Forge Engineering Design Solutions

FLOOD RISK ASSESSMENT
MINOR EXTENSION IN FLOOD ZONES 2 & 3

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List of Abbreviations / Glossary:

Term	Definition
OCC	Oxford City Council
NPPF	National Planning Policy Framework
FRA	Flood Risk Assessment
SFRA	Strategic Flood Risk Assessment
LPA	Local Planning Authority
PPS25	Planning Policy Statement 25 'Development and Flood Risk' for England and Wales
PPG FRCC	Planning Practice Guidance Flood Risk and Climate Change
SuDS	Sustainable Drainage Systems – methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
IOH	Institute of Hydrology
SWMS	Surface Water Management Strategy
CIRIA	Construction Industry Research and Information Association
URBAN	Urbanisation factor
CIND	Catchment Index
CWI	Catchment Wetness Index
SAAR	Standard Average Annual Rainfall
NC	Rainfall Continentality Factor
QBAR	A Flood Studies Report denoting the Mean Annual Flood flow rate
QMED	The median annual maximum flood estimated from catchment descriptors
BFIHOST	Measure of level of catchment baseflow based on soil HOST class
Return Period	An estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
AEP	Annual Exceedence Probability

1. Introduction

Forge Engineering Design Solutions Ltd was commissioned by Mr Amad Hassan, to carry out a site-specific FRA to support a planning application to Oxford City Council (OCC) for a minor extension to an existing building, which is less than 250m², in compliance with the National Planning Policy Framework (NPPF). A minor extension is a household or non-domestic extension with a floor space of no more than 250 square metres.

1.1. National Planning Policy Framework

When determining planning applications, paragraphs 159-169 of the NPPF (2021) require that local planning authorities should ensure flood risk is not increased elsewhere, and only consider development appropriate in areas at risk of flooding when informed by a site-specific FRA, which is compliant with the technical guidance to the NPPF, "Planning Practice Guidance Flood Risk and Coastal Change" (PPG FRCC), following the Sequential Test, and if required the Exception Test. More specifically, the site-specific FRA should seek to demonstrate that:

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

1.2. District Council's Strategic Flood Risk Assessment

OCC carried out a Level 1 Strategic Flood Risk Assessment (SFRA) for the City in 2008, which was subsequently updated in 2011. The Level 1 SFRA was prepared in accordance with Planning Policy Statement 25 (PPS25) to inform the OCC's planning process, specifically to:

- Provide sufficient data and information to enable the LPA to apply the Sequential Test to land use allocations and, where necessary, the Exception Test.
- Enable the LPA to prepare appropriate policies for the management of flood risk within the Local Development Documents.
- Inform the Sustainability Appraisal so that flood risk is taken into account when considering options and preparing strategic land use policies.
- Identify the level of detail required for site-specific FRAs in particular locations.
- Enable LPAs to determine the acceptability of flood risk in relation to emergency planning capability.

In addition, the Level 1 SFRA references OCCs Core Strategy that requires the suitability of developments to be assessed according to the PPS25 sequential approach and Exceptions Test.

There is a requirement on Developers to carry out a FRA, which includes information showing how the proposed development will not increase flood risk, highlighting necessary mitigation measures that must be implemented. Site specific FRA's should ensure that:

- Downstream flooding problems are not made worse by surface water run-off from the development.
- Proposed surface water drainage systems for developments should ensure that there is little or no residual risk of flooding for events in excess of the return period for which the sewer system on the site is designed.
- For previously undeveloped sites the rate of run-off from the development sites should be no greater than the existing (Greenfield) rate of run-off from the site.
- For developments on previously developed (brownfield) sites the rate of run-off should not exceed the run-off of the site in its previously developed condition. However, developers should be encouraged to reduce run-off from these developments to below previous rates wherever practicable to take account of Climate Change effect.
- Unless it is shown not to be feasible, all developments will be expected to incorporate sustainable drainage systems or techniques to limit run-off from new development, and preferably reduce the existing rate of run-off.
- Developments that lead to increased flood risk elsewhere, or where the occupants will not be safe from flooding will not be permitted.

The Level 1 SFRA was used to carry out a Sequential Test for sites being considered for allocation in the Sites and Housing Policies Development Plan Document. The Sequential Test has suggested pressure to allocate sites in Flood Zone 3a for more vulnerable uses such as housing. To have enough information to show that the Exceptions Test could be passed for all relevant sites, OCC undertook a Level 2 SFRA in 2012.

As part of the Level 2 SFRA, which was published in February 2012, a technical appraisal was undertaken to provide greater detail on the flood risk for the sites that will require an Exception Test, including an assessment of whether the development can be feasibly designed to be safe from flooding in a manner that does not increase flood risk elsewhere.

The Level 2 SFRA is to be utilised to inform surface water management strategies and the use of SUDS.

Please note that PPS25 has been superseded by the NPPF and the technical guidance to the NPPF, PPG FRCC.

The proposed development has been designed to comply with the above planning and flood risk mitigation requirements.

1.3. Environment Agency Standing Advice

The EA's online Indicative Flood Zone Map for planning initially indicates that the site could be located within Flood Zones 2 and 3, which potentially has a Medium and High risk of fluvial flooding from Main Rivers. See EA's Indicative Flood Map for Planning in Appendix 1.

Therefore, this FRA has been prepared in accordance with the EA's Flood Risk Assessment Standing Advice for a minor extension to an existing building in Flood Zones 2 and 3. A minor extension is a household or non-domestic extension with a floor space of no more than 250m^2.

The FRA for all relevant vulnerable developments (i.e. more vulnerable, less vulnerable and water compatible), must follow the advice for:

- *Surface Water Management*
- *Access and Evacuation*
- *Floor Levels*

Surface Water Management
The proposed development's management of surface water needs to meet the requirements set out in either the local authority's:

- surface water management plan where available
- strategic flood risk assessment
- plus meet the requirements of the approved building regulations Part H: drainage and water disposal. Section H3 rainwater drainage.

Access and Evacuation
The proposed development needs to provide details of the emergency escape plans for any parts of a building that are below the estimated flood level.

- single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby
- basement rooms have clear internal access to an upper level, e.g. a staircase
- occupants can leave the building if there's a flood and there's enough time for them to leave after flood warnings

Floor Levels
Ground floor levels should be either:

- No lower than the existing floor levels
- 300mm above the estimated river or sea flood level

All levels must be in relation to Ordnance Datum (also known as height above average sea level), either from the Ordnance Survey or a site-specific topographical survey.

The estimated flood level is stated as the 1 in 100-year (1% probability) flood event level including and allowance for Climate Change for the life of the development.

2. Development Site Information

In this section, site-specific information is presented in regard to the site location, main rivers, watercourses and flood zones. Data pertaining to both existing and proposed developments are shown, allowing a comparison of permeable and impermeable areas. Lastly, information is presented on ground levels through a topographical survey, descriptions of existing site drainage and site-specific geology, hydrogeology and permeability.

2.1. Site Location, Main Rivers, Watercourses and Flood Zones

The site is located to the south of Oxford city centre, to the west of Abingdon Road (A4144). The site can be located by Grid Coordinates 451835mE, 204250mN, and covers an area of approximately 356.1 m^2 (0.0356 hectares).

The site is bound to the north, south and west by both residential and commercial properties. The site is bound by the A4144, known as Abingdon Road, to the east.

The nearest Main Rivers are the River Thames, which is located approximately 500m to the east of the site and the Hinksey Stream that is located approximately 500m to the west of the site. See location maps in Appendix 1.

The online EA Indicative Flood Zone Map indicates that the site is located within Flood Zones 2 and 3, which has a Medium to High risk of fluvial flooding from Main Rivers. See EA's Indicative Flood Map for Planning in Appendix 1.

2.2. Existing Development

The existing development consists of an existing single storey commercial unit with associated asphalt hardstanding and parking areas.

The existing site has a total impermeable area of 356.1m^2 (0.0356 ha) and a total permeable area of 0.0m^2 (0.0000 ha). The site covers a total area of 356.1m^2 (0.0356 ha). Therefore, 0.0% of the existing site is permeable and 100.0% of the site is impermeable. See Existing Site Plan in Appendix 2.

2.3. Proposed Development

The proposed development includes a minor extension, which is less than 250m^2, to the existing building to increase the size of the building. See Proposed Site Plan in Appendix 2.
The proposed development has a total impermeable area of 204.4m^2 (0.0204 ha) and a total permeable area of 151.7m^2 (0.0152 ha). The site covers a total area of 356.1m^2 (0.0356 ha). Consequently, 57.4% of the proposed site is impermeable and 42.6% is permeable. See Proposed Site Plan in Appendix 2.

Table 1: Permeable and Impermeable areas for existing and proposed developments

	Existing Development	Proposed Development
Impermeable Area (m^2, ha)	356.1; 0.0356	204.4; 0.0204
Fraction of total site (%)	100.0%	57.4%
Permeable Area (m^2, ha)	0.0; 0.000	151.7; 0.0152
Fraction of total site Area (%)	0.0%	42.6%

2.4. Topographical Survey

Ground levels, to Ordnance Survey Datum, at the site are shown on the Topographical Survey in Appendix 3.

The topographical survey shows the ground levels to be sloping from 55.950m AOD at the north west corner of the site, to 55.900m in the centre of the site, down to 55.610m AOD at the north east corner of the site.

The average ground level at the site is approximately 55.820m AOD.

The finished floor levels (FFL) of the existing building is approximately 55.950m.

2.5. Existing Site Drainage

The existing site is currently 100.0% impermeable. As a result all surface water would be discharge to existing drainage and there would be no infiltration into the ground below.

The Thames Water Asset Location Plans indicate that there is a 375mm diameter public surface water sewer within the vicinity of the site, which is located to the east of the site in Abingdon Road.

It is anticipated that the existing site currently discharges surface water run-off to the public surface water sewer to the east of the site.

Foul water currently discharges to the 100mm diameter public foul water sewer located in Abingdon Road via an existing on-site foul water drainage system.

See Thames Water Asset Location Plans in Appendix 4.

2.6. Geology, Hydrogeology and Permeability

2.6.1. Published BGS Maps and Boreholes

The British Geological Survey (BGS) Maps indicate that the site is underlain by the superficial drift geology of the Northmoor Sand and Gravel Member, with a lithology of Sand and Gravel. BGS[1] maps are included in Appendix 1. This type of geology is known to have a good to very good permeability.

The BGS maps also indicate that the site is underlain by a bedrock geology of the Oxford Clay Formation and West Walton Formation with a lithology of Mudstone.

The BGS published borehole records identify a borehole on Abingdon Road near the site with reference SP50SW7, which was carried out by OCC for road works. The borehole is also located within the same Northmoor Sand and Gravel Member as the proposed development site.

The borehole was sunk to a depth of 3m in the winter month of December. Groundwater was encountered at 1.420m below ground level. The top of the borehole was recorded as 55.250m AOD, which is similar to the site's ground levels near the road.

This would indicate that groundwater during winter months would be approximately 1.420m below ground level, which is approximately 53.830mAOD and lower in the summer months. See BGS Borehole log in Appendix 1.

Groundwater monitoring was carried out at the site for several months at the site. The ground level at the top of the test pit was approximately 55.800m AOD. The results were:
24.04.23 – 1.500m bgl
23.07.23 – 1.700m bgl
04.08.23 – 1.700m bgl
12.08.23 – 1.700m bgl
18.08.23 – 1.700m bgl
06.10.23 – 1.800m bgl
13.10.23 – 1.500m bgl
20.10.23 – 1.500m bgl

As a result, the highest ground water level was approximately 1.500m below ground level, which equates to a level of approximately 54.300m AOD. Accordingly only shallow SuDS would be suitable for the site and the underside of the SuDS should not be deeper than 55.300m AOD, which allows a 1m buffer of dry soil for any variations in the water levels. See Trial pit log on drawing 222106-004.

[1] British Geological Survey. Accessed online at:
https://www.bgs.ac.uk/data/services/digmapgb625kml.html

2.6.2. Published Aquifer Designation Maps

The EA's aquifer maps[2] identify aquifers within the superficial and bedrock geology.

The published Aquifer Designation Maps[3] identify a Secondary A Aquifer within the superficial drift geology. A Secondary Aquifer includes permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers, which is in correlation with BGS Maps.

The published Aquifer Designation Maps identify Unproductive Strata, also known as a Non Aquifer, within the bedrock geology beneath the proposed development site. This correlates with BGS Maps See Aquifer Designation Maps in Appendix 1.

2.6.3. BRE 365 Infiltration Tests

Building Research Establishment (BRE) 365 Infiltration Tests should be carried out prior to the detailed design of the surface water management strategy to confirm the use of infiltration and or attenuation SuDS techniques.

A BRE 365 Permeability Test was undertaken in accordance with the methods described in BRE Digest 365 "*Soakaway Design*" and B.S. 5930:2015.

Geology observed in the test pit correlated with the published geology. The following infiltration rates were produced:

Test Pit 1

1. 3.75×10^{-5} m/s
2. 2.58×10^{-5} m/s
3. 2.16×10^{-5} m/s

See BRE 365 Infiltration Test Results in Appendix 5.

The slowest infiltration rate was calculated to be 2.16×10^{-5} m/s which is equivalent to an infiltration rate of 0.078m/hr and will be used for the Detailed SuDS design.

This calculated infiltration rate of 0.078m/hr indicates that the soil at the site can be classed as having good permeability.

[2] Aquifer Maps, Department for Environment, Food & Rural Affairs, UK Government. Accessed online at: https://magic.defra.gov.uk/MagicMap.aspx
[3] Aquifer Maps, Department for Environment, Food & Rural Affairs, UK Government. Accessed online at: https://magic.defra.gov.uk/MagicMap.aspx

The SuDS surface water management strategy should focus on minimizing post development impermeable areas through "Preventative SuDS" and subsequently, reduce the site's post development surface water run-off rate in order to reduce flood risk and provide betterment.

