



Flood Risk Assessment

Development at
159 Charville Lane, Hayes, UB4 8PB



On behalf of
BFCGC

Date: 2nd November 2018

Reference: WTFR-FRA-2018/09/Q20 Rev B

Issue sheet

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A	JH	28/09/18		
B	JS	01/11/18	JH	02/11/18

Rev A – Amendments after feedback from client.

Rev B – Amendments relating to historical flooding, flood resilience measures, surface water disposal and further comments after client feedback.

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1. Introduction

WtFR Ltd has been commissioned by Joseph Jones of BFSGC to undertake a Flood Risk Assessment (FRA) in connection with the planning application for the proposed development at 159 Charville Lane, Hayes, UB4 8PB.

This FRA has been produced to demonstrate how risks from all sources of flooding to the site and flood risk to others from the development will be managed, in order to satisfy the requirements set out in the National Planning Policy Framework (NPPF).

A full assessment of the flood risk to the site and consideration of the surface water management as a result of the development has been considered as part of this analysis.

Data has been gathered from a number of other sources including: the Environment Agency (EA), the British Geological Society (BGS), National Soil Research Institute (NSRI), aerial photographs, Ordnance Survey (OS), commercially available historical mapping and relevant strategic documents developed by the London Borough of Hillingdon, in their capacity as both Local Planning Authority and Lead Local Flood Authority.

2. Site Description

Area Size: 650m² - Difference in footprint of dwelling +35m²

Grid reference: TQ 09198 83353

The proposals are for the replacement a previous bungalow at 159 Charville Lane, Hayes, UB4 8PB.

Figures 1 and 2 below show location details of the development site. Figure 3 shows an aerial photograph of the development site.

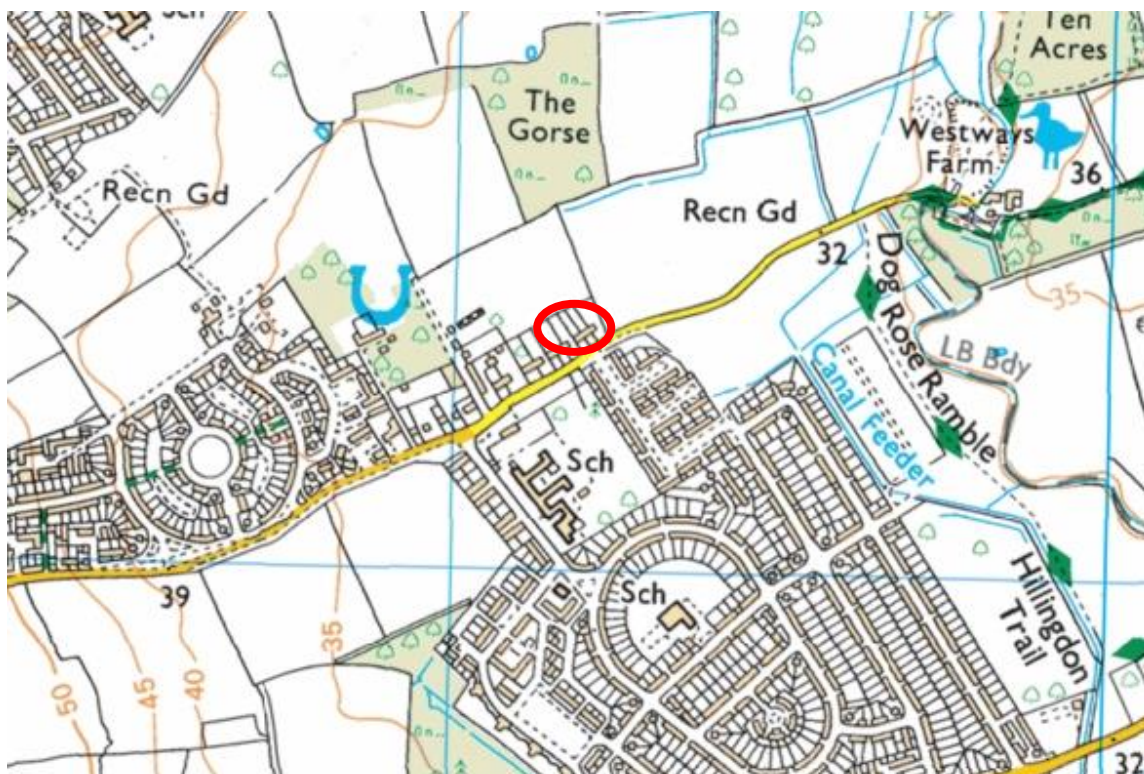


Figure 1 – Location of the site, highlighted.



Figure 2 – detailed location of the development site, highlighted.



Figure 3 – aerial photograph of the development site.

3. Flood Risk Assessment

3.1 National Planning Policy

Paragraph 163 of the NPPF states "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment⁵⁰. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (the sequential and exception tests, as applicable) it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- b) the development is appropriately flood resistant and resilient;
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- d) any residual risk can be safely managed; and
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan".

Footnote 50 states "A site-specific flood risk assessment should be provided for all development 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".

Furthermore paragraph 30 of the Planning Practice Guide on Flood Risk and Climate Change states "A site-specific flood risk assessment is carried out by (or on behalf of) a developer to assess the flood risk to and from a development site. Where necessary, the assessment should accompany a planning application submitted to the local planning authority. The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.

The objectives of a site-specific flood risk assessment are to establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- evidence for the local planning authority to apply (necessary) the Sequential Test, and;
- whether the development will be safe and pass the Exception Test, if applicable".

Continuing paragraph 31 of the Planning Practice Guidance quotes "The information provided in the flood risk assessment should be credible and fit for purpose. Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a Strategic Flood Risk Assessment for the area, and the interactive flood risk maps available on the Environment Agency's web site.

A flood risk assessment should also be appropriate to the scale, nature and location of the development. For example, where the development is an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people present in an area at risk of flooding, the local planning authority would generally need a less detailed assessment to be able to reach an informed decision on the planning application. For a new development comprising a greater number of houses in a similar location, or one where the flood risk is greater, the local planning authority would need a more detailed assessment”.

3.2 Local Planning Policy

Local Authorities consider flood risk through relevant environmental and climate change policies which enforce the requirements of the NPPF. Relevant local policy, as outlined by the London Borough of Hillingdon, is contained within the;

- i) Strategic Flood Risk Assessment
- ii) Local Flood Risk Management Strategy

The Strategic Flood Risk Assessment (SFRA) and the Local Flood Risk Management Strategy (LFRMS) are key sources of flood risk specific information for the area. The SFRA provides a more detailed review of flood risks and recommendations for ensuring developments can be constructed and operated safely in accordance with the NPPF. Furthermore, reference to the London Plan Policy 5.12 is taken into account within this assessment.

3.3 Flood Risk Zones, Vulnerability and Classification

These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency’s Flood Map for Planning available on the Environment Agency’s web site, as indicated in the table below.

Table 1 – Flood Zones

Flood Zone	Definition
Zone 1 <i>Low Probability</i>	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as ‘clear’ on the Flood Map – all land outside Zones 2 and 3)
Zone 2 <i>Medium Probability</i>	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a <i>High Probability</i>	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b <i>The Functional Floodplain</i>	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Table 2 – Flood Risk Vulnerability Classification

Essential Infrastructure
• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable
• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable
• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable
• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill* and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

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Water Compatible Development	
• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.	

* Landfill as defined in Schedule 10 to the Environmental Permitting (England and Wales) Regulations 2010.

Table 3 - Flood risk vulnerability and flood zone 'compatibility'

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a†	Exception Test required†	X	Exception Test required	✓	✓
Zone 3b*	Exception Test required*	X	X	X	✓*

Key:

✓ Development is appropriate

X Development should not be permitted.

