RIDGE

BICESTER MOTION

F.A.S.T. HUB

FLOOD RISK AND DRAINAGE ASSESSMENT

12 November 2019

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FLOOD RISK AND DRAINAGE ASSESSMENT

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12 November 2019

Prepared for

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CONTENTS

1. SUMMARY

Ridge and Partners LLP have been commissioned to prepare a Flood Risk and Drainage Assessment in support of the Bicester Motion Future Automotive Speed and Technology (F.A.S.T.) development at the former RAF Bicester site, Buckingham Road, Bicester, Oxfordshire, OX27 8AL.

This report has been prepared to provide an assessment of the sites Flood Risk and to develop a drainage strategy for the proposed F.A.S.T. development which will support the outline planning application with the Local Planning Authority (LPA), Cherwell District Council (CDC).

The site is located in Flood Zone 1 as defined in the NPPF and has not been identified as being at risk of flooding associated with fluvial, pluvial, tidal, sewers or groundwater. As the site is located in Flood Zone 1, the Sequential Test was passed and there is no requirement to apply the Exception Test.

Proposals for the surface water drainage require the use of Sustainable Urban Drainage Systems (SuDS) as these will manage surface water run-off whilst offering benefits in pollution prevention and creating sustainably better places for people and nature.

A pre-app was carried out for the project. The LPA were unable to consult external parties as part of this process so the LLFA were not consulted. A phone call with Mr Richard Bennett from Oxfordshire County Council which is the LLFA confirmed the strategy put forward was an acceptable proposal. He also suggested that a detailed site investigation which includes infiltration testing, groundwater monitoring and contamination testing is required along with detailed hydraulic modelling prior to the approval of the drainage strategy.

There are known capacity constraints in Thames Water's foul sewer network therefore discussions will be required with Thames Water via a predevelopment enquiry to establish how additional capacity can be provided to accommodate the development.

The proposal for the foul sewer network is likely to require a pumped system to accommodate the F.A.S.T. development due to the topography of the site. As a pumped connection is likely to be required, the flow rate is likely to be in the order of 3 to 5l/s.

2. INTRODUCTION

Ridge and Partners LLP have been commissioned to prepare a Flood Risk and Drainage Assessment in support of the Bicester Motion Future Automotive Speed and Technology (F.A.S.T.) development at the former RAF Bicester site, Buckingham Road, Bicester, Oxfordshire, OX27 8AL.

This report has been prepared to provide an assessment of the sites Flood Risk and to develop a drainage strategy for the proposed F.A.S.T. development which will support the outline planning application with the Local Planning Authority (LPA), Cherwell District Council (CDC).

The National Planning Policy Framework (NPPF) states that a site-specific Flood Risk Assessment (FRA) is required in the following circumstances:

- For proposals of 1 hectare or greater in Flood Zone 1;
- All proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency); and,
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

This site falls within the Flood Zone 1 and is greater than 1ha in size. Therefore, a site specific FRA is required to ensure the development is safe from flooding and will not increase the risk of flooding elsewhere.

This FRA assesses the flood risk of the existing site whilst setting out the parameters for the drainage design of the future development to minimise flood risk on the site and the neighbouring properties. It not only considers the risk of fluvial flooding on the development, but also the risk of flooding from the non-fluvial sources, including overland flows, groundwater, sewer flooding and flooding from artificial sources.

The report includes a review of the existing foul flows and identifies the need for a Pre-development Enquiry with Thames Water to establish the likely capacity constraints and identify any off-site improvements that may be required to accommodate the development.

3. SITE DESCRIPTION

3.1. Site Location

Site Name: Bicester Motion Future Automotive Speed and Technology (F.A.S.T.) at the former RAF Bicester site
Site Address : Buckingham Road, Bicester, Oxfordshire, OX27 8AL
Site National Grid Reference: Eastings: 459859, Northings: 224563

The site lies to the north of Bicester town centre within the boundary of the former RAF Bicester Site. Buildings in the south west corner of the site are currently occupied by Bicester Heritage and the existing hangars occupied by the Bicester Gliding Club. Scattered around the site are a number of listed defence structures and to the east of the site there are a number of bomb stores. The airfield taxiway is located to the west of the buildings.

The site is bounded by Buckingham Road (A4421) to the west, Skimmingdish Lane to the south and Bicester Road (road to Stratton Audley) to the North. The south east corner of the site is bounded by the newly constructed Bakels factory and to the north east, the site is bounded by agricultural land. The site benefits from three vehicular entrances, two from the A4421 Buckingham Road and one from Skimmingdish Lane.

The wider surrounding area is characterised by residential, commercial, agricultural land and associated road networks as illustrated below in Figure 1.

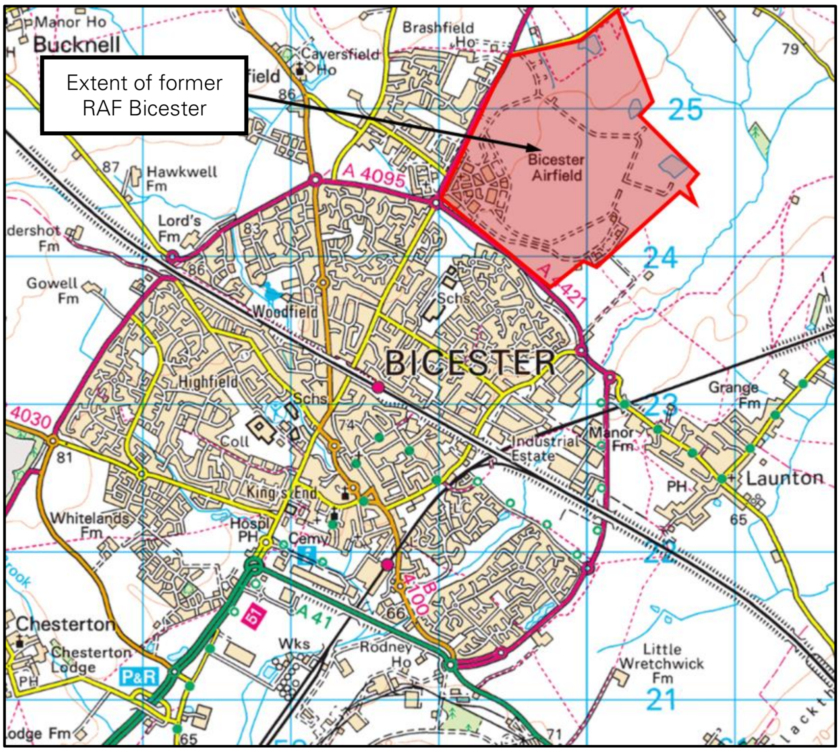


Figure 1 – Site Location

3.2. Land Use and Topography

The existing site is relatively level with ground levels sloping from 83.0m above ordnance datum (mAOD) along the western side of the site to 73.0mAOD along the eastern boundary. This equates to an average gradient across the site of approximately 1:100.

The former RAF site is approximately 1.3km wide and 1.3km in length. The approximate area of the site is 171 hectares.

Appendix A shows the topographic survey and the existing site layout.

3.3. Hydrology

The closest main river to the site is Langford Brook, which is located approximately 500m to the east of the site and is designated as Main River by the EA. This watercourse flows north to south before it joins the River Ray approximately 7.5km downstream of the site to the south.

The closest watercourse is located at the north of the site. The presence of the watercourse runs from north to south towards the centre of the site. It is currently unclear on the route the watercourse takes through the site but the topography of the site suggests the watercourse drains to the east. Further investigation is required.

The nearest standing water body is located within the site. There are three lakes adjacent to the north east boundary of the site which are former quarry pits that have been filed with water. The depth of the quarries are currently unknown.

There are no canals within the proximity of the proposed development.

3.4. Geology

Based on published geological records for the area (British Geological Survey online mapping), the site is underlain by Jurassic bedrock of the Cornbrash Formation, overlying the Forest Marble Formation. No significant superficial deposits are recorded locally. Refer to Figure 2 below:

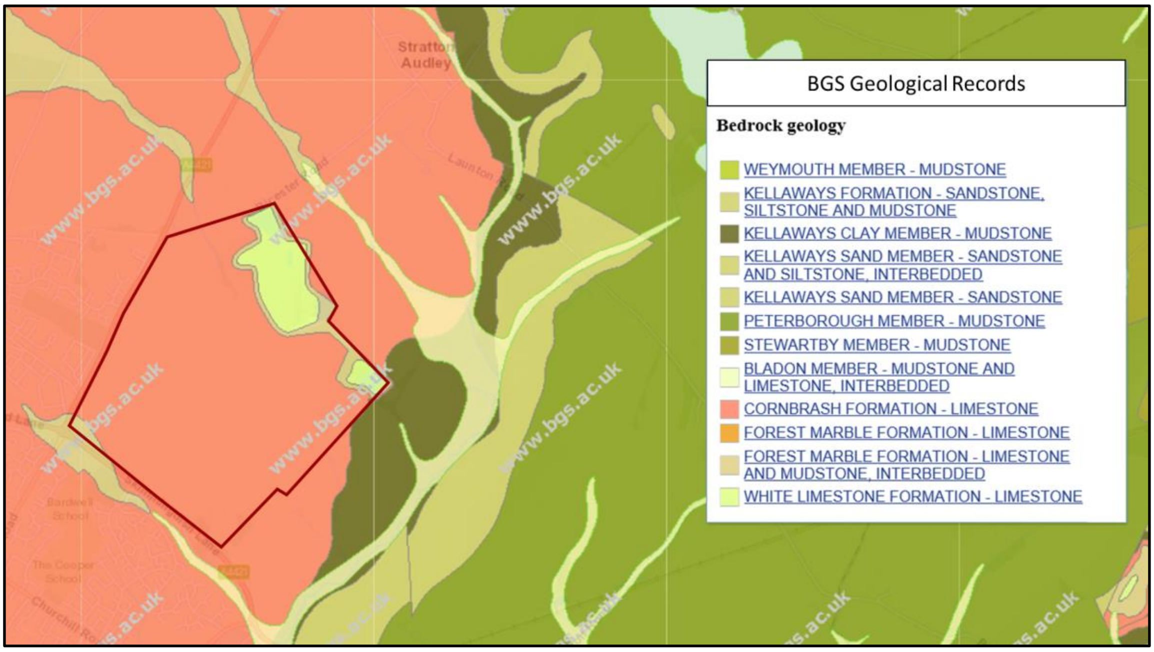


Figure 2 – British Geological Survey Records for North east Bicester (sourced from BGS website 01/02/2019)

Reference to BGS borehole scan SP52SE174, enclosed in Appendix B, located in the south east corner of the site, confirms the presence of the Cornbrash Formation layer approx. 9ft deep, Forest Marble formation layer approximately 10ft deep and white limestone layer approximately 38ft deep. The borehole also indicates that groundwater was encountered which varied during the time of year from 3ft to 12ft deep below ground level (mBGL).

Planning applications for the New Technical Site (NTS) and the Hotel and conference centre have been submitted and approved by Cherwell District Council. A full site investigation was carried out in support of the NTS planning application and infiltration testing was undertaken for the Hotel planning application.

The exploratory field work for the NTS site, which is located in the south west corner of the former RAF Bicester site, identified that the site is generally underlain by thin Topsoil (down to a maximum depth of 0.40m bgl), overlying localised Made Ground (encountered down to a maximum depth of 0.40m bgl), overlying a weathered Cornbrash Formation (down to a maximum depth of 1.0m bgl) becoming unweathered Cornbrash Formation. Rock quality strata was then proven down to 1.60m and 2.0m bgl across the site. However, no Forest Marble Formation soils were encountered. Monitoring of the groundwater level was carried out between September 2018 and January 2019 which recorded the groundwater level between 1.1 and 1.71m below ground level. Three infiltration tests were carried out in accordance with the BRE365 standard with infiltration rates of between 1.02x10-4m/s to 9.78x10-5m/s within the Cornbrash Formation being achieved.

