Surface Water Drainage Strategy (SWDS)

REF N. 4003/SWDS

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REDROW

AMBIENTAL
ENVIRONMENTAL ASSESSMENT

265 BURLINGTON ROAD
NEW MALDEN

Document Issue Record

Project: Surface Water Drainage Strategy (SWDS)

Prepared for: Redrow Homes

Reference: 4003 SWDS Final V1.0

Site Location: 265 Burlington Road, New Malden, KT3 4NE

Proposed Development: The development is construction of circa 456 new dwellings and commercial accommodation.

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Amendment V1	Mark Naumann	21/05/2019	

Amendment V1 – Site plans updated to suit updated scheme.

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1. Introduction

1.1 Ambiental Environmental Assessment has been appointed by Redrow Homes Limited to undertake a Surface Water Drainage Strategy for the proposed development at 265 Burlington Road, New Malden, KT3 4NE.

1.2 The site compromises a vacant 1980's office building arranged over two storeys with an interconnecting single storey office building at the rear and a section of car park land. The existing site is largely hardstanding.

Figure 1: Site Location

1.3 Demolition of the existing buildings and erection of two blocks of development ranging in height between seven and 15 storeys and comprising 456 new homes, of which 114 will be one beds, 290 will be two beds and 52 will be three beds. 499sqm of B1(a) office space will be accommodated at ground floor level along with 220 car parking spaces, 830 cycle parking spaces, a realigned junction onto Burlington Road, hard and soft landscaping and associated residential facilities. The application also includes minor changes to the layout and configuration of the retained Tesco car park.

1.4 The redline boundary, as provided on the proposed layout, has a plan area of approximately 12,000m^2. The proposed building development covers the majority of the site with an access road bisecting the site centrally.

1.5 Elevations on site vary between approximately 14.02mAOD at the lowest point along the west boundary rising to 15.00mAOD to the east on Burlington Road. Analysis of topographic levels indicates that the site generally slopes from north to south.

1.6 The podium levels of the new development are proposed to include elements of green roof. The form of the main block roofs is yet to be finalised but inclusion of green or brown roofs could be feasible.

1.7 A review of the EA flood map for planning (Figure 3) has demonstrated that the site is located in Flood Zone 2 (Medium Risk) and Flood Zone 3 (High Risk). The dominant source of flooding at the site is Fluvial from the Pyl Brook to the north of the site and Beverley Brook to the west. Both rivers are recognised as an EA main river.

1.8 The purpose of this assessment is to demonstrate that the development proposal outlined above can be satisfactorily accommodated without worsening flood risk for the area and without placing the development itself at risk of flooding, as per National guidance provided within the National Planning Policy Framework (NPPF) the National Planning Practice Guidance (NPPG), DEFRA's National Standards for Sustainable Drainage and the London Plan (including Supplementary Planning Guidance to the London Plan). Proposals also need to comply with London Borough (LB) of Merton (acting as the Lead Local Flood Authority LLFA)) local policy relating to Sustainable Urban Drainage Systems (SUDS).

2. Site Overview

2.1 In order to mitigate flood risk posed by the proposed development, adequate control measures are required to be considered. This will ensure that surface water runoff is dealt with at source and the flood risk off site is not increased.

2.2 The existing site is largely hardstanding area. All proposed on-site drainage should be designed to accommodate a 1 in 100 year rainfall event including the appropriate allowance for climate change as set out within the NPPF at 40%.

2.3 The London Borough of Merton Sustainable Drainage Design and Evaluation Guide (2018) for local SuDS specific requirements has demonstrated that:

> ***"Discharge rates for new developments should be restricted to Greenfield runoff rates. For brownfield sties, runoff rates should not be more than three times the calculated greenfield rate, in line with the London Plan's Sustainable Construction and Design SPG (Section 2.5.2)"***

***Source**: (Local SuDS Requirements for Merton)*

2.4 Given the position of the site within a surface flood area, and there being a potential for surface water to affect the site at ground level, the aim is to provide storage on site where feasible. Given there is a feasible limit as to what can be stored on site the restricting flow rate of 3X Greenfield runoff rate is proposed for this development. It can be seen that this would still offer a significant reduction in storm flow rates from the proposed development over the existing situation.

2.5 The LLFA have requested that new surface water drainage from the proposed development is routed to the Pyl Brook to reduce the impact on the underperforming offsite sewer network where feasible.

2.6 In order to mitigate flood risk posed by the proposed development, adequate control measures are required to be considered. This will ensure that surface water runoff is dealt with at source and the flood risk on/off site is not increased over the lifetime of the development. In terms of storage, analysis has been undertaken to accommodate a 1 in 100 year storm event with an allowance for climate change in accordance with current EA guidance.

Existing Drainage Infrastructure and Nearby Watercourses

2.7 An EA main river, the Pyl Brook, is located adjacent to the north boundary of the development site. The Pyl Brook is culverted where it passes beneath Burlington Road to the east and Beverley Way to the west.

2.8 The EA have provided outputs for a 1D Model and 2D Model of the Beverley Brook. The output from the defended modelled flood extents has demonstrated worst case part of the southern element of the site to be located in the 2% annual exceedance probability (AEP) and part of the north west of the site to be located in the 2% (AEP), 1 in 50 year event. The majority of the site is located outside of the modelled floodplain extents. If viewing the site as if it has been divided into two elements, north and south; the southern portion of the site is more affected compared to the north. This is due to the topographic differences across the site as previously mentioned.

2.9 A topographic survey and services scan have been undertaken for the proposed development area and this shows that the existing buildings on site drains roof-runoff and some external area to the Pyl Brook. This existing drained area equates to approximately 50% of the proposed development area.

2.10 The southern car park area does not appear to have a dedicated storm drainage network shown on the sub surface services scan. At this stage it is assumed to drain to the main drainage within Burlington Road or to the main drainage within the Tesco demise.

2.11 The LLFA have requested that new surface water drainage from the proposed development is routed to the Pyl Brook to reduce the impact on the underperforming offsite sewer network.

2.12 The site is located within Critical Drainage area Group7_002 which defined in the Merton level 2 SFRA as an area with localised flooding issues.

Geology and Infiltration Potential

2.13 No specific site investigation has been provided to Ambiental to date. The British Geological Survey (BGS) Geology of Britain Viewer indicates that the bedrock underlying the site is London Clay Formation - Clay and Silt Sedimentary Bedrock.

2.14 The British Geological Survey (BGS) Geology of Britain Viewer indicates that there are superficial deposits of Kempton Park Gravel Member - Sand and Gravel underlying the site. Figure 2 below.

2.15 Based on the BGS, infiltration can be considered unlikely to be feasible due to the soil likely to be found underlying the site.

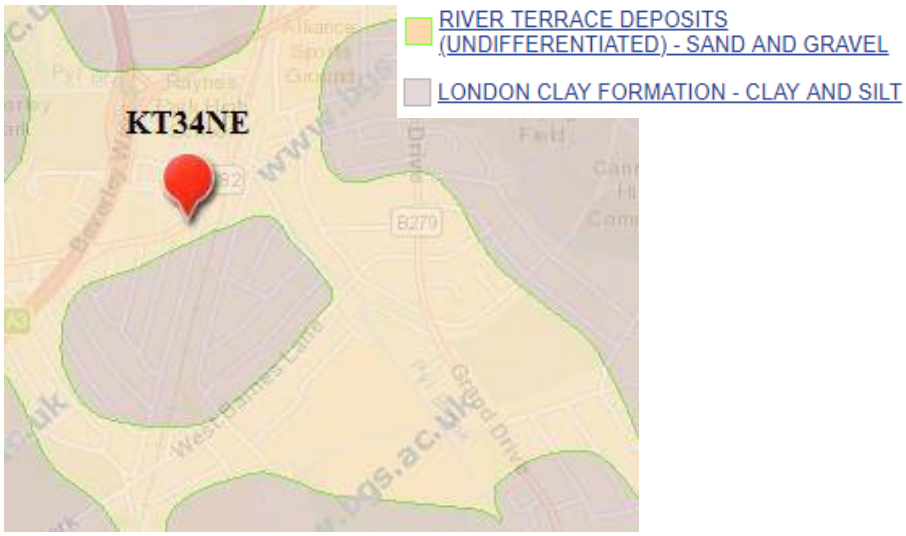


Figure 2 BGS Geology Viewer showing bedrock geology

2.16 Groundwater levels have been reviewed by assessing the BGS online borehole logs for the nearby area. The records within the vicinity of the site do not identify any groundwater strikes.

2.17 Furthermore, MAGIC Map provided by DEFRA has demonstrated that the site is in an area of a minor aquifer of high groundwater vulnerability. The aquifer has a Secondary A, designation for the superficial geology. This is expected given that the Kempton Park Gravels are more susceptible to groundwater movement. It is therefore recommended that borehole tests are conducted to understand the groundwater depth (water table) as well as percolation tests to assess the viability for infiltration devices at the site.

2.18 If it is not possible to utilise infiltration devices due to the geological and water table following the recommended investigations being undertaken, the CIRIA SuDS Hierarchy should be adhered to, in order to identify other means of providing Sustainable Drainage Systems (SuDS) and tomitigate surface water as part of this development. Further consideration will be made to the London Plan Policy 5.13 focused to surface water, and London Borough of Merton Sustainable Drainage Design and Evaluation Guide 2018.

Flood Zone and Vulnerability

2.19 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development is located within Flood Zones 2 and 3 (see Figure 3). The proposed development is considered "Less Vulnerable" and "More vulnerable" under the NPPF vulnerability classifications.

Figure 3: EA Flood Map for Planning

Figure 4:London Boroughs of Croydon, Sutton, Merton and Wandsworth SFRA (2015).

2.20 The London Boroughs of Croydon, Sutton, Merton and Wandsworth SFRA have undertaken further analysis of the site with respect to potential future development and the resulting mapping has been extracted as shown in Figure 4 (underlain with the proposed site layout). This shows the flood extents on site to be reduced over that shown on the EA Flood Map for Planning.

2.21 Ambiental have undertaken an FRA for the site (see report ref: 4003 FRA). The FRA has addressed the potential impact of flooding to the site, and details proposed flood mitigation measures.

3. SUDS Assessment

3.1 In accordance with the SuDS management train approach, the use of various SuDS measures to reduce and control surface water flows have been considered in detail for the development.

3.2 Paragraph 80 of the Planning Practice Guidance of the National Planning Policy Framework (NPPF) states that: Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer

3.3 The management of surface water has been considered in respect to the SuDS hierarchy (below) (as detailed in Building Regulations Part H and within the the *CIRIA 753 'The SUDS Manual', Section 3.2.3)*:

SuDS Drainage Hierarchy			
		Suitability	Comment
1.	Infiltration	-	Due to the geology at the site, infiltration is unlikely to be suitable for total infiltration.
2.	Discharge to Surface Water	✓	Discharge to the Pyl Brook to the north of the site
3.	Discharge to Surface Water Sewer, Highway Drain or another Drainage System	✓	There is a Thames Water surface water sewer east of the site.
4.	Discharge to Combined Sewer	-	
5.	Discharge to a foul sewer (should not be considered as a possible option)	-	

Table 1:SuDS Hierarchy

3.4 Full infiltration has not been deemed possible given the extent of the proposed built footprint as well as the underlying clay geology. Discharge to the Pyl Brook has been stated as the preferred option by the Merton LLFA during the Pre-App process. It is proposed to utilise this as the discharge mechanism, however should it prove unfeasible to make this connection an outfall to the Thames Water surface water sewer adjacent the site may be necessary.

3.5 However, in order to ensure that flood risk is not increased as part of the development proposals, it is proposed to reduce runoff rates (in line with The London Borough of Merton Sustainable Drainage Design and Evaluation Guide (2018) guidance) to 3x greenfield (demonstrated to provide a significant improvement over existing).

3.6 To achieve the reduction in site run off rates, the use of various SuDS have been considered for the development as follows:

Suitability of SuDS Components		
SuDS Component	Description	Suitability
Infiltrating SuDS	Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The suitability and infiltration rate depends on the permeability of the surrounding soils	x
Permeable Pavement	Pervious surfaces can be used in combination with aggregate sub-base and/or geocellular/modular storage to attenuate and/or infiltrate runoff from surrounding surfaces and roofs. Liners can be used where ground conditions are not suitable for infiltration	✓
Green Roofs	Green Roofs provide areas of visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They are generally more costly to install and maintain than conventional roofs but can provide many long-term benefits and reduce the on-site storage volumes	✓
Blue Roof	Storage of water at roof/podium level.	✓
Rainwater Harvesting	Rainwater Harvesting is the collection of rainwater runoff for use. It can be collected form roofs or other impermeable area, stored, treated (where required) and then used as a supply of water for domestic, commercial and industrial properties	✓
Swales	Swales are designed to convey, treat and attenuate surface water runoff and provide aesthetic and biodiversity benefits. They can replace conventional pipework as a means of conveying runoff, however space constraints of some sites can make it difficult incorporating them into the design	x
Rills and Channels	Rills and Channels keep runoff on the surface and convey runoff along the surface to downstream SuDS components. They can be incorporated into the design to provide a visually appealing method of conveyance, they also provide effectiveness in pre-treatment removal of silts	x
Bioretention Systems	Bioretention systems can reduce runoff rates and volumes and treat pollution through the use of engineer soils and vegetation. They are particularly effective in delivering interception, but can also be an attractive landscape feature whilst providing habitat and biodiversity	x
Retention Ponds and Wetlands	Ponds and Wetlands are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. They enhance treatment processes and have great amenity and biodiversity benefits. Often a flow control system at the outfall controls the rates of discharge for a range of water levels during storm events	x
Detention Basins	Detention Basins are landscaped depressions that are usually dry except during and immediately following storm events, and can be used as a recreational or other amenity facility. They generally appropriate to manage high volumes of surface water from larger sites such as a neighbourhoods	x
Geocellular Systems	Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The inherent flexibility in size and shape means they can be tailored to suit the specific characteristics and requirements of any site	✓

Proprietary Treatment Systems	Proprietary treatment systems are manufactured products that remove specific pollutants from surface water runoff. They are especially useful where site constraints preclude the use of other methods and can be useful in reducing the maintenance requirements of downstream SuDS	✓
Filter Drains and Filter Strips	Filter drains are shallow trenches filled with stone, gravel that cerate temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter strips are uniformly graded and gently sloping strips of grass or dense vegetation, designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration	x

Table 2: Suitability of SuDS Components

3.7 It has been indicated in Table 2 above, that several SuDS components are deemed appropriate to be used in the following SuDS management train.

3.8 Based on the BGS, infiltration may not be feasible due to the soil underlay the site. Moreover, due to the extent of the proposed building on the site the remaining areas that may be used for infiltration are limited by the requirement for soakage devices to be a minimum of 5m from highways and structures. As such, and given these reasons above, the infiltration option has been discounted as a feasible solution for managing surface water at the site.

3.9 Green roofs have been considered feasible for this development for the areas where flat roofs are proposed.

3.10 Rainwater harvesting (RWH) Systems should be considered for rainwater re-use. Rainwater harvesting can take various forms including simple water butts to utilise runoff for watering and irrigation, to more complex pumped RWH systems to be used in grey water uses. It is strongly recommended that rainwater harvesting is considered, however, the viability and suitability of an RWH system should be reviewed by a specialist to determine the suitability in context to the rest of the site proposals. For the purposes of attenuation and storage calculations it is considered the harvesting devices are full at the time of the design rainfall event.

3.11 Geocellular storage systems may be required to offer additional storage at ground floor level to enable water to be managed on site effectively.

3.12 Permeable paving can be proposed in any new external hardstanding areas within the redline boundary to minimise the runoff generated by the new development.

3.13 SuDS components should be designed to accommodate and dispose of runoff from storms up to and including the 1:100 year +40% climate change event without flooding.

Green Roof

3.14 A green roof or living roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. It may also include additional layers such as a root barrier and drainage and irrigation systems.

Blue Roof

3.15 A Blue Roof is a Flat Roof, designed to allow controlled attenuation of rain fall during heavy and storm events as part of a Sustainable Urban Drainage Systems (SUDS) good practise policy, replicating the natural environment or improving the as built environment. A Blue Roof will treat and release the water at a managed and controlled rate directly into the sewers waterways and river systems.

Geocellular System

3.16 Geocellular Systems are generally built by placing together (e.g. stacking) cuboid plastic structures with very high void ratios (90-95%). The formed volume is then surrounded by an impermeable geomembrane and backfilled with the excavated soil to form the attenuation tank. Within the proposed SuDS scheme the Geocellular tanks are used to provide the storage volume requirement. They are to be located within the car parking area, however, the exact layout to be determined at the detailed design stage.

Permeable Paving

3.17 Permeable paving is proposed in any new external hardstanding areas (within the redline boundary excluding bin store area to avoid the risk of contamination). The permeable paving will primarily be designed to be self draining (to mimic an equivalent area of soft landscaping). The paving could be formed by the following make up:

- Permeable surfacing as required
- Laying Course Material.
- Geotextile filter.
- Sub-Base: 6-20mm clean crushed stone (depths as required to offer suitable storage)
- Geotextile filter.
- Geomembrane (only if ground water levels are high).

4. Surface Water Drainage Strategy

4.1 In order to mitigate flood risk posed by the proposed development, adequate control measures are required to be considered. This will ensure that surface water runoff is dealt with at source and the flood risk on/off site is not increased over the lifetime of the development.

Runoff rates

4.2 Greenfield runoff rates have been calculated using Micro Drainage Software and applying the *Institute of Hydrology Report 124* (Marshall and Bayliss, 1994), as recommended in the *CIRIA 753 'The SUDS Manual'* (See *Table 3 and calculations in Appendix 3)* for calculating the greenfield runoff rates. *Calculations are included in Appendix 3.*

4.3 In addition, the existing brownfield runoff rates have also been calculated; the results are shown in Table 3 and Appendix 3.

SURFACE WATER DISCHARGE RATES SUMMARY					
	Impermeable Area (ha)	Discharge Rates (l/s)			
		Q_{BAR}	1 year	30 year	100 year
Greenfield Volume m^3	1.2	1.9	1.6 259m^3	4.3 596m^3	6.1 776m^3
Brownfield	1.03		161.7	393.6	505.7
Proposed Post-Development Rates. Approach One (3x Greenfield) Required Storage Volume m^3	1.12		4.8 492m^3	12.9 526m^3	18.3 681m^3

Table 3: Surface Water Discharge Rates Summary

4.4 In order to ensure that flood risk is not increase as part of the development proposals, it is proposed to reduce runoff rates (in line with The London Borough of Merton Sustainable Drainage Design and Evaluation Guide (2018) guidance) to 3x greenfield (demonstrated to provide a significant improvement over existing).

4.5 The above runoff rates have been based on the FSR Rainfall Profiles for the 1 in 100 year plus 40% climate change allowance.

Climate Change

4.6 The design lifetime of a residential site is typically 100 years and an allowance for climate change should be considered in accordance with published guidance within the NPPF. Given the design life would place the developments end of life cycle at 2118, in line with The London Borough of Merton Sustainable Drainage Design and Evaluation Guide (2018) guidance, the 'upper end' allowance 40% climate change allowance has been applied to the drainage and storage calculations (*Table 4*).

PEAK RAINFALL INTENSITY ALLOWANCE IN SMALL AND URBAN CATCHMENTS			
Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

Table 4: Peak rainfall intensity allowance in small and urban catchments

Long Term Storage

4.7 Long-term storage is usually required to address the additional runoff caused by the development compared to the volume that would be contributed from the site in its Greenfield state. The specialised literature CIRIA 753 'The SUDS Manual' provides two approaches guidance for the rates of discharge in relation to runoff mitigation:

- Approach 1

"Where there is extra volume generated by the development that has to be discharged (because there are no opportunities for it to be infiltrated and/or used on site), this volume should be released at a very low rate (e.g. <2 l/s/ha or as agreed with the local drainage approving body and/or environmental regulator) and the 1:100 year greenfield allowable runoff rate reduced to take account of this extra discharge." (Kellagher, 2002).

- Approach 2

"An alternative approach to managing the extra runoff volumes from extreme events separately from the main drainage system is to release all runoff (above the 1 year event) from the site at a maximum rate of 2 l/s/ha or QBAR, whichever is the higher value (or as agreed with the drainage approving body and/or environmental regulator). This avoids the need to undertake more detailed calculations and modelling."

4.8 For the purposes of this report, Approach 2 has been adopted (3x Greenfield as published within The London Borough of Merton Sustainable Drainage Design and Evaluation Guide (2018) guidance) to estimate likely storage/attenuation volumes required. Therefore no long term storage is required.

Urban Creep

4.9 Urban Creep has not been applied to this site given that the proposed structure extends over the vast majority of the site and the site is shared between multiple occupants.

Attenuation Storage

4.10 Attenuation storage is needed to temporarily store water during periods when the runoff rates from the development site exceed the allowable discharge rates from the site.

4.11 Rainfall depths for the 1 in 100 years return period plus 40% of CC were produced using Micro Drainage software to estimate the largest volume and critical storm, for typical storm durations.

