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ENVIRONMENTAL CONSULTING , SOFTWARE & TRAINING

Flood Risk Assessment and Preliminary Surface Water Drainage Strategy

Site Address

200 Ladygate Lane
Ruislip
HA4 7QY

Client

N Shah

Date

02/11/2021

FLOOD RISK ASSESSMENT

Site Address:	200 Ladygate Lane Ruislip HA4 7QY
National Grid Reference:	508030, 188178
STM Reference:	FRA – 2021 – 000095
Version No:	1.0
Prepared for:	N Shah
Date:	02/11/2021
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2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
LBH	London Borough of Hillingdon
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone
LLFA	Lead Local Flood Authority
mbgl	metres below ground level
DCLG	Department for Communities and Local Government
PPGPS	Planning practice guidance and Planning system

3 Disclaimer

This report and any information or advice which it contains, is provided by STM Environmental Consultants Ltd (STM) and can only be used and relied upon by N Shah (Client).

STM has exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant when undertaking works of this nature. However, STM gives no warranty, representation or assurance as to the accuracy or completeness of any information, assessments or evaluations presented within this report. Furthermore, STM accepts no liability whatsoever for any loss or damage arising from the interpretation or use of the information contained within this report. Any party other than the Client using or placing reliance upon any information contained in this report, do so at their own risk.

4 Executive Summary

Location	**200 Ladygate Lane, Ruislip, HA4 7QY** **Grid Reference: 508030, 188178**
Proposed Development	Rear ground floor and first floor extension.
Flood Zone	The site lies in Flood Zone 3.
Main Sources of Flooding	The River Pinn (500m south), Mad Bees Brook (30m north) and Cannon Brook (75m east).
Sequential and Exception Tests	Development is minor and more vulnerable so Sequential and Exception Tests should not be required. LLFA to decide.
Flood Defences	None.
Records of Historic Flooding	Three flooding incidents identified within the vicinity of the site in 1977, 1999, and 2016, though the site remained dry.
Fluvial Flood Risk	Low to Medium – the site will witness flood depths to 210mm (42.11mAOD) during the 1 in 100-year + 35% CC scenario.
Surface Water Flood Risk	High – the site will witness flood depths up to 600mm during the 1 in 30-year and 1 in 100-year rainfall scenario. During the 1 in 1000-year event, flood depths will reach 1200mm. The SFRA indicates no previous surface water flooding incidents within the vicinity of the site and 11-20 sewer flooding incidents within the postcode area HA4 7.
Groundwater Flood Risk	Low – the site is not susceptible to groundwater flooding; GW incidents were not identified with 500m of the site.
Flood Risk from Artificial Sources.	Low – although the site is categorised as being at risk from artificial flooding sources, the SFRA states the risk is residual.
Infiltration Potential	Highly variable bedrock permeability. Opportunities for bespoke infiltration SuDS techniques.
Site Area	300m^2

Existing and Proposed Site Layout	**Ground Cover**	**Existing**	**Proposed (Without SuDS)**
	Buildings	107	115
	Driveways/Patio	75	67

	Gardens/ Soft landscaping	118	118
	Total Impermeable Area	182	182
Changes in Impermeable Area	The proposed development will not increase the impermeable area of the site. It will increase the rooftop area by 8m^2, so will have an impact on the runoff rate.		
Run-Off Rates	Greenfield (GF) (l/s)	Pre - Development (PD) (l/s)	Post Development (PD) (l/s)
Qbar	0.1748	0.2060	0.2060
1 in 1	0.1486	0.1751	0.1751
1 in 30	0.4020	0.4739	0.4739
1 in 100	0.5576	0.6572	0.6572
1 in 100 + CC (40%)	0.8266	0.9743	0.9743
Proposed Flood Risk Mitigation Measures	• Finished floor levels will be no lower than existing ground floor levels; • Construction will utilise flood resistant materials and services will be placed as high as practicable to reduce impact of flooding; • Occupants will sign up for EA Emergency Flood Warning Direct Service; • Safe egress to flood zone 1 is a 2-minute walk away and safe refuge is available on upper floors.		
Preliminary SuDS Strategy	The proposed development will attempt to employ a range of techniques in line with the SuDS hierarchy including permeable paving (18m^2) in combination with rainwater garden (15m^2) or soakaways / attenuation tanks (6m^3). A preliminary drainage plan has been provided. The precise configuration will be subject to the preparation of a Detailed Surface Water Management Strategy and consultation with the LLFA.		
Conclusion	Based on the information reviewed, we believe that the overall flood risk to the site is medium to high, given the fluvial and pluvial sources of flood risk identified. As the proposal will not increase the site's impermeable area, it may have an impact on flood storage due to the increase in building footprint. However, this would be displaced onto the gardens of the site. No flood compensation storage has been provided as the site is within Fluvial flood zone 3.		

	The implementation of the proposed SuDS measures, will reduce the impermeable area of the site by providing permeable paving within the rear patio. It will provide attenuation for more than half of the rooftop area. We believe the proposal will provide a betterment in terms of the flood risk the site currently has.

5 Introduction

STM Environmental Consultants Limited (STM) has been appointed by N Shah (Client) to provide a Flood Risk Assessment (FRA) and a Preliminary Surface Water Drainage Strategy (SWDS) to support a planning application of a site located at 200 Ladygate Lane, Ruislip, HA4 7QY (the site).

5.1 Proposed Development

The proposed development is for a rear ground floor and first floor extension. Further details including drawings of the development plans are available in Appendix 1.

6 Report Aims and Objectives

The purpose of this report is to establish the flood risk to the site from all potential sources and, where possible, to propose suitable mitigation methods to reduce any risks to an acceptable level. It aims to make an assessment of whether the development will be safe for its lifetime (in this case assumed to be 100 years for residential development), taking into account climate change and the vulnerability of its users, without increasing flood risk elsewhere.

The FRA assesses flood risk to the site from tidal, fluvial, surface water, groundwater, sewers and artificial sources. The FRA has been produced in accordance with the National Planning Policy Framework (NPPF) and its supporting guidance.

Moreover, this report sets out the proposed drainage strategy that will be employed in the designs to meet the requirements of the planning condition and the National Planning Policy Framework.

7 Summary of Data Review Undertaken

The following research has been undertaken as part of the FRA:

- Desktop assessment of topographical, hydrological and hydrogeological settings through review of the information sourced from the British Geological Survey (BGS), the Environment Agency (EA) and the Ordnance Survey (OS);
- Review of publicly available flood risk mapping provided by the EA;
- Review of the Preliminary Flood Risk Assessment (PFRA) and Level 1 Strategic Flood Risk Assessment (SFRA) produced by the LLFA outlining flood risk from various sources within the borough.

8 Context

8.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England. The policies set out in this framework apply to the preparation of local and neighbourhood plans and to decisions on planning applications.

Paragraph 163 of the National Planning Policy Framework (NPPF) states that:

> When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:
>
> - 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
> - development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely

managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems.

Paragraph 165 states that:

> Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:
>
> - take account of advice from the lead local flood authority;
> - have appropriate proposed minimum operational standards;
> - have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
> - where possible, provide multifunctional benefits.
>
> A major development is defined as:
>
> - a residential development: 10 dwellings or more or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known
> - a non-residential development: provision of a building or buildings where the total floor space to be created is 1000 square metres or more or where the floor area is not yet known, a site area of 1 hectare or more.
>
> Evidence that sustainable drainage (SuDS) has been considered should be submitted for Minor Developments.

8.1.1 The London Plan - Policy SI 13 Sustainable drainage

Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

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. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

- rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation);
- rainwater infiltration to ground at or close to source;
- rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
- rainwater discharge direct to a watercourse (unless not appropriate);
- controlled rainwater discharge to a surface water sewer or drain;
- controlled rainwater discharge to a combined sewer;

Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

8.1.2 LLFA/LPA Policy

Policy EM6 of the Hillingdon Local Plan: Flood Risk Management states the following:

"The Council will require new development to be directed away from Flood Zones 2 and 3 in accordance with the principles of the National Planning Policy Framework (NPPF).

The subsequent Hillingdon Local Plan: Part 2 -Site Specific Allocations LDD will be subjected to the Sequential Test in accordance with the NPPF. Sites will only be allocated within Flood Zones 2 or 3 where there are overriding issues that outweigh flood risk. In these instances, policy criteria will be set requiring future applicants of these sites to demonstrate that flood risk can be suitably mitigated".

With regards to SuDS, the policy also says:

"The Council will require all development across the borough to use sustainable urban drainage systems (SUDS) unless demonstrated that it is not viable. The Council will encourage SUDS to be linked to water efficiency methods. The Council may require developer contributions to guarantee the long term maintenance and performance of SUDS is to an appropriate standard".

The Local Plan then states the policy should be implemented by:

- "Working with the Environment Agency, British Waterways, Natural England and other partners to develop a management plan for the Grand Union Canal and other Blue Ribbon Networks where they are not currently in place.

- Developing flood risk policies including SUDS in the Hillingdon Local Plan: Part 2- Development Management Policies LDD".

8.2 EA Standing Advice on Flood Risk

Flood risk assessments are required for developments within one of the flood zones. This includes developments:

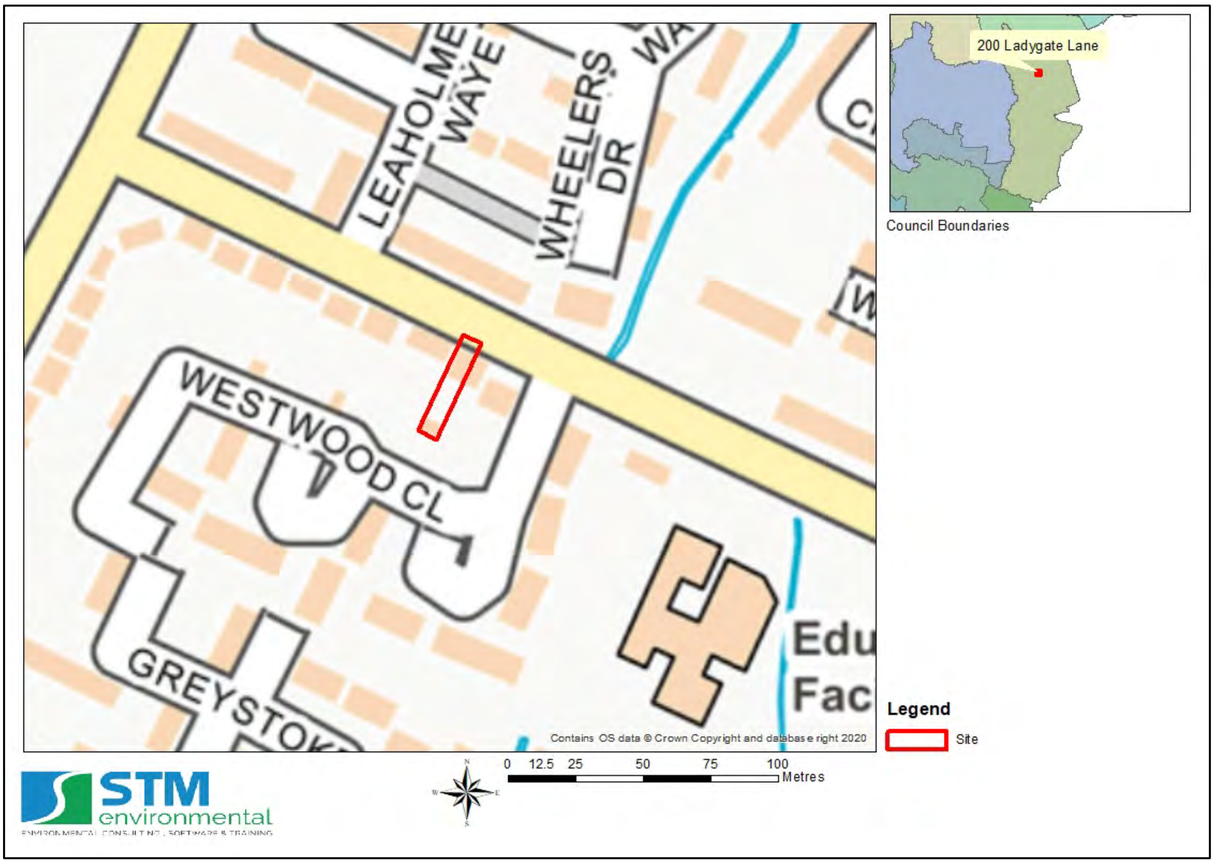
- In flood zone 2 or 3 including minor development and change of use more than 1 hectare (ha) in flood zone 1
- less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs)
- in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency.

The Environment Agency's standing advice lays out the process that must be followed when carrying out flood risk assessments for developments.

9 Background

9.1 Site Location and Area

The site is located at 200 Ladygate Lane, Ruislip, HA4 7QY. It is centred at national grid reference 508030, 188178. Site location maps and photographs of the site are available in Appendix 2.



9.2 Local Planning Authority

The site falls within the jurisdiction of London Borough of Hillingdon in terms of the planning process.

9.3 Lead Local Flood Authority

London Borough of Hillingdon is also the Lead Local Flood Authority (LLFA).

9.4 Site Area

The site has an area of approximately 300m^2.

9.5 Flood Zone

For planning purposes, the site is located in Flood Zone 3 as defined by the EA and LLFA.

9.6 Site and Surrounding Land Uses

9.6.1 Site Current Land Use

The site is used as a residential property. Photos of the site are available in Appendix 2.

9.6.2 Surrounding Land Use

A description of current land uses surrounding the boundaries of the site is given below in Table 1 below.

Table 1: Summary of surrounding land uses

Boundary	Land Use Description	
	Immediately Adjacent (within 0 – 25m)	General Local Area (i.e. within 25 - 250m)
Northern	Residential	Residential
Eastern	Residential	Residential/Education
Southern	Residential	Residential
Western	Residential	Residential/Green Space

10 Site Environmental Characteristics

10.1 Hydrology

The nearest main watercourse is the River Pinn 500m south of the site. Culverted watercourses including the Mad Bees Brook (30m north) and Cannon Brook (75m east) are within close proximity to the site.

10.2 Geology, Hydrogeology, and Permeability

Data from the British Geological Survey indicates that no superficial deposits are identified at the site. The underlying bedrock geology is characterized as Lambeth Group and the site lies upon a Secondary A bedrock aquifer.

Appendix 3 provides BGS mapping showing the hydrogeology at the site location.

Moreover, the bedrock permeability map available in Appendix 3 shows that the site is located on ground classified as having highly variable permeability.

The site lies upon a Secondary A bedrock aquifer. The site lies within a groundwater Source Protection Zone 2 and 3.

Table 2: Groundwater Source Protection Zone (SPZ) classifications according to the EA (2017).

SPZ	Description
Outer Zone (Zone 2)	Defined by a 400-day travel time from a point below the water table. The previous methodology gave an option to define SPZ2 as the minimum recharge area required to support 25 per cent of the protected yield. This option is no longer available in defining new SPZs and instead this zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction
Total Catchment (zone 3)	Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management

10.3 Topography

A LIDAR map showing the topology of the site and surrounding area is available in Appendix 3. The ground levels at the site range between 42.1mAOD (N) and 41.7mAOD (S). The existing dwelling sits at an average of 42.0mAOD, and the proposed development sits at an average of 41.9mAOD.

A topographic survey has not been conducted.

11 The Sequential and Exception Tests

The Sequential Test aims to steer developments and redevelopments to areas of lower flood risk. The test compares the proposed development site with other available sites, in terms of flood risk, to aid the steering process. The Sequential Test is not required if the proposed development is a minor development or if it involves a change of use (e.g. from commercial to residential) unless the development is a caravan, camping chalet, mobile home or park home site.

If alternative sites of lower flood risk are not available then the proposed development may require an Exception Test to be granted planning permission. Where the exception test is required, it should be applied as soon as possible to all local development document allocations for developments and all planning applications other than for minor developments. All three elements of the exception test have to be passed before development is allocated or permitted. For the exception test to be passed:

- It must demonstrate that the development provides wider sustainability benefits to the community that outweigh the flood risk, informed by an SFRA, where one has been prepared;
- The development should be on developed land or on previously developed land;
- A flood risk assessment must demonstrate that the development will be safe without increasing flood risk elsewhere, and where possible will reduce the overall flood risk.

The requirements for an Exception Test are given in Table 3 and are defined in terms of Flood Zone and development vulnerability classification.

Table 3: NPPF flood zone vulnerability compatibility (source: NPPF).

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	✗	Exception Test required	✓	✓
Zone 3b	Exception Test required	✗	✗	✗	✓

Key:

✓ Development is appropriate

✗ Development should not be permitted.

The development is considered to be minor and as such the Sequential and Exception Tests are considered unlikely to be required by the LLFA.

12 Site Specific Flood Risk Analysis

The PFRA and Level 1 SFRA produced by the LLFA and maps from the EA provide information regarding historic flooding events and incidents as well as predictions of flood extents and depths during extreme rainfall events.

12.1 Fluvial (River) Flood Risk

Fluvial, or river flooding, occurs when excessive rainfall over an extended period of time or heavy snow melt causes a river to exceed its capacity. The damage from a fluvial flood can be widespread as the overflow may affect downstream tributaries, overtopping defences and flooding nearby inhabited areas. Fluvial flooding consists of two main types:

- Overbank flooding – this occurs when water rises steadily and overflows over the edges of a river or stream.
- Flash flooding – this is characterized by an intense, high velocity torrent of water that occurs in an existing river channel with little to no notice. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

12.1.1 Definition of EA Modelled Fluvial Flood Risk Zones

Fluvial flood risk is assessed using flooding maps produced by the Environment Agency. These maps use available historic data and hydraulic modelling to define zones of flood risk. The maps allow a site to be defined in terms of its flood zone (e.g. 1, 2, 3) and in terms of the overall flood risk (very low, low, medium or high). It is important to note that existing flood defences are not taken into account within the models or the maps. The EA fluvial flood zones are defined as follows:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 2: Between 1 in 100 and 1 in 1000 annual probability of flooding;
- Flood zone 3 - Greater than 1 in 100 annual probability of fluvial flooding.

Flood zone 3 is split into two sub-categories (3a and 3b) by LLFAs depending on whether the land is considered to be a functional flood plain (i.e. an important storage area for flood waters in extreme events).

- Flood zone 3a: Greater than 1 in 100 annual probability of fluvial flooding and/or greater than 1 in 200 annual probability of tidal flooding;
- Flood zone 3b: functional flood plain (definition specific to the LLFA). Less than a 1 in 20 annual probability of fluvial and/or tidal flooding.

12.1.2 Main Potential Sources of Local Fluvial Flooding

The nearest potential sources of fluvial flooding to the site are considered to be Mad Bee Brook, Cannon Brook, and the River Pinn.

12.1.3 Records of Historic Fluvial Flooding Incidents

The EA's historic and recorded flood outline maps show the locations and extents of historic flooding. These maps indicate that the site has not witnessed any historic fluvial flood events.

The Historic Flood Map which is available as part of the EA Product 4 data in Appendix 7 indicates that the last time the borough suffered a significant fluvial flooding event was in 1977, 1999, and 2016, though the flood extent outline did not impact the site.

12.1.4 Designated Fluvial Flood Risk Zone for the Site

The site is considered to be located within Flood Zone 3 as defined by the Environment Agency and the LLFA indicating that it has a greater than 1% annual probability of fluvial flooding.

A map showing the site and flood zone is available in Appendix 5.

12.2 Tidal (Sea) Flood Risk

Tidal flooding may be described simply as the inundation of low-lying coastal areas by the sea, or the overtopping or breaching of sea defences. Tidal flooding may be caused by seasonal high tides, storm surges and where increase in water level above the astronomical tide level is created by strong on shore winds or by storm driven wave action.

12.2.1 Definition of EA Tidal Flood Risk Zones

As with fluvial flood risk, tidal flood risk is assessed using flooding maps produced by the Environment Agency. The difference is in the probability return periods used to define tidal flood zones. The EA tidal flood zones are defined as:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 2: Between 1 in 200 and 1 in 1000 annual probability of tidal flooding;
- Flood zone 3 - Greater 1 in 200 annual probability of tidal flooding.

12.2.2 Potential Sources of Tidal Flooding

The area in which the site is located is considered unlikely to be affected by tidal flooding.

12.2.3 Flood Defences

The EA's Areas benefitting from flood defences and current flood defences map shows no indication of any flood defences in the vicinity of the site]/ shows that the site benefits from flood defences.

12.2.4 Climate Change - EA Modelled Predictions of Fluvial and Tidal Flood Levels and Extents

The EA Product 4 dataset which is presented in Appendix 7 provides modelled flood levels for model node points at the site. These are summarised in Table 4 below.

Modelled Flood Levels During Different AEP Scenarios (mAOD)			
0.1%	**1%**	**1% + 35% CC**	**1% + 70% CC**
42.18	42.05	42.11	42.14

Table 4: EA modelled flood levels and expected flood depths for different return periods and scenarios.

As the model flood levels were taken adjacent to the proposed rear extension, and the topography of this area is approximately 41.9mAOD, maximum flood levels during the 1 in 100-year + 70% climate change event are anticipated to reach 240mm.

12.2.5 Long Term Fluvial Flood Risk Considering Flood Defences

The EA's long term flood risk maps give an indication of the actual risk associated with flooding after taking into account the effect of any flood defences in the area. Copies of maps for the site which are available in Appendix 8 indicate that the long-term risk from fluvial flooding to the site is medium.

12.3 Pluvial (Surface Water) Flood Risk

A pluvial, or surface water flood, is caused when heavy rainfall creates a flood event independent of an overflowing water body. Surface water flooding occurs when high intensity rainfall leads to run-off which flows over the ground surface, causing ponding in low-lying areas when the precipitation rate or overland flow rate is greater than the rate of infiltration, or return into watercourses. Surface water flooding can be exacerbated when the underlying soil and geology is saturated (as a result of prolonged precipitation or a high-water table) or when the drainage network has insufficient capacity.

12.3.1 Mechanisms of Pluvial Flooding

The chief mechanisms for surface water flooding can be divided into the following categories:

- Runoff from higher topography;
- Localised surface water runoff – as a result of localised ponding of surface water;
- Sewer Flooding – areas where extensive and deep surface water flooding is likely to be influenced by sewer flooding. Where the sewer network has reached capacity, and surcharged, this will exacerbate the flood risk in these areas;
- Low Lying Areas – areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
- Railway Cuttings –railway infrastructure cut into the natural geological formations can cause extra surface run off and pooling disrupting service and potentially affecting adjacent structures;
- Railway Embankments – discrete surface water flooding locations along the up-stream side of the raised network rail embankments where water flows are interrupted and ponding can occur.

- Failure of artificial sources (i.e. man-made structures) such as such as canals and reservoirs.

12.3.2 Main Potential Sources of Local Pluvial Flooding

The main potential source of pluvial flooding to the site is considered to be surface water ponding and flooding associated with heavy rainfall and reservoir flooding in the area.

12.3.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFAs Level 1 SFRA revealed no evidence of records of pluvial flooding on the site. However, there have been numerous events within the borough. The mapping from the PFRA is available in Appendix 4.

12.3.4 Climate Change - Modelled Predictions of Surface Water Run-off Flooding

Mapping of the predicted extent and depth of surface water flooding for the 1 in 100 year and 1 in 1000 rainfall return periods provided by the EA are available in Appendix 9.

The maps show that the site would witness surface water flooding during all modelled scenarios. During the 1 in 30-year and 1 in 100-year events, the site will witness flooding to depths of up to 600mm, whilst during the 1 in 1000-year event, the site will flood to depths of 1200mm.

12.3.5 Sewer Flooding

The SFRA sewer flood map indicates the site lies within an area that has witnessed 11-20 sewer flooding incidents within the postcode area HA4 7. A copy of the map is available in Appendix 4.

12.3.6 Long Term Flood Risk Considering Flood Defences

The EA's long term flood risk maps which are available in Appendix 8 indicate that the long term risk of flooding from surface water is considered to be medium to high.

12.4 Surface Water Flood Risk from Artificial Sources (Reservoirs and Canals)

An examination of OS mapping and the EA's mapping revealed that there are significant reservoirs or canals in the area of the site. The Grand Union Canal is located approximately 3km west of the site.

12.5 Risk of Flooding From Multiple Sources (ROFMS)

The Environment Agency provides a map which gives an indication the overall flood risk from fluvial, tidal and surface water sources considering the presence of river defences. This map indicates that there is a greater than 3.3% chance of flooding at the site in any year. A copy of the map is presented in Appendix 8.

12.6 Groundwater Flood Risk

Groundwater flooding occurs when water rises from the underlying aquifer at the location of a spring – where the underlying impermeable geology meets the ground surface. This tends to occur after much longer periods of intense precipitation, in often low-lying areas where the water table is likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels. A high groundwater table also has the potential to exacerbate the risk of surface water and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer/groundwater interactions.

12.6.1 Historic Records of Groundwater Flooding

A map showing the locations of historic groundwater flooding incidents is available in Appendix 4. The mapping indicates that there have been no recorded incidents of groundwater flooding at or within 500m of the site.

12.6.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS indicates that the potential for groundwater flooding to occur at the surface does not exist. The

Groundwater Depth map also provided by BGS indicates that the groundwater level may be at approximately less than 3mbgl.

The west London SFRA indicates that there is a less than 25% susceptibility on site for groundwater flooding to occur.

12.7 Critical Drainage Area

A Critical Drainage Area may be defined as an area that has critical drainage problems and which has been notified to the local planning authority by bodies such as the Environment Agency. Generally, the expectation is that new developments will reduce downstream local flood risk rather than having just neutral impact.

The site is located within a Critical Drainage Area. The site is located within CDA 028 Ladygate Lane, Ruislip as shown on online here.

"19 known properties flooded in postcode from surface water sewer flooding. Also flooded in area in 1977 and 1988."

13 Potential Impacts of the Development On Local Flood Risk

13.1 Impacts on Flood Storage

13.1.1 Changes to Impermeable Area and Building Footprint

Changes in ground cover arising from the development are presented in Table 5 below. The change to the impermeable area of the site is considered to be insignificant.

Table 5: Existing and proposed site ground cover.

	Impermeable Area (m^2)	Permeable Area (m^2)	Total Area (m^2)
Existing	197	103	300
Proposed	197	103	300

As the development will not increase the site's impermeable area as the proposed extensions are being placed on existing impermeable surfaces, it is considered unlikely that it will impact upon local flood storage.

13.2 Impacts on Flood Flow Routes

As the development involves the addition of buildings at the site, it may alter flood flow paths.

14 Flood Risk Mitigation Measures

Flood resilient construction uses methods and materials that reduce the impact from a flood, ensuring that structural integrity is maintained, and the drying out and cleaning required, following inundation and before reoccupation, is minimised.

14.1 Finished Floor Levels

The average ground level of the proposed development is 41.9mAOD.

For minor extensions, the EA's Standing Advice states that finished floor levels are either no lower than existing floor levels or 300 millimetres (mm) above the estimated flood level. Where floor levels cannot be set to 300mm above existing flood levels, applicants should check with the LPA if they need to take flood resistance and resilience measures.

As the development is for a minor extension, finished floor levels can be retained as existing and extra flood resilience measures should be implemented.

14.2 Flood Displacement Storage

All new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water, and should seek opportunities to provide a betterment with respect to floodplain storage.

As the proposal it taking place on existing hardstanding, there will be no increase in the site's impermeable area. As such, flood compensatory storage is not deemed to be required.

14.3 Flood Mitigation Measures

In terms of achieving resilience, there are two main strategies, whose applicability is dependent on the water depth the property is subjected to. These are:

- Water exclusion strategy - where emphasis is placed on minimising water entry whilst maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning. This strategy is favoured when low flood water depths are involved (not more than 0.3m).
- Water entry strategy - buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. This strategy is therefore favoured when high flood water depths are involved (greater than 0.6m).

Given that flood depths less than 0.6m are predicted in extreme rainfall scenarios, the water exclusion strategy is considered most applicable for this site.

Water-resistant and resilient materials are recommended to be utilized through the construction to minimize the flood risk and potential impacts.

