WH202C JUNE 2023

Bull Field, Takeley

Flood Risk Assessment & SuDS Report by EAS

Prepared in support of the Section 62A Planning Application at Bull Field, Takeley.

Flood Risk Assessment &
SuDS Report

June 2023

EAS

Bull Field, Warish Hall Farm, Takeley

Weston Homes

Document History

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1 Introduction

1.1 This Flood Risk Assessment and SuDS report has been prepared in support of an application by Weston Homes for a residential development at Bull Field, Warish Hall Farm, Takeley Essex. A location plan is included in **Appendix A.**

1.2 The site covers 19.8 hectares of currently undeveloped land. Proposals are for residential development, open space and associated works. The proposed development layout is enclosed in **Appendix B.**

1.3 The site is located in Flood Zone 1, at low risk of fluvial flooding and is shown to be at very low risk of surface water flooding however, as the site exceeds 1 hectare, a full flood risk assessment is required. This report will examine all sources of flood risk to the site and consider suitable mitigation measures and a sustainable drainage strategy.

1.4 A previous application for a much larger, 24ha area, which included the Bull Field site, was made in September 2021 (Ref. No. UTT/21/1987/FUL). The application, whilst supported by planning officers, was refused at planning committee (December 2021) and ultimately dismissed at appeal (Ref. No. APP/C1570/W/22/3291524) principally on the grounds of impact on heritage assets and landscape character. However, in regards to flood-related matters there was no technical objection to the proposals. Initial holding objections received from the Essex County Council in their role as the Lead Local Flood Authority (LLFA) were addressed within the consultation period and removed as part of the application. Flood Risk did not constitute a reason for refusal listed on the Decision Notice, and therefore it was not discussed during the Appeal. As part of this application, all principles agreed with the LLFA in the previous consultation period have been retained as part of this revised application and therefore it is anticipated will be accepted on the same grounds as previously agreed.

1.5 The contents of this FRA is based on the advice set out in the National Planning Policy Framework (NPPF) published in July 2021, Annex 3: Flood risk vulnerability classification, also from the NPPF and PPG 'Guidance for Flood Risk and Coastal Change', updated in August 2022.

1.6 This document includes the following sections:

Section 2 - describes relevant policy;

Section 3 - site description, including site levels, proximity to watercourses etc.;

Section 4 – provides a brief review of potential sources of flooding;

Section 5 – details of the proposed surface water management;

Section 6 – details of management and maintenance;

Section 7 – provides a summary and conclusions.

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2 Policy Context

Introduction

2.1 This section sets out the policy context. This report is based on the requirements set out in the National Planning Policy Framework (NPPF) published in July 2021 and the Planning Practice Guidance (PPG) updated in August 2022.

National Planning Policy Framework

2.2 Paragraph 167 footnote 55 of the NPPF states:

"A site-specific flood risk assessment should be provided for all developments in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."

The flood zones are defined as:

- Flood Zone 1 – Land assessed as having a less than 1 in 1,000 (<0.1%) annual probability of flooding from fluvial sources;
- Flood Zone 2 – Land assessed as having between a 1 in a 100 and 1 in 1,000 (1% to 0.1%) annual probability of flooding from fluvial sources;
- Flood Zone 3a – Land assessed as having a 1 in 100 or greater (>1%) annual probability of flooding from fluvial sources, or at least 0.5% annual probability of tidal flooding;
- Flood Zone 3b – Land where water has to flow or be stored in times of flood.

2.3 Paragraph 159 discusses the suitability of development location, particularly with regards to future risks induced by climate change:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere".

2.4 Paragraph 160 of the National Planning Policy Framework (NPPF) sets out how:

"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards".

2.5 The EA Flood Map for Planning enclosed in **Appendix C** shows the site to be located in Flood Zone 1, land assessed as having a less than 1 in 1,000 (<0.1%) annual probability of flooding.

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The Sustainable Drainage Systems Design Guide for Essex (2020)

2.6 This guide was prepared by Essex County Council to aid developers, designers and consultants in the design of Sustainable Drainage Systems (SuDS) in Essex. The guidance is intended to advise on the planning, design and delivery of attractive and high-quality SuDS scheme to benefit both the environment and the community. The website contains all the information on the SuDS Design Guide for Essex and can be accessed here: [redacted]

2.7 This guidance was considered and used to inform the development of the proposed SuDS strategy for the site.

Uttlesford District Adopted Local Plan 2005

2.8 The 'Uttlesford Local Plan 2019' draft was withdrawn in April 2020 and work on a replacement has been ongoing since this time and is unlikely to be adopted prior to December 2025.

2.9 Once complete the new Local Plan will guide future development in the district.

2.10 In the meantime, whilst significantly dated, the Uttlesford Adopted Local Plan 2005 is the relevant development plan document and the principle of Policy GEN3 remain broadly applicable and is reflected in more up to date guidance.

2.11 Policy GEN3: Flood Protection of the Adopted Local Plan 2005 states:

"Outside flood risk areas development must not increase the risk of flooding through surface water run-off. A flood risk assessment will be required to demonstrate this. Sustainable Drainage Systems should also be considered as an appropriate flood mitigation measure in the first instance.

For all areas where development will be exposed to or may lead to an increase in the risk of flooding applications will be accompanied by a full Flood Risk Assessment (FRA) which sets out the level of risk associated with the proposed development. The FRA will show that the proposed development can be provided with the appropriate minimum standard of protection throughout its lifetime and will demonstrate the effectiveness of flood mitigation measures proposed."

2.12 This report demonstrates that the proposed development will use SuDS methods to manage the volume and rate of surface water runoff and the proposals will not increase flood risk to the local area, outside the site.

Uttlesford District Council Strategic Flood Risk Assessment (May 2016)

2.13 The Uttlesford Strategic Flood Risk Assessment (SFRA) was published in May 2016, providing an update to the original report which was published in 2008 in response to several legislative changes including the Flood and Water Management Act of 2010 and SuDS guidance published in 2015.

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2.14 Uttlesford is located within the headwaters of three major catchments including the Great Ouse, North Essex and Thames. Surface water flooding and flooding sourced from ordinary watercourses is noted as a significant issue across the district.

2.15 Map 5 of the SFRA shows there have been no recorded flood incidents at the site or within the vicinity of the site.

2.16 Map 6 confirms the site is located in Flood Zone 1.

2.17 Map 7 shows there is a culvert to the south of the site within the existing residential development.

2.18 Map 8 shows the extent of surface water flood across the district. The site is shown not be located within a surface water flood extent.

2.19 Map 9 of the SFRA shows the susceptibility of groundwater flooding across the district. The site is shown to be located in an area with < 25% susceptibility of groundwater flooding.

2.20 Map 10 shows the number of recorded sewer flooding incidents across the district categorised by postcode. The site is located within an area with 1-5 sewer flooding incidents have been recorded.

2.21 Each of the above maps have been included at **Appendix D**. Assessing the data within the SFRA, it is concluded that there are no significant flood risks at the site.

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3 Existing Site Assessment

Site Description

3.1 The red line boundary covers 19.8 ha and is located between Smiths Green and Parsonage Road and comprises rural farmland and Ancient semi-natural Woodland. Existing residential areas of Takeley lie to the south and west of this land parcel. To the north is further rural farmland, beyond which is the A120.

3.2 The site is approximately 2km southeast of London Stansted Airport.

3.3 The proposed development will comprises 96 two to five-bedroom dwellings along with garages, driveways, access roads, open space and associated works. The proposals also include two separate flatted blocks comprising one-bedroom and two-bedroom apartments. The proposed layout is included in **Appendix B**.

Local Watercourses and Ditches

3.4 The nearest EA 'Main River' is the Pincey Brook, which is located approximately 1.3km west of the site. A tributary of this watercourse flows through Takeley and is culverted for most of this reach.

3.5 A site walkover identified several perimeter ditches located with the site which fall to the north west but the disconnected nature of them and shallow gradients suggest that they appear to act as infiltration ditches rather than conveyance. In addition, the ditches do not seem to have an outfall to a watercourse, which further suggests the ditches promote infiltration instead of conveyance.

Site Levels

3.6 A topographical survey is enclosed in **Appendix E.** The site falls east to west. The higher levels near to Smiths Green Lane at the eastern boundary of the site are around 103.9m AOD, falling to around 101.3m AOD along the western border of the site.

Sewer Records

3.7 Sewer records obtained by Thames Water are enclosed in **Appendix F.** There are no adopted sewers within the site itself. However, there a number of both surface and foul water sewers within the residential areas to the east and south east of the site.

Geology

3.8 With reference to the British Geological Survey online mapping, the site is located within an area with a bedrock of London Clay Formation - clay, silt and sand with superficial deposits of Lowestoft Formation – diamicton.

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3.9 This type of geology typically does not favour infiltration, but infiltration tests were carried out to confirm this and have been discussed below.

Infiltration Tests

3.10 Infiltration tests were carried out across the wider earlier development site on 28th April 2021. Tests were in six locations including three on application site.

3.11 The infiltration test report is included in **Appendix G**, which shows the test locations on a map and summarises the details. The strata was recorded as 'orange-brown-grey silty clay with occasional chalk fragments) and 'orange-brown-grey sandy clay with occasional chalk fragments'.

3.12 Deep and shallow testing across three trial pits (SA3, SA4 & SA5) was carried out to BRE 365 standard and demonstrated good infiltration rates. Some of the tests were not filled three times but also demonstrated a reasonable rate.

3.13 Where tests were not carried out to BRE 365 standard, the worst case rate can be used, with the anticipation that further testing could be required pursuant to any suggested planning condition which is usual practice for the LLFA in our experience.

3.14 Table 3.1 summarises the rates for each of the trial pits within the site.

Character Area	Test Pit	Depth	No. of Fills	Infiltration Rate
Bull Field (West)	SA3S	0.60m	2	5.9×10^{-6} m/s
Bull Field (West)	SA3D	1.50m	2	6.2×10^{-6} m/s
Bull Field (East)	SA4S	0.60m	2	5.5×10^{-6} m/s
Bull Field (East)	SA4D	1.50m	2	4.1×10^{-6} m/s
Bull Field (South)	SA5S	0.60m	3	1.6×10^{-5} m/s
Bull Field (South)	SA5D	1.50m	2	1.6×10^{-5} m/s

Table 3.1: Infiltration Rate Summary (Full test results in **Appendix G**)

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4 Potential Sources of Flooding

Fluvial

4.1 A copy of the Environment Agency's Flood Map is enclosed in **Appendix C.** The site is located entirely in Flood Zone 1, at low risk of fluvial flooding, Land in Flood Zone 1 is defined as land having less than 1 in 1000 annual probability of river or sea flooding (<0.1%) in any year.

Surface Water

4.2 Surface water flooding refers to flooding caused when the intensity of rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the local drainage systems including sewers, rivers and watercourses or does not infiltrate into the ground. The water ponds on the ground and flows towards low-lying land. This source of flood risk is also known as 'pluvial'.

4.3 The surface water mapping on the gov.uk website shows the site is at **'very low'** risk of surface water flooding. Surface water flooding is shown along the perimeter of the site however this is associated with the presence of ditches.

4.4 An effective and sustainable drainage system will prevent surface water flooding within the development. The EA's surface water flood risk map can be seen in **Appendix H.**

Groundwater

4.5 Map 9 of the SFRA shows the susceptibility of groundwater flooding across the district. The site is shown to be located in an area with < 25% susceptibility of groundwater flooding which is the lowest shown category included on the map.

4.6 The site is not located in a groundwater source protection zone. The MAGIC Map website (https://magic.defra.gov.uk/MagicMap.aspx) confirms this.

4.7 The site is located above a Secondary (undifferentiated) Aquifer based on the superficial deposits of diamicton. A Secondary (undifferentiated) aquifer is defined on the gov.uk website as: *"…aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value."*

4.8 It is therefore unlikely that the superficial deposits would yield significant quantities of groundwater.

4.9 Given the above, the risk of flooding from groundwater is considered to be low.

Artificial

4.10 The EA Flood Map for Planning shows the site is not at risk of flooding from reservoirs. Online OS mapping does not show any other large artificial sources nearby which would pose a significant risk to the site, so the risk of flooding from artificial sources is considered to be low.

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Sewer Flooding

4.11 Sewer flooding generally results from localised short-term intense rainfall events overloading the capacity of the private and public drainage or due to failures within the public sewer.

4.12 As there are no adopted sewers located within the site the risk from sewer flooding is considered to be low.

Flood Risk Summary

4.13 Given the risk from flooding from all assessed sources is low, there are no specific mitigation measures required.

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5 Drainage Strategy

Existing Drainage

5.1 As the site is currently undeveloped, there is no existing formal drainage strategy in place. Surface water simply infiltrates to ground and once saturated, overland flow would flow into the surrounding ditches and infiltrate to ground. Excess surface water would pool and either slowly infiltrate or evaporate.

Greenfield Runoff Rates

5.2 Greenfield runoff rates were calculated using the ICP SuDS method on the WINDES Micro Drainage software. The site covers an area of 7.9 ha. The runoff rates for 1 hectare has been estimated and scaled to the site area for the 1 in 1 year, 1 in 30 year and 1 in 100-year events:

- QBAR – 2.8 l/s/ha (22.1 l/s)
- 1 in 100 year- 9.1 l/s/ha (71.9 l/s)
- 1 in 30 year- 6.4 l/s/ha (50.6 l/s)
- 1 in 1 year- 2.4 l/s/ha (19.0 l/s)

5.3 The MicroDrainage greenfield runoff rates are included at **Appendix I.**

Relevant SuDS Policy

5.4 SuDS mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk, these features can improve water quality and provide biodiversity and amenity benefits.

5.5 The SuDS management train incorporates a hierarchy of techniques and considers all three SuDS criteria of flood reduction, pollution reduction, and landscape and wildlife benefit. In decreasing order of preference, the preferred means of disposal of surface water runoff is:

1) Discharge to ground.
2) Discharge to a surface water body.
3) Discharge to a surface water sewer.
4) Discharge to a combined sewer.

5.6 The philosophy of SuDS is to replicate as closely as possible the natural drainage from a site pre-development and to treat runoff to remove pollutants, resulting in a reduced impact on the receiving watercourses. The benefits of this approach are as follows:

- Reducing runoff rates, thus reducing the flood risk downstream.

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- Reducing pollutant concentrations, thus protecting the quality of the receiving water body.
- Groundwater recharge.
- Contributing to the enhanced amenity and aesthetic value of development areas.
- Providing habitats for wildlife in developed areas, and opportunity for biodiversity enhancement.

Site-Specific SuDS

5.7 The various SuDS methods need to be considered in relation to site-specific constraints. Several SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. Table 5.1 outlines the constraints and opportunities to each of the SuDS devices in accordance with the hierarchical approach outlined in The SuDS Manual CIRIA C753. It also indicates what could and could not be incorporated within the development, based upon site-specific criteria.

Device	Description	Constraints / Comments	Appropriate
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	Not suitable due to the pitch of the roofs.	No
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	A crate soakaway has been proposed as testing proved infiltration to be viable	Yes
Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	Infiltration testing confirms good rates across the site, therefore permeable surfaces are viable.	Yes
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the site by reusing water for non-potable uses e.g. toilet flushing, recycling processes.	Not proposed within the development	No
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	Not recommended due to risk of attracting birds close to airport	No
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	A filter drain has been proposed to improve water quality	Yes
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	Not required due to the provision of alternative SuDS devices	No

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Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	Infiltration basin proposed but only to be used for rainfall events greater than a 1 in 5 year storm	Yes
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	Not recommended due to risk of attracting birds close to airport.	No
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	Not required due to other SuDS features being used.	No

Table 5.1: Site Specific Sustainable Drainage

SuDS Features and London Stansted Airport

5.8 Given the proximity of the site to London Stansted Airport which is around 2km to the northwest, it is necessary to assess the application of the SuDS features against the risk of flocking birds. Guidance provided by the MAG Airports Safeguarding Officer highlighted the risk of having permanent water bodies so close to the airport which could attract birds, causing hazards to aircraft. As such, no ponds or other permanent waterbodies could be used in the proposed drainage strategy.

5.9 It was recommended that any swales or attenuation/infiltration basins being provided in the scheme should ensure that storm events greater than the 1 in 5 year event could achieve a drain down time of less than 72 hours. For the majority of the time, these areas should remain dry, as they would only be used in the more extreme events. This guidance has been considered and the modelling carried out to inform the drainage design ensures that the SuDS features included have a drain down time of significantly less than 72 hours.

Proposed Drainage Strategy

5.10 Infiltration testing across the site demonstrated that infiltration would be a viable means of draining the proposed development. The infiltration test report is included in **Appendix G** and the rates used are summarised in Table 3.1. In addition, the minimum sub-base depths discussed in the following section are at this stage indicative and will be reviewed and subject to further testing at detailed design stage to confirm precise depths.

5.11 The Infiltration rate used from the test pit in the eastern part of the site was to the worst-case result in order to ensure the design for the drainage for the site is robust. This was a rate of 4.1 x 10^{-6}m/s. It is anticipated that infiltration tests can be conditioned and further testing can take place across the site to inform detailed design.

5.12 It is understood that the main roads within the site will be offered for adoption, so permeable paving cannot be used on these. As such, a number of different infiltration SuDS features have been included in the development to manage the runoff, which are described below.

5.13 Where possible, the roof areas and driveways will discharge to permeable paving on the private driveways within the site.

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5.14 Several of the smaller roads and car parking areas will be permeably paved and drain themselves. If there are houses close to these which do not have private driveways, these properties will drain to the nearest section of permeable paving.

5.15 The main road will be constructed from tarmac and not be permeable. This will be served by a traditional piped drainage system which directs the runoff to a crate soakaway and infiltration basin located in the area of open space to the east. Runoff from the main road will pass through a perforated pipe in a filter drain upstream of the crate soakaway to filter the runoff before it reaches this point.

5.16 The proposed footpath/cycleway which crosses the site will utilise a semi-permeable, bound-aggregate construction to allow some infiltration to occur. Where infiltration doesn't occur, it is expected that runoff will be to the surrounding grassed areas. There is the potential to utilise a French drain or similar alongside the paths where required. Therefore, the proposed footpath/cycleway has not been included in the permeable paving calculations.

5.17 WINDES MicroDrainage Source Control models were set up for each permeable paving catchment, to estimate the sub-base depth required to manage a 1 in 100 year (+40%CC) storm event, using the infiltration rate of 4.1 x 10^{-6}m/s.

5.18 Due to the natural topography of the site, including the northwest section of the proposed access road within the drainage system was not viable. As such, surface water runoff from this section of the access road is to be directed towards the adjacent 7 Acres site. The runoff from this area was therefore accounted for within the drainage system proposed as part of the separate 7 Acres application.

5.19 The catchments which drained to permeable paving on the smaller roads were identified as PP1 to PP5. The catchments which drained to permeable paving on the car parks were identified as Car Parks A to D.

5.20 The catchments, impermeable areas and permeable paving details are shown on SK13 in **Appendix J** and the WINDES MicroDrainage results are included in **Appendix K**. The various catchments and details of permeable paving are summarised in Table 5.2.

Section	Catchment Area	Permeable Paving Area	Minimum Sub-Base Depth	Half Drain Time
1	170m^2	170m^2	146mm	174 mins
2	110m^2	110m^2	137mm	163 mins
3	140m^2	140m^2	145mm	174 mins
4	550m^2	550m^2	426mm	306 mins

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5	100m²	100m²	152mm	184 mins
Car Park A	990m²	510m²	333mm	397 mins
Car Park B	1350m²	630m²	372mm	449 mins
Car Park C	730m²	350m²	359mm	434 mins
Car Park D	740m²	360m²	355mm	429 mins
House Type 2B	160m²	50m²	595mm	736 mins
House Type 3A & 3B	120m²	50m²	433mm	531 mins
House Type 4B	140m²	50m²	523mm	651 mins
House Type 4C	170m²	50m²	218mm *95% Voids	842 mins
House Type 5B	230m²	50m²	314mm *95% Voids	1203 mins
House Type 5C	240m²	50m²	331mm *95% Voids	1271 mins

Table 5.2 – Proposed Permeable Paving Catchments and Details

5.21 Although some of the minimum sub-base depths required are thin, it is anticipated that the minimum sub-base depth required for structural requirements and water quality benefits will be at least 300mm, and therefore also provide for a greater level of attenuation.

5.22 Also, as stated within the CIRIA SuDS Manual, unlined pavements should only be used in locations when positioned close to building foundations, when a full assessment of the risks has been carried out by a suitably qualified geotechnical engineer. Given the proposed driveways throughout the development are proposed to utilise unlined permeable paving and is proposed to accommodate roof runoff, a geotechnical/structural engineer will need to undertake an assessment at the detailed design stage.

5.23 In the event an engineer determines some areas are not able to utilise unlined permeable paving due to structural concerns, these areas will become lined and will instead be drained to the proposed soakaway within the public open space to the east of the site, which can be resized accordingly.

5.24 Silt traps/catchpits will also be included upstream of permeable paving connections to collect silt and debris before runoff enters the permeable paving.

5.25 Some of the private driveways of the larger house types required particularly deep sub-base depths in order to provide adequate attenuation. Therefore, in order to reduce the required sub-base depths these driveways are proposed to utilise a *permavoid* sub-base replacement system with 95% voids.

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5.26 The main road will be constructed from tarmac and not be permeable. A full pipe network was built to model the drainage system serving the road, which is included in **Appendix K**. The final section of the pipe network was too deep to discharge to the crate soakaway in the open space by gravity, therefore a pump will be necessary. The pumping station has been shown to be just downstream of the filter drain on the SuDS layout **Appendix J**. It is intended this would be a private pump located below ground within a manhole chamber. The pumping station will pump at a maximum rate of 30 l/s, which was the lowest pump rate that could be used while ensuring the upstream manholes do not flood.

5.27 The crate soakaway was sized to manage up to and including a 1 in 5 year storm. Any return period event greater than the 1 in 5 year will be accommodated in the infiltration basin above the soakaway. The infiltration basin was sized to manage up to and including a 1 in 100 year (+40%CC) event.

5.28 The system was modelled in WINDES MicroDrainage with an infiltration rate of 4.1 x 10^{-6}m/s, and the model was run for the 1 in 100 year (+40%CC) storm event. This resulted in the filter drain with perforated pipe being 25m long, 1m wide with a 150mm perforated pipe in the base to filter the runoff. The outlet of the filter drain will be set 0.5m below the inlet to ensure the runoff passes through an adequate amount of granular material to ensure the water is well filtered before entering the pump and crate soakaway.

5.29 The model demonstrated that the pump should be set at a rate of 30 l/s. The crate soakaway was modelled with the dimensions 7m x 10m x 1.32m deep to provide attenuated for storms up to and including a 1 in 5 year event. Any storm events exceeding this will overflow into the infiltration basin located above it.

5.30 The infiltration basin was sized to manage up to a 1 in 100 year (+40%CC) event. It would be 0.5m deep with a surface area of 746m^2 and side slopes of 1:20.

5.31 The infiltration basin was modelled in WINDES Source Control to determine the half drain time and it was higher than 24 hours. Therefore, it was modelled to accommodate a 1 in 30 year (+40%CC) event followed by a 1 in 10 year event to ensure there would be enough volume. This test confirmed that the 1 in 100 year (+40%CC) event would require more volume, therefore the infiltration basin dimensions have been based on the storage required to manage this event. This meets the Essex County Council requirements for half drain time.

5.32 The suggested location and shape of the infiltration basin and filter drain is shown on the plan SK13 in **Appendix J** and is reflected in the detailed landscape design.

5.33 The drainage system has been designed to meet the water quality requirements set out by Table 26.2 of the CIRIA SuDS Manual C753 which sets out the specific pollution hazard indices for residential roofing and low traffic roads/individual driveways in Table 5.8 below.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** [redacted]

Land Use	Hazard Level	Pollution Hazard Indices		
		Suspended Solids	Metals	Hydrocarbons
Residential Roofing	Very Low	0.2	0.2	0.05
Low Traffic Roads/Individual Driveways	Low	0.5	0.4	0.4
Total Pollution Mitigation Required		0.5	0.4	0.4

Table 5.8: Land Use Pollution Hazard Ratings. Extracted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

5.34 It is clear from Table 5.9 and 5.10 that the required level of pollution mitigation is provided and exceeded for removing total suspended solids, metals and hydrocarbons from the surface water runoff, and no further treatment stages are necessary.

SuDS Component	Pollution Mitigation Indices		
	Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Total Pollution Mitigation Provided	0.85	0.6	0.7

Table 5.9: SuDS Component Pollution Mitigation for Permeable Paving Extracted and adapted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

SuDS Component	Pollution Mitigation Indices		
	Suspended Solids	Metals	Hydrocarbons
Catchpit/Silt Trap	0.5	0.0	0.0
Filter Drain	0.2 (0.4/2)	0.4	0.4
Total Pollution Mitigation Provided	0.7	0.4	0.4

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
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Table 5.10: SuDS Component Pollution Mitigation for Filter Drain Extracted and adapted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

Essex SuDS Proforma

5.35 A completed SuDS proforma is enclosed in **Appendix L.** The site has split into a number of catchments managed by a number of permeable paving sections, and the SuDS strategy is entirely based on infiltration. Therefore, it is not possible to provide some of the information required by the proforma for some parts of the form relating to the storage volume for a 1 in 30 (+CC) event and the 50% storage drain down time for a 1 in 30 year event for example, since the proforma requires a single value. As the site is split into many catchments, with each catchment having a different value, this information cannot be provided in the form requested.

5.36 However, the drainage strategy has been designed to manage runoff from a 1 in 100 year (+40%CC) event, and all half drain times are less than 24 hours.

Exceedance Flow Paths and Areas

5.37 In a storm event greater than that modelled, the capacity of surface water drainage system could become overwhelmed. In this instance, surface water would pool in the shallower parts of the site and overflow to the boundary ditches, where it is likely to be captured and therefore remain within the site. An exceedance plan is included in **Appendix M**.

5.38 As all residential properties will have a freeboard a minimum of 150mm above the surrounding ground level, this should prevent internal surface water flooding in an exceedance event occur.

Maintenance of Development Drainage

5.39 A maintenance and management plan has been included at **Appendix N** and details the suggested maintenance tasks for the proposed drainage system.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
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6 Summary and Conclusion

6.1 A previous application for a much larger site (Ref. No. UTT/21/1987/FUL) which included the Bull Field site, was made in September 2021. The application was ultimately dismissed at appeal however, in regards to flood-related matters there was no technical objection to the proposals. Initial holding objections received from the Essex County Council in their role as the Lead Local Flood Authority (LLFA) were addressed within the consultation period and removed as part of the application. As part of this application, all principles agreed with the LLFA in the previous consultation period have been retained as part of this revised application and therefore it is anticipated will be accepted on the same grounds as previously agreed.

6.2 The site is in Flood Zone 1 on the EA's Flood Map for Planning. All sources of flooding have been assessed and the risk considered to be low. Therefore, no specific mitigation measures are required for the proposed development.

6.3 The geology of London Clay with deposits of Diamicton suggests that infiltration would not be viable. However, a number of infiltration tests were carried out across the site which provided good results. As a result, an infiltration based strategy has been proposed throughout the development.

6.4 The drainage system was modelled for a 1 in 100 year (+40%CC) storm event using WINDES MicroDrainage. The site was divided into a number of different catchments and each was run with the worst recorded infiltration rate at the site. The WINDES models demonstrated that all surface water runoff from the new development could be managed effectively using infiltration methods.

6.5 Given the proximity of the site to London Stanstead Airport a MAG Airports Safeguarding Officer was consulted with regards the design of any above ground SuDS in order to ensure the proposed SuDS did not encourage flocking birds. The Safeguarding Officer confirmed the design of the infiltration basin was suitable.

6.6 The CIRIA guidance on pollution hazards was also considered and the selected drainage measures also provided sufficient water quality benefit to remove suspended solids, metals and hydrocarbons from the runoff before it infiltrated to ground.

6.7 All elements of the proposed drainage system will remain private and the responsibility for maintenance will remain with a maintenance company set up by the developer.

Conclusion

6.8 The site is at a low risk of flooding and the proposals do not increase flood risk onsite or elsewhere. The proposed SuDS strategy effectively manages the surface water runoff associated with the roof, roads and other impermeable areas, using infiltration which is at the top of the SuDS hierarchy.

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6.9 In conclusion, the proposals have been shown to be policy compliant on flood risk and SuDS grounds.

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7 Appendices

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
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Appendix: A – Location Plan

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]


Site Location
Terminal C
Stansted Airport
Stansted Cargo Centre
London Stansted Airport
Mill End
Bamber's Green
Highwood Quarry
Birchanger Green
Duck End
Bury Lodge Lane
Round Coppice Road
Long Border Road
Bassingbourn Road
Coopers End Road
Parsonage Road
Thremhall Avenue
Priory Wood
Start Hill
Dunmow Road
B1256
A120
Dunmow West Interchange
High Wood
Beaumont Park
Sapphire Fields
Tilekiln Green
Takeley Street
Takeley
Little Canfield
Stortford Road
B183
Bedlars Green Road
Hatfield Forest Road
Bedlars Green
Church Road
Hope End Green
Hatfield Forest
Hallingbury Street
Bush End
Bush End Road
Puttock's End
Canfield Hart
Baconend Green

Appendix: B – Development Plans

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

Key Plan
1:20000@A1

ACCOMMODATION SCHEDULE

1 Bed Flats	09
2 Bed Flats	06
2 Bed FOG	02
2 Bed Bung	02
2 Bed B1	18
3 Bed Bung	02
3 Bed C1	34
4 Bed C3	06
4 Bed D1	08
5 Bed P B1	05
5 Bed P B2	04
Total	96

Notes:

Rev
01

PLANNING

Title
General Arrangement

Site
WH202C Bulls Field

Date	Drawn	Checked
March 2023	HM	PM/R

Scale
1:750@A1

Drawing No.	Rev
WH202C_10_P_10.20	-

Weston Homes

General Notes

Head Office
Weston Group Business Centre,
Parsonage Road, Takeley, Essex.
CM22 6PU.
T: 01279 873333

London Office
10 Portman Square,
London.
W1H 6AZ
T: 3203 096 7238

www.weston-homes.com | email: info@weston-homes.com

Appendix: C – EA Flood Map for Planning

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** [redacted]

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**556575/221532**	**20 Apr 2023 15:27**

Your selected location is in flood zone 1, an area with a low probability of flooding.