4.12 The proposed development can be broken down into the following areas:

North Block – Built footprint = 5372m² 47.9% site area

Podium area = 1950 m²

South Block – Built footprint = 2709 m² 24.2% site area

Podium area = 902 m²

External ground floor areas = 3119 m² 27.9% site area

4.13 A breakdown for storage of each element has been undertaken and assumes that storage can be accommodated at podium level of the 2 main blocks with runoff from these elements feeding into a below ground storage element. The following storage schedule assumes no green roof – just storage on the podium as a 'worst case' study.

SURFACE WATER DISCHARGE RATES SUMMARY				
Proposed Post-Development Rates. Approach One (3x Greenfield)	QBAR 1.12	1 in 1 4.8 l/s	1 in 30 12.9 l/s	1in 100 18.3 l/s
North block (5732m²)				
Design runoff				5.4l/s
Half drain time				699mins
Storage in podium		1950sqm	182mm	335.2m3
South Block (2709m²)				
Design runoff				2.8l/s
Half drain time				596mins
Storage in podium		902sqm	193mm	164.6m3
North and south block runoff cascade into Below ground storage				
External Ground Floor (3119m²)				
		Q_{BAR}	1 year	30 year	100 year
Design runoff (permitted runoff rate)			4.8	12.9	18.3
Calculated cascade site runoff			4.8	12.2	16.1
Storage required below ground			44.2	114.9	137.9m3
Total Volume Summary		North Podium + South Podium + Below Ground			637.7m3

Table 5: Discharge Rates and Volumes

4.14 The above schedule shows that storage can be accommodated at podium level for both blocks with storage depths at circa 182-193mm depth for the north and south blocks respectively. ABG do a green/blue roof system that could be utilised to accommodate this volume – others are also available.

4.15 The podium drainage is designed to drain down to the below ground drainage. As approximately 30% of the site is at ground level some ground level storage is necessary to meet the design flow rates. This has been calculated at 137.9m³ and takes into account runoff from the 2 podium attenuation devices.

4.16 A study for inclusion of 50% green roof area on the north and south blocks with orifice plates minimised to give max storage on the podiums (but still achieving the ½ drain time requirement) has been undertaken. This would reduce the stored max water depth on the podium (to circa 150mm north and 130mm south) but below ground max storage is largely unchanged as below ground storage is dictated by the ground level runoff.

4.17 Should it be feasible, the introduction of additional soft landscaping at ground level or the introduction of permeable paving could reduce the volume required for below ground storage.

4.18 Should storage at podium level not be preferred the volumes could be accommodated below the parking at ground floor under the podium but this would need to be accommodated in and around the foundations in these areas. If using 30% void aggregate this could result in higher storage thicknesses/construction depths.

4.19 An assessment for a single underground storage option (within geocellular crate of similar) yields a required storage volume of 590m^3 when considered in tandem with a green roof to each podium.

4.20 An outline strategy plan for a podium storage option and a wholly below ground option are included in Appendix 2.

Drainage Strategy

4.21 The proposals show the majority of the site to be taken by the proposed structures. As such, there are limited areas and scope to incorporate open SuDS devices (such as ponds). It is proposed that where new external surfacing area is proposed that this is made of permeable construction and designed to mimic equivalent soft landscaping. The existing access road between the blocks is to remain non-permeable to maintain robustness during construction stages and post development.

4.22 There may be two options considered feasible to accommodate the required storage for the remaining impermeable areas:

Option 1: Underground Geocellular Tank

- Based on the hardstanding roof area provided, the storage of 590m^3 would be necessary when considered in tandem with a green roof to each podium. The proposed tank location would be subject to detailed design but could be located under the north block in a 28m x 28m x 0.8m deep crate. The final location of the tank should be confirmed at detailed design stage.

Option 2: Blue/Green Roof Storage

- If underground Geocellular Tank is not feasible, an alternative method could be Blue/Green Roof Storage. From the calculations undertaken the minimum depth of 193mm depth Blue/Green roof will be required to manage runoff off of the main block in the podium areas in the south block and 182mm on the podium of the north block. Additionally for the ground level areas an additional 137.9m^3 of below ground crate storage would be required.

4.23 The flow control manhole should be fitted with a Hydrobrake (or similar) flow control device (or devices as required) to limit offsite flow rates matching the 3xgreenfield rates shown in Table 3 in line with The London Borough of Merton Sustainable Drainage Design and Evaluation Guide (2018) guidance.

4.24 Where any drainage elements are located in or near Flood Zone 2 or 3, these should be fully sealed with non-return valves to prevent potential flood waters backing up into the system where feasible.

4.25 The structure above and around the proposed tank will need to be carefully designed to ensure that the tank is not subject to any structural loadings.

4.26 Should an offsite connection be necessary any new connections to the public sewer will be subject to approvals by Thames Water.

4.27 Guidance about proper use, installation and maintenance of any proprietary system must be provided by the supplier and incorporated into the site proposals at detailed design stage.

4.28 Proposed Drainage Layout options drawings have been included in Appendix 2.

5. Design Exceedance

5.1 In the event of drainage system failure under extreme rainfall events or blockage, flooding may occur within the site. In the event of the development's drainage system failure, the runoff flow will be dictated by topography on site. This will not impact on the site or nearby dwellings.

5.2 Design of external ground levels will need to be undertaken at detailed design stage to finalise these routes, but some indicative flow paths have been indicated on the outline strategy drawings in Appendix 2. These show levels designed to encourage water away from the building and match the surface water flood flow paths defined with the Ambiental FRA report 4003 FRA.

5.3 It is advised that the finished floor level of the proposed building should be 150mm above surrounding finished ground levels where feasible. This is to mitigate against any potential surface water flows, with external ground levels should be design to direct water to the main road areas and away from buildings and thresholds where feasible.

6. Water Quality

6.1 Adequate treatment must be delivered to the water runoff to remove pollutants through SuDS devices, which are able to provide pollution mitigation. Pollution Hazards and the SuDS Mitigation have been indexed in the CIRIA 753 'The SUDS Manual'.

6.2 The Pollution Hazard Indices are summarized in Table 6 – Summary of Pollution Hazard Indices for different Land Use below (reference: Table 26.3.CIRIA SuDS Manual 2015).

POLLUTION HAZARD INDICES FOR DIFFERENT LAND USE CLASSIFICATIONS				
LAND USE	Pollution Hazard Level	Total suspended Solids (TSS)	Metals	Hydrocarbons
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, home zones and general access roads) and non-residential car parking with infrequent change (e.g schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

Table 6: Summary of Pollution hazard Indices for different Land Use.

6.3 The Mitigation Indices of the proposed SuDS techniques are summarised in the Table 7 - Indicative SuDS Mitigation Indices below.

6.4 Given the limited space available, following construction, it is likely that only proprietary treatment would be feasible for treatment of the access road and under croft trafficked areas.

INDICATIVE SuDS MITIGATION INDICES FOR DISCHARGES TO SURFACE WATER			
SuDS Component	Total suspended Solids (TSS)	Metals	Hydrocarbons
Proprietary Treatment Systems	These must demonstrate that they can address each of the contamination types to acceptable levels for frequent events up to approximately the 1 in1 year return period event, for inflow concentrations relevant to the contributing area.		

Table 7: Indicative SuDS Mitigation Indices

6.5 Runoff from roof areas is considered to generally be uncontaminated. However, to prevent any potential sediment from impacting on the storage structure, S*ediments Traps* should be provided on the outlet to the storage structure to prevent sedimentation, with rodding access provided either side for cleaning and maintenance.

6.6 The contamination risk associated with the proposed development site is considered to be very low, with sediment traps (for the roof runoff) and proprietary treatment devices (for the road and trafficked areas) deemed suitable to mitigate against the potential contamination risk prior to discharging to the River Pyl.

7. Adoption and Maintenance

7.1 All onsite SuDS and drainage systems will be privately maintained. A long-term maintenance regime should be agreed with the site owners before adoption. In addition to a long-term maintenance regime it is recommended that all drainage elements implemented on site should be inspected following the first rainfall event post construction and monthly for the first quarter following construction.

Item	Visual Inspection	Cleanse / De-sludge	CCTV Survey	Comments
Foul Drainage System (pipework, chambers etc.)	5 years	10 years	10 years	Cleansing to be carried as necessary
Surface Water Drainage System (pipework, chambers etc.)	5 years	10 years	10 years	Cleansing to be carried as necessary
Gullies/Channels	1 year	1 year	N/A	Cleansing to be carried as necessary
Catchpits	1 year		N/A	Cleansing to be carried as necessary
Blue/green roof	6 months	As required		General green roof plant maintenance as per green roof manufacturers advice. Green/blue Outlet inspections as part of routine drainage inspections.
Proprietary Products	3-6 months			Refer to individual manufacturers recommendations.

Table 7: Proposed Schedule of Maintenance for Below Ground Drainage.

8. Conclusion

8.1 This study has been undertaken in accordance with the principles set out in the NPPF and The London Borough of Merton guidance. Providing the development adheres to the conditions advised in this report, the said development proposals can be accommodated without increasing flood risk within the locality in accordance with objectives set within the NPPF and published guidance.

8.2 The proposed development site currently compromises a vacant 1980's office building arranged over two storeys with an interconnecting single storey office building at the rear and a section of car park land.

8.3 The proposed development is to deliver a range of 456 Apartment dwellings, within 6-14 storey accommodation, to the area along with a circa 5371sqft of commercial space and landscaping and residential parking beneath courtyard podium levels.

8.4 The site is located within Critical Drainage area Group7_002 which defined in the Merton level 2 SFRA as an area with localised flooding issues. As such the Merton LLFA have requested that new surface water drainage from the proposed development is routed to the Pyl Brook to reduce the impact on the underperforming offsite sewer network.

8.5 A review of the EA flood map for planning (Figure 3) has demonstrated that the site is located in Flood Zone 2 (Medium Risk) and Flood Zone 3 (High Risk). The dominant source of flooding at the site is Fluvial from the Pyl Brook to the north of the site and Beverley Brook to the west. Both rivers are recognised as an EA main river. Ambiental have compiled a separate FRA document Ref: 4003 FRA specific to flood risk issues at the site.

8.6 The use of infiltration on site is limited given the requirement for soakage devices to be a minimum of 5m from highways and structures and the underlying clay geology. As such, infiltration has been discounted as a feasible solution for managing all runoff on site.

8.7 In order to ensure that flood risk is not increase as part of the development proposals, it is proposed to reduce runoff rates (in line with The London Borough of Merton Sustainable Drainage Design and Evaluation Guide (2018) guidance) to 3x greenfield (demonstrated to provide a significant improvement over existing). This outflow is currently shown to be routed to the Pyl Brook in accordance with LB Merton requirements.

8.8 There may be two options considered feasible to accommodate the required storage:

Option 1: Underground Geocellular Tank

- Based on the hardstanding roof area provided, the storage of 590m^3 would be necessary when considered in tandem with a green roof to each podium. The proposed tank location would be subject to detailed design but could be located under the north block in a 28.5x28.5mx0.8m deep crate. The final location of the tank should be confirmed at detailed design stage.

Option 2: Blue/Green Roof Storage

- If underground Geocellular Tank is no feasible, an alternative method could be Blue/Green Roof Storage. From the calculations undertaken the minimum depth of 193mm depth Blue/Green roof will be required to manage runoff off of the main block in the podium areas in the south block and 182mm on the podium of the north block. Additionally, for the ground level areas an additional 137.9m^3 of below ground crate storage would be required.

8.9 In order to finalise connection locations, it is advised a CCTV survey is undertaken to identify the location of the existing offsite connection. This could be reused where possible, however if not deemed feasible a new connection could be provided to the Thames Water sewer.

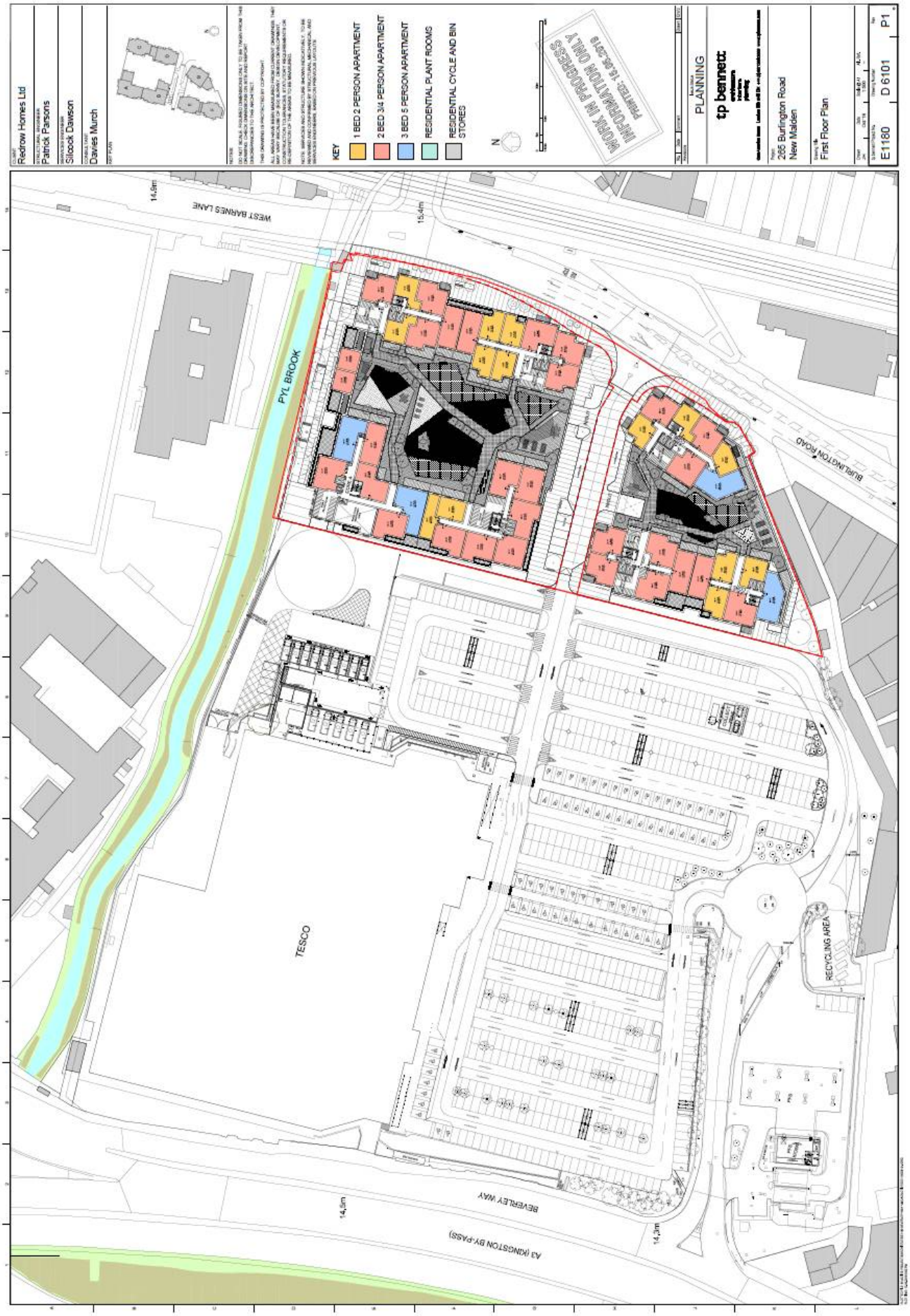
8.10 The proposals demonstrate that a significant reduction in runoff rates post development can be achieved via implementation of the development and therefore can provide a betterment both in respect to flood risk and surface water drainage at the site in accordance with NPPF, the London Plan and London Borough of Merton requirements.

8.11 The findings and recommendations of this report are for the use of the client who commissioned the assessment, and no responsibility or liability can be accepted for the use of the report or its findings by any other person or for any other purpose.

Appendix 1 – Supporting Information

Architect Drawings


Redrow Homes Ltd
Patrick Parsons
Silcock Dawson
Davies Murch
KEY
COMMERCIAL SPACE
RESIDENTIAL ENTRANCES
RESIDENTIAL CONCIERGE AND MEETING SPACE
RESIDENTIAL PLANT ROOMS
RESIDENTIAL CYCLE AND BIN STORES
WORK IN PROGRESS
PLANNING
tp bennett
265 Burlington Road
New Malden
Ground Floor Plan
E1180
D 6100
P1
WEST BARNES LANE
PYL BROOK
BURLINGTON ROAD
TESCO
RECYCLING AREA
BEVERLEY WAY
A3 (KINGSTON BY-PASS)
14.9m
15.4m
14.5m
14.3m


Redrow Homes Ltd
Patrick Parsons
Silcock Dawson
Davies Murch
KEY
1 BED 2 PERSON APARTMENT
2 BED 3/4 PERSON APARTMENT
3 BED 5 PERSON APARTMENT
RESIDENTIAL PLANT ROOMS
RESIDENTIAL CYCLE AND BIN STORES
WORK IN PROGRESS
PLANNING
tp bennett
285 Burlington Road
New Malden
First Floor Plan
E1180
D 6101
P1
WEST BARNES LANE
PYL BROOK
BURLINGTON ROAD
TESCO
RECYCLING AREA
BEVERLEY WAY
A3 (KINGSTON BY-PASS)

Appendix 2 – Drainage Strategy Plans

EXTERNAL PAVING DRAINAGE TO BE CONFIRMED- TO BE PERMEABLE OR ROUTED TO NEW DRAINAGE NETWORK

SUSPENDED DRAINAGE CONNECTION FROM PODIUM STORAGE TO EXTENT OF BLOCK. FINAL ROUTE AND NUMBER OF CONNECTIONS TO BE FINALISED

SURFACE WATER RUNOFF FROM ROOF AND PODIUM OF SOUTH BLOCK TO BE SUSPENDED ON UNDERSIDE OF PODIUM TO ENTRANCE OF BLOCK

EXTERNAL PAVING DRAINAGE TO BE CONFIRMED- TO BE ROUTED TO NEW DRAINAGE NETWORK

OIL INTERCEPTION FOR ACCESS ROAD DRAINAGE. NAYLOR 'SMART SPONGE' OR AS AGREED WITH LLFA OFFICER.

EXISTING BELLMOUTH GULLIES AND DRAINAGE TO BE MAINTAINED. CAP OFF EXISTING RUN FROM WITHIN SITE.

CATCHPIT CONNECTION CHAMBERS ON DRAINAGE CHANNEL/DRAIN. FORM AND LOCATION TO BE AGREED.

CATCHPIT CONNECTION CHAMBERS ON DRAINAGE . FORM AND LOCATION TO BE AGREED.

CHANNEL DRAIN WITH TRAPPED OUTLETS TO DRAIN ACCESS ROAD SIZE AND DETAILED DESIGN TO BE FINALISED

SURFACE WATER STORAGE WITHIN CAR PARK AREA UNDER PODIUM SLAB. STORAGE VOLUME 586.2m³ ASSUMING GREEN ROOF IS INCORPORATED ON EACH PODIUM. FINAL VOLUMES SUBJECT TO DETAILED DESIGN

RE-USE EXISTING OFFSITE STORM WATER CONNECTION TO PYL BROOK OR CREATE A NEW CONNECTION AS REQUIRED. PROVIDE NON-RETURN FLAT ON OUTLET

HYDROBRAKE MANHOLE LIMITING FLOWS TO 3x GREENFIELD RATES AS DEFINED IN AMBIENTAL REPORT 4003 SWDS. MAX OUTFLOW 18.3l/s FOR THE1IN100YR +40% RAINFALL EVENT

PYL BROOK

149 Spaces

1. GENERAL
   a. THIS DRAWING IS NOT TO BE SCALED, WORK TO FIGURED DIMENSIONS ONLY, CONFIRMED ON SITE.
   b. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS, DETAILED SPECIFICATIONS WHERE APPLICABLE AND ALL ASSOCIATED DRAWINGS IN THIS SERIES.
   c. ANY DISCREPANCY ON THIS DRAWING IS TO BE REPORTED IMMEDIATELY TO THE PARTNERSHIP FOR CLARIFICATION.
   d. THE CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY WORKS AND FOR THE STABILITY OF THE WORKS IN PROGRESS.

DRAWING TO BE READ IN CONJUNCTION WITH AMBIENTAL REPORTS
4003_SWDS
4003_FRA

LEGEND

- MAIN DRAIN
- EXISTING DRAIN
- INDICATIVE SUSPENDED DRAINAGE
- ACO CHANNEL
- TYPE 2 MANHOLE
- INSPECTION CHAMBER
- INSPECTION CHAMBER INCORPORATING OIL INTERCEPTION
- RAIN WATER PIPE
- BELOW GROUND STORAGE
- PODIUM ATTENUATION SYSTEM
- OVERLAND FLOW ROUTE

REV	DATE	CKD	APPD	BY	DESCRIPTION
A	21.05.19	--	--	--	SITE LAYOUT UPDATED

PRELIMINARY DRAWING
FOR INFORMATION ONLY. NOT FOR CONSTRUCTION.