Floor construction:

- Use of resilient flooring materials as ceramic tiles or stone floor finishes;
- Use of a concrete slab 150mm thick;
- Use of ceramic tiles or stone floor finishes is recommended

- Maintain existing under floor ventilation by UPVC telescopic vents above 400 mm to external face of extension;
- Damp proof membrane of impermeable polythene at least 1200 gauge;
- Avoid the use of MDF carpentry.

Wall construction:

- Include in the external face of the extension a damp – proof course, 250 mm above ground level, to prevent damp rising through the wall;
- Use rigid closed – cell material for insulation above the DPC;
- Spread hardcore over the site within the external walls of the building to such thickness as required to raise the finished surface of the site concrete. The hardcore should be spread until it is roughly level and rammed until it forms a compact bed for the oversite concrete. This hardcore bed will be 100 mm thick and composed by well compacted inert material, blinded with fine inert material.

Doors:

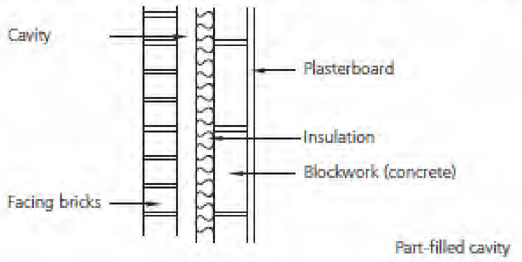
- Seal doors around edges and openings. UPVC or composite material will be used with passive protection meaning that minimal intervention will be required in the event of flooding.

Underground drainage:

- Avoid use of metal for any underground piping;
- Use closed cell insulation for pipes that are below the predicted flood level;
- Provide non – return valves for the drainage system to prevent back water flow;
- Use UPVC or clay pipework for fouls and surface water drainage.

Improving the flood performance of new buildings

Figure 6.10 Cavity External Walls – Part-filled cavity with sacrificial plasterboard



Part-filled cavity

- External face consisting of engineering bricks up to required level for flood protection (up to d.p.c.). Other external facing materials can be used above this level, but ensure transition is watertight.
- Rigid insulation
- Internal cement based render, preferably with lime content. Composition depends on masonry; the following mix is effective:

  1 cement : 6 sand: 1 lime on concrete blocks.
- Stainless steel wall ties should be used to minimise corrosion and consequent staining.
- Sacrificial plasterboard can be used, but it needs to be removed between ground floor to flood level. The board should be laid horizontally to make removal easier.

As well as the above the following flood resilience features will be applied as part of the development:

- Electrical sockets should be installed above flood level for the ground floor;
- Utility services such as fuse boxes, meters, main cables, gas pipes, phone lines and sockets will be positioned as high as practicable;
- All external openings for pipes or vents below 400mm to be sealed around pipe or vent with expanding foam and mastic.

14.4 Emergency Plan

The dangers associated with flood water to people are possible injury and/or death. This can occur as a result of drowning or being carried along by the waters into hard objects or vice versa.

The risk to life is largely a function of the depth and velocity of the floodwater as it crosses the floodplain. Fast flowing deep water that contains debris would represent the greatest hazard.

The assessment of danger to people from walking in floodwater is described in the Flood Risks to People guidance documents (FD2321_TR1 and FD2321_TR2) by DEFRA/EA. Danger can be estimated by the simple formula:

$$HR = d \times (v + 0.5) + DF$$

where, HR = (flood) hazard rating; d = depth of flooding (m); v = velocity of floodwaters (m/sec); and DF = debris factor calculated using Tables below. The scoring methodology and calculation matrix for this is summarised in Appendix 12.

The EA Product 4 data did not provide hazard mapping for the site and therefore it is not possible to determine the flood hazard score at the site.

The use of a flood emergency plan is therefore sufficient for the proposed development. The key elements of the emergency plan are described below.

14.4.1 EA Flood Warnings Direct Service Subscription

The occupants will subscribe to the EA Flood Warnings Direct Service which is a free service offered by the EA providing flood warnings direct to people by telephone, mobile, email, SMS text message and fax. The EA aims to provide 2 hours' notice of flood, day or night, allowing timely evacuation of the site.

The agency operates a 24 hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. In addition, this information can also be found at https://fwd.environment-agency.gov.uk/app/olr/home along with recommendations on what steps should be taken to prepare for floods, what to do when warnings are issued, and how best to cope with the aftermath of floods.

14.4.2 Access and Safe Egress

Safe egress to Flood Zone 1 is available by 2-minute walk away to the west along Ladygate Lane. Directions of this route are presented in Appendix 11 .

14.4.3 Safe Refuge

The proposed development will have internal connections to upper floors in the property which will act to provide sufficient safe refuge in the event of an extreme flood event.

15 Surface Water Drainage Strategy

15.1 Hydrological Run-off Assessment

To minimise the impact of the new development on local flood risk, the NPPF requires that the water drainage arrangements for any development site are that the volumes and peak flow rates leaving the site post-development are improved upon those of the existing conditions. The following run-off assessment predicts the Greenfield, pre- and post-development run-off rates and provides the required SuDS necessary for complying with the relevant planning policies.

15.2 Existing and Proposed Ground Cover

A summary of the ground cover is shown in the tables below:

Table 6: Breakdown of Ground Cover in the Proposed Development

Ground Cover	Existing Development Area		Proposed Development Area		Difference (m2)
	m^2	%	m^2	%	
Buildings	107	36	115	38	8
Hard Standing	75	25	67	22	-8
Soft landscaping	118	39	118	39	0
Total	300	100	300	100	

Table 7: Summary of Permeable and Impermeable Areas

	Impermeable Area		Permeable Area		Total Area
	m^2	%	m2	%	m^2
Existing Site	182	61	118	39	300
Proposed Site	182	61	118	39	300
Difference	0	0	0	0	

15.3 Peak Flow Control

With regard to peak flow control, the non-statutory technical standards for sustainable drainage systems state that:

- S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

The London Plan SI.13 states that 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. The London Plan Sustainable Design and Construction SPG (section 3.4.10) states that all developments on Greenfield sites must maintain Greenfield runoff rates. On previously developed sites, runoff rates should not be more than three times the calculated Greenfield rate.

15.4 Volume Control Requirements

With regard to volume control, the non-statutory technical standards for sustainable drainage systems state that:

- S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

- S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

15.5 Run-off and Storage Calculations

The IH124 method was applied to calculate the Greenfield and post-development run-off rates including 40% allowances for climate change. The full calculations and results are presented in Appendix 13. The table below gives a summary of the results:

Table 8: Calculation of post-development run-off rates for the site.

	Greenfield (l/s)	Greenfield + CC	Pre - Development	Pre - Development + CC	Post Development	Post Development + CC
Qbar	0.1748	0.2591	0.2060	0.3054	0.2060	0.3054
1 in 1	0.1486	0.2202	0.1751	0.2596	0.1751	0.2596
1 in 30	0.4020	0.5959	0.4739	0.7025	0.4739	0.7025
1 in 100	**0.5576**	**0.8266**	**0.6572**	**0.9743**	**0.6572**	**0.9743**

As per the Hillingdon Borough Council guidance, all surface water runoff from a minor extension should not be directed into the sewer. It should be diverted into a new source control element on site wherever possible.

The quick storage estimate tool in or Microdrainage was used to estimate the approximate storage required. The storage volume required is estimated to be 6.9 - 10.0m^3 to attenuate all hard standing on site. This reduces to 1.1 - 1.9m^3 when assessing the rooftops to the rear of the proposal only. Screenshots of the quick storage estimate and variables are available Appendix 13.

16 SuDS Implementation

As mentioned above, planning policies require that SuDS strategies consider source control (i.e. disposal of runoff within the plot boundary), followed by site control (site wide disposal) and then regional control (appropriate for larger development with strategic drainage infrastructure). They also require that that those methods that give the most benefits in terms of sustainability are prioritised for employment (generally known as the SuDS Hierarchy) as further described below.

16.1 SuDS Hierarchy

The SuDS Hierarchy sets out the preferred method of selecting which Sustainable Drainage System should be used. Generally, 'soft SuDS' such as ponds and swales are the preferred drainage systems as they mimic natural drainage and provide a number of benefits including attenuation of surface water flows and flow rates as well as pollution.

Smaller developments which may not have the physical room for pond and swales would need to consider other options. In these cases, preference should be given to infiltration systems. However, care should be taken if implementing infiltration systems near aquifer protection zones, close to buildings or structural foundations or in areas where soils may be polluted.

The SuDS hierarchy is Figure 1 summarised in below.

Figure 1 SuDS Hierarchy

Most Sustainable	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
↑	**Living roofs**	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
↓	**Permeable surfaces and filter drains** - gravelled areas - solid paving blocks - porous paviors	✔	✔	
Least Sustainable	**Tanked systems** - over-sized pipes/tanks - storms cells	✔		

Figure 2 Surface water storage facilities and potential SuDS features – rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual).

16.2 Assessment of SuDS Options

An assessment was made of the suitability of a range of potential SuDS techniques that could be implemented as part of the development. The results of the assessment are summarised in Appendix 14 and are further discussed below.

16.2.1 Living Roofs

Although buildings will cover approximately 38% of the site, given the current pitched roof design, living roofs are not considered a suitable option.

16.2.2 Basins, Ponds, Filter Strips and Swales

There is not sufficient space for these options.

16.2.3 Rain Gardens

The garden will cover 39% (118m^2) of the site. The development proposal is to retain it as a large grassy landscaped garden, which would be suitable for the installation of a rain garden. However, a overflow connection into the sewer would be required without establishing infiltration rates.

16.2.4 Infiltration Devices

Infiltration techniques should be given priority in any SuDS design as they deal with discharge on the site returning water to the aquifer and subsequently rivers via baseflow.

Given the highly variable nature of the bedrock geology, groundwater susceptibility and surface water ponding indicated on site, it thought infiltration soakaway are unlikely to be suitable on site. A soakaway with connection may be the preferable option.

Infiltration testing will be required if a soakaway without connection to the sewer is recommended.

16.2.5 Permeable Surfaces and Filter Drains

Approximately 18m^2 (6%) of the development will consist of rear garden patios which could be designed to be permeable.

16.2.6 Tanked Systems

A tanked system incorporating a hydro brake restricting flow to the would be suitable for the site, however it is ranked as being the least sustainable in the SuDS hierarchy.

Table 9 gives a breakdown of the suitable SuDS options for the proposed development.

Table 9: Suitable SuDS Strategy

SuDS Technique	Potential Suitability	Comments
Rainwater Harvesting	Suitable	Suitable
Infiltration: Soakaways/Infiltrations Trenches/Basins	Likely to be unsuitable	Testing is required
Green/Brown/Blue roofs	Unsuitable	Pitched roofs and roof lights
Rain Gardens	Suitable	Large garden
Permeable Pavements/Surfaces	Suitable	Suitable for rear patio
Swales	Unsuitable	Insufficient space
Detention Basin/Ponds	Unsuitable	Insufficient space
Storage Tanks/Geocellular storage	Suitable	Least sustainable
Oversized Piping	Suitable	Not required

16.3 SuDS Strategy

16.3.1 Primary SuDS Option

Based on all the above considerations a preliminary SuDS strategy consisting of a potential mix of options was formulated.

The small size of the site limits the options that can be explored. Subject to the production of a Detailed Surface Water Management Strategy, a summary of the preliminary SuDS measures that will be employed are discussed below.

The patios form a total of 18m^2 of the rear impermeable area of the proposed development (not including the existing driveway). Laying permeable paving in these areas would give a total of approximately 1.6m^3 for use as interception and attenuation storage.

The rear garden forms an area of 118m^2. The proposed extension forms an area of 22m^2, whilst the rear rooftop (including the extension) totals 65m^2. A rain garden 5 - 15m^2 would be a suitable rain size to accommodate surface water roof from the rooftop. The area required is calculated is based on 20% of the total area contributing to the rain garden.

It is recommended to accommodate for the entire of the rear rooftops due to the existing flood risk indicated on site.

As the drainage characteristics of the underlying geology have not been established, the rain garden should allow for an overflow connection into the existing surface water drainage network.

Table 10 gives a breakdown of the proposed impermeable areas with possible SuDS options and the resulting storage that could be provided.

Table 10: Breakdown of Recommended SuDS Techniques

Location	Proposed Area (m^2)	SuDS Option	Estimated Storage Provided (m^3)
Buildings	15	Rain Garden	2.14
Patio	18	Permeable Paving	1.6
Total	**37**		3.74

A drainage layout plan is available in Appendix 17.

Detailed descriptions of some of the proposed SuDS techniques are available in Appendix 15.

16.3.2 Surface Water Discharge Points

The surface water runoff from the proposal will infiltrated into the ground below the rain garden. When the rain garden is full, the overflow will connect into the existing drainage network on site.

16.3.3 Treatment of Run-off

Treatment of roof water runoff will be provided through the provision of the raingarden and permeable paving, to intercept gross solids and sediment, guidance will be provided to householders on appropriate maintenance requirements.

16.3.4 Exceedance Flows

The elevation review of the LIDAR 1m DTM Mapping indicates that in the event of exceedance on the site, overland flows would likely south and pool within the gardens of the site. The LIDAR data suggests the garden is at a lower elevation than the proposed development.

16.4 Secondary SuDS

The secondary system will involve the use of a shallow underground storage tank that will attenuate all surface water runoff from the rear of the site before discharging into the existing drainage connection via an orifice flow control device at 0.5l/s.

The tank will be formed from geocellular crates that will be joined together to form the required attenuation. The geocellular system will allow for infiltration but will also allow for discharge into the sewer as infiltration rate has not been determined on site.

The geocellular system will provide $6m^3$ of surface water attenuation.

An indicative drainage layout plan is available in Appendix 17.

16.5 Maintenance and Adoption of SuDS

All SuDS features will be properly installed by competent persons. They will be maintained regularly to ensure that their design capacity and attenuation characteristics provide the required storage volume.

Landscaping and adjacent areas will be designed such that they do not cause soil, mulch and other materials to be washed onto the permeable surfaces and into drains causing clogging.

Owners of the properties/persons responsible for maintenance of SuDS components will be provided with operation and maintenance manuals which will include information such as:

- the location of SuDS components;
- an explanation of design intent and objective of the SuDS;
- the requirements for regular and occasional inspection and maintenance;
- visual indicators that may trigger maintenance.

Regular maintenance of SuDS components is relatively straightforward with the main tasks consisting of:

- Regular visual inspections – checking inlets are not blocked and verifying that clogging has not occurred;
- Litter and debris removal;
- Grass cutting;
- Preventive sweeping;
- Weeding and invasive plant control;
- Oil and stain removal.

Occasional maintenance activities to ensure the long-term performance of the SuDS features include:

- Sediment removal
- Vegetation and plant replacement

These simple measures will ensure that the storage capacity of the system is maintained and that the need for reconstruction and replacement of components is minimised.

Further details on SuDS maintenance measures that will be employed at the site can be found in Appendix 16.

17 Conclusions and Recommendations

This assessment has considered the potential risks to the application site associated with flooding from fluvial, tidal, surface water, artificial and groundwater sources.

A review of LLFA's SFRA as well as data provided by the EA was undertaken. The main findings of the review are provided below:

- The main source of potential flooding to the site is from fluvial and surface water;
- The EA define the site as being within Flood Zone 3;
- The development is considered to be a more vulnerable minor development and is therefore unlikely to require sequential and exception tests to be undertaken.
- The site is not in an area that benefits from flood defences;
- No surface water flooding incidents were identified within 200m of the site;
- The is within a CDA 028 Ladygate Lane.
- It is not in an area that has a significant number of sewage flooding incidents, no sewer flooding incidents were identified within the postcode;
- No records of groundwater, fluvial and sewer flooding incidents were identified at or in the vicinity of the site;

- As the development will result in a change in the impermeable area of the site it may have an impact on local flood risk.
- There is opportunity for implementing SuDS mitigation measures such as rain gardens, permeable paving, soakaways or geocellular attenuation;
- A 15m^2 raingarden is the preferred solution to mitigate the impacts of surface water run-off from the rear of the development, in combination with the permeable paving across the rear patio.
- As infiltration rates of the underlying geology have not been obtained, an overflow connection into the sewer will be required.
- The development will utilise flood resilient materials and construction methods so as to ensure that the impacts of any potential flooding are minimised.
- Safe egress to Flood Zone 1 is a 2-minute walk away and safe refuge is available on the upper floors which is accessible via an internal staircase.

Based on the information reviewed, we believe that the overall flood risk to the site is medium to high, given the fluvial and pluvial sources of flood risk identified. As the proposal will not increase the site's impermeable area, it may have an impact on flood storage due to the increase in building footprint. However, this would be displaced onto the gardens of the site. No flood compensation storage has been provided as the site is within Fluvial flood zone 3.

The implementation of the proposed SuDS measures, will reduce the impermeable area of the site by providing permeable paving within the rear patio. It will provide attenuation for more than half of the rooftop area. We believe the proposal will provide a betterment in terms of the flood risk the site currently has.

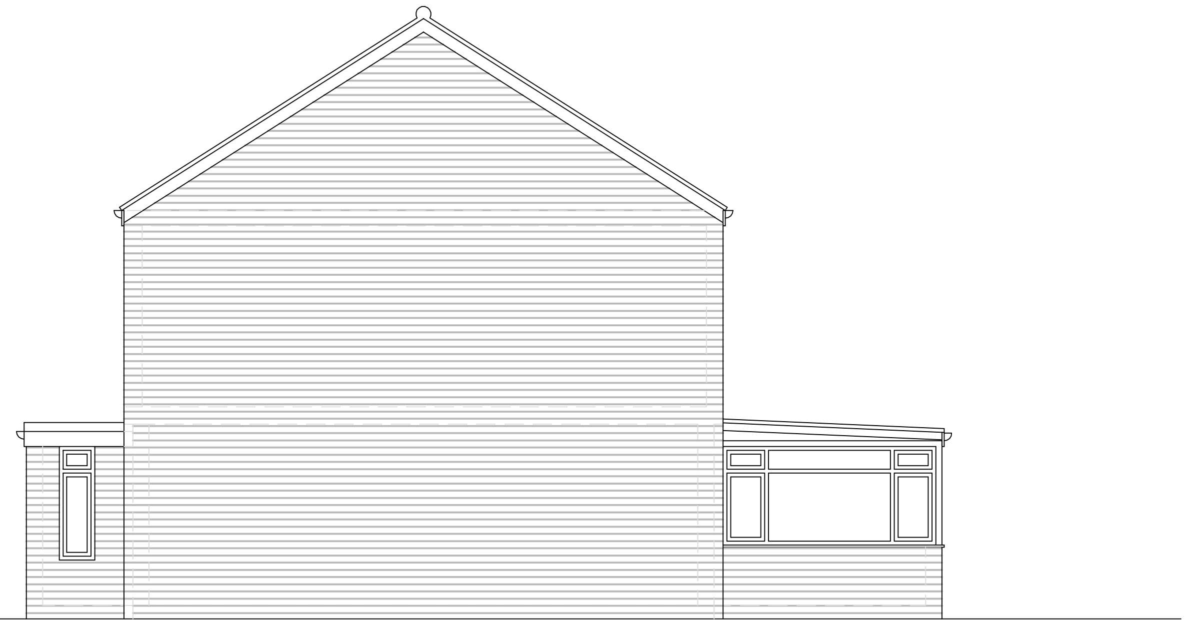
18 References

1. Communities and Local Government - National Planning Policy Framework NPPF, March 2012.
2. Communities and Local Government - Planning Practice Guidance: Flood Risk and Coastal Change, Updated 06 March 2014.
3. Preliminary Flood Risk Assessment - Hillingdon - Jan 2011
4. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
5. West London SFRA - Online - https://westlondonsfra.london/mapping-tool/
6. Greater London Authority – London Sustainable Drainage Action Plan, 2015.
7. Google Maps accessed September 2017.

19 Appendices

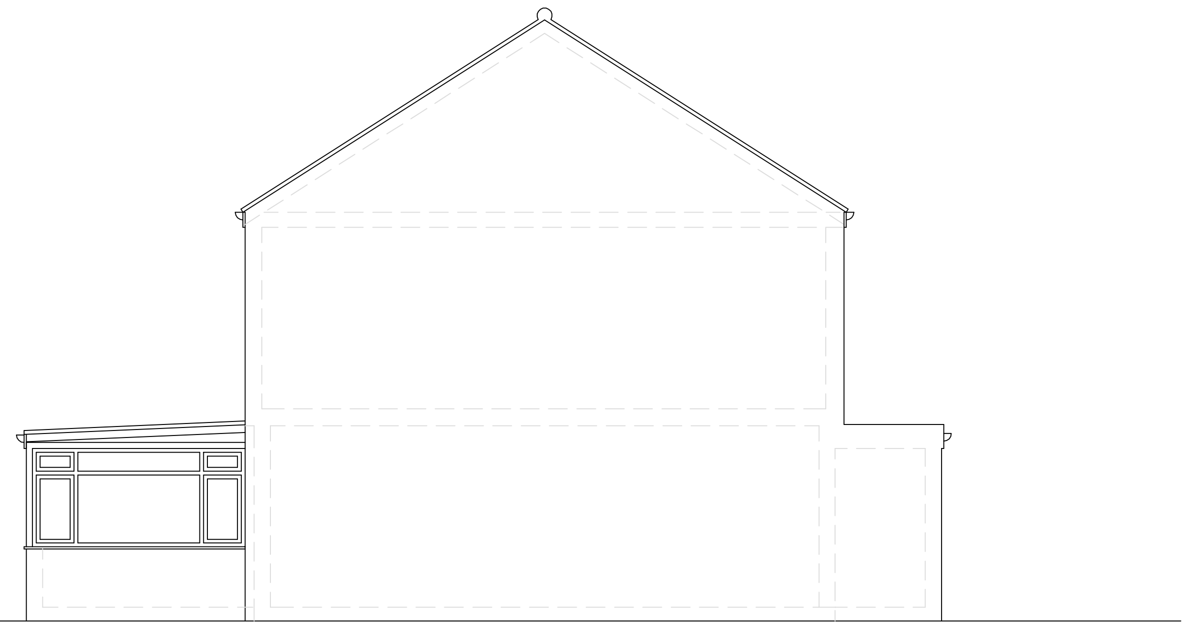
19.1 Appendix 1 – Development Plans

FRONT (North) ELEVATION (Extg)



RIGHT SIDE (West) ELEVATION (Extg)

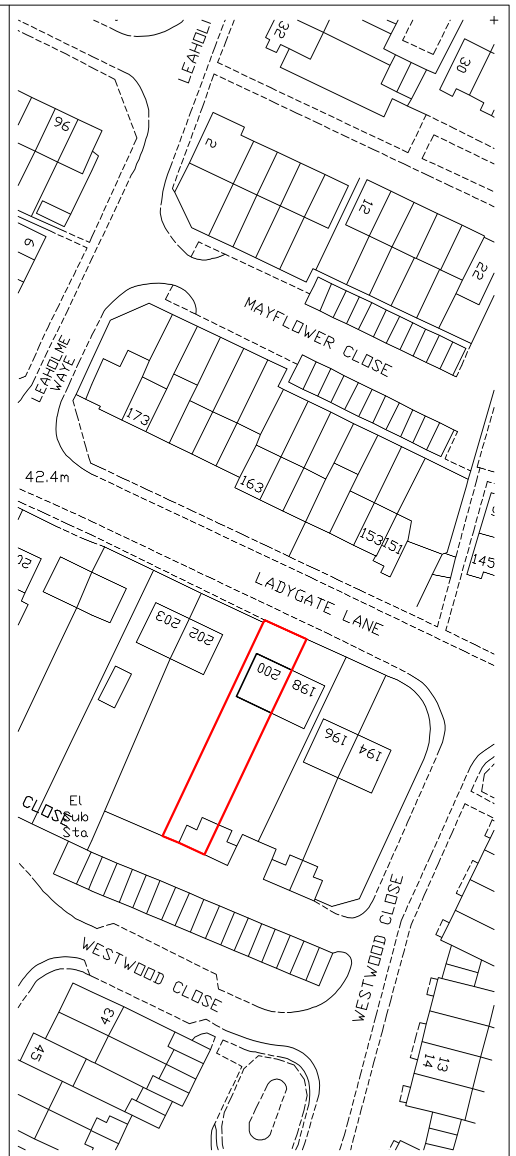
REAR (South) ELEVATION (Extg)



LEFT SIDE (East) ELEVATION (Extg)

NOTES:
1. Proposal Site is shown in Red outline.

Scale 1:100 5 4 3 2 1 0m



LOCATION PLAN

Scale 1:1250 50 40 30 20 10 0m

A	Original Issue	V&R 27Dec20
Ver	Amendments	Drn By Date

Client
MRS D SHAH

Project
TWO STOREY REAR EXTENSION
at
200 Ladygate Lane, Ruislip HA4 7QY

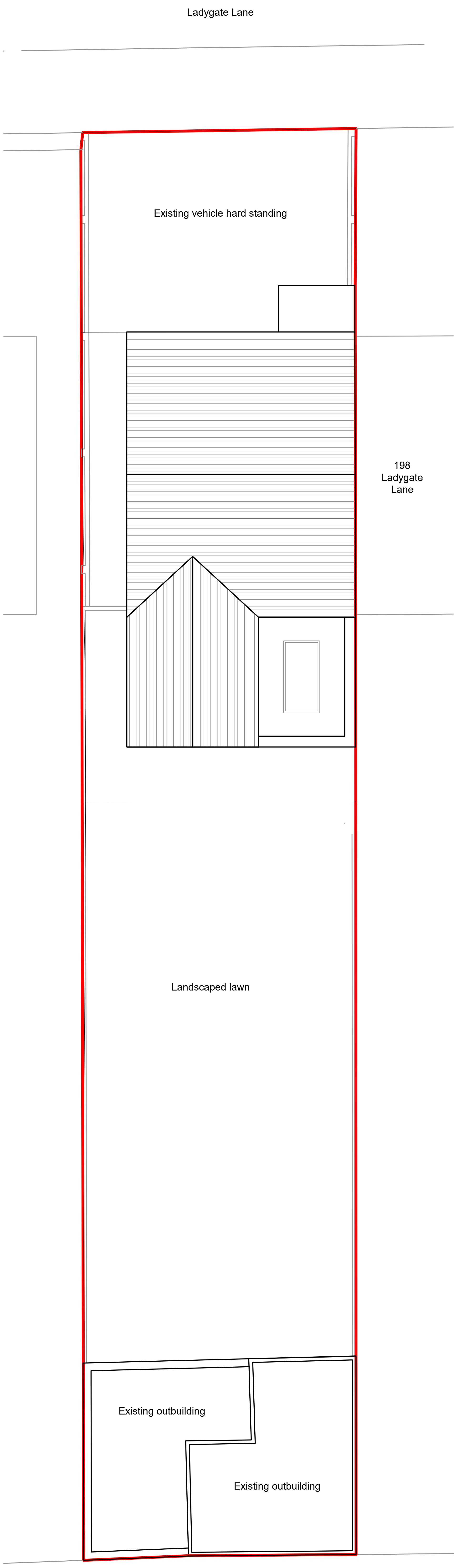
Drawing Title
EXISTING ELEVATIONS (1:100)
LOCATION PLAN (1:1250)

Scale @ A3 1:100, 1:1250. Print@ A3 Landscape in pdf format. Use mentioned and drawn scales to read.