A test pit was excavated at the site, which identified that groundwater was approximately 1.500m below ground level. See photograph of test pit in Appendix 5. This correlates with the borehole data.

Based on groundwater levels dropping in the summer months, there would be sufficient dry soil buffer all year round to implement shallow infiltrating SuDS for the proposed development, infiltrating pervious paving.

3. The SuDS Manual and Sustainable Systems

3.1. The SuDS Manual and Sustainable Systems

The implementation of a SWMS for new developments can ensure that there would be no increase of flood risk as a result of the proposed development by avoiding the creation of, reducing and delaying the discharge of rainfall run-off to watercourses and public sewers using SuDS techniques.

The SuDS Management Train as set out in the SuDS Manual[4] (CIRIA C753), which provides best practice guidance on the planning, design, construction and maintenance of SuDS, should be utilized in the SuDS design to mimic natural catchment processes as closely as possible. It uses SuDS drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

3.1.1. Hierarchical Approach to Design of Sustainable Systems

The hierarchy of techniques that should be considered in developing the management train are as follows:

1. **Prevention** - the use of good site design and site housekeeping measures to prevent run-off and pollution (e.g. sweeping to remove surface dust and detritus from car parks), and rainwater reuse/harvesting. Prevention policies should generally be included within the site management plan.
2. **Source control** - control of run-off at or very near its source (e.g. soakaways, other infiltration methods, green roofs, pervious pavements).
3. **Site control** - management of water in a local area or site (e.g. routing water from building roofs and car parks to a large soakaway, infiltration or detention basin).
4. **Regional control** - management of run-off from a site or several sites, typically in a balancing pond or wetland.

Wherever possible, storm water should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas (end of pipe solutions).

The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls.

The use of the SuDS management train and infiltration techniques also allows for the management of potential pollution to controlled waters, through sedimentation and infiltration.

[4] CIRIA 753 The SuDS Manual 2015. Accessed online at:
https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

SuDS ensure that surface water run-off cannot discharge directly into controlled waters such as groundwater and watercourses, and consequently reduces the risk of pollution.

3.1.2. Types of SuDS Infiltration and Attenuation Techniques

The proposed site's existing surface water run-off rate can be maintained or reduced through the utilisation of SuDS. SuDS aim to mimic the natural drainage processes whilst also removing pollutants from urban run-off at the source before entering a watercourse.

There are a wide range of SuDS infiltration techniques. These include, but are not limited to;

- Soakaways (Recharge groundwater/aquifer)
- Filter strips adjacent to roads (Re-charge groundwater/aquifer)
- Swales around the site and adjacent to roads (Re-charge groundwater/aquifer and biodiversity)
- Pervious paving of road and car parks (Re-charge groundwater/aquifer)

There are other forms of SuDS that do not use infiltration. These SuDS provide attenuation and controlled release of surface water, which can assist in the reduction of the post-development surface water run-off. Examples of these are;

- Rainwater harvesting tanks and rainwater harvesting butts (water conservation)
- Above ground attenuation ponds and detention basins (amenity and biodiversity areas)
- Below ground geo-cellular attenuation tanks
- Green Roof (attenuation)

3.1.3. Other Uses and Benefits of SuDS

SuDS can be used to mitigate flooding or pollution. They also provide environmental benefits. Some of the environmental benefits are listed below:

- The hydraulic benefits, including peak flow rate reductions, storm run-off volume reductions, and enhancements to river base flow and aquifer recharge.
- The pollutant loading reductions achieved by the system, and associated benefits to in-stream ecology, human health, and human value perceptions.
- The amenity and recreational benefit enjoyed by those who live close to the SUDS scheme.
- The additional value of properties adjacent or within view of the SUDS scheme.
- The ecological value of the SUDS schemes themselves.

In conclusion, one or more of the above SuDS techniques should be utilized in the surface water management strategy to minimise the surface water run-off from the site and the potential impacts of the development on the surrounding area.

3.2. Climate Change

Climate change is expected to increase the risk of fluvial flooding due to increased river flows, and surface water run-off is expected to increase due to increased rainfall intensities (Environment Agency, 2017).

Developments should not increase flood risk at the site or the surrounding area and, where possible, they should aim to reduce existing flood risk by incorporating SuDS to reduce the surface water run-off rate of the site.

Paragraphs 159 and 169 of the NPPF requires Climate Change to be considered with regards to flood risk (NPPF 2021). The national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights that should be applied to new developments – these are shown in Table 2 (Environment Agency 2017).

Table 2 Climate change allowances related to peak river flows, pluvial intensity, offshore wind speeds and extreme wave height. Source: Flood risk assessments: climate change allowances[5]

Parameter	2015 to 2039	2040 to 2069	2070 to 2115
Peak Rainfall intensity – Upper End	10%	20%	40%
Peak Rainfall intensity – Central	5%	10%	20%
SE England Peak River Flow – Upper End	25%	50%	105%
SE England Peak River Flow – Higher Central	15%	30%	45%
SE England Peak River Flow – Central	10%	20%	35%
Thames England Peak River Flow – Upper End	25%	30%	70%
Thames England Peak River Flow – Higher Central	15%	25%	35%
Thames England Peak River Flow – Central	10%	15%	25%
Offshore wind speed	5%		10%
Extreme wave height	5%		10%

The surface water management strategy should ensure that the new SuDS surface water drainage system at the site is capable of attenuating the 1 in 100-year storm event including an allowance for climate change, while limiting the surface water discharge rate from the site to the site's existing run-off rate or where possible the sites estimated Greenfield run-off rate or less.

[5] Flood risk assessments: climate change allowances, UK Government, EA (2017). Accessed online at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances on 08/02/2019

3.3. Development Contributing Areas – Existing and Proposed

The existing development consists of a listed building containing a Restaurant and staff flat above, and a small area of courtyard laid with decking.

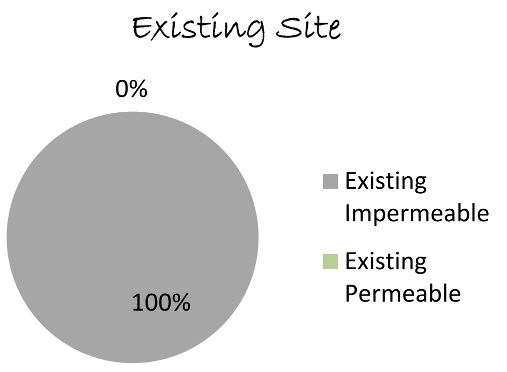
The existing site has a total impermeable area of 356.1m² (0.0356 ha) and a total permeable area of 0.0m² (0.000 ha). The site covers a total area of 356.1m² (0.0356 ha). Therefore, 0.0% of the existing site was permeable and 100.0% was impermeable. See Existing Site Plan in Appendix 2.

The proposed development includes the conversion of the existing listed building to a smaller restaurant and 2 flats. See Proposed Site Plan in Appendix 2.

The proposed development has a total impermeable area of 204.4m² (0.0204 ha) and a total permeable area of 151.7m² (0.0152 ha). The site covers a total area of 356.1m² (0.0356 ha). Consequently, 57.4% of the proposed site would be impermeable and 42.6% would be permeable. See Proposed Site Plan in Appendix 2.

Table 3: Permeable and Impermeable areas for existing and proposed developments

	Impermeable Area	% of Total Site Area	Permeable Area	% of Total Site Area
Existing Development	356.1; 0.0356	100.0%	0.0; 0.000	0.0%
Proposed Development	204.4; 0.0204	57.4%	151.7; 0.0152	42.6%



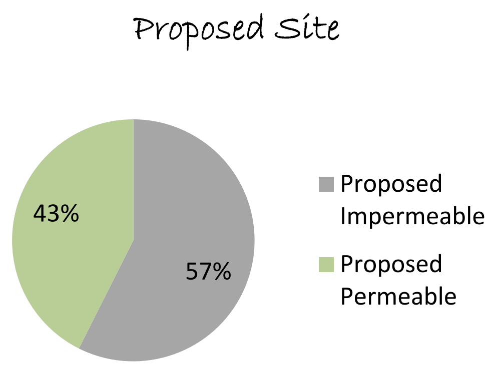


Table 3 indicates there could be a significant decrease in the impermeable areas at the site, from 356.1m² to 204.4m² before implementation of any mitigating SuDS. This equates to a decrease in the percentage of impermeable area of 42.6%.

As such, the development proposals would not need to incorporate mitigating SuDS to mitigate potential impacts due any increase in impermeable area. However, it is proposed to implement SuDS to mitigate Climate Change to provide further betterment.

3.4 Institute of Hydrology (IOH) Surface Water Run-Off Calculations

3.4.1. Greenfield Run-off Rates

Greenfield run-off rates are calculated to determine the theoretical peak flow rates of discharge from the Greenfield site to surrounding areas and receiving watercourses in the vicinity, for the 1, 30, 100 and 100 year plus a climate change allowance return periods.

The calculation of peak rates of run-off from Greenfield areas is related to catchment characteristics that include size, soil index, annual rainfall and regional growth curves.

As stated in The SuDS Manual, the existing site's estimated Greenfield run-off rate - denoted herein as QBarGreenfield - was calculated using the Institute of Hydrology's Report No. 124 methodology[6] for sites with an area between 0 ha and 50 ha:

$QBar_{Greenfield} = 0.00108\ AREA^{0.89}\ SAAR^{1.17}\ SOIL^{2.17}$ (IHR 124 equation 7.1)
where,

0.00108 is a conversion factor for the units used,
AREA is the site catchment area in km^2,
SAAR is the Standard Average Annual Rainfall in mm, and
SOIL is the soil index classification.

The run-off rate is calculated for a 50 ha ($0.50km^2$) catchment using the site's catchment details, and then interpolated using the site's total area to calculate the site's Greenfield run-off rate.

Using a SAAR of 631mm and SOIL of 0.370, the estimated existing site's Greenfield surface water run-off rate is:

$$QBar_{Greenfield} = 0.00108 \times 0.50^{0.89} \times 631^{1.17} \times 0.370^{2.17}$$
$$= 0.1272 \text{ cumecs / 50 ha}$$

Multiplying the latter by 1000 yields:

$$QBar_{Greenfield} = 127.2/s/\ 50 \text{ ha}$$

Dividing by 50 leads to:

$$QBar_{Greenfield} = 2.54 \text{ l/s/ha}$$

Thus, a site area of 0.036 ha gives a final $QBar_{Greenfield} = 0.091$ l/s

[6] Flood estimation for small catchments, Report No. 124. Accessed online at: http://nora.nerc.ac.uk/id/eprint/7367/1/IH_124.pdf

For the site's catchment area of 0.036 ha and specified storm events, the site's estimated Greenfield peak run-off rates and volumes (without mitigating SuDS) for the 1, 30, 100 and 100 year with climate change allowance return periods are shown in Table 4.

Table 4: Shown are the site's estimated Greenfield peak run-off rates and volumes for the 1, 30, 100 and 100 year with climate change allowance return periods.

Storm Event 1 in n year	Growth Curve Factor	Greenfield Site's Run-off Rate Peak Flows (l/s)	Greenfield Site's Run-off Peak Volume (m^3)
$QBAR_{Greenfield}$	-	0.091	1.96
1 in 1 year	0.85	0.077	1.66
1 in 30 year	2.30	0.208	4.50
1 in 100 year	3.19	0.289	6.24
1 in 100 year plus 40% CC	4.47	0.405	8.74

3.4.2. Brownfield Run-off Rates

3.4.2.1. Run-off Rates for Existing Development

The IOH 124 method requires that Brownfield run-off rates are calculated using the Greenfield Run-off rates and an adjustment for urbanisation, to allow for the Brownfield impermeable areas, which is demonstrated below for the proposed development site;

The ratio of $QBar_{Brownfield}$ to $QBar_{Greenfield}$, denoted herein as R, is defined as:

$$R = (1+URBAN)^{2NC} [1+URBAN((21/CIND)-0.3)]$$

where,

URBAN is the fraction of the catchment that is impermeable,
NC is the Rainfall continentality factor which is a function of SAAR,
CIND is the catchment index = 102.4 SOIL+0.28(CWI-125),
CWI is the Catchment Wetness Index which is a function of SAAR from FSR Report.

For the existing site, these variable parameters are calculated as:

$$URBAN = 1.00$$
$$NC = 0.92-(0.00024 \times 631) = 0.77$$
$$CWI = 88.0$$
$$CIND = (102.4 \times 0.370) + 0.28(88.0 - 125) = 27.53$$

leads to a ratio:

$$R_{Existing} = QBar_{Brownfield\ Existing} / QBar_{Greenfield}$$
$$= (1+1.00)^{1.54}[1+1.00((21/27.53)-0.3)]$$
$$= 4.25$$

For the site's catchment area of 0.036 ha, $QBAR_{Existing}$ of 0.385 l/s (4.25 x 0.091) and specified storm events, the site's existing Brownfield peak run-off rates and volumes calculated for the 1, 30, 100 and 100 with climate change allowance return periods are shown in Table 5.

Table 5: Shown are the existing site's calculated Brownfield peak run-off rates and volumes for the 1, 30, 100 and 100 with climate change allowance return periods.

Storm Event 1 in n year	Growth Curve Factor	Existing Brownfield Peak Run-off Rate Flows (l/s)	Existing Brownfield Run-off Volumes (m^3)
QBrown Existing	-	0.385	8.31
1 in 1 year	0.85	0.327	7.06
1 in 30 year	2.30	0.885	19.11
1 in 100 year	3.19	1.227	26.50
1 in 100 year + 40% CC	4.47	1.718	37.11

3.4.2.2. Run-off Rates for Proposed Development

For the proposed site, the following parameters are calculated as:

$$URBAN = 0.57$$

$$NC = 0.92-(0.00024 \times 631) = 0.77$$

$$CWI = 88.0$$

$$CIND = (102.4 \times 0.370) + 0.28(88.0 - 125) = 27.53$$

leads to a ratio

$$R_{Proposed} = QBar_{Brownfield\ Proposed} / QBar_{Greenfield}$$

$$= (1+0.57)^{1.54}[1+0.57((21/27.53)-0.3)]$$

$$= 2.54$$

For the site's catchment area of 0.036 ha, $QBAR_{Proposed}$ of 0.247 l/s (2.54 x 0.091), and specified storm events, the site's existing Brownfield run-off rate as well as estimated peak flow rates and volumes for 1, 30, 100 and 100 with climate change allowance return periods (without mitigating SuDS) are shown in Table 6.

