Pell Frischmann

The Kingsfields, Land to the West of Cambourne

Flood Risk Assessment and Outline Drainage Strategy

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Ref. reference. Rev revision. Suit suitability.

Prepared for

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1 Introduction

1.1 Project Brief

1.1.1 Pell Frischmann has been appointed by the Church Commissioners for England to undertake a Flood Risk Assessment (FRA) and Drainage Strategy to support promotion of a potential development site near Cambourne referred to as 'The Kingsfields, Land to the West of Cambourne' for allocation within the emerging Local Plan for South Cambridgeshire.

1.1.2 The purpose of this FRA is to review available information and assess the flood risk posed to the site and potential future development from a range of sources, now and in the future. The FRA has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) and associated Planning Practice Guidance (PPG), in respect to flood risks and coastal change.

1.1.3 A Drainage Strategy has also been prepared to demonstrate how the potential concept masterplan can be delivered, giving due regard to the requirement for sustainable drainage systems to comply with local and national policy in terms of surface water drainage arrangements.

1.1.4 To complete the Flood Risk Assessment, the following key stages of work have been undertaken:

- Collation of desk-based information and undertaken a review of publicly available flood risk information including Environment Agency mapping and local data, policy, and guidance
- Undertaken a desktop review of other data that has been made available such as topographical surveys, utility plans and proposed development layout options
- Consultation with relevant stakeholders to obtain further information on local risks and issues
- Provision of advice on appropriate flood risk mitigation measures for any potential future development
- Identifying existing surface water drainage arrangements to understand how the site currently drains
- Quantifying a suitable allowable discharge rate from the potential future scheme to accord with local policy, and explore options for means of surface water disposal
- Calculate the volume of storage required to balance additional runoff from the development, and make recommendations for SuDS features that could be incorporated to provide this storage volume

1.2 Sources of Information

1.2.1 A review of relevant information and guidance from a range of sources has been undertaken and includes the following key documents:

- National Planning Policy Framework (NPPF), July 2021
- Planning Practice Guidance (PPG), June 2021
- Environment Agency Flood Map for Planning and Risk of Flooding from Surface Water datasets from the DEFRA Spatial Data Catalogue
- DEFRA Magic Map, 2021
- British Geological Survey Geology of Britain viewer, 2021
- South Cambridgeshire Local Plan, September 2018
- Cambridge and South Cambridgeshire Level 1 Strategy Flood Risk Assessment, September 2010
- Cambridge Preliminary Flood Risk Assessment, March 2011
- Cambridgeshire's Local Flood Risk Management Strategy, 2015
- Cambridgeshire County Council Surface Water Management Plan, September 2014
- Great Ouse Catchment Flood Management Plan, January 2011

2 Background & Site Context

2.1 Site Location & Existing Use

2.1.1 The site is located approximately 1.7km west of Cambourne and to the south of Papworth Everard. A site location plan is included for reference as **Figure 2.1**. In total, the Development Site area covers approximately 402 hectares.

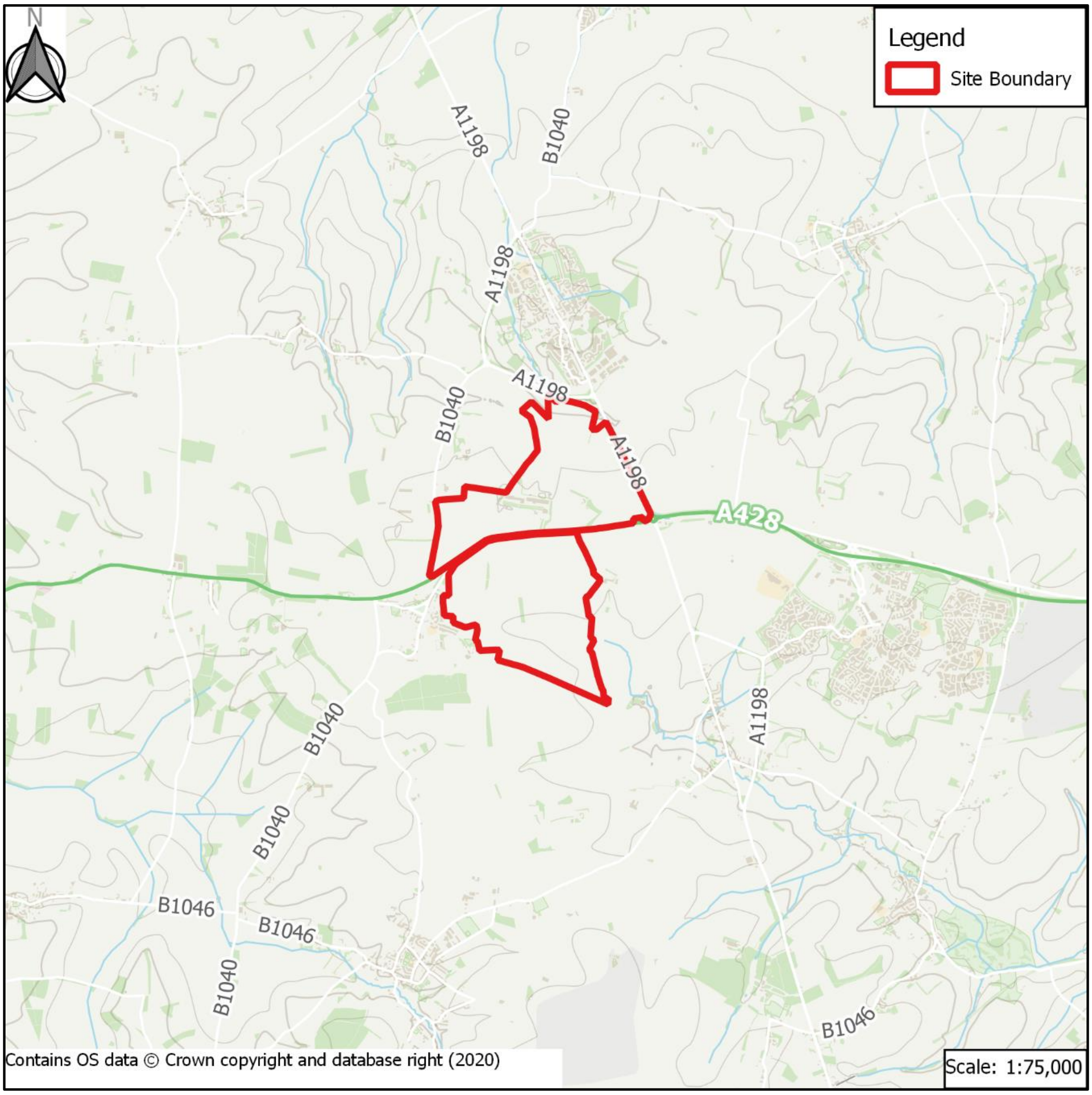

Figure 2.1 Site Location Plan

2.1.2 The northern boundary is formed by the A1198, beyond which is Papworth Everard. To the east is Ermine Street South (A1198) beyond which is open agricultural land. The A428 runs broadly east-west through the centre of the site, while south east lies the village of Cambourne. The western boundary is formed by St Ives Road (B1040).

2.1.3 Mapping suggests there are several farm buildings on site associated with North East Farm, and other agricultural buildings in the south. Overall, the site is considered to be subject to a natural regime of runoff and infiltration where ground conditions permit. Engineered land drains are present in line with the current agricultural use.

2.2 Local Watercourses

2.2.1 The site has several watercourses that fall within the site boundary as identified by the OS Open Rivers Dataset. Two watercourses emerge within the northern parcel of the development; the Ermine Brook being found along the eastern boundary and an unnamed tributary of the Nill Well watercourse to the west.

2.2.2 The Eastern Brook and two further unnamed tributaries are found in the southern parcel. Initial investigations have identified these to be agricultural assets. Mapping also shows two watercourses to pass by the western and eastern boundary of the northern parcel. **Figure 2.2** shows a plan of the local watercourses for context.

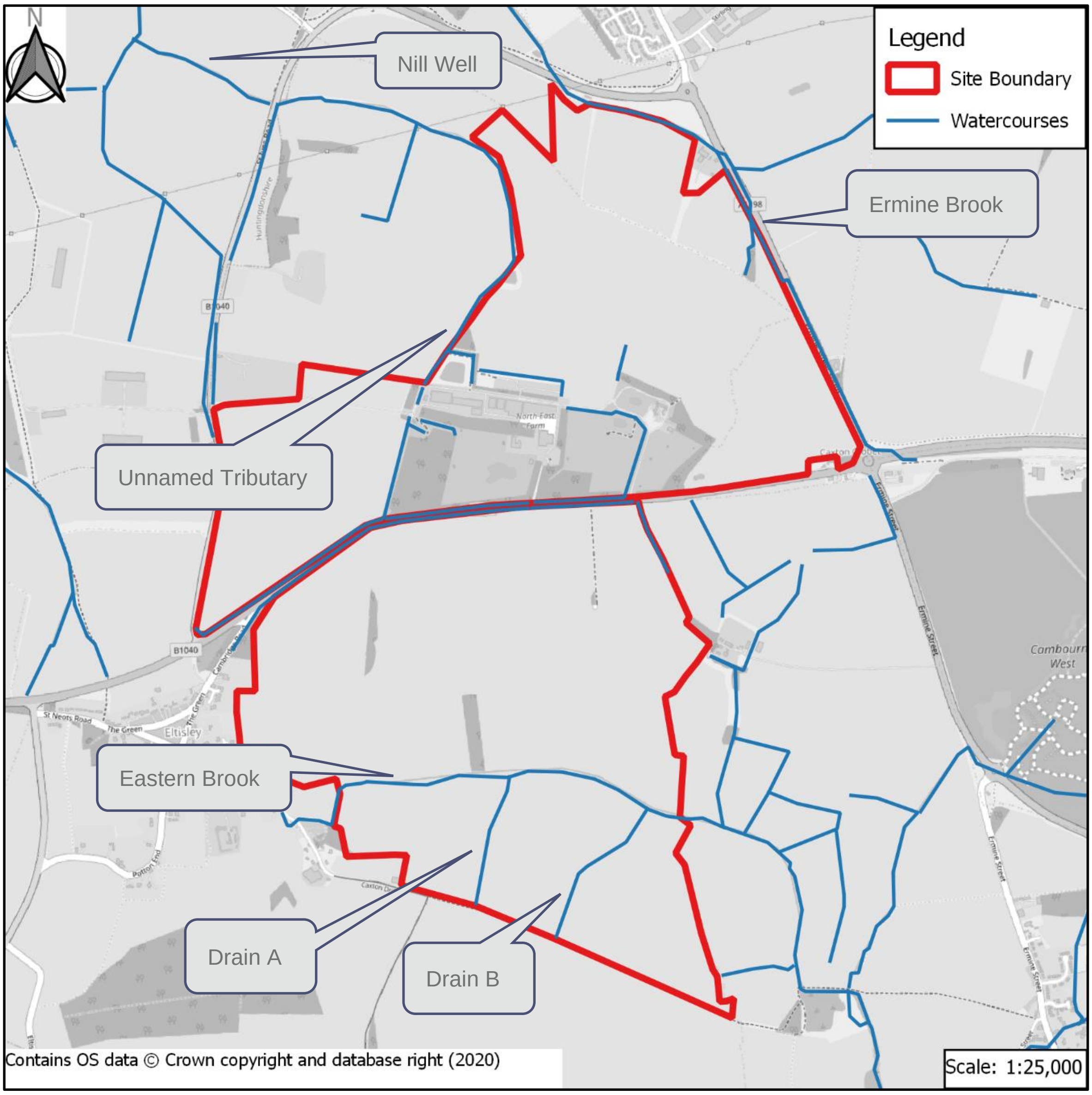

Figure 2.2 Watercourse Map

2.2.3 The watercourses and drains can be seen in the LiDAR mapping in **Figure 2.3**. These have been referred to on **Figure 2.2** as the Ermine Brook, Eastern Brook, Drain A and Drain B. Drains A and B are identified to be agricultural drains. The Ermine Brook serves the north of the site, flowing northwards away from the boundary. The Eastern Brook flows west to east across the site and Drains A and B flow northwards and connect with the Eastern Brook.

2.2.4 **Table 2.1** shows the approximate depth and width of the watercourses identified on topographical, OS and LiDAR mapping. The depths have been calculated using 1m LiDAR data supplied by the EA OpenData catalogue. Three measurements have been taken for each watercourse; at the upstream extent, centre point and the downstream limit of the watercourse within the site boundary and will be referred to as Points 1-3 respectively within **Table 2.1**. These will also help identify the flow direction and therefore the connectivity of these drains.

Table 2.1 On-Site Drains and Brooks Approximate Depths and Widths

Drain / Watercourse Name	Point 1			Point 2			Point 3		
	Depth 1 (m)	Bank Width 1 (m)	Channel Width 1 (m)	Depth 2 (m)	Bank width 2 (m)	Channel width 2 (m)	Depth 3 (m)	Bank width 3 (m)	Channel width 3 (m)
Ermine Brook	0.418	6.975	2.693	0.468	6.595	2.274	1.343	5.920	3.113
Eastern Brook	0.497	7.986	2.869	1.142	6.127	3.348	1.130	5.602	3.301
Drain A	0.772	5.157	2.273	0.368	5.048	4.390	0.378	7.448	4.704
Drain B	0.152	5.677	3.144	0.708	4.056	2.399	0.740	5.522	2.455

2.2.5 The Ermine Brook flows south to north across the northern part of the site. The topography of the area shows elevations surrounding the Brook fall northwards and westwards towards the drain. This suggests the Ermine Brook has a moderate catchment falling within the site.

2.2.6 The Eastern Brook flows west to east across the southern portion of the site. This suggests the Eastern Brook has a large catchment consisting of the south of the proposed development. There is evidence the Brook has wider connectivity to the west, beyond the site, as it is connected to a wider watercourse system off site to the east.

2.2.7 Drain A flows south to north towards the Eastern Brook. This suggests the drain has a limited catchment and is used to drain a portion of the far south east of the site. There is evidence the drain has a positive connection, as mapping shows it to join with the Eastern Brook and drain off site to the east.

2.2.8 Drain B flows south to north until it meets the Eastern Brook. Drain B has a limited catchment consisting of the south western most part of the site. There is evidence the drain has a positive connection, as mapping shows it to join with the Eastern Brook to the north.

2.2.9 There are also numerous smaller watercourses within and near to the site, serving functions including highway drainage and land drainage. Their flow characteristics and wider connectivity has not been established at this stage.

2.3 Topography

2.3.1 The northern parcel of the site generally falls from south to north towards the A1198. Elevations range from approximately 41.5m AOD at the northern boundary where the site abuts the A1198 to approximately 64.93m AOD in the southern boundary where it abuts the A428.

2.3.2 The southern parcel of the site generally falls from north west to south east. Elevations range from approximately 64.34m AOD in the west of the site where it connects to the residential development along Cambridge Road to approximately 54.2m AOD at the eastern boundary.

2.3.3 LiDAR mapping provided by DEFRA, shown in **Figure 2.3**, shows the approximate elevation across the site. This mapping clearly identifies the key watercourses and their associated valleys within and near to the site, further confirming the watersheds draining to the individual features.

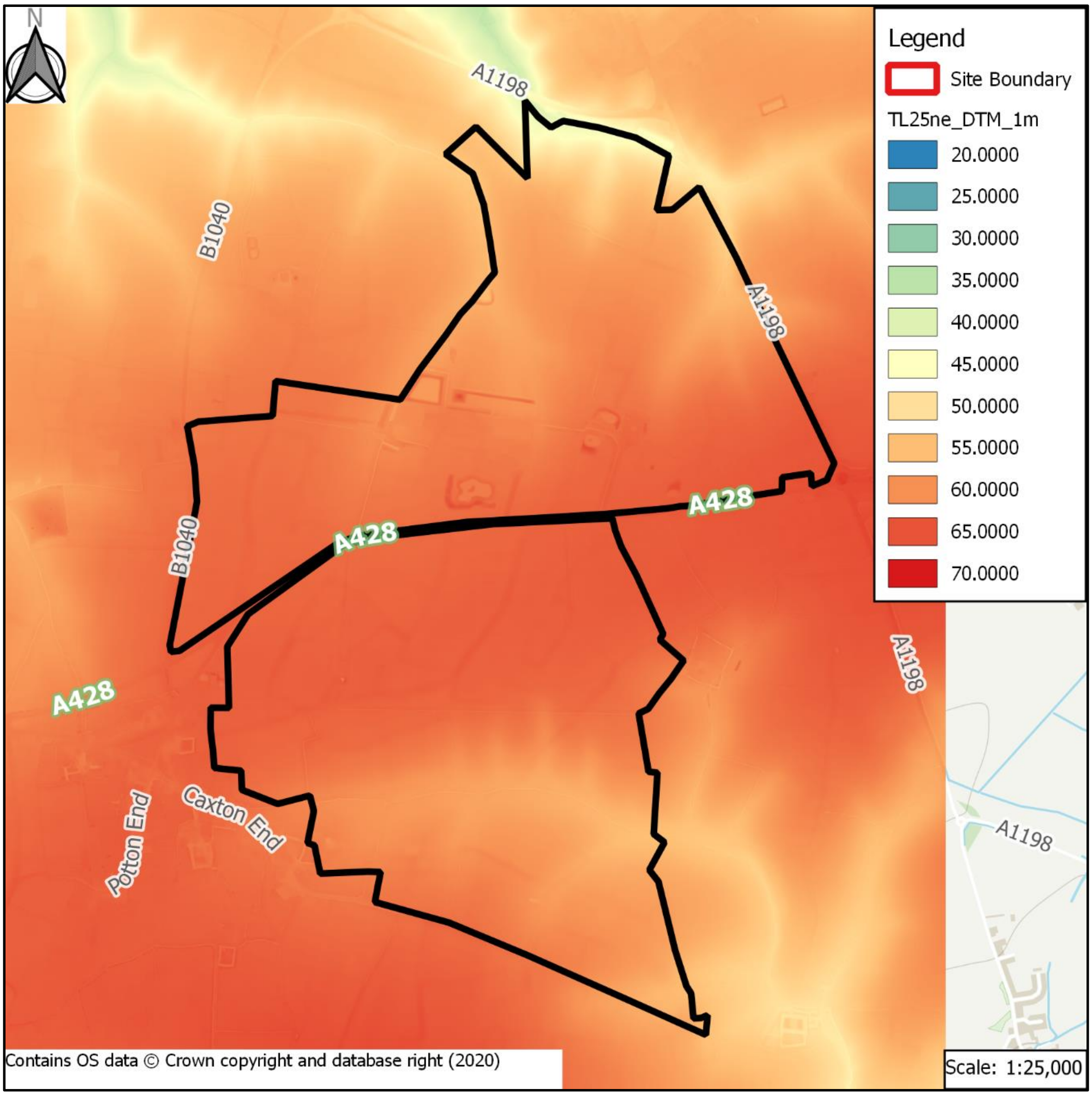

Figure 2.3 LiDAR Elevations

2.4 Geology

2.4.1 British Geological Survey (BGS) survey mapping suggests the site is underlain by superficial deposits comprising Oadby Member Diamictons of subordinate lenses of sands, gravels, silts and clays. There are also layers with chalk and flint fragments present. No significant areas of made ground are anticipated across the site due to no buildings or farm structures being present.

2.4.2 The site is wholly underlain by a bedrock geology of Ampthill Clay Formation (undifferentiated).

2.4.3 Two historic boreholes along the A428 at the southern boundary of the site bored September 2001 (BGS reference: TL26SE42 and TL26SE43) to a depth of 5m bgl and 3.1m bgl respectively did not record any groundwater strikes.

2.4.4 Boreholes also confirm the geology of the site in the top 5m to be stiff silty clays with flint fragments throughout, which matches the BGS designations.

2.5 Development Proposals

2.5.1 The site is currently being promoted as a residential-led scheme with a mix of development including, retail, educational facilities and landscaping and open space. Separate to this promotion is the improvement and upgrade of the A428 through the site and junctions nearby.

3 Policy Context

3.1 National Planning Policy Framework

3.1.1 The NPPF[1] was first published in 2012, with a subsequent revision by the Ministry of Housing, Communities and Local Government appended in July 2018 and February 2019 with the most recent update made in July 2021.

3.1.2 The NPPF is the primary source of national planning guidance in England, setting out the Government's planning policies, and how they are to be applied by local councils.

3.1.3 'Chapter 14: Meeting the challenge of climate change, flooding and coastal change' outlines the guiding principles for managing flood risk as part of the planning process, notably paragraphs 159-169.

3.1.4 The Planning Practice Guidance[2] sets out the vulnerability of flooding of different land uses. It encourages development to be in areas of lower flood risk and stresses the importance of preventing increases in flood risk off site to the wider catchment.

3.1.5 The PPG includes a series of tables that define Flood Zones, the flood risk vulnerability classification of development land uses, and 'compatibility' of development within the defined Flood Zones.

3.1.6 Therefore, this FRA has been completed in line with the guidance and requirements of the NPPF and PPG.

3.2 Local Plan Policies

3.2.1 The South Cambridgeshire Local Plan[3] was adopted in September 2018 and sets out how land within the Council can be developed, providing policies the council uses to determine application and regeneration activities.

3.2.2 The plan aims to oversee how the Council will manage future growth, encourage sustainable development, and ensure changes are appropriate to local need now, and in the future.

3.2.3 More generally, the Local Plan lists policies that influence the design and principles of development within the Council. Those relevant to this FRA are summarised as follows:

- Policy CC/7: Water Quality
- Policy CC/9: Managing Flood Risk

3.3 Local SFRA

3.3.1 The Cambridge and South Cambridgeshire Level 1 Strategic Flood Risk Assessment[4] (SFRA) was published in September 2010 in partnership with WSP UK Ltd. The SFRA was prepared to provide an appropriate evidence base for developments, a summary of flood risk and to provide and assessment for the Local Plan.

3.3.2 The SFRA also includes relevant background flooding data and a summary of flood risks within the County.

[1] Ministry of Housing, Communities and Local Government (July 2021); *The National Planning Policy Framework*
[2] Ministry of Housing, Communities and Local Government (June 2021); *The Planning Practice Guidance*
[3] South Cambridgeshire District Council (September 2018); *South Cambridgeshire Local Plan*; prepared by SCDC
[4] Cambridge City Council & South Cambridgeshire District Council (September 2010); *Cambridge and South Cambridgeshire Level 1 Strategic Flood Risk Assessment*; prepared by WSP

3.4 Local PFRA

3.4.1 The Cambridge Preliminary Flood Risk Assessment[5] (PFRA) was published in March 2011 in partnership with Hyder Consulting. The PFRA was prepared to assist Cambridgeshire County Council meet their duties to manage local flood risk and deliver and legal requirements placed on the as the LLFA under the Flood Risk Regulations 2009.

3.4.2 The PFRA also identifies the past and future flood risk for the County and includes an assessment where within the County flooding, including overland flows and direct rainfall, will occur and to what extent, along with the number of properties at risk.

3.5 Local Flood Risk Management Strategy

3.5.1 The Cambridgeshire Local Flood Risk Management Strategy 2015-2020[6] (LFRMS) was published in July 2015. The LFRMS was produced to comply with Section 9 of the Flood and Water Management Act 2010 and aims to provide a framework for meeting their requirements to develop, maintain, apply and monitor a local strategy for flood risk management.

3.5.2 The LFRMS provides further information regarding surface runoff, groundwater and sewer flooding and flood risk around the County, and the introduction of flood risk alleviation schemes including SuDS.

3.6 Cambridgeshire Flood and Water Supplementary Planning Document

3.6.1 The Cambridgeshire Flood and Water Supplementary Planning Document[7] (SPD) was adopted in November 2016 as a collaboration between, Cambridge County Council, Fenland District Council, East Cambridgeshire District Council, Huntingdonshire District Council, South Cambridgeshire District Council and Cambridge City Council.

