



UK Flood Risk
Flood Risk Consultants

Site Drainage Strategy
(Sustainable Urban Drainage
Systems SuDS)
7 Dorset Way, Uxbridge UB10 0JR

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Executive Summary

UK Flood Risk Consultants has been commissioned to develop a Sustainable Urban Drainage Systems (SuDS) Strategy in support of a proposal consisting of a residential development with the existing Bungalow to be replaced by 2 no. three-bed semi-detached houses located at 7 Dorset Way, Uxbridge UB10 0JR.

The main sources of information to develop the SuDS strategy are the guidelines of the National Planning Policy Framework (NPPF, July 2021) and the Environment Agency's Flood Risk Assessment (FRA) Guidance Notes along with the best practice guidance in flood risk and drainage including the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015).

The overall risk of surface water flooding to the site is low.

The surface runoff will be improved by implementing appropriate SuDS measures.

An open ground attenuation storage will not be feasible at the site due to the limited space available. Therefore, underground geo-cellular storage (Length = 4m, Width = 3m, Depth = 0.40m) will be implemented on each of the two plots in order to temporarily store storm water from the site.

The outflow from the attenuation storage will be discharged into the existing SW sewer that runs across the site. The outflow discharge will be limited by implementing Hydrobrake or similar so that the maximum discharge will not be more than 1 litre per second.

The landowners will be fully responsible for the repair and management of the implemented SuDS throughout the lifetime of the proposed development.

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Abbreviations

Abbreviation	Description
mAOD	Metres Above Ordnance Datum
DEFRA	Department for Environment, Food, and Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
PFRA	Preliminary Flood Risk Assessment
SuDS	Sustainable Drainage Systems

1.0 Background

UK Flood Risk Consultants has been commissioned to develop a Sustainable Urban Drainage Systems (SuDS) Strategy in support of a proposal consisting of a residential development with the existing Bungalow to be replaced by 2 no. three-bed semi-detached houses located at 7 Dorset Way, Uxbridge UB10 0JR.

This Sustainable Urban Drainage Systems (SuDS) Strategy has been developed in accordance with the guidelines and the requirements of the National Planning Policy Framework (NPPF, July 2021) and the Environment Agency's Flood Risk Assessment (FRA) Guidance Notes along with the best practice guidance in flood risk and drainage including the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015).

2.0 Surface Water Drainage Requirements

A surface water drainage assessment should be undertaken to demonstrate that surface water runoff from the proposed development can be effectively managed without increasing flood risk elsewhere. A surface water drainage assessment should include the following:

- Assessment of whether the development will increase the overall discharge from the site by calculating the change in area covered by roofs and hard-standing.
- Details of how overland flow from the new development can be intercepted to prevent flooding of adjacent land.
- Details of how additional onsite surface water attenuation can be provided to mitigate against known flooding problems or as a result of incapacity on the drainage systems.
- Demonstration that overland flows will not increase flood risk to both existing development and receiving watercourses.

3.0 General Description of the Site and the Proposals

3.1. Description of the site

The proposal site is located at 7 Dorset Way, Uxbridge UB10 0JR approximately centred on the OS NGR (**Appendix A Figure 1**). The site is located within the administrative boundary of London Borough of Hillingdon which is the Local Planning Authority.

The site comprises a residential dwelling with hardstanding and soft landscaping areas. The site occupies an area of approximately 747m². The access to the site is via Dorset Way. The surrounding area consists of predominantly residential use (**Appendix A Figure 2**).

The British Geological Survey's geological maps show that the bedrock of the site comprises London Clay Formation - Clay, Silt and Sand that formed approximately 48 to 56 million years ago in the Palaeogene Period (**Appendix A Figure 3**). The superficial deposits consist of Black Park Gravel Member - Sand and Gravel that formed up to 2 million years ago in the Quaternary Period.

There are no major watercourses in the vicinity of the site.

The site topography is relatively flat and level with the general elevation varying from 52.10mAOD to 52.96mAOD. Further details about the existing site are provided in **Appendix B**.

3.2. Proposed Development

The proposal consists of a residential development with the existing Bungalow to be replaced by 2 no. three-bed semi-detached houses. The total footprint area of the proposed houses is approximately 196m². Further details about the proposals have been provided in **Appendix B**.