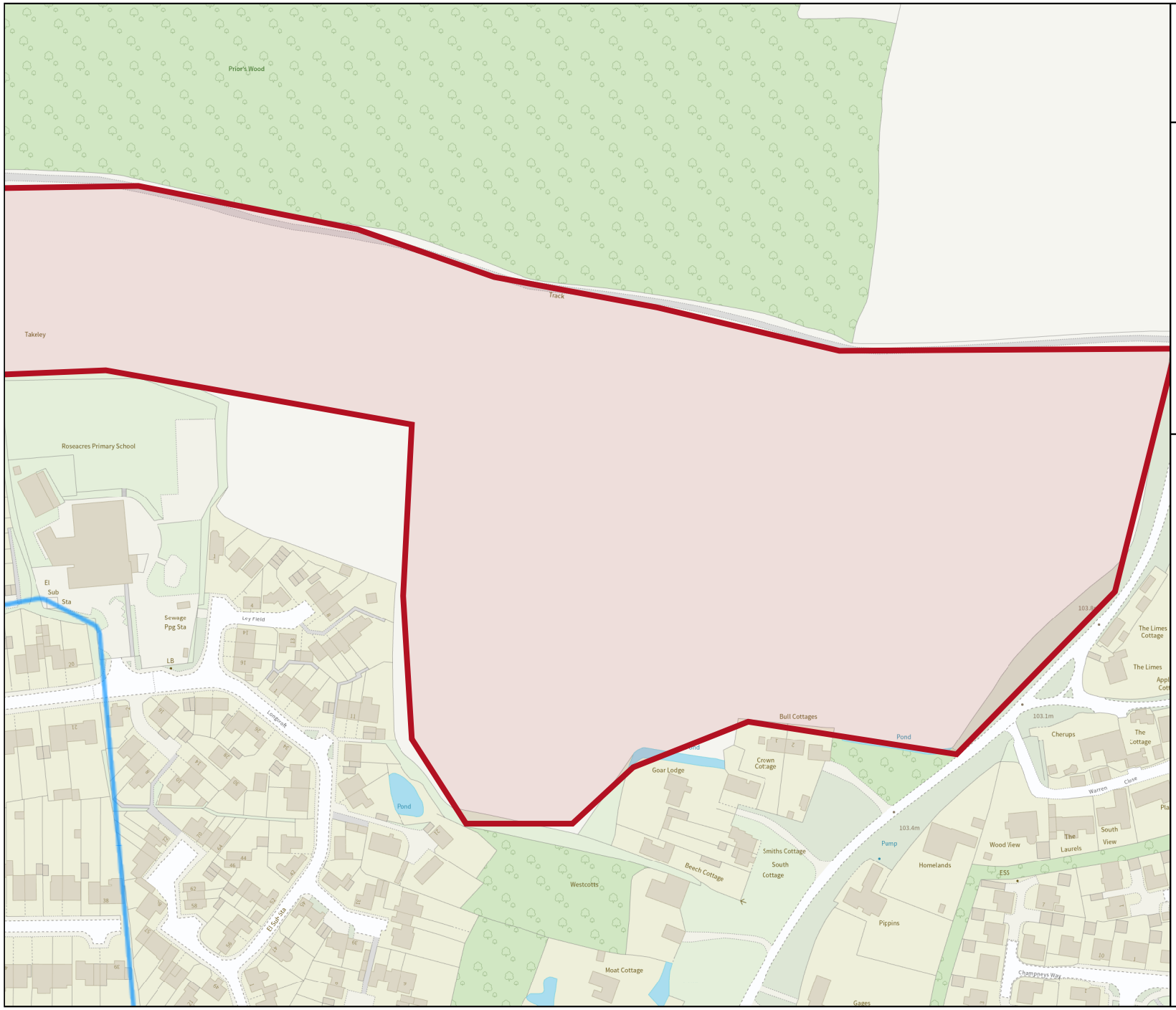
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
556575/221532

Scale
1:2500

Created
20 Apr 2023 15:27

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

Appendix: D – Uttlesford SFRA Mapping

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Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

N

0 2.5 5 Km

LEGEND

- Environment Agency Historic Flood Map
- Uttlesford Region

STRATEGIC FLOOD RISK ASSESSMENT

MAP 5: HISTORIC FLOOD MAP

Uttlesford District Council

JBA consulting

Information regarding modelled and historical flood risk is constantly changing. Users should consult the Environment Agency for the latest flood risk information relating to specific planning applications.

N

Notes

Flood Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Flood Zone 2: Comprised of land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.

Flood Zone 3a: This zone comprises land assessed as having a greater than 1in 100 annual probability of river flooding or a greater than 1 in 200 annual probability of flooding from sea in any year.

Flood Zone 3a plus climate change: An approximate representation of the impact of the 'upper end' climate change allowance on Flood Zone 3a.

Flood Zone 3b: This zone comprises land where water has to flow or be stored in times of flood (the functional floodplain).
The SFRA identified this Flood Zone as land which would flood with an annual probability of 1 in 20 years or 1 in 25 years, where detailed modelling exists. Where no modelling exists, the extent of Flood Zone 3b is assumed to be equal to Flood Zone 3a.

0 2.5 5 Km

LEGEND

- Uttlesford District Boundary
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 3a plus climate change
- Flood Zone 2
- Detailed River Network

STRATEGIC FLOOD RISK ASSESSMENT

MAP 6: FLOOD ZONES (REVISION 2)

Uttlesford District Council

JBA consulting

Information regarding modelled and historical flood risk is constantly changing. Users should consult the Environment Agency for the latest flood risk information relating to specific planning applications.

N

Notes

AIMS data was not available for the Cambridgeshire and Bedfordshire Environment Agency area

0 2.5 5 Km

LEGEND

Environment Agency National Flood Map

- Defences
- Areas Benefiting from Flood Defences

Detailed River Networks (DRN)

- Culverts
- Uttlesford District Boundary

Environment Agency Asset Information Management System (AIMS)

- Active Monitoring Instrument
- Bridge
- Control Gate
- Screen
- Outfall
- Weir
- Raised Defence (Embankments/Walls)
- Culvert

STRATEGIC FLOOD RISK ASSESSMENT

MAP 7: FLOOD DEFENCES, ASSETS AND STRUCTURES

Uttlesford District Council

JBA consulting

Information regarding modelled and historical flood risk is constantly changing. Users should consult the Environment Agency for the latest flood risk information relating to specific planning applications.

N

Notes

The updated Flood Map for Surface Water (uFMfSW) shows the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which:
(a) is on the surface of the ground (whether or not it is moving), and
(b) has not yet entered a watercourse, drainage system or public sewer.

The uFMfSW will pick out natural drainage channels, rivers, low areas in the floodplain and flow paths between buildings but it will only indicate flooding caused by local rainfall.

Note: The uFMfSW shows predictions of flooded areas but does not show whether individual properties will be affected by surface water flooding or have been affected in the past. The uFMfSW should not be used to predict if individual properties will flood.

0 2.5 5 Km

LEGEND

Environment Agency Updated Flood Map for Surface Water

- 1 in 30 flood extent
- 1 in 100 flood extent
- 1 in 1000 flood extent
- Uttlesford District Boundary

STRATEGIC FLOOD RISK ASSESSMENT

MAP 8: UPDATED FLOOD MAP FOR SURFACE WATER

Uttlesford District Council

JBA consulting

Information regarding modelled and historical flood risk is constantly changing. Users should consult the Environment Agency for the latest flood risk information relating to specific planning applications.

N

Notes

The Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound.This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGWF data should be used only in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

0 2.5 5 Km

LEGEND

Environment Agency Areas Susceptible to Groundwater Flooding

RISK

- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%
- Uttlesford District Boundary

STRATEGIC FLOOD RISK ASSESSMENT

MAP 9: AREAS SUSCEPTIBLE TO GROUNDWATER FLOODING

Uttlesford District Council

JBA consulting

Information regarding modelled and historical flood risk is constantly changing. Users should consult the Environment Agency for the latest flood risk information relating to specific planning applications.

N

CB10 1A

CB11 4

CB11 3U

CM22 6

CM24 8

CM23 2

CM23 5

CM23 3

CM22 7

CM6 1F

CM6 1F

CM6 1F

CM6 1F

CM6 1F

CM6 1H

0 2.5 5 Km

LEGEND

Number of Properties on Register

- 1-5
- 6-10
- Uttlesford District Boundary

STRATEGIC FLOOD RISK ASSESSMENT

MAP 10: SEWER FLOODING REGISTER

Uttlesford District Council

JBA consulting

Information regarding modelled and historical flood risk is constantly changing. Users should consult the Environment Agency for the latest flood risk information relating to specific planning applications.

Appendix: E – Topographical Survey

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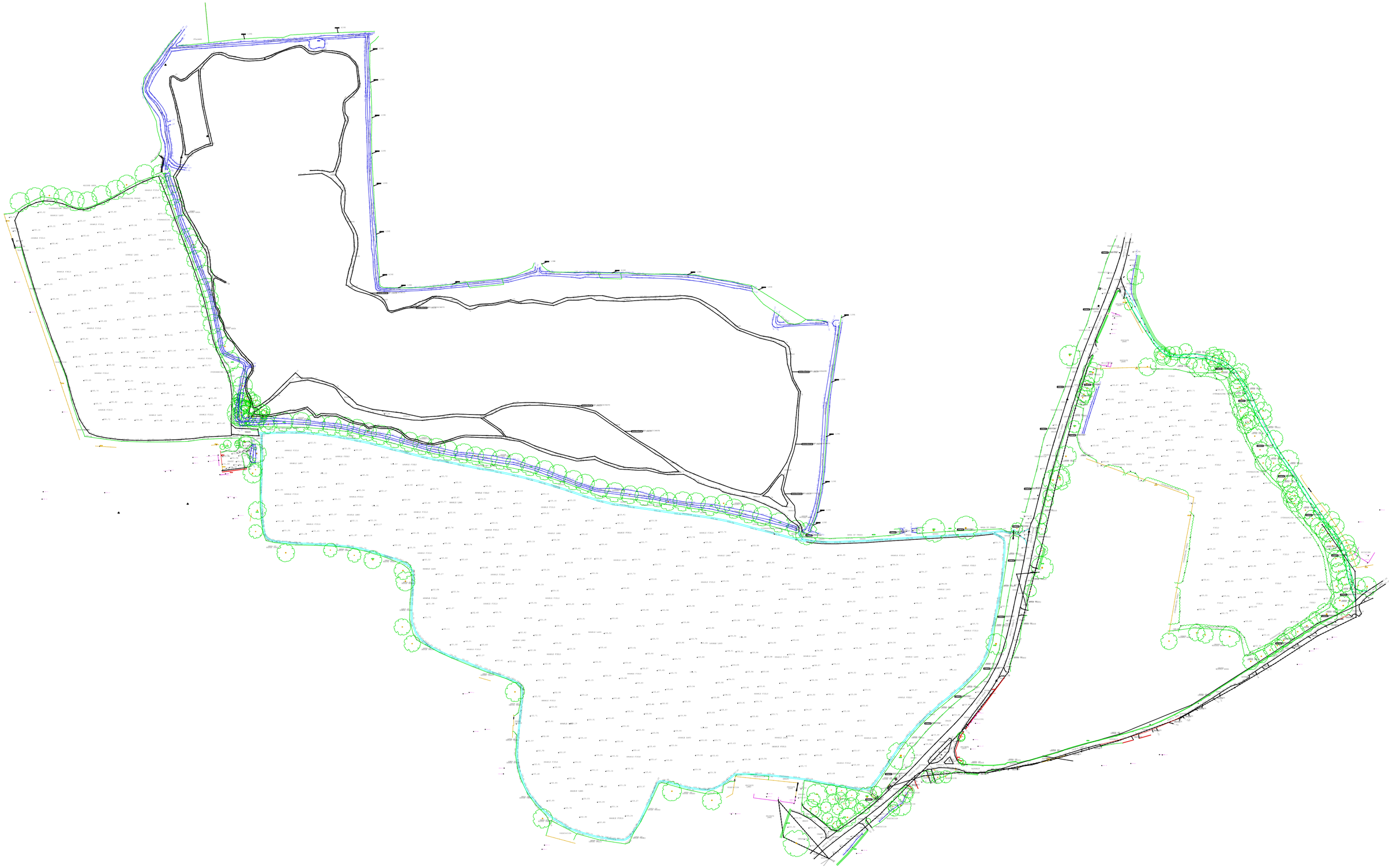
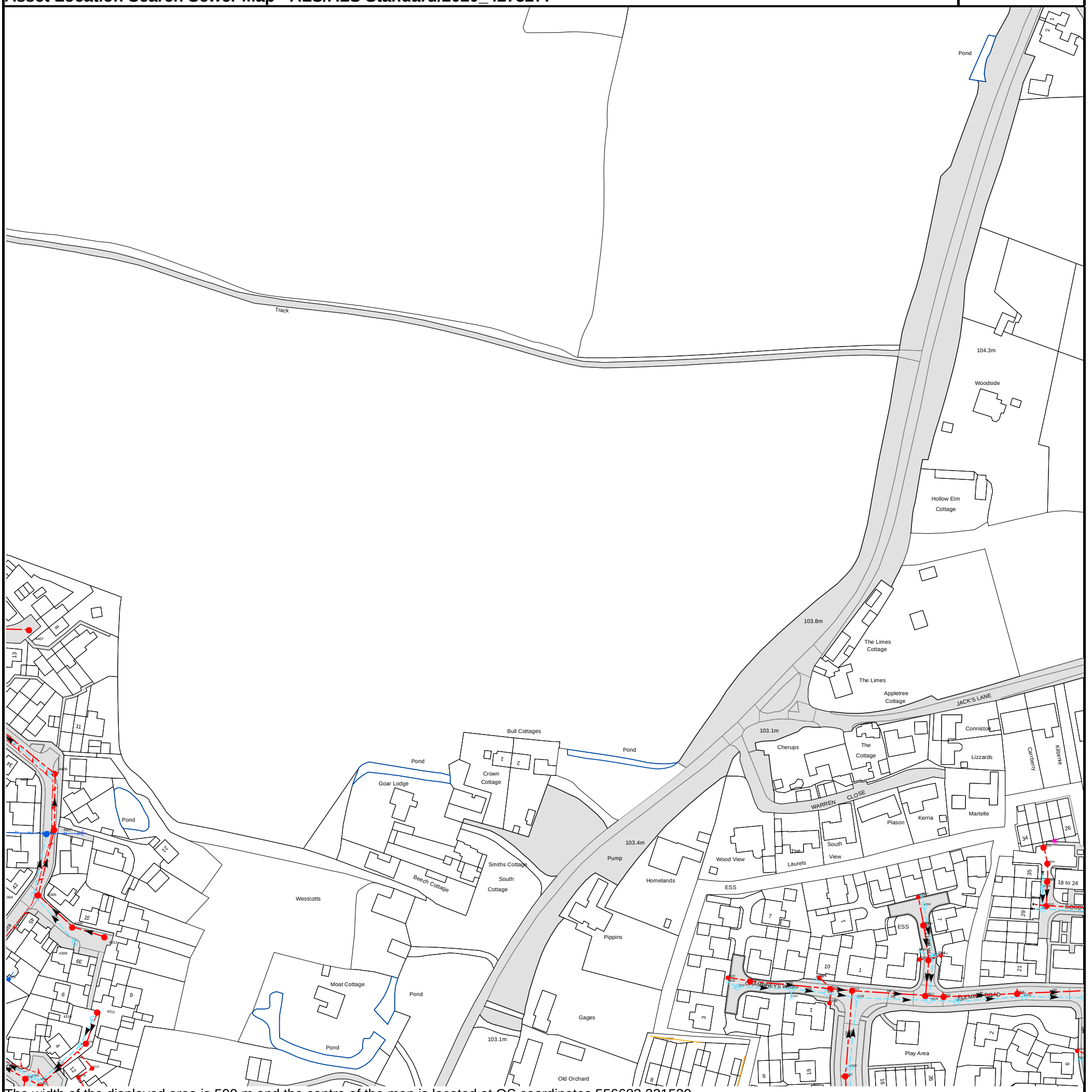
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** [redacted]



Appendix: F - Thames Water Sewer Reccords

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

Asset Location Search Sewer Map - ALS/ALS Standard/2020_4273277



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 556683,221520

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

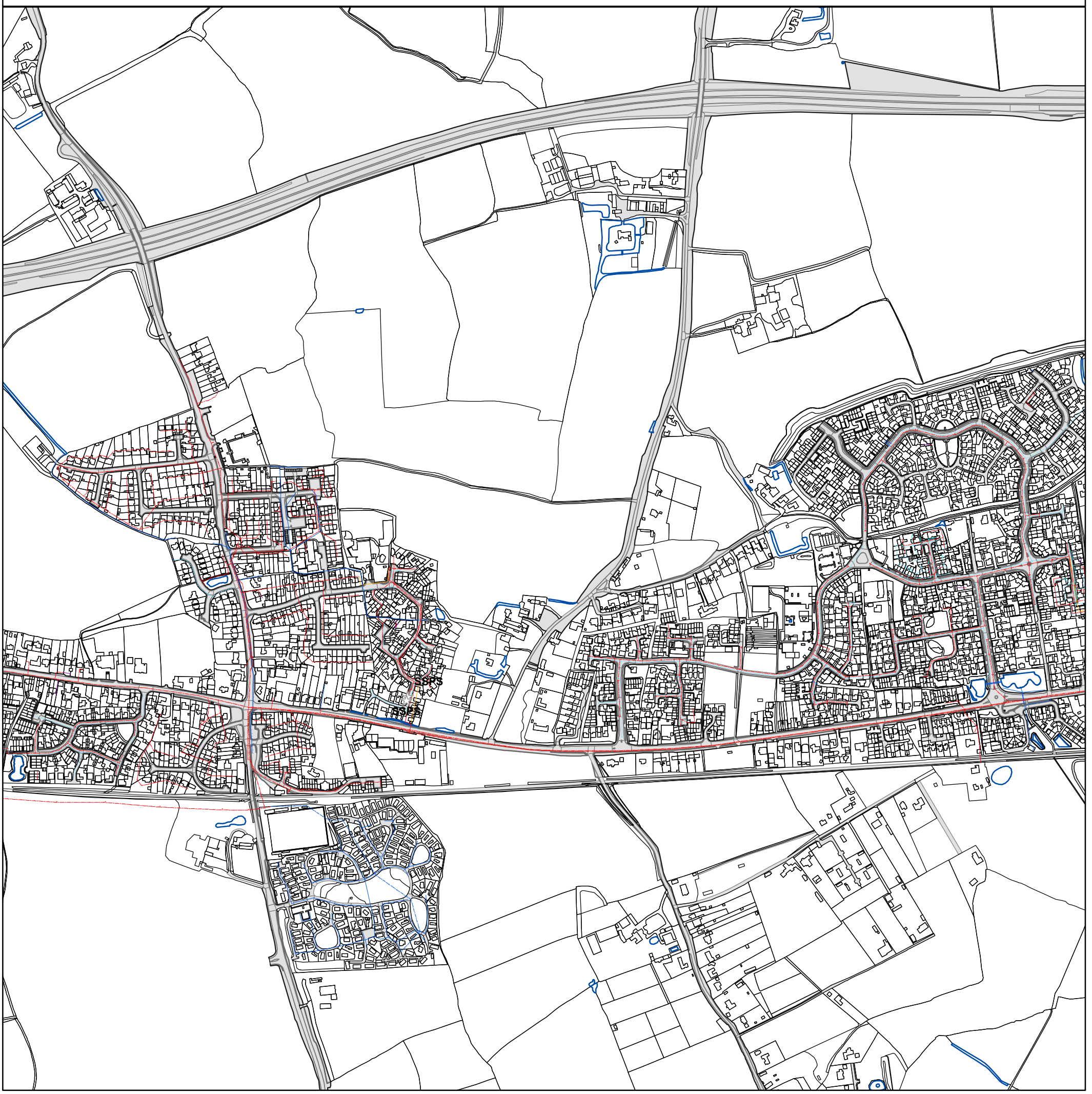
NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
931N	100.797	99.333
932G	n/a	n/a
931Q	100.765	98.74
931R	100.721	99.04
932H	n/a	n/a
921N	n/a	n/a
921X	n/a	n/a
931C	101.221	n/a
921D	99.827	97.461
921K	99.856	97.227
831B	101.832	n/a
831P	n/a	n/a
831R	n/a	n/a
831O	n/a	n/a
831T	n/a	n/a
831H	101.703	100
831K	101.844	100.485
831J	101.557	99.532
831I	101.443	99.69
831M	101.683	98.734
831L	101.438	100.075
831S	n/a	n/a
831V	n/a	n/a
831C	101.688	n/a
831D	101.71	n/a
831E	101.216	n/a
931A	101.086	n/a
931M	100.785	99.175
4310	102.08	101.03
4311	n/a	n/a
4312	n/a	n/a
731D	n/a	n/a
731E	n/a	n/a
731A	102.523	101.13
731C	102.547	100.6
731F	n/a	n/a
731B	102.276	97.709
831Q	n/a	n/a
831N	n/a	n/a
831F	102.063	98.722
831W	n/a	n/a
831G	102.06	97.957
821C	101.285	n/a
821D	101.301	n/a
831A	101.837	n/a
421D	n/a	n/a
421E	n/a	n/a
4204	n/a	n/a
421B	n/a	n/a
4203	102.03	100.25
421C	n/a	n/a
4205	102	100.75
4206	n/a	n/a
431A	n/a	n/a
4309	102.2	101.24
4308	n/a	n/a
4305	n/a	n/a
4304	101.78	101.06
4407	101.78	99.96
4306	101.79	100.77
4408	101.64	100.35
4307	101.82	100
4409	101.65	99.57

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2020_4273277



0 45 90 180 270 360
Meters

Scale:	1:7158
Width:	2000m
Printed By:	G1KANAGA
Print Date:	08/10/2020
Map Centre:	556683,221519
Grid Reference:	TL5621NE

Comments:

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Appendix: G – Site Investigations Report

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

STANSTED ENVIRONMENTAL SERVICES

The Stansted Centre
Parsonage Road,
Takeley
Essex CM22 6PU

T. 01279 873380
F. 01279 873381
E. enquiries@stansted-environmental.com
W. [redacted]

Our Ref: CON01-WARI-070
Your Ref: WH200

14 May 2021

David Poole
Weston Homes Plc
The Stansted Centre
Parsonage Road
Takeley
Essex
CM22 6PU

Dear Mr Poole ,

Re: Trial Pit Infiltration Tests – Warish Hall Farm, Takeley

Stansted Environmental Services Ltd (SES) was commissioned by Weston Homes plc (the client) to undertake trial pit soakaway testing at the above site on 28th April 2021. Soakaway tests were undertaken at six locations (SA1 to SA6) in general accordance with the methodology specified in BRE Special Digest 365.

Two trial pits were excavated by hand at each location to depths ranging from approximately 0.60m to 1.50m below ground level (bgl) as specified by Weston Homes' consultant EAS.

Beneath a surface covering of topsoil, all the trial pits encountered an orange-grey silty clay with occasional fragments of chalk believed to represent the Lowestoft Formation in this area. Locally, the strata may be described as sandy to very sandy and at one location, SA2, a band of flints was noted between 0.70m bgl and 0.85m bgl. A location plan is included within Appendix A.

Calculated permeability characteristics of the soil over the depth of the test zones are presented in the table below:

TABLE 1: Summary of Test Results

Test	Strata Description	Test Depth	No of Tests	Indicative Infiltration Rate
SA1S	Orange-brown-grey silty clay with occasional chalk fragments	0.60m	1	7.7×10^{-6} m/s
SA1D	Orange-brown-grey silty clay with occasional chalk fragments	1.50	2	1.5×10^{-6} m/s
SA2S	Orange-brown-grey silty clay with occasional chalk fragments. Band of flints noted at 0.70m	0.70m	3	7.0×10^{-4} m/s
SA2D	Orange-brown-grey silty clay with occasional chalk fragments. Band of flints noted at 0.70m	1.50m	3	1.6×10^{-4} m/s
SA3S	Orange-brown-grey sandy clay with occasional chalk fragments.	0.60m	2	5.9×10^{-6} m/s
SA3D	Orange-brown-grey sandy clay with occasional chalk fragments.	1.50m	2	6.2×10^{-6} m/s
SA4S	Orange-brown-grey sandy clay with occasional chalk fragments.	0.50m	2	5.5×10^{-6} m/s
SA4D	Orange-brown-grey sandy clay with occasional chalk fragments.	1.50m	2	4.1×10^{-6} m/s
SA5S	Orange-brown-grey sandy clay with occasional chalk fragments.	0.60m	3	1.6×10^{-5} m/s
SA5D	Orange-brown-grey sandy clay with occasional chalk fragments.	1.50m	2	1.6×10^{-5} m/s
SA6S	Orange-brown-grey sandy clay with occasional chalk fragments.	0.60m	3	2.9×10^{-4} m/s
SA6D	Orange-brown-grey sandy clay with occasional chalk fragments.	1.50m	2	1.1×10^{-5} m/s

Soakaway test sheets are appended to this report in Appendix B.

Average infiltration rates for the soils ranged between 5.9 x 10^{-6} m/s and 2.9 x 10^{-4} m/s.

I hope the information presented above meets your requirements. Should you wish to discuss the findings of the report, please do not hesitate to contact me.