3.6.2 The SPD was adopted by local planning authorities to be a material planning consideration when determining planning applications. The SPD does not introduce new policy but rather elaborates on and is consistent with Local Plan Policies and includes further information regarding The Sequential Test and The Exclusion Test for developments.

3.7 Cambridge's Surface Water Management Plan

3.7.1 The Cambridge County Council Surface Water Management Plan[8] (SWMP) was published in September 2014 in partnership with Hyder Consulting. The SWMP was produced to provide context and information to support the delivery of the LFRMS whilst further outlining measure to take in future to manage the risk of flooding within the catchment.

3.8 Great Ouse Catchment Flood Management Plan

3.8.1 The Great Ouse Catchment Flood Management Plan[9] (CFMP) was published in January 2011 by the Environment Agency to help understand the scale and extent of flooding now and in the future within the catchment. The CFMP should be used to inform planning and decision making by key stakeholders and promote more sustainable approaches to managing flood risk.

[5] Cambridgeshire County Council (March 2011); *The Cambridgeshire Preliminary Flood Risk Assessment*; prepared by Hyder Consulting
[6] Cambridgeshire County Council (July 2015); *The Cambridge County Council Surface Water Management Plan*; prepared by CCC
[7] Assortment of Council as listed above (November 2016); *Cambridgeshire Flood and Water Supplementary Planning Document*; prepared by the aforementioned councils
[8] Cambridgeshire County Council (September 2014); *The Cambridgeshire County Council Surface Water Management Plan*; prepared by Hyder Consulting
[9] Environment Agency (January 2011); *Great Ouse Catchment Flood Management Plan*; prepared by The EA

4 Assessment of Flood Risk

4.1 Desk-Based Information

4.1.1 The NPPF states that all sources of flood risk must be identified and appraised. Flooding can occur from a variety of sources individually, or in combination and can result from both natural and artificial processes.

4.1.2 **Table 4.1** provides an initial desk-based review of the level of flood risk from all sources, which are then assessed in further detail where the risk is considered significant and merits further investigation.

Table 4.1 Desk-Based Assessment of Flood Risk

Sources of Flood Risk	Degree of Risk			Comments
	Significant	Moderate	Low	
Fluvial			X	The Site is in Flood Zone 1
Coastal & Tidal			X	The site is far removed from the coast and impact of tidal flood levels.
Groundwater			X	Impermeable superficial and bedrock geologies and limited susceptibility to flooding during extreme events
Surface Water		X		Areas of high risk associated with on-site watercourses and agricultural drains, with areas of moderate and low risk associated with topographical depressions.
Sewers			X	Limited extent of sewers in the immediate vicinity.
Canals			X	No canals in the area
Reservoirs & Waterbodies			X	One small impounded agricultural reservoir within site, actively managed with outfalls to watercourses.

4.2 Fluvial Flood Risk

4.2.1 The Environment Agency has produced a resource called the Flood Map for Planning, which identifies areas at risk of flooding from Main Rivers and the sea. An extract of this mapping is included for reference as **Figure 4.1**.

4.2.2 The site is shown to be wholly within Flood Zone 1 (Low Probability) which is defined in the NPPF as land having less than a 1 in 1000 annual chance of flooding from rivers or the sea. The nearest extent of Flood Zone 2 and 3 (Moderate and High Probability respectively) is found immediately to the north of site along the A1198 and approximately 200m south east of the southern parcels south east border.

4.2.3 The site is located at the head of catchment of several different watersheds. The watercourses are at a lower elevation than the majority of the site, with water tending to flow away from the boundary, confirming the potential low fluvial risk to the site.

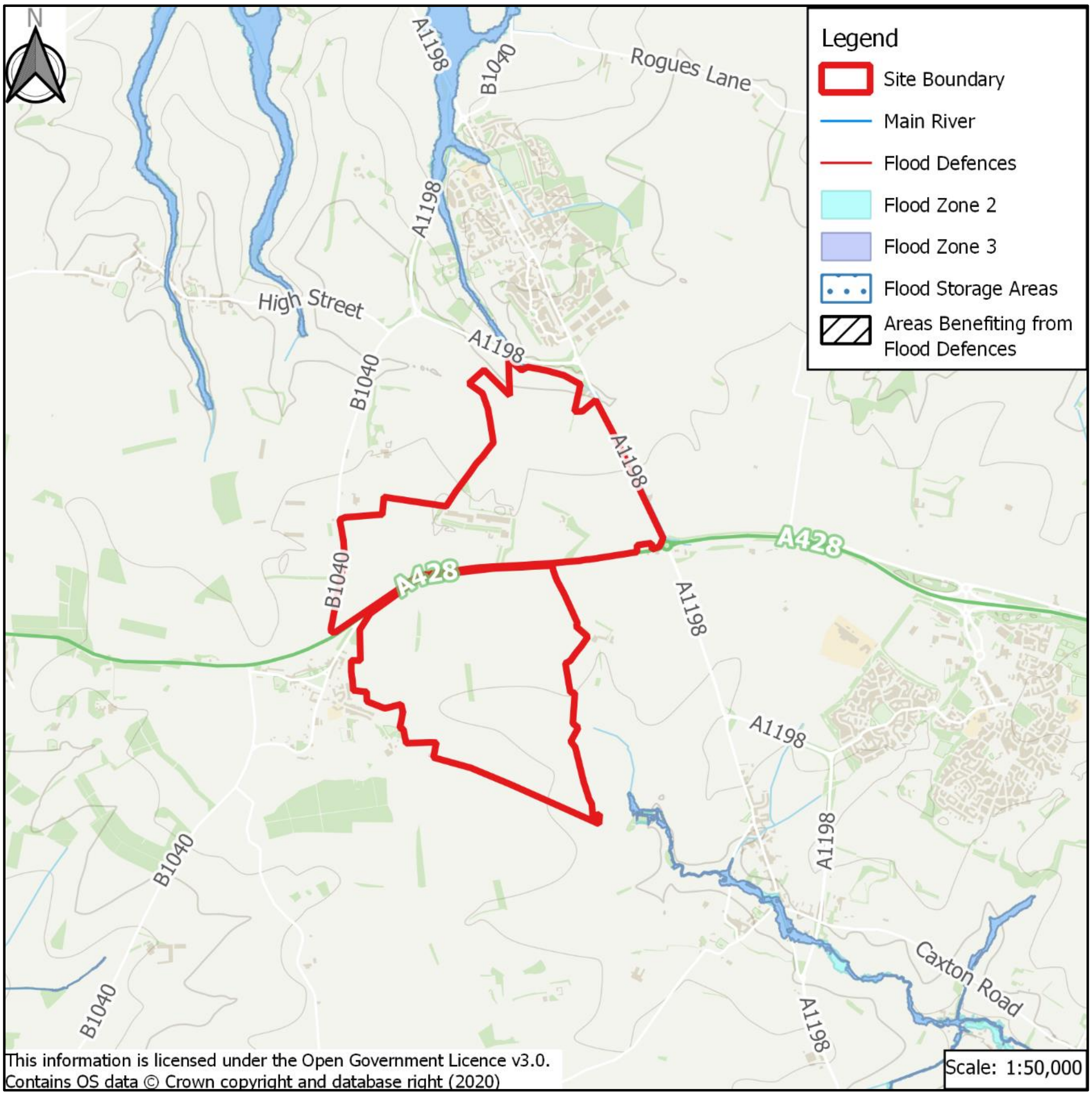

Figure 4.1 Flood Map for Planning

4.2.4 Climate change allowances to use as part of Flood Risk Assessments have recently been updated in line with guidance published by the Environment Agency. The site is split between catchments and falls within the 'Upper and Bedford Ouse' management catchment and the 'Cam and Ely Ouse' management catchment.

4.2.5 As the site falls wholly within Flood Zone 1 and is being put forward as a strategic allocation, then climate change scenarios should be considered as part of a planning application.

4.2.6 Furthermore, Cambridgeshire County Council, in their PFRA, concluded that Cambourne, and the promoted site in question, is not considered to be a current or future risk from flooding from fluvial sources.

4.2.7 As such, the site is considered to be a low risk from flooding from fluvial sources and other local watercourses.

4.3 Coastal & Tidal

4.3.1 The site is located in Flood Zone 1 (Low Probability) and is sufficiently removed from the coast to be unaffected by tidal influences.

4.3.2 Therefore, the risk of flooding from Coastal or Tidal related events is low.

4.4 Groundwater

4.4.1 Groundwater flooding occurs when the water table rises above ground elevations. It is most likely to happen in low lying areas underlain by permeable geology. This may be regional scale chalk or sandstone aquifers, or localised deposits of sands and gravels underlain by less permeable strata such as that in a river valley.

4.4.2 Boreholes in the area carried out to depths of 5m bgl and 3.1m bgl did not strike groundwater during their investigations. However, the superficial geology recorded of Oadby Member Diamictons comprising sands, gravels, silts and clays, and the confirmation of clay heavy geology from the boreholes suggests a very limited potential for groundwater to move within the strata to the surface. These underlying geologies present limited to no potential for infiltration.

4.4.3 Aquifer designations by DEFRA show the superficial drift classification to be Secondary (undifferentiated) suggesting limited water supplies within the strata, and the bedrock classification to be Unproductive. This suggests little to no volume of water within the strata.

4.4.4 The PFRA states groundwater is not considered to be a significant risk within Cambridgeshire with only a small number of recorded instances and does not provide a groundwater susceptibility map.

4.4.5 The site is not within a Source Protection Zone (SPZ), however there is a SPZ (Zone III – Total Catchment) approximately 250m to the south of the southernmost extent of the site.

4.4.6 Overall, considering the aquifer designations, underlying geologies and the data on groundwater flooding provided within the SFRA, PFRA and by DEFRA, the risk of flooding from groundwater is considered to be low.

4.5 Surface Water (Pluvial)

4.5.1 The risk of flooding from surface water has been mapped by the Environment Agency on a strategic scale to understand areas that may be susceptible to ponding and routing of surface water during extreme rainfall. Surface water flooding extent for the area has been included as **Figure 4.2**.

4.5.2 This mapping indicates discrete parts of the site may be at a moderate risk from flooding from surface water. There are areas of the site that experience high risk of surface water flooding, but these are limited to the extents of the on-site watercourses and agricultural drainage ditches.

4.5.3 In the northern parcel there are three distinct areas of high risk; along the western boundary associated with the unnamed tributary of Nill Well, along the northern boundary associated with a localised topographical depression and along the eastern boundary associated with the Ermine Brook.

4.5.4 In the southern parcel the areas of high risk are mostly limited in extent to the flow routes of the Eastern Brook and its tributaries, with small areas of medium and low risk branching off from this due to localised topographical depressions and flow routes.

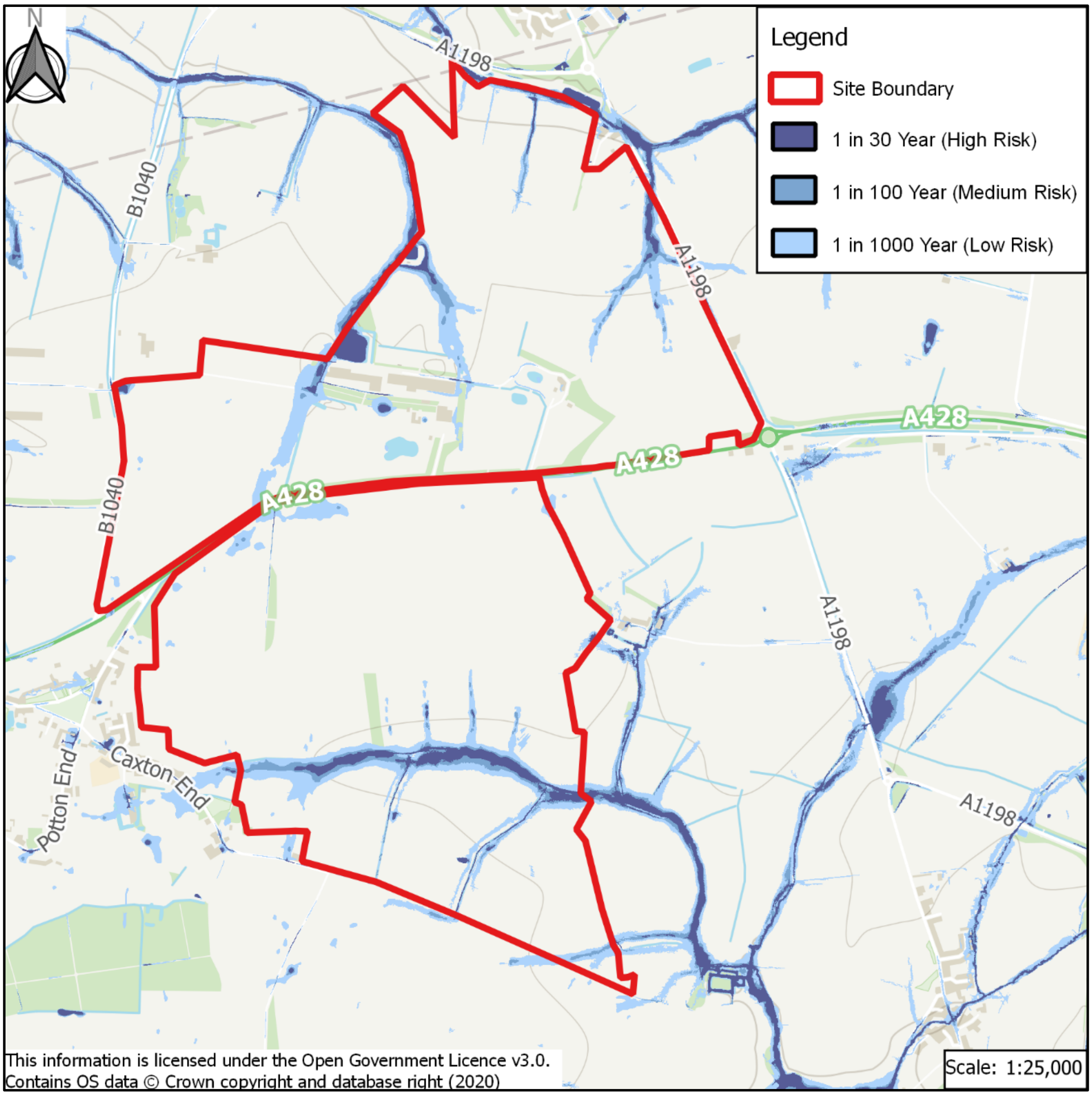

Figure 4.2 Surface Water Flooding Map

4.5.5 Reviewing the available information suggests for the 'medium risk' event (1 in 100 year) potential depths are estimated up to over 1200mm within the watercourse channels but classified as 'below 150mm' and '300-600mm' outside of this. However, the majority of this is contained within the watercourse channels and areas of lower topography. An extract of the 'medium risk' event depth mapping can be seen for reference in **Figure 4.3**.

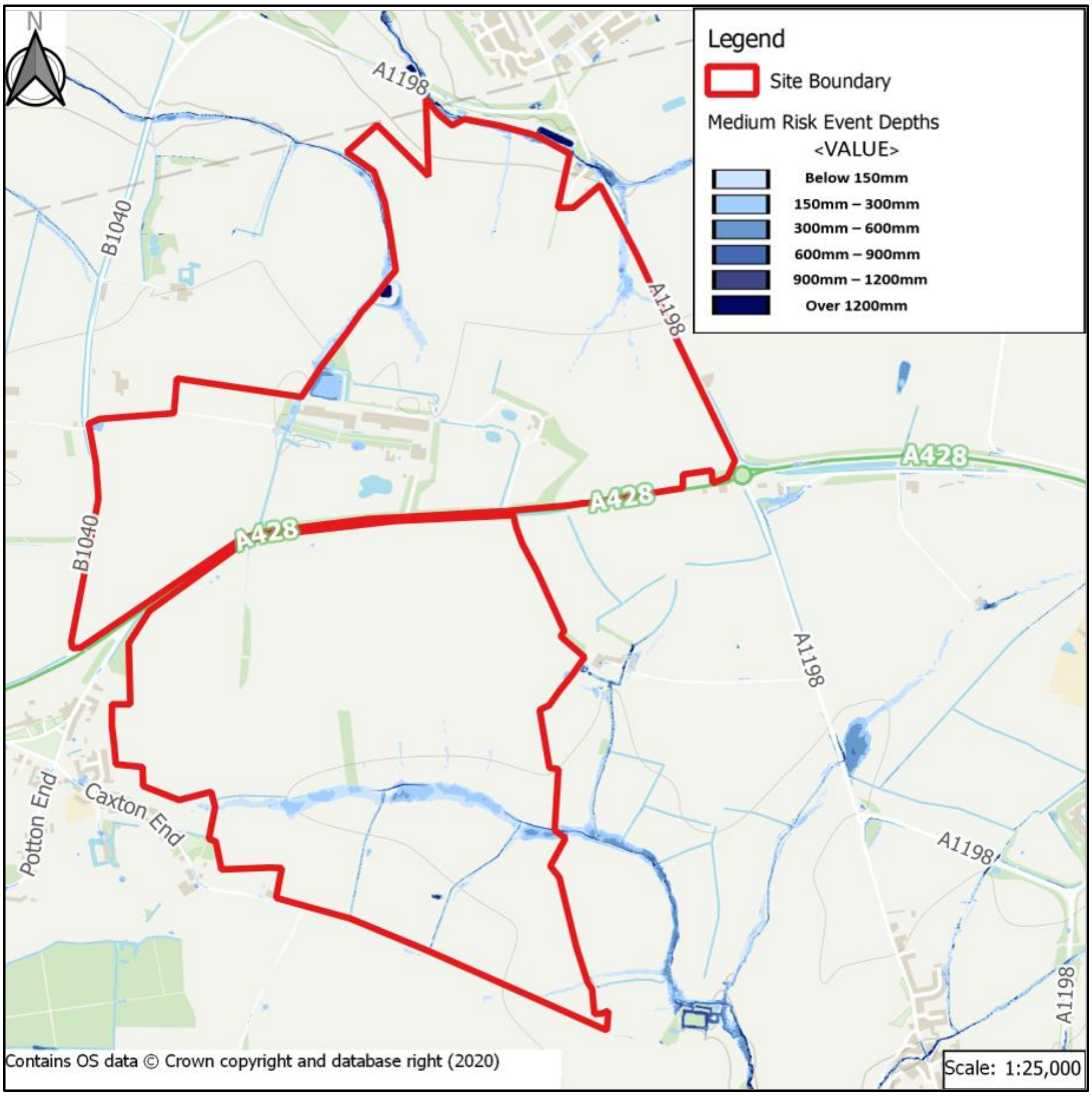

Figure 4.3 **Medium Risk Event Depths – Surface Water**

4.5.6 For the 'low risk' event (1 in 1000 year) the overall extent of affected areas increases, with a greater area covered by the 300-600mm depth category. However, the majority of this increase in flood depth is still within the topographical depressions, watercourses and drains on site. An extract of the 'low risk' event depth mapping is included for reference as **Figure 4.4**.

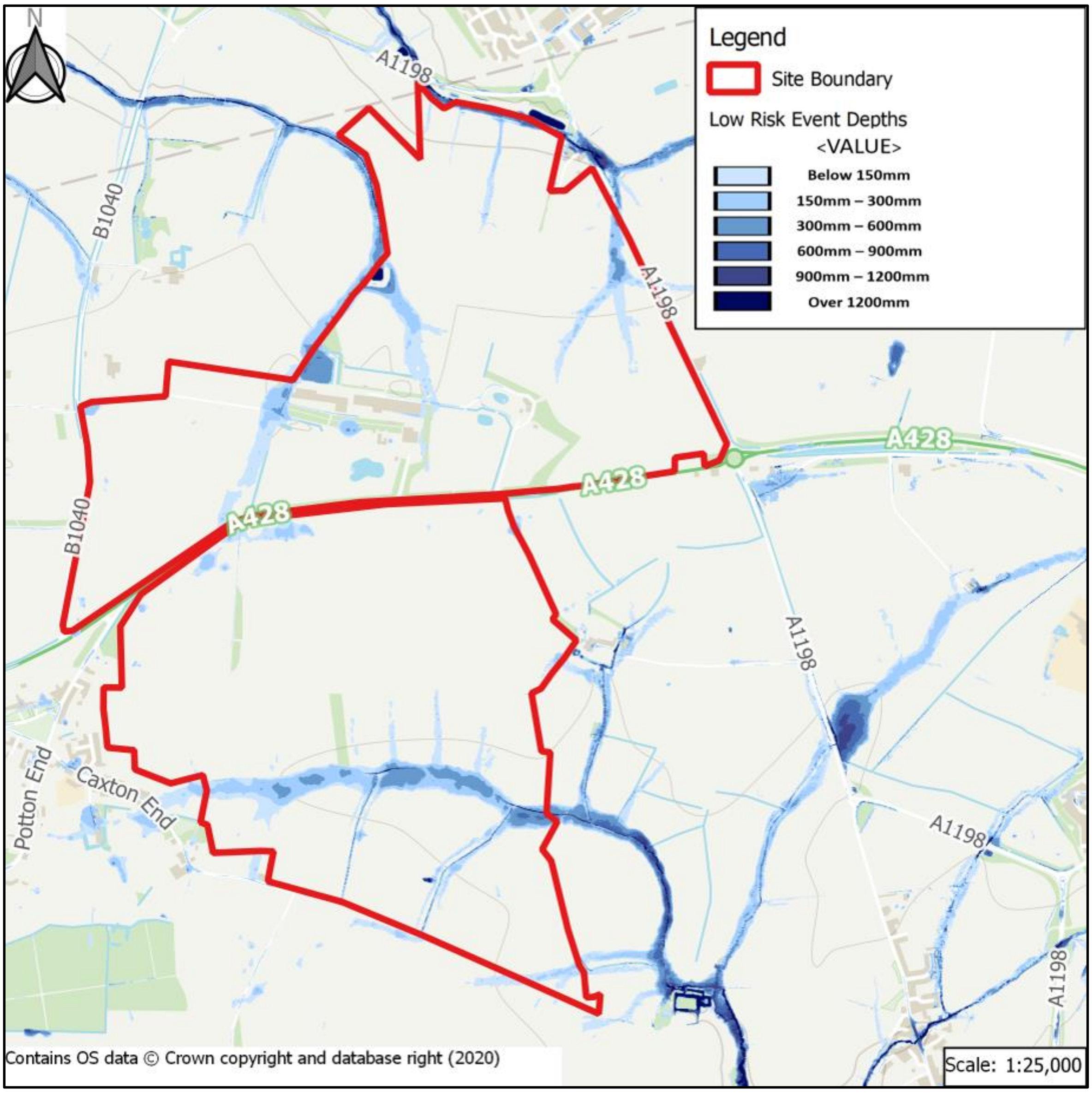

Figure 4.4 Low Risk Event Depths – Surface Water

4.5.7 Therefore, the risk posed to the site from surface water flooding is considered to be moderate. At this early concept stage, mitigation measures can be incorporated through appropriate site design and consideration of these flow routes, which should be incorporated into landscaping and external areas.

4.6 Sewers

4.6.1 Flooding from sewers typically results from the network capacity being exceeded or as a result of blockages to key elements. Flooding usually occurs by way of surcharging manholes, gullies or other features that allow water from the sewers to reach the surface, resulting in overland flows that can affect nearby properties.

4.6.2 A review of sewer records, included as **Appendix A**, show no existing sewerage networks pipes serving the site. The nearest foul sewer can be found beyond the western boundary of the northern parcel along St Ives Road comprising a 4-inch PVC pipe. There are no manholes noted along this stretch of sewer.

4.6.3 Due to the sewers being located outside of the site and there being no recorded manholes, any surcharging or emergence at ground level is unlikely to have an impact on the site.

4.6.4 There may be a limited extent of private sewers within the site boundary for the farm buildings on site, however the limited extent of this network and location close to the lowest elevations of the site mean the risk from this source is negligible.

