FLOOD RISK ASSESSMENT

Site Address

14 Ellesmere Close

Ruislip

HA4 7PQ

Client

Mr and Mrs Thorne

Date

26/03/2021

1 Document Control

FLOOD RISK ASSESSMENT

Site Address:	14 Ellesmere Close Ruislip HA4 7PQ
National Grid Reference:	508387, 187828
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Prepared for:	Mr and Mrs Thorne
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Contents

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 Mr and Mrs Thorne (Client).

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4 Executive Summary

Location	14 Ellesmere Close, Ruislip, HA4 7PQ Grid reference: 508387, 187828
Proposed Development	Proposed single storey side extension and alterations to main roof.
Flood Zone	Flood Zone 3.
Topography	39.9mAOD (SW) to 40.4mAOD (NE).
Sequential and Exception Tests	Development is minor so Sequential and Exception Tests should not be required.
Main Sources of Flooding	River Pinn.
Flood Defences	None.
Records of Historic Flooding	One in 1977.
Fluvial (River) and Tidal (Sea) Flood Risk	Medium – flood depths across site from 100mm to 600mm during the 1 in 100-year + 35%climate change event. At the proposed location of the extension, flood depths do not exceed 200mm.
Pluvial (Surface Water) Flood Risk	Low – the location of the extension will remain dry during all modelled events.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low – Although the site lies within the extent from reservoirs' flooding, its residual risk is classified as being low.
Groundwater Flood Risk	Low – Site is not susceptible to groundwater flooding.
Development Impacts on Local Flood Risk	The development will increase the site impermeable area. As such it may impact on local flood risk if unmitigated.
Proposed Flood Risk Mitigation Measures	• Finished floor levels will be set to 40.6mAOD to match existing; • 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 1-minute walk away and safe refuge is available on upper floors.
Surface Water Management (SuDS)	SuDS would reduce current surface water run off rates. The client has informed that the water from the new extension will be directed into a soakaway in the rear garden.
Conclusions	With the proposed mitigation measures in place, the proposal is unlikely to have a significant impact on local flood risk and it will be safe for its residents.

5 Introduction

STM Environmental Consultants Limited (STM) has been appointed by Mr and Mrs Torne (Client) to provide a Flood Risk Assessment (FRA) at a site located at 14 Ellesmere Close, Ruislip, HA4 7PQ.

6 Development Proposal

The FRA is required to support a planning application for a proposed single storey side extension and alterations to main roof.

Further details including drawings of the development plans are available in Appendix 2.

7 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, 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.

8 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.

9 Legislative and Policy Context

9.1 Legislative Context

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

9.2 Policy Context

9.2.1 National Planning Policy Framework (NPPF)

The NPPF sets out the government’s planning policies for England and how these are expected to be applied. It also provides a set of guidelines and philosophy with which local planning authorities (LPAs) can build their own unique policies to appropriately regulate development within their jurisdictions.

Section 14 entitled “Meeting the challenge of climate change, flooding and coastal change” deals specifically with flood risk. Among other things it states that LPAs

should try to ensure that “Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere”. It further states that when determining planning application, LPAs should “ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment50. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) 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;
- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Applications for minor development and changes of use should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 50.

Footnote 50 states: “A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.”

The NPPF also lays out requirements for how LPAs should deal with planning applications in coastal areas. They should ensure that should they “reduce risk from coastal change by avoiding inappropriate development in vulnerable areas or adding to the impacts of physical changes to the coast.”

Developments in Coastal Change Management Areas should only be considered appropriate where it is demonstrated that:

- it will be safe over its planned lifetime and will not have an unacceptable impact on coastal change;
- the character of the coast including designations is not compromised;
- the development provides wider sustainability benefits;
- the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast.

9.2.2 Local Planning Policy

Policy EM6 of the Local Plan addresses Flood Risk Management:

- 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.
- 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.

Policy DMEI 9 of the: Management of Flood Risk

- Development proposals in Flood Zones 2 and 3a will be required to demonstrate that there are no suitable sites available in areas of lower flood risk. Where no appropriate sites are available, development should be located on the areas of lowest flood risk within the site. Flood defences should provide protection for the lifetime of the development. Finished floor levels should reflect the Environment Agency's latest guidance on climate change.
- Development proposals in these areas will be required to submit an appropriate level Flood Risk Assessment (FRA) to demonstrate that the development is resilient to all sources of flooding.
- Development in Flood Zone 3b will be refused in principle unless identified as an appropriate development in Flood Risk Planning Policy Guidance. Development for appropriate uses in Flood Zone 3b will only be approved if accompanied by an appropriate FRA that demonstrates the development will be resistant and resilient to flooding and suitable warning and evacuation methods are in place.
- Developments may be required to make contributions (through legal agreements) to previously identified flood improvement works that will benefit the development site.
- Proposals that fail to make appropriate provision for flood risk mitigation, or which would increase the risk or consequences of flooding, will be refused.

9.3 EA Standing Advice on Flood Risk

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

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;

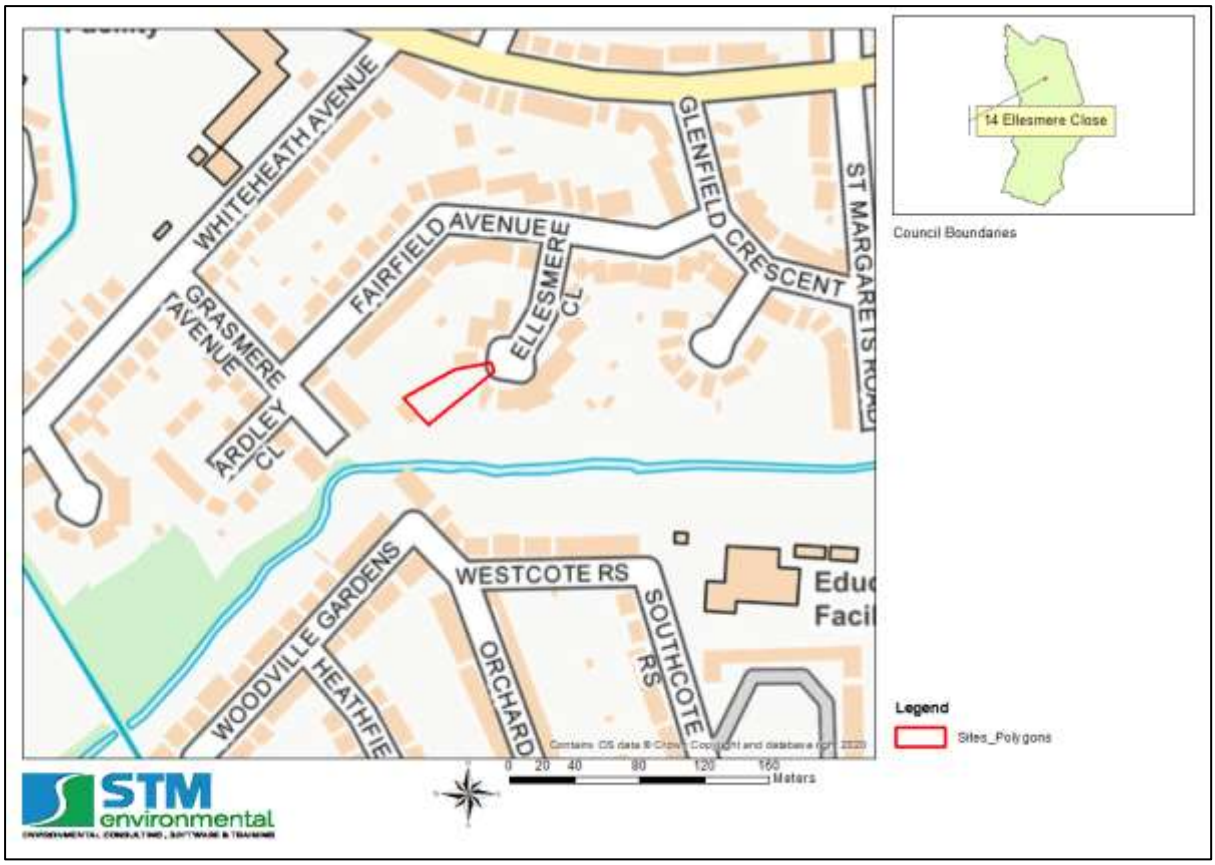
- less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs);
- in an area within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

10 Site Description and Environmental Characteristics

10.1 Site Location and Area

The site is located at 14 Ellesmere Close, Ruislip, HA4 7PQ. It is centred at national grid reference 508387, 187828. The site has an area of approximately 790m^2.

A site location map and aerial photo are shown below. Photographs of the site are available in Appendix 1.



10.2 Site Access

The site is accessed via Ellesmere Close.

10.3 Local Planning Authority

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

10.4 Lead Local Flood Authority

LBH is also the Lead Local Flood Authority (LLFA).

10.5 Flood Zone

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

10.6 Site and Surrounding Land Uses

10.6.1 Site Current Land Use

The site is currently used as residential.

10.6.2 Surrounding Land Uses

The land use surrounding the site is mainly residential.

10.7 Hydrology

The nearest main watercourse is the River Pinn which is located 40m to the south of the site.

10.8 Geology

Data from the British Geological Survey indicates that the underlying bedrock geology is characterized as Lambeth Group. No superficial deposits were identified.

10.9 Hydrogeology

The site lies upon a secondary A bedrock aquifer.

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

10.10 Topography

A LIDAR map showing the topology of the site and surrounding area is available in Appendix 3. The ground level at the site is predominantly flat ranging from 39.9mAOD in the south west to 40.4mAOD in the north east. At the propose location of the development, the site sits at an average of 40.32mAOD.

A topographic survey has not been conducted.

11 The Sequential and Exception Tests

11.1 The Sequential Test

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 unless the development is a caravan, camping chalet, mobile home or park home site.

Minor development means:

- minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metre.
- alterations: development that does not increase the size of buildings eg alterations to external appearance.
- householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling eg subdivision of houses into flats.

With regard to residential and commercial developments, major development means one or more of the following:

- c(i) - the number of dwelling houses to be provided is 10 or more; or
- c(ii) - the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph (c)(i);
- the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more;
- or development carried out on a site having an area of 1 hectare or more.

The development is considered to be minor and as such the Sequential Test should not be required by the LLFA.

11.2 The Exception Test

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 1 and are defined in terms of Flood Zone and development vulnerability classification.

Table 1: 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.

Based on its scale and nature, the development is classified as minor. As such the Exception Test should not 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) and Tidal (Sea) Flood Risk

12.1.1 Mechanisms for Fluvial Flooding

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.

12.1.2 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 (1%) and 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 3: Greater than 1 in 100 (1%) 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 (1%) annual probability of fluvial flooding and/or greater than 1 in 200 (0.5%) annual probability of tidal flooding;
- Flood zone 3b: Functional flood plain (definition specific to the LLFA). Less than a 1 in 20 (5%) annual probability of fluvial and/or tidal flooding.

12.1.3 Main Potential Sources of Local Fluvial Flooding

The nearest potential source of fluvial flooding to the site is considered to be the River Pinn.

12.1.4 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 there has been historic flooding at the site in 1977. Copies of the maps at the site location are available in Appendix 4.

The Historic Flood Map which is available as part of the EA Product 4 data in Appendix 11 indicates that the last time the borough suffered a significant fluvial flooding event was in 2016. The flood extent outline did not impact the site.

12.1.5 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 greater than 1 in 100 annual probability of fluvial flooding.

12.1.6 Mechanisms for Tidal Flooding

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.

12.1.7 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 (0.5%) and 1 in 1000 (0.1%) annual probability of tidal flooding;
- Flood zone 3: Greater 1 in 200 (0.5%) annual probability of tidal flooding.

12.1.8 Potential Sources of Tidal Flooding

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

12.1.9 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.

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

The EA Product 4 dataset which is presented in Appendix 11 provides modelled flood levels and flows for model node points close to the site. These are summarised in Table 2 below.

Table 2: EA modelled flood levels and expected flood depths for different return periods and scenarios.

	Flood Levels in mAOD during different AEP events				
	1 in 100	1 in 100 + 20%CC	1 in 100 + 35%CC	1 in 100 + 70%CC	1 in 1000
P235in1	40.27	40.40	40.50	40.75	41.02

The ground level at the site ranges from 39.9mAOD to 40.4mAOD. As such, during the 1 in 100-year event, the site would witness flood depths from 100mm in the north east to 600mm in the south west. As the proposed location of the extension sits at approximately 40.32mAOD, the development would potentially witness shallow depths up to 180mm during this scenario.

12.1.11 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 9 indicate that the long-term risk from fluvial flooding to the site is high.

12.2 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.

12.2.1 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.

12.2.2 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 reservoirs and canals in the area.

12.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the West London SFRA revealed no evidence of records of pluvial flooding on or in the vicinity of the site.

A map showing the location of surface water flooding incidents is available as part of the Hillingdon Surface Water Management Plan. A map showing the location of surface water flooding incidents is available in Appendix 4 . No records were identified at or in the vicinity of the site.

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

The EA's reservoir flood risk map indicates that the site does lie within an area that is at risk of reservoir flooding. However, reservoirs in the UK have an extremely good safety record. As such, the residual risk associated with them flooding is classified as being very low.

12.2.5 Sewer Flooding

The Hillingdon Surface Water Management plan shows that the postcode area HA4 7 has witnessed 11 to 20 recorded incidents. A copy of this map is available as well in Appendix 4. However, the West London SFRA map, also available in Appendix 4, show no recorded incidents in the area.

12.2.6 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 30-year, 1 in 100-year and 1 in 1000-year rainfall return periods provided by the EA are available in Appendix 6.

The maps show that the majority of the site would remain dry during all precipitation events. Only during the 1 in 1000-year event the site would witness some pooling in the south west with depths up to 600mm, away from the proposed location of the extension.

12.2.7 Long Term Surface Water Flood Risk

The EA's long term flood risk maps which are available in Appendix 9 indicate that the long term risk of flooding from surface water is considered to be very low at the majority of the site to low in the south west.

12.3 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 greater than 3.3% chance of flooding at the site in any year. A copy of the map is presented in Appendix 8.

12.4 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.

12.4.1 Historic Records of Groundwater Flooding

A map showing the locations of historic groundwater flooding incidents is available as part of Hillingdon Surface Water Management Plan. A copy of this map is

available in Appendix 4. It shows no recorded groundwater incidents at or in the vicinity of the site.

12.4.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS, which is available in Appendix 10 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.

12.5 Critical Drainage Area

A Critical Drainage Area (CDA) may be defined as "a discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure". A CDA is defined in the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 as "an area within Flood Zone 1 which has critical drainage problems and which has been notified… [to]…the local planning authority by the Environment Agency".

The site is not located within a Critical Drainage Area as shown in the West London SFRA Policy Map.

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 3 below.

Table 3: Existing and proposed site ground cover.

	Impermeable Area (m^2)	Permeable Area (m^2)	Total Area (m^2)
Existing	189.6	600	789.6
Proposed	215.36	574.24	789.6

The development will alter the site impermeable area by approximately 26m^2. As such, it may impact upon surface water runoff rates.

Additionally, as it will increase the site's built-up area by approximately 38m^2, it is likely to impact upon local flood storage. Flood displacement storage is discussed in section 14.2.2 below.

13.2 Impacts on Flood Flow Routes

As the development does involve the significant redesign of buildings at the site, it may alter flood flow paths. However, given that the extension is proposed at the highest elevation within the site itself, the impact on flood flows is not considered to be required.

14 Flood Risk Mitigation Measures

14.1 SuDS

Planning practice guidance (PPG) which is prepared by the Ministry of Housing, Communities and Local Government (DCLG) states that developers and Local Authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

As such, the developer has to implement a SuDS strategy in line with the drainage hierarchy as outlined in Table 4 below to reduce surface water discharges from the site.

Table 4: SuDs Options

- Store rainwater for later use;
- Use infiltration techniques, such as porous surfaces in non-clay areas;
- Attenuate rainwater in ponds or open water features for gradual release;
- Attenuate rainwater by storing in tanks or sealed water features for gradual release;
- Discharge directly to a water course;
- Discharge rainwater directly to a surface water sewer/drain;
- Discharge to a combined sewer.

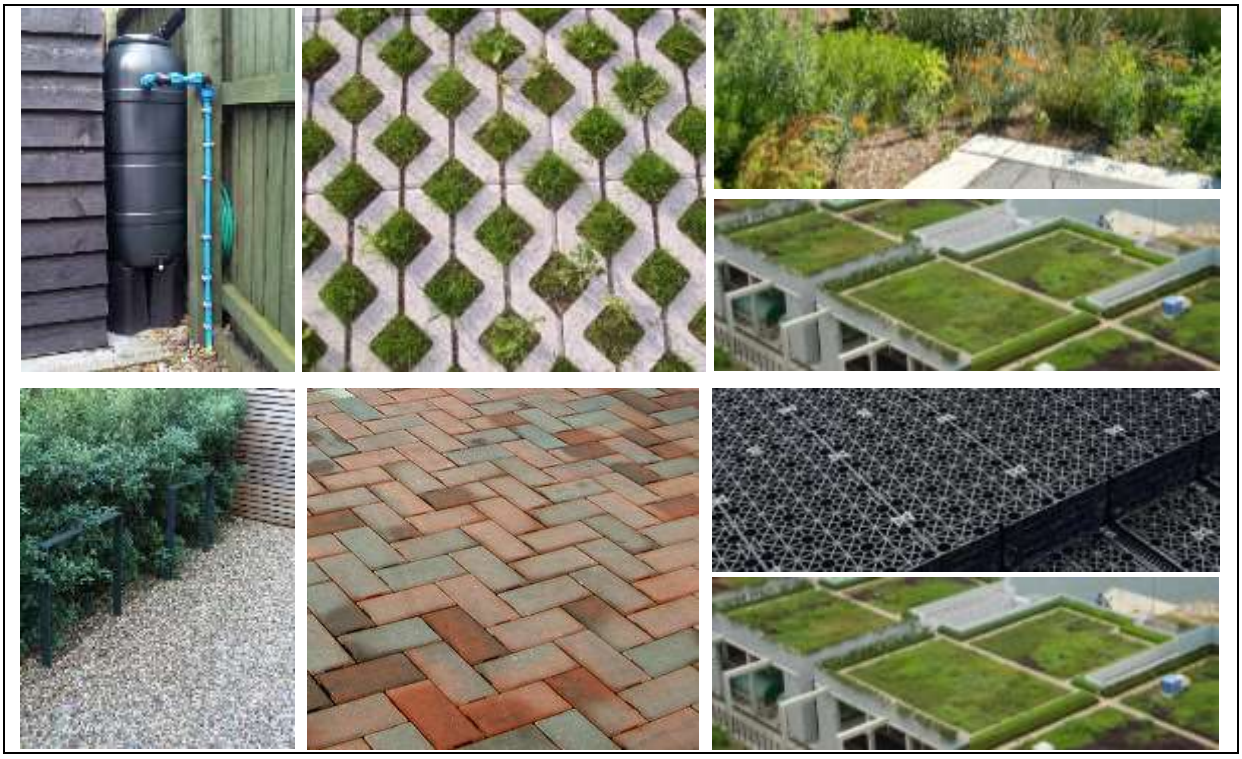


Figure 1: Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

Given the nature of the development and the size of the site, it is considered that there are opportunities for implementing SuDS. Measures such as green roofs, rainwater harvesting, infiltration (soakaways, permeable paving, rain gardens) or attenuation storage tanks should be considered. The client has informed that the runoff from the roof will be directed into a soakaway as per Building Control

requirements. If required, the SuDS strategy will be detailed in a separate report as is outside the scope of works of this FRA.