Yours sincerely

For and on behalf of Stansted Environmental Services Limited

Gavin Greenwood
Associate Director (Geoenvironmental)

Encs: *Appendix A - Infiltration Test Location Plan*
Appendix B - Infiltration Test Results

APPENDIX A
PLANS & FIGURES

LEGEND

⊗ Infiltration Test Location

Originator	GB	**WARISH HALL FARM**
		CON01-WARI-070
Checked & Approved	WGG	**INFILTRATION TEST LOCATION PLAN**

STANSTED ENVIRONMENTAL SERVICES

16/08/2017

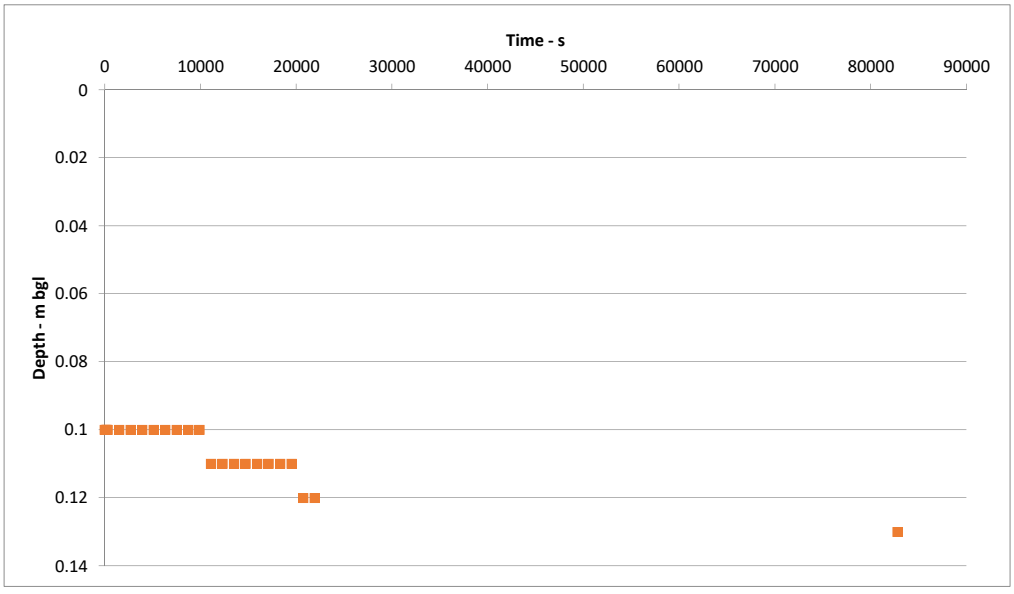
APPENDIX B
INFILTRATION TEST SHEETS

SOIL INFILTRATION RATE TEST

Test No.	SA1S No 1	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.10
		WaterLevel at End - m bgl	0.13
		V_{p75}	0.09
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.06
Depth	0.60	**a_{p50}**	0.75
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**7.72E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.10	0.50
1	60	0.10	0.50
2	120	0.10	0.50
3	180	0.10	0.50
4	240	0.10	0.50
5	300	0.10	0.50
25	1500	0.10	0.50
45	2700	0.10	0.50
65	3900	0.10	0.50
85	5100	0.10	0.50
105	6300	0.10	0.50
125	7500	0.10	0.50
145	8700	0.10	0.50
165	9900	0.10	0.50
185	11100	0.11	0.49
205	12300	0.11	0.49
225	13500	0.11	0.49
245	14700	0.11	0.49
265	15900	0.11	0.49
285	17100	0.11	0.49
305	18300	0.11	0.49
325	19500	0.11	0.49
345	20700	0.12	0.48
365	21900	0.12	0.48
1380	82800	0.13	0.47

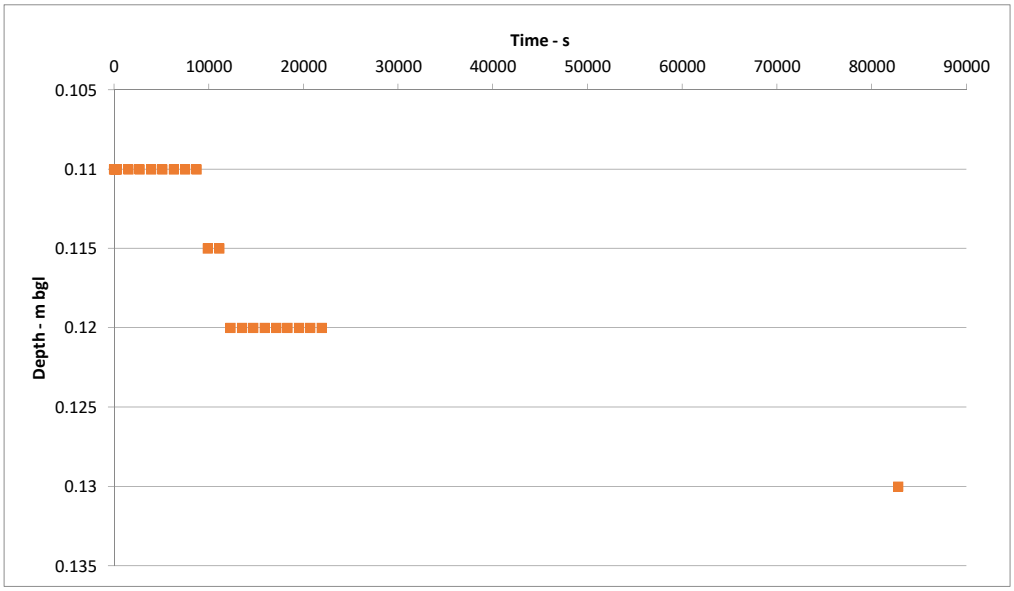


SOIL INFILTRATION RATE TEST

Test No.	SA1D No 1	**Date:**	04/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.11
		WaterLevel at End - m bgl	0.13
		V_{p75}	0.26
Width	0.50	**V_{p25}**	0.09
		V_{p75-25}	0.17
Depth	1.50	**a_{p50}**	1.64
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.48E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.11	1.39
1	60	0.11	1.39
2	120	0.11	1.39
3	180	0.11	1.39
4	240	0.11	1.39
5	300	0.11	1.39
25	1500	0.11	1.39
45	2700	0.11	1.39
65	3900	0.11	1.39
85	5100	0.11	1.39
105	6300	0.11	1.39
125	7500	0.11	1.39
145	8700	0.11	1.39
165	9900	0.12	1.39
185	11100	0.12	1.39
205	12300	0.12	1.38
225	13500	0.12	1.38
245	14700	0.12	1.38
265	15900	0.12	1.38
285	17100	0.12	1.38
305	18300	0.12	1.38
325	19500	0.12	1.38
345	20700	0.12	1.38
365	21900	0.12	1.38
1380	82800	0.13	1.37

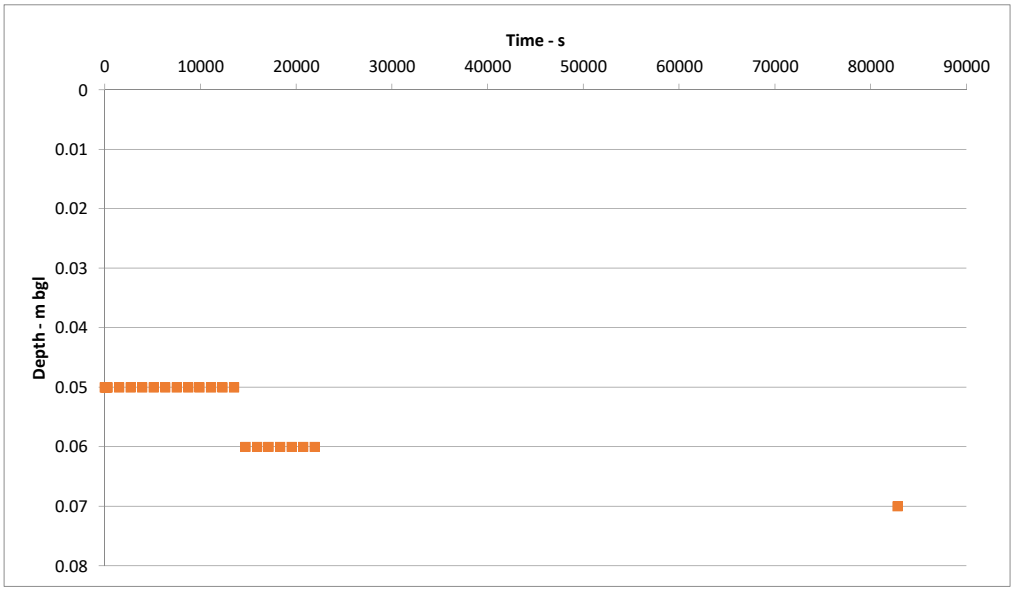


SOIL INFILTRATION RATE TEST

Test No.	SA1D No 2	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.05
		WaterLevel at End - m bgl	0.07
		V_{p75}	0.27
Width	0.50	**V_{p25}**	0.09
		V_{p75-25}	0.18
Depth	1.50	**a_{p50}**	1.70
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.57E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.05	1.45
1	60	0.05	1.45
2	120	0.05	1.45
3	180	0.05	1.45
4	240	0.05	1.45
5	300	0.05	1.45
25	1500	0.05	1.45
45	2700	0.05	1.45
65	3900	0.05	1.45
85	5100	0.05	1.45
105	6300	0.05	1.45
125	7500	0.05	1.45
145	8700	0.05	1.45
165	9900	0.05	1.45
185	11100	0.05	1.45
205	12300	0.05	1.45
225	13500	0.05	1.45
245	14700	0.06	1.44
265	15900	0.06	1.44
285	17100	0.06	1.44
305	18300	0.06	1.44
325	19500	0.06	1.44
345	20700	0.06	1.44
365	21900	0.06	1.44
1380	82800	0.07	1.43



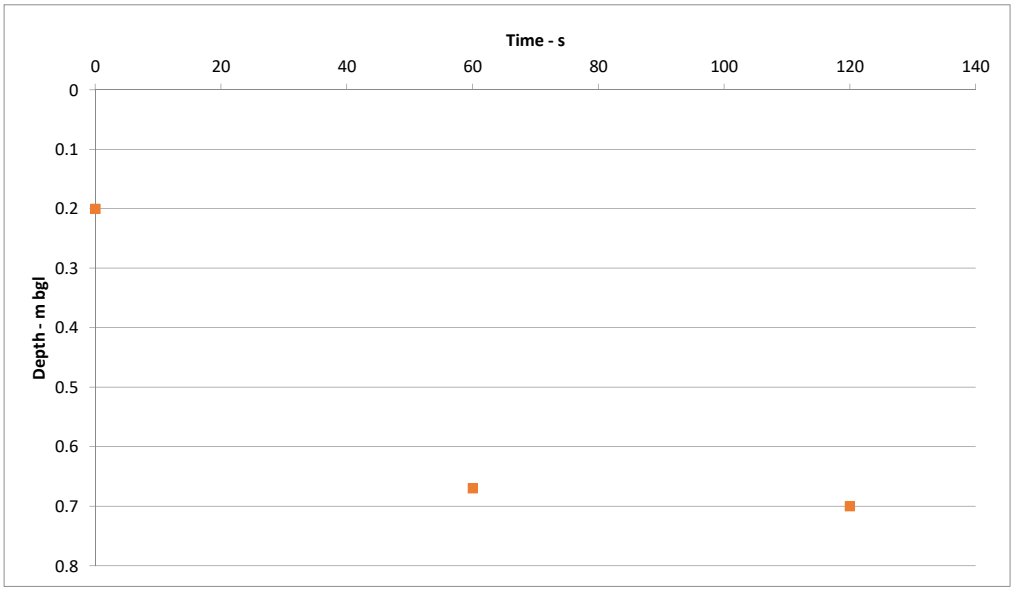
SOIL INFILTRATION RATE TEST

Test No.	SA2S No 1	**Date:**	04/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.20
		WaterLevel at End - m bgl	0.70
		V_{p75}	0.09
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.06
Depth	0.70	**a_{p50}**	0.75
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.19E-03**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.20	0.50
1	60	0.67	0.03
2	120	0.70	0.00

NB: Band of flints noted at 0.70m bgl



SOIL INFILTRATION RATE TEST

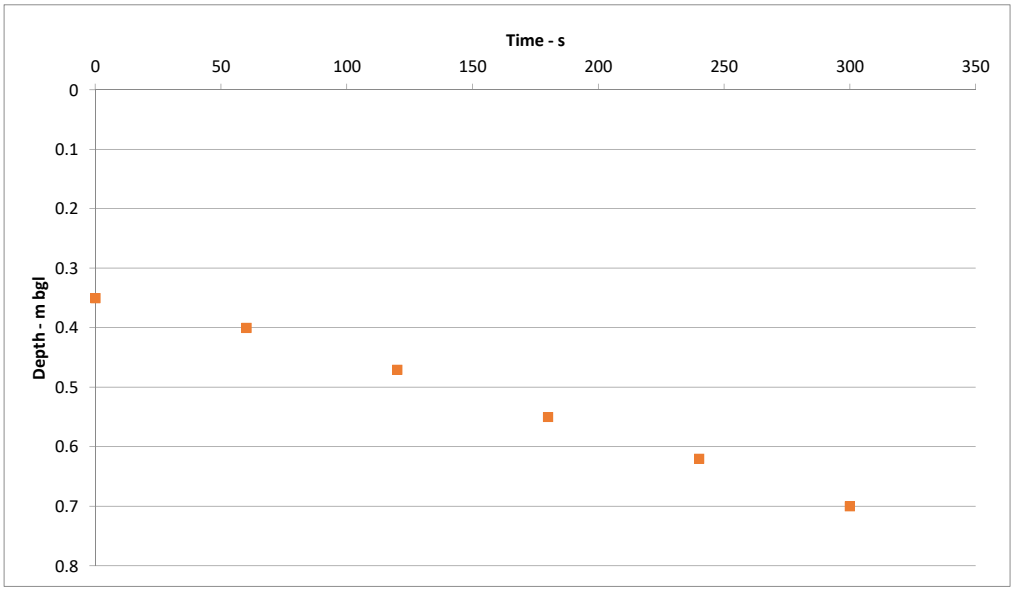
Test No.	SA2S No 2	**Date:**	04/05/2021	**Job No:**	CON01-WARI-070

Client:	Weston Homes plc	**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)		**Water Level at Start - m bgl**	0.35
Length	0.50	**WaterLevel at End - m bgl**	0.70
		V_{p75}	0.07
Width	0.50	**V_{p25}**	0.02
		V_{p75-25}	0.04
Depth	0.70	**a_{p50}**	0.60
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**5.21E-04**

Elapsed Time		**Depth recorded on dip meter (m bgl)**	**Head of Water above Base (m)**
Minutes	**Seconds**		
0	0	0.35	0.35
1	60	0.40	0.30
2	120	0.47	0.23
3	180	0.55	0.15
4	240	0.62	0.08
5	300	0.70	0.00

NB: Band of flints noted at 0.70m



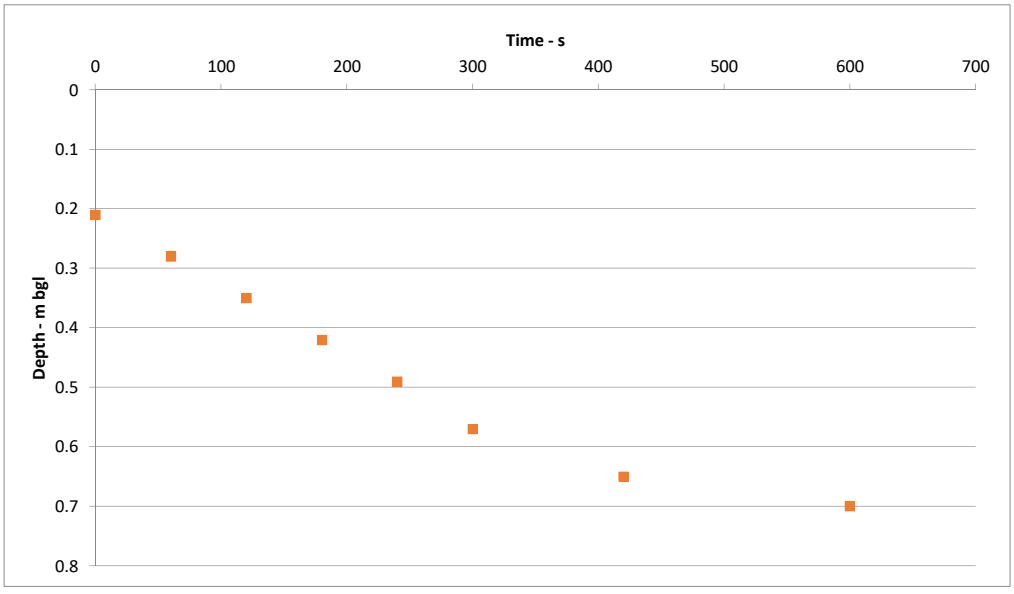
SOIL INFILTRATION RATE TEST

Test No.	SA2S No 3	**Date:**	04/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.21
		WaterLevel at End - m bgl	0.70
		V_{p75}	0.09
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.06
Depth	0.70	**a_{p50}**	0.74
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**3.76E-04**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.21	0.49
1	60	0.28	0.42
2	120	0.35	0.35
3	180	0.42	0.28
4	240	0.49	0.21
5	300	0.57	0.13
7	420	0.65	0.05
10	600	0.70	0.00

NB: Band of flints noted at 0.70m

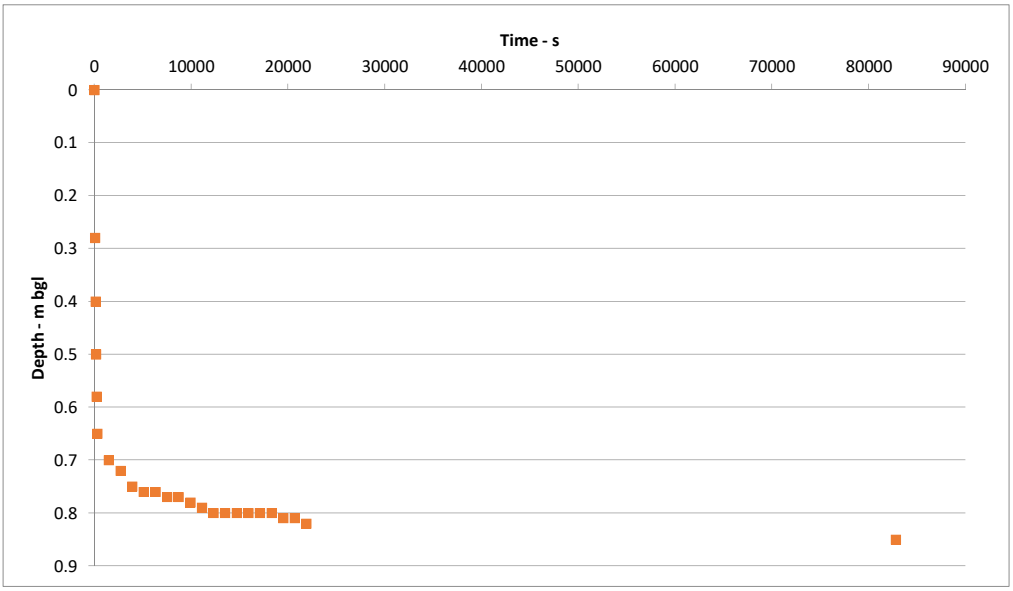


SOIL INFILTRATION RATE TEST

Test No.	SA2D No 1	**Date:**	04/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.00
		WaterLevel at End - m bgl	0.85
		V_{p75}	0.28
Width	0.50	**V_{p25}**	0.09
		V_{p75-25}	0.19
Depth	1.50	**a_{p50}**	1.75
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**4.20E-04**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.00	1.50
1	60	0.28	1.22
2	120	0.40	1.10
3	180	0.50	1.00
4	240	0.58	0.92
5	300	0.65	0.85
25	1500	0.70	0.80
45	2700	0.72	0.78
65	3900	0.75	0.75
85	5100	0.76	0.74
105	6300	0.76	0.74
125	7500	0.77	0.73
145	8700	0.77	0.73
165	9900	0.78	0.72
185	11100	0.79	0.71
205	12300	0.80	0.70
225	13500	0.80	0.70
245	14700	0.80	0.70
265	15900	0.80	0.70
285	17100	0.80	0.70
305	18300	0.80	0.70
325	19500	0.81	0.69
345	20700	0.81	0.69
365	21900	0.82	0.68
1380	82800	0.85	0.65

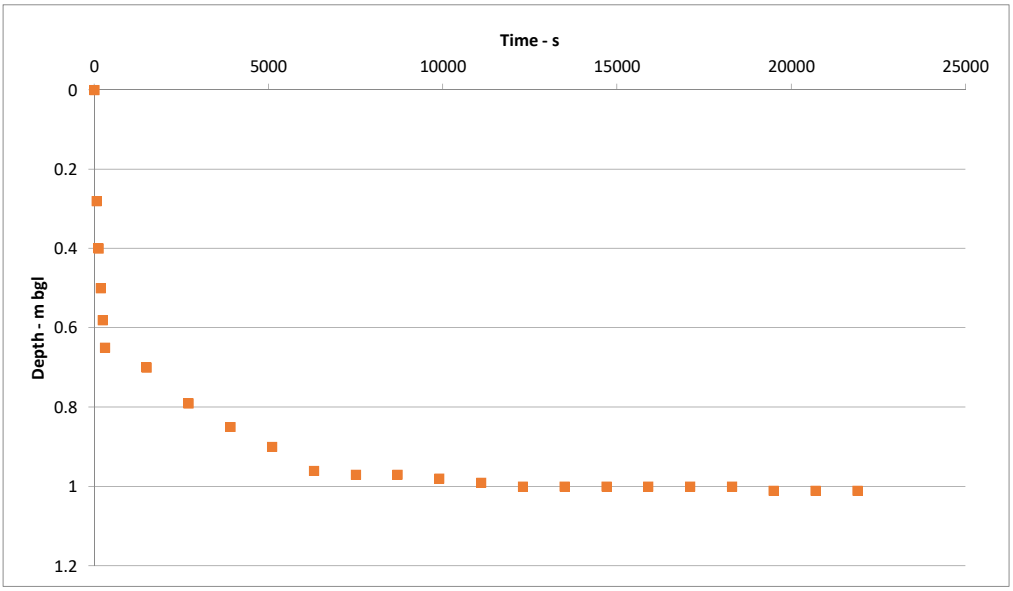


SOIL INFILTRATION RATE TEST

Test No.	SA2D No 2	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.00
		WaterLevel at End - m bgl	1.01
		V_{p75}	0.28
Width	0.50	**V_{p25}**	0.09
		V_{p75-25}	0.19
Depth	1.50	**a_{p50}**	1.75
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**5.21E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.00	1.50
1	60	0.28	1.22
2	120	0.40	1.10
3	180	0.50	1.00
4	240	0.58	0.92
5	300	0.65	0.85
25	1500	0.70	0.80
45	2700	0.79	0.71
65	3900	0.85	0.65
85	5100	0.90	0.60
105	6300	0.96	0.54
125	7500	0.97	0.53
145	8700	0.97	0.53
165	9900	0.98	0.52
185	11100	0.99	0.51
205	12300	1.00	0.50
225	13500	1.00	0.50
245	14700	1.00	0.50
265	15900	1.00	0.50
285	17100	1.00	0.50
305	18300	1.00	0.50
325	19500	1.01	0.49
345	20700	1.01	0.49
365	21900	1.01	0.49

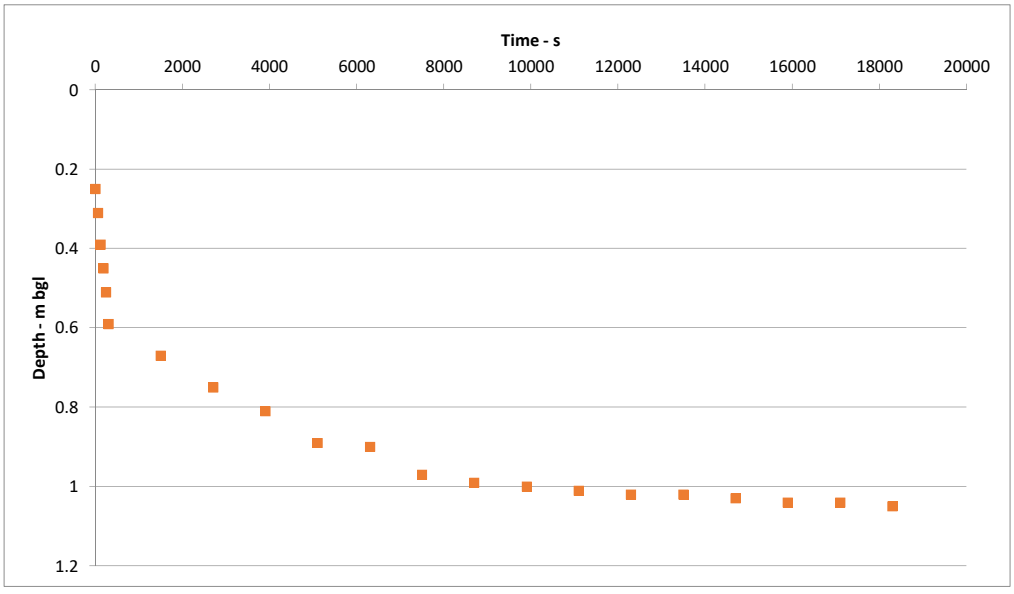


SOIL INFILTRATION RATE TEST

Test No.	SA2D No 3	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Jacks

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.25
		WaterLevel at End - m bgl	1.00
		V_{p75}	0.23
Width	0.50	**V_{p25}**	0.08
		V_{p75-25}	0.16
Depth	1.50	**a_{p50}**	1.50
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**2.78E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.25	1.25
1	60	0.31	1.19
2	120	0.39	1.11
3	180	0.45	1.05
4	240	0.51	0.99
5	300	0.59	0.91
25	1500	0.67	0.83
45	2700	0.75	0.75
65	3900	0.81	0.69
85	5100	0.89	0.61
105	6300	0.90	0.60
125	7500	0.97	0.53
145	8700	0.99	0.51
165	9900	1.00	0.50
185	11100	1.01	0.49
205	12300	1.02	0.48
225	13500	1.02	0.48
245	14700	1.03	0.47
265	15900	1.04	0.46
285	17100	1.04	0.46
305	18300	1.05	0.45

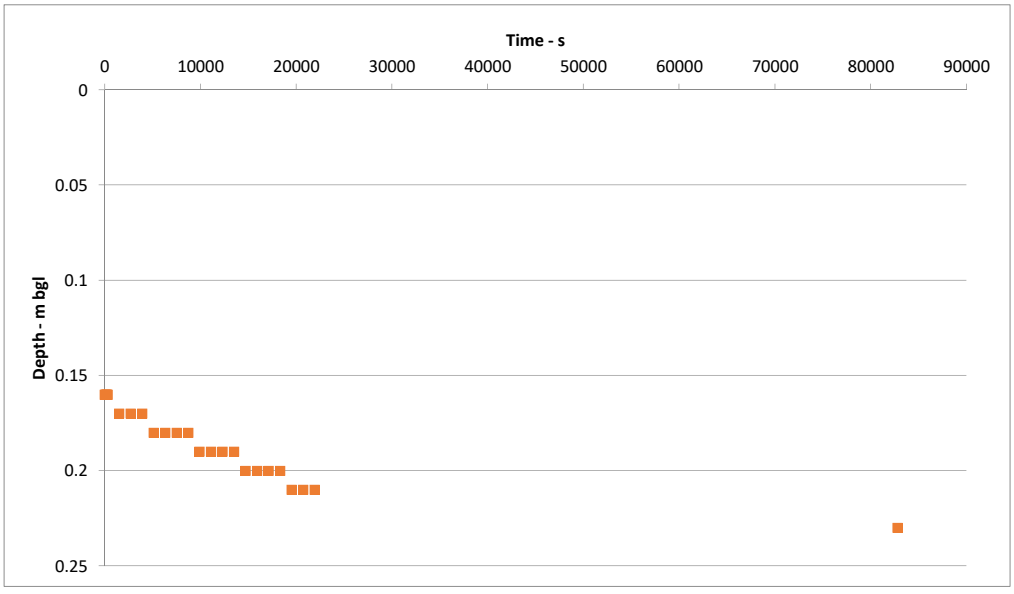


SOIL INFILTRATION RATE TEST

Test No.	SA3S No1	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.16
		WaterLevel at End - m bgl	0.23
		V_{p75}	0.08
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.06
Depth	0.60	**a_{p50}**	0.69
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**4.74E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.16	0.44
1	60	0.16	0.44
2	120	0.16	0.44
3	180	0.16	0.44
4	240	0.16	0.44
5	300	0.16	0.44
25	1500	0.17	0.43
45	2700	0.17	0.43
65	3900	0.17	0.43
85	5100	0.18	0.42
105	6300	0.18	0.42
125	7500	0.18	0.42
145	8700	0.18	0.42
165	9900	0.19	0.41
185	11100	0.19	0.41
205	12300	0.19	0.41
225	13500	0.19	0.41
245	14700	0.20	0.40
265	15900	0.20	0.40
285	17100	0.20	0.40
305	18300	0.20	0.40
325	19500	0.21	0.39
345	20700	0.21	0.39
365	21900	0.21	0.39
1380	82800	0.23	0.37

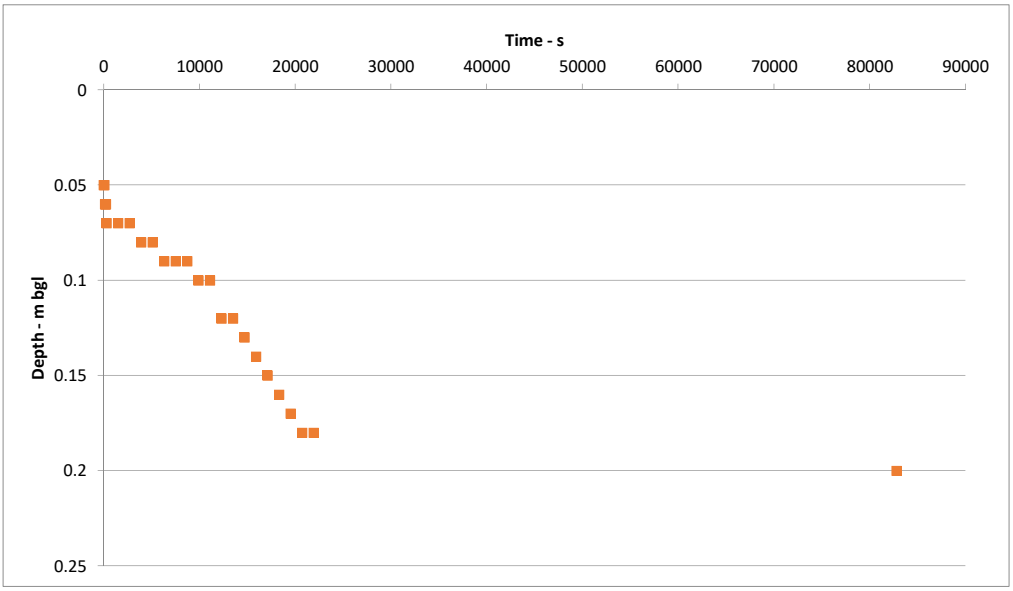


SOIL INFILTRATION RATE TEST

Test No.	SA3S No 2	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.05
		WaterLevel at End - m bgl	0.20
		V_{p75}	0.10
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.07
Depth	0.60	**a_{p50}**	0.80
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**7.16E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.05	0.55
1	60	0.05	0.55
2	120	0.06	0.54
3	180	0.06	0.54
4	240	0.06	0.54
5	300	0.07	0.53
25	1500	0.07	0.53
45	2700	0.07	0.53
65	3900	0.08	0.52
85	5100	0.08	0.52
105	6300	0.09	0.51
125	7500	0.09	0.51
145	8700	0.09	0.51
165	9900	0.10	0.50
185	11100	0.10	0.50
205	12300	0.12	0.48
225	13500	0.12	0.48
245	14700	0.13	0.47
265	15900	0.14	0.46
285	17100	0.15	0.45
305	18300	0.16	0.44
325	19500	0.17	0.43
345	20700	0.18	0.42
365	21900	0.18	0.42
1380	82800	0.20	0.40