4.6.5 Overall, the site is considered to be at a low residual risk of flooding from surcharging of the local network.

4.7 Canals

4.7.1 The nearest canal to the site is the Grand Union Canal where it flows through Milton Keynes approximately 44.6km to the west of the site.

4.7.2 Due to the distance of the canal from the site and the intervening topography, the risk of flooding from canals is considered to be negligible.

4.8 Reservoirs

4.8.1 The Environment Agency has produced strategic-scale mapping showing the potential risk of flooding from failure of large waterbodies and reservoirs, if the relevant impounding structure was to fail.

4.8.2 This mapping confirms the site is far removed from the extent of any modelled flooding from such structures.

4.8.3 A review of Ordnance Survey mapping shows one small impounded agricultural reservoir located within the site boundary, associated with North East Farm. This small reservoir is impounded on all sites with freeboard provided in case of seasonal variations in water depth. The reservoir does not appear to be naturally fed by a stream or wider catchment and shows evidence of positive drainage connections to watercourses in the area. This reservoir is actively managed and used and as such, the risk associated with this small reservoir is considered to be low.

4.8.4 A further review of Ordnance Survey mapping shows two reservoirs nearby to the site. One to the east and one to the west. To the east is a small irrigation reservoir north of the village of Elsworth approximately 3.7km to the east of the site. This structure is slightly impounded with freeboard provided in case of seasonal variations in water depth. This reservoir does not appear to be naturally fed by a stream or wider catchment, and so there will be a finite volume of water stored in the reservoir depending on its size and depth.

4.8.5 To the west is the artificial lake and Site of Special Scientific Interest (SSSI) Grafham Water approximately 12.3km to the west. The structure is impounded with a raised Dam edge along its eastern boundary. This reservoir is partially naturally fed by a small watercourse to the west of the reservoir, but mainly artificially fed by pumping water from the River Great Ouse nearby. This means the volume of water stored in the reservoir can be controlled.

4.8.6 Grafham Water is actively managed as a working reservoir and water sports/leisure facility and so will be subject to a regime of regular inspection and maintenance. The smaller irrigation reservoir is also actively used for farming purposes so will also be subject to a regime of regular inspection and maintenance. The likelihood of failure is low, and in the result of an uncontrolled release of water, flow would be intercepted by various areas of lower topography, natural and artificial lakes and meres, and local watercourses, with minor encroachment towards the site.

4.8.7 In conclusion, the site is considered at low risk of flooding from reservoirs and other large water bodies.

4.9 Previous Flooding

4.9.1 It should be noted the PFRA mentions extreme rainfall and flooding events to have affected large amounts of Cambridgeshire. These include:

- 1947 – Due to very fast snow melt
- September 1968 – Fluvial Main river Watercourses and Ordinary Watercourses
- May 1978 – Flooding in approximately 6 villages following exceedance of Ordinary Watercourses
- Easter 1998 – Widespread flooding and disruption to the County
- October 2001 – Following very heavy rainfall. Properties were flooding by surface water and exceedance of local drainage ditches as well as Main River Fluvial flooding

4.9.2 A review of the flooding maps provided in tandem with the PFRA show the proposed development site to be far removed from the influences and effects of these flood events. No other instances of flooding to the site or immediate vicinity are recorded by the Environment Agency.

4.10 Impact of the Proposed Development

4.10.1 The site is not within defined floodplains of nearby watercourses and is unlikely to detrimentally affect floodplain volumes or conveyance routes.

4.10.2 The introduction of an increased impermeable footprint on site would give rise to an increase in the rate and volume of water being discharged if not managed appropriately. This could result in increases in flood risk downstream and would require suitable mitigation.

5 Flood Risk Mitigation

5.1 Sequential Arrangement

5.1.1 The site is considered sequentially preferable due to its location within Flood Zone 1.

5.1.2 A sequential approach to the layout should be considered by ensuring development is not within close proximity to the existing watercourses where surface water risk areas were identified.

5.2 Development Levels

5.2.1 There are no specific requirements for finished floor levels to address the low risk of fluvial flooding. However, it is recommended that any schemes brought forward consider appropriate design of external levels and their relation to building thresholds to manage the residual risk of flooding from the watercourses around the site boundaries.

5.2.2 In particular, finished floor levels could be designed so there is a nominal threshold above surrounding ground levels, in accordance with relevant building regulations and generally external levels should be designed in a way so that any surface flows shed away from buildings and towards landscaping and positively drained areas.

5.3 Watercourse Standoff

5.3.1 Whilst not considered Main Rivers by the EA, development should still consider a suitable standoff from the top of bank of the nearby watercourses to allow for suitable access and future improvement in line with any local byelaws, and/or in consultation with the Lead Local Flood Authority.

5.4 Surface Water Management

5.4.1 To manage the potential increase in runoff from any proposed development, a surface water drainage strategy has been prepared to demonstrate how a potential development could be brought forward whilst ensuring suitable management of surface water.

5.4.2 In summary, the strategy sets out a strategy based on a restricted outfall rate to the equivalent greenfield rate via the on-site watercourses, and provision of above-ground attenuation features to manage and store the additional runoff from the proposed development. Discharge to the on-site watercourses is achieved via a short section of sewer from the attenuation basins. Attenuation basins within the site boundary are used to balance the excess volume of water, discharged at the restricted rate. Further details on the drainage strategy are provided in Section 6.0 of this report.

5.4.3 Therefore, the development will not have an adverse impact on the flood risk elsewhere.

6 Surface Water Drainage Strategy

6.1 Context

6.1.1 This section of the report contains details on a Sustainable Drainage Strategy for 'The Kingsfields, Land to the West of Cambourne' and will set out the principles of the drainage design for the proposed development and summarises the reasons behind the chosen design. This includes;

- Consideration of national and local guidance
- A suitable framework for the sustainable management of surface water
- Justification of specific flow rates
- Volumes of attenuation provided
- The sustainable drainage features to be implemented and their associated benefits
- A proposed adoption and maintenance scheme.

6.1.2 The intention is to demonstrate how the site can be brought forward with due consideration for surface water management, confirming how the promoted scheme can be effectively delivered alongside this requirement. It will also provide a framework for any future applications at the site to follow if the principles can be agreed.

6.2 Sustainable Drainage Guidance

6.2.1 Sustainable Drainage Systems (SuDS) aim to mimic the natural runoff regime and minimise any detriment to the wider water environment. In keeping with the 4 pillars of SuDS design, using a range of features can provide a plethora of benefits, from managing water quantity and quality, to improving biodiversity and local amenity value.

6.2.2 The NPPF and local policy specifies that surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development. Opportunities to reduce the flood risk to the site itself and elsewhere, taking climate change into account, should be investigated. The drainage proposals within this strategy have been prepared to meet planning policy requirements.

6.2.3 The CIRIA SuDS Manual and the DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems provide extensive information on the implementation of SuDS features. Furthermore, Cambridgeshire County Council (CCC) have prepared the 'Surface Water Drainage Guidance for Developers' in November 2019 that outlines specific requirements for surface water drainage in new developments and provides advice and guidance on the use of suitable SuDS, which has been incorporated into this section of the FRA.

6.2.4 In their role as Lead Local Flood Authority, the CCC have also published the 'Cambridgeshire Flood and Water Supplementary Planning Document'. In this, the Council advocates a 'Water reuse first' approach to surface water drainage, recommending that methods and techniques to recycle and reuse rainwater should be embedded in new developments. Such measures have been considered and will be a material consideration in any potential development.

6.2.5 Furthermore, specific local guidance from the South Cambridgeshire Local Plan, Surface Water Management Plan and SFRA's has been utilised and will be referenced within the report where appropriate, this local guidance echoes the national guidance.

6.2.6 In line with the Environment Agency (EA) guidance on rainfall climate change predictions and considering the nature of the proposals, a 40% climate change allowance has been applied when calculating volumes of attenuation required.

6.3 Local Policy and Studies

6.3.1 Generally, 'Chapter 4: Climate Change' of the South Cambridgeshire Local Plan addressed 'Water' with policies that guide the design and principles of all development within the borough.

6.3.2 The following list provides a summary of key policies related to the Water Environment.

- **Policy CC/1: Mitigation and Adaptation to Climate Change** – This policy states that development will only be permitted where it shows it has demonstrated and embedded the principles of climate change mitigation and adaptation into the development. These include the introduction of SuDS features and that all sources of flood risk have been managed or avoided.
- **Policy CC/7: Water Quality** – This policy states that all development proposals should demonstrate that there are adequate water supplies, sewerage and land drainage systems, the quality of ground, surface or water bodies will not be harmed, and that appropriate consideration is given to sources of pollution, and appropriate SuDS measures are incorporated to protect water quality. It further states that foul drainage to a public sewer should be provided wherever possible.
- **Policy CC/8: Sustainable Drainage Systems** – This policy states that all development proposals must incorporate appropriate SuDS features appropriate to the nature of the site and that these SuDS features meet the Non-statutory technical standard for design, along with provisions for the integration of SuDS, enhancement of biodiversity and that surface water is managed as close to its source and on the surface where it is practicable to do so. Furthermore, this policy also ensures that arrangements have been established for the whole life management and maintenance of surface water drainage systems.
- **Policy CC/9: Managing Flood Risk** – This policy states that all developments should pass the sequential test as established by the NPPF and finished floor levels should be 300mm above the 1 in 100-year flood level plus an allowance for climate change whilst there being no increase in flood risk elsewhere. This policy also states that the destination of discharge must obey the drainage hierarchy.

6.4 Existing Runoff Rates

6.4.1 An assessment of the equivalent greenfield surface water runoff rate from the proposed development area has been undertaken using Micro Drainage software and is summarised within **Table 6.1** below.

6.4.2 The entire site comprises a total of 402.0ha and is divided into 20 development parcels which total approximately 172.80ha, the remainder being used for public open space. Of the total developable area (172.80ha) an assumed impermeable area for each parcel has been used, depending on the use, to derive a contributing impermeable area. This gives a total contributing impermeable area of 116.13ha across 20 plots.

6.4.3 The runoff rates have been estimated using the IH124 method, calculated for a total area of 116.13ha which equates to the anticipated contributing impermeable area for the development to ensure a pre and post development comparison is representative as all other permeable areas will continue to drain as they currently do. Overall, the QBAR rate for the site equates to 2.18l/s/ha which has been used to pro-rata a rate for the discrete drainage catchments identified across the site.

Table 6.1 Equivalent Runoff Rates

Return Period (Years)	Runoff Rate (l/s)
1	220.0
Mean Annual Flow Rate (QBAR)	252.9
30	607.5
100	900.2

6.5 Existing Runoff Volume

6.5.1 An assessment of the surface water runoff volume from the proposed development area has been made for a 1 in 100-year 6-hour storm. As the site is currently undeveloped, this assessment has been carried out using the Source Control module within Micro Drainage (using FEH Data) to be 30,811m^3. Full results are included within **Appendix B**.

6.6 Drainage Hierarchy

6.6.1 The Planning Policy Guidance and the SuDS Manual identify that surface water from a development should be disposed of as high up the following hierarchy as reasonably practical.

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

6.6.2 CC policy also advocates for water re-use and recycling as the first stage of the hierarchy, and any scheme brought forward as part of a planning application should fully consider options for capturing, storing, and reusing rainwater where possible. However, for the purposes of this promotional support a drainage strategy has been put forward assuming the runoff expected has to be managed through the use of SuDS only.

6.6.3 The aim of this approach is to manage surface water runoff as close to where it falls as possible and in doing so, mimic the natural drainage regime as closely as possible.

6.6.4 When assessing the suitability of disposing surface water via infiltration, the underlying geology and the groundwater table must be considered. A review of British Geological Survey (BGS) mapping indicates that the site is underlain by a large area of superficial deposits, comprising Oadby Member (Diamicton).

6.6.5 The only bedrock underlying the site is shown to be West Walton Formation and Ampthill Clay Formation (Mudstone). This bedrock geology has a typically low permeability which would prevent effective infiltration.

6.6.6 The available information strongly indicates that discharging surface water via infiltration will be unfeasible. There may be scope for localised infiltration features, but a site wide strategy based on infiltration is deemed unsuitable. It is recommended that targeted infiltration testing is carried out at the earliest opportunity to discount infiltration as a means of discharge, otherwise provide suitable indicative results to be used to inform an infiltration-based strategy.

6.6.7 There are numerous watercourses and land drainage ditches which can be utilised throughout the site to discharge the surface water runoff from the various plots, and a connection to these will be sought in the first instance.

6.6.8 The proposed site does have direct frontage onto the Ermine Brook in the north east portion of the site, and direct access to the Eastern Brook in the southern portion. The north west portion of the site does have access to small drains to the west. Therefore, there is a suitable means of direct discharge from the proposed development into a watercourse for all portions of the site.

6.6.9 Due to the rural location of the site, the extent of public surface water sewers is limited in proximity to the site and therefore it is not feasible to discharge surface water to the public sewer.

6.7 Surface Water Attenuation

6.7.1 The overall area of the application site is approximately 402.0ha, this includes both development space and some areas of ancillary landscaping. Of this, the development space comprises 172.80ha. As the site has been divided into 20 distinct drainage catchments, each will have its own attenuation provision.

6.7.2 Residential plots have been given an assumed impermeability of 65% which accounts for footprint, driveways, access etc and excludes areas given over to gardens and communal green spaces. As this is dependent on the nature of the proposals and how much green space is present, the school plot has been given an anticipated impermeability of 50%, and a 90% impermeability has been applied to the employment and retail plots.

6.7.3 These figures may change as plans for the scheme evolve but these figures represent a conservative approach for the current outline strategy. Further refinement of impermeable areas and allowance for urban creep will need to be considered at later stages as individual development phases are brought forward.

6.7.4 A greenfield QBAR runoff rate for the site has been calculated based on its contributing impermeable area, as demonstrated in Error! Reference source not found. above. Detailed design should also ensure t here is no increase in the runoff rate for the 1 in 1-year event, in compliance with latest policy and best practice.

6.7.5 As a runoff rate restriction is required, it is necessary to provide surface water attenuation to balance the excess volume in a safe manner. Sufficient storage is provided for all events up to the 1 in 100-year storm with a 40% allowance for climate change for all development plots.

6.7.6 Details of the proposed plots, their percentage of impermeability and volume of attenuation required are included in **Table 6.2** . Corresponding plot references are included for reference on the drainage strategy drawing included as **Appendix C**.

Table 6.2 Plot areas, runoff rates and volumes of attenuation

Plot	Area (ha)	Impermeability (%)	Resultant Impermeable Area (ha)	Discharge Rate (l/s)	Volume of Attenuation (m³)
P1	28.19	65%	18.32	39.9	15869
P2	7.68	65%	4.99	10.9	4254
P3	10.86	50%	5.43	11.8	4632
P4	3.02	90%	2.71	5.9	2301
P5	2.53	65%	1.64	3.6	1388
P6	7.93	65%	5.15	11.2	4395
P7	40.98	65%	26.64	58.0	23204
P8	3.07	90%	2.76	6.0	2340
P9	8.42	65%	5.47	11.9	4669
P10	5.61	65%	3.64	7.9	3097
P11	6.94	90%	6.24	13.6	5334
P12	1.86	90%	1.67	3.6	1417
P13	3.78	90%	3.40	7.4	2888
P14	8.40	65%	5.46	11.9	4655
P15	3.11	90%	2.80	6.1	2368
P16	11.02	65%	7.16	15.6	6132
P17	9.23	65%	6.00	13.1	5121
P18	2.66	65%	1.73	3.8	1458
P19	3.04	65%	1.98	4.3	1670
P20	4.50	65%	2.93	6.4	2480
Total	**172.80**		**116.13**	**252.9**	**99,673**

6.7.7 The primary nature of these attenuation SuDS features is that of dry, grassed basins which fill up when storm events occur but do not have a permanent body of water. In line with existing design standards and best practice they have a total depth of 1.3m which provides 1m depth for water storage and 300mm as freeboard. A maintenance track around the top of the basin with a width of at least 3m is also provided to each basin.

6.7.8 These basins provide suitable storage capacity, treat the water by naturally filtering out contaminants, provide a pleasant green landscape when not attenuating runoff and enhance biodiversity through wildflower planting and the associated habitats that offers. This achieves all 4 pillars of good SuDS design.

6.7.9 The CCC Supplementary Planning Document also strongly recommends a landscape-led approach to the design of surface water drainage, retaining as many features above-ground as possible and incorporating larger ponds and basins into the place-making of the development.

6.7.10 These surface water attenuation SuDS have been positioned between the plot they serve and their respective receiving watercourse to facilitate gravity connections. A drainage strategy drawing, reference 104677-PEF-ZZ-XX-DR-CD-0500 shows an indicative location for the attenuation features and is included as **Appendix C.**

6.7.11 To complement these principal SuDS features, other measures should be included at detailed design to promote rainwater capture and localised source control measures, providing additional levels of treatment to surface water runoff. These include, but are not limited to;

- Rainwater harvesting systems
- Permeable paving
- Filter drains
- Rain gardens

6.7.12 It is recommended that the final layout uses the proposed road infrastructure to provide drainage exceedance routes (overland flood flow) through the development and towards the formal drainage features, for events in excess of the capacity of the drainage systems or in the event of there being a failure of part of the network (e.g., blockage/damage).

6.7.13 In addition to the volume of storage provided within the main attenuation basins, there will be additional capacity within the upstream pipes and manholes which has not been accounted for at this stage and therefore a further level of redundancy to the network is provided.

6.8 Maintenance

6.8.1 For the proposed surface water drainage system to function correctly, it will need to be appropriately maintained. There are essentially 3 possibilities for these maintenance responsibilities, they are:

- Anglian Water, as the local sewerage undertaker
- CCC, as LLFA
- A private management company

6.8.2 Furthermore, there are 3 discrete components to the system – the pipe network, the principal SuDS and ancillary SuDS (permeable paving, tree planters etc). A situation may arise whereby one of the bodies adopts a specific part of the network (the pipe network for example) but not one of the other components. In this case, a combination of adopting bodies may be required and agreements should be put in place to reflect this.

6.8.3 The maintenance schedule for the network must be comprehensive and detail the specific maintenance requirements for each element of the drainage system. The CIRIA SuDS Manual has extensive information relating to the maintenance of SuDS which should be consulted when specifying the requirements.

6.8.4 For pipes, manholes and gullies, both general practice and specific manufacturer maintenance protocols should be followed.

6.8.5 In the event that a management company adopts all, or some of the drainage network, requirements for the ongoing maintenance of the infrastructure should form part of the Operation and Maintenance (O&M) manual for the wider and application site, clearly detailing the extent of responsibility and features to be maintained. Any specialist or proprietary products specified should have a manufacturer specific maintenance regime which should be included. It is envisaged that the O&M manual will be developed at the detailed design stage. A summary of general best practice maintenance is given below.

- All drainage features should be situated in open areas which are readily accessible.
- Gullies, pipes, manholes and silt traps should be inspected and de-silted at least once per year,.
- Wherever permeable paving is incorporated it should be swept a minimum of every 6 months to maintain flow capacity of the joints between blocks.
- For the basins which are designed to be dry, they should be seeded with a wildflower grass seed mix that can tolerate wet ground conditions and should be mowed periodically over the summer months to ensure they do not become overgrown.
- For the basins which are designed to be wet, plants which are suitable for growing in permanent water should be used, such as bull rushes and reeds.
- Regular inspections of all basins should be undertaken to remove litter/debris, invasive/colonising vegetation, and silt build-up as necessary.
- Inlet and outlet structures should be regularly inspected with remedial work as required to ensure clear flow of water and the prevention of silt/vegetation build up.
- Flow control chambers should be inspected every 6 months to ensure proper function with any litter or debris removed as necessary.

7 Conclusions & Recommendations

7.1.1 This Flood Risk Assessment and Drainage Strategy has been prepared to support promotion of the 'The Kingsfields, Land to the West of Cambourne' for allocation as part of the emerging Local Plan. It details the risk of flooding to the site and how these can be managed, alongside presentation of a sustainable strategy for the management of surface water, to show how the scheme could be developed giving these constraints due consideration.

7.1.2 To summarise the findings of the FRA:

- The site is shown to be in Flood Zone 1 and so considered at low risk of flooding from fluvial and tidal sources. This means it is sequentially preferable and passes the Sequential Test.
- The underlying stratum for the area presents a low possibility of groundwater emergence, resulting in a low risk, but susceptibility from abnormally elevated groundwater.
- There are no sewers serving the site, with the nearest foul sewer along St Ives Road to the west of the site. These sewers have no identified manholes and as such the risk of surcharging remains low.
- Reservoirs to the east and west of the site are actively used and will be subject to a regular regime of monitoring and assessment. Furthermore, local topography, watercourses and waterbodies will limit the encroachment into the site.
- The risk of flooding from surface water mapping shows a moderate risk to the site, with areas of high risk being limited to the extents of the on-site watercourses. The residual risk outside of these defined boundaries is considered moderate and should be adequately mitigated through the introduction of a surface water drainage strategy.

7.1.3 Recommendations are made in respect of appropriate consideration of finished floor levels and external level deign to manage the residual risk of overland flows by conveying water away from dwellings and toward positively drained areas.

7.1.4 Runoff from a potential development should be restricted to an equivalent greenfield QBAR rate for all events up to the 100-year event, including a 40% increase in rainfall intensity to account for climate change. A number of strategic attenuation basins have been identified that could be incorporated within the scheme to show how the promoted allocation can be brought forward to include delivery of this infrastructure in line with local and national guidance.

7.1.5 In accordance with the requirements of the NPPF, this FRA has demonstrated the development could proceed without being subject to significant flood risk and complies within relevant Local Plan policies.

7.1.6 Furthermore, the development will not result in increased flood risk to third parties because of suitable management of surface water runoff.