4.0 Sustainable Urban Drainage Systems Policy

4.1. Flood and Water Management Act 2010

The method of drainage of surface water from the site is bound by the Flood and Water Management Act 2010. Schedule 3 Paragraph 5 of the Flood and Water Management Act 2010 states that the following hierarchy is to be applied to surface water runoff in the following order or priority:

- Discharge into the ground (infiltration)
- Discharge to a surface water body (lake, river, drain);
- Discharge to a surface water sewer, highway drain or another drainage system; or Discharge into a combined sewer.

4.2. Drainage Hierarchy

Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy as set out by the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015):

1. rainwater harvesting (including a combination of green and blue roofs)
2. infiltration techniques and green roofs
3. rainwater attenuation in open water features for gradual release
4. rainwater discharge direct to a watercourse (unless not appropriate)
5. rainwater attenuation above ground (including blue roofs)
6. rainwater attenuation below ground
7. rainwater discharge to a surface water sewer or drain
8. rainwater discharge to a combined sewer.

5.0 Assessment of Surface Runoff Flood Risk

The surface water flooding arises when the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded and the excess rainwater flows overland. The severity of surface water flooding depends on several factors such as the degree of saturation of the soil before the event, the permeability of soils and geology, hill slope steepness and the intensity of land use.

Information on the risk of surface water flooding is held by the Environment Agency. The Environment Agency's Surface Water Flood Risk Maps are provided in **Appendix C Figure 1 and Figure 2** which indicate that the risk of surface water flooding to the site is 'low'.

6.0 Sustainable Urban Drainage Systems (SuDS)

London Borough of Hillingdon strongly encourages the principles of SuDS on all forms of development. The developer should seek the most sustainable SuDS solution in order to reduce flood risk, improve water quality and improve the environment overall. The Local Authority encourages the developers to provide SuDS on major developments while paying due regard to the National Planning Policy Framework (NPPF), Planning practice guidance, Non-statutory technical standards for sustainable drainage systems and the District local plan policies.

6.1. Existing Drainage

Most of the surface runoff infiltrates into the ground. The excess overland flow discharges into Dorset Way following the natural gradient slope towards the road.

6.2. Greenfield Runoff Estimation

The estimation of the Greenfield Runoff rate has been undertaken using the HR Wallingford's Greenfield Runoff Estimation tool available on the website: http://www.uksuds-.com/greenfieldrunoff_js.htm. The aim of the tool is to provide flow rate information based on a minimum amount of data so that anybody can use the tool. The methodology is built around the concept that a flow rate discharge constraint is needed for storm water runoff from a site, resulting in attenuation volume being needed. In addition, current drainage criteria include the requirement for the 100 year

6hr volume to be controlled. The tool is based on the results of simple model analysis and correlating the results against key known site parameters. As such the results need to be treated as providing indicative information only and should not be used to produce final designs of drainage systems without additional modelling being carried out. The peak flow estimation can now be estimated using two different formulae.

- 1) The formula developed in IH124 (IH 1994) and use of the FSSR growth curve information for regions of the UK (FSSR 14),
- 2) The use of FEH statistical correlation equation revised in 2008.

However, only the IH124 method can be used without providing specific parameter values. Therefore, this method has been used for estimating greenfield runoff rate from the proposed development site. Details about the parameters used in the estimation are provided in **Appendix D** and the results are summarised in **Table 1** below. The total site area of 0.10ha has been used which is the minimum area required for this technique. The proposed development will consider the greenfield runoff rates for addressing surface water discharge requirements from the developed site. The greenfield runoff rates will also be utilised for developing the drainage strategy for the site.

Table 1 – Greenfield Runoff Rates

Events	Greenfield runoff rates (l/s) (Estimated)
Qbar	0.16
1 in 1 year	0.14
1 in 30 year	0.37
1 in 100 year	0.51

6.3. Estimation of Permeable and Impermeable Areas

The changes in land cover have been summarised in **Table 2** below. It can be seen that the proposed development will lead an increase of impermeable area by 42m². This means the surface runoff will be increased as a result of the proposed development.

Table 2 Changes in Land Cover Areas

Land Cover	Pre-development, m ²	Post-development, m ²	Change, m ²
Impermeable Surface Area			
Hard standing	118	112	
Building footprint	148	196	
Total Impermeable	266	308	(+) 42
Permeable Surface Area			
Grass cover	481	439	
Total Permeable	481	439	(-) 42
Total Area	747	747	

6.4. Estimation of peak surface runoff rates

Pre-development Peak Runoff Rates

The Rational Method has been used in order to estimate the peak surface runoff from the site.