14.2 Flood Resilience

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.

14.2.1 Finished Floor Levels

The average ground level at the proposed location of the extension is 40.32mAOD.

For minor extensions EA 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 outlined above, the EA's maximum predicted flood level at the site for 1% AEP plus 35% climate change event is 40.50mAOD (see Appendix 11). Based on this finished ground floor levels across internal areas of the development should be set at a minimum of 40.8mAOD which is approximately 500mm above external ground levels. Given the extent of the proposal and the development being a small minor extension, it is not possible to set finished floor levels above existing finished floor levels of the house. As such, finished floor levels are proposed to match existing which are set to approximately 40.6mAOD which accounts for about 300mm above general ground levels at the site.

14.2.2 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.

Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced. The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage.

The use of under-floor voids with adequate openings beneath the raised finished floor levels can be considered for development in Flood Zone 2 and 3. They are generally considered to provide indirect compensation or mitigation, but not true compensation for loss of floodplain storage.

As the whole site lies within the 1 in 100-year plus 35% climate change event, level for level compensation is not considered to be feasible within the site boundary.

As such, it is recommended to implement underfloor voids.

Ideally, void openings should be a minimum of 1m long and open from existing ground levels to at least the 1% annual probability (1 in 100-year) plus climate change flood level. By setting finished floor levels above the design flood level, there

should be sufficient space provision for voids below. There should be a minimum of 1m of open void length per 5m length of wall. Void openings should be provided along all external walls of the proposed extension. If security is an issue, 10mm diameter vertical bars set at 100mm centres can be incorporated into the void openings.

14.2.3 Flood Resilience 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 0.3m are predicted at the proposed location of the extension, the water exclusion strategy is considered most applicable for this site.

Flood resilience design and measures that will be implemented are outlined below. Water-resistant and resilient materials will 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.

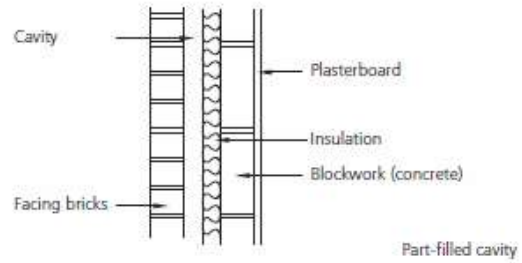
Doors:

- 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.

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 should 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.

14.3 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.
The scoring methodology and calculation matrix for this is summarised in Appendix 13.

The EA Product 4 data does only provide flood flows in-channel within the River Pinn. As such, it is not possible to calculate a 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.

14.3.1 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.

14.3.2 Access and Safe Egress

Safe egress to Flood Zone 1 is available by a 1-minute walk to the north of Ellsmere Close where it crossed Fairfield Avenue. Directions of this route are presented in Appendix 12 .

14.3.3 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 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 and the potential impacts of climate change.

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

- The site is classified as a more vulnerable minor development and is therefore unlikely to require sequential and exception tests to be undertaken;
- The main source of potential flooding to the site is the River Pinn;
- The EA define the site as being within flood zone 3;
- EA mapping indicates that the site is not in an area that benefits from flood defences;
- One record of fluvial flooding was identified at the site in 1977;
- No records of surface water, groundwater or artificial flooding incidents were identified at or in the vicinity of the site;
- The site is not within a CDA. It is not in an area that has had a significant number of sewage flooding incidents according to the West London SFRA;

- The development will result in a change in the impermeable area of the site and therefore may increase local flood risk;
- There is opportunity for implementing SuDS mitigation measures. A soakaway will be installed as part of the development in order to deal with the surface water runoff of the proposed extension;
- Flood resilient materials and construction methods will be used so as to ensure that the impacts of any potential flooding are minimised as much as possible;
- Occupants will subscribe to the EA Flood Warnings Direct Service;
- Safe egress routes to flood zone 1 are easily accessible;
- In the event that evacuation is not possible, safe refuge is available in the upper floors of the building which are accessible via an internal staircase.

Based on the information reviewed and taking into account the proposed mitigation measures, the proposal is unlikely to have a significant impact on local flood risk and it will be safe for its residents.

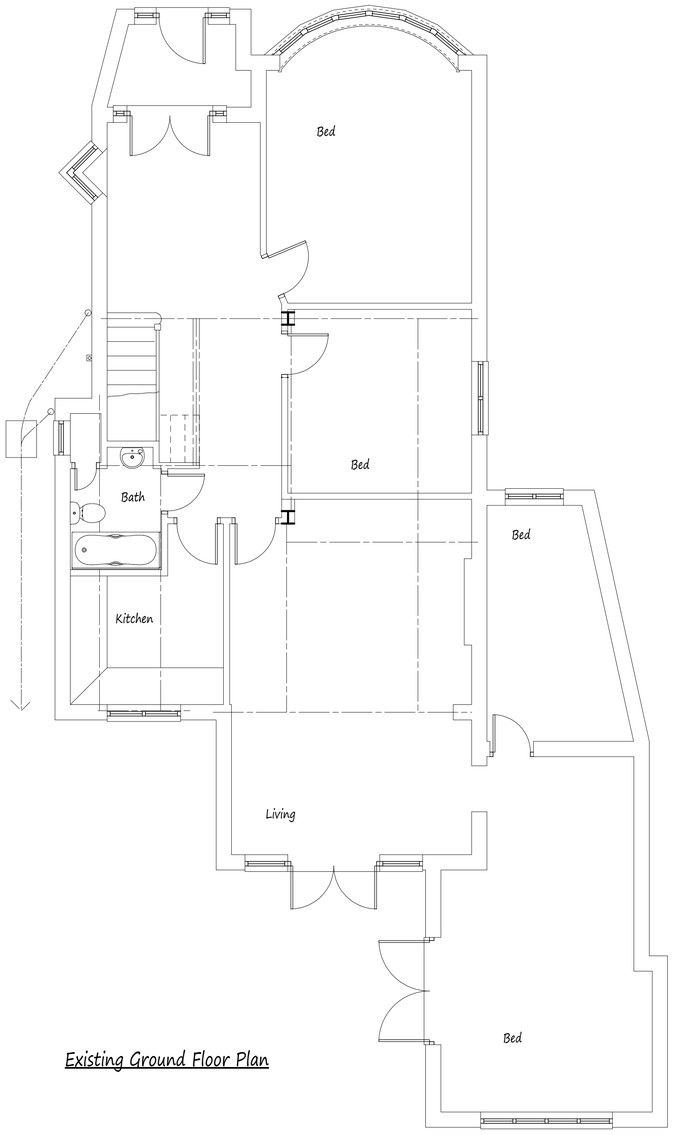
16 References

1. Communities and Local Government - National Planning Policy Framework NPPF, March 2019.
2. Communities and Local Government - Planning Practice Guidance: Flood Risk and Coastal Change, Updated 06 March 2014.
3. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
4. Strategic Flood Risk Assessment – West London, accessed online March 2021.
5. Surface Water Management Plan – London Borough of Hillingdon, 2011.
6. Local Plan, Strategic Policies – London Borough of Hillingdon, 2012.
7. Local Plan Part 2, Development Management Policies – London Borough of Hillingdon, 2020.

17 Appendices

17.1 Appendix 1 – Site Photographs

17.2 Appendix 2 – Development Plans



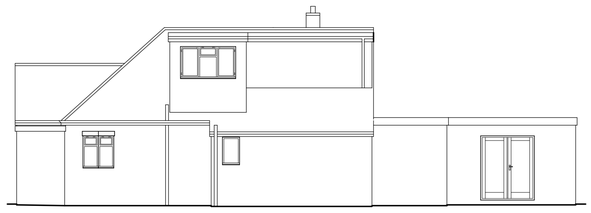
Existing Ground Floor Plan

Existing Rooms in Roof Space

This drawing to be read in conjunction with Drg No 4386/04

Existing Elevations

Front Elevation



Side Elevation

Rear Elevation

Side Elevation

NOTES:
All dimensions must be checked on site and not scaled from this drawing.

A		
	Date	Revisions

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Mr & Mrs Thorne

Job Title
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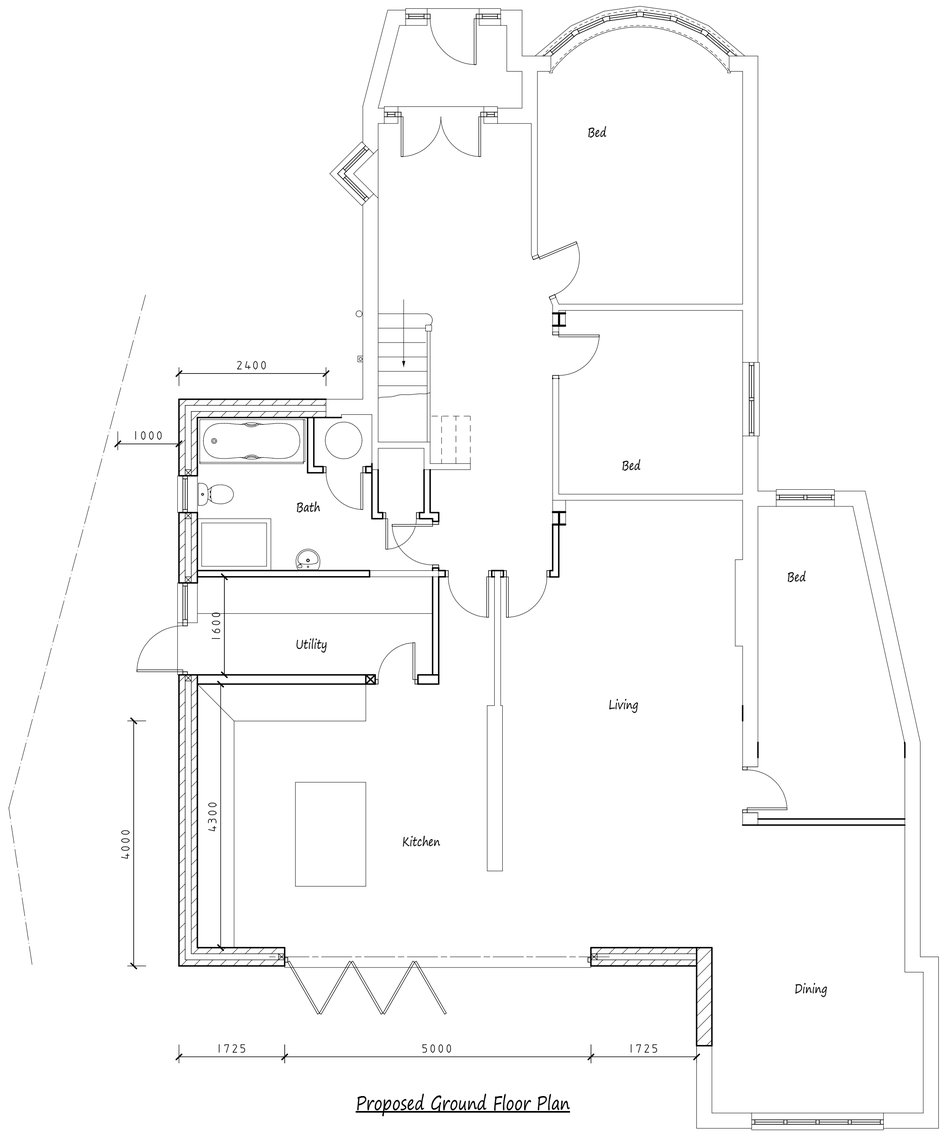
Ruislip
Middlesex

Drawing Title
Existing Details

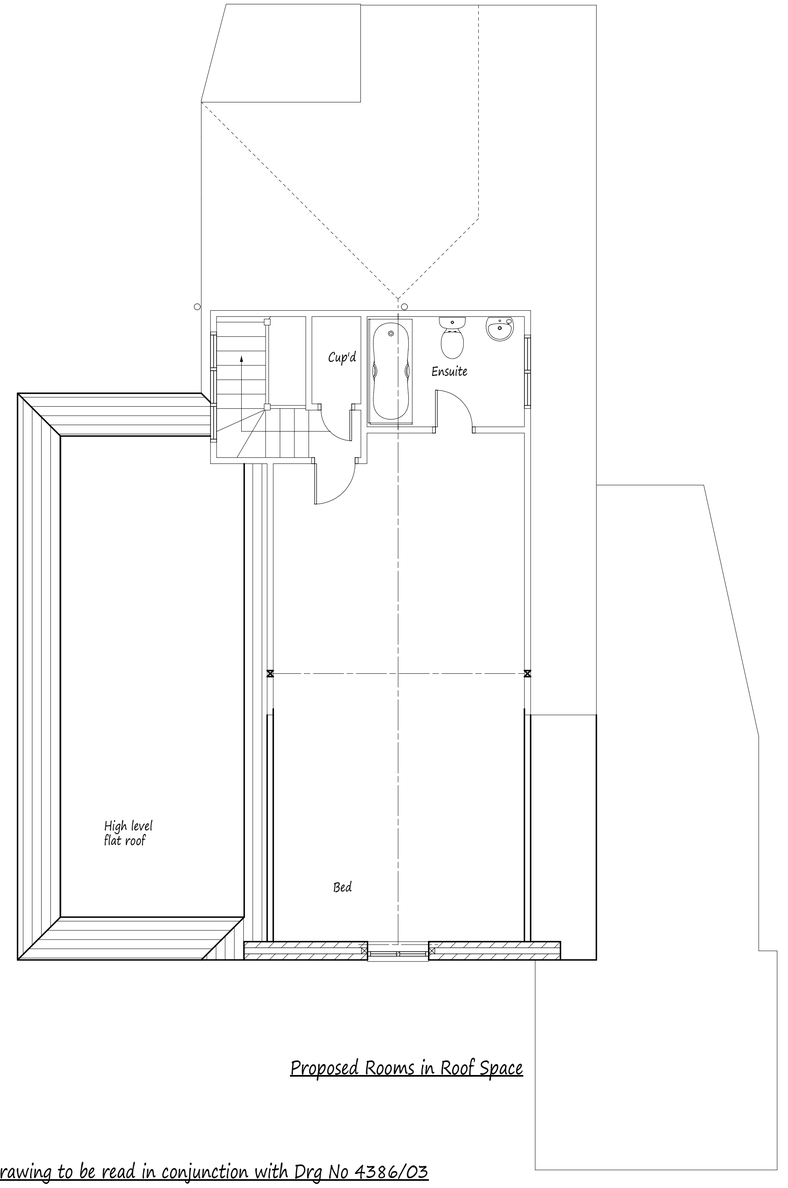
Scale
1:50. 100

Date	Drawn by
November 2020	MDP

Drg No.
4386/03



Proposed Ground Floor Plan



Proposed Rooms in Roof Space

This drawing to be read in conjunction with Drg No 4386/03

Proposed Elevations - All Materials to Match Existing

Front Elevation

Side Elevation

Rear Elevation

Side Elevation

NOTES:
All dimensions must be checked on site and not scaled from this drawing.

A		
	Date	Revisions

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Client
Mr & Mrs Thorne

Job Title
14 Ellesmere Close
Ruislip
Middlesex

Drawing Title
Proposed Single Storey Side and Rear Exension and Alterations to Main Roof.