The drainage strategy, prepared by AKS ward, in support of the planning application for the Bicester Heritage Hotel, references two soakaway tests in accordance with BRE365 Digest. The results of the tests report a soil infiltration rate of between 1.43x10-6m/s and 1.81x10-6m/s at a depth of 1 metre.

3.5. Hydrogeology

According to the MAGiC database which reference the Environment Agency records on Aquifer Designations, the majority of the site falls within a Secondary A bedrock aquifer and a small area towards the north east boundary of the site is designated as a Principal bedrock aquifer. No superficial aquifers fall within the vicinity of the site. In addition, there are no Groundwater Source Protection Zones within the site vicinity. An extract from the MAGiC database is shown below in Figure 3.

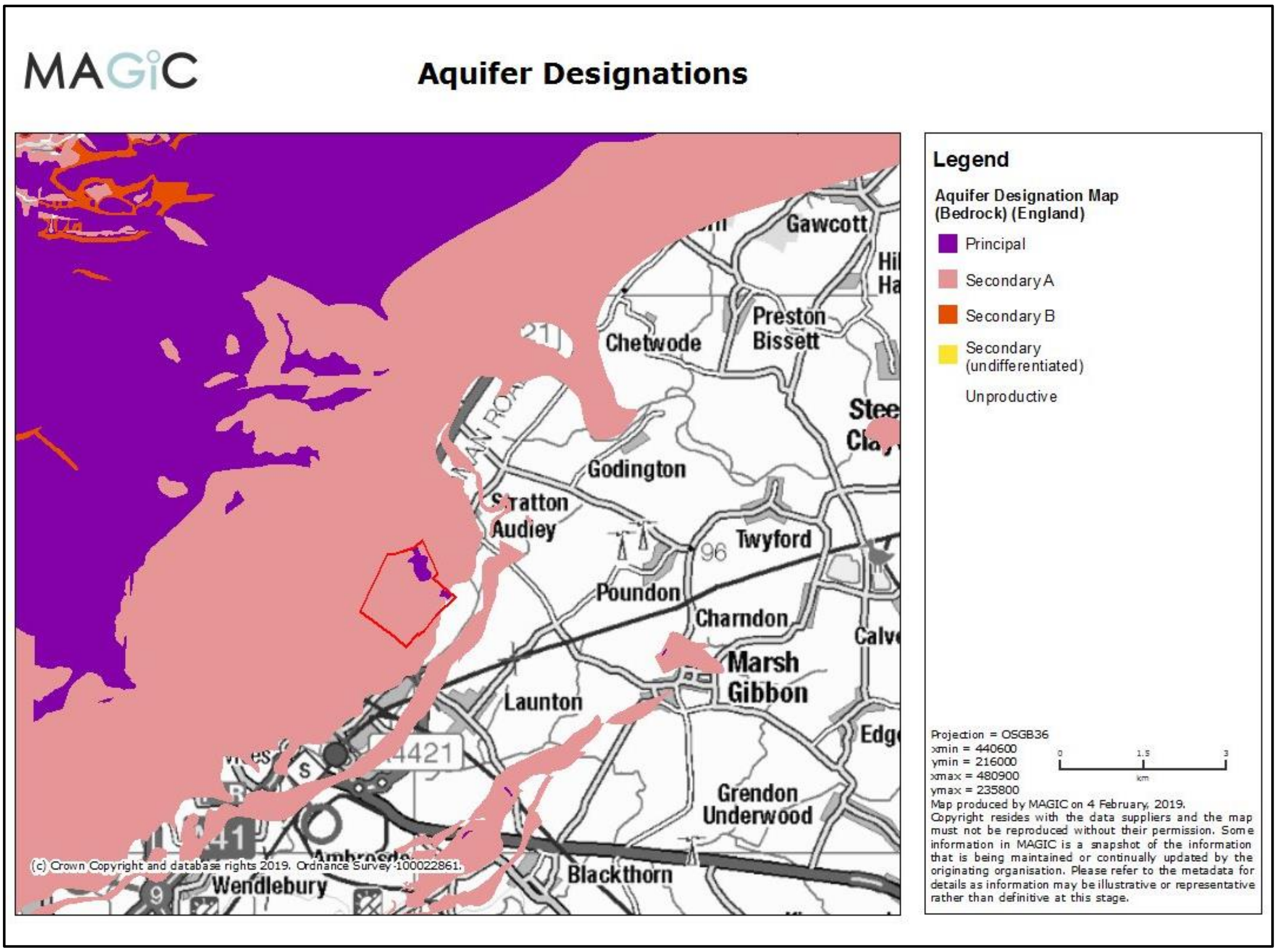


Figure 3 – Aquifer Designations (sourced from MAGiC database 04/02/2019)

3.6. Existing Drainage

Public sewer

Sewer details have been referenced from Thames Water sewer records, found in Appendix C.

Foul water

The sewer records indicate that there is a 225mm diameter foul water sewer that runs along the westerly edge of the site and then cuts across the south west corner of the site. The sewer flows from north to south.

A 450mm diameter foul water sewer is located beneath the A4421 Buckingham Road to the west of the site. This sewer runs from north to south and continues to run along the Buckingham Road towards Bicester Town.

It is understood that the sewer drains to the sewage treatment works located to the south of Bicester Town, adjacent to the Tesco Superstore.

It is apparent, based on our knowledge from the NTS development that the Thames Water's foul sewer network in Bicester has limited capacity for future development and therefore further discussions with Thames Water Development Team will be required through the Pre-development Enquiry application process to establish how the additional capacity can be provided.

Surface water

The sewer records do not indicate any surface water sewers within the vicinity of the site.

Private drainage

There are a number of internal foul and surface water drains that serve the former Bicester RAF site. Typically, the surface water within the site is managed using soakaways.

The network of internal foul drains connect to the foul sewers within the site.

3.7. Other Site constraints

According to the MAGiC database the site is home to a number of grade 2 listed buildings and scheduled monuments. In addition to this, there are two areas on the site that are designated as a Site of Special Scientific Interest (SSSI) which are the Stratton Audley Quarries 1 and 2. The SSSI sites are classified as destroyed which mean that lasting damage has occurred to the designated feature such that the feature has been irretrievably lost (no amount of management will bring this feature back). An Extract from the MAGiC database can be seen below in Figure 4.

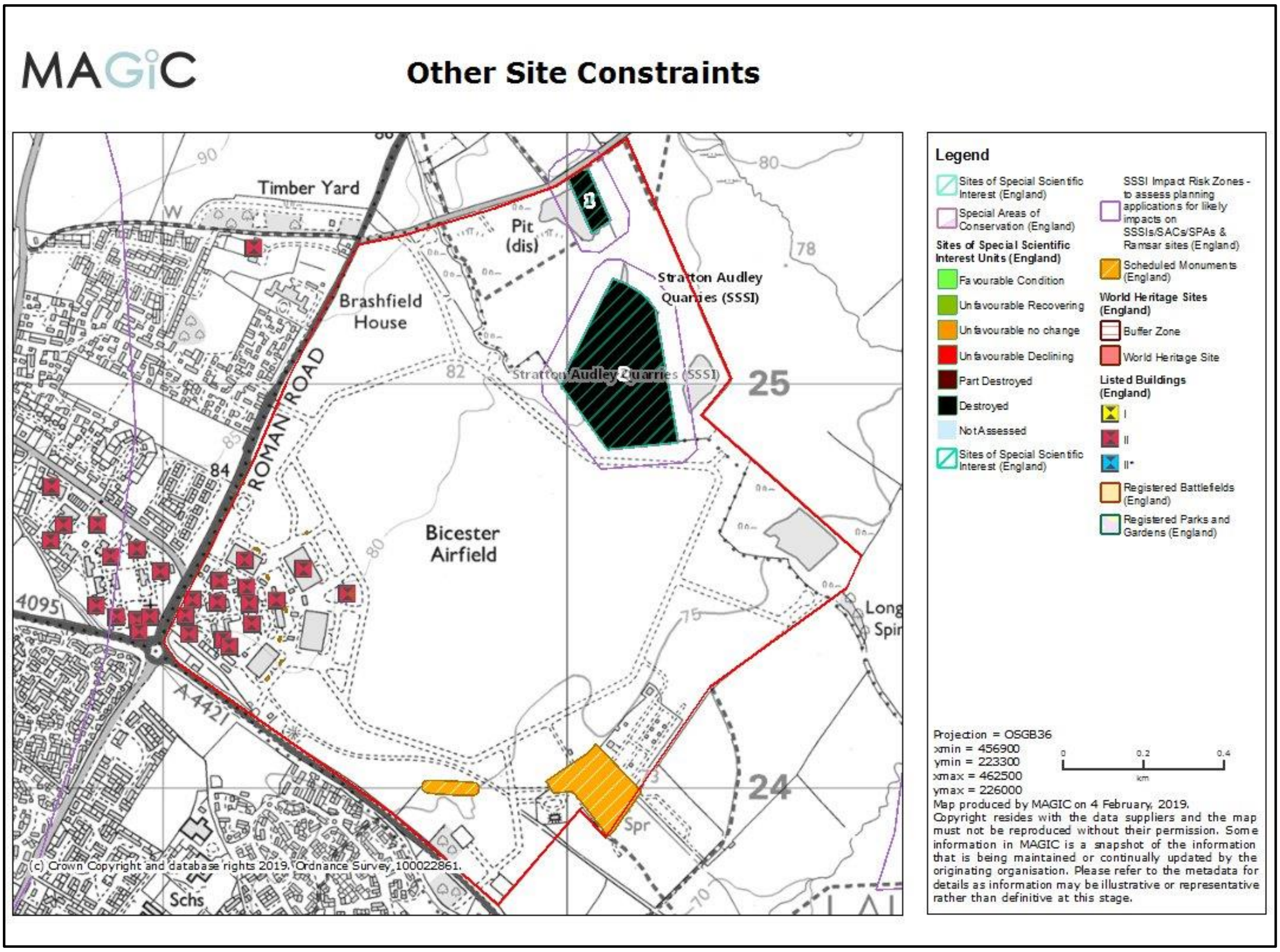


Figure 4 – Other Site Constraints (sourced from MAGiC database 04/02/2019)

4. DEVELOPMENT PROPOSALS

The proposed Bicester Motion Narrative is as follows:

"The world in which we live is undergoing a profound technology-driven transformation, the future of mobility will define how people, goods and services move around our towns, cities and countryside.

A range of premium brands are pioneering innovative mobility systems including autonomous, electrified and connected driving.

Our aim is to build upon the success of Bicester Heritage and its position as a centre of excellence for classic car ownership and partner with leading mobility technology brands to become world's first demonstration facility for vehicles of the past, present and future."

F.A.S.T. – Future Automotive Speed and Technology - F.A.S.T. is a centre of excellence for advanced technologies and cutting edge businesses. The proposed development is located at the southern corner of the site and falls under the B1, B2 and B8 use class and will provide facilities for automotive technology and engineering business, formula E motorsport, education and research.

In total the F.A.S.T. Hub proposes a combined building footprint of 10,100m^2, road/service yard footprint of 13,785m^2 and car park footprint of 4,089m^2.

Refer to Appendix D for the layout of the proposed development.

There have been recent planning applications on the former RAF Bicester site to provide a Hotel and Conference Centre as well as a New Technical Site. The Hotel and Conference Centre is a 344-room hotel which features an expansive four-storey atrium, restaurant and bar, courtyard, gym, swimming pool and spa whilst the New Technical Site proposes to construct eight new buildings with a combined total footprint of 70,000 square feet which are earmarked for showroom, workshop, office and apprenticeship facilities. Both sites, have had their plans approved by Cherwell District Council's planning committee.