Notes to table 3:

- This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;

- Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

* In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

4. Sources of flooding

4.1 Fluvial/Tidal

The Environment Agency's Flood Map for Planning (Rivers and Sea) identifies fluvial and tidal flood zones, and provides an indication of whether or not these zones are protected, due to the presence of flood defences (also highlighted). Figure 4, below, presents the Flood Map for the surrounding area.

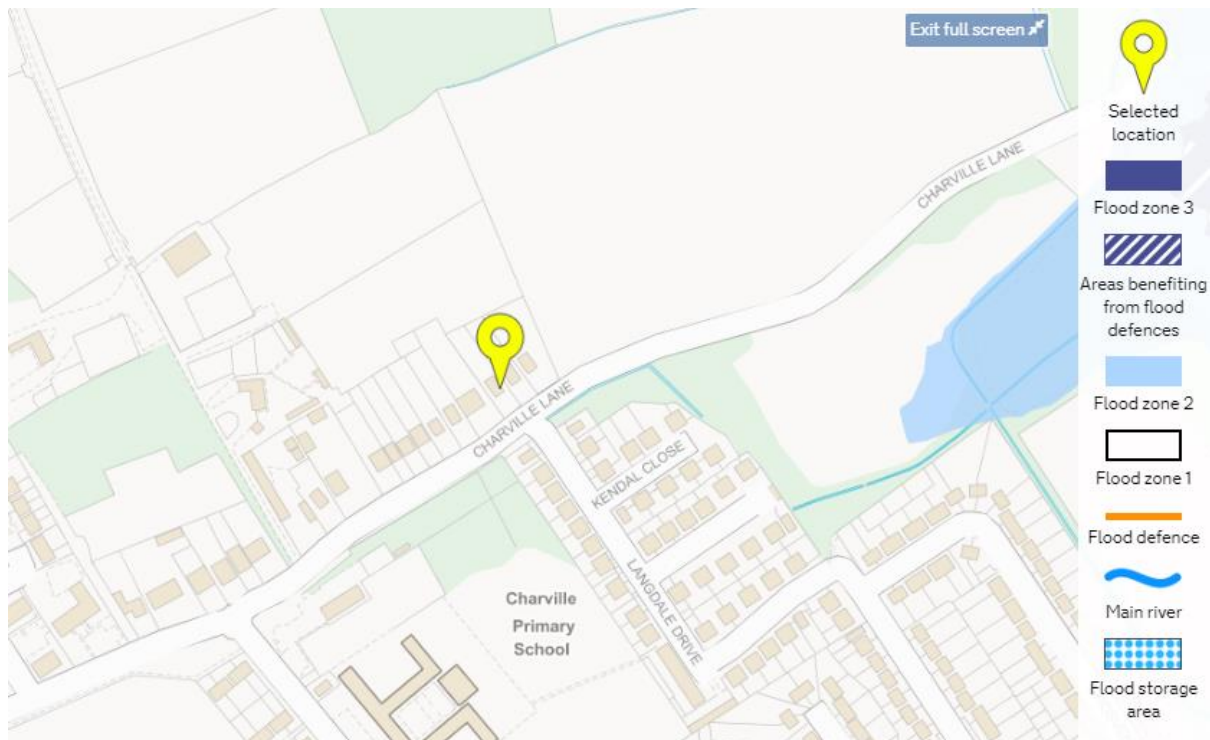


Figure 4 – Fluvial/tidal flood risk – EA Flood Map.

The EA Flood Map identifies the development site to lie within flood zone 1, where the chance of flooding in any given year is greater than 1 in 1000 (0.1%) in a flood event.

4.2 Historic Flooding

Analysis of strategic flood risk documents developed by the London Borough of Hillingdon does indicate historic flooding in and around the development site. The development area flooded on 24/12/13, 1/01/14 and 07/02/14. Figure 5 below is an extract is taken from the London Borough of Hillingdon 2014 flood investigation report and provides information on the historic flood events.

Area affected	f) Charville Lane, Ullswater Close, Kendall Close and Langdale Drive
Date of flooding	24/12/13, 1/01/14, and 07/02/2014
Grid Reference	509302 183279 or TQ0983SW
Land ownership	Residents, Private Landowner and Council
Map of Area	Photo
Location of flooding marked as a red star	December 2013 (From LBH)
	
Duration of flooding	Approx 24 hours
Source of flooding	Multiple - Main River - Yeading Brook, Ordinary Watercourse and surface water sewer
Cause/Pathway	River levels rising coming into back garden and Highway.
Impact of flooding	6 reports of flooded access roads and front and back gardens and garages flooded on Ullswater, and Kendal Close, also road flooded on Langdale Drive. 2 reported properties surrounded by water on Charville Lane. However approx 40 given sand bags.
Evidence	Anecdotal evidence and photos from Highways officers and residents
History of flooding	2013 and previous.
Summary	River levels high causing water to flow up Thames Water sewers, onto Highway, front drives and garages.
Action Residents and or Businesses	The Council recommends the residents work together to produce a Community Flood Plan, support will be offered in starting this, and identifying and signposting to any grants and appropriate property level protection which may be available.
Action by the Environment Agency	Investigation into issuing a specific surface water alert for this area. Feedback provided to the Environment Agency by the Council who have given a commitment to reviewing their monitoring and issuing of warnings in this area.
Action Thames Water	Confirm ownership and maintenance of culvert, jetting of manhole and clearance of culvert and trash screens to the rear of Kendal and Ullswater Close.
Action by the Council	Continue to ensure the Risk Management Authorities undertake the actions identified above. Continue to clear the ditch on Council owned land and clear the screens until Thames Water clarify their ownership and responsibility.

Figure 5 – Historic flood information

4.3 Surface Water Flooding

The Environment Agency's updated Flood Map for Surface Water (uFMfSW) identifies pluvial flood risk. Figure 6, below, presents the uFMfSW for the development site and the surrounding area.