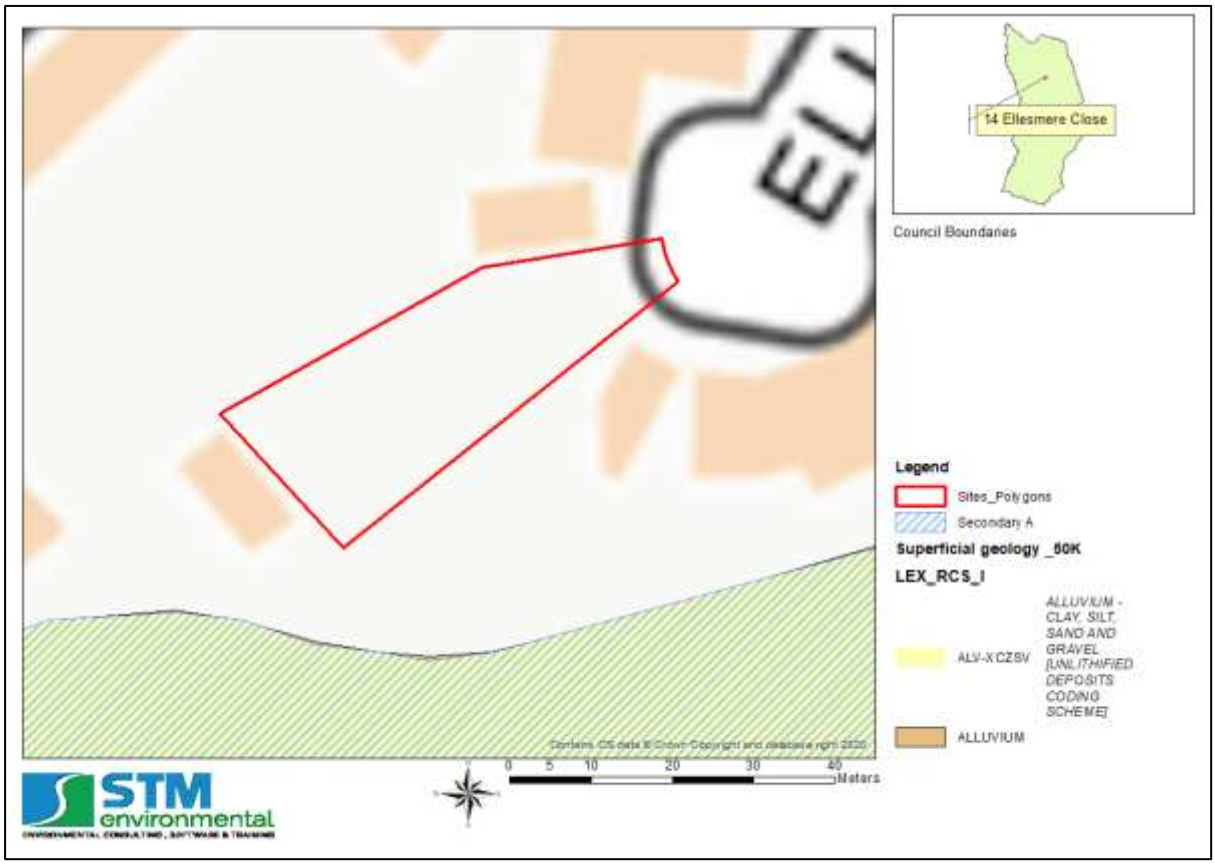
Scale
1:50. 100

Date	Drawn by
November 2020	MDP

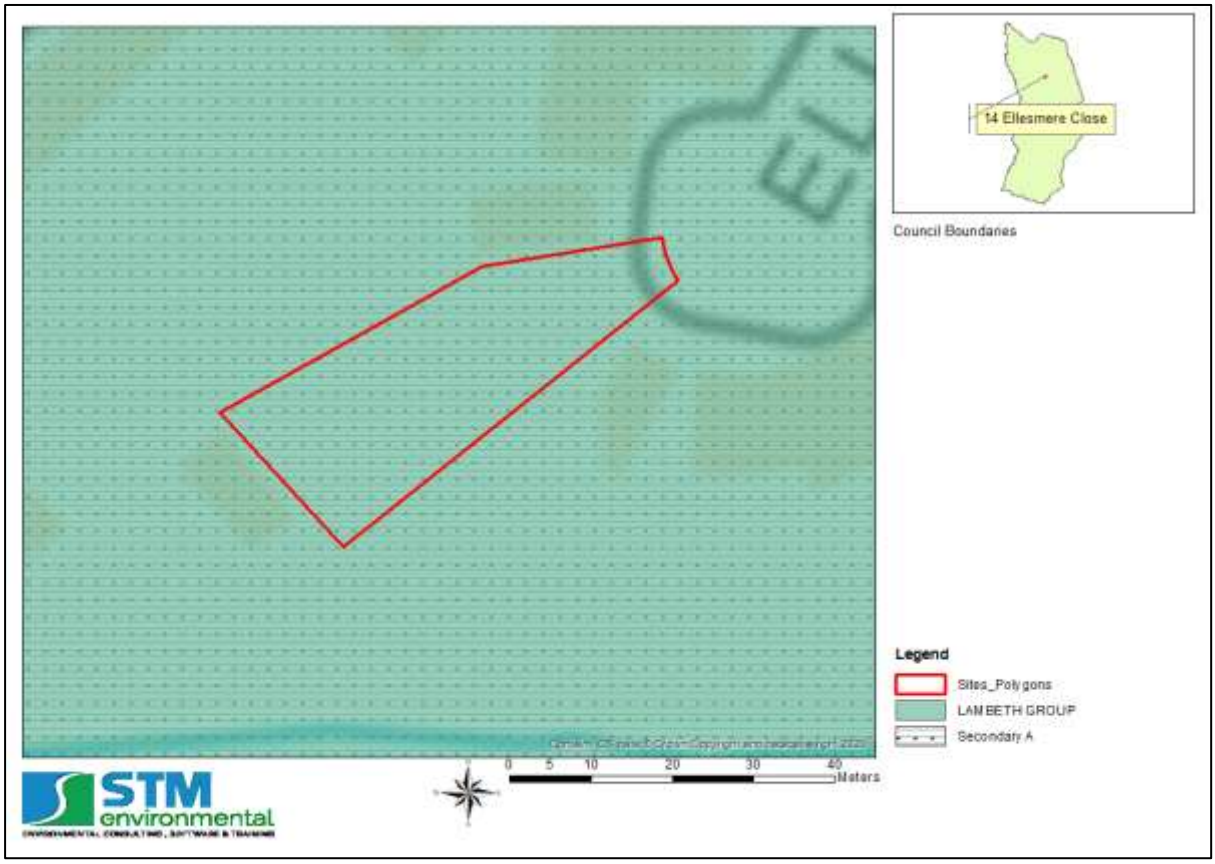
Drg No.
4386/04

17.3 Appendix 3 – Environmental Characteristics

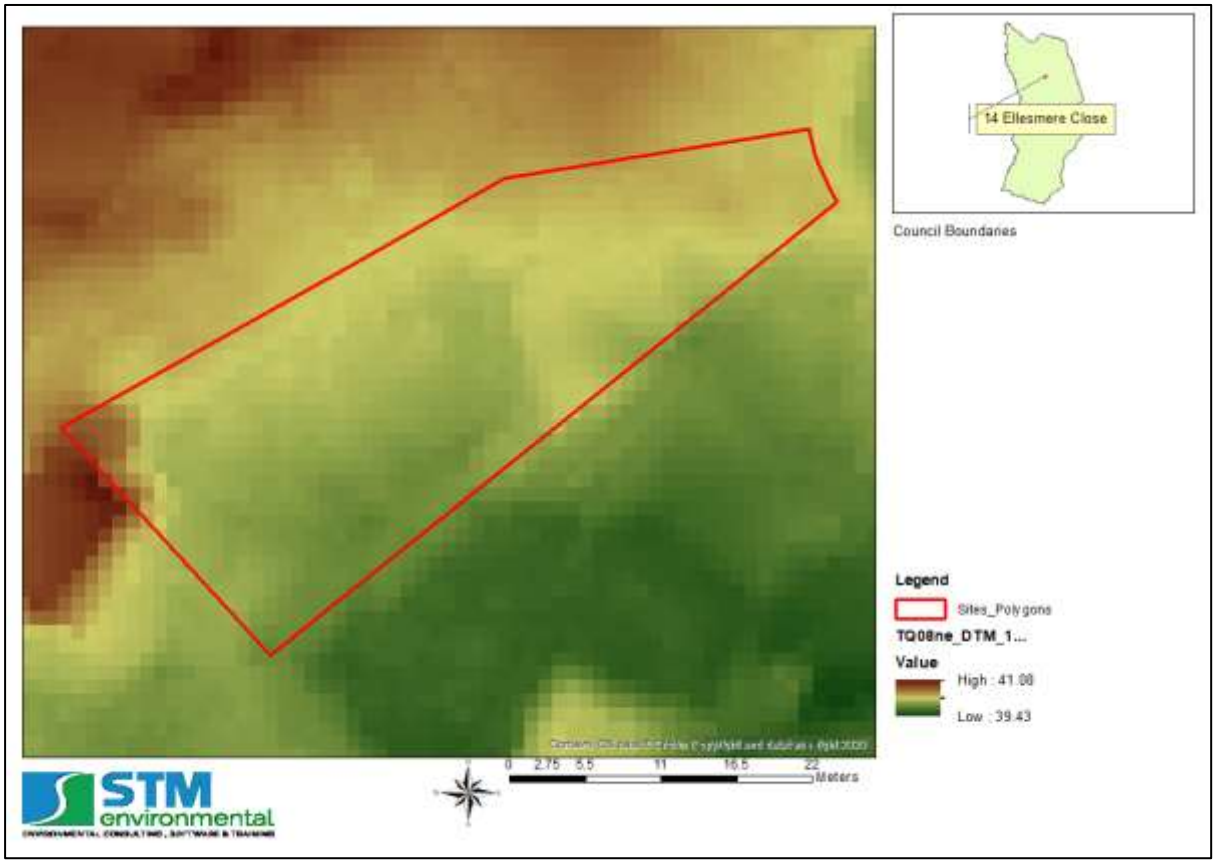
17.3.1 Superficial Hydrogeology Map



17.3.2 Bedrock Hydrogeology Map

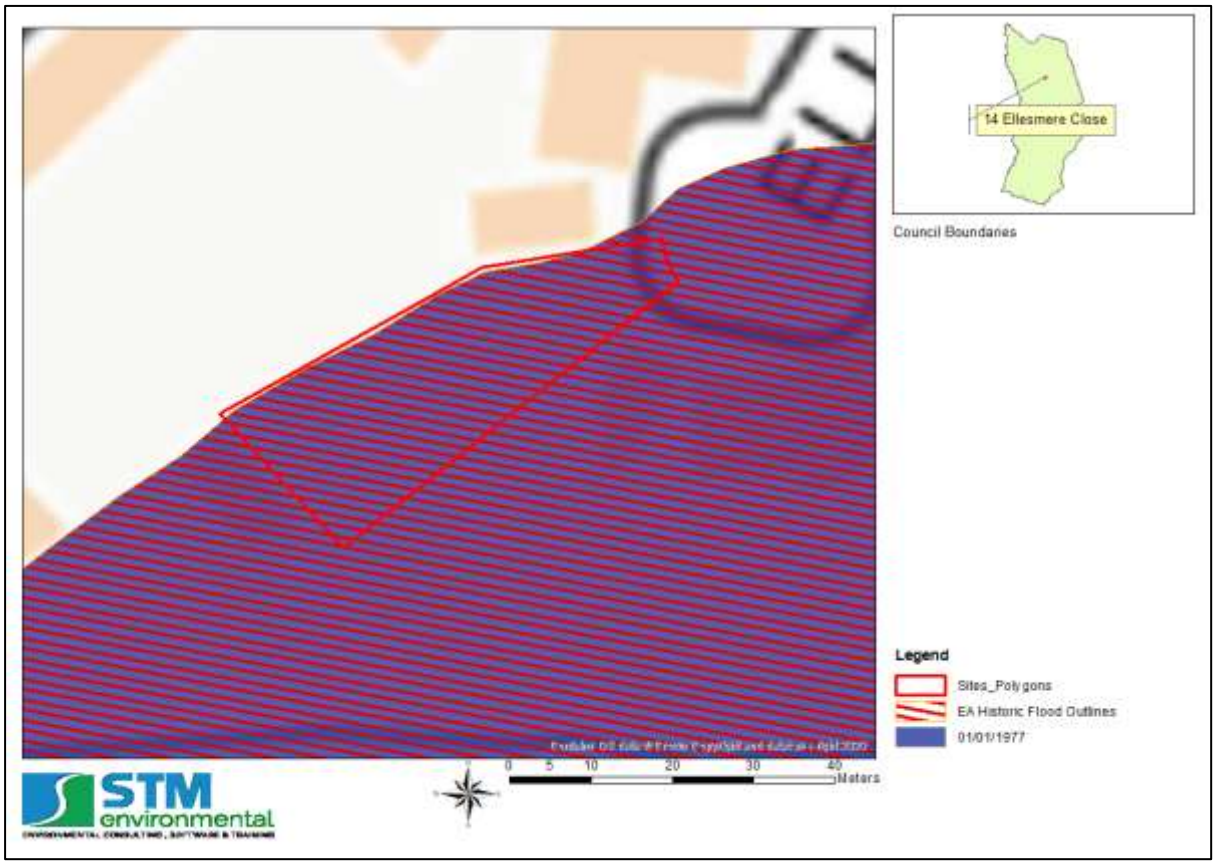


17.3.3 Topology Map

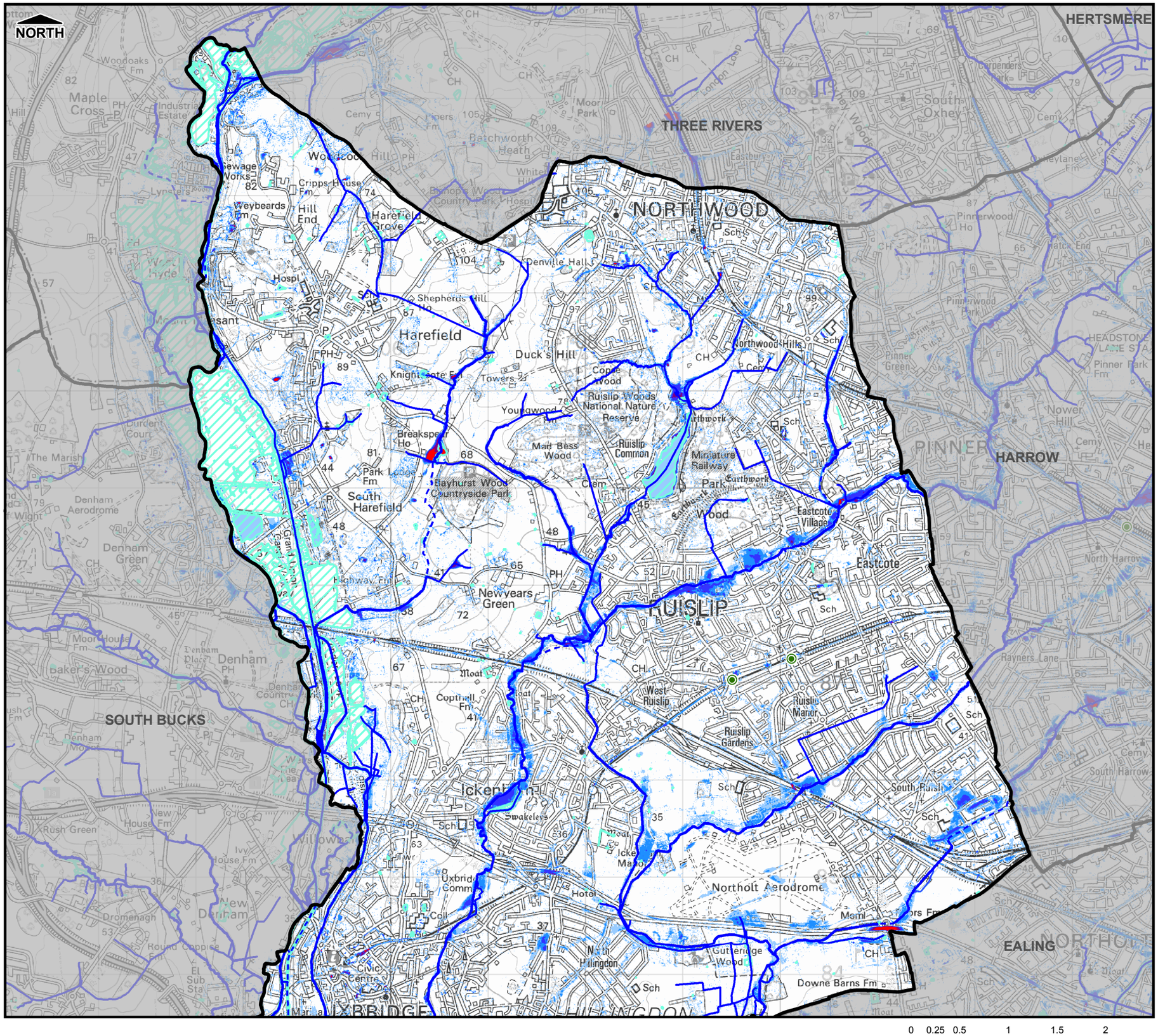


17.4 Appendix 4 – Historical Flood Incident Maps

17.4.1 EA Historic Flood Outlines



17.4.2 SFRA Historic Surface Water Incidentst



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

HILLINGDON LONDON

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
Flood Risk Management
Scott Wilson
Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

Drain London Programme Board Members

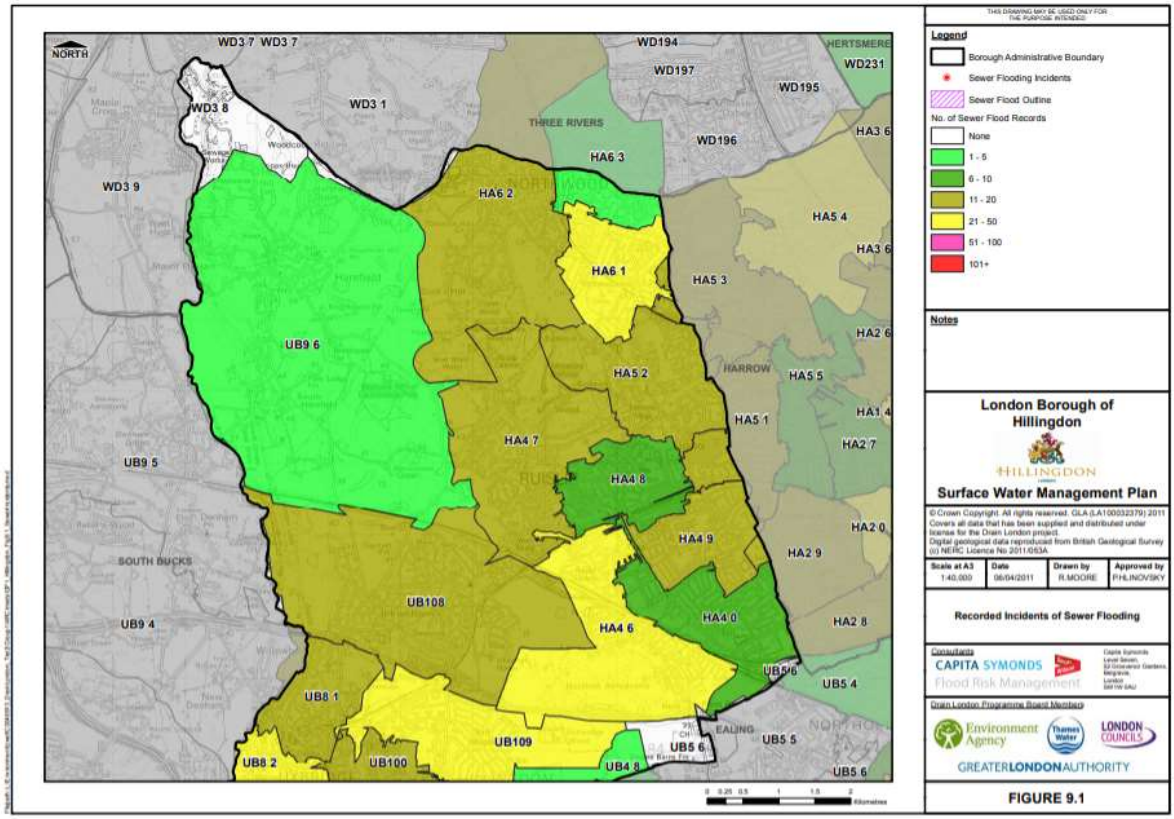
Environment Agency · Thames Water · LONDON COUNCILS · GREATERLONDONAUTHORITY

FIGURE 5.1

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

17.4.3 West London Map Recorded Sewer Flooding

17.4.4 Hillingdon recorded sewer flooding incidents



17.4.5 Map of Recorded Groundwater Flooding

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Culverted Watercourse (Main River)
- Groundwater Flood Incident (EA Records)
- Groundwater Flood Incident (Other Records)

Increased Potential for Elevated Groundwater in

- Permeable Superficial Deposits
- Consolidated Aquifers

Notes

1. The increased Potential for Elevated Groundwater map shows those areas within the London Boroughs where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or be within 2 m of the ground surface. Such groundwater rise could lead to the following consequences:
   - flooding of basements of buildings below ground level;
   - flooding of buried services or other assets below ground level;
   - inundation of farmland, roads, commercial, residential and amenity areas;
   - flooding of ground floors of buildings above ground level; and
   - overflowing of sewers and drains.
2. Incident records shown are generally unconfirmed and may include issues such as water main bursts or non-groundwater related problems.
3. Areas not shown to have increased potential for elevated groundwater should be considered to have a low potential for elevated groundwater – Lack of information does not imply 'no potential' of elevated groundwater in that area.
4. Includes groundwater flood mapping provided by JBA Consulting