5. SOURCES OF FLOOD RISK

5.1. Flooding from rivers (fluvial flood risk)

The Environment Agency online Flood Map identifies the site outside the 0.1% Annual Exceedance Probability (AEP) flood extent associated with the Langford Brook. Refer to Figure 3 below. To the east of the site, the adjacent land is situated within an area of Flood Zone 2. The Flood Zone 2 does not fall within the site extents.

Furthermore, site contours from the topographical survey show that the site is approximately 3-10m above the Langford Brook level which was obtained from the Ordnance Survey contours for the brook. This natural topography provides protection to the former RAF site as the majority of Bicester and surrounding land would flood before the proposed development.

On the basis of these findings it can be determined the site is not at risk of fluvial flooding.

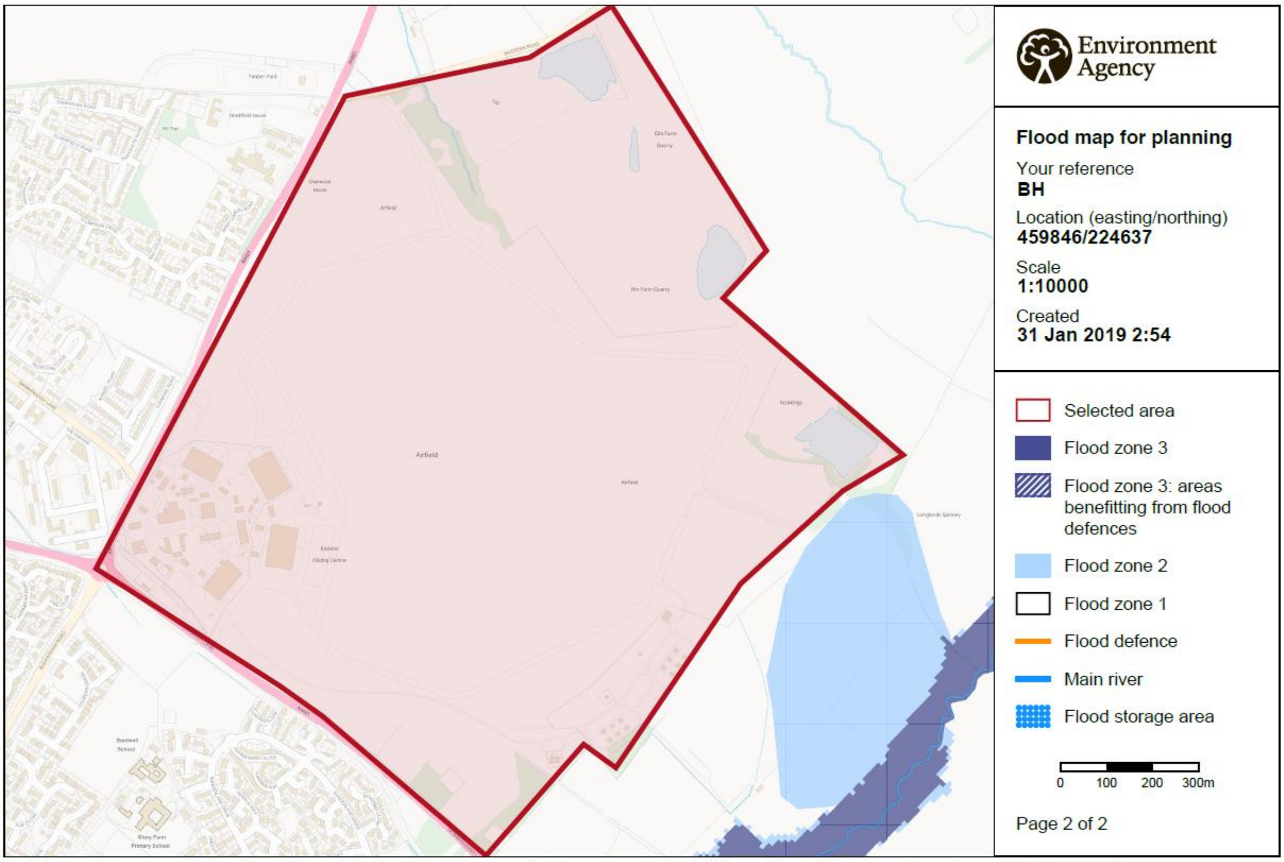


Figure 3 – Fluvial Flood Risk (sourced from EA website 31/01/2019)

5.2. Flooding from the sea (tidal flood risk)

The site is a considerable distance from the sea and therefore is not currently identified at risk of coastal or tidal flooding.

5.3. Flooding from the land (overland pluvial flood risk)

In the event of intense rainfall and when the infiltration capacity of the land has been exceeded, rainwater will flow overland. This rainwater will collect in depressions of the topography and at obstructions, which can inundate development in low lying areas.

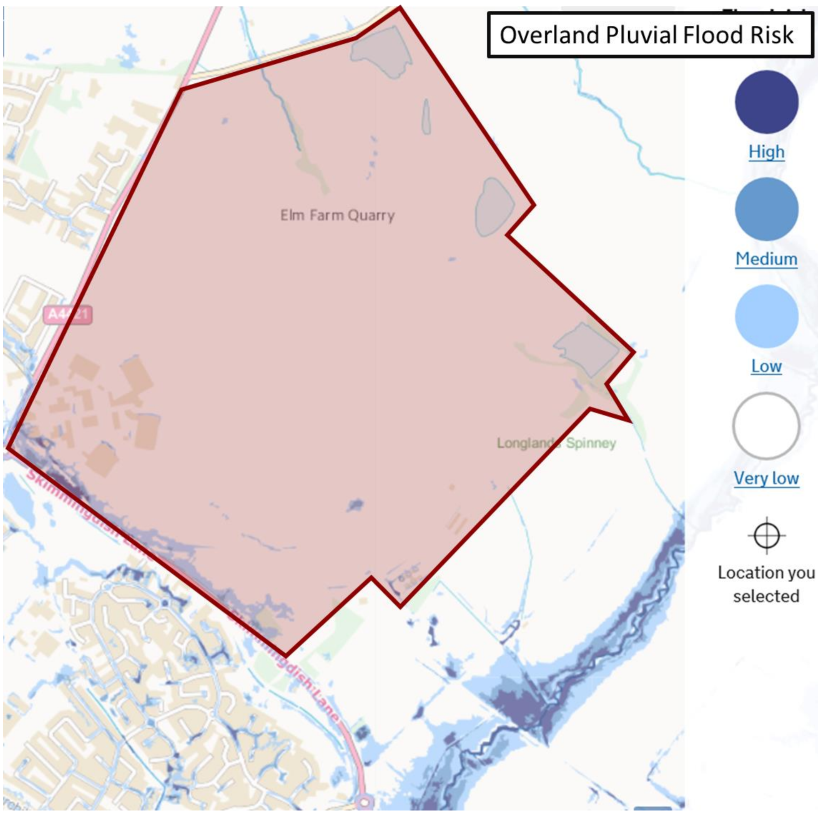


Figure 4 – Overland Pluvial Flood Risk (sourced from EA website 31/01/2019)

The Environment Agency Flood Maps for Surface Water (as shown in Figure 4) show the approximate areas that could experience surface water flooding from a range of AEP's, which is used to categorise the risk. The surface water maps identify that there is a very low risk of surface water flooding (<0.1% AEP) for the majority of the airfield. The northern side of Skimmingdish Lane, however, has been identified as medium to high risk, part of which falls within the boundary of the proposed NTS development. These overland pluvial flood flows will be managed on the NTS site by introducing an infiltration basin at the low point of the site and utilising the proposed road network as a flow conveyance route to the pond.

5.4. Flooding from groundwater

According to the Cherwell District Council Strategic Flood Risk Assessment (SFRA) (2017) Plan B8, the northeast quadrant of Bicester, which includes the site and surrounding area, is not considered at risk from groundwater flooding. The site is located within the wider slope of the valley, and as such any emerging groundwater would flow under gravity to the east, resulting in minimal flood levels if groundwater did emerge.

Monitoring of the groundwater level was carried out for the NTS development between September 2018 and January 2019. The results of which recorded the groundwater level between 1.1 and 1.71m below ground level.

On the basis of these findings, the risk of groundwater flooding is understood to be low.

5.5. Flooding from sewers

According to the Cherwell SFRA Plan B-10, the site has had 0-5 sewer flooding incidents due to failure or capacity issues. Therefore the site is deemed to be at low risk of sewer flooding.

5.6. Flooding from Artificial Sources

The site is not identified as being at risk of reservoir flooding from the Environment Agency Reservoir Flood Map as shown in Figure 5. The site is located a considerable distance from any canal and therefore not at risk from flooding from this source.

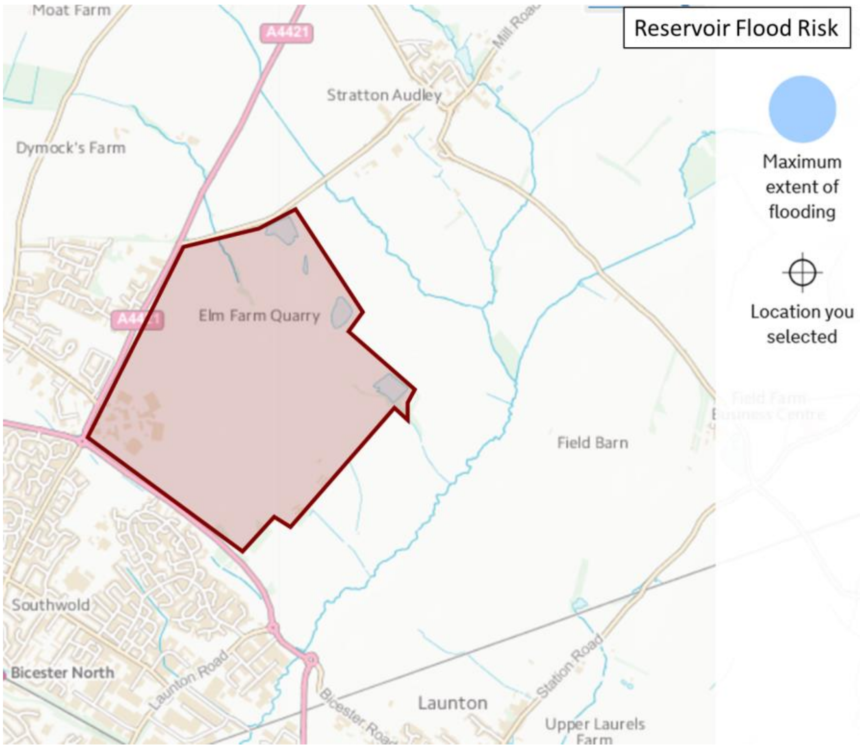


Figure 5 – Reservoir Flood Risk (sourced from EA website 31/01/2019)

5.7. Flooding History

No historic flooding has been recorded within the Cherwell SFRA for the site or surrounding area of north east Bicester. Flooding has been limited to the southern reaches of the Langford Brook floodplain within Bicester which is located over 500m east of the site, and roughly 3m lower than the lowest site levels.

5.8. Sequential Test

The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of directing development to areas at little or no risk of flooding from any source in preference to areas at higher risk. NPPF Table 2 confirms the 'Flood risk vulnerability classification' of a site, depending upon the proposed usage. This classification is subsequently applied to Table 3 'Flood risk vulnerability and flood zone compatibility' to determine whether:

- The development is suitable for the flood zone in which it is located; and
- Whether an Exception Test is required for the proposed development.

The proposed development is made up of of 'less vulnerable' commercial uses.

As the entire site lies within Flood Zone 1, the Sequential Test is passed and there is no requirement to apply the Exception Test.

6. SURFACE WATER DRAINAGE PROPOSALS

The F.A.S.T. Hub is designated as major planning development. The NPPF sets out the requirement for all major development to include Sustainable Urban Drainage Systems (SuDS).