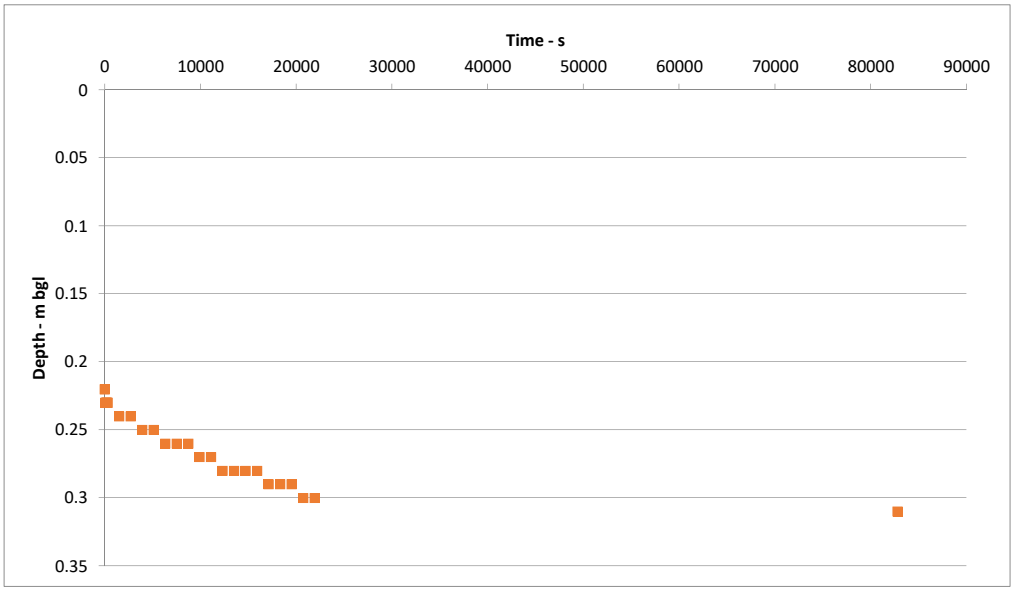


SOIL INFILTRATION RATE TEST

Test No.	SA3D No 1	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)		**Water Level at Start - m bgl**	0.22
Length	0.50	**WaterLevel at End - m bgl**	0.31
		V_{p75}	0.24
Width	0.50	V_{p25}	0.08
		V_{p75-25}	0.16
Depth	1.50	a_{p50}	1.53
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**6.22E-06**

Elapsed Time		**Depth recorded on dip meter (m bgl)**	**Head of Water above Base (m)**
Minutes	**Seconds**		
0	0	0.22	1.28
1	60	0.23	1.27
2	120	0.23	1.27
3	180	0.23	1.27
4	240	0.23	1.27
5	300	0.23	1.27
25	1500	0.24	1.26
45	2700	0.24	1.26
65	3900	0.25	1.25
85	5100	0.25	1.25
105	6300	0.26	1.24
125	7500	0.26	1.24
145	8700	0.26	1.24
165	9900	0.27	1.23
185	11100	0.27	1.23
205	12300	0.28	1.22
225	13500	0.28	1.22
245	14700	0.28	1.22
265	15900	0.28	1.22
285	17100	0.29	1.21
305	18300	0.29	1.21
325	19500	0.29	1.21
345	20700	0.30	1.20
365	21900	0.30	1.20
1380	82800	0.31	1.19

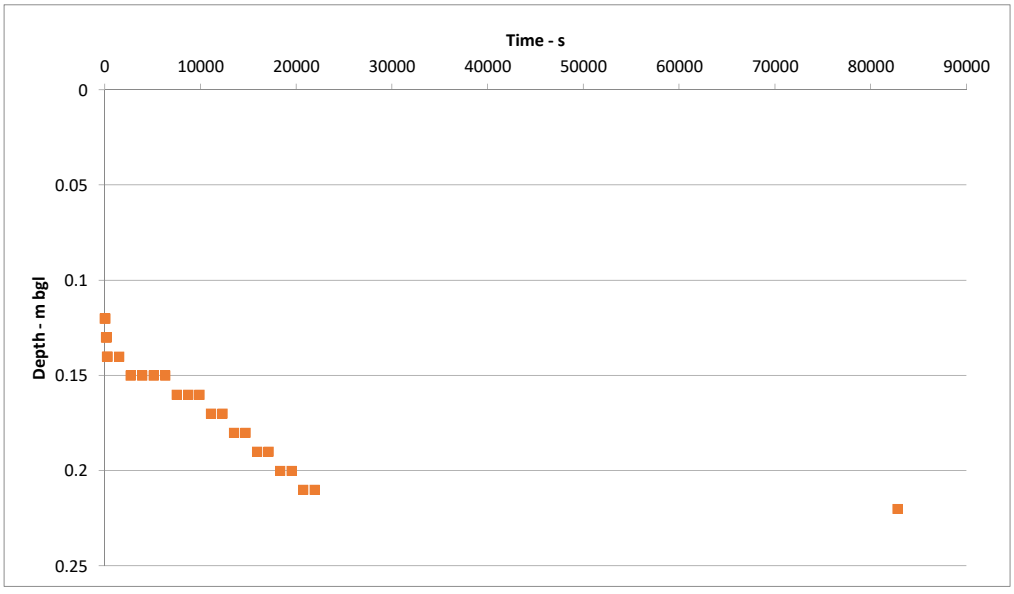


SOIL INFILTRATION RATE TEST

Test No.	SA3D No 2	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.12
		WaterLevel at End - m bgl	0.22
		V_{p75}	0.26
Width	0.50	**V_{p25}**	0.09
		V_{p75-25}	0.17
Depth	1.50	**a_{p50}**	1.63
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**6.30E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.12	1.38
1	60	0.12	1.38
2	120	0.13	1.37
3	180	0.13	1.37
4	240	0.14	1.36
5	300	0.14	1.36
25	1500	0.14	1.36
45	2700	0.15	1.35
65	3900	0.15	1.35
85	5100	0.15	1.35
105	6300	0.15	1.35
125	7500	0.16	1.34
145	8700	0.16	1.34
165	9900	0.16	1.34
185	11100	0.17	1.33
205	12300	0.17	1.33
225	13500	0.18	1.32
245	14700	0.18	1.32
265	15900	0.19	1.31
285	17100	0.19	1.31
305	18300	0.20	1.30
325	19500	0.20	1.30
345	20700	0.21	1.29
365	21900	0.21	1.29
1380	82800	0.22	1.28

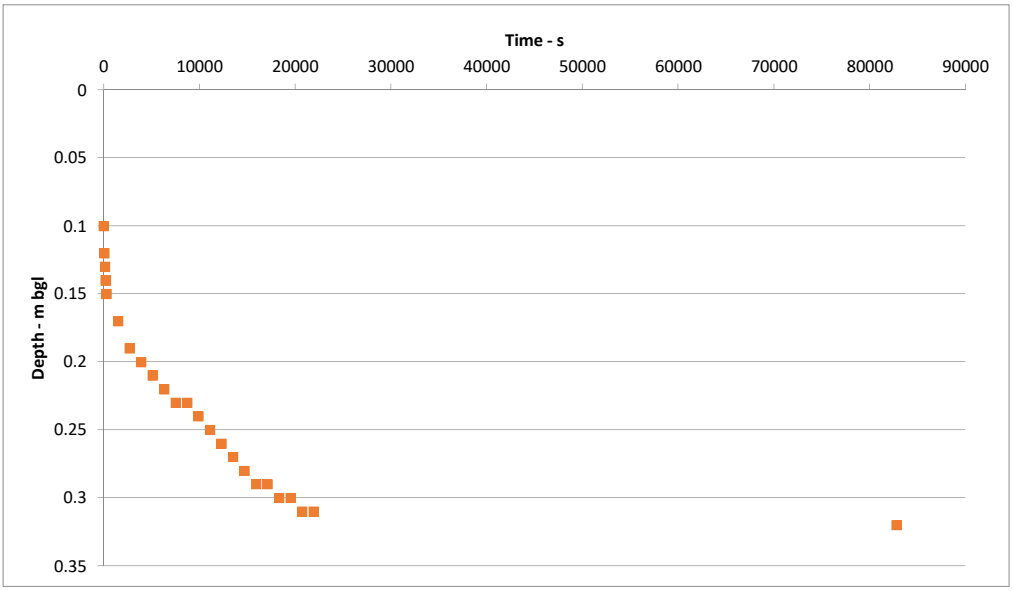


SOIL INFILTRATION RATE TEST

Test No.	SA4S No 1	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.10
		WaterLevel at End - m bgl	0.32
		V_{p75}	0.09
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.06
Depth	0.60	**a_{p50}**	0.75
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**6.67E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.10	0.50
1	60	0.12	0.48
2	120	0.13	0.47
3	180	0.14	0.46
4	240	0.14	0.46
5	300	0.15	0.45
25	1500	0.17	0.43
45	2700	0.19	0.41
65	3900	0.20	0.40
85	5100	0.21	0.39
105	6300	0.22	0.38
125	7500	0.23	0.37
145	8700	0.23	0.37
165	9900	0.24	0.36
185	11100	0.25	0.35
205	12300	0.26	0.34
225	13500	0.27	0.33
245	14700	0.28	0.32
265	15900	0.29	0.31
285	17100	0.29	0.31
305	18300	0.30	0.30
325	19500	0.30	0.30
345	20700	0.31	0.29
365	21900	0.31	0.29
1380	82800	0.32	0.28

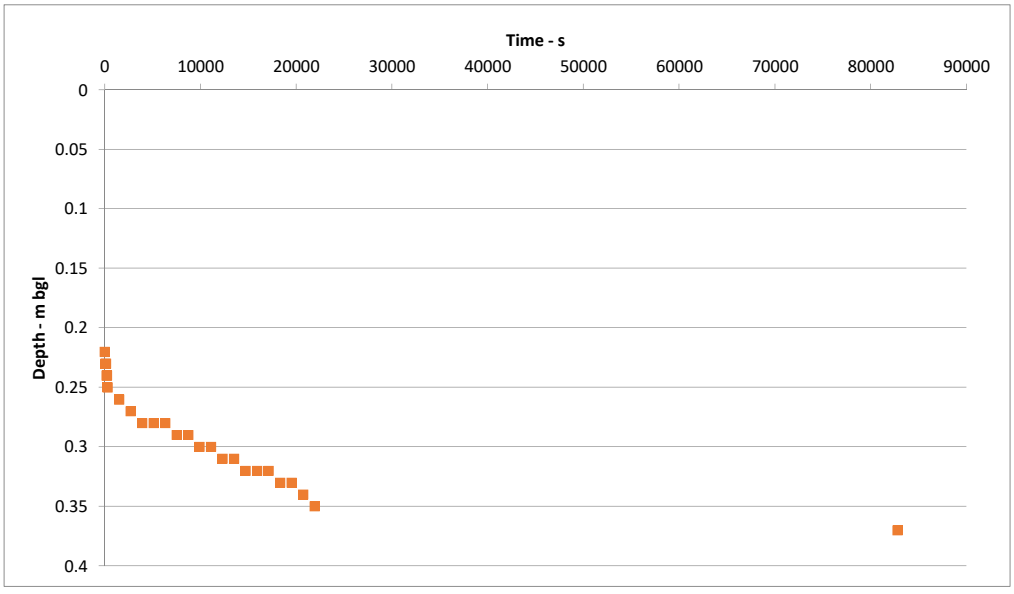


SOIL INFILTRATION RATE TEST

Test No.	SA4S No 1	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.22
		WaterLevel at End - m bgl	0.37
		V_{p75}	0.07
Width	0.50	**V_{p25}**	0.02
		V_{p75-25}	0.05
Depth	0.60	**a_{p50}**	0.63
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**4.19E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.22	0.38
1	60	0.23	0.37
2	120	0.23	0.37
3	180	0.24	0.36
4	240	0.24	0.36
5	300	0.25	0.35
25	1500	0.26	0.34
45	2700	0.27	0.33
65	3900	0.28	0.32
85	5100	0.28	0.32
105	6300	0.28	0.32
125	7500	0.29	0.31
145	8700	0.29	0.31
165	9900	0.30	0.30
185	11100	0.30	0.30
205	12300	0.31	0.29
225	13500	0.31	0.29
245	14700	0.32	0.28
265	15900	0.32	0.28
285	17100	0.32	0.28
305	18300	0.33	0.27
325	19500	0.33	0.27
345	20700	0.34	0.26
365	21900	0.35	0.25
1380	82800	0.37	0.23

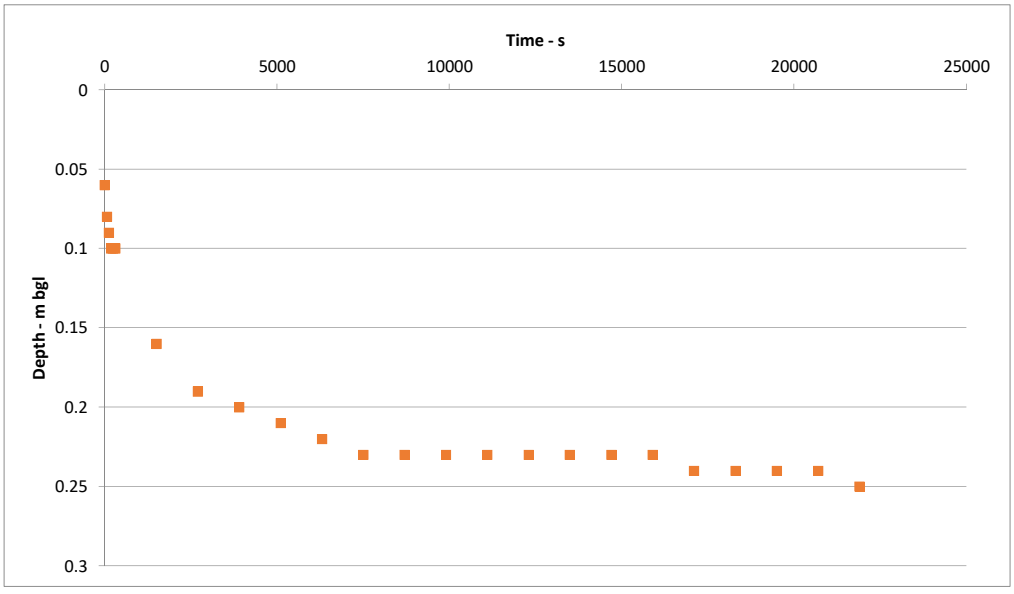


SOIL INFILTRATION RATE TEST

Test No.	SA4D No 1	**Date:**	05/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)		**Water Level at Start - m bgl**	0.06
Length	0.50	**WaterLevel at End - m bgl**	0.25
		V_{p75}	0.27
Width	0.50	**V_{p25}**	0.09
		V_{p75-25}	0.18
Depth	1.50	**a_{p50}**	1.69
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**3.13E-05**

Elapsed Time		**Depth recorded on dip meter (m bgl)**	**Head of Water above Base (m)**
Minutes	**Seconds**		
0	0	0.06	1.44
1	60	0.08	1.42
2	120	0.09	1.41
3	180	0.10	1.40
4	240	0.10	1.40
5	300	0.10	1.40
25	1500	0.16	1.34
45	2700	0.19	1.31
65	3900	0.20	1.30
85	5100	0.21	1.29
105	6300	0.22	1.28
125	7500	0.23	1.27
145	8700	0.23	1.27
165	9900	0.23	1.27
185	11100	0.23	1.27
205	12300	0.23	1.27
225	13500	0.23	1.27
245	14700	0.23	1.27
265	15900	0.23	1.27
285	17100	0.24	1.26
305	18300	0.24	1.26
325	19500	0.24	1.26
345	20700	0.24	1.26
365	21900	0.25	1.25

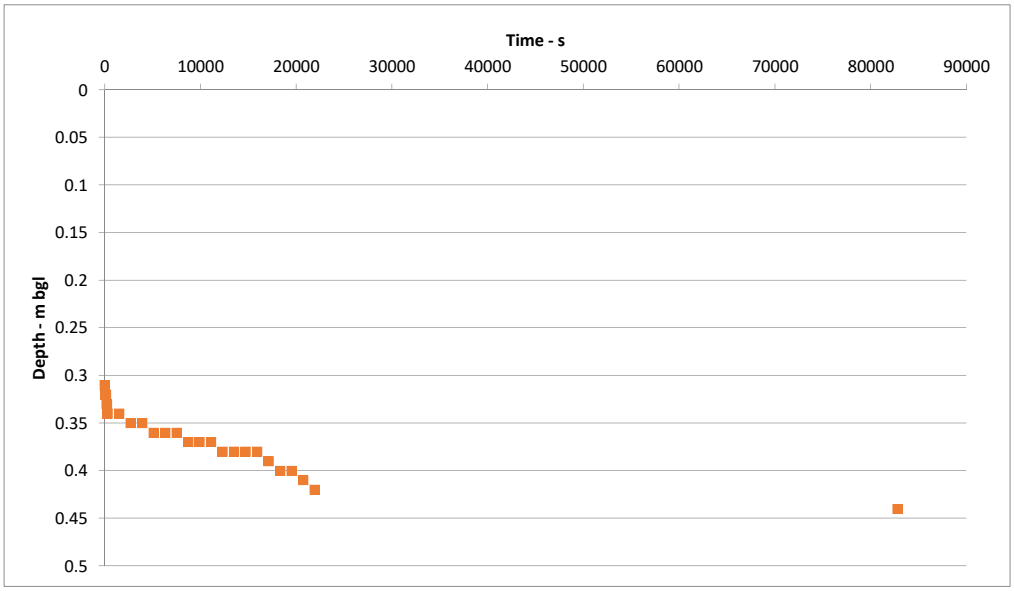


SOIL INFILTRATION RATE TEST

Test No.	SA4D No 2	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.31
		WaterLevel at End - m bgl	0.44
		V_{p75}	0.22
Width	0.50	**V_{p25}**	0.07
		V_{p75-25}	0.15
Depth	1.50	**a_{p50}**	1.44
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**5.06E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.31	1.19
1	60	0.32	1.18
2	120	0.32	1.18
3	180	0.33	1.17
4	240	0.33	1.17
5	300	0.34	1.16
25	1500	0.34	1.16
45	2700	0.35	1.15
65	3900	0.35	1.15
85	5100	0.36	1.14
105	6300	0.36	1.14
125	7500	0.36	1.14
145	8700	0.37	1.13
165	9900	0.37	1.13
185	11100	0.37	1.13
205	12300	0.38	1.12
225	13500	0.38	1.12
245	14700	0.38	1.12
265	15900	0.38	1.12
285	17100	0.39	1.11
305	18300	0.40	1.10
325	19500	0.40	1.10
345	20700	0.41	1.09
365	21900	0.42	1.08
1380	82800	0.44	1.06

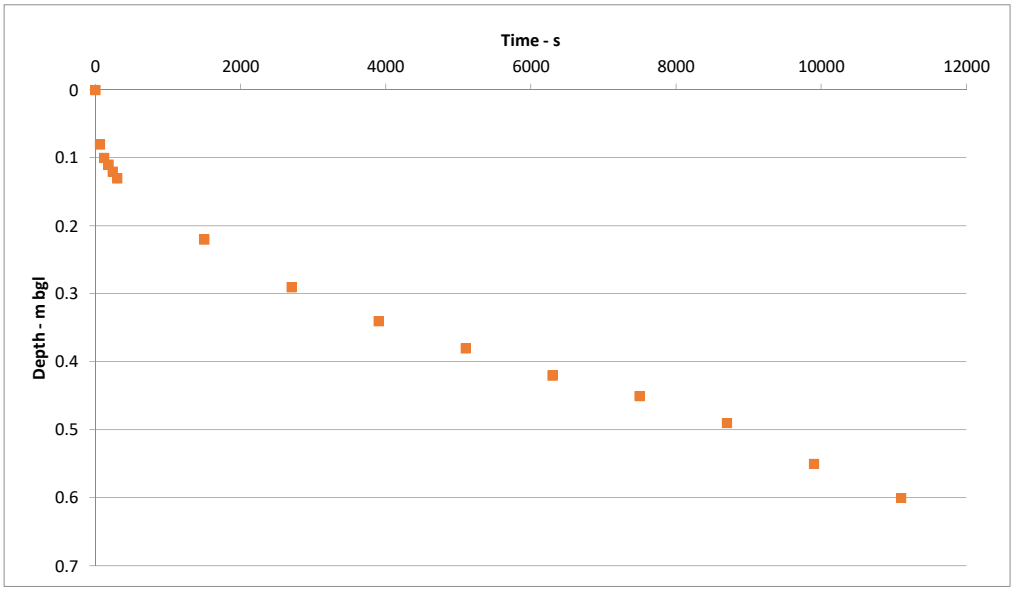


SOIL INFILTRATION RATE TEST

Test No.	SA5S No 1	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.00
		WaterLevel at End - m bgl	0.60
		V_{p75}	0.11
Width	0.50	**V_{p25}**	0.04
		V_{p75-25}	0.08
Depth	0.60	**a_{p50}**	0.85
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.25E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.00	0.60
1	60	0.08	0.52
2	120	0.10	0.50
3	180	0.11	0.49
4	240	0.12	0.48
5	300	0.13	0.47
25	1500	0.22	0.38
45	2700	0.29	0.31
65	3900	0.34	0.26
85	5100	0.38	0.22
105	6300	0.42	0.18
125	7500	0.45	0.15
145	8700	0.49	0.11
165	9900	0.55	0.05
185	11100	0.60	0.00

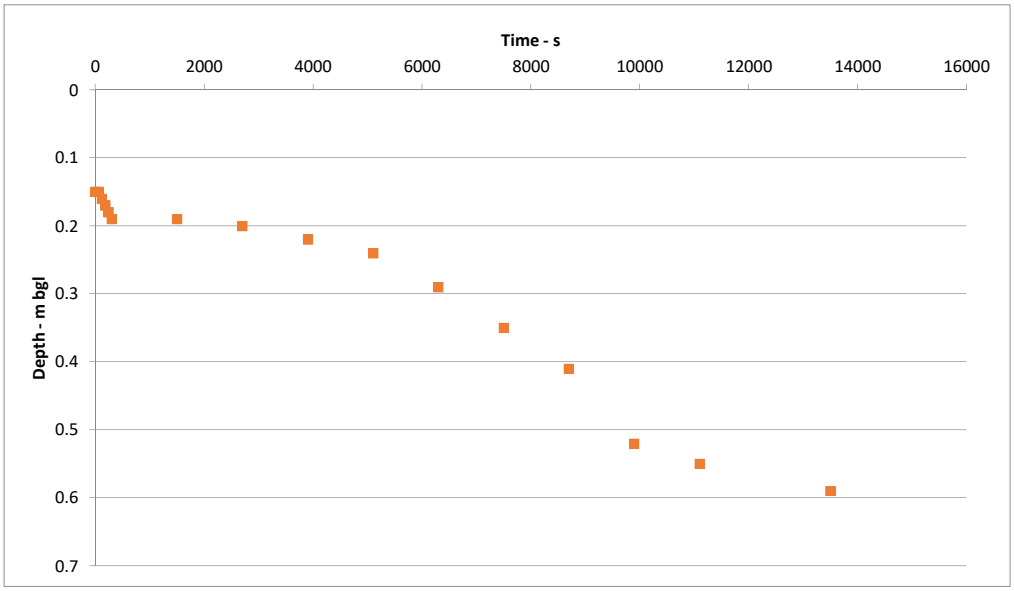


SOIL INFILTRATION RATE TEST

Test No.	SA5S No2	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.15
		WaterLevel at End - m bgl	0.59
		V_{p75}	0.08
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.06
Depth	0.60	**a_{p50}**	0.70
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**2.11E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.15	0.45
1	60	0.15	0.45
2	120	0.16	0.44
3	180	0.17	0.43
4	240	0.18	0.42
5	300	0.19	0.41
25	1500	0.19	0.41
45	2700	0.20	0.40
65	3900	0.22	0.38
85	5100	0.24	0.36
105	6300	0.29	0.31
125	7500	0.35	0.25
145	8700	0.41	0.19
165	9900	0.52	0.08
185	11100	0.55	0.05
225	13500	0.59	0.01

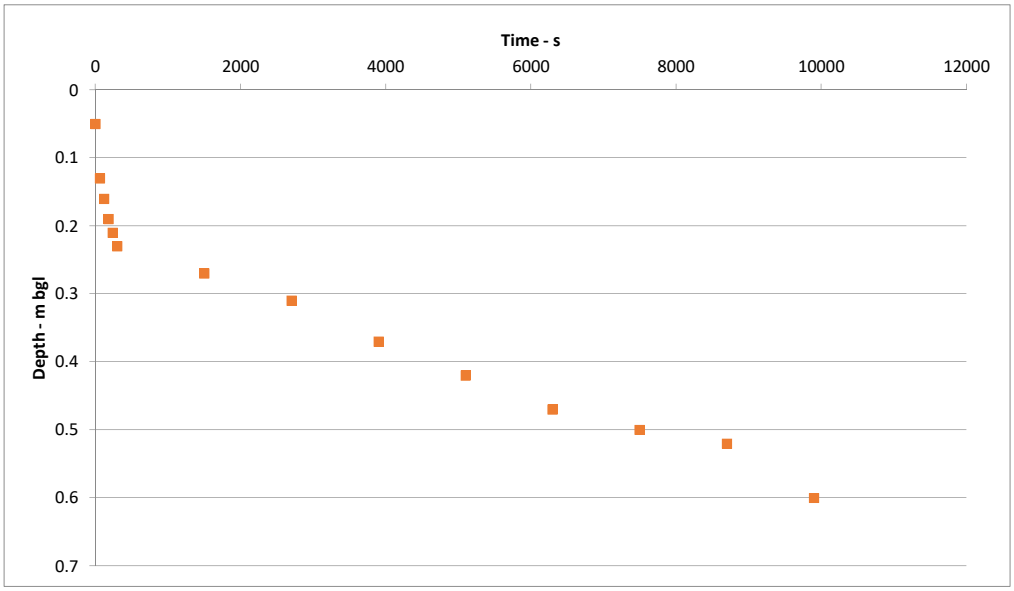


SOIL INFILTRATION RATE TEST

Test No.	SA5S No 3	**Date:**	07/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.05
		WaterLevel at End - m bgl	0.60
		V_{p75}	0.10
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.07
Depth	0.60	**a_{p50}**	0.80
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.48E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.05	0.55
1	60	0.13	0.47
2	120	0.16	0.44
3	180	0.19	0.41
4	240	0.21	0.39
5	300	0.23	0.37
25	1500	0.27	0.33
45	2700	0.31	0.29
65	3900	0.37	0.23
85	5100	0.42	0.18
105	6300	0.47	0.13
125	7500	0.50	0.10
145	8700	0.52	0.08
165	9900	0.60	0.00

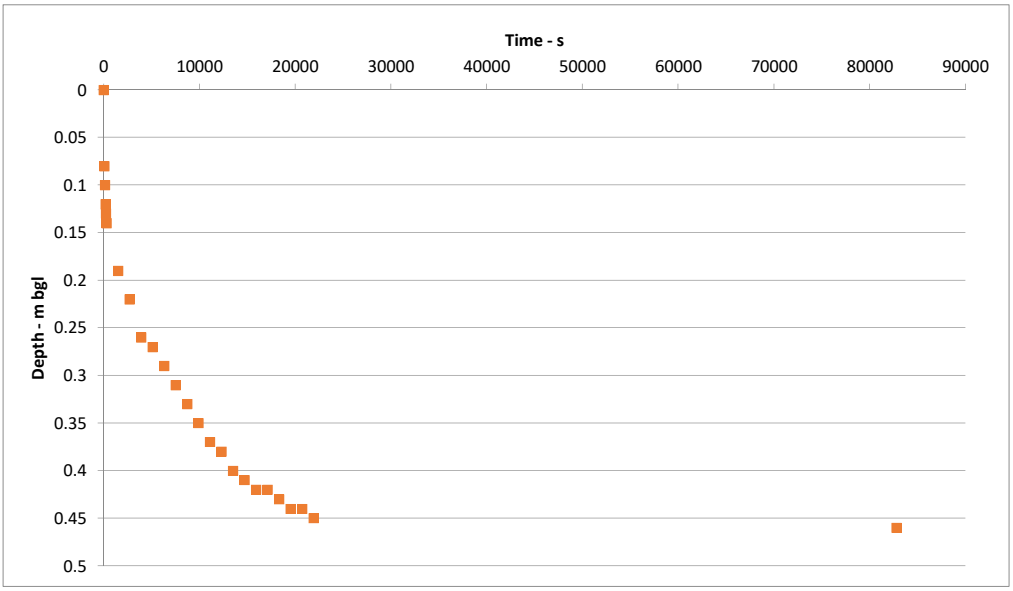


SOIL INFILTRATION RATE TEST

Test No.	SA5D No 1	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)		**Water Level at Start - m bgl**	0.00
Length	0.50	**WaterLevel at End - m bgl**	0.46
		V_{p75}	0.28
Width	0.50	V_{p25}	0.09
		V_{p75-25}	0.19
Depth	1.50	a_{p50}	1.75
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.10E-05**

Elapsed Time		**Depth recorded on dip meter (m bgl)**	**Head of Water above Base (m)**
Minutes	**Seconds**		
0	0	0.00	1.50
1	60	0.08	1.42
2	120	0.10	1.40
3	180	0.12	1.38
4	240	0.13	1.37
5	300	0.14	1.36
25	1500	0.19	1.31
45	2700	0.22	1.28
65	3900	0.26	1.24
85	5100	0.27	1.23
105	6300	0.29	1.21
125	7500	0.31	1.19
145	8700	0.33	1.17
165	9900	0.35	1.15
185	11100	0.37	1.13
205	12300	0.38	1.12
225	13500	0.40	1.10
245	14700	0.41	1.09
265	15900	0.42	1.08
285	17100	0.42	1.08
305	18300	0.43	1.07
325	19500	0.44	1.06
345	20700	0.44	1.06
365	21900	0.45	1.05
1380	82800	0.46	1.04