Appendix A Sewer Records

Date: 06/11/20 | Scale: 1:1250 | Map Centre: 529540,259387 | Data updated: 30/09/20 | Our Ref: 456378 - 2 | Wastewater Plan A0

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station

*(Colour denotes effluent type)

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89945

CHECKED

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
1001	530146	259075	F	61.737	59.96	1.777
1002	530158	259080	F	-	-	-
1901	530174	258995	F	60.826	58.961	1.865
2901	530248	258909	F	57.683	56.236	1.447
2902	530205	258912	F	59.074	57.702	1.372

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Date: 06/11/20 | Scale: 1:1250 | Map Centre: 529690,258520 | Data updated: 30/09/20 | Our Ref: 456378 - 3 | Wastewater Plan A0

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station

*(Colour denotes effluent type)

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love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
1400	530148	258481	F	-	-	-
1401	530164	258474	F	-	-	-
1402	530152	258491	F	-	-	-
1500	530169	258510	F	-	-	-
1501	530187	258523	F	-	-	-
1901	530174	258995	F	60.826	58.961	1.865
2501	530295	258573	F	48.811	46.092	2.719
2502	530292	258569	F	48.881	47.168	1.713
2503	530283	258593	F	48.741	46.266	2.475
2504	530202	258531	F	-	-	-
2505	530204	258528	F	-	-	-
2506	530208	258524	F	-	-	-
2507	530211	258521	F	-	-	-
2508	530216	258516	F	-	-	-
2509	530219	258512	F	-	-	-
2510	530221	258507	F	-	-	-
2511	530225	258503	F	-	-	-
2601	530261	258646	F	48.95	47.527	1.423
2602	530257	258648	F	49.158	47.582	1.576
2603	530253	258670	F	49.884	47.912	1.972
2605	530219	258673	F	51.636	49.707	1.929
2701	530280	258743	F	-	-	-
2702	530249	258701	F	51.057	49.228	1.829
2801	530271	258839	F	-	-	-
2802	530258	258853	F	-	-	-
2901	530248	258909	F	57.683	56.236	1.447
2902	530205	258912	F	59.074	57.702	1.372
3001	530379	258062	F	45.016	43.644	1.372
3101	530389	258156	F	45.546	43.629	1.917
3201	530389	258287	F	50.588	49.155	1.433
3202	530392	258223	F	48.939	47.11	1.829
3301	530354	258379	F	53.998	52.538	1.46
3302	530347	258391	F	54.361	52.938	1.423
3401	530320	258475	F	51.55	49.685	1.865
3501	530304	258536	F	49.292	47.908	1.384
3601	530374	258644	F	49.356	45.47	3.886
3602	530333	258628	F	48.966	45.65	3.316
3603	530362	258694	F	51.127	49.74	1.387
3701	530369	258700	F	51.502	50.53	0.972
3702	530358	258755	F	-	-	-
3703	530331	258789	F	-	-	-
3801	530367	258834	F	-	-	-
3802	530315	258835	F	-	-	-
3803	530363	258834	F	-	-	-
3804	530362	258841	F	-	-	-
3805	530361	258851	F	-	-	-
4005	530415	258092	F	44.406	42.934	1.472
4102	530418	258169	F	44.866	43.394	1.472
4201	530407	258223	F	47.162	45.662	1.5
1451	530132	258455	S	47.045	45.55	1.495
1452	530143	258463	S	47.65	45.65	2
1453	530152	258485	S	47.84	45.815	2.025
1551	530181	258516	S	48.04	46.08	1.96
2551	530218	258566	S	48.8	46.66	2.14
2552	530237	258564	S	-	47.52	-
2553	530242	258548	S	-	47.9	-
2554	530258	258537	S	49.535	48.185	1.35
2555	530273	258519	S	50.26	48.91	1.35
2751	530265	258727	S	52.504	51.177	1.327
2752	530285	258729	S	53.118	50.966	2.152
3751	530338	258722	S	51.864	50.282	1.582
3752	530302	258717	S	53.091	50.71	2.381
3753	530349	258715	S	53.531	50.131	3.4

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix B Micro Drainage Results

ICP SUDS Mean Annual Flood

Input

Return Period (years)	10	Soil	0.400
Area (ha)	107.166	Urban	0.000
SAAR (mm)	550	Region Number	Region 5

Results	**l/s**
QBAR Rural	252.9
QBAR Urban	252.9
Q10 years	418.5
Q1 year	220.0
Q30 years	607.5
Q100 years	900.2

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Areal Reduction Factor	1.00
Area (ha)	116.133
SAAR (mm)	548
CWI	75.560
SPR Host	47.200
URBEXT (1990)	0.0000

Results

Percentage Runoff (%)	39.40
Greenfield Runoff Volume (m^3)	30810.616

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.184	0.484	39.8	7579.4	O K
30 min Summer	99.241	0.541	39.8	8492.7	O K
60 min Summer	99.304	0.604	39.8	9498.8	O K
120 min Summer	99.371	0.671	39.8	10589.9	O K
180 min Summer	99.412	0.712	39.8	11257.3	O K
240 min Summer	99.442	0.742	39.8	11736.8	O K
360 min Summer	99.483	0.783	39.8	12408.2	O K
480 min Summer	99.511	0.811	39.8	12865.6	O K
600 min Summer	99.531	0.831	39.8	13197.9	O K
720 min Summer	99.546	0.846	39.8	13447.9	O K
960 min Summer	99.565	0.865	39.8	13757.0	O K
1440 min Summer	99.581	0.881	39.8	14018.2	O K
2160 min Summer	99.578	0.878	39.8	13966.8	O K
2880 min Summer	99.560	0.860	39.8	13675.3	O K
4320 min Summer	99.521	0.821	39.8	13038.0	O K
5760 min Summer	99.484	0.784	39.8	12423.5	O K
7200 min Summer	99.444	0.744	39.8	11773.3	O K
8640 min Summer	99.405	0.705	39.8	11129.2	O K
10080 min Summer	99.367	0.667	39.8	10518.4	O K
15 min Winter	99.241	0.541	39.8	8493.0	O K
30 min Winter	99.305	0.605	39.8	9519.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	3383.3	31
30 min Summer	124.568	0.0	3379.9	46
60 min Summer	69.918	0.0	6531.9	76
120 min Summer	39.244	0.0	6643.4	134
180 min Summer	27.993	0.0	6563.4	194
240 min Summer	22.027	0.0	6469.2	254
360 min Summer	15.712	0.0	6278.3	374
480 min Summer	12.363	0.0	6122.5	492
600 min Summer	10.266	0.0	5992.1	612
720 min Summer	8.819	0.0	5877.8	730
960 min Summer	6.925	0.0	5678.7	968
1440 min Summer	4.926	0.0	5341.3	1446
2160 min Summer	3.504	0.0	11549.1	2160
2880 min Summer	2.751	0.0	10982.4	2688
4320 min Summer	1.949	0.0	9850.1	3372
5760 min Summer	1.526	0.0	18820.0	4144
7200 min Summer	1.262	0.0	19184.2	4904
8640 min Summer	1.081	0.0	19290.8	5704
10080 min Summer	0.948	0.0	19025.1	6456
15 min Winter	221.935	0.0	3395.5	31
30 min Winter	124.568	0.0	3363.5	45

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.375	0.675	39.8	10650.2	O K
120 min Winter	99.451	0.751	39.8	11881.4	O K
180 min Winter	99.497	0.797	39.8	12638.2	O K
240 min Winter	99.530	0.830	39.8	13181.5	O K
360 min Winter	99.576	0.876	39.8	13940.9	O K
480 min Winter	99.608	0.908	39.8	14460.6	O K
600 min Winter	99.631	0.931	39.8	14841.8	O K
720 min Winter	99.648	0.948	39.8	15131.1	O K
960 min Winter	99.670	0.970	39.8	15499.0	O K
1440 min Winter	99.691	0.991	39.8	15840.2	O K
2160 min Winter	99.692	0.992	39.8	15868.9	O K
2880 min Winter	99.678	0.978	39.8	15622.1	O K
4320 min Winter	99.625	0.925	39.8	14753.2	O K
5760 min Winter	99.579	0.879	39.8	13986.5	O K
7200 min Winter	99.530	0.830	39.8	13175.8	O K
8640 min Winter	99.477	0.777	39.8	12318.6	O K
10080 min Winter	99.420	0.720	39.8	11377.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	6695.8	74
120 min Winter	39.244	0.0	6568.1	134
180 min Winter	27.993	0.0	6425.3	192
240 min Winter	22.027	0.0	6321.8	250
360 min Winter	15.712	0.0	6178.1	368
480 min Winter	12.363	0.0	6075.7	484
600 min Winter	10.266	0.0	5994.4	602
720 min Winter	8.819	0.0	5926.0	720
960 min Winter	6.925	0.0	5810.5	952
1440 min Winter	4.926	0.0	5629.9	1414
2160 min Winter	3.504	0.0	11756.7	2096
2880 min Winter	2.751	0.0	11279.8	2748
4320 min Winter	1.949	0.0	10345.4	3512
5760 min Winter	1.526	0.0	20841.2	4392
7200 min Winter	1.262	0.0	20964.0	5336
8640 min Winter	1.081	0.0	20643.5	6232
10080 min Winter	0.948	0.0	20014.7	7064

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 18.320

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	4.580	4	8	4.580	8	12	4.580	12	16	4.580

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	15327.5	1.000	16672.4	1.300	17086.9

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0267-3990-1000-3990
Design Head (m)	1.000
Design Flow (l/s)	39.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	267
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	39.9
Flush-Flo™	0.417	39.8
Kick-Flo®	0.766	35.1
Mean Flow over Head Range	-	32.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.5	1.200	43.5	3.000	67.8	7.000	102.4
0.200	27.5	1.400	46.9	3.500	73.1	7.500	105.9
0.300	39.0	1.600	50.0	4.000	78.0	8.000	109.3
0.400	39.8	1.800	52.9	4.500	82.6	8.500	112.6
0.500	39.5	2.000	55.7	5.000	86.9	9.000	115.8
0.600	38.7	2.200	58.3	5.500	91.0	9.500	118.9
0.800	35.8	2.400	60.8	6.000	95.0		
1.000	39.9	2.600	63.3	6.500	98.8		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.201	0.501	10.9	2065.9	O K
30 min Summer	99.259	0.559	10.9	2314.5	O K
60 min Summer	99.322	0.622	10.9	2587.7	O K
120 min Summer	99.389	0.689	10.9	2883.3	O K
180 min Summer	99.429	0.729	10.9	3063.0	O K
240 min Summer	99.458	0.758	10.9	3190.8	O K
360 min Summer	99.497	0.797	10.9	3366.7	O K
480 min Summer	99.523	0.823	10.9	3484.1	O K
600 min Summer	99.542	0.842	10.9	3567.8	O K
720 min Summer	99.555	0.855	10.9	3629.4	O K
960 min Summer	99.571	0.871	10.9	3701.1	O K
1440 min Summer	99.581	0.881	10.9	3749.2	O K
2160 min Summer	99.572	0.872	10.9	3704.5	O K
2880 min Summer	99.548	0.848	10.9	3598.6	O K
4320 min Summer	99.500	0.800	10.9	3382.1	O K
5760 min Summer	99.457	0.757	10.9	3184.9	O K
7200 min Summer	99.414	0.714	10.9	2995.9	O K
8640 min Summer	99.370	0.670	10.9	2799.9	O K
10080 min Summer	99.326	0.626	10.9	2605.4	O K
15 min Winter	99.259	0.559	10.9	2315.0	O K
30 min Winter	99.323	0.623	10.9	2594.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	923.5	27
30 min Summer	124.568	0.0	908.2	42
60 min Summer	69.918	0.0	1816.0	72
120 min Summer	39.244	0.0	1761.0	132
180 min Summer	27.993	0.0	1716.7	190
240 min Summer	22.027	0.0	1686.5	250
360 min Summer	15.712	0.0	1645.9	370
480 min Summer	12.363	0.0	1617.8	490
600 min Summer	10.266	0.0	1596.1	608
720 min Summer	8.819	0.0	1578.4	728
960 min Summer	6.925	0.0	1550.3	966
1440 min Summer	4.926	0.0	1513.4	1444
2160 min Summer	3.504	0.0	3174.9	2160
2880 min Summer	2.751	0.0	3051.8	2688
4320 min Summer	1.949	0.0	2803.6	3376
5760 min Summer	1.526	0.0	5325.8	4152
7200 min Summer	1.262	0.0	5447.4	4968
8640 min Summer	1.081	0.0	5505.0	5792
10080 min Summer	0.948	0.0	5451.0	6472
15 min Winter	221.935	0.0	912.0	27
30 min Winter	124.568	0.0	888.1	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.393	0.693	10.9	2901.7	O K
120 min Winter	99.468	0.768	10.9	3234.8	O K
180 min Winter	99.513	0.813	10.9	3437.6	O K
240 min Winter	99.545	0.845	10.9	3582.4	O K
360 min Winter	99.589	0.889	10.9	3783.5	O K
480 min Winter	99.619	0.919	10.9	3919.4	O K
600 min Winter	99.640	0.940	10.9	4017.7	O K
720 min Winter	99.656	0.956	10.9	4091.2	O K
960 min Winter	99.675	0.975	10.9	4181.0	O K
1440 min Winter	99.691	0.991	10.9	4254.4	O K
2160 min Winter	99.687	0.987	10.9	4235.5	O K
2880 min Winter	99.667	0.967	10.9	4144.4	O K
4320 min Winter	99.607	0.907	10.9	3865.8	O K
5760 min Winter	99.554	0.854	10.9	3623.8	O K
7200 min Winter	99.500	0.800	10.9	3378.6	O K
8640 min Winter	99.444	0.744	10.9	3130.2	O K
10080 min Winter	99.386	0.686	10.9	2870.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1771.6	72
120 min Winter	39.244	0.0	1707.7	130
180 min Winter	27.993	0.0	1677.0	188
240 min Winter	22.027	0.0	1658.5	246
360 min Winter	15.712	0.0	1637.7	364
480 min Winter	12.363	0.0	1627.5	482
600 min Winter	10.266	0.0	1623.6	600
720 min Winter	8.819	0.0	1624.4	716
960 min Winter	6.925	0.0	1625.3	952
1440 min Winter	4.926	0.0	1601.2	1414
2160 min Winter	3.504	0.0	3225.7	2096
2880 min Winter	2.751	0.0	3131.3	2744
4320 min Winter	1.949	0.0	2957.0	3544
5760 min Winter	1.526	0.0	5907.2	4392
7200 min Winter	1.262	0.0	5957.4	5336
8640 min Winter	1.081	0.0	5784.5	6304
10080 min Winter	0.948	0.0	5578.2	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.992

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.664	4	8	1.664	8	12	1.664

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3951.4	1.000	4648.2	1.300	4868.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0152-1090-1000-1090
Design Head (m)	1.000
Design Flow (l/s)	10.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	152
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	10.9
Flush-Flo™	0.306	10.9
Kick-Flo®	0.680	9.1
Mean Flow over Head Range	-	9.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.5	1.200	11.9	3.000	18.3	7.000	27.6
0.200	10.6	1.400	12.8	3.500	19.7	7.500	28.5
0.300	10.9	1.600	13.6	4.000	21.1	8.000	29.4
0.400	10.8	1.800	14.4	4.500	22.3	8.500	30.3
0.500	10.5	2.000	15.1	5.000	23.4	9.000	31.1
0.600	10.0	2.200	15.8	5.500	24.5	9.500	31.9
0.800	9.8	2.400	16.5	6.000	25.6		
1.000	10.9	2.600	17.1	6.500	26.6		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.203	0.503	11.8	2246.9	O K
30 min Summer	99.261	0.561	11.8	2517.3	O K
60 min Summer	99.324	0.624	11.8	2814.5	O K
120 min Summer	99.392	0.692	11.8	3136.2	O K
180 min Summer	99.433	0.733	11.8	3331.9	O K
240 min Summer	99.462	0.762	11.8	3471.2	O K
360 min Summer	99.501	0.801	11.8	3663.0	O K
480 min Summer	99.527	0.827	11.8	3791.2	O K
600 min Summer	99.546	0.846	11.8	3882.7	O K
720 min Summer	99.560	0.860	11.8	3950.2	O K
960 min Summer	99.576	0.876	11.8	4029.1	O K
1440 min Summer	99.587	0.887	11.8	4083.1	O K
2160 min Summer	99.578	0.878	11.8	4036.9	O K
2880 min Summer	99.554	0.854	11.8	3923.8	O K
4320 min Summer	99.507	0.807	11.8	3691.4	O K
5760 min Summer	99.463	0.763	11.8	3479.4	O K
7200 min Summer	99.421	0.721	11.8	3276.3	O K
8640 min Summer	99.377	0.677	11.8	3067.5	O K
10080 min Summer	99.333	0.633	11.8	2856.2	O K
15 min Winter	99.261	0.561	11.8	2517.8	O K
30 min Winter	99.326	0.626	11.8	2821.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	999.3	27
30 min Summer	124.568	0.0	982.8	42
60 min Summer	69.918	0.0	1965.5	72
120 min Summer	39.244	0.0	1906.3	132
180 min Summer	27.993	0.0	1858.7	190
240 min Summer	22.027	0.0	1826.3	250
360 min Summer	15.712	0.0	1782.7	370
480 min Summer	12.363	0.0	1752.5	490
600 min Summer	10.266	0.0	1729.1	608
720 min Summer	8.819	0.0	1709.9	728
960 min Summer	6.925	0.0	1679.4	966
1440 min Summer	4.926	0.0	1638.9	1444
2160 min Summer	3.504	0.0	3435.9	2160
2880 min Summer	2.751	0.0	3302.2	2688
4320 min Summer	1.949	0.0	3032.6	3376
5760 min Summer	1.526	0.0	5781.4	4152
7200 min Summer	1.262	0.0	5908.7	4968
8640 min Summer	1.081	0.0	5961.0	5792
10080 min Summer	0.948	0.0	5891.6	6552
15 min Winter	221.935	0.0	987.0	27
30 min Winter	124.568	0.0	961.4	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.396	0.696	11.8	3156.0	O K
120 min Winter	99.471	0.771	11.8	3518.5	O K
180 min Winter	99.517	0.817	11.8	3739.3	O K
240 min Winter	99.549	0.849	11.8	3897.0	O K
360 min Winter	99.594	0.894	11.8	4116.2	O K
480 min Winter	99.624	0.924	11.8	4264.4	O K
600 min Winter	99.645	0.945	11.8	4371.7	O K
720 min Winter	99.661	0.961	11.8	4452.1	O K
960 min Winter	99.681	0.981	11.8	4550.6	O K
1440 min Winter	99.697	0.997	11.8	4632.1	O K
2160 min Winter	99.694	0.994	11.8	4613.9	O K
2880 min Winter	99.674	0.974	11.8	4516.8	O K
4320 min Winter	99.614	0.914	11.8	4217.2	O K
5760 min Winter	99.561	0.861	11.8	3956.9	O K
7200 min Winter	99.507	0.807	11.8	3692.9	O K
8640 min Winter	99.452	0.752	11.8	3425.5	O K
10080 min Winter	99.394	0.694	11.8	3148.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1918.0	72
120 min Winter	39.244	0.0	1849.7	130
180 min Winter	27.993	0.0	1817.0	188
240 min Winter	22.027	0.0	1797.5	246
360 min Winter	15.712	0.0	1775.4	364
480 min Winter	12.363	0.0	1764.6	482
600 min Winter	10.266	0.0	1760.6	600
720 min Winter	8.819	0.0	1761.5	716
960 min Winter	6.925	0.0	1762.1	952
1440 min Winter	4.926	0.0	1734.8	1414
2160 min Winter	3.504	0.0	3494.3	2096
2880 min Winter	2.751	0.0	3391.9	2744
4320 min Winter	1.949	0.0	3202.1	3544
5760 min Winter	1.526	0.0	6409.1	4392
7200 min Winter	1.262	0.0	6455.0	5336
8640 min Winter	1.081	0.0	6255.3	6240
10080 min Winter	0.948	0.0	6019.6	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 5.429

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.810	4	8	1.810	8	12	1.810

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4287.6	1.000	5012.2	1.300	5240.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0157-1180-1000-1180
Design Head (m)	1.000
Design Flow (l/s)	11.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	157
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.8
Flush-Flo™	0.308	11.8
Kick-Flo®	0.683	9.9
Mean Flow over Head Range	-	10.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	12.9	3.000	19.9	7.000	29.9
0.200	11.4	1.400	13.8	3.500	21.4	7.500	30.9
0.300	11.8	1.600	14.7	4.000	22.8	8.000	31.9
0.400	11.7	1.800	15.6	4.500	24.1	8.500	32.8
0.500	11.4	2.000	16.4	5.000	25.4	9.000	33.7
0.600	10.9	2.200	17.1	5.500	26.6	9.500	34.6
0.800	10.6	2.400	17.9	6.000	27.7		
1.000	11.8	2.600	18.6	6.500	28.8		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.215	0.515	5.9	1123.4	O K
30 min Summer	99.273	0.573	5.9	1258.6	O K
60 min Summer	99.336	0.636	5.9	1407.2	O K
120 min Summer	99.403	0.703	5.9	1567.3	O K
180 min Summer	99.443	0.743	5.9	1664.1	O K
240 min Summer	99.471	0.771	5.9	1732.8	O K
360 min Summer	99.510	0.810	5.9	1826.9	O K
480 min Summer	99.535	0.835	5.9	1889.2	O K
600 min Summer	99.553	0.853	5.9	1933.4	O K
720 min Summer	99.566	0.866	5.9	1965.6	O K
960 min Summer	99.580	0.880	5.9	2002.0	O K
1440 min Summer	99.589	0.889	5.9	2023.5	O K
2160 min Summer	99.577	0.877	5.9	1993.1	O K
2880 min Summer	99.552	0.852	5.9	1930.4	O K
4320 min Summer	99.501	0.801	5.9	1804.9	O K
5760 min Summer	99.455	0.755	5.9	1693.8	O K
7200 min Summer	99.413	0.713	5.9	1590.6	O K
8640 min Summer	99.371	0.671	5.9	1490.6	O K
10080 min Summer	99.327	0.627	5.9	1384.2	O K
15 min Winter	99.273	0.573	5.9	1259.0	O K
30 min Winter	99.338	0.638	5.9	1410.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	496.2	27
30 min Summer	124.568	0.0	484.2	42
60 min Summer	69.918	0.0	966.8	72
120 min Summer	39.244	0.0	928.7	132
180 min Summer	27.993	0.0	907.6	190
240 min Summer	22.027	0.0	893.9	250
360 min Summer	15.712	0.0	876.4	370
480 min Summer	12.363	0.0	865.5	490
600 min Summer	10.266	0.0	858.3	608
720 min Summer	8.819	0.0	853.4	728
960 min Summer	6.925	0.0	848.3	966
1440 min Summer	4.926	0.0	839.5	1444
2160 min Summer	3.504	0.0	1724.1	2160
2880 min Summer	2.751	0.0	1664.9	2688
4320 min Summer	1.949	0.0	1546.3	3380
5760 min Summer	1.526	0.0	2925.6	4152
7200 min Summer	1.262	0.0	2995.9	4976
8640 min Summer	1.081	0.0	3016.7	5800
10080 min Summer	0.948	0.0	2967.3	6560
15 min Winter	221.935	0.0	486.2	27
30 min Winter	124.568	0.0	464.4	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.408	0.708	5.9	1577.8	O K
120 min Winter	99.482	0.782	5.9	1758.2	O K
180 min Winter	99.526	0.826	5.9	1867.9	O K
240 min Winter	99.558	0.858	5.9	1946.0	O K
360 min Winter	99.601	0.901	5.9	2054.2	O K
480 min Winter	99.630	0.930	5.9	2127.0	O K
600 min Winter	99.651	0.951	5.9	2179.3	O K
720 min Winter	99.666	0.966	5.9	2218.3	O K
960 min Winter	99.684	0.984	5.9	2265.1	O K
1440 min Winter	99.698	0.998	5.9	2301.2	O K
2160 min Winter	99.692	0.992	5.9	2285.8	O K
2880 min Winter	99.671	0.971	5.9	2231.9	O K
4320 min Winter	99.609	0.909	5.9	2073.1	O K
5760 min Winter	99.554	0.854	5.9	1936.8	O K
7200 min Winter	99.499	0.799	5.9	1801.5	O K
8640 min Winter	99.444	0.744	5.9	1667.0	O K
10080 min Winter	99.388	0.688	5.9	1531.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	933.9	72
120 min Winter	39.244	0.0	903.6	130
180 min Winter	27.993	0.0	890.5	188
240 min Winter	22.027	0.0	883.8	246
360 min Winter	15.712	0.0	879.4	364
480 min Winter	12.363	0.0	881.7	482
600 min Winter	10.266	0.0	887.8	600
720 min Winter	8.819	0.0	892.3	716
960 min Winter	6.925	0.0	894.2	952
1440 min Winter	4.926	0.0	883.8	1414
2160 min Winter	3.504	0.0	1751.9	2096
2880 min Winter	2.751	0.0	1711.4	2744
4320 min Winter	1.949	0.0	1636.4	3548
5760 min Winter	1.526	0.0	3247.4	4432
7200 min Winter	1.262	0.0	3270.4	5336
8640 min Winter	1.081	0.0	3152.2	6304
10080 min Winter	0.948	0.0	3016.4	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.715

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.905	4	8	0.905	8	12	0.905

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	2054.7	1.000	2565.0	1.300	2729.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0114-5900-1000-5900
Design Head (m)	1.000
Design Flow (l/s)	5.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	114
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	5.9
Flush-Flo™	0.295	5.9
Kick-Flo®	0.645	4.8
Mean Flow over Head Range	-	5.1