The SuDS systems aim to deal with rainwater where it falls (at source), allowing as much water as possible to either evaporate or soak into the ground. Remaining runoff is then drained to the nearest water body, ideally via other forms of SuDS, at the same rate and volume or lower as would naturally have occurred prior to development. During this process, SuDS reduce pollutants in the water, such as hydrocarbons, nutrients and heavy metals, by filtering and treating runoff. This ensures that the water soaking into the ground and discharging to nearby watercourses or sewers is cleaner, protecting water quality and wildlife.

Management of surface water run-off using SuDS is just one aspect of SuDS design. If managed appropriately, SuDS can offer real value to a development through enhancing green space which supports the provision of habitats and places for wildlife to live and flourish.

The use of SuDS is also highly encouraged by the Lead Local Flood Authority (LLFA). Typical SuDS applications that could be used for this development are shown in Table 1 below:

SUDS FEATURE	DESCRIPTION
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water.
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. Although this does not count towards on-site storage as it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event due to the potential sporadic use of the stored water
Permeable Surfaces	Permeable surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.
Filter Drains	Linear drains/trenches filled with a permeable material, often with perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site.
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.
Swales	Shallow vegetated channels that convey and/or retain water and can permit infiltration when unlined.
Ponds	Depressions used for storing and treating water.
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.
Detention Basin	Dry depressions designed to store water for a specified retention time.
Soakaways	Sub-surface structures that store and dispose of water via infiltration.
Infiltration Trenches	Depressions that store and dispose of water via infiltration.

Table 1 – Description of SuDS Features

An outline drainage strategy has been prepared for the proposed F.A.S.T. Hub development which is presented in Appendix D.

The outline drainage strategy has been prepared with the view of using SuDS systems as mentioned in Table 1 above. As areas around the site are recorded to have infiltration rates greater than $1x10^{-6}$m/s, it is therefore a fair assumption that draining at source is the most appropriate method of managing the surface water run-off. A site investigation will be carried out to validate this assumption.

The outline drainage Strategy for the F.A.S.T. proposes to use a network of infiltration swales with stone pile dams to convey and attenuate the roof/road surface water run off from the proposed development. The Swales will discharge via orifice controls into two shallow infiltration basins.

The car park areas will contain and manage their own run-off at source through the use of infiltration. The car park will have an impermeable circulatory corridor with permeable parking bays. The permeable parking bays will be designed to accommodate the run-off from the impermeable circulatory lane and their own catchment.

The sizing of the SUDs features have been simulated for a 1in100 year return period plus 40% climate change using a Microdrainage Source Control Cascade model. The approximate volume of storage is calculated based on an infiltration rate of $5x10^{-5}$m/s which is the average of the infiltration rates from existing site records (refer to section 3.4). The results of the Microdrainage model are shown in Appendix E.

In the event of an exceedance event, where the rainfall event exceeds the designed rainfall event, any overland flows will follow the existing land profile which falls to the south east corner of the site. Basin 1 and Swale 5 have been located along the South East/ Eastern boundary in order to capture these overland flows.

It is important for the performance of the SuDS systems that they are maintained on a regular basis. In this development the Bicester Motion will be responsible for the operation and maintenance of the SuDS systems. The designer will need to prepare a management and maintenance manual follow detailed design which will be set out in accordance with the guidance in the CIRIA C753 “SuDS Manual”.

Pre-App comments

A pre-app was carried out for the F.A.S.T. project with Cherwell District Council as Local Planning Authority (LPA). Unfortunately, LPA were unable to consult external parties as part of the Pre-App process so the LLFA were not consulted.

However, Mr Richard Bennett from Oxfordshire County Council as the LLFA was contacted to discuss the proposed high level drainage strategy. Mr Bennett kindly reviewed the drainage proposals and confirmed that the strategy was an acceptable approach to managing the surface water run-off. Due to the use of infiltration features, Mr Bennett was keen to see site investigation information which includes infiltration testing, groundwater monitoring and contamination testing across the site to ensure the site is suitable for draining at source. In addition to this, detailed hydraulic modelling will be submitted prior to approval of the drainage strategy.

A site investigation has not been undertaken yet and shall be carried out in advance of determination of outline planning .

7. FOUL DRAINAGE PROPOSALS

7.1. Proposed Foul Network

The existing site has a network of private foul water drains in the south west corner of the site which connect to the foul sewer. The F.A.S.T. development is situated adjacent to the south east boundary of the former RAF site. The site does not have any existing foul drainage infrastructure.

Therefore in view of the topography of the site, it is likely that the foul waste for the F.A.S.T. development will require a pumped system to convey the foul waste to the foul sewers. The pump system will need to provide 24 hour storage in the event of a pump failure to comply with the Part H of Building Regulations. Pumps systems generally discharge at a higher flow rate than gravity systems with a typical pumped flow rate being 3 to 5l/s.

An assessment of the potential foul flows from the development has been calculated as per the Table 3 below. As occupancy values for development are currently unknown, the Sewers For Adoption flow rates for use class have been used as a means of calculating the development flows.

DEVELOPMENT AREA	FOOTPRINT (M^2)	NO. OF FLOORS	FLOOR AREA	DESIGN FLOW (L/S/HA)	TOTAL FLOW RATE (L/S)
New Future Automotive Speed and Technology Hub	10,100	2	20,200	1.1	2.22

Table 3 – Estimated Foul Flow Rate

The total flow rate referenced in Table 3 above is based on a gravity connection to the mains sewer. It is likely that flow rates from the F.A.S.T. development will be higher due to the need to pump.

7.2. Limitations with the Existing Foul Network

It is apparent, based on our knowledge from the NTS development, that the Thames Waters foul sewer network in Bicester has limited capacity for future development. Measures are being put in place by Thames Water to mitigate the capacity issues but it is likely that these measure will not provide enough capacity for the F.A.S.T. Hub. A Pre-development Enquiry with Thames Water shall therefore be requested to understand whether the sewer network has capacity whilst informing Thames Water to the potential development so that their programme of network improvements consider this development.

8. CONCLUSION

This flood risk and drainage assessment report has been prepared in support of an outline planning application for the Bicester Motion F.A.S.T. Hub development at the former RAF Bicester Airfield, Bicester, OX26 5HA.

Based on the information available from the Environment Agency, Cherwell District Council, County Council (Lead Local Flood Authority) and MAGiC Database, the site, which is located in Flood Zone 1, as defined in the NPPF, is not identified as being at risk of flooding associated with fluvial, pluvial, tidal, sewers or groundwater. There is an overland pluvial flood risk within the south west part of the development but the proposed drainage strategy for the New Technical Site will manage the overland flows. However, should overland flows enter the site then the proposed infiltration swales will convey them to a shallow infiltration basin located in the southern corner of the site.

As the entire site lies within Flood Zone 1, the Sequential Test was passed and there is no requirement to apply the Exception Test.

Surface water runoff from the proposed development should be managed using Sustainable Urban Drainage Systems (SuDS) as these will not only manage surface water run-off, but also offer benefits in pollution prevention creating and sustaining better places for people and nature. SuDS systems identified to manage the surface water run off from the Bicester Motion development have been detailed on the outline drainage strategy drawing provided in Appendix D. The local geology (cornbrash formation) suggests there is a high potential for infiltration which greatly benefits use of the SuDS systems. Infiltration testing undertaken as part of the site investigation for NTS identified that soakage systems are a suitable means of surface water disposal.

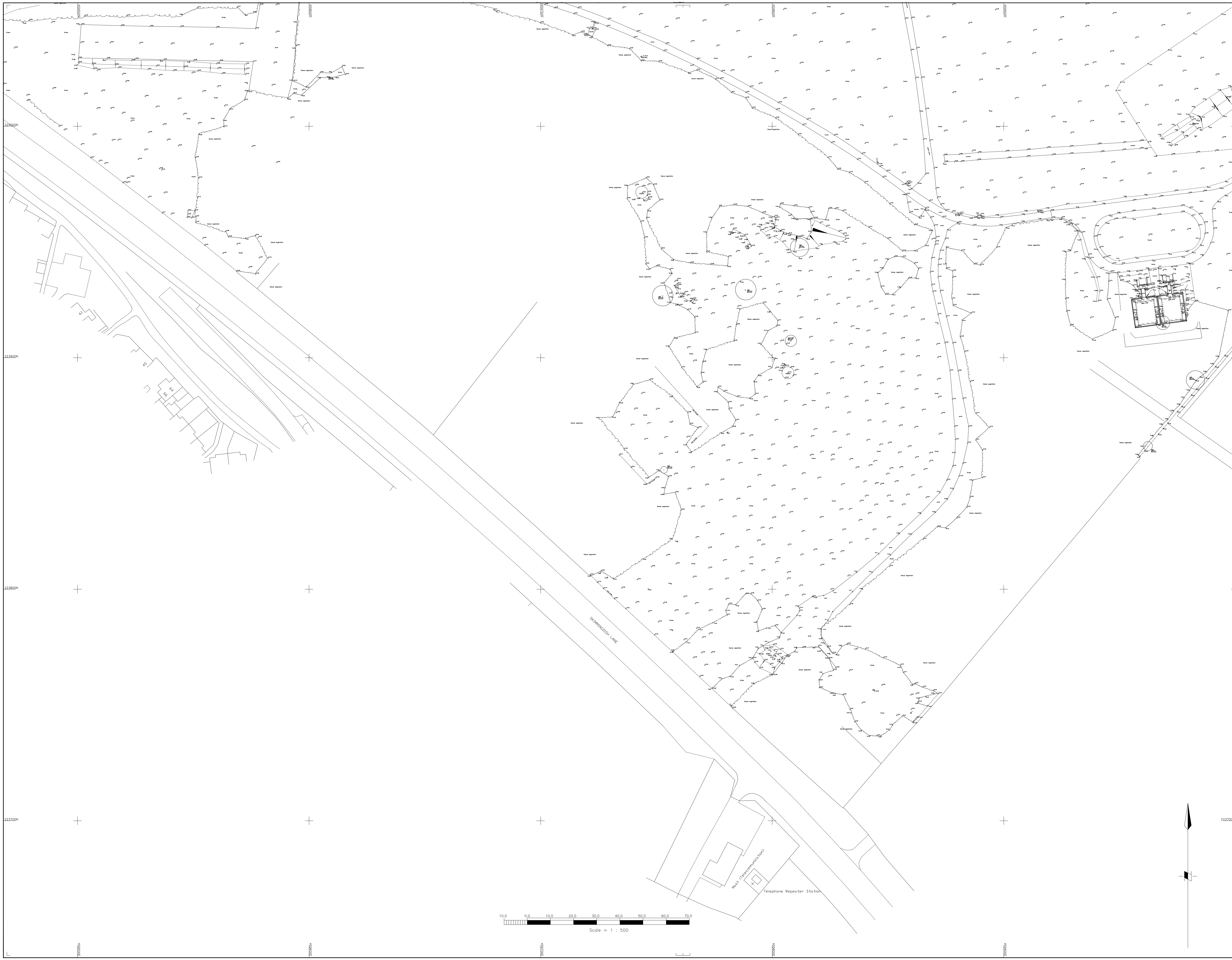
The peak rate of surface water run-off from the site should never exceed the peak greenfield run-off rate from the existing site for the 1in1 year and 1in100 year rainfall events.

Any attenuation or infiltration structures shall accommodate up to the 1in100 year return period plus climate change storm event with any surface run-off and overland flow caused by exceedance events being conveyed to the SuDS systems.

The existing foul sewer network is likely to have capacity issues, therefore a pre-development enquiry will be carried out with Thames Water to establish how additional capacity can be provided to accommodate the development.

The majority of the development is located in an area where access to a foul sewer by gravity is limited. Therefore in view of the topography, it is likely that a pumped system will be required. The anticipated foul flow from the development is approximately 2.22l/s, however, actual flow rates are likely to be higher (3 to 5l/s) due to the need to pump.