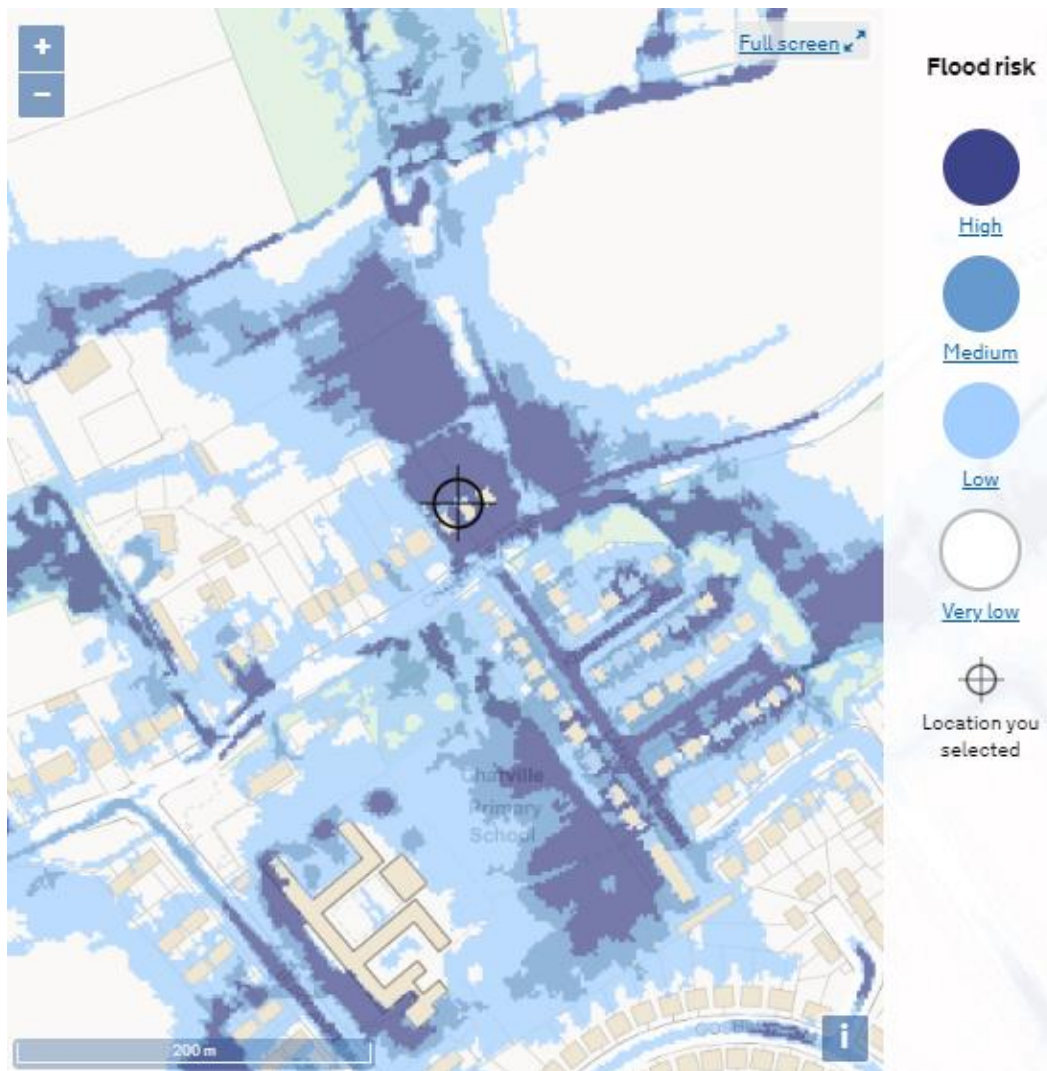


Figure 6 – Flooding from surface water sources, uFMfSW, site highlighted.

The uFMfSW shows that area in the vicinity of the development site is at high risk of surface water flooding. High risk means that the probability of flooding in any given year is greater than 1 in 30 (3.3%).

Further analysis of the uFMfSW has been undertaken to determine the surface water flood depths and velocities in the high, medium and low risk scenarios and these are shown in Figures 7a and 7b below.

This shows that in the high-risk scenario the flood depth ranges between below 300mm and 300-900mm with flood velocities less than 0.25m/s. In the medium and low risk scenarios the flood depths are predicted to be between 300 and 900mm, in the medium risk scenario the flood velocities are less than 0.25m/s and greater than 0.25m/s in the low risk scenario.

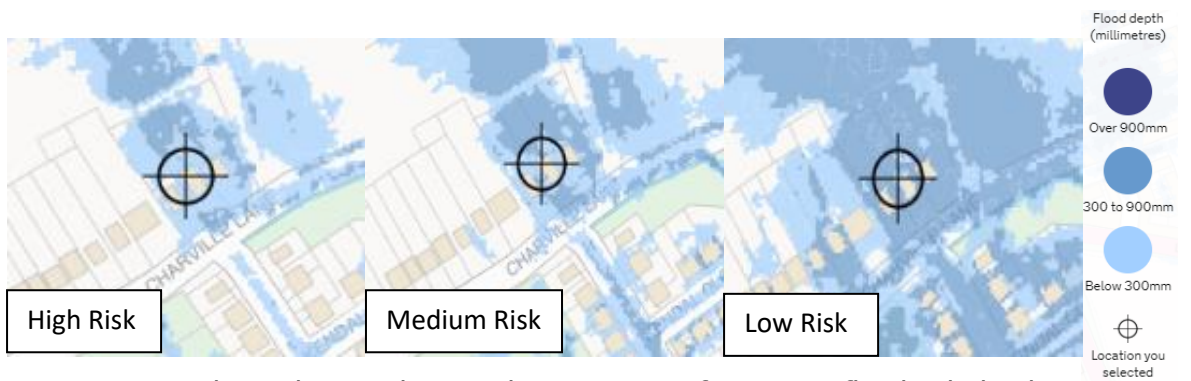


Figure 7a – High, Medium and Low risk scenario; surface water flood risk depth.

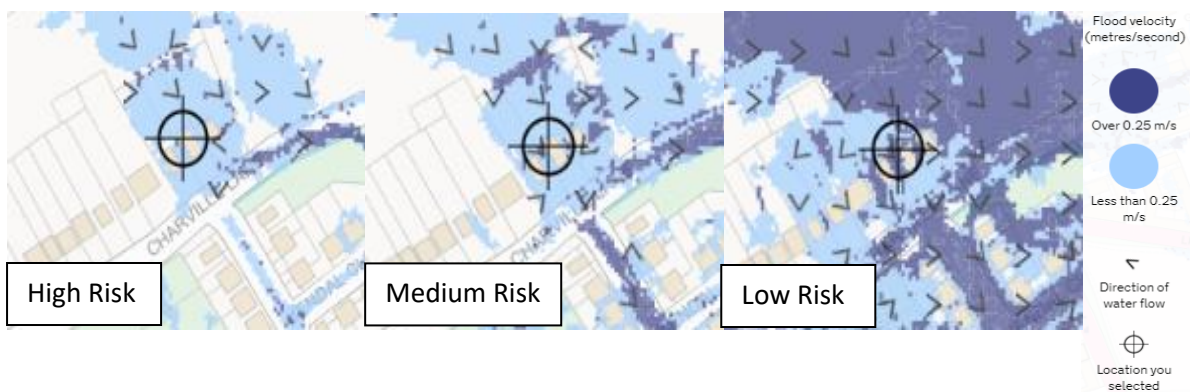


Figure 7b – High, Medium and Low risk scenario; surface water flood risk velocity.

4.4 Reservoir

The Environment Agency's Risk of Reservoir Flooding Map identifies the maximum extent of flooding that may be expected in the unlikely event that a reservoir dam failed. The development is at risk of a reservoir failing as shown below Figure 8.

The development is at risk of flooding from the Charville Lane FSA reservoir, which is owned by Environment Agency.

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensures that reservoirs are inspected regularly, and essential safety work is carried out.