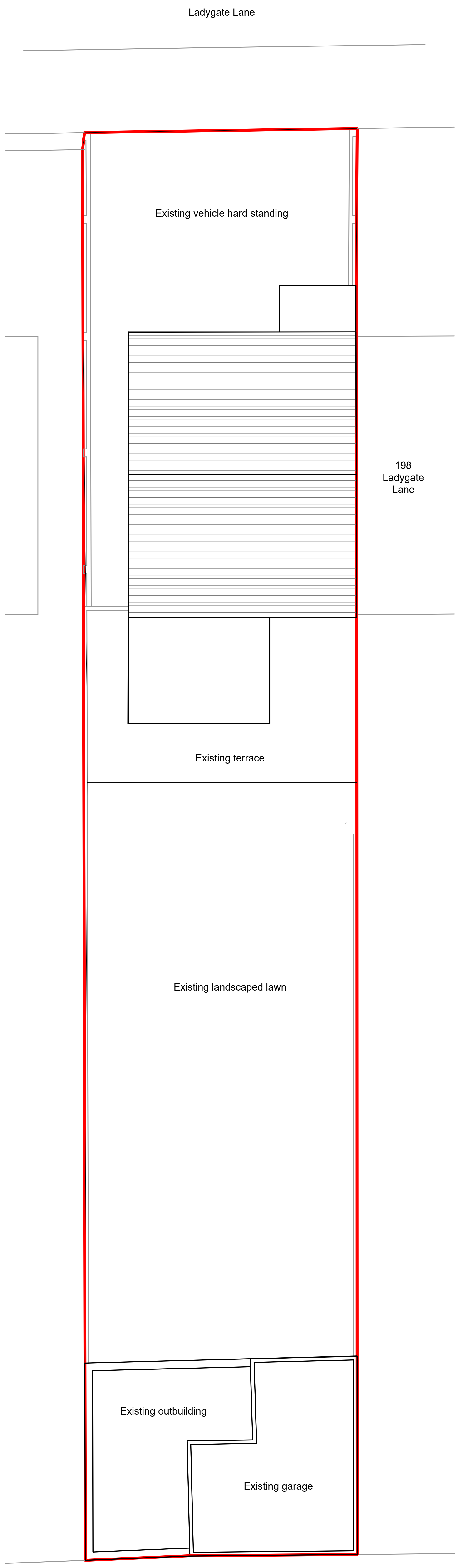
Drg No	Version	Sheet
041_PA_1-2	A	

PlanApps

Mob: 07583 503 862
email: rumi.hakim@sky.com



1. Proposed Site Plan
1.200 @ A2



2. Existing Site Plan
1.200 @ A2

NOTES

1. This drawing has been produced for planning purposes only.

LADYGATE LANE, HILLINGDON

Existing and Proposed Site Plan
Scale: 1:100 @ A2
Date: 25.08.2021
Drawing: LL_SK010_00

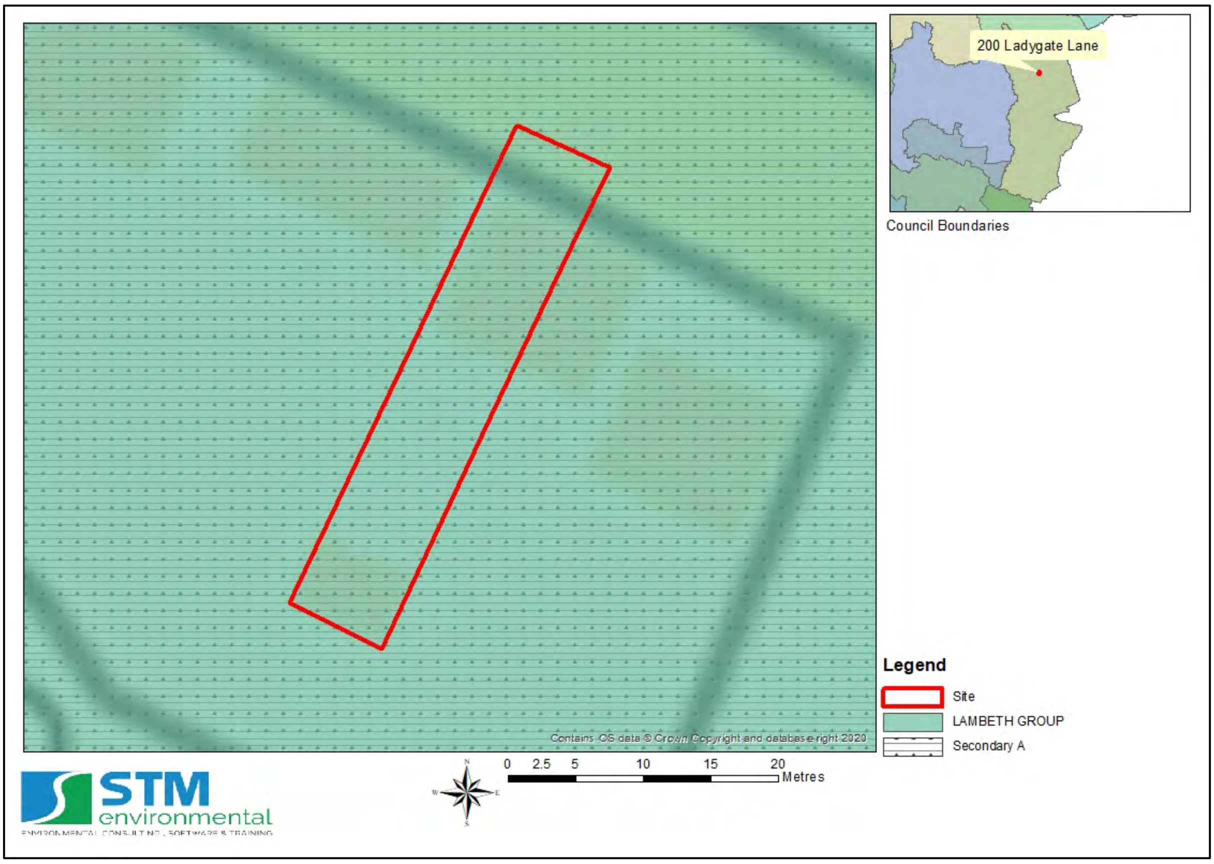
19.2 Appendix 2 – Site Photos

19.3 Appendix 3 – Environmental Characteristics

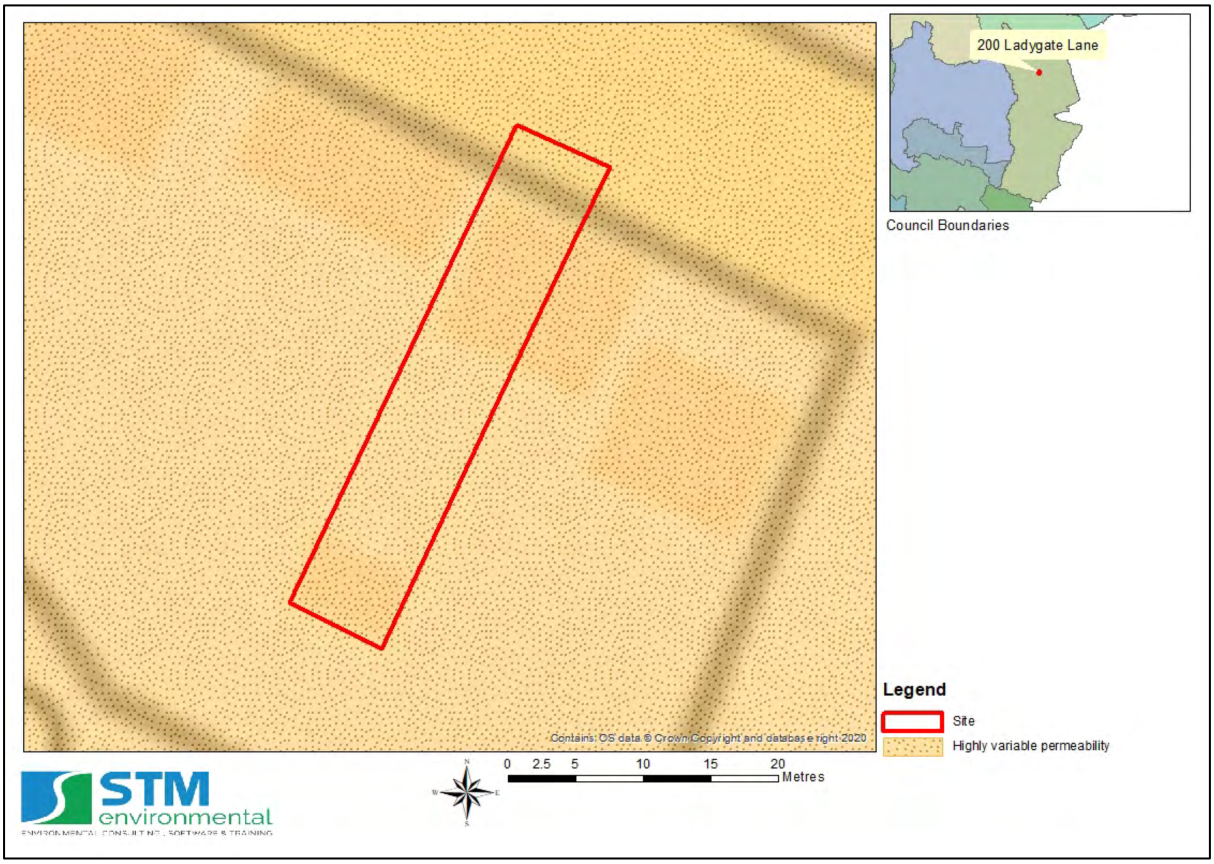
19.3.1 Superficial Geology and Hydrogeology

N.A – no superficial deposits identified.

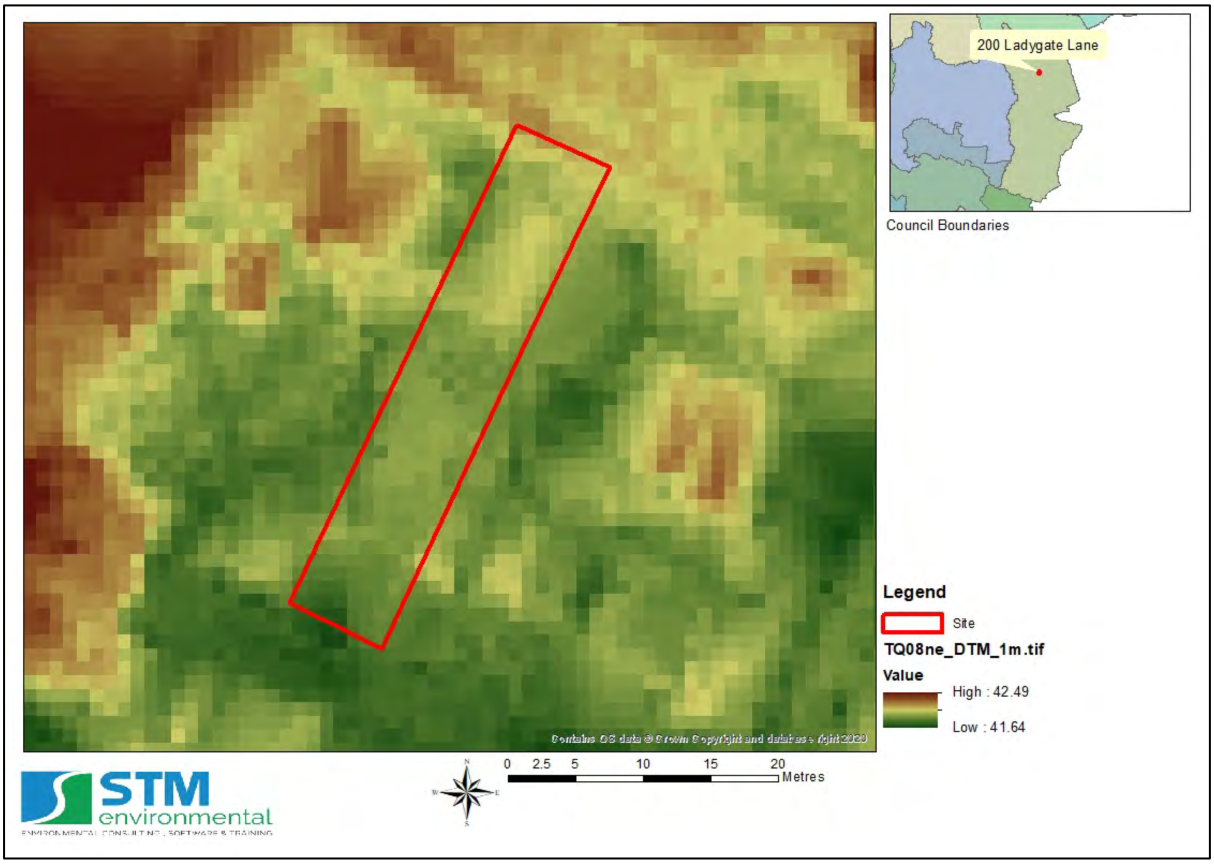
19.3.2 Bedrock Geology and Hydrogeology



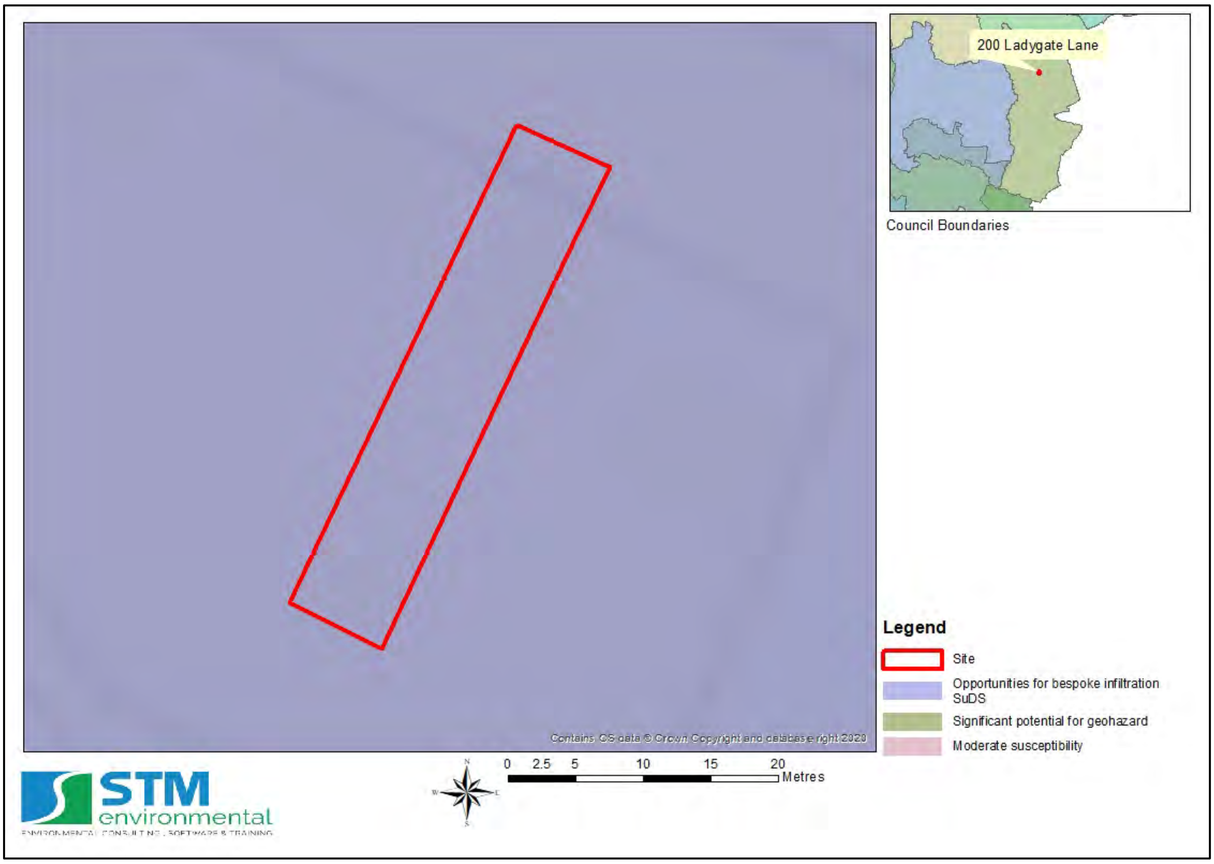
19.3.3 Bedrock Permeability



19.3.4 Topography Map



19.3.5 Drainage Summary



19.4 Appendix 4 – Historical Flood Incident Maps

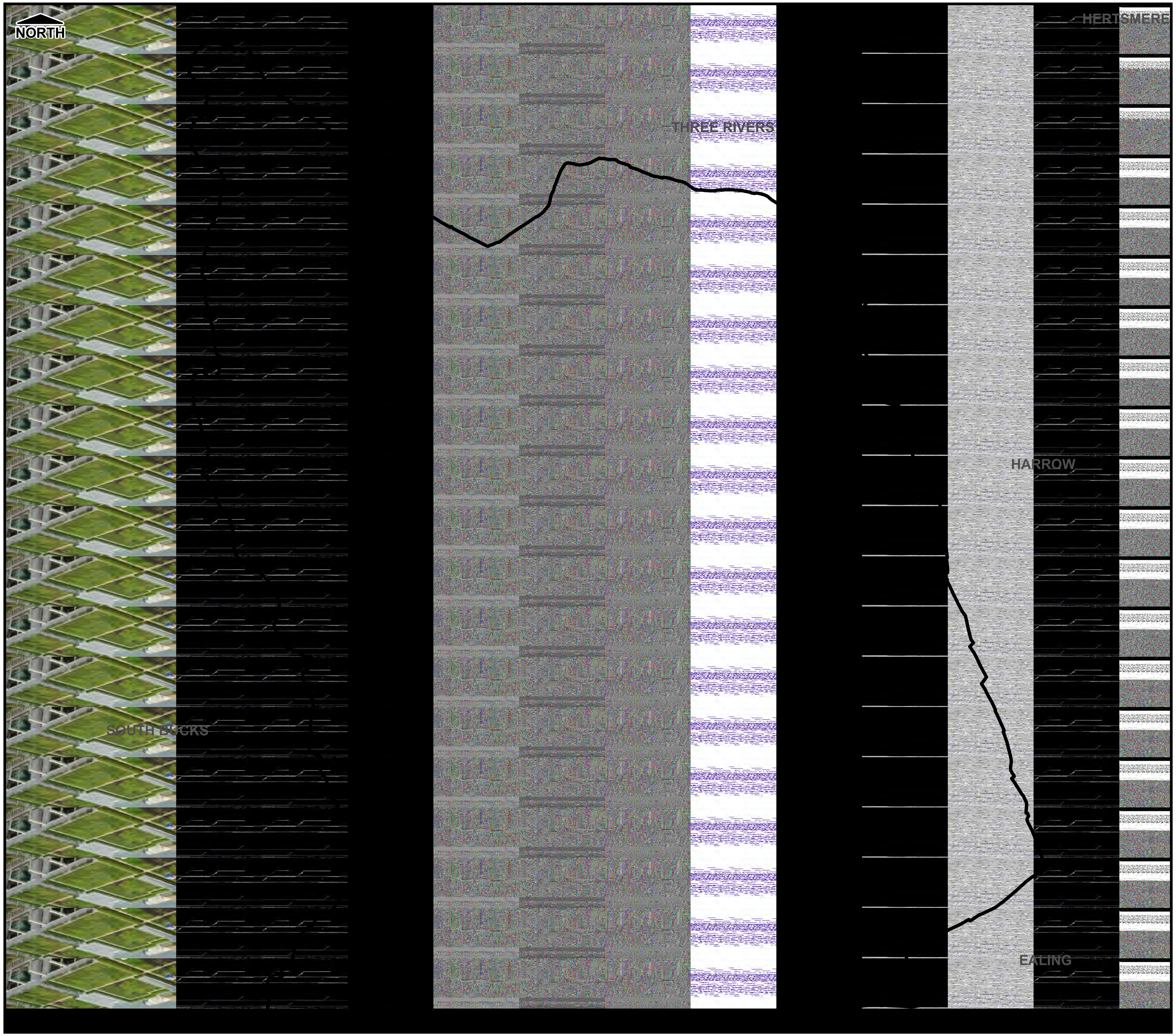
19.4.1 EA Historic Flood Outlines

N.A

19.4.2 Recorded Flood Outlines

N.A

19.4.3 Map Showing Recorded Groundwater Flooding



Legend

Notes

London Borough of Hillingdon

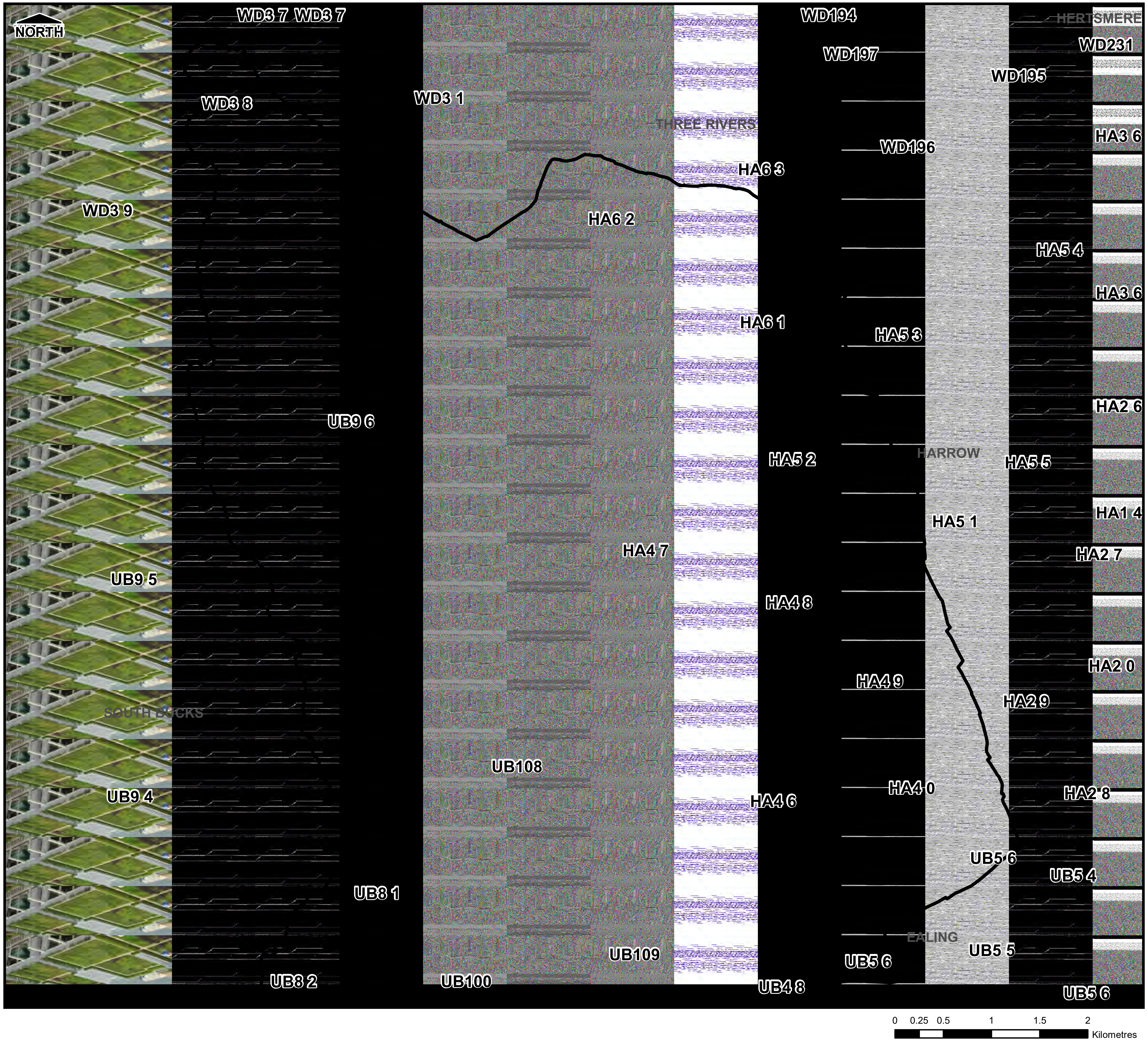
Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by

Increased Potential for Elevated Groundwater Map

FIGURE 10.1

19.4.4 Map Showing Recorded Sewer Flooding



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Sewer Flooding Incidents
- Sewer Flood Outline

No. of Sewer Flood Records

- None
- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 50
- 51 - 100
- 101+

Notes

London Borough of Hillingdon

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:40,000	06/04/2011	R.MOORE	P.HLINOVSKY

Recorded Incidents of Sewer Flooding

Consultants

Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

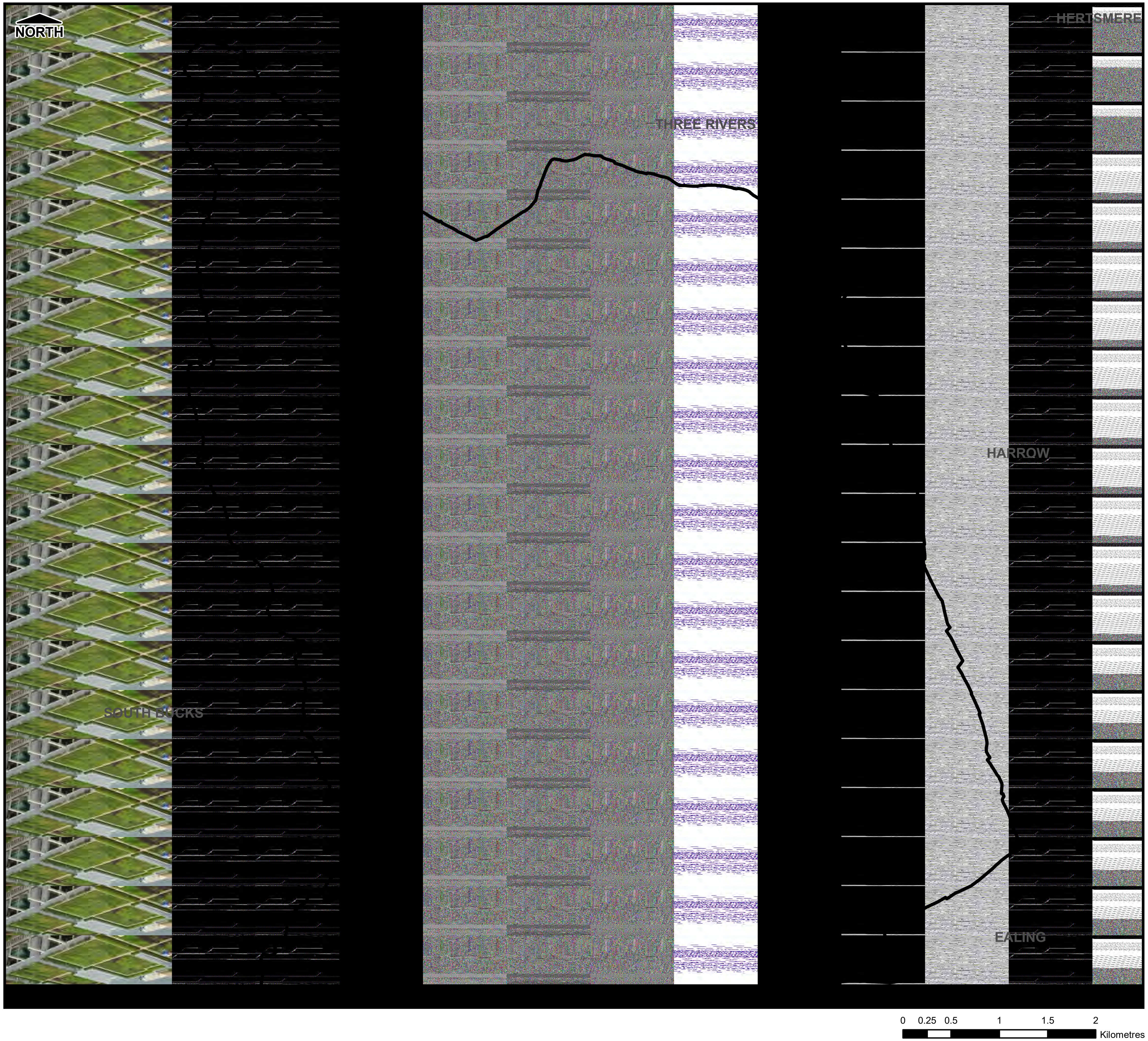
Drain London Programme Board Members

FIGURE 9.1

Filepath: L:\Environment\zwet\CS046913_DrainLondon_Tier2\Group1\ARC\mxds\GP1_Hillingdon_Fig9.1_SewerIncidents.mxd