Table 6: Shown are the proposed site's calculated Brownfield peak run-off rates and volumes for the 1, 30, 100 and 100 with climate change allowance return periods.

Storm Event 1 in n year	Growth Curve Factor	Proposed Brownfield Peak Run-off Rate Flows (l/s)	Proposed Brownfield Run-off Volumes (m^3)
QBrown Proposed	-	0.230	4.97
1 in 1 year	0.85	0.196	4.23
1 in 30 year	2.30	0.530	11.44
1 in 100 year	3.19	0.735	15.87
1 in 100 year + 40% CC	4.47	1.029	22.22

3.4.2.3. Summary

In light of data presented in Tables 5 and 6, it can be seen that without mitigating SuDS, the post development site's surface water peak run-off rates and volumes could have a significant decrease.

As such, there could be a substantial decrease in flood risk due to the 40.1% reduction in impermeable area. As a result, the development proposals would not need to mitigate any potential increase in impermeable area and Climate Change by implementing SuDS.

However, it is proposed to implement zero piped outflow infiltrating SuDS to mitigate the impermeable area due to the extension of the building, Urban Creep and Climate Change, which would provide additional betterment.

4. Proposed Surface Water Management Strategy

The proposed conceptual surface water management strategy (SWMS) aims to not increase, and where practicable reduce the rate of run-off from the site as a result of the proposed development, in accordance with sustainable drainage principles and the published SFRA.

4.1. Preventative SuDS

Firstly, in accordance with the SuDS Management Train, it is proposed to mitigate any increase in surface water run-off by implementing conceptual preventative SuDS techniques, as per the hierarchy approach described in section 3.1.1.

Accordingly, it is proposed to include permeable hardstanding areas (e.g. pervious paving, porous asphalt, gravel paths) and maximise soft permeable landscaped areas (i.e. grass, planting etc) in order to minimise any increase in post development impermeable areas and their surface water run-off.

4.2. Source Control:

In addition to preventative SuDS, it is also proposed to implement "Source Control" attenuation techniques such as tanks and pipes, as well as pervious paving to manage surface water run-off from roofs and roads at their source.

The Flood and Water Management Act 2010, Sewers for Adoption and The SuDS Manual require that, as a minimum, the SuDS should be designed to manage and attenuate the 1 in 30-year storm event so that there is no flooding of the site.

However, new developments should also mitigate Climate Change, so SuDS should be designed for exceedence and, be designed to manage and attenuate the 100-year storm event including an allowance for Climate Change.

4.2.1. Conceptual SuDS Design:

The proposed conceptual SuDS design is based on (1) "preventative" techniques in the form of permeable hard landscaping and (2) "source control" attenuating SuDS techniques.

Firstly, surface water run-off from impermeable areas is minimized through the maximization of preventative permeable soft and hard landscaping, such as planting, grassed areas and pervious hardstandings.

Secondly, the surface water run-off from impermeable areas such as impermeable roofs would be discharged to and managed via SuDS pervious paving.

4.2.1.1. Impermeable Roof and Hardstanding Areas

The proposed extension and alterations to the existing building would result in an increase in impermeable roof area of approximately 87.9m^2, which equates to an area of 0.0088 ha. The self-draining pervious paving area has an area of 134.2m^2, which equate to 0.0134 ha. This results in a total Contributing Area of 0.025 ha, which includes an allowance of 10% for Urban Creep. Note that the significant decrease in impermeable hardstanding has been ignored to provide betterment.

Using MicroDrainage, a contributing area of 0.025 ha, the 6 hr 100 year storm event plus a 40% Climate Change, a permeability rate of 2.16x10^{-5}m/s (0.078m/hr), a zero piped discharge, 10% Urban Creep and a factor of safety of 2, the new development's pervious paving would need to have a net storage capacity of approximately 10.3m^3.

Therefore, provide pervious paving with minimum dimensions of 133.9m^2 x 0.275m deep, which would provide a net storage capacity of 11.0m^3, which is greater than the required volume of 10.3m^3. See MicroDrainage calculations in Appendix 4.

4.2.1.2. Reduction in Run-off Rates and Volumes

The above SuDS are sized to mitigate the 100 year storm including a 40% allowance for climate change, a 10% allowance for urban creep and with a zero piped outflow. That is, the new impermeable roof of the new building extension and the self-draining pervious paving are proposed to discharge to infiltrating SuDS with a zero piped discharge.

Consequently, with the proposed mitigating SuDS 63.0% of the site (0.0225 ha of impermeable roof and permeable paving) would not have a Greenfield or Brownfield run-off rate as they would discharge to zero piped outflow SuDS. Only the existing impermeable roof areas would have a run-off.

Accordingly, only 37.0% of the post development site would discharge surface water at the Brownfield run-off rate, reducing the run-off rate to below the existing site's Brownfield run-off rate, and mitigating Climate Change, this would provide betterment as less water would be discharged to the existing sewers and Main Rivers.

Therefore, the site's post development run-off rate could be reduced from 0.247 l/s to approximately 0.085 l/s through the utilization of mitigating SuDS, which is less than the site's existing Brownfield run-off rate of 0.385 l/s and the Greenfield run-off rate of 0.091 l/s.

4.2.1.3. Summary

In light of the above, it has been demonstrated that the proposed Detailed SuDS surface water management strategy ensures that:

- there would be no increase in run-off as a result of the proposed development,
- there would be no increased flood risk as a result of the proposed development,
- there would be a decrease in the site's overall run-off rates and volumes, as a direct result of the proposed development,
- the site's run-off rates would be reduced to less than the Brownfield run-off rates,
- the site's run-off rates would be reduced to less than the Greenfield run-off rates,
- there would be a decrease in flood risk as a result of the proposed development,
- betterment would be provided with regards to surface water reduction and flood risk reduction.

The SWMS demonstrates the feasibility of the use of infiltrating SuDS as part of the proposed development. The SWMS identifies just a few of the available SuDS techniques for feasibility purposes.

A combination of the proposed techniques could be used with other techniques at the detailed design stage as long as there was no increase in the site's post development surface water run-off rates and volumes and the SuDS mitigates Climate Change.

5. Assessment of Flood Risk from All Potential Sources

The Flooding of a site can occur from several sources, including, watercourses such as Main Rivers, Ordinary Watercourses and streams, tidal seas and estuaries, groundwater, sewers, surface water run-off and failure of water infrastructure. The risk of flooding to the site from each source has been assessed in turn.

5.1. Main Rivers

The SFRA states that the primary source of flood risk in Oxford is fluvial flooding based on the number of properties at risk. Located at the confluence of the Rivers Cherwell and Thames, the city is vulnerable from both watercourses independently and, in wider flood events, concurrently.

The River Thames flows into the city from the North-West, passing through Wolvercote before entering the western side of the city centre. The River Cherwell flows into the city from the North-East, passing through Marston before entering the eastern side of the city centre. The flood plains of both of these watercourses consist of farm land and recreational area with few properties at risk.

The River Cherwell joins the River Thames south of the city centre, which then flows south through New Hinksey and out of the city boundary. In this area, the flood plain contains a number of housing estates which are known to have flooded in 2003.

Boundary Brook also joins the River Thames, south of New Hinksey, and the EA's Flood Zone Mapping suggests that there is flooding along its length. Historically flood events have shown a greater area of flooding than the flood zones due to the effect of structures on water levels within the watercourse. The EA has been undertaking modelling work to establish risk more accurately in this area.

The River Thames and the River Cherwell flow through wide, flat floodplain corridors upstream, through, and downstream of Oxford City. During times of high water out of bank flow causes flooding across these low lying floodplains covering vast areas. This out of bank flow potentially impacts the urban areas of New Botley, Osney, New Hinksey, South Hinksey, Grandpont, Wolvercote, Summertown and New Marston.

Further flood risk is associated with Castle Mill Stream through the West End of Oxford, Boundary Brook through Florence Park and Temple Cowley, and Northfield Brook/Littlemore Brook through Blackbird Leys.

The nearest Main Rivers are the River Thames, which is located approximately 500m to the east of the site and the Hinksey Stream that is located approximately 500m to the west of the site. See location maps in Appendix 1.

The online EA Indicative Flood Zone Map indicates that the site is located within Flood Zones 2 and 3, which has a Medium to High risk of fluvial flooding from Main Rivers. See EA's Indicative Flood Map for Planning in Appendix 1.

5.1.1. Summary of Historic Flooding

Appendix C of the SFRA include historic flood maps, which show the extents of significant flood events noted to have affected the area in 1947, 1977, 1979, 1992, 1993, 1998, 2000, 2003 and 2007.

1947 was a particularly bad flood event as it involved both snow melt and heavy rainfall. 2007 was also a particularly bad event to prolonged heavy rainfall and blocked surface water drains that exacerbated highway flooding.

The SFRA indicates that the site was not subjected to the floods of 1947, 1977, 1979, 1992, 1993, 1998, 2000, 2003 and 2007.

The SFRA does not appear to identify the site as being flooded by historic flood events.

5.1.2. Flooding within the last 5 years

The SFRA does not include any historic flood maps for the past 5 years.

5.1.3. EA's Flood Zone Map and Modelled Data

The EA's online indicative flood zone maps identify the site as being located within Flood Zones 2 and 3, which has a High risk of fluvial flooding from Main Rivers.

The EA were consulted and the Product 4 Modelled and Historic Flood Level Data obtained. The modelled flood levels for the nodes that are closest to the site are shown in Table 7.

Table 7: The EA's modelled AEP flood levels applicable to the site are summarised below:

	Flood Levels (mAOD)						
Annual Exceedence Probability and Flood Zone	5% AEP 1:20 Year	3.3% AEP 1:30 Year FZ 3b	1% AEP 1:100 Year FZ3a	1% AEP + 25% CC 1:100 Year + 25% CC	1% AEP + 35% CC 1:100 Year + 35% CC	1% AEP + 70% CC 1:100 Year + 70% CC	0.1% AEP 1:100 Year FZ2
Flood Point 2	-	-	55.980	56.160	56.270	56.590	56.300
Flood Point 3	55.770	55.795	55.970	56.140	56.260	56.580	56.290

The Department for Environment Food and Rural Affairs (DEFRA) advises that the peak river flow Climate Change Allowance for the site is 26%. See in Appendix 5. The Product 4 Data did not include the 100 year plus 26% Climate Change Allowance modelled flood level. As a result, this was interpolated using the 25% and 35% allowance data.

The estimated flood level for the site was calculated to be 1%+26% CC = 100 year + 26% Climate Change Allowance flood event level 56.171m AOD.

The 3.3% AEP event was also not available and was interpolated using the available data. The 1 in 30 year (3.3% AEP) level was calculated to be 55.795 and is shown on drawings 222106-002 and 222106-003.

Ground levels, to Ordnance Survey Datum, at the site are shown on the Topographical Survey in Appendix 3.

The topographical survey shows the ground levels to be sloping from 55.950m AOD at the north west corner of the site, to 55.900m in the centre of the site, down to 55.610m AOD at the north east corner of the site closet to the Abingdon Road.

The average ground level at the site is approximately 55.820m AOD. The finished floor level (FFL) of the existing building is approximately 55.950m.

Accordingly, the proposed development appears to be within Flood Zone 2 and 3a. This correlates with the indicative flood zone maps for planning.

In accordance with the Government's Standing Advice, for minor extensions to an existing building, ground floor levels should be set either:

- *no lower than the building's existing Finished Floor Level (FFL).*
- *300mm above the estimated flood level where practicable*

If floor levels cannot be raised in this way, extra flood resistance and resilience measures must be included. These measures should protect the property to at least 300mm above the estimated flood level. The estimated flood level including an allowance for Climate Change is 56.171m.

Ground floor levels should be set at either:

- The existing building's FFL of 55.950m.
- 56.471m, which is 300mm above the estimated flood level of 56.171m.

At the request of the LLFA it is proposed to set the extension's FFL at 56.771, which is 600mm above the estimated flood level, including a 26% allowance for Climate Change, of 56.171m.

Extra flood resistance and resilience measures could be provided to a level of 600mm above the ground levels at the site. See Appendix 7.

Based on keeping water out, of the new extension, flood water could be displaced by the new extension. The average ground level is approximately 55.820m AOD. The estimated flood level including an allowance for Climate Change is 56.171m. This equates to an approximate flood water depth of 0.351m.

The proposed extension has a gross footprint of approximately 87.9m^2, which is less than the allowable 250m^2. As a result, the potential displaced flood water volume could be in the region of 30.851m^3 if flood water reached the predicted modelled flood levels.

To compensate for this potential loss of flood water storage volume the LLFA has confirmed that it would be acceptable to allow water to store below the ground floor of the new extension.

The net internal area below the ground floor of the proposed extension, which allows for the cavity walls, is 78.496m^2.

Therefore, based on a potential displaced water volume of 30.851m^3, there would need to be a void with a depth of 0.393m below the suspended ground floor slab.

The underside of the suspended ground floor would be set no lower than 56.171m AOD and the ground below the suspended ground floor would be set no higher than 55.778m AOD. See SuDS Layout on drawing 222106-002 and SuDS Details on drawing 222106-005.

To ensure the void is retained 1m long grilles would be installed at no less than every 5m of wall. The grilles would be maintained as part of the SuDS system on an annual basis and after flood events. See planning elevation drawings for location of flood water grilles.