London Borough of Hillingdon

HILLINGDON LONDON

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:40,000	05/04/2011	R.MOORE	P.HLINOVSKY

Increased Potential for Elevated Groundwater Map

Consultants
CAPITA SYMONDS / Scott Wilson
Flood Risk Management
Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

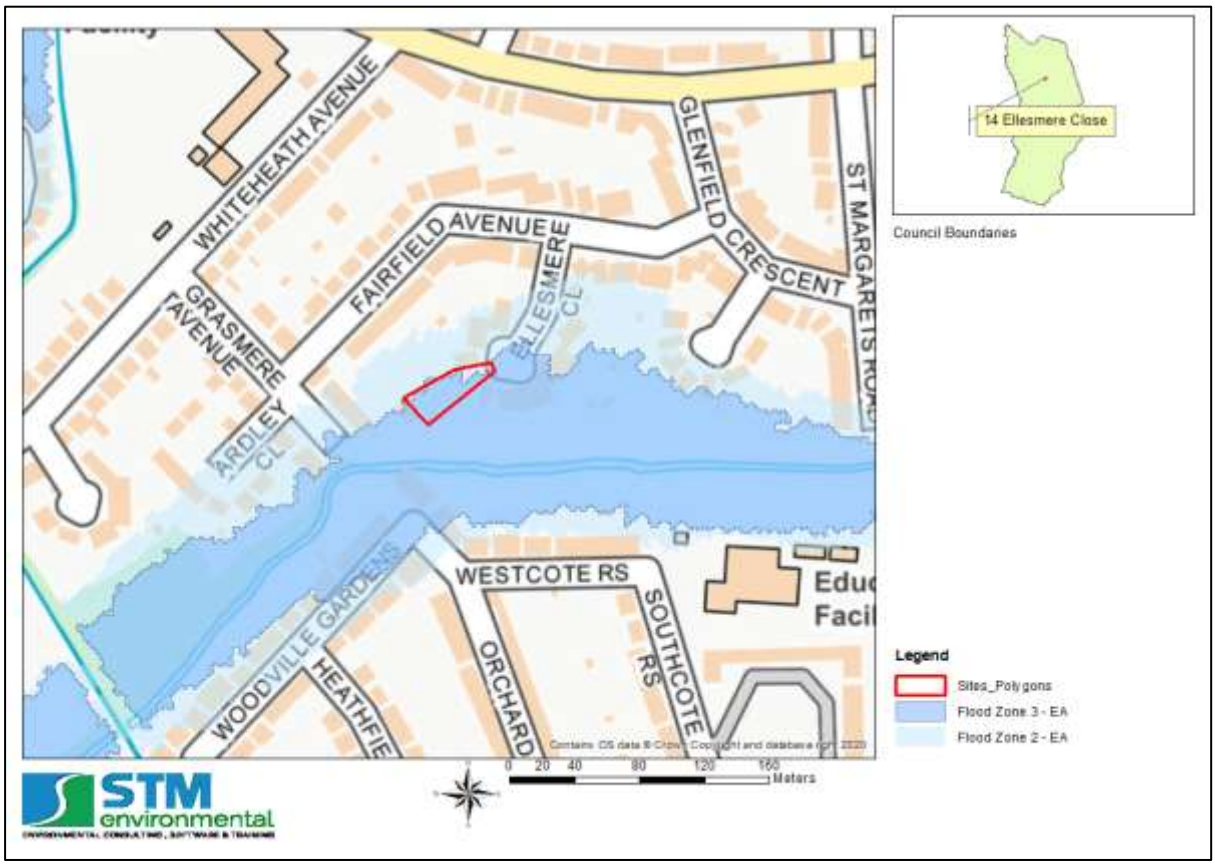
Drain London Programme Board Members

Environment Agency · Thames Water · LONDON COUNCILS · GREATER LONDON AUTHORITY

FIGURE 10.1

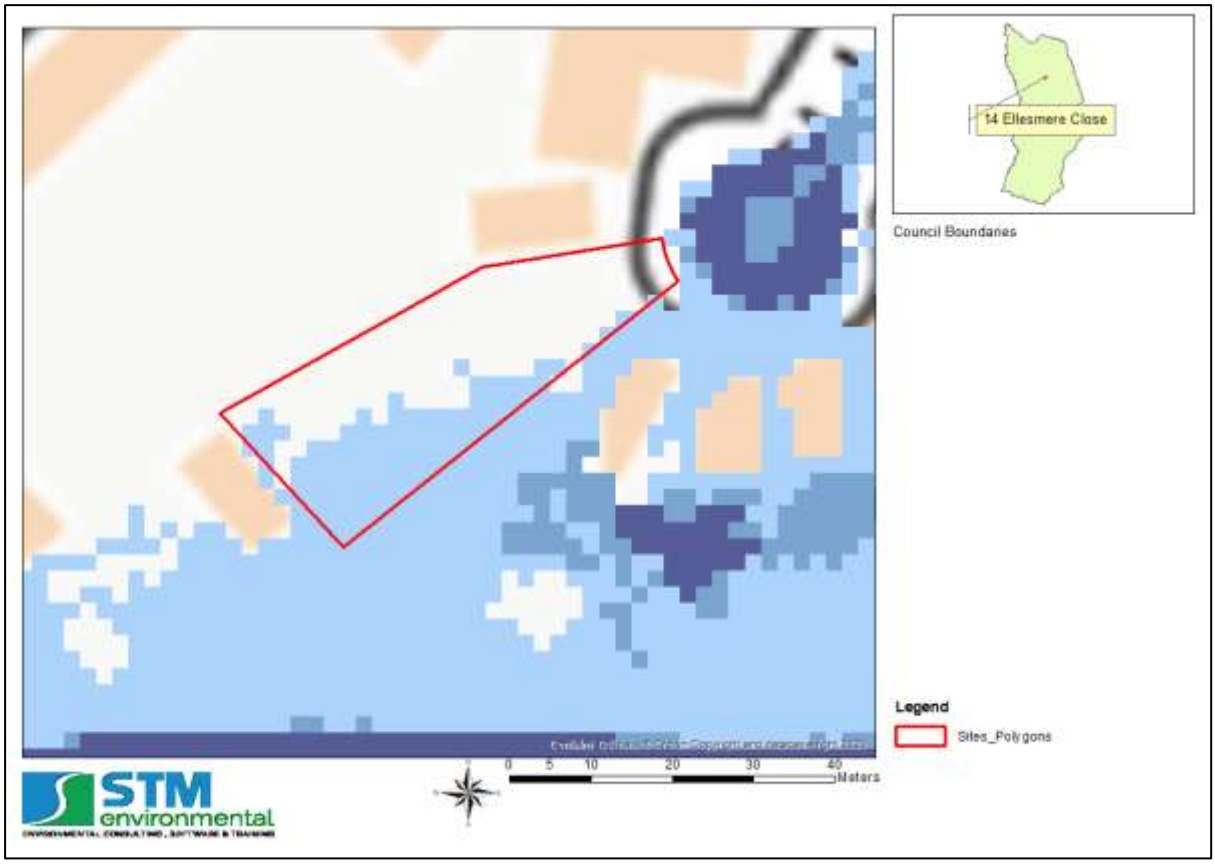
0 0.25 0.5 1 1.5 2 Kilometres

17.5 Appendix 5 - EA Flood Zone Map

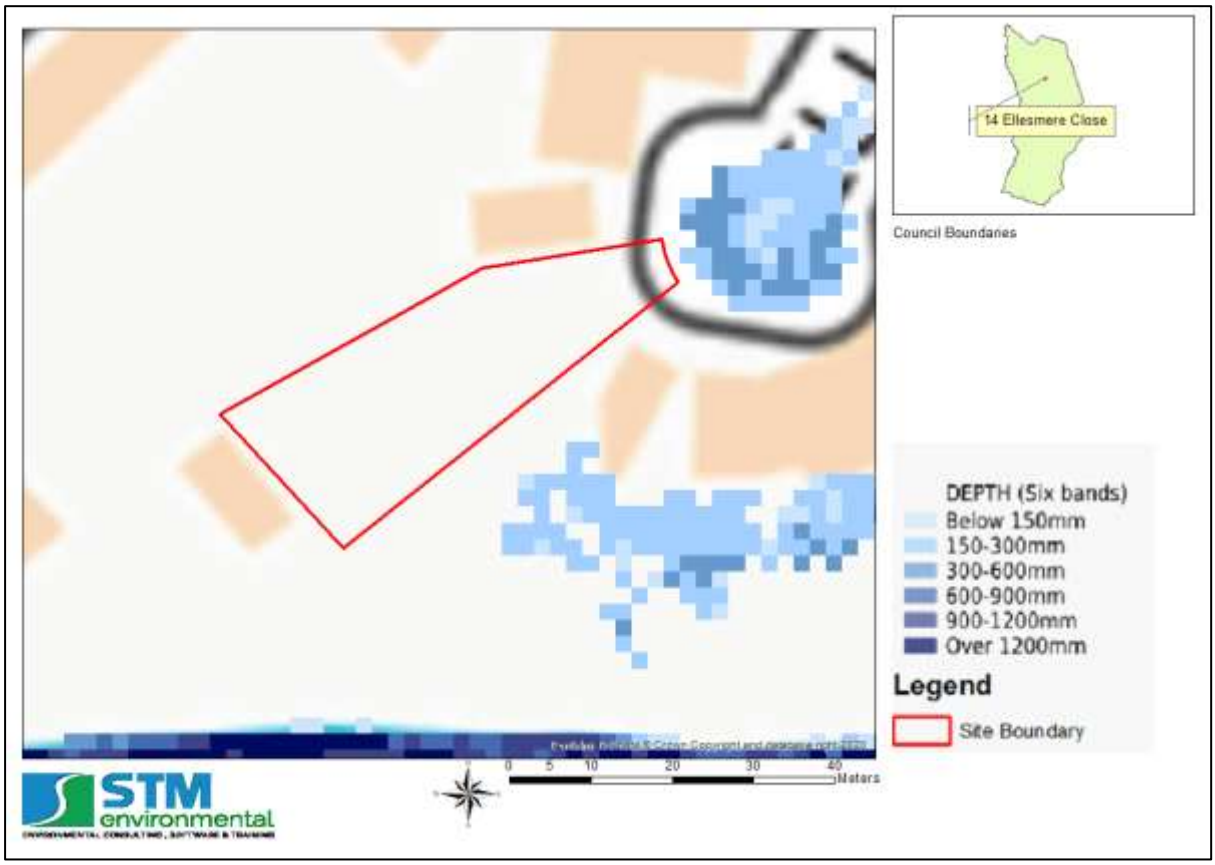


17.6 Appendix 6 – Surface Water Flood Extent and Depth Maps

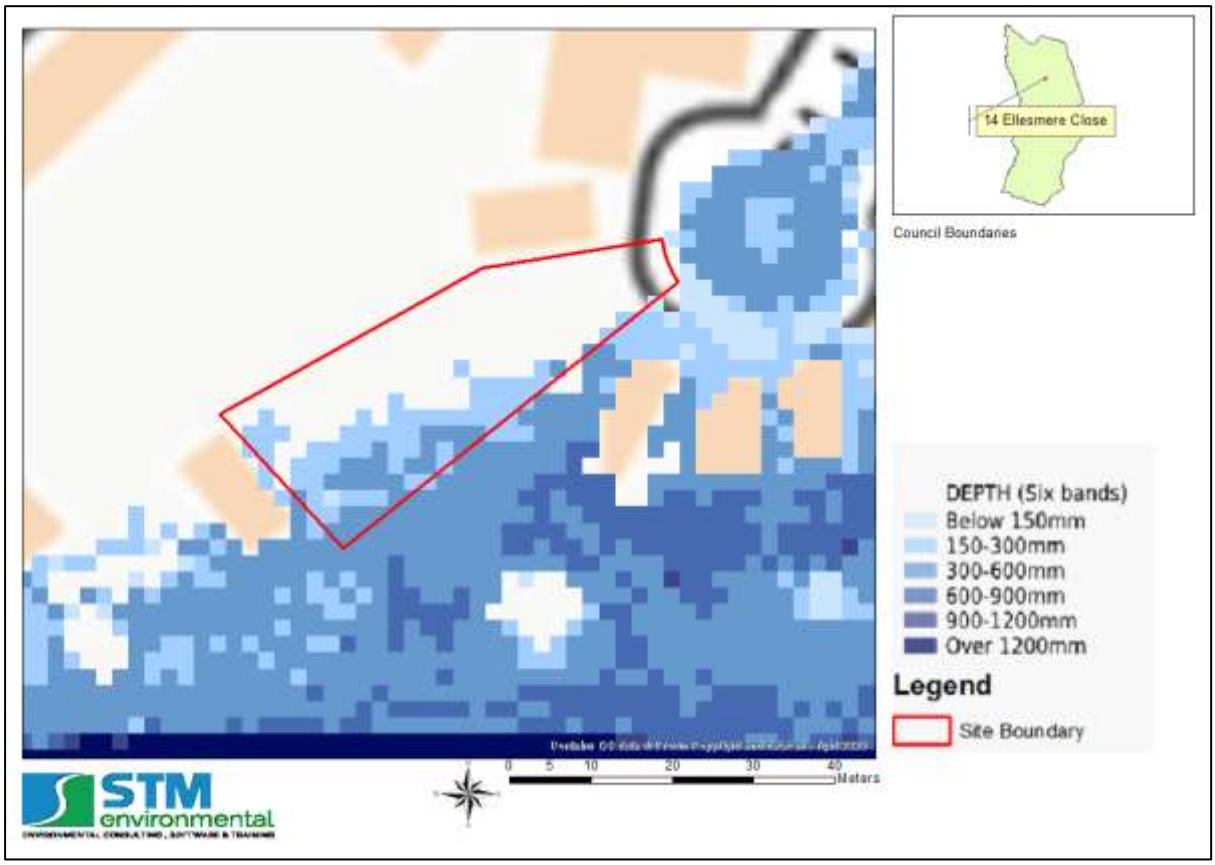
17.6.1 Map showing surface water flood extents for the 1 in 30-year, 1 in 100-year and the 1 in 1000-year rainfall return period (Source: EA, 2016).



17.6.2 Predicted surface water flood depth for the 1 in 100-year return period (Source: EA, 2016).



17.6.3 Predicted surface water flood depth for the 1 in 1000-year return period (Source: EA, 2016).

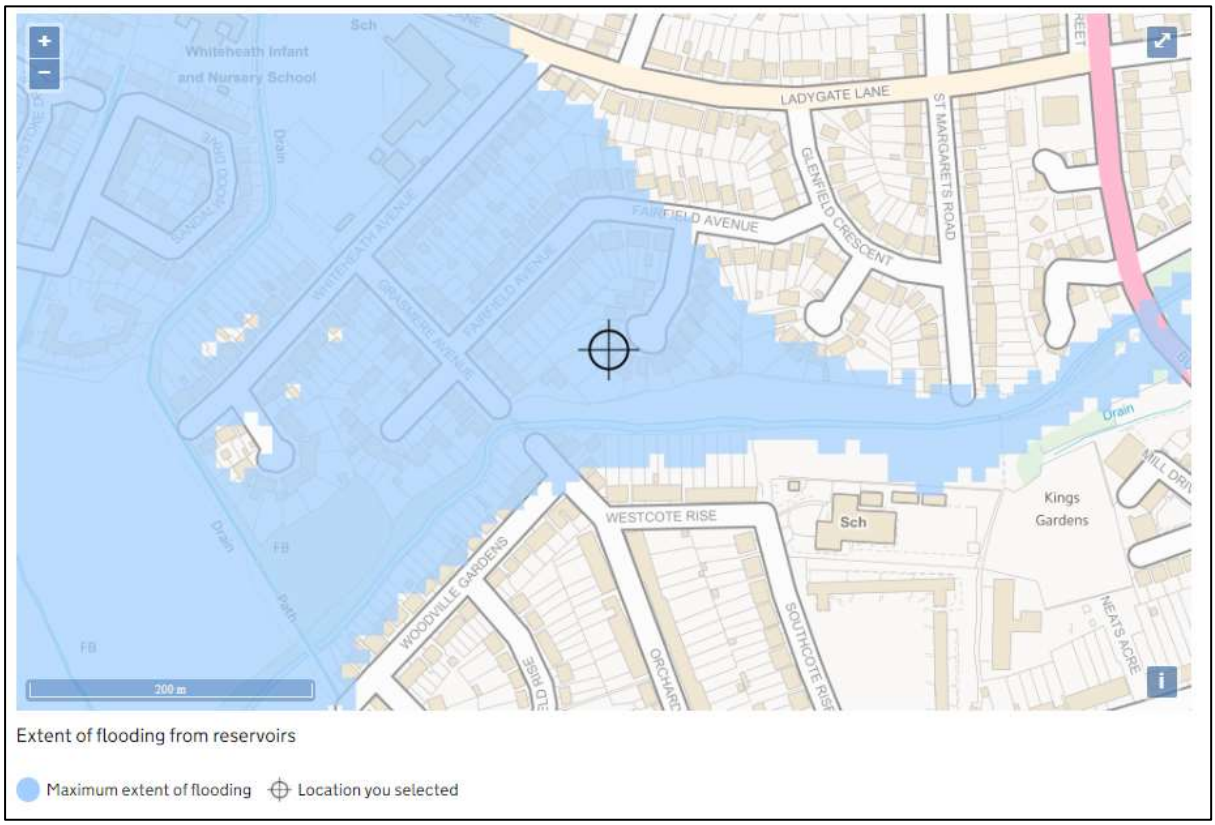


17.7 Appendix 7 –Flood Defence and Reservoir Flood Risk Maps

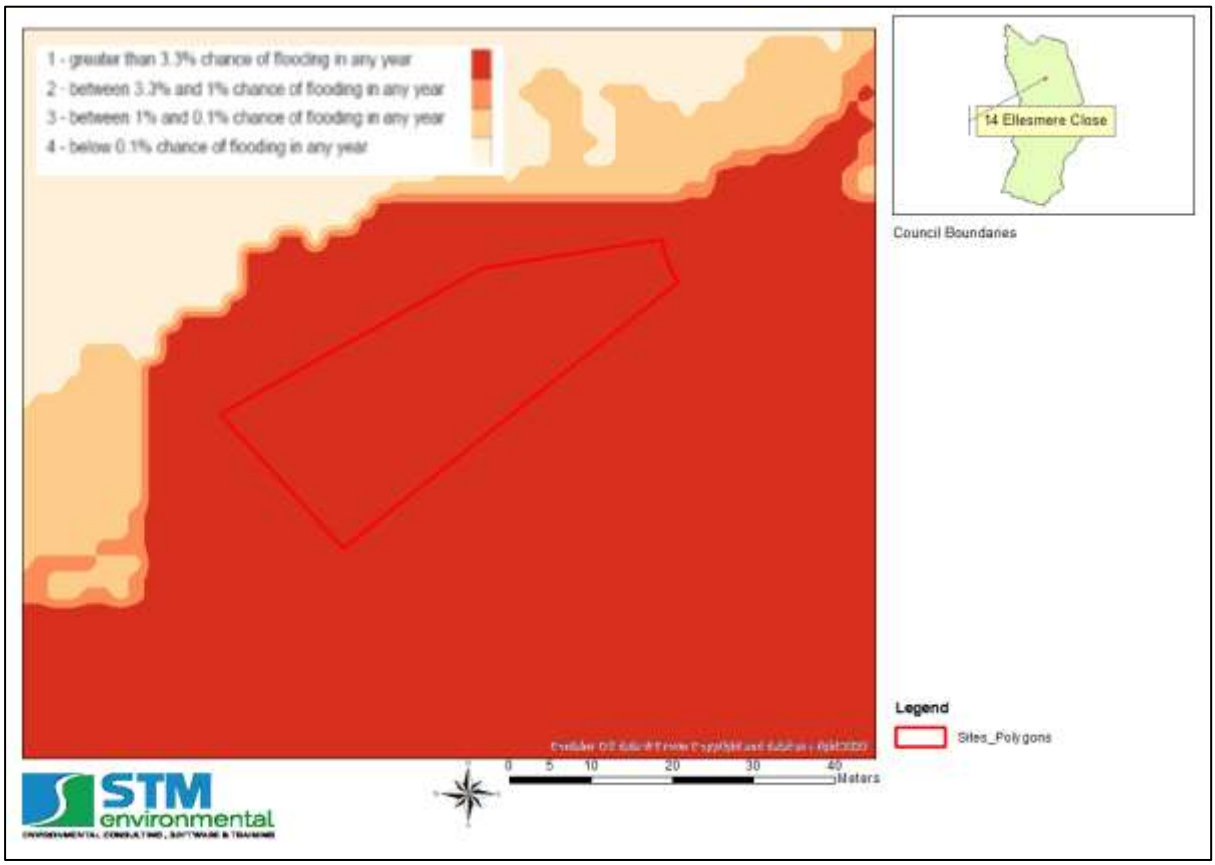
17.7.1 EA Map showing areas benefitting from flood defences

None.