The Rational Equation is given by:

$$Q = A_r \times P \times R_i$$

Where, A_r = Effective catchment area, m²

P = Impermeability factor

R_i = Rainfall Intensity, mm/hr

Q = Peak surface runoff, m³/s

The peak surface runoff rates for the existing site condition (i.e. pre-development condition) are summarised in **Table 3** below. An impermeability factor of 0.90 has been used for the site. Information on the maximum rainfall intensity for a range of return period events has been taken from the MicroDrainage Model developed for the site which is provided in **Appendix E**. The impermeable surface areas in **Table 2** have been used as catchment for the calculations.

Table 3 Estimation of Peak Runoff Rates from the site (Pre-development condition)
based on the land cover area

Return Periods	Max Rainfall Intensity, Ri mm/hr	Catchment Area, A m ²	Impermeability factor, P	# Peak Runoff, Q, m ³ /sec	Peak Runoff, Q, litres/sec
1/ 1 year	32	266	0.9	0.00213	2.13
1/2 year	41.35	266	0.9	0.00275	2.75
1/5 year	53.2	266	0.9	0.00354	3.54
1/10 year	61.85	266	0.9	0.00411	4.11
1/30 year	78.55	266	0.9	0.00522	5.22
1/100 year	87.78	266	0.9	0.00584	5.84
1/100 year + 40% CC	87.78	266	0.9	0.00817	8.17

$Q = (R_i/1000 \times A \times P)/3600$

Ri taken from MicroDrainage model (**Appendix E**).

Post-development Peak Runoff Rates (without attenuation storage)

The peak surface runoff rates for the proposed site condition based on the land cover area but without considering any SuDS or attenuation storage are summarised in **Table 4** below. An impermeability factor of 0.90 has been used for the site. Information on the maximum rainfall intensity for a range of return period events has been taken from the MicroDrainage Model developed for the site which is provided in **Appendix E**. The impermeable surface areas in **Table 2** have been used as catchment for the calculations.

Table 4 Estimation of Peak Runoff Rates from the site (Post-development condition) based on the land cover area (not considering SuDS/Attenuation Storage)

Return Periods	Max Rainfall Intensity, Ri mm/hr	Catchment Area, A m ²	Impermeability factor, P	# Peak Runoff, Q, m ³ /sec	Peak Runoff, Q, litres/sec
1/ 1 year	32	308	0.9	0.00246	2.46
1/2 year	41.35	308	0.9	0.00318	3.18
1/5 year	53.2	308	0.9	0.00410	4.10
1/10 year	61.85	308	0.9	0.00476	4.76
1/30 year	78.55	308	0.9	0.00605	6.05
1/100 year	87.78	308	0.9	0.00676	6.76
1/100 year + 40% CC	87.78	308	0.9	0.00946	9.46

$Q = (Ri/1000 \times A \times P)/3600$

Ri taken from MicroDrainage model (**Appendix E**).

Post-development Peak Runoff Rates (with attenuation storage)

The peak surface runoff from the post-development condition will be limited to 1 litre/sec with the implementation of the attenuation storage system. The surface runoff rates for the site are summarised in **Table 5** below.

Table 5 Summary of Peak Runoff Rates from the site (Post-development condition with the provision of attenuation storage)

Return Periods	Peak Runoff Rate, Q, litre/sec
1/ 1 year	1
1/2 year	1
1/5 year	1
1/10 year	1
1/30 year	1
1/100 year	1

1/100 year + 40% CC

1

6.5. Hierarchy of SuDS Measures

The surface runoff from the site will be improved by implementing appropriate SuDS. The requirements for SuDS will ensure that any redevelopment or new development does not negatively contribute to the surface water flood risk of other properties and instead provides a positive benefit to the level of risk in the area. It will also ensure that appropriate measures are taken to increase the flood resilience of new properties and developments in surface water flood risk areas, such as those identified as being locally important flood risk areas.

The SuDS hierarchy and management train has been discussed in the SuDS Manual (C753) which aims to mimic the natural catchment processes as closely as possible. The general hierarchy of the SuDS measures is provided in **Table 6** below.