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	4.0	1.200	6.4	3.000	9.9	7.000	14.8
0.200	5.7	1.400	6.9	3.500	10.6	7.500	15.3
0.300	5.9	1.600	7.3	4.000	11.3	8.000	15.8
0.400	5.8	1.800	7.8	4.500	12.0	8.500	16.2
0.500	5.6	2.000	8.2	5.000	12.6	9.000	16.7
0.600	5.2	2.200	8.5	5.500	13.2	9.500	17.1
0.800	5.3	2.400	8.9	6.000	13.7		
1.000	5.9	2.600	9.2	6.500	14.3		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.220	0.520	3.6	680.6	O K
30 min Summer	99.277	0.577	3.6	762.4	O K
60 min Summer	99.339	0.639	3.6	852.3	O K
120 min Summer	99.405	0.705	3.6	948.9	O K
180 min Summer	99.444	0.744	3.6	1007.1	O K
240 min Summer	99.471	0.771	3.6	1048.4	O K
360 min Summer	99.508	0.808	3.6	1104.7	O K
480 min Summer	99.533	0.833	3.6	1141.8	O K
600 min Summer	99.550	0.850	3.6	1167.9	O K
720 min Summer	99.562	0.862	3.6	1186.8	O K
960 min Summer	99.575	0.875	3.6	1207.7	O K
1440 min Summer	99.582	0.882	3.6	1218.4	O K
2160 min Summer	99.568	0.868	3.6	1197.0	O K
2880 min Summer	99.542	0.842	3.6	1156.6	O K
4320 min Summer	99.490	0.790	3.6	1077.1	O K
5760 min Summer	99.444	0.744	3.6	1007.7	O K
7200 min Summer	99.402	0.702	3.6	944.2	O K
8640 min Summer	99.361	0.661	3.6	883.2	O K
10080 min Summer	99.316	0.616	3.6	818.6	O K
15 min Winter	99.277	0.577	3.6	762.7	O K
30 min Winter	99.341	0.641	3.6	854.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	302.4	27
30 min Summer	124.568	0.0	293.8	42
60 min Summer	69.918	0.0	585.6	72
120 min Summer	39.244	0.0	563.1	132
180 min Summer	27.993	0.0	550.8	190
240 min Summer	22.027	0.0	542.8	250
360 min Summer	15.712	0.0	533.1	370
480 min Summer	12.363	0.0	527.4	490
600 min Summer	10.266	0.0	524.1	608
720 min Summer	8.819	0.0	522.3	728
960 min Summer	6.925	0.0	521.6	966
1440 min Summer	4.926	0.0	517.7	1444
2160 min Summer	3.504	0.0	1056.9	2160
2880 min Summer	2.751	0.0	1022.7	2688
4320 min Summer	1.949	0.0	953.9	3376
5760 min Summer	1.526	0.0	1783.5	4152
7200 min Summer	1.262	0.0	1830.6	4968
8640 min Summer	1.081	0.0	1848.7	5800
10080 min Summer	0.948	0.0	1821.0	6560
15 min Winter	221.935	0.0	295.0	27
30 min Winter	124.568	0.0	278.8	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.410	0.710	3.6	955.6	O K
120 min Winter	99.482	0.782	3.6	1064.6	O K
180 min Winter	99.525	0.825	3.6	1130.7	O K
240 min Winter	99.556	0.856	3.6	1177.8	O K
360 min Winter	99.598	0.898	3.6	1242.7	O K
480 min Winter	99.625	0.925	3.6	1286.2	O K
600 min Winter	99.645	0.945	3.6	1317.4	O K
720 min Winter	99.660	0.960	3.6	1340.5	O K
960 min Winter	99.677	0.977	3.6	1367.8	O K
1440 min Winter	99.689	0.989	3.6	1387.8	O K
2160 min Winter	99.682	0.982	3.6	1375.8	O K
2880 min Winter	99.660	0.960	3.6	1340.7	O K
4320 min Winter	99.596	0.896	3.6	1240.8	O K
5760 min Winter	99.542	0.842	3.6	1155.7	O K
7200 min Winter	99.487	0.787	3.6	1072.2	O K
8640 min Winter	99.432	0.732	3.6	989.8	O K
10080 min Winter	99.377	0.677	3.6	907.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	565.9	72
120 min Winter	39.244	0.0	548.1	130
180 min Winter	27.993	0.0	540.6	188
240 min Winter	22.027	0.0	537.1	246
360 min Winter	15.712	0.0	536.0	364
480 min Winter	12.363	0.0	539.2	482
600 min Winter	10.266	0.0	543.9	600
720 min Winter	8.819	0.0	546.8	716
960 min Winter	6.925	0.0	548.5	950
1440 min Winter	4.926	0.0	543.3	1414
2160 min Winter	3.504	0.0	1071.6	2096
2880 min Winter	2.751	0.0	1049.4	2744
4320 min Winter	1.949	0.0	1007.6	3544
5760 min Winter	1.526	0.0	1983.3	4400
7200 min Winter	1.262	0.0	2003.2	5336
8640 min Winter	1.081	0.0	1934.1	6304
10080 min Winter	0.948	0.0	1852.2	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.645

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.548	4	8	0.548	8	12	0.548

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1210.8	1.000	1609.1	1.300	1739.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0090-3600-1000-3600
Design Head (m)	1.000
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.6
Flush-Flo™	0.300	3.6
Kick-Flo®	0.631	2.9
Mean Flow over Head Range	-	3.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.9	3.000	6.0	7.000	9.0
0.200	3.5	1.400	4.2	3.500	6.5	7.500	9.3
0.300	3.6	1.600	4.5	4.000	6.9	8.000	9.5
0.400	3.5	1.800	4.7	4.500	7.3	8.500	9.8
0.500	3.4	2.000	5.0	5.000	7.6	9.000	10.1
0.600	3.1	2.200	5.2	5.500	8.0	9.500	10.4
0.800	3.2	2.400	5.4	6.000	8.3		
1.000	3.6	2.600	5.6	6.500	8.6		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.200	0.500	11.2	2132.2	O K
30 min Summer	99.257	0.557	11.2	2388.8	O K
60 min Summer	99.320	0.620	11.2	2670.8	O K
120 min Summer	99.387	0.687	11.2	2975.9	O K
180 min Summer	99.427	0.727	11.2	3161.6	O K
240 min Summer	99.456	0.756	11.2	3293.8	O K
360 min Summer	99.495	0.795	11.2	3475.8	O K
480 min Summer	99.521	0.821	11.2	3597.3	O K
600 min Summer	99.540	0.840	11.2	3684.2	O K
720 min Summer	99.553	0.853	11.2	3748.1	O K
960 min Summer	99.569	0.869	11.2	3823.0	O K
1440 min Summer	99.580	0.880	11.2	3874.1	O K
2160 min Summer	99.571	0.871	11.2	3830.2	O K
2880 min Summer	99.548	0.848	11.2	3722.3	O K
4320 min Summer	99.500	0.800	11.2	3500.1	O K
5760 min Summer	99.457	0.757	11.2	3297.5	O K
7200 min Summer	99.414	0.714	11.2	3103.1	O K
8640 min Summer	99.370	0.670	11.2	2900.3	O K
10080 min Summer	99.326	0.626	11.2	2701.4	O K
15 min Winter	99.257	0.557	11.2	2389.3	O K
30 min Winter	99.321	0.621	11.2	2677.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	949.5	27
30 min Summer	124.568	0.0	934.3	42
60 min Summer	69.918	0.0	1868.0	72
120 min Summer	39.244	0.0	1814.2	132
180 min Summer	27.993	0.0	1768.3	190
240 min Summer	22.027	0.0	1736.8	250
360 min Summer	15.712	0.0	1694.3	370
480 min Summer	12.363	0.0	1664.8	490
600 min Summer	10.266	0.0	1642.0	608
720 min Summer	8.819	0.0	1623.2	728
960 min Summer	6.925	0.0	1593.2	966
1440 min Summer	4.926	0.0	1553.3	1444
2160 min Summer	3.504	0.0	3262.9	2160
2880 min Summer	2.751	0.0	3135.9	2692
4320 min Summer	1.949	0.0	2879.8	3380
5760 min Summer	1.526	0.0	5490.2	4152
7200 min Summer	1.262	0.0	5613.3	4976
8640 min Summer	1.081	0.0	5669.8	5792
10080 min Summer	0.948	0.0	5605.9	6472
15 min Winter	221.935	0.0	938.3	27
30 min Winter	124.568	0.0	914.8	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.391	0.691	11.2	2994.8	O K
120 min Winter	99.466	0.766	11.2	3338.8	O K
180 min Winter	99.511	0.811	11.2	3548.3	O K
240 min Winter	99.543	0.843	11.2	3698.0	O K
360 min Winter	99.587	0.887	11.2	3905.9	O K
480 min Winter	99.616	0.916	11.2	4046.6	O K
600 min Winter	99.638	0.938	11.2	4148.4	O K
720 min Winter	99.654	0.954	11.2	4224.6	O K
960 min Winter	99.673	0.973	11.2	4318.0	O K
1440 min Winter	99.690	0.990	11.2	4395.3	O K
2160 min Winter	99.686	0.986	11.2	4377.9	O K
2880 min Winter	99.667	0.967	11.2	4285.6	O K
4320 min Winter	99.607	0.907	11.2	4000.0	O K
5760 min Winter	99.554	0.854	11.2	3751.7	O K
7200 min Winter	99.500	0.800	11.2	3500.0	O K
8640 min Winter	99.445	0.745	11.2	3244.7	O K
10080 min Winter	99.387	0.687	11.2	2977.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1825.1	72
120 min Winter	39.244	0.0	1758.6	130
180 min Winter	27.993	0.0	1726.5	188
240 min Winter	22.027	0.0	1707.1	246
360 min Winter	15.712	0.0	1684.7	364
480 min Winter	12.363	0.0	1673.4	482
600 min Winter	10.266	0.0	1668.5	600
720 min Winter	8.819	0.0	1668.3	716
960 min Winter	6.925	0.0	1668.9	952
1440 min Winter	4.926	0.0	1643.7	1414
2160 min Winter	3.504	0.0	3315.2	2096
2880 min Winter	2.751	0.0	3217.5	2744
4320 min Winter	1.949	0.0	3036.4	3548
5760 min Winter	1.526	0.0	6086.5	4432
7200 min Winter	1.262	0.0	6131.0	5336
8640 min Winter	1.081	0.0	5945.1	6304
10080 min Winter	0.948	0.0	5735.2	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 5.152

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.717	4	8	1.717	8	12	1.717

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4095.5	1.000	4804.4	1.300	5028.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0154-1120-1000-1120
Design Head (m)	1.000
Design Flow (l/s)	11.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	154
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.2
Flush-Flo™	0.308	11.2
Kick-Flo®	0.683	9.4
Mean Flow over Head Range	-	9.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.5	1.200	12.2	3.000	18.9	7.000	28.3
0.200	10.8	1.400	13.1	3.500	20.3	7.500	29.3
0.300	11.2	1.600	14.0	4.000	21.6	8.000	30.2
0.400	11.1	1.800	14.8	4.500	22.9	8.500	31.1
0.500	10.8	2.000	15.5	5.000	24.1	9.000	32.0
0.600	10.3	2.200	16.3	5.500	25.2	9.500	32.8
0.800	10.1	2.400	17.0	6.000	26.3		
1.000	11.2	2.600	17.6	6.500	27.3		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.182	0.482	58.0	11023.3	O K
30 min Summer	99.239	0.539	58.0	12351.1	O K
60 min Summer	99.301	0.601	58.0	13814.8	O K
120 min Summer	99.369	0.669	58.0	15403.5	O K
180 min Summer	99.410	0.710	58.0	16376.0	O K
240 min Summer	99.440	0.740	58.0	17074.8	O K
360 min Summer	99.481	0.781	58.0	18054.3	O K
480 min Summer	99.509	0.809	58.0	18728.8	O K
600 min Summer	99.530	0.830	58.0	19221.8	O K
720 min Summer	99.546	0.846	58.0	19595.1	O K
960 min Summer	99.565	0.865	58.0	20063.0	O K
1440 min Summer	99.583	0.883	58.0	20476.9	O K
2160 min Summer	99.581	0.881	58.0	20447.1	O K
2880 min Summer	99.565	0.865	58.0	20064.0	O K
4320 min Summer	99.530	0.830	58.0	19209.1	O K
5760 min Summer	99.494	0.794	58.0	18359.3	O K
7200 min Summer	99.456	0.756	58.0	17468.8	O K
8640 min Summer	99.419	0.719	58.0	16594.2	O K
10080 min Summer	99.384	0.684	58.0	15754.1	O K
15 min Winter	99.239	0.539	58.0	12351.1	O K
30 min Winter	99.303	0.603	58.0	13843.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	4861.8	31
30 min Summer	124.568	0.0	4914.7	46
60 min Summer	69.918	0.0	9233.3	76
120 min Summer	39.244	0.0	9635.0	134
180 min Summer	27.993	0.0	9605.7	194
240 min Summer	22.027	0.0	9502.2	254
360 min Summer	15.712	0.0	9266.8	372
480 min Summer	12.363	0.0	9029.9	492
600 min Summer	10.266	0.0	8821.4	612
720 min Summer	8.819	0.0	8635.5	730
960 min Summer	6.925	0.0	8308.0	968
1440 min Summer	4.926	0.0	7743.6	1446
2160 min Summer	3.504	0.0	16792.7	2160
2880 min Summer	2.751	0.0	15928.6	2688
4320 min Summer	1.949	0.0	14180.0	3344
5760 min Summer	1.526	0.0	26949.2	4104
7200 min Summer	1.262	0.0	27432.2	4896
8640 min Summer	1.081	0.0	27537.1	5632
10080 min Summer	0.948	0.0	27139.7	6456
15 min Winter	221.935	0.0	4937.2	31
30 min Winter	124.568	0.0	4923.2	45

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.373	0.673	58.0	15488.6	O K
120 min Winter	99.448	0.748	58.0	17280.2	O K
180 min Winter	99.495	0.795	58.0	18383.4	O K
240 min Winter	99.528	0.828	58.0	19178.2	O K
360 min Winter	99.575	0.875	58.0	20291.5	O K
480 min Winter	99.607	0.907	58.0	21055.5	O K
600 min Winter	99.630	0.930	58.0	21617.7	O K
720 min Winter	99.648	0.948	58.0	22046.3	O K
960 min Winter	99.671	0.971	58.0	22596.4	O K
1440 min Winter	99.693	0.993	58.0	23121.5	O K
2160 min Winter	99.696	0.996	58.0	23203.7	O K
2880 min Winter	99.683	0.983	58.0	22881.7	O K
4320 min Winter	99.633	0.933	58.0	21688.3	O K
5760 min Winter	99.589	0.889	58.0	20632.7	O K
7200 min Winter	99.542	0.842	58.0	19500.8	O K
8640 min Winter	99.490	0.790	58.0	18274.0	O K
10080 min Winter	99.435	0.735	58.0	16974.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	9700.2	74
120 min Winter	39.244	0.0	9657.5	132
180 min Winter	27.993	0.0	9490.0	192
240 min Winter	22.027	0.0	9331.6	250
360 min Winter	15.712	0.0	9098.8	368
480 min Winter	12.363	0.0	8925.4	484
600 min Winter	10.266	0.0	8783.3	602
720 min Winter	8.819	0.0	8660.5	720
960 min Winter	6.925	0.0	8447.0	952
1440 min Winter	4.926	0.0	8098.4	1414
2160 min Winter	3.504	0.0	17107.7	2096
2880 min Winter	2.751	0.0	16356.7	2748
4320 min Winter	1.949	0.0	14875.3	3512
5760 min Winter	1.526	0.0	29841.8	4392
7200 min Winter	1.262	0.0	30015.0	5336
8640 min Winter	1.081	0.0	29686.0	6232
10080 min Winter	0.948	0.0	28804.3	7064

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 26.637

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	6.659	4	8	6.659	8	12	6.659	12	16	6.659

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	22488.1	1.000	24111.1	1.300	24609.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0313-5800-1000-5800
Design Head (m)	1.000
Design Flow (l/s)	58.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	313
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	58.0
Flush-Flo™	0.466	58.0
Kick-Flo®	0.796	52.0
Mean Flow over Head Range	-	46.1

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	9.4	1.200	63.3	3.000	98.8	7.000	149.4
0.200	32.1	1.400	68.2	3.500	106.5	7.500	154.5
0.300	55.7	1.600	72.8	4.000	113.6	8.000	159.5
0.400	57.7	1.800	77.1	4.500	120.4	8.500	164.3
0.500	57.9	2.000	81.1	5.000	126.7	9.000	168.9
0.600	57.0	2.200	84.9	5.500	132.8	9.500	173.5
0.800	52.1	2.400	88.6	6.000	138.5		
1.000	58.0	2.600	92.1	6.500	144.1		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.214	0.514	6.0	1142.1	O K
30 min Summer	99.273	0.573	6.0	1279.5	O K
60 min Summer	99.336	0.636	6.0	1430.5	O K
120 min Summer	99.403	0.703	6.0	1593.3	O K
180 min Summer	99.443	0.743	6.0	1691.8	O K
240 min Summer	99.471	0.771	6.0	1761.6	O K
360 min Summer	99.509	0.809	6.0	1857.4	O K
480 min Summer	99.534	0.834	6.0	1920.9	O K
600 min Summer	99.552	0.852	6.0	1965.8	O K
720 min Summer	99.565	0.865	6.0	1998.6	O K
960 min Summer	99.580	0.880	6.0	2035.8	O K
1440 min Summer	99.589	0.889	6.0	2057.9	O K
2160 min Summer	99.577	0.877	6.0	2027.4	O K
2880 min Summer	99.552	0.852	6.0	1963.9	O K
4320 min Summer	99.501	0.801	6.0	1836.6	O K
5760 min Summer	99.456	0.756	6.0	1723.9	O K
7200 min Summer	99.413	0.713	6.0	1619.0	O K
8640 min Summer	99.371	0.671	6.0	1517.4	O K
10080 min Summer	99.327	0.627	6.0	1409.0	O K
15 min Winter	99.273	0.573	6.0	1279.9	O K
30 min Winter	99.337	0.637	6.0	1434.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	503.9	27
30 min Summer	124.568	0.0	492.0	42
60 min Summer	69.918	0.0	982.4	72
120 min Summer	39.244	0.0	944.1	132
180 min Summer	27.993	0.0	922.7	190
240 min Summer	22.027	0.0	908.7	250
360 min Summer	15.712	0.0	890.8	370
480 min Summer	12.363	0.0	879.6	490
600 min Summer	10.266	0.0	872.1	608
720 min Summer	8.819	0.0	866.9	728
960 min Summer	6.925	0.0	861.3	966
1440 min Summer	4.926	0.0	852.0	1444
2160 min Summer	3.504	0.0	1751.1	2160
2880 min Summer	2.751	0.0	1690.9	2688
4320 min Summer	1.949	0.0	1569.9	3380
5760 min Summer	1.526	0.0	2973.1	4152
7200 min Summer	1.262	0.0	3044.1	4976
8640 min Summer	1.081	0.0	3064.6	5800
10080 min Summer	0.948	0.0	3014.0	6560
15 min Winter	221.935	0.0	494.0	27
30 min Winter	124.568	0.0	472.7	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.407	0.707	6.0	1604.0	O K
120 min Winter	99.481	0.781	6.0	1787.4	O K
180 min Winter	99.526	0.826	6.0	1898.9	O K
240 min Winter	99.557	0.857	6.0	1978.4	O K
360 min Winter	99.601	0.901	6.0	2088.4	O K
480 min Winter	99.629	0.929	6.0	2162.5	O K
600 min Winter	99.650	0.950	6.0	2215.8	O K
720 min Winter	99.665	0.965	6.0	2255.4	O K
960 min Winter	99.684	0.984	6.0	2303.2	O K
1440 min Winter	99.698	0.998	6.0	2340.1	O K
2160 min Winter	99.692	0.992	6.0	2324.9	O K
2880 min Winter	99.671	0.971	6.0	2270.3	O K
4320 min Winter	99.609	0.909	6.0	2109.2	O K
5760 min Winter	99.554	0.854	6.0	1971.1	O K
7200 min Winter	99.500	0.800	6.0	1833.8	O K
8640 min Winter	99.445	0.745	6.0	1697.2	O K
10080 min Winter	99.389	0.689	6.0	1559.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	949.4	72
120 min Winter	39.244	0.0	918.7	130
180 min Winter	27.993	0.0	905.2	188
240 min Winter	22.027	0.0	898.3	246
360 min Winter	15.712	0.0	893.6	364
480 min Winter	12.363	0.0	895.5	482
600 min Winter	10.266	0.0	901.3	600
720 min Winter	8.819	0.0	905.9	716
960 min Winter	6.925	0.0	907.8	952
1440 min Winter	4.926	0.0	897.2	1414
2160 min Winter	3.504	0.0	1779.4	2096
2880 min Winter	2.751	0.0	1737.9	2744
4320 min Winter	1.949	0.0	1661.1	3548
5760 min Winter	1.526	0.0	3299.6	4432
7200 min Winter	1.262	0.0	3321.5	5336
8640 min Winter	1.081	0.0	3200.5	6304
10080 min Winter	0.948	0.0	3063.6	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.760

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.920	4	8	0.920	8	12	0.920

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2092.5	1.000	2607.2	1.300	2772.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0115-6000-1000-6000
Design Head (m)	1.000
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	115
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	6.0
Flush-Flo™	0.298	6.0
Kick-Flo®	0.647	4.9
Mean Flow over Head Range	-	5.2

