DRAINAGE STRATEGY

Hoyland Common

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Contents

1 INTRODUCTION 1
1.2 Site Location and Extents 1

2 EXISTING SITE 2
2.1 Description 2
2.2 Existing Drainage Features 2
2.3 Geology and Ground Conditions 3
2.4 Infiltration 3
2.5 Flood Risk 3
2.6 proposed development 4

3 DESIGN CONSTRAINTS / PARAMETERS 5
3.1 Surface Water Drainage Design Constraints 5
3.2 Surface Water Hydraulic Design Variables 5

4 PROPOSED SURFACE WATER DRAINAGE STRATEGY 7
4.1 Discharge Rates 7
4.2 Surface Water Drainage Strategy 7

5 SUDS 9
5.1 Objectives 9
5.2 Strategy 9
5.3 Water Quantity 9
5.4 Water Quality 9

6 MAINTENANCE 13

7 FOUL WATER DRAINAGE 17
7.1 Foul Water Drainage Design 17
7.2 Peak Foul Water Discharge Rate 17
7.3 Pumping 17

8 CONCLUSIONS 18
8.1 Surface Water Drainage Design 18
8.2 Foul Water Drainage Design 18

Appendices

Appendix A Proposed strategic Layout Plans
Appendix B Topographic Survey
Appendix C RPS UK SUDS Calculations
Appendix D RPS MicroDrainage Calculations
Appendix E RPS Drainage Drawings

1 INTRODUCTION

1.1.1 RPS Group has been commissioned by Newlands to prepare the drainage strategy for its site in Hoyland, near Barnsley to support the Hybrid planning application for a development of employment uses (B1, B2 and B8), new link road, associated works including provision of internal access roads, drainage and landscaping

- Outline with all matter reserved apart from means of access for up to 71,515 sq. m of employment uses (B1, B2, B8)
- Full application for 31,568 sq. of B8, new link road including new roundabout to link with Hoyland south Masterplan Area (Local Plan references HS68, HS65, HS61, HS58, HS6, SL5)

1.1.2 The proposed development comprises of a National distribution centre with accompanying haulage, operational and parking areas, alongside multiple open plots for other commercial developments and a single plot for a proposed residential development indicated within the regional council's local plan, refer to **Appendix A**

In addition to the proposed development above, is the requirement for further accompanying infrastructure, including a major highway reconfiguration for the diversion of the A6135/Sheffield road to access the development plots and a significant drainage scheme to cater for the storm water and foul water generated as a result of the development and the new hardstanding areas. This report specifically reviews the main segment of the proposed drainage infrastructure which includes the drainage within the highway, and the main carrier drainage which conveys storm water to the outfalls at the development boundary. This report will not define the strategies for each individual development plot.

1.1.3 The purpose of this report is to confirm the strategy for the foul and surface water drainage systems within Key Phase 4. This report has been prepared in conjunction with a Flood Risk Assessment, RCEF76268.

1.1.4 The contents of this report are to be read in conjunction with all supporting drawings and/or documents referenced herein, appended to this report or submitted in support of the Outline Planning Application for this development.

1.2 Site Location and Extents

1.2.1 The proposed development site is located approximately 6.5km to the south of Barnsley city centre in Yorkshire, at National Grid reference 435439, 399598

1.2.2 The area of the proposed development encompasses an area of a total of 50 ha that extends for a length of around 2km from the proposed diversion of the existing highway (A6135) at the northern end of the site at Tankersley Roundabout, to the southern outfall of the proposed drainage infrastructure, to the east of Tankersley park.

2 EXISTING SITE

2.1 Description

2.1.1 The site from the proposed Hoyland development is located approximately 6.5km south of Barnsley, directly adjacent to the east of junction 36 of the M1 motorway. Approximate National Grid coordinates for the site are 435439mE, 399598mN. The proposed development site comprises of an area of approximately 50 hectares. The existing site currently has several points of access, primarily via Tankersley Lane, Black Lane or Sheffield Road (A6135) which all pass-through different segments of the developable land.

2.1.2 The existing site currently encompasses several areas which have a variety of land uses. At the northern end of the site (directly adjacent to M1 junction 36 and to the north of Tankersley lane), the land is currently utilised for agricultural purposes and sport and leisure events, which include the use of existing football and cricket pitches. At the southern end of the site, the land is predominately agricultural.

2.1.3 The topographical survey for the developable land was undertaken was undertaken in 3 separate phases, with the latest two phases undertaken by Ellam Land Surveys in March 2019 and February 2020. According to the survey there is a general fall in ground level from East to West across the majority of the proposed development site, refer to **Appendix B**

2.1.4 In order to facilitate construction of the proposed commercial developments, it will be necessary to undertake preliminary earthworks to build-up the existing ground levels to create level areas for the construction of commercial units. The required earthworks would primarily be required in the eastern plots where the existing ground levels fall away significantly from east to west.

2.1.5 Geotechnical survey reports have been produced by Applied Geology and form part of this planning submission, reference AG3080-19-AK21 and AG3080-19-AK36

2.2 Existing Drainage Features

2.2.1 Following desktop study and site investigations, it is understood that the existing site has 6 outfall points discharging surface water. These are denoted as follows:

1. Motorway Drain A – this appears to link into the Birdwell Roundabout Attenuation built for the road and collects the existing field run-off within a perimeter French drain
2. Motorway Drain B – this appears to be a low point collecting water from the field and a low ditch collecting from Tankersley Road, this then opens into the field and follows the field boundary to the outfall point. Although no formal outfall could be seen in the dense vegetation but did show signs of ponding water but no water present.
3. Motorway Drain C – this appears to be a low ditch discharging towards the motorway but with no formal c evidence of how it was connected
4. Motorway Sheet flow - this field also included a low point that shed flows of water onto the motorway which had a series of gullies collecting it
5. Eastern Outfall in a 400mm culvert that runs by Sheffield road and connects to a culvert under the railway to the south and entering the Harley Dike
6. Western outfall appears to be a series of ditches and culverts through the Bell Ground woods and the field to the south, eventually entering the Western culvert under the railway to the south and entering the Harley Dike

2.2.2 The Eastern catchment collects approximately 26.1Ha of the proposed development site and connects to the Harley Dike down the eastern edge of the site in an existing Culvert. The Culvert is identified as 400mm on the topographic survey. This culvert is believed to become above ground about 180m to the south beyond the Parkside Farm. This channel then goes below ground and is then assumed to head towards a culvert (unknown size) under the railway, behind the station House building. From the south of the railway line this then meanders to Longley Spring cottage and connects to the Harley Dike as it crosses Sheffield Road. It is not proposed to reutilise this outfall.

The Western catchment collects approximately 16.55Ha of the proposed development site, this is then funnelled by walls and a shallow ditch to the woodland area where it then appears to sheet flow and funnel through low sections of the topography to the Western Culvert and into Harley Dike

The Northern catchment is split into two outfalls, both appearing to connect to Highway agency drains. As the site is re-levelled it is proposed to connect to the Motorway Drain A with site area.

2.3 Geology and Ground Conditions

2.3.1 At present, geotechnical investigations of the development site include basic desktop study, and topsoil analysis report carried out by TIM O'HARE ASSOCIATES in March 2020. The topsoil report has confirmed that the topsoil across site generally comprise of a variety of clay soils. It was noted that the samples collected by the analysis appeared to have undergone structural degradation (albeit this may have been in part caused by damage to the soil during sampling when the soil was wet), and this could indicate that the soils are likely to suffer from a "*lack of drainage and insufficient aeration, particularly in a wet and plastic state*" (TIM O'HARE 2020).

2.3.2 Applied geology Geotechnical survey reports have been produced and form a separate part of this planning submission, reference AG3080-19-AK21 and AG3080-19-AK36

2.4 Infiltration

2.4.1 Based on the Applied Geology geotechnical information available, the site is showing typical infiltration rates with very low infiltration rates not adequate for the use of soakaways. Therefore, at this stage the proposals for the outline drainage strategy is based upon the assumption that there will be no infiltration from the site. However, BRE Digest permeability testing will need to be scheduled to confirm whether the site has any areas viable for surface water infiltration.

2.5 Flood Risk

2.5.1 According to the Flood Risk Assessment, (RPS Report RCEF76268 included as a separate report as part of the Planning application). The site is in a Low Flood Risk Zone (as shown on the EA website);

- As the site is within Flood Zone 1 and is therefore considered to have less than 1 in 1000 annual probability of fluvial flooding.
- There are some small areas of surface water flooding shown within the site, however, these will largely be altered and collected by the development and development drainage.

The risk of flooding from groundwater is considered to be low; the investigative work carried out by Applied Geology did not encounter significant amounts of groundwater.

2.5.2 The SuDS being proposed.

- For the larger units, plots 1 and 2 along with the majority of the road, surface water will be stored within an attenuation pond located at the southern end of the site, discharged at the QBAR discharge rate based only on the area of contributing catchment for the western ditch located to the south of the site.
- Surface water for the residential plot and plot 5 will be attenuated locally and discharged into the southern surface water network at Qbar rates.
- Surface water attenuation to the south will be provided for events up to the 1 in 100 year plus 30% allowance for climate change as required by BMBC.
- For the northern plots surface water attenuation will be provided at a rate of 20.3l/s matching the existing Qbar rate discharging into the Highway drain, this connection is to be formally agreed with BMBC, providing attenuation up to the 1 in 100 year plus 30% climate change allowance.

2.6 proposed development

2.6.1 Primarily it is proposed that the Hoyland development scheme will create a new central UK hub and distribution centre for Hermes courier service. In addition, it is anticipated that the development will facilitate the opportunity and expansion for both Hermes and non-Hermes related commercial business within the district of Hoyland.

The overall development is proposed to be divided into five different plot areas as follows:

- The main plot area for Hermes distribution centre
- Three separate commercial plots for other businesses
- And a separate plot for residential expansion (highlighted within the district council's local plan)

3 DESIGN CONSTRAINTS / PARAMETERS

3.1 Surface Water Drainage Design Constraints

3.1.1 Constraints placed on the design of surface water drainage serving the proposed development are as follows:

- For greenfield developments within the Barnsley metropolitan district, the peak rate of run-off from the development to any surface water body for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield run-off rate for the same event. Therefore, the surface water discharge rate for all storms up to and including the 1 in 100-year return period, with an additional 30% allowance for future climate change will be limited to Qbar. The discharge rates are subject to approval from Barnsley metropolitan district, as Lead Local Flood Authority (LLFA) and the Environment Agency.
- Storm simulations are to be carried out using Flood Studies Report (FSR) rainfall data for all events as agreed with BMBC
- Infiltration is considered to be unviable (see 2.4 above), so it is proposed to convey storm water to two outfalls:
  - Motorway Drain A – It is proposed to convey water from the Northern catchment via this outfall, this has been provisionally agreed with BMBC but is subject to the following conditions of the hierarchy of discharge to ensure that all other avenues (Public Sewer, Watercourse and Soakaways) have been exhausted prior to considering connection to the Highway Drainage system.
  - Western culvert to Harley Dike – It is proposed that the for the surface water from the southern catchment will pass through this outfall after passing through a proposed storage pond, subject to Environment Agency approval.
- On the residential development parcel, impermeable catchments are assumed to be 60%
- Attenuation features to be designed to have 300mm freeboard over the critical 1:100 year + climate change water level.
- The surface water drainage design has been carried out in accordance with C753 'The SuDS Manual', 'Sewage Sector Guidance Appendix C, the Flood and Water Management Act 2010 and any additional requirements set out Barnsley Metropolitan Borough Council (as Lead Local Flood Authority – LLFA), the Environment Agency and the Local Water Authority.

3.2 Surface Water Hydraulic Design Variables

3.2.1 The proposed surface water drainage design has been carried out using the industry standard MicroDrainage software suite, incorporating the following parameters;

- Catchment Area: approximately 50 ha; contributing impermeable area 47Ha
- FSR Data
- FSR Rainfall Model - England & Wales
- PIMP (%) 100
- M5-60 (mm) 19.000
- Ratio R 0.362
- Maximum time of Concentration (mins) 30
- Volumetric Runoff Coefficient 0.750
- Design return periods: 1 in 1, 1 in 30 & 1 in 100 year
- Climate change: Rainfall profiles increased by 30% during the 1 in 100-year event.
- CV (proportion of rainfall forming surface water run-off): Summer 0.75, Winter 0.84
- Maximum allowable discharge rate, refer to **Appendix C** (Qbar, based on contributing area from UK SUDS):

- Northern Catchment area = 4.233Ha – 20.3l/s
- Southern Catchment area = 16.789Ha – 82.41l/s

- Ignore infiltration for peak flow design.

3.2.2 The new surface water drainage systems have been designed to satisfy the following criteria;

i) No surcharging to be permitted during the critical 1 in 1-year return period;

ii) No flooding to be permitted during the critical 1:30 year return period;

iii) Controlled flooding may be permitted during the critical 1 in 100-year return period, with an additional 30% allowance for future climate change.

The proposed drainage system has been modelled as a network within MicroDrainage and simulations have been run for the 1:1, 1:30 and 1:100-year return period, the latter with an additional 30% allowance for future climate change. The MicroDrainage calculations can be found in **Appendix D**.

4 PROPOSED SURFACE WATER DRAINAGE STRATEGY

4.1 Discharge Rates

4.1.1 Due to infiltration being considered unviable for site-wide surface water drainage disposal as discussed in 2.4.1 above, the proposed surface water drainage strategy is to restrict the post-development discharge rate to Greenfield rates for all storms up to the 1:100 year + 30% climate change event, in accordance with the Lead Local Flood Authority (Barnsley Metropolitan Borough Council) requirements. As it is proposed to discharge the flows from the southern catchment to Harley Dike via a storage pond this discharge rate will also be subject to approval from the Environment Agency to ensure that flood risk is not increased downstream of the development.

4.1.2 The Hoyland development has been split into two separate regions (The Northern and Southern Catchments) based on the proposed plot layouts and the existing and proposed levels and will discharge into two existing outfalls;

1. Through a proposed storage pond before discharging into the existing Western culvert joining Harley Dike (An existing EA watercourse)

2. Via an existing outfall connecting into the existing BMBC highway drainage on the north-western side of the development land at Birdwell Roundabout

Using UK SUDS, existing rural run-off rates for each of the development areas have been calculated and the flow rates summarised within each catchment as tabulated below;

The UK SUDS calculations can be found in **Appendix C.**

4.2 Surface Water Drainage Strategy

4.2.1 As stated in 4.1.2 above, the catchment that will be served by the two new networks totals approximately 50Ha. In terms of impermeable area post-development, the contributing area has been estimated based on a proposed density of

- 95% per parcel for plot 1 and 2
- 90% per parcel for plot 3, 4 and 5
- 60% for the residential plot
- 100% for all roads
- 30% for Green banks

4.2.2 It is proposed to install an adopted underground piped gravity system to serve the Hoyland development that will incorporate spurs into each future development plot to allow for future connections. In terms of the site wide drainage system, this is a robust approach as the plot catchments are taken into the network as single point inflows, plot with minimal allowance for the potential storage in the upstream pipe networks with plots.

4.2.3 Each system has been designed in line with 'Sewage Sector Guidance Appendix C. Cut-off filter drains will also be incorporated to deal with areas of soft landscaping that are to be reprofiled due to the earthworks operations; these filter drains will be lined with impermeable membranes as infiltration is considered effectively unviable at the site.

4.2.4 In order to achieve the restricted discharge rate, it will be necessary to provide attenuation storage. As per the original Outline Planning application for the Southern and Northern catchment, this volume will be provided by a combination of storage features. It is proposed that the storage within the southern catchment will be within a proposed pond constructed upstream of the outfall at the western culvert directly adjacent to Bell woods, with attenuation for plot 5 and 6 done within each plot. Within the northern catchment it is proposed that storage will be provided within each individual plot, before discharging into the public highway drainage at motorway drain A adjacent to Birdwell roundabout.

4.2.5 Immediately downstream of the proposed storage pond, it is intended to install a flow control, Hydro-brake or similar equivalent, that will control the flows sufficiently to ensure that even during the critical 1 in 100 year event, surface water discharge from the Southern catchment does not exceed 82.4l/s.

4.2.6 In the Northern catchment it is proposed that the flows from the northern plots will be controlled by a hydro break before discharging into the existing motorway drain which flows into existing storage pond situated within the central island of Birdwell roundabout. It is proposed that the flows from the northern plots will be limited to the existing greenfield run-off rate from the site of 20.3l/s

5 SUDS

5.1 Objectives

5.1 Surface water runoff on new developments should be managed at source, with flows controlled to mimic the natural pre-development rates to reduce downstream impact wherever possible. Water should be conveyed through SuDS components of the surface water management train to ensure effective pre-treatment and appropriate flow control prior to discharge from site, thus giving due consideration to water quality and water quantity whilst creating & sustaining better places for people and nature, local amenity & diversity.

5.2 Strategy

5.2.1 The general drainage strategy for the proposed site is based on SuDS, in accordance with CIRIA C753 'The SuDS Manual' to reduce the impact on the receiving watercourse.

5.2.2 In addition to the water flow and quality benefits, the on-site SuDS measures seek to provide biodiversity enhancements for the local environment. The nature and location of the future development would suggest a lesser importance is placed with regards to potential amenity benefits.