Client
REDROW

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predicting · preventing · protecting
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Tel +44 (0) 203 857 8530 | www.ambiental.co.uk | drainage@ambiental.co.uk

Project
265 BURLINGTON ROAD
NEW MALDEN, KT3 4PJ

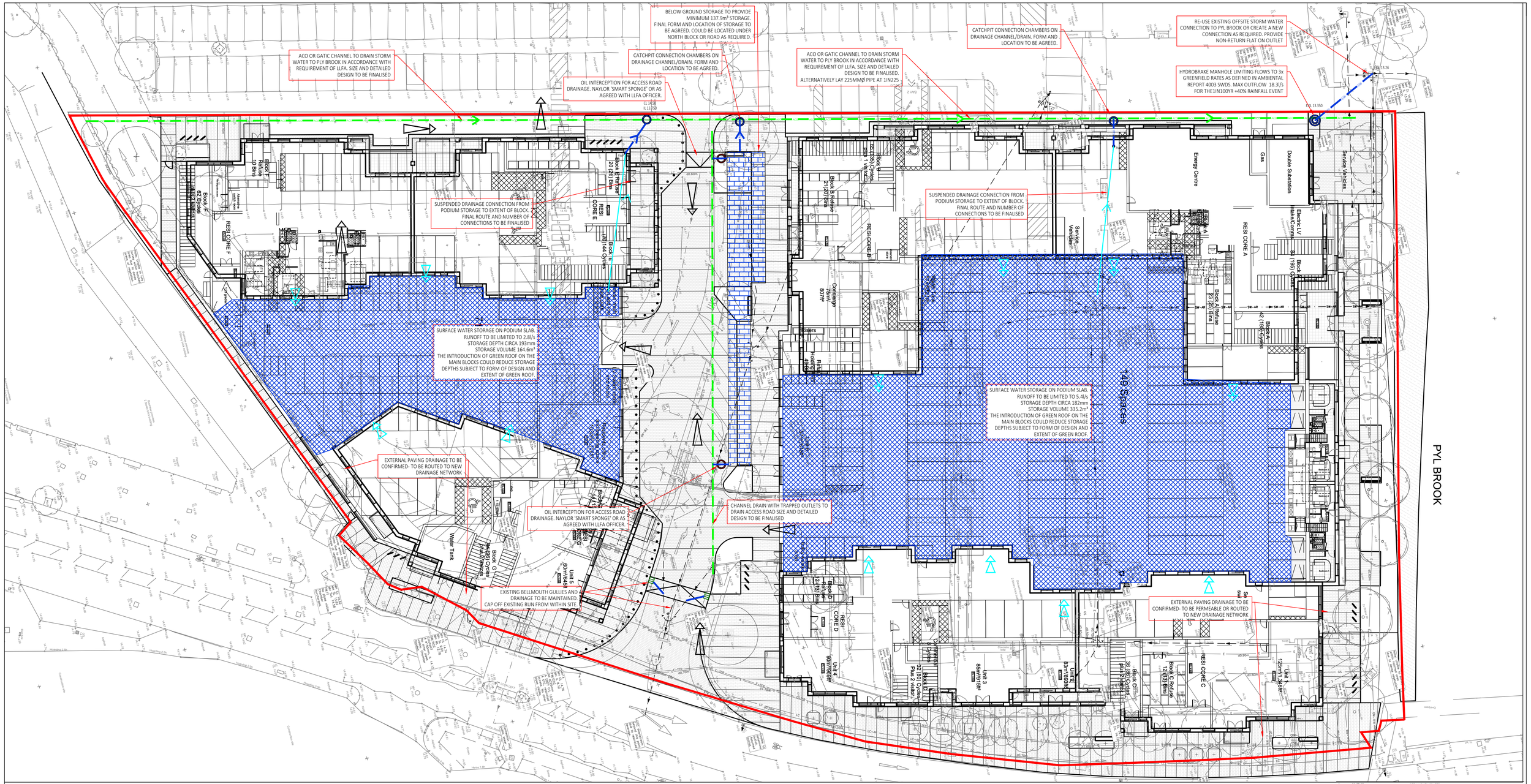
Drawing
SITE LAYOUT - OPTION 1 BELOW GROUND
OUTLINE DRAINAGE STRATEGY

Drawn by: MN
Date: JAN - 2018

Drawing No.: 4003 - STR 01 OPT1
Revision: A

Drawing Scale: 1:250 @ A1
0 2.5m 5m 7.5m 10m 12.5m

Drawing No: Y:\PROJECTS\4003_Redrow_NewMalden_FRA\Plans\Amb\4003_Amb STR01 OPT1.dwg



1. GENERAL
   a. THIS DRAWING IS NOT TO BE SCALED, WORK TO FIGURED DIMENSIONS ONLY, CONFIRMED ON SITE.
   b. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS, DETAILED SPECIFICATIONS WHERE APPLICABLE AND ALL ASSOCIATED DRAWINGS IN THIS SERIES.
   c. ANY DISCREPANCY ON THIS DRAWING IS TO BE REPORTED IMMEDIATELY TO THE PARTNERSHIP FOR CLARIFICATION.
   d. THE CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY WORKS AND FOR THE STABILITY OF THE WORKS IN PROGRESS.

DRAWING TO BE READ IN CONJUNCTION WITH AMBIENTAL REPORTS
4003_SWDS
4003_FRA

LEGEND

- MAIN DRAIN
- EXISTING DRAIN
- INDICATIVE SUSPENDED DRAINAGE
- ACO CHANNEL
- TYPE 2 MANHOLE
- INSPECTION CHAMBER
- INSPECTION CHAMBER INCORPORATING OIL INTERCEPTION
- RWP RAIN WATER PIPE
- BELOW GROUND STORAGE
- PODIUM ATTENUATION SYSTEM
- ROOF RUNOFF ROUTE (BASED ON SURFACE FLOW ROUTES FROM AMBIENTAL FRA 4003_FRA)
- OVERLAND FLOW ROUTE

REV	DATE	CKD	APPD	BY	DESCRIPTION
A	21.05.19	–	–	–	SITE LAYOUT UPDATED

PRELIMINARY DRAWING
FOR INFORMATION ONLY. NOT FOR CONSTRUCTION.

Client
REDROW

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Tel +44 (0) 203 857 8530 | www.ambiental.co.uk | drainage@ambiental.co.uk

Project
265 BURLINGTON ROAD
NEW MALDEN, KT3 4PJ

Drawing
SITE LAYOUT - OPTION 2 PODIUM STORAGE
OUTLINE DRAINAGE STRATEGY

Drawn by: MN
Date: JAN - 2018

Drawing No. | Revision
4003 - STR 01 OPT2 | A

Drawing Scale: 1:250 @ A1
0 2.5m 5m 7.5m 10m 12.5m

Drawing No: Y:\PROJECTS\4003_Redrow_NewMalden_FRA\Plans\Amb\4003_Amb STR01 OPT2.dwg

Appendix 3 – Calculations

Greenfield Runoff

Brownfield Runoff

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.200	Urban	0.000
SAAR (mm)	620	Region Number	Region 6

Results l/s

QBAR Rural	1.9
QBAR Urban	1.9
Q100 years	6.1
Q1 year	1.6
Q30 years	4.3
Q100 years	6.1

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	14.105	0.505	161.7	1.7	O K
30 min Summer	14.017	0.417	134.3	1.4	O K
60 min Summer	13.926	0.326	100.6	1.0	O K
120 min Summer	13.836	0.236	63.9	0.7	O K
180 min Summer	13.806	0.206	49.4	0.6	O K
240 min Summer	13.788	0.188	40.4	0.5	O K
360 min Summer	13.760	0.160	30.3	0.4	O K
480 min Summer	13.744	0.144	24.7	0.4	O K
600 min Summer	13.733	0.133	20.9	0.3	O K
720 min Summer	13.725	0.125	18.2	0.3	O K
960 min Summer	13.711	0.111	14.9	0.3	O K
1440 min Summer	13.696	0.096	11.0	0.2	O K
2160 min Summer	13.680	0.080	8.2	0.2	O K
2880 min Summer	13.670	0.070	6.6	0.1	O K
4320 min Summer	13.659	0.059	4.9	0.1	O K
5760 min Summer	13.653	0.053	4.0	0.1	O K
7200 min Summer	13.649	0.049	3.4	0.1	O K
8640 min Summer	13.646	0.046	3.0	0.1	O K
10080 min Summer	13.644	0.044	2.7	0.1	O K
15 min Winter	14.089	0.489	154.9	1.7	O K
30 min Winter	13.988	0.388	123.8	1.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.296	0.0	60.4	10
30 min Summer	20.325	0.0	78.5	17
60 min Summer	12.800	0.0	98.9	34
120 min Summer	7.895	0.0	122.0	62
180 min Summer	5.922	0.0	137.2	92
240 min Summer	4.823	0.0	149.0	122
360 min Summer	3.593	0.0	166.5	182
480 min Summer	2.905	0.0	179.5	244
600 min Summer	2.464	0.0	190.3	302
720 min Summer	2.153	0.0	199.6	362
960 min Summer	1.741	0.0	215.2	480
1440 min Summer	1.291	0.0	239.3	712
2160 min Summer	0.957	0.0	266.3	1100
2880 min Summer	0.774	0.0	287.1	1440
4320 min Summer	0.574	0.0	319.0	2196
5760 min Summer	0.464	0.0	344.0	2896
7200 min Summer	0.394	0.0	364.8	3544
8640 min Summer	0.344	0.0	382.8	4264
10080 min Summer	0.307	0.0	398.8	5136
15 min Winter	31.296	0.0	67.7	10
30 min Winter	20.325	0.0	87.9	18

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	13.874	0.274	76.4	0.9	O K
120 min Winter	13.803	0.203	47.7	0.6	O K
180 min Winter	13.777	0.177	36.0	0.5	O K
240 min Winter	13.758	0.158	29.4	0.4	O K
360 min Winter	13.736	0.136	22.0	0.3	O K
480 min Winter	13.723	0.123	17.7	0.3	O K
600 min Winter	13.712	0.112	15.0	0.3	O K
720 min Winter	13.704	0.104	13.1	0.2	O K
960 min Winter	13.694	0.094	10.6	0.2	O K
1440 min Winter	13.679	0.079	7.9	0.2	O K
2160 min Winter	13.666	0.066	6.0	0.1	O K
2880 min Winter	13.658	0.058	4.8	0.1	O K
4320 min Winter	13.650	0.050	3.6	0.1	O K
5760 min Winter	13.646	0.046	3.0	0.1	O K
7200 min Winter	13.643	0.043	2.5	0.1	O K
8640 min Winter	13.640	0.040	2.2	0.1	O K
10080 min Winter	13.639	0.039	2.0	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	12.800	0.0	110.7	34
120 min Winter	7.895	0.0	136.6	62
180 min Winter	5.922	0.0	153.7	94
240 min Winter	4.823	0.0	166.9	124
360 min Winter	3.593	0.0	186.5	178
480 min Winter	2.905	0.0	201.1	244
600 min Winter	2.464	0.0	213.2	298
720 min Winter	2.153	0.0	223.5	366
960 min Winter	1.741	0.0	241.0	476
1440 min Winter	1.291	0.0	268.0	730
2160 min Winter	0.957	0.0	298.2	1068
2880 min Winter	0.774	0.0	321.6	1432
4320 min Winter	0.574	0.0	357.3	2160
5760 min Winter	0.464	0.0	385.3	2840
7200 min Winter	0.394	0.0	408.5	3352
8640 min Winter	0.344	0.0	428.7	4568
10080 min Winter	0.307	0.0	446.7	4832

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.030

Time (mins) From:	To:	Area (ha)
0	4	1.030

Model Details

Storage is Online Cover Level (m) 14.600

Pipe Structure

Diameter (m)	0.600	Length (m)	5.000
Slope (1:X)	150.000	Invert Level (m)	13.600

Pipe Outflow Control

Diameter (m)	0.600	Entry Loss Coefficient	0.500
Slope (1:X)	150.0	Coefficient of Contraction	0.600
Length (m)	5.000	Upstream Invert Level (m)	13.600
Roughness k (mm)	0.600		

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	14.331	0.731	393.6	2.1	Flood Risk
30 min Summer	14.286	0.686	334.7	2.1	O K
60 min Summer	14.228	0.628	239.7	2.0	O K
120 min Summer	14.081	0.481	154.9	1.6	O K
180 min Summer	13.957	0.357	112.5	1.2	O K
240 min Summer	13.918	0.318	96.6	1.1	O K
360 min Summer	13.853	0.253	72.2	0.8	O K
480 min Summer	13.814	0.214	53.3	0.6	O K
600 min Summer	13.797	0.197	45.0	0.6	O K
720 min Summer	13.785	0.185	39.0	0.5	O K
960 min Summer	13.763	0.163	31.1	0.4	O K
1440 min Summer	13.738	0.138	22.6	0.3	O K
2160 min Summer	13.718	0.118	16.5	0.3	O K
2880 min Summer	13.704	0.104	13.0	0.2	O K
4320 min Summer	13.689	0.089	9.4	0.2	O K
5760 min Summer	13.676	0.076	7.6	0.2	O K
7200 min Summer	13.668	0.068	6.3	0.1	O K
8640 min Summer	13.663	0.063	5.6	0.1	O K
10080 min Summer	13.659	0.059	4.9	0.1	O K
15 min Winter	14.326	0.726	387.5	2.1	Flood Risk
30 min Winter	14.251	0.651	281.2	2.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.797	0.0	148.3	10
30 min Summer	49.754	0.0	192.2	17
60 min Summer	30.811	0.0	238.1	34
120 min Summer	18.522	0.0	286.2	64
180 min Summer	13.611	0.0	315.4	92
240 min Summer	10.893	0.0	336.6	122
360 min Summer	7.936	0.0	367.8	180
480 min Summer	6.337	0.0	391.6	244
600 min Summer	5.319	0.0	410.9	298
720 min Summer	4.609	0.0	427.2	362
960 min Summer	3.673	0.0	454.0	476
1440 min Summer	2.665	0.0	494.2	726
2160 min Summer	1.932	0.0	537.3	1092
2880 min Summer	1.536	0.0	569.7	1452
4320 min Summer	1.112	0.0	618.3	2152
5760 min Summer	0.883	0.0	654.9	2936
7200 min Summer	0.738	0.0	684.6	3640
8640 min Summer	0.638	0.0	709.6	4296
10080 min Summer	0.564	0.0	731.4	5000
15 min Winter	76.797	0.0	166.1	10
30 min Winter	49.754	0.0	215.2	18

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	14.203	0.603	185.4	2.0	O K
120 min Winter	13.967	0.367	112.5	1.4	O K
180 min Winter	13.895	0.295	84.4	1.1	O K
240 min Winter	13.853	0.253	72.2	0.9	O K
360 min Winter	13.804	0.204	48.2	0.6	O K
480 min Winter	13.784	0.184	38.7	0.5	O K
600 min Winter	13.767	0.167	32.5	0.4	O K
720 min Winter	13.754	0.154	28.2	0.4	O K
960 min Winter	13.738	0.138	22.5	0.3	O K
1440 min Winter	13.717	0.117	16.3	0.3	O K
2160 min Winter	13.700	0.100	12.0	0.2	O K
2880 min Winter	13.689	0.089	9.4	0.2	O K
4320 min Winter	13.672	0.072	6.9	0.1	O K
5760 min Winter	13.663	0.063	5.6	0.1	O K
7200 min Winter	13.656	0.056	4.6	0.1	O K
8640 min Winter	13.653	0.053	4.0	0.1	O K
10080 min Winter	13.649	0.049	3.5	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	30.811	0.0	266.6	32
120 min Winter	18.522	0.0	320.5	60
180 min Winter	13.611	0.0	353.3	100
240 min Winter	10.893	0.0	377.0	120
360 min Winter	7.936	0.0	412.0	178
480 min Winter	6.337	0.0	438.6	242
600 min Winter	5.319	0.0	460.2	306
720 min Winter	4.609	0.0	478.5	350
960 min Winter	3.673	0.0	508.5	478
1440 min Winter	2.665	0.0	553.5	732
2160 min Winter	1.932	0.0	601.7	1084
2880 min Winter	1.536	0.0	638.1	1468
4320 min Winter	1.112	0.0	692.5	2204
5760 min Winter	0.883	0.0	733.5	2904
7200 min Winter	0.738	0.0	766.6	3632
8640 min Winter	0.638	0.0	794.7	4280
10080 min Winter	0.564	0.0	819.2	5168

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.030

Time (mins) From:	To:	Area (ha)
0	4	1.030

Model Details

Storage is Online Cover Level (m) 14.600

Pipe Structure

Diameter (m)	0.600	Length (m)	5.000
Slope (1:X)	150.000	Invert Level (m)	13.600

Pipe Outflow Control

Diameter (m)	0.600	Entry Loss Coefficient	0.500
Slope (1:X)	150.0	Coefficient of Contraction	0.600
Length (m)	5.000	Upstream Invert Level (m)	13.600
Roughness k (mm)	0.600		

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	14.438	0.838	505.7	2.2	Flood Risk
30 min Summer	14.362	0.762	429.1	2.2	Flood Risk
60 min Summer	14.263	0.663	301.4	2.1	O K
120 min Summer	14.209	0.609	198.9	2.0	O K
180 min Summer	14.063	0.463	146.9	1.6	O K
240 min Summer	13.991	0.391	123.8	1.4	O K
360 min Summer	13.916	0.316	96.6	1.1	O K
480 min Summer	13.863	0.263	72.4	0.9	O K
600 min Summer	13.824	0.224	57.9	0.7	O K
720 min Summer	13.808	0.208	50.1	0.6	O K
960 min Summer	13.787	0.187	39.9	0.5	O K
1440 min Summer	13.756	0.156	28.7	0.4	O K
2160 min Summer	13.732	0.132	20.6	0.3	O K
2880 min Summer	13.717	0.117	16.3	0.3	O K
4320 min Summer	13.699	0.099	11.9	0.2	O K
5760 min Summer	13.688	0.088	9.3	0.2	O K
7200 min Summer	13.677	0.077	7.7	0.2	O K
8640 min Summer	13.670	0.070	6.7	0.1	O K
10080 min Summer	13.665	0.065	5.9	0.1	O K
15 min Winter	14.436	0.836	503.3	2.2	Flood Risk
30 min Winter	14.319	0.719	378.3	2.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.705	0.0	192.6	10
30 min Summer	65.132	0.0	251.6	17
60 min Summer	40.510	0.0	313.0	32
120 min Summer	24.342	0.0	376.1	60
180 min Summer	17.833	0.0	413.3	92
240 min Summer	14.218	0.0	439.4	122
360 min Summer	10.298	0.0	477.3	188
480 min Summer	8.192	0.0	506.2	244
600 min Summer	6.854	0.0	529.5	300
720 min Summer	5.923	0.0	549.1	360
960 min Summer	4.701	0.0	581.0	476
1440 min Summer	3.389	0.0	628.3	712
2160 min Summer	2.439	0.0	678.4	1100
2880 min Summer	1.930	0.0	715.6	1444
4320 min Summer	1.385	0.0	770.6	2200
5760 min Summer	1.094	0.0	811.3	2912
7200 min Summer	0.911	0.0	844.1	3656
8640 min Summer	0.783	0.0	871.4	4352
10080 min Summer	0.690	0.0	895.1	5048
15 min Winter	99.705	0.0	215.7	9
30 min Winter	65.132	0.0	281.8	17

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	14.231	0.631	245.5	2.0	O K
120 min Winter	14.055	0.455	146.9	1.7	O K
180 min Winter	13.957	0.357	112.5	1.4	O K
240 min Winter	13.915	0.315	92.5	1.1	O K
360 min Winter	13.836	0.236	63.7	0.7	O K
480 min Winter	13.808	0.208	50.1	0.6	O K
600 min Winter	13.791	0.191	42.1	0.5	O K
720 min Winter	13.777	0.177	36.1	0.5	O K
960 min Winter	13.756	0.156	28.9	0.4	O K
1440 min Winter	13.733	0.133	20.7	0.3	O K
2160 min Winter	13.712	0.112	15.1	0.3	O K
2880 min Winter	13.700	0.100	12.0	0.2	O K
4320 min Winter	13.682	0.082	8.5	0.2	O K
5760 min Winter	13.671	0.071	6.8	0.1	O K
7200 min Winter	13.663	0.063	5.5	0.1	O K
8640 min Winter	13.658	0.058	4.9	0.1	O K
10080 min Winter	13.654	0.054	4.3	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	40.510	0.0	350.5	36
120 min Winter	24.342	0.0	421.2	64
180 min Winter	17.833	0.0	462.9	88
240 min Winter	14.218	0.0	492.1	118
360 min Winter	10.298	0.0	534.6	178
480 min Winter	8.192	0.0	567.0	240
600 min Winter	6.854	0.0	593.0	308
720 min Winter	5.923	0.0	615.0	356
960 min Winter	4.701	0.0	650.7	478
1440 min Winter	3.389	0.0	703.7	728
2160 min Winter	2.439	0.0	759.7	1084
2880 min Winter	1.930	0.0	801.5	1432
4320 min Winter	1.385	0.0	863.0	2204
5760 min Winter	1.094	0.0	908.7	2920
7200 min Winter	0.911	0.0	945.4	3536
8640 min Winter	0.783	0.0	976.1	4544
10080 min Winter	0.690	0.0	1002.5	4792