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	4.0	1.200	6.5	3.000	10.0	7.000	15.0
0.200	5.8	1.400	7.0	3.500	10.8	7.500	15.5
0.300	6.0	1.600	7.5	4.000	11.5	8.000	16.0
0.400	5.9	1.800	7.9	4.500	12.2	8.500	16.5
0.500	5.7	2.000	8.3	5.000	12.8	9.000	17.0
0.600	5.3	2.200	8.7	5.500	13.4	9.500	17.4
0.800	5.4	2.400	9.0	6.000	14.0		
1.000	6.0	2.600	9.4	6.500	14.5		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.204	0.504	11.9	2265.0	O K
30 min Summer	99.262	0.562	11.9	2537.6	O K
60 min Summer	99.325	0.625	11.9	2837.2	O K
120 min Summer	99.393	0.693	11.9	3161.5	O K
180 min Summer	99.434	0.734	11.9	3358.7	O K
240 min Summer	99.463	0.763	11.9	3499.2	O K
360 min Summer	99.502	0.802	11.9	3692.6	O K
480 min Summer	99.529	0.829	11.9	3821.7	O K
600 min Summer	99.547	0.847	11.9	3914.0	O K
720 min Summer	99.561	0.861	11.9	3981.9	O K
960 min Summer	99.577	0.877	11.9	4061.4	O K
1440 min Summer	99.588	0.888	11.9	4115.7	O K
2160 min Summer	99.579	0.879	11.9	4068.9	O K
2880 min Summer	99.556	0.856	11.9	3954.7	O K
4320 min Summer	99.508	0.808	11.9	3720.2	O K
5760 min Summer	99.464	0.764	11.9	3506.3	O K
7200 min Summer	99.422	0.722	11.9	3300.8	O K
8640 min Summer	99.378	0.678	11.9	3088.1	O K
10080 min Summer	99.333	0.633	11.9	2876.2	O K
15 min Winter	99.262	0.562	11.9	2538.2	O K
30 min Winter	99.327	0.627	11.9	2844.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	1008.7	27
30 min Summer	124.568	0.0	992.6	42
60 min Summer	69.918	0.0	1984.6	72
120 min Summer	39.244	0.0	1927.2	132
180 min Summer	27.993	0.0	1879.2	190
240 min Summer	22.027	0.0	1846.4	250
360 min Summer	15.712	0.0	1802.1	370
480 min Summer	12.363	0.0	1771.3	490
600 min Summer	10.266	0.0	1747.3	608
720 min Summer	8.819	0.0	1727.6	728
960 min Summer	6.925	0.0	1695.9	966
1440 min Summer	4.926	0.0	1653.4	1444
2160 min Summer	3.504	0.0	3470.4	2160
2880 min Summer	2.751	0.0	3334.9	2688
4320 min Summer	1.949	0.0	3061.5	3376
5760 min Summer	1.526	0.0	5828.8	4152
7200 min Summer	1.262	0.0	5958.4	4968
8640 min Summer	1.081	0.0	6015.5	5792
10080 min Summer	0.948	0.0	5947.9	6472
15 min Winter	221.935	0.0	996.9	27
30 min Winter	124.568	0.0	971.9	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.397	0.697	11.9	3181.5	O K
120 min Winter	99.472	0.772	11.9	3546.9	O K
180 min Winter	99.518	0.818	11.9	3769.5	O K
240 min Winter	99.550	0.850	11.9	3928.4	O K
360 min Winter	99.595	0.895	11.9	4149.3	O K
480 min Winter	99.625	0.925	11.9	4298.8	O K
600 min Winter	99.647	0.947	11.9	4406.9	O K
720 min Winter	99.663	0.963	11.9	4487.8	O K
960 min Winter	99.683	0.983	11.9	4587.1	O K
1440 min Winter	99.699	0.999	11.9	4669.1	O K
2160 min Winter	99.695	0.995	11.9	4650.3	O K
2880 min Winter	99.676	0.976	11.9	4552.3	O K
4320 min Winter	99.615	0.915	11.9	4250.1	O K
5760 min Winter	99.562	0.862	11.9	3987.3	O K
7200 min Winter	99.508	0.808	11.9	3720.7	O K
8640 min Winter	99.453	0.753	11.9	3450.3	O K
10080 min Winter	99.394	0.694	11.9	3169.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1938.9	72
120 min Winter	39.244	0.0	1870.0	130
180 min Winter	27.993	0.0	1836.8	188
240 min Winter	22.027	0.0	1816.8	246
360 min Winter	15.712	0.0	1793.9	364
480 min Winter	12.363	0.0	1782.3	482
600 min Winter	10.266	0.0	1777.4	600
720 min Winter	8.819	0.0	1777.4	716
960 min Winter	6.925	0.0	1777.8	952
1440 min Winter	4.926	0.0	1750.2	1414
2160 min Winter	3.504	0.0	3528.7	2096
2880 min Winter	2.751	0.0	3424.4	2744
4320 min Winter	1.949	0.0	3230.4	3544
5760 min Winter	1.526	0.0	6462.6	4392
7200 min Winter	1.262	0.0	6511.5	5336
8640 min Winter	1.081	0.0	6316.3	6240
10080 min Winter	0.948	0.0	6084.7	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 5.473

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.824	4	8	1.824	8	12	1.824

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4316.4	1.000	5043.4	1.300	5272.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0158-1190-1000-1190
Design Head (m)	1.000
Design Flow (l/s)	11.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	158
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.9
Flush-Flo™	0.311	11.9
Kick-Flo®	0.687	10.0
Mean Flow over Head Range	-	10.2

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	5.7	1.200	13.0	3.000	20.0	7.000	30.1
0.200	11.5	1.400	13.9	3.500	21.6	7.500	31.1
0.300	11.9	1.600	14.9	4.000	23.0	8.000	32.1
0.400	11.8	1.800	15.7	4.500	24.3	8.500	33.1
0.500	11.5	2.000	16.5	5.000	25.6	9.000	34.0
0.600	11.0	2.200	17.3	5.500	26.8	9.500	34.9
0.800	10.7	2.400	18.0	6.000	28.0		
1.000	11.9	2.600	18.7	6.500	29.1		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.209	0.509	7.9	1507.5	O K
30 min Summer	99.267	0.567	7.9	1689.0	O K
60 min Summer	99.330	0.630	7.9	1888.3	O K
120 min Summer	99.398	0.698	7.9	2103.8	O K
180 min Summer	99.438	0.738	7.9	2234.3	O K
240 min Summer	99.467	0.767	7.9	2327.0	O K
360 min Summer	99.506	0.806	7.9	2454.4	O K
480 min Summer	99.531	0.831	7.9	2539.1	O K
600 min Summer	99.549	0.849	7.9	2599.3	O K
720 min Summer	99.563	0.863	7.9	2643.4	O K
960 min Summer	99.578	0.878	7.9	2694.1	O K
1440 min Summer	99.588	0.888	7.9	2726.3	O K
2160 min Summer	99.577	0.877	7.9	2689.9	O K
2880 min Summer	99.552	0.852	7.9	2609.3	O K
4320 min Summer	99.503	0.803	7.9	2446.0	O K
5760 min Summer	99.458	0.758	7.9	2299.6	O K
7200 min Summer	99.416	0.716	7.9	2161.9	O K
8640 min Summer	99.374	0.674	7.9	2026.4	O K
10080 min Summer	99.328	0.628	7.9	1881.3	O K
15 min Winter	99.268	0.568	7.9	1689.4	O K
30 min Winter	99.332	0.632	7.9	1893.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	666.7	27
30 min Summer	124.568	0.0	653.1	42
60 min Summer	69.918	0.0	1305.7	72
120 min Summer	39.244	0.0	1257.1	132
180 min Summer	27.993	0.0	1227.2	190
240 min Summer	22.027	0.0	1207.4	250
360 min Summer	15.712	0.0	1181.4	370
480 min Summer	12.363	0.0	1164.3	490
600 min Summer	10.266	0.0	1151.9	608
720 min Summer	8.819	0.0	1142.5	728
960 min Summer	6.925	0.0	1129.6	966
1440 min Summer	4.926	0.0	1113.0	1444
2160 min Summer	3.504	0.0	2305.1	2160
2880 min Summer	2.751	0.0	2221.9	2688
4320 min Summer	1.949	0.0	2054.1	3380
5760 min Summer	1.526	0.0	3907.4	4152
7200 min Summer	1.262	0.0	3997.1	4976
8640 min Summer	1.081	0.0	4025.5	5800
10080 min Summer	0.948	0.0	3971.2	6560
15 min Winter	221.935	0.0	655.9	27
30 min Winter	124.568	0.0	633.0	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.402	0.702	7.9	2117.4	O K
120 min Winter	99.477	0.777	7.9	2360.0	O K
180 min Winter	99.522	0.822	7.9	2507.6	O K
240 min Winter	99.554	0.854	7.9	2612.9	O K
360 min Winter	99.597	0.897	7.9	2759.0	O K
480 min Winter	99.627	0.927	7.9	2857.4	O K
600 min Winter	99.648	0.948	7.9	2928.5	O K
720 min Winter	99.664	0.964	7.9	2981.5	O K
960 min Winter	99.683	0.983	7.9	3045.8	O K
1440 min Winter	99.698	0.998	7.9	3097.2	O K
2160 min Winter	99.693	0.993	7.9	3080.4	O K
2880 min Winter	99.672	0.972	7.9	3011.3	O K
4320 min Winter	99.611	0.911	7.9	2803.3	O K
5760 min Winter	99.557	0.857	7.9	2623.9	O K
7200 min Winter	99.502	0.802	7.9	2444.2	O K
8640 min Winter	99.447	0.747	7.9	2264.2	O K
10080 min Winter	99.391	0.691	7.9	2081.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1264.5	72
120 min Winter	39.244	0.0	1221.5	130
180 min Winter	27.993	0.0	1202.0	188
240 min Winter	22.027	0.0	1191.1	246
360 min Winter	15.712	0.0	1181.1	364
480 min Winter	12.363	0.0	1179.4	482
600 min Winter	10.266	0.0	1182.8	600
720 min Winter	8.819	0.0	1188.2	716
960 min Winter	6.925	0.0	1190.1	952
1440 min Winter	4.926	0.0	1174.5	1414
2160 min Winter	3.504	0.0	2343.0	2096
2880 min Winter	2.751	0.0	2282.6	2744
4320 min Winter	1.949	0.0	2172.5	3548
5760 min Winter	1.526	0.0	4333.6	4432
7200 min Winter	1.262	0.0	4361.9	5336
8640 min Winter	1.081	0.0	4208.5	6304
10080 min Winter	0.948	0.0	4036.7	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.643

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.214	4	8	1.214	8	12	1.214

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2813.7	1.000	3406.1	1.300	3594.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0131-7900-1000-7900
Design Head (m)	1.000
Design Flow (l/s)	7.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	131
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	7.9
Flush-Flo™	0.299	7.9
Kick-Flo®	0.660	6.5
Mean Flow over Head Range	-	6.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	1.200	8.6	3.000	13.3	7.000	19.9
0.200	7.7	1.400	9.2	3.500	14.3	7.500	20.6
0.300	7.9	1.600	9.9	4.000	15.2	8.000	21.2
0.400	7.8	1.800	10.4	4.500	16.1	8.500	21.8
0.500	7.6	2.000	10.9	5.000	16.9	9.000	22.4
0.600	7.1	2.200	11.4	5.500	17.7	9.500	23.0
0.800	7.1	2.400	11.9	6.000	18.5		
1.000	7.9	2.600	12.4	6.500	19.2		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.202	0.502	13.6	2584.6	O K
30 min Summer	99.260	0.560	13.6	2895.7	O K
60 min Summer	99.323	0.623	13.6	3237.7	O K
120 min Summer	99.391	0.691	13.6	3607.7	O K
180 min Summer	99.432	0.732	13.6	3833.3	O K
240 min Summer	99.461	0.761	13.6	3994.0	O K
360 min Summer	99.501	0.801	13.6	4215.4	O K
480 min Summer	99.528	0.828	13.6	4363.4	O K
600 min Summer	99.546	0.846	13.6	4469.4	O K
720 min Summer	99.560	0.860	13.6	4547.5	O K
960 min Summer	99.577	0.877	13.6	4639.5	O K
1440 min Summer	99.588	0.888	13.6	4703.7	O K
2160 min Summer	99.579	0.879	13.6	4653.3	O K
2880 min Summer	99.556	0.856	13.6	4525.6	O K
4320 min Summer	99.510	0.810	13.6	4262.8	O K
5760 min Summer	99.466	0.766	13.6	4021.5	O K
7200 min Summer	99.424	0.724	13.6	3788.4	O K
8640 min Summer	99.380	0.680	13.6	3543.8	O K
10080 min Summer	99.336	0.636	13.6	3305.9	O K
15 min Winter	99.260	0.560	13.6	2896.3	O K
30 min Winter	99.325	0.625	13.6	3245.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	1153.7	27
30 min Summer	124.568	0.0	1136.3	42
60 min Summer	69.918	0.0	2271.0	72
120 min Summer	39.244	0.0	2212.3	132
180 min Summer	27.993	0.0	2156.8	190
240 min Summer	22.027	0.0	2118.4	250
360 min Summer	15.712	0.0	2066.0	370
480 min Summer	12.363	0.0	2029.2	490
600 min Summer	10.266	0.0	2000.3	608
720 min Summer	8.819	0.0	1976.1	728
960 min Summer	6.925	0.0	1936.4	966
1440 min Summer	4.926	0.0	1880.5	1444
2160 min Summer	3.504	0.0	3962.3	2160
2880 min Summer	2.751	0.0	3803.8	2688
4320 min Summer	1.949	0.0	3484.3	3376
5760 min Summer	1.526	0.0	6633.2	4152
7200 min Summer	1.262	0.0	6778.8	4968
8640 min Summer	1.081	0.0	6845.4	5784
10080 min Summer	0.948	0.0	6769.7	6464
15 min Winter	221.935	0.0	1141.3	27
30 min Winter	124.568	0.0	1114.8	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.395	0.695	13.6	3630.4	O K
120 min Winter	99.471	0.771	13.6	4047.7	O K
180 min Winter	99.517	0.817	13.6	4302.0	O K
240 min Winter	99.549	0.849	13.6	4483.6	O K
360 min Winter	99.594	0.894	13.6	4736.3	O K
480 min Winter	99.624	0.924	13.6	4907.3	O K
600 min Winter	99.646	0.946	13.6	5031.2	O K
720 min Winter	99.662	0.962	13.6	5124.1	O K
960 min Winter	99.682	0.982	13.6	5238.3	O K
1440 min Winter	99.699	0.999	13.6	5333.6	O K
2160 min Winter	99.696	0.996	13.6	5314.7	O K
2880 min Winter	99.676	0.976	13.6	5205.0	O K
4320 min Winter	99.617	0.917	13.6	4864.4	O K
5760 min Winter	99.564	0.864	13.6	4567.7	O K
7200 min Winter	99.510	0.810	13.6	4265.3	O K
8640 min Winter	99.455	0.755	13.6	3957.7	O K
10080 min Winter	99.396	0.696	13.6	3634.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	2226.0	72
120 min Winter	39.244	0.0	2146.2	130
180 min Winter	27.993	0.0	2107.1	188
240 min Winter	22.027	0.0	2083.2	246
360 min Winter	15.712	0.0	2054.9	364
480 min Winter	12.363	0.0	2039.3	482
600 min Winter	10.266	0.0	2031.0	600
720 min Winter	8.819	0.0	2027.9	716
960 min Winter	6.925	0.0	2025.9	952
1440 min Winter	4.926	0.0	1992.7	1414
2160 min Winter	3.504	0.0	4030.3	2096
2880 min Winter	2.751	0.0	3906.7	2744
4320 min Winter	1.949	0.0	3674.6	3540
5760 min Winter	1.526	0.0	7354.0	4392
7200 min Winter	1.262	0.0	7411.2	5336
8640 min Winter	1.081	0.0	7203.4	6240
10080 min Winter	0.948	0.0	6947.6	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 6.245

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	2.082	4	8	2.082	8	12	2.082

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4956.4	1.000	5733.4	1.300	5977.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0167-1360-1000-1360
Design Head (m)	1.000
Design Flow (l/s)	13.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	167
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	13.6
Flush-Flo™	0.316	13.6
Kick-Flo®	0.694	11.5
Mean Flow over Head Range	-	11.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.0	1.200	14.8	3.000	22.9	7.000	34.5
0.200	13.1	1.400	15.9	3.500	24.7	7.500	35.7
0.300	13.6	1.600	17.0	4.000	26.3	8.000	36.8
0.400	13.5	1.800	18.0	4.500	27.9	8.500	37.9
0.500	13.2	2.000	18.9	5.000	29.3	9.000	39.0
0.600	12.7	2.200	19.8	5.500	30.7	9.500	40.0
0.800	12.2	2.400	20.6	6.000	32.0		
1.000	13.6	2.600	21.4	6.500	33.3		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.221	0.521	3.6	693.1	O K
30 min Summer	99.279	0.579	3.6	776.5	O K
60 min Summer	99.342	0.642	3.6	868.1	O K
120 min Summer	99.408	0.708	3.6	966.5	O K
180 min Summer	99.447	0.747	3.6	1026.0	O K
240 min Summer	99.474	0.774	3.6	1068.2	O K
360 min Summer	99.512	0.812	3.6	1125.8	O K
480 min Summer	99.536	0.836	3.6	1163.9	O K
600 min Summer	99.553	0.853	3.6	1190.9	O K
720 min Summer	99.566	0.866	3.6	1210.4	O K
960 min Summer	99.580	0.880	3.6	1232.3	O K
1440 min Summer	99.587	0.887	3.6	1244.5	O K
2160 min Summer	99.575	0.875	3.6	1224.5	O K
2880 min Summer	99.549	0.849	3.6	1184.4	O K
4320 min Summer	99.498	0.798	3.6	1104.1	O K
5760 min Summer	99.452	0.752	3.6	1034.2	O K
7200 min Summer	99.410	0.710	3.6	970.5	O K
8640 min Summer	99.370	0.670	3.6	909.6	O K
10080 min Summer	99.327	0.627	3.6	846.9	O K
15 min Winter	99.279	0.579	3.6	776.7	O K
30 min Winter	99.343	0.643	3.6	870.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	302.2	27
30 min Summer	124.568	0.0	293.3	42
60 min Summer	69.918	0.0	584.6	72
120 min Summer	39.244	0.0	561.7	132
180 min Summer	27.993	0.0	549.5	190
240 min Summer	22.027	0.0	541.7	250
360 min Summer	15.712	0.0	532.3	370
480 min Summer	12.363	0.0	527.0	490
600 min Summer	10.266	0.0	524.2	608
720 min Summer	8.819	0.0	523.0	728
960 min Summer	6.925	0.0	523.2	966
1440 min Summer	4.926	0.0	519.3	1444
2160 min Summer	3.504	0.0	1056.4	2160
2880 min Summer	2.751	0.0	1023.0	2740
4320 min Summer	1.949	0.0	956.9	3416
5760 min Summer	1.526	0.0	1813.9	4152
7200 min Summer	1.262	0.0	1858.6	4976
8640 min Summer	1.081	0.0	1864.7	5800
10080 min Summer	0.948	0.0	1816.3	6656
15 min Winter	221.935	0.0	294.5	27
30 min Winter	124.568	0.0	277.9	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.412	0.712	3.6	973.3	O K
120 min Winter	99.485	0.785	3.6	1084.4	O K
180 min Winter	99.528	0.828	3.6	1151.9	O K
240 min Winter	99.559	0.859	3.6	1199.9	O K
360 min Winter	99.601	0.901	3.6	1266.4	O K
480 min Winter	99.629	0.929	3.6	1311.1	O K
600 min Winter	99.649	0.949	3.6	1343.1	O K
720 min Winter	99.664	0.964	3.6	1366.9	O K
960 min Winter	99.682	0.982	3.6	1395.4	O K
1440 min Winter	99.695	0.995	3.6	1417.0	O K
2160 min Winter	99.689	0.989	3.6	1406.7	O K
2880 min Winter	99.668	0.968	3.6	1372.5	O K
4320 min Winter	99.605	0.905	3.6	1272.2	O K
5760 min Winter	99.551	0.851	3.6	1186.9	O K
7200 min Winter	99.497	0.797	3.6	1103.2	O K
8640 min Winter	99.443	0.743	3.6	1020.9	O K
10080 min Winter	99.389	0.689	3.6	938.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	564.6	72
120 min Winter	39.244	0.0	546.9	130
180 min Winter	27.993	0.0	539.7	188
240 min Winter	22.027	0.0	536.7	246
360 min Winter	15.712	0.0	536.5	364
480 min Winter	12.363	0.0	540.8	482
600 min Winter	10.266	0.0	545.6	600
720 min Winter	8.819	0.0	548.5	716
960 min Winter	6.925	0.0	550.1	952
1440 min Winter	4.926	0.0	544.8	1414
2160 min Winter	3.504	0.0	1072.7	2096
2880 min Winter	2.751	0.0	1052.4	2744
4320 min Winter	1.949	0.0	1011.8	3588
5760 min Winter	1.526	0.0	2013.0	4440
7200 min Winter	1.262	0.0	2017.2	5336
8640 min Winter	1.081	0.0	1937.1	6304
10080 min Winter	0.948	0.0	1848.9	7176

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.675

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.558	4	8	0.558	8	12	0.558

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1229.4	1.000	1630.5	1.300	1761.9

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0090-3600-1000-3600
Design Head (m)	1.000
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.6
Flush-Flo™	0.300	3.6
Kick-Flo®	0.631	2.9
Mean Flow over Head Range	-	3.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.9	3.000	6.0	7.000	9.0
0.200	3.5	1.400	4.2	3.500	6.5	7.500	9.3
0.300	3.6	1.600	4.5	4.000	6.9	8.000	9.5
0.400	3.5	1.800	4.7	4.500	7.3	8.500	9.8
0.500	3.4	2.000	5.0	5.000	7.6	9.000	10.1
0.600	3.1	2.200	5.2	5.500	8.0	9.500	10.4
0.800	3.2	2.400	5.4	6.000	8.3		
1.000	3.6	2.600	5.6	6.500	8.6		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.211	0.511	7.4	1407.4	O K
30 min Summer	99.269	0.569	7.4	1576.7	O K
60 min Summer	99.332	0.632	7.4	1762.8	O K
120 min Summer	99.399	0.699	7.4	1963.7	O K
180 min Summer	99.439	0.739	7.4	2085.4	O K
240 min Summer	99.468	0.768	7.4	2171.8	O K
360 min Summer	99.507	0.807	7.4	2290.3	O K
480 min Summer	99.532	0.832	7.4	2369.1	O K
600 min Summer	99.550	0.850	7.4	2425.0	O K
720 min Summer	99.563	0.863	7.4	2465.8	O K
960 min Summer	99.579	0.879	7.4	2512.6	O K
1440 min Summer	99.588	0.888	7.4	2541.5	O K
2160 min Summer	99.576	0.876	7.4	2506.0	O K
2880 min Summer	99.552	0.852	7.4	2429.6	O K
4320 min Summer	99.502	0.802	7.4	2275.8	O K
5760 min Summer	99.457	0.757	7.4	2138.2	O K
7200 min Summer	99.414	0.714	7.4	2009.3	O K
8640 min Summer	99.372	0.672	7.4	1882.9	O K
10080 min Summer	99.327	0.627	7.4	1747.4	O K
15 min Winter	99.269	0.569	7.4	1577.1	O K
30 min Winter	99.333	0.633	7.4	1767.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	623.7	27
30 min Summer	124.568	0.0	610.6	42
60 min Summer	69.918	0.0	1220.3	72
120 min Summer	39.244	0.0	1174.2	132
180 min Summer	27.993	0.0	1146.7	190
240 min Summer	22.027	0.0	1128.5	250
360 min Summer	15.712	0.0	1104.8	370
480 min Summer	12.363	0.0	1089.4	490
600 min Summer	10.266	0.0	1078.3	608
720 min Summer	8.819	0.0	1070.1	728
960 min Summer	6.925	0.0	1059.2	966
1440 min Summer	4.926	0.0	1044.8	1444
2160 min Summer	3.504	0.0	2159.9	2160
2880 min Summer	2.751	0.0	2082.7	2688
4320 min Summer	1.949	0.0	1927.0	3376
5760 min Summer	1.526	0.0	3653.0	4152
7200 min Summer	1.262	0.0	3738.7	4968
8640 min Summer	1.081	0.0	3767.5	5800
10080 min Summer	0.948	0.0	3718.9	6560
15 min Winter	221.935	0.0	613.1	27
30 min Winter	124.568	0.0	590.5	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.403	0.703	7.4	1976.6	O K
120 min Winter	99.478	0.778	7.4	2203.0	O K
180 min Winter	99.523	0.823	7.4	2340.6	O K
240 min Winter	99.555	0.855	7.4	2438.7	O K
360 min Winter	99.598	0.898	7.4	2574.8	O K
480 min Winter	99.628	0.928	7.4	2666.4	O K
600 min Winter	99.649	0.949	7.4	2732.5	O K
720 min Winter	99.664	0.964	7.4	2781.7	O K
960 min Winter	99.683	0.983	7.4	2841.2	O K
1440 min Winter	99.698	0.998	7.4	2888.1	O K
2160 min Winter	99.692	0.992	7.4	2871.0	O K
2880 min Winter	99.672	0.972	7.4	2805.2	O K
4320 min Winter	99.610	0.910	7.4	2609.5	O K
5760 min Winter	99.555	0.855	7.4	2440.9	O K
7200 min Winter	99.501	0.801	7.4	2272.3	O K
8640 min Winter	99.446	0.746	7.4	2103.8	O K
10080 min Winter	99.389	0.689	7.4	1932.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1181.0	72
120 min Winter	39.244	0.0	1141.5	130
180 min Winter	27.993	0.0	1123.8	188
240 min Winter	22.027	0.0	1114.0	246
360 min Winter	15.712	0.0	1105.4	364
480 min Winter	12.363	0.0	1104.7	482
600 min Winter	10.266	0.0	1108.9	600
720 min Winter	8.819	0.0	1114.2	716
960 min Winter	6.925	0.0	1116.1	952
1440 min Winter	4.926	0.0	1101.9	1414
2160 min Winter	3.504	0.0	2195.1	2096
2880 min Winter	2.751	0.0	2139.6	2744
4320 min Winter	1.949	0.0	2038.1	3544
5760 min Winter	1.526	0.0	4053.4	4400
7200 min Winter	1.262	0.0	4084.0	5336
8640 min Winter	1.081	0.0	3943.3	6304
10080 min Winter	0.948	0.0	3781.4	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.401