19.4.5 Map Showing Recorded Surface Water Flooding

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED



Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Culverted Watercourse (Main River)
- Permanent Water Bodies
- Surface Water Flooding Incidents
- Surface Water Flood Outline

Flood Depth

- < 0.1m
- 0.1m - 0.25m
- 0.25m - 0.5m
- 0.5m - 1.0m
- 1.0m - 1.5m
- > 1.5m

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

London Borough of Hillingdon

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:40,000	08/04/2011	R.MOORE	P.HLINOVSKY

1 in 100 year rainfall event depth and recorded surface water flood incidents

Consultants

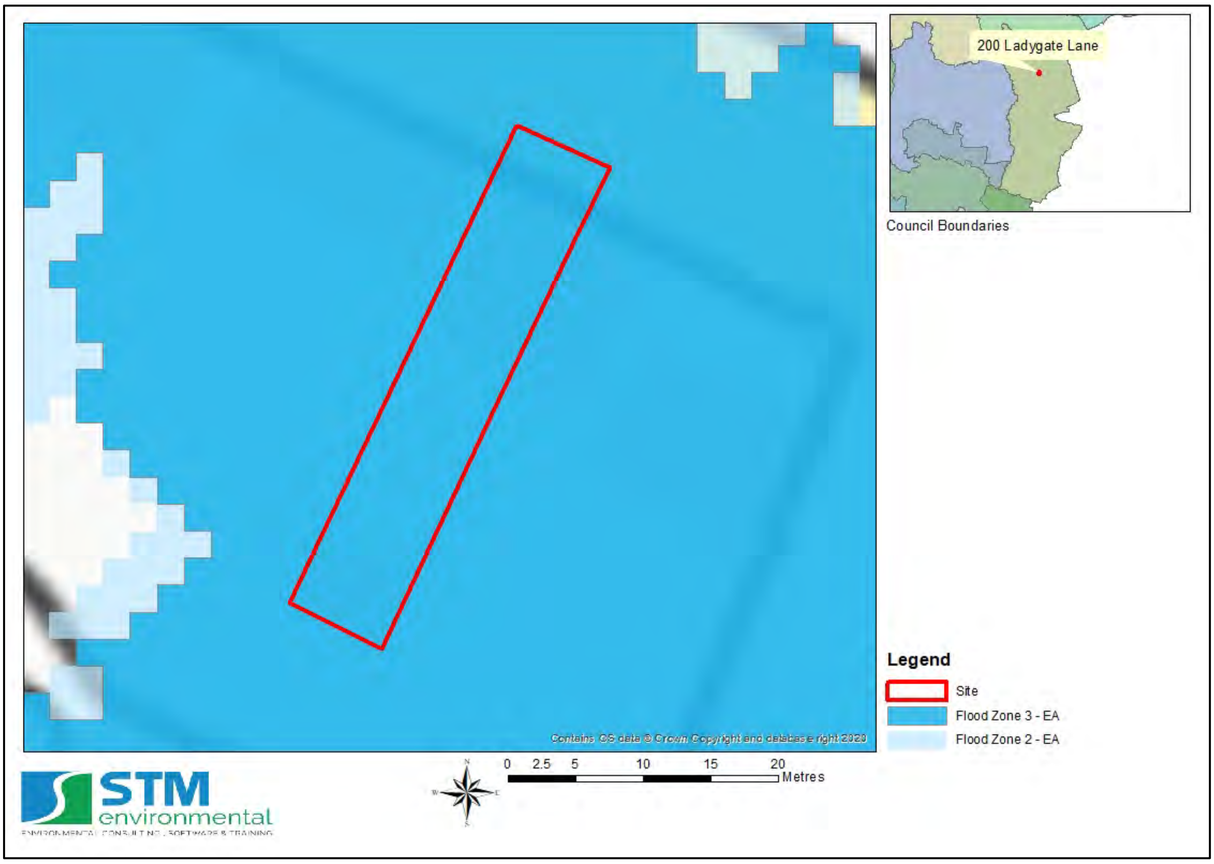
Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

Drain London Programme Board Members

FIGURE 5.1

Filepath: L:\Environment\zwet\CS046913_DrainLondon_Tier2\Group1\ARC\mxds\GP1_Hillingdon_Fig5.1_Depth_SWIncidents_100.mxd

19.5 Appendix 5 - EA Flood Zone Map



19.6 Appendix 6 – Flood Defence And Reservoir Flood Risk Maps

19.6.1 EA Map showing areas benefitting from flood defences

N.A

19.6.2 Reservoir Flood Risk Map

19.7 Appendix 7 – EA Product 4 Data

Detailed FRA centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

Defended Flood Outlines

- 1 in 2 year (50%) Defended
- 1 in 5 year (20%) Defended
- 1 in 10 year (10%) Defended
- 1 in 20 year (5%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
Modelled outlines take into account catchment wide defences.

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

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Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

Defended Flood Outlines

1 in 30 year (3.33%) Defended

1 in 50 year (2%) Defended

1 in 75 year (1.33%) Defended

1 in 100 year (1%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
Modelled outlines take into account catchment wide defences.
Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

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Hertfordshire & North London

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Environment Agency

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Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

Defended Flood Outlines

1 in 100 year + 20% (*CC) Defended

1 in 100 year + 25% (*CC) Defended

1 in 100 year + 35% (*CC) Defended

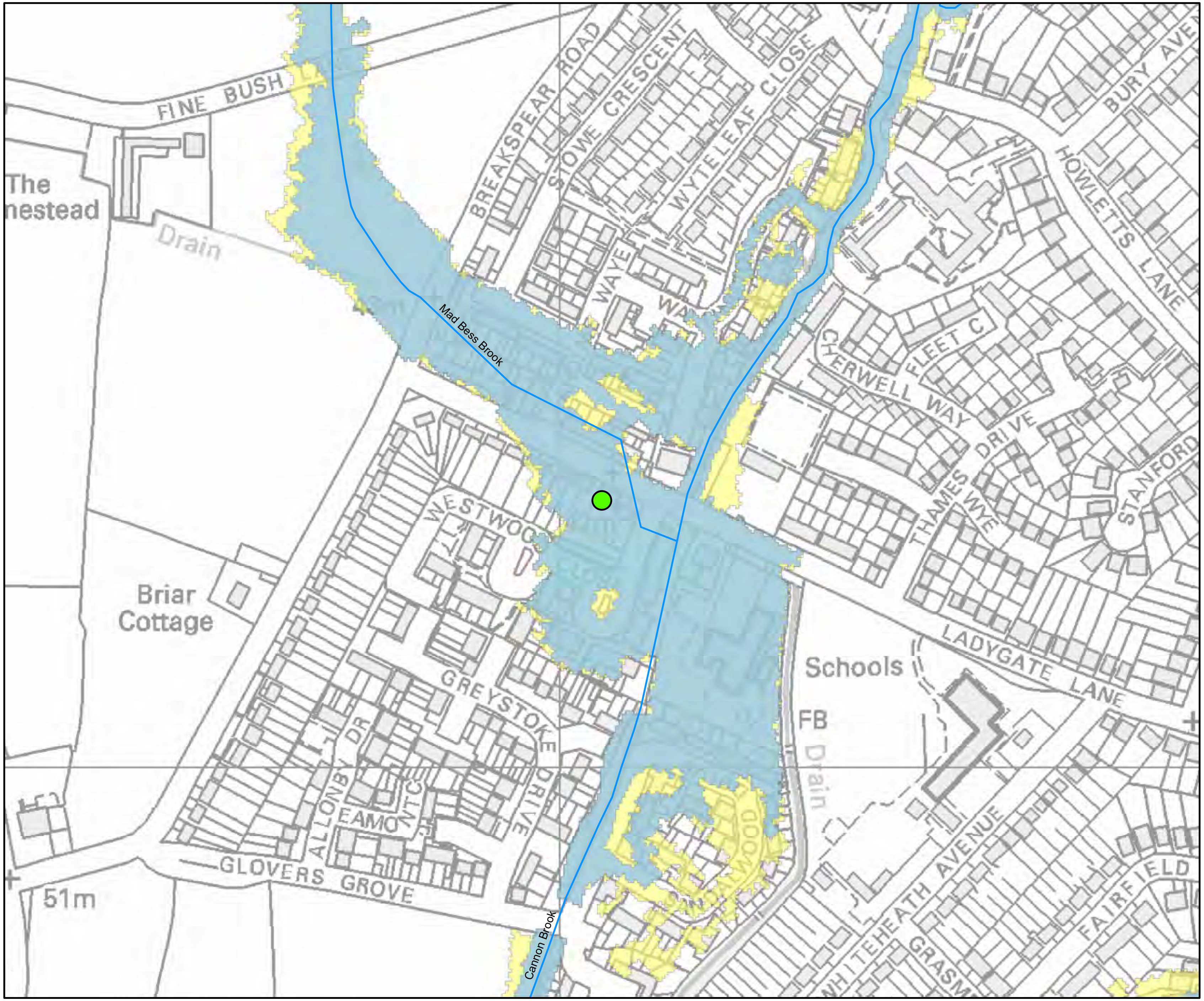
1 in 100 year + 70% (*CC) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
Modelled outlines take into account catchment wide defences.

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH



Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

Defended Flood Outlines

1 in 250 year (0.4%) Defended

1 in 1000 year (0.1%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
Modelled outlines take into account catchment wide defences.
Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

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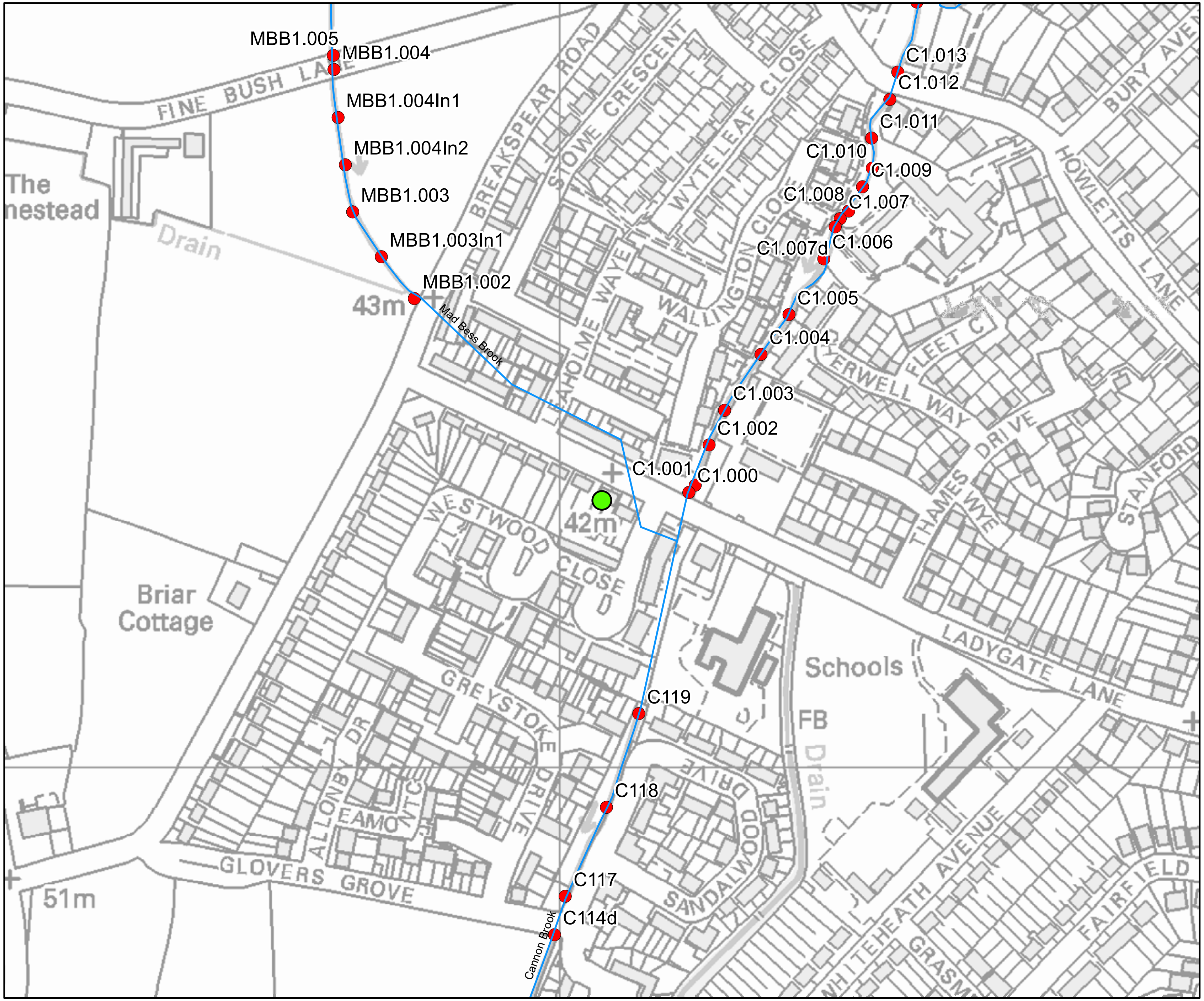
Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH



Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

1D Nodes

Nodes

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
Modelled outlines take into account catchment wide defences.
Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Environment Agency ref: HNL 218471 HH

The following information has been extracted from the River Pinn Mapping Study (JBA, 2015)

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Caution:

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites across the entire catchment.

All flood levels are given in metres Above Ordnance Datum (mAOD)
All flows are given in cubic metres per second (cumecs)

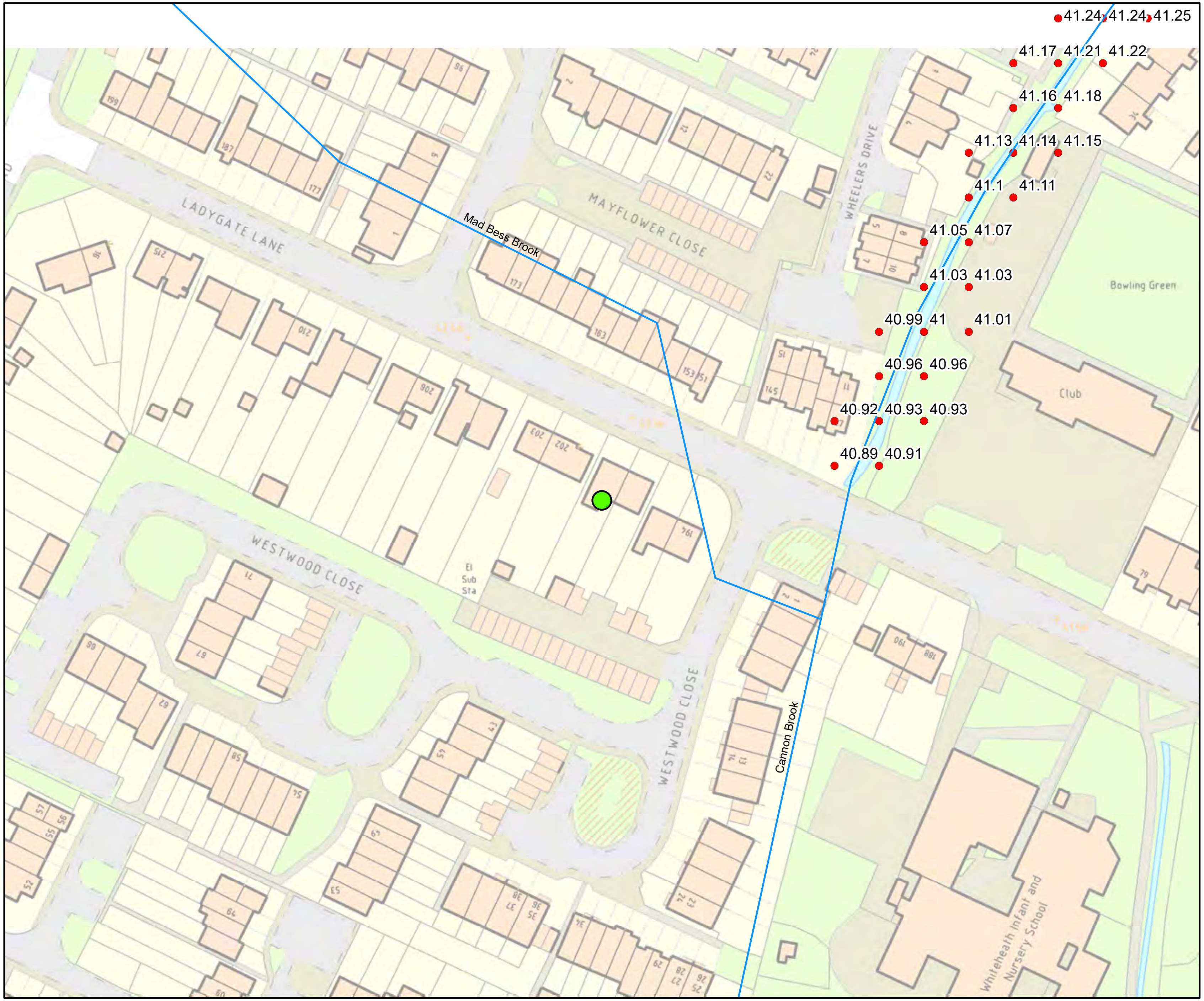
MODELLED FLOOD LEVEL

			Return Period													
Node Label	**Easting**	**Northing**	**2 yr**	**5 yr**	**10 yr**	**20 yr**	**30 yr**	**50 yr**	**75 yr**	**100 yr**	**100yr + 20%**	**100yr + 25%**	**100yr + 35%**	**100yr + 70%**	**250 yr**	**1000yr**
C1.013	508220	188452	41.55	41.62	41.67	41.72	41.76	41.80	41.85	41.90	42.13	42.19	42.31	42.70	42.21	42.80
C1.012	508215	188434	41.53	41.59	41.63	41.68	41.71	41.75	41.79	41.82	41.96	41.99	42.06	42.28	42.01	42.37
C1.011	508203	188409	41.49	41.56	41.60	41.65	41.68	41.72	41.76	41.79	41.93	41.96	42.03	42.25	41.97	42.34
C1.010	508203	188390	41.46	41.52	41.57	41.62	41.65	41.69	41.73	41.76	41.89	41.93	41.99	42.23	41.94	42.33
C1.009	508197	188377	41.44	41.50	41.55	41.60	41.63	41.68	41.72	41.75	41.87	41.91	41.98	42.22	41.92	42.33
C1.008	508188	188362	41.40	41.47	41.52	41.57	41.60	41.65	41.69	41.72	41.83	41.86	41.93	42.20	41.88	42.31
C1.007	508182	188357	41.39	41.45	41.50	41.56	41.59	41.64	41.68	41.71	41.82	41.85	41.93	42.20	41.87	42.32
C1.007d	508179	188351	41.39	41.45	41.50	41.55	41.58	41.63	41.67	41.70	41.78	41.82	41.88	42.11	41.83	42.24
C1.006	508172	188330	41.34	41.41	41.46	41.51	41.54	41.58	41.62	41.65	41.74	41.77	41.83	42.05	41.78	42.19
C1.005	508149	188294	41.27	41.33	41.38	41.43	41.46	41.50	41.54	41.57	41.65	41.69	41.75	41.98	41.70	42.13
C1.004	508131	188268	41.19	41.25	41.30	41.34	41.37	41.41	41.45	41.48	41.56	41.59	41.65	41.89	41.61	42.06
C1.003	508107	188232	41.05	41.12	41.16	41.21	41.24	41.28	41.31	41.35	41.45	41.47	41.52	41.82	41.51	42.02
C1.002	508097	188209	40.97	41.04	41.09	41.14	41.16	41.20	41.24	41.28	41.38	41.41	41.46	41.79	41.46	42.00
C1.001	508088	188183	40.89	40.96	41.01	41.06	41.09	41.13	41.17	41.21	41.32	41.35	41.41	41.76	41.40	41.98
C1.000	508084	188178	40.89	40.96	41.01	41.06	41.09	41.13	41.17	41.21	41.32	41.35	41.40	41.75	41.40	41.97
C119	508051	188034	40.17	40.22	40.25	40.29	40.31	40.34	40.37	40.45	40.60	40.63	40.69	40.85	40.68	41.07
C118	508030	187973	39.92	39.95	39.97	40.00	40.02	40.04	40.08	40.16	40.29	40.32	40.37	40.53	40.37	40.76
C117	508003	187915	39.62	39.68	39.73	39.77	39.79	39.83	39.89	39.99	40.14	40.18	40.23	40.42	40.23	40.68
C114d	507996	187890	39.56	39.62	39.66	39.70	39.72	39.75	39.82	39.89	40.02	40.05	40.09	40.23	40.09	40.39
MBB1.005	507852	188463	44.19	44.41	44.44	44.47	44.48	44.50	44.51	44.52	44.54	44.54	44.55	44.58	44.55	44.62
MBB1.004	507852	188454	43.64	43.70	43.75	43.80	43.82	43.87	43.90	43.92	43.98	43.99	44.02	44.08	44.02	44.13
MBB1.004In1	507855	188422	43.44	43.50	43.54	43.59	43.61	43.66	43.68	43.70	43.74	43.75	43.76	43.81	43.76	43.86
MBB1.004In2	507860	188392	43.25	43.30	43.33	43.37	43.45	43.55	43.58	43.60	43.65	43.66	43.67	43.72	43.67	43.78
MBB1.003	507865	188361	43.04	43.08	43.12	43.24	43.41	43.53	43.57	43.59	43.64	43.64	43.66	43.71	43.66	43.77
MBB1.003In1	507883	188332	42.71	42.80	42.89	43.20	43.40	43.53	43.56	43.59	43.63	43.64	43.66	43.71	43.66	43.76
MBB1.002	507905	188304	42.51	42.64	42.78	43.19	43.40	43.52	43.56	43.58	43.63	43.64	43.66	43.70	43.66	43.76

MODELLED FLOWS

			Return Period													
Node Label	**Easting**	**Northing**	**2 yr**	**5 yr**	**10 yr**	**20 yr**	**30 yr**	**50 yr**	**75 yr**	**100 yr**	**100yr + 20%**	**100yr + 25%**	**100yr + 35%**	**100yr + 70%**	**250 yr**	**1000yr**
C1.013	508220	188452	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	3.09	1.94	3.43
C1.012	508215	188434	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	3.09	1.94	3.43
C1.011	508203	188409	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	3.09	1.94	3.47
C1.010	508203	188390	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	2.73	1.94	2.96
C1.009	508197	188377	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	2.72	1.94	2.90
C1.008	508188	188362	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	2.73	1.94	2.77
C1.007	508182	188357	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	2.56	1.94	2.57
C1.007d	508179	188351	0.48	0.59	0.69	0.79	0.86	0.97	1.08	1.25	1.76	1.89	2.16	2.56	1.94	2.57
C1.006	508172	188330	0.57	0.72	0.85	0.99	1.08	1.22	1.35	1.45	1.82	1.96	2.23	3.21	2.01	3.66
C1.005	508149	188294	0.57	0.72	0.85	0.99	1.08	1.22	1.35	1.45	1.82	1.96	2.23	3.21	2.01	3.66
C1.004	508131	188268	0.57	0.72	0.85	0.99	1.08	1.22	1.35	1.45	1.82	1.96	2.23	3.21	2.01	3.66
C1.003	508107	188232	0.57	0.72	0.85	0.99	1.08	1.22	1.35	1.45	1.82	1.96	2.23	3.21	2.01	3.63
C1.002	508097	188209	0.57	0.72	0.85	0.99	1.08	1.22	1.35	1.45	1.82	1.96	2.23	3.21	2.01	3.66
C1.001	508088	188183	0.57	0.72	0.85	0.99	1.08	1.22	1.35	1.45	1.82	1.96	2.23	3.21	2.03	3.67
C1.000	508084	188178	0.57	0.72	0.85	0.99	1.08	1.22	1.35	1.45	1.82	1.96	2.23	3.21	2.03	3.67
C119	508051	188034	0.59	0.71	0.80	0.89	0.94	1.02	1.07	1.11	1.25	1.29	1.36	1.75	1.35	1.95
C118	508030	187973	0.61	0.74	0.84	0.93	0.99	1.07	1.22	1.56	2.16	2.31	2.56	3.39	2.55	4.54
C117	508003	187915	0.61	0.74	0.84	0.93	0.99	1.07	1.22	1.56	2.16	2.31	2.56	3.46	2.55	4.80
C114d	507996	187890	0.61	0.74	0.84	0.93	0.99	1.07	1.22	1.56	2.16	2.31	2.56	3.46	2.55	4.80
MBB1.005	507852	188463	0.56	0.71	0.78	0.85	0.90	0.98	1.04	1.10	1.24	1.27	1.32	1.54	1.32	1.84
MBB1.004	507852	188454	0.56	0.71	0.78	0.85	0.90	0.98	1.04	1.10	1.24	1.27	1.32	1.54	1.32	1.84
MBB1.004In1	507855	188422	0.56	0.78	1.00	1.22	1.36	1.60	1.77	1.91	2.26	2.34	2.49	2.92	2.49	3.35
MBB1.004In2	507860	188392	0.56	0.78	1.00	1.23	1.36	1.55	1.63	1.69	1.78	1.81	1.87	2.00	1.87	2.24
MBB1.003	507865	188361	0.56	0.78	1.00	1.22	1.34	1.43	1.50	1.53	1.58	1.58	1.60	1.65	1.61	1.69
MBB1.003In1	507883	188332	0.67	0.93	1.19	1.37	1.42	1.46	1.50	1.53	1.57	1.57	1.59	1.63	1.59	1.67
MBB1.002	507905	188304	0.67	0.93	1.18	1.37	1.44	1.44	1.44	1.44	1.46	1.47	1.49	1.55	1.50	1.65

Detailed FRA centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH



Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 2 year (50%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
Modelled outlines take into account catchment wide defences.
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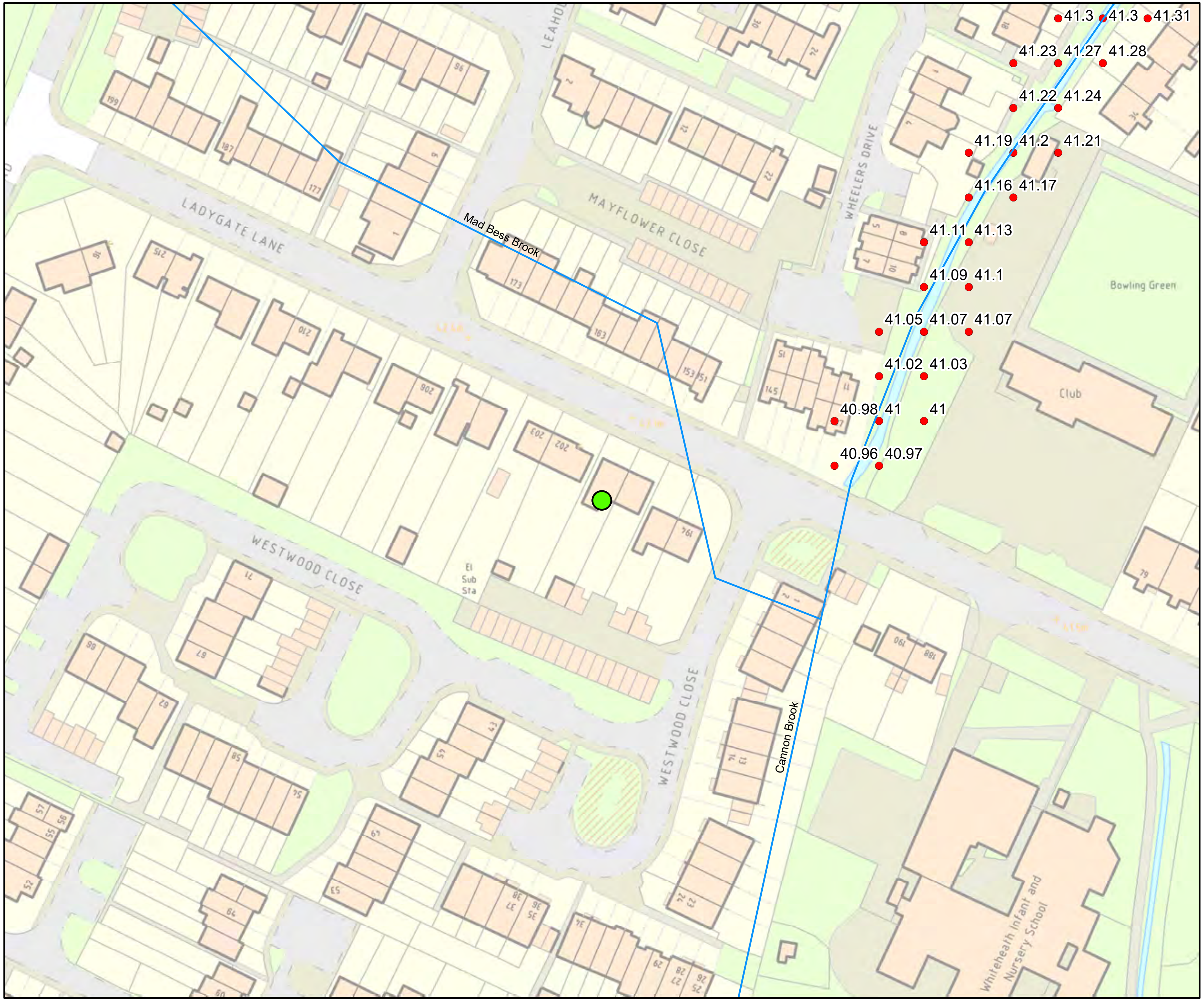
Detailed FRA centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH



Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

- Main Rivers
- Site location

2D Node Results: Heights

- 1 in 5 year (20%) Defended

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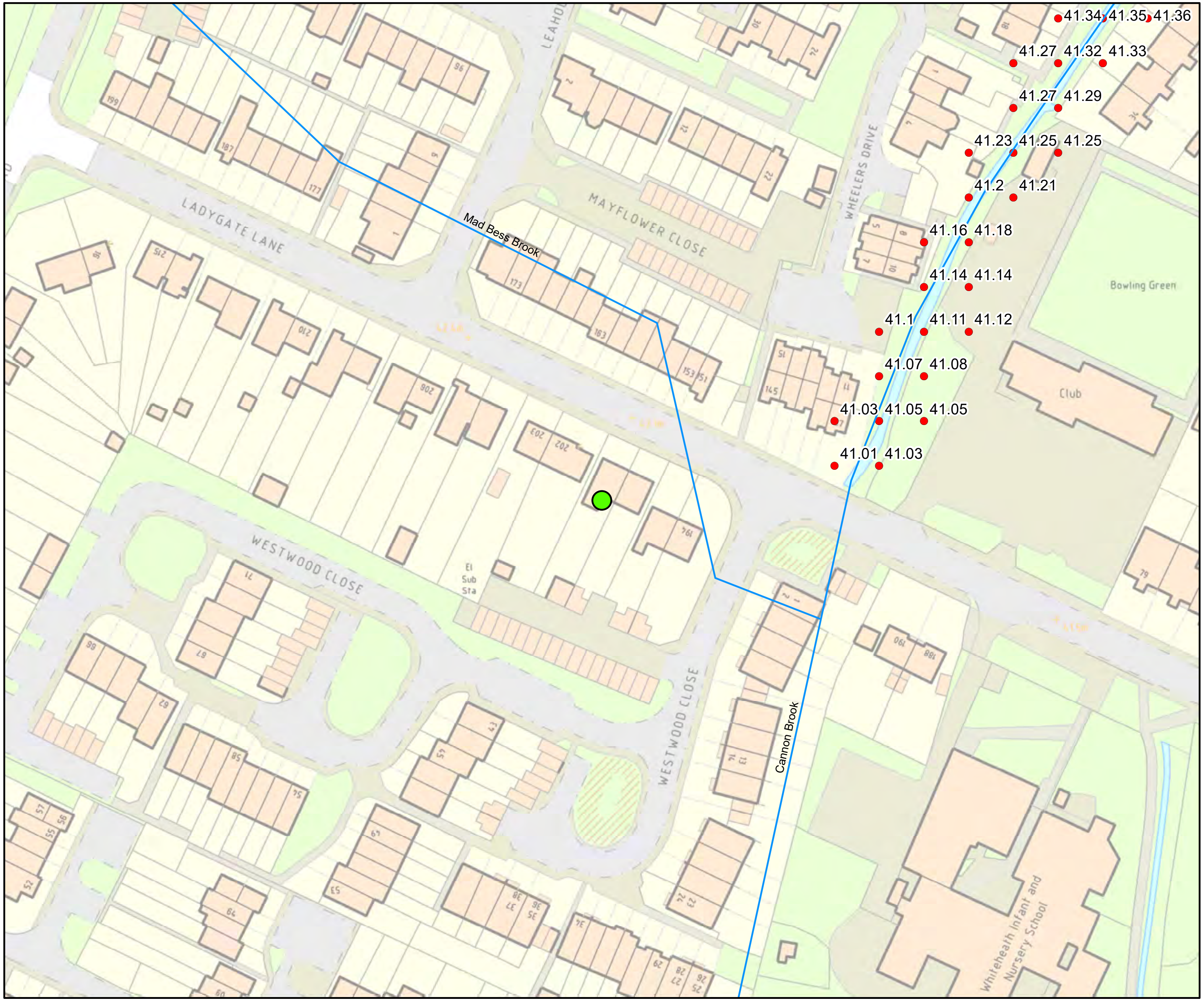

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 10 year (10%) Defended

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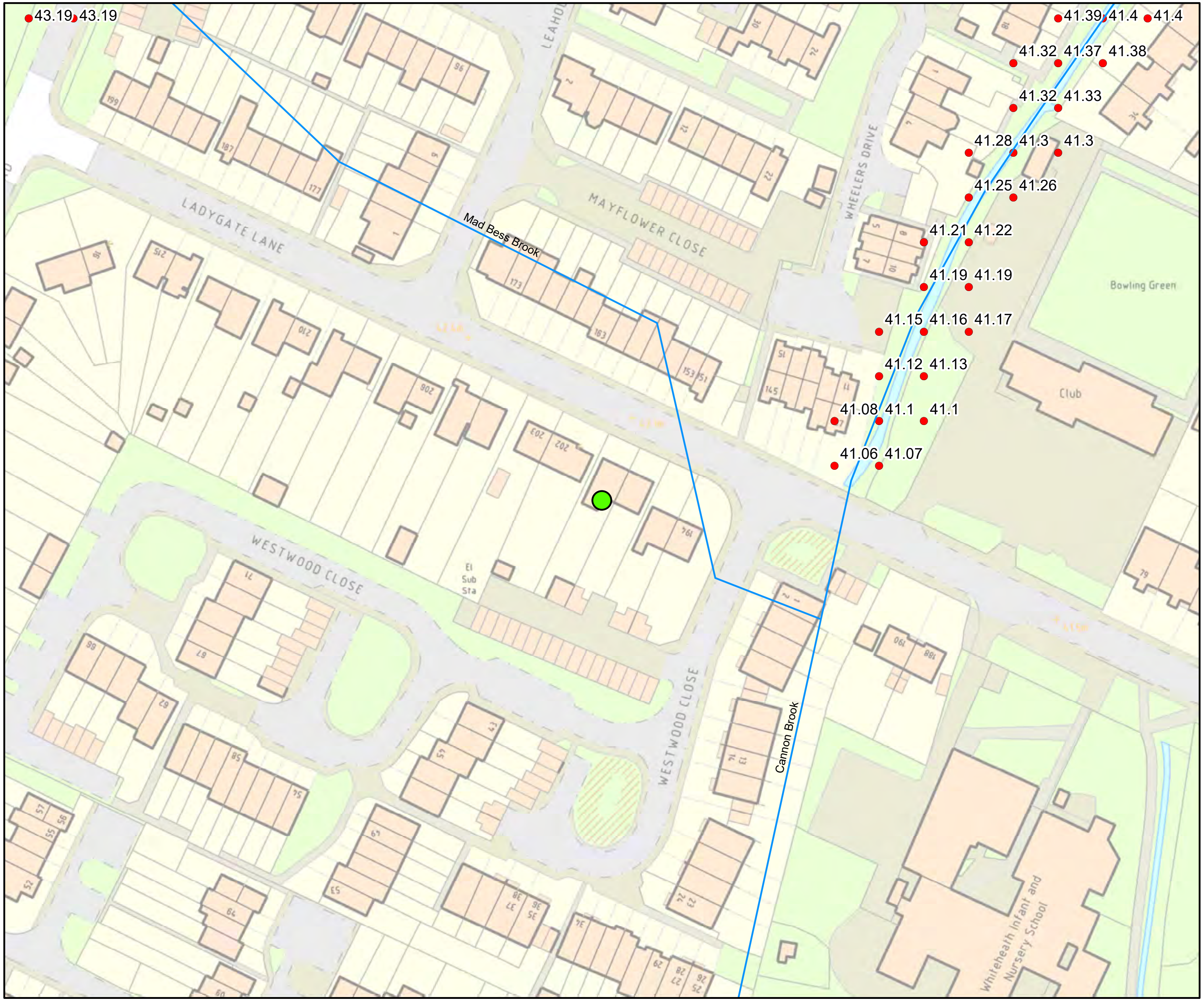

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 20 year (5%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
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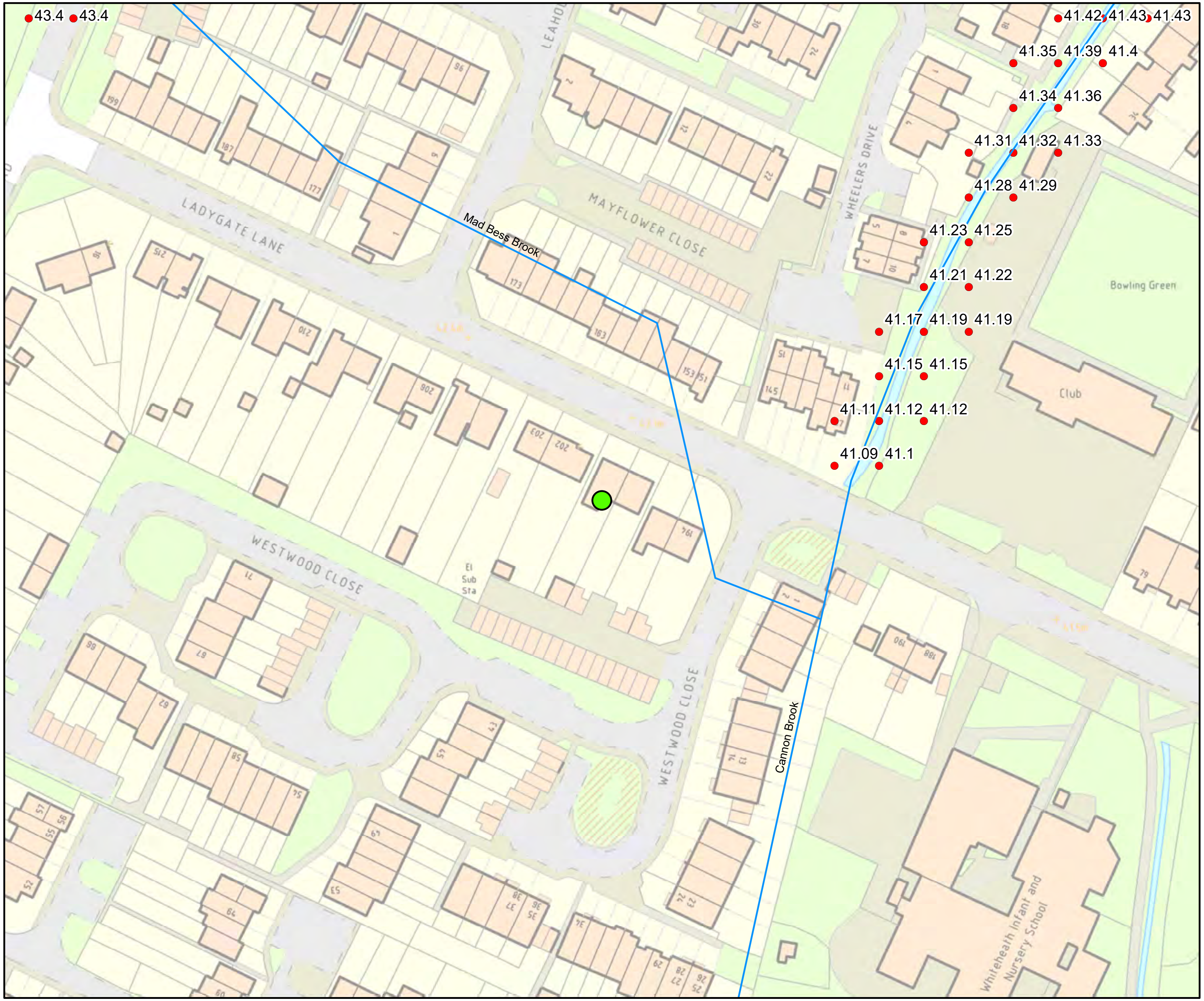

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 30 year (3.33%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
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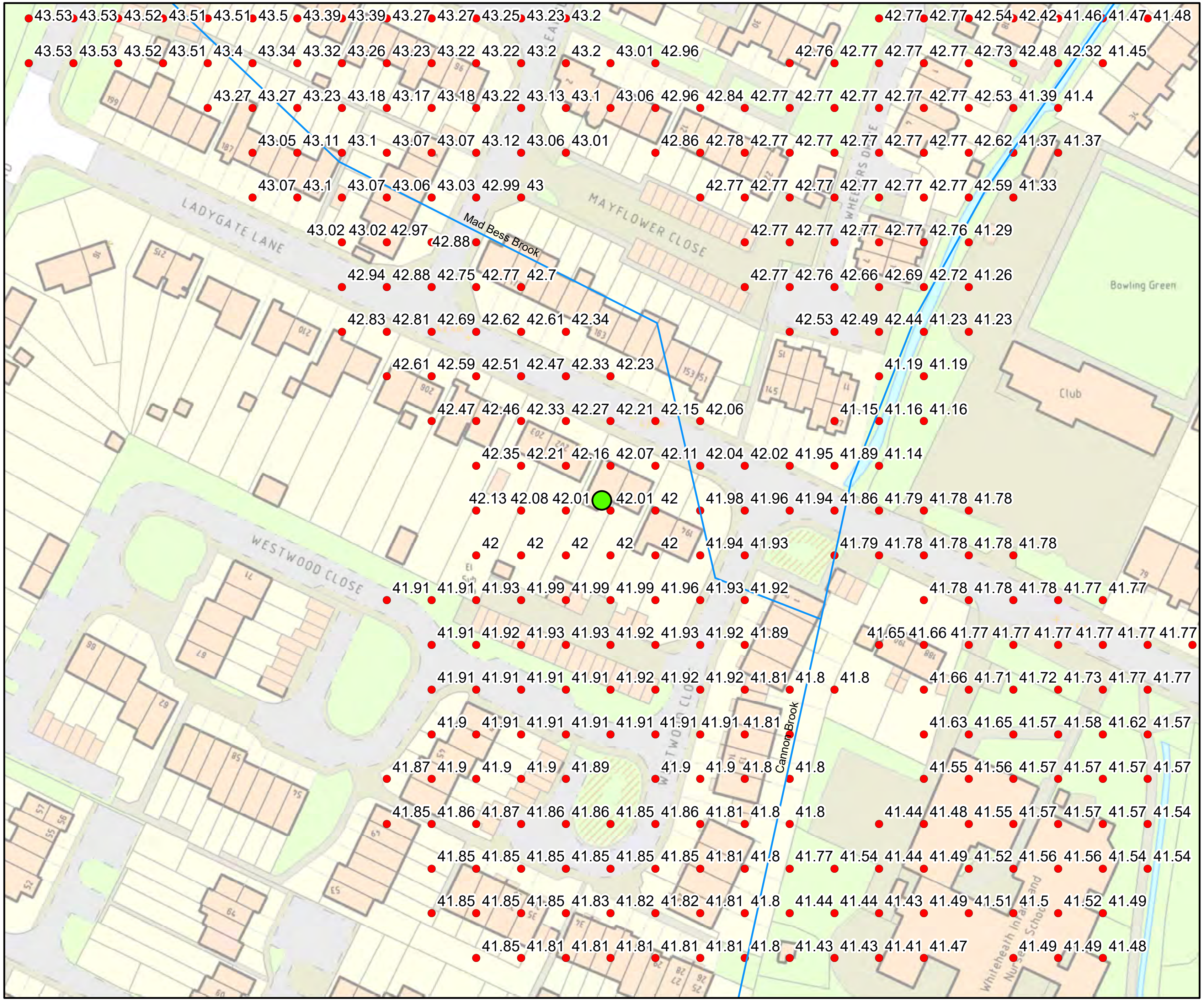

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 50 year (2%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
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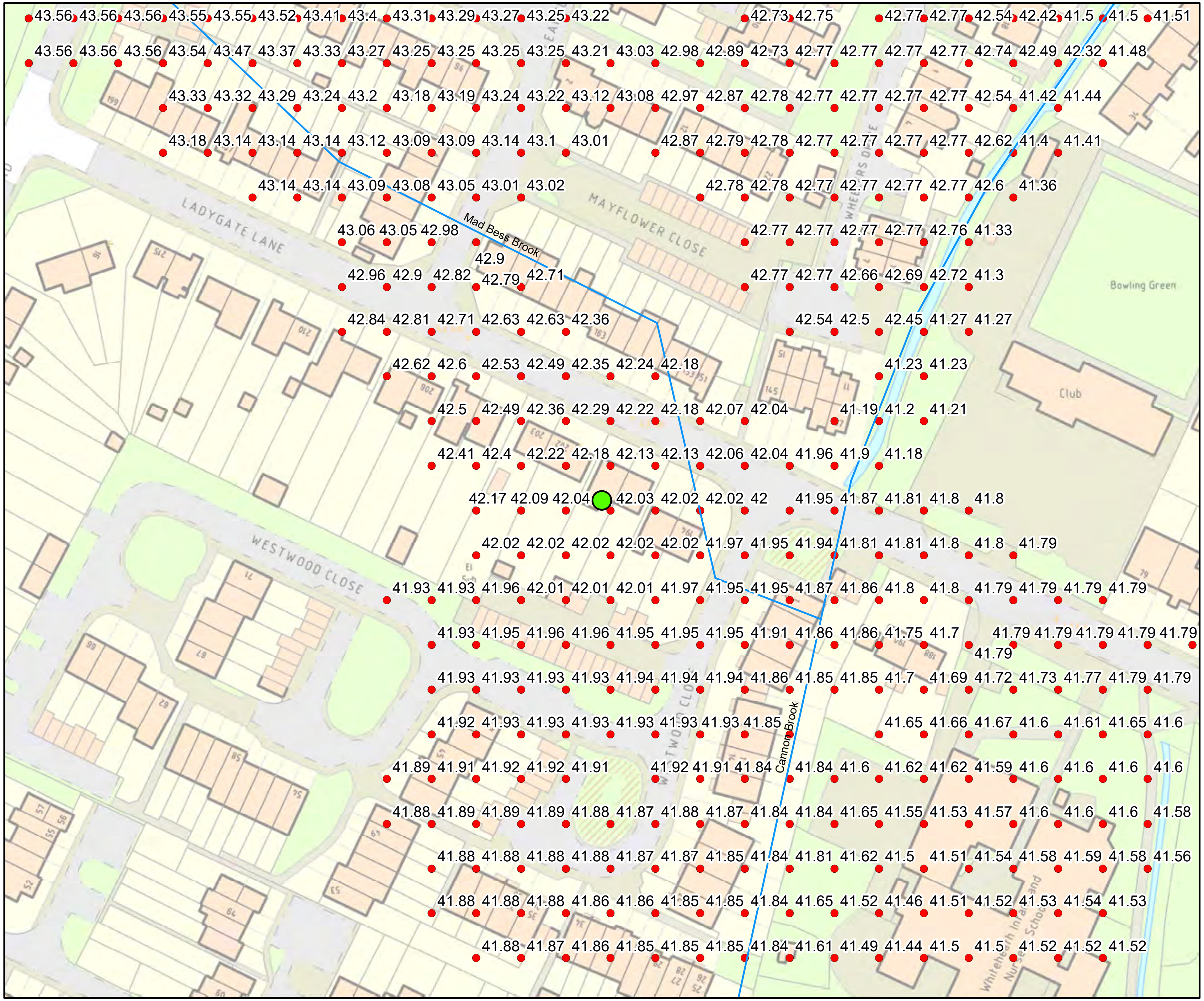

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 75 year (1.33%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment.
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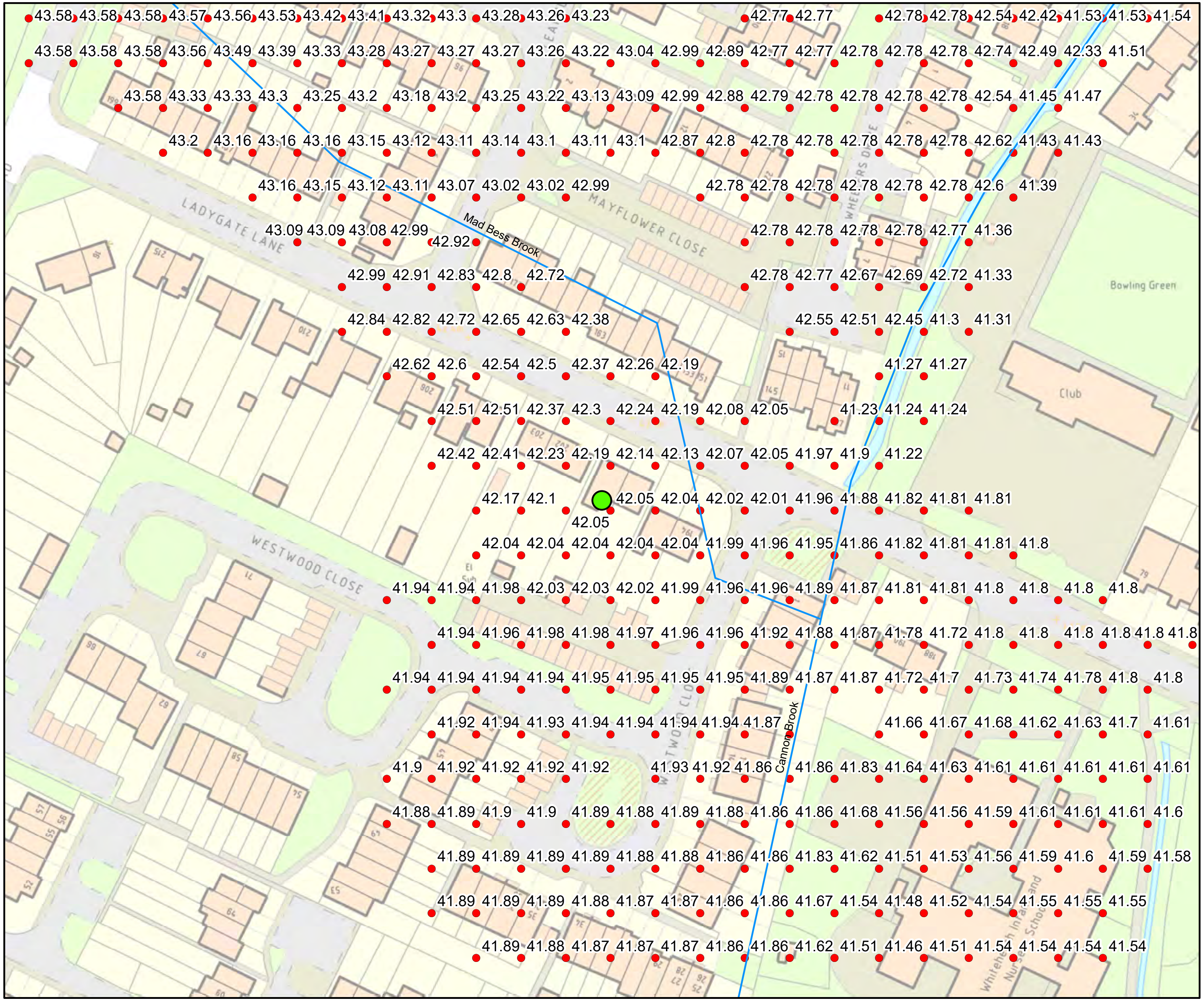

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 100 year (1%) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
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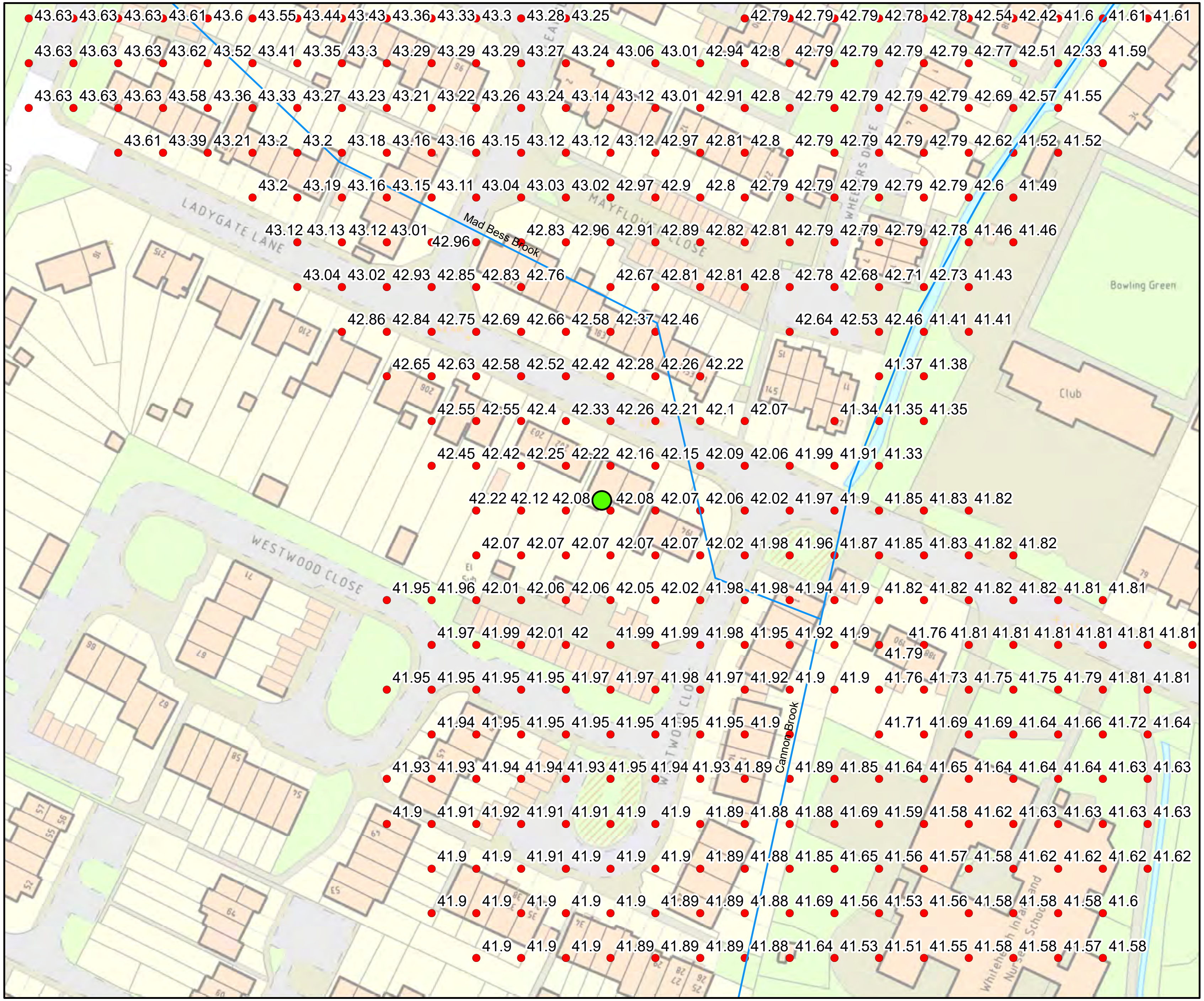