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.030

Time (mins) From:	To:	Area (ha)
0	4	1.030

Model Details

Storage is Online Cover Level (m) 14.600

Pipe Structure

Diameter (m)	0.600	Length (m)	5.000
Slope (1:X)	150.000	Invert Level (m)	13.600

Pipe Outflow Control

Diameter (m)	0.600	Entry Loss Coefficient	0.500
Slope (1:X)	150.0	Coefficient of Contraction	0.600
Length (m)	5.000	Upstream Invert Level (m)	13.600
Roughness k (mm)	0.600		

Option 1 geocellular calcs

Summary of Results for 1 year Return Period (+40%)

Half Drain Time : 333 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	13.354	0.094	0.0	3.5	3.5	69.8	O K
30 min Summer	13.379	0.119	0.0	4.4	4.4	88.7	O K
60 min Summer	13.405	0.145	0.0	4.5	4.5	108.1	O K
120 min Summer	13.429	0.169	0.0	4.5	4.5	126.0	O K
180 min Summer	13.441	0.181	0.0	4.5	4.5	134.5	O K
240 min Summer	13.447	0.187	0.0	4.5	4.5	139.1	O K
360 min Summer	13.454	0.194	0.0	4.5	4.5	144.5	O K
480 min Summer	13.459	0.199	0.0	4.5	4.5	148.3	O K
600 min Summer	13.462	0.202	0.0	4.5	4.5	150.4	O K
720 min Summer	13.463	0.203	0.0	4.5	4.5	151.3	O K
960 min Summer	13.463	0.203	0.0	4.5	4.5	150.9	O K
1440 min Summer	13.454	0.194	0.0	4.5	4.5	144.7	O K
2160 min Summer	13.435	0.175	0.0	4.5	4.5	130.7	O K
2880 min Summer	13.416	0.156	0.0	4.5	4.5	116.2	O K
4320 min Summer	13.385	0.125	0.0	4.5	4.5	93.2	O K
5760 min Summer	13.368	0.108	0.0	4.1	4.1	80.8	O K
7200 min Summer	13.358	0.098	0.0	3.7	3.7	72.7	O K
8640 min Summer	13.350	0.090	0.0	3.3	3.3	66.7	O K
10080 min Summer	13.343	0.083	0.0	3.0	3.0	62.0	O K
15 min Winter	13.365	0.105	0.0	4.0	4.0	78.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	43.815	0.0	61.5	18
30 min Summer	28.454	0.0	82.3	33
60 min Summer	17.920	0.0	111.5	62
120 min Summer	11.054	0.0	138.6	122
180 min Summer	8.291	0.0	156.5	180
240 min Summer	6.753	0.0	170.2	222
360 min Summer	5.030	0.0	195.6	332
480 min Summer	4.067	0.0	215.0	394
600 min Summer	3.449	0.0	230.9	458
720 min Summer	3.014	0.0	244.4	522
960 min Summer	2.437	0.0	266.8	658
1440 min Summer	1.807	0.0	300.2	928
2160 min Summer	1.340	0.0	344.4	1324
2880 min Summer	1.084	0.0	372.2	1704
4320 min Summer	0.803	0.0	411.0	2424
5760 min Summer	0.649	0.0	446.9	3168
7200 min Summer	0.551	0.0	470.5	3896
8640 min Summer	0.482	0.0	489.4	4664
10080 min Summer	0.430	0.0	504.8	5440
15 min Winter	43.815	0.0	69.9	18

Summary of Results for 1 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	13.394	0.134	0.0	4.5	4.5	99.7	O K
60 min Winter	13.424	0.164	0.0	4.5	4.5	121.9	O K
120 min Winter	13.452	0.192	0.0	4.5	4.5	143.0	O K
180 min Winter	13.466	0.206	0.0	4.5	4.5	153.6	O K
240 min Winter	13.480	0.220	0.0	4.5	4.5	163.5	O K
360 min Winter	13.494	0.234	0.0	4.5	4.5	174.4	O K
480 min Winter	13.498	0.238	0.0	4.5	4.5	177.1	O K
600 min Winter	13.498	0.238	0.0	4.5	4.5	177.6	O K
720 min Winter	13.498	0.238	0.0	4.5	4.5	177.6	O K
960 min Winter	13.495	0.235	0.0	4.5	4.5	174.7	O K
1440 min Winter	13.477	0.217	0.0	4.5	4.5	161.9	O K
2160 min Winter	13.444	0.184	0.0	4.5	4.5	136.7	O K
2880 min Winter	13.413	0.153	0.0	4.5	4.5	114.3	O K
4320 min Winter	13.375	0.115	0.0	4.4	4.4	85.6	O K
5760 min Winter	13.359	0.099	0.0	3.8	3.8	74.0	O K
7200 min Winter	13.349	0.089	0.0	3.3	3.3	66.3	O K
8640 min Winter	13.342	0.082	0.0	2.9	2.9	60.8	O K
10080 min Winter	13.336	0.076	0.0	2.6	2.6	56.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	28.454	0.0	93.1	32
60 min Winter	17.920	0.0	125.5	62
120 min Winter	11.054	0.0	155.8	118
180 min Winter	8.291	0.0	176.8	176
240 min Winter	6.753	0.0	197.0	236
360 min Winter	5.030	0.0	226.7	348
480 min Winter	4.067	0.0	248.5	448
600 min Winter	3.449	0.0	266.4	488
720 min Winter	3.014	0.0	281.7	562
960 min Winter	2.437	0.0	306.9	714
1440 min Winter	1.807	0.0	344.6	1022
2160 min Winter	1.340	0.0	394.9	1428
2880 min Winter	1.084	0.0	426.8	1816
4320 min Winter	0.803	0.0	471.8	2488
5760 min Winter	0.649	0.0	512.8	3232
7200 min Winter	0.551	0.0	540.7	3960
8640 min Winter	0.482	0.0	563.4	4680
10080 min Winter	0.430	0.0	581.5	5448

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time From:	(mins) To:	Area (ha)
0	4	0.312

Green Roof

Area (m³) 900 Evaporation (mm/day) 3
Depression Storage (mm) 20 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.016355	32	36	0.003302	64	68	0.000667	96	100	0.000135
4	8	0.013390	36	40	0.002703	68	72	0.000546	100	104	0.000110
8	12	0.010963	40	44	0.002213	72	76	0.000447	104	108	0.000090
12	16	0.008976	44	48	0.001812	76	80	0.000366	108	112	0.000074
16	20	0.007349	48	52	0.001484	80	84	0.000300	112	116	0.000060
20	24	0.006017	52	56	0.001215	84	88	0.000245	116	120	0.000050
24	28	0.004926	56	60	0.000995	88	92	0.000201			
28	32	0.004033	60	64	0.000814	92	96	0.000164			

Green Roof

Area (m³) 1950 Evaporation (mm/day) 3
Depression Storage (mm) 20 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.035435	32	36	0.007154	64	68	0.001444	96	100	0.000292
4	8	0.029012	36	40	0.005857	68	72	0.001183	100	104	0.000239
8	12	0.023753	40	44	0.004796	72	76	0.000968	104	108	0.000195
12	16	0.019447	44	48	0.003926	76	80	0.000793	108	112	0.000160
16	20	0.015922	48	52	0.003215	80	84	0.000649	112	116	0.000131
20	24	0.013036	52	56	0.002632	84	88	0.000531	116	120	0.000107
24	28	0.010673	56	60	0.002155	88	92	0.000435			
28	32	0.008738	60	64	0.001764	92	96	0.000356			

Time Area Diagram

Total Area (ha) 0.378

Time (mins) From:	To:	Area (ha)
0	4	0.378

Time Area Diagram

Total Area (ha) 0.181

Time (mins) From:	To:	Area (ha)
0	4	0.181

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 14.600

Cellular Storage Structure

Invert Level (m) 13.260 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	784.0	784.0	0.801	0.0	873.6
0.800	784.0	873.6			

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0110-4500-0250-4500
Design Head (m)	0.250
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	110
Invert Level (m)	13.260
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.250	4.5
Flush-Flo™	0.150	4.5
Kick-Flo®	0.220	4.2
Mean Flow over Head Range	-	3.2

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	3.8	1.200	9.4	3.000	14.4	7.000	22.1
0.200	4.4	1.400	10.1	3.500	15.6	7.500	22.9
0.300	4.9	1.600	10.7	4.000	16.7	8.000	23.7
0.400	5.6	1.800	11.4	4.500	17.7	8.500	24.4
0.500	6.2	2.000	11.9	5.000	18.7	9.000	25.1
0.600	6.8	2.200	12.5	5.500	19.6	9.500	25.8
0.800	7.7	2.400	13.0	6.000	20.5		
1.000	8.6	2.600	13.4	6.500	21.3		

Hydro-Brake® Optimum

Unit Reference	MD-SCU-0108-9000-0550-9000
Design Head (m)	0.550
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	13.510
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.550	9.0
Flush-Flo™	0.134	5.2
Kick-Flo®	0.161	5.1
Mean Flow over Head Range	-	6.0

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	4.1	1.200	13.0	3.000	20.2	7.000	30.3
0.200	5.6	1.400	14.0	3.500	21.7	7.500	31.4
0.300	6.8	1.600	14.9	4.000	23.1	8.000	32.4
0.400	7.8	1.800	15.8	4.500	24.5	8.500	33.4
0.500	8.6	2.000	16.6	5.000	25.8	9.000	34.4
0.600	9.4	2.200	17.4	5.500	27.0	9.500	35.4
0.800	10.7	2.400	18.1	6.000	28.1		
1.000	11.9	2.600	18.8	6.500	29.2		

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 381 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	13.492	0.232	0.0	4.5	4.5	172.6	O K
30 min Summer	13.557	0.297	0.0	6.1	6.1	221.2	O K
60 min Summer	13.637	0.377	0.0	10.6	10.6	280.5	O K
120 min Summer	13.717	0.457	0.0	11.7	11.7	340.2	O K
180 min Summer	13.749	0.489	0.0	12.2	12.2	363.9	O K
240 min Summer	13.760	0.500	0.0	12.4	12.4	372.1	O K
360 min Summer	13.767	0.507	0.0	12.6	12.6	377.5	O K
480 min Summer	13.770	0.510	0.0	12.6	12.6	379.9	O K
600 min Summer	13.770	0.510	0.0	12.6	12.6	379.8	O K
720 min Summer	13.767	0.507	0.0	12.6	12.6	377.9	O K
960 min Summer	13.758	0.498	0.0	12.4	12.4	370.7	O K
1440 min Summer	13.731	0.471	0.0	11.9	11.9	350.9	O K
2160 min Summer	13.690	0.430	0.0	11.1	11.1	320.1	O K
2880 min Summer	13.652	0.392	0.0	10.7	10.7	292.2	O K
4320 min Summer	13.608	0.348	0.0	9.3	9.3	259.4	O K
5760 min Summer	13.581	0.321	0.0	7.6	7.6	239.4	O K
7200 min Summer	13.559	0.299	0.0	6.3	6.3	222.9	O K
8640 min Summer	13.537	0.277	0.0	5.2	5.2	206.1	O K
10080 min Summer	13.506	0.246	0.0	4.5	4.5	183.1	O K
15 min Winter	13.520	0.260	0.0	4.6	4.6	193.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.516	0.0	162.2	19
30 min Summer	69.655	0.0	227.5	33
60 min Summer	43.136	0.0	309.1	72
120 min Summer	25.931	0.0	384.0	122
180 min Summer	19.056	0.0	429.3	182
240 min Summer	15.250	0.0	462.0	240
360 min Summer	11.110	0.0	509.9	294
480 min Summer	8.872	0.0	546.1	356
600 min Summer	7.447	0.0	575.2	422
720 min Summer	6.452	0.0	599.6	490
960 min Summer	5.143	0.0	639.2	626
1440 min Summer	3.731	0.0	695.8	896
2160 min Summer	2.705	0.0	769.5	1296
2880 min Summer	2.151	0.0	815.5	1668
4320 min Summer	1.556	0.0	880.0	2416
5760 min Summer	1.236	0.0	935.2	3176
7200 min Summer	1.034	0.0	972.6	3968
8640 min Summer	0.893	0.0	1002.2	4840
10080 min Summer	0.789	0.0	1024.9	5648
15 min Winter	107.516	0.0	188.5	19

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	13.597	0.337	0.0	8.6	8.6	250.8	O K
60 min Winter	13.691	0.431	0.0	11.2	11.2	320.7	O K
120 min Winter	13.782	0.522	0.0	12.8	12.8	388.9	O K
180 min Winter	13.821	0.561	0.0	13.4	13.4	417.5	O K
240 min Winter	13.836	0.576	0.0	13.7	13.7	428.9	O K
360 min Winter	13.840	0.580	0.0	13.7	13.7	432.3	O K
480 min Winter	13.841	0.581	0.0	13.8	13.8	433.0	O K
600 min Winter	13.837	0.577	0.0	13.7	13.7	430.0	O K
720 min Winter	13.830	0.570	0.0	13.6	13.6	424.5	O K
960 min Winter	13.810	0.550	0.0	13.3	13.3	409.4	O K
1440 min Winter	13.764	0.504	0.0	12.5	12.5	375.0	O K
2160 min Winter	13.701	0.441	0.0	11.4	11.4	328.1	O K
2880 min Winter	13.648	0.388	0.0	10.7	10.7	288.9	O K
4320 min Winter	13.598	0.338	0.0	8.7	8.7	251.5	O K
5760 min Winter	13.569	0.309	0.0	6.8	6.8	229.8	O K
7200 min Winter	13.541	0.281	0.0	5.3	5.3	209.2	O K
8640 min Winter	13.492	0.232	0.0	4.5	4.5	172.5	O K
10080 min Winter	13.422	0.162	0.0	4.5	4.5	120.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	69.655	0.0	262.6	58
60 min Winter	43.136	0.0	353.8	74
120 min Winter	25.931	0.0	437.7	122
180 min Winter	19.056	0.0	488.6	178
240 min Winter	15.250	0.0	525.2	232
360 min Winter	11.110	0.0	578.9	316
480 min Winter	8.872	0.0	619.6	374
600 min Winter	7.447	0.0	652.3	450
720 min Winter	6.452	0.0	679.8	526
960 min Winter	5.143	0.0	724.3	674
1440 min Winter	3.731	0.0	788.4	954
2160 min Winter	2.705	0.0	871.0	1360
2880 min Winter	2.151	0.0	923.1	1728
4320 min Winter	1.556	0.0	996.9	2468
5760 min Winter	1.236	0.0	1059.4	3320
7200 min Winter	1.034	0.0	1102.6	4248
8640 min Winter	0.893	0.0	1137.2	5184
10080 min Winter	0.789	0.0	1164.7	5744

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time From:	(mins) To:	Area (ha)
0	4	0.312

Green Roof

Area (m³) 900 Evaporation (mm/day) 3
Depression Storage (mm) 20 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.016355	32	36	0.003302	64	68	0.000667	96	100	0.000135
4	8	0.013390	36	40	0.002703	68	72	0.000546	100	104	0.000110
8	12	0.010963	40	44	0.002213	72	76	0.000447	104	108	0.000090
12	16	0.008976	44	48	0.001812	76	80	0.000366	108	112	0.000074
16	20	0.007349	48	52	0.001484	80	84	0.000300	112	116	0.000060
20	24	0.006017	52	56	0.001215	84	88	0.000245	116	120	0.000050
24	28	0.004926	56	60	0.000995	88	92	0.000201			
28	32	0.004033	60	64	0.000814	92	96	0.000164			

Green Roof

Area (m³) 1950 Evaporation (mm/day) 3
Depression Storage (mm) 20 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.035435	32	36	0.007154	64	68	0.001444	96	100	0.000292
4	8	0.029012	36	40	0.005857	68	72	0.001183	100	104	0.000239
8	12	0.023753	40	44	0.004796	72	76	0.000968	104	108	0.000195
12	16	0.019447	44	48	0.003926	76	80	0.000793	108	112	0.000160
16	20	0.015922	48	52	0.003215	80	84	0.000649	112	116	0.000131
20	24	0.013036	52	56	0.002632	84	88	0.000531	116	120	0.000107
24	28	0.010673	56	60	0.002155	88	92	0.000435			
28	32	0.008738	60	64	0.001764	92	96	0.000356			

Time Area Diagram

Total Area (ha) 0.378

Time (mins) From:	To:	Area (ha)
0	4	0.378

Time Area Diagram

Total Area (ha) 0.181

Time (mins) From:	To:	Area (ha)
0	4	0.181

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 14.600

Cellular Storage Structure

Invert Level (m) 13.260 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	784.0	784.0	0.801	0.0	873.6
0.800	784.0	873.6			

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0110-4500-0250-4500
Design Head (m)	0.250
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	110
Invert Level (m)	13.260
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.250	4.5
Flush-Flo™	0.150	4.5
Kick-Flo®	0.220	4.2
Mean Flow over Head Range	-	3.2

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	3.8	1.200	9.4	3.000	14.4	7.000	22.1
0.200	4.4	1.400	10.1	3.500	15.6	7.500	22.9
0.300	4.9	1.600	10.7	4.000	16.7	8.000	23.7
0.400	5.6	1.800	11.4	4.500	17.7	8.500	24.4
0.500	6.2	2.000	11.9	5.000	18.7	9.000	25.1
0.600	6.8	2.200	12.5	5.500	19.6	9.500	25.8
0.800	7.7	2.400	13.0	6.000	20.5		
1.000	8.6	2.600	13.4	6.500	21.3		

Hydro-Brake® Optimum

Unit Reference	MD-SCU-0108-9000-0550-9000
Design Head (m)	0.550
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	13.510
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.550	9.0
Flush-Flo™	0.134	5.2
Kick-Flo®	0.161	5.1
Mean Flow over Head Range	-	6.0

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	4.1	1.200	13.0	3.000	20.2	7.000	30.3
0.200	5.6	1.400	14.0	3.500	21.7	7.500	31.4
0.300	6.8	1.600	14.9	4.000	23.1	8.000	32.4
0.400	7.8	1.800	15.8	4.500	24.5	8.500	33.4
0.500	8.6	2.000	16.6	5.000	25.8	9.000	34.4
0.600	9.4	2.200	17.4	5.500	27.0	9.500	35.4
0.800	10.7	2.400	18.1	6.000	28.1		
1.000	11.9	2.600	18.8	6.500	29.2		

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 367 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	13.561	0.301	0.0	6.4	6.4	224.3	O K
30 min Summer	13.663	0.403	0.0	10.7	10.7	300.4	O K
60 min Summer	13.779	0.519	0.0	12.8	12.8	386.7	O K
120 min Summer	13.886	0.626	0.0	14.4	14.4	466.5	O K
180 min Summer	13.928	0.668	0.0	15.0	15.0	497.9	O K
240 min Summer	13.942	0.682	0.0	15.2	15.2	508.3	O K
360 min Summer	13.947	0.687	0.0	15.3	15.3	511.8	O K
480 min Summer	13.948	0.688	0.0	15.3	15.3	512.6	O K
600 min Summer	13.946	0.686	0.0	15.3	15.3	510.6	O K
720 min Summer	13.940	0.680	0.0	15.2	15.2	506.7	O K
960 min Summer	13.924	0.664	0.0	15.0	15.0	494.9	O K
1440 min Summer	13.885	0.625	0.0	14.4	14.4	465.4	O K
2160 min Summer	13.826	0.566	0.0	13.5	13.5	421.2	O K
2880 min Summer	13.774	0.514	0.0	12.7	12.7	382.8	O K
4320 min Summer	13.695	0.435	0.0	11.2	11.2	324.2	O K
5760 min Summer	13.638	0.378	0.0	10.6	10.6	281.2	O K
7200 min Summer	13.608	0.348	0.0	9.2	9.2	259.0	O K
8640 min Summer	13.586	0.326	0.0	7.9	7.9	243.2	O K
10080 min Summer	13.569	0.309	0.0	6.8	6.8	230.0	O K
15 min Winter	13.597	0.337	0.0	8.6	8.6	251.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.587	0.0	228.3	19
30 min Summer	91.185	0.0	317.9	56
60 min Summer	56.713	0.0	426.3	74
120 min Summer	34.079	0.0	524.6	124
180 min Summer	24.967	0.0	582.4	182
240 min Summer	19.906	0.0	622.7	240
360 min Summer	14.417	0.0	681.0	302
480 min Summer	11.468	0.0	725.2	364
600 min Summer	9.596	0.0	760.5	428
720 min Summer	8.292	0.0	789.9	496
960 min Summer	6.581	0.0	837.2	634
1440 min Summer	4.744	0.0	904.6	904
2160 min Summer	3.415	0.0	991.0	1296
2880 min Summer	2.702	0.0	1044.3	1676
4320 min Summer	1.940	0.0	1118.7	2420
5760 min Summer	1.532	0.0	1181.0	3112
7200 min Summer	1.275	0.0	1223.1	3832
8640 min Summer	1.097	0.0	1256.3	4592
10080 min Summer	0.966	0.0	1281.8	5440
15 min Winter	139.587	0.0	263.4	49