APPENDIX A – TOPOGRAPHICAL SURVEY



Notes

THIS SURVEY HAS BEEN PREPARED WITH A SCALING ACCURACY FOR A PLOT AT A SCALE OF 1/500

ALL LEVELS ARE IN METRES DERIVED FROM GPS TRANSFORMATION OSGM15

THE CO-ORDINATES ARE DERIVED FROM THE ORDNANCE SURVEY ACTIVE STATION NETWORK OSTN15 (BASE STATION ST01)

ALL TREE HEIGHTS AND SPREADS ARE APPROXIMATE

WE HAVE TRIED TO IDENTIFY TREE TYPES, HOWEVER IF TREE SPECIES ARE CRITICAL SPECIALIST ADVICE SHOULD BE GAINED.

THIS DRAWING IS A COMPILATION OF ON CENTRE SURVEYS SURVEY UNDERTAKEN AUGUST 2018, INHERITED SURVEY DRAWINGS AS SUPPLIED BY THE CLIENT & ORDNANCE SURVEY DIGITAL DATA

job	BICESTER HERITAGE CENTRE BUCKINGHAM ROAD BICESTER OX26 5HA
client	BICESTER HERITAGE
title	LAND SURVEY
dwg no.	25557C-5
scale	1/500
date	AUGUST 2018

PRELIMINARY
ISSUED 17/9/18

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LAND & BUILDING SURVEYORS
GEODETIC ENGINEERS
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APPENDIX B – BGS BOREHOLE SCAN SP52SE174

At *Bicester R.A.F. Station* ~~site, which is 5910 2425~~ Ref. SP 5910 2425

Town or Village *Bicester* County *Oxon* Six-inch quarter sheet

Exact site *E. side of Roman Way, 1650 yds NE. of the railway.* in parish of SP 5910 2446 (A rough sketch or a tracing of maps is very desirable)

123 A

Level of ground surface above sea-level (O.D.) *c240* ft. If well starts below ground surface, state how far

Shaft ft., diameter ft. Bore *140* ft. Diameter of bore: at top *15* ins.; at bottom *15*

Details of permanent lining tubes (internal diameters preferred) *30' x 15 in., from surface; then 12 in. to bottom, part perforated. (101'–120') see over page*

SP52/46

Water struck at depths of (feet)

Rest-level of water below ~~above~~ top of well *3–12* * feet. Suction at feet. Yield on *5* ~~hours'~~ days' test *4000* gallons per *hr* (with pump of capacity g.p.h.); depressing water level to *110* feet below top. Time of recovery hrs. Amount normally pumped daily g.p.h. for hours.

Quality (attach copy of analysis if available)

Sunk by *Richardson-Timmins, Ltd.* for Mr. Date of well *1939*

Information from *T. Richardson, Ltd.*

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS Feet.	Inches.	DEPTH Feet.	Inches.
	Top soil	1	6	1	6
	Brash	4	.	5	6
Cornbrash	Hard brash	3	.	8	6
9 ft.	Light blue rock	2	.	6	6
	Light blue clay	2	.	12	6
Forest	Blue rock and layers of clay	2	.	14	6
Marble	Very hard grey rock	3	.	18	6
10½ ft.	Grey clay	3	6	21	.
	Grey hard Limestone Rock	5	.	26	.
White	Blue sandy clay	1	6	27	6
Limestone	Light limestone rock	7	6	35	.
38½ ft.	Grey rock	24	6	59	6
	Blue clay	1	6	61	.
Hampen	Light grey rock	2	.	63	.
Marly Beds	Light blue rock	1	6	64	6
21½ ft.	Grey rock	2	6	67	.
	Blue clay, layers of rock	14	.	81	.
Taynton	Grey rock	5	.	86	.
Stone	Rock with layers of clay	8	.	94	.
20 ft.	Grey rock	7	.	101	.
	Fine grey sandstone	4	.	105	.
	Dark brown clay	1	6	106	6
	Fine grey sandstone	4	.	110	6
Swerford and	Hard sandstone	4	.	114	6
Hook Norton	~~Blue clay~~	~~6~~	~~6~~	~~121~~	
Beds.	~~Hard dark grey rock~~	~~3~~	~~6~~		
23½ ft.	~~Blue clay~~				
	Fine grey sandstone	6	6	121	.
	Hard sandstone	3	6	124	6
	Blue clay	5	.	129	6
Upper Lias	Hard dark grey rock	2	6	132	.
15½ ft.	Blue clay	8	.	140	.

MWW. 12.11.40 * R.W.L. 12 ft. down in May 1940, 3 ft. down in Aug. 1939.

For Survey use only

APPENDIX C – THAMES WATER SEWER RECORDS

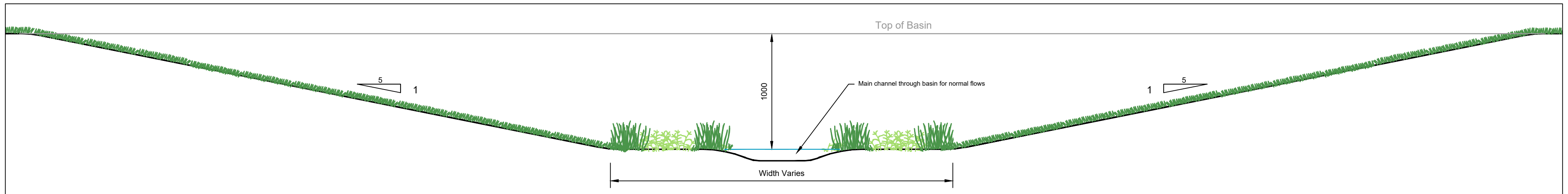
CDWS/CDWS Standard/2012_2270346

0 10 20 40 60 80
Meters

Scale:	1:1791
Width:	500m
Printed By:	mrajen
Print Date:	10/07/2012
Map Centre:	459750,223750
Grid Reference:	SP5923NE

Comments:

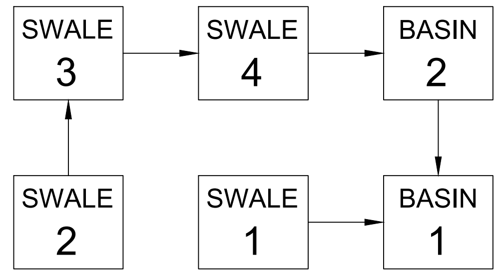
APPENDIX D – OUTLINE DRAINAGE STRATEGY

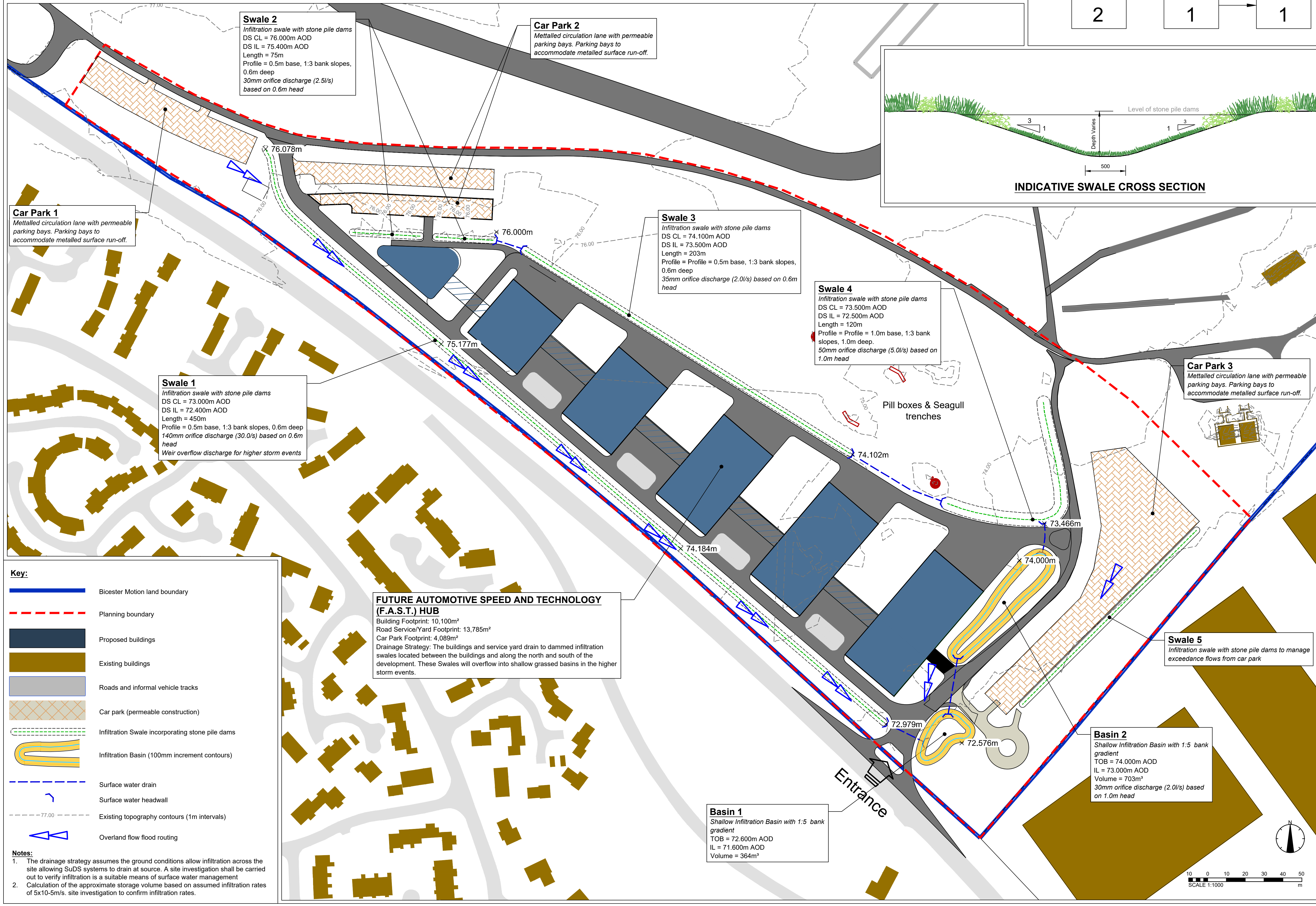


INDICATIVE INFILTRATION BASIN CROSS SECTION

MICRODRAINAGE CASCADE MODEL SCHEMATIC

For Microdrainage calculations, refer to report 5002854-RDG-XX-XX-DOC-C-0552, Appendix E





Key:

- Bicester Motion land boundary
- Planning boundary
- Proposed buildings
- Existing buildings
- Roads and informal vehicle tracks
- Car park (permeable construction)
- Infiltration Swale incorporating stone pile dams
- Infiltration Basin (100mm increment contours)
- Surface water drain
- Surface water headwall
- Existing topography contours (1m intervals) (77.00)
- Overland flow flood routing

Notes:

1. The drainage strategy assumes the ground conditions allow infiltration across the site allowing SuDS systems to drain at source. A site investigation shall be carried out to verify infiltration is a suitable means of surface water management
2. Calculation of the approximate storage volume based on assumed infiltration rates of 5x10-5m/s. site investigation to confirm infiltration rates.

DRAWING NOTES:

CDM REGULATIONS 2015

SIGNIFICANT OR NON-OBVIOUS RISKS AND RISKS WHICH ARE DIFFICULT TO MANAGE ARE IDENTIFIED ON THIS DRAWING USING THE FOLLOWING SYMBOL IDENTIFIED TO THE RIGHT WITH BRIEF ACCOMPANYING TEXT. FOR FURTHER DETAILS OF THE RISKS IDENTIFIED BY DESIGNERS, REFERENCE SHOULD BE MADE TO CDM HAZARD REGISTER.