5.3 Water Quantity

5.3.1 Run-off from the Hoyland development will be restricted to a combined total of 102.7l/s, equivalent to the pre-development Qbar flow rate for the outfall catchments but substantially smaller the total site Qbar rate as the site collects and diverts flows from other catchments.

5.3.2 This restricted discharge will be achieved using individual on-plot SuDS storage features in the northern catchment before discharging to an existing pond located in Birdwell roundabout. In the southern catchment a storage pond will be used before the southern rail culvert crossing. As per Chapter 23 of C753 'The SuDS Manual', the attenuation will be located immediately upstream of the proposed outfalls. These features are illustrated on RPS drawing **HOYLA-RPS-SI-XX-DR-D--0300-302** included in **Appendix E**. Discharge from these attenuation features is controlled via vortex flow controls installed immediately upstream of the outfalls from the site.

5.4 Water Quality

5.4.1 Surface water quality management is an important requirement for all storm drainage proposals. The proximity of Plots 1 and 2 to the existing site of bell woods as a wildlife site highlights importance to this issue on the development. With regards to the quality of the discharge from site, C753 describes a Simple Index Approach based on assessing the pollution hazard indices for a particular catchment / development and also providing indicative mitigation indices for typical SuDS features. Table 26.2 of C753 extracted below identifies pollution hazard indices for the varying land usage pertinent to this application.

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]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Based on the above, the proposed development can be broken down and categorised as follows:

Catchment	Pollution Hazard Level	TSS	Metals	Hydrocarbons
Roofs	Low	0.3	0.2	0.05
Highways	Medium	0.7	0.6	0.7
Commercial Haulage yard	High	0.8	0.8	0.9

5.4.2 Table 26.3 indicates indicative pollution hazard level mitigation indices for different SuDS measures

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.		

Notes

1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.

2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.

3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.

4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.

5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **http://tinyurl.com/qf7yuj7**

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

5.4.3 Based on Tables 26.2 & 26.3 illustrated above, the ponds should provide the majority of treatment required for the run-off from the proposed infrastructure development except for hydrocarbons. However, when used in combination with individual plot SuDS features such as lined paving, permeable paving or filter drains. this will provide enough treatment to mitigate the pollutive impact of the development on storm water drainage system.

5.4.4 In order to resolve the individual requirement for additional treatment for hydrocarbons associated with the roads, SDS Aqua-Swirls are proposed for the northern outfall along with in plot controls and for the southern outfall the Pond and an outfall Swale as secondary cleansing. While typical mitigation indices for such devices are not currently available, the 'Aqua-swirl' vortex separator manufactured by SDS Limited has been advised to achieve the figures references within 5.4.6 below.

5.4.5 In addition to the quantity and quality improvements discussed above, using ponds for the attenuation storage can provide amenity benefits to the local community, as well as and biodiversity benefits to the local environment.

5.4.6 The following table provides details of the proposed water quality treatments associated with the potential pollutants from the site wide catchments;

Southern Catchment	Pollution Hazard Level	TSS	Metals	Hydrocarbons
		Pollutants		
Roofs	Low	0.3	0.2	0.05
Highways	Medium	0.7	0.6	0.7
Worse case	**Medium**	**0.7**	**0.6**	**0.7**
		Mitigation		
Ponds		0.7	0.7	0.5
Remaining		**0.0**	**0.0**	**0.2**
Where the ponds alone are not enough to mitigate the potential pollutants (In particular hydrocarbons) associated with the development therefore additional mitigation is required.				
		Additional Mitigation		
Swale		0.25 (1/2 0.5)	0.3 (1/2 0.6)	0.3 (1/2 0.6)
Remaining Pollutants		**0.0**	**0.0**	**0.0**

Northern Catchment	Pollution Hazard Level	TSS	Metals	Hydrocarbons
		Pollutants		
Roofs	Low	0.3	0.2	0.05
Highways & commercial yards	Medium	0.7	0.6	0.7
Worse case	**Medium**	**0.7**	**0.6**	**0.7**
		Mitigation		
SDS AquaSwirl		0.8	0.5	0.7
Remaining		**0**	**0.1**	**0**
Where the ponds alone are not enough to mitigate the potential pollutants (In particular the hydrocarbons) associated with the development therefore additional mitigation is required.				
		Additional Mitigation		
Oil Separators		0.4	0.2	0.2
Remaining Pollutants		**0.0**	**0.0**	**0.0**

6 MAINTENANCE

The following information indicates the typical maintenance regime that will need to be implemented by the Developer / End User to ensure continued satisfactory operation of the site drainage systems. The maintenance activities would be split into three categories, namely Regular, Occasional & Remedial, as detailed in the table below;

TABLE 32.1 Typical key SuDS components operation and maintenance activities (for full specifications, see Chapters 11–23)

Operation and maintenance activity	SuDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter drain	Modular storage	Pervious pavement	Swale/bioretention/ trees	Filter strip	Green roofs	Proprietary treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter and debris removal	■	■	■	■	□	■	■	□	■	■	■		□
Grass cutting	■	■	■	■	□	■	■	□	□	■	■		
Weed and invasive plant control	□	□	□	□		□	□		□		□	■	
Shrub management (including pruning)	□	□	□	□					□	□	□		
Shoreline vegetation management	■	■	□										
Aquatic vegetation management	■	■	□										
Occasional maintenance													
Sediment management[1]	■	■	■	■	■	■	■	■	■	■	■		■
Vegetation replacement	□	□	□	□						□	□	■	
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation /repair	□	□	□	□	□	□	□	□	□	□	□	□	
Infiltration surface reconditioning				□	□	□	□		□	□	□		

Key

■ will be required

□ may be required

Notes

1 Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

Regular maintenance consists of basic tasks carried out on a frequent and predictable schedule, including inspections/monitoring, silt or oil removal (if required more frequently than once per year), sweeping of surfaces and litter/debris removal.

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis that the regular tasks. Guidance on the components pertinent to this drainage proposal are detailed in the extracted Table 16.1 below.

Remedial maintenance comprises the intermittent tasks that may be required to rectify faults associated with system, although the likelihood of faults can be minimised by good design, construction and regular

maintenance activities. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, so timings are difficult to predict.

In addition to general cleaning, Tables 16.1 and 23.1 indicate the minimum required maintenance regime that needs to be implemented post construction for the SuDS elements that will comprise the bulk of the proposed drainage system – see extracts from C753 below. In addition to this, Table 14.2 indicates the potential maintenance requirements for the proprietary 'Aqua-swirl' vortex separators and full retention separators, however further advice would need to be sought from the Manufacturers.

TABLE 16.1 Operation and maintenance requirements for filter drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

TABLE 23.1 Operation and maintenance requirements for ponds and wetlands

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices, eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

TABLE 14.2 An example of operation and maintenance requirements for a proprietary treatment system

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

It is currently understood that unless the site or individual plots of the site are sold (typically the commercial development parcels), the responsibility for the maintenance of the core drainage system will lie with the Developer, Newlands Developments. The foul and surface water drainage networks are proposed to be adopted by Yorkshire water when the site reaches 50% occupancy, until which time the maintenance will be the responsibility of Newlands Developments. The newly proposed pond will not be adopted, so will require future maintenance provided by a maintenance contract, it is anticipated that pond maintenance will be linked with the maintenance requirements for the Green spaces within the Southern catchment plots 1 2 and 5

7 FOUL WATER DRAINAGE

7.1 Foul Water Drainage Design

It is proposed to design and construct a new below ground foul water drainage system to convey commercial wastewater from the proposed development plots to the existing Yorkshire Water public sewer network to the northeast of the application area. The drainage network for the Hoyland Development will be constructed on the perimeter of the site areas and situated within the proposed highway network as illustrated on RPS drawing **HOYLA-RPS-SI-XX-DR-D-0300-301** included in **Appendix E.** It is envisaged that the entire network will be designed and constructed in accordance with 'Sewage Sector Guidance Appendix C as well as BS EN 752. The development network will be subject to a S104 agreement with Yorkshire Water. Yorkshire Water retain the rights to a full S104 agreement for the development until the site is fully developed. The proposed residential development is proposed to have a separate foul water connection not associated to this development

7.2 Peak Foul Water Discharge Rate

'Sewage Sector Guidance Appendix C' has been used to calculate the peak foul flows from the residential, commercial and school. The following breakdown applies:

Commercial – 0.6l/s/ha

Peak Flows Hoyland development

Type	No. Units/Area	Peak Flow (l/s)
Commercial	39.61 ha	23.766 l/s
	Total	**23.766 l/s**

7.3 Pumping

Due to the site's low-lying ground levels and scarce availability of any existing foul drainage networks, close in proximity to the Hoyland Development site, this has forced a requirement for a section of the foul drainage system to be pumped in order to reach the nearest public foul drainage network located in Fitzwilliam street to the Northeast. The proposed pumping station will be offered to YWS for adoption and will discharge at 23.8l/s (or as agreed with YWS) with its own emergency storage with telemetry control to manage flows.

It is anticipated that the proposed pumping station will need to be designed for adoption in accordance with the standards required by Yorkshire Water

Based on SSG v2 the pumping station will require an emergency storage of: 3hr x Peak rate:

Type	No. Units/Area	Peak Flow	Storage (m^3)
Commercial	39.61 ha	23.766 l/s	256.7
	Total		**256.7m3**

And the pumping station will need to pump at a rate of 23.8l/s:

8 CONCLUSIONS

8.1 Surface Water Drainage Design

8.1.1 The proposed surface water network has been designed to be incorporated into the proposed landscape providing both amenity and environmental benefits. It will provide the Hoyland development area with a sustainable drainage network to manage extreme storm events up to 1 in 100 year + 30% (Climate Change) storm events.

a. The entire surface water network in The Hoyland development has been designed in accordance with Sewage Sector Guidance Appendix C as well as BS EN 752. The development network will be subject to a S104 agreement from Yorkshire Water.

b. The proposed Network will provide betterment to the greenfield runoff currently discharging from this site as flows have been limited to Qbar rates for the existing site catchments to each outfall used, but includes for area outside of those catchments so will reduce the catchment area and subsequent flooding risk for the Eastern catchment and the M1 motorway drains..

8.2 Foul Water Drainage Design

8.2.1 The proposed foul water network will provide the Hoyland development area with a sustainable gravity foul drainage network, linked to an adopted pumping station.

a. The entire foul water network in the Hoyland development has been designed in accordance with Sewage Sector Guidance Appendix C as well as BS EN 752. The development network will be subject to a S104 agreement from Yorkshire Water.

APPENDICES

Appendix A

Proposed strategic Layout Plans

Areas Schedule

Plot No.	Warehouse GIA sqft	Warehouse GIA sqm	Offices GIA sqft	Offices GIA sqm	**Total GIA sqft**	Total GIA sqm	Cars Parking	HGV Parking	Docks
1	298700	27750	40594	3771	**339821**	31571	650	595	163
2	480000	44593	44800	4162	**524800**	48755	380	133	64
Total	778700	72343	85394	7933	**864621**	80326	1030	728	227

Note: total Area figure for plot 1 includes VMU / gatehouse areas (as area schedule on Site Plan)

net site area
4.92ha

net site area
18.00ha

net site area
10.47ha

APPLICATION RED LINE AREA

Overhead Electricity Cables
No Building Zone hatched Blue

Revision:

P1	first issue	29mar2019 PL
P2	Unit 2 scheme added	09dec2019 PL
P3	Unit 2 layout updated	10dec2019 PL
P4	layout updated	16dec2019 PL
P5	new road design, redline adjusted	29jan2020 PL
P6	residential site access proposal indicated	29jan2020 PL
P7	small commercial site layouts added	31jan2020 PL
P8	areas table corrected	03feb2020 PL
P9	updated following comments	03feb2020 PL
P10	net site areas noted	03feb2020 PL
P11	plot 2 changed to 2 units	12feb2020 RM
P12	road updated, ponds added	24feb2020 PL
P13	plot 2 amended to single unit	25mar2020 RM
P14	new RPS road design update	13apr2020 PL
P15	balancing pond, road and red line amended	15apr2020 RM
P16	Minor update to road	20apr2020 JM
P17	roundabout and Plot 2 access update	28apr2020 PL
P18	net site plot areas adjusted and shown	07may2020 PL
P19	plateau contours updated	19may2020 PL
P20	further earthworks update	20may2020 PL
P21	redline and road update	21may2020 PL
P22	acoustic fence, generator added, areas update	29may2020 PL
P23	acoustic barrier extent updated	04jun2020 PL
P24	Area Table corrected	10jun2020 PL
P25	Plot 5 access added	15jun2020 PL

0 50m 100m SCALE 1:2500

N

Hoyland Common
Barnsley M1, J36

newlands developments

pHp Architects
www.peter-haddon.com

Masterplan

Drawing Status:	Preliminary
CAD Reference:	4400-001
Drawn:	PL
Date:	feb2020
Scale @A1:	1/2500

Project No:	Drawing No:	Rev:
4400	001	P25

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Hoyland North
Masterplan Framework Area
(visible extents)

Birdwell Roundabout

Plot 4
(EMP)
2.03ha

Plot 3
(EMP)
5.09ha

Hoyland Common
Primary School

B6096 Hoyland Road

HOYLAND COMMON

M1

Tankersley Lane

Plot 6
(RESI)
2.53ha

Plot 5
(EMP)
1.70ha

A6135 Sheffield Road

Potential Access into
Sports & Community
Facilities

Plot 1
(EMP)
18.35ha

Plot 2
(EMP)
9.02ha

Hoyland South
Masterplan Framework Area
(visible extents)

Bell Ground

ATTENUATION

DRAFT

NOTES
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Ordnance Survey base mapping - supplied by client.

N

0 50 100 150 200 250m

KEY

- Allocation Site Boundary
- Approximate Extent of Existing Vegetation (based on aerial image)
- Approximate Location of Overhead Wires (with 30m clearance zone)
- Existing Public Rights of Way
- Employment Parcels (approx 34.05ha)
- Residential Parcels (approx 2.53ha)
- Proposed Spine Road
- Access Points
- Indicative Location of Attenuation Features
- Proposed Buffer Planting
- Inidicative Green Link

Newlands Developments
Hoyland West,
Hoyland

CAPACITY PLAN

1:2500 @ A1
17 April 2020 CC / DH
9295-L-02 rev **I**

masterplanning
environmental assessment
landscape design
urban design
ecology
architecture
arboriculture

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w: www.fpcr.co.uk

File: K:\9200\9295\LANDS\Plans\9295-L-02I Capacity Plan.vwx

Appendix B

Topographic Survey

BMBC
Drain A

Unknown how it is collected

400mm Culvert

150mm culvert

O/H Power 11KV?

225mm culvert

O/H Power 11KV?

O/H telecom?

Buried telecom?

225mm culvert

Eastern Culvert

Existing watercourse Harley Dike

Western Culvert
- Northern inlet

Brick Circular Culvert approximately 1200mm
- Southern outfall

Twin wall with an Althon Headwall approximately 1350mm

Appendix C

RPS UK SUDS Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Joshua Battram
Site name:	Hoyland Northern Catchment
Site location:	Hoyland - Barnsley

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:	53.49768° N
Longitude:	1.47146° W
Reference:	1473594626
Date:	Apr 01 2020 10:39

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 4.229

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	696	696
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

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):	20.28	20.28
1 in 1 year (l/s):	17.44	17.44
1 in 30 years (l/s):	35.49	35.49
1 in 100 year (l/s):	42.18	42.18
1 in 200 years (l/s):	48.06	48.06

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.