It should also be acknowledged that the impermeable area at the site has been significantly reduced by 42.6 % and the site's run-off rates and volumes have in turn been reduced by 40.1% through the implementation of SuDS.

The combination of oversized SuDS and the 42.6% reduction in impermeable area, as a result of the proposed development, provides a significant reduction in surface water run-off rates and volumes and accordingly, a significant reduction in flood risk to the site and the surrounding area.

5.1.4. Sequential Test and Sequential Approach

The Sequential Test looks at the Flood Risk Vulnerability and Flood Zone Compatibility of a development.

The sequential approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high flood risk areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible.

Following the application of the Sequential Approach, the Sequential Test investigates the Flood Risk Vulnerability and Flood Zone Compatibility of a development.

Table 3 of the PPG FRCC identifies the development types that are appropriate in each flood zone, subject to the requirements of the EA National Standing Advice and the Application of the Sequential Test.

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception Test	✓	✓
Flood Zone 3a	Exception Test	✓	X	Exception Test	✓
Flood Zone 3b Functional FZ	Exception Test	✓	X	X	X

Key:
✓ Development is appropriate
X Development should not be permitted

Commercial developments are classified as Less Vulnerable development, in accordance with Table 2: Flood Risk Classification of TGNPPF, which are suitable for Floods Zones 1 and 2 and potentially 3a if the Exception Test is passed.

The location of the boundary of Flood Zone 3b, which has a level of 55.795m AOD has been highlighted on drawing 222106-002 and 222106-003. No part of the extension is to be constructed in Flood Zone 3b.

Furthermore, it should be noted that the Sequential Test is not applicable to developments that incorporate a change of use or a minor extension as it is not possible to relocate the existing building.

Therefore, in this instance as the development incorporates an extension of an existing building, the Sequential Test is not applicable.

5.2. Ordinary Watercourses and Streams

There is a stream approximately 250m to the west of the proposed development site, which is a tributary of the Hinksey Stream.

The SFRA does not have any records of flooding at the site from watercourses or streams. There are no known records of watercourses and streams causing flooding at the site.

Therefore, the site is perceived to have a Low risk of fluvial flooding from ordinary watercourses and streams.

5.3. Coastal or Estuarine

The site is not located near the coastline or an estuary. Consequently, the site is at Low risk of tidal flooding.

5.4. Groundwater

Groundwater flooding issues do exist within the Thames Valley through Oxfordshire. The floodplain is situated above buried gravels which act as underground reservoirs, spilling into the floodplain when full. The majority of the sites where groundwater flood risk exists are in the low lying areas, also subject to fluvial flood risk.

The EA has worked with a number of parties, including the BGS to investigate groundwater flooding. The BGS was contacted and enquiries made regarding this collaborative study, the specific aims and findings. Unfortunately, at the time of publishing no specific information was available for incorporation within the SFRA. The BGS did however provide a summary of the study outcomes. It found that the local ground water was linked to river flows and has an independent response to rainfall. A lack of reliable data was identified and a system of water level measurement points for future monitoring purposes was created. The study recognised groundwater as an important source of flooding in Oxford and the investigation into this source of flooding continues.

In addition to the work being undertaken by the BGS and the EA, a groundwater flooding register is held by the EA which identifies the locations and narration of specific groundwater flooding events.

The groundwater register contains 21 records of suspected ground water flooding that occurred between 2000 and 2003 inclusive and 2007 and 2009 inclusive. The locations of the incidents are spread throughout, and beyond in the case of 6 incidents, the extents of the Oxford City Boundary but clusters of incidents in the New Hinksey, Grandpont and Sunnymead areas and in the Oxford District area to the East of the city centre can be identified. The incident within the EA's groundwater records for Headington, north of hospital, has been confirmed to be a mains water leak rather than groundwater.

The type of incident reported is typically associated with cellar and sub floorboard flooding of property and the emergence of groundwater in gardens and garages. The Registered Groundwater Flooding Incidents Map presents the information contained within this register.
The map coordinates within the register have been used to map the groundwater flooding incidents and is presented within Appendix B. The Strategic Locations for Development and sites identified within the West End are also shown to demonstrate that there are no recorded incidents of groundwater flooding at any of the site locations put forward by OCC for development.

The 3 groundwater incidents located within New Hinksey are all located within Flood Zone 3b, the incident in New Botley in Flood Zone 3a and the 2 incidents in the vicinity of Grandpont are located within Flood Zone 3a. The register reports that these 6 locations have underlying gravels, associated with the Thames floodplain, and therefore, the groundwater incidents reported are partially associated with fluvial flooding.

The 4 incidents reported immediately to the west of the Cherwell Thames confluence are within Flood Zone 1. The proximity to the Cherwell and Thames floodplains suggests that groundwater emergence at these sites are likely, at least in part, to be associated with periods of high water in the two rivers. Of the remaining 5 incidents, 2 are located in Headington, 2 in Sunnymead and 1 in Iffley, all of which are located within Flood Zone 1.

The SFRA Registered Groundwater Flooding Incidents Map, indicates that the proposed development site has not been impacted by groundwater flooding. The nearest recorded flood incident Reference No.12 was located in Weirs Lane, which is closer to the River Thames.

The SFRA does not have any records of groundwater flooding events at the site. This correlates with the BGS borehole log data.

The BGS published borehole records identify a borehole on Abingdon Road near the site with reference SP50SW7, which was carried out by OCC for road works. The borehole is also located within the same Northmoor Sand and Gravel Member as the proposed development site.

The borehole was sunk to a depth of 3m in the winter month of December. Groundwater was encountered at 1.420m below ground level. The top of the borehole was recorded as 55.250m AOD, which is similar to the site's ground levels near the road.

This would indicate that groundwater during winter months would be approximately 1.420m below ground level, which is approximately 53.830mAOD and lower in the summer months. This is significantly lower than the average ground level of 55.820m at the site. See BGS Borehole log in Appendix 1.

A test pit was excavated at the site, which identified that groundwater was approximately 1.500m below ground level. See photograph of test pit in Appendix 5. This correlates with the borehole data.

Based on groundwater levels dropping in the summer months, there would be sufficient dry soil buffer all year round to implement shallow infiltrating SuDS for the proposed development, infiltrating pervious paving.

There are no known records of the site being flooded due to groundwater. Therefore, the site is perceived to have a Low risk of Groundwater flooding.

5.5. Sewers and Highway Drains

The sewerage infrastructure of Oxford is largely based on Victorian sewers and there is a risk of localised flooding associated with the existing drainage and sewer system.

Flooding from sewers can occur when the artificial drainage system is overwhelmed hydraulically, becomes blocked or suffers structural failure or pump failure. Blockage and structural failure incidents tend to be isolated and unpredictable.

Thames Water is responsible for the management of the urban drainage system throughout Oxford including surface water and foul sewerage. Thames Water has procedures in place to respond to and rectify such incidents, which are also recorded on databases to inform maintenance and improvement plans.

A review of areas where the sewer system has been overwhelmed can potentially identify under capacity of the drainage system or where the system does not provide an adequate level of service. Thames Water maintains an extensive database of incidents of hydraulic overload of sewers. This is a strategic level problem and is addressed by Thames Water through their ongoing asset management procedures, supported by a programme of detailed network modelling. Thames Water has the following target levels of protection against sewer flooding of properties:

- Foul and combined systems: 1 in 10 to 1 in 50 years (depending on property type).
- Surface water system: 1 in 10 to 1 in 30 years (depending on property type).

Wherever possible, Thames Water seeks to promote the highest specified standard. However, this is dependent on the cost-benefit analysis of the improvement scheme. It is therefore not appropriate for the SFRA to recommend strategic options for managing sewer flooding where levels of protection to properties are inadequate as this is a fundamental part of Thames Water’s existing asset management procedures.

Thames Water holds records of flooding issues relating to surface and foul water sewers and they were consulted to provide their up to date information. The records provided show flood incidents on a postcode area basis during the last 10 year period. This data does not provide the specific location of each incident and is therefore of limited use for providing location specific information. This data is presented graphically in the Thames Water Sewer Flooding Incidents by Postcode Area Map in Appendix C of the SFRA.

Postcodes in the OCC area that had recorded incidents of sewer flooding were OX1 2; OX2 0, OX2 6; OX2 8; OX4 3; OX4 4; OX4 6 and OX4 7. The Thames Water Sewer Flooding Incidents by Postcode Area Map indicates that the Postcode area OX1 4 there were no recorded incidents of sewer flooding

The SFRA does not identify any records of sewer flooding at the proposed site and the site is not located in a Critical Drainage Area.

There are no known records of the site being flooded, due to surcharging of sewers. Therefore, the risk of flooding at the site due to surcharging of local sewers is considered to be Low.

Any new drainage on site should be constructed to comply with the current CIRIA 753 The SuDS Manual and Building Regulations Approved Document H and Sewers for Adoption, to ensure that sewer surcharging is mitigated.

5.6. Surface Water and Overland Flow

Surface water flooding occurs when excess water runs off across the surface of the land. Surface water flooding has the potential to contribute significant flood risk in urban areas due to the rapid run off rates associated with urban land use.

Surface water flooding, either on its own or as a contributing factor in other types of flooding is considered to be relatively frequent. The scale of the disruption or damage caused is less certain, and there are few records of significant losses resulting from surface water flooding.

“Making Space for Water” defines surface water flooding as an “event that results from rainfall generated overland flow before the runoff enters any watercourse or sewer. Usually associated with high intensity rainfall (typically >30mm/hr) resulting in overland flow and ponding in depressions in the topography, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability. Urban underground sewerage/drainage systems and surface watercourses may be completely overwhelmed, preventing drainage. Surface water flooding does not include sewer surcharge in isolation.’

The Areas Susceptible to Surface Water Flooding (AStSWF) maps show areas where surface water would be expected to flow or pond. The map was procured as a preliminary national output to provide Local Resilience Forums with an initial indication of areas that may be susceptible to surface water flooding. It was also provided to Regional Resilience Teams for use in their functions which relate to emergencies as defined and as required by the Civil Contingencies Act 2004 and to LPAs for land use planning purposes.

The AStSWF maps are based on the modelling of a single rainfall event with a 1 in 200 chance of occurring in any year. The maps display the chance of this rainfall and not of the resulting flood extent occurring. Consequently, the map provides only a general indication of areas which may be more likely to suffer from surface water flooding for this rainfall probability. The map provides three bandings, indicating 'less' to 'more' susceptible to surface water flooding. The AStSWF map is shown in Appendix D of the SFRA.

The AStSWF map shows there are substantial areas of Oxford City susceptible to surface water flooding including New Botley, Osney, City Centre, Walton Manor, Littlemore, Blackbird Leys and New Headington. There are also areas outside of the urban area of Oxford City which are susceptible to surface water flooding.

The Flood Map for Surface Water (FMfSW) was developed from a number of improvements to the original model in areas where it was known to be weaker; for example considering:
- more storm events;
- the influence of buildings;
- the influence of the sewer system.

Two rainfall events, one with a 1 in 30 and the other with a 1 in 200 chance of occurring in any year, are modelled and mapped. The map shows Surface Water flooding greater than 0.1m deep, Deeper Surface Water Flooding greater than 0.3m deep and flooding between 0.1 and 0.3m deep. The 0.3m threshold was chosen as it represents a typical value for the onset of significant property damages when property flooding may start (above doorstep level) and because it is at around this depth that moving through floodwater (driving or walking) may become more difficult; both of which may lead users to consider the need to close roads or evacuate areas.

The AStSWF map indicates that the site is not located in an area susceptible to surface water flooding to depths >0.1m or >0.3m.

The FMfSW map is shown in Appendix E of the SFRA. The map shows that there are isolated areas in Wolvercote, Cutteslowe, New Botley, Osney, City Centre, Walton Manor, Littlemore, Blackbird Leys and New Headington which are at risk from depths of surface water flooding of greater than 0.3m.

The FMtSWF map indicates that the site is not located in an area susceptible to surface water flooding to depths >0.1m or >0.3m.

The SFRA does not have any recorded events of surface water flooding at the proposed development site.

The EA Indicative Surface Water Flood Map indicates that Abingdon Road is likely to be at risk of surface water flooding. However, the existing development site is indicated to be in an area at a very low to risk of surface water flooding (less than 1 in 1000 (0.1%) chance of flooding).

The proposed SuDS can provide betterment by reducing the post-development site's surface water run-off rate to below the existing Brownfield run-off rate, and consequently reduce flood risk to the site and the surrounding areas.

The SFRA does not identify any records of surface water flooding at the proposed site and the site is not located in a Critical Drainage Area.

There are no other known records of the property being flooded due to surface water. This indicates that the risk of flooding at the site due to surface water flooding is Low.

5.7. Water Infrastructure Failure

Flooding may result from the failure of engineering installations such as canals, reservoirs, flood defence, land drainage pumps, sluice gates and floodgates.

The SFRA states that consultation with the EA has revealed there to be no formal, permanent, flood defences for which the Agency is responsible for performance and maintenance within Oxford. The EA do own and deploy demountable flood defences at Osney Island and New Hinksey, these defences are erected as required during high water events.

There is an EA controlled 0.6m wide sluice gate (penstock) and 8 no. x 300mm diameter overflow pipes set in a stone headwall either side of an earth bank walkway, upstream of Hythe Bridge Street. This water level control is operated by the lock keeper at Osney.

The SFRA states that consultation with OCC confirmed that Oxford has no formal flood defences maintained by the council or riparian landowners.

As a result, the site is perceived to have a low risk of flooding from failure of flood defences.

The Indicative Reservoir Flood Risk Map included in Appendix A indicates that the site could potentially be at risk from failure of a reservoir structure.
The nearest reservoir is Farmoor Reservoir, which is located approximately 10km to the west of the site with a significant number of structures such as the A34 dual carriageway and other roads between the site and the reservoir.