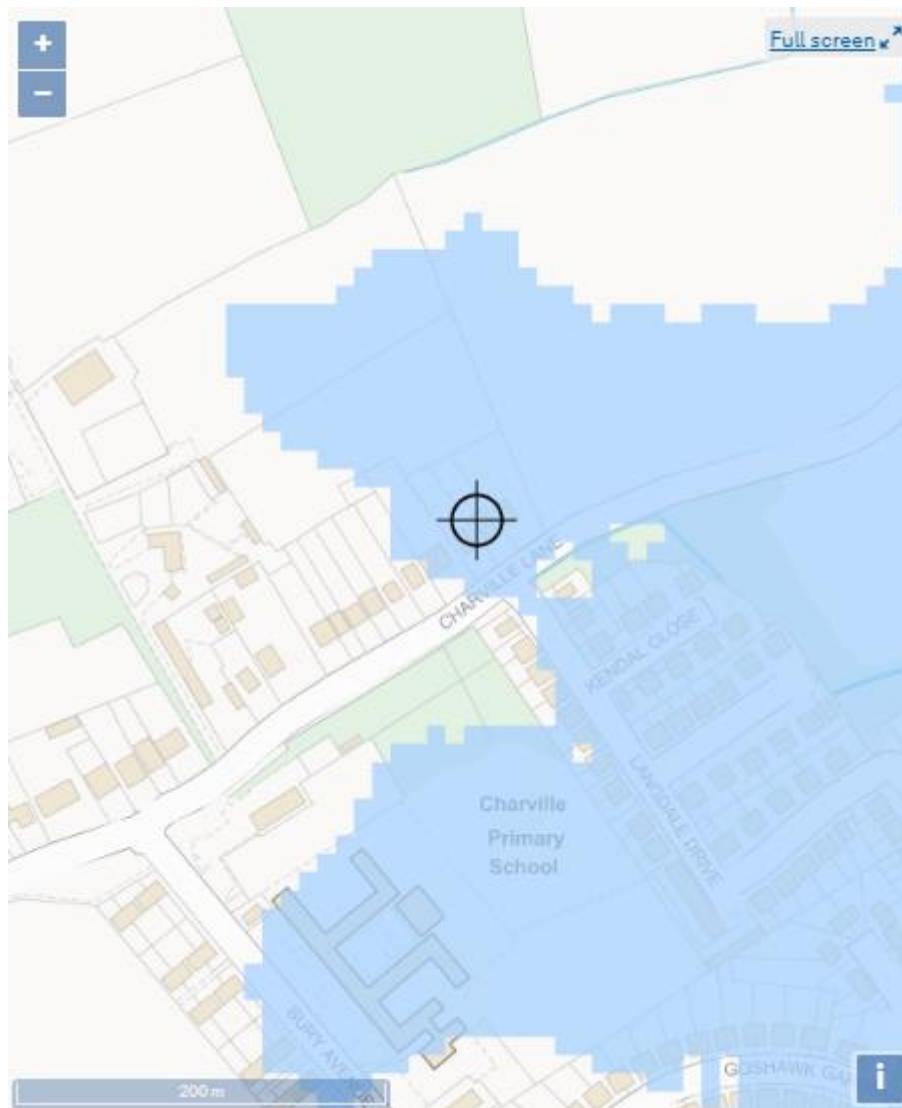


Figure 8 – Reservoir Flood Map.

4.5 Groundwater

The Environment Agency's Groundwater Vulnerability Map indicates that the development site is not situated over a groundwater vulnerability area, as shown in Figure 9. Further analysis shows that the development site is not situated over a Groundwater Source Protection Zone as shown in Figure 10.

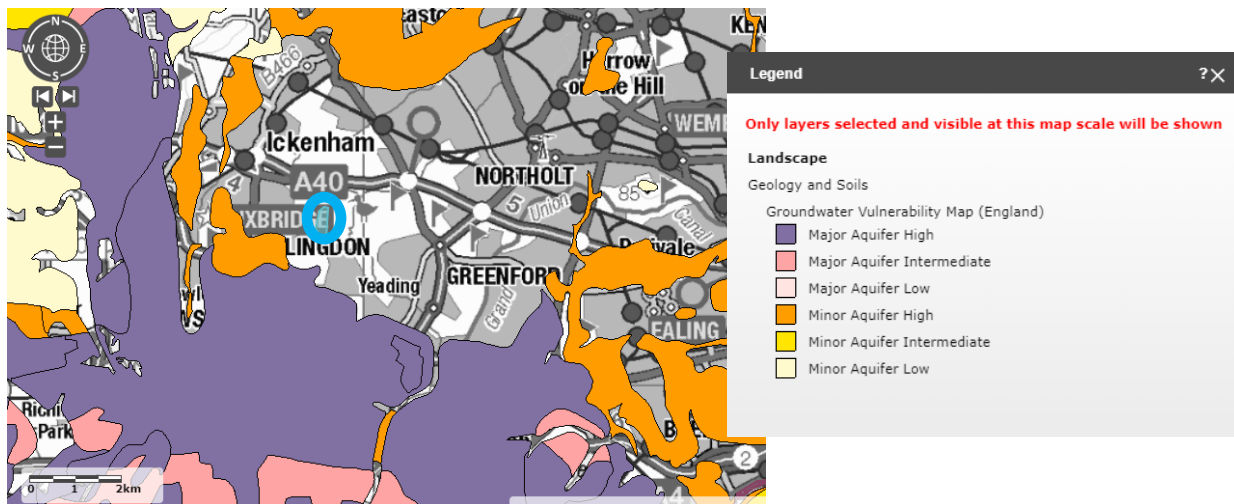


Figure 9 – Groundwater vulnerability map, site highlighted.

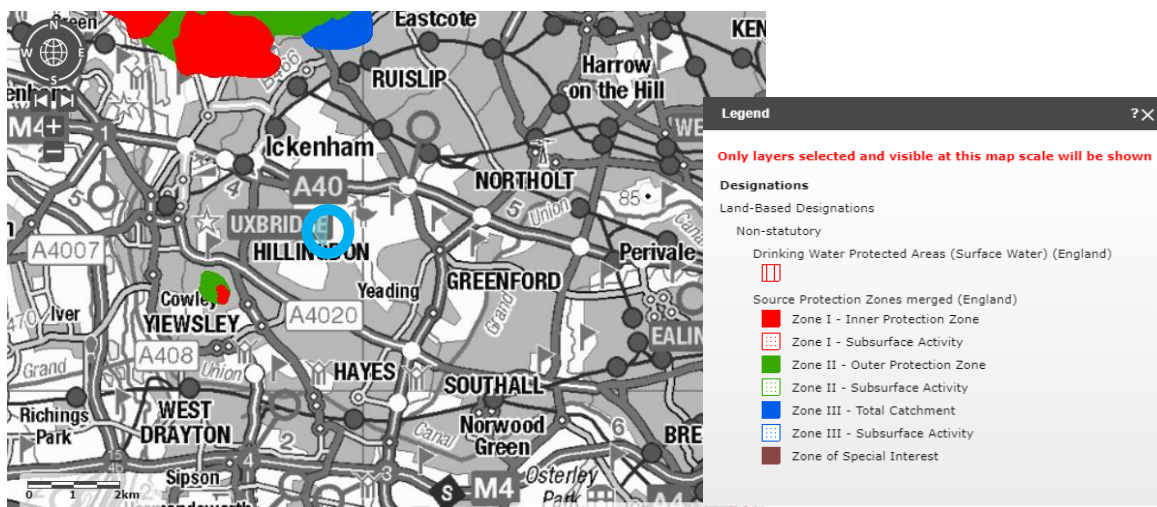


Figure 10 – Groundwater source protection zones, site highlighted.

Due to the minimal groundworks required for this development the impact on groundwater is considered to be negligible. However, the LPA have informed us of high groundwater levels in the immediate area to the development, with standing water being present in parks. As such mitigation measures will be proposed.

4.6 Geology

Figures 11 and 12 present information from the British Geological Survey.