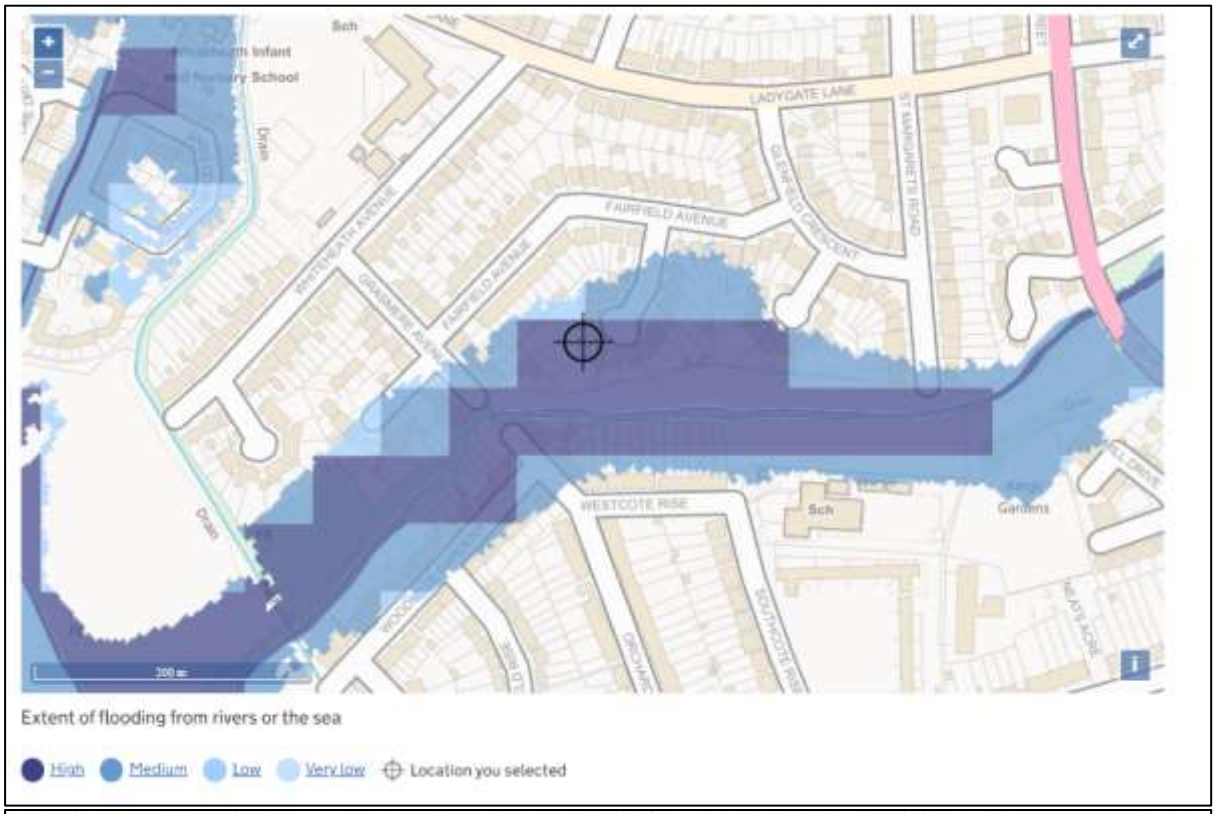
17.7.2 Reservoir Flood Risk Map



17.8 Appendix 8 – Risk of Flooding from Multiple Sources Map

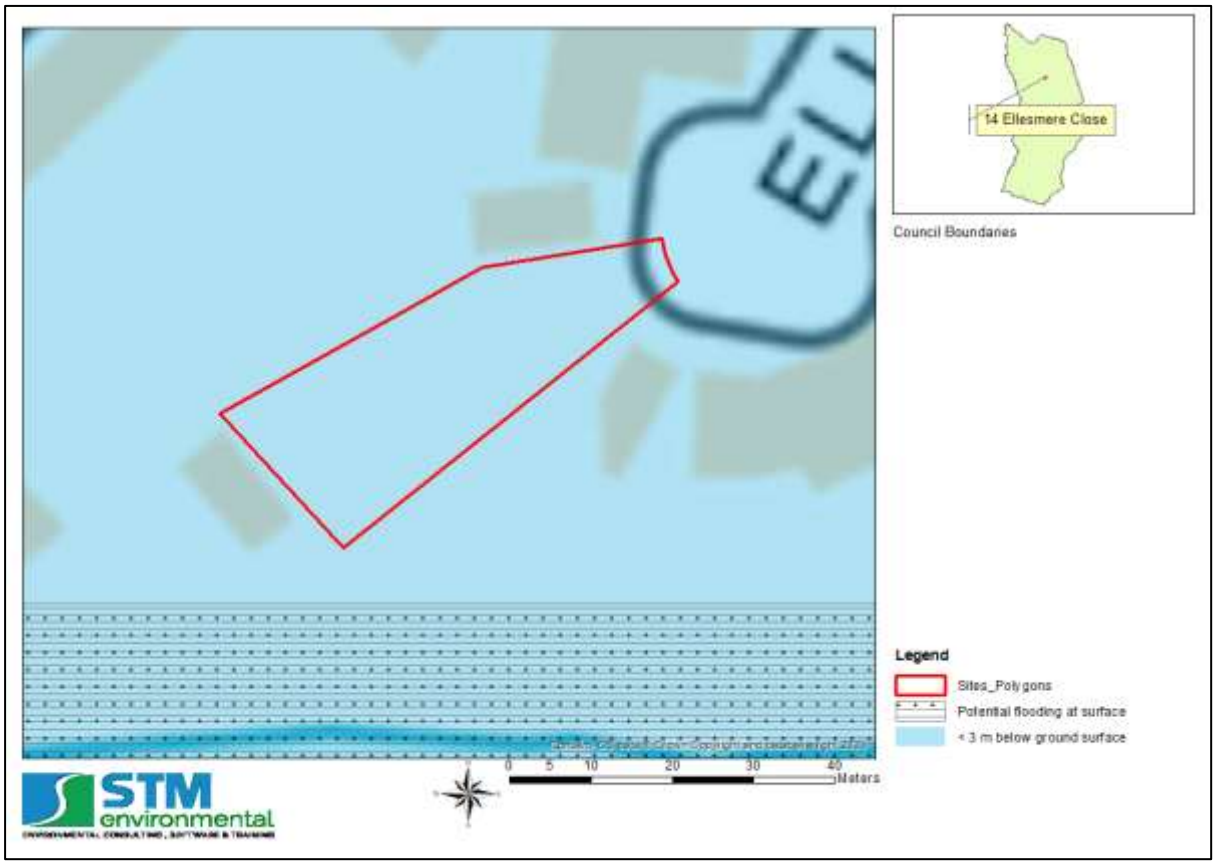


17.9 Appendix 9 - Long Term Flood Risk Maps



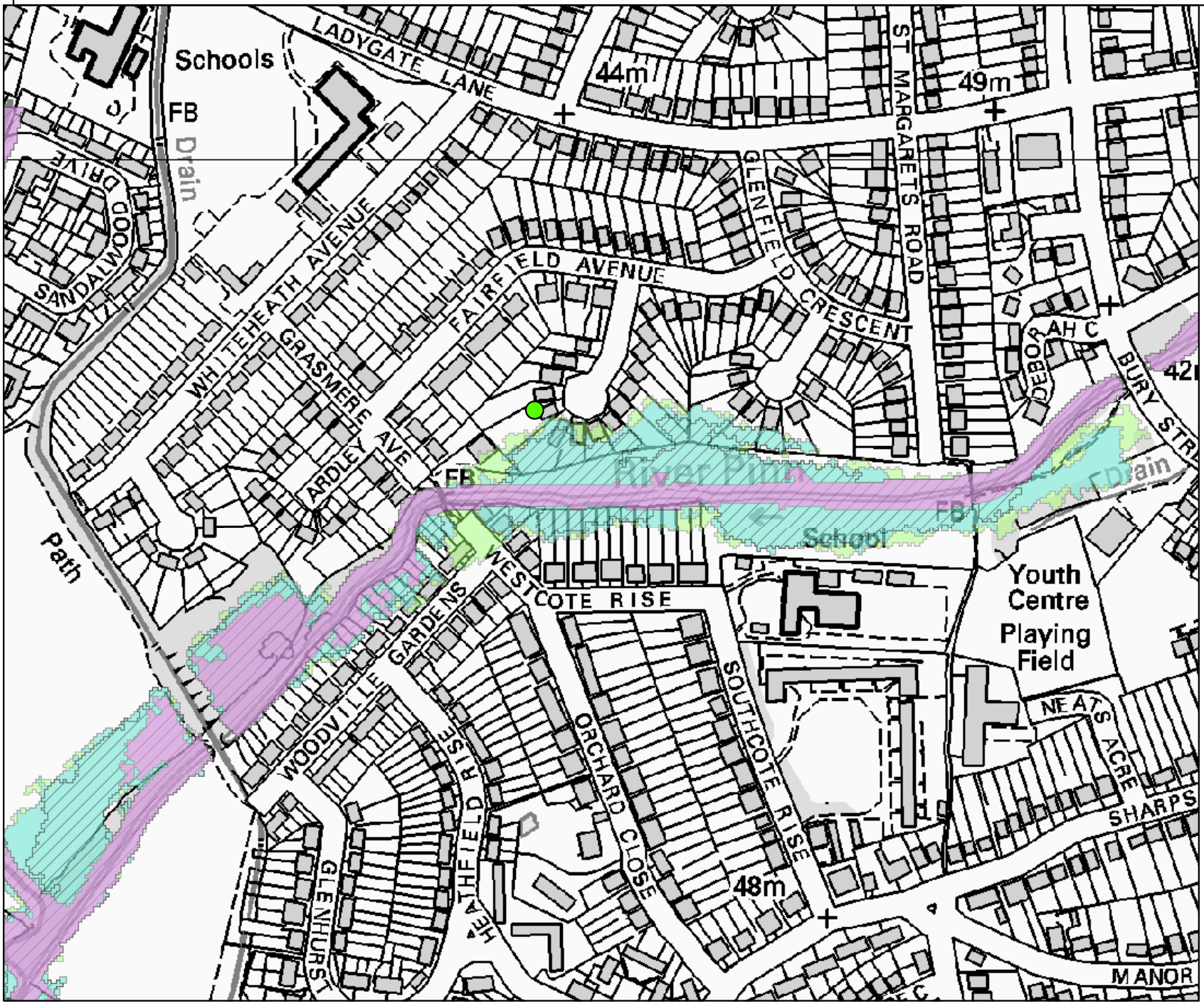
17.10 Appendix 10 – Groundwater Flood Maps

17.10.1 Groundwater Flooding (Susceptibility) Map (BGS)



17.11 Appendix 11 - EA Product 4 (Detailed Flood Risk) Data

Detailed FRA centred on:14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



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

N

0 50 100 200
Metres

Legend

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

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

Detailed FRA centred on:14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH

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

N

0 50 100 200
Metres

Legend

Site location

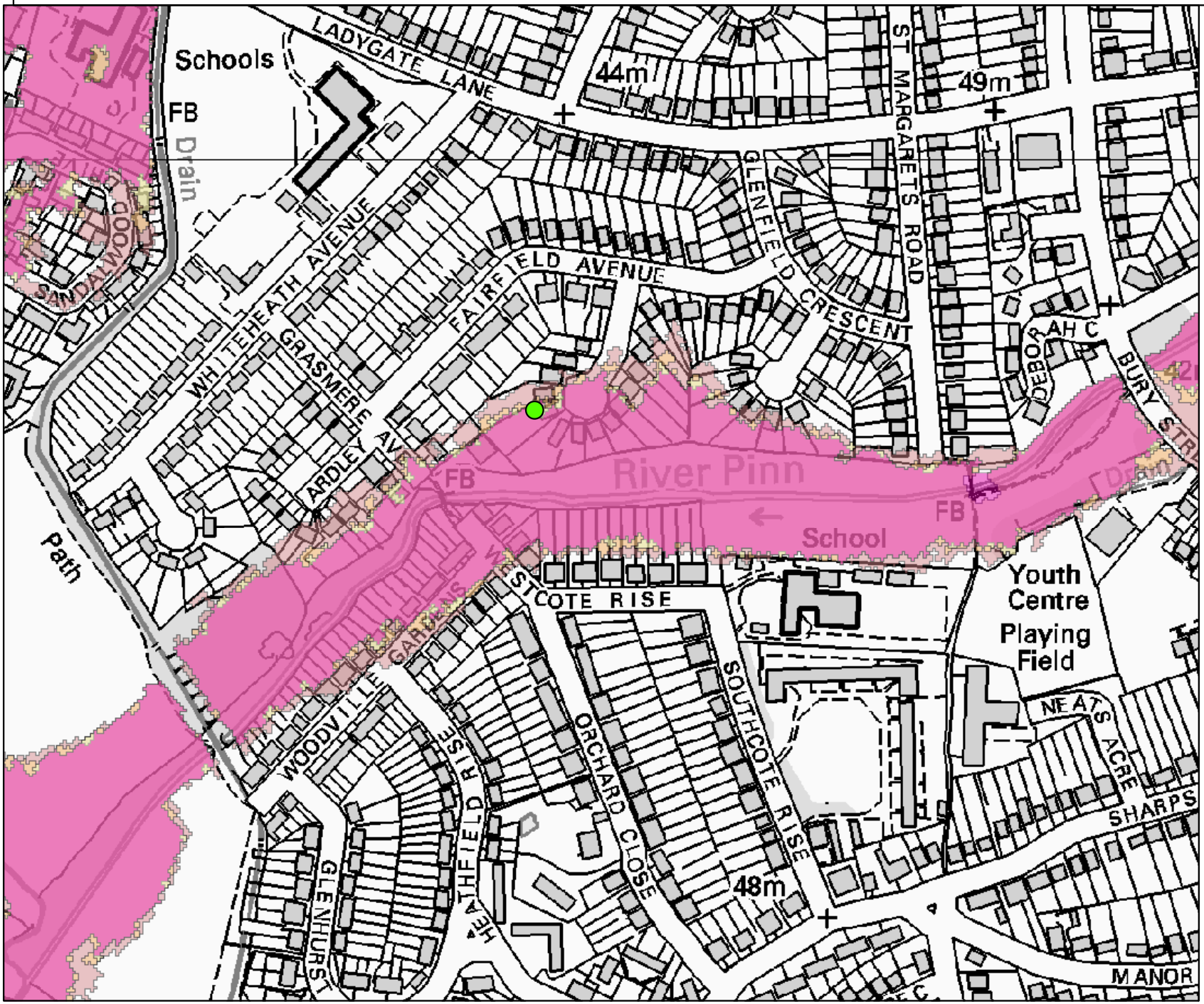
Defended Flood Outlines

- 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

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

Detailed FRA centred on:14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



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

N

0 50 100 200
Metres

Legend

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

Produced by:
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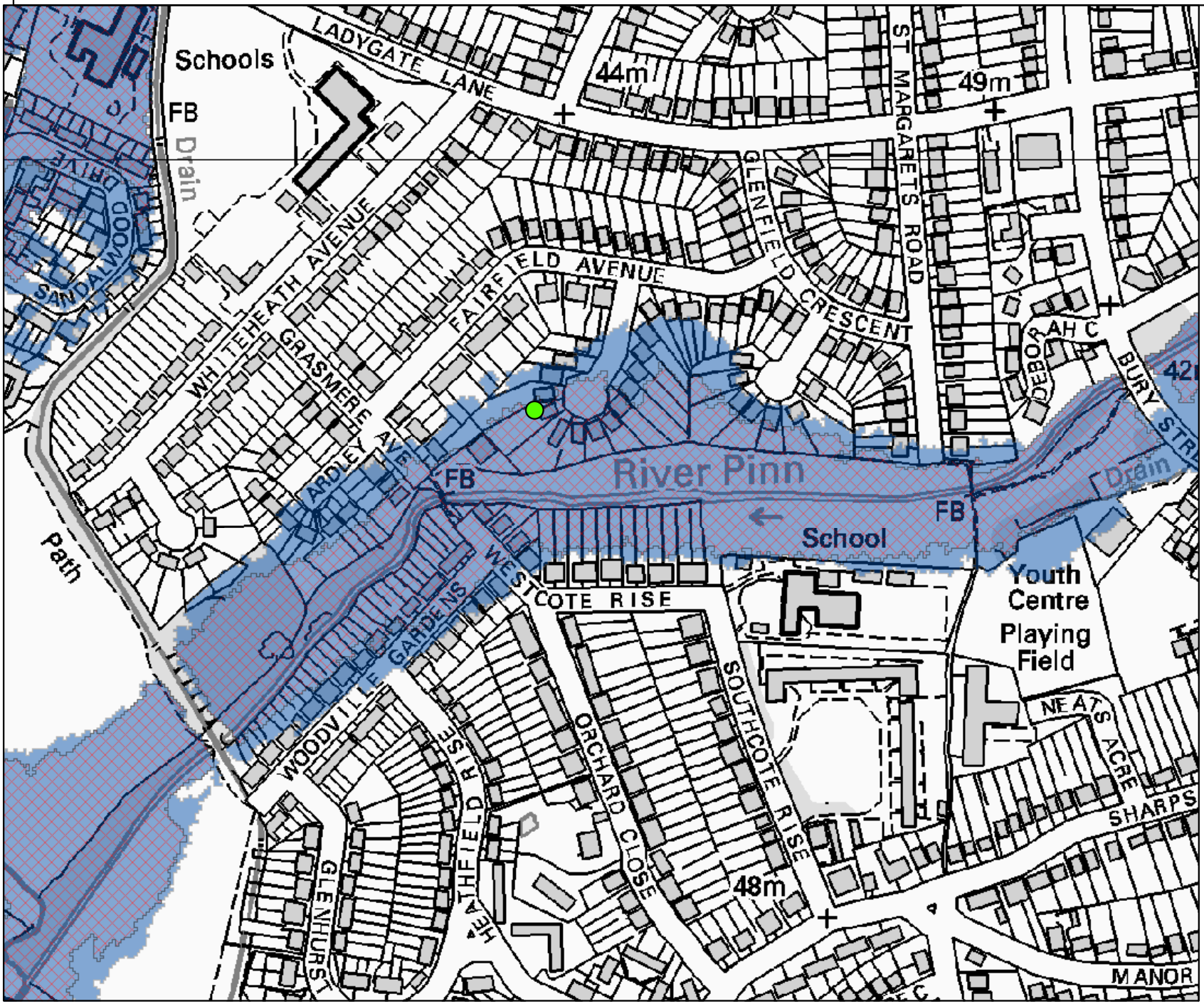
Detailed FRA centred on:14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