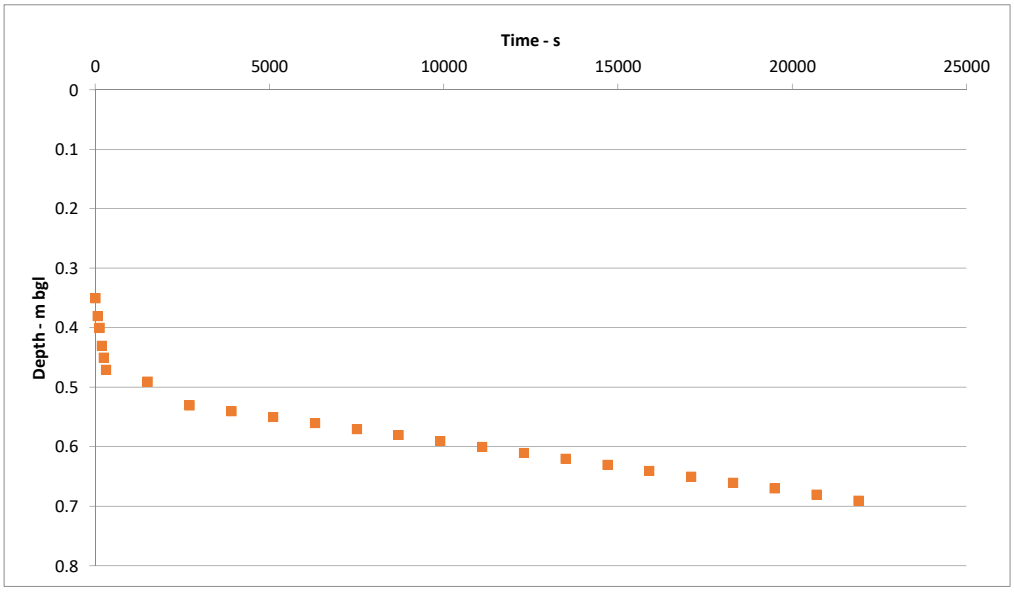


SOIL INFILTRATION RATE TEST

Test No.	SA5D No 2	**Date:**	07/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - Bulls Field

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.35
		WaterLevel at End - m bgl	0.69
		V_{p75}	0.22
Width	0.50	**V_{p25}**	0.07
		V_{p75-25}	0.14
Depth	1.50	**a_{p50}**	1.40
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**8.49E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.35	1.15
1	60	0.38	1.12
2	120	0.40	1.10
3	180	0.43	1.07
4	240	0.45	1.05
5	300	0.47	1.03
25	1500	0.49	1.01
45	2700	0.53	0.97
65	3900	0.54	0.96
85	5100	0.55	0.95
105	6300	0.56	0.94
125	7500	0.57	0.93
145	8700	0.58	0.92
165	9900	0.59	0.91
185	11100	0.60	0.90
205	12300	0.61	0.89
225	13500	0.62	0.88
245	14700	0.63	0.87
265	15900	0.64	0.86
285	17100	0.65	0.85
305	18300	0.66	0.84
325	19500	0.67	0.83
345	20700	0.68	0.82
365	21900	0.69	0.81

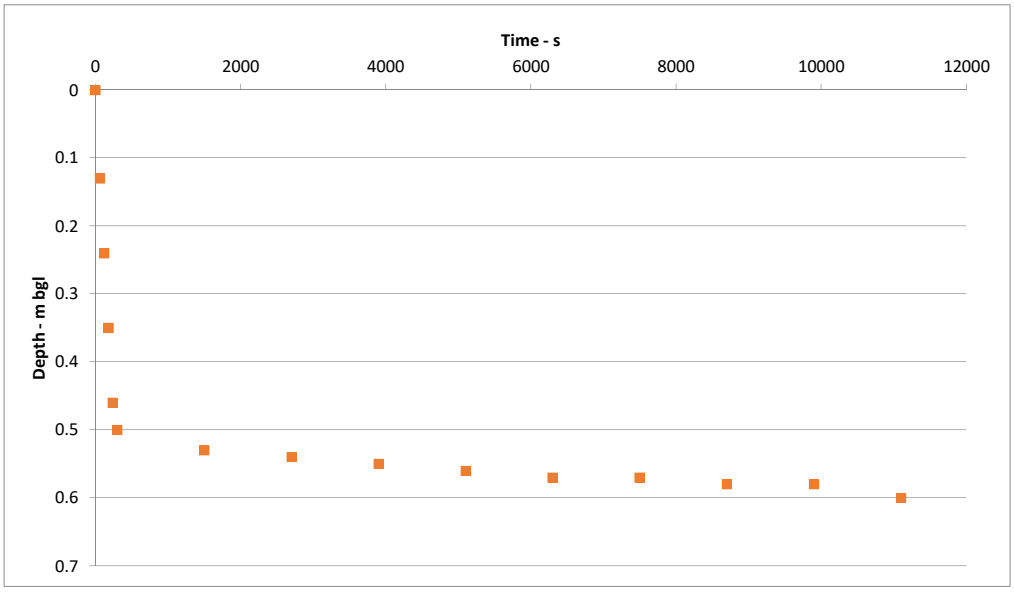


SOIL INFILTRATION RATE TEST

Test No.	SA6S No 1	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - 7 Acres

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.00
		WaterLevel at End - m bgl	0.60
		V_{p75}	0.11
Width	0.50	**V_{p25}**	0.04
		V_{p75-25}	0.08
Depth	0.60	**a_{p50}**	0.85
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**8.02E-04**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.00	0.60
1	60	0.13	0.47
2	120	0.24	0.36
3	180	0.35	0.25
4	240	0.46	0.14
5	300	0.50	0.10
25	1500	0.53	0.07
45	2700	0.54	0.06
65	3900	0.55	0.05
85	5100	0.56	0.04
105	6300	0.57	0.03
125	7500	0.57	0.03
145	8700	0.58	0.02
165	9900	0.58	0.02
185	11100	0.60	0.00

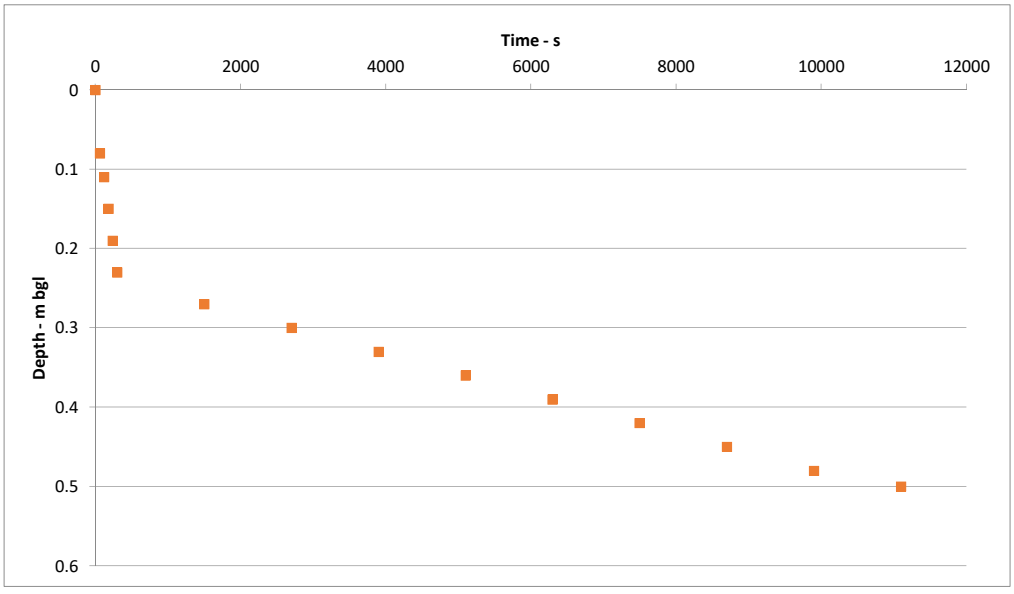


SOIL INFILTRATION RATE TEST

Test No.	SA6S No 2	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - 7 Acres

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.00
		WaterLevel at End - m bgl	0.50
		V_{p75}	0.11
Width	0.50	**V_{p25}**	0.04
		V_{p75-25}	0.08
Depth	0.60	**a_{p50}**	0.85
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.51E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.00	0.60
1	60	0.08	0.52
2	120	0.11	0.49
3	180	0.15	0.45
4	240	0.19	0.41
5	300	0.23	0.37
25	1500	0.27	0.33
45	2700	0.30	0.30
65	3900	0.33	0.27
85	5100	0.36	0.24
105	6300	0.39	0.21
125	7500	0.42	0.18
145	8700	0.45	0.15
165	9900	0.48	0.12
185	11100	0.50	0.10

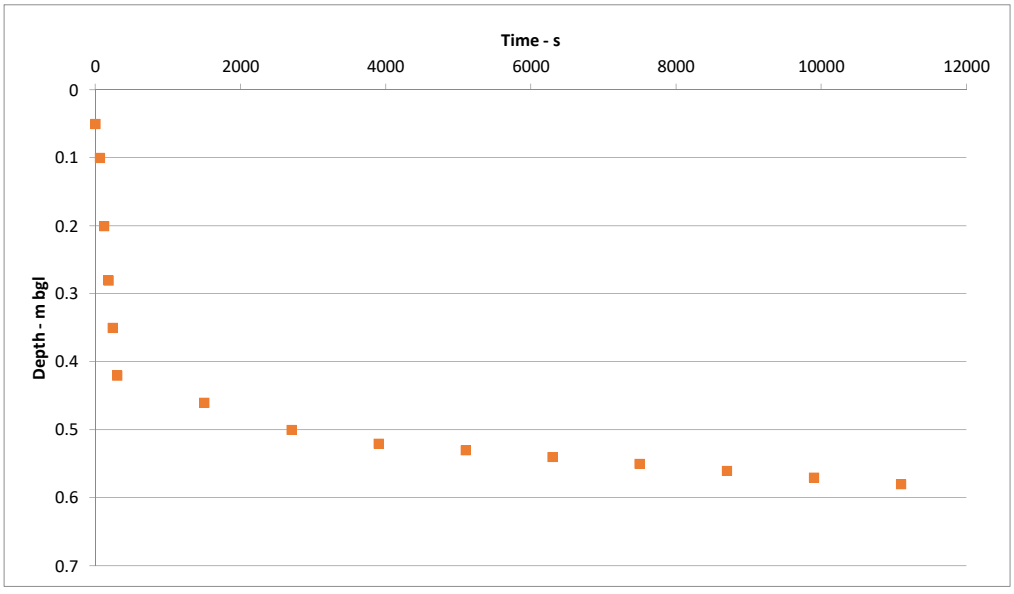


SOIL INFILTRATION RATE TEST

Test No.	SA6S No 3	**Date:**	07/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - 7 Acres

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.05
		WaterLevel at End - m bgl	0.58
		V_{p75}	0.10
Width	0.50	**V_{p25}**	0.03
		V_{p75-25}	0.07
Depth	0.60	**a_{p50}**	0.80
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**6.61E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.05	0.55
1	60	0.10	0.50
2	120	0.20	0.40
3	180	0.28	0.32
4	240	0.35	0.25
5	300	0.42	0.18
25	1500	0.46	0.14
45	2700	0.50	0.10
65	3900	0.52	0.08
85	5100	0.53	0.07
105	6300	0.54	0.06
125	7500	0.55	0.05
145	8700	0.56	0.04
165	9900	0.57	0.03
185	11100	0.58	0.02

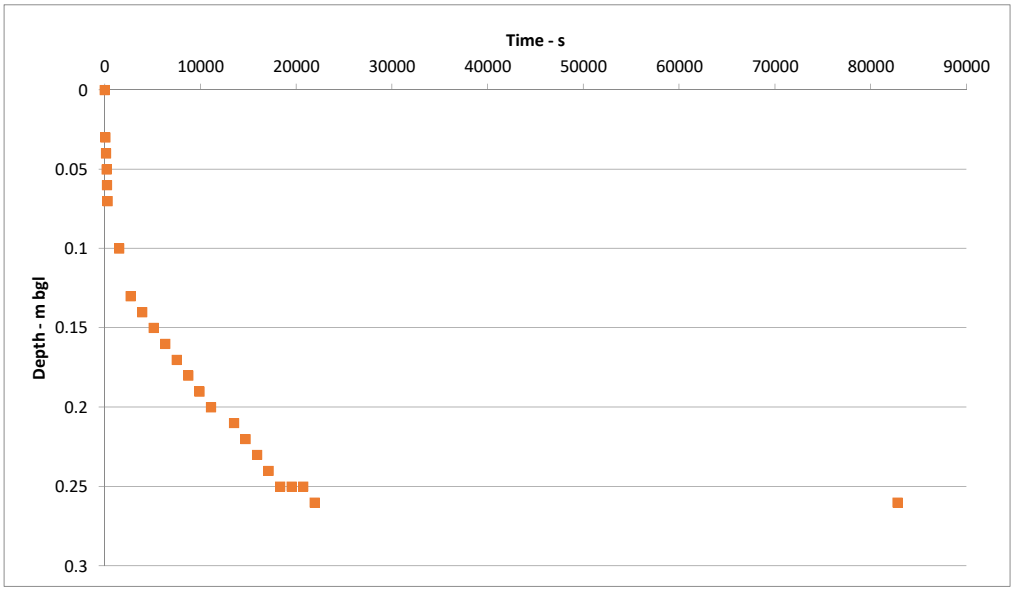


SOIL INFILTRATION RATE TEST

Test No.	SA6D No 1	**Date:**	06/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - 7 Acres

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.00
		WaterLevel at End - m bgl	0.26
		V_{p75}	0.27
Width	0.50	**V_{p25}**	0.09
		V_{p75-25}	0.18
Depth	1.45	**a_{p50}**	1.70
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**9.87E-06**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.00	1.45
1	60	0.03	1.42
2	120	0.04	1.41
3	180	0.05	1.40
4	240	0.06	1.39
5	300	0.07	1.38
25	1500	0.10	1.35
45	2700	0.13	1.32
65	3900	0.14	1.31
85	5100	0.15	1.30
105	6300	0.16	1.29
125	7500	0.17	1.28
145	8700	0.18	1.27
165	9900	0.19	1.26
185	11100	0.20	1.25
225	13500	0.21	1.24
245	14700	0.22	1.23
265	15900	0.23	1.22
285	17100	0.24	1.21
305	18300	0.25	1.20
325	19500	0.25	1.20
345	20700	0.25	1.20
365	21900	0.26	1.19
1380	82800	0.26	1.19

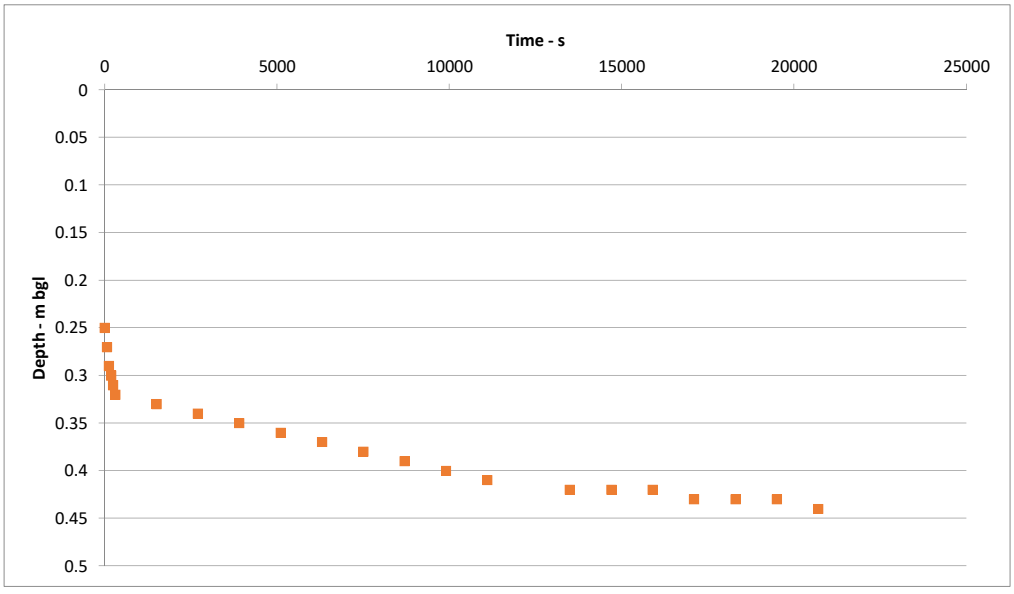


SOIL INFILTRATION RATE TEST

Test No.	SA6D No 2	**Date:**	07/05/2021	**Job No:**	CON01-WARI-070
Client:	Weston Homes plc			**Site Name:**	Warish Hall Farm - 7 Acres

Trial Pit Dimensions (m)			
Length	0.50	**Water Level at Start - m bgl**	0.25
		WaterLevel at End - m bgl	0.44
		V_{p75}	0.23
Width	0.50	**V_{p25}**	0.08
		V_{p75-25}	0.15
Depth	1.45	**a_{p50}**	1.45
Height of pipe above ground level (if applicable)	N/A	**Infiltration Rate - m/s**	**1.21E-05**

Elapsed Time		Depth recorded on dip meter (m bgl)	Head of Water above Base (m)
Minutes	**Seconds**		
0	0	0.25	1.20
1	60	0.27	1.18
2	120	0.29	1.16
3	180	0.30	1.15
4	240	0.31	1.14
5	300	0.32	1.13
25	1500	0.33	1.12
45	2700	0.34	1.11
65	3900	0.35	1.10
85	5100	0.36	1.09
105	6300	0.37	1.08
125	7500	0.38	1.07
145	8700	0.39	1.06
165	9900	0.40	1.05
185	11100	0.41	1.04
225	13500	0.42	1.03
245	14700	0.42	1.03
265	15900	0.42	1.03
285	17100	0.43	1.02
305	18300	0.43	1.02
325	19500	0.43	1.02
345	20700	0.44	1.01



Appendix: H – Surface Water Flood Maps

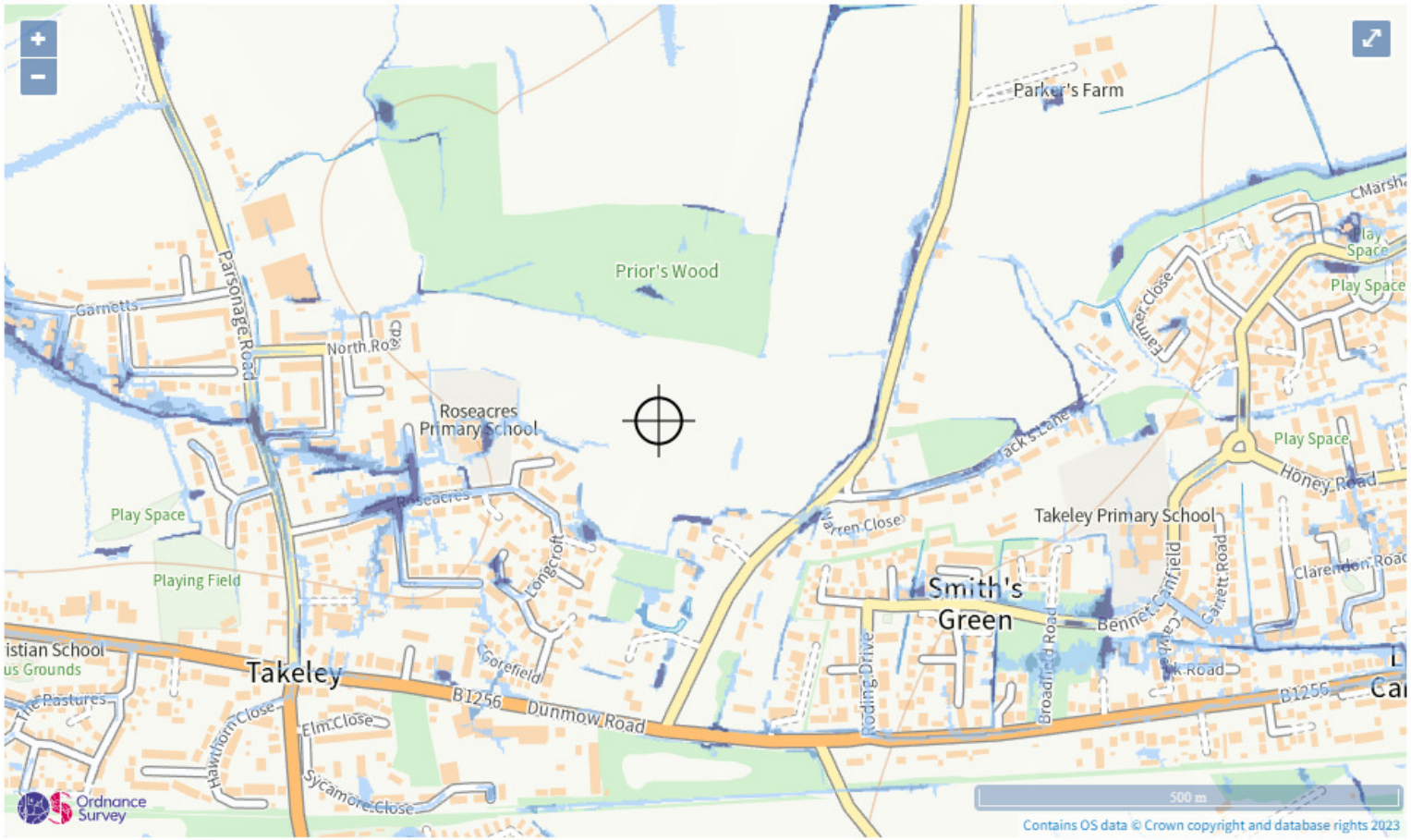
TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

Flood risk

Extent of flooding

Location

Enter a place or postcode



Extent of flooding from surface water

High Medium Low Very low Location you selected

Appendix: I – Greenfield Runoff Rates

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.400
Area (ha)	1.000	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results l/s

QBAR Rural	2.8
QBAR Urban	2.8
Q1 year	2.4
Q1 year	2.4
Q30 years	6.4
Q100 years	9.1

Appendix: J – Proposed SuDS Layout

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

KEY:

- PROPOSED ROOF AREA – 6919m² (7610.9m² INCLUDING 10% URBAN CREEP)
- PROPOSED PERMEABLE PRIVATE DRIVEWAYS – 2927m², MINIMUM SUB-BASE DEPTH TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM VARIES BETWEEN 218mm – 595mm DEPENDING ON HOUSE TYPE ASSOCIATED WITH DRIVEWAY. SEE FRA PREPARED BY EAS FOR FURTHER DETAILS
- (3B) HOUSE TYPE
- PROPOSED IMPERMEABLE TARMAC ACCESS ROAD TO DRAIN VIA PROPOSED CRATE SOAKAWAY AND INFILTRATION BASIN – 2632m²
- PROPOSED IMPERMEABLE FOOTPATHS TO DRAIN VIA PROPOSED CRATE SOAKAWAY AND INFILTRATION BASIN – 230m²
- PROPOSED PERMEABLE PAVING (ACCESS ROADS AND CAR PARKS) – 2729m²
- PROPOSED PERMEABLE TARMAC – 166m²
- PROPOSED FOOTPATH/CYCLEWAY TO UTILISE SEMI-PERMEABLE SELF BOUND GRAVEL/TAR SPRAY AND CHIPPING CONSTRUCTION TO ALLOW SOME INFILTRATION WITH SOME RUNOFF TO THE SURROUNDING GRASSED AREAS
- PROPOSED IMPERMEABLE TARMAC ACCESS ROAD AND FOOTPATH TO DRAIN VIA ADJACENT 7 ACRES SITE DUE TO TOPOGRAPHY OF SITE.

NOTES:

NOTE: ALL ATTENUATION CACLULATIONS HAVE BEEN CALCULATED USING AN INFILTRATION RATE OF 4.1 X 10^{-6} m/s

ALL SECTIONS OF PERMEABLE PAVING TO EXTEND MINIMUM SUB-BASE DEPTH TO 300mm IN ORDER TO ACHIEVE WATER QUALITY REQUIREMENTS

PERMEABLE TARMAC SECTION 1

PERMEABLE TARMAC WITH MINIMUM SUB-BASE DEPTH OF 146mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM.

CAR PARK A

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 333mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM

CAR PARK B

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 372mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM

CAR PARK D

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 355mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM

PERMEABLE PAVING SECTION 5

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 152mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM.

PERMEABLE PAVING SECTION 4

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 426mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM.

CAR PARK C

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 359mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM

PERMEABLE PAVING SECTION 2

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 137mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM.

PERMEABLE PAVING SECTION 3

PERMEABLE PAVING WITH MINIMUM SUB-BASE DEPTH OF 145mm IN ORDER TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM.

FILTER DRAIN

25.0m LONG x 1.0m WIDE FILTER DRAIN WITH 150mm PERFORATED PIPE TO IMPROVE WATER QUALITY OF SURFACE WATER RUNOFF PRIOR TO DISCHARGE TO PROPOSED CELLULAR CRATE SOAKAWAY. OUTLET OF FILTER DRAIN TO BE SET 0.5m BELOW INLET TO ENSURE SURFACE WATER RUNOFF PASSES THROUGH ADEQUATE AMOUNT OF GRANULAR MATERIAL

PUMPING STATION

PUMPING STATION TO PUMP DISCHARGE FROM PROPOSED FILTER DRAIN TO PROPOSED CRATE SOAKAWAY AT MAX RATE OF 30.0 l/s

CRATE SOAKAWAY

7.0m x 10.0m x 1.32m DEEP CELLULAR CRATE SOAKAWAY TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 5 YEAR STORM AND TO BE USED ALONGSIDE INFILTRATION BASIN TO PROVIDE ADEQUATE ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100 YEAR +40%CC STORM.

OVERFLOW INFILTRATION BASIN

0.5m DEEP INFILTRATION BASIN WITH BASE AREA OF 41m² AND SURFACE AREA OF 746m² WITH SIDE SLOPES OF 1:20. BASIN TO REMAIN DRY FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 5YR STORM AND PROVIDE ADDITIONAL ATTENUATION FOR RAINFALL EVENTS UP TO AND INCLUDING A 1 IN 100YR +40%CC STORM.

