winter	Pump	Pump		1.1				74.2

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Results for 30 year Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	12	2.662	0.689	21.4	0.7796	0.0000	SURCHARGED
15 minute winter	S2	12	2.633	0.904	39.7	1.0219	0.0000	SURCHARGED
15 minute winter	S3	12	2.621	0.927	56.3	1.0485	0.0000	SURCHARGED
15 minute winter	S4	12	2.564	0.978	48.6	1.1058	0.0000	SURCHARGED
15 minute winter	S5	13	2.619	0.674	16.6	0.7623	0.0000	SURCHARGED
15 minute winter	S6	13	2.606	0.836	27.4	0.9451	0.0000	SURCHARGED
15 minute winter	S7	12	2.578	0.889	33.9	1.0052	0.0000	SURCHARGED
15 minute winter	S8	12	2.539	1.063	78.9	1.8779	0.0000	SURCHARGED
15 minute winter	S9	12	2.512	1.065	85.6	1.8825	0.0000	SURCHARGED
15 minute winter	S10	12	2.577	0.727	40.7	0.8222	0.0000	SURCHARGED
15 minute winter	S11	12	2.553	0.816	50.7	0.9226	0.0000	SURCHARGED
15 minute winter	S12	12	2.495	0.981	63.5	1.7342	0.0000	SURCHARGED
15 minute winter	S13	12	2.479	1.068	146.0	1.8869	0.0000	SURCHARGED
15 minute winter	S14	12	2.354	0.993	157.3	1.7555	0.0000	SURCHARGED
15 minute winter	S15	12	2.087	0.840	168.8	1.4839	0.0000	SURCHARGED
15 minute winter	S16	12	1.964	0.821	180.2	1.4515	0.0000	SURCHARGED
15 minute winter	S17	12	1.900	0.781	191.2	1.3804	0.0000	SURCHARGED
15 minute winter	S18	12	1.773	0.716	205.1	1.2643	0.0000	SURCHARGED
15 minute winter	S19	12	1.693	0.658	230.7	1.1628	0.0000	SURCHARGED
15 minute winter	S20	12	1.584	0.575	256.4	1.0165	0.0000	SURCHARGED
1440 minute winter	S21	1410	1.499	0.660	17.4	503.2146	0.0000	SURCHARGED
1440 minute winter	S22	1410	1.500	0.671	3.0	1.7069	0.0000	SURCHARGED
1440 minute winter	S23	1410	1.496	0.746	1.6	1.8990	0.0000	SURCHARGED
1440 minute winter	Pump	1410	1.497	0.764	2.8	1.9440	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S2	19.5	0.895	0.491	1.1451	
15 minute winter	S2	1.001	S3	35.8	0.677	0.502	0.5964	
15 minute winter	S3	1.002	S4	48.6	0.912	0.681	1.8297	
15 minute winter	S4	1.003	S8	45.3	0.803	0.634	0.5957	
15 minute winter	S5	2.000	S6	13.4	0.625	0.336	1.1805	
15 minute winter	S6	2.001	S7	24.8	0.796	0.625	0.5509	
15 minute winter	S7	2.002	S8	27.4	0.943	0.689	0.4272	
15 minute winter	S8	1.004	S9	80.0	0.726	0.696	0.9538	
15 minute winter	S9	1.005	S13	88.5	0.803	0.770	1.1770	
15 minute winter	S10	3.000	S11	36.7	0.866	0.514	1.9029	
15 minute winter	S11	3.001	S12	49.5	0.957	0.694	2.5034	
15 minute winter	S12	3.002	S13	53.0	0.524	0.352	1.9988	
15 minute winter	S13	1.006	S14	147.6	1.338	1.284	1.6439	
15 minute winter	S14	1.007	S15	159.7	1.448	1.390	3.7847	
15 minute winter	S15	1.008	S16	171.1	1.551	1.488	0.9754	
15 minute winter	S16	1.009	S17	182.3	1.151	1.142	1.5714	
15 minute winter	S17	1.010	S18	193.3	1.220	1.211	3.9850	
15 minute winter	S18	1.011	S19	206.2	1.302	1.292	1.3935	
15 minute winter	S19	1.012	S20	230.7	1.456	1.445	1.6614	
15 minute winter	S20	1.013	S21	256.9	1.655	1.609	5.6213	
1440 minute winter	S21	1.014	S22	2.8	0.271	0.013	1.0119	
1440 minute winter	S22	1.015	S23	1.6	0.162	0.005	4.2578	
1440 minute winter	S23	1.016	Pump	2.7	0.070	0.012	1.8322	
1440 minute winter	Pump	Pump		1.8				112.5