Environment Agency

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

N

0 50 100 200
Metres

Legend

Site location

Defended Flood Outlines

1 in 250 year (0.4%) Defended

1 in 1000 year (0.1%) Defended

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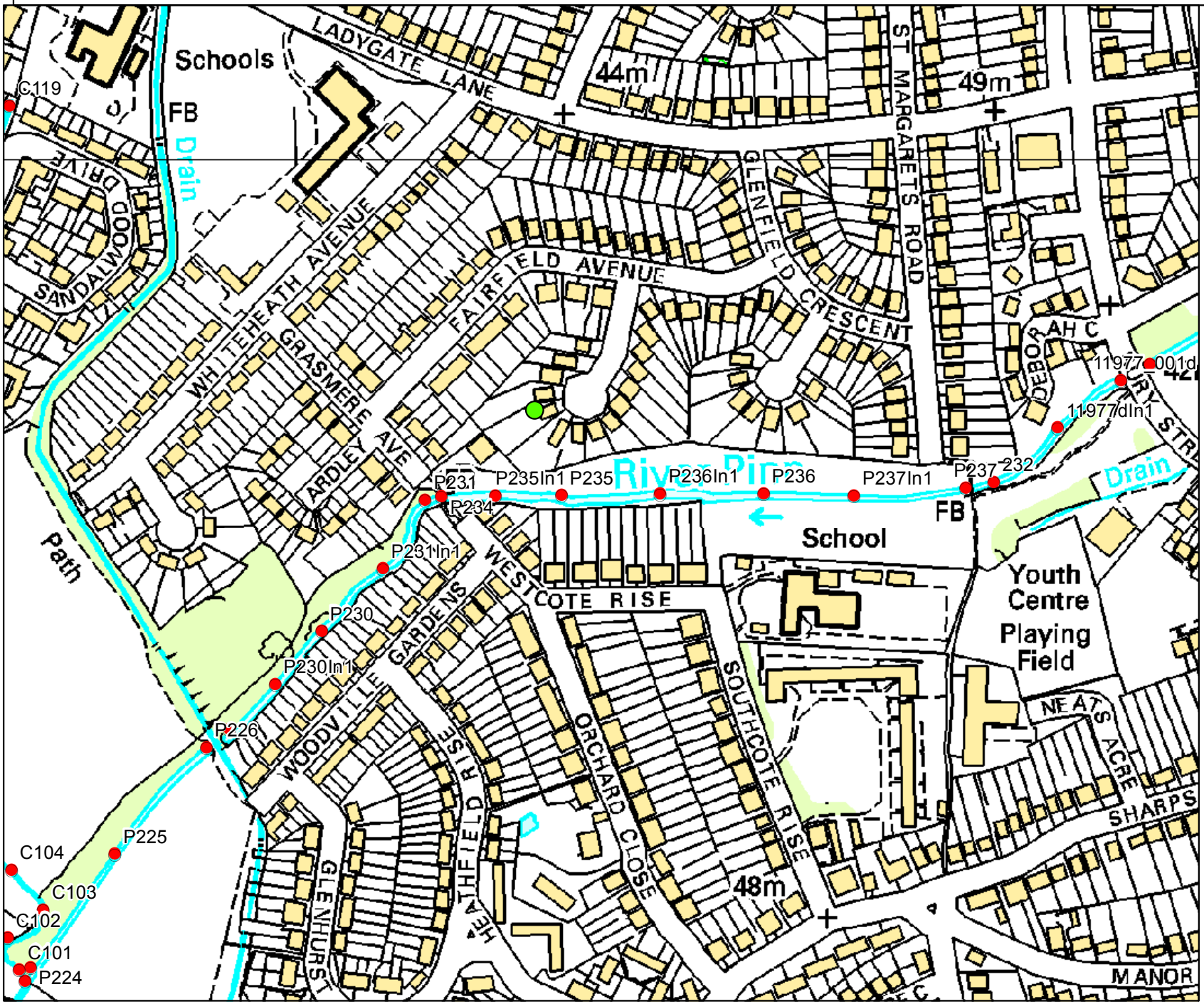

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Hertfordshire,
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N

0 50 100 200

Metres

Legend

Site location

1D Node Results

Nodes

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Environment Agency ref: HNL208726HH

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

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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
11977_001u	508794	187866	40.13	40.28	40.36	40.41	40.44	40.49	40.52	40.55	40.62	40.64	40.69	40.92	40.67	41.17
11977_001d	508775	187855	40.13	40.28	40.36	40.41	40.44	40.48	40.51	40.54	40.61	40.63	40.67	40.86	40.65	41.11
11977dln1	508734	187824	39.97	40.16	40.24	40.30	40.33	40.39	40.43	40.47	40.56	40.58	40.64	40.85	40.61	41.09
232	508692	187789	39.91	40.11	40.21	40.28	40.31	40.37	40.42	40.46	40.56	40.58	40.64	40.86	40.61	41.11
P237	508674	187785	39.86	40.06	40.15	40.22	40.26	40.33	40.37	40.41	40.52	40.55	40.61	40.83	40.58	41.09
P237ln1	508601	187780	39.82	40.01	40.11	40.18	40.21	40.27	40.32	40.36	40.47	40.50	40.56	40.80	40.53	41.07
P236	508542	187782	39.78	39.97	40.07	40.15	40.18	40.25	40.30	40.34	40.46	40.48	40.55	40.79	40.52	41.06
P236ln1	508475	187781	39.74	39.94	40.04	40.12	40.15	40.22	40.28	40.32	40.43	40.46	40.53	40.78	40.50	41.05
P235	508411	187781	39.69	39.90	40.02	40.10	40.14	40.21	40.26	40.31	40.43	40.45	40.52	40.77	40.49	41.05
P235ln1	508368	187780	39.64	39.86	39.97	40.05	40.09	40.17	40.23	40.27	40.40	40.43	40.50	40.75	40.46	41.02
P234	508332	187780	39.60	39.80	39.92	40.00	40.04	40.12	40.18	40.24	40.38	40.41	40.49	40.76	40.45	41.04
P231	508322	187778	39.59	39.80	39.91	39.99	40.03	40.11	40.16	40.21	40.35	40.39	40.47	40.74	40.43	41.04
P231ln1	508294	187733	39.55	39.75	39.87	39.95	39.98	40.06	40.12	40.16	40.30	40.34	40.42	40.72	40.38	41.02
P230	508254	187692	39.51	39.71	39.83	39.92	39.95	40.04	40.10	40.14	40.28	40.32	40.41	40.70	40.36	41.01
P230ln1	508224	187658	39.47	39.69	39.81	39.90	39.94	40.03	40.09	40.14	40.28	40.32	40.41	40.70	40.36	41.01
P229	508195	187628	39.42	39.63	39.74	39.82	39.85	39.94	39.99	40.04	40.18	40.21	40.30	40.59	40.25	40.89
P226	508179	187616	39.34	39.51	39.59	39.64	39.66	39.70	39.72	39.75	39.80	39.81	39.84	39.93	39.83	40.01
P225	508120	187547	39.27	39.42	39.50	39.55	39.57	39.61	39.64	39.66	39.72	39.73	39.76	39.87	39.75	39.97
P224	508065	187473	39.21	39.36	39.43	39.48	39.51	39.55	39.57	39.59	39.65	39.66	39.69	39.82	39.68	39.93
P224a	508061	187464	39.21	39.36	39.43	39.48	39.51	39.55	39.57	39.59	39.65	39.66	39.69	39.82	39.68	39.93
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
C104	508052	187537	39.25	39.39	39.47	39.52	39.54	39.59	39.61	39.64	39.69	39.71	39.74	39.85	39.72	39.95
C103	508073	187511	39.24	39.38	39.46	39.51	39.53	39.57	39.60	39.62	39.68	39.69	39.72	39.84	39.71	39.95
C101	508057	187472	39.21	39.36	39.43	39.48	39.51	39.55	39.57	39.59	39.65	39.66	39.69	39.82	39.68	39.93

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
11977_001u	508794	187866	5.22	7.04	8.26	9.26	9.87	10.95	11.79	12.55	14.49	15.00	16.20	19.94	15.75	23.06
11977_001d	508775	187855	5.22	7.04	8.26	9.26	9.87	10.95	11.79	12.55	14.49	15.00	16.20	19.94	15.75	23.06
11977dln1	508734	187824	5.21	5.84	6.13	6.41	6.50	6.76	6.95	7.10	7.39	7.43	7.48	10.55	7.46	15.80
232	508692	187789	5.21	5.83	6.06	6.14	6.16	6.17	6.17	6.18	6.17	6.17	6.16	6.16	6.16	6.16
P237	508674	187785	5.21	5.83	6.06	6.14	6.16	6.17	6.17	6.18	6.17	6.17	6.16	6.16	6.16	6.16
P237ln1	508601	187780	5.29	6.84	7.57	8.08	8.32	8.75	9.03	9.24	9.67	9.75	9.94	10.41	9.91	10.81
P236	508542	187782	5.29	6.72	7.18	7.52	7.66	7.92	8.05	8.15	8.45	8.53	8.74	9.28	8.70	9.77
P236ln1	508475	187781	5.36	6.80	7.57	8.05	8.30	8.77	8.99	9.17	9.62	9.70	9.91	10.45	9.86	11.00
P235	508411	187781	5.36	7.02	7.48	7.60	7.64	7.79	8.04	8.25	8.75	8.85	9.06	9.66	8.99	10.06
P235ln1	508368	187780	5.36	7.12	8.39	9.32	9.63	10.03	10.22	10.35	10.80	10.96	11.40	13.16	11.19	15.05
P234	508332	187780	5.36	7.12	8.40	9.48	9.94	10.66	11.01	11.13	11.21	11.21	11.22	11.31	11.22	11.37
P231	508322	187778	5.36	7.12	8.40	9.48	9.94	10.66	11.01	11.13	11.21	11.21	11.22	11.31	11.22	11.37
P231ln1	508294	187733	5.35	7.05	8.12	9.05	9.48	10.43	11.11	11.66	12.76	12.82	12.99	13.12	12.96	13.08
P230	508254	187692	5.35	6.85	7.78	8.30	8.62	9.11	9.50	9.91	10.93	11.09	11.47	12.09	11.28	12.26
P230ln1	508224	187658	5.16	5.94	6.28	6.52	6.69	6.98	7.20	7.41	7.93	8.03	8.25	8.65	8.15	8.75
P229	508195	187628	5.35	7.10	8.39	9.52	10.06	11.22	12.08	12.81	14.82	15.33	16.51	20.27	15.93	23.85
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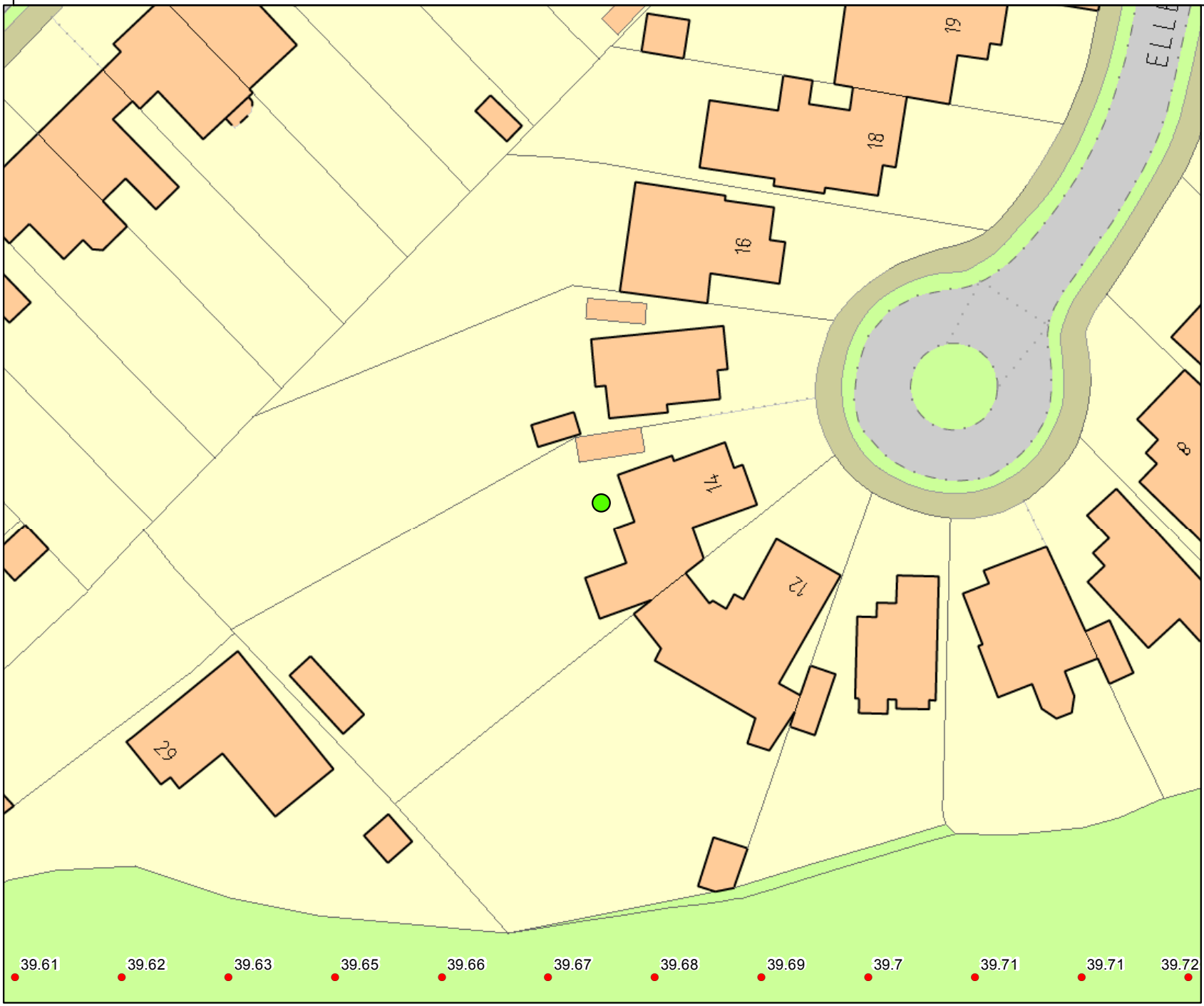
P224	508065	187473	4.14	5.22	5.80	6.30	6.50	7.02	7.43	7.82	8.65	8.85	9.24	9.84	9.03	10.42
P224a	508061	187464	5.87	7.63	8.41	8.94	9.13	9.68	10.17	10.72	11.83	12.05	12.53	13.19	12.26	13.85
C119	508051	188034	0.59	0.71	0.80	0.89	0.94	1.02	1.07	1.11	1.25	1.29	1.36	1.75	1.35	1.95
C104	508052	187537	0.64	0.78	0.90	1.01	1.07	1.18	1.40	1.71	2.13	2.22	2.36	2.62	2.37	2.89
C103	508073	187511	1.07	1.34	1.56	1.71	1.82	2.05	2.25	2.44	2.78	2.84	2.94	3.18	2.93	3.29
C101	508057	187472	1.73	2.42	2.63	2.66	2.66	2.68	2.74	2.89	3.19	3.23	3.30	3.48	3.24	3.56