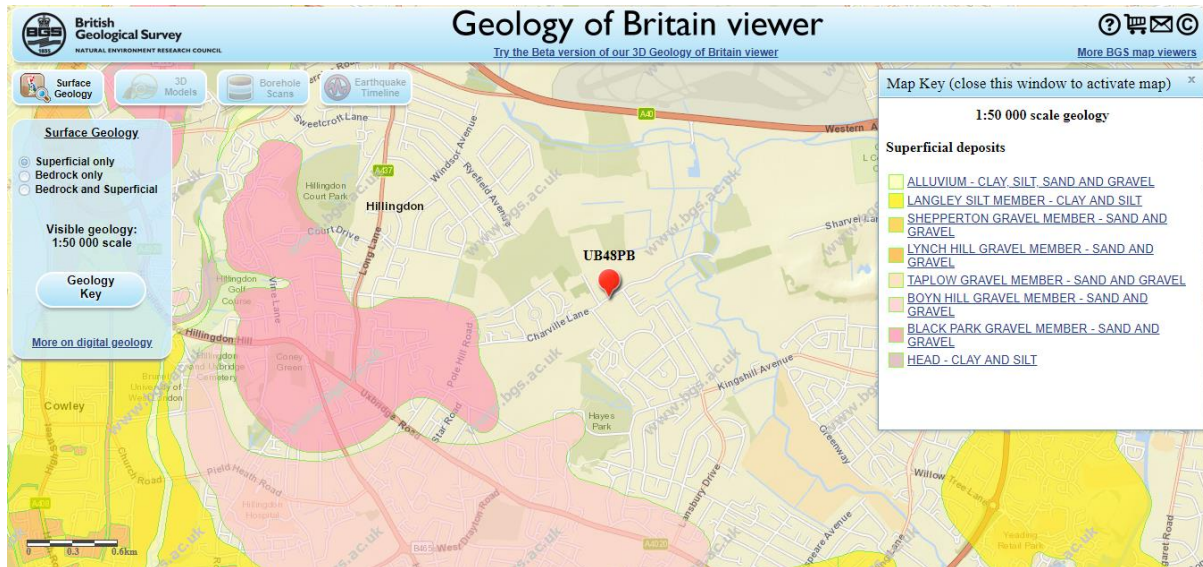


Figure 11 – Superficial Geology of the development.



Figure 12 – Bedrock geology of the development.

There are no superficial deposit records at the development site.

With regards to the bedrock, the site is underlain by the London Clay Formation - Clay, Silt and Sand. Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period. Local environment previously dominated by deep seas.

5. Proposed development

This FRA is prepared to support a planning application for the replacement a previous bungalow at 159 Charville Lane, Hayes, UB4 8PB. The replacement dwelling will be 35m² greater in size and its flood level will be at the same height as previous.

Buildings used for residential dwellings are classified as being **More Vulnerable** development within Table 2 of the National Planning Practice Guidance. More Vulnerable developments are acceptable within Flood Zone 1.

Figures 13 and 14 below show the existing development layouts.



Figure 13 – Existing ground floor plan.

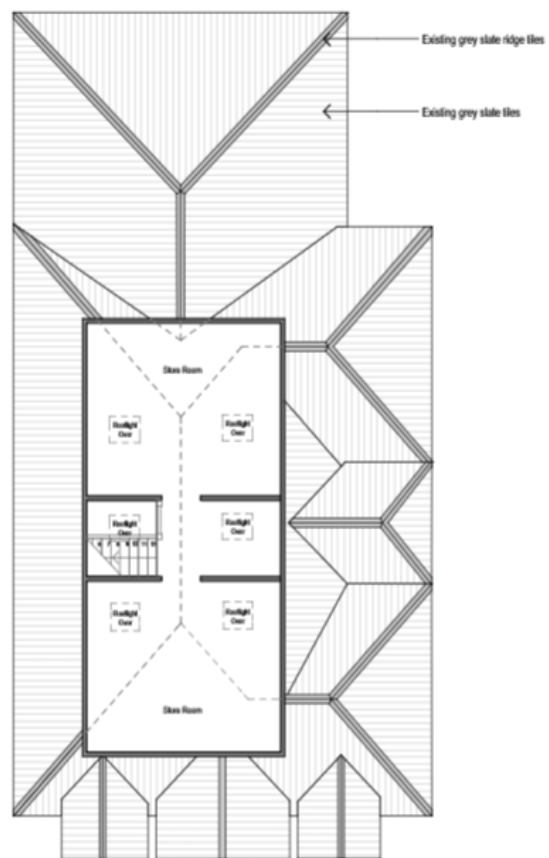


Figure 14 – Existing loft plan.

6. Surface Water Drainage

The greenfield runoff rate has been calculated using IH124 methodology. Table 4 below shows the calculations to determine the existing greenfield runoff rate.



HR Wallingford
Working with water

**Greenfield runoff
estimation for sites**

www.uksuds.com | Greenfield runoff tool

Calculated by: James Scott

Site name: Development Site

Site location: Charville Lane

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude: 51.53860° N

Longitude: 0.42704° W

Reference: 6434313

Date: 2018-09-25T12:43:13

Methodology	IH124
Site characteristics	
Total site area (ha)	0.1
Methodology	
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
	Default Edited
SOIL type	4 4
HOST class	--- ---
SPR/SPRHOST	0.47 0.47
Hydrological characteristics	
	Default Edited
SAAR (mm)	626 626
Hydrological region	6 6
Growth curve factor: 1 year	0.85 0.85
Growth curve factor: 30 year	2.3 2.3
Growth curve factor: 100 year	3.19 3.19
Greenfield runoff rates	
	Default Edited
Qbar (l/s)	0.42 0.42
1 in 1 year (l/s)	0.36 0.36
1 in 30 years (l/s)	0.97 0.97
1 in 100 years (l/s)	1.35 1.35

Notes:

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3 ?

Table 4 – Greenfield runoff calculations.

The Qbar Greenfield runoff rate is 0.42l/s, However as dictated by the local planning authority / lead local flood authority the discharge rates will be limited to 2l/s post development.

As detailed in section 4.6, the underlying geology is the London Clay Formation and as such infiltration is not a viable method of surface water disposal and so surface water attenuation will be required.

Table 5 below looks at the required attenuation that will be required on site. The figures include an allowance of 1.4 (+40%) for climate change.

The calculations show that 6m³ of attenuation is required.



Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by: James Scott
 Site name: Development Site
 Site location: 159 Charville Lane

Site coordinates
 Latitude: 51.53862° N
 Longitude: 0.42696° W

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance 'Preliminary rainfall runoff management for developments', WS-2 (Rev. 1) (2012) and the SuDS Manual, C753 (Cra, 2016). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the drainage scheme.

Reference: 6486700
 Date: 2018-10-31T13:20:41

Methodology	IH124
Site characteristics	
Total site area (ha)	0.065
Significant public open space (ha)	0.025
Area positively drained (ha)	0.04
Pervious area contribution (%)	30
Impermeable area (ha)	0.02
Percentage of drained area that is impermeable (%)	50
Impervious area drained via infiltration (ha)	0
Return period for infiltration system design (year)	10
Impervious area drained to rainwater harvesting systems (ha)	0
Return period for rainwater harvesting system design (year)	10
Compliance factor for rainwater harvesting system design (%)	66
Net site area for storage volume design (ha)	0.04
Net impermeable area for storage volume design (ha)	0.02
* Where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50 % of the area positively drained, the net site area and the estimates of Qbar and other flow rates will have been reduced accordingly.	
Design criteria	
Volume control approach	Use long term storage
Climate change allowance factor	Default: 1.4 Edited: 1.4
Urban creep allowance factor	Default: 1.1 Edited: 1.1
Interception rainfall depth (mm)	Default: 5 Edited: 5
Minimum flow rate (l/s)	Default: 2 Edited: 2
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
Qbar total site area (l/s)	Default: 0.28 Edited: --
SOIL type	Default: 4 Edited: 4
HOST class	Default: N/A Edited: N/A
SPR	Default: 0.47 Edited: 0.47
Hydrology	
SAAR (mm)	Default: 626 Edited: 626
M5-60 Rainfall Depth (mm)	Default: 20 Edited: 20
Y' Ratio M5-60/M5-2 day	Default: 0.4 Edited: 0.4
Rainfall 100 yrs 6 hrs	Default: 63 Edited: 63
Rainfall 100 yrs 12 hrs	Default: 92.4 Edited: 92.4
FEH/FSR conversion factor	Default: 1.2 Edited: 1.2
Hydrological region	Default: 6 Edited: 6
Growth curve factor: 1 year	Default: 0.85 Edited: 0.85
Growth curve factor: 10 year	Default: 1.62 Edited: 1.62
Growth curve factor: 30 year	Default: 2.3 Edited: 2.3
Growth curve factor: 100 year	Default: 3.19 Edited: 3.19
Site discharge rates	
Qbar total site area (l/s)	Default: 0.28 Edited: 0.28
Qbar net site area (l/s)	Default: 0.17 Edited: 0.17
1 in 1 year (l/s)	Default: 2 Edited: 2
1 in 30 years (l/s)	Default: 2 Edited: 2
1 in 100 years (l/s)	Default: 2 Edited: 2
Estimated storage volumes	
Interception storage (m³)	Default: 1 Edited: 1
Attenuation storage (m³)	Default: 5 Edited: 5
Long term storage (m³)	Default: 0 Edited: 0
Treatment storage (m³)	Default: 2 Edited: 2
Total storage (excluding treatment) (m³)	Default: 6 Edited: 6

Table 5 – Estimated attenuation calculations.