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Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	S1	17	3.400	1.427	30.2	1.6139	6.8595	FLOOD
15 minute winter	S2	10	3.400	1.671	56.9	1.8899	6.1397	FLOOD
15 minute winter	S3	10	3.400	1.706	79.0	1.9295	4.1704	FLOOD
15 minute winter	S4	10	3.400	1.814	64.2	2.0516	0.3205	FLOOD
15 minute winter	S5	10	3.400	1.455	27.0	1.6456	4.2592	FLOOD
15 minute winter	S6	10	3.400	1.630	35.4	1.8435	4.1895	FLOOD
15 minute winter	S7	10	3.400	1.711	38.3	1.9351	1.5090	FLOOD
15 minute winter	S8	10	3.400	1.924	93.3	3.3997	0.4386	FLOOD
15 minute winter	S9	10	3.400	1.953	104.8	3.4510	0.0051	FLOOD
15 minute winter	S10	10	3.400	1.550	74.2	1.7531	10.3409	FLOOD
15 minute winter	S11	10	3.400	1.663	80.9	1.8809	1.5921	FLOOD
15 minute winter	S12	10	3.400	1.886	92.2	3.3326	0.3403	FLOOD
15 minute winter	S13	10	3.389	1.978	175.7	3.4958	0.0000	FLOOD RISK
15 minute winter	S14	11	3.253	1.892	197.4	3.3425	0.0000	FLOOD RISK
15 minute winter	S15	11	2.944	1.697	219.0	2.9985	0.0000	SURCHARGED
15 minute winter	S16	11	2.776	1.633	236.3	2.8855	0.0000	SURCHARGED
15 minute winter	S17	11	2.676	1.557	253.4	2.7520	0.0000	SURCHARGED
15 minute winter	S18	11	2.458	1.401	284.4	2.4752	0.0000	SURCHARGED
15 minute winter	S19	11	2.306	1.271	341.3	2.2453	0.0000	SURCHARGED
15 minute winter	S20	11	2.068	1.059	398.1	1.8711	0.0000	SURCHARGED
1440 minute winter	S21	1410	2.019	1.180	30.5	899.4681	0.0000	SURCHARGED
1440 minute winter	S22	1440	2.019	1.190	6.3	3.0281	0.0000	SURCHARGED
1440 minute winter	S23	1440	2.020	1.270	5.6	3.2319	0.0000	SURCHARGED
1440 minute winter	Pump	1440	2.022	1.289	5.8	3.2808	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	1.000	S2	19.6	0.895	0.493	1.1451	
15 minute winter	S2	1.001	S3	41.8	0.696	0.585	0.5964	
15 minute winter	S3	1.002	S4	64.2	0.924	0.900	1.8297	
15 minute winter	S4	1.003	S8	53.7	0.824	0.752	0.5957	
15 minute winter	S5	2.000	S6	14.3	0.647	0.360	1.1805	
15 minute winter	S6	2.001	S7	25.6	0.795	0.644	0.5509	
15 minute winter	S7	2.002	S8	34.0	0.965	0.855	0.4272	
15 minute winter	S8	1.004	S9	100.1	0.908	0.871	0.9538	
15 minute winter	S9	1.005	S13	112.4	1.019	0.978	1.1770	
15 minute winter	S10	3.000	S11	55.5	0.882	0.777	1.9029	
15 minute winter	S11	3.001	S12	66.8	0.949	0.936	2.5034	
15 minute winter	S12	3.002	S13	70.8	0.642	0.470	1.9988	
15 minute winter	S13	1.006	S14	180.0	1.632	1.566	1.6439	
15 minute winter	S14	1.007	S15	196.6	1.783	1.710	3.7847	
15 minute winter	S15	1.008	S16	212.8	1.930	1.852	0.9754	
15 minute winter	S16	1.009	S17	229.2	1.446	1.435	1.5714	
15 minute winter	S17	1.010	S18	251.7	1.588	1.576	3.9850	
15 minute winter	S18	1.011	S19	285.1	1.800	1.786	1.3935	
15 minute winter	S19	1.012	S20	342.0	2.159	2.142	1.6614	
15 minute winter	S20	1.013	S21	398.7	2.517	2.497	5.9846	
1440 minute winter	S21	1.014	S22	6.3	0.250	0.029	1.0119	
1440 minute winter	S22	1.015	S23	5.6	0.138	0.018	4.2578	
1440 minute winter	S23	1.016	Pump	5.8	0.128	0.027	1.8322	
1440 minute winter	Pump	Pump		2.8				179.0

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