Pond

Pond

103.4m

Pump

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:

EAS
Unit 23, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777
www.eastp.co.uk

CLIENT: WESTON HOMES

ARCHITECTS:

PROJECT: WARISH HALL FARM
TAKELY

TITLE: WOODLANDS PROPOSED SuDS STRATEGY

SCALE @ A3:	DESIGN-DRAWN:	DATE:
1:500	MC	06/06/2023

PROJECT No:	DRAWING No:
2951	SK13 – REV E

Appendix: K – WinDes SourceControl and MicroDrainage Output

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk [redacted]

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

Half Drain Time : 397 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	102.752	0.152	1.0	21.5	O K
30 min Summer	102.798	0.198	1.0	28.4	O K
60 min Summer	102.840	0.240	1.0	34.8	O K
120 min Summer	102.874	0.274	1.0	39.9	O K
180 min Summer	102.886	0.286	1.0	41.8	O K
240 min Summer	102.889	0.289	1.0	42.2	O K
360 min Summer	102.883	0.283	1.0	41.3	O K
480 min Summer	102.875	0.275	1.0	40.1	O K
600 min Summer	102.867	0.267	1.0	38.8	O K
720 min Summer	102.858	0.258	1.0	37.5	O K
960 min Summer	102.841	0.241	1.0	34.9	O K
1440 min Summer	102.808	0.208	1.0	29.9	O K
2160 min Summer	102.764	0.164	1.0	23.3	O K
2880 min Summer	102.728	0.128	1.0	17.7	O K
4320 min Summer	102.676	0.076	1.0	9.9	O K
5760 min Summer	102.651	0.051	1.0	6.0	O K
7200 min Summer	102.643	0.043	0.9	4.8	O K
8640 min Summer	102.637	0.037	0.8	4.0	O K
10080 min Summer	102.633	0.033	0.7	3.3	O K
15 min Winter	102.772	0.172	1.0	24.4	O K
30 min Winter	102.823	0.223	1.0	32.2	O K
60 min Winter	102.872	0.272	1.0	39.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	25
30 min Summer	87.861	0.0	39
60 min Summer	54.368	0.0	68
120 min Summer	32.554	0.0	124
180 min Summer	23.829	0.0	182
240 min Summer	19.002	0.0	242
360 min Summer	13.711	0.0	326
480 min Summer	10.884	0.0	384
600 min Summer	9.094	0.0	446
720 min Summer	7.849	0.0	510
960 min Summer	6.218	0.0	646
1440 min Summer	4.472	0.0	914
2160 min Summer	3.211	0.0	1300
2880 min Summer	2.537	0.0	1672
4320 min Summer	1.817	0.0	2340
5760 min Summer	1.433	0.0	2992
7200 min Summer	1.192	0.0	3680
8640 min Summer	1.024	0.0	4416
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	25
30 min Winter	87.861	0.0	39
60 min Winter	54.368	0.0	66

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	102.912	0.312	1.0	45.6	Flood Risk
180 min Winter	102.928	0.328	1.0	48.0	Flood Risk
240 min Winter	102.933	0.333	1.0	48.9	Flood Risk
360 min Winter	102.929	0.329	1.0	48.3	Flood Risk
480 min Winter	102.919	0.319	1.0	46.7	Flood Risk
600 min Winter	102.907	0.307	1.0	45.0	Flood Risk
720 min Winter	102.896	0.296	1.0	43.3	O K
960 min Winter	102.872	0.272	1.0	39.6	O K
1440 min Winter	102.823	0.223	1.0	32.2	O K
2160 min Winter	102.757	0.157	1.0	22.2	O K
2880 min Winter	102.704	0.104	1.0	14.1	O K
4320 min Winter	102.649	0.049	1.0	5.7	O K
5760 min Winter	102.639	0.039	0.8	4.2	O K
7200 min Winter	102.632	0.032	0.7	3.2	O K
8640 min Winter	102.628	0.028	0.6	2.5	O K
10080 min Winter	102.624	0.024	0.5	2.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	124
180 min Winter	23.829	0.0	180
240 min Winter	19.002	0.0	238
360 min Winter	13.711	0.0	348
480 min Winter	10.884	0.0	446
600 min Winter	9.094	0.0	478
720 min Winter	7.849	0.0	552
960 min Winter	6.218	0.0	704
1440 min Winter	4.472	0.0	994
2160 min Winter	3.211	0.0	1388
2880 min Winter	2.537	0.0	1736
4320 min Winter	1.817	0.0	2256
5760 min Winter	1.433	0.0	3000
7200 min Winter	1.192	0.0	3688
8640 min Winter	1.024	0.0	4416
10080 min Winter	0.901	0.0	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.099

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.051	4	8	0.024	8	12	0.024

Model Details

Storage is Online Cover Level (m) 103.200

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	22.5
Membrane Percolation (mm/hr)	1000	Length (m)	22.5
Max Percolation (l/s)	140.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	102.600	Cap Volume Depth (m)	0.000

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

Half Drain Time : 449 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	102.370	0.170	1.3	29.7	O K
30 min Summer	102.420	0.220	1.3	39.1	O K
60 min Summer	102.466	0.266	1.3	48.0	O K
120 min Summer	102.505	0.305	1.3	55.2	Flood Risk
180 min Summer	102.520	0.320	1.3	58.0	Flood Risk
240 min Summer	102.524	0.324	1.3	58.9	Flood Risk
360 min Summer	102.519	0.319	1.3	57.9	Flood Risk
480 min Summer	102.511	0.311	1.3	56.3	Flood Risk
600 min Summer	102.502	0.302	1.3	54.7	Flood Risk
720 min Summer	102.493	0.293	1.3	53.0	O K
960 min Summer	102.475	0.275	1.3	49.6	O K
1440 min Summer	102.441	0.241	1.3	43.1	O K
2160 min Summer	102.395	0.195	1.3	34.4	O K
2880 min Summer	102.355	0.155	1.3	27.0	O K
4320 min Summer	102.296	0.096	1.3	15.7	O K
5760 min Summer	102.261	0.061	1.3	9.1	O K
7200 min Summer	102.247	0.047	1.2	6.6	O K
8640 min Summer	102.241	0.041	1.1	5.4	O K
10080 min Summer	102.237	0.037	0.9	4.5	O K
15 min Winter	102.391	0.191	1.3	33.8	O K
30 min Winter	102.448	0.248	1.3	44.4	O K
60 min Winter	102.501	0.301	1.3	54.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	26
30 min Summer	87.861	0.0	40
60 min Summer	54.368	0.0	68
120 min Summer	32.554	0.0	126
180 min Summer	23.829	0.0	184
240 min Summer	19.002	0.0	242
360 min Summer	13.711	0.0	350
480 min Summer	10.884	0.0	402
600 min Summer	9.094	0.0	462
720 min Summer	7.849	0.0	524
960 min Summer	6.218	0.0	658
1440 min Summer	4.472	0.0	926
2160 min Summer	3.211	0.0	1320
2880 min Summer	2.537	0.0	1700
4320 min Summer	1.817	0.0	2384
5760 min Summer	1.433	0.0	3048
7200 min Summer	1.192	0.0	3680
8640 min Summer	1.024	0.0	4408
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	25
30 min Winter	87.861	0.0	39
60 min Winter	54.368	0.0	68

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	102.546	0.346	1.3	63.1	Flood Risk
180 min Winter	102.565	0.365	1.3	66.6	Flood Risk
240 min Winter	102.572	0.372	1.3	68.0	Flood Risk
360 min Winter	102.571	0.371	1.3	67.7	Flood Risk
480 min Winter	102.562	0.362	1.3	66.0	Flood Risk
600 min Winter	102.549	0.349	1.3	63.6	Flood Risk
720 min Winter	102.538	0.338	1.3	61.5	Flood Risk
960 min Winter	102.513	0.313	1.3	56.9	Flood Risk
1440 min Winter	102.463	0.263	1.3	47.4	O K
2160 min Winter	102.394	0.194	1.3	34.3	O K
2880 min Winter	102.335	0.135	1.3	23.2	O K
4320 min Winter	102.258	0.058	1.3	8.7	O K
5760 min Winter	102.243	0.043	1.1	5.7	O K
7200 min Winter	102.236	0.036	0.9	4.3	O K
8640 min Winter	102.231	0.031	0.8	3.4	O K
10080 min Winter	102.227	0.027	0.7	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	124
180 min Winter	23.829	0.0	182
240 min Winter	19.002	0.0	238
360 min Winter	13.711	0.0	350
480 min Winter	10.884	0.0	456
600 min Winter	9.094	0.0	496
720 min Winter	7.849	0.0	564
960 min Winter	6.218	0.0	716
1440 min Winter	4.472	0.0	1010
2160 min Winter	3.211	0.0	1416
2880 min Winter	2.537	0.0	1788
4320 min Winter	1.817	0.0	2380
5760 min Winter	1.433	0.0	2992
7200 min Winter	1.192	0.0	3728
8640 min Winter	1.024	0.0	4472
10080 min Winter	0.901	0.0	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.135

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.063	4	8	0.036	8	12	0.036

Model Details

Storage is Online Cover Level (m) 102.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	25.1
Membrane Percolation (mm/hr)	1000	Length (m)	25.1
Max Percolation (l/s)	175.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	102.200	Cap Volume Depth (m)	0.000

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

Half Drain Time : 434 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.162	0.162	0.7	16.0	O K
30 min Summer	103.210	0.210	0.7	21.1	O K
60 min Summer	103.256	0.256	0.7	25.9	O K
120 min Summer	103.293	0.293	0.7	29.8	O K
180 min Summer	103.307	0.307	0.7	31.3	Flood Risk
240 min Summer	103.312	0.312	0.7	31.7	Flood Risk
360 min Summer	103.306	0.306	0.7	31.2	Flood Risk
480 min Summer	103.299	0.299	0.7	30.3	O K
600 min Summer	103.290	0.290	0.7	29.5	O K
720 min Summer	103.282	0.282	0.7	28.6	O K
960 min Summer	103.264	0.264	0.7	26.7	O K
1440 min Summer	103.231	0.231	0.7	23.2	O K
2160 min Summer	103.185	0.185	0.7	18.5	O K
2880 min Summer	103.147	0.147	0.7	14.4	O K
4320 min Summer	103.090	0.090	0.7	8.4	O K
5760 min Summer	103.057	0.057	0.7	5.0	O K
7200 min Summer	103.046	0.046	0.7	3.8	O K
8640 min Summer	103.040	0.040	0.6	3.2	O K
10080 min Summer	103.036	0.036	0.5	2.8	O K
15 min Winter	103.183	0.183	0.7	18.2	O K
30 min Winter	103.238	0.238	0.7	24.0	O K
60 min Winter	103.290	0.290	0.7	29.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	25
30 min Summer	87.861	0.0	40
60 min Summer	54.368	0.0	68
120 min Summer	32.554	0.0	126
180 min Summer	23.829	0.0	184
240 min Summer	19.002	0.0	242
360 min Summer	13.711	0.0	344
480 min Summer	10.884	0.0	396
600 min Summer	9.094	0.0	456
720 min Summer	7.849	0.0	520
960 min Summer	6.218	0.0	654
1440 min Summer	4.472	0.0	924
2160 min Summer	3.211	0.0	1320
2880 min Summer	2.537	0.0	1684
4320 min Summer	1.817	0.0	2380
5760 min Summer	1.433	0.0	3008
7200 min Summer	1.192	0.0	3680
8640 min Summer	1.024	0.0	4408
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	25
30 min Winter	87.861	0.0	39
60 min Winter	54.368	0.0	68

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.334	0.334	0.7	34.0	Flood Risk
180 min Winter	103.352	0.352	0.7	35.9	Flood Risk
240 min Winter	103.359	0.359	0.7	36.6	Flood Risk
360 min Winter	103.357	0.357	0.7	36.4	Flood Risk
480 min Winter	103.347	0.347	0.7	35.5	Flood Risk
600 min Winter	103.335	0.335	0.7	34.2	Flood Risk
720 min Winter	103.324	0.324	0.7	33.0	Flood Risk
960 min Winter	103.300	0.300	0.7	30.5	Flood Risk
1440 min Winter	103.251	0.251	0.7	25.3	O K
2160 min Winter	103.183	0.183	0.7	18.2	O K
2880 min Winter	103.126	0.126	0.7	12.2	O K
4320 min Winter	103.054	0.054	0.7	4.7	O K
5760 min Winter	103.041	0.041	0.6	3.4	O K
7200 min Winter	103.035	0.035	0.5	2.6	O K
8640 min Winter	103.030	0.030	0.4	2.1	O K
10080 min Winter	103.026	0.026	0.4	1.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	124
180 min Winter	23.829	0.0	180
240 min Winter	19.002	0.0	238
360 min Winter	13.711	0.0	350
480 min Winter	10.884	0.0	454
600 min Winter	9.094	0.0	490
720 min Winter	7.849	0.0	562
960 min Winter	6.218	0.0	712
1440 min Winter	4.472	0.0	1006
2160 min Winter	3.211	0.0	1408
2880 min Winter	2.537	0.0	1768
4320 min Winter	1.817	0.0	2336
5760 min Winter	1.433	0.0	3000
7200 min Winter	1.192	0.0	3688
8640 min Winter	1.024	0.0	4408
10080 min Winter	0.901	0.0	5096

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.073

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.035	4	8	0.019	8	12	0.019

Model Details

Storage is Online Cover Level (m) 103.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	18.7
Membrane Percolation (mm/hr)	1000	Length (m)	18.7
Max Percolation (l/s)	97.1	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	103.000	Cap Volume Depth (m)	0.000

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

Half Drain Time : 429 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	102.160	0.160	0.7	16.2	O K
30 min Summer	102.209	0.209	0.7	21.4	O K
60 min Summer	102.254	0.254	0.7	26.2	O K
120 min Summer	102.291	0.291	0.7	30.2	O K
180 min Summer	102.305	0.305	0.7	31.7	Flood Risk
240 min Summer	102.309	0.309	0.7	32.1	Flood Risk
360 min Summer	102.303	0.303	0.7	31.5	Flood Risk
480 min Summer	102.296	0.296	0.7	30.7	O K
600 min Summer	102.287	0.287	0.7	29.8	O K
720 min Summer	102.279	0.279	0.7	28.9	O K
960 min Summer	102.261	0.261	0.7	27.0	O K
1440 min Summer	102.228	0.228	0.7	23.4	O K
2160 min Summer	102.183	0.183	0.7	18.6	O K
2880 min Summer	102.144	0.144	0.7	14.5	O K
4320 min Summer	102.088	0.088	0.7	8.4	O K
5760 min Summer	102.056	0.056	0.7	5.0	O K
7200 min Summer	102.046	0.046	0.7	3.9	O K
8640 min Summer	102.040	0.040	0.6	3.2	O K
10080 min Summer	102.035	0.035	0.5	2.8	O K
15 min Winter	102.181	0.181	0.7	18.4	O K
30 min Winter	102.236	0.236	0.7	24.3	O K
60 min Winter	102.287	0.287	0.7	29.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	25
30 min Summer	87.861	0.0	39
60 min Summer	54.368	0.0	68
120 min Summer	32.554	0.0	126
180 min Summer	23.829	0.0	184
240 min Summer	19.002	0.0	242
360 min Summer	13.711	0.0	342
480 min Summer	10.884	0.0	394
600 min Summer	9.094	0.0	454
720 min Summer	7.849	0.0	518
960 min Summer	6.218	0.0	654
1440 min Summer	4.472	0.0	924
2160 min Summer	3.211	0.0	1316
2880 min Summer	2.537	0.0	1680
4320 min Summer	1.817	0.0	2380
5760 min Summer	1.433	0.0	3008
7200 min Summer	1.192	0.0	3680
8640 min Summer	1.024	0.0	4408
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	25
30 min Winter	87.861	0.0	39
60 min Winter	54.368	0.0	68

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	102.331	0.331	0.7	34.4	Flood Risk
180 min Winter	102.349	0.349	0.7	36.3	Flood Risk
240 min Winter	102.355	0.355	0.7	37.1	Flood Risk
360 min Winter	102.353	0.353	0.7	36.9	Flood Risk
480 min Winter	102.344	0.344	0.7	35.8	Flood Risk
600 min Winter	102.332	0.332	0.7	34.6	Flood Risk
720 min Winter	102.321	0.321	0.7	33.4	Flood Risk
960 min Winter	102.297	0.297	0.7	30.8	O K
1440 min Winter	102.248	0.248	0.7	25.5	O K
2160 min Winter	102.180	0.180	0.7	18.2	O K
2880 min Winter	102.123	0.123	0.7	12.2	O K
4320 min Winter	102.053	0.053	0.7	4.7	O K
5760 min Winter	102.041	0.041	0.6	3.4	O K
7200 min Winter	102.034	0.034	0.5	2.7	O K
8640 min Winter	102.029	0.029	0.4	2.1	O K
10080 min Winter	102.026	0.026	0.4	1.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	124
180 min Winter	23.829	0.0	180
240 min Winter	19.002	0.0	238
360 min Winter	13.711	0.0	348
480 min Winter	10.884	0.0	452
600 min Winter	9.094	0.0	488
720 min Winter	7.849	0.0	560
960 min Winter	6.218	0.0	712
1440 min Winter	4.472	0.0	1004
2160 min Winter	3.211	0.0	1408
2880 min Winter	2.537	0.0	1764
4320 min Winter	1.817	0.0	2336
5760 min Winter	1.433	0.0	2992
7200 min Winter	1.192	0.0	3688
8640 min Winter	1.024	0.0	4488
10080 min Winter	0.901	0.0	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.074

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.036	4	8	0.019	8	12	0.019

Model Details

Storage is Online Cover Level (m) 102.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	18.9
Membrane Percolation (mm/hr)	1000	Length (m)	18.9
Max Percolation (l/s)	99.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	102.000	Cap Volume Depth (m)	0.000

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

Half Drain Time : 736 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.249	0.249	0.1	3.7	O K
30 min Summer	103.324	0.324	0.1	4.9	O K
60 min Summer	103.397	0.397	0.1	6.0	O K
120 min Summer	103.462	0.462	0.1	6.9	O K
180 min Summer	103.492	0.492	0.1	7.4	O K
240 min Summer	103.507	0.507	0.1	7.6	Flood Risk
360 min Summer	103.515	0.515	0.1	7.7	Flood Risk
480 min Summer	103.512	0.512	0.1	7.7	Flood Risk
600 min Summer	103.503	0.503	0.1	7.5	Flood Risk
720 min Summer	103.492	0.492	0.1	7.4	O K
960 min Summer	103.472	0.472	0.1	7.1	O K
1440 min Summer	103.433	0.433	0.1	6.5	O K
2160 min Summer	103.380	0.380	0.1	5.7	O K
2880 min Summer	103.330	0.330	0.1	4.9	O K
4320 min Summer	103.244	0.244	0.1	3.6	O K
5760 min Summer	103.174	0.174	0.1	2.6	O K
7200 min Summer	103.121	0.121	0.1	1.8	O K
8640 min Summer	103.083	0.083	0.1	1.2	O K
10080 min Summer	103.059	0.059	0.1	0.8	O K
15 min Winter	103.281	0.281	0.1	4.2	O K
30 min Winter	103.366	0.366	0.1	5.5	O K
60 min Winter	103.449	0.449	0.1	6.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	22
30 min Summer	87.861	0.0	37
60 min Summer	54.368	0.0	66
120 min Summer	32.554	0.0	124
180 min Summer	23.829	0.0	184
240 min Summer	19.002	0.0	242
360 min Summer	13.711	0.0	362
480 min Summer	10.884	0.0	480
600 min Summer	9.094	0.0	572
720 min Summer	7.849	0.0	618
960 min Summer	6.218	0.0	740
1440 min Summer	4.472	0.0	996
2160 min Summer	3.211	0.0	1404
2880 min Summer	2.537	0.0	1792
4320 min Summer	1.817	0.0	2556
5760 min Summer	1.433	0.0	3288
7200 min Summer	1.192	0.0	3960
8640 min Summer	1.024	0.0	4584
10080 min Summer	0.901	0.0	5240
15 min Winter	135.270	0.0	22
30 min Winter	87.861	0.0	36
60 min Winter	54.368	0.0	64

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.524	0.524	0.1	7.9	Flood Risk
180 min Winter	103.560	0.560	0.1	8.4	Flood Risk
240 min Winter	103.579	0.579	0.1	8.7	Flood Risk
360 min Winter	103.594	0.594	0.1	8.9	Flood Risk
480 min Winter	103.595	0.595	0.1	9.0	Flood Risk
600 min Winter	103.589	0.589	0.1	8.9	Flood Risk
720 min Winter	103.579	0.579	0.1	8.7	Flood Risk
960 min Winter	103.550	0.550	0.1	8.3	Flood Risk
1440 min Winter	103.500	0.500	0.1	7.5	O K
2160 min Winter	103.422	0.422	0.1	6.3	O K
2880 min Winter	103.347	0.347	0.1	5.2	O K
4320 min Winter	103.218	0.218	0.1	3.2	O K
5760 min Winter	103.119	0.119	0.1	1.8	O K
7200 min Winter	103.059	0.059	0.1	0.8	O K
8640 min Winter	103.046	0.046	0.1	0.6	O K
10080 min Winter	103.040	0.040	0.1	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	122
180 min Winter	23.829	0.0	180
240 min Winter	19.002	0.0	238
360 min Winter	13.711	0.0	354
480 min Winter	10.884	0.0	468
600 min Winter	9.094	0.0	578
720 min Winter	7.849	0.0	684
960 min Winter	6.218	0.0	794
1440 min Winter	4.472	0.0	1082
2160 min Winter	3.211	0.0	1532
2880 min Winter	2.537	0.0	1956
4320 min Winter	1.817	0.0	2724
5760 min Winter	1.433	0.0	3400
7200 min Winter	1.192	0.0	3888
8640 min Winter	1.024	0.0	4408
10080 min Winter	0.901	0.0	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.016

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.011	4	8	0.005

Model Details

Storage is Online Cover Level (m) 103.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	7.1
Membrane Percolation (mm/hr)	1000	Length (m)	7.1
Max Percolation (l/s)	14.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	103.000	Cap Volume Depth (m)	0.000

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

Half Drain Time : 531 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.188	0.188	0.1	2.7	O K
30 min Summer	103.245	0.245	0.1	3.6	O K
60 min Summer	103.300	0.300	0.1	4.4	O K
120 min Summer	103.346	0.346	0.1	5.0	O K
180 min Summer	103.366	0.366	0.1	5.3	O K
240 min Summer	103.374	0.374	0.1	5.4	O K
360 min Summer	103.373	0.373	0.1	5.4	O K
480 min Summer	103.365	0.365	0.1	5.3	O K
600 min Summer	103.357	0.357	0.1	5.2	O K
720 min Summer	103.348	0.348	0.1	5.1	O K
960 min Summer	103.330	0.330	0.1	4.8	O K
1440 min Summer	103.295	0.295	0.1	4.3	O K
2160 min Summer	103.246	0.246	0.1	3.6	O K
2880 min Summer	103.203	0.203	0.1	2.9	O K
4320 min Summer	103.133	0.133	0.1	1.9	O K
5760 min Summer	103.085	0.085	0.1	1.2	O K
7200 min Summer	103.057	0.057	0.1	0.8	O K
8640 min Summer	103.047	0.047	0.1	0.6	O K
10080 min Summer	103.042	0.042	0.1	0.6	O K
15 min Winter	103.213	0.213	0.1	3.1	O K
30 min Winter	103.277	0.277	0.1	4.0	O K
60 min Winter	103.340	0.340	0.1	4.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	22
30 min Summer	87.861	0.0	37
60 min Summer	54.368	0.0	66
120 min Summer	32.554	0.0	126
180 min Summer	23.829	0.0	184
240 min Summer	19.002	0.0	244
360 min Summer	13.711	0.0	360
480 min Summer	10.884	0.0	432
600 min Summer	9.094	0.0	488
720 min Summer	7.849	0.0	548
960 min Summer	6.218	0.0	678
1440 min Summer	4.472	0.0	944
2160 min Summer	3.211	0.0	1344
2880 min Summer	2.537	0.0	1732
4320 min Summer	1.817	0.0	2464
5760 min Summer	1.433	0.0	3112
7200 min Summer	1.192	0.0	3752
8640 min Summer	1.024	0.0	4408
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	22
30 min Winter	87.861	0.0	37
60 min Winter	54.368	0.0	66

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.394	0.394	0.1	5.7	O K
180 min Winter	103.418	0.418	0.1	6.1	O K
240 min Winter	103.429	0.429	0.1	6.3	O K
360 min Winter	103.433	0.433	0.1	6.3	O K
480 min Winter	103.427	0.427	0.1	6.2	O K
600 min Winter	103.416	0.416	0.1	6.1	O K
720 min Winter	103.403	0.403	0.1	5.9	O K
960 min Winter	103.380	0.380	0.1	5.5	O K
1440 min Winter	103.330	0.330	0.1	4.8	O K
2160 min Winter	103.257	0.257	0.1	3.7	O K
2880 min Winter	103.192	0.192	0.1	2.8	O K
4320 min Winter	103.093	0.093	0.1	1.3	O K
5760 min Winter	103.049	0.049	0.1	0.7	O K
7200 min Winter	103.041	0.041	0.1	0.5	O K
8640 min Winter	103.035	0.035	0.1	0.5	O K
10080 min Winter	103.031	0.031	0.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	124
180 min Winter	23.829	0.0	182
240 min Winter	19.002	0.0	238
360 min Winter	13.711	0.0	352
480 min Winter	10.884	0.0	462
600 min Winter	9.094	0.0	564
720 min Winter	7.849	0.0	588
960 min Winter	6.218	0.0	734
1440 min Winter	4.472	0.0	1032
2160 min Winter	3.211	0.0	1452
2880 min Winter	2.537	0.0	1848
4320 min Winter	1.817	0.0	2512
5760 min Winter	1.433	0.0	2992
7200 min Winter	1.192	0.0	3680
8640 min Winter	1.024	0.0	4488
10080 min Winter	0.901	0.0	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.012

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.005	4	8	0.007

Model Details

Storage is Online Cover Level (m) 103.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	13.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	103.000	Cap Volume Depth (m)	0.000

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

Half Drain Time : 651 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.222	0.222	0.1	3.2	O K
30 min Summer	103.290	0.290	0.1	4.2	O K
60 min Summer	103.355	0.355	0.1	5.2	O K
120 min Summer	103.412	0.412	0.1	6.0	O K
180 min Summer	103.437	0.437	0.1	6.4	O K
240 min Summer	103.449	0.449	0.1	6.5	O K
360 min Summer	103.453	0.453	0.1	6.6	O K
480 min Summer	103.447	0.447	0.1	6.5	O K
600 min Summer	103.437	0.437	0.1	6.4	O K
720 min Summer	103.428	0.428	0.1	6.2	O K
960 min Summer	103.409	0.409	0.1	6.0	O K
1440 min Summer	103.372	0.372	0.1	5.4	O K
2160 min Summer	103.320	0.320	0.1	4.7	O K
2880 min Summer	103.273	0.273	0.1	4.0	O K
4320 min Summer	103.193	0.193	0.1	2.8	O K
5760 min Summer	103.131	0.131	0.1	1.9	O K
7200 min Summer	103.088	0.088	0.1	1.2	O K
8640 min Summer	103.061	0.061	0.1	0.8	O K
10080 min Summer	103.049	0.049	0.1	0.7	O K
15 min Winter	103.251	0.251	0.1	3.6	O K
30 min Winter	103.327	0.327	0.1	4.8	O K
60 min Winter	103.401	0.401	0.1	5.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	23
30 min Summer	87.861	0.0	37
60 min Summer	54.368	0.0	66
120 min Summer	32.554	0.0	126
180 min Summer	23.829	0.0	186
240 min Summer	19.002	0.0	244
360 min Summer	13.711	0.0	362
480 min Summer	10.884	0.0	480
600 min Summer	9.094	0.0	526
720 min Summer	7.849	0.0	588
960 min Summer	6.218	0.0	708
1440 min Summer	4.472	0.0	974
2160 min Summer	3.211	0.0	1384
2880 min Summer	2.537	0.0	1764
4320 min Summer	1.817	0.0	2512
5760 min Summer	1.433	0.0	3224
7200 min Summer	1.192	0.0	3888
8640 min Summer	1.024	0.0	4496
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	22
30 min Winter	87.861	0.0	37
60 min Winter	54.368	0.0	66

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
120 min Winter	103.467	0.467	0.1	6.8	O K
180 min Winter	103.498	0.498	0.1	7.3	O K
240 min Winter	103.514	0.514	0.1	7.5	Flood Risk
360 min Winter	103.523	0.523	0.1	7.6	Flood Risk
480 min Winter	103.521	0.521	0.1	7.6	Flood Risk
600 min Winter	103.513	0.513	0.1	7.5	Flood Risk
720 min Winter	103.501	0.501	0.1	7.3	Flood Risk
960 min Winter	103.475	0.475	0.1	6.9	O K
1440 min Winter	103.424	0.424	0.1	6.2	O K
2160 min Winter	103.348	0.348	0.1	5.1	O K
2880 min Winter	103.277	0.277	0.1	4.0	O K
4320 min Winter	103.158	0.158	0.1	2.3	O K
5760 min Winter	103.077	0.077	0.1	1.1	O K
7200 min Winter	103.048	0.048	0.1	0.6	O K
8640 min Winter	103.041	0.041	0.1	0.6	O K
10080 min Winter	103.036	0.036	0.1	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Time-Peak (mins)
120 min Winter	32.554	0.0	124
180 min Winter	23.829	0.0	182
240 min Winter	19.002	0.0	240
360 min Winter	13.711	0.0	354
480 min Winter	10.884	0.0	466
600 min Winter	9.094	0.0	574
720 min Winter	7.849	0.0	676
960 min Winter	6.218	0.0	762
1440 min Winter	4.472	0.0	1060
2160 min Winter	3.211	0.0	1496
2880 min Winter	2.537	0.0	1908
4320 min Winter	1.817	0.0	2640
5760 min Winter	1.433	0.0	3232
7200 min Winter	1.192	0.0	3680
8640 min Winter	1.024	0.0	4416
10080 min Winter	0.901	0.0	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.005	4	8	0.009

Model Details

Storage is Online Cover Level (m) 103.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	13.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	103.000	Cap Volume Depth (m)	0.000

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

Half Drain Time : 842 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.489	0.089	0.1	4.0	O K
30 min Summer	103.516	0.116	0.1	5.2	Flood Risk
60 min Summer	103.541	0.141	0.1	6.4	Flood Risk
120 min Summer	103.565	0.165	0.1	7.5	Flood Risk
180 min Summer	103.577	0.177	0.1	8.1	Flood Risk
240 min Summer	103.583	0.183	0.1	8.4	Flood Risk
360 min Summer	103.589	0.189	0.1	8.6	Flood Risk
480 min Summer	103.590	0.190	0.1	8.7	Flood Risk
600 min Summer	103.589	0.189	0.1	8.7	Flood Risk
720 min Summer	103.587	0.187	0.1	8.6	Flood Risk
960 min Summer	103.583	0.183	0.1	8.3	Flood Risk
1440 min Summer	103.573	0.173	0.1	7.9	Flood Risk
2160 min Summer	103.558	0.158	0.1	7.2	Flood Risk
2880 min Summer	103.543	0.143	0.1	6.5	Flood Risk
4320 min Summer	103.516	0.116	0.1	5.2	Flood Risk
5760 min Summer	103.493	0.093	0.1	4.2	O K
7200 min Summer	103.475	0.075	0.1	3.3	O K
8640 min Summer	103.462	0.062	0.1	2.7	O K
10080 min Summer	103.453	0.053	0.1	2.3	O K
15 min Winter	103.500	0.100	0.1	4.5	Flood Risk
30 min Winter	103.530	0.130	0.1	5.9	Flood Risk
60 min Winter	103.559	0.159	0.1	7.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	23
30 min Summer	87.861	0.0	37
60 min Summer	54.368	0.0	68
120 min Summer	32.554	0.0	126
180 min Summer	23.829	0.0	186
240 min Summer	19.002	0.0	246
360 min Summer	13.711	0.0	364
480 min Summer	10.884	0.0	482
600 min Summer	9.094	0.0	600
720 min Summer	7.849	0.0	658
960 min Summer	6.218	0.0	766
1440 min Summer	4.472	0.0	1016
2160 min Summer	3.211	0.0	1428
2880 min Summer	2.537	0.0	1820
4320 min Summer	1.817	0.0	2596
5760 min Summer	1.433	0.0	3344
7200 min Summer	1.192	0.0	4032
8640 min Summer	1.024	0.0	4672
10080 min Summer	0.901	0.0	5344
15 min Winter	135.270	0.0	23
30 min Winter	87.861	0.0	37
60 min Winter	54.368	0.0	66