REV	DESCRIPTION	DATE	DRAWN
B	ISSUED FOR OUTLINE PLANNING - BOUNDARY AMENDED & WESTERN CAR PARK ADDED	12/11/2019	MG
A	ISSUED FOR OUTLINE PLANNING	25/10/2019	MG
-	DRAFT ISSUE	21/05/2019	MG

ORIGINATOR:

RIDGE
PROPERTY & CONSTRUCTION CONSULTANTS

THE COWYARDS
BLENHEIM PARK
OXFORD ROAD
WOODSTOCK, OX20 1QR

TEL: 01993 815000
WWW.RIDGE.CO.UK

CLIENT:

BICESTER MOTION

IN ASSOCIATION WITH:

PROJECT:

F.A.S.T.

TITLE:

SURFACE WATER DRAINAGE STRATEGY

ENG:	CSE:	ICSE:	SCALE: 1:1000 @ A1
MG	SW		INITIAL ISSUE: 21/05/2019

STATUS:

PLANNING

DRAWING No:

PROJECT:	ORG:	ZONE:	LEVEL:	TYPE:	ROLE:	NUMBER:	REV:
5002854	RDG	XX	ST	PL	C	0503	B

APPENDIX E – MICRODRAINAGE CALCULATIONS

Cascade Summary of Results for Swale 1.SRCX

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

Half Drain Time : 81 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	72.861	0.461	38.5	25.6	0.0	64.0	389.9	O K
30 min Summer	72.925	0.525	43.1	27.6	3.4	74.1	490.5	O K
60 min Summer	72.960	0.560	45.5	28.6	12.4	86.6	549.1	O K
120 min Summer	72.966	0.566	45.9	28.8	14.4	89.1	558.9	O K
180 min Summer	72.957	0.557	45.3	28.5	11.5	85.4	543.5	O K
240 min Summer	72.943	0.543	44.3	28.1	7.7	80.1	520.8	O K
360 min Summer	72.915	0.515	42.3	27.3	1.5	71.1	473.3	O K
480 min Summer	72.885	0.485	40.2	26.4	0.0	66.6	427.1	O K
600 min Summer	72.858	0.458	38.2	25.5	0.0	63.7	385.7	O K
720 min Summer	72.832	0.432	36.4	24.6	0.0	61.0	349.7	O K
960 min Summer	72.788	0.388	33.3	23.1	0.0	56.4	290.7	O K
1440 min Summer	72.719	0.319	28.4	20.4	0.0	48.8	209.4	O K
2160 min Summer	72.648	0.248	23.3	17.3	0.0	40.6	139.1	O K
2880 min Summer	72.602	0.202	20.0	14.9	0.0	34.9	100.9	O K
4320 min Summer	72.553	0.153	16.5	10.0	0.0	26.6	66.2	O K
5760 min Summer	72.523	0.123	14.4	7.0	0.0	21.4	48.1	O K
7200 min Summer	72.501	0.101	12.8	5.2	0.0	18.0	36.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	139.469	0.0	454.9	0.0	26
30 min Summer	91.145	0.0	594.6	2.4	37
60 min Summer	56.713	0.0	740.0	19.9	60
120 min Summer	34.093	0.0	889.7	32.3	92
180 min Summer	24.982	0.0	977.9	25.9	126
240 min Summer	19.920	0.0	1039.7	16.1	160
360 min Summer	14.430	0.0	1129.8	2.1	230
480 min Summer	11.481	0.0	1198.5	0.0	296
600 min Summer	9.608	0.0	1253.7	0.0	360
720 min Summer	8.303	0.0	1300.2	0.0	424
960 min Summer	6.590	0.0	1376.0	0.0	548
1440 min Summer	4.752	0.0	1488.3	0.0	788
2160 min Summer	3.421	0.0	1607.1	0.0	1144
2880 min Summer	2.707	0.0	1695.6	0.0	1500
4320 min Summer	1.944	0.0	1826.1	0.0	2212
5760 min Summer	1.535	0.0	1923.1	0.0	2944
7200 min Summer	1.278	0.0	2000.7	0.0	3672

Cascade Summary of Results for Swale 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	72.484	0.084	11.6	4.0	0.0	15.5	28.4	O K
10080 min Summer	72.473	0.073	10.8	3.0	0.0	13.8	23.4	O K
15 min Winter	72.894	0.494	40.8	26.6	0.0	67.4	440.5	O K
30 min Winter	72.961	0.561	45.6	28.7	12.9	87.2	551.6	O K
60 min Winter	72.998	0.598	48.2	29.7	26.0	104.0	616.4	O K
120 min Winter	72.999	0.599	48.3	29.8	26.6	104.7	620.0	O K
180 min Winter	72.986	0.586	47.4	29.4	21.4	98.1	594.8	O K
240 min Winter	72.968	0.568	46.1	28.9	15.0	90.0	562.6	O K
360 min Winter	72.930	0.530	43.4	27.8	4.5	75.6	498.8	O K
480 min Winter	72.891	0.491	40.6	26.6	0.0	67.2	436.1	O K
600 min Winter	72.853	0.453	37.9	25.3	0.0	63.2	378.5	O K
720 min Winter	72.818	0.418	35.4	24.1	0.0	59.6	330.0	O K
960 min Winter	72.759	0.359	31.2	22.0	0.0	53.2	254.7	O K
1440 min Winter	72.672	0.272	25.0	18.4	0.0	43.4	161.4	O K
2160 min Winter	72.596	0.196	19.6	14.3	0.0	33.9	95.7	O K
2880 min Winter	72.557	0.157	16.8	10.4	0.0	27.2	68.9	O K
4320 min Winter	72.513	0.113	13.7	6.1	0.0	19.8	42.9	O K
5760 min Winter	72.485	0.085	11.7	4.1	0.0	15.8	28.9	O K
7200 min Winter	72.469	0.069	10.5	2.6	0.0	13.1	21.8	O K
8640 min Winter	72.456	0.056	9.6	1.7	0.0	11.3	16.7	O K
10080 min Winter	72.447	0.047	8.7	1.3	0.0	9.9	13.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	1.099	0.0	2065.8	0.0	4408
10080 min Summer	0.968	0.0	2122.0	0.0	5128
15 min Winter	139.469	0.0	509.5	0.0	27
30 min Winter	91.145	0.0	666.0	13.9	38
60 min Winter	56.713	0.0	828.8	47.9	60
120 min Winter	34.093	0.0	996.5	70.5	96
180 min Winter	24.982	0.0	1095.3	62.4	134
240 min Winter	19.920	0.0	1164.5	43.4	170
360 min Winter	14.430	0.0	1265.4	10.8	244
480 min Winter	11.481	0.0	1342.3	0.0	314
600 min Winter	9.608	0.0	1404.2	0.0	380
720 min Winter	8.303	0.0	1456.2	0.0	444
960 min Winter	6.590	0.0	1541.1	0.0	568
1440 min Winter	4.752	0.0	1666.8	0.0	806
2160 min Winter	3.421	0.0	1800.0	0.0	1148
2880 min Winter	2.707	0.0	1899.0	0.0	1504
4320 min Winter	1.944	0.0	2045.3	0.0	2212
5760 min Winter	1.535	0.0	2153.8	0.0	2944
7200 min Winter	1.278	0.0	2240.8	0.0	3672
8640 min Winter	1.099	0.0	2313.7	0.0	4392
10080 min Winter	0.968	0.0	2376.7	0.0	5136

Cascade Rainfall Details for Swale 1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.411	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.740

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.435	4	8	0.435	8	12	0.435	12	16	0.435

Cascade Model Details for Swale 1.SRCX

Storage is Online Cover Level (m) 73.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.18000	Length (m)	450.0
Infiltration Coefficient Side (m/hr)	0.18000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	72.400	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.140 Discharge Coefficient 0.600 Invert Level (m) 72.400

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.500 Invert Level (m) 72.900

Cascade Summary of Results for Swale 2.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Swale 3.SRCX	(None)

Half Drain Time : 54 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	75.770	0.270	3.9	1.9	5.8	24.7	O K
30 min Summer	75.801	0.301	4.2	2.0	6.2	29.6	O K
60 min Summer	75.814	0.314	4.4	2.0	6.4	31.6	O K
120 min Summer	75.809	0.309	4.3	2.0	6.3	30.8	O K
180 min Summer	75.796	0.296	4.2	1.9	6.1	28.7	O K
240 min Summer	75.781	0.281	4.0	1.9	5.9	26.4	O K
360 min Summer	75.754	0.254	3.7	1.8	5.5	22.4	O K
480 min Summer	75.730	0.230	3.4	1.8	5.2	19.2	O K
600 min Summer	75.709	0.209	3.2	1.7	4.9	16.5	O K
720 min Summer	75.690	0.190	3.0	1.7	4.6	14.3	O K
960 min Summer	75.659	0.159	2.6	1.6	4.2	10.8	O K
1440 min Summer	75.611	0.111	2.1	1.4	3.5	6.5	O K
2160 min Summer	75.566	0.066	1.6	1.2	2.8	3.2	O K
2880 min Summer	75.545	0.045	1.3	1.1	2.4	2.0	O K
4320 min Summer	75.525	0.025	0.7	1.0	1.7	1.0	O K
5760 min Summer	75.514	0.014	0.4	1.0	1.4	0.5	O K
7200 min Summer	75.507	0.007	0.2	0.9	1.1	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.469	0.0	28.7	17
30 min Summer	91.145	0.0	37.6	31
60 min Summer	56.713	0.0	46.8	48
120 min Summer	34.093	0.0	56.2	82
180 min Summer	24.982	0.0	61.8	116
240 min Summer	19.920	0.0	65.7	150
360 min Summer	14.430	0.0	71.5	216
480 min Summer	11.481	0.0	75.8	280
600 min Summer	9.608	0.0	79.2	342
720 min Summer	8.303	0.0	82.2	404
960 min Summer	6.590	0.0	87.0	522
1440 min Summer	4.752	0.0	94.1	764
2160 min Summer	3.421	0.0	101.6	1108
2880 min Summer	2.707	0.0	107.2	1468
4320 min Summer	1.944	0.0	115.4	2200
5760 min Summer	1.535	0.0	121.6	2904
7200 min Summer	1.278	0.0	126.5	3672

Cascade Summary of Results for Swale 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	75.503	0.003	0.1	0.9	1.0	0.1	O K
10080 min Summer	75.500	0.000	0.0	0.9	0.9	0.0	O K
15 min Winter	75.791	0.291	4.1	1.9	6.1	28.0	O K
30 min Winter	75.827	0.327	4.5	2.0	6.5	33.8	O K
60 min Winter	75.840	0.340	4.7	2.1	6.7	36.2	O K
120 min Winter	75.833	0.333	4.6	2.0	6.6	34.9	O K
180 min Winter	75.814	0.314	4.4	2.0	6.4	31.7	O K
240 min Winter	75.793	0.293	4.1	1.9	6.1	28.4	O K
360 min Winter	75.755	0.255	3.7	1.8	5.6	22.6	O K
480 min Winter	75.722	0.222	3.3	1.7	5.1	18.2	O K
600 min Winter	75.694	0.194	3.0	1.7	4.7	14.7	O K
720 min Winter	75.669	0.169	2.8	1.6	4.3	11.9	O K
960 min Winter	75.628	0.128	2.3	1.5	3.8	8.0	O K
1440 min Winter	75.573	0.073	1.7	1.2	2.9	3.7	O K
2160 min Winter	75.539	0.039	1.1	1.1	2.2	1.7	O K
2880 min Winter	75.525	0.025	0.7	1.0	1.8	1.0	O K
4320 min Winter	75.511	0.011	0.3	1.0	1.3	0.4	O K
5760 min Winter	75.503	0.003	0.1	0.9	1.0	0.1	O K
7200 min Winter	75.500	0.000	0.0	0.8	0.8	0.0	O K
8640 min Winter	75.500	0.000	0.0	0.7	0.7	0.0	O K
10080 min Winter	75.500	0.000	0.0	0.6	0.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.099	0.0	130.6	4312
10080 min Summer	0.968	0.0	134.2	0
15 min Winter	139.469	0.0	32.2	17
30 min Winter	91.145	0.0	42.1	31
60 min Winter	56.713	0.0	52.4	52
120 min Winter	34.093	0.0	63.0	90
180 min Winter	24.982	0.0	69.2	126
240 min Winter	19.920	0.0	73.6	162
360 min Winter	14.430	0.0	80.0	230
480 min Winter	11.481	0.0	84.9	294
600 min Winter	9.608	0.0	88.8	356
720 min Winter	8.303	0.0	92.1	420
960 min Winter	6.590	0.0	97.4	538
1440 min Winter	4.752	0.0	105.4	766
2160 min Winter	3.421	0.0	113.8	1104
2880 min Winter	2.707	0.0	120.0	1468
4320 min Winter	1.944	0.0	129.3	2172
5760 min Winter	1.535	0.0	136.2	2936
7200 min Winter	1.278	0.0	141.7	0
8640 min Winter	1.099	0.0	146.3	0
10080 min Winter	0.968	0.0	150.3	0