Detailed FRA centred on:14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



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

N

0 5 10 20
Metres

Legend

Site location

2D Node Results: Heights

1 in 2 year (50%) Defended

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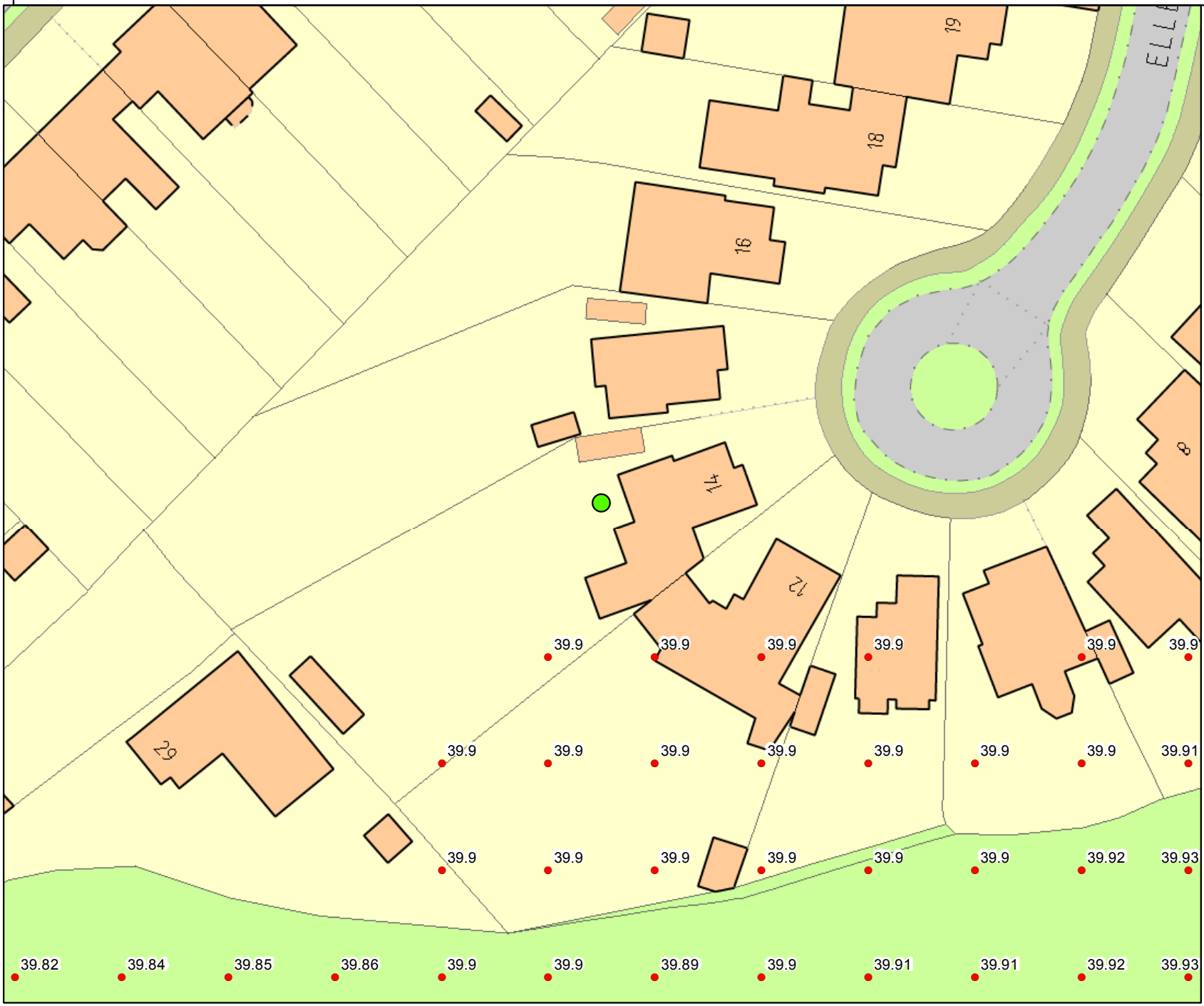
Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA centred on:14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



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

N

0 5 10 20
Metres

Legend

Site location

2D Node Results: Heights

1 in 5 year (20%) Defended

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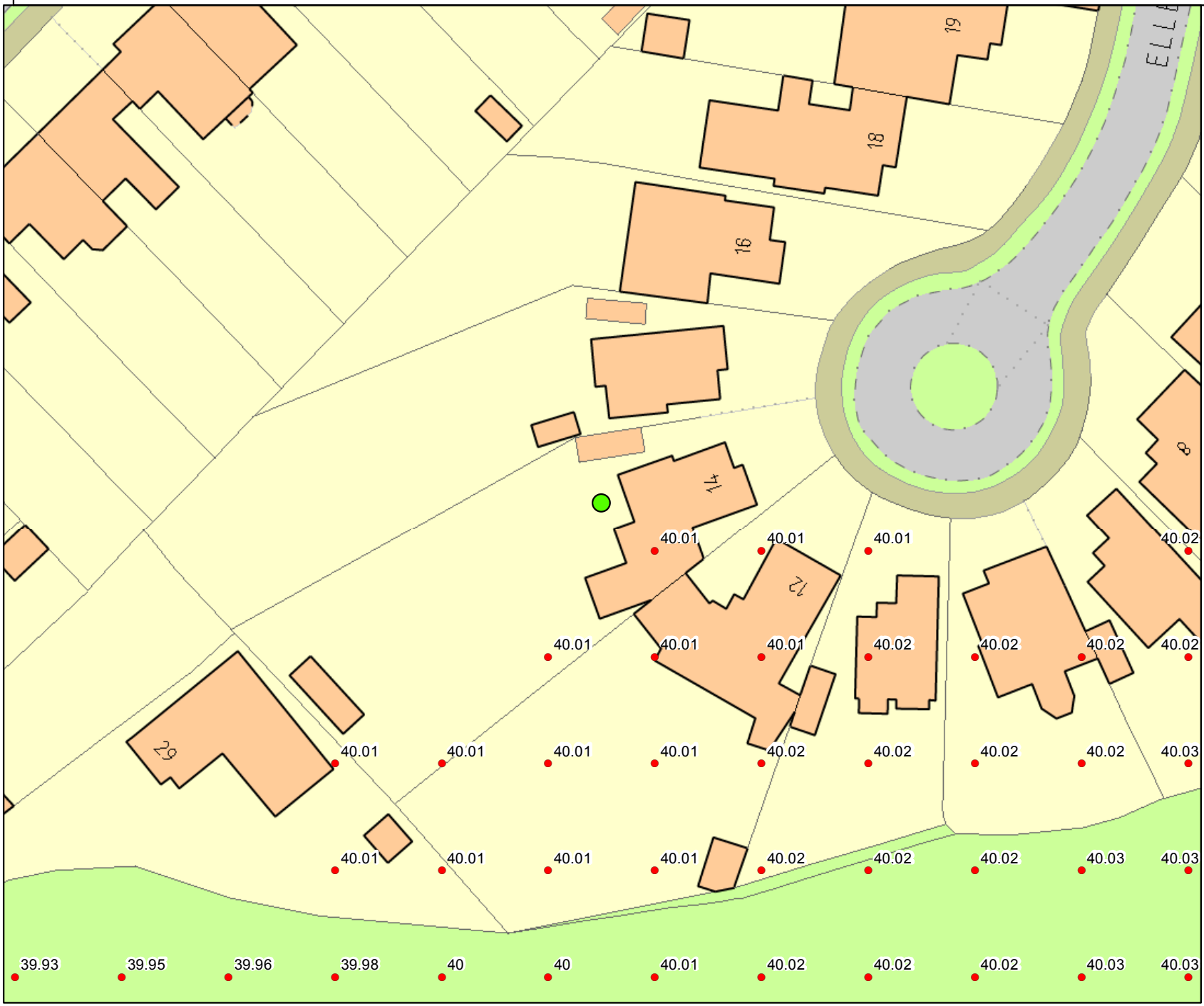

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AL7 1HE

N

0 5 10 20
Metres

Legend

Site location

2D Node Results: Heights

1 in 10 year (10%) Defended

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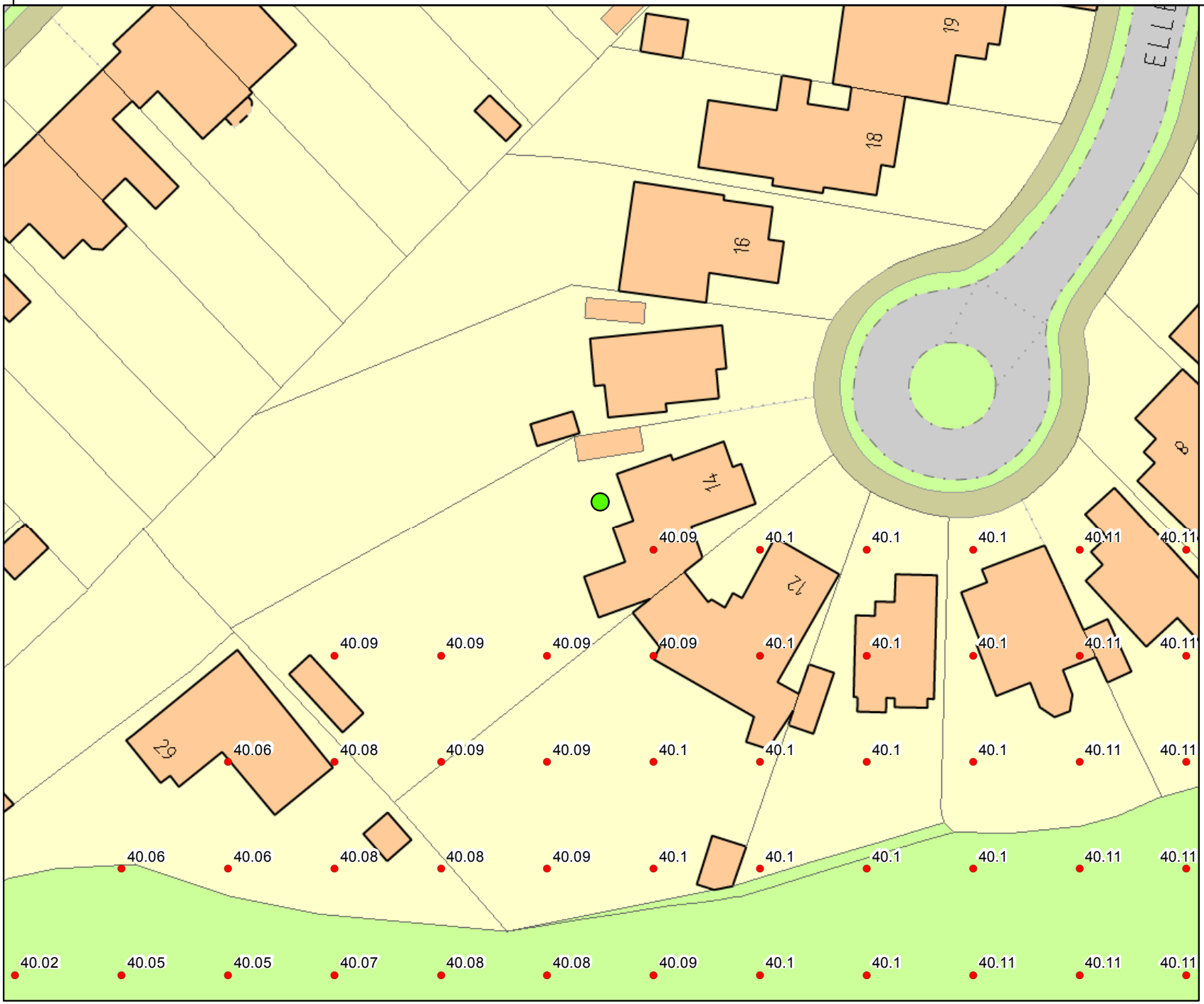

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Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 5 10 20
Metres

Legend

Site location

2D Node Results: Heights

1 in 20 year (5%) Defended

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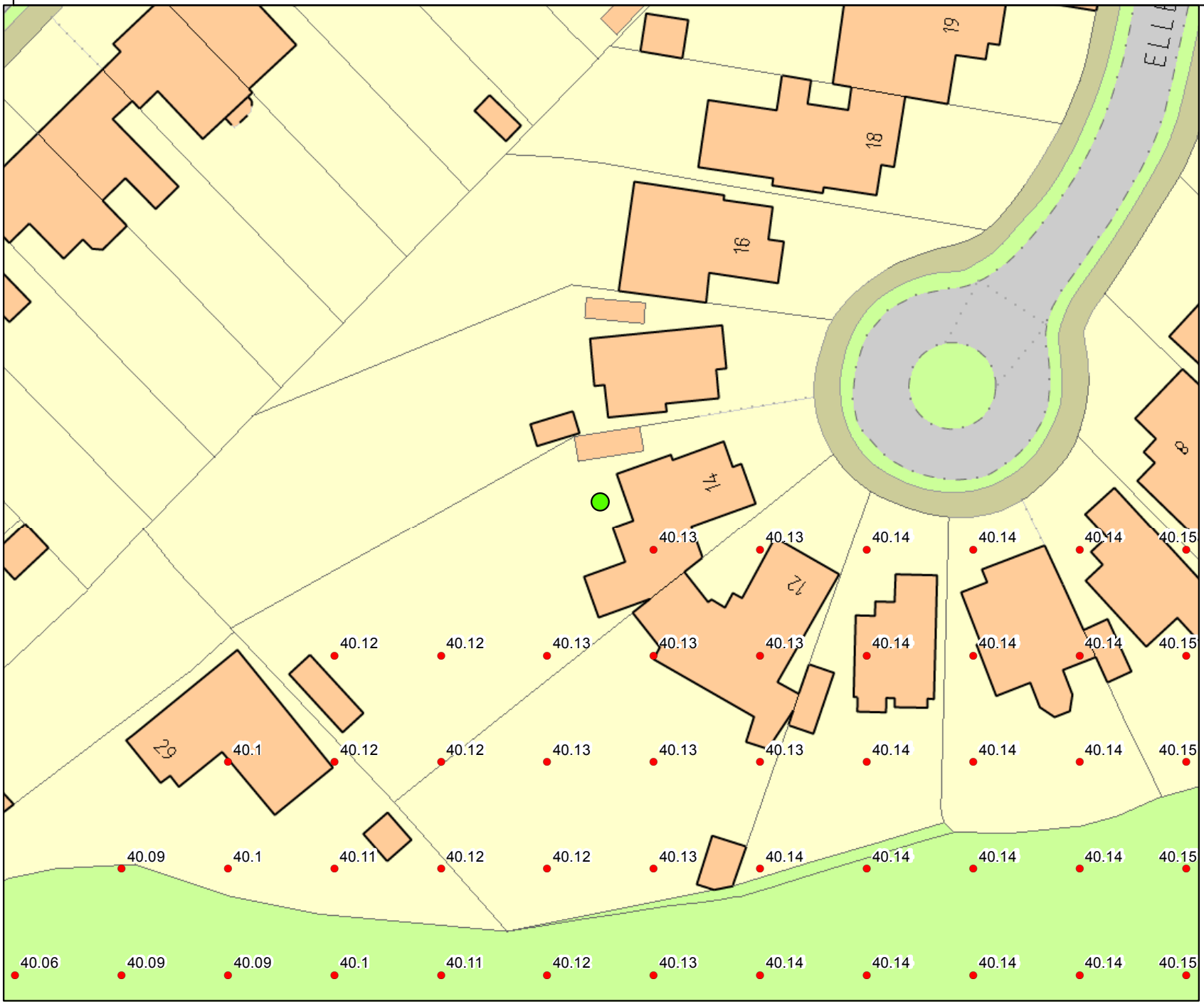

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Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
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N

0 5 10 20

Metres

Legend

Site location

2D Node Results: Heights

1 in 30 year (3.33%) Defended

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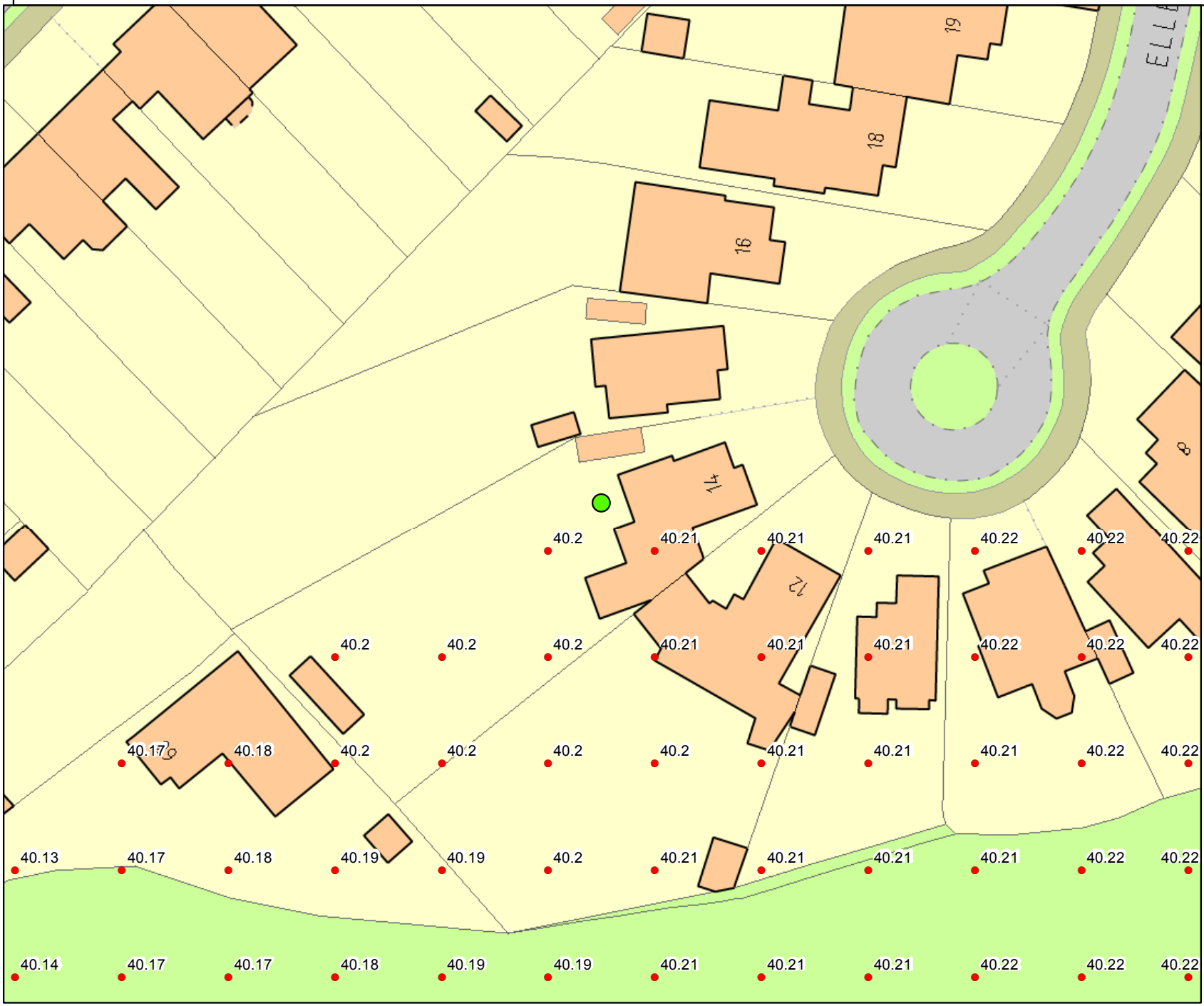

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Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 5 10 20
Metres