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	scott mclean
Site name:	Hoyland Common
Site location:	Southern Outfall

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:	53.48500° N
Longitude:	1.46056° W
Reference:	3992267808
Date:	Apr 07 2020 21:29

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 16.789

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	710	710
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

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):	82.41	82.41
1 in 1 year (l/s):	70.87	70.87
1 in 30 years (l/s):	144.22	144.22
1 in 100 year (l/s):	171.42	171.42
1 in 200 years (l/s):	195.31	195.31

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Appendix D

RPS MicroDrainage Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.60	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	3.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	0.00	Maximum Backdrop Height (m)	0.000
Persons per House	0.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	0.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	38.372	0.385	99.7	1.640	0	0.0	1.500	o	150	Pipe/Conduit	
F2.000	23.287	2.155	10.8	0.895	0	0.0	1.500	o	150	Pipe/Conduit	
F1.001	35.042	0.235	149.1	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.002	48.969	0.330	148.4	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F3.000	20.272	2.030	10.0	0.695	0	0.0	1.500	o	150	Pipe/Conduit	
F1.003	27.103	0.185	146.5	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F4.000	36.849	0.460	80.1	3.720	0	0.0	1.500	o	150	Pipe/Conduit	
F1.004	46.206	0.310	149.1	0.000	0	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	143.600	1.640	0.0	0	0.0	44	0.67	0.88	15.5	3.0
F2.000	145.390	0.895	0.0	0	0.0	19	1.22	2.68	47.3	1.6
F1.001	143.215	2.535	0.0	0	0.0	62	0.66	0.72	12.7	4.6
F1.002	142.980	2.535	0.0	0	0.0	62	0.66	0.72	12.7	4.6
F3.000	144.680	0.695	0.0	0	0.0	17	1.16	2.78	49.2	1.3
F1.003	142.650	3.230	0.0	0	0.0	71	0.71	0.72	12.8	5.8
F4.000	142.925	3.720	0.0	0	0.0	65	0.92	0.98	17.3	6.7
F1.004	142.465	6.950	0.0	0	0.0	121	0.82	0.72	12.7	12.5

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Network Design Table for Foul

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F5.000	15.967	1.600	10.0	1.210	0	0.0	1.500	o	150	Pipe/Conduit	
F1.005	84.487	0.845	100.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.006	57.596	0.575	100.2	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.007	51.956	0.520	99.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.008	52.231	0.520	100.4	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.009	62.418	0.625	99.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.010	49.956	0.500	99.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F6.000	12.654	1.265	10.0	1.918	0	0.0	1.500	o	150	Pipe/Conduit	
F1.011	41.947	0.350	120.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.012	39.145	0.325	120.4	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.013	65.035	0.540	120.4	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.014	90.000	1.865	48.3	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F7.000	29.404	0.160	183.8	19.240	0	0.0	1.500	o	300	Pipe/Conduit	
F1.015	67.371	0.265	254.2	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.016	53.855	0.210	256.5	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.017	71.232	1.265	56.3	0.000	0	0.0	1.500	o	300	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F5.000	143.755	1.210	0.0	0	0.0	22	1.38	2.78	49.2	2.2
F1.005	142.080	8.160	0.0	0	0.0	88	1.02	1.15	45.6	14.7
F1.006	141.235	8.160	0.0	0	0.0	88	1.02	1.15	45.6	14.7
F1.007	140.660	8.160	0.0	0	0.0	88	1.02	1.15	45.7	14.7
F1.008	140.140	8.160	0.0	0	0.0	88	1.02	1.15	45.5	14.7
F1.009	139.620	8.160	0.0	0	0.0	88	1.02	1.15	45.7	14.7
F1.010	138.995	8.160	0.0	0	0.0	88	1.02	1.15	45.7	14.7
F6.000	139.835	1.918	0.0	0	0.0	27	1.59	2.78	49.1	3.5
F1.011	138.495	10.078	0.0	0	0.0	104	1.01	1.05	41.6	18.1
F1.012	138.145	10.078	0.0	0	0.0	104	1.01	1.05	41.6	18.1
F1.013	137.820	10.078	0.0	0	0.0	104	1.01	1.05	41.6	18.1
F1.014	137.280	10.078	0.0	0	0.0	81	1.41	1.65	65.8	18.1
F7.000	135.500	19.240	0.0	0	0.0	146	1.01	1.02	72.2	34.6
F1.015	135.340	29.318	0.0	0	0.0	215	0.97	0.87	61.3	52.8
F1.016	135.075	29.318	0.0	0	0.0	216	0.97	0.86	61.1	52.8
F1.017	134.865	29.318	0.0	0	0.0	133	1.75	1.85	130.8	52.8

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Network Design Table for Foul

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.018	60.817	2.950	20.6	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.019	85.094	2.260	37.7	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F1.020	73.598	2.105	35.0	0.000	0	0.0	1.500	o	300	Pipe/Conduit	
F8.000	16.723	0.140	119.5	10.290	0	0.0	1.500	o	225	Pipe/Conduit	
F1.021	2.480	0.010	248.0	0.000	0	0.0	1.500	o	375	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.018	133.600	29.318	0.0	0	0.0	101	2.53	3.06	216.4	52.8
F1.019	130.650	29.318	0.0	0	0.0	118	2.03	2.26	160.0	52.8
F1.020	128.390	29.318	0.0	0	0.0	116	2.09	2.35	166.1	52.8
F8.000	126.500	10.290	0.0	0	0.0	105	1.02	1.05	41.7	18.5
F1.021	126.210	39.608	0.0	0	0.0	217	1.07	1.02	112.3	71.3

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PIPELINE SCHEDULES for Foul

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	150	FC3b	145.600	143.600	1.850	Open Manhole	1200
F2.000	o	150	FC4b	148.300	145.390	2.760	Open Manhole	1200
F1.001	o	150	F1	147.200	143.215	3.835	Open Manhole	1200
F1.002	o	150	F2	147.725	142.980	4.595	Open Manhole	1200
F3.000	o	150	FC4b2	148.600	144.680	3.770	Open Manhole	1200
F1.003	o	150	F3	148.100	142.650	5.300	Open Manhole	1200
F4.000	o	150	FC3a	145.600	142.925	2.525	Open Manhole	1200
F1.004	o	150	F4	148.110	142.465	5.495	Open Manhole	1200
F5.000	o	150	FC4a	148.600	143.755	4.695	Open Manhole	1200
F1.005	o	225	F5	148.400	142.080	6.095	Open Manhole	1200
F1.006	o	225	F6	148.400	141.235	6.940	Open Manhole	1200
F1.007	o	225	F7	147.900	140.660	7.015	Open Manhole	1200
F1.008	o	225	F8	146.875	140.140	6.510	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	38.372	99.7	F1	147.200	143.215	3.835	Open Manhole	1200
F2.000	23.287	10.8	F1	147.200	143.235	3.815	Open Manhole	1200
F1.001	35.042	149.1	F2	147.725	142.980	4.595	Open Manhole	1200
F1.002	48.969	148.4	F3	148.100	142.650	5.300	Open Manhole	1200
F3.000	20.272	10.0	F3	148.100	142.650	5.300	Open Manhole	1200
F1.003	27.103	146.5	F4	148.110	142.465	5.495	Open Manhole	1200
F4.000	36.849	80.1	F4	148.110	142.465	5.495	Open Manhole	1200
F1.004	46.206	149.1	F5	148.400	142.155	6.095	Open Manhole	1200
F5.000	15.967	10.0	F5	148.400	142.155	6.095	Open Manhole	1200
F1.005	84.487	100.0	F6	148.400	141.235	6.940	Open Manhole	1200
F1.006	57.596	100.2	F7	147.900	140.660	7.015	Open Manhole	1200
F1.007	51.956	99.9	F8	146.875	140.140	6.510	Open Manhole	1200
F1.008	52.231	100.4	F9	145.700	139.620	5.855	Open Manhole	1200

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PIPELINE SCHEDULES for Foul

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.009	o	225	F9	145.700	139.620	5.855	Open Manhole	1200
F1.010	o	225	F10	144.600	138.995	5.380	Open Manhole	1200
F6.000	o	150	FC5	144.425	139.835	4.440	Open Manhole	1200
F1.011	o	225	F11	143.900	138.495	5.180	Open Manhole	1200
F1.012	o	225	F12	143.725	138.145	5.355	Open Manhole	1200
F1.013	o	225	F13	143.800	137.820	5.755	Open Manhole	1200
F1.014	o	225	F14	143.050	137.280	5.545	Open Manhole	1200
F7.000	o	300	FC1	139.500	135.500	3.700	Open Manhole	1200
F1.015	o	300	F15	141.100	135.340	5.460	Open Manhole	1200
F1.016	o	300	F16	139.550	135.075	4.175	Open Manhole	1200
F1.017	o	300	F17	137.825	134.865	2.660	Open Manhole	1200
F1.018	o	300	F18	135.100	133.600	1.200	Open Manhole	1200
F1.019	o	300	F19	132.150	130.650	1.200	Open Manhole	1200
F1.020	o	300	F20	129.890	128.390	1.200	Open Manhole	1200
F8.000	o	225	FC2	130.500	126.500	3.775	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.009	62.418	99.9	F10	144.600	138.995	5.380	Open Manhole	1200
F1.010	49.956	99.9	F11	143.900	138.495	5.180	Open Manhole	1200
F6.000	12.654	10.0	F11	143.900	138.570	5.180	Open Manhole	1200
F1.011	41.947	120.0	F12	143.725	138.145	5.355	Open Manhole	1200
F1.012	39.145	120.4	F13	143.800	137.820	5.755	Open Manhole	1200
F1.013	65.035	120.4	F14	143.050	137.280	5.545	Open Manhole	1200
F1.014	90.000	48.3	F15	141.100	135.415	5.460	Open Manhole	1200
F7.000	29.404	183.8	F15	141.100	135.340	5.460	Open Manhole	1200
F1.015	67.371	254.2	F16	139.550	135.075	4.175	Open Manhole	1200
F1.016	53.855	256.5	F17	137.825	134.865	2.660	Open Manhole	1200
F1.017	71.232	56.3	F18	135.100	133.600	1.200	Open Manhole	1200
F1.018	60.817	20.6	F19	132.150	130.650	1.200	Open Manhole	1200
F1.019	85.094	37.7	F20	129.890	128.390	1.200	Open Manhole	1200
F1.020	73.598	35.0	F21	130.500	126.285	3.915	Open Manhole	1350
F8.000	16.723	119.5	F21	130.500	126.360	3.915	Open Manhole	1350

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PIPELINE SCHEDULES for Foul

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.021	o	375	F21	130.500	126.210	3.915	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.021	2.480	248.0	FSUMP	135.250	126.200	8.675	Open Manhole	3000

Free Flowing Outfall Details for Foul

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.021	FSUMP	135.250	126.200	0.000	3000	0

Simulation Criteria for Foul

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.351		

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Northern Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.362	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Northern Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
N1.000	25.180	0.100	251.8	3.344	5.00	0.0	0.600	o	750	Pipe/Conduit	
N1.001	18.730	0.126	149.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
N2.000	89.502	0.640	139.8	0.100	5.00	0.0	0.600	o	375	Pipe/Conduit	
N2.001	83.500	0.600	139.2	0.160	0.00	0.0	0.600	o	375	Pipe/Conduit	
N2.002	7.140	0.055	129.8	0.060	0.00	0.0	0.600	o	375	Pipe/Conduit	
N2.003	57.610	0.410	140.5	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
N2.004	58.240	0.430	135.4	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
N1.002	12.580	0.090	139.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
N1.003	53.913	0.220	245.1	0.116	0.00	0.0	0.600	o	375	Pipe/Conduit	
N3.000	19.850	1.070	18.6	0.626	5.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
N1.000	0.00	5.24	143.000	3.344	0.0	0.0	0.0	1.76	777.1	0.0
N1.001	0.00	5.62	142.900	3.344	0.0	0.0	0.0	0.82	14.5	0.0
N2.000	0.00	5.97	144.655	0.100	0.0	0.0	0.0	1.53	169.0	0.0
N2.001	0.00	6.88	144.015	0.260	0.0	0.0	0.0	1.53	169.4	0.0
N2.002	0.00	6.96	143.415	0.320	0.0	0.0	0.0	1.59	175.5	0.0
N2.003	0.00	7.59	143.360	0.320	0.0	0.0	0.0	1.53	168.6	0.0
N2.004	0.00	8.21	142.950	0.320	0.0	0.0	0.0	1.56	171.8	0.0
N1.002	0.00	8.35	142.520	3.664	0.0	0.0	0.0	1.53	169.1	0.0
N1.003	0.00	9.13	142.430	3.780	0.0	0.0	0.0	1.15	127.3	0.0
N3.000	0.00	5.07	146.000	0.626	0.0	0.0	0.0	4.74	753.5	0.0

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Network Design Table for Northern Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
N3.001	24.956	2.495	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
N1.004	62.969	0.455	138.4	0.159	0.00	0.0	0.600	o	375	Pipe/Conduit	
N4.000	27.144	0.270	100.5	0.806	5.00	0.0	0.600	o	450	Pipe/Conduit	
N4.001	31.428	3.140	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
N5.000	69.339	0.770	90.0	0.180	5.00	0.0	0.600	o	450	Pipe/Conduit	
N5.001	39.671	0.450	88.2	0.100	0.00	0.0	0.600	o	450	Pipe/Conduit	
N1.005	29.342	0.120	244.5	0.045	0.00	0.0	0.600	o	450	Pipe/Conduit	
N1.006	47.361	0.195	242.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
N1.007	58.237	0.110	529.4	1.476	0.00	0.0	0.600	o	600	Pipe/Conduit	
N1.008	23.207	1.105	21.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
N3.001	0.00	5.20	144.930	0.626	0.0	0.0	0.0	3.20	56.6	0.0
N1.004	0.00	9.81	142.210	4.565	0.0	0.0	0.0	1.54	169.9	0.0
N4.000	0.00	5.22	145.515	0.806	0.0	0.0	0.0	2.03	322.5	0.0
N4.001	0.00	5.39	145.245	0.806	0.0	0.0	0.0	3.20	56.6	0.0
N5.000	0.00	5.54	142.900	0.180	0.0	0.0	0.0	2.14	341.0	0.0
N5.001	0.00	5.84	142.130	0.280	0.0	0.0	0.0	2.17	344.5	0.0
N1.005	0.00	10.19	141.680	5.695	0.0	0.0	0.0	1.30	206.1	0.0
N1.006	0.00	10.79	141.560	5.695	0.0	0.0	0.0	1.30	206.8	0.0
N1.007	0.00	11.72	141.215	7.171	0.0	0.0	0.0	1.05	297.3	0.0
N1.008	0.00	11.85	141.105	7.171	0.0	0.0	0.0	2.87	114.0	0.0

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PIPELINE SCHEDULES for Northern Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
N1.000	o	750	NCS3a.1	145.600	143.000	1.850	Open Manhole	1800
N1.001	o	150	NCS3a.2	145.500	142.900	2.450	Open Manhole	1800
N2.000	o	375	NS9	145.600	144.655	0.570	Open Manhole	1350
N2.001	o	375	NS10	147.000	144.015	2.610	Open Manhole	1350
N2.002	o	375	NS11	146.250	143.415	2.460	Open Manhole	1350
N2.003	o	375	NS12	146.250	143.360	2.515	Open Manhole	1350
N2.004	o	375	NS13	146.250	142.950	2.925	Open Manhole	1350
N1.002	o	375	NS14	146.250	142.520	3.355	Open Manhole	1350
N1.003	o	375	NS1	148.150	142.430	5.345	Open Manhole	1350
N3.000	o	450	NCS4b.1	148.450	146.000	2.000	Open Manhole	1350
N3.001	o	150	NCS4b.2	148.450	144.930	3.370	Open Manhole	1350
N1.004	o	375	NS2	147.900	142.210	5.315	Open Manhole	1350
N4.000	o	450	NCS4c.1	148.300	145.515	2.335	Open Manhole	1350
N4.001	o	150	NCS4c.2	148.300	145.245	2.905	Open Manhole	1350
N5.000	o	450	NS3	145.300	142.900	1.950	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
N1.000	25.180	251.8	NCS3a.2	145.500	142.900	1.850	Open Manhole	1800
N1.001	18.730	149.0	NS14	146.250	142.774	3.326	Open Manhole	1350
N2.000	89.502	139.8	NS10	147.000	144.015	2.610	Open Manhole	1350
N2.001	83.500	139.2	NS11	146.250	143.415	2.460	Open Manhole	1350
N2.002	7.140	129.8	NS12	146.250	143.360	2.515	Open Manhole	1350
N2.003	57.610	140.5	NS13	146.250	142.950	2.925	Open Manhole	1350
N2.004	58.240	135.4	NS14	146.250	142.520	3.355	Open Manhole	1350
N1.002	12.580	139.8	NS1	148.150	142.430	5.345	Open Manhole	1350
N1.003	53.913	245.1	NS2	147.900	142.210	5.315	Open Manhole	1350
N3.000	19.850	18.6	NCS4b.2	148.450	144.930	3.070	Open Manhole	1350
N3.001	24.956	10.0	NS2	147.900	142.435	5.315	Open Manhole	1350
N1.004	62.969	138.4	NS5	147.100	141.755	4.970	Open Manhole	1350
N4.000	27.144	100.5	NCS4c.2	148.300	145.245	2.605	Open Manhole	1350
N4.001	31.428	10.0	NS5	147.100	142.105	4.845	Open Manhole	1350
N5.000	69.339	90.0	NS4	146.300	142.130	3.720	Open Manhole	1350

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PIPELINE SCHEDULES for Northern Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
N5.001	o	450	NS4	146.300	142.130	3.720	Open Manhole	1350
N1.005	o	450	NS5	147.100	141.680	4.970	Open Manhole	1350
N1.006	o	450	NS6	145.600	141.560	3.590	Open Manhole	1350
N1.007	o	600	NS7	145.600	141.215	3.785	Open Manhole	1500
N1.008	o	225	NS8	145.600	141.105	4.270	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
N5.001	39.671	88.2	NS5	147.100	141.680	4.970	Open Manhole	1350
N1.005	29.342	244.5	NS6	145.600	141.560	3.590	Open Manhole	1350
N1.006	47.361	242.9	NS7	145.600	141.365	3.785	Open Manhole	1500
N1.007	58.237	529.4	NS8	145.600	141.105	3.895	Open Manhole	1500
N1.008	23.207	21.0	NS7	141.000	140.000	0.775	Open Manhole	1200

Free Flowing Outfall Details for Northern Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
N1.008	NS7	141.000	140.000	140.000	1200	0

Simulation Criteria for Northern Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.351
Return Period (years)	30	Profile Type	Summer
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

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Synthetic Rainfall Details

Storm Duration (mins) 30

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Online Controls for Northern Storm

Hydro-Brake® Optimum Manhole: NCS3a.2, DS/PN: N1.001, Volume (m³): 16.9

Unit Reference	MD-SHE-0126-9000-1900-9000
Design Head (m)	1.900
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	126
Invert Level (m)	142.900
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.900	9.0
Flush-Flo™	0.547	8.9
Kick-Flo®	1.121	7.0
Mean Flow over Head Range	-	7.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	1.200	7.2	3.000	11.2	7.000	16.7
0.200	7.6	1.400	7.8	3.500	12.0	7.500	17.3
0.300	8.3	1.600	8.3	4.000	12.8	8.000	17.8
0.400	8.7	1.800	8.8	4.500	13.5	8.500	18.3
0.500	8.9	2.000	9.2	5.000	14.2	9.000	18.8
0.600	8.9	2.200	9.6	5.500	14.9	9.500	19.3
0.800	8.6	2.400	10.0	6.000	15.5		
1.000	7.9	2.600	10.4	6.500	16.1		