Cascade Rainfall Details for Swale 2.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.411	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.110

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.110

Cascade Model Details for Swale 2.SRCX

Storage is Online Cover Level (m) 76.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.18000	Length (m)	70.0
Infiltration Coefficient Side (m/hr)	0.18000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	75.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.039 Discharge Coefficient 0.600 Invert Level (m) 75.400

Cascade Summary of Results for Swale 3.SRCX

Upstream Structures	Outflow To	Overflow To
Swale 2.SRCX	Swale 4.SRCX	(None)

Half Drain Time : 120 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	73.938	0.436	16.6	1.7	18.2	159.9	O K
30 min Summer	74.000	0.498	18.6	1.8	20.4	201.7	O K
60 min Summer	74.043	0.541	20.0	1.9	21.8	233.3	O K
120 min Summer	74.058	0.556	20.5	1.9	22.3	244.7	O K
180 min Summer	74.056	0.554	20.4	1.9	22.3	243.3	O K
240 min Summer	74.049	0.547	20.2	1.9	22.0	237.8	O K
360 min Summer	74.030	0.528	19.5	1.8	21.4	223.5	O K
480 min Summer	74.010	0.508	18.9	1.8	20.7	209.1	O K
600 min Summer	73.991	0.489	18.3	1.8	20.0	195.4	O K
720 min Summer	73.973	0.471	17.7	1.7	19.4	182.7	O K
960 min Summer	73.939	0.437	16.6	1.7	18.3	160.7	O K
1440 min Summer	73.883	0.381	14.8	1.5	16.3	127.0	O K
2160 min Summer	73.819	0.317	12.7	1.4	14.1	93.2	O K
2880 min Summer	73.771	0.269	11.2	1.3	12.5	71.3	O K
4320 min Summer	73.705	0.203	9.1	1.1	10.2	45.6	O K
5760 min Summer	73.660	0.158	7.6	1.0	8.6	31.3	O K
7200 min Summer	73.630	0.128	6.7	0.9	7.5	23.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.469	0.0	183.7	21
30 min Summer	91.145	0.0	239.6	35
60 min Summer	56.713	0.0	298.0	62
120 min Summer	34.093	0.0	358.5	102
180 min Summer	24.982	0.0	394.6	134
240 min Summer	19.920	0.0	420.3	168
360 min Summer	14.430	0.0	458.9	236
480 min Summer	11.481	0.0	490.0	304
600 min Summer	9.608	0.0	515.8	372
720 min Summer	8.303	0.0	537.6	438
960 min Summer	6.590	0.0	573.1	568
1440 min Summer	4.752	0.0	626.1	814
2160 min Summer	3.421	0.0	683.5	1176
2880 min Summer	2.707	0.0	727.6	1532
4320 min Summer	1.944	0.0	794.1	2252
5760 min Summer	1.535	0.0	843.5	2952
7200 min Summer	1.278	0.0	882.1	3680

Cascade Summary of Results for Swale 3.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	73.607	0.105	5.9	0.8	6.7	17.5	O K
10080 min Summer	73.589	0.087	5.3	0.7	6.0	13.4	O K
15 min Winter	73.969	0.467	17.6	1.7	19.3	180.0	O K
30 min Winter	74.036	0.534	19.7	1.8	21.6	227.7	O K
60 min Winter	74.084	0.582	21.3	1.9	23.2	265.1	O K
120 min Winter	74.101	0.599	21.8	2.0	23.8	279.4	O K
180 min Winter	74.097	0.595	21.7	1.9	23.7	276.2	O K
240 min Winter	74.087	0.585	21.4	1.9	23.3	268.1	O K
360 min Winter	74.061	0.559	20.5	1.9	22.4	247.1	O K
480 min Winter	74.033	0.531	19.6	1.8	21.5	226.0	O K
600 min Winter	74.006	0.504	18.8	1.8	20.6	206.2	O K
720 min Winter	73.981	0.479	18.0	1.7	19.7	188.2	O K
960 min Winter	73.934	0.432	16.5	1.6	18.1	157.7	O K
1440 min Winter	73.859	0.357	14.0	1.5	15.5	113.7	O K
2160 min Winter	73.778	0.276	11.4	1.3	12.7	74.4	O K
2880 min Winter	73.722	0.220	9.6	1.2	10.8	51.9	O K
4320 min Winter	73.652	0.150	7.4	0.9	8.3	28.9	O K
5760 min Winter	73.611	0.109	6.0	0.8	6.8	18.3	O K
7200 min Winter	73.583	0.081	5.1	0.6	5.8	12.1	O K
8640 min Winter	73.562	0.060	4.5	0.5	5.0	8.2	O K
10080 min Winter	73.550	0.048	4.0	0.4	4.4	6.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.099	0.0	913.4	4408
10080 min Summer	0.968	0.0	939.0	5136
15 min Winter	139.469	0.0	205.5	21
30 min Winter	91.145	0.0	268.1	35
60 min Winter	56.713	0.0	333.3	62
120 min Winter	34.093	0.0	400.9	114
180 min Winter	24.982	0.0	441.2	142
240 min Winter	19.920	0.0	469.8	180
360 min Winter	14.430	0.0	512.3	256
480 min Winter	11.481	0.0	545.8	328
600 min Winter	9.608	0.0	574.4	398
720 min Winter	8.303	0.0	599.2	466
960 min Winter	6.590	0.0	639.4	598
1440 min Winter	4.752	0.0	699.6	852
2160 min Winter	3.421	0.0	766.6	1212
2880 min Winter	2.707	0.0	818.2	1560
4320 min Winter	1.944	0.0	895.4	2256
5760 min Winter	1.535	0.0	951.5	2992
7200 min Winter	1.278	0.0	991.6	3672
8640 min Winter	1.099	0.0	1023.9	4408
10080 min Winter	0.968	0.0	1051.7	5136

Cascade Rainfall Details for Swale 3.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.411	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.660

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.330	4	8	0.330

Cascade Model Details for Swale 3.SRCX

Storage is Online Cover Level (m) 74.102

Swale Structure

Infiltration Coefficient Base (m/hr)	0.18000	Length (m)	203.0
Infiltration Coefficient Side (m/hr)	0.18000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	73.502	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.035 Discharge Coefficient 0.600 Invert Level (m) 73.502

Cascade Summary of Results for Swale 4.SRCX

Upstream Structures	Outflow To	Overflow To
Swale 3.SRCX Swale 2.SRCX	Basin 2.SRCX	(None)

Half Drain Time : 141 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	73.029	0.529	13.1	3.6	16.7	164.0	O K
30 min Summer	73.111	0.611	14.7	3.8	18.5	207.6	O K
60 min Summer	73.170	0.670	15.8	4.0	19.8	241.9	O K
120 min Summer	73.193	0.693	16.3	4.1	20.4	256.2	O K
180 min Summer	73.192	0.692	16.2	4.1	20.3	255.4	O K
240 min Summer	73.184	0.684	16.1	4.1	20.2	250.7	O K
360 min Summer	73.163	0.663	15.7	4.0	19.7	237.6	O K
480 min Summer	73.140	0.640	15.2	3.9	19.2	224.0	O K
600 min Summer	73.116	0.616	14.8	3.9	18.6	210.8	O K
720 min Summer	73.094	0.594	14.4	3.8	18.1	198.4	O K
960 min Summer	73.053	0.553	13.6	3.6	17.2	176.5	O K
1440 min Summer	72.983	0.483	12.2	3.4	15.6	142.0	O K
2160 min Summer	72.901	0.401	10.7	3.1	13.7	106.0	O K
2880 min Summer	72.838	0.338	9.4	2.8	12.2	81.6	O K
4320 min Summer	72.746	0.246	7.7	2.4	10.1	51.4	O K
5760 min Summer	72.685	0.185	6.5	2.0	8.5	34.6	O K
7200 min Summer	72.642	0.142	5.7	1.7	7.4	24.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.469	0.0	194.5	21
30 min Summer	91.145	0.0	253.6	35
60 min Summer	56.713	0.0	315.0	62
120 min Summer	34.093	0.0	378.3	108
180 min Summer	24.982	0.0	415.9	140
240 min Summer	19.920	0.0	442.4	172
360 min Summer	14.430	0.0	481.4	242
480 min Summer	11.481	0.0	511.4	310
600 min Summer	9.608	0.0	535.8	378
720 min Summer	8.303	0.0	556.4	444
960 min Summer	6.590	0.0	589.9	576
1440 min Summer	4.752	0.0	638.4	828
2160 min Summer	3.421	0.0	688.9	1192
2880 min Summer	2.707	0.0	725.9	1560
4320 min Summer	1.944	0.0	779.1	2256
5760 min Summer	1.535	0.0	817.1	2992
7200 min Summer	1.278	0.0	846.4	3680

Cascade Summary of Results for Swale 4.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	72.611	0.111	5.1	1.5	6.6	17.7	O K
10080 min Summer	72.586	0.086	4.6	1.2	5.9	13.1	O K
15 min Winter	73.069	0.569	13.9	3.7	17.6	184.6	O K
30 min Winter	73.157	0.657	15.6	4.0	19.6	234.4	O K
60 min Winter	73.223	0.723	16.8	4.2	21.0	274.8	O K
120 min Winter	73.252	0.752	17.4	4.3	21.7	293.9	O K
180 min Winter	73.248	0.748	17.3	4.3	21.6	291.2	O K
240 min Winter	73.238	0.738	17.1	4.2	21.4	284.6	O K
360 min Winter	73.209	0.709	16.6	4.1	20.7	266.0	O K
480 min Winter	73.177	0.677	15.9	4.0	20.0	246.2	O K
600 min Winter	73.145	0.645	15.3	3.9	19.3	227.1	O K
720 min Winter	73.114	0.614	14.7	3.8	18.6	209.3	O K
960 min Winter	73.057	0.557	13.6	3.7	17.3	178.4	O K
1440 min Winter	72.962	0.462	11.8	3.3	15.1	132.2	O K
2160 min Winter	72.855	0.355	9.8	2.9	12.6	87.9	O K
2880 min Winter	72.777	0.277	8.3	2.5	10.8	61.0	O K
4320 min Winter	72.677	0.177	6.4	2.0	8.3	32.5	O K
5760 min Winter	72.617	0.117	5.2	1.5	6.8	19.0	O K
7200 min Winter	72.579	0.079	4.5	1.2	5.7	11.7	O K
8640 min Winter	72.557	0.057	4.1	0.8	4.9	8.0	O K
10080 min Winter	72.547	0.047	3.7	0.6	4.3	6.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.099	0.0	870.0	4408
10080 min Summer	0.968	0.0	889.6	5144
15 min Winter	139.469	0.0	217.6	21
30 min Winter	91.145	0.0	283.6	35
60 min Winter	56.713	0.0	352.2	62
120 min Winter	34.093	0.0	423.1	116
180 min Winter	24.982	0.0	465.0	146
240 min Winter	19.920	0.0	494.6	184
360 min Winter	14.430	0.0	538.1	260
480 min Winter	11.481	0.0	571.7	334
600 min Winter	9.608	0.0	599.1	406
720 min Winter	8.303	0.0	622.3	476
960 min Winter	6.590	0.0	660.4	610
1440 min Winter	4.752	0.0	716.5	868
2160 min Winter	3.421	0.0	774.7	1236
2880 min Winter	2.707	0.0	817.5	1588
4320 min Winter	1.944	0.0	878.1	2292
5760 min Winter	1.535	0.0	920.0	3000
7200 min Winter	1.278	0.0	951.0	3680
8640 min Winter	1.099	0.0	975.4	4408
10080 min Winter	0.968	0.0	996.7	5136