7. Hierarchy of disposing surface water

The Planning Practice Guidance and part H of the Building Regulations state that “generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

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

7.1 Infiltration

Records from the British Geological Survey show that the proposed development is underlain by the London Clay Formation consisting of clay, silt and sand. This generally has a mixed infiltration coefficient and therefore may be appropriate for infiltration.

It has been informed that a previous development on site utilised infiltration and installed soakaways to dispose the surface water from the development. On 7th August 2015 Building Control inspected three soakaways each sized at 2.0x2.0x1.0m each one to front and two to the rear.

As such, infiltration may be a viable option for disposal of surface water for this development. However, after feedback from the local authority these methods has been dismissed and alternative measures are proposed.

7.2 Surface Water Body

There is a culverted watercourse south of the dwelling outline. Investigation should be undertaken to see if the existing dwellings surface water drains to this location or the sewer. It is recommended that the surface water post-development goes to the same location as before (albeit at a restricted discharge rate). This will ensure flood risk does not increase downstream from the respective receptive source.

7.3 Surface Water or Combined Sewer

As above, if the investigations show surface water goes to the sewerage network, then it is proposed that surface water from the development continues to be discharged into the public sewerage system.

Any water shall be separated into surface water and foul.

8. Use of SuDS

The NPPF, Planning Practice Guide and the Ministerial Statement all look at the use of SuDS as a priority to aid the disposal of surface water from new developments.

Due to the minor nature of the development proposal there is limited capacity to include SuDS measures although permeable paving and the use of water butts may be considered for use, where appropriate, to minimise surface water runoff from the site.

9. Management of flood risk

9.1 Fluvial

The analysis of flooding from fluvial and tidal sources shows that the building is not at risk from fluvial sources. The site is situated in flood zone 1.

Dwellings are classified as being a More Vulnerable development within Table 2 of the Planning Practice Guidance. Such developments are acceptable in Flood Zone 1.

There is a culverted watercourse to the south of the dwelling outline. This culverted watercourse is outside of the scope of this planning application. Any activities which have been undertaken or are to be undertaken need to be discussed with the Lead Local Flood Authority. Any works to this watercourse is outside the scope of this planning application.

9.2 Surface Water

The vicinity of the development site is described as being at high risk from surface water flooding, which means that the flood risk is greater than 1 in 30 (3.3%) in any year. In the medium and low risk scenarios the flood depths are predicted to be between 300 and 900mm, in the medium risk scenario the flood velocities are less than 0.25m/s and greater than 0.25m/s in the low risk scenario.

The proposed dwelling will have a footprint that is 35m² larger than existing. With a precautionary flood depth of 900mm, this equates to a volume of 31.5m³ which needs to be mitigated against. It is proposed that part of the rear garden can be lowered by this amount to provide the necessary flood displacement volume.

Surface water disposal will continue to be to the public sewerage system, with water separated into surface water and foul.

Calculations show that 6m³ of attenuation storage is required.

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Figure 14 – Surface water indicative schematic scheme

With regards to maintenance of the surface water system on site, we make reference to the House of Commons Ministerial Statement (HCWS161) on Sustainable Drainage Systems. “in considering planning applications, local planning authorities should consult the relevant lead local flood authority on the management of surface water; satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development”.

In response to this statement on Sustainable Drainage Systems a maintenance schedule has been produced. This can be found in Table 5 below.

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Item	SuDS Feature	Maintenance schedule	Requirement	Frequency	Responsibility
1	Waterbutts	Regular maintenance	Clearing of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters and other debris	Annual (or following poor performance)	Landowner
		Occasional maintenance	Replacement of any filters	As required	Landowner
		Remedial actions	Repair any erosion damage, or damage to tank	As required	Landowner
		Monitoring	Inspection of tank for debris and sediment build up	Annual (or following poor performance)	Landowner
			Inspection of inlets, outlets and withdrawal devices	Annual (or following poor performance)	Landowner
			Inspection of areas receiving overflow, for evidence of erosion	After extreme storms	Landowner
			Inspection of roof drain filters	Annual (or following poor performance)	Landowner
2	Attenuation Tank	Regular maintenance	Inspect and identify any areas that are not operating correctly, if required take remedial action	Monthly for three months, then six months	Landowner
			Debris removal from catchment (where may cause risks to performance)	Monthly	Landowner
		Remedial actions	Repair / rehabilitation of inlets, outlet, overflows and vents	As required	Landowner
		Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms	Landowner
3	Flow Control Device	Regular maintenance	Clearance of any debris	Annually and after large storms	Landowner
		Remedial actions	Repair / replace feature	As required	Landowner
		Monitoring	Inspect feature of condition and debris	As required	Landowner

Table 5 – proposed maintenance

To mitigate against extreme events it is recommended that flood resistance and resilience measures are incorporated in the development. Suitable measures are specified in section 9.2 of this report.

Appropriate SuDS features and measures may be considered within the development to minimise surface water discharges. Due to the small-scale nature of the development this would be limited to permeable paving and water butts, if appropriate.

The proposed development will not increase the risk of flooding elsewhere from surface water sources.

9.2 Flood Resistance and Resilience Measures

It is recommended that flood resistance and resilience measures are to be installed within the development.

Reviewing the CLG document - 'Improving the Flood Performance of New Buildings' (2007), we offer the following advice to the development.

-Materials

Although this guidance covers the main types of building material commonly in use in the UK for typical domestic construction, it should be borne in mind that other materials also may prove to be suitable for resilient constructions. It should also be noted that there is variability within materials that may affect their resilience performance. As expected, the denser materials such as concrete and engineering bricks were found to have good resilience characteristics. In general, the findings of the materials testing confirmed existing knowledge and experience but provided new quantitative data on construction material behaviour.

Table 6.1 (of CLG document - 'Improving the Flood Performance of New Buildings' (2007)) presents the characteristics of common building materials, tested in the laboratory, classified as having good, medium or poor performance with regard to water penetration, drying ability and integrity.

Definitions of the characteristics used in Table 6.1 are:

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- water penetration – the seepage (rate and volume) through the material (note that this is different from “water absorption”)
- drying ability – the capability to regain its original moisture condition (assessed by the average drying rate and the time taken to reach the original value)
- retention of pre-flood dimensions, integrity – the lack of deformation or change in form or appearance of the material.