Hydro-Brake® Optimum Manhole: NCS4b.2, DS/PN: N3.001, Volume (m³): 8.0

Unit Reference	MD-SHE-0075-2500-1000-2500
Design Head (m)	1.000
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	144.930
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: NCS4b.2, DS/PN: N3.001, Volume (m³): 8.0

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.5
Flush-Flo™	0.307	2.5
Kick-Flo®	0.627	2.0
Mean Flow over Head Range	-	2.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	2.7	3.000	4.1	7.000	6.2
0.200	2.4	1.400	2.9	3.500	4.5	7.500	6.4
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.6
0.400	2.5	1.800	3.3	4.500	5.0	8.500	6.8
0.500	2.4	2.000	3.4	5.000	5.3	9.000	7.0
0.600	2.1	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.3	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	6.0		

Hydro-Brake® Optimum Manhole: NCS4c.2, DS/PN: N4.001, Volume (m³): 8.5

Unit Reference	MD-SHE-0074-3000-1600-3000
Design Head (m)	1.600
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	74
Invert Level (m)	145.245
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	3.0
Flush-Flo™	0.323	2.5
Kick-Flo®	0.661	2.0
Mean Flow over Head Range	-	2.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.300	2.5	0.500	2.4	0.800	2.2
0.200	2.4	0.400	2.5	0.600	2.2	1.000	2.4

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Hydro-Brake® Optimum Manhole: NCS4c.2, DS/PN: N4.001, Volume (m³): 8.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	2.6	2.400	3.6	5.000	5.1	8.000	6.4
1.400	2.8	2.600	3.8	5.500	5.3	8.500	6.5
1.600	3.0	3.000	4.0	6.000	5.6	9.000	6.7
1.800	3.2	3.500	4.3	6.500	5.8	9.500	6.9
2.000	3.3	4.000	4.6	7.000	6.0		
2.200	3.5	4.500	4.9	7.500	6.2		

Hydro-Brake® Optimum Manhole: NS8, DS/PN: N1.008, Volume (m³): 24.0

Unit Reference	MD-SHE-0179-2030-2400-2030
Design Head (m)	2.400
Design Flow (l/s)	20.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	179
Invert Level (m)	141.105
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.400	20.3
Flush-Flo™	0.700	20.2
Kick-Flo®	1.451	16.0
Mean Flow over Head Range	-	17.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.3	1.200	18.7	3.000	22.5	7.000	33.9
0.200	16.0	1.400	16.7	3.500	24.3	7.500	35.0
0.300	18.0	1.600	16.7	4.000	25.9	8.000	36.1
0.400	19.2	1.800	17.7	4.500	27.4	8.500	37.2
0.500	19.8	2.000	18.6	5.000	28.8	9.000	38.3
0.600	20.2	2.200	19.4	5.500	30.2	9.500	39.3
0.800	20.2	2.400	20.3	6.000	31.5		
1.000	19.7	2.600	21.1	6.500	32.7		

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Storage Structures for Northern Storm

Cellular Storage Manhole: NCS3a.2, DS/PN: N1.001

Invert Level (m) 142.900 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	3000.0	3000.0	1.300	0.0	3230.0
0.100	3000.0	3021.9	1.400	0.0	3230.0
0.200	3000.0	3043.8	1.500	0.0	3230.0
0.300	3000.0	3065.7	1.600	0.0	3230.0
0.400	3000.0	3087.6	1.700	0.0	3230.0
0.500	3000.0	3109.5	1.800	0.0	3230.0
0.600	3000.0	3131.5	1.900	0.0	3230.0
0.700	3000.0	3153.4	2.000	0.0	3230.0
0.800	3000.0	3175.3	2.100	0.0	3230.0
0.900	3000.0	3197.2	2.200	0.0	3230.0
1.000	3000.0	3219.1	2.300	0.0	3230.0
1.100	0.0	3230.0	2.400	0.0	3230.0
1.200	0.0	3230.0	2.500	0.0	3230.0

Cellular Storage Manhole: NCS4b.2, DS/PN: N3.001

Invert Level (m) 144.930 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	760.0	760.0	1.300	0.0	875.8
0.100	760.0	771.0	1.400	0.0	875.8
0.200	760.0	782.1	1.500	0.0	875.8
0.300	760.0	793.1	1.600	0.0	875.8
0.400	760.0	804.1	1.700	0.0	875.8
0.500	760.0	815.1	1.800	0.0	875.8
0.600	760.0	826.2	1.900	0.0	875.8
0.700	760.0	837.2	2.000	0.0	875.8
0.800	760.0	848.2	2.100	0.0	875.8
0.900	760.0	859.2	2.200	0.0	875.8
1.000	760.0	870.3	2.300	0.0	875.8
1.100	0.0	875.8	2.400	0.0	875.8
1.200	0.0	875.8	2.500	0.0	875.8

Cellular Storage Manhole: NCS4c.2, DS/PN: N4.001

Invert Level (m) 145.245 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

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Cellular Storage Manhole: NCS4c.2, DS/PN: N4.001

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	865.0	2000.0	1.300	0.0	2187.8
0.100	865.0	2017.9	1.400	0.0	2187.8
0.200	865.0	2035.8	1.500	0.0	2187.8
0.300	865.0	2053.7	1.600	0.0	2187.8
0.400	865.0	2071.6	1.700	0.0	2187.8
0.500	865.0	2089.4	1.800	0.0	2187.8
0.600	865.0	2107.3	1.900	0.0	2187.8
0.700	865.0	2125.2	2.000	0.0	2187.8
0.800	865.0	2143.1	2.100	0.0	2187.8
0.900	865.0	2161.0	2.200	0.0	2187.8
1.000	865.0	2178.9	2.300	0.0	2187.8
1.100	0.0	2187.8	2.400	0.0	2187.8
1.200	0.0	2187.8	2.500	0.0	2187.8

Cellular Storage Manhole: NS8, DS/PN: N1.008

Invert Level (m) 141.105 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	2000.0	3000.0	1.300	0.0	3230.0
0.100	2000.0	3021.9	1.400	0.0	3230.0
0.200	2000.0	3043.8	1.500	0.0	3230.0
0.300	2000.0	3065.7	1.600	0.0	3230.0
0.400	2000.0	3087.6	1.700	0.0	3230.0
0.500	2000.0	3109.5	1.800	0.0	3230.0
0.600	2000.0	3131.5	1.900	0.0	3230.0
0.700	2000.0	3153.4	2.000	0.0	3230.0
0.800	2000.0	3175.3	2.100	0.0	3230.0
0.900	2000.0	3197.2	2.200	0.0	3230.0
1.000	2000.0	3219.1	2.300	0.0	3230.0
1.100	0.0	3230.0	2.400	0.0	3230.0
1.200	0.0	3230.0	2.500	0.0	3230.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.351
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N1.000	NCS3a.1	15 Winter	1	+0%	30/15 Summer			
N1.001	NCS3a.2	1440 Winter	1	+0%	1/180 Winter			
N2.000	NS9	15 Winter	1	+0%				
N2.001	NS10	15 Winter	1	+0%	100/15 Winter			
N2.002	NS11	15 Winter	1	+0%	100/15 Summer			
N2.003	NS12	15 Winter	1	+0%	100/15 Summer			
N2.004	NS13	15 Winter	1	+0%	100/15 Summer			
N1.002	NS14	15 Winter	1	+0%	100/15 Summer			
N1.003	NS1	15 Winter	1	+0%	30/15 Winter			
N3.000	NCS4b.1	15 Winter	1	+0%				
N3.001	NCS4b.2	960 Winter	1	+0%	30/30 Winter			
N1.004	NS2	15 Winter	1	+0%	30/15 Winter			
N4.000	NCS4c.1	15 Winter	1	+0%	100/15 Summer			
N4.001	NCS4c.2	960 Winter	1	+0%	1/480 Winter			
N5.000	NS3	15 Winter	1	+0%	100/15 Summer			
N5.001	NS4	15 Winter	1	+0%	100/15 Summer			
N1.005	NS5	15 Winter	1	+0%	30/15 Summer			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N1.000	NCS3a.1	143.479	-0.271	0.000	0.72			417.2	OK
N1.001	NCS3a.2	143.118	0.068	0.000	0.57		1014	7.7	SURCHARGED
N2.000	NS9	144.725	-0.305	0.000	0.07			12.1	OK
N2.001	NS10	144.122	-0.268	0.000	0.17			27.9	OK
N2.002	NS11	143.560	-0.230	0.000	0.32			33.9	OK
N2.003	NS12	143.477	-0.258	0.000	0.21			33.3	OK
N2.004	NS13	143.065	-0.260	0.000	0.20			32.7	OK
N1.002	NS14	142.658	-0.237	0.000	0.29			34.4	OK
N1.003	NS1	142.587	-0.218	0.000	0.35			42.0	OK
N3.000	NCS4b.1	146.110	-0.340	0.000	0.14			79.0	OK
N3.001	NCS4b.2	145.063	-0.017	0.000	0.04		572	2.2	OK
N1.004	NS2	142.361	-0.224	0.000	0.34			53.6	OK
N4.000	NCS4c.1	145.706	-0.259	0.000	0.37			101.4	OK
N4.001	NCS4c.2	145.407	0.012	0.000	0.04		691	2.3	SURCHARGED
N5.000	NS3	142.979	-0.371	0.000	0.07			22.3	OK
N5.001	NS4	142.228	-0.351	0.000	0.11			33.0	OK
N1.005	NS5	141.897	-0.233	0.000	0.47			83.0	OK

PN	US/MH Name	Level Exceeded
N1.000	NCS3a.1	
N1.001	NCS3a.2	
N2.000	NS9	
N2.001	NS10	
N2.002	NS11	
N2.003	NS12	
N2.004	NS13	
N1.002	NS14	
N1.003	NS1	
N3.000	NCS4b.1	
N3.001	NCS4b.2	
N1.004	NS2	
N4.000	NCS4c.1	
N4.001	NCS4c.2	
N5.000	NS3	
N5.001	NS4	
N1.005	NS5	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N1.006	NS6	15 Winter	1	+0%	30/15 Summer				141.769
N1.007	NS7	15 Winter	1	+0%	30/15 Summer				141.635
N1.008	NS8	2160 Winter	1	+0%	1/480 Winter				141.365

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N1.006	NS6	-0.241	0.000	0.44			82.1	OK	
N1.007	NS7	-0.179	0.000	0.83			219.9	OK	
N1.008	NS8	0.036	0.000	0.17		1128	17.3	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.351
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N1.000	NCS3a.1	15 Winter	30	+0%	30/15 Summer			
N1.001	NCS3a.2	1440 Winter	30	+0%	1/180 Winter			
N2.000	NS9	15 Winter	30	+0%				
N2.001	NS10	15 Winter	30	+0%	100/15 Winter			
N2.002	NS11	15 Winter	30	+0%	100/15 Summer			
N2.003	NS12	15 Winter	30	+0%	100/15 Summer			
N2.004	NS13	15 Winter	30	+0%	100/15 Summer			
N1.002	NS14	15 Winter	30	+0%	100/15 Summer			
N1.003	NS1	15 Winter	30	+0%	30/15 Winter			
N3.000	NCS4b.1	15 Winter	30	+0%				
N3.001	NCS4b.2	720 Winter	30	+0%	30/30 Winter			
N1.004	NS2	15 Winter	30	+0%	30/15 Winter			
N4.000	NCS4c.1	15 Winter	30	+0%	100/15 Summer			
N4.001	NCS4c.2	960 Winter	30	+0%	1/480 Winter			
N5.000	NS3	15 Winter	30	+0%	100/15 Summer			
N5.001	NS4	15 Winter	30	+0%	100/15 Summer			
N1.005	NS5	15 Winter	30	+0%	30/15 Summer			

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N1.000	NCS3a.1	144.056	0.306	0.000	1.77			1023.2	SURCHARGED
N1.001	NCS3a.2	143.395	0.345	0.000	0.65		1458	8.8	SURCHARGED
N2.000	NS9	144.766	-0.264	0.000	0.18			29.6	OK
N2.001	NS10	144.204	-0.186	0.000	0.47			76.6	OK
N2.002	NS11	143.686	-0.104	0.000	0.87			93.1	OK
N2.003	NS12	143.568	-0.167	0.000	0.58			91.6	OK
N2.004	NS13	143.153	-0.172	0.000	0.56			89.6	OK
N1.002	NS14	142.877	-0.018	0.000	0.77			89.9	OK
N1.003	NS1	142.806	0.001	0.000	0.86			101.4	SURCHARGED
N3.000	NCS4b.1	146.179	-0.271	0.000	0.33			193.6	OK
N3.001	NCS4b.2	145.251	0.171	0.000	0.05			2.5	SURCHARGED
N1.004	NS2	142.652	0.067	0.000	0.80			127.7	SURCHARGED
N4.000	NCS4c.1	145.854	-0.111	0.000	0.91			248.4	OK
N4.001	NCS4c.2	145.632	0.237	0.000	0.05			2.5	SURCHARGED
N5.000	NS3	143.027	-0.323	0.000	0.17			54.5	OK
N5.001	NS4	142.471	-0.108	0.000	0.27			81.5	OK
N1.005	NS5	142.391	0.261	0.000	1.11			195.4	SURCHARGED

PN	US/MH Name	Level Exceeded
N1.000	NCS3a.1	
N1.001	NCS3a.2	
N2.000	NS9	
N2.001	NS10	
N2.002	NS11	
N2.003	NS12	
N2.004	NS13	
N1.002	NS14	
N1.003	NS1	
N3.000	NCS4b.1	
N3.001	NCS4b.2	
N1.004	NS2	
N4.000	NCS4c.1	
N4.001	NCS4c.2	
N5.000	NS3	
N5.001	NS4	
N1.005	NS5	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
N1.006	NS6	15 Winter	30	+0%	30/15 Summer				142.263
N1.007	NS7	15 Winter	30	+0%	30/15 Summer				142.107
N1.008	NS8	2160 Winter	30	+0%	1/480 Winter				141.709

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
N1.006	NS6	0.254	0.000	1.05			196.8	SURCHARGED	
N1.007	NS7	0.292	0.000	1.92			507.5	SURCHARGED	
N1.008	NS8	0.380	0.000	0.17		1840	17.9	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.351
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N1.000	NCS3a.1	15 Winter	100	+30%	30/15 Summer			
N1.001	NCS3a.2	2160 Winter	100	+30%	1/180 Winter			
N2.000	NS9	15 Winter	100	+30%				
N2.001	NS10	15 Winter	100	+30%	100/15 Winter			
N2.002	NS11	15 Winter	100	+30%	100/15 Summer			
N2.003	NS12	15 Winter	100	+30%	100/15 Summer			
N2.004	NS13	15 Winter	100	+30%	100/15 Summer			
N1.002	NS14	15 Winter	100	+30%	100/15 Summer			
N1.003	NS1	15 Winter	100	+30%	30/15 Winter			
N3.000	NCS4b.1	15 Winter	100	+30%				
N3.001	NCS4b.2	1440 Winter	100	+30%	30/30 Winter			
N1.004	NS2	15 Winter	100	+30%	30/15 Winter			
N4.000	NCS4c.1	15 Winter	100	+30%	100/15 Summer			
N4.001	NCS4c.2	1440 Winter	100	+30%	1/480 Winter			

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N1.000	NCS3a.1	144.815	1.065	0.000	2.92			1695.4	SURCHARGED
N1.001	NCS3a.2	143.813	0.763	0.000	0.65			8.8	SURCHARGED
N2.000	NS9	144.802	-0.228	0.000	0.31			49.8	OK
N2.001	NS10	144.489	0.099	0.000	0.76			123.1	SURCHARGED
N2.002	NS11	144.377	0.587	0.000	1.17			125.8	SURCHARGED
N2.003	NS12	144.298	0.563	0.000	0.71			111.4	SURCHARGED
N2.004	NS13	144.127	0.802	0.000	0.78			124.5	SURCHARGED
N1.002	NS14	143.984	1.089	0.000	1.12			131.4	SURCHARGED
N1.003	NS1	143.884	1.079	0.000	1.12			132.9	SURCHARGED
N3.000	NCS4b.1	146.242	-0.208	0.000	0.56			325.7	OK
N3.001	NCS4b.2	145.538	0.458	0.000	0.05			2.5	SURCHARGED
N1.004	NS2	143.721	1.136	0.000	0.92			146.1	SURCHARGED
N4.000	NCS4c.1	146.335	0.370	0.000	1.52			416.3	SURCHARGED
N4.001	NCS4c.2	145.977	0.582	0.000	0.05			2.5	SURCHARGED