Cascade Rainfall Details for Swale 4.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.411	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.674

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.337	4	8	0.337

Cascade Model Details for Swale 4.SRCX

Storage is Online Cover Level (m) 73.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.18000	Length (m)	120.0
Infiltration Coefficient Side (m/hr)	0.18000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	72.500	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Orifice Outflow Control

Diameter (m) 0.049 Discharge Coefficient 0.600 Invert Level (m) 72.500

Cascade Summary of Results for Basin 1.SRCX

Upstream Structures	Outflow To	Overflow To
Swale 1.SRCX	(None)	(None)
Basin 2.SRCX		
Swale 4.SRCX		
Swale 3.SRCX		
Swale 2.SRCX		

Half Drain Time : 126 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	71.982	0.382	11.5	93.1	O K
30 min Summer	72.068	0.468	13.2	121.1	O K
60 min Summer	72.160	0.560	15.1	154.3	O K
120 min Summer	72.234	0.634	16.6	183.5	O K
180 min Summer	72.254	0.654	17.0	191.6	O K
240 min Summer	72.257	0.657	17.1	192.8	O K
360 min Summer	72.250	0.650	16.9	190.0	O K
480 min Summer	72.239	0.639	16.7	185.7	O K
600 min Summer	72.227	0.627	16.4	180.5	O K
720 min Summer	72.215	0.615	16.2	175.6	O K
960 min Summer	72.190	0.590	15.7	165.7	O K
1440 min Summer	72.138	0.538	14.6	146.0	O K
2160 min Summer	72.054	0.454	13.0	116.5	O K
2880 min Summer	71.965	0.365	11.2	87.9	O K
4320 min Summer	71.805	0.205	8.2	44.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	139.469	0.0	138
30 min Summer	91.145	0.0	169
60 min Summer	56.713	0.0	200
120 min Summer	34.093	0.0	240
180 min Summer	24.982	0.0	280
240 min Summer	19.920	0.0	320
360 min Summer	14.430	0.0	396
480 min Summer	11.481	0.0	468
600 min Summer	9.608	0.0	524
720 min Summer	8.303	0.0	582
960 min Summer	6.590	0.0	698
1440 min Summer	4.752	0.0	936
2160 min Summer	3.421	0.0	1284
2880 min Summer	2.707	0.0	1624
4320 min Summer	1.944	0.0	2332

Cascade Summary of Results for Basin 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
5760 min Summer	71.699	0.099	6.3	19.6	O K
7200 min Summer	71.648	0.048	5.3	9.3	O K
8640 min Summer	71.638	0.038	4.1	7.2	O K
10080 min Summer	71.629	0.029	3.0	5.4	O K
15 min Winter	72.017	0.417	12.2	104.1	O K
30 min Winter	72.119	0.519	14.3	139.3	O K
60 min Winter	72.233	0.633	16.6	182.9	O K
120 min Winter	72.322	0.722	18.4	221.1	O K
180 min Winter	72.343	0.743	18.9	230.4	O K
240 min Winter	72.337	0.737	18.7	227.8	O K
360 min Winter	72.314	0.714	18.3	217.3	O K
480 min Winter	72.297	0.697	17.9	210.1	O K
600 min Winter	72.281	0.681	17.6	203.0	O K
720 min Winter	72.263	0.663	17.2	195.5	O K
960 min Winter	72.225	0.625	16.4	179.7	O K
1440 min Winter	72.142	0.542	14.7	147.7	O K
2160 min Winter	72.000	0.400	11.9	98.9	O K
2880 min Winter	71.863	0.263	9.3	59.0	O K
4320 min Winter	71.679	0.079	6.0	15.5	O K
5760 min Winter	71.639	0.039	4.1	7.4	O K
7200 min Winter	71.626	0.026	2.7	4.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
5760 min Summer	1.535	0.0	3024
7200 min Summer	1.278	0.0	3688
8640 min Summer	1.099	0.0	4416
10080 min Summer	0.968	0.0	5144
15 min Winter	139.469	0.0	148
30 min Winter	91.145	0.0	178
60 min Winter	56.713	0.0	202
120 min Winter	34.093	0.0	238
180 min Winter	24.982	0.0	278
240 min Winter	19.920	0.0	320
360 min Winter	14.430	0.0	404
480 min Winter	11.481	0.0	482
600 min Winter	9.608	0.0	542
720 min Winter	8.303	0.0	600
960 min Winter	6.590	0.0	724
1440 min Winter	4.752	0.0	966
2160 min Winter	3.421	0.0	1300
2880 min Winter	2.707	0.0	1652
4320 min Winter	1.944	0.0	2332
5760 min Winter	1.535	0.0	2976
7200 min Winter	1.278	0.0	3648

Cascade Summary of Results for Basin 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Winter	71.617	0.017	1.8	3.2	O K
10080 min Winter	71.613	0.013	1.3	2.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
8640 min Winter	1.099	0.0	4376
10080 min Winter	0.968	0.0	5048

Cascade Rainfall Details for Basin 1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.411	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Cascade Model Details for Basin 1.SRCX

Storage is Online Cover Level (m) 72.600

Infiltration Basin Structure

Invert Level (m) 71.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.18000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.18000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	184.0	1.000	580.0

Cascade Summary of Results for Basin 2.SRCX

Upstream Structures	Outflow To	Overflow To
Swale 4.SRCX Swale 3.SRCX Swale 2.SRCX	Basin 1.SRCX	(None)

Half Drain Time : 45 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	73.139	0.139	13.5	1.8	15.3	54.2	O K
30 min Summer	73.165	0.165	14.5	1.8	16.3	65.8	O K
60 min Summer	73.178	0.178	14.9	1.9	16.8	71.5	O K
120 min Summer	73.178	0.178	14.9	1.9	16.8	71.5	O K
180 min Summer	73.169	0.169	14.6	1.9	16.4	67.7	O K
240 min Summer	73.159	0.159	14.2	1.8	16.1	63.1	O K
360 min Summer	73.139	0.139	13.5	1.8	15.3	54.4	O K
480 min Summer	73.122	0.122	12.9	1.7	14.6	47.0	O K
600 min Summer	73.107	0.107	12.4	1.7	14.1	40.7	O K
720 min Summer	73.094	0.094	12.0	1.6	13.6	35.5	O K
960 min Summer	73.075	0.075	11.3	1.3	12.6	27.7	O K
1440 min Summer	73.052	0.052	10.5	0.9	11.4	18.8	O K
2160 min Summer	73.042	0.042	8.6	0.6	9.2	15.0	O K
2880 min Summer	73.036	0.036	7.3	0.5	7.8	12.8	O K
4320 min Summer	73.028	0.028	5.7	0.3	6.0	10.1	O K
5760 min Summer	73.024	0.024	4.7	0.2	4.9	8.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.469	0.0	104.4	17
30 min Summer	91.145	0.0	135.8	31
60 min Summer	56.713	0.0	168.2	50
120 min Summer	34.093	0.0	201.7	84
180 min Summer	24.982	0.0	221.5	118
240 min Summer	19.920	0.0	235.6	152
360 min Summer	14.430	0.0	256.4	218
480 min Summer	11.481	0.0	272.3	282
600 min Summer	9.608	0.0	284.9	344
720 min Summer	8.303	0.0	295.3	404
960 min Summer	6.590	0.0	312.0	522
1440 min Summer	4.752	0.0	333.0	750
2160 min Summer	3.421	0.0	351.4	1104
2880 min Summer	2.707	0.0	363.8	1468
4320 min Summer	1.944	0.0	378.4	2204
5760 min Summer	1.535	0.0	384.8	2936

Cascade Summary of Results for Basin 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	73.020	0.020	4.0	0.2	4.2	7.1	O K
8640 min Summer	73.018	0.018	3.5	0.1	3.6	6.2	O K
10080 min Summer	73.015	0.015	3.0	0.1	3.1	5.4	O K
15 min Winter	73.155	0.155	14.1	1.8	15.9	61.2	O K
30 min Winter	73.185	0.185	15.2	1.9	17.0	74.8	O K
60 min Winter	73.199	0.199	15.7	1.9	17.6	81.4	O K
120 min Winter	73.197	0.197	15.6	1.9	17.5	80.1	O K
180 min Winter	73.184	0.184	15.1	1.9	17.0	74.3	O K
240 min Winter	73.169	0.169	14.6	1.9	16.4	67.5	O K
360 min Winter	73.141	0.141	13.6	1.8	15.4	55.0	O K
480 min Winter	73.117	0.117	12.7	1.7	14.4	44.7	O K
600 min Winter	73.097	0.097	12.1	1.6	13.7	36.5	O K
720 min Winter	73.081	0.081	11.5	1.4	12.9	30.1	O K
960 min Winter	73.058	0.058	10.7	1.0	11.7	21.1	O K
1440 min Winter	73.043	0.043	8.9	0.7	9.6	15.6	O K
2160 min Winter	73.035	0.035	7.0	0.5	7.5	12.4	O K
2880 min Winter	73.029	0.029	5.9	0.3	6.2	10.4	O K
4320 min Winter	73.022	0.022	4.4	0.2	4.6	7.9	O K
5760 min Winter	73.018	0.018	3.6	0.1	3.7	6.4	O K
7200 min Winter	73.015	0.015	2.9	0.1	3.0	5.2	O K
8640 min Winter	73.012	0.012	2.3	0.1	2.3	4.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.278	0.0	386.7	3672
8640 min Summer	1.099	0.0	386.3	4384
10080 min Summer	0.968	0.0	384.8	5144
15 min Winter	139.469	0.0	116.7	17
30 min Winter	91.145	0.0	151.7	31
60 min Winter	56.713	0.0	187.8	56
120 min Winter	34.093	0.0	225.0	90
180 min Winter	24.982	0.0	247.1	128
240 min Winter	19.920	0.0	262.9	164
360 min Winter	14.430	0.0	286.2	234
480 min Winter	11.481	0.0	304.4	298
600 min Winter	9.608	0.0	319.2	362
720 min Winter	8.303	0.0	331.6	420
960 min Winter	6.590	0.0	351.4	532
1440 min Winter	4.752	0.0	378.9	752
2160 min Winter	3.421	0.0	402.4	1140
2880 min Winter	2.707	0.0	416.9	1484
4320 min Winter	1.944	0.0	430.6	2248
5760 min Winter	1.535	0.0	431.9	2968
7200 min Winter	1.278	0.0	426.6	3640
8640 min Winter	1.099	0.0	419.1	4400

Cascade Summary of Results for Basin 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	73.010	0.010	1.9	0.1	1.9	3.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.968	0.0	420.3	5152

Cascade Rainfall Details for Basin 2.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.411	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.237

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.237

Cascade Model Details for Basin 2.SRCX

Storage is Online Cover Level (m) 74.000

Infiltration Basin Structure

Invert Level (m) 73.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.18000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.18000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	350.0	1.000	1131.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	73.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

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	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

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