Flooding from reservoirs is extremely unlikely. An area is considered at risk if peoples' lives could be threatened in the event of a dam or reservoir failure.

Therefore, the risk of flooding from water infrastructure failure is assessed as low.

6. Flood Resilience and Resistance

6.1. Floor Levels

For minor extensions or change of use of an existing building, ground floor levels should be set either:

- no lower than the building's existing Finished Floor Level (FFL).
- 300mm above the estimated flood level including an allowance for Climate Change

The 1 in 100 year + 26% CC flood level is 56.171m AOD. Ground floor levels should be set at either:

- The existing building's FFL of 55.950m.
- 56.471m, which is 300mm above the estimated flood level, including CC, of 56.171m.

At the request of the LLFA it is proposed to set the extension's FFL at 56.771, which is 600mm above the estimated flood level, including a 26% allowance for Climate Change, of 56.171m.

Extra flood resistance and resilience measures could be provided to a level of 600mm above the ground levels at the site. See Appendix 7.

6.2. Access and Evacuation

A Flood Action Plan, which includes an emergency escape plan should be produced and implemented for any parts of a building that are below the estimated flood level, which is the 100 year plus 26% CC flood event level of 56.171m AOD.

The Flood Action Plan should show:

- single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, eg higher ground nearby.
- basement rooms have clear internal access to an upper level, eg a staircase.
- how occupants can leave the building if there is a flood and there is enough time for them to leave after flood warnings

The existing and proposed extended building would be non-residential single storey. A Flood Action Plan and Flood Action Plan Training documents for the site have been included in Appendix 6. This identifies how occupants would leave the building prior to a flood.

There are no basement rooms within the proposed development.

The EA advises everyone to check whether their property is at risk of flooding. For properties that are at risk of flooding, the EA advises that they sign up to their free Floodline Warnings Direct service and prepare and implement a flood action plan as appropriate. It is advised that the proposed development is registered with the EA for free Floodline Warnings Direct service, at https://fwd.environment-agency.gov.uk/app/olr/home, which would benefit the occupants of the site during and after construction.

To ensure there is time for the property to be evacuated prior to a flood event, the property owner should sign up to the Floodline warning Service and implement the Flood Action Plan and Flood Action Plan Training documents for the site that have been included in Appendix 6.

6.3. Extra Flood Resilient and Resistant Mitigation Measures

When developments can't be located in a lower flood risk area, consideration should be given to the incorporation of flood resistance and resilience measures, if it is not possible to raise the development's ground floor levels above the estimated flood level for the site.

The type of flood resistance and resilience measures that should be utilized depends on the estimated depth in metres (m), the Design Flood Water Depth, which flood water would reach in the building.

For flood water depth up to 0.3m, the building or development should be designed to keep water out as much as possible. This is done by using materials that have low permeability (i.e. materials that water can't pass through such as impermeable concrete).

For flood water depth from 0.3m to 0.6m, the building or development should be designed to keep water out (unless there are structural concerns) by:

- using materials with low permeability to at least 0.3m
- using flood resilient materials (e.g. lime plaster) and design (raised electrical sockets)
- making sure there's access to all spaces to enable drying and cleaning

For flood water depth above 0.6m, the building or development should be designed to allow water to pass through the property to avoid structural damage by:

- using materials with low permeability to at least 0.3m.
- making it easy for water to drain away after flooding.
- making sure there's access to all spaces to enable drying and cleaning.

When floor levels cannot be raised 300mm above the estimated flood level, extra flood resistance and resilience measures must be included. These measures should protect the property to at least 300mm above the estimated flood level. The estimated flood level including an allowance for Climate Change is 56.171m.

The proposed development was perceived to be within Flood Zones 2 and 3. At the request of the LLFA it is proposed to set the extension's FFL at 56.771, which is 600mm above the estimated flood level, including a 26% allowance for Climate Change, of 56.171m.

Extra flood resistance and resilience measures could be provided to a level of 600mm above the ground levels at the site. See Appendix 7.

Therefore, flood resilient and resistant mitigation techniques, as identified in with “Improving the Flood Performance of New Buildings – Flood Resilience” and “Improving the Flood Resilience of Buildings through Improved Materials, Methods and Details” could be incorporated into the proposed development in line with the guidance for flood water depths up to 600mm. See information in Appendix 7.

During extreme flood events groundwater could rise up higher than the predicted levels. Therefore, a suitable Damp Proof Membrane (DPM) that extends up to a Damp Proof Course (DPC) 150mm above the external ground levels should be installed.

Non-return valves and backflow valves could be incorporated into the new drainage system, which would connect into the existing drainage system, to prevent the proposed development experiencing flooding from sewers.

7. Main River Bylaw Distance

In accordance with the Land Drainage Act 1976, The Water Resources Act 1991 and the Environment Act 1995 an Environmental Permit must be separately obtained from the EA for any work in, over, under or within the Bylaw distance of a Main River.

This is to ensure that the work activities do not cause or make existing flood risk worse, interfere with the EA’s work, and do not adversely affect the local environment, fisheries or wildlife.

The nearest Main Rivers are the River Thames, which is located approximately 500m to the east of the site and the Hinksey Stream that is located approximately 500m to the west of the site.

All works would be outside the 8m Main River Bylaw distance would not require an Environmental Permit granted by the EA.

8. Conclusions and Recommendations

When determining planning applications, paragraphs 159-169 of the NPPF (2021) require that local planning authorities should ensure flood risk is not increased elsewhere, and only consider development appropriate in areas at risk of flooding when informed by a site-specific FRA, which is compliant with the technical guidance to the NPPF, "Planning Practice Guidance Flood Risk and Coastal Change" (PPG FRCC), following the Sequential Test, and if required the Exception Test. More specifically, the site-specific FRA should seek to demonstrate 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;
- the 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.

The site is located to the south of Oxford city centre, to the west of Abingdon Road (A4144). The site can be located by Grid Coordinates 451835mE, 204250mN, and covers an area of approximately 356.1 m^2 (0.0356 hectares).

The site is bound to the north, south and west by both residential and commercial properties. The site is bound by the A4144, known as Abingdon Road, to the east.

The existing development consists of an existing single storey commercial unit with associated asphalt hardstanding and parking areas.

The proposed development includes a minor extension, which is less than the allowable 250m^2, to the existing building to increase the size of the building.

A review of available data including the EA flood maps and SFRA documents indicated that the site is at a low risk of flooding from ordinary watercourses and streams, surface water, sewer surcharging, water infrastructure failure, tidal and groundwater flooding.

The nearest Main Rivers are the River Thames, which is located approximately 500m to the east of the site and the Hinksey Stream that is located approximately 500m to the west of the site.

The online EA Indicative Flood Zone Map indicates that the site is located within Flood Zones 2 and 3, which has a Medium to High risk of fluvial flooding from Main Rivers.

Comparison of site levels with the EA's Product 4 Modelled Flood Level Data indicated that the site was located within Flood Zones 2 and 3a with a medium to high risk of flooding from main rivers.

The Historic Flood Maps indicate that the site itself has not been flooded by Main Rivers.

The Sequential Approach is not applicable due to the development being a small extension and conversion of an existing building.

The topographical survey shows the ground levels to be sloping from 55.950m AOD at the north west corner of the site, to 55.900m in the centre of the site, down to 55.610m AOD at the north east corner of the site.

The average ground level at the site is approximately 55.820m AOD. The finished floor levels (FFL) of the existing building is approximately 55.950m.

At the request of the LLFA it is proposed to set the extension's FFL at 56.771, which is 600mm above the estimated flood level, including a 26% allowance for Climate Change, of 56.171m.

Extra flood resistance and resilience measures could be provided to a level of 600mm above the ground levels at the site.

If the existing building is to be refurbished extra flood resilience and resistant mitigation measures could be used. Flood resistant barriers could be installed to a height of 600mm above ground level. Flood resilient materials and design can be used to a higher level as required.

To ensure there is time for the property to be evacuated prior to a flood event, the property owner should sign up to the Floodline warning Service.

A Flood Action Plan and Flood Action Plan Training has been prepared for the proposed development site. The Flood Action Plan should be implemented and followed on receipt of a flood warning.

Therefore, there are no perceived issues in respect of safe access/egress to the development as residents/customers would be able to evacuate in a timely manner prior to a flooding event.

The existing site has a total impermeable area of 356.1m^2 (0.0356 ha) and a total permeable area of 0.0m^2 (0.0000 ha). The site covers a total area of 356.1m^2 (0.0356 ha). Therefore, 0.0% of the existing site is permeable and 100.0% of the site is impermeable.

The proposed development has a total impermeable area of 204.4m^2 (0.0204 ha) and a total permeable area of 151.7m^2 (0.0152 ha). The site covers a total area of 356.1m^2 (0.0356 ha). Consequently, 57.4% of the proposed site is impermeable and 42.6% is permeable.

The development proposals include the implementation of the SuDS philosophy that would provide betterment by reducing the post-development's surface water run-off rate and volumes to below the existing Brownfield run-off rate, and consequently reduce flood risk to the site and the surrounding areas.

The proposed conceptual SuDS design is based on (1) "preventative" techniques in the form of permeable hard landscaping and (2) "source control" infiltrating SuDS techniques.

The above SuDS are sized to mitigate the 100 year storm including a 40% allowance for climate change, a 10% allowance for urban creep and with a zero piped outflow. That is, the new impermeable roof of the new building extension and the self-draining pervious paving are proposed to discharge to infiltrating SuDS with a zero piped discharge.

Consequently, with the proposed mitigating SuDS 63.0% of the site (0.0225 ha of impermeable roof and permeable paving) would not have a Greenfield or Brownfield run-off rate as they would discharge to zero piped outflow SuDS. Only the existing impermeable roof areas would have a run-off.

Accordingly, only 37.0% of the post development site would discharge surface water at the Brownfield run-off rate, reducing the run-off rate to below the existing site's Brownfield run-off rate, and mitigating Climate Change, this would provide betterment as less water would be discharged to the existing sewers and Main Rivers.

Therefore, the site's post development run-off rate could be reduced from 0.247 l/s to approximately 0.085 l/s through the utilization of mitigating SuDS, which is less than the site's existing Brownfield run-off rate of 0.385 l/s and the Greenfield run-off rate of 0.091 l/s.

The combination of oversized SuDS and the 40.1% reduction in impermeable area, as a result of the proposed development, provides a significant reduction in surface water run-off rates and volumes and accordingly, a significant reduction in flood risk to the site and the surrounding area.

Therefore, the implementation of the proposed oversized SuDS could provide a significant reduction in flood risk at and around the site.

Based on keeping water out, of the new extension, flood water could be displaced by the new extension. The average ground level is approximately 55.820m AOD. The estimated flood level including an allowance for Climate Change is 56.171m. This equates to an approximate flood water depth of 0.351m.

The proposed extension has a gross footprint of approximately 87.9m^2, which is less than the allowable 250m^2. As a result, the potential displaced flood water volume could be in the region of 30.851m^3 if flood water reached the predicted modelled flood levels.

To compensate for this potential loss of flood water storage volume the LLFA has confirmed that it would be acceptable to allow water to store below the ground floor of the new extension.

The net internal area below the ground floor of the proposed extension, which allows for the cavity walls, is 78.496m^2.

Therefore, based on a potential displaced water volume of 30.851m^3, there would need to be a void with a depth of 0.393m below the suspended ground floor slab.

The underside of the suspended ground floor would be set no lower than 56.171m AOD and the ground below the suspended ground floor would be set no higher than 55.778m AOD.

To ensure the void is retained 1m long grilles would be installed at no less than every 5m of wall. The grilles would be maintained as part of the SuDS system on an annual basis and after flood events. See planning elevation drawings for location of flood water grilles.

In light of the above, it has been demonstrated that the proposed Conceptual SuDS surface water management strategy ensures that:

- there would be no increase in run-off as a result of the proposed development,
- there would be no increased flood risk as a result of the proposed development,
- there would be a decrease in the site's overall run-off rates and volumes, as a direct result of the proposed development,
- the site's run-off rates would be reduced to less than the Brownfield run-off rates,
- the site's run-off rates would be reduced to less than the Greenfield run-off rates,
- there would be a decrease in flood risk as a result of the proposed development,
- betterment would be provided with regards to surface water reduction and flood risk reduction.

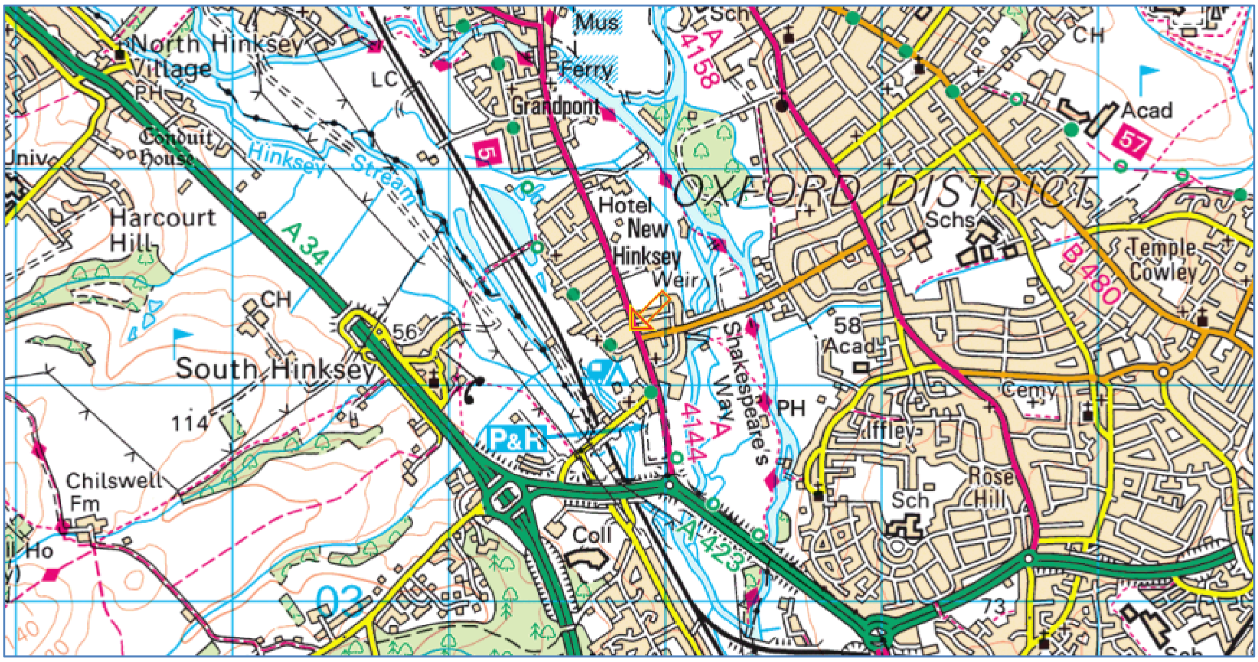
Based on the findings of this site-specific FRA the proposed SuDS SWMS is perceived to be feasible and consequently the development proposals are considered acceptable.