Table 6 General Hierarchy of SuDS Measures

Measures	Definition/Description
Prevention	The use of good site design and housekeeping measures to prevent runoff and pollution (e.g. rainwater harvesting/reuse).
Source control	Control of runoff at or very near its source (e.g. soakaways, porous and pervious surfaces, green roofs).
Site control	Management of water in a local area on site (e.g. routing water to large soakaways, infiltration or detention basins)
Regional control	Management of runoff from a site or several sites (e.g. balancing ponds, wetlands).

6.6. General Assessment of SuDS Measures for the site

Table 6 below presents the feasibility assessment of several SuDS measures for the site. The

Table 7 General Assessment of SuDS measures for the site

SuDS Measures	Issues/Description	Feasibility for the site
Source Control Porous and pervious materials/soakaways/green roof/infiltration trenches/disconnect downpipes to drain to lawns or infiltrate to soakaway.	Infiltration SuDS (Soakaway, Permeable paving) will improve the surface runoff from the site.	No. Due to the underlying soil condition composed of fine silt/clay, the potential for infiltration SuDS is low.
Site and Regional Control Infiltration/detention basins/ balancing ponds/ wetlands/underground storage/swales/retention ponds.	Open surface Balancing pond will not be feasible due to limited space available. Geo-cellular underground storage will improve the surface runoff conditions by temporarily storing the surface runoff from extreme rainfall event (1 in 100 year plus climate change)	No. The potential for balancing pond is low as there is very limited space available for open ground balancing pond. Yes. A Geo-cellular underground storage system can be implemented beneath the access drive in order to attenuate the surface runoff from the extreme event of 1 in 100 year plus climate change.

6.7. Proposed SuDS

Based on the general assessment of the potential SuDS measures above, an underground attenuation storage will be implemented in order to attenuate the surface runoff from the design 1 in 100-year 6-hour rainfall event plus 40% Climate Change. site.

7.0 Outline Design of SUDS

7.1. Proposed Surface Water Management

Attenuation Storage

An open ground attenuation storage will not be feasible at the site due to the limited space available. Therefore, an underground geo-cellular storage will be implemented in order to temporarily store storm water from the site.

The proposed scheme will therefore include underground Geo-cellular attenuation storage for each of the plot. The model has used the total attenuation storage volume as follows:

Total Area = 24m², Depth = 0.40m (for the two plots)

Therefore, each plot will be provided attenuation storage of 12m² area and 0.40m depth as shown in **Appendix F**.

The size of the proposed attenuation storage for each of the plots is as follows:

Length = 4m, Width = 3m, Depth = 0.40m

The greenfield runoff rate for the site is 0.16 litre/sec (**Table 1**). However, this is a very small flow rate which may lead to the blockage issues in the drainage system. Therefore, the maximum flow control of 1 litre per second has been adopted for all events up to and including 1% AEP + 40%CC with no flooding. The outflow discharge will be controlled by using a Hydrobrake so that the maximum outflow does not exceed 1 litre/sec. The proposed layout plan of the attenuation storage has been provided in **Appendix F**.

Thames Water's sewer asset map shows that a SW sewer runs across the site (**Appendix G**). The controlled outflow from the attenuation storage will be discharged into the existing SW sewer using 150mm linear drainpipe as shown in **Appendix F**.

Hydraulic Modelling

The proposed drainage scheme has been modelled by using Micro Drainage Source Control to understand the evolving flow regime under flood conditions and the potential for flooding. The site area considered for the modelling is 0.031ha, which is the area of the impermeable surface (i.e. building footprint and hardstanding area). The

attenuation storage has been modelled considering the 1 in 100 year (1%AEP) plus 40% climate change event. Both summer and winter profiles of the storm events have been considered for a range of duration, from 15 minutes to 8640 minutes. All input parameters (i.e. rainfall and model details) have been provided in **Appendix H**. The summary of the model output for the 1 in 100 year plus 40% climate change event is provided in **Table 8** below.

It can be seen from **Table 8** that for the maximum volume of 13.70m³ will be generated by the 120 minutes Winter event, and there will be no flooding for this event. Therefore, the adopted attenuation storage will provide full storage for the surface runoff generated from the design event of 1 in 100 year plus 40% climate change event.

Table 8 – Summary of Model Output (1 in 100 year plus 40% climate change)

Events	Rainfall mm/hr	Max Volume m ³	Discharge Volume m ³	Max Overflow m ³	Flooded Volume m ³
120 min (Winter)	34.69	13.70	18.10	3.1	0.0

The location and layout of the proposed attenuation storage and its dimensions (area and depth) can be changed to suit the site conditions. This will be to the client's discretion ensuring that the required attenuation storage volume is provided within the site.