Table 6.1 Flood resilience characteristics of building materials (based on laboratory testing)			
Material	Resilience characteristics*		
	Water penetration	Drying ability	Retention of pre-flood dimensions, integrity
Bricks			
Engineering bricks (Classes A and B)	Good	Good	Good
Facing bricks (pressed)	Medium	Medium	Good
Facing bricks (handmade)	Poor	Poor	Poor
Blocks			
Concrete (3.5N, 7N)	Poor	Medium	Good
Aircrete	Medium	Poor	Good
Timber board			
OSB2, 11mm thick	Medium	Poor	Poor
OSB3, 18mm thick	Medium	Poor	Poor
Gypsum plasterboard			
Gypsum Plasterboard, 9mm thick	Poor	Not assessed	Poor
Mortars			
Below d.p.c. 1:3(cement:sand)	Good	Good	Good
Above d.p.c. 1:6(cement:sand)	Good	Good	Good
* Resilience characteristics are related to the testing carried out and exclude aspects such as ability to withstand freeze/thaw cycles, cleanability and mould growth			

For this development it is recommend that materials which meet the medium and good criteria of table 6.1 are incorporated.

- Foundations

Foundations are designed to suit site conditions, namely the local geotechnical characteristics and the building design. Strip and trench-fill foundations are generally used where no special problems are identified, whereas raft, pile, pier and beam foundations may be necessary in other cases. In general, the choice of foundation type will be dictated by ground conditions, rather than resilience considerations. However, improvements can be made to increase the resilience.

For typical dwellings shallow footings are likely to be appropriate in most cases. It is common practice to use concrete blocks as substructure elements in typical cavity wall buildings but laboratory work has shown that groundwater can penetrate through the blocks into the wall cavity (and from there into the building) if care is not taken to minimise the passage of water. There is a general recommendation in the NHBC Standards, (2006) to allow a clear cavity of at least 225mm below damp proof course (d.p.c.) to prevent the build up of any mortar dropped during construction from having a detrimental effect on the performance of the wall. However, this unsealed void may be an entry point for rising groundwater into the property via the blockwork.

As this development is for an extension in flood zone 1, albeit at high risk of surface water flooding, it is recommended that strip and trench-fill foundations are used.

-Walls

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Table 6.2 Flood resilience characteristics of walls (based on laboratory testing)			
Material	Resilience characteristics*		
	Water penetration	Drying Ability	Retention of pre-flood dimensions, integrity
External face			
Engineering bricks (Classes A and B)	Good	Good	Good
Facing bricks (pressed)	Medium	Medium	Good
Internal face			
Concrete blocks	Poor	Medium	Good
Aircrete	Medium	Poor	Good
Cavity insulation			
Mineral fibre	Poor	Poor	Poor
Blown-in expanded mica	Poor	Poor	Poor
Rigid PU foam	Medium	Medium	Good
Renders/Plaster			
Cement render – external	Good	Good	Good
Cement/lime render – external	Good	Good	Good
Gypsum Plasterboard	Poor	Not assessed	Poor
Lime plaster (young)	Poor	Not assessed	Poor
* Resilience characteristics are related to the testing carried out and exclude aspects such as ability to withstand freeze/thaw cycles, cleanability and mould growth			

Masonry walls:

Ensure mortar joints are thoroughly filled to reduce the risk of water penetration. If frogged bricks are used, they should be laid frog up so that filling becomes easier and coverage more certain. Bricks manufactured with perforations should not be used for flood resilient design.

Where possible, use engineering bricks up to predicted flood level plus one course of bricks to provide freeboard (up to maximum of 0.6m depth above floor level); this will increase resistance to water penetration. Blocks (and dense facing bricks) have much improved performance when covered with render.

Aircrete blocks allow less leakage than typical concrete blocks but concrete blocks dry more quickly.

Therefore, design of blockwork walls needs to take into account these two opposite types of behaviour and consider whether drying or resistance to water is most relevant in each situation. For a “water exclusion strategy”, the expected amount of leakage is minimal and therefore, Aircrete blocks are recommended, although they may retain moisture for longer than concrete blocks. Compared with heavier blocks, Aircrete may offer less restraint to floor/slab edges which under the action of uplift forces could promote the opening up of floor/wall junctions.

Do not use highly porous bricks such as hand made clay bricks. Solid masonry walls are a good option but will need to be fitted with internal or external wall insulation in order to comply with Building Regulations.

Clear cavity walls, i.e. with no insulation in the cavity, have better flood resilience characteristics than filled or part filled cavity walls as they dry more quickly. The requirements for insulation can be satisfied by external insulated renders or internal thermal boards.

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There is evidence that thin layer mortar construction (or thin joint, as it is also commonly known) is a good flood resilience option.

Framed walls:

Avoid timber framed walls containing construction materials that have poor performance in floods, for example oriented strand board and mineral fibre insulation. Timber framed walls are not recommended in a "water exclusion strategy". Steel framed walls may offer a suitable alternative option but specialist advice needs to be sought on how to incorporate resilient materials/construction methods in the design, in particular with regard to the insulation.

Reinforced concrete wall/floor:

Construction should be considered for flood-prone areas, i.e. where the frequency of flooding is predicted to be high (see Chapter 4). This form of construction is effective at resisting forces generated by floodwater and will provide an adequate barrier to water ingress (provided service ducts and other openings into the building are adequately sealed). Design details for this type of construction are beyond the scope of this document.

External renders are effective barriers to water penetration and should be used with blocks (or bricks) at least up to the predicted flood level plus the equivalent of a course of bricks as freeboard.

Structural checks may be necessary to ensure stability, because of the external water pressures that could occur for design flood depths above 0.3m. External cement renders with lime content (in addition to cement) can induce faster surface drying.

Insulation:

External insulation is better than cavity insulation because it is easily replaced if necessary. Cavity insulation should preferably incorporate rigid closed cell materials as these retain integrity and have low moisture take-up. Other common types, such as mineral fibre batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).

Internal linings:

Internal cement renders (with good bond) are effective at reducing flood water leakage into a building and assist rapid drying of the internal surface of the wall. The extent to which render prevents drying of other parts of the wall is not currently clear. This may be important, particularly for solid wall construction. This applies also to external renders.

Avoid standard gypsum plasterboard as it tends to disintegrate when immersed in water. Splash proof boards do not necessarily offer protection against flood waters, which may remain for some time and exert pressure on the board.

Anecdotal evidence suggests that internal lime plaster/render can be a good solution. Lime plaster depends on contact with the air to set and harden. Because of this, full strength lime plaster, which typically requires over 6 months, was not possible to test. Consequently, no assurance can be given for its performance. Tests performed when young showed that it crumbles very easily under high pressure.

For this development as it falls within a high risk surface water flooding area, it is proposed that the walls are constructed to stop water coming in. Therefore it is proposed that options with a medium or good option as detailed in table 6.2 of the CLG document are implemented. As the predicted flood depths are between 300 and 900mm it is recommended that all flood resilience measures should be incorporated up to 900mm above ground level.

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-Doors and Windows

Should be considered as the primary measure. In addition, sealed PVC external framed doors should be used and, where the use of wooden doors is a preferred option, all effort should be made to ensure a good fit and seal to their frames.

Hollow core timber internal doors should not be used where the predicted frequency of flooding is high. Where sufficient flood warning is given, butt hinges, that allow internal doors to be easily removed and stored in dry areas prior to a flood, should be used. Where the frequency of predicted flooding is low or where there is no warning (e.g. overland or sewer flooding) it may be necessary to replace the doors after the flood.

Windows/patio doors:

Windows and patio doors are vulnerable to flood water and similar measures to those used for doors should be taken. Special care should be taken to ensure adequate sealing of any PVC window/door sills to the fabric of the house. Of particular concern would be excessive water pressure on the glazing of patio doors. Double glazing conforming to the relevant standards would in principle adequately resist the pressures generated by flood waters; debris carrying flows may cause damage.