APPENDIX 1

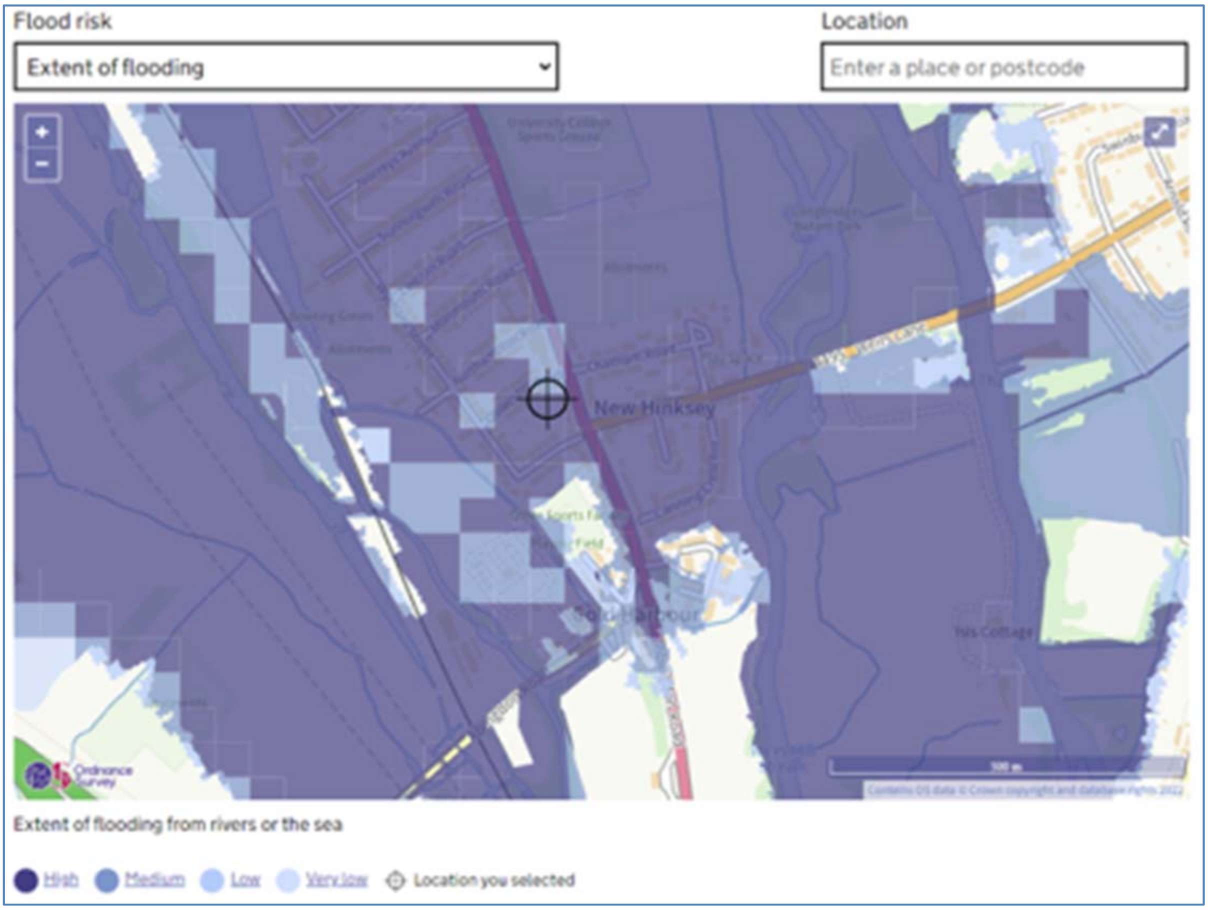
Site Location Maps

332 Abingdon Road, Oxford OX1 4TQ

Site Centre Grid Reference 451835mE, 204250mN



EA Indicative Main River Flood Zone Maps



Key:

Flood Zone 3 – Medium to High Risk

Flood Zone 2 – Low to Medium Risk

Flood Zone 1 – None to Low

Flood Defence Protected Area

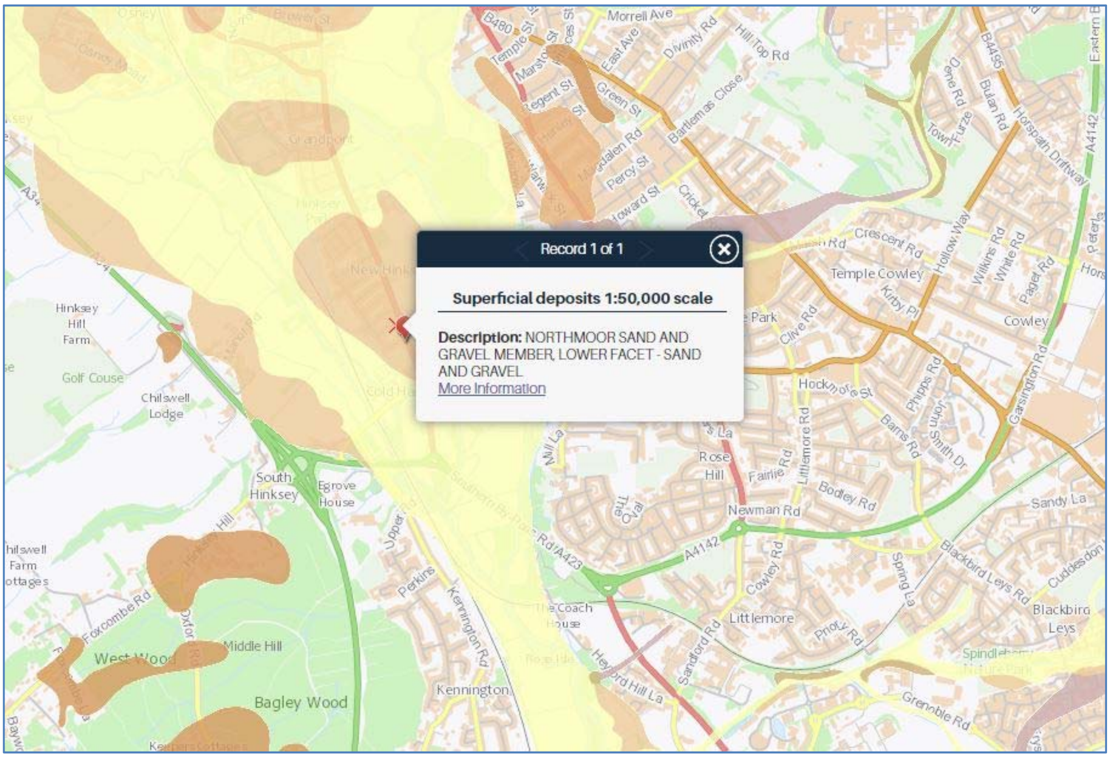
Flood Storage

Flood Defence

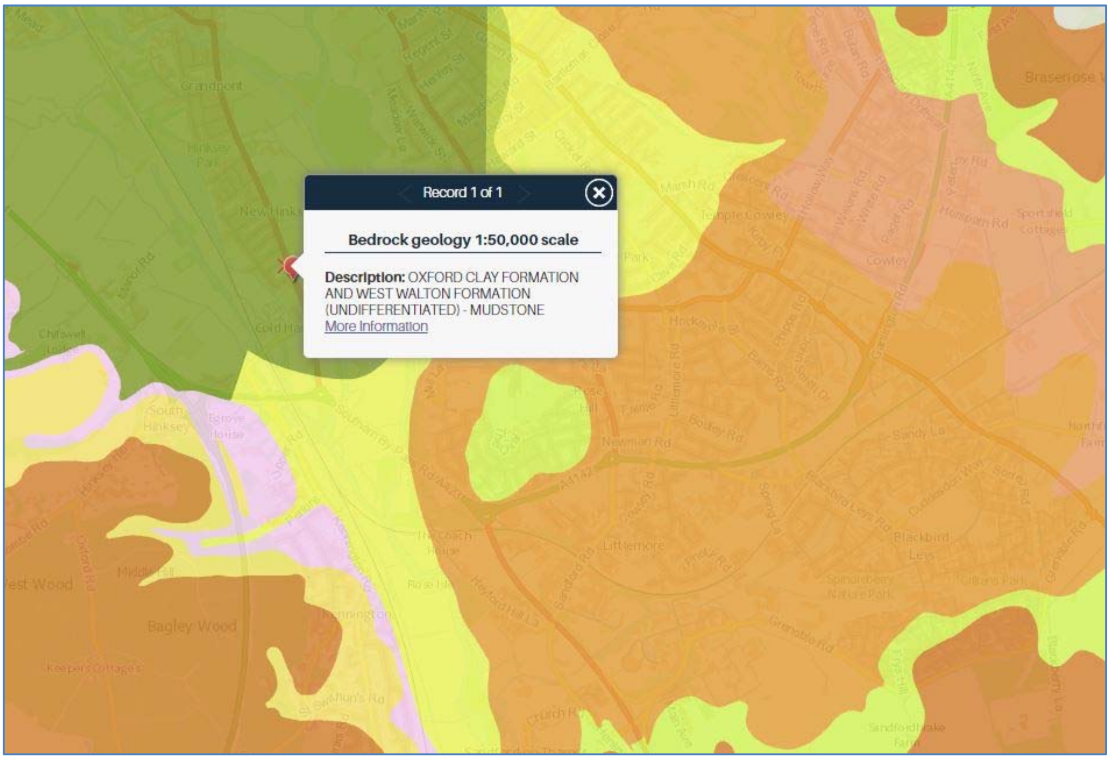
Main River

British Geological Survey Published Geological Maps

Superficial Drift Geology – Northmoor Sand and Gravel Member – Sand and Gravel.