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.134	4	8	1.134	8	12	1.134

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2613.9	1.000	3185.9	1.300	3368.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0127-7400-1000-7400
Design Head (m)	1.000
Design Flow (l/s)	7.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	127
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	7.4
Flush-Flo™	0.298	7.4
Kick-Flo®	0.656	6.1
Mean Flow over Head Range	-	6.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	8.1	3.000	12.4	7.000	18.6
0.200	7.2	1.400	8.7	3.500	13.4	7.500	19.2
0.300	7.4	1.600	9.2	4.000	14.2	8.000	19.8
0.400	7.3	1.800	9.8	4.500	15.1	8.500	20.4
0.500	7.1	2.000	10.2	5.000	15.8	9.000	21.0
0.600	6.6	2.200	10.7	5.500	16.6	9.500	21.6
0.800	6.7	2.400	11.2	6.000	17.3		
1.000	7.4	2.600	11.6	6.500	18.0		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.200	0.500	11.9	2258.4	O K
30 min Summer	99.258	0.558	11.9	2530.2	O K
60 min Summer	99.321	0.621	11.9	2828.9	O K
120 min Summer	99.388	0.688	11.9	3152.0	O K
180 min Summer	99.429	0.729	11.9	3348.8	O K
240 min Summer	99.457	0.757	11.9	3488.9	O K
360 min Summer	99.497	0.797	11.9	3681.7	O K
480 min Summer	99.523	0.823	11.9	3810.5	O K
600 min Summer	99.542	0.842	11.9	3902.5	O K
720 min Summer	99.555	0.855	11.9	3970.2	O K
960 min Summer	99.571	0.871	11.9	4049.5	O K
1440 min Summer	99.582	0.882	11.9	4103.7	O K
2160 min Summer	99.573	0.873	11.9	4057.1	O K
2880 min Summer	99.550	0.850	11.9	3943.2	O K
4320 min Summer	99.502	0.802	11.9	3709.1	O K
5760 min Summer	99.459	0.759	11.9	3495.2	O K
7200 min Summer	99.416	0.716	11.9	3289.1	O K
8640 min Summer	99.372	0.672	11.9	3073.3	O K
10080 min Summer	99.328	0.628	11.9	2863.8	O K
15 min Winter	99.258	0.558	11.9	2530.7	O K
30 min Winter	99.322	0.622	11.9	2835.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	1009.2	27
30 min Summer	124.568	0.0	993.5	42
60 min Summer	69.918	0.0	1986.0	72
120 min Summer	39.244	0.0	1931.2	132
180 min Summer	27.993	0.0	1882.4	190
240 min Summer	22.027	0.0	1848.9	250
360 min Summer	15.712	0.0	1803.4	370
480 min Summer	12.363	0.0	1771.7	490
600 min Summer	10.266	0.0	1747.0	608
720 min Summer	8.819	0.0	1726.4	728
960 min Summer	6.925	0.0	1693.3	966
1440 min Summer	4.926	0.0	1648.3	1444
2160 min Summer	3.504	0.0	3467.9	2160
2880 min Summer	2.751	0.0	3331.5	2688
4320 min Summer	1.949	0.0	3056.2	3376
5760 min Summer	1.526	0.0	5811.4	4152
7200 min Summer	1.262	0.0	5942.6	4968
8640 min Summer	1.081	0.0	6005.9	5784
10080 min Summer	0.948	0.0	5944.1	6464
15 min Winter	221.935	0.0	997.8	27
30 min Winter	124.568	0.0	973.5	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.392	0.692	11.9	3172.1	O K
120 min Winter	99.467	0.767	11.9	3536.5	O K
180 min Winter	99.512	0.812	11.9	3758.4	O K
240 min Winter	99.545	0.845	11.9	3916.9	O K
360 min Winter	99.589	0.889	11.9	4137.1	O K
480 min Winter	99.619	0.919	11.9	4286.1	O K
600 min Winter	99.640	0.940	11.9	4393.9	O K
720 min Winter	99.656	0.956	11.9	4474.7	O K
960 min Winter	99.676	0.976	11.9	4573.6	O K
1440 min Winter	99.692	0.992	11.9	4655.2	O K
2160 min Winter	99.688	0.988	11.9	4636.5	O K
2880 min Winter	99.669	0.969	11.9	4538.6	O K
4320 min Winter	99.609	0.909	11.9	4236.9	O K
5760 min Winter	99.556	0.856	11.9	3974.3	O K
7200 min Winter	99.502	0.802	11.9	3707.5	O K
8640 min Winter	99.447	0.747	11.9	3436.4	O K
10080 min Winter	99.388	0.688	11.9	3150.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1942.8	72
120 min Winter	39.244	0.0	1872.4	130
180 min Winter	27.993	0.0	1838.1	188
240 min Winter	22.027	0.0	1817.3	246
360 min Winter	15.712	0.0	1793.0	364
480 min Winter	12.363	0.0	1780.2	482
600 min Winter	10.266	0.0	1774.0	600
720 min Winter	8.819	0.0	1772.6	716
960 min Winter	6.925	0.0	1772.4	952
1440 min Winter	4.926	0.0	1745.0	1414
2160 min Winter	3.504	0.0	3524.0	2096
2880 min Winter	2.751	0.0	3418.3	2744
4320 min Winter	1.949	0.0	3221.2	3544
5760 min Winter	1.526	0.0	6444.4	4392
7200 min Winter	1.262	0.0	6497.4	5336
8640 min Winter	1.081	0.0	6313.8	6240
10080 min Winter	0.948	0.0	6096.7	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 5.457

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.819	4	8	1.819	8	12	1.819

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4335.5	1.000	5064.1	1.300	5293.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0158-1190-1000-1190
Design Head (m)	1.000
Design Flow (l/s)	11.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	158
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.9
Flush-Flo™	0.311	11.9
Kick-Flo®	0.687	10.0
Mean Flow over Head Range	-	10.2

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	5.7	1.200	13.0	3.000	20.0	7.000	30.1
0.200	11.5	1.400	13.9	3.500	21.6	7.500	31.1
0.300	11.9	1.600	14.9	4.000	23.0	8.000	32.1
0.400	11.8	1.800	15.7	4.500	24.3	8.500	33.1
0.500	11.5	2.000	16.5	5.000	25.6	9.000	34.0
0.600	11.0	2.200	17.3	5.500	26.8	9.500	34.9
0.800	10.7	2.400	18.0	6.000	28.0		
1.000	11.9	2.600	18.7	6.500	29.1		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.214	0.514	6.1	1156.5	O K
30 min Summer	99.272	0.572	6.1	1295.6	O K
60 min Summer	99.335	0.635	6.1	1448.5	O K
120 min Summer	99.402	0.702	6.1	1613.3	O K
180 min Summer	99.442	0.742	6.1	1713.0	O K
240 min Summer	99.470	0.770	6.1	1783.7	O K
360 min Summer	99.509	0.809	6.1	1880.5	O K
480 min Summer	99.534	0.834	6.1	1944.7	O K
600 min Summer	99.552	0.852	6.1	1990.1	O K
720 min Summer	99.565	0.865	6.1	2023.2	O K
960 min Summer	99.579	0.879	6.1	2060.6	O K
1440 min Summer	99.588	0.888	6.1	2082.5	O K
2160 min Summer	99.576	0.876	6.1	2050.9	O K
2880 min Summer	99.550	0.850	6.1	1986.1	O K
4320 min Summer	99.499	0.799	6.1	1856.9	O K
5760 min Summer	99.454	0.754	6.1	1742.2	O K
7200 min Summer	99.411	0.711	6.1	1635.4	O K
8640 min Summer	99.369	0.669	6.1	1531.2	O K
10080 min Summer	99.323	0.623	6.1	1419.6	O K
15 min Winter	99.272	0.572	6.1	1296.0	O K
30 min Winter	99.337	0.637	6.1	1452.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	514.1	27
30 min Summer	124.568	0.0	502.3	42
60 min Summer	69.918	0.0	1003.0	72
120 min Summer	39.244	0.0	964.0	132
180 min Summer	27.993	0.0	941.8	190
240 min Summer	22.027	0.0	927.3	250
360 min Summer	15.712	0.0	908.5	370
480 min Summer	12.363	0.0	896.6	490
600 min Summer	10.266	0.0	888.3	608
720 min Summer	8.819	0.0	882.6	728
960 min Summer	6.925	0.0	875.8	966
1440 min Summer	4.926	0.0	866.0	1444
2160 min Summer	3.504	0.0	1784.0	2160
2880 min Summer	2.751	0.0	1722.0	2688
4320 min Summer	1.949	0.0	1596.8	3376
5760 min Summer	1.526	0.0	3011.6	4152
7200 min Summer	1.262	0.0	3085.4	4968
8640 min Summer	1.081	0.0	3112.6	5800
10080 min Summer	0.948	0.0	3074.8	6560
15 min Winter	221.935	0.0	504.3	27
30 min Winter	124.568	0.0	483.2	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.407	0.707	6.1	1624.2	O K
120 min Winter	99.481	0.781	6.1	1809.9	O K
180 min Winter	99.525	0.825	6.1	1922.8	O K
240 min Winter	99.557	0.857	6.1	2003.2	O K
360 min Winter	99.600	0.900	6.1	2114.5	O K
480 min Winter	99.629	0.929	6.1	2189.4	O K
600 min Winter	99.650	0.950	6.1	2243.2	O K
720 min Winter	99.665	0.965	6.1	2283.2	O K
960 min Winter	99.683	0.983	6.1	2331.2	O K
1440 min Winter	99.697	0.997	6.1	2368.1	O K
2160 min Winter	99.691	0.991	6.1	2351.9	O K
2880 min Winter	99.670	0.970	6.1	2296.0	O K
4320 min Winter	99.607	0.907	6.1	2132.2	O K
5760 min Winter	99.552	0.852	6.1	1991.5	O K
7200 min Winter	99.497	0.797	6.1	1851.5	O K
8640 min Winter	99.442	0.742	6.1	1712.1	O K
10080 min Winter	99.385	0.685	6.1	1571.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	969.4	72
120 min Winter	39.244	0.0	937.4	130
180 min Winter	27.993	0.0	923.3	188
240 min Winter	22.027	0.0	915.7	246
360 min Winter	15.712	0.0	910.0	364
480 min Winter	12.363	0.0	911.0	482
600 min Winter	10.266	0.0	916.2	600
720 min Winter	8.819	0.0	920.8	716
960 min Winter	6.925	0.0	922.8	950
1440 min Winter	4.926	0.0	912.1	1414
2160 min Winter	3.504	0.0	1811.5	2096
2880 min Winter	2.751	0.0	1767.9	2744
4320 min Winter	1.949	0.0	1688.2	3544
5760 min Winter	1.526	0.0	3344.4	4400
7200 min Winter	1.262	0.0	3374.1	5336
8640 min Winter	1.081	0.0	3259.6	6304
10080 min Winter	0.948	0.0	3125.8	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.795

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.932	4	8	0.932	8	12	0.932

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2120.9	1.000	2639.0	1.300	2805.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0116-6100-1000-6100
Design Head (m)	1.000
Design Flow (l/s)	6.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	116
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	6.1
Flush-Flo™	0.298	6.1
Kick-Flo®	0.650	5.0
Mean Flow over Head Range	-	5.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.1	1.200	6.6	3.000	10.2	7.000	15.3
0.200	5.9	1.400	7.1	3.500	11.0	7.500	15.8
0.300	6.1	1.600	7.6	4.000	11.7	8.000	16.3
0.400	6.0	1.800	8.0	4.500	12.4	8.500	16.8
0.500	5.8	2.000	8.4	5.000	13.0	9.000	17.2
0.600	5.4	2.200	8.8	5.500	13.6	9.500	17.7
0.800	5.5	2.400	9.2	6.000	14.2		
1.000	6.1	2.600	9.5	6.500	14.8		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.196	0.496	15.5	2965.2	O K
30 min Summer	99.253	0.553	15.5	3322.1	O K
60 min Summer	99.316	0.616	15.5	3714.5	O K
120 min Summer	99.383	0.683	15.5	4139.1	O K
180 min Summer	99.424	0.724	15.5	4398.5	O K
240 min Summer	99.453	0.753	15.5	4583.7	O K
360 min Summer	99.492	0.792	15.5	4839.2	O K
480 min Summer	99.519	0.819	15.5	5010.5	O K
600 min Summer	99.538	0.838	15.5	5133.5	O K
720 min Summer	99.552	0.852	15.5	5224.5	O K
960 min Summer	99.569	0.869	15.5	5332.5	O K
1440 min Summer	99.581	0.881	15.5	5411.0	O K
2160 min Summer	99.573	0.873	15.5	5359.6	O K
2880 min Summer	99.551	0.851	15.5	5218.1	O K
4320 min Summer	99.505	0.805	15.5	4923.3	O K
5760 min Summer	99.463	0.763	15.5	4650.7	O K
7200 min Summer	99.421	0.721	15.5	4384.4	O K
8640 min Summer	99.377	0.677	15.5	4101.7	O K
10080 min Summer	99.335	0.635	15.5	3835.4	O K
15 min Winter	99.253	0.553	15.5	3322.7	O K
30 min Winter	99.317	0.617	15.5	3723.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	1322.5	27
30 min Summer	124.568	0.0	1304.9	42
60 min Summer	69.918	0.0	2605.2	72
120 min Summer	39.244	0.0	2549.8	132
180 min Summer	27.993	0.0	2487.6	190
240 min Summer	22.027	0.0	2441.6	250
360 min Summer	15.712	0.0	2377.8	370
480 min Summer	12.363	0.0	2332.5	490
600 min Summer	10.266	0.0	2296.3	608
720 min Summer	8.819	0.0	2265.8	728
960 min Summer	6.925	0.0	2214.5	966
1440 min Summer	4.926	0.0	2137.4	1444
2160 min Summer	3.504	0.0	4531.3	2160
2880 min Summer	2.751	0.0	4344.3	2688
4320 min Summer	1.949	0.0	3968.3	3376
5760 min Summer	1.526	0.0	7578.8	4152
7200 min Summer	1.262	0.0	7741.6	4968
8640 min Summer	1.081	0.0	7816.7	5720
10080 min Summer	0.948	0.0	7722.8	6464
15 min Winter	221.935	0.0	1310.6	27
30 min Winter	124.568	0.0	1283.8	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.387	0.687	15.5	4164.8	O K
120 min Winter	99.462	0.762	15.5	4644.3	O K
180 min Winter	99.507	0.807	15.5	4936.7	O K
240 min Winter	99.540	0.840	15.5	5145.7	O K
360 min Winter	99.585	0.885	15.5	5436.7	O K
480 min Winter	99.615	0.915	15.5	5634.1	O K
600 min Winter	99.637	0.937	15.5	5777.4	O K
720 min Winter	99.653	0.953	15.5	5885.1	O K
960 min Winter	99.673	0.973	15.5	6018.3	O K
1440 min Winter	99.690	0.990	15.5	6131.9	O K
2160 min Winter	99.688	0.988	15.5	6115.9	O K
2880 min Winter	99.670	0.970	15.5	5995.1	O K
4320 min Winter	99.611	0.911	15.5	5611.3	O K
5760 min Winter	99.560	0.860	15.5	5276.3	O K
7200 min Winter	99.507	0.807	15.5	4933.0	O K
8640 min Winter	99.452	0.752	15.5	4581.5	O K
10080 min Winter	99.393	0.693	15.5	4203.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	2566.6	70
120 min Winter	39.244	0.0	2474.2	130
180 min Winter	27.993	0.0	2426.5	188
240 min Winter	22.027	0.0	2396.7	246
360 min Winter	15.712	0.0	2360.0	364
480 min Winter	12.363	0.0	2337.8	482
600 min Winter	10.266	0.0	2323.7	600
720 min Winter	8.819	0.0	2315.3	716
960 min Winter	6.925	0.0	2307.2	952
1440 min Winter	4.926	0.0	2267.1	1414
2160 min Winter	3.504	0.0	4608.4	2096
2880 min Winter	2.751	0.0	4460.5	2744
4320 min Winter	1.949	0.0	4178.8	3544
5760 min Winter	1.526	0.0	8398.2	4392
7200 min Winter	1.262	0.0	8457.1	5336
8640 min Winter	1.081	0.0	8231.1	6240
10080 min Winter	0.948	0.0	7962.9	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 7.164

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	2.388	4	8	2.388	8	12	2.388

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	5781.5	1.000	6618.5	1.300	6880.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0178-1560-1000-1560
Design Head (m)	1.000
Design Flow (l/s)	15.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	178
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	15.6
Flush-Flo™	0.323	15.5
Kick-Flo®	0.702	13.2
Mean Flow over Head Range	-	13.2

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	6.3	1.200	17.0	3.000	26.3	7.000	39.6
0.200	15.0	1.400	18.3	3.500	28.4	7.500	41.0
0.300	15.5	1.600	19.5	4.000	30.2	8.000	42.3
0.400	15.4	1.800	20.6	4.500	32.0	8.500	43.5
0.500	15.1	2.000	21.7	5.000	33.7	9.000	44.8
0.600	14.6	2.200	22.7	5.500	35.3	9.500	45.9
0.800	14.0	2.400	23.7	6.000	36.8		
1.000	15.6	2.600	24.6	6.500	38.2		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.201	0.501	13.1	2483.2	O K
30 min Summer	99.259	0.559	13.1	2782.0	O K
60 min Summer	99.322	0.622	13.1	3110.4	O K
120 min Summer	99.390	0.690	13.1	3465.7	O K
180 min Summer	99.430	0.730	13.1	3682.3	O K
240 min Summer	99.459	0.759	13.1	3836.5	O K
360 min Summer	99.499	0.799	13.1	4048.9	O K
480 min Summer	99.525	0.825	13.1	4190.8	O K
600 min Summer	99.544	0.844	13.1	4292.4	O K
720 min Summer	99.558	0.858	13.1	4367.1	O K
960 min Summer	99.574	0.874	13.1	4454.8	O K
1440 min Summer	99.585	0.885	13.1	4515.4	O K
2160 min Summer	99.576	0.876	13.1	4465.3	O K
2880 min Summer	99.553	0.853	13.1	4341.5	O K
4320 min Summer	99.506	0.806	13.1	4086.8	O K
5760 min Summer	99.462	0.762	13.1	3853.1	O K
7200 min Summer	99.420	0.720	13.1	3626.9	O K
8640 min Summer	99.375	0.675	13.1	3388.4	O K
10080 min Summer	99.332	0.632	13.1	3160.3	O K
15 min Winter	99.259	0.559	13.1	2782.6	O K
30 min Winter	99.323	0.623	13.1	3118.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	1112.9	27
30 min Summer	124.568	0.0	1096.3	42
60 min Summer	69.918	0.0	2190.8	72
120 min Summer	39.244	0.0	2134.9	132
180 min Summer	27.993	0.0	2081.1	190
240 min Summer	22.027	0.0	2043.7	250
360 min Summer	15.712	0.0	1992.7	370
480 min Summer	12.363	0.0	1956.8	490
600 min Summer	10.266	0.0	1928.6	608
720 min Summer	8.819	0.0	1905.0	728
960 min Summer	6.925	0.0	1866.3	966
1440 min Summer	4.926	0.0	1811.6	1444
2160 min Summer	3.504	0.0	3821.5	2160
2880 min Summer	2.751	0.0	3668.6	2688
4320 min Summer	1.949	0.0	3360.4	3376
5760 min Summer	1.526	0.0	6379.8	4144
7200 min Summer	1.262	0.0	6523.8	4968
8640 min Summer	1.081	0.0	6595.6	5720
10080 min Summer	0.948	0.0	6531.6	6464
15 min Winter	221.935	0.0	1101.1	27
30 min Winter	124.568	0.0	1075.7	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.394	0.694	13.1	3487.7	O K
120 min Winter	99.469	0.769	13.1	3888.6	O K
180 min Winter	99.515	0.815	13.1	4132.7	O K
240 min Winter	99.547	0.847	13.1	4307.1	O K
360 min Winter	99.591	0.891	13.1	4549.5	O K
480 min Winter	99.622	0.922	13.1	4713.5	O K
600 min Winter	99.643	0.943	13.1	4832.3	O K
720 min Winter	99.659	0.959	13.1	4921.2	O K
960 min Winter	99.679	0.979	13.1	5030.4	O K
1440 min Winter	99.696	0.996	13.1	5120.8	O K
2160 min Winter	99.692	0.992	13.1	5101.1	O K
2880 min Winter	99.673	0.973	13.1	4994.3	O K
4320 min Winter	99.613	0.913	13.1	4664.8	O K
5760 min Winter	99.560	0.860	13.1	4377.5	O K
7200 min Winter	99.506	0.806	13.1	4084.9	O K
8640 min Winter	99.450	0.750	13.1	3786.9	O K
10080 min Winter	99.390	0.690	13.1	3469.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	2148.0	72
120 min Winter	39.244	0.0	2070.2	130
180 min Winter	27.993	0.0	2031.9	188
240 min Winter	22.027	0.0	2008.4	246
360 min Winter	15.712	0.0	1980.3	364
480 min Winter	12.363	0.0	1964.6	482
600 min Winter	10.266	0.0	1956.1	600
720 min Winter	8.819	0.0	1952.6	716
960 min Winter	6.925	0.0	1950.5	952
1440 min Winter	4.926	0.0	1919.3	1414
2160 min Winter	3.504	0.0	3884.3	2096
2880 min Winter	2.751	0.0	3764.8	2744
4320 min Winter	1.949	0.0	3540.1	3540
5760 min Winter	1.526	0.0	7075.7	4392
7200 min Winter	1.262	0.0	7137.9	5336
8640 min Winter	1.081	0.0	6951.3	6240
10080 min Winter	0.948	0.0	6721.6	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 6.000

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	2.000	4	8	2.000	8	12	2.000

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4768.6	1.000	5531.2	1.300	5771.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0165-1310-1000-1310
Design Head (m)	1.000
Design Flow (l/s)	13.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	165
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	13.1
Flush-Flo™	0.315	13.1
Kick-Flo®	0.694	11.0
Mean Flow over Head Range	-	11.2