PN	US/MH Name	Level Exceeded
N1.000	NCS3a.1	
N1.001	NCS3a.2	
N2.000	NS9	
N2.001	NS10	
N2.002	NS11	
N2.003	NS12	
N2.004	NS13	
N1.002	NS14	
N1.003	NS1	
N3.000	NCS4b.1	
N3.001	NCS4b.2	
N1.004	NS2	
N4.000	NCS4c.1	
N4.001	NCS4c.2	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Northern Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
N5.000	NS3	15 Winter	100	+30%	100/15 Summer			
N5.001	NS4	15 Winter	100	+30%	100/15 Summer			
N1.005	NS5	15 Winter	100	+30%	30/15 Summer			
N1.006	NS6	15 Winter	100	+30%	30/15 Summer			
N1.007	NS7	15 Winter	100	+30%	30/15 Summer			
N1.008	NS8	2160 Winter	100	+30%	1/480 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
N5.000	NS3	143.686	0.336	0.000	0.28			88.4	SURCHARGED
N5.001	NS4	143.507	0.927	0.000	0.35			106.1	SURCHARGED
N1.005	NS5	143.328	1.198	0.000	1.46			257.8	SURCHARGED
N1.006	NS6	143.068	1.058	0.000	1.37			256.4	SURCHARGED
N1.007	NS7	142.749	0.935	0.000	3.02			798.9	SURCHARGED
N1.008	NS8	142.105	0.776	0.000	0.19			19.7	SURCHARGED

PN	US/MH Name	Level Exceeded
N5.000	NS3	
N5.001	NS4	
N1.005	NS5	
N1.006	NS6	
N1.007	NS7	
N1.008	NS8	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Southern Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.362	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Southern Storm

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	19.850	0.050	400.0	1.089	5.00	0.0	0.600	o	450	Pipe/Conduit	
S1.001	21.643	0.215	100.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	74.175	0.435	170.5	0.184	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	66.530	0.390	170.6	0.194	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	55.864	0.230	242.9	0.103	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	56.016	0.515	108.8	0.073	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.006	67.245	1.860	36.2	0.109	0.00	0.0	0.600	o	400	Pipe/Conduit	
S2.000	19.850	0.040	496.3	1.741	5.00	0.0	0.600	o	600	Pipe/Conduit	
S2.001	19.869	0.130	152.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	0.00	5.33	146.500	1.089	0.0	0.0	0.0	1.01	160.7	0.0
S1.001	0.00	5.69	146.450	1.089	0.0	0.0	0.0	1.00	17.7	0.0
S1.002	0.00	6.58	146.010	1.273	0.0	0.0	0.0	1.38	152.9	0.0
S1.003	0.00	7.38	145.575	1.467	0.0	0.0	0.0	1.38	152.9	0.0
S1.004	0.00	8.19	145.185	1.570	0.0	0.0	0.0	1.16	127.9	0.0
S1.005	0.00	8.72	144.955	1.643	0.0	0.0	0.0	1.74	191.8	0.0
S1.006	0.00	9.08	144.415	1.752	0.0	0.0	0.0	3.15	395.5	0.0
S2.000	0.00	5.30	142.900	1.741	0.0	0.0	0.0	1.09	307.2	0.0
S2.001	0.00	5.62	142.860	1.741	0.0	0.0	0.0	1.06	42.0	0.0

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Network Design Table for Southern Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.000	196.055	4.345	45.1	0.245	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	54.308	1.195	45.4	0.100	0.00	0.0	0.600	o	600	Pipe/Conduit	
S4.000	19.850	0.045	441.1	1.726	5.00	0.0	0.600	o	600	Pipe/Conduit	
S4.001	25.983	0.270	96.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.008	70.786	0.120	590.0	0.250	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.009	68.451	0.120	570.4	0.110	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.010	90.000	3.450	26.1	0.427	0.00	0.0	0.600	o	600	Pipe/Conduit	
S5.000	494.826	2.800	176.7	7.000	5.00	0.0	0.600	o	1200	Pipe/Conduit	
S6.000	79.840	0.340	234.8	1.500	5.00	0.0	0.600	o	1500	Pipe/Conduit	
S5.001	132.986	0.320	415.6	1.100	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S7.000	462.157	3.400	135.9	7.000	5.00	0.0	0.600	o	1200	Pipe/Conduit	
S5.002	291.717	0.450	648.3	1.300	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S5.003	37.342	0.080	466.8	1.300	0.00	0.0	0.600	o	1500	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	0.00	6.39	147.000	0.245	0.0	0.0	0.0	2.35	165.9	0.0
S1.007	0.00	9.33	142.355	3.838	0.0	0.0	0.0	3.62	1023.2	0.0
S4.000	0.00	5.29	141.925	1.726	0.0	0.0	0.0	1.15	326.0	0.0
S4.001	0.00	5.71	141.880	1.726	0.0	0.0	0.0	1.02	18.1	0.0
S1.008	0.00	10.51	141.160	5.814	0.0	0.0	0.0	1.00	281.4	0.0
S1.009	0.00	11.64	141.040	5.924	0.0	0.0	0.0	1.01	286.3	0.0
S1.010	0.00	11.96	140.920	6.351	0.0	0.0	0.0	4.78	1351.7	0.0
S5.000	0.00	7.93	140.800	7.000	0.0	0.0	0.0	2.81	3179.6	0.0
S6.000	0.00	5.48	138.000	1.500	0.0	0.0	0.0	2.80	4939.2	0.0
S5.001	0.00	8.99	137.660	9.600	0.0	0.0	0.0	2.10	3707.2	0.0
S7.000	0.00	7.40	140.800	7.000	0.0	0.0	0.0	3.21	3627.5	0.0
S5.002	0.00	11.89	137.100	17.900	0.0	0.0	0.0	1.68	2963.8	0.0
S5.003	0.00	12.20	136.650	19.200	0.0	0.0	0.0	1.98	3496.7	0.0

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Network Design Table for Southern Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.011	39.650	0.080	495.6	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.012	75.804	1.490	50.9	0.349	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.013	75.923	3.000	25.3	0.204	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.014	81.214	3.175	25.6	0.304	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.015	57.566	1.575	36.5	0.199	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.016	72.116	2.100	34.3	0.368	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.017	56.067	1.850	30.3	0.368	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.018	90.058	1.200	75.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S8.000	400.000	5.250	76.2	5.195	5.00	0.0	0.600	o	900	Pipe/Conduit	
S9.000	400.000	5.250	76.2	5.195	5.00	0.0	0.600	o	900	Pipe/Conduit	
S8.001	51.376	4.500	11.4	0.000	0.00	0.0	0.600	o	1050	Pipe/Conduit	
S1.019	89.816	1.500	59.9	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.020	57.407	2.500	23.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.021	44.667	1.500	29.8	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.022	63.910	4.250	15.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.023	20.812	1.150	18.1	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.024	43.217	2.100	20.6	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	
S1.025	38.874	1.600	24.3	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.011	0.00	12.55	136.570	25.551	0.0	0.0	0.0	1.92	3392.7	0.0
S1.012	0.00	12.76	136.490	25.900	0.0	0.0	0.0	6.02	10637.8	0.0
S1.013	0.00	12.91	135.000	26.104	0.0	0.0	0.0	8.54	15092.5	0.0
S1.014	0.00	13.07	132.000	26.408	0.0	0.0	0.0	8.50	15012.1	0.0
S1.015	0.00	13.20	128.825	26.607	0.0	0.0	0.0	7.10	12554.8	0.0
S1.016	0.00	13.36	127.250	26.975	0.0	0.0	0.0	7.33	12953.0	0.0
S1.017	0.00	13.48	125.150	27.343	0.0	0.0	0.0	7.80	13789.7	0.0
S1.018	0.00	13.79	123.300	27.343	0.0	0.0	0.0	4.95	8754.5	0.0
S8.000	0.00	6.86	132.500	5.195	0.0	0.0	0.0	3.59	2285.1	0.0
S9.000	0.00	6.86	132.500	5.195	0.0	0.0	0.0	3.59	2285.1	0.0
S8.001	0.00	6.94	127.100	10.390	0.0	0.0	0.0	10.23	8854.6	0.0
S1.019	0.00	14.06	122.100	37.733	0.0	0.0	0.0	5.55	9803.8	0.0
S1.020	0.00	14.16	120.600	37.733	0.0	0.0	0.0	8.97	15845.5	0.0
S1.021	0.00	14.26	118.100	37.733	0.0	0.0	0.0	7.87	13911.8	0.0
S1.022	0.00	14.35	116.600	37.733	0.0	0.0	0.0	11.08	19586.3	0.0
S1.023	0.00	14.39	112.350	37.733	0.0	0.0	0.0	10.10	17851.9	0.0
S1.024	0.00	14.46	111.200	37.733	0.0	0.0	0.0	9.47	16739.2	0.0
S1.025	0.00	14.54	109.100	37.733	0.0	0.0	0.0	8.72	15403.9	0.0

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Network Design Table for Southern Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.026	72.258	2.000	36.1	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit	
S1.027	51.127	1.515	33.7	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit	
S1.028	36.030	1.600	22.5	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit	
S1.029	62.914	0.630	99.9	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit	
S1.030	20.666	0.205	100.8	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit	
S1.031	25.780#	0.250	103.1	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit	
S1.032	33.652	0.335	100.5	2.940	0.00	0.0	0.600	o	400	Pipe/Conduit	
S1.033	55.453	0.160	346.6	0.000	0.00	0.0	0.600	o	400	Pipe/Conduit	
S1.034	73.194	0.790	92.7	0.000	0.00	0.0	0.600	\/	-4	Pipe/Conduit	
S1.035	73.194	5.250	13.9	0.000	0.00	0.0	0.600	\/	-4	Pipe/Conduit	
S1.036	18.228	0.450	40.5	0.000	0.00	0.0	0.600	\/	-4	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.026	0.00	14.69	107.200	37.733	0.0	0.0	0.0	7.99	20321.3	0.0
S1.027	0.00	14.79	105.200	37.733	0.0	0.0	0.0	8.26	21027.3	0.0
S1.028	0.00	14.85	103.685	37.733	0.0	0.0	0.0	10.12	25748.9	0.0
S1.029	0.00	15.07	102.085	37.733	0.0	0.0	0.0	4.80	12209.6	0.0
S1.030	0.00	15.14	101.455	37.733	0.0	0.0	0.0	4.78	12152.0	0.0
S1.031	0.00	15.23	101.250	37.733	0.0	0.0	0.0	4.72	12014.7	0.0
S1.032	0.00	15.53	101.000	40.673	0.0	0.0	0.0	1.88	236.6	0.0
S1.033	0.00	16.45	100.665	40.673	0.0	0.0	0.0	1.01	126.7	0.0
S1.034	0.00	16.77	100.405	40.673	0.0	0.0	0.0	3.74	5157.4	0.0
S1.035	0.00	16.90	99.615	40.673	0.0	0.0	0.0	9.67	13323.8	0.0
S1.036	0.00	16.95	94.365	40.673	0.0	0.0	0.0	5.67	7809.2	0.0

Conduit Sections for Southern Storm

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-4	\/	750	500	14.0		1.128	1.378

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PIPELINE SCHEDULES for Southern Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	450	SC4a1	149.000	146.500	2.050	Open Manhole	1350
S1.001	o	150	SC4a2	149.000	146.450	2.400	Open Manhole	1350
S1.002	o	375	S1	148.400	146.010	2.015	Open Manhole	1350
S1.003	o	375	S2	148.690	145.575	2.740	Open Manhole	1350
S1.004	o	375	S3	148.225	145.185	2.665	Open Manhole	1350
S1.005	o	375	S4	147.250	144.955	1.920	Open Manhole	1350
S1.006	o	400	S5	146.000	144.415	1.185	Open Manhole	1350
S2.000	o	600	SC6.0	144.875	142.900	1.375	Open Manhole	1500
S2.001	o	225	SC6.1	144.875	142.860	1.790	Open Manhole	1500
S3.000	o	300	SEmb Drain	148.000	147.000	0.700	Open Manhole	1200
S1.007	o	600	S6	144.850	142.355	1.895	Open Manhole	1500
S4.000	o	600	SC5.0	144.200	141.925	1.675	Open Manhole	1500
S4.001	o	150	SC5.1	144.200	141.880	2.170	Open Manhole	1500
S1.008	o	600	S7	144.150	141.160	2.390	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	19.850	400.0	SC4a2	149.000	146.450	2.100	Open Manhole	1350
S1.001	21.643	100.7	S1	148.400	146.235	2.015	Open Manhole	1350
S1.002	74.175	170.5	S2	148.690	145.575	2.740	Open Manhole	1350
S1.003	66.530	170.6	S3	148.225	145.185	2.665	Open Manhole	1350
S1.004	55.864	242.9	S4	147.250	144.955	1.920	Open Manhole	1350
S1.005	56.016	108.8	S5	146.000	144.440	1.185	Open Manhole	1350
S1.006	67.245	36.2	S6	144.850	142.555	1.895	Open Manhole	1500
S2.000	19.850	496.3	SC6.1	144.875	142.860	1.415	Open Manhole	1500
S2.001	19.869	152.8	S6	144.850	142.730	1.895	Open Manhole	1500
S3.000	196.055	45.1	S6	144.850	142.655	1.895	Open Manhole	1500
S1.007	54.308	45.4	S7	144.150	141.160	2.390	Open Manhole	1500
S4.000	19.850	441.1	SC5.1	144.200	141.880	1.720	Open Manhole	1500
S4.001	25.983	96.2	S7	144.150	141.610	2.390	Open Manhole	1500
S1.008	70.786	590.0	S8	143.850	141.040	2.210	Open Manhole	1500

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PIPELINE SCHEDULES for Southern Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.009	o	600	S8	143.850	141.040	2.210	Open Manhole	1500
S1.010	o	600	S9	142.850	140.920	1.330	Open Manhole	1500
S5.000	o	1200	SC1.1	143.250	140.800	1.250	Open Manhole	2100
S6.000	o	1500	SC1.2	141.000	138.000	1.500	Open Manhole	2400
S5.001	o	1500	SC1.3	143.250	137.660	4.090	Open Manhole	2400
S7.000	o	1200	SC1.4	143.250	140.800	1.250	Open Manhole	2100
S5.002	o	1500	SC1.5	142.000	137.100	3.400	Open Manhole	2400
S5.003	o	1500	SC1.6	139.500	136.650	1.350	Open Manhole	2400
S1.011	o	1500	S10	141.100	136.570	3.030	Open Manhole	2400
S1.012	o	1500	S11	140.210	136.490	2.220	Open Manhole	2400
S1.013	o	1500	S12	137.710	135.000	1.210	Open Manhole	2400
S1.014	o	1500	S13	134.700	132.000	1.200	Open Manhole	2400
S1.015	o	1500	S14	131.525	128.825	1.200	Open Manhole	2400
S1.016	o	1500	S15	129.950	127.250	1.200	Open Manhole	2400
S1.017	o	1500	S16	127.850	125.150	1.200	Open Manhole	2400

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.009	68.451	570.4	S9	142.850	140.920	1.330	Open Manhole	1500
S1.010	90.000	26.1	S10	141.100	137.470	3.030	Open Manhole	2400
S5.000	494.826	176.7	SC1.3	143.250	138.000	4.050	Open Manhole	2400
S6.000	79.840	234.8	SC1.3	143.250	137.660	4.090	Open Manhole	2400
S5.001	132.986	415.6	SC1.5	142.000	137.340	3.160	Open Manhole	2400
S7.000	462.157	135.9	SC1.5	142.000	137.400	3.400	Open Manhole	2400
S5.002	291.717	648.3	SC1.6	139.500	136.650	1.350	Open Manhole	2400
S5.003	37.342	466.8	S10	141.100	136.570	3.030	Open Manhole	2400
S1.011	39.650	495.6	S11	140.210	136.490	2.220	Open Manhole	2400
S1.012	75.804	50.9	S12	137.710	135.000	1.210	Open Manhole	2400
S1.013	75.923	25.3	S13	134.700	132.000	1.200	Open Manhole	2400
S1.014	81.214	25.6	S14	131.525	128.825	1.200	Open Manhole	2400
S1.015	57.566	36.5	S15	129.950	127.250	1.200	Open Manhole	2400
S1.016	72.116	34.3	S16	127.850	125.150	1.200	Open Manhole	2400
S1.017	56.067	30.3	S17	126.000	123.300	1.200	Open Manhole	2400

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PIPELINE SCHEDULES for Southern Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.018	o	1500	S17	126.000	123.300	1.200	Open Manhole	2400
S8.000	o	900	SC2.1	134.750	132.500	1.350	Open Manhole	1800
S9.000	o	900	SC2.2	134.750	132.500	1.350	Open Manhole	1800
S8.001	o	1050	SC2.3	134.750	127.100	6.600	Open Manhole	1950
S1.019	o	1500	S18	124.500	122.100	0.900	Open Manhole	2400
S1.020	o	1500	S19	123.000	120.600	0.900	Open Manhole	2400
S1.021	o	1500	S25	120.500	118.100	0.900	Open Manhole	2400
S1.022	o	1500	S26	119.000	116.600	0.900	Open Manhole	2400
S1.023	o	1500	S27	114.750	112.350	0.900	Open Manhole	2400
S1.024	o	1500	S28	113.600	111.200	0.900	Open Manhole	2400
S1.025	o	1500	S29	111.500	109.100	0.900	Open Manhole	2400
S1.026	o	1800	S30	109.900	107.200	0.900	Open Manhole	2700
S1.027	o	1800	S31	108.700	105.200	1.700	Open Manhole	2700
S1.028	o	1800	S32	108.250	103.685	2.765	Open Manhole	2700
S1.029	o	1800	S33	108.250	102.085	4.365	Open Manhole	2700
S1.030	o	1800	S34	105.750	101.455	2.495	Open Manhole	2700
S1.031	o	1800	S35	106.250	101.250	3.200	Open Manhole	2700