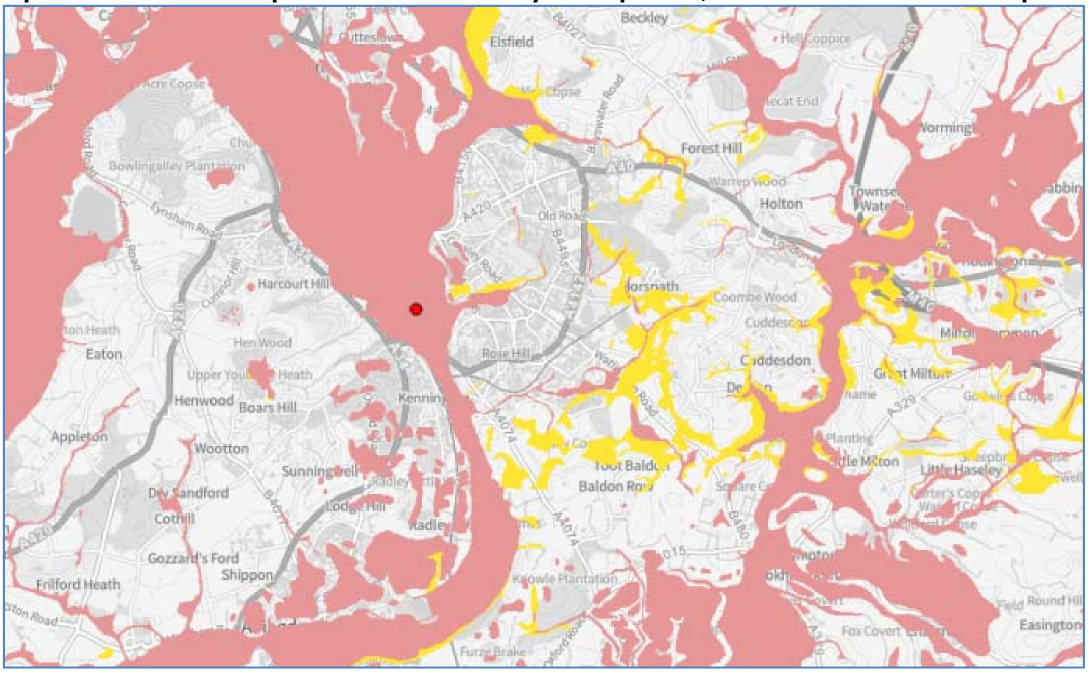


Bedrock Geology – Oxford Clay Formation and West Walton Formation – Mudstone

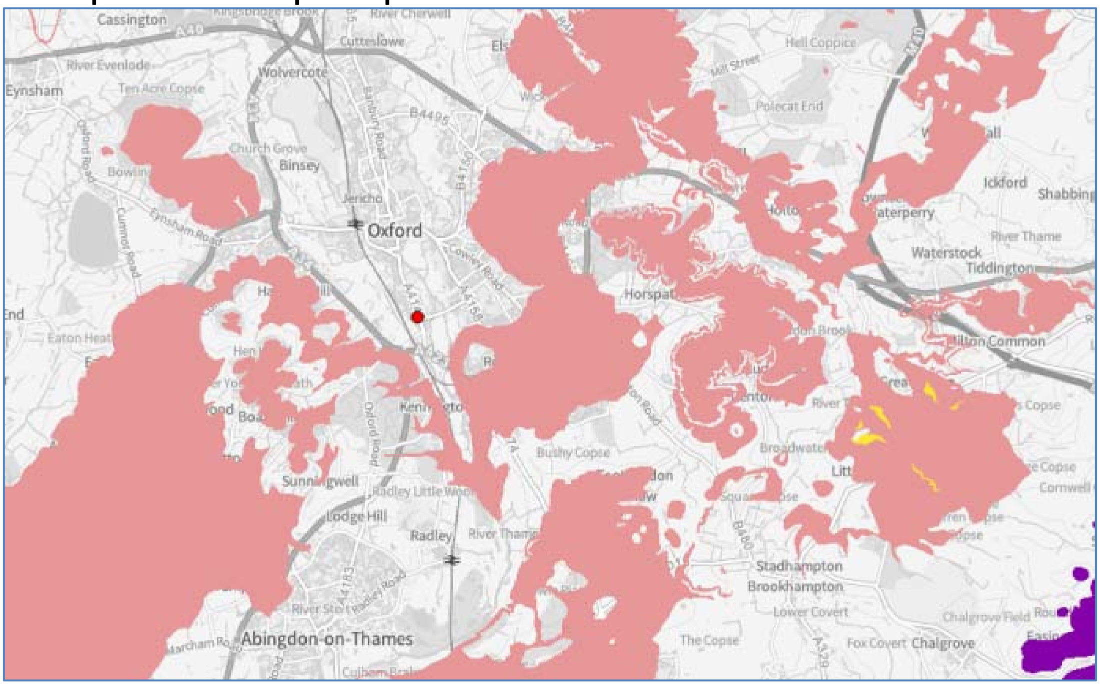


Published Aquifer Maps

Superficial Drift Aquifer – Secondary B Aquifer/ Undifferentiated Aquifer

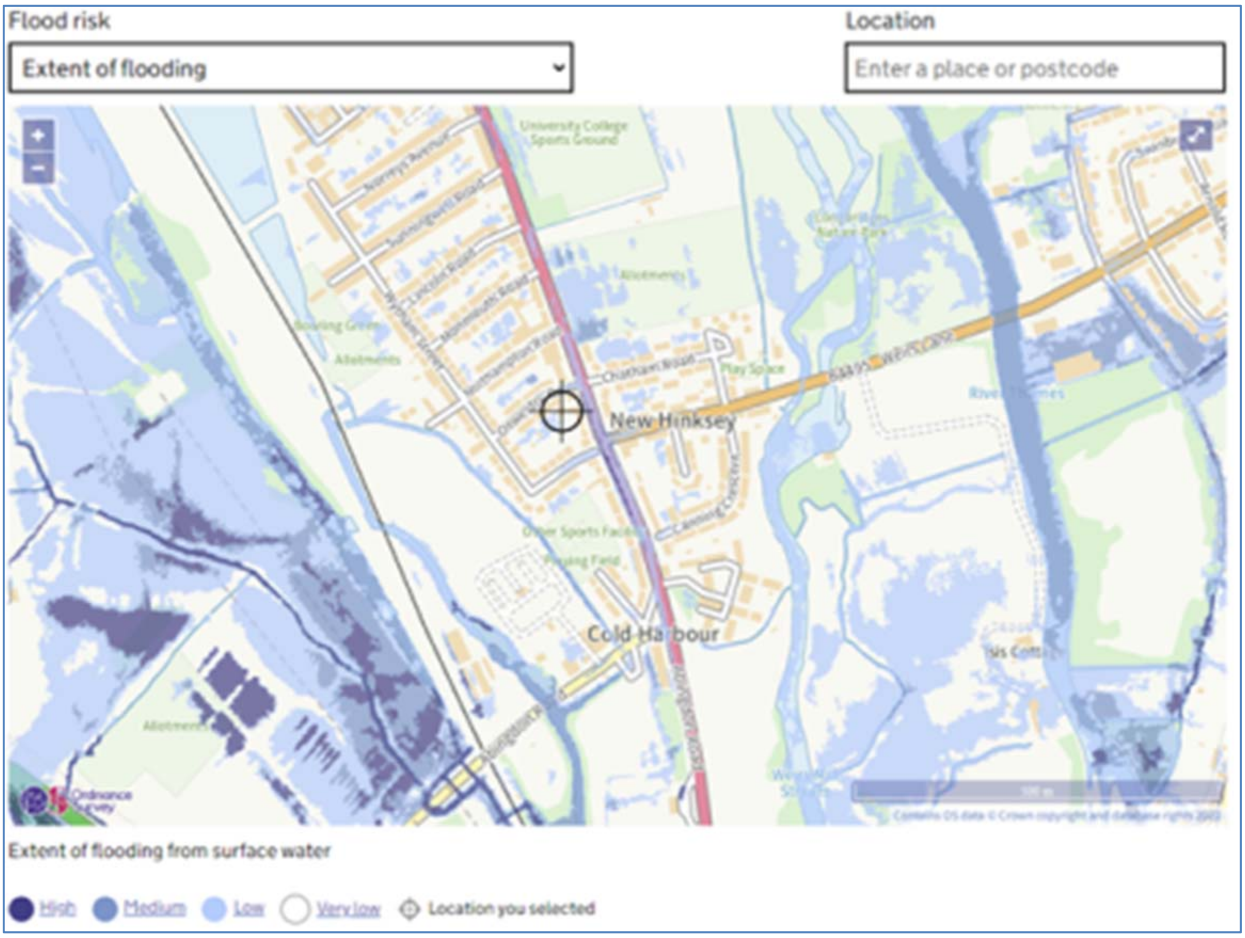


Bedrock Aquifer – Principle Aquifer



(purple)	Principal Aquifer
(pink)	Secondary A Aquifer
(orange)	Secondary B Aquifer
(yellow)	Secondary Undifferentiated Aquifer
(white)	Unproductive Strata – Non Aquifer

EA Indicative Surface Water Flood Map



Key

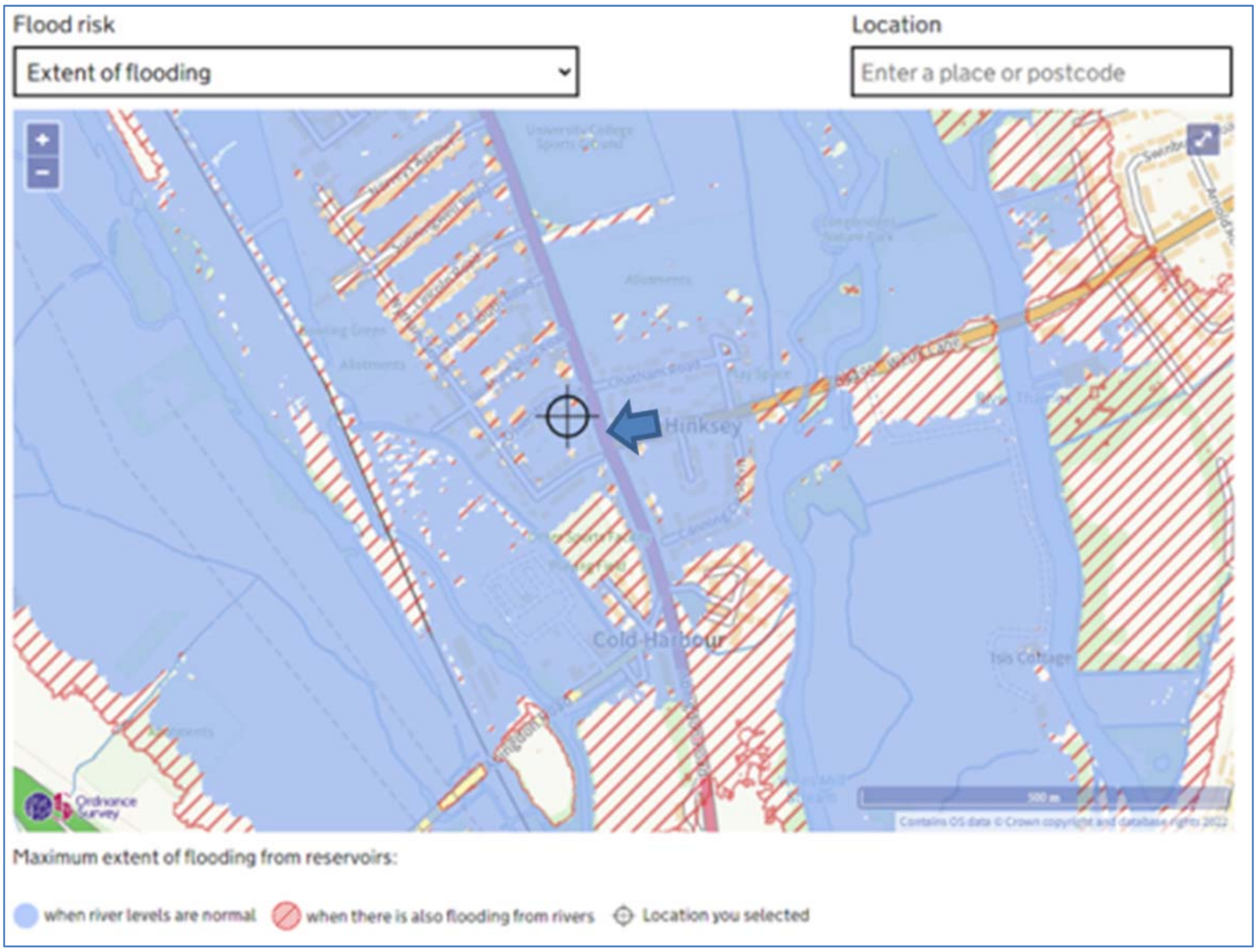
High

Medium

Low

Very Low

EA Indicative Reservoir Flood Map



Maximum extent of flooding from Reservoirs

Site Location

SP 50SW/7 5166.0482 1:236

WM. COULSON LTD.,

BOREHOLE LOG

Work for: Oxford City Council — Location: Scheme 'D'

B.H. No.: 31 — Type of boring: Shell and Auger

Date(s): 11 - 12 - 69 — Dia. of boring: 0·20 m

Ground Level: 55·25 — Lining tubes: to 3·05 m

Scale: 50:1 — C185

	Description of Strata	Reduced Level	Legend	Thickness	Depth	Samples Type	Samples Depth	NOTES
	TOPSOIL.			0·23	0·23			
ALLUVIUM	Soft brown organic silty CLAY.			1·19	1·42	B (15)	0·61 0·76 1·22	
FIRST TERRACE RIVER GRAVELS	Medium yellow brown clayey SAND and fine and medium GRAVEL.			1·02	2·44	B C	1·52 1·98 2·13	N = 18
	Medium yellow brown blowing SAND and fine and medium GRAVEL.			0·61	3·05	B C	2·44 2·89 3·05	N = 15
	Borehole Completed.							Water level:- 1st. encountered 1·42 m. p.m. 1·42 m.

M.D.A.S
8/89.

ABBREVIATIONS

Samples: J = Jar, W = Water; U4. No. of blows to take; S S.P.T.; CORE % Recovery

REMARKS:-

Product 4 (Detailed Flood Risk) for OX1 4TQ
Our Ref: THM285812

Product 4 is designed for developers where Flood Risk Standing Advice FRA (Flood Risk Assessment) Guidance Note 3 Applies. This is:
i) "all applications in Flood Zone 3, other than non-domestic extensions less than 250 sq metres; and all domestic extensions", and
ii) "all applications with a site area greater than 1 ha" in Flood Zone 2.

Product 4 includes the following information:

Ordnance Survey 1:25k colour raster base mapping;
Flood Zone 2 and Flood Zone 3;
Relevant model node locations and unique identifiers (for cross referencing to the water levels, depths and flows table);
Model extents showing *defended* scenarios;
FRA site boundary (where a suitable GIS layer is supplied);
Flood defence locations (where available/relevant) and unique identifiers; (supplied separately)
Flood Map areas benefiting from defences (where available/relevant);
Flood Map flood storage areas (where available/relevant);
Historic flood events outlines (where available/relevant, not the Historic Flood Map) and unique identifiers;
Statutory (Sealed) Main River (where available within map extents);

A table showing:
i) Model node X/Y coordinate locations, unique identifiers, and levels and flows for *defended* scenarios.
ii) Flood defence locations unique identifiers and attributes; (supplied seperately)
iii) Historic flood events outlines unique identifiers and attributes; and
iv) Local flood history data (where available/relevant).

Please note:

If you will be carrying out computer modelling as part of your Flood Risk Assessment, please request our guidance which sets out the requirements and best practice for computer river modelling.