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60

Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 100 year + 20% (*CC) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
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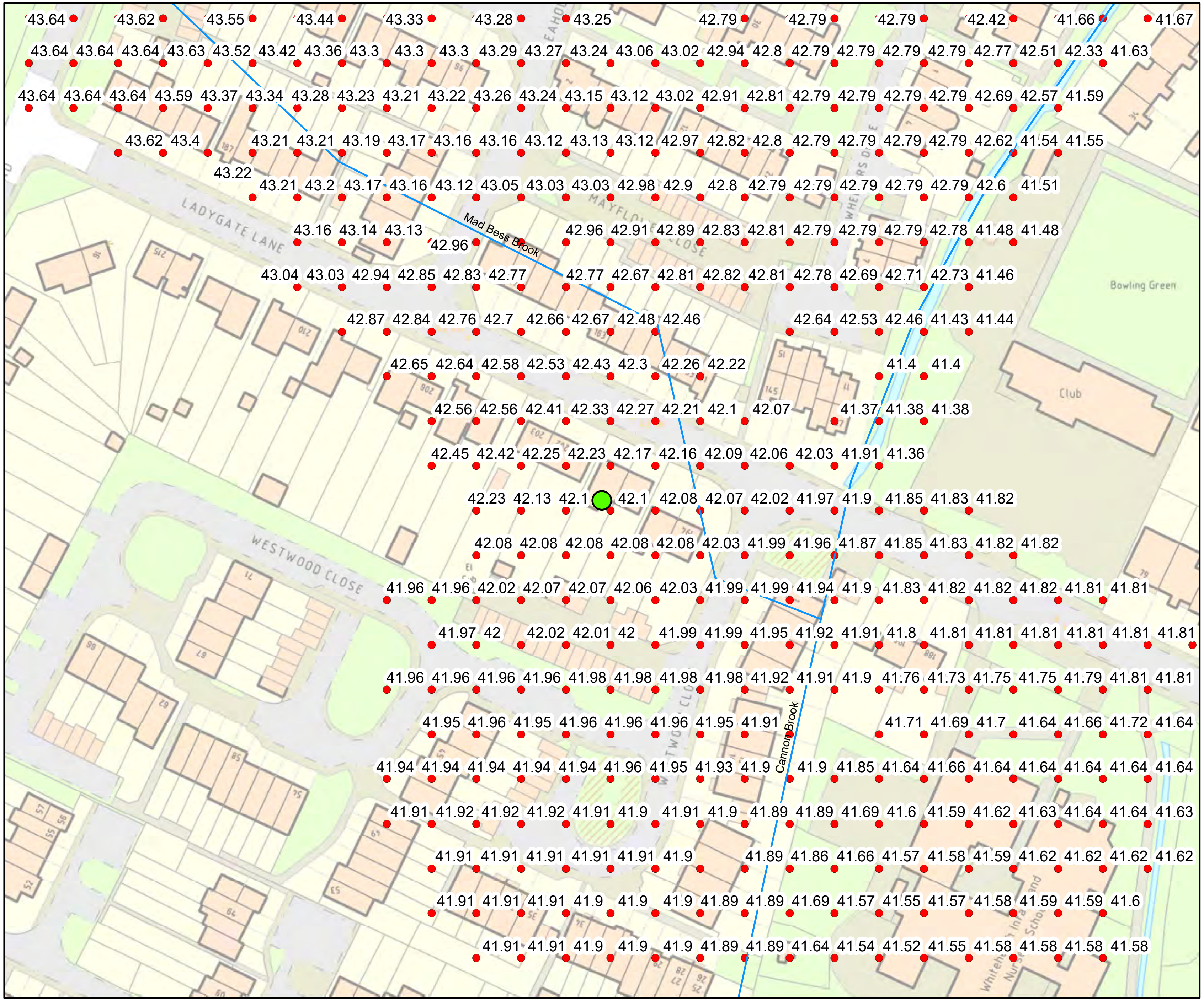
Detailed FRA centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH



Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 100 year + 25% (*CC) Defended

The data in this map has been extracted from the River Pinn Mapping Study (JBA, 2015).
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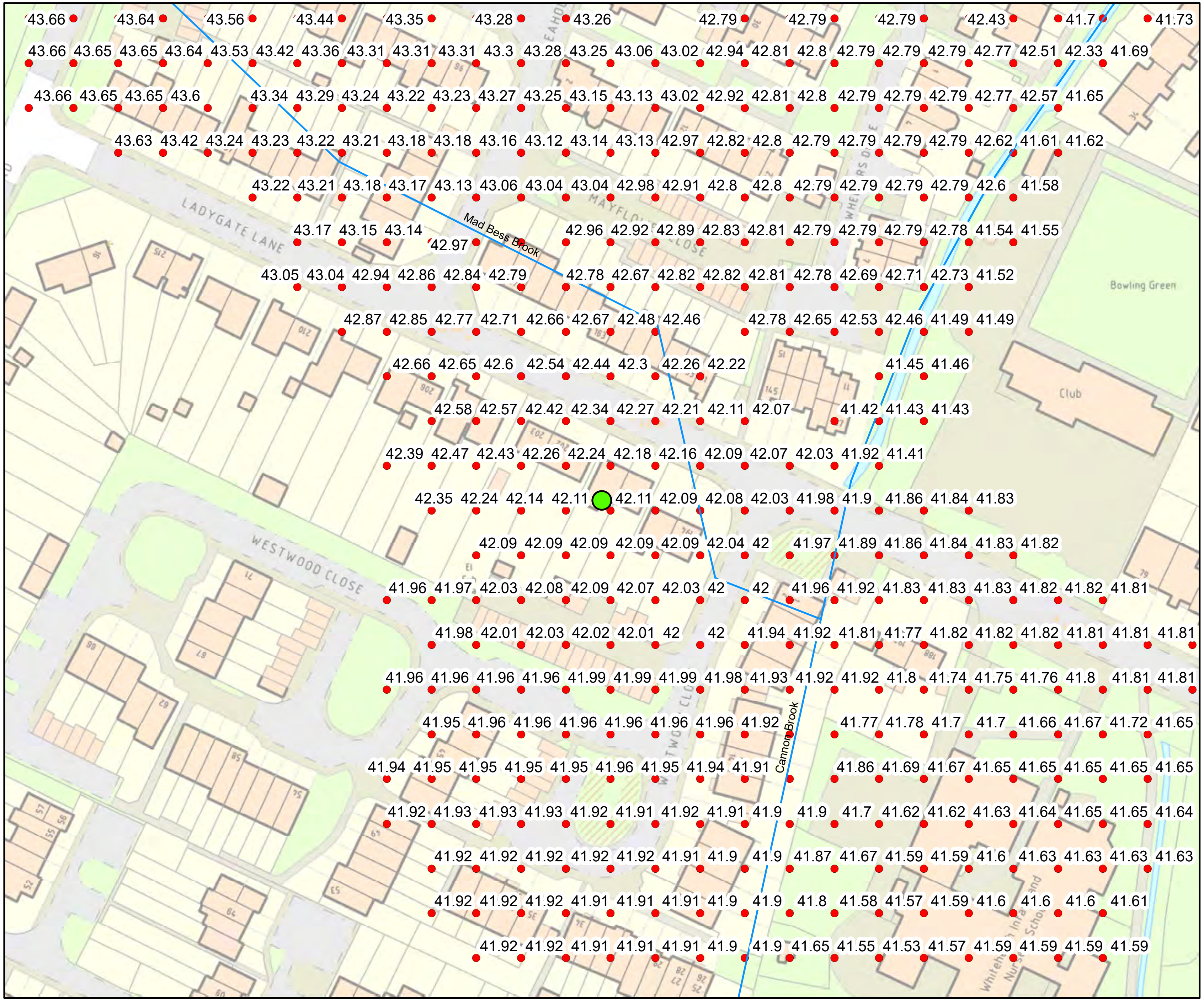

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 100 year + 35% (*CC) Defended

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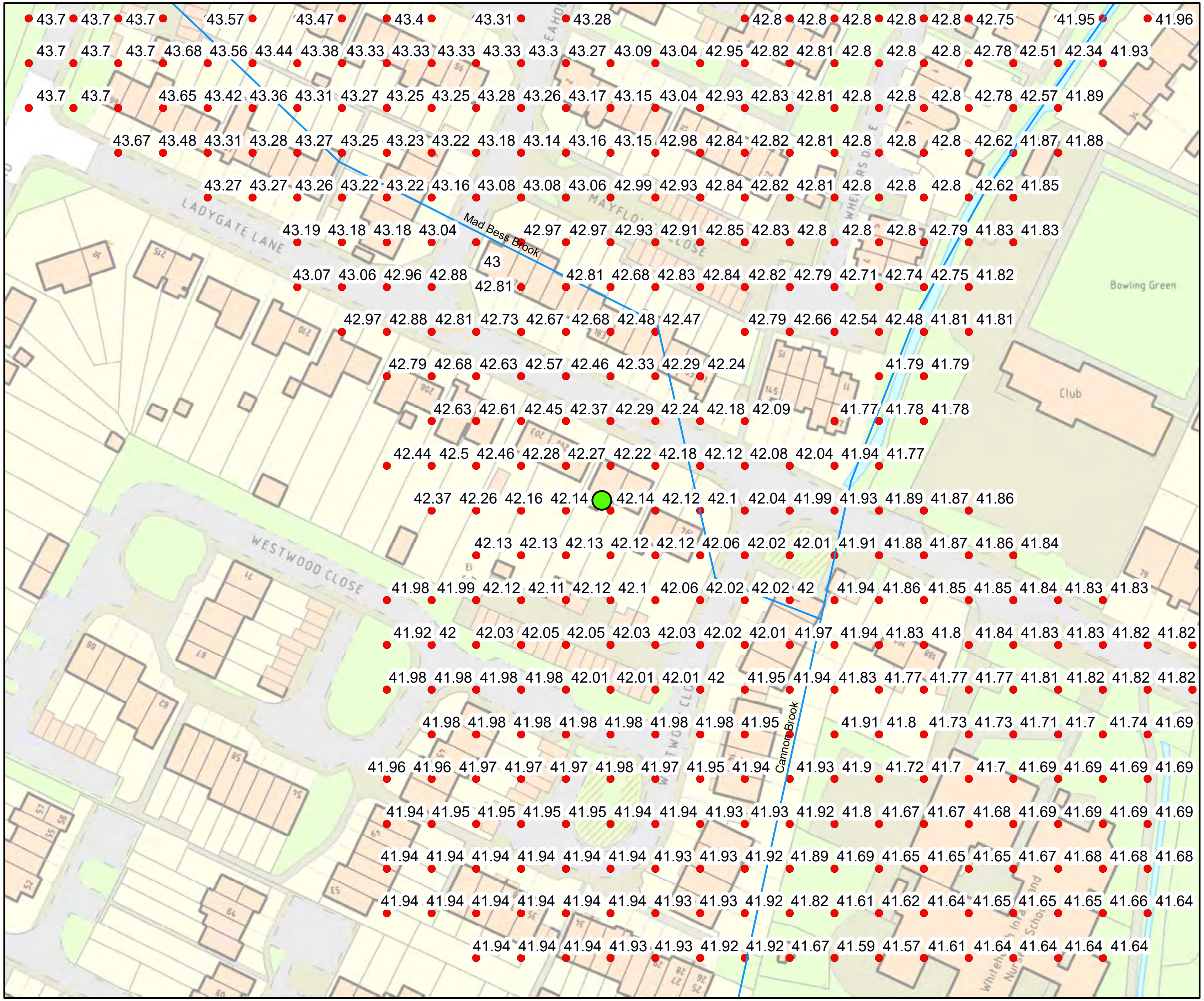

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 100 year + 70% (*CC) Defended

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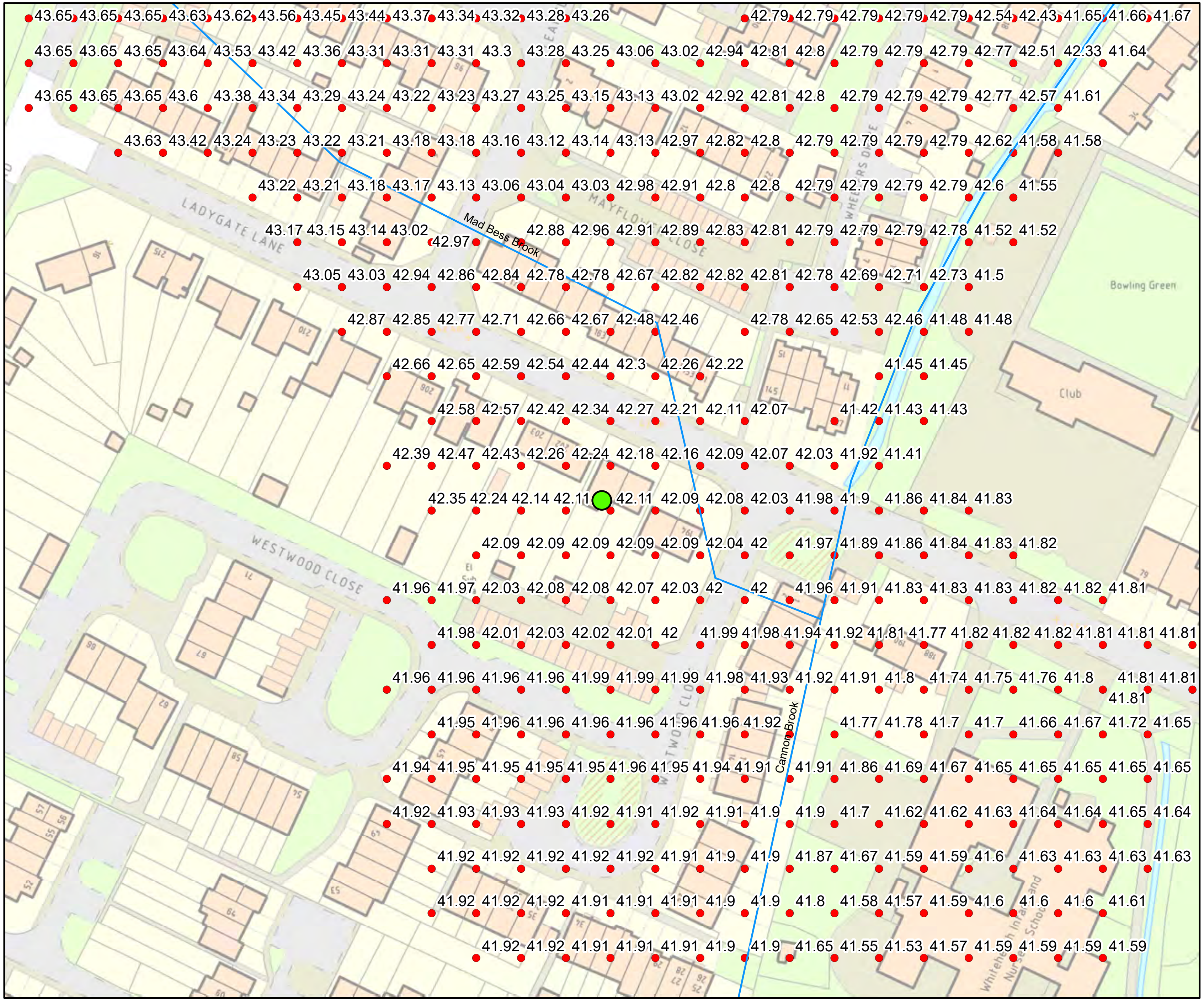

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 250 year (0.4%) Defended

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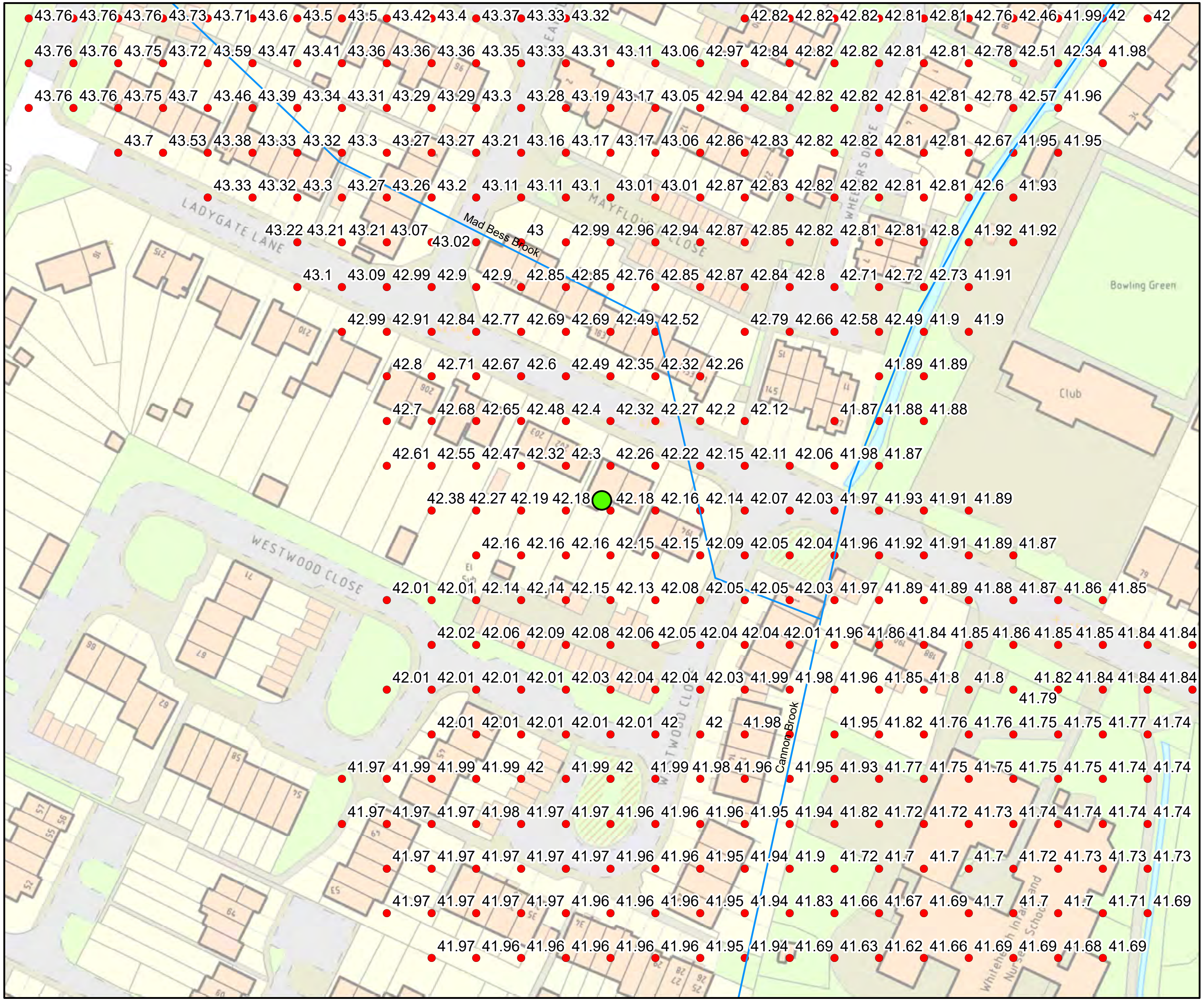

Environment Agency

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 1000 year (0.1%) Defended

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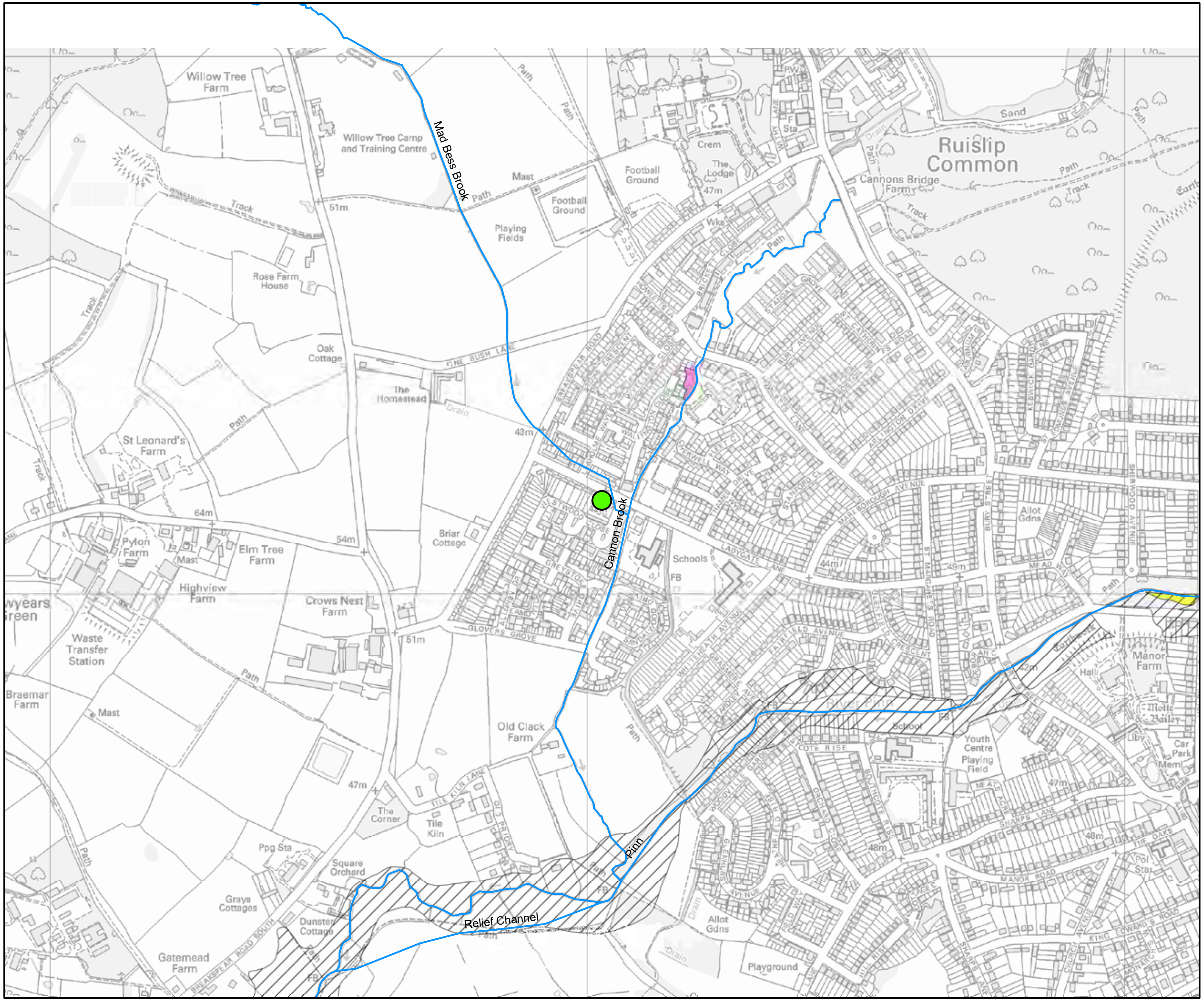
Historic Flood Map centred on: 200 Ladygate Lane, Ruislip, HA4 7QY - 02/06/2021 - HNL 218471 HH



Environment Agency

Environment Agency
Alchemy,
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Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 150 300 600
Metres

Legend

Main Rivers

Site location

Flood Event Outlines

1977

1999

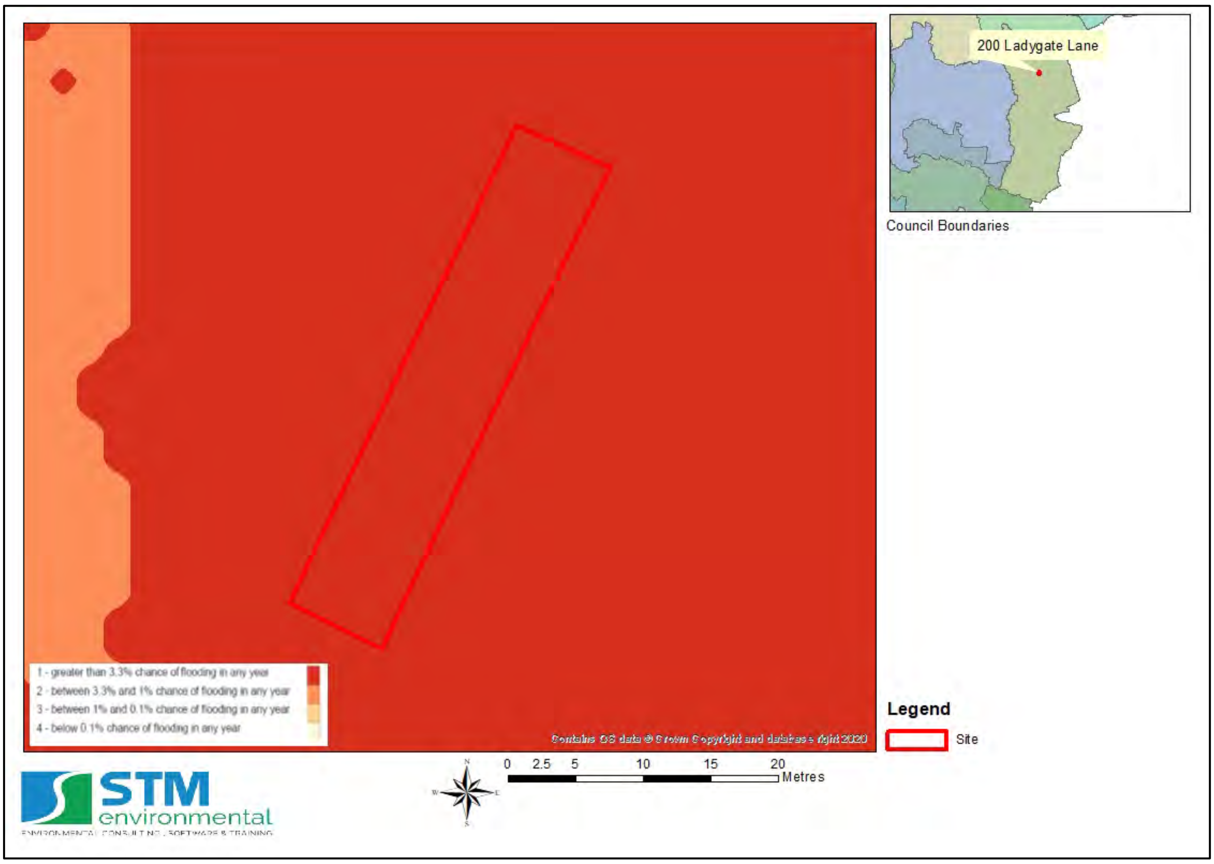
2016

The historic flood event outlines are based on a combination of anecdotal evidence, Environment Agency staff observations and survey.
Our historic flood event outlines do not provide a definitive record of flooding.
It is possible that there will be an absence of datain places where we have not been able to record the extent of flooding.
It is also possible for errors occur in the digitisation of historic records of flooding.