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	13.722	0.462	0.0	11.7	11.7	344.0	O K
60 min Winter	13.852	0.592	0.0	13.9	13.9	440.7	O K
120 min Winter	13.973	0.713	0.0	15.6	15.6	531.4	O K
180 min Winter	14.024	0.764	0.0	16.3	16.3	569.0	O K
240 min Winter	14.043	0.783	0.0	16.5	16.5	583.4	O K
360 min Winter	14.047	0.787	0.0	16.6	16.6	586.2	O K
480 min Winter	14.043	0.783	0.0	16.5	16.5	583.2	O K
600 min Winter	14.036	0.776	0.0	16.4	16.4	577.8	O K
720 min Winter	14.024	0.764	0.0	16.3	16.3	569.2	O K
960 min Winter	13.995	0.735	0.0	15.9	15.9	547.4	O K
1440 min Winter	13.929	0.669	0.0	15.0	15.0	498.5	O K
2160 min Winter	13.839	0.579	0.0	13.7	13.7	431.3	O K
2880 min Winter	13.767	0.507	0.0	12.6	12.6	377.3	O K
4320 min Winter	13.661	0.401	0.0	10.7	10.7	298.5	O K
5760 min Winter	13.610	0.350	0.0	9.4	9.4	260.9	O K
7200 min Winter	13.584	0.324	0.0	7.8	7.8	241.6	O K
8640 min Winter	13.564	0.304	0.0	6.6	6.6	226.4	O K
10080 min Winter	13.543	0.283	0.0	5.4	5.4	210.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	91.185	0.0	363.7	57
60 min Winter	56.713	0.0	485.0	76
120 min Winter	34.079	0.0	595.2	122
180 min Winter	24.967	0.0	660.0	178
240 min Winter	19.906	0.0	705.1	234
360 min Winter	14.417	0.0	770.6	334
480 min Winter	11.468	0.0	820.2	382
600 min Winter	9.596	0.0	859.8	456
720 min Winter	8.292	0.0	892.9	532
960 min Winter	6.581	0.0	946.1	682
1440 min Winter	4.744	0.0	1021.8	966
2160 min Winter	3.415	0.0	1119.1	1376
2880 min Winter	2.702	0.0	1179.4	1760
4320 min Winter	1.940	0.0	1264.1	2504
5760 min Winter	1.532	0.0	1334.6	3168
7200 min Winter	1.275	0.0	1383.1	3960
8640 min Winter	1.097	0.0	1421.8	4768
10080 min Winter	0.966	0.0	1452.3	5752

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time From:	(mins) To:	Area (ha)
0	4	0.312

Green Roof

Area (m³) 900 Evaporation (mm/day) 3
Depression Storage (mm) 20 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.016355	32	36	0.003302	64	68	0.000667	96	100	0.000135
4	8	0.013390	36	40	0.002703	68	72	0.000546	100	104	0.000110
8	12	0.010963	40	44	0.002213	72	76	0.000447	104	108	0.000090
12	16	0.008976	44	48	0.001812	76	80	0.000366	108	112	0.000074
16	20	0.007349	48	52	0.001484	80	84	0.000300	112	116	0.000060
20	24	0.006017	52	56	0.001215	84	88	0.000245	116	120	0.000050
24	28	0.004926	56	60	0.000995	88	92	0.000201			
28	32	0.004033	60	64	0.000814	92	96	0.000164			

Green Roof

Area (m³) 1950 Evaporation (mm/day) 3
Depression Storage (mm) 20 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.035435	32	36	0.007154	64	68	0.001444	96	100	0.000292
4	8	0.029012	36	40	0.005857	68	72	0.001183	100	104	0.000239
8	12	0.023753	40	44	0.004796	72	76	0.000968	104	108	0.000195
12	16	0.019447	44	48	0.003926	76	80	0.000793	108	112	0.000160
16	20	0.015922	48	52	0.003215	80	84	0.000649	112	116	0.000131
20	24	0.013036	52	56	0.002632	84	88	0.000531	116	120	0.000107
24	28	0.010673	56	60	0.002155	88	92	0.000435			
28	32	0.008738	60	64	0.001764	92	96	0.000356			

Time Area Diagram

Total Area (ha) 0.378

Time (mins) From:	To:	Area (ha)
0	4	0.378

Time Area Diagram

Total Area (ha) 0.181

Time (mins) From:	To:	Area (ha)
0	4	0.181

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 14.600

Cellular Storage Structure

Invert Level (m) 13.260 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	784.0	784.0	0.801	0.0	873.6
0.800	784.0	873.6			

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0110-4500-0250-4500
Design Head (m)	0.250
Design Flow (l/s)	4.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	110
Invert Level (m)	13.260
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.250	4.5
Flush-Flo™	0.150	4.5
Kick-Flo®	0.220	4.2
Mean Flow over Head Range	-	3.2

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	3.8	1.200	9.4	3.000	14.4	7.000	22.1
0.200	4.4	1.400	10.1	3.500	15.6	7.500	22.9
0.300	4.9	1.600	10.7	4.000	16.7	8.000	23.7
0.400	5.6	1.800	11.4	4.500	17.7	8.500	24.4
0.500	6.2	2.000	11.9	5.000	18.7	9.000	25.1
0.600	6.8	2.200	12.5	5.500	19.6	9.500	25.8
0.800	7.7	2.400	13.0	6.000	20.5		
1.000	8.6	2.600	13.4	6.500	21.3		

Hydro-Brake® Optimum

Unit Reference	MD-SCU-0108-9000-0550-9000
Design Head (m)	0.550
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	13.510
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

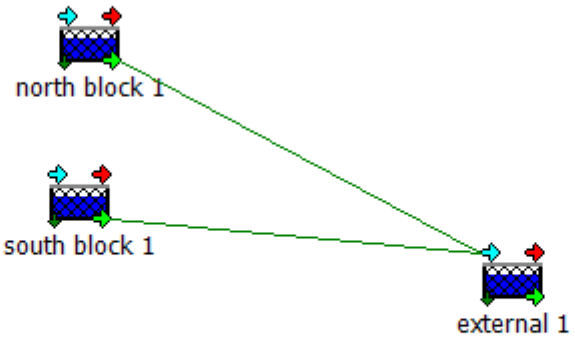
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.550	9.0
Flush-Flo™	0.134	5.2
Kick-Flo®	0.161	5.1
Mean Flow over Head Range	-	6.0

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

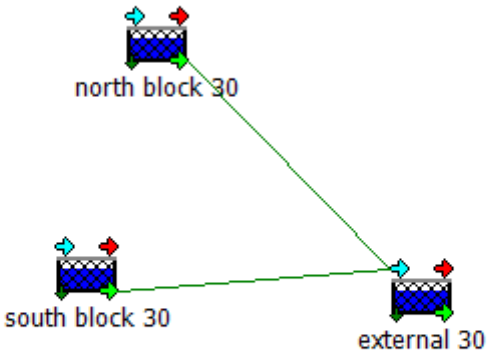
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.1	1.200	13.0	3.000	20.2	7.000	30.3
0.200	5.6	1.400	14.0	3.500	21.7	7.500	31.4
0.300	6.8	1.600	14.9	4.000	23.1	8.000	32.4
0.400	7.8	1.800	15.8	4.500	24.5	8.500	33.4
0.500	8.6	2.000	16.6	5.000	25.8	9.000	34.4
0.600	9.4	2.200	17.4	5.500	27.0	9.500	35.4
0.800	10.7	2.400	18.1	6.000	28.1		
1.000	11.9	2.600	18.8	6.500	29.2		

Option 2 Podium storage calcs

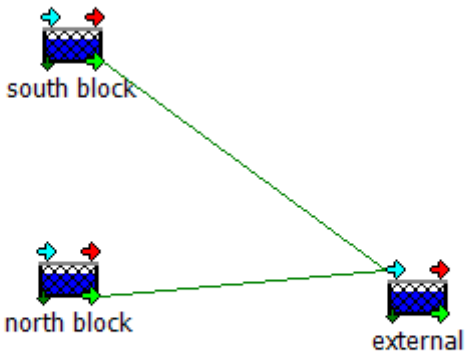
1 in 1 yr Cascade model arrangement



1 in 30 yr Cascade model arrangement

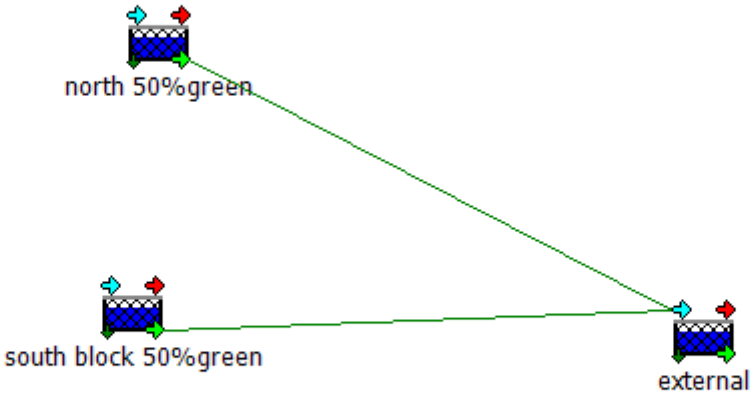


1 in 100 yr Cascade model arrangement



1 in 100 yr 50% Green Roof

Cascade model arrangement



Cascade Summary of Results for external 1.SRCX

Upstream Structures	Outflow To	Overflow To
north block 1.SRCX south block 1.SRCX	(None)	(None)

Half Drain Time : 82 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.122	0.122	0.0	4.7	4.7	23.2	O K
30 min Summer	1.152	0.152	0.0	4.8	4.8	28.8	O K
60 min Summer	1.177	0.177	0.0	4.8	4.8	33.7	O K
120 min Summer	1.194	0.194	0.0	4.8	4.8	36.9	O K
180 min Summer	1.201	0.201	0.0	4.8	4.8	38.2	O K
240 min Summer	1.203	0.203	0.0	4.8	4.8	38.6	O K
360 min Summer	1.200	0.200	0.0	4.8	4.8	38.1	O K
480 min Summer	1.194	0.194	0.0	4.8	4.8	36.8	O K
600 min Summer	1.186	0.186	0.0	4.8	4.8	35.4	O K
720 min Summer	1.179	0.179	0.0	4.8	4.8	34.0	O K
960 min Summer	1.165	0.165	0.0	4.8	4.8	31.4	O K
1440 min Summer	1.143	0.143	0.0	4.8	4.8	27.1	O K
2160 min Summer	1.121	0.121	0.0	4.7	4.7	23.0	O K
2880 min Summer	1.112	0.112	0.0	4.4	4.4	21.4	O K
4320 min Summer	1.101	0.101	0.0	3.9	3.9	19.1	O K
5760 min Summer	1.093	0.093	0.0	3.6	3.6	17.7	O K
7200 min Summer	1.088	0.088	0.0	3.3	3.3	16.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	43.815	0.0	47.5	20
30 min Summer	28.454	0.0	67.1	33
60 min Summer	17.920	0.0	110.6	60
120 min Summer	11.054	0.0	142.3	100
180 min Summer	8.291	0.0	163.5	136
240 min Summer	6.753	0.0	179.8	174
360 min Summer	5.030	0.0	203.8	246
480 min Summer	4.067	0.0	221.3	316
600 min Summer	3.449	0.0	235.6	386
720 min Summer	3.014	0.0	247.6	456
960 min Summer	2.437	0.0	267.0	590
1440 min Summer	1.807	0.0	294.4	852
2160 min Summer	1.340	0.0	369.5	1192
2880 min Summer	1.084	0.0	396.8	1588
4320 min Summer	0.803	0.0	431.6	2336
5760 min Summer	0.649	0.0	502.7	3056
7200 min Summer	0.551	0.0	530.2	3816

Cascade Summary of Results for external 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.083	0.083	0.0	3.0	3.0	15.8	O K
10080 min Summer	1.080	0.080	0.0	2.9	2.9	15.1	O K
15 min Winter	1.137	0.137	0.0	4.8	4.8	26.1	O K
30 min Winter	1.172	0.172	0.0	4.8	4.8	32.7	O K
60 min Winter	1.204	0.204	0.0	4.8	4.8	38.7	O K
120 min Winter	1.226	0.226	0.0	4.8	4.8	43.0	O K
180 min Winter	1.232	0.232	0.0	4.8	4.8	44.2	O K
240 min Winter	1.233	0.233	0.0	4.8	4.8	44.2	O K
360 min Winter	1.227	0.227	0.0	4.8	4.8	43.2	O K
480 min Winter	1.217	0.217	0.0	4.8	4.8	41.3	O K
600 min Winter	1.206	0.206	0.0	4.8	4.8	39.2	O K
720 min Winter	1.195	0.195	0.0	4.8	4.8	37.1	O K
960 min Winter	1.176	0.176	0.0	4.8	4.8	33.4	O K
1440 min Winter	1.145	0.145	0.0	4.8	4.8	27.5	O K
2160 min Winter	1.119	0.119	0.0	4.6	4.6	22.6	O K
2880 min Winter	1.109	0.109	0.0	4.3	4.3	20.7	O K
4320 min Winter	1.096	0.096	0.0	3.7	3.7	18.3	O K
5760 min Winter	1.088	0.088	0.0	3.3	3.3	16.6	O K
7200 min Winter	1.082	0.082	0.0	3.0	3.0	15.5	O K
8640 min Winter	1.077	0.077	0.0	2.7	2.7	14.5	O K
10080 min Winter	1.073	0.073	0.0	2.5	2.5	13.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.482	0.0	551.7	4576
10080 min Summer	0.430	0.0	567.0	5336
15 min Winter	43.815	0.0	55.2	20
30 min Winter	28.454	0.0	77.9	34
60 min Winter	17.920	0.0	126.9	62
120 min Winter	11.054	0.0	163.0	118
180 min Winter	8.291	0.0	186.9	172
240 min Winter	6.753	0.0	205.3	200
360 min Winter	5.030	0.0	232.4	282
480 min Winter	4.067	0.0	252.2	362
600 min Winter	3.449	0.0	268.3	442
720 min Winter	3.014	0.0	281.9	520
960 min Winter	2.437	0.0	304.0	672
1440 min Winter	1.807	0.0	335.1	952
2160 min Winter	1.340	0.0	417.4	1320
2880 min Winter	1.084	0.0	448.3	1704
4320 min Winter	0.803	0.0	488.3	2468
5760 min Winter	0.649	0.0	565.3	3224
7200 min Winter	0.551	0.0	596.5	4032
8640 min Winter	0.482	0.0	621.2	4672
10080 min Winter	0.430	0.0	639.0	5512

Cascade Rainfall Details for external 1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.156	4	8	0.156

Cascade Model Details for external 1.SRCX

Storage is Online Cover Level (m) 5.000

Cellular Storage Structure

Invert Level (m) 1.000 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	200.0	200.0	1.201	0.0	272.0
1.200	200.0	272.0			

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0111-4800-0400-4800
Design Head (m)	0.400
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	1.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	4.8
Flush-Flo™	0.167	4.8
Kick-Flo®	0.311	4.3
Mean Flow over Head Range	-	3.8

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	3.9	1.200	8.0	3.000	12.4	7.000	18.7
0.200	4.8	1.400	8.6	3.500	13.3	7.500	19.4
0.300	4.4	1.600	9.2	4.000	14.2	8.000	20.0
0.400	4.8	1.800	9.7	4.500	15.0	8.500	20.6
0.500	5.3	2.000	10.2	5.000	15.8	9.000	21.2
0.600	5.8	2.200	10.7	5.500	16.6	9.500	21.8
0.800	6.6	2.400	11.1	6.000	17.3		
1.000	7.4	2.600	11.5	6.500	18.0		

Hydro-Brake® Optimum

Unit Reference	MD-SCU-0115-1200-0800-1200
Design Head (m)	0.800
Design Flow (l/s)	12.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	115
Invert Level (m)	1.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	12.0
Flush-Flo™	0.143	5.9
Kick-Flo®	0.172	5.9
Mean Flow over Head Range	-	8.0

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	4.4	1.200	14.5	3.000	22.5	7.000	33.9
0.200	6.3	1.400	15.7	3.500	24.3	7.500	35.1
0.300	7.6	1.600	16.7	4.000	25.9	8.000	36.2
0.400	8.7	1.800	17.6	4.500	27.4	8.500	37.2
0.500	9.6	2.000	18.6	5.000	28.8	9.000	38.3
0.600	10.5	2.200	19.4	5.500	30.2	9.500	39.3
0.800	12.0	2.400	20.3	6.000	31.5		
1.000	13.3	2.600	21.0	6.500	32.7		

Cascade Summary of Results for north block 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external 1.SRCX	(None)

Half Drain Time : 915 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.024	0.024	0.0	0.2	0.2	44.1	O K
30 min Summer	1.031	0.031	0.0	0.4	0.4	57.0	O K
60 min Summer	1.039	0.039	0.0	0.6	0.6	71.3	O K
120 min Summer	1.047	0.047	0.0	1.0	1.0	86.2	O K
180 min Summer	1.052	0.052	0.0	1.1	1.1	95.0	O K
240 min Summer	1.055	0.055	0.0	1.2	1.2	101.0	O K
360 min Summer	1.059	0.059	0.0	1.4	1.4	108.2	O K
480 min Summer	1.061	0.061	0.0	1.4	1.4	111.8	O K
600 min Summer	1.062	0.062	0.0	1.5	1.5	114.0	O K
720 min Summer	1.063	0.063	0.0	1.5	1.5	115.9	O K
960 min Summer	1.065	0.065	0.0	1.6	1.6	118.9	O K
1440 min Summer	1.067	0.067	0.0	1.6	1.6	122.5	O K
2160 min Summer	1.067	0.067	0.0	1.7	1.7	124.1	O K
2880 min Summer	1.067	0.067	0.0	1.7	1.7	123.5	O K
4320 min Summer	1.065	0.065	0.0	1.6	1.6	119.8	O K
5760 min Summer	1.063	0.063	0.0	1.5	1.5	115.1	O K
7200 min Summer	1.060	0.060	0.0	1.4	1.4	110.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	43.815	0.0	14.5	23
30 min Summer	28.454	0.0	22.1	38
60 min Summer	17.920	0.0	44.3	68
120 min Summer	11.054	0.0	58.6	126
180 min Summer	8.291	0.0	68.2	184
240 min Summer	6.753	0.0	75.7	244
360 min Summer	5.030	0.0	86.5	362
480 min Summer	4.067	0.0	94.4	480
600 min Summer	3.449	0.0	100.7	536
720 min Summer	3.014	0.0	106.0	586
960 min Summer	2.437	0.0	114.4	704
1440 min Summer	1.807	0.0	125.6	970
2160 min Summer	1.340	0.0	168.7	1380
2880 min Summer	1.084	0.0	180.7	1768
4320 min Summer	0.803	0.0	194.5	2556
5760 min Summer	0.649	0.0	236.0	3336
7200 min Summer	0.551	0.0	248.3	4040

Cascade Summary of Results for north block 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.058	0.058	0.0	1.3	1.3	106.5	O K
10080 min Summer	1.056	0.056	0.0	1.3	1.3	102.7	O K
15 min Winter	1.027	0.027	0.0	0.3	0.3	49.3	O K
30 min Winter	1.035	0.035	0.0	0.5	0.5	63.8	O K
60 min Winter	1.043	0.043	0.0	0.8	0.8	79.7	O K
120 min Winter	1.052	0.052	0.0	1.2	1.2	96.4	O K
180 min Winter	1.058	0.058	0.0	1.3	1.3	106.3	O K
240 min Winter	1.061	0.061	0.0	1.4	1.4	113.0	O K
360 min Winter	1.066	0.066	0.0	1.6	1.6	121.2	O K
480 min Winter	1.068	0.068	0.0	1.7	1.7	125.3	O K
600 min Winter	1.069	0.069	0.0	1.7	1.7	127.5	O K
720 min Winter	1.070	0.070	0.0	1.8	1.8	129.0	O K
960 min Winter	1.072	0.072	0.0	1.9	1.9	131.7	O K
1440 min Winter	1.073	0.073	0.0	1.9	1.9	133.5	O K
2160 min Winter	1.072	0.072	0.0	1.9	1.9	132.1	O K
2880 min Winter	1.070	0.070	0.0	1.8	1.8	128.9	O K
4320 min Winter	1.066	0.066	0.0	1.6	1.6	121.3	O K
5760 min Winter	1.062	0.062	0.0	1.5	1.5	113.7	O K
7200 min Winter	1.058	0.058	0.0	1.3	1.3	107.0	O K
8640 min Winter	1.055	0.055	0.0	1.3	1.3	101.3	O K
10080 min Winter	1.052	0.052	0.0	1.2	1.2	96.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.482	0.0	257.4	4840
10080 min Summer	0.430	0.0	262.9	5544
15 min Winter	43.815	0.0	17.5	23
30 min Winter	28.454	0.0	26.4	37
60 min Winter	17.920	0.0	51.7	66
120 min Winter	11.054	0.0	68.1	124
180 min Winter	8.291	0.0	79.0	182
240 min Winter	6.753	0.0	87.4	238
360 min Winter	5.030	0.0	99.7	352
480 min Winter	4.067	0.0	108.7	462
600 min Winter	3.449	0.0	115.9	562
720 min Winter	3.014	0.0	121.9	584
960 min Winter	2.437	0.0	131.5	728
1440 min Winter	1.807	0.0	144.3	1028
2160 min Winter	1.340	0.0	191.4	1468
2880 min Winter	1.084	0.0	205.1	1880
4320 min Winter	0.803	0.0	221.3	2720
5760 min Winter	0.649	0.0	266.0	3464
7200 min Winter	0.551	0.0	279.9	4248
8640 min Winter	0.482	0.0	290.5	5008
10080 min Winter	0.430	0.0	297.2	5744