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.586	0.186	0.1	8.5	Flood Risk
180 min Winter	103.600	0.200	0.1	9.1	Flood Risk
240 min Winter	103.608	0.208	0.1	9.5	Flood Risk
360 min Winter	103.615	0.215	0.1	9.9	Flood Risk
480 min Winter	103.618	0.218	0.1	10.0	Flood Risk
600 min Winter	103.618	0.218	0.1	10.0	Flood Risk
720 min Winter	103.617	0.217	0.1	9.9	Flood Risk
960 min Winter	103.611	0.211	0.1	9.6	Flood Risk
1440 min Winter	103.597	0.197	0.1	9.0	Flood Risk
2160 min Winter	103.575	0.175	0.1	8.0	Flood Risk
2880 min Winter	103.553	0.153	0.1	7.0	Flood Risk
4320 min Winter	103.513	0.113	0.1	5.1	Flood Risk
5760 min Winter	103.480	0.080	0.1	3.6	O K
7200 min Winter	103.457	0.057	0.1	2.5	O K
8640 min Winter	103.447	0.047	0.1	2.0	O K
10080 min Winter	103.442	0.042	0.1	1.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	124
180 min Winter	23.829	0.0	182
240 min Winter	19.002	0.0	240
360 min Winter	13.711	0.0	356
480 min Winter	10.884	0.0	470
600 min Winter	9.094	0.0	582
720 min Winter	7.849	0.0	692
960 min Winter	6.218	0.0	892
1440 min Winter	4.472	0.0	1102
2160 min Winter	3.211	0.0	1556
2880 min Winter	2.537	0.0	1988
4320 min Winter	1.817	0.0	2772
5760 min Winter	1.433	0.0	3464
7200 min Winter	1.192	0.0	4040
8640 min Winter	1.024	0.0	4664
10080 min Winter	0.901	0.0	5344

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.017

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005	4	8	0.012

Model Details

Storage is Online Cover Level (m) 103.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	13.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	103.400	Cap Volume Depth (m)	0.000

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

Half Drain Time : 1203 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.522	0.122	0.1	5.5	Flood Risk
30 min Summer	103.558	0.158	0.1	7.2	Flood Risk
60 min Summer	103.594	0.194	0.1	8.8	Flood Risk
120 min Summer	103.627	0.227	0.1	10.4	Flood Risk
180 min Summer	103.645	0.245	0.1	11.2	Flood Risk
240 min Summer	103.655	0.255	0.1	11.7	Flood Risk
360 min Summer	103.666	0.266	0.1	12.2	Flood Risk
480 min Summer	103.671	0.271	0.1	12.5	Flood Risk
600 min Summer	103.673	0.273	0.1	12.6	Flood Risk
720 min Summer	103.673	0.273	0.1	12.5	Flood Risk
960 min Summer	103.668	0.268	0.1	12.3	Flood Risk
1440 min Summer	103.657	0.257	0.1	11.8	Flood Risk
2160 min Summer	103.640	0.240	0.1	11.0	Flood Risk
2880 min Summer	103.623	0.223	0.1	10.2	Flood Risk
4320 min Summer	103.591	0.191	0.1	8.7	Flood Risk
5760 min Summer	103.562	0.162	0.1	7.4	Flood Risk
7200 min Summer	103.537	0.137	0.1	6.2	Flood Risk
8640 min Summer	103.515	0.115	0.1	5.2	Flood Risk
10080 min Summer	103.497	0.097	0.1	4.3	O K
15 min Winter	103.537	0.137	0.1	6.2	Flood Risk
30 min Winter	103.577	0.177	0.1	8.1	Flood Risk
60 min Winter	103.618	0.218	0.1	10.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	23
30 min Summer	87.861	0.0	38
60 min Summer	54.368	0.0	68
120 min Summer	32.554	0.0	126
180 min Summer	23.829	0.0	186
240 min Summer	19.002	0.0	246
360 min Summer	13.711	0.0	366
480 min Summer	10.884	0.0	484
600 min Summer	9.094	0.0	604
720 min Summer	7.849	0.0	722
960 min Summer	6.218	0.0	918
1440 min Summer	4.472	0.0	1140
2160 min Summer	3.211	0.0	1516
2880 min Summer	2.537	0.0	1912
4320 min Summer	1.817	0.0	2728
5760 min Summer	1.433	0.0	3512
7200 min Summer	1.192	0.0	4256
8640 min Summer	1.024	0.0	4936
10080 min Summer	0.901	0.0	5648
15 min Winter	135.270	0.0	23
30 min Winter	87.861	0.0	37
60 min Winter	54.368	0.0	66

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.656	0.256	0.1	11.8	Flood Risk
180 min Winter	103.676	0.276	0.1	12.7	Flood Risk
240 min Winter	103.689	0.289	0.1	13.3	Flood Risk
360 min Winter	103.702	0.302	0.1	13.9	Flood Risk
480 min Winter	103.710	0.310	0.1	14.3	Flood Risk
600 min Winter	103.713	0.313	0.1	14.4	Flood Risk
720 min Winter	103.714	0.314	0.1	14.5	Flood Risk
960 min Winter	103.712	0.312	0.1	14.4	Flood Risk
1440 min Winter	103.697	0.297	0.1	13.7	Flood Risk
2160 min Winter	103.674	0.274	0.1	12.6	Flood Risk
2880 min Winter	103.651	0.251	0.1	11.5	Flood Risk
4320 min Winter	103.603	0.203	0.1	9.3	Flood Risk
5760 min Winter	103.561	0.161	0.1	7.3	Flood Risk
7200 min Winter	103.523	0.123	0.1	5.6	Flood Risk
8640 min Winter	103.492	0.092	0.1	4.1	O K
10080 min Winter	103.468	0.068	0.1	3.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	126
180 min Winter	23.829	0.0	184
240 min Winter	19.002	0.0	242
360 min Winter	13.711	0.0	360
480 min Winter	10.884	0.0	476
600 min Winter	9.094	0.0	590
720 min Winter	7.849	0.0	704
960 min Winter	6.218	0.0	926
1440 min Winter	4.472	0.0	1328
2160 min Winter	3.211	0.0	1644
2880 min Winter	2.537	0.0	2104
4320 min Winter	1.817	0.0	2944
5760 min Winter	1.433	0.0	3752
7200 min Winter	1.192	0.0	4472
8640 min Winter	1.024	0.0	5184
10080 min Winter	0.901	0.0	5752

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.023

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005	4	8	0.018

Model Details

Storage is Online Cover Level (m) 103.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	13.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	103.400	Cap Volume Depth (m)	0.000

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

Half Drain Time : 1271 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.527	0.127	0.1	5.8	Flood Risk
30 min Summer	103.565	0.165	0.1	7.5	Flood Risk
60 min Summer	103.602	0.202	0.1	9.3	Flood Risk
120 min Summer	103.638	0.238	0.1	10.9	Flood Risk
180 min Summer	103.656	0.256	0.1	11.8	Flood Risk
240 min Summer	103.667	0.267	0.1	12.3	Flood Risk
360 min Summer	103.679	0.279	0.1	12.8	Flood Risk
480 min Summer	103.685	0.285	0.1	13.1	Flood Risk
600 min Summer	103.687	0.287	0.1	13.2	Flood Risk
720 min Summer	103.688	0.288	0.1	13.2	Flood Risk
960 min Summer	103.683	0.283	0.1	13.0	Flood Risk
1440 min Summer	103.671	0.271	0.1	12.5	Flood Risk
2160 min Summer	103.654	0.254	0.1	11.7	Flood Risk
2880 min Summer	103.637	0.237	0.1	10.9	Flood Risk
4320 min Summer	103.604	0.204	0.1	9.3	Flood Risk
5760 min Summer	103.575	0.175	0.1	8.0	Flood Risk
7200 min Summer	103.549	0.149	0.1	6.8	Flood Risk
8640 min Summer	103.526	0.126	0.1	5.7	Flood Risk
10080 min Summer	103.506	0.106	0.1	4.8	Flood Risk
15 min Winter	103.543	0.143	0.1	6.5	Flood Risk
30 min Winter	103.585	0.185	0.1	8.5	Flood Risk
60 min Winter	103.627	0.227	0.1	10.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	23
30 min Summer	87.861	0.0	38
60 min Summer	54.368	0.0	68
120 min Summer	32.554	0.0	128
180 min Summer	23.829	0.0	186
240 min Summer	19.002	0.0	246
360 min Summer	13.711	0.0	366
480 min Summer	10.884	0.0	486
600 min Summer	9.094	0.0	604
720 min Summer	7.849	0.0	724
960 min Summer	6.218	0.0	954
1440 min Summer	4.472	0.0	1156
2160 min Summer	3.211	0.0	1536
2880 min Summer	2.537	0.0	1936
4320 min Summer	1.817	0.0	2728
5760 min Summer	1.433	0.0	3520
7200 min Summer	1.192	0.0	4256
8640 min Summer	1.024	0.0	5016
10080 min Summer	0.901	0.0	5744
15 min Winter	135.270	0.0	23
30 min Winter	87.861	0.0	37
60 min Winter	54.368	0.0	66

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.668	0.268	0.1	12.3	Flood Risk
180 min Winter	103.689	0.289	0.1	13.3	Flood Risk
240 min Winter	103.702	0.302	0.1	13.9	Flood Risk
360 min Winter	103.717	0.317	0.1	14.6	Flood Risk
480 min Winter	103.725	0.325	0.1	15.0	Flood Risk
600 min Winter	103.729	0.329	0.1	15.2	Flood Risk
720 min Winter	103.731	0.331	0.1	15.2	Flood Risk
960 min Winter	103.729	0.329	0.1	15.1	Flood Risk
1440 min Winter	103.715	0.315	0.1	14.5	Flood Risk
2160 min Winter	103.692	0.292	0.1	13.4	Flood Risk
2880 min Winter	103.668	0.268	0.1	12.3	Flood Risk
4320 min Winter	103.620	0.220	0.1	10.1	Flood Risk
5760 min Winter	103.576	0.176	0.1	8.0	Flood Risk
7200 min Winter	103.537	0.137	0.1	6.2	Flood Risk
8640 min Winter	103.504	0.104	0.1	4.7	Flood Risk
10080 min Winter	103.478	0.078	0.1	3.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	126
180 min Winter	23.829	0.0	184
240 min Winter	19.002	0.0	242
360 min Winter	13.711	0.0	360
480 min Winter	10.884	0.0	476
600 min Winter	9.094	0.0	590
720 min Winter	7.849	0.0	704
960 min Winter	6.218	0.0	928
1440 min Winter	4.472	0.0	1344
2160 min Winter	3.211	0.0	1652
2880 min Winter	2.537	0.0	2108
4320 min Winter	1.817	0.0	2984
5760 min Winter	1.433	0.0	3800
7200 min Winter	1.192	0.0	4544
8640 min Winter	1.024	0.0	5192
10080 min Winter	0.901	0.0	5848

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.024

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005	4	8	0.019

Model Details

Storage is Online Cover Level (m) 103.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	13.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	103.400	Cap Volume Depth (m)	0.000

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

Half Drain Time : 174 minutes.

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15	min Summer	102.072	0.072	0.3	3.3	O K
30	min Summer	102.094	0.094	0.3	4.4	O K
60	min Summer	102.113	0.113	0.3	5.3	O K
120	min Summer	102.125	0.125	0.3	5.9	O K
180	min Summer	102.126	0.126	0.3	6.0	O K
240	min Summer	102.125	0.125	0.3	5.9	O K
360	min Summer	102.121	0.121	0.3	5.7	O K
480	min Summer	102.115	0.115	0.3	5.4	O K
600	min Summer	102.109	0.109	0.3	5.1	O K
720	min Summer	102.103	0.103	0.3	4.8	O K
960	min Summer	102.090	0.090	0.3	4.2	O K
1440	min Summer	102.069	0.069	0.3	3.1	O K
2160	min Summer	102.050	0.050	0.3	2.2	O K
2880	min Summer	102.042	0.042	0.3	1.8	O K
4320	min Summer	102.032	0.032	0.2	1.3	O K
5760	min Summer	102.026	0.026	0.2	1.0	O K
7200	min Summer	102.022	0.022	0.2	0.8	O K
8640	min Summer	102.019	0.019	0.1	0.6	O K
10080	min Summer	102.017	0.017	0.1	0.5	O K
15	min Winter	102.082	0.082	0.3	3.8	O K
30	min Winter	102.107	0.107	0.3	5.0	O K
60	min Winter	102.129	0.129	0.3	6.1	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15	min Summer	135.270	0.0	18
30	min Summer	87.861	0.0	33
60	min Summer	54.368	0.0	62
120	min Summer	32.554	0.0	120
180	min Summer	23.829	0.0	154
240	min Summer	19.002	0.0	184
360	min Summer	13.711	0.0	250
480	min Summer	10.884	0.0	316
600	min Summer	9.094	0.0	384
720	min Summer	7.849	0.0	450
960	min Summer	6.218	0.0	578
1440	min Summer	4.472	0.0	822
2160	min Summer	3.211	0.0	1148
2880	min Summer	2.537	0.0	1524
4320	min Summer	1.817	0.0	2248
5760	min Summer	1.433	0.0	2944
7200	min Summer	1.192	0.0	3680
8640	min Summer	1.024	0.0	4408
10080	min Summer	0.901	0.0	5144
15	min Winter	135.270	0.0	18
30	min Winter	87.861	0.0	32
60	min Winter	54.368	0.0	60

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	102.144	0.144	0.3	6.8	O K
180 min Winter	102.146	0.146	0.3	6.9	O K
240 min Winter	102.143	0.143	0.3	6.8	O K
360 min Winter	102.136	0.136	0.3	6.5	O K
480 min Winter	102.127	0.127	0.3	6.0	O K
600 min Winter	102.118	0.118	0.3	5.6	O K
720 min Winter	102.108	0.108	0.3	5.1	O K
960 min Winter	102.089	0.089	0.3	4.1	O K
1440 min Winter	102.060	0.060	0.3	2.7	O K
2160 min Winter	102.042	0.042	0.3	1.8	O K
2880 min Winter	102.034	0.034	0.2	1.4	O K
4320 min Winter	102.025	0.025	0.2	0.9	O K
5760 min Winter	102.020	0.020	0.1	0.7	O K
7200 min Winter	102.017	0.017	0.1	0.5	O K
8640 min Winter	102.014	0.014	0.1	0.4	O K
10080 min Winter	102.013	0.013	0.1	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	118
180 min Winter	23.829	0.0	172
240 min Winter	19.002	0.0	198
360 min Winter	13.711	0.0	272
480 min Winter	10.884	0.0	346
600 min Winter	9.094	0.0	418
720 min Winter	7.849	0.0	488
960 min Winter	6.218	0.0	618
1440 min Winter	4.472	0.0	850
2160 min Winter	3.211	0.0	1188
2880 min Winter	2.537	0.0	1556
4320 min Winter	1.817	0.0	2248
5760 min Winter	1.433	0.0	3000
7200 min Winter	1.192	0.0	3736
8640 min Winter	1.024	0.0	4416
10080 min Winter	0.901	0.0	4952

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.017

Time (mins) From:	To:	Area (ha)
0	4	0.017

Model Details

Storage is Online Cover Level (m) 102.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	12.9
Membrane Percolation (mm/hr)	1000	Length (m)	12.9
Max Percolation (l/s)	46.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	102.000	Cap Volume Depth (m)	0.000

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

Half Drain Time : 163 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	103.367	0.067	0.2	2.1	O K
30 min Summer	103.388	0.088	0.2	2.8	O K
60 min Summer	103.406	0.106	0.2	3.4	O K
120 min Summer	103.417	0.117	0.2	3.8	O K
180 min Summer	103.418	0.118	0.2	3.8	O K
240 min Summer	103.418	0.118	0.2	3.8	O K
360 min Summer	103.414	0.114	0.2	3.6	O K
480 min Summer	103.408	0.108	0.2	3.5	O K
600 min Summer	103.402	0.102	0.2	3.3	O K
720 min Summer	103.396	0.096	0.2	3.1	O K
960 min Summer	103.384	0.084	0.2	2.7	O K
1440 min Summer	103.365	0.065	0.2	2.0	O K
2160 min Summer	103.348	0.048	0.2	1.4	O K
2880 min Summer	103.340	0.040	0.2	1.2	O K
4320 min Summer	103.331	0.031	0.1	0.9	O K
5760 min Summer	103.325	0.025	0.1	0.7	O K
7200 min Summer	103.321	0.021	0.1	0.5	O K
8640 min Summer	103.318	0.018	0.1	0.4	O K
10080 min Summer	103.316	0.016	0.1	0.4	O K
15 min Winter	103.377	0.077	0.2	2.4	O K
30 min Winter	103.401	0.101	0.2	3.2	O K
60 min Winter	103.422	0.122	0.2	3.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	18
30 min Summer	87.861	0.0	33
60 min Summer	54.368	0.0	62
120 min Summer	32.554	0.0	120
180 min Summer	23.829	0.0	150
240 min Summer	19.002	0.0	182
360 min Summer	13.711	0.0	248
480 min Summer	10.884	0.0	314
600 min Summer	9.094	0.0	382
720 min Summer	7.849	0.0	448
960 min Summer	6.218	0.0	578
1440 min Summer	4.472	0.0	812
2160 min Summer	3.211	0.0	1148
2880 min Summer	2.537	0.0	1524
4320 min Summer	1.817	0.0	2248
5760 min Summer	1.433	0.0	2952
7200 min Summer	1.192	0.0	3680
8640 min Summer	1.024	0.0	4408
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	18
30 min Winter	87.861	0.0	32
60 min Winter	54.368	0.0	60

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.435	0.135	0.2	4.4	O K
180 min Winter	103.437	0.137	0.2	4.4	O K
240 min Winter	103.434	0.134	0.2	4.4	O K
360 min Winter	103.428	0.128	0.2	4.1	O K
480 min Winter	103.419	0.119	0.2	3.8	O K
600 min Winter	103.410	0.110	0.2	3.5	O K
720 min Winter	103.400	0.100	0.2	3.2	O K
960 min Winter	103.382	0.082	0.2	2.6	O K
1440 min Winter	103.355	0.055	0.2	1.7	O K
2160 min Winter	103.341	0.041	0.2	1.2	O K
2880 min Winter	103.333	0.033	0.2	0.9	O K
4320 min Winter	103.324	0.024	0.1	0.6	O K
5760 min Winter	103.319	0.019	0.1	0.5	O K
7200 min Winter	103.316	0.016	0.1	0.3	O K
8640 min Winter	103.314	0.014	0.1	0.3	O K
10080 min Winter	103.312	0.012	0.1	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	118
180 min Winter	23.829	0.0	170
240 min Winter	19.002	0.0	194
360 min Winter	13.711	0.0	270
480 min Winter	10.884	0.0	344
600 min Winter	9.094	0.0	416
720 min Winter	7.849	0.0	484
960 min Winter	6.218	0.0	614
1440 min Winter	4.472	0.0	836
2160 min Winter	3.211	0.0	1172
2880 min Winter	2.537	0.0	1556
4320 min Winter	1.817	0.0	2248
5760 min Winter	1.433	0.0	2992
7200 min Winter	1.192	0.0	3680
8640 min Winter	1.024	0.0	4424
10080 min Winter	0.901	0.0	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.011

Time (mins) From:	To:	Area (ha)
0	4	0.011

Model Details

Storage is Online Cover Level (m) 103.900

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	10.6
Membrane Percolation (mm/hr)	1000	Length (m)	10.6
Max Percolation (l/s)	31.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	103.300	Cap Volume Depth (m)	0.000

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

Half Drain Time : 174 minutes.

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15	min Summer	103.272	0.072	0.3	2.7	O K
30	min Summer	103.294	0.094	0.3	3.6	O K
60	min Summer	103.313	0.113	0.3	4.4	O K
120	min Summer	103.324	0.124	0.3	4.9	O K
180	min Summer	103.326	0.126	0.3	4.9	O K
240	min Summer	103.325	0.125	0.3	4.9	O K
360	min Summer	103.321	0.121	0.3	4.7	O K
480	min Summer	103.315	0.115	0.3	4.5	O K
600	min Summer	103.309	0.109	0.3	4.2	O K
720	min Summer	103.303	0.103	0.3	4.0	O K
960	min Summer	103.290	0.090	0.3	3.5	O K
1440	min Summer	103.270	0.070	0.3	2.6	O K
2160	min Summer	103.250	0.050	0.3	1.8	O K
2880	min Summer	103.242	0.042	0.2	1.5	O K
4320	min Summer	103.232	0.032	0.2	1.1	O K
5760	min Summer	103.226	0.026	0.1	0.8	O K
7200	min Summer	103.222	0.022	0.1	0.7	O K
8640	min Summer	103.219	0.019	0.1	0.5	O K
10080	min Summer	103.217	0.017	0.1	0.5	O K
15	min Winter	103.282	0.082	0.3	3.1	O K
30	min Winter	103.307	0.107	0.3	4.2	O K
60	min Winter	103.329	0.129	0.3	5.0	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15	min Summer	135.270	0.0	18
30	min Summer	87.861	0.0	33
60	min Summer	54.368	0.0	62
120	min Summer	32.554	0.0	120
180	min Summer	23.829	0.0	154
240	min Summer	19.002	0.0	184
360	min Summer	13.711	0.0	250
480	min Summer	10.884	0.0	318
600	min Summer	9.094	0.0	384
720	min Summer	7.849	0.0	450
960	min Summer	6.218	0.0	578
1440	min Summer	4.472	0.0	822
2160	min Summer	3.211	0.0	1148
2880	min Summer	2.537	0.0	1524
4320	min Summer	1.817	0.0	2248
5760	min Summer	1.433	0.0	2944
7200	min Summer	1.192	0.0	3680
8640	min Summer	1.024	0.0	4408
10080	min Summer	0.901	0.0	5144
15	min Winter	135.270	0.0	18
30	min Winter	87.861	0.0	32
60	min Winter	54.368	0.0	60

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	103.343	0.143	0.3	5.6	O K
180 min Winter	103.345	0.145	0.3	5.7	O K
240 min Winter	103.343	0.143	0.3	5.6	O K
360 min Winter	103.336	0.136	0.3	5.3	O K
480 min Winter	103.327	0.127	0.3	5.0	O K
600 min Winter	103.318	0.118	0.3	4.6	O K
720 min Winter	103.308	0.108	0.3	4.2	O K
960 min Winter	103.289	0.089	0.3	3.4	O K
1440 min Winter	103.260	0.060	0.3	2.2	O K
2160 min Winter	103.243	0.043	0.2	1.5	O K
2880 min Winter	103.234	0.034	0.2	1.2	O K
4320 min Winter	103.225	0.025	0.1	0.8	O K
5760 min Winter	103.220	0.020	0.1	0.6	O K
7200 min Winter	103.217	0.017	0.1	0.4	O K
8640 min Winter	103.214	0.014	0.1	0.3	O K
10080 min Winter	103.212	0.012	0.1	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	118
180 min Winter	23.829	0.0	172
240 min Winter	19.002	0.0	198
360 min Winter	13.711	0.0	272
480 min Winter	10.884	0.0	346
600 min Winter	9.094	0.0	418
720 min Winter	7.849	0.0	488
960 min Winter	6.218	0.0	618
1440 min Winter	4.472	0.0	850
2160 min Winter	3.211	0.0	1172
2880 min Winter	2.537	0.0	1556
4320 min Winter	1.817	0.0	2248
5760 min Winter	1.433	0.0	3000
7200 min Winter	1.192	0.0	3744
8640 min Winter	1.024	0.0	4336
10080 min Winter	0.901	0.0	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

Model Details

Storage is Online Cover Level (m) 103.800

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	11.7
Membrane Percolation (mm/hr)	1000	Length (m)	11.7
Max Percolation (l/s)	38.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	103.200	Cap Volume Depth (m)	0.000

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

Half Drain Time : 306 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	102.678	0.278	0.5	10.9	O K
30 min Summer	102.724	0.324	0.6	14.7	Flood Risk
60 min Summer	102.760	0.360	0.7	18.2	Flood Risk
120 min Summer	102.787	0.387	0.7	21.0	Flood Risk
180 min Summer	102.795	0.395	0.8	21.9	Flood Risk
240 min Summer	102.796	0.396	0.8	22.1	Flood Risk
360 min Summer	102.795	0.395	0.8	22.0	Flood Risk
480 min Summer	102.793	0.393	0.8	21.7	Flood Risk
600 min Summer	102.790	0.390	0.7	21.4	Flood Risk
720 min Summer	102.787	0.387	0.7	21.0	Flood Risk
960 min Summer	102.778	0.378	0.7	20.0	Flood Risk
1440 min Summer	102.758	0.358	0.7	18.0	Flood Risk
2160 min Summer	102.730	0.330	0.6	15.3	Flood Risk
2880 min Summer	102.705	0.305	0.6	13.1	Flood Risk
4320 min Summer	102.665	0.265	0.5	9.9	O K
5760 min Summer	102.634	0.234	0.4	7.7	O K
7200 min Summer	102.609	0.209	0.4	6.2	O K
8640 min Summer	102.589	0.189	0.4	5.0	O K
10080 min Summer	102.573	0.173	0.3	4.2	O K
15 min Winter	102.699	0.299	0.6	12.5	O K
30 min Winter	102.746	0.346	0.7	16.8	Flood Risk
60 min Winter	102.785	0.385	0.7	20.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	19
30 min Summer	87.861	0.0	33
60 min Summer	54.368	0.0	62
120 min Summer	32.554	0.0	122
180 min Summer	23.829	0.0	180
240 min Summer	19.002	0.0	224
360 min Summer	13.711	0.0	280
480 min Summer	10.884	0.0	344
600 min Summer	9.094	0.0	410
720 min Summer	7.849	0.0	480
960 min Summer	6.218	0.0	616
1440 min Summer	4.472	0.0	882
2160 min Summer	3.211	0.0	1276
2880 min Summer	2.537	0.0	1668
4320 min Summer	1.817	0.0	2380
5760 min Summer	1.433	0.0	3112
7200 min Summer	1.192	0.0	3824
8640 min Summer	1.024	0.0	4576
10080 min Summer	0.901	0.0	5248
15 min Winter	135.270	0.0	18
30 min Winter	87.861	0.0	33
60 min Winter	54.368	0.0	62

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	102.814	0.414	0.8	24.0	Flood Risk
180 min Winter	102.823	0.423	0.8	25.2	Flood Risk
240 min Winter	102.826	0.426	0.8	25.5	Flood Risk
360 min Winter	102.823	0.423	0.8	25.1	Flood Risk
480 min Winter	102.820	0.420	0.8	24.7	Flood Risk
600 min Winter	102.815	0.415	0.8	24.1	Flood Risk
720 min Winter	102.809	0.409	0.8	23.5	Flood Risk
960 min Winter	102.795	0.395	0.8	21.9	Flood Risk
1440 min Winter	102.768	0.368	0.7	19.0	Flood Risk
2160 min Winter	102.729	0.329	0.6	15.2	Flood Risk
2880 min Winter	102.696	0.296	0.6	12.3	O K
4320 min Winter	102.644	0.244	0.5	8.4	O K
5760 min Winter	102.606	0.206	0.4	5.9	O K
7200 min Winter	102.577	0.177	0.3	4.4	O K
8640 min Winter	102.555	0.155	0.3	3.4	O K
10080 min Winter	102.537	0.137	0.3	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	120
180 min Winter	23.829	0.0	176
240 min Winter	19.002	0.0	230
360 min Winter	13.711	0.0	292
480 min Winter	10.884	0.0	366
600 min Winter	9.094	0.0	442
720 min Winter	7.849	0.0	520
960 min Winter	6.218	0.0	666
1440 min Winter	4.472	0.0	952
2160 min Winter	3.211	0.0	1360
2880 min Winter	2.537	0.0	1732
4320 min Winter	1.817	0.0	2468
5760 min Winter	1.433	0.0	3176
7200 min Winter	1.192	0.0	3896
8640 min Winter	1.024	0.0	4584
10080 min Winter	0.901	0.0	5344

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.055

Time (mins) From:	To:	Area (ha)
0	4	0.055

Model Details

Storage is Online Cover Level (m) 103.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	7.8
Membrane Percolation (mm/hr)	1000	Length (m)	70.0
Max Percolation (l/s)	151.7	Slope (1:X)	120.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	102.400	Cap Volume Depth (m)	0.000

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

Half Drain Time : 184 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	101.774	0.074	0.2	1.9	O K
30 min Summer	101.797	0.097	0.2	2.6	O K
60 min Summer	101.817	0.117	0.2	3.2	O K
120 min Summer	101.830	0.130	0.2	3.5	O K
180 min Summer	101.831	0.131	0.2	3.6	O K
240 min Summer	101.831	0.131	0.2	3.6	O K
360 min Summer	101.826	0.126	0.2	3.4	O K
480 min Summer	101.821	0.121	0.2	3.3	O K
600 min Summer	101.815	0.115	0.2	3.1	O K
720 min Summer	101.808	0.108	0.2	2.9	O K
960 min Summer	101.796	0.096	0.2	2.6	O K
1440 min Summer	101.774	0.074	0.2	2.0	O K
2160 min Summer	101.753	0.053	0.2	1.4	O K
2880 min Summer	101.744	0.044	0.2	1.1	O K
4320 min Summer	101.733	0.033	0.1	0.8	O K
5760 min Summer	101.727	0.027	0.1	0.6	O K
7200 min Summer	101.723	0.023	0.1	0.5	O K
8640 min Summer	101.720	0.020	0.1	0.4	O K
10080 min Summer	101.718	0.018	0.1	0.4	O K
15 min Winter	101.785	0.085	0.2	2.3	O K
30 min Winter	101.811	0.111	0.2	3.0	O K
60 min Winter	101.834	0.134	0.2	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.270	0.0	18
30 min Summer	87.861	0.0	33
60 min Summer	54.368	0.0	62
120 min Summer	32.554	0.0	120
180 min Summer	23.829	0.0	156
240 min Summer	19.002	0.0	188
360 min Summer	13.711	0.0	252
480 min Summer	10.884	0.0	320
600 min Summer	9.094	0.0	386
720 min Summer	7.849	0.0	454
960 min Summer	6.218	0.0	584
1440 min Summer	4.472	0.0	824
2160 min Summer	3.211	0.0	1168
2880 min Summer	2.537	0.0	1524
4320 min Summer	1.817	0.0	2248
5760 min Summer	1.433	0.0	2944
7200 min Summer	1.192	0.0	3680
8640 min Summer	1.024	0.0	4408
10080 min Summer	0.901	0.0	5144
15 min Winter	135.270	0.0	18
30 min Winter	87.861	0.0	32
60 min Winter	54.368	0.0	60