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.018	90.058	75.0	S18	124.500	122.100	0.900	Open Manhole	2400
S8.000	400.000	76.2	SC2.3	134.750	127.250	6.600	Open Manhole	1950
S9.000	400.000	76.2	SC2.3	134.750	127.250	6.600	Open Manhole	1950
S8.001	51.376	11.4	S18	124.500	122.600	0.850	Open Manhole	2400
S1.019	89.816	59.9	S19	123.000	120.600	0.900	Open Manhole	2400
S1.020	57.407	23.0	S25	120.500	118.100	0.900	Open Manhole	2400
S1.021	44.667	29.8	S26	119.000	116.600	0.900	Open Manhole	2400
S1.022	63.910	15.0	S27	114.750	112.350	0.900	Open Manhole	2400
S1.023	20.812	18.1	S28	113.600	111.200	0.900	Open Manhole	2400
S1.024	43.217	20.6	S29	111.500	109.100	0.900	Open Manhole	2400
S1.025	38.874	24.3	S30	109.900	107.500	0.900	Open Manhole	2700
S1.026	72.258	36.1	S31	108.700	105.200	1.700	Open Manhole	2700
S1.027	51.127	33.7	S32	108.250	103.685	2.765	Open Manhole	2700
S1.028	36.030	22.5	S33	108.250	102.085	4.365	Open Manhole	2700
S1.029	62.914	99.9	S34	105.750	101.455	2.495	Open Manhole	2700
S1.030	20.666	100.8	S35	106.250	101.250	3.200	Open Manhole	2700
S1.031	25.780#	103.1	S36	104.000	101.000	1.200	Open Manhole	2700

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PIPELINE SCHEDULES for Southern Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.032	o	400	S36	104.000	101.000	2.600	Open Manhole	2700
S1.033	o	400	S37	101.600	100.665	0.535	Open Manhole	1350
S1.034	\/	-4	S38	101.500	100.405	0.595	Open Manhole	1350
S1.035	\/	-4	S39	99.750	99.615	-0.365	Junction	
S1.036	\/	-4	S40	94.500	94.365	-0.365	Junction	

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.032	33.652	100.5	S37	101.600	100.665	0.535	Open Manhole	1350
S1.033	55.453	346.6	S38	101.500	100.505	0.595	Open Manhole	1350
S1.034	73.194	92.7	S39	99.750	99.615	-0.365	Junction	
S1.035	73.194	13.9	S40	94.500	94.365	-0.365	Junction	
S1.036	18.228	40.5	S	93.500	93.915	-0.915	Open Manhole	0

Free Flowing Outfall Details for Southern Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.036	S	93.500	93.915	92.750	0	0

Simulation Criteria for Southern Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.351		

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Online Controls for Southern Storm

Hydro-Brake® Optimum Manhole: SC4a2, DS/PN: S1.001, Volume (m³): 6.6

Unit Reference	MD-SHE-0106-5300-1200-5300
Design Head (m)	1.200
Design Flow (l/s)	5.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	146.450
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.3
Flush-Flo™	0.356	5.3
Kick-Flo®	0.749	4.3
Mean Flow over Head Range	-	4.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.3	3.000	8.1	7.000	12.2
0.200	5.0	1.400	5.7	3.500	8.8	7.500	12.6
0.300	5.3	1.600	6.1	4.000	9.3	8.000	13.0
0.400	5.3	1.800	6.4	4.500	9.9	8.500	13.4
0.500	5.2	2.000	6.7	5.000	10.4	9.000	13.7
0.600	5.0	2.200	7.0	5.500	10.8	9.500	14.1
0.800	4.4	2.400	7.3	6.000	11.3		
1.000	4.9	2.600	7.6	6.500	11.7		

Hydro-Brake® Optimum Manhole: SC6.1, DS/PN: S2.001, Volume (m³): 8.7

Unit Reference	MD-SHE-0164-1430-1500-1430
Design Head (m)	1.500
Design Flow (l/s)	14.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	164
Invert Level (m)	142.860
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

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Hydro-Brake® Optimum Manhole: SC6.1, DS/PN: S2.001, Volume (m³): 8.7

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	14.3
Flush-Flo™	0.439	14.3
Kick-Flo®	0.950	11.5
Mean Flow over Head Range	-	12.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.9	1.200	12.9	3.000	19.9	7.000	29.9
0.200	12.9	1.400	13.8	3.500	21.4	7.500	30.9
0.300	13.9	1.600	14.7	4.000	22.8	8.000	31.9
0.400	14.3	1.800	15.6	4.500	24.1	8.500	32.8
0.500	14.2	2.000	16.4	5.000	25.4	9.000	33.7
0.600	14.1	2.200	17.1	5.500	26.6	9.500	34.6
0.800	13.2	2.400	17.9	6.000	27.7		
1.000	11.8	2.600	18.6	6.500	28.8		

Hydro-Brake® Optimum Manhole: SC5.1, DS/PN: S4.001, Volume (m³): 9.3

Unit Reference	MD-SHE-0143-1070-1500-1070
Design Head (m)	1.500
Design Flow (l/s)	10.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	143
Invert Level (m)	141.880
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	10.7
Flush-Flo™	0.443	10.7
Kick-Flo®	0.938	8.6
Mean Flow over Head Range	-	9.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.300	10.4	0.500	10.7	0.800	9.8
0.200	9.6	0.400	10.7	0.600	10.5	1.000	8.8

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Hydro-Brake® Optimum Manhole: SC5.1, DS/PN: S4.001, Volume (m³): 9.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	9.6	2.400	13.4	5.000	19.0	8.000	23.8
1.400	10.4	2.600	13.9	5.500	19.8	8.500	24.5
1.600	11.0	3.000	14.9	6.000	20.7	9.000	25.1
1.800	11.7	3.500	16.0	6.500	21.5	9.500	25.8
2.000	12.3	4.000	17.0	7.000	22.3		
2.200	12.8	4.500	18.0	7.500	23.0		

Hydro-Brake® Optimum Manhole: S36, DS/PN: S1.032, Volume (m³): 75.9

Unit Reference	MD-SHE-0344-8240-2500-8240
Design Head (m)	2.500
Design Flow (l/s)	82.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	344
Invert Level (m)	101.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	82.3
Flush-Flo™	0.761	82.4
Kick-Flo®	1.654	67.4
Mean Flow over Head Range	-	71.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	10.0	1.200	79.6	3.000	89.9	7.000	135.9
0.200	34.9	1.400	76.5	3.500	96.9	7.500	140.5
0.300	63.7	1.600	70.1	4.000	103.4	8.000	145.0
0.400	76.9	1.800	70.2	4.500	109.5	8.500	149.4
0.500	79.9	2.000	73.9	5.000	115.3	9.000	153.6
0.600	81.6	2.200	77.4	5.500	120.8	9.500	157.7
0.800	82.3	2.400	80.7	6.000	126.0		
1.000	81.4	2.600	83.9	6.500	131.0		

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Storage Structures for Southern Storm

Cellular Storage Manhole: SC4a2, DS/PN: S1.001

Invert Level (m) 146.450 Safety Factor 10.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1000.0	1000.0	1.300	0.0	1132.8
0.100	1000.0	1012.6	1.400	0.0	1132.8
0.200	1000.0	1025.3	1.500	0.0	1132.8
0.300	1000.0	1037.9	1.600	0.0	1132.8
0.400	1000.0	1050.6	1.700	0.0	1132.8
0.500	1000.0	1063.2	1.800	0.0	1132.8
0.600	1000.0	1075.9	1.900	0.0	1132.8
0.700	1000.0	1088.5	2.000	0.0	1132.8
0.800	1000.0	1101.2	2.100	0.0	1132.8
0.900	1000.0	1113.8	2.200	0.0	1132.8
1.000	1000.0	1126.5	2.300	0.0	1132.8
1.100	0.0	1132.8	2.400	0.0	1132.8
1.200	0.0	1132.8	2.500	0.0	1132.8

Tank or Pond Manhole: SC6.1, DS/PN: S2.001

Invert Level (m) 142.860

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1500.0	0.700	1500.0	1.400	0.0	2.100	0.0
0.100	1500.0	0.800	1500.0	1.500	0.0	2.200	0.0
0.200	1500.0	0.900	1500.0	1.600	0.0	2.300	0.0
0.300	1500.0	1.000	1500.0	1.700	0.0	2.400	0.0
0.400	1500.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	1500.0	1.200	0.0	1.900	0.0		
0.600	1500.0	1.300	0.0	2.000	0.0		

Tank or Pond Manhole: SC5.1, DS/PN: S4.001

Invert Level (m) 141.880

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1750.0	0.700	1750.0	1.400	0.0	2.100	0.0
0.100	1750.0	0.800	1750.0	1.500	0.0	2.200	0.0
0.200	1750.0	0.900	1750.0	1.600	0.0	2.300	0.0
0.300	1750.0	1.000	1750.0	1.700	0.0	2.400	0.0
0.400	1750.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	1750.0	1.200	0.0	1.900	0.0		
0.600	1750.0	1.300	0.0	2.000	0.0		

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Tank or Pond Manhole: S36, DS/PN: S1.032

Invert Level (m) 101.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	10353.0	2.000	15044.0	2.999	17540.0
1.000	12649.0	2.400	16031.0	3.000	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.351
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SC4a1	15 Winter	1	+0%	30/15 Summer			
S1.001	SC4a2	720 Winter	1	+0%	1/360 Winter			
S1.002	S1	15 Winter	1	+0%	100/15 Summer			
S1.003	S2	15 Winter	1	+0%	100/15 Summer			
S1.004	S3	15 Winter	1	+0%	30/15 Summer			
S1.005	S4	15 Winter	1	+0%	100/15 Summer			
S1.006	S5	15 Winter	1	+0%				
S2.000	SC6.0	15 Winter	1	+0%	30/15 Summer			
S2.001	SC6.1	600 Winter	1	+0%	30/60 Summer			
S3.000	SEmb Drain	15 Winter	1	+0%				
S1.007	S6	15 Winter	1	+0%				
S4.000	SC5.0	15 Winter	1	+0%	30/15 Summer			
S4.001	SC5.1	720 Winter	1	+0%	30/30 Summer			
S1.008	S7	15 Winter	1	+0%	30/15 Summer			
S1.009	S8	15 Winter	1	+0%	30/15 Summer			
S1.010	S9	15 Winter	1	+0%				
S5.000	SC1.1	15 Winter	1	+0%	100/15 Summer			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	SC4a1	146.918	-0.032	0.000	1.00			129.3	OK
S1.001	SC4a2	146.612	0.011	0.000	0.29		442	4.8	SURCHARGED
S1.002	S1	146.103	-0.282	0.000	0.13			19.4	OK
S1.003	S2	145.709	-0.241	0.000	0.27			38.8	OK
S1.004	S3	145.352	-0.208	0.000	0.40			47.6	OK
S1.005	S4	145.096	-0.234	0.000	0.30			53.5	OK
S1.006	S5	144.525	-0.290	0.000	0.17			62.4	OK
S2.000	SC6.0	143.417	-0.083	0.000	1.00			206.8	OK
S2.001	SC6.1	143.013	-0.072	0.000	0.28			10.7	OK
S3.000	SEmb Drain	147.089	-0.211	0.000	0.19			30.5	OK
S1.007	S6	142.488	-0.467	0.000	0.11			100.2	OK
S4.000	SC5.0	142.382	-0.143	0.000	0.92			215.2	OK
S4.001	SC5.1	142.025	-0.005	0.000	0.48			8.2	OK
S1.008	S7	141.458	-0.302	0.000	0.46			117.8	OK
S1.009	S8	141.332	-0.308	0.000	0.46			119.2	OK
S1.010	S9	141.055	-0.465	0.000	0.11			143.2	OK
S5.000	SC1.1	141.240	-0.760	0.000	0.25			778.1	OK

PN	US/MH Name	Level Exceeded
S1.000	SC4a1	
S1.001	SC4a2	
S1.002	S1	
S1.003	S2	
S1.004	S3	
S1.005	S4	
S1.006	S5	
S2.000	SC6.0	
S2.001	SC6.1	
S3.000	SEmb Drain	
S1.007	S6	
S4.000	SC5.0	
S4.001	SC5.1	
S1.008	S7	
S1.009	S8	
S1.010	S9	
S5.000	SC1.1	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S6.000	SC1.2	15 Winter	1	+0%	100/15 Summer			
S5.001	SC1.3	15 Winter	1	+0%	100/15 Summer			
S7.000	SC1.4	15 Winter	1	+0%	100/15 Winter			
S5.002	SC1.5	15 Winter	1	+0%	30/15 Summer			
S5.003	SC1.6	30 Winter	1	+0%	30/15 Summer			
S1.011	S10	30 Winter	1	+0%	30/15 Winter			
S1.012	S11	30 Winter	1	+0%				
S1.013	S12	30 Winter	1	+0%				
S1.014	S13	30 Winter	1	+0%				
S1.015	S14	30 Winter	1	+0%				
S1.016	S15	30 Winter	1	+0%				
S1.017	S16	30 Winter	1	+0%				
S1.018	S17	30 Winter	1	+0%				
S8.000	SC2.1	15 Winter	1	+0%	100/15 Summer			
S9.000	SC2.2	15 Winter	1	+0%	100/15 Summer			
S8.001	SC2.3	15 Winter	1	+0%				
S1.019	S18	30 Winter	1	+0%				
S1.020	S19	30 Winter	1	+0%				
S1.021	S25	30 Winter	1	+0%				
S1.022	S26	30 Winter	1	+0%				
S1.023	S27	30 Winter	1	+0%	100/30 Summer			
S1.024	S28	30 Winter	1	+0%				
S1.025	S29	30 Winter	1	+0%				
S1.026	S30	30 Winter	1	+0%				
S1.027	S31	30 Winter	1	+0%				
S1.028	S32	30 Winter	1	+0%				
S1.029	S33	30 Winter	1	+0%	100/15 Summer			
S1.030	S34	30 Winter	1	+0%	100/15 Summer			
S1.031	S35	30 Winter	1	+0%	100/15 Summer			
S1.032	S36	2160 Winter	1	+0%	1/120 Winter			
S1.033	S37	2160 Winter	1	+0%				
S1.034	S38	2160 Winter	1	+0%				
S1.035	S39	2160 Winter	1	+0%				
S1.036	S40	2160 Winter	1	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S6.000	SC1.2	138.291	-1.209	0.000	0.05			176.0	OK
S5.001	SC1.3	138.244	-0.916	0.000	0.30			966.6	OK
S7.000	SC1.4	141.210	-0.790	0.000	0.21			748.0	OK
S5.002	SC1.5	137.953	-0.647	0.000	0.52			1425.0	OK
S5.003	SC1.6	137.520	-0.630	0.000	0.56			1304.1	OK
S1.011	S10	137.423	-0.647	0.000	0.62			1412.0	OK
S1.012	S11	136.925	-1.065	0.000	0.19			1423.1	OK
S1.013	S12	135.360	-1.140	0.000	0.13			1428.3	OK

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.014	S13	132.355	-1.145	0.000	0.13			1435.1	OK
S1.015	S14	129.256	-1.069	0.000	0.18			1438.5	OK
S1.016	S15	127.649	-1.101	0.000	0.16			1445.1	OK
S1.017	S16	125.564	-1.086	0.000	0.17			1455.1	OK
S1.018	S17	123.766	-1.034	0.000	0.21			1455.3	OK
S8.000	SC2.1	132.835	-0.565	0.000	0.27			600.0	OK
S9.000	SC2.2	132.835	-0.565	0.000	0.27			600.0	OK
S8.001	SC2.3	127.405	-0.745	0.000	0.19			1204.9	OK
S1.019	S18	122.610	-0.990	0.000	0.25			1925.4	OK
S1.020	S19	121.045	-1.055	0.000	0.20			1931.9	OK
S1.021	S25	118.606	-0.994	0.000	0.25			1923.7	OK
S1.022	S26	116.987	-1.113	0.000	0.15			1910.5	OK
S1.023	S27	112.900	-0.950	0.000	0.28			1899.5	OK
S1.024	S28	111.668	-1.032	0.000	0.21			1916.1	OK
S1.025	S29	109.599	-1.001	0.000	0.24			1925.1	OK
S1.026	S30	107.662	-1.338	0.000	0.15			1925.1	OK
S1.027	S31	105.700	-1.300	0.000	0.17			1915.8	OK
S1.028	S32	104.181	-1.304	0.000	0.17			1901.3	OK
S1.029	S33	102.719	-1.166	0.000	0.27			1912.6	OK
S1.030	S34	102.190	-1.065	0.000	0.35			1906.0	OK
S1.031	S35	101.989	-1.061	0.000	0.35			1891.5	OK
S1.032	S36	101.649	0.249	0.000	0.39			82.0	SURCHARGED
S1.033	S37	100.912	-0.153	0.000	0.70			82.0	OK
S1.034	S38	100.466	-0.439	0.000	0.02			82.0	OK
S1.035	S39	99.645	-0.470	0.000	0.01			82.0	FLOOD RISK*
S1.036	S40	94.416	-0.449	0.000	0.03			82.0	FLOOD RISK*