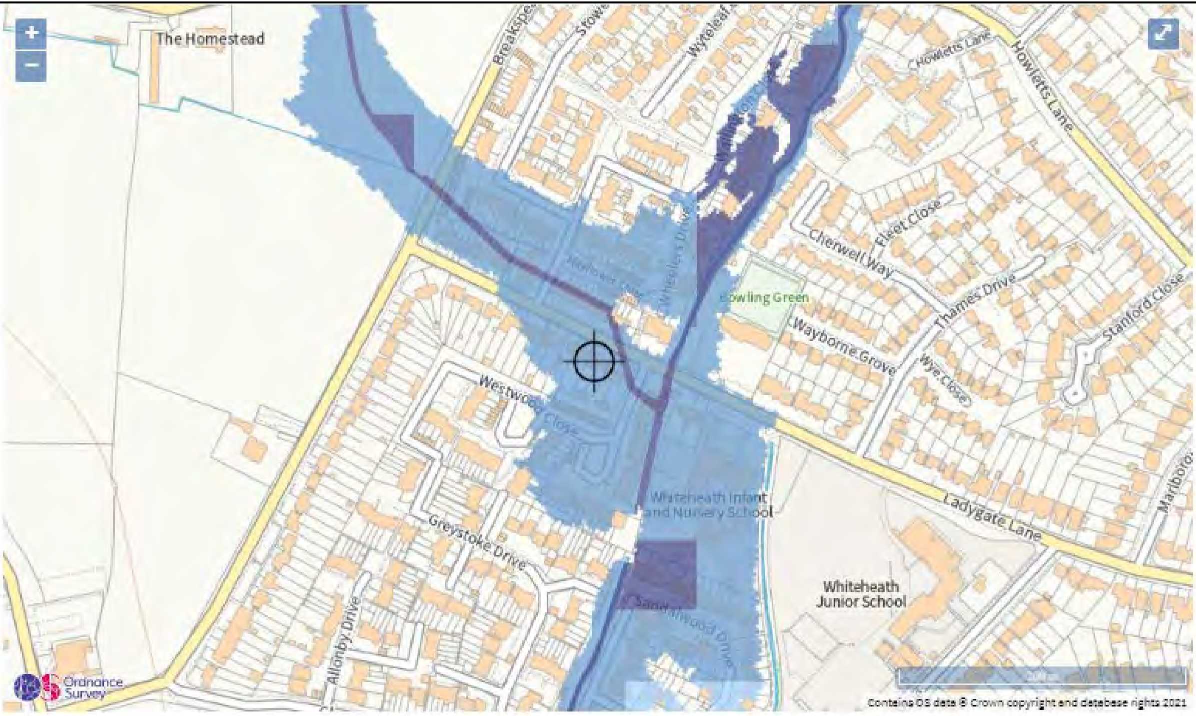
Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

19.8 Appendix 8 –Risk of Flooding Maps

19.8.1 Risk of Flooding from Multiple Sources Map

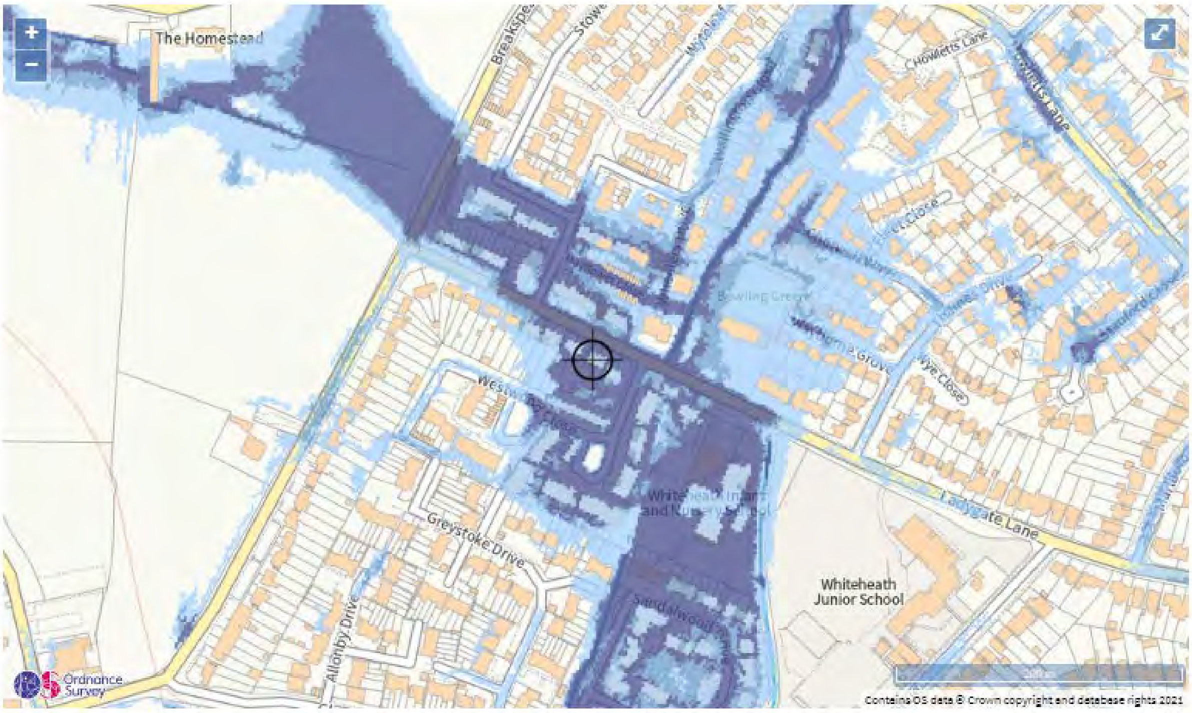


19.8.2 Long Term Flood Risk Maps



Extent of flooding from rivers or the sea

High Medium Low Very low Location you selected

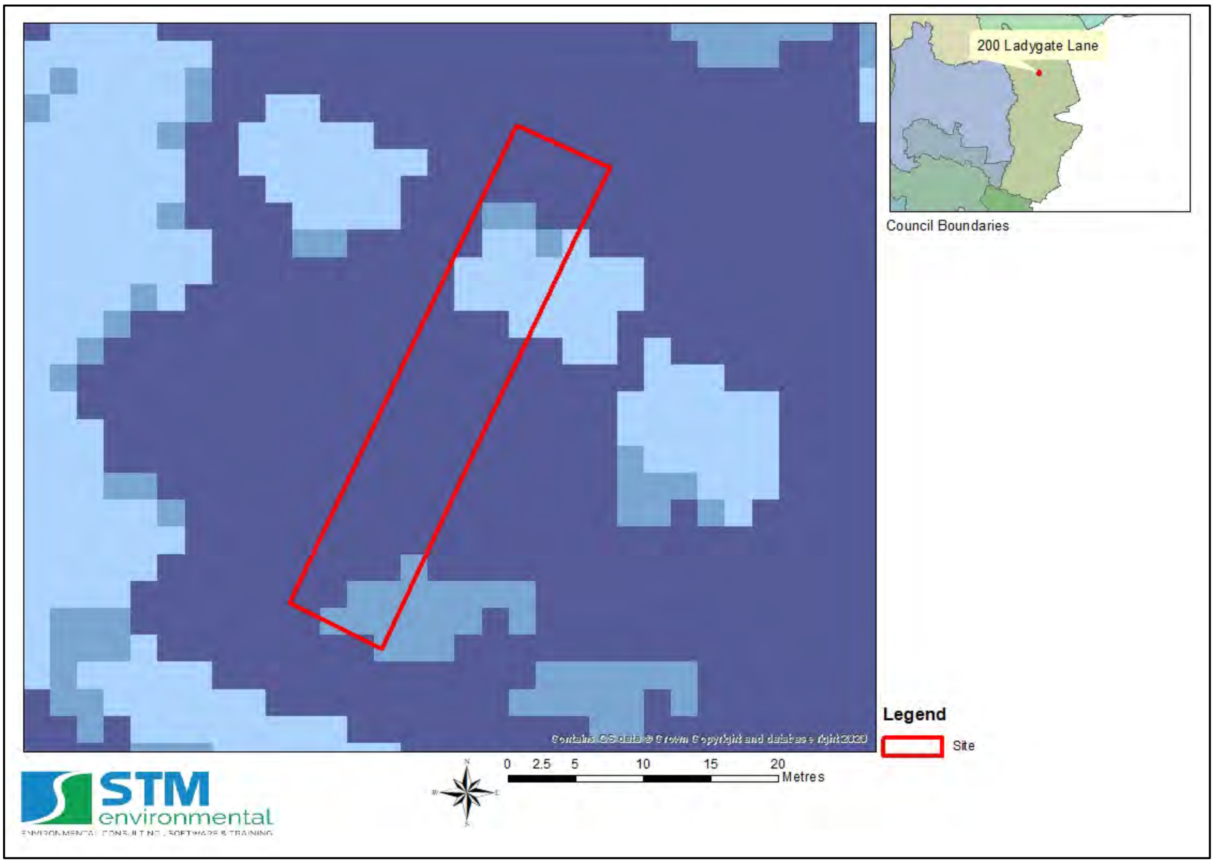


Extent of flooding from surface water

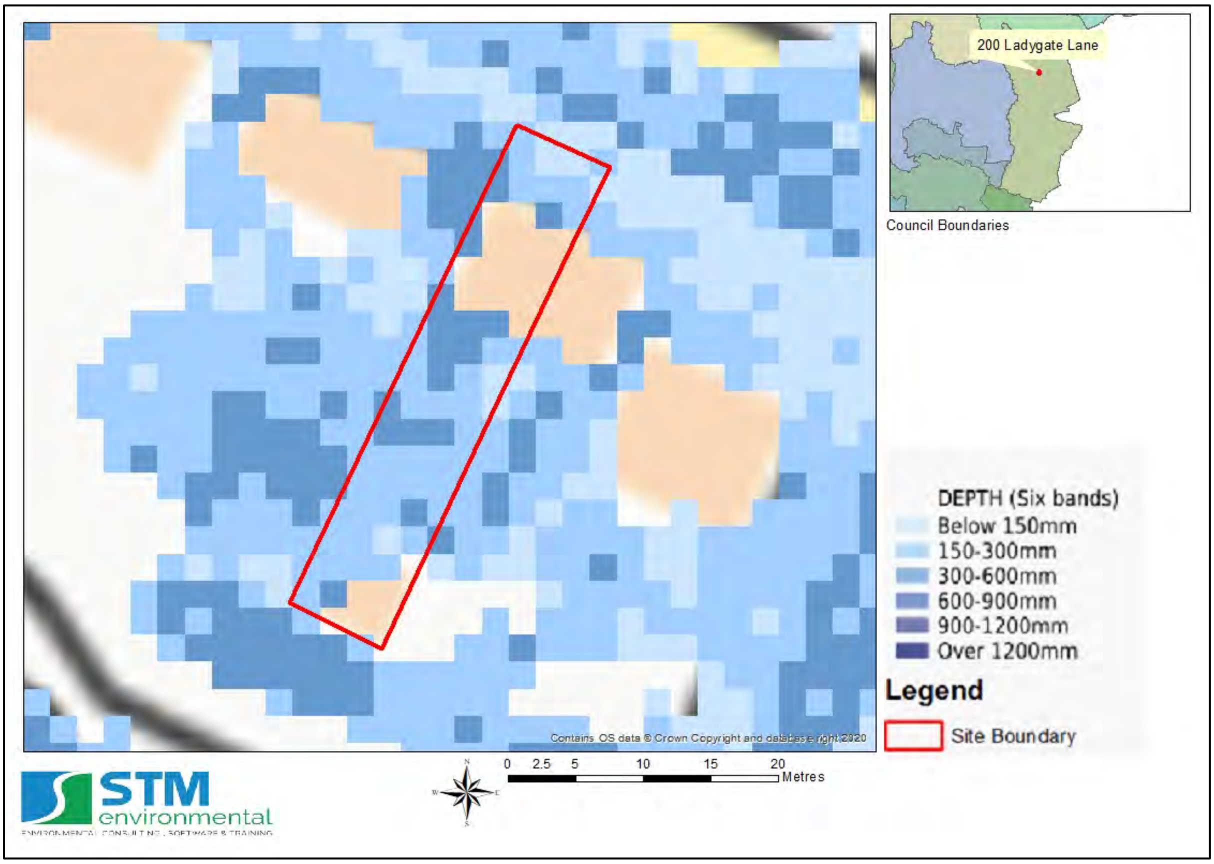
High Medium Low Very low Location you selected

19.9 Appendix 9 – Surface Water Flood Extent and Depth Maps

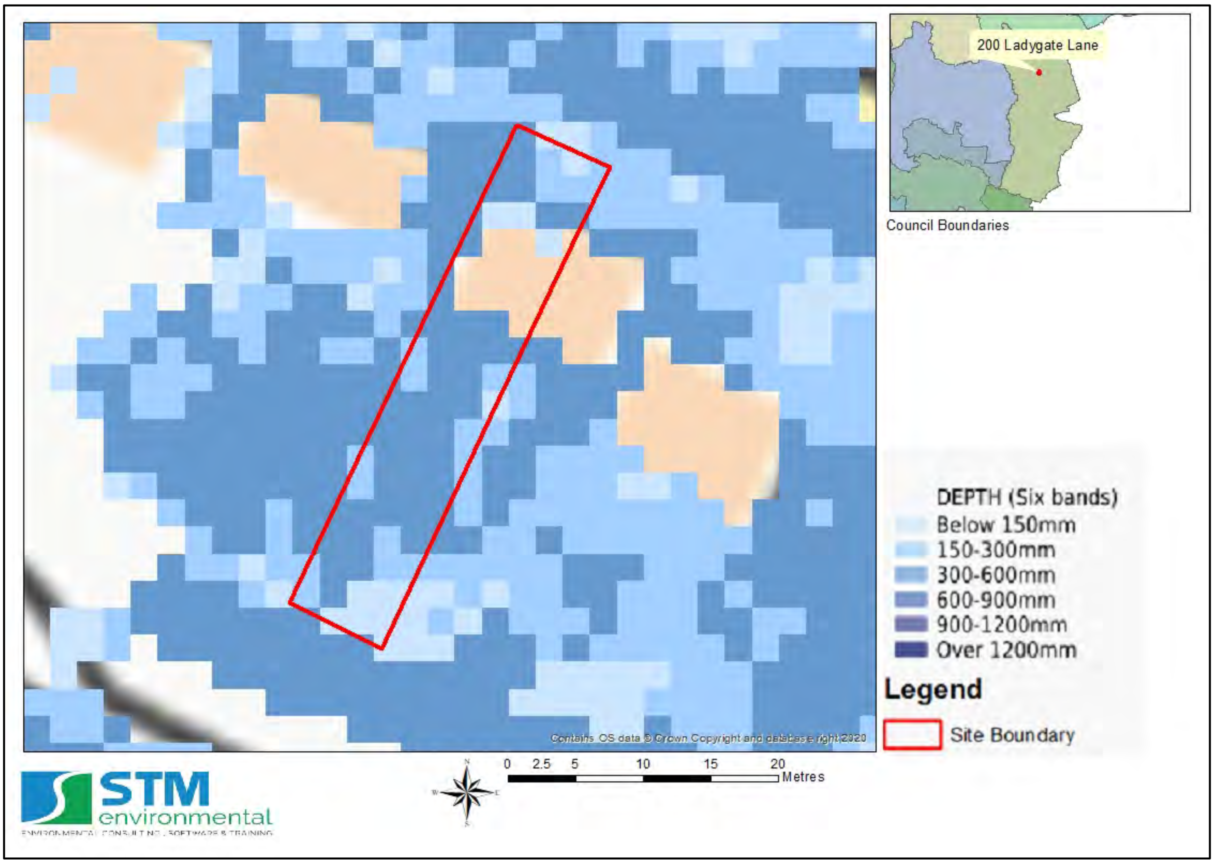
19.9.1 Map showing surface water flood extents during the 1 in 30-year, 1 in 100-year, and 1 in 1000-year rainfall return period (Source: EA, 2016).



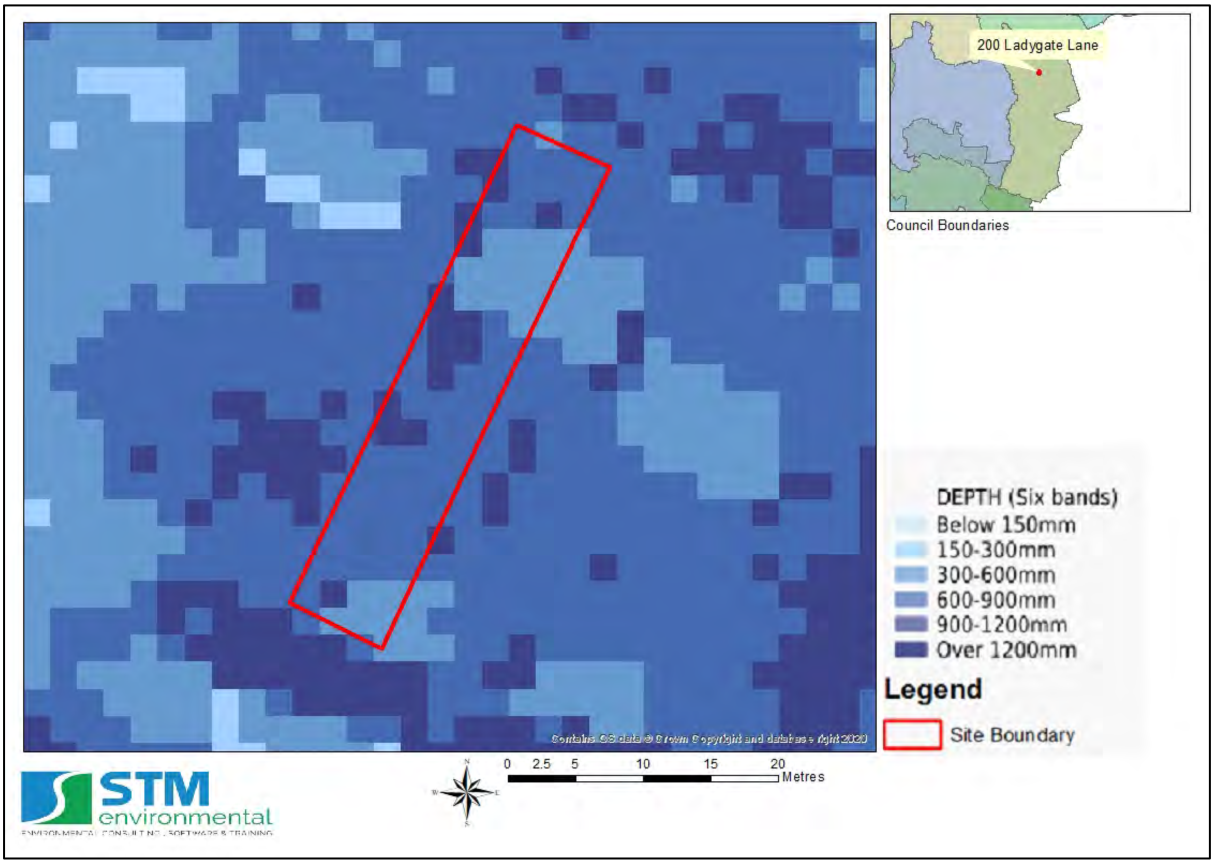
19.9.2 Predicted surface water flood depth for the 1 in 30-year return period.



19.9.3 Predicted surface water flood depth for the 1 in 100-year return period.

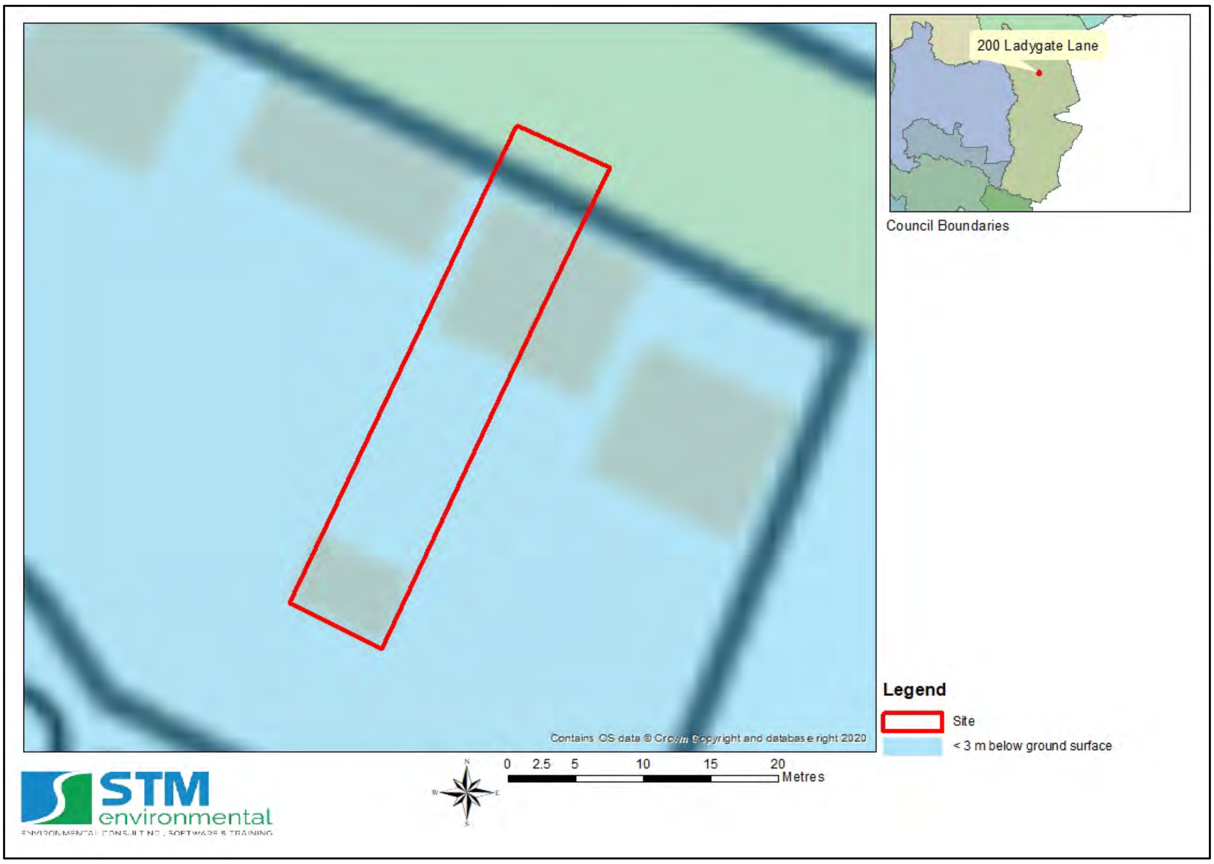


19.9.4 Predicted surface water flood depth for the 1 in 1000-year return period.



19.10 Appendix 10 – Groundwater Maps

19.10.1 Depth to Water Table (BGS)



19.10.2 Groundwater Susceptibility (BGS)

N.A

19.11 Appendix 11 – Safe Egress

19.12 Appendix 12 - Calculation of Flood Hazard Rating

Depth/ Velocity	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.0	2.25	2.50
0.0	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25
0.5	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
1.0	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75
1.5	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
2.0	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
2.5	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
3.0	0.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75
3.5	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
4.0	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25
4.5	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
5.0	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75

Table 11: Summary of Scores

	Score From	Score To	Flood Hazard	Description
	<0.75	0.75	Low	Exercise Caution
Class 1	0.75	1.5	Moderate	Danger for some
Class 2	1.5	2.5	Significant	Danger for most

Class 3	2.5	20.0	Extreme	Danger for all

Table 12: Values for Debris Factor for different flood depths

Depths	Pasture/Arable Land	Woodland	Urban
0 to 0.25	0	0	0
0.25 to 0.75	0.5	1	1
d>0.75 and/or v > 2	0.5	1	1

- The “danger to some” category includes vulnerable groups such as children, the elderly and infirm. “Danger: Flood zone with deep or fast
- flowing water”
- The “danger to most” category includes the general public.
- The danger to all category includes the emergency services.

A flood emergency plan is considered to be an acceptable way of managing flood risk where the flood hazard has been given a “very low hazard” rating. In some instances, flood emergency plans may also be acceptable where the rating is “danger for some”. However, it is unlikely to be an acceptable way of managing residual flood risk where the hazard to people classification is “danger for most” or “danger for all”.

19.13 Appendix 13 – SuDS

19.13.1 UK SuDS

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Freya Berkin
Site name:	200 Ladygate Lane
Site location:	HA4 7QY

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.58204° N
Longitude:	0.44225° W
Reference:	3447099388
Date:	Sep 21 2021 15:06

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	655	655
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

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

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	0.45	0.45
1 in 1 year (l/s):	0.38	0.38
1 in 30 years (l/s):	1.03	1.03
1 in 100 year (l/s):	1.42	1.42
1 in 200 years (l/s):	1.67	1.67

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Richard Viner
Site name:	200 Ladygate Lane
Site location:	HA4 7QY

Site Details

Latitude:	51.58211° N
Longitude:	0.44231° W
Reference:	1187977525
Date:	Sep 21 2021 15:07

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). 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 design of the drainage scheme.