Cascade Rainfall Details for north block 1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.538

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.269	4	8	0.269

Cascade Model Details for north block 1.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	1936.0	1936.0	0.401	0.0	2006.4
0.400	1936.0	2006.4			

Orifice Outflow Control

Diameter (m) 0.083 Discharge Coefficient 0.600 Invert Level (m) 1.000

Cascade Summary of Results for south block 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external 1.SRCX	(None)

Half Drain Time : 582 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.026	0.026	0.0	0.2	0.2	22.1	O K
30 min Summer	1.033	0.033	0.0	0.4	0.4	28.5	O K
60 min Summer	1.041	0.041	0.0	0.6	0.6	35.4	O K
120 min Summer	1.050	0.050	0.0	0.7	0.7	42.5	O K
180 min Summer	1.054	0.054	0.0	0.9	0.9	46.3	O K
240 min Summer	1.057	0.057	0.0	0.9	0.9	48.7	O K
360 min Summer	1.060	0.060	0.0	1.0	1.0	50.9	O K
480 min Summer	1.061	0.061	0.0	1.0	1.0	52.3	O K
600 min Summer	1.062	0.062	0.0	1.1	1.1	53.3	O K
720 min Summer	1.063	0.063	0.0	1.1	1.1	54.1	O K
960 min Summer	1.064	0.064	0.0	1.1	1.1	55.0	O K
1440 min Summer	1.065	0.065	0.0	1.2	1.2	55.6	O K
2160 min Summer	1.064	0.064	0.0	1.1	1.1	54.9	O K
2880 min Summer	1.063	0.063	0.0	1.1	1.1	53.5	O K
4320 min Summer	1.059	0.059	0.0	1.0	1.0	50.4	O K
5760 min Summer	1.056	0.056	0.0	0.9	0.9	47.5	O K
7200 min Summer	1.053	0.053	0.0	0.8	0.8	45.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	43.815	0.0	10.8	23
30 min Summer	28.454	0.0	15.8	37
60 min Summer	17.920	0.0	27.5	66
120 min Summer	11.054	0.0	35.3	126
180 min Summer	8.291	0.0	40.6	184
240 min Summer	6.753	0.0	44.6	242
360 min Summer	5.030	0.0	50.5	340
480 min Summer	4.067	0.0	54.8	388
600 min Summer	3.449	0.0	58.3	448
720 min Summer	3.014	0.0	61.3	510
960 min Summer	2.437	0.0	66.1	646
1440 min Summer	1.807	0.0	72.8	914
2160 min Summer	1.340	0.0	90.7	1320
2880 min Summer	1.084	0.0	97.4	1704
4320 min Summer	0.803	0.0	106.0	2468
5760 min Summer	0.649	0.0	122.5	3224
7200 min Summer	0.551	0.0	129.3	3960

Cascade Summary of Results for south block 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.050	0.050	0.0	0.8	0.8	42.9	O K
10080 min Summer	1.048	0.048	0.0	0.7	0.7	41.1	O K
15 min Winter	1.029	0.029	0.0	0.3	0.3	24.8	O K
30 min Winter	1.037	0.037	0.0	0.5	0.5	31.9	O K
60 min Winter	1.046	0.046	0.0	0.7	0.7	39.7	O K
120 min Winter	1.056	0.056	0.0	0.9	0.9	47.5	O K
180 min Winter	1.061	0.061	0.0	1.0	1.0	51.8	O K
240 min Winter	1.064	0.064	0.0	1.1	1.1	54.4	O K
360 min Winter	1.067	0.067	0.0	1.2	1.2	57.0	O K
480 min Winter	1.068	0.068	0.0	1.2	1.2	58.1	O K
600 min Winter	1.069	0.069	0.0	1.3	1.3	59.1	O K
720 min Winter	1.070	0.070	0.0	1.3	1.3	59.7	O K
960 min Winter	1.070	0.070	0.0	1.3	1.3	60.0	O K
1440 min Winter	1.069	0.069	0.0	1.3	1.3	59.3	O K
2160 min Winter	1.066	0.066	0.0	1.2	1.2	56.9	O K
2880 min Winter	1.063	0.063	0.0	1.1	1.1	54.2	O K
4320 min Winter	1.058	0.058	0.0	1.0	1.0	49.3	O K
5760 min Winter	1.053	0.053	0.0	0.8	0.8	45.5	O K
7200 min Winter	1.050	0.050	0.0	0.7	0.7	42.4	O K
8640 min Winter	1.047	0.047	0.0	0.7	0.7	39.8	O K
10080 min Winter	1.044	0.044	0.0	0.6	0.6	37.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.482	0.0	134.5	4672
10080 min Summer	0.430	0.0	138.1	5448
15 min Winter	43.815	0.0	12.7	23
30 min Winter	28.454	0.0	18.6	37
60 min Winter	17.920	0.0	31.5	66
120 min Winter	11.054	0.0	40.4	122
180 min Winter	8.291	0.0	46.3	180
240 min Winter	6.753	0.0	50.9	236
360 min Winter	5.030	0.0	57.5	342
480 min Winter	4.067	0.0	62.4	390
600 min Winter	3.449	0.0	66.4	462
720 min Winter	3.014	0.0	69.8	538
960 min Winter	2.437	0.0	75.2	688
1440 min Winter	1.807	0.0	82.8	980
2160 min Winter	1.340	0.0	102.4	1392
2880 min Winter	1.084	0.0	110.0	1792
4320 min Winter	0.803	0.0	119.8	2592
5760 min Winter	0.649	0.0	137.7	3344
7200 min Winter	0.551	0.0	145.3	4104
8640 min Winter	0.482	0.0	151.3	4840
10080 min Winter	0.430	0.0	155.6	5640

Cascade Rainfall Details for south block 1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.271

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.135	4	8	0.136

Cascade Model Details for south block 1.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	900.0	900.0	0.401	0.0	948.0
0.400	900.0	948.0			

Orifice Outflow Control

Diameter (m) 0.058 Discharge Coefficient 0.600 Invert Level (m) 1.000

Cascade Summary of Results for external 30.SRCX

Upstream Structures	Outflow To	Overflow To
north block 30.SRCX south block 30.SRCX	(None)	(None)

Half Drain Time : 116 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.318	0.318	0.0	4.8	4.8	60.4	O K
30 min Summer	1.411	0.411	0.0	4.9	4.9	78.1	O K
60 min Summer	1.486	0.486	0.0	8.9	8.9	92.4	O K
120 min Summer	1.523	0.523	0.0	10.9	10.9	99.3	O K
180 min Summer	1.530	0.530	0.0	11.3	11.3	100.6	O K
240 min Summer	1.533	0.533	0.0	11.4	11.4	101.2	O K
360 min Summer	1.534	0.534	0.0	11.4	11.4	101.5	O K
480 min Summer	1.533	0.533	0.0	11.4	11.4	101.2	O K
600 min Summer	1.530	0.530	0.0	11.3	11.3	100.8	O K
720 min Summer	1.527	0.527	0.0	11.1	11.1	100.2	O K
960 min Summer	1.521	0.521	0.0	10.9	10.9	99.0	O K
1440 min Summer	1.510	0.510	0.0	10.3	10.3	96.9	O K
2160 min Summer	1.496	0.496	0.0	9.5	9.5	94.3	O K
2880 min Summer	1.485	0.485	0.0	8.8	8.8	92.2	O K
4320 min Summer	1.468	0.468	0.0	7.7	7.7	88.9	O K
5760 min Summer	1.453	0.453	0.0	6.7	6.7	86.0	O K
7200 min Summer	1.436	0.436	0.0	5.8	5.8	82.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.516	0.0	152.9	22
30 min Summer	69.655	0.0	209.6	37
60 min Summer	43.136	0.0	309.8	64
120 min Summer	25.931	0.0	379.7	120
180 min Summer	19.056	0.0	422.1	150
240 min Summer	15.250	0.0	452.5	180
360 min Summer	11.110	0.0	497.0	250
480 min Summer	8.872	0.0	530.4	320
600 min Summer	7.447	0.0	557.0	388
720 min Summer	6.452	0.0	579.1	458
960 min Summer	5.143	0.0	614.0	596
1440 min Summer	3.731	0.0	661.5	866
2160 min Summer	2.705	0.0	777.7	1260
2880 min Summer	2.151	0.0	821.6	1672
4320 min Summer	1.556	0.0	877.5	2464
5760 min Summer	1.236	0.0	974.7	3288
7200 min Summer	1.034	0.0	1014.7	4168

Cascade Summary of Results for external 30.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.392	0.392	0.0	4.8	4.8	74.5	O K
10080 min Summer	1.252	0.252	0.0	4.8	4.8	47.9	O K
15 min Winter	1.358	0.358	0.0	4.8	4.8	68.1	O K
30 min Winter	1.459	0.459	0.0	7.1	7.1	87.3	O K
60 min Winter	1.535	0.535	0.0	11.4	11.4	101.7	O K
120 min Winter	1.590	0.590	0.0	11.9	11.9	112.2	O K
180 min Winter	1.603	0.603	0.0	12.1	12.1	114.5	O K
240 min Winter	1.605	0.605	0.0	12.2	12.2	114.9	O K
360 min Winter	1.603	0.603	0.0	12.1	12.1	114.5	O K
480 min Winter	1.595	0.595	0.0	12.0	12.0	113.1	O K
600 min Winter	1.586	0.586	0.0	11.8	11.8	111.3	O K
720 min Winter	1.576	0.576	0.0	11.6	11.6	109.4	O K
960 min Winter	1.553	0.553	0.0	11.5	11.5	105.0	O K
1440 min Winter	1.525	0.525	0.0	11.0	11.0	99.7	O K
2160 min Winter	1.503	0.503	0.0	9.9	9.9	95.5	O K
2880 min Winter	1.488	0.488	0.0	9.0	9.0	92.7	O K
4320 min Winter	1.466	0.466	0.0	7.6	7.6	88.6	O K
5760 min Winter	1.448	0.448	0.0	6.4	6.4	85.1	O K
7200 min Winter	1.417	0.417	0.0	5.1	5.1	79.2	O K
8640 min Winter	1.210	0.210	0.0	4.8	4.8	39.8	O K
10080 min Winter	1.120	0.120	0.0	4.7	4.7	22.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.893	0.0	1045.6	5104
10080 min Summer	0.789	0.0	1066.4	5792
15 min Winter	107.516	0.0	175.9	22
30 min Winter	69.655	0.0	240.2	36
60 min Winter	43.136	0.0	351.6	62
120 min Winter	25.931	0.0	430.2	118
180 min Winter	19.056	0.0	477.7	170
240 min Winter	15.250	0.0	511.9	194
360 min Winter	11.110	0.0	561.8	270
480 min Winter	8.872	0.0	599.3	348
600 min Winter	7.447	0.0	629.1	424
720 min Winter	6.452	0.0	653.9	500
960 min Winter	5.143	0.0	693.2	636
1440 min Winter	3.731	0.0	747.0	896
2160 min Winter	2.705	0.0	875.0	1300
2880 min Winter	2.151	0.0	924.7	1704
4320 min Winter	1.556	0.0	988.4	2512
5760 min Winter	1.236	0.0	1094.1	3408
7200 min Winter	1.034	0.0	1139.7	4480
8640 min Winter	0.893	0.0	1175.0	5192
10080 min Winter	0.789	0.0	1199.5	5448

Cascade Rainfall Details for external 30.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.156	4	8	0.156

Cascade Model Details for external 30.SRCX

Storage is Online Cover Level (m) 5.000

Cellular Storage Structure

Invert Level (m) 1.000 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	200.0	200.0	1.201	0.0	272.0
1.200	200.0	272.0			

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0111-4800-0400-4800
Design Head (m)	0.400
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	1.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	4.8
Flush-Flo™	0.167	4.8
Kick-Flo®	0.311	4.3
Mean Flow over Head Range	-	3.8

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	3.9	1.200	8.0	3.000	12.4	7.000	18.7
0.200	4.8	1.400	8.6	3.500	13.3	7.500	19.4
0.300	4.4	1.600	9.2	4.000	14.2	8.000	20.0
0.400	4.8	1.800	9.7	4.500	15.0	8.500	20.6
0.500	5.3	2.000	10.2	5.000	15.8	9.000	21.2
0.600	5.8	2.200	10.7	5.500	16.6	9.500	21.8
0.800	6.6	2.400	11.1	6.000	17.3		
1.000	7.4	2.600	11.5	6.500	18.0		

Hydro-Brake® Optimum

Unit Reference	MD-SCU-0115-1200-0800-1200
Design Head (m)	0.800
Design Flow (l/s)	12.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	115
Invert Level (m)	1.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	12.0
Flush-Flo™	0.143	5.9
Kick-Flo®	0.172	5.9
Mean Flow over Head Range	-	8.0

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	4.4	1.200	14.5	3.000	22.5	7.000	33.9
0.200	6.3	1.400	15.7	3.500	24.3	7.500	35.1
0.300	7.6	1.600	16.7	4.000	25.9	8.000	36.2
0.400	8.7	1.800	17.6	4.500	27.4	8.500	37.2
0.500	9.6	2.000	18.6	5.000	28.8	9.000	38.3
0.600	10.5	2.200	19.4	5.500	30.2	9.500	39.3
0.800	12.0	2.400	20.3	6.000	31.5		
1.000	13.3	2.600	21.0	6.500	32.7		

Cascade Summary of Results for north block 30.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external 30.SRCX	(None)

Half Drain Time : 696 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.059	0.059	0.0	1.4	1.4	107.7	O K
30 min Summer	1.075	0.075	0.0	2.0	2.0	138.6	O K
60 min Summer	1.092	0.092	0.0	2.8	2.8	169.2	O K
120 min Summer	1.107	0.107	0.0	3.5	3.5	197.5	O K
180 min Summer	1.115	0.115	0.0	3.8	3.8	211.3	O K
240 min Summer	1.119	0.119	0.0	4.0	4.0	218.8	O K
360 min Summer	1.123	0.123	0.0	4.1	4.1	225.4	O K
480 min Summer	1.124	0.124	0.0	4.1	4.1	228.5	O K
600 min Summer	1.126	0.126	0.0	4.2	4.2	230.9	O K
720 min Summer	1.126	0.126	0.0	4.2	4.2	232.5	O K
960 min Summer	1.127	0.127	0.0	4.2	4.2	234.0	O K
1440 min Summer	1.126	0.126	0.0	4.2	4.2	232.6	O K
2160 min Summer	1.123	0.123	0.0	4.1	4.1	225.6	O K
2880 min Summer	1.118	0.118	0.0	4.0	4.0	217.1	O K
4320 min Summer	1.109	0.109	0.0	3.6	3.6	201.0	O K
5760 min Summer	1.102	0.102	0.0	3.2	3.2	187.3	O K
7200 min Summer	1.096	0.096	0.0	2.9	2.9	175.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.516	0.0	58.3	23
30 min Summer	69.655	0.0	83.2	37
60 min Summer	43.136	0.0	136.5	66
120 min Summer	25.931	0.0	169.2	126
180 min Summer	19.056	0.0	189.0	184
240 min Summer	15.250	0.0	203.2	242
360 min Summer	11.110	0.0	223.9	358
480 min Summer	8.872	0.0	239.3	406
600 min Summer	7.447	0.0	251.5	466
720 min Summer	6.452	0.0	261.5	526
960 min Summer	5.143	0.0	277.1	660
1440 min Summer	3.731	0.0	297.1	930
2160 min Summer	2.705	0.0	363.3	1340
2880 min Summer	2.151	0.0	383.1	1732
4320 min Summer	1.556	0.0	406.0	2508
5760 min Summer	1.236	0.0	462.1	3232
7200 min Summer	1.034	0.0	480.1	3968

Cascade Summary of Results for north block 30.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.090	0.090	0.0	2.7	2.7	166.3	O K
10080 min Summer	1.086	0.086	0.0	2.5	2.5	158.2	O K
15 min Winter	1.066	0.066	0.0	1.6	1.6	120.5	O K
30 min Winter	1.084	0.084	0.0	2.4	2.4	155.1	O K
60 min Winter	1.103	0.103	0.0	3.3	3.3	189.4	O K
120 min Winter	1.120	0.120	0.0	4.0	4.0	221.2	O K
180 min Winter	1.129	0.129	0.0	4.2	4.2	237.0	O K
240 min Winter	1.134	0.134	0.0	4.4	4.4	246.0	O K
360 min Winter	1.138	0.138	0.0	4.5	4.5	254.7	O K
480 min Winter	1.140	0.140	0.0	4.5	4.5	257.5	O K
600 min Winter	1.141	0.141	0.0	4.5	4.5	258.6	O K
720 min Winter	1.141	0.141	0.0	4.5	4.5	259.6	O K
960 min Winter	1.141	0.141	0.0	4.5	4.5	258.8	O K
1440 min Winter	1.137	0.137	0.0	4.4	4.4	251.7	O K
2160 min Winter	1.129	0.129	0.0	4.2	4.2	236.8	O K
2880 min Winter	1.121	0.121	0.0	4.0	4.0	221.9	O K
4320 min Winter	1.108	0.108	0.0	3.5	3.5	198.6	O K
5760 min Winter	1.098	0.098	0.0	3.1	3.1	180.7	O K
7200 min Winter	1.091	0.091	0.0	2.7	2.7	166.7	O K
8640 min Winter	1.085	0.085	0.0	2.4	2.4	155.5	O K
10080 min Winter	1.080	0.080	0.0	2.2	2.2	146.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.893	0.0	493.4	4752
10080 min Summer	0.789	0.0	500.9	5448
15 min Winter	107.516	0.0	68.4	23
30 min Winter	69.655	0.0	96.7	37
60 min Winter	43.136	0.0	156.1	66
120 min Winter	25.931	0.0	193.0	122
180 min Winter	19.056	0.0	215.3	180
240 min Winter	15.250	0.0	231.2	236
360 min Winter	11.110	0.0	254.5	348
480 min Winter	8.872	0.0	271.8	450
600 min Winter	7.447	0.0	285.5	482
720 min Winter	6.452	0.0	296.7	556
960 min Winter	5.143	0.0	314.3	708
1440 min Winter	3.731	0.0	337.2	1008
2160 min Winter	2.705	0.0	409.8	1428
2880 min Winter	2.151	0.0	432.3	1820
4320 min Winter	1.556	0.0	458.7	2600
5760 min Winter	1.236	0.0	519.3	3392
7200 min Winter	1.034	0.0	540.0	4112
8640 min Winter	0.893	0.0	555.3	4848
10080 min Winter	0.789	0.0	564.5	5648

Cascade Rainfall Details for north block 30.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.538

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.269	4	8	0.269

Cascade Model Details for north block 30.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	1936.0	1936.0	0.401	0.0	2006.4
0.400	1936.0	2006.4			

Orifice Outflow Control

Diameter (m) 0.083 Discharge Coefficient 0.600 Invert Level (m) 1.000

Cascade Summary of Results for south block 30.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external 30.SRCX	(None)

Half Drain Time : 559 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.063	0.063	0.0	1.1	1.1	54.0	O K
30 min Summer	1.081	0.081	0.0	1.6	1.6	69.2	O K
60 min Summer	1.098	0.098	0.0	1.8	1.8	84.2	O K
120 min Summer	1.114	0.114	0.0	2.1	2.1	97.8	O K
180 min Summer	1.122	0.122	0.0	2.1	2.1	104.2	O K
240 min Summer	1.126	0.126	0.0	2.2	2.2	107.6	O K
360 min Summer	1.129	0.129	0.0	2.2	2.2	110.1	O K
480 min Summer	1.130	0.130	0.0	2.2	2.2	111.4	O K
600 min Summer	1.131	0.131	0.0	2.2	2.2	112.1	O K
720 min Summer	1.132	0.132	0.0	2.3	2.3	112.5	O K
960 min Summer	1.131	0.131	0.0	2.2	2.2	112.4	O K
1440 min Summer	1.129	0.129	0.0	2.2	2.2	109.9	O K
2160 min Summer	1.122	0.122	0.0	2.1	2.1	104.1	O K
2880 min Summer	1.114	0.114	0.0	2.1	2.1	97.8	O K
4320 min Summer	1.101	0.101	0.0	1.9	1.9	86.6	O K
5760 min Summer	1.091	0.091	0.0	1.7	1.7	77.7	O K
7200 min Summer	1.083	0.083	0.0	1.6	1.6	71.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.516	0.0	37.4	23
30 min Summer	69.655	0.0	51.5	37
60 min Summer	43.136	0.0	76.5	66
120 min Summer	25.931	0.0	93.5	124
180 min Summer	19.056	0.0	103.8	184
240 min Summer	15.250	0.0	111.2	242
360 min Summer	11.110	0.0	122.0	340
480 min Summer	8.872	0.0	130.1	392
600 min Summer	7.447	0.0	136.6	452
720 min Summer	6.452	0.0	141.9	518
960 min Summer	5.143	0.0	150.5	654
1440 min Summer	3.731	0.0	162.0	926
2160 min Summer	2.705	0.0	189.7	1324
2880 min Summer	2.151	0.0	200.5	1728
4320 min Summer	1.556	0.0	214.2	2468
5760 min Summer	1.236	0.0	236.8	3224
7200 min Summer	1.034	0.0	246.5	3896