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	101.849	0.149	0.2	4.1	O K
180 min Winter	101.852	0.152	0.2	4.2	O K
240 min Winter	101.850	0.150	0.2	4.1	O K
360 min Winter	101.843	0.143	0.2	3.9	O K
480 min Winter	101.834	0.134	0.2	3.7	O K
600 min Winter	101.825	0.125	0.2	3.4	O K
720 min Winter	101.815	0.115	0.2	3.1	O K
960 min Winter	101.796	0.096	0.2	2.6	O K
1440 min Winter	101.764	0.064	0.2	1.7	O K
2160 min Winter	101.744	0.044	0.2	1.1	O K
2880 min Winter	101.736	0.036	0.1	0.9	O K
4320 min Winter	101.726	0.026	0.1	0.6	O K
5760 min Winter	101.721	0.021	0.1	0.4	O K
7200 min Winter	101.717	0.017	0.1	0.3	O K
8640 min Winter	101.715	0.015	0.1	0.3	O K
10080 min Winter	101.713	0.013	0.0	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.554	0.0	118
180 min Winter	23.829	0.0	172
240 min Winter	19.002	0.0	218
360 min Winter	13.711	0.0	274
480 min Winter	10.884	0.0	348
600 min Winter	9.094	0.0	422
720 min Winter	7.849	0.0	492
960 min Winter	6.218	0.0	626
1440 min Winter	4.472	0.0	854
2160 min Winter	3.211	0.0	1172
2880 min Winter	2.537	0.0	1552
4320 min Winter	1.817	0.0	2248
5760 min Winter	1.433	0.0	2992
7200 min Winter	1.192	0.0	3680
8640 min Winter	1.024	0.0	4408
10080 min Winter	0.901	0.0	5240

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.428	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.010

Time (mins) From:	To:	Area (ha)
0	4	0.010

Model Details

Storage is Online Cover Level (m) 102.300

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01476	Width (m)	9.7
Membrane Percolation (mm/hr)	1000	Length (m)	9.7
Max Percolation (l/s)	26.1	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	101.700	Cap Volume Depth (m)	0.000

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
1.000	65.000	0.260	250.0	0.031	4.00	0.600	o	300
1.001	21.300	0.085	250.6	0.031	0.00	0.600	o	300
1.002	38.200	0.153	249.7	0.027	0.00	0.600	o	300
2.000	29.500	0.118	250.0	0.027	4.00	0.600	o	300
1.003	68.400	0.274	249.6	0.027	0.00	0.600	o	300
3.000	55.800	0.224	249.1	0.031	4.00	0.600	o	300
3.001	10.100	0.040	252.5	0.031	0.00	0.600	o	300
1.004	31.700	0.126	251.6	0.041	0.00	0.600	o	300
1.005	16.000	0.064	250.0	0.041	0.00	0.600	o	300
1.006	25.000	0.167	149.7	0.000	0.00	0.600	o	150
* 1.007	51.400	-1.519	-33.8	0.000	0.00	0.600	o	150
* 1.008	5.000	0.200	25.0	0.000	0.00	0.600	o	150

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	MH01	102.860	101.360	1.200	103.000	101.100	1.600		1200
1.001	MH02	103.000	101.100	1.600	103.000	101.015	1.685		1200
1.002	MH03	103.000	101.015	1.685	103.200	100.862	2.038		1200
2.000	MH04	103.400	100.980	2.120	103.200	100.862	2.038		1200
1.003	MH05	103.200	100.862	2.038	103.870	100.588	2.982		1200
3.000	MH06	103.800	100.852	2.648	103.900	100.628	2.972		1200
3.001	MH07	103.900	100.628	2.972	103.870	100.588	2.982		1200
1.004	MH08	103.870	100.588	2.982	103.800	100.462	3.038		1200
1.005	MH09	103.800	100.462	3.038	103.750	100.398	3.052		1200
1.006	FD1	103.750	100.398	3.202	103.600	100.231	3.219		1200
* 1.007	PUMP	103.600	99.731	3.719	103.600	101.250	2.200	Pump	1200
* 1.008	DR1	103.600	101.250	2.200	104.000	101.050	2.800	Pump	1200

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008		104.000	101.050	0.000	0	0

Simulation Criteria for Storm

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Storm Duration (mins)	30
Ratio R	0.426		

Online Controls for Storm

Pump Manhole: PUMP, DS/PN: 1.007, Volume (m³): 4.8

Invert Level (m) 99.731

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	30.0000	0.900	30.0000	1.700	30.0000	2.500	30.0000
0.200	30.0000	1.000	30.0000	1.800	30.0000	2.600	30.0000
0.300	30.0000	1.100	30.0000	1.900	30.0000	2.700	30.0000
0.400	30.0000	1.200	30.0000	2.000	30.0000	2.800	30.0000
0.500	30.0000	1.300	30.0000	2.100	30.0000	2.900	30.0000
0.600	30.0000	1.400	30.0000	2.200	30.0000	3.000	30.0000
0.700	30.0000	1.500	30.0000	2.300	30.0000		
0.800	30.0000	1.600	30.0000	2.400	30.0000		

Pump Manhole: DR1, DS/PN: 1.008, Volume (m³): 3.5

Invert Level (m) 101.250

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0000	0.900	0.0000	1.700	0.0000	2.500	0.0000
0.200	0.0000	1.000	0.0000	1.800	0.0000	2.600	0.0000
0.300	0.0000	1.100	0.0000	1.900	0.0000	2.700	0.0000
0.400	0.0000	1.200	0.0000	2.000	0.0000	2.800	0.0000
0.500	0.0000	1.300	0.0000	2.100	0.0000	2.900	0.0000
0.600	0.0000	1.400	0.0000	2.200	0.0000	3.000	0.0000
0.700	0.0000	1.500	0.0000	2.300	0.0000		
0.800	0.0000	1.600	0.0000	2.400	0.0000		

Storage Structures for Storm

Filter Drain Manhole: FD1, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Trench Length (m)	25.0
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Diameter (m)	0.150
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	150.0
Invert Level (m)	100.398	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000

Complex Manhole: DR1, DS/PN: 1.008

Cellular Storage

Invert Level (m)	101.250	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01476	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.01476		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	70.0	70.0	1.321	0.0	114.9
1.320	70.0	114.9			

Infiltration Basin

Invert Level (m)	103.100	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01476	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.01476		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	42.0	0.500	746.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.426
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	5
Climate Change (%)	0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	5	0%					
1.001	15 Winter	5	0%					
1.002	15 Winter	5	0%					
2.000	15 Winter	5	0%					
1.003	15 Winter	5	0%					
3.000	15 Winter	5	0%					
3.001	15 Winter	5	0%					
1.004	15 Winter	5	0%	5/15 Winter				
1.005	15 Winter	5	0%	5/15 Summer				
1.006	15 Winter	5	0%	5/15 Summer				
1.007	15 Winter	5	0%					
1.008	1440 Winter	5	0%	5/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	MH01	101.427	-0.233	0.000	0.10	0.0	7.0	OK
1.001	MH02	101.193	-0.207	0.000	0.21	0.0	12.9	OK
1.002	MH03	101.122	-0.193	0.000	0.27	0.0	17.6	OK
2.000	MH04	101.046	-0.234	0.000	0.10	0.0	6.5	OK
1.003	MH05	100.995	-0.167	0.000	0.39	0.0	26.3	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
3.000	MH06	100.919	-0.233	0.000	0.11	0.0	7.0	OK
3.001	MH07	100.909	-0.019	0.000	0.20	0.0	10.9	OK
1.004	MH08	100.907	0.019	0.000	0.56	0.0	35.7	SURCHARGED
1.005	MH09	100.882	0.120	0.000	0.54	0.0	32.2	SURCHARGED
1.006	FD1	100.859	0.311	0.000	1.70	0.0	23.5	SURCHARGED
1.007	PUMP	99.809	-0.072	0.000	4.36	0.0	23.3	OK
1.008	DR1	102.515	1.115	0.000	0.00	0.0	0.0	SURCHARGED

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
1.000	65.000	0.260	250.0	0.031	4.00	0.600	o	300
1.001	21.300	0.085	250.6	0.031	0.00	0.600	o	300
1.002	38.200	0.153	249.7	0.027	0.00	0.600	o	300
2.000	29.500	0.118	250.0	0.027	4.00	0.600	o	300
1.003	68.400	0.274	249.6	0.027	0.00	0.600	o	300
3.000	55.800	0.224	249.1	0.031	4.00	0.600	o	300
3.001	10.100	0.040	252.5	0.031	0.00	0.600	o	300
1.004	31.700	0.126	251.6	0.041	0.00	0.600	o	300
1.005	16.000	0.064	250.0	0.041	0.00	0.600	o	300
1.006	25.000	0.167	149.7	0.000	0.00	0.600	o	150
* 1.007	51.400	-1.519	-33.8	0.000	0.00	0.600	o	150
* 1.008	5.000	0.200	25.0	0.000	0.00	0.600	o	150

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	MH01	102.860	101.360	1.200	103.000	101.100	1.600		1200
1.001	MH02	103.000	101.100	1.600	103.000	101.015	1.685		1200
1.002	MH03	103.000	101.015	1.685	103.200	100.862	2.038		1200
2.000	MH04	103.400	100.980	2.120	103.200	100.862	2.038		1200
1.003	MH05	103.200	100.862	2.038	103.870	100.588	2.982		1200
3.000	MH06	103.800	100.852	2.648	103.900	100.628	2.972		1200
3.001	MH07	103.900	100.628	2.972	103.870	100.588	2.982		1200
1.004	MH08	103.870	100.588	2.982	103.800	100.462	3.038		1200
1.005	MH09	103.800	100.462	3.038	103.750	100.398	3.052		1200
1.006	FD1	103.750	100.398	3.202	103.600	100.231	3.219		1200
* 1.007	PUMP	103.600	99.731	3.719	103.600	101.250	2.200	Pump	1200
* 1.008	DR1	103.600	101.250	2.200	104.000	101.050	2.800	Pump	1200

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008		104.000	101.050	0.000	0	0

Simulation Criteria for Storm

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Storm Duration (mins)	30
Ratio R	0.426		

Online Controls for Storm

Pump Manhole: PUMP, DS/PN: 1.007, Volume (m³): 4.8

Invert Level (m) 99.731

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	30.0000	0.900	30.0000	1.700	30.0000	2.500	30.0000
0.200	30.0000	1.000	30.0000	1.800	30.0000	2.600	30.0000
0.300	30.0000	1.100	30.0000	1.900	30.0000	2.700	30.0000
0.400	30.0000	1.200	30.0000	2.000	30.0000	2.800	30.0000
0.500	30.0000	1.300	30.0000	2.100	30.0000	2.900	30.0000
0.600	30.0000	1.400	30.0000	2.200	30.0000	3.000	30.0000
0.700	30.0000	1.500	30.0000	2.300	30.0000		
0.800	30.0000	1.600	30.0000	2.400	30.0000		

Pump Manhole: DR1, DS/PN: 1.008, Volume (m³): 3.5

Invert Level (m) 101.250

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0000	0.900	0.0000	1.700	0.0000	2.500	0.0000
0.200	0.0000	1.000	0.0000	1.800	0.0000	2.600	0.0000
0.300	0.0000	1.100	0.0000	1.900	0.0000	2.700	0.0000
0.400	0.0000	1.200	0.0000	2.000	0.0000	2.800	0.0000
0.500	0.0000	1.300	0.0000	2.100	0.0000	2.900	0.0000
0.600	0.0000	1.400	0.0000	2.200	0.0000	3.000	0.0000
0.700	0.0000	1.500	0.0000	2.300	0.0000		
0.800	0.0000	1.600	0.0000	2.400	0.0000		

Storage Structures for Storm

Filter Drain Manhole: FD1, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Trench Length (m)	25.0
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Diameter (m)	0.150
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	150.0
Invert Level (m)	100.398	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000

Complex Manhole: DR1, DS/PN: 1.008

Cellular Storage

Invert Level (m)	101.250	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01476	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.01476		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	70.0	70.0	1.321	0.0	114.9
1.320	70.0	114.9			

Infiltration Basin

Invert Level (m)	103.100	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01476	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.01476		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	42.0	0.500	746.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.426
Region England and Wales		Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	30 Winter	100	+40%	100/15 Summer				
1.001	30 Winter	100	+40%	100/15 Summer				
1.002	30 Winter	100	+40%	100/15 Summer				
2.000	30 Winter	100	+40%	100/15 Summer				
1.003	30 Winter	100	+40%	100/15 Summer				
3.000	30 Winter	100	+40%	100/15 Summer				
3.001	30 Winter	100	+40%	100/15 Summer				
1.004	30 Winter	100	+40%	100/15 Summer				
1.005	30 Winter	100	+40%	100/15 Summer				
1.006	30 Winter	100	+40%	100/15 Summer				
1.007	30 Winter	100	+40%	100/15 Summer				
1.008	960 Winter	100	+40%	100/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	MH01	102.543	0.883	0.000	0.21	0.0	14.0	SURCHARGED
1.001	MH02	102.538	1.138	0.000	0.38	0.0	23.6	SURCHARGED
1.002	MH03	102.532	1.217	0.000	0.47	0.0	30.3	SURCHARGED
2.000	MH04	102.523	1.243	0.000	0.16	0.0	10.4	SURCHARGED
1.003	MH05	102.520	1.358	0.000	0.51	0.0	34.0	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
3.000	MH06	102.505	1.353	0.000	0.16	0.0	10.6	SURCHARGED
3.001	MH07	102.500	1.572	0.000	0.36	0.0	19.5	SURCHARGED
1.004	MH08	102.496	1.608	0.000	0.85	0.0	53.9	SURCHARGED
1.005	MH09	102.465	1.703	0.000	1.14	0.0	67.4	SURCHARGED
1.006	FD1	102.437	1.889	0.000	2.97	0.0	40.9	SURCHARGED
1.007	PUMP	101.646	1.765	0.000	5.61	0.0	30.0	SURCHARGED
1.008	DR1	103.485	2.085	0.000	0.00	0.0	0.0	FLOOD RISK

Appendix: L – Essex SuDS Proforma

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
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Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Introduction

This proforma identifies the information required by Essex LLFA to enable technical assessment the Designers approach to water quantity and water quality as part of SuDS design approach in compliance with Essex SuDS Design Guide.

Completion of the proforma will also allow for technical assessment against Non-statutory technical standards (NSTS) for Sustainable Drainage. The proforma will accompany the site specific Flood Risk Assessment and Drainage Strategy submitted as part of the planning application.

Please complete this form in full for full applications and the coloured sections for outline appllications. This will help us identify what information has been included and will assist with a smoother and quicker application.

Instructions for use

Use the units defined for input of figures

Numbers in brackets refer to accompanying notes.

Where ……m^3 .....m^3/m^2 *are noted – both values should be filled in.*

Site details

1.1	Planning application reference (if known)			
1.2	Site name	Bullsfield, Warsih Hall Farm		
1.3	Total application site area (1)	7.9	ha	
1.4	Predevelopment use (4)	Greenfield		
1.5	Post development use	Residential		
	If other, please sepcify			
1.6	Urban creep applicable	Yes	if yes, factor applied:	10%
1.7	Proposed design life / planning application life	100 years		
1.8	Method(s) of discharge: (5)			

☐ *Reuse* ☑ *Infiltration* ☐ *Hybrid* ☐ *Waterbody* ☐ *Storm sewer* ☐ *Combined sewer*

1.9	Is discharge direct to estuary / sea	No	
1.10	Have agreements in principle (where applicable) for discharge been provided	No	

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment

Calculation inputs

2.1	Area within site which is drained by SuDS (2)	16295	m^2
2.2	Impermeable area drained pre development (3)	0	m^2
2.3	Impermeable area drained post development (3)	16295	m^2
2.4	Additional impermeable area (2.3 minus 2.2)	16295	m^2
2.5	Method for assessing greenfield runoff rate	ICP SuDS	
2.6	Method for assessing brownfield runoff rate		
2.7	Coefficient of runoff (Cv) (6)	0.75/0.84	
2.8	Source of rainfall data (FEH Preferred)	FSR	
2.9	Climate change factor applied 40	%	

Attenuation (positive outlet)

2.10 Drainage outlet at risk of drowning (tidal locking, elevated water levels in watercourse/sewer)
Note: Vortex controls require conditions of free discharge to operate as per manufacturers specification.

2.11 Invert level at final outlet N/A mAOD

2.12 Design level used for surcharge water level at point of discharge (16) N/A mAOD

Infiltration (Discharge to Ground)

2.13 Have infiltration tests been undertaken Yes

2.14 If yes, which method has been used BRE 365

2.15 Infiltration rate (where applicable) 4.1 x 10^-6 m/s

2.16 Depth to highest known ground water table N/A mAOD

2.17 If there are multiple infiltration features please specify where they can be found in the FRA Section 5

2.18 Depth of infiltration feature Varies mAOD

2.19 Factor of safety used for sizing infiltration storage 2

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Calculation outputs

Sections 3 and 4 refer to site where storage is provided by full attenuation or partial infiltration. Where all flows are infiltrated to ground go straight to Section 6.

3.0	**Greenfield runoff rates** (incl. Urban Creep)				
3.1	1 in 1 year rainfall	2.4	l/s/ha,	3.9	l/s for the site
3.2	1 in 30 year rainfall	6.4	l/s/ha,	10.4	l/s for the site
3.3	1 in 100 year rainfall + CCA	9.1	l/s/ha,	14.8	l/s for the site
4.0	**Brownfield runoff rates** (incl. Urban Creep)				
4.1	1 in 1 year rainfall		l/s/ha,		l/s for the site
4.2	1 in 30 year rainfall		l/s/ha,		l/s for the site
4.3	1 in 100 year rainfall + CCA		l/s/ha,		l/s for the site
5.0	Proposed maximum rate of runoff from site (incl. Urban Creep) (7)				
5.1	1 in 1 year rainfall		l/s/ha,		l/s for the site
5.2	1 in 30 year rainfall		l/s/ha,		l/s for the site
5.3	1 in 100 year rainfall + CCA		l/s/ha,		l/s for the site
6.0	Attenuation storage to manage flow rates from site (incl. **Climate Change Allowance** (CCA) and Urban Creep)				
6.1	Storage - 1 in 100 year + CCA (9)		m^3		m^3/m^2
6.2	50% storage drain down time 1 in 30 years				hours
7.0	Controlling volume of runoff from the site(10)				
7.1	Pre development runoff volume(12) (development area)				m^3 for the site
7.2	Post development runoff volume (unmitigated) (12)				m^3 for the site
7.3	Volume to be controlled (5.2 - 5.1)				m^3 for the site

Essex County Council

7.4 Volume control provided by:

- Interception losses[13] m^3
- Rain harvesting [14] m^3
- Infiltration m^3
- Attenuation m^3
- Separate volume designated as long term storage[15] m^3

7.5 Total volume control (sum of inputs for 5.4) m^3 [17]

8.0 Site storage volumes (full infiltration only)

8.1	Storage - 1in 30 year + CCA [8]	m^3	m^3/m^2 (of developed impermeable area)
8.2	Storage - 1 in 100 year + CCA [11]	m^3	m^3/m^2

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Design Inputs

Proposed site use: Residential

Pollution hazard category (see C753 Table 26.2): Very low/Low

High risk area defined as area storing fuels chemicals, refuelling area, washdown area, loading bay.

Design Outputs

List order of SuDS techniques proposed for treatment

Note that gully pots, pipes and tanks are not accepted by Essex LLFA as a form of treatment (for justification see C753 Section 4.1, Table 26.15 and Box B.2)

Are very high pollution risk areas drained separate from SuDS to foul system: No

Other

Please include any other information that is relevant to your application

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.
3. Impermeable area should be measured pre and post development. Impermeable surfaces include, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF (Essex SuDS Design Guide).
5. Runoff may be discharge via one or more methods.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the applicant should justify the selection of Cv.
7. It is Essex County Council's preference that discharge rates for all events up to the 1 in 100 year event plus climate change are limited to the 1 in 1 greenfield rate. This is also considered to mitigate the increased runoff volumes that occur with the introduction of impermeable surfaces. If discharge rates are limited to a range of matched greenfield flows then it is necessary to provide additional mitigation of increased runoff volumes by the provision of Long-term Storage.
8. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
9. Runoff generated from rainfall events up to the 1 in 100 year will not be allowed to leave the site in an uncontrolled way. Temporary flooding of designated areas to shallow depths and velocities may be acceptable.
10. The following information should only be provided if increased runoff volumes are not mitigated by limiting all discharge rates back to the greenfield 1 in 1 year rate.
11. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
12. To be determined using the 100 year return period 6 hour duration winter rainfall event.
13. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques. Further information is available in the SuDS Design Guide.
14. Please refer to Rain harvesting BS for guidance on available storage.
15. Flows within long term storage areas should be infiltrated to the ground or discharged at low flow rate of maximum 2 l/s/ha.
16. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Outlets can be tidally locked where discharge is direct to estuary or sea. Calculations should demonstrate that risk of downed outlet has been taken into consideration. Vortex controls require conditions of free discharge to operate as per specification.
17. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.

Appendix: M - Exceedance and Conveyance Routes

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KEY:

OVERLAND SURFACE WATER FLOW ROUTE – TAKING INTO ACCOUNT PROPOSED COVER LEVELS

Pond

Pond

Pond

103.4m

Pump

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:

PLANNING

EAS

Unit 23, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777

www.eastp.co.uk

CLIENT:

WESTON HOMES

ARCHITECTS:

PROJECT:

WARISH HALL FARM
TAKELY

TITLE:

WOODLANDS
OVERLAND SURFACE WATER FLOW PATHS AND EXCEEDANCE ROUTES

SCALE @ A3:	DESIGN - DRAWN:	DATE:
1:500	MC	06/06/2023

PROJECT No:	DRAWING No:
2951	SK16 – REV C

Appendix: N – Maintenance and Management Plan

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Maintenance and Management Plan

April 2023

EAS

Bull Field, Warish Hall Farm,

Takeley

Weston Homes

Document History

JOB NUMBER: 2951/2023
DOCUMENT REF: Maintenance and Management Plan
REVISIONS: A - Final

Revision	Comments	By	Checked	Authorised	Date
A	Client Draft	MC	SA	SA	27/04/2023
B					
C					
D					
E					

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1 Introduction

1.1 This maintenance and management plan has been prepared in support of a SuDS Strategy and Flood Risk Assessment submitted for an application by Weston Homes for a proposed development at Bull Field, Warish Hall Farm, Takeley, Essex.

1.2 The proposed development comprises of a residential development consisting of 96 two to five-bedroom dwellings along with garages, driveways and amenity areas. The proposals also include two separate flatted blocks comprising one – bedroom and two – bedroom apartments. The total site area is approximately 7.9ha.

1.3 Sustainable Drainage Systems (SuDS) are a sequence of water management techniques and features used to mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk, these features can improve water quality and provide biodiversity and amenity benefits.

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2 SuDS Strategy at Bull Field

Proposed SuDS Strategy

2.1 It is proposed that the private driveways and car parking areas will utilise permeable surfacing within its construction. The majority of the access road is to be adopted and therefore cannot utilise permeable surfacing however, the areas of the access road not being offered for adoption will also use permeable surfacing. This will allow surface water to infiltrate through the paving and be stored within the sub-base of the driveways, car parking areas and sections of the access road before allowing the surface water runoff to infiltrate to the ground.

2.2 The permeable private driveways are to manage surface water runoff from roof areas of the adjacent dwellings with the runoff from dwellings adjacent to car parking areas to be directed to these sections of permeable paving.

2.3 The depth of sub-base for the areas of permeable surfacing will range from 137mm to 426mm in order to provide adequate attenuation whilst allowing surface water runoff to infiltrate to the ground. Due to attenuation requirements, some sections of permeable paving are proposed to utilise a permavoid sub-base replacement in order to reduce sub-base depths.

2.4 As the main section of the access road is to be adopted it is proposed to utilise an impermeable tarmac construction. Therefore, a pipe network has been proposed to collect surface water runoff from this section of the access road. The pipe networks then directs the runoff to a filter drain followed by a crate soakaway with an infiltration basin located above the crate soakaway to act as an overflow for more sever rainfall events.

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3 Management of Development Drainage

3.1 It is assumed that all elements of the proposed drainage system will remain private and the responsibility will remain with a maintenance company set up by the developer.

3.2 Maintenance of the drainage systems serving the private driveways and residential roofs will be the responsibility of the individual residents.

3.3 Regular inspections of the permeable paving, inspection chambers and orifice plate controls should be made, to ensure they are effective throughout the lifetime of the development and do not become blocked or damaged over time.

3.4 Some maintenance activities for the proposed SuDS devices as detailed in CIRIA C753 'The SuDS Manual' are set out in Tables 3.1-3.4 below.

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times per year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturer's recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas. Removal of weeds.	As required. As required.
Remedial actions	Remediate any landscaping which, through vegetation maintenance of soil slip, has been raised to within 50mm of the level of the paving. Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of a hazard to the user. Rehabilitation of surface and upper sub-surface.	As required As required As required (if infiltration performance is reduced as a result of significant clogging.)
Monitoring	Initial inspection Inspect for evidence of poor operation and/or weed growth. If required, take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Monitor inspection chambers.	Monthly for 3 months after installation. 3 monthly, 48 hours after large storms. Annually. Annually.

Table 3.1: Maintenance tasks for permeable paving (Source: CIRIA C753, The SuDS Manual)
Manholes and Sewers

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

Table 3.2: Maintenance tasks for filter drains (Source: CIRIA C753, The SuDS Manual)

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Removing litter, debris and trash	Monthly
	Cut grass – for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional maintenance	Reseed areas of poor vegetation growth	Annually, or as required
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required

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Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies	Half yearly
	Inspect infiltration surfaces for compaction and ponding	Monthly

Table 3.3: Maintenance tasks for infiltration basins (Source: CIRIA C753, The SuDS Manual)

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Table 3.4: Maintenance tasks for soakaways (Source: CIRIA C753, The SuDS Manual

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3.5 It is recommended that during the first 12 months of operation all SuDS and drainage features are visually inspected on a monthly basis to determine any seasonal patterns this includes the permeable surfacing, inspection chambers, inlets, outlets and flow control devices. This will determine whether or not the recommended service intervals set out by CIRIA in the figure above and recommended in this document will be sufficient for maintenance beyond the first year.

3.6 After the first 12 months of monitoring, the maintenance schedule may need to be revised to provide specific actions at more frequent intervals but it should be noted that maintenance should not be provided at intervals less than those specified in the tables above set out by CIRIA.

3.7 All catchpits prior to the permeable surfacing should be inspected on a quarterly basis after the first year and are likely to need maintenance once or twice a year to clear silt and debris but this should be based on the first years monitoring.

3.8 During the quarterly visual inspections, the final site inspection chamber and headwall should also be checked to ensure the drainage is able to leave the site and enter the receiving watercourse.

3.9 It is important that the maintenance schedule changes throughout the lifetime of the development and with changes in weather conditions. The maintenance schedule set out in this document is only a guideline and it may be necessary to increase the frequency of inspections during particularly wet seasons or if there are any signs of reduced performance.

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4 Summary and Conclusion

4.1 This maintenance and management plan has been prepared in support of an application by Weston Homes for a proposed development at Bull Field, Warish Hall Farm, Takeley, Essex.

4.2 The Sustainable Drainage System (SuDS) proposed on site consists of separate sections of permeable surfacing with varying subbase depths between 137-426mm, each allowing surface water to naturally infiltrate to the ground whilst providing the required attenuation.

4.3 Section of the proposed access road are to be adopted and therefore cannot utilise permeable paving. As such, surface water runoff from these areas are to be managed by a filter drain, crate soakaway and infiltration basin.

4.4 The development drainage is the responsibility of the site owner and will be maintained by a private management company who are yet to be appointed.

4.5 It is recommended that during the first 12 months of operation all SuDS and drainage features are visually inspected on a monthly basis to determine any seasonal patterns this includes all SuDS features, inspection chambers, inlets, outlets and flow control devices.

4.6 Following this initial 12 month period, maintenance will be carried out to at least the requirements set out in Figures 1 and 2 based on information from the CIRIA SuDS Manual. A visual inspection of all flow control devices and headwall will be carried out quarterly as a minimum.

4.7 It is important that the maintenance schedule changes throughout the lifetime of the development and with changes in weather conditions. The maintenance schedule set out in this document is only a guideline and it may be necessary to increase the frequency of inspections during particularly wet seasons or if there are any signs of reduced performance.

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