Site characteristics

Total site area (ha):	0.03
Significant public open space (ha):	0
Area positively drained (ha):	0.03
Impermeable area (ha):	0.018
Percentage of drained area that is impermeable (%):	60
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.03
Net impermable area for storage volume design (ha):	0.02
Pervious area contribution to runoff (%):	30

* 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 Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Use long term storage
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2

Methodology

esti	IH124
Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47

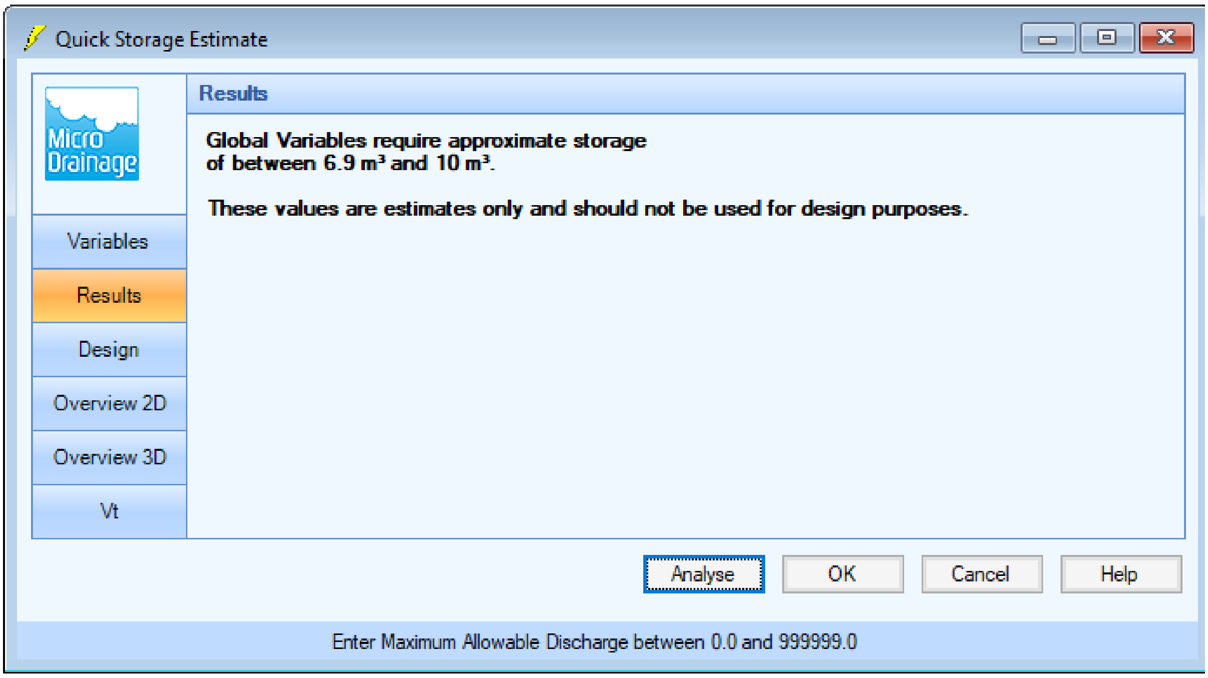
Hydrological characteristics

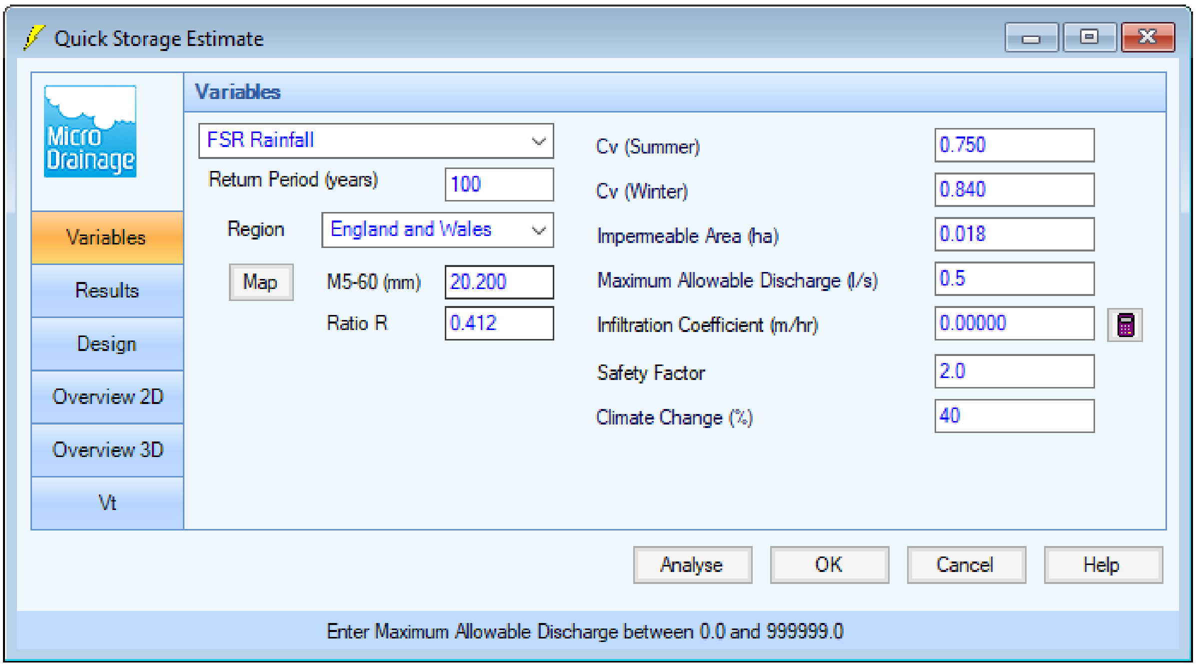
	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	89.32
FEH / FSR conversion factor:	1.16	1.16
SAAR (mm):	655	655
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	0.13	0.13
Q_{BAR} for net site area (l/s):	0.13	0.13

Site discharge rates	Default	Edited
1 in 1 year (l/s):	2	2
1 in 30 years (l/s):	2	2
1 in 100 year (l/s):	2	2

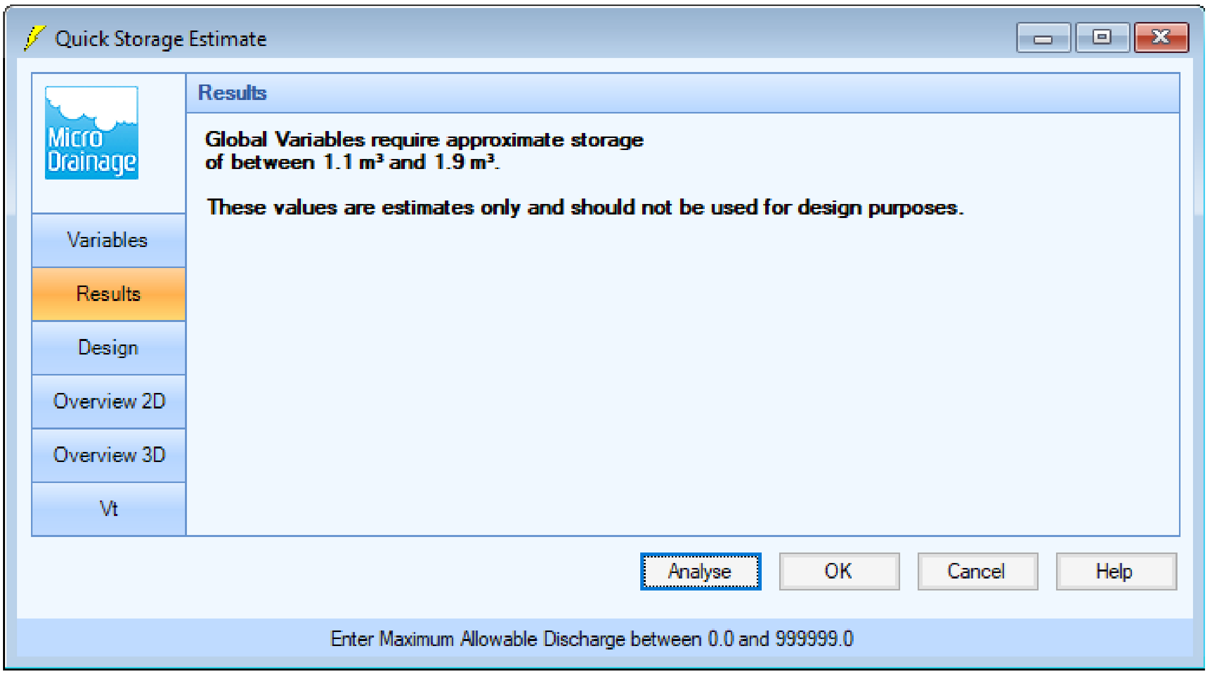
Estimated storage volumes	Default	Edited
Attenuation storage 1/100 years (m^3):	3	3
Long term storage 1/100 years (m^3):	0	0
Total storage 1/100 years (m^3):	3	3

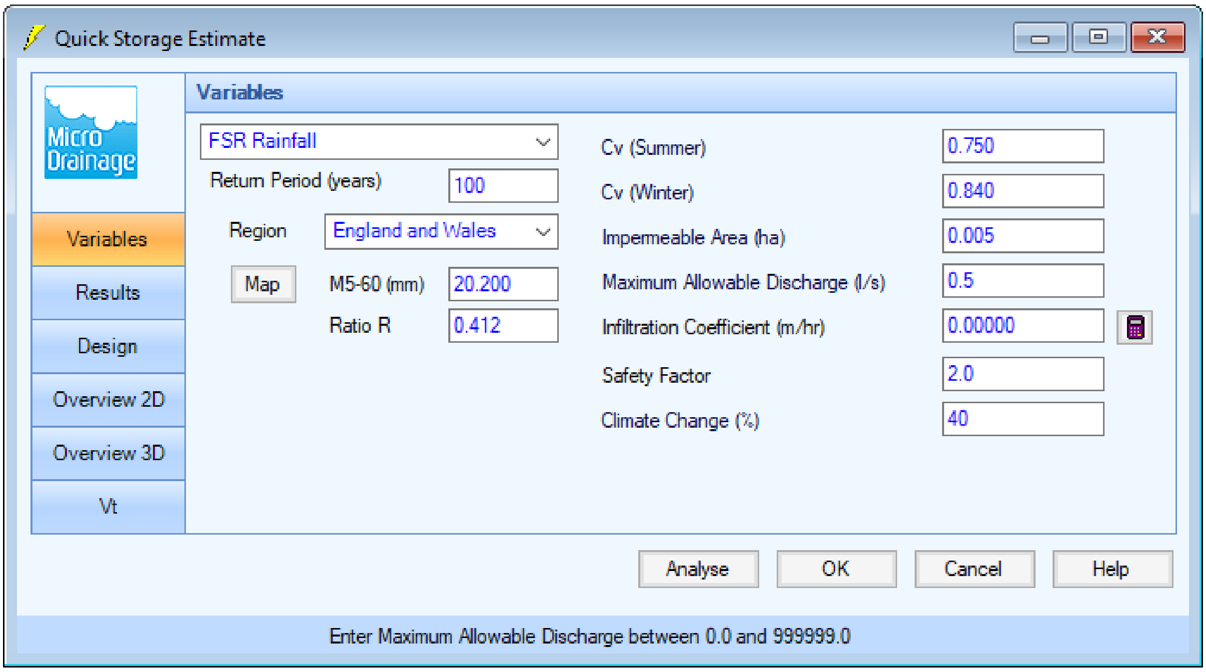
19.13.2 Microdrainage Calculations - Entire Impermeable Site





19.13.3 Microdrainage Calculations - Rear rooftop and extension only





19.14 Appendix 14 – SuDS Suitability Assessment

SuDS Technique	Typical Uses	Potential Issues	Potential Suitability
Rainwater harvesting	Capture of rainwater into a tank(s) for use (usually non-potable) such as irrigation, toilet flushing, vehicle or plant cleansing.	Care is needed to prevent the development of bacteria, algae and insect infestation.	Suitable on small scale for interception storage
Infiltration: Soakaways Infiltrations trenches and basins	Infiltration components are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, into the groundwater.	Highly variable draining Clay bedrock but groundwater table is potentially < 3m below surface. Could increase flood risk. Maintenance	Potentially suitable – subject to site investigation Or installed with connection to sewer.
Green/brown /blue roofs	Used on flat or shallow pitched roofs to provide a durable roof covering which also provides thermal insulation, amenity space, biodiversity habitat as well as attenuation of rainwater.	Maintenance - Ensuring safe access	Unsuitable
Raingardens	Creation of planted landscaped areas to allow the diversion of a portion of rainwater from either downpipes or surrounding paved surfaces. Raingardens can either allow infiltration into the ground or have tanked systems for water retention.	Require maintenance	Suitable - may require connection to sewer
Permeable pavements / surfaces	Permeable hard surfaces that allow rainwater to pass through either into the ground or to tanked systems. Good as interception storage.	Potential impact of saturation on pavement stability to be considered. May require extensive use of impermeable	Suitable

SuDS Technique	Typical Uses	Potential Issues	Potential Suitability
		membranes and under-drainage. Maintenance required.	
Swales	Dry ditches used as landscape features to allow the storage and infiltration of rainwater. Often used as linear features alongside roads, footpaths or rail lines but capable of being integrated into the design of many open spaces.	Finding available space in proposed site layout	Unsuitable
Detention basin/ponds	Landscape features designed to store and in some cases infiltrate rainwater. Detentions basins are usually dry, whereas a pond should retain water. These features need areas of open space but can often be combined with other sustainable drainage techniques.	Potential health and safety issues. Finding available space in proposed site layout	Unsuitable
Storage tanks/ Geocellular storage	Usually below ground level, they attenuate rainwater for later slow release back into the drainage system.	Pumping may sometimes be required to empty the tank into the drainage system	Suitable
Oversized piping	Using larger than necessary pipework creates additional space to store rainwater.	Lacks the wider benefits of the green infrastructure-based techniques	Suitable

19.15 Appendix 15 – Descriptions of SuDS Techniques

19.15.1 Soakaways

Soakaways are square or circular excavations either filled with rubble or lined with brickwork, pre-cast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. The supporting structure and backfill can be substituted by modular or geocellular units.

Soakaways provide stormwater attenuation, stormwater treatment and groundwater recharge:

- The hole where the soakaway will be placed has to be at least 300 mm away from any pipe and cable ducts.
- The base of the soakaway must be at least 1.0m above the water table.
- The soakaway must be placed at least 5m away from any building.

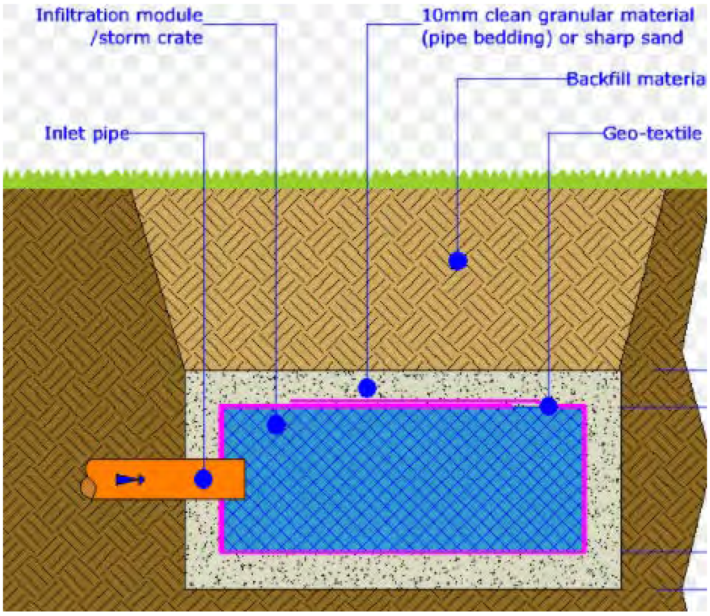
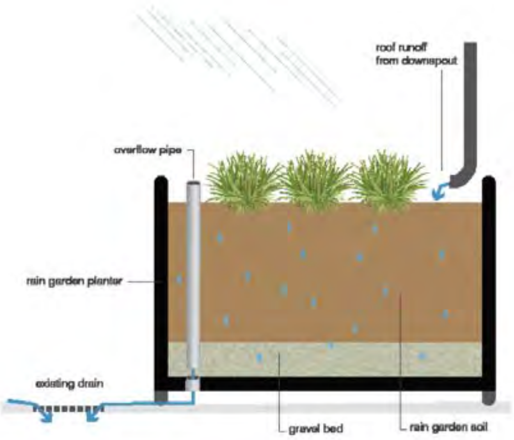


Figure 6: Cross section of a soakaway.

19.15.2 Rain Garden

A rain garden is a shallow depression, with absorbent, yet free draining soil and plants that can withstand occasional temporary flooding. Rain gardens are designed to mimic the natural water retention of undeveloped land and to reduce the volume of rainwater running off into drains from impervious areas and treat low level pollution.

Rain gardens usually absorb all the rainwater that flows into them, but when they do fill up following particularly heavy rainfall, any excess water is redirected to the existing drains. These simple rain gardens do not require any redesign of the existing drainage system and can be installed wherever space permits (see Planning and Design below) and in most soil types.



Rain garden planter

Street rain garden

Rain gardens are usually situated some distance from buildings or site boundaries, although the exact location will depend on the local topography and available space. In order to reduce the likelihood of property damage to insignificant levels, it is recommended that rain gardens are situated at least 3m (10 feet) from any building.

A rain garden 150mm deep and 20% of the area of the area of the roof that it serves will be able to intercept all of the run-off from a typical summer storm where 10-15mm of rain might fall. Rain gardens on more permeable soils will be even more effective. Over the course of an average year, a rain garden of this size will intercept most of the rainfall that it receives, only overflowing after several days of persistent rainfall.

19.15.3 Permeable Paving

Various options are available for the type of permeable paving that can be installed. Permeable block paving allows for infiltration through gaps in the surface. This can be underlain by a geotextile membrane and fine gravel course followed by with a sub-base or geocellular crates as shown in the figures below.

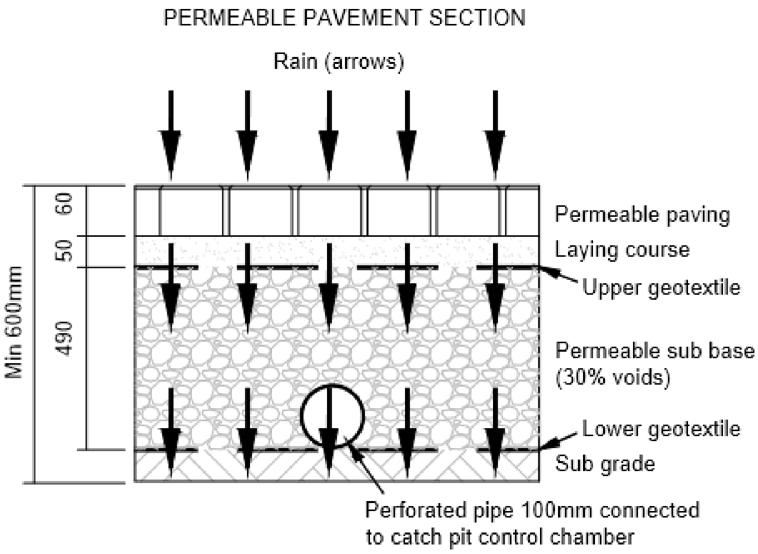


Figure 7: Block Permeable Paving with sub-base

The use of geocellular module storage provides structural strength (up to 400kN/m2) and high water storage capacity with void space of 95%+.

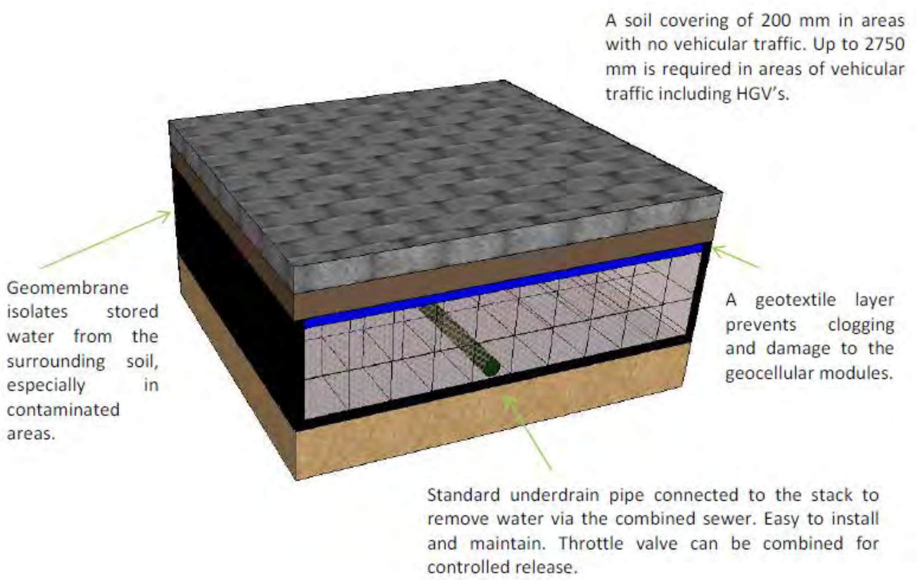


Figure 8: Block Permeable Paving with Geocellular Module

The plastic or concrete grid system is usually installed with a depth of 40 mm, with gaps between filled with an appropriate planting soil and seeded with a turf mix.

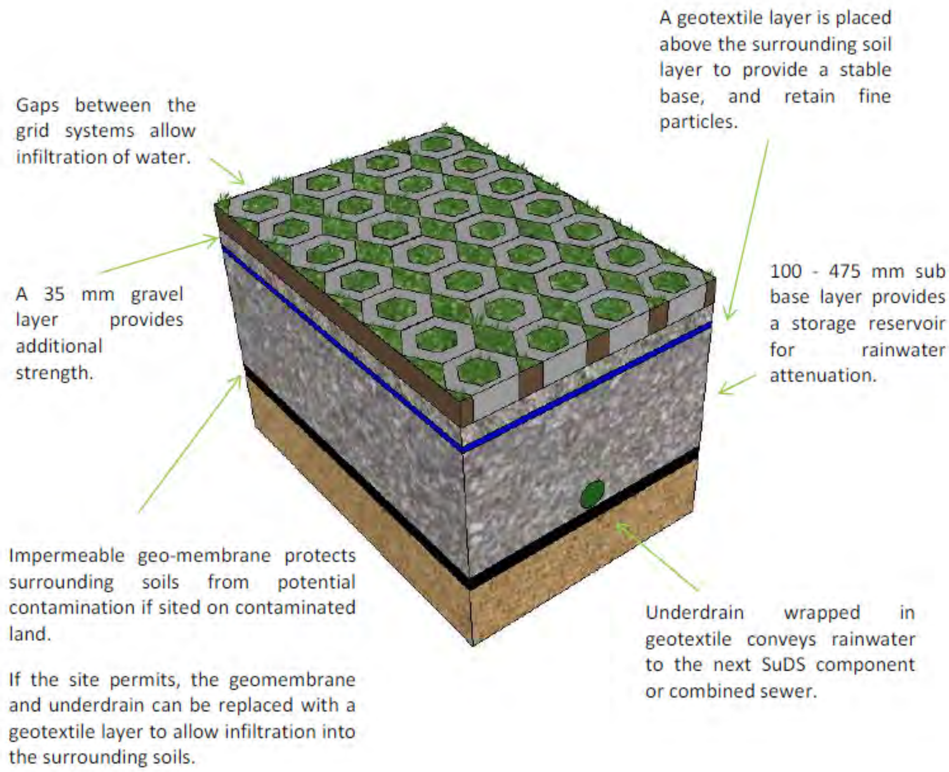


Figure 9: Plastic or Grid Permeable Paving with Sub-base

1.1.1 SuDs Planter Storage Volume/ Rain water Harvesting Systems

SuDs planters are an innovative way of increasing the water attenuation, additionally providing an opportunity to green areas where is not practical to remove or break up permeable surfaces. With excellent retro-fit potential SuDs planters can be designed to receive rain water from a drainpipe or other inlet or simply used to receive rainwater falling on them. SuDS planters are best placed where they can be used in conjunction with other SuDS.

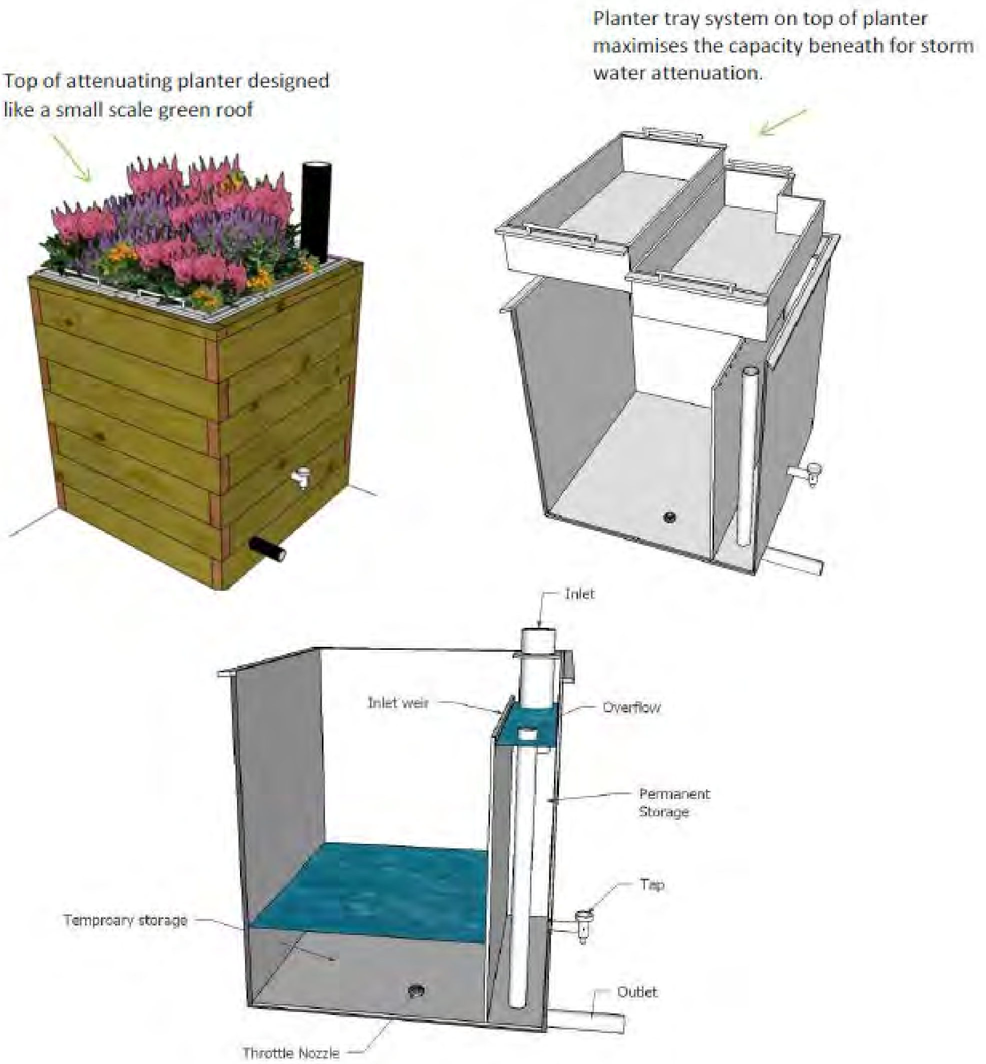


Figure 10: SuDS Planter with attenuation storage (Thames Water)

They offer multi-use benefits such as aesthetic improvements and biodiversity potential. Furthermore with capacity for water storage, they are well situated in grow your own schemes, providing a substrate for plant growth and a water storage capacity, for use in watering other plants.

19.15.4 Geocellular structures, oversized pipes and tanks

Modular plastic geocellular structures, with a high void ratio, are a new below ground storage arrangement that can replace underground pipes or tanks that have been used to store water. They can also be used to convey or infiltrate surface water runoff into the ground.

Underground storage features attenuate an agreed volume with a control structure to limit the discharge rate. Structural design must be provided to ensure integrity of the box, pipe or tank under loading. Silt interception and management arrangement is critical to long-term effectiveness of these structures and this must be demonstrated at design stage and confirmed for the design life of the development. It can be implemented either in the form if a modular box system with inlet and outlet pipework connected to the sides of the structure or in the form of an honeycomb structure with perforated pipes running under or through the box. Water is forced into the box when flows increase. There are now shallow, load bearing boxes which can be used under pavements and in particular below permeable pavement which protects the box from silt contamination and provides treatment with enhanced storage. Moreover, geocellular systems can be installed above a high water table.

19.16 Appendix 16 - SuDS Maintenance

All maintenance activities will be the responsibility of the owner N Shar They will appoint a management company to undertake the general maintenance duties within the site and will join service agreements with the suppliers and manufactures of the SuDS/Pumps when required.

The cost of the services and management company will be funded through the service charge fee which will be paid and manged by home owners.

The information presented below is taken from the CIRIA SuDS Manual (Report c753) and SuDS. Further details on installation and maintenance can be found detailed below and online.

19.16.1 Pervious Pavements

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations - pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.	N SHAR will be responsible for setting up the management company.
Occasional maintenance	Stabilise and mow contributing and areas.	As required.	
	Removal of weeds or manage using weed killer applied directly into the weeds rather than spraying.	As required - once per year on less frequently used pavements.	
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.	
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and lost material.	As required.	

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging).	N SHAR will be responsible for setting up the management company.
Monitoring	Initial Inspection.	Monthly for three months after installation.	
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action.	Three-monthly, 48h after large storms in first six months.	
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.	
	Monitor Inspection chambers.	Annually.	

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy). Therefore, if litter management is already required at the site, this should have marginal cost implications.

19.16.2 Rain Garden Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in inlet and outlet components	Quarterly; As required.	N SHAR will be responsible for setting up the management company.
	Inspection & Cleaning of gutters and any filters on downpipes feeding into rain gardens as required.	Quarterly; As required.	
	Remove, replace and maintain vegetation as required; Ensuring cuttings are removed to prevent debris build up; Weeding of flower bed to maintain the desired vegetation, density and biodiversity - Vegetation management	Monthly inspections Summer; As required Quarterly during Winter month; Or as required.	
Remedial actions	Replace dead or overgrown vegetation as required.	As required.	
	Replacement of clogged geotextile (will require reconstruction of raingarden).	As required.	
Monitoring	Inspect silt traps / discharge points and note rate of sediment accumulation and ensure no erosion pathways forming.	Monthly in the first year and then annually.	
	Check raingardens are emptying as required following a storm event occurring.	After storms; When possible.	

Maintenance will be carried out manually. All monitoring and maintenance will be carried out by the appointed estate management company that undertakes the general landscaping maintenance.

19.16.3 Geo-Cellular Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
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.	N SHAR will be responsible for setting up the management company.
	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 manhole, storage structure and components and floor of inspection tube or chamber and inside of concrete manhole rings.	As required, based on Inspections.	
Remedial actions	Reconstruct geocellular and/or replace or clean void fill, if performance failure occurs	As required	N SHAR will be responsible for setting up the management company / Contractors - Suitable professionals.
	Replacement of clogged geotextile (will require reconstruction of soakaway).	As required.	
Monitoring	Inspect silt raps and note rate of sediment accumulation.	Monthly in the first year and then annually.	
	Check soakaway to ensure emptying is occurring.	Annually.	

Maintenance will usually be carried out manually, although a suction tanker can be used for sediment / debris removal for large systems. If maintenance is not undertaken

for long periods, deposits can become hard-packed and require considerable effort to remove.
Replacement of the geocellular units will be necessary if the system becomes blocked with silt. Effective monitoring will give information on changes in infiltration rate and provide a warning of potential failure in the long term.

Areas draining to infiltration components should be regularly swept to prevent silt being washed off the surface. This will minimize the need for maintenance.

Maintenance responsibility should be placed with an appropriate organisation, and maintenance schedules should be developed during the design phase.

19.17 Appendix 17 - Proposed Drainage Plan

19.17.1 Primary SuDS Plan

19.17.2 Secondary SuDS Plan