PN	US/MH Name	Level Exceeded
S6.000	SC1.2	
S5.001	SC1.3	
S7.000	SC1.4	
S5.002	SC1.5	
S5.003	SC1.6	
S1.011	S10	
S1.012	S11	
S1.013	S12	
S1.014	S13	
S1.015	S14	
S1.016	S15	
S1.017	S16	
S1.018	S17	
S8.000	SC2.1	
S9.000	SC2.2	
S8.001	SC2.3	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Level Exceeded
S1.019	S18	
S1.020	S19	
S1.021	S25	
S1.022	S26	
S1.023	S27	
S1.024	S28	
S1.025	S29	
S1.026	S30	
S1.027	S31	
S1.028	S32	
S1.029	S33	
S1.030	S34	
S1.031	S35	
S1.032	S36	
S1.033	S37	
S1.034	S38	
S1.035	S39	
S1.036	S40	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.351
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SC4a1	15 Winter	30	+0%	30/15 Summer			
S1.001	SC4a2	600 Winter	30	+0%	1/360 Winter			
S1.002	S1	15 Winter	30	+0%	100/15 Summer			
S1.003	S2	15 Winter	30	+0%	100/15 Summer			
S1.004	S3	15 Winter	30	+0%	30/15 Summer			
S1.005	S4	15 Winter	30	+0%	100/15 Summer			
S1.006	S5	15 Winter	30	+0%				
S2.000	SC6.0	15 Winter	30	+0%	30/15 Summer			
S2.001	SC6.1	480 Winter	30	+0%	30/60 Summer			
S3.000	SEmb Drain	15 Winter	30	+0%				
S1.007	S6	15 Winter	30	+0%				
S4.000	SC5.0	15 Winter	30	+0%	30/15 Summer			
S4.001	SC5.1	720 Winter	30	+0%	30/30 Summer			
S1.008	S7	15 Winter	30	+0%	30/15 Summer			

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	SC4a1	147.242	0.292	0.000	2.57			332.3	SURCHARGED
S1.001	SC4a2	146.844	0.244	0.000	0.31			5.3	SURCHARGED
S1.002	S1	146.183	-0.203	0.000	0.41			58.7	OK
S1.003	S2	145.842	-0.108	0.000	0.80			115.9	OK
S1.004	S3	145.608	0.048	0.000	1.10			131.2	SURCHARGED
S1.005	S4	145.213	-0.117	0.000	0.80			143.5	OK
S1.006	S5	144.603	-0.213	0.000	0.44			162.8	OK
S2.000	SC6.0	143.724	0.224	0.000	2.57			531.9	SURCHARGED
S2.001	SC6.1	143.210	0.125	0.000	0.37			14.2	SURCHARGED
S3.000	SEmb Drain	147.144	-0.156	0.000	0.46			74.6	OK
S1.007	S6	142.580	-0.375	0.000	0.29			265.1	OK
S4.000	SC5.0	142.741	0.216	0.000	2.27			528.6	SURCHARGED
S4.001	SC5.1	142.207	0.177	0.000	0.61			10.5	SURCHARGED
S1.008	S7	141.837	0.077	0.000	1.19			303.7	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	SC4a1	
S1.001	SC4a2	
S1.002	S1	
S1.003	S2	
S1.004	S3	
S1.005	S4	
S1.006	S5	
S2.000	SC6.0	
S2.001	SC6.1	
S3.000	SEmb Drain	
S1.007	S6	
S4.000	SC5.0	
S4.001	SC5.1	
S1.008	S7	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.009	S8	15 Winter	30	+0%	30/15 Summer			
S1.010	S9	15 Winter	30	+0%				
S5.000	SC1.1	15 Winter	30	+0%	100/15 Summer			
S6.000	SC1.2	15 Winter	30	+0%	100/15 Summer			
S5.001	SC1.3	15 Winter	30	+0%	100/15 Summer			
S7.000	SC1.4	15 Winter	30	+0%	100/15 Winter			
S5.002	SC1.5	15 Winter	30	+0%	30/15 Summer			
S5.003	SC1.6	30 Winter	30	+0%	30/15 Summer			
S1.011	S10	30 Winter	30	+0%	30/15 Winter			
S1.012	S11	30 Winter	30	+0%				
S1.013	S12	30 Winter	30	+0%				
S1.014	S13	30 Winter	30	+0%				
S1.015	S14	30 Winter	30	+0%				
S1.016	S15	30 Winter	30	+0%				
S1.017	S16	30 Winter	30	+0%				
S1.018	S17	30 Winter	30	+0%				
S8.000	SC2.1	15 Winter	30	+0%	100/15 Summer			
S9.000	SC2.2	15 Winter	30	+0%	100/15 Summer			
S8.001	SC2.3	15 Winter	30	+0%				
S1.019	S18	30 Winter	30	+0%				
S1.020	S19	30 Winter	30	+0%				
S1.021	S25	30 Winter	30	+0%				
S1.022	S26	30 Winter	30	+0%				
S1.023	S27	30 Winter	30	+0%	100/30 Summer			
S1.024	S28	30 Winter	30	+0%				
S1.025	S29	30 Winter	30	+0%				
S1.026	S30	30 Winter	30	+0%				
S1.027	S31	30 Winter	30	+0%				
S1.028	S32	30 Winter	30	+0%				
S1.029	S33	30 Winter	30	+0%	100/15 Summer			
S1.030	S34	30 Winter	30	+0%	100/15 Summer			
S1.031	S35	2160 Winter	30	+0%	100/15 Summer			
S1.032	S36	2160 Winter	30	+0%	1/120 Winter			
S1.033	S37	10080 Summer	30	+0%				
S1.034	S38	10080 Winter	30	+0%				
S1.035	S39	8640 Winter	30	+0%				
S1.036	S40	600 Winter	30	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.009	S8	141.677	0.037	0.000	1.15			299.0	SURCHARGED
S1.010	S9	141.134	-0.386	0.000	0.27			339.3	OK
S5.000	SC1.1	141.552	-0.448	0.000	0.56			1726.5	OK
S6.000	SC1.2	138.945	-0.555	0.000	0.12			431.7	OK
S5.001	SC1.3	138.882	-0.278	0.000	0.59			1885.2	OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S7.000	SC1.4	141.490	-0.510	0.000	0.51			1798.1	OK
S5.002	SC1.5	138.776	0.176	0.000	1.08			2973.8	SURCHARGED
S5.003	SC1.6	138.209	0.059	0.000	1.28			2971.9	SURCHARGED
S1.011	S10	138.077	0.007	0.000	1.42			3247.3	SURCHARGED
S1.012	S11	137.174	-0.816	0.000	0.43			3268.0	OK
S1.013	S12	135.563	-0.937	0.000	0.30			3279.9	OK
S1.014	S13	132.555	-0.945	0.000	0.30			3294.0	OK
S1.015	S14	129.501	-0.824	0.000	0.42			3299.7	OK
S1.016	S15	127.876	-0.874	0.000	0.37			3314.9	OK
S1.017	S16	125.801	-0.849	0.000	0.39			3337.8	OK
S1.018	S17	124.038	-0.762	0.000	0.49			3333.6	OK
S8.000	SC2.1	133.075	-0.325	0.000	0.64			1412.7	OK
S9.000	SC2.2	133.075	-0.325	0.000	0.64			1412.7	OK
S8.001	SC2.3	127.584	-0.566	0.000	0.44			2834.7	OK
S1.019	S18	122.910	-0.690	0.000	0.57			4357.0	OK
S1.020	S19	121.295	-0.805	0.000	0.44			4357.0	OK
S1.021	S25	118.910	-0.690	0.000	0.57			4353.7	OK
S1.022	S26	117.200	-0.900	0.000	0.34			4347.7	OK
S1.023	S27	113.231	-0.619	0.000	0.65			4352.8	OK
S1.024	S28	111.932	-0.768	0.000	0.48			4355.9	OK
S1.025	S29	109.894	-0.706	0.000	0.55			4356.6	OK
S1.026	S30	107.924	-1.076	0.000	0.34			4354.8	OK
S1.027	S31	105.981	-1.019	0.000	0.39			4349.2	OK
S1.028	S32	104.454	-1.031	0.000	0.38			4350.9	OK
S1.029	S33	103.100	-0.785	0.000	0.61			4353.0	OK
S1.030	S34	102.683	-0.572	0.000	0.80			4342.7	OK
S1.031	S35	102.496	-0.554	0.000	0.08			436.9	OK
S1.032	S36	102.466	1.066	0.000	0.39			82.3	SURCHARGED
S1.033	S37	100.912	-0.153	0.000	0.70			82.3	OK
S1.034	S38	100.467	-0.438	0.000	0.02			82.3	OK
S1.035	S39	99.645	-0.470	0.000	0.01			82.3	FLOOD RISK*
S1.036	S40	94.416	-0.449	0.000	0.03			82.3	FLOOD RISK*

PN	US/MH Name	Level Exceeded
S1.009	S8	
S1.010	S9	
S5.000	SC1.1	
S6.000	SC1.2	
S5.001	SC1.3	
S7.000	SC1.4	
S5.002	SC1.5	
S5.003	SC1.6	
S1.011	S10	
S1.012	S11	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Level Exceeded
S1.013	S12	
S1.014	S13	
S1.015	S14	
S1.016	S15	
S1.017	S16	
S1.018	S17	
S8.000	SC2.1	
S9.000	SC2.2	
S8.001	SC2.3	
S1.019	S18	
S1.020	S19	
S1.021	S25	
S1.022	S26	
S1.023	S27	
S1.024	S28	
S1.025	S29	
S1.026	S30	
S1.027	S31	
S1.028	S32	
S1.029	S33	
S1.030	S34	
S1.031	S35	
S1.032	S36	
S1.033	S37	
S1.034	S38	
S1.035	S39	
S1.036	S40	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.351
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SC4a1	15 Winter	100	+30%	30/15 Summer			
S1.001	SC4a2	960 Winter	100	+30%	1/360 Winter			
S1.002	S1	15 Winter	100	+30%	100/15 Summer			
S1.003	S2	15 Winter	100	+30%	100/15 Summer			
S1.004	S3	15 Winter	100	+30%	30/15 Summer			
S1.005	S4	15 Winter	100	+30%	100/15 Summer			
S1.006	S5	15 Winter	100	+30%				
S2.000	SC6.0	15 Winter	100	+30%	30/15 Summer			
S2.001	SC6.1	600 Winter	100	+30%	30/60 Summer			
S3.000	SEmb Drain	15 Winter	100	+30%				
S1.007	S6	15 Winter	100	+30%				
S4.000	SC5.0	15 Winter	100	+30%	30/15 Summer			
S4.001	SC5.1	720 Winter	100	+30%	30/30 Summer			
S1.008	S7	15 Winter	100	+30%	30/15 Summer			

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	SC4a1	147.872	0.922	0.000	4.27			552.7	SURCHARGED
S1.001	SC4a2	147.211	0.610	0.000	0.31			5.3	SURCHARGED
S1.002	S1	146.683	0.298	0.000	0.64			92.6	SURCHARGED
S1.003	S2	146.558	0.608	0.000	1.11			159.4	SURCHARGED
S1.004	S3	146.042	0.482	0.000	1.60			191.0	SURCHARGED
S1.005	S4	145.471	0.141	0.000	1.13			201.5	SURCHARGED
S1.006	S5	144.645	-0.170	0.000	0.61			227.4	OK
S2.000	SC6.0	144.236	0.736	0.000	4.27			883.2	SURCHARGED
S2.001	SC6.1	143.516	0.431	0.000	0.38			14.2	SURCHARGED
S3.000	SEmb Drain	147.202	-0.098	0.000	0.77			125.4	OK
S1.007	S6	142.640	-0.315	0.000	0.45			406.7	OK
S4.000	SC5.0	143.252	0.727	0.000	3.78			880.7	SURCHARGED
S4.001	SC5.1	142.496	0.466	0.000	0.62			10.7	SURCHARGED
S1.008	S7	142.377	0.617	0.000	1.82			464.7	SURCHARGED

PN	US/MH Name	Level Exceeded
S1.000	SC4a1	
S1.001	SC4a2	
S1.002	S1	
S1.003	S2	
S1.004	S3	
S1.005	S4	
S1.006	S5	
S2.000	SC6.0	
S2.001	SC6.1	
S3.000	SEmb Drain	
S1.007	S6	
S4.000	SC5.0	
S4.001	SC5.1	
S1.008	S7	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.009	S8	15 Winter	100	+30%	30/15 Summer			
S1.010	S9	15 Winter	100	+30%				
S5.000	SC1.1	15 Winter	100	+30%	100/15 Summer			
S6.000	SC1.2	30 Winter	100	+30%	100/15 Summer			
S5.001	SC1.3	30 Winter	100	+30%	100/15 Summer			
S7.000	SC1.4	15 Winter	100	+30%	100/15 Winter			
S5.002	SC1.5	30 Winter	100	+30%	30/15 Summer			
S5.003	SC1.6	30 Winter	100	+30%	30/15 Summer			
S1.011	S10	30 Winter	100	+30%	30/15 Winter			
S1.012	S11	30 Winter	100	+30%				
S1.013	S12	30 Winter	100	+30%				
S1.014	S13	30 Winter	100	+30%				
S1.015	S14	30 Winter	100	+30%				
S1.016	S15	30 Winter	100	+30%				
S1.017	S16	30 Winter	100	+30%				
S1.018	S17	30 Winter	100	+30%				
S8.000	SC2.1	15 Winter	100	+30%	100/15 Summer			
S9.000	SC2.2	15 Winter	100	+30%	100/15 Summer			
S8.001	SC2.3	15 Winter	100	+30%				
S1.019	S18	30 Winter	100	+30%				
S1.020	S19	30 Winter	100	+30%				
S1.021	S25	30 Winter	100	+30%				
S1.022	S26	30 Winter	100	+30%				
S1.023	S27	30 Winter	100	+30%	100/30 Summer			
S1.024	S28	30 Winter	100	+30%				
S1.025	S29	30 Winter	100	+30%				
S1.026	S30	30 Winter	100	+30%				
S1.027	S31	30 Winter	100	+30%				
S1.028	S32	30 Winter	100	+30%				
S1.029	S33	30 Winter	100	+30%	100/15 Summer			
S1.030	S34	30 Winter	100	+30%	100/15 Summer			
S1.031	S35	2880 Winter	100	+30%	100/15 Summer			
S1.032	S36	2880 Winter	100	+30%	1/120 Winter			
S1.033	S37	10080 Summer	100	+30%				
S1.034	S38	10080 Winter	100	+30%				
S1.035	S39	10080 Summer	100	+30%				
S1.036	S40	960 Summer	100	+30%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.009	S8	141.943	0.303	0.000	1.84			475.5	SURCHARGED
S1.010	S9	141.211	-0.309	0.000	0.46			576.6	OK
S5.000	SC1.1	142.532	0.532	0.000	0.91			2778.9	SURCHARGED
S6.000	SC1.2	140.535	1.035	0.000	0.15			536.8	SURCHARGED
S5.001	SC1.3	140.525	1.365	0.000	0.77			2459.9	SURCHARGED

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S7.000	SC1.4	142.123	0.123	0.000	0.83			2916.5	SURCHARGED
S5.002	SC1.5	140.326	1.726	0.000	1.58			4358.2	SURCHARGED
S5.003	SC1.6	139.088	0.938	0.000	1.96			4549.9	SURCHARGED
S1.011	S10	138.554	0.484	0.000	2.18			4997.3	SURCHARGED
S1.012	S11	137.380	-0.610	0.000	0.66			5033.2	OK
S1.013	S12	135.719	-0.781	0.000	0.47			5052.3	OK
S1.014	S13	132.709	-0.791	0.000	0.46			5079.6	OK
S1.015	S14	129.706	-0.619	0.000	0.65			5095.8	OK
S1.016	S15	128.058	-0.692	0.000	0.56			5127.0	OK
S1.017	S16	125.994	-0.656	0.000	0.61			5162.3	OK
S1.018	S17	124.276	-0.524	0.000	0.75			5162.6	OK
S8.000	SC2.1	134.193	0.793	0.000	1.02			2251.9	SURCHARGED
S9.000	SC2.2	134.193	0.793	0.000	1.02			2251.9	SURCHARGED
S8.001	SC2.3	127.744	-0.406	0.000	0.69			4491.8	OK
S1.019	S18	123.297	-0.303	0.000	0.99			7627.2	OK
S1.020	S19	121.590	-0.510	0.000	0.77			7617.8	OK
S1.021	S25	119.296	-0.304	0.000	0.99			7593.6	OK
S1.022	S26	117.431	-0.669	0.000	0.59			7604.1	OK
S1.023	S27	114.118	0.268	0.000	1.14			7628.7	SURCHARGED
S1.024	S28	112.254	-0.446	0.000	0.84			7622.6	OK
S1.025	S29	110.267	-0.333	0.000	0.96			7603.6	OK
S1.026	S30	108.205	-0.795	0.000	0.60			7596.4	OK
S1.027	S31	106.300	-0.700	0.000	0.69			7621.3	OK
S1.028	S32	105.470	-0.015	0.000	0.66			7487.4	OK
S1.029	S33	104.774	0.889	0.000	1.05			7481.8	SURCHARGED
S1.030	S34	104.088	0.833	0.000	1.38			7472.3	SURCHARGED
S1.031	S35	103.434	0.384	0.000	0.10			558.4	SURCHARGED
S1.032	S36	103.432	2.032	0.000	0.39			82.3	SURCHARGED
S1.033	S37	100.912	-0.153	0.000	0.70			82.3	OK
S1.034	S38	100.467	-0.438	0.000	0.02			82.3	OK
S1.035	S39	99.645	-0.470	0.000	0.01			82.3	FLOOD RISK*
S1.036	S40	94.416	-0.449	0.000	0.03			82.3	FLOOD RISK*

PN	US/MH Name	Level Exceeded
S1.009	S8	
S1.010	S9	
S5.000	SC1.1	
S6.000	SC1.2	
S5.001	SC1.3	
S7.000	SC1.4	
S5.002	SC1.5	
S5.003	SC1.6	
S1.011	S10	
S1.012	S11	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Southern Storm

PN	US/MH Name	Level Exceeded
S1.013	S12	
S1.014	S13	
S1.015	S14	
S1.016	S15	
S1.017	S16	
S1.018	S17	
S8.000	SC2.1	
S9.000	SC2.2	
S8.001	SC2.3	
S1.019	S18	
S1.020	S19	
S1.021	S25	
S1.022	S26	
S1.023	S27	
S1.024	S28	
S1.025	S29	
S1.026	S30	
S1.027	S31	
S1.028	S32	
S1.029	S33	
S1.030	S34	
S1.031	S35	
S1.032	S36	
S1.033	S37	
S1.034	S38	
S1.035	S39	
S1.036	S40	

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Appendix E

RPS Drainage Drawings

Proposed Drainage

Based on the 20.3/s Qbar outfall rate at Drain A

7.782Ha - total site area to be discharged to the outfall, This has a varied impermeable area site

90% impermeable for commercial plots

100% for adopted highway

then this equates to - 7.051Ha impermeable site area

Based on this and with the 20.3/s restriction we can estimate, using Microdrainge models, that the Northern site outfall will need approximately ?m3 of attenuation.