Cascade Summary of Results for south block 30.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.078	0.078	0.0	1.5	1.5	66.4	O K
10080 min Summer	1.073	0.073	0.0	1.4	1.4	62.5	O K
15 min Winter	1.071	0.071	0.0	1.3	1.3	60.4	O K
30 min Winter	1.091	0.091	0.0	1.7	1.7	77.5	O K
60 min Winter	1.110	0.110	0.0	2.0	2.0	94.4	O K
120 min Winter	1.129	0.129	0.0	2.2	2.2	109.9	O K
180 min Winter	1.137	0.137	0.0	2.3	2.3	117.4	O K
240 min Winter	1.142	0.142	0.0	2.4	2.4	121.4	O K
360 min Winter	1.146	0.146	0.0	2.4	2.4	124.8	O K
480 min Winter	1.147	0.147	0.0	2.4	2.4	125.3	O K
600 min Winter	1.147	0.147	0.0	2.4	2.4	125.6	O K
720 min Winter	1.147	0.147	0.0	2.4	2.4	125.5	O K
960 min Winter	1.145	0.145	0.0	2.4	2.4	123.9	O K
1440 min Winter	1.138	0.138	0.0	2.3	2.3	118.2	O K
2160 min Winter	1.127	0.127	0.0	2.2	2.2	108.2	O K
2880 min Winter	1.115	0.115	0.0	2.1	2.1	98.6	O K
4320 min Winter	1.097	0.097	0.0	1.8	1.8	82.9	O K
5760 min Winter	1.084	0.084	0.0	1.7	1.7	71.9	O K
7200 min Winter	1.076	0.076	0.0	1.5	1.5	65.1	O K
8640 min Winter	1.070	0.070	0.0	1.3	1.3	60.0	O K
10080 min Winter	1.065	0.065	0.0	1.2	1.2	56.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.893	0.0	254.0	4664
10080 min Summer	0.789	0.0	259.0	5352
15 min Winter	107.516	0.0	43.1	22
30 min Winter	69.655	0.0	59.0	36
60 min Winter	43.136	0.0	86.7	66
120 min Winter	25.931	0.0	105.8	122
180 min Winter	19.056	0.0	117.3	180
240 min Winter	15.250	0.0	125.6	236
360 min Winter	11.110	0.0	137.7	346
480 min Winter	8.872	0.0	146.8	442
600 min Winter	7.447	0.0	154.1	474
720 min Winter	6.452	0.0	160.1	550
960 min Winter	5.143	0.0	169.6	704
1440 min Winter	3.731	0.0	182.6	998
2160 min Winter	2.705	0.0	213.3	1424
2880 min Winter	2.151	0.0	225.5	1820
4320 min Winter	1.556	0.0	241.2	2592
5760 min Winter	1.236	0.0	265.7	3288
7200 min Winter	1.034	0.0	276.8	4032
8640 min Winter	0.893	0.0	285.4	4752
10080 min Winter	0.789	0.0	291.4	5544

Cascade Rainfall Details for south block 30.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.271

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.135	4	8	0.136

Cascade Model Details for south block 30.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	900.0	900.0	0.401	0.0	948.0
0.400	900.0	948.0			

Orifice Outflow Control

Diameter (m) 0.058 Discharge Coefficient 0.600 Invert Level (m) 1.000

Cascade Summary of Results for external.SRCX

Upstream Structures	Outflow To	Overflow To
north block.SRCX south block.SRCX	(None)	(None)

Half Drain Time : 123 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.418	0.418	0.0	5.1	5.1	79.5	O K
30 min Summer	1.526	0.526	0.0	11.7	11.7	100.0	O K
60 min Summer	1.618	0.618	0.0	13.3	13.3	117.4	O K
120 min Summer	1.671	0.671	0.0	14.4	14.4	127.5	O K
180 min Summer	1.681	0.681	0.0	14.5	14.5	129.4	O K
240 min Summer	1.682	0.682	0.0	14.6	14.6	129.6	O K
360 min Summer	1.677	0.677	0.0	14.5	14.5	128.7	O K
480 min Summer	1.669	0.669	0.0	14.3	14.3	127.0	O K
600 min Summer	1.659	0.659	0.0	14.1	14.1	125.2	O K
720 min Summer	1.649	0.649	0.0	13.9	13.9	123.2	O K
960 min Summer	1.629	0.629	0.0	13.6	13.6	119.4	O K
1440 min Summer	1.592	0.592	0.0	12.8	12.8	112.4	O K
2160 min Summer	1.542	0.542	0.0	12.5	12.5	102.9	O K
2880 min Summer	1.522	0.522	0.0	11.5	11.5	99.2	O K
4320 min Summer	1.498	0.498	0.0	10.0	10.0	94.6	O K
5760 min Summer	1.483	0.483	0.0	8.9	8.9	91.7	O K
7200 min Summer	1.470	0.470	0.0	7.9	7.9	89.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.587	0.0	210.5	23
30 min Summer	91.185	0.0	288.9	35
60 min Summer	56.713	0.0	419.7	64
120 min Summer	34.079	0.0	511.9	120
180 min Summer	24.967	0.0	566.0	148
240 min Summer	19.906	0.0	603.5	180
360 min Summer	14.417	0.0	657.6	248
480 min Summer	11.468	0.0	698.2	318
600 min Summer	9.596	0.0	730.3	386
720 min Summer	8.292	0.0	756.7	456
960 min Summer	6.581	0.0	798.3	590
1440 min Summer	4.744	0.0	853.8	854
2160 min Summer	3.415	0.0	990.6	1196
2880 min Summer	2.702	0.0	1041.5	1584
4320 min Summer	1.940	0.0	1105.2	2336
5760 min Summer	1.532	0.0	1212.5	3112
7200 min Summer	1.275	0.0	1257.0	3888

Cascade Summary of Results for external.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.459	0.459	0.0	7.2	7.2	87.1	O K
10080 min Summer	1.447	0.447	0.0	6.4	6.4	85.0	O K
15 min Winter	1.467	0.467	0.0	7.8	7.8	88.8	O K
30 min Winter	1.589	0.589	0.0	12.7	12.7	111.8	O K
60 min Winter	1.696	0.696	0.0	14.8	14.8	132.3	O K
120 min Winter	1.762	0.762	0.0	15.9	15.9	144.7	O K
180 min Winter	1.770	0.770	0.0	16.1	16.1	146.3	O K
240 min Winter	1.771	0.771	0.0	16.1	16.1	146.4	O K
360 min Winter	1.758	0.758	0.0	15.9	15.9	144.0	O K
480 min Winter	1.740	0.740	0.0	15.6	15.6	140.6	O K
600 min Winter	1.721	0.721	0.0	15.2	15.2	137.0	O K
720 min Winter	1.702	0.702	0.0	14.9	14.9	133.4	O K
960 min Winter	1.668	0.668	0.0	14.3	14.3	126.9	O K
1440 min Winter	1.610	0.610	0.0	13.2	13.2	115.9	O K
2160 min Winter	1.537	0.537	0.0	12.3	12.3	102.1	O K
2880 min Winter	1.515	0.515	0.0	11.1	11.1	97.8	O K
4320 min Winter	1.490	0.490	0.0	9.4	9.4	93.0	O K
5760 min Winter	1.473	0.473	0.0	8.2	8.2	89.9	O K
7200 min Winter	1.459	0.459	0.0	7.2	7.2	87.2	O K
8640 min Winter	1.446	0.446	0.0	6.4	6.4	84.7	O K
10080 min Winter	1.427	0.427	0.0	5.4	5.4	81.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.097	0.0	1290.8	4672
10080 min Summer	0.966	0.0	1313.1	5528
15 min Winter	139.587	0.0	241.1	22
30 min Winter	91.185	0.0	329.6	35
60 min Winter	56.713	0.0	474.9	62
120 min Winter	34.079	0.0	578.3	118
180 min Winter	24.967	0.0	638.9	150
240 min Winter	19.906	0.0	681.0	188
360 min Winter	14.417	0.0	741.6	264
480 min Winter	11.468	0.0	787.1	340
600 min Winter	9.596	0.0	823.0	414
720 min Winter	8.292	0.0	852.6	488
960 min Winter	6.581	0.0	899.3	630
1440 min Winter	4.744	0.0	961.1	908
2160 min Winter	3.415	0.0	1113.4	1236
2880 min Winter	2.702	0.0	1170.9	1616
4320 min Winter	1.940	0.0	1243.9	2380
5760 min Winter	1.532	0.0	1360.5	3224
7200 min Winter	1.275	0.0	1411.1	3960
8640 min Winter	1.097	0.0	1450.0	4840
10080 min Winter	0.966	0.0	1476.4	5864

Cascade Rainfall Details for external.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.156	4	8	0.156

Cascade Model Details for external.SRCX

Storage is Online Cover Level (m) 5.000

Cellular Storage Structure

Invert Level (m) 1.000 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	200.0	200.0	1.201	0.0	272.0
1.200	200.0	272.0			

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0111-4800-0400-4800
Design Head (m)	0.400
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	1.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	4.8
Flush-Flo™	0.167	4.8
Kick-Flo®	0.311	4.3
Mean Flow over Head Range	-	3.8

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	3.9	1.200	8.0	3.000	12.4	7.000	18.7
0.200	4.8	1.400	8.6	3.500	13.3	7.500	19.4
0.300	4.4	1.600	9.2	4.000	14.2	8.000	20.0
0.400	4.8	1.800	9.7	4.500	15.0	8.500	20.6
0.500	5.3	2.000	10.2	5.000	15.8	9.000	21.2
0.600	5.8	2.200	10.7	5.500	16.6	9.500	21.8
0.800	6.6	2.400	11.1	6.000	17.3		
1.000	7.4	2.600	11.5	6.500	18.0		

Hydro-Brake® Optimum

Unit Reference	MD-SCU-0123-1200-0600-1200
Design Head (m)	0.600
Design Flow (l/s)	12.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	123
Invert Level (m)	1.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	12.0
Flush-Flo™	0.154	7.0
Kick-Flo®	0.184	6.9
Mean Flow over Head Range	-	8.0

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	4.8	1.200	16.7	3.000	25.9	7.000	38.9
0.200	7.2	1.400	17.9	3.500	27.9	7.500	40.2
0.300	8.7	1.600	19.1	4.000	29.7	8.000	41.6
0.400	9.9	1.800	20.2	4.500	31.4	8.500	42.9
0.500	11.0	2.000	21.3	5.000	33.1	9.000	44.1
0.600	12.0	2.200	22.3	5.500	34.6	9.500	45.3
0.800	13.7	2.400	23.2	6.000	36.1		
1.000	15.3	2.600	24.1	6.500	37.4		

Cascade Summary of Results for north block.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external.SRCX	(None)

Half Drain Time : 699 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.076	0.076	0.0	2.0	2.0	139.6	O K
30 min Summer	1.098	0.098	0.0	3.1	3.1	181.0	O K
60 min Summer	1.120	0.120	0.0	4.0	4.0	221.6	O K
120 min Summer	1.141	0.141	0.0	4.5	4.5	258.6	O K
180 min Summer	1.150	0.150	0.0	4.7	4.7	276.4	O K
240 min Summer	1.155	0.155	0.0	4.8	4.8	285.8	O K
360 min Summer	1.160	0.160	0.0	4.9	4.9	293.8	O K
480 min Summer	1.161	0.161	0.0	5.0	5.0	296.3	O K
600 min Summer	1.162	0.162	0.0	5.0	5.0	298.1	O K
720 min Summer	1.163	0.163	0.0	5.0	5.0	299.0	O K
960 min Summer	1.163	0.163	0.0	5.0	5.0	299.3	O K
1440 min Summer	1.160	0.160	0.0	5.0	5.0	294.7	O K
2160 min Summer	1.154	0.154	0.0	4.8	4.8	282.6	O K
2880 min Summer	1.146	0.146	0.0	4.7	4.7	268.8	O K
4320 min Summer	1.132	0.132	0.0	4.3	4.3	242.6	O K
5760 min Summer	1.120	0.120	0.0	4.0	4.0	221.4	O K
7200 min Summer	1.112	0.112	0.0	3.7	3.7	205.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.587	0.0	83.6	23
30 min Summer	91.185	0.0	118.6	37
60 min Summer	56.713	0.0	188.2	66
120 min Summer	34.079	0.0	231.6	126
180 min Summer	24.967	0.0	256.9	184
240 min Summer	19.906	0.0	274.5	242
360 min Summer	14.417	0.0	299.7	360
480 min Summer	11.468	0.0	318.5	420
600 min Summer	9.596	0.0	333.1	480
720 min Summer	8.292	0.0	345.1	540
960 min Summer	6.581	0.0	363.6	672
1440 min Summer	4.744	0.0	387.2	942
2160 min Summer	3.415	0.0	465.0	1344
2880 min Summer	2.702	0.0	488.1	1736
4320 min Summer	1.940	0.0	514.3	2508
5760 min Summer	1.532	0.0	576.0	3232
7200 min Summer	1.275	0.0	596.2	3968

Cascade Summary of Results for north block.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.105	0.105	0.0	3.4	3.4	193.1	O K
10080 min Summer	1.099	0.099	0.0	3.1	3.1	182.7	O K
15 min Winter	1.085	0.085	0.0	2.4	2.4	156.2	O K
30 min Winter	1.110	0.110	0.0	3.6	3.6	202.6	O K
60 min Winter	1.135	0.135	0.0	4.4	4.4	248.3	O K
120 min Winter	1.158	0.158	0.0	4.9	4.9	290.5	O K
180 min Winter	1.169	0.169	0.0	5.1	5.1	310.9	O K
240 min Winter	1.175	0.175	0.0	5.3	5.3	322.0	O K
360 min Winter	1.181	0.181	0.0	5.4	5.4	332.2	O K
480 min Winter	1.182	0.182	0.0	5.4	5.4	335.2	O K
600 min Winter	1.182	0.182	0.0	5.4	5.4	334.6	O K
720 min Winter	1.182	0.182	0.0	5.4	5.4	334.7	O K
960 min Winter	1.181	0.181	0.0	5.4	5.4	332.2	O K
1440 min Winter	1.174	0.174	0.0	5.2	5.2	320.7	O K
2160 min Winter	1.162	0.162	0.0	5.0	5.0	298.3	O K
2880 min Winter	1.150	0.150	0.0	4.7	4.7	276.0	O K
4320 min Winter	1.130	0.130	0.0	4.3	4.3	238.3	O K
5760 min Winter	1.115	0.115	0.0	3.8	3.8	211.8	O K
7200 min Winter	1.105	0.105	0.0	3.4	3.4	193.5	O K
8640 min Winter	1.097	0.097	0.0	3.0	3.0	179.0	O K
10080 min Winter	1.091	0.091	0.0	2.7	2.7	167.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.097	0.0	610.7	4752
10080 min Summer	0.966	0.0	618.6	5448
15 min Winter	139.587	0.0	97.2	23
30 min Winter	91.185	0.0	137.1	37
60 min Winter	56.713	0.0	214.2	66
120 min Winter	34.079	0.0	262.9	122
180 min Winter	24.967	0.0	291.4	180
240 min Winter	19.906	0.0	311.1	238
360 min Winter	14.417	0.0	339.3	350
480 min Winter	11.468	0.0	360.3	456
600 min Winter	9.596	0.0	376.8	506
720 min Winter	8.292	0.0	390.2	568
960 min Winter	6.581	0.0	411.0	720
1440 min Winter	4.744	0.0	437.4	1022
2160 min Winter	3.415	0.0	523.7	1452
2880 min Winter	2.702	0.0	549.9	1852
4320 min Winter	1.940	0.0	580.4	2636
5760 min Winter	1.532	0.0	647.0	3352
7200 min Winter	1.275	0.0	670.1	4112
8640 min Winter	1.097	0.0	687.0	4848
10080 min Winter	0.966	0.0	696.8	5584

Cascade Rainfall Details for north block.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.538

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.269	4	8	0.269

Cascade Model Details for north block.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	1936.0	1936.0	0.401	0.0	2006.4
0.400	1936.0	2006.4			

Orifice Outflow Control

Diameter (m) 0.083 Discharge Coefficient 0.600 Invert Level (m) 1.000

Cascade Summary of Results for south block.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external.SRCX	(None)

Half Drain Time : 596 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.082	0.082	0.0	1.6	1.6	69.9	O K
30 min Summer	1.106	0.106	0.0	1.9	1.9	90.6	O K
60 min Summer	1.130	0.130	0.0	2.2	2.2	110.8	O K
120 min Summer	1.151	0.151	0.0	2.5	2.5	129.0	O K
180 min Summer	1.161	0.161	0.0	2.5	2.5	137.5	O K
240 min Summer	1.166	0.166	0.0	2.6	2.6	141.7	O K
360 min Summer	1.169	0.169	0.0	2.6	2.6	144.7	O K
480 min Summer	1.170	0.170	0.0	2.6	2.6	145.6	O K
600 min Summer	1.171	0.171	0.0	2.6	2.6	146.0	O K
720 min Summer	1.171	0.171	0.0	2.6	2.6	145.9	O K
960 min Summer	1.170	0.170	0.0	2.6	2.6	145.0	O K
1440 min Summer	1.165	0.165	0.0	2.6	2.6	140.9	O K
2160 min Summer	1.155	0.155	0.0	2.5	2.5	132.6	O K
2880 min Summer	1.145	0.145	0.0	2.4	2.4	123.9	O K
4320 min Summer	1.127	0.127	0.0	2.2	2.2	108.3	O K
5760 min Summer	1.112	0.112	0.0	2.0	2.0	95.9	O K
7200 min Summer	1.101	0.101	0.0	1.9	1.9	86.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.587	0.0	51.7	23
30 min Summer	91.185	0.0	70.9	37
60 min Summer	56.713	0.0	103.2	66
120 min Summer	34.079	0.0	125.6	124
180 min Summer	24.967	0.0	138.7	184
240 min Summer	19.906	0.0	147.8	242
360 min Summer	14.417	0.0	160.9	360
480 min Summer	11.468	0.0	170.8	410
600 min Summer	9.596	0.0	178.5	470
720 min Summer	8.292	0.0	184.9	532
960 min Summer	6.581	0.0	195.0	664
1440 min Summer	4.744	0.0	208.3	938
2160 min Summer	3.415	0.0	241.2	1344
2880 min Summer	2.702	0.0	253.7	1732
4320 min Summer	1.940	0.0	269.4	2508
5760 min Summer	1.532	0.0	294.3	3232
7200 min Summer	1.275	0.0	305.1	3968

Cascade Summary of Results for south block.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.092	0.092	0.0	1.8	1.8	78.7	O K
10080 min Summer	1.085	0.085	0.0	1.7	1.7	72.7	O K
15 min Winter	1.092	0.092	0.0	1.8	1.8	78.3	O K
30 min Winter	1.119	0.119	0.0	2.1	2.1	101.5	O K
60 min Winter	1.145	0.145	0.0	2.4	2.4	124.3	O K
120 min Winter	1.170	0.170	0.0	2.6	2.6	145.1	O K
180 min Winter	1.181	0.181	0.0	2.7	2.7	154.8	O K
240 min Winter	1.187	0.187	0.0	2.8	2.8	159.8	O K
360 min Winter	1.192	0.192	0.0	2.8	2.8	164.0	O K
480 min Winter	1.193	0.193	0.0	2.8	2.8	164.6	O K
600 min Winter	1.192	0.192	0.0	2.8	2.8	163.9	O K
720 min Winter	1.191	0.191	0.0	2.8	2.8	163.4	O K
960 min Winter	1.188	0.188	0.0	2.8	2.8	160.9	O K
1440 min Winter	1.179	0.179	0.0	2.7	2.7	153.0	O K
2160 min Winter	1.163	0.163	0.0	2.6	2.6	139.3	O K
2880 min Winter	1.148	0.148	0.0	2.4	2.4	126.3	O K
4320 min Winter	1.123	0.123	0.0	2.1	2.1	104.8	O K
5760 min Winter	1.104	0.104	0.0	1.9	1.9	88.8	O K
7200 min Winter	1.090	0.090	0.0	1.7	1.7	77.2	O K
8640 min Winter	1.081	0.081	0.0	1.6	1.6	69.5	O K
10080 min Winter	1.075	0.075	0.0	1.4	1.4	64.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.097	0.0	313.4	4672
10080 min Summer	0.966	0.0	318.7	5352
15 min Winter	139.587	0.0	59.3	22
30 min Winter	91.185	0.0	80.8	37
60 min Winter	56.713	0.0	116.6	66
120 min Winter	34.079	0.0	141.7	122
180 min Winter	24.967	0.0	156.3	180
240 min Winter	19.906	0.0	166.5	238
360 min Winter	14.417	0.0	181.3	348
480 min Winter	11.468	0.0	192.3	452
600 min Winter	9.596	0.0	201.0	490
720 min Winter	8.292	0.0	208.2	562
960 min Winter	6.581	0.0	219.4	714
1440 min Winter	4.744	0.0	234.2	1014
2160 min Winter	3.415	0.0	270.9	1448
2880 min Winter	2.702	0.0	285.0	1848
4320 min Winter	1.940	0.0	303.1	2636
5760 min Winter	1.532	0.0	330.1	3352
7200 min Winter	1.275	0.0	342.4	4104
8640 min Winter	1.097	0.0	351.9	4752
10080 min Winter	0.966	0.0	358.4	5456