Thames Water's sewer asset maps data indicate that a SW sewer runs across the site (**Appendix G**). The outflow from the attenuation storage will be discharged into the existing SW sewer not more than 1 litre/sec using a 150mm linear drain system.

Exceedance Flow Paths

It is inevitable that as a result of heavy or extreme rainfall, the capacities of sewers and other drainage systems will be exceeded on occasion. Drainage exceedance will occur when the rate of surface water runoff exceeds the inlet capacity of the drainage system, when the receiving water or pipe system becomes overloaded, when the outfall becomes restricted due to flood levels in the receiving water, or due to poor maintenance of the SuDS features.

The proposed attenuation storage has been designed for the 1 in 100 year plus 40% climate change event. Any extreme event greater than this design event may lead to

the situation where the rate of surface water runoff exceeds the inlet capacity of the drainage system. In such circumstances, the flow routes from the site will naturally follow towards Dorset Way, as this will be the only open area for the floodwater to flow across the site. The exceedance flow routes are shown in **Appendix I**.

7.2. SuDS Management and Maintenance Plan

The owners will be fully responsible for regular repair and maintenance of the proposed SuDS measures as required for the lifetime of the development. The SuDS at this site have been designed for easy maintenance to comprise:

Geo-cellular Storage System

Remedial work for repairing damage will be carried out whenever necessary. The repair and maintenance will include regular inspection of silt traps, manholes, pipework and pre-treatment devices, with removal of sediment and debris as required. **Table 9** provides further details on the regular maintenance of the Geo-cellular storage system.

Table 9 Regular Maintenance and remedial measures for Geo-cellular storage system

Regular Maintenance	Actions/Remedial measures
Monthly	- Inspect and identify any areas that are not operating correctly. If required, take remedial action. (for 3 months following installation) - Debris removal from catchment surface (where may cause risks to performance) - Inspect systems as specified by the manufacturer - Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.
Six monthly	Inspect and identify any areas that are not operating correctly. If required, take

	remedial action (following initial 3 month period).
Annually	- Remove sediment from pre-treatment structures (e.g. upstream silt- traps or Vortex flow control upstream) and geocellular system where required (High pressure water jetting) - Inspect and document the presence of wildlife.
Following all significant storms	Inspect and carry out essential recovery works to return the feature to full working order.

Flow control structures

Remedial work for repairing any damage to flow control structures/devices will be carried out whenever necessary. **Table 10** provides further details on the regular maintenance of the flow control structures/devices.

Table 10 Regular Maintenance and remedial measures for flow control structures

Regular Maintenance	Actions/Remedial measures
Monthly	Inspect and identify any areas that are not operating correctly. If required, take remedial action (for 3 months following installation).
Six monthly	- Inspect and identify any areas that are not operating correctly. If required, take remedial action. - Remove sediment from pre-treatment structures.
Following all significant storms	Inspect and carry out essential recovery works to return the feature to full working order.

8.0 Conclusion

The proposal consists of a residential development with the existing Bungalow to be replaced by 2 no. three-bed semi-detached houses located at 7 Dorset Way, Uxbridge UB10 0JR.

The overall risk of surface water flooding to the site is low.

The surface runoff will be improved by implementing appropriate SuDS measures.

An open ground attenuation storage will not be feasible at the site due to the limited space available. Therefore, underground geo-cellular storage (Length = 4m, Width = 3m, Depth = 0.40m) will be implemented on each of the two plots in order to temporarily store storm water from the site.

The outflow from the attenuation storage will be discharged into the existing SW sewer that runs across the site. The outflow discharge will be limited by implementing Hydrobrake or similar so that the maximum discharge will not be more than 1 litre per second.

The landowners will be fully responsible for the repair and management of the implemented SuDS throughout the lifetime of the proposed development.

Appendix A Collection of Maps and Figures

Appendix B Existing Site and Proposed Plans

Appendix C Surface Water Flood Maps

Appendix D Greenfield Runoff Rates

Appendix E Rainfall Runoff Summary

Appendix F Proposed Surface Runoff Improvement Measures

Appendix G Sewer Asset Maps Data

Appendix H Attenuation Storage Modelling Summary

Appendix I Exceedance Flow Routes