Existing Site

The Northern catchment is split into two outfalls, both appearing to connect to Highway agency drains. As the site is re-leveled it is proposed to connect the northern development area to the Motorway Drain A with the proposed site area.

Green field runoff calculations for Drain A have been done. Using UKSUDS and the 4.233Ha catchment going to Drain A, would generate an approximate Qbar rate of 20.3l/s.

based on:

SAAR - 696

Region - 3

SPR - 0.47

Soil type - 4

Existing Highway / Field toe drain

Existing SW connection for fields

Ex. 1350mm
CL: 141.000
IL: 140.000 tbc

NS8 1500mm
CL: 145.600
IL: 141.105

NS7 1500mm
CL: 145.600
IL: 141.215

Plot 3b
Future Office & General Industry
SW and FW connection
SW restricted to 20.3l/s with 2000m³ of attenuation
Attenuation based upon a 90% impermeable area for commercial plots

NS6 1500mm
AS5 AquaSwirl
CL: 145.600
IL: 141.560

FC3b 1200mm
CL: 145.600
IL: 143.600

Existing Highway / Field toe drain

NS2 1350mm
CL: 147.900
IL: 142.210

NS3 1350mm
CL: 145.300
IL: 142.900

NS4 1350mm
CL: 146.300
IL: 142.130

NS5 1350mm
CL: 147.100
IL: 141.680

Future Plot 4c
Future Storage and Distribution SW and FW connection
SW restricted to 3l/s with 865m³ of attenuation.
Attenuation based upon a 90% impermeable area for commercial plots.

NCS4c.2 1350mm
CL: 148.300
IL: 145.245

NCS4c.1
CL: 148.300
IL: 145.515

FC4b 1200mm
CL: 148.300
IL: 145.390

F1 1200mm
CL: 147.200
IL: 143.215

F2 1200mm
CL: 147.725
IL: 142.980

Future Plot 4b
Future Storage and Distribution SW and FW connection
SW restricted to 5.26l/s with 760m³ of attenuation.
Attenuation based upon a 90% impermeable area for commercial plots.

NCS4b.1
CL: 148.450
IL: 146.000

NCS4b.2 1350mm
CL: 148.450
IL: 144.930

FC4b2 1200mm
CL: 148.600
IL: 144.680

F3 1200mm
CL: 148.100
IL: 142.650

F4 1200mm
CL: 148.110
IL: 142.465

NS14 1200mm
CL: 146.250
IL: 142.520

NCS3a.2 1800mm
CL: 145.600
IL: 142.900

NS1 1350mm
CL: 148.150
IL: 142.430

NCS3a.1
CL: 145.600
IL: 143.000

FC3a 1350mm
CL: 145.600
IL: 142.925

Plot 3a
Storage and Distribution
SW restricted to 9l/s with 3000m³ of attenuation
Attenuation based upon a 90% impermeable area for commercial plots

SS1 1350mm
CL: 148.400
IL: 146.010

NS13 1200mm
CL: 146.250
IL: 142.950

SS2 1350mm
CL: 148.690
IL: 145.575

NS12 1200mm
CL: 146.250
IL: 143.360

NS9 1200mm
CL: 145.600
IL: 144.655

NS10 1200mm
CL: 147.000
IL: 144.015

NS11 1200mm
CL: 146.000
IL: 143.415

Toe drain to direct flow to the existing Field outfall point. TBC as drain exist's but detail is unknown, assumed to connect o M1 Highway drainage

SC4a1
CL: 149.000
IL: 146.500

SC4a2 1350mm
CL: 149.000
IL: 146.450

FC4a 1200mm
CL: 148.600
IL: 143.755

F5 1200mm
CL: 148.400
IL: 142.080

Future Plot 4a
Future Storage and Distribution SW and FW connection
SW restricted to 5.26l/s with 1000m³ of attenuation.
Attenuation based upon a 90% impermeable area for commercial plots.

Area: 1.097Ha
Greenfield Run-off rates:
Qbar: 5.3 l/s
1 in 1 year: 4.52 l/s
1 in 30 year: 9.21 l/s
1 in 100 year: 10.94 l/s
1 in 200 year: 12.47 l/s

F6 1200mm
CL: 148.400
IL: 141.235

SFD1 1200mm
CL: 150.900
IL: 149.400

F7 1200mm
CL: 147.900
IL: 140.660

SFD2 1200mm
CL: 147.700
IL: 146.575

SS3 1200mm
CL: 148.225
IL: 145.185

Future Plot 6
Future residential SW connection
SW restricted to 14.3l/s with 1500m³ of attenuation. Attenuation based upon a 60% residential run-off
Area: 2.90Ha
Greenfield Run-off rate of Qbar 14.3l/s
1 in 1 year: 12.33 l/s
1 in 30 year: 25.09 l/s
1 in 100 year: 29.82 l/s
1 in 200 year: 33.98 l/s

SFD3 1200mm
CL: 147.100
IL: 145.975

F8 1200mm
CL: 146.875
IL: 140.140

SFD3a 1200mm
anticipated diversion of existing SW from Houses
CL: 147.100
IL: 145.975

F9 1200mm
CL: 145.700
IL: 139.620

SS4 1350mm
CL: 147.250
IL: 144.955

SFD4 1200mm
CL: 145.400
IL: 144.275

SC6.0
CL: 144.875
IL: 142.900

F10 1200mm
CL: 144.600
IL: 138.995

SC6.1 1500mm
CL: 144.875
IL: 142.860

F11 1200mm
CL: 143.900
IL: 138.495

SS5 1350mm
CL: 146.000
IL: 144.415

SC6.2 1500mm
CL: 144.875
IL: 142.800

FC5 1200mm
CL: 144.425
IL: 139.835

SC5.0
CL: 144.200
IL: 141.925

SC5.1 1500mm
CL: 144.200
IL: 141.880

Future Plot 5
Future multiuse commercial SW and FW connection
SW restricted to 10.72l/s with 1750m³ of attenuation
Attenuation based upon a 90% impermeable area for commercial plots.

Area: 1.92Ha
Greenfield Run-off rate of Qbar 10.7l/s
1 in 1 year: 9.22 l/s
1 in 30 year: 18.76 l/s
1 in 100 year: 22.3 l/s
1 in 200 year: 25.41 l/s

SS6 1500mm
CL: 144.850
IL: 142.355

SFD5 1200mm
CL: 145.000
IL: 143.875

F12 1200mm
CL: 143.725
IL: 138.125

SS7 1500mm
CL: 144.150
IL: 141.160

F13 1200mm
CL: 143.800
IL: 137.820

SFD6 1200mm
CL: 144.000
IL: 142.875

SS8 1500mm
CL: 143.850
IL: 141.040

F14 1200mm
CL: 143.050
IL: 137.280

SFD7 1200mm
CL: 142.750
IL: 141.625

SS9 1500mm
CL: 142.850
IL: 140.920

SFD8 1200mm
CL: 142.300
IL: 141.175

EX MH
CL: 147.00
IL: tbc

YWS Agreed Sewer Connection point

F22 1200mm
CL: 146.200
IL: 144.775

Rising main

225mm French Drain

Key Plan
Not to Scale

Rev	Description	By	Ckd	Date
P06	Access added	JNB	SMC	16.06.20
P05	Issued for Planning	JNB	SMC	11.06.20
P04	Issued for Draft Planning	SMC	LM	22.05.20
P03	Drainage Layout Amended	JNB	SMC	09.04.20
P02	Drainage Detail Added	SMC	SG	23.03.20
P01	First Issue	AB	SMC	09.03.20

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Project: Hoyland

Title: Proposed Drainage Strategy Sheet 1 of 3

RPS Project Number	Scale @ A1	Date Created
NK020040	1:1000	09.03.20
Task Team Manager	Information Author	Task Information Manager
SG	JNB	SMC

Status: S2

Document Number: HOYLA-RPS-SI-XX-DR-D-0300

Revision: P06

Project Code - Originator - Zone - Level - Type - Role - Drawing Number

rpsgroup.com

10m SCALE 1:1000

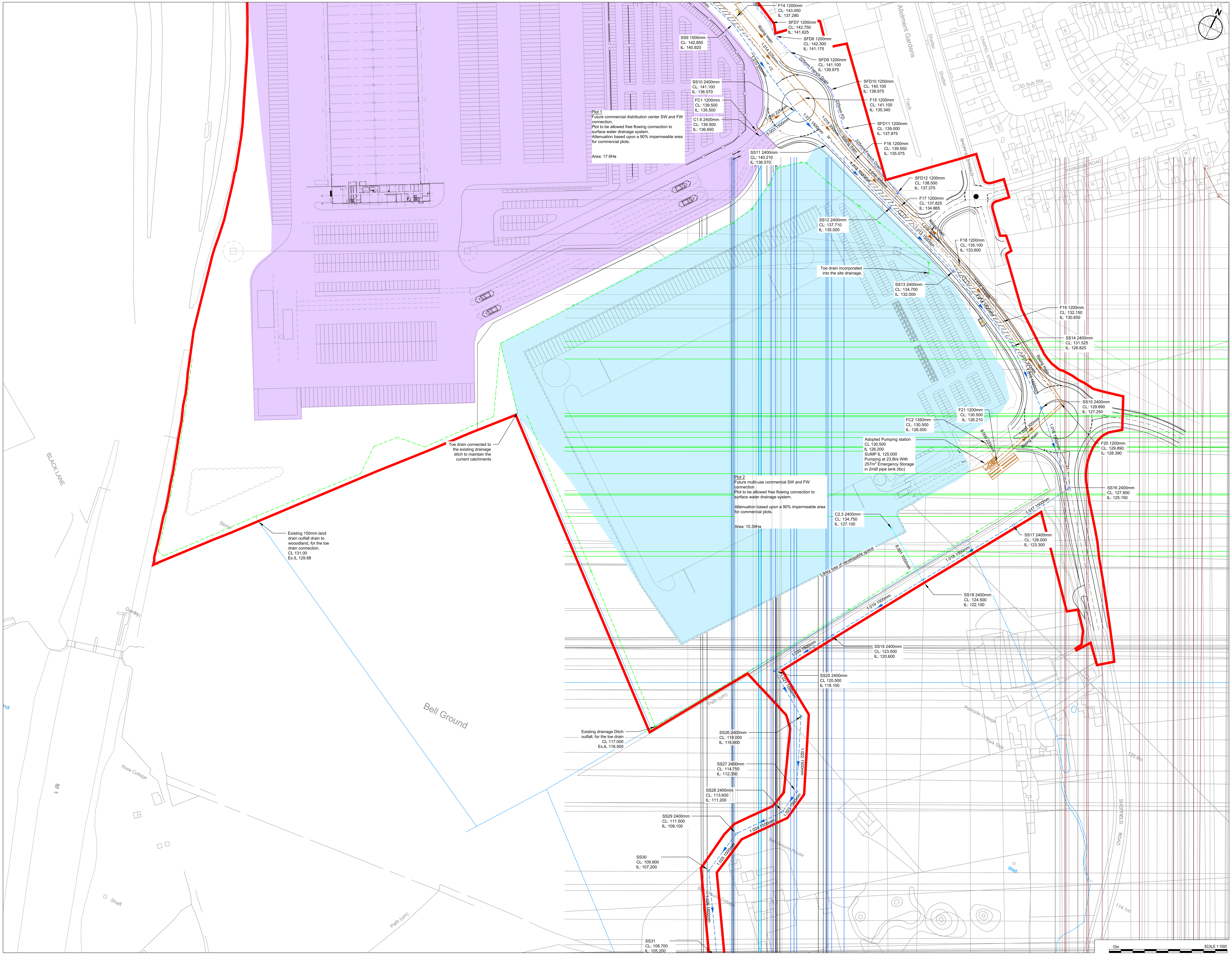
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Notes

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2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.
4. Masterplan taken from PHP drawing 4400-001 Rev P25, received 15/06/2020.

Key:

- Proposed Adoptable Surface Water
- Proposed Private Surface Water
- Proposed Adoptable Foul Water
- Proposed Adoptable rising Main
- Proposed Toe Drain
- Development Plot Area 1 (Hermes)
- Development Plot Area 2
- Development Plot Area 3
- Development Plot Area 4
- Development Plot Area 5
- Development Plot Area 6



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Notes

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2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.
4. Masterplan taken from PHP drawing 4400-001 Rev P25, received 15/06/2020.

Key:

- Proposed Adoptable Surface Water
- Proposed Private Surface Water
- Proposed Adoptable Foul Water
- Proposed Adoptable rising Main
- Proposed Toe Drain
- Development Plot Area 1 (Hermes)
- Development Plot Area 2
- Development Plot Area 3
- Development Plot Area 4
- Development Plot Area 5
- Development Plot Area 6



Key Plan

Not to Scale

Rev	Description	By	Ckd	Date
P07	Access added	JNB	SMC	16.06.20
P06	Issued for Planning	JNB	SMC	11.06.20
P05	Issued for Draft Planning	SMC	LM	22.05.20
P04	Drainage Option 1 Amended	SMC	SMC	30.04.20
P03	Drainage Layout Amended	JNB	SMC	09.04.20
P02	Drainage Detail Added	SMC	SG	23.03.20
P01	First Issue	AB	SMC	09.03.20

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Client: newlands developments

Project: Hoyland

Title: Proposed Drainage Strategy Sheet 2 of 3

RPS Project Number	Scale @ A1	Date Created
NK020040	1:1000	09.03.20

Task Team Manager	Information Author	Task Information Manager
SG	JNB	SMC

Status: S2

Document Number: HOYLA-RPS-SI-XX-DR-D-0301

Revision: P07

Project Code - Originator - Zone - Level - Type - Role - Drawing Number

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Key:

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SS31
CL: 108.700
IL: 105.200

1800mm

102.1 1800mm

SS32
CL: 108.250
IL: 103.685

1029.1 1800mm

SS33
CL: 108.250
IL: 102.085

1029.1 1800mm

Existing Drainage Culvert IL and size tbc likley to be 225mm with IL 104.000 so above the proposed culvert crown of 103.75

SS34
CL: 105.750
IL: 101.455

1,031 1800mm

SS35
CL: 106.250
IL: 101.250

1,031 1800mm

Proposed 31,525m³ Attenuation Pond made up of:
- 11,482m³ attenuated below the natural ground level
- 20,043m³ impounded above the natural ground level

TB - 104.000
BB - 99.800
NWL - 101.000
TWL - 103.400
Restricted to Qbar - 82.4l/s by Hydrobrake Optimum MD-SHE-0344-8240-2500-8240
Design Head 2.4m
344mm orifice
Pond Inlet to be designed with a pre treatment forebay and 6m of placed stone erosion protection by the inlet

100m Radius from Old Hall

Proposed Pond Bund
To construct the pond requires that a bund is needed to bring the 102.00m existing ground level up to 104.00m top of bund level. This will require Geotechnical guidance on soils to calculate a safe bund construction to support retaining the potential 3m head of water behind it.

Hydrobrake Optimum
Restricted to 82.4l/s

1,002 400mm

SS36 1350mm
CL 104.000
IL 101.000

SS37 1350mm
CL: 101.600
IL: 100.300

1,029 400mm

Inlet Headwall with 4m of placed stone erosion protection in the Swale
CL 101.500
IL 100.040

1,029 Swale

Grass Swale with bund's to dissipate flow allowing for further pollution control
750mm Base
500mm Deep
1:4 Side Slopes
CL 99.750
IL 99.250

1,005 Swale

Grass Swale with bunds
750mm Base
500mm Deep
1:4 Side Slopes
CL 94.500
IL 94.000

1,005 Swale

Outlet to existing culvert

Key Plan
Not to Scale

P07	Access added	JNB	SMC	16.06.20
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