Cascade Rainfall Details for south block.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.271

Time From: (mins)	To:	Area (ha)	Time From: (mins)	To:	Area (ha)
0	4	0.135	4	8	0.136

Cascade Model Details for south block.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	900.0	900.0	0.401	0.0	948.0
0.400	900.0	948.0			

Orifice Outflow Control

Diameter (m) 0.058 Discharge Coefficient 0.600 Invert Level (m) 1.000

Cascade Summary of Results for external.SRCX

Upstream Structures	Outflow To	Overflow To
south block 50%green.SRCX north 50%green.SRCX	(None)	(None)

Half Drain Time : 118 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.412	0.412	0.0	5.0	5.0	78.2	O K
30 min Summer	1.513	0.513	0.0	11.0	11.0	97.6	O K
60 min Summer	1.586	0.586	0.0	12.7	12.7	111.4	O K
120 min Summer	1.620	0.620	0.0	13.4	13.4	117.8	O K
180 min Summer	1.625	0.625	0.0	13.5	13.5	118.7	O K
240 min Summer	1.619	0.619	0.0	13.4	13.4	117.6	O K
360 min Summer	1.598	0.598	0.0	12.9	12.9	113.6	O K
480 min Summer	1.575	0.575	0.0	12.6	12.6	109.2	O K
600 min Summer	1.554	0.554	0.0	12.6	12.6	105.2	O K
720 min Summer	1.538	0.538	0.0	12.3	12.3	102.2	O K
960 min Summer	1.517	0.517	0.0	11.2	11.2	98.2	O K
1440 min Summer	1.491	0.491	0.0	9.5	9.5	93.3	O K
2160 min Summer	1.469	0.469	0.0	7.9	7.9	89.1	O K
2880 min Summer	1.454	0.454	0.0	6.9	6.9	86.3	O K
4320 min Summer	1.429	0.429	0.0	5.5	5.5	81.5	O K
5760 min Summer	1.369	0.369	0.0	4.8	4.8	70.2	O K
7200 min Summer	1.226	0.226	0.0	4.8	4.8	42.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.587	0.0	125.0	22
30 min Summer	91.185	0.0	171.1	34
60 min Summer	56.713	0.0	250.8	62
120 min Summer	34.079	0.0	310.0	98
180 min Summer	24.967	0.0	360.9	130
240 min Summer	19.906	0.0	396.0	164
360 min Summer	14.417	0.0	445.6	234
480 min Summer	11.468	0.0	482.1	302
600 min Summer	9.596	0.0	510.4	366
720 min Summer	8.292	0.0	533.3	432
960 min Summer	6.581	0.0	568.1	568
1440 min Summer	4.744	0.0	609.8	840
2160 min Summer	3.415	0.0	756.4	1260
2880 min Summer	2.702	0.0	797.8	1704
4320 min Summer	1.940	0.0	840.1	2640
5760 min Summer	1.532	0.0	955.1	3632
7200 min Summer	1.275	0.0	987.2	4320

Cascade Summary of Results for external.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.147	0.147	0.0	4.8	4.8	28.0	O K
10080 min Summer	1.119	0.119	0.0	4.6	4.6	22.7	O K
15 min Winter	1.460	0.460	0.0	7.2	7.2	87.4	O K
30 min Winter	1.573	0.573	0.0	12.6	12.6	108.8	O K
60 min Winter	1.663	0.663	0.0	14.2	14.2	125.9	O K
120 min Winter	1.700	0.700	0.0	14.9	14.9	133.0	O K
180 min Winter	1.702	0.702	0.0	14.9	14.9	133.4	O K
240 min Winter	1.690	0.690	0.0	14.7	14.7	131.1	O K
360 min Winter	1.656	0.656	0.0	14.1	14.1	124.7	O K
480 min Winter	1.623	0.623	0.0	13.4	13.4	118.4	O K
600 min Winter	1.593	0.593	0.0	12.8	12.8	112.6	O K
720 min Winter	1.563	0.563	0.0	12.6	12.6	107.0	O K
960 min Winter	1.530	0.530	0.0	11.9	11.9	100.6	O K
1440 min Winter	1.499	0.499	0.0	10.1	10.1	94.7	O K
2160 min Winter	1.475	0.475	0.0	8.3	8.3	90.3	O K
2880 min Winter	1.461	0.461	0.0	7.3	7.3	87.5	O K
4320 min Winter	1.438	0.438	0.0	5.9	5.9	83.3	O K
5760 min Winter	1.398	0.398	0.0	4.8	4.8	75.6	O K
7200 min Winter	1.219	0.219	0.0	4.8	4.8	41.7	O K
8640 min Winter	1.129	0.129	0.0	4.7	4.7	24.6	O K
10080 min Winter	1.114	0.114	0.0	4.4	4.4	21.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.097	0.0	1008.6	4848
10080 min Summer	0.966	0.0	1019.2	5448
15 min Winter	139.587	0.0	143.1	21
30 min Winter	91.185	0.0	195.0	34
60 min Winter	56.713	0.0	284.8	60
120 min Winter	34.079	0.0	373.1	100
180 min Winter	24.967	0.0	429.7	138
240 min Winter	19.906	0.0	468.4	176
360 min Winter	14.417	0.0	523.4	252
480 min Winter	11.468	0.0	563.9	324
600 min Winter	9.596	0.0	595.2	396
720 min Winter	8.292	0.0	620.3	462
960 min Winter	6.581	0.0	657.7	590
1440 min Winter	4.744	0.0	700.2	870
2160 min Winter	3.415	0.0	875.5	1320
2880 min Winter	2.702	0.0	921.5	1764
4320 min Winter	1.940	0.0	968.1	2768
5760 min Winter	1.532	0.0	1102.9	3912
7200 min Winter	1.275	0.0	1141.1	4608
8640 min Winter	1.097	0.0	1167.4	5096
10080 min Winter	0.966	0.0	1181.8	5648

Cascade Rainfall Details for external.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.156	4	8	0.156

Cascade Model Details for external.SRCX

Storage is Online Cover Level (m) 5.000

Cellular Storage Structure

Invert Level (m) 1.000 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	200.0	200.0	1.201	0.0	272.0
1.200	200.0	272.0			

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0111-4800-0400-4800
Design Head (m)	0.400
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	1.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	4.8
Flush-Flo™	0.167	4.8
Kick-Flo®	0.311	4.3
Mean Flow over Head Range	-	3.8

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	3.9	1.200	8.0	3.000	12.4	7.000	18.7
0.200	4.8	1.400	8.6	3.500	13.3	7.500	19.4
0.300	4.4	1.600	9.2	4.000	14.2	8.000	20.0
0.400	4.8	1.800	9.7	4.500	15.0	8.500	20.6
0.500	5.3	2.000	10.2	5.000	15.8	9.000	21.2
0.600	5.8	2.200	10.7	5.500	16.6	9.500	21.8
0.800	6.6	2.400	11.1	6.000	17.3		
1.000	7.4	2.600	11.5	6.500	18.0		

Hydro-Brake® Optimum

Unit Reference	MD-SCU-0123-1200-0600-1200
Design Head (m)	0.600
Design Flow (l/s)	12.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	123
Invert Level (m)	1.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	12.0
Flush-Flo™	0.154	7.0
Kick-Flo®	0.184	6.9
Mean Flow over Head Range	-	8.0

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	4.8	1.200	16.7	3.000	25.9	7.000	38.9
0.200	7.2	1.400	17.9	3.500	27.9	7.500	40.2
0.300	8.7	1.600	19.1	4.000	29.7	8.000	41.6
0.400	9.9	1.800	20.2	4.500	31.4	8.500	42.9
0.500	11.0	2.000	21.3	5.000	33.1	9.000	44.1
0.600	12.0	2.200	22.3	5.500	34.6	9.500	45.3
0.800	13.7	2.400	23.2	6.000	36.1		
1.000	15.3	2.600	24.1	6.500	37.4		

Cascade Summary of Results for south block 50%green.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external.SRCX	(None)

Half Drain Time : 551 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.041	0.041	0.0	0.6	0.6	35.1	O K
30 min Summer	1.053	0.053	0.0	0.8	0.8	45.4	O K
60 min Summer	1.065	0.065	0.0	1.1	1.1	55.5	O K
120 min Summer	1.075	0.075	0.0	1.4	1.4	64.3	O K
180 min Summer	1.085	0.085	0.0	1.7	1.7	72.9	O K
240 min Summer	1.093	0.093	0.0	1.8	1.8	79.5	O K
360 min Summer	1.101	0.101	0.0	1.9	1.9	86.5	O K
480 min Summer	1.105	0.105	0.0	1.9	1.9	89.5	O K
600 min Summer	1.106	0.106	0.0	1.9	1.9	90.6	O K
720 min Summer	1.107	0.107	0.0	2.0	2.0	91.4	O K
960 min Summer	1.108	0.108	0.0	2.0	2.0	92.5	O K
1440 min Summer	1.109	0.109	0.0	2.0	2.0	92.9	O K
2160 min Summer	1.106	0.106	0.0	2.0	2.0	90.8	O K
2880 min Summer	1.102	0.102	0.0	1.9	1.9	87.5	O K
4320 min Summer	1.094	0.094	0.0	1.8	1.8	80.0	O K
5760 min Summer	1.086	0.086	0.0	1.7	1.7	73.4	O K
7200 min Summer	1.080	0.080	0.0	1.5	1.5	68.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.587	0.0	21.0	19
30 min Summer	91.185	0.0	30.0	34
60 min Summer	56.713	0.0	47.3	64
120 min Summer	34.079	0.0	59.2	122
180 min Summer	24.967	0.0	72.2	192
240 min Summer	19.906	0.0	81.1	244
360 min Summer	14.417	0.0	94.0	362
480 min Summer	11.468	0.0	103.6	480
600 min Summer	9.596	0.0	111.2	556
720 min Summer	8.292	0.0	117.4	608
960 min Summer	6.581	0.0	127.0	724
1440 min Summer	4.744	0.0	139.7	990
2160 min Summer	3.415	0.0	167.4	1396
2880 min Summer	2.702	0.0	177.9	1800
4320 min Summer	1.940	0.0	189.7	2592
5760 min Summer	1.532	0.0	210.0	3344
7200 min Summer	1.275	0.0	216.8	4112

Cascade Summary of Results for south block 50%green.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.075	0.075	0.0	1.4	1.4	64.0	O K
10080 min Summer	1.071	0.071	0.0	1.3	1.3	60.4	O K
15 min Winter	1.046	0.046	0.0	0.6	0.6	39.3	O K
30 min Winter	1.059	0.059	0.0	1.0	1.0	50.9	O K
60 min Winter	1.073	0.073	0.0	1.4	1.4	62.1	O K
120 min Winter	1.090	0.090	0.0	1.7	1.7	77.0	O K
180 min Winter	1.105	0.105	0.0	1.9	1.9	89.6	O K
240 min Winter	1.114	0.114	0.0	2.0	2.0	97.1	O K
360 min Winter	1.123	0.123	0.0	2.2	2.2	105.2	O K
480 min Winter	1.128	0.128	0.0	2.2	2.2	109.0	O K
600 min Winter	1.129	0.129	0.0	2.2	2.2	110.5	O K
720 min Winter	1.129	0.129	0.0	2.2	2.2	110.6	O K
960 min Winter	1.130	0.130	0.0	2.2	2.2	111.1	O K
1440 min Winter	1.128	0.128	0.0	2.2	2.2	109.5	O K
2160 min Winter	1.121	0.121	0.0	2.1	2.1	103.6	O K
2880 min Winter	1.113	0.113	0.0	2.0	2.0	96.8	O K
4320 min Winter	1.099	0.099	0.0	1.9	1.9	84.3	O K
5760 min Winter	1.087	0.087	0.0	1.7	1.7	74.4	O K
7200 min Winter	1.079	0.079	0.0	1.5	1.5	67.7	O K
8640 min Winter	1.073	0.073	0.0	1.4	1.4	62.6	O K
10080 min Winter	1.068	0.068	0.0	1.2	1.2	58.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.097	0.0	221.1	4848
10080 min Summer	0.966	0.0	222.9	5640
15 min Winter	139.587	0.0	24.5	19
30 min Winter	91.185	0.0	34.8	33
60 min Winter	56.713	0.0	53.9	62
120 min Winter	34.079	0.0	75.3	146
180 min Winter	24.967	0.0	89.8	190
240 min Winter	19.906	0.0	99.9	242
360 min Winter	14.417	0.0	114.4	356
480 min Winter	11.468	0.0	125.2	466
600 min Winter	9.596	0.0	133.7	572
720 min Winter	8.292	0.0	140.7	662
960 min Winter	6.581	0.0	151.6	754
1440 min Winter	4.744	0.0	165.8	1054
2160 min Winter	3.415	0.0	197.2	1496
2880 min Winter	2.702	0.0	209.3	1924
4320 min Winter	1.940	0.0	223.5	2724
5760 min Winter	1.532	0.0	246.1	3480
7200 min Winter	1.275	0.0	254.5	4248
8640 min Winter	1.097	0.0	260.1	5016
10080 min Winter	0.966	0.0	263.0	5760

Cascade Rainfall Details for south block 50%green.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Green Roof

Area (m^3)	1360	Evaporation (mm/day)	3
Depression Storage (mm)	50	Decay Coefficient	0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.024714	32	36	0.004990	64	68	0.001007	96	100	0.000203
4	8	0.020234	36	40	0.004085	68	72	0.000825	100	104	0.000167
8	12	0.016566	40	44	0.003345	72	76	0.000675	104	108	0.000136
12	16	0.013563	44	48	0.002738	76	80	0.000553	108	112	0.000112
16	20	0.011105	48	52	0.002242	80	84	0.000453	112	116	0.000091
20	24	0.009092	52	56	0.001836	84	88	0.000371	116	120	0.000075
24	28	0.007444	56	60	0.001503	88	92	0.000303			
28	32	0.006094	60	64	0.001230	92	96	0.000248			

Time Area Diagram

Total Area (ha) 0.135

Time From:	(mins) To:	Area (ha)
0	4	0.135

Cascade Model Details for south block 50%green.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	900.0	900.0	0.401	0.0	948.0
0.400	900.0	948.0			

Orifice Outflow Control

Diameter (m) 0.058 Discharge Coefficient 0.600 Invert Level (m) 1.000

Cascade Summary of Results for north 50%green.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	external.SRCX	(None)

Half Drain Time : 1310 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.038	0.038	0.0	0.5	0.5	70.2	O K
30 min Summer	1.050	0.050	0.0	0.7	0.7	91.4	O K
60 min Summer	1.061	0.061	0.0	1.0	1.0	112.8	O K
120 min Summer	1.072	0.072	0.0	1.3	1.3	133.3	O K
180 min Summer	1.085	0.085	0.0	1.5	1.5	155.7	O K
240 min Summer	1.093	0.093	0.0	1.6	1.6	171.8	O K
360 min Summer	1.105	0.105	0.0	1.8	1.8	192.7	O K
480 min Summer	1.112	0.112	0.0	1.8	1.8	206.5	O K
600 min Summer	1.117	0.117	0.0	1.9	1.9	215.8	O K
720 min Summer	1.121	0.121	0.0	1.9	1.9	222.1	O K
960 min Summer	1.124	0.124	0.0	2.0	2.0	229.0	O K
1440 min Summer	1.126	0.126	0.0	2.0	2.0	232.1	O K
2160 min Summer	1.127	0.127	0.0	2.0	2.0	233.5	O K
2880 min Summer	1.127	0.127	0.0	2.0	2.0	232.7	O K
4320 min Summer	1.123	0.123	0.0	2.0	2.0	226.3	O K
5760 min Summer	1.118	0.118	0.0	1.9	1.9	217.2	O K
7200 min Summer	1.113	0.113	0.0	1.8	1.8	206.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.587	0.0	26.7	19
30 min Summer	91.185	0.0	39.7	34
60 min Summer	56.713	0.0	74.6	64
120 min Summer	34.079	0.0	95.4	124
180 min Summer	24.967	0.0	118.0	206
240 min Summer	19.906	0.0	133.4	258
360 min Summer	14.417	0.0	154.5	368
480 min Summer	11.468	0.0	169.6	484
600 min Summer	9.596	0.0	180.8	604
720 min Summer	8.292	0.0	189.5	722
960 min Summer	6.581	0.0	201.8	960
1440 min Summer	4.744	0.0	212.4	1256
2160 min Summer	3.415	0.0	305.2	1620
2880 min Summer	2.702	0.0	321.1	2012
4320 min Summer	1.940	0.0	330.1	2816
5760 min Summer	1.532	0.0	403.1	3640
7200 min Summer	1.275	0.0	414.9	4464

Cascade Summary of Results for north 50%green.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	1.107	0.107	0.0	1.8	1.8	196.7	O K
10080 min Summer	1.102	0.102	0.0	1.7	1.7	187.0	O K
15 min Winter	1.043	0.043	0.0	0.6	0.6	78.6	O K
30 min Winter	1.056	0.056	0.0	0.9	0.9	102.3	O K
60 min Winter	1.069	0.069	0.0	1.2	1.2	126.2	O K
120 min Winter	1.088	0.088	0.0	1.6	1.6	162.7	O K
180 min Winter	1.104	0.104	0.0	1.7	1.7	190.4	O K
240 min Winter	1.113	0.113	0.0	1.8	1.8	208.6	O K
360 min Winter	1.126	0.126	0.0	2.0	2.0	232.5	O K
480 min Winter	1.135	0.135	0.0	2.1	2.1	248.3	O K
600 min Winter	1.141	0.141	0.0	2.1	2.1	259.0	O K
720 min Winter	1.145	0.145	0.0	2.2	2.2	266.4	O K
960 min Winter	1.150	0.150	0.0	2.2	2.2	275.0	O K
1440 min Winter	1.152	0.152	0.0	2.2	2.2	279.1	O K
2160 min Winter	1.151	0.151	0.0	2.2	2.2	277.4	O K
2880 min Winter	1.149	0.149	0.0	2.2	2.2	273.4	O K
4320 min Winter	1.141	0.141	0.0	2.1	2.1	259.1	O K
5760 min Winter	1.132	0.132	0.0	2.0	2.0	242.3	O K
7200 min Winter	1.123	0.123	0.0	1.9	1.9	225.7	O K
8640 min Winter	1.114	0.114	0.0	1.9	1.9	210.3	O K
10080 min Winter	1.107	0.107	0.0	1.8	1.8	196.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.097	0.0	421.0	5256
10080 min Summer	0.966	0.0	420.7	6048
15 min Winter	139.587	0.0	31.9	19
30 min Winter	91.185	0.0	46.5	34
60 min Winter	56.713	0.0	86.2	64
120 min Winter	34.079	0.0	123.7	160
180 min Winter	24.967	0.0	148.6	206
240 min Winter	19.906	0.0	165.3	256
360 min Winter	14.417	0.0	188.3	364
480 min Winter	11.468	0.0	204.6	478
600 min Winter	9.596	0.0	216.8	594
720 min Winter	8.292	0.0	226.0	708
960 min Winter	6.581	0.0	238.3	934
1440 min Winter	4.744	0.0	246.1	1356
2160 min Winter	3.415	0.0	360.4	1684
2880 min Winter	2.702	0.0	377.6	2136
4320 min Winter	1.940	0.0	385.9	3032
5760 min Winter	1.532	0.0	473.7	3912
7200 min Winter	1.275	0.0	488.3	4752
8640 min Winter	1.097	0.0	496.6	5544
10080 min Winter	0.966	0.0	497.8	6352

Cascade Rainfall Details for north 50%green.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.412	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Green Roof

Area (m^3)	2690	Evaporation (mm/day)	3
Depression Storage (mm)	50	Decay Coefficient	0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.048883	32	36	0.009869	64	68	0.001993	96	100	0.000402
4	8	0.040022	36	40	0.008080	68	72	0.001631	100	104	0.000329
8	12	0.032767	40	44	0.006616	72	76	0.001336	104	108	0.000270
12	16	0.026827	44	48	0.005416	76	80	0.001094	108	112	0.000221
16	20	0.021964	48	52	0.004435	80	84	0.000895	112	116	0.000181
20	24	0.017983	52	56	0.003631	84	88	0.000733	116	120	0.000148
24	28	0.014723	56	60	0.002973	88	92	0.000600			
28	32	0.012054	60	64	0.002434	92	96	0.000491			

Time Area Diagram

Total Area (ha) 0.269

Time From:	(mins) To:	Area (ha)
0	4	0.269

Cascade Model Details for north 50%green.SRCX

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 1.000 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	1936.0	1936.0	0.401	0.0	2006.4
0.400	1936.0	2006.4			

Orifice Outflow Control

Diameter (m) 0.055 Discharge Coefficient 0.600 Invert Level (m) 1.000