Air vents:

Special designs of air vent are available in the market to prevent water ingress in circumstances where the predicted flood depth is low (i.e. < 0.3m); e.g. periscopic air vent. Careful consideration should be given to effectively sealing any associated joints.

For this extension any doors, windows and air vents should be installed with an appropriate sealant. Although the development is in flood zone, it would be prudent for this to occur in case of flooding in extreme events.

-Fittings

The main principle is to use durable fittings that are not significantly affected by water and can be easily cleaned (e.g. use of plastic materials or stainless steel for kitchen units). The cost of these units may need to be balanced against the predicted frequency of flooding. Place fittings (e.g. electrical appliances, gas oven) on plinths as high as practicable above floor so that they are out of reach of flood water.

Ensure adequate sealing of joints between kitchen units and surfaces to prevent any penetration of water behind fittings.

Ensure high quality workmanship in the application of fittings.

As this development is only at risk of surface water flooding, it is not cost effective, for the pricier kitchen units to be installed. Other flood resilience measures proposed will help prevent any water entering the building.

-Services

Where possible, all service entries should be sealed (e.g. with expanding foam or similar closed cell material).

Pipework: Closed cell insulation should be used for pipes that are below the predicted flood level.

Drainage services: Non-return valves are recommended in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging.

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Maintenance of these valves is important to ensure their continued effectiveness.

Water, electricity and gas meters: should be located above predicted flood level.

Electrical services: electrical sockets should be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation. Electric ring mains should be installed at first floor level with drops to ground floor sockets and switches.

Heating systems: boiler units and ancillary devices should be installed above predicted flood level and preferably on the first floor of two-storey properties. Underfloor heating should be avoided on ground floors and controls such as thermostats should be placed above flood level. Conventional heating systems, e.g. hot water pipes are unlikely to be significantly affected by flood water unless it contains a large amount of salts. The less common, hot air duct heating would remain effective provided it is installed above the design flood level.

Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.

It is proposed that all the options described above are installed within the development wherever possible.

As previously discussed there is a potential risk of flooding to the development from groundwater and surface water sources.

Due to the possibility of this flooding, information from the Environment Agency guide on groundwater flooding has been referenced:

"The most effective way to keep groundwater out of your property is to use a drainage or pump system to divert the water away from your home or business. However, in some cases there may be too much water and even pumping may not be effective.

Pumps work best when the inlet is installed in a sump (a low point into which water can drain). Pumping is likely to be required over many days, weeks or months. Pumps can be electric or petrol/diesel driven. Electric pumps may be the most convenient but remember there is a chance of power cuts during a flood. You may need to consider a back up generator. Care must be taken if a mains powered electric pump is used during a flood. You should contact a qualified electrician for further advice.

Petrol or diesel pumps are possible alternatives but can be noisier and will require refuelling. This can be a problem as flooding from groundwater can often last for many weeks or even months. Position the generator outside in the open air as generators produce carbon monoxide fumes which can kill. You will also need to consider where you will pump water to. Pumping from one place to another may cause flooding elsewhere. You must not pump water into the public foul sewer. For this development a septic tank will be used to dispose foul water therefore this is not an issue.

Only pump out water when flood levels outside your property start to be lower than inside. This reduces the risk of structural damage. It may also be worth you contacting a structural engineer before pumping very deep water from basements".

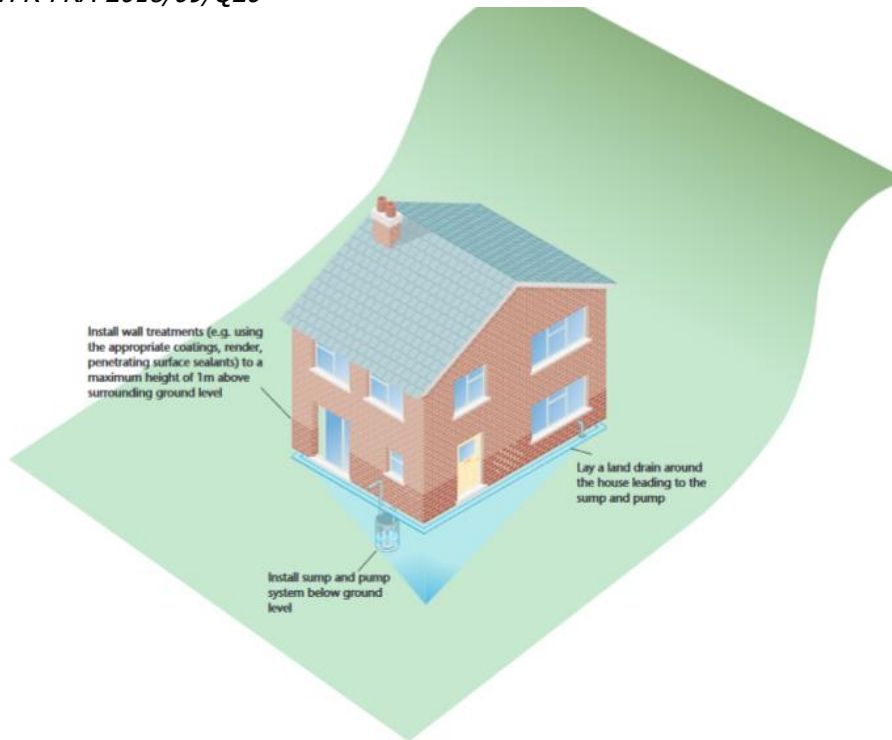


Figure 15 – Groundwater prevention measures (source EA Groundwater Flooding).

The EA Groundwater guidance continues to offer the following advice on groundwater protection, in particular referencing the floors, lower parts of walls and openings such as airbricks as they are the most vulnerable parts of the property.

10. Conclusions

The development is situated in Flood Zone 1. The development is for the replacement a previous bungalow, which is classed as being More Vulnerable. Such developments are appropriate in flood zone 1.

There is a culverted watercourse to the south of the dwelling outline. This culverted watercourse is outside of the scope of this planning application. Any activities which have been undertaken or are to be undertaken need to be discussed with the Lead Local Flood Authority. Any works to this watercourse is outside the scope of this planning application.

The vicinity of the development site is at high risk of surface water flooding.

The proposed dwelling will have a footprint that is 35m² larger than existing. With a precautionary flood depth of 900mm, this equates to a volume of 31.5m³ which needs to be mitigated against. It is proposed that part of the rear garden can be lowered by this amount to provide the necessary flood displacement volume.

Surface water disposal shall via the culverted watercourse or via the public sewerage system. Foul and surface water shall be separated. Non-return valves should also be fitted.

Calculations show that 6m³ of attenuation storage is required.

It is recommended that appropriate SuDS measures should be incorporated in the development to minimise surface water discharges.

The proposed development will not increase the risk of flooding elsewhere from surface water sources.

The area in and around the development site has experienced flooding in the past. Three recorded instances were on 24/12/13, 1/01/14 and 07/02/14. These were from numerous sources – main river, ordinary watercourse and surface water sewer.

The development is at low risk of groundwater flooding; however anecdotal evidence from the LPA/LLFA suggests it is present within the area.

It is recommended that appropriate flood resistance and resilience measures are incorporated in the development to prevent flooding from all sources of flooding.

The development is at risk of flooding from the Charville Lane FSA reservoir, which is owned by the Environment Agency.

As this is a replacement dwelling, betterment will be achieved wherever possible. The finished floor level will be set the same as existing and flood displacement volumes will be provided to mitigate against any increase in flooding elsewhere.

Based on the likely flooding risk, it is considered that the proposed development can be operated safely in flood risk terms, without increasing flood risk elsewhere and is therefore appropriate development in accordance with the NPPF.

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