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	5.9	1.200	14.3	3.000	22.1	7.000	33.2
0.200	12.7	1.400	15.4	3.500	23.8	7.500	34.3
0.300	13.1	1.600	16.4	4.000	25.4	8.000	35.4
0.400	13.0	1.800	17.3	4.500	26.8	8.500	36.5
0.500	12.7	2.000	18.2	5.000	28.2	9.000	37.5
0.600	12.2	2.200	19.0	5.500	29.6	9.500	38.5
0.800	11.8	2.400	19.9	6.000	30.8		
1.000	13.1	2.600	20.6	6.500	32.0		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.224	0.524	3.8	715.7	O K
30 min Summer	99.282	0.582	3.8	801.8	O K
60 min Summer	99.345	0.645	3.8	896.4	O K
120 min Summer	99.411	0.711	3.8	997.9	O K
180 min Summer	99.450	0.750	3.8	1059.1	O K
240 min Summer	99.478	0.778	3.8	1102.4	O K
360 min Summer	99.515	0.815	3.8	1161.5	O K
480 min Summer	99.539	0.839	3.8	1200.5	O K
600 min Summer	99.556	0.856	3.8	1227.8	O K
720 min Summer	99.569	0.869	3.8	1247.6	O K
960 min Summer	99.582	0.882	3.8	1269.3	O K
1440 min Summer	99.589	0.889	3.8	1280.3	O K
2160 min Summer	99.575	0.875	3.8	1257.2	O K
2880 min Summer	99.548	0.848	3.8	1214.5	O K
4320 min Summer	99.496	0.796	3.8	1131.0	O K
5760 min Summer	99.450	0.750	3.8	1058.2	O K
7200 min Summer	99.407	0.707	3.8	991.4	O K
8640 min Summer	99.365	0.665	3.8	927.4	O K
10080 min Summer	99.321	0.621	3.8	860.2	O K
15 min Winter	99.282	0.582	3.8	802.1	O K
30 min Winter	99.346	0.646	3.8	898.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	318.9	27
30 min Summer	124.568	0.0	309.5	42
60 min Summer	69.918	0.0	617.0	72
120 min Summer	39.244	0.0	593.6	132
180 min Summer	27.993	0.0	580.9	190
240 min Summer	22.027	0.0	572.8	250
360 min Summer	15.712	0.0	562.8	370
480 min Summer	12.363	0.0	557.1	490
600 min Summer	10.266	0.0	553.8	608
720 min Summer	8.819	0.0	552.2	728
960 min Summer	6.925	0.0	551.7	966
1440 min Summer	4.926	0.0	547.5	1444
2160 min Summer	3.504	0.0	1116.4	2160
2880 min Summer	2.751	0.0	1080.2	2684
4320 min Summer	1.949	0.0	1007.4	3372
5760 min Summer	1.526	0.0	1875.7	4144
7200 min Summer	1.262	0.0	1925.6	4968
8640 min Summer	1.081	0.0	1945.9	5792
10080 min Summer	0.948	0.0	1917.5	6568
15 min Winter	221.935	0.0	310.7	27
30 min Winter	124.568	0.0	293.1	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.415	0.715	3.8	1005.0	O K
120 min Winter	99.489	0.789	3.8	1119.6	O K
180 min Winter	99.532	0.832	3.8	1189.0	O K
240 min Winter	99.563	0.863	3.8	1238.4	O K
360 min Winter	99.605	0.905	3.8	1306.7	O K
480 min Winter	99.633	0.933	3.8	1352.3	O K
600 min Winter	99.653	0.953	3.8	1385.0	O K
720 min Winter	99.668	0.968	3.8	1409.1	O K
960 min Winter	99.685	0.985	3.8	1437.7	O K
1440 min Winter	99.697	0.997	3.8	1458.3	O K
2160 min Winter	99.689	0.989	3.8	1445.1	O K
2880 min Winter	99.667	0.967	3.8	1407.8	O K
4320 min Winter	99.603	0.903	3.8	1302.7	O K
5760 min Winter	99.547	0.847	3.8	1213.1	O K
7200 min Winter	99.492	0.792	3.8	1125.1	O K
8640 min Winter	99.437	0.737	3.8	1038.3	O K
10080 min Winter	99.381	0.681	3.8	951.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	596.6	70
120 min Winter	39.244	0.0	578.4	130
180 min Winter	27.993	0.0	570.8	188
240 min Winter	22.027	0.0	567.4	246
360 min Winter	15.712	0.0	566.8	364
480 min Winter	12.363	0.0	570.5	482
600 min Winter	10.266	0.0	575.5	600
720 min Winter	8.819	0.0	578.6	716
960 min Winter	6.925	0.0	580.3	950
1440 min Winter	4.926	0.0	574.7	1414
2160 min Winter	3.504	0.0	1132.7	2096
2880 min Winter	2.751	0.0	1109.2	2744
4320 min Winter	1.949	0.0	1064.7	3512
5760 min Winter	1.526	0.0	2086.7	4392
7200 min Winter	1.262	0.0	2111.2	5336
8640 min Winter	1.081	0.0	2041.3	6240
10080 min Winter	0.948	0.0	1953.6	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.730

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.577	4	8	0.577	8	12	0.577

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1264.7	1.000	1671.2	1.300	1804.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0092-3800-1000-3800
Design Head (m)	1.000
Design Flow (l/s)	3.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	92
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.8
Flush-Flo™	0.298	3.8
Kick-Flo®	0.632	3.1
Mean Flow over Head Range	-	3.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	1.200	4.1	3.000	6.3	7.000	9.5
0.200	3.7	1.400	4.4	3.500	6.8	7.500	9.8
0.300	3.8	1.600	4.7	4.000	7.3	8.000	10.1
0.400	3.7	1.800	5.0	4.500	7.7	8.500	10.4
0.500	3.6	2.000	5.2	5.000	8.1	9.000	10.7
0.600	3.3	2.200	5.5	5.500	8.4	9.500	10.9
0.800	3.4	2.400	5.7	6.000	8.8		
1.000	3.8	2.600	5.9	6.500	9.1		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.220	0.520	4.3	817.6	O K
30 min Summer	99.279	0.579	4.3	915.9	O K
60 min Summer	99.341	0.641	4.3	1024.0	O K
120 min Summer	99.408	0.708	4.3	1140.2	O K
180 min Summer	99.447	0.747	4.3	1210.3	O K
240 min Summer	99.475	0.775	4.3	1260.0	O K
360 min Summer	99.513	0.813	4.3	1328.0	O K
480 min Summer	99.537	0.837	4.3	1372.8	O K
600 min Summer	99.555	0.855	4.3	1404.5	O K
720 min Summer	99.567	0.867	4.3	1427.4	O K
960 min Summer	99.581	0.881	4.3	1453.1	O K
1440 min Summer	99.589	0.889	4.3	1467.0	O K
2160 min Summer	99.576	0.876	4.3	1442.6	O K
2880 min Summer	99.550	0.850	4.3	1395.1	O K
4320 min Summer	99.498	0.798	4.3	1301.1	O K
5760 min Summer	99.452	0.752	4.3	1218.8	O K
7200 min Summer	99.409	0.709	4.3	1143.1	O K
8640 min Summer	99.368	0.668	4.3	1070.4	O K
10080 min Summer	99.324	0.624	4.3	993.8	O K
15 min Winter	99.279	0.579	4.3	916.2	O K
30 min Winter	99.343	0.643	4.3	1026.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	361.4	27
30 min Summer	124.568	0.0	351.4	42
60 min Summer	69.918	0.0	700.5	72
120 min Summer	39.244	0.0	673.4	132
180 min Summer	27.993	0.0	658.6	190
240 min Summer	22.027	0.0	649.1	250
360 min Summer	15.712	0.0	637.3	370
480 min Summer	12.363	0.0	630.4	490
600 min Summer	10.266	0.0	626.3	608
720 min Summer	8.819	0.0	624.0	728
960 min Summer	6.925	0.0	622.8	966
1440 min Summer	4.926	0.0	617.6	1444
2160 min Summer	3.504	0.0	1261.4	2160
2880 min Summer	2.751	0.0	1220.0	2688
4320 min Summer	1.949	0.0	1137.2	3380
5760 min Summer	1.526	0.0	2138.0	4152
7200 min Summer	1.262	0.0	2192.3	4976
8640 min Summer	1.081	0.0	2209.5	5800
10080 min Summer	0.948	0.0	2169.7	6568
15 min Winter	221.935	0.0	352.8	27
30 min Winter	124.568	0.0	334.1	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.412	0.712	4.3	1148.1	O K
120 min Winter	99.486	0.786	4.3	1279.2	O K
180 min Winter	99.530	0.830	4.3	1358.7	O K
240 min Winter	99.561	0.861	4.3	1415.3	O K
360 min Winter	99.603	0.903	4.3	1493.6	O K
480 min Winter	99.631	0.931	4.3	1546.2	O K
600 min Winter	99.652	0.952	4.3	1583.9	O K
720 min Winter	99.666	0.966	4.3	1611.8	O K
960 min Winter	99.684	0.984	4.3	1645.1	O K
1440 min Winter	99.697	0.997	4.3	1670.0	O K
2160 min Winter	99.690	0.990	4.3	1656.9	O K
2880 min Winter	99.669	0.969	4.3	1615.9	O K
4320 min Winter	99.605	0.905	4.3	1497.5	O K
5760 min Winter	99.550	0.850	4.3	1396.5	O K
7200 min Winter	99.496	0.796	4.3	1297.1	O K
8640 min Winter	99.441	0.741	4.3	1198.8	O K
10080 min Winter	99.385	0.685	4.3	1100.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	676.9	72
120 min Winter	39.244	0.0	655.6	130
180 min Winter	27.993	0.0	646.7	188
240 min Winter	22.027	0.0	642.6	246
360 min Winter	15.712	0.0	641.2	364
480 min Winter	12.363	0.0	644.8	482
600 min Winter	10.266	0.0	650.2	600
720 min Winter	8.819	0.0	653.7	716
960 min Winter	6.925	0.0	655.4	952
1440 min Winter	4.926	0.0	648.8	1414
2160 min Winter	3.504	0.0	1280.5	2096
2880 min Winter	2.751	0.0	1253.6	2744
4320 min Winter	1.949	0.0	1202.5	3548
5760 min Winter	1.526	0.0	2375.6	4432
7200 min Winter	1.262	0.0	2394.7	5336
8640 min Winter	1.081	0.0	2308.2	6304
10080 min Winter	0.948	0.0	2207.5	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.976

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.659	4	8	0.659	8	12	0.659

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1462.5	1.000	1897.5	1.300	2039.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0098-4300-1000-4300
Design Head (m)	1.000
Design Flow (l/s)	4.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.3
Flush-Flo™	0.298	4.3
Kick-Flo®	0.636	3.5
Mean Flow over Head Range	-	3.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	4.7	3.000	7.2	7.000	10.7
0.200	4.2	1.400	5.0	3.500	7.7	7.500	11.1
0.300	4.3	1.600	5.3	4.000	8.2	8.000	11.4
0.400	4.2	1.800	5.6	4.500	8.7	8.500	11.8
0.500	4.1	2.000	5.9	5.000	9.1	9.000	12.1
0.600	3.7	2.200	6.2	5.500	9.6	9.500	12.4
0.800	3.9	2.400	6.5	6.000	10.0		
1.000	4.3	2.600	6.7	6.500	10.4		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.212	0.512	6.4	1210.7	O K
30 min Summer	99.270	0.570	6.4	1356.4	O K
60 min Summer	99.333	0.633	6.4	1516.4	O K
120 min Summer	99.399	0.699	6.4	1689.0	O K
180 min Summer	99.439	0.739	6.4	1793.4	O K
240 min Summer	99.468	0.768	6.4	1867.5	O K
360 min Summer	99.506	0.806	6.4	1969.0	O K
480 min Summer	99.531	0.831	6.4	2036.2	O K
600 min Summer	99.549	0.849	6.4	2083.8	O K
720 min Summer	99.562	0.862	6.4	2118.5	O K
960 min Summer	99.576	0.876	6.4	2157.8	O K
1440 min Summer	99.585	0.885	6.4	2181.0	O K
2160 min Summer	99.573	0.873	6.4	2148.2	O K
2880 min Summer	99.548	0.848	6.4	2080.8	O K
4320 min Summer	99.497	0.797	6.4	1946.1	O K
5760 min Summer	99.452	0.752	6.4	1826.4	O K
7200 min Summer	99.409	0.709	6.4	1714.7	O K
8640 min Summer	99.367	0.667	6.4	1605.5	O K
10080 min Summer	99.322	0.622	6.4	1488.5	O K
15 min Winter	99.270	0.570	6.4	1356.8	O K
30 min Winter	99.334	0.634	6.4	1520.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.935	0.0	538.8	27
30 min Summer	124.568	0.0	526.6	42
60 min Summer	69.918	0.0	1051.9	72
120 min Summer	39.244	0.0	1011.3	132
180 min Summer	27.993	0.0	987.9	190
240 min Summer	22.027	0.0	972.6	250
360 min Summer	15.712	0.0	952.7	370
480 min Summer	12.363	0.0	940.0	490
600 min Summer	10.266	0.0	931.2	608
720 min Summer	8.819	0.0	924.9	728
960 min Summer	6.925	0.0	917.2	966
1440 min Summer	4.926	0.0	906.4	1444
2160 min Summer	3.504	0.0	1868.9	2160
2880 min Summer	2.751	0.0	1803.3	2688
4320 min Summer	1.949	0.0	1671.0	3376
5760 min Summer	1.526	0.0	3150.7	4152
7200 min Summer	1.262	0.0	3227.6	4968
8640 min Summer	1.081	0.0	3256.6	5800
10080 min Summer	0.948	0.0	3219.0	6560
15 min Winter	221.935	0.0	528.8	27
30 min Winter	124.568	0.0	507.2	41

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.404	0.704	6.4	1700.4	O K
120 min Winter	99.478	0.778	6.4	1894.8	O K
180 min Winter	99.522	0.822	6.4	2013.0	O K
240 min Winter	99.554	0.854	6.4	2097.2	O K
360 min Winter	99.597	0.897	6.4	2213.8	O K
480 min Winter	99.626	0.926	6.4	2292.2	O K
600 min Winter	99.647	0.947	6.4	2348.7	O K
720 min Winter	99.662	0.962	6.4	2390.6	O K
960 min Winter	99.680	0.980	6.4	2440.9	O K
1440 min Winter	99.694	0.994	6.4	2479.8	O K
2160 min Winter	99.688	0.988	6.4	2463.0	O K
2880 min Winter	99.667	0.967	6.4	2404.6	O K
4320 min Winter	99.605	0.905	6.4	2233.7	O K
5760 min Winter	99.550	0.850	6.4	2086.8	O K
7200 min Winter	99.495	0.795	6.4	1940.4	O K
8640 min Winter	99.440	0.740	6.4	1794.4	O K
10080 min Winter	99.383	0.683	6.4	1646.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	69.918	0.0	1017.0	72
120 min Winter	39.244	0.0	983.4	130
180 min Winter	27.993	0.0	968.5	188
240 min Winter	22.027	0.0	960.4	246
360 min Winter	15.712	0.0	954.1	364
480 min Winter	12.363	0.0	954.8	482
600 min Winter	10.266	0.0	959.7	600
720 min Winter	8.819	0.0	964.5	716
960 min Winter	6.925	0.0	966.5	950
1440 min Winter	4.926	0.0	955.0	1414
2160 min Winter	3.504	0.0	1898.2	2096
2880 min Winter	2.751	0.0	1851.6	2744
4320 min Winter	1.949	0.0	1766.9	3544
5760 min Winter	1.526	0.0	3498.8	4392
7200 min Winter	1.262	0.0	3531.1	5336
8640 min Winter	1.081	0.0	3413.5	6240
10080 min Winter	0.948	0.0	3273.7	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 527850 261900 TL 27850 61900
C (1km)	-0.027
D1 (1km)	0.291
D2 (1km)	0.284
D3 (1km)	0.274
E (1km)	0.318
F (1km)	2.448
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.926

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.975	4	8	0.975	8	12	0.975

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	2234.4	1.000	2765.4	1.300	2935.7

Hydro-Brake® Optimum Outflow Control

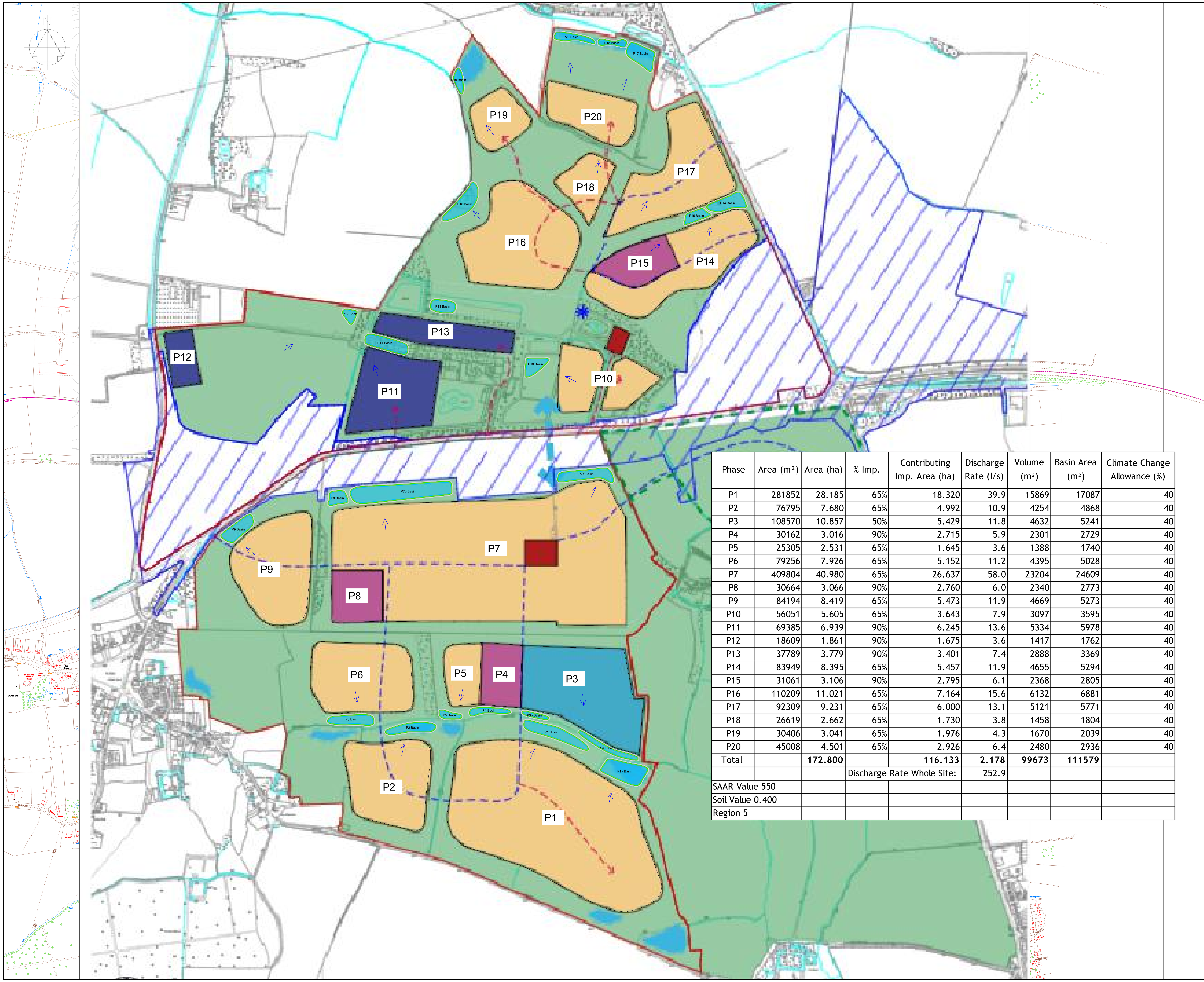
Unit Reference	MD-SHE-0119-6400-1000-6400
Design Head (m)	1.000
Design Flow (l/s)	6.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	6.4
Flush-Flo™	0.297	6.4
Kick-Flo®	0.649	5.2
Mean Flow over Head Range	-	5.5

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	4.2	1.200	7.0	3.000	10.7	7.000	16.1
0.200	6.2	1.400	7.5	3.500	11.5	7.500	16.6
0.300	6.4	1.600	8.0	4.000	12.3	8.000	17.1
0.400	6.3	1.800	8.4	4.500	13.0	8.500	17.6
0.500	6.1	2.000	8.9	5.000	13.7	9.000	18.1
0.600	5.7	2.200	9.3	5.500	14.3	9.500	18.6
0.800	5.8	2.400	9.7	6.000	14.9		
1.000	6.4	2.600	10.0	6.500	15.5		

Appendix C Indicative Attenuation Layout



Phase	Area (m^2)	Area (ha)	% Imp.	Contributing Imp. Area (ha)	Discharge Rate (l/s)	Volume (m^3)	Basin Area (m^2)	Climate Change Allowance (%)
P1	281852	28.185	65%	18.320	39.9	15869	17087	40
P2	76795	7.680	65%	4.992	10.9	4254	4868	40
P3	108570	10.857	50%	5.429	11.8	4632	5241	40
P4	30162	3.016	90%	2.715	5.9	2301	2729	40
P5	25305	2.531	65%	1.645	3.6	1388	1740	40
P6	79256	7.926	65%	5.152	11.2	4395	5028	40
P7	409804	40.980	65%	26.637	58.0	23204	24609	40
P8	30664	3.066	90%	2.760	6.0	2340	2773	40
P9	84194	8.419	65%	5.473	11.9	4669	5273	40
P10	56051	5.605	65%	3.643	7.9	3097	3595	40
P11	69385	6.939	90%	6.245	13.6	5334	5978	40
P12	18609	1.861	90%	1.675	3.6	1417	1762	40
P13	37789	3.779	90%	3.401	7.4	2888	3369	40
P14	83949	8.395	65%	5.457	11.9	4655	5294	40
P15	31061	3.106	90%	2.795	6.1	2368	2805	40
P16	110209	11.021	65%	7.164	15.6	6132	6881	40
P17	92309	9.231	65%	6.000	13.1	5121	5771	40
P18	26619	2.662	65%	1.730	3.8	1458	1804	40
P19	30406	3.041	65%	1.976	4.3	1670	2039	40
P20	45008	4.501	65%	2.926	6.4	2480	2936	40
Total		**172.800**		**116.133**	**2.178**	**99673**	**111579**	
			Discharge Rate Whole Site:		252.9			
SAAR Value 550								
Soil Value 0.400								
Region 5								

GENERAL NOTES

G1. DO NOT SCALE THIS DRAWING.

G2. ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE ENGINEER IMMEDIATELY.

G3. ALL DIMENSIONS ARE IN MILLIMETRES - (mm) ALL LEVELS ARE IN METRES - (m) AND ARE ABOVE ORDNANCE DATUM AT NEWLYN, CORNWALL UNLESS NOTED OTHERWISE.

G4. NORTH SHOWN INDICATIVE ONLY

G5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT; SPECIFICATIONS; DRAWINGS; DETAILS AND OTHER DESIGN INFORMATION.

G6. ALL DRAWINGS AND WRITTEN MATERIAL CONTAINED WITHIN, CONSTITUTE ORIGINAL AND UNPUBLISHED WORK OF THE ENGINEER AND MAY NOT BE DUPLICATED, USED, REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OR EXPRESS PERMISSION FROM THE ENGINEER.

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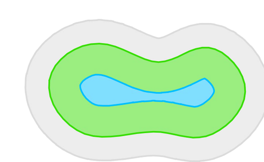
G9. TOPOGRAPHY OF PLOTS P2-P9 ASSUMED. FURTHER DETAIL WILL BE REQUIRED IN DUE COURSE TO CONFIRM.

G10. BASINS ARE DESIGNED TO BE DRY WHEN NOT ATTENUATING.

G10. BASINS DESIGNED FOR 1:100 Y + CC EVENT.

LEGEND:



SURFACE WATER BASIN
ASSUMED WATER DEPTH 1.0m
+ 0.3m FREEBOARD
+ 3.0m ACCESS TRACK
SURROUNDING BASIN

REV	DESCRIPTION	DRN	CHK	APP	DATE
P04	MASTERPLAN UPDATED	HJ	DAR	DAR	13.12.21
P03	MASTERPLAN UPDATED	HJ	DAR	DAR	09.12.21
P02	UPDATED LAYOUT AND STRATEGY	HJ	DAR	DAR	03.12.21
P01	PRELIMINARY	HJ	DAR	RH	16.11.20

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Architect/Client/Contractor

CHURCH COMMISSIONERS FOR ENGLAND

Project

THE KINGSFIELDS LAND TO THE WEST OF CAMBOURNE

Drawing Title

INDICATIVE ATTENUATION LAYOUT

Drawing Status

PRELIMINARY

	Name	Date
Drawn	H. JABBAR	16.11.20
Designed	H. JABBAR	16.11.20
Eng Chk	D. ALLUM-ROONEY	16.11.20
Approved	R. HOLMES	16.11.20

Status Code S2

Scale NTS

Revision P04

Drawing No.

104677 - PEF - ZZ - XX - DR - CD - 0500