Legend

Site location

2D Node Results: Heights

1 in 50 year (2%) Defended

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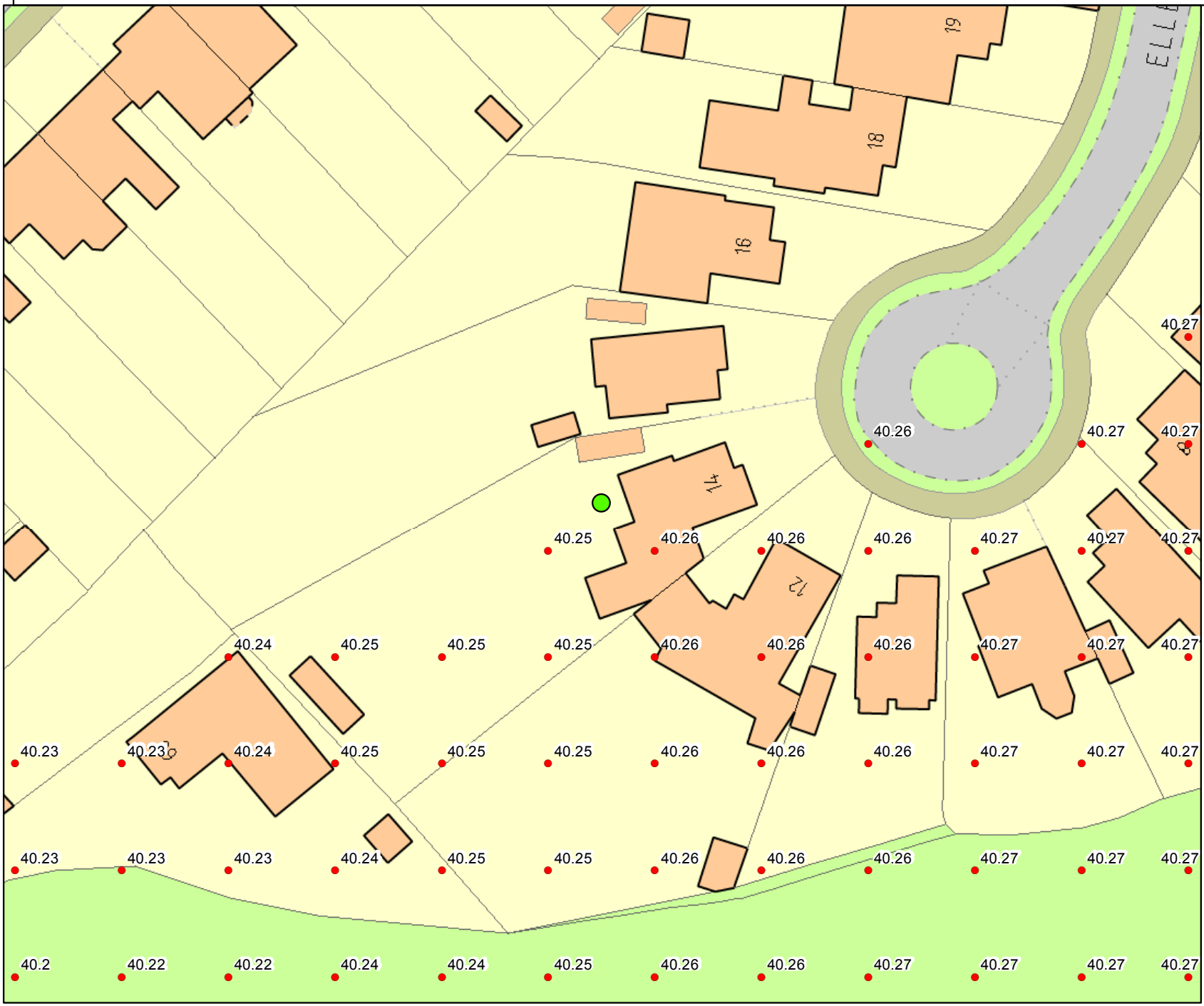

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Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 5 10 20
Metres

Legend

Site location

2D Node Results: Heights

1 in 75 year (1.33%) Defended

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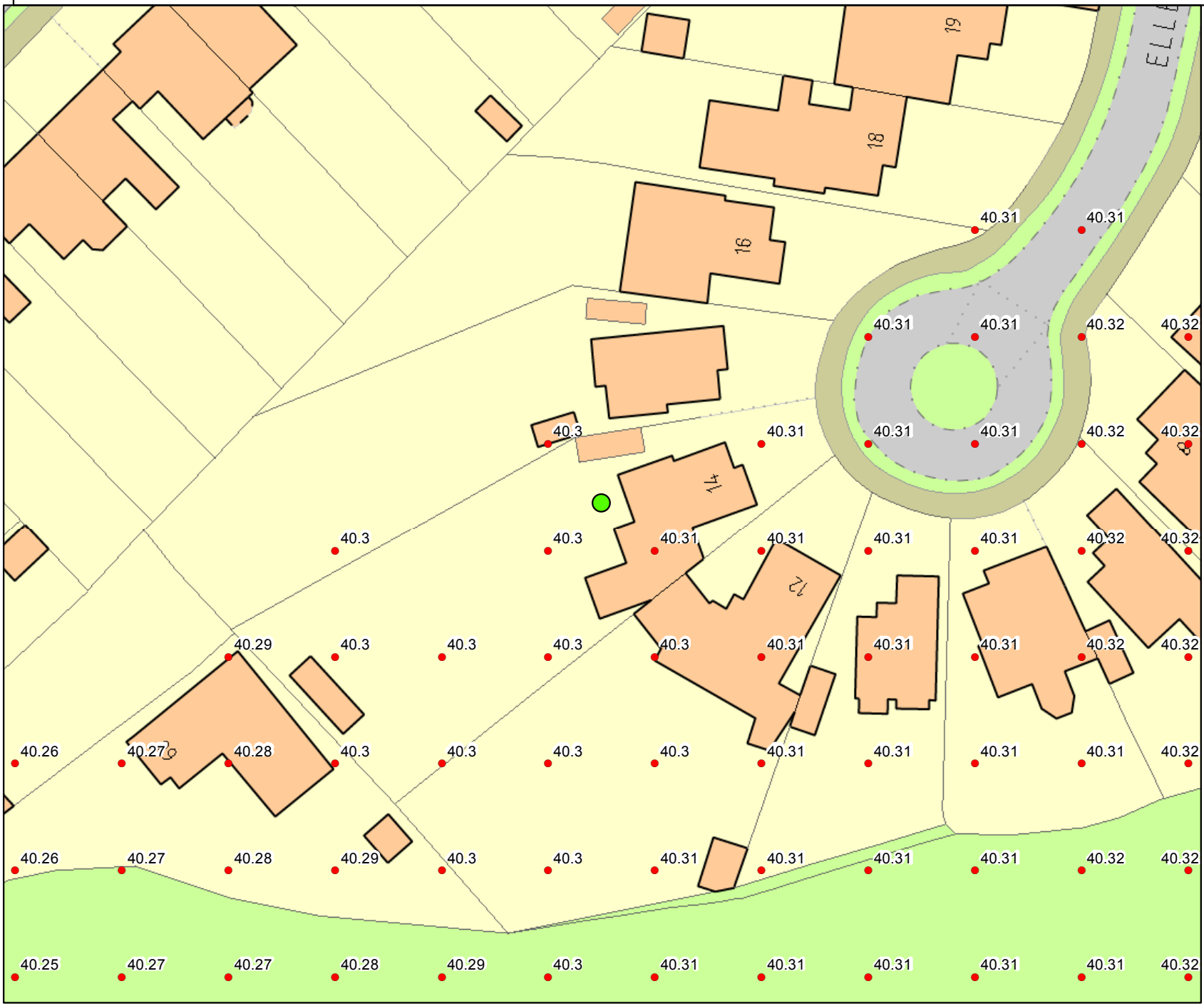
Hertfordshire & North London

Detailed FRA centred on:14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



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

N

0 5 10 20
Metres

Legend

Site location

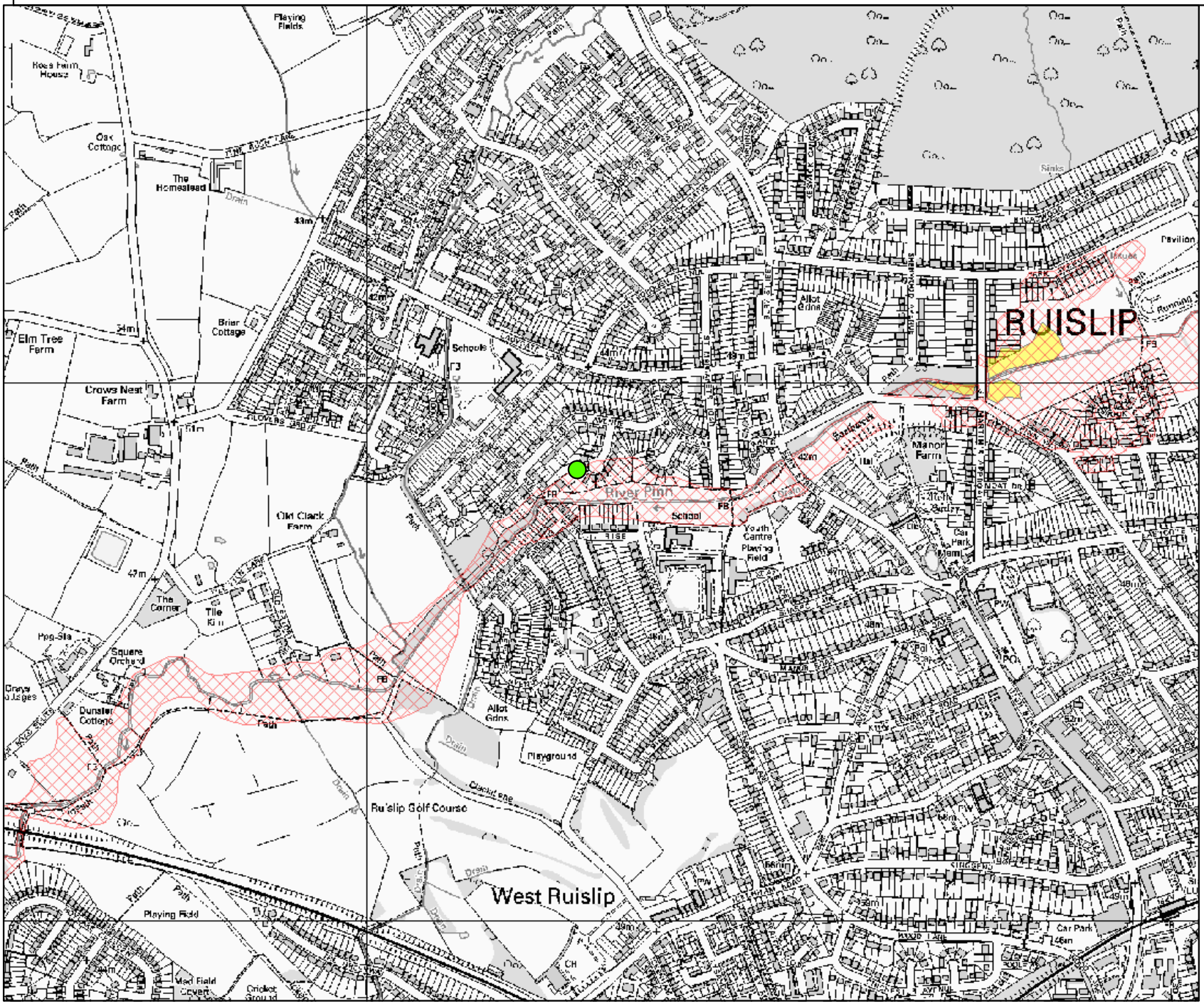
2D Node Results: Heights

1 in 100 year (1%) Defended

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

Historic Flood Map centred on: 14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



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

N

0 150 300 600
Metres

Legend

Site location

Flood Event Outlines

1977

1999

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.

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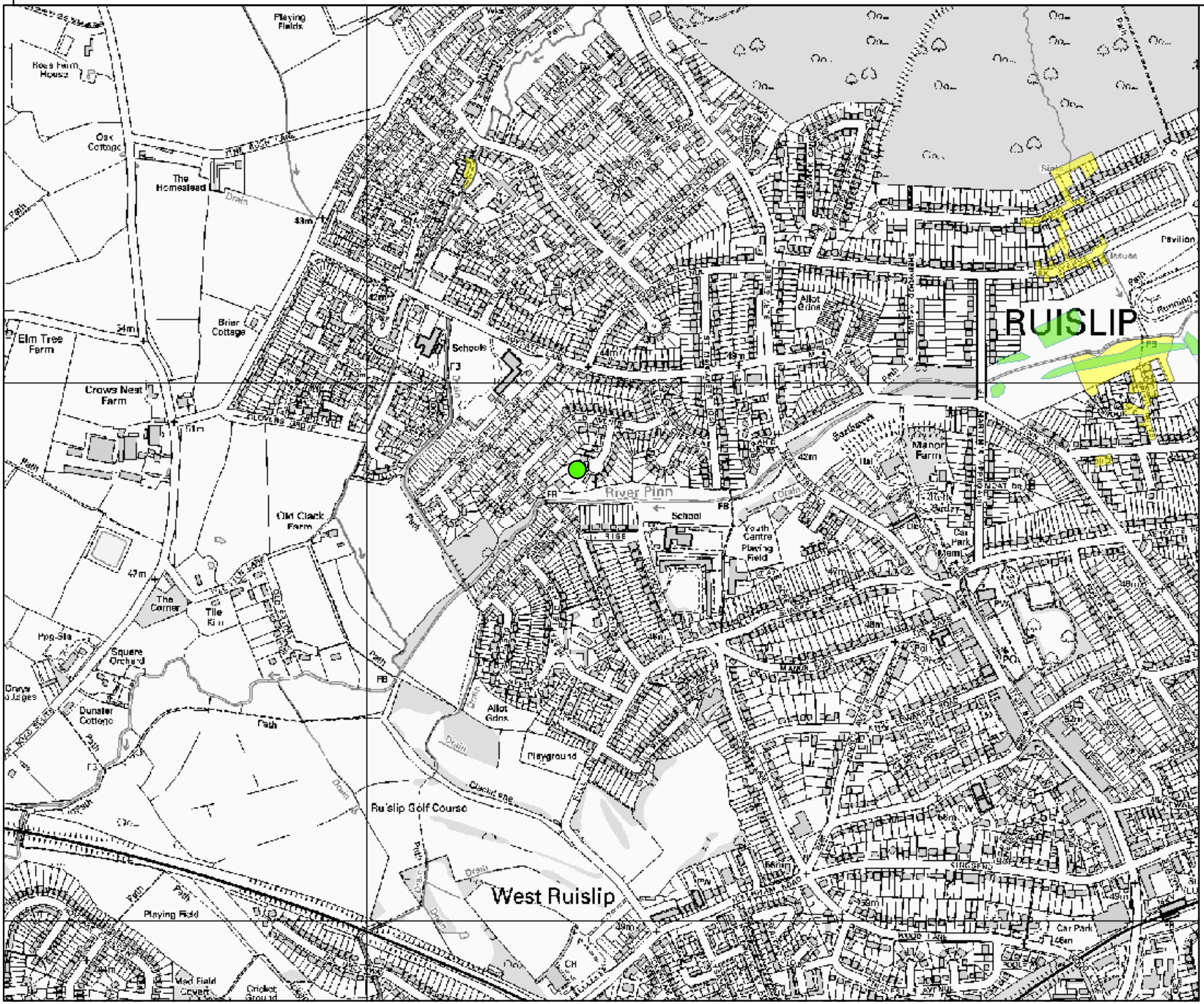
Historic Flood Map centred on: 14 Ellesmere Close Ruislip HA4 7PQ - 18/03/2021 - HNL208726HH



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Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 150 300 600

Metres

Legend

Site location

Flood Event Outlines

2009

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.

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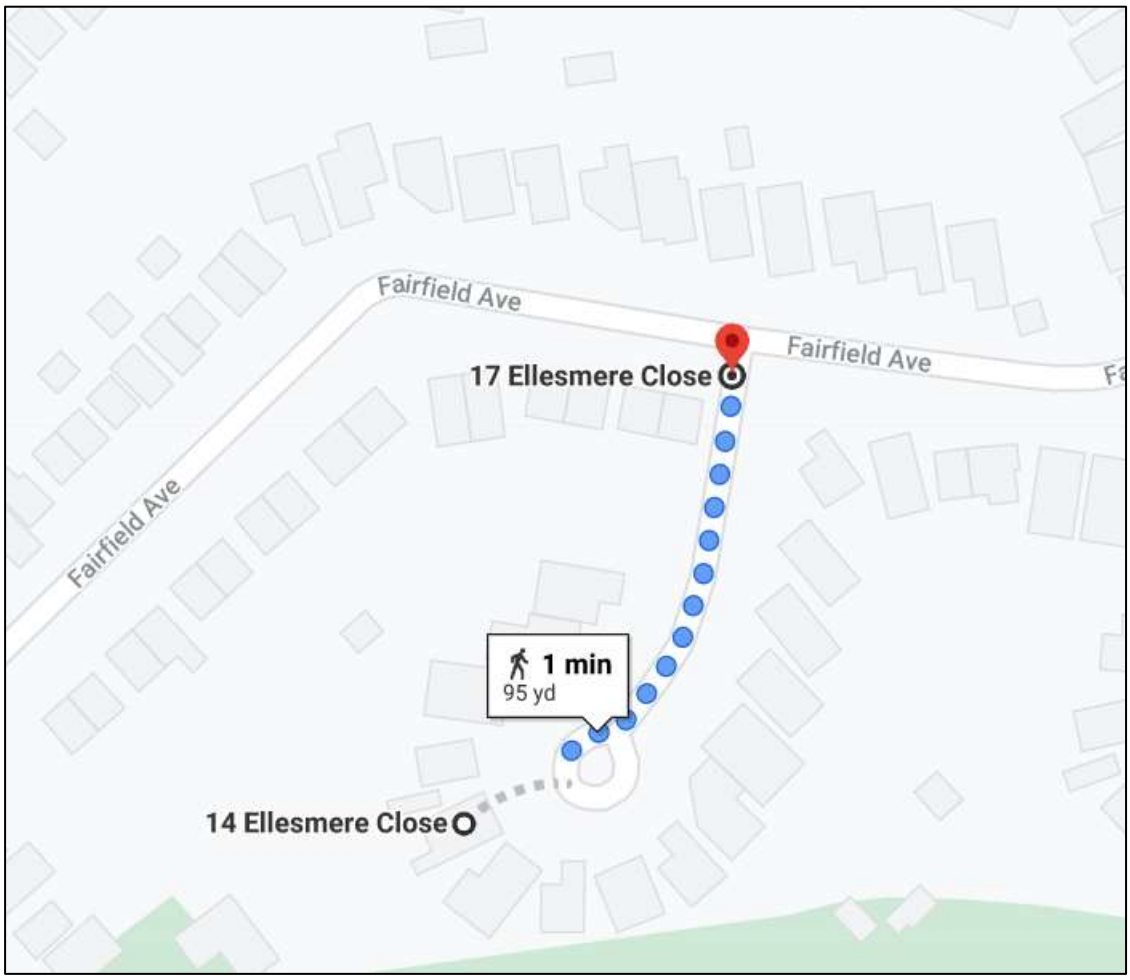
17.12 Appendix 12 – Safe Egress to Flood Zone 1 Map



17.13 Appendix 13 – Calculation of Flood Hazard Rating

Table 5: Flood Hazard Rating Scores – based on DF score of 0

Velocity	Depth									
	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 6: 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 7: 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”.