This information is based on that currently available as of the date of this letter. You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

This information is provided subject to the enclosed notice which you should read.
This letter is not a Flood Risk Assessment. The information supplied can be used to form part of your Flood Risk Assessment. Further advice and guidance regarding Flood Risk Assessments can be found on our website at:

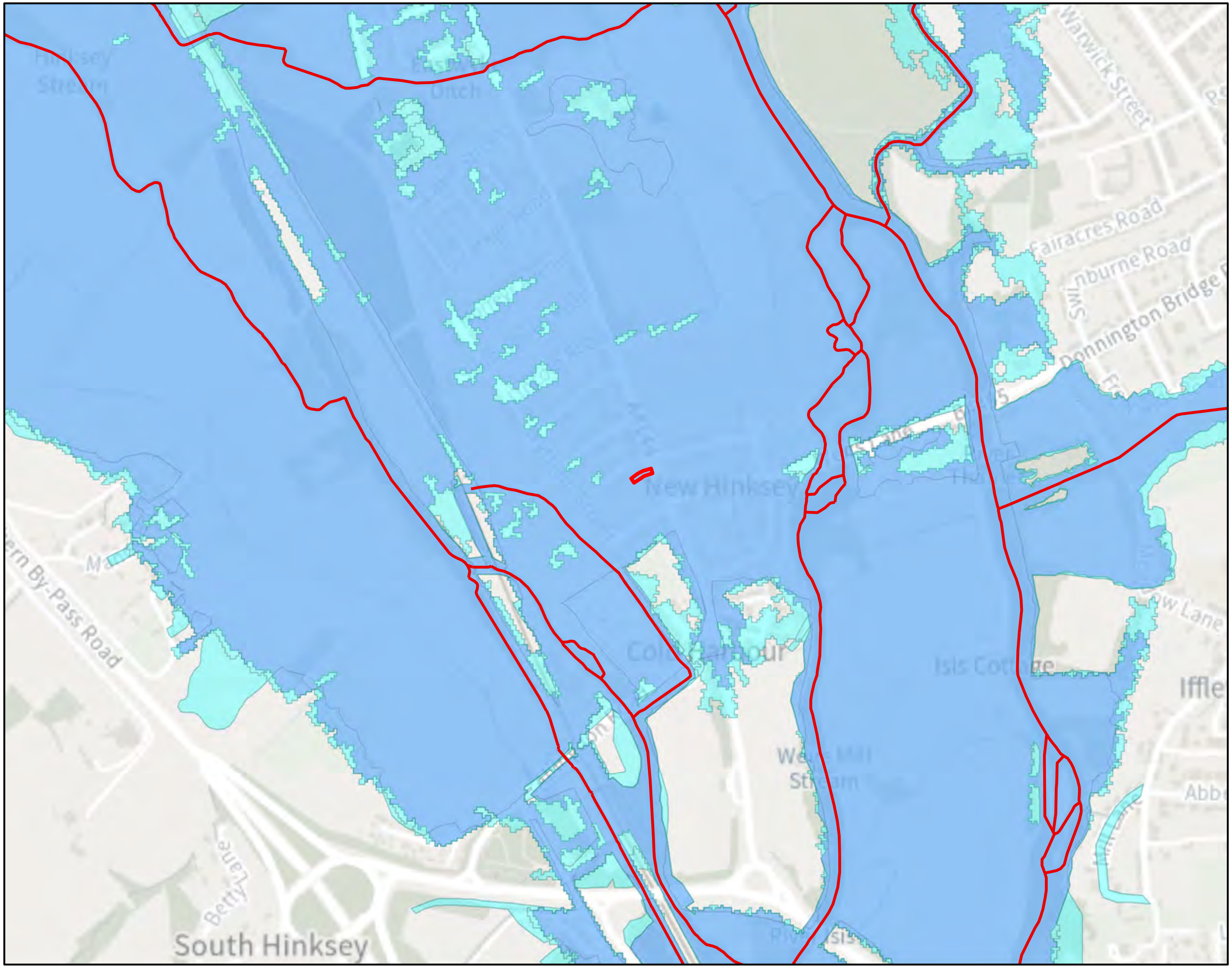
https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

If you would like advice from us regarding your development proposals you can complete our pre application enquiry form which can be found at:

https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Red Kite House, Howbery Park, Wallingford, Oxon OX10 8BD
Customer services line: 08708 506 506
Email: enquiries_THM@environment-agency.gov.uk

Flood Map for Planning centred on OX1 4TQ
Created on 16/12/2022 REF: THM285812



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Site
- Main River
- Flood defences
- Areas benefiting from flood defences
- Flooding from rivers or sea (FZ3)
- Extent of extreme flood (FZ2)
- Flood Map - flood storage areas

Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Defence information

THM285812

Defence Location:	No defences on Main River
Description:	This location is not currently protected by any formal defences and we do not currently have any flood alleviation works planned for the area. However we continue to maintain certain watercourses and the schedule of these can be found on our internet pages.

Model information

THM285812

Model: Thames (Eynsham to Sandford) 2018

Description: The information provided is from the Oxford Flood Alleviation Scheme mapping completed in March 2018. The project included updating the existing (2014) hydraulic model to support development of the outline FAS design. The study was carried out using 1D-2D modelling software (Flood modeller-Tuflow).

Model design runs:
1 in 2/ 50% AEP; 1 in 5 / 20% AEP; 1 in 10/ 10% AEP; 1 in 20 / 5% AEP; 1 in 50/ 2% AEP; 1 in 75 / 1.3% AEP; 1 in 100 / 1% AEP, 1 in 100+25% / 1% + 25% AEP with climate change; 1 in 100+35% / 1% + 35% AEP with climate change; 1 in 100+70% / 1% + 70% AEP with climate change; 1 in 200/ 0.5% AEP and 1 in 1000 / 0.1% AEP.

Mapped outputs:
1 in 2/ 50% AEP; 1 in 5 / 20% AEP; 1 in 10/ 10% AEP; 1 in 20 / 5% AEP; 1 in 50/ 2% AEP; 1 in 75 / 1.3% AEP; 1 in 100 / 1% AEP, 1 in 100+25% / 1% + 25% AEP with climate change; 1 in 100+35% / 1% + 35% AEP with climate change; 1 in 100+70% / 1% + 70% AEP with climate change; 1 in 200/ 0.5% AEP and 1 in 1000 / 0.1% AEP.

Modelled in-channel flood flows and levels

THM285812

The modelled flood levels and flows for the closest most appropriate model node points for your site that are within the river channel are provided below:

Node label	Model	Easting	Northing	Flood Levels (mAOD) 20% AEP	5% AEP	1% AEP	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2018_03_D-00600	Thames (Eynsham to Sandford) 2018	451598	204223	55.52	56.01	56.20	56.34	56.43	56.69	56.45
061_00_2018_03_D-00482	Thames (Eynsham to Sandford) 2018	451695	204167	55.51	55.99	56.18	56.32	56.40	56.66	56.42
061_00_2018_03_D-00412	Thames (Eynsham to Sandford) 2018	451743	204117	55.50	55.98	56.17	56.31	56.39	56.66	56.41
061_00_2018_03_D-00273	Thames (Eynsham to Sandford) 2018	451835	204013	55.48	55.96	56.17	56.31	56.40	56.65	56.42
061_00_2018_03_D-00182	Thames (Eynsham to Sandford) 2018	451887	203939	55.45	55.94	56.16	56.29	56.38	56.64	56.40
061_00_2018_03_N-00121	Thames (Eynsham to Sandford) 2018	451922	203890	55.38	55.69	55.86	56.01	56.10	56.46	56.12
061_00_2018_03_WMS.030	Thames (Eynsham to Sandford) 2018	452154	203974	55.01	55.23	55.52	55.80	55.94	56.32	55.98
061_00_2018_03_WMS.031	Thames (Eynsham to Sandford) 2018	452119	204124	55.05	55.26	55.54	55.84	55.98	56.35	56.01
061_00_2018_03_46h.070A	Thames (Eynsham to Sandford) 2018	452126	204186	55.09	55.31	55.59	55.87	56.01	56.37	56.04
061_00_2018_03_46j.040T	Thames (Eynsham to Sandford) 2018	452145	204374	55.41	55.75	55.97	56.14	56.26	56.59	56.29

Node label	Model	Easting	Northing	Flood Flows (m3/s) 20% AEP	5% AEP	1% AEP	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2018_03_D-00600	Thames (Eynsham to Sandford) 2018	451598	204223	2.71	6.27	8.25	9.84	10.37	12.36	10.45
061_00_2018_03_D-00482	Thames (Eynsham to Sandford) 2018	451695	204167	2.71	6.81	8.75	10.02	11.28	16.21	11.70
061_00_2018_03_D-00412	Thames (Eynsham to Sandford) 2018	451743	204117	2.71	6.75	8.71	10.32	10.50	14.24	10.76
061_00_2018_03_D-00273	Thames (Eynsham to Sandford) 2018	451835	204013	2.71	4.73	4.75	4.74	4.74	5.52	4.74
061_00_2018_03_D-00182	Thames (Eynsham to Sandford) 2018	451887	203939	2.71	4.75	5.17	5.42	5.96	7.81	6.14
061_00_2018_03_N-00121	Thames (Eynsham to Sandford) 2018	451922	203890	2.71	4.89	5.18	5.29	5.31	5.64	5.32
061_00_2018_03_WMS.030	Thames (Eynsham to Sandford) 2018	452154	203974	63.86	73.80	80.59	81.95	83.83	89.28	84.44
061_00_2018_03_WMS.031	Thames (Eynsham to Sandford) 2018	452119	204124	66.80	85.30	93.65	93.45	93.16	93.11	93.14
061_00_2018_03_46h.070A	Thames (Eynsham to Sandford) 2018	452126	204186	66.91	86.09	93.28	93.27	93.14	92.69	93.07
061_00_2018_03_46j.040T	Thames (Eynsham to Sandford) 2018	452145	204374	12.21	12.08	12.07	12.15	12.20	12.48	12.22

Note:

Due to changes in guidance on the allowances for climate change, the percentage increase in river flows above should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Modelled floodplain flood levels

THM285812

The modelled flood levels for the closest most appropriate model grid cells for your site are provided below:

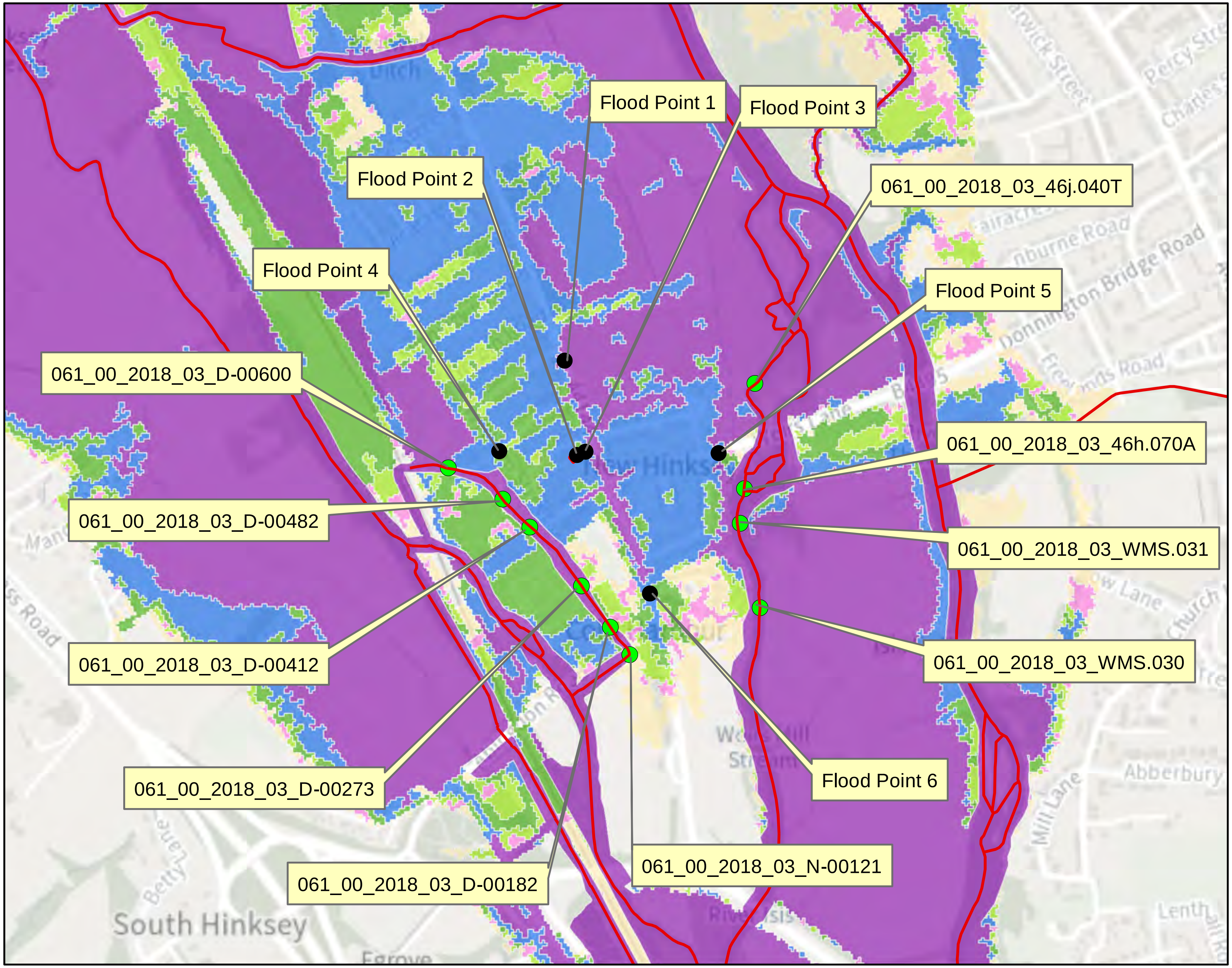
				flood levels (mAOD)						
2D grid cell reference	Model	Easting	Northing	20% AEP	5% AEP	1% AEP	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
Flood Point 1	Thames (Eynsham to Sandford) 2018	451806	204416	55.46	55.75	55.97	56.14	56.26	56.59	56.29
Flood Point 2	Thames (Eynsham to Sandford) 2018	451827	204247	No data	No data	55.98	56.16	56.27	56.59	56.30
Flood Point 3	Thames (Eynsham to Sandford) 2018	451843	204254	No data	55.77	55.97	56.14	56.26	56.58	56.29
Flood Point 4	Thames (Eynsham to Sandford) 2018	451687	204254	No data	56.00	56.16	56.26	56.35	56.63	56.37
Flood Point 5	Thames (Eynsham to Sandford) 2018	452080	204247	No data	No data	55.87	56.03	56.14	56.47	56.17
Flood Point 6	Thames (Eynsham to Sandford) 2018	451957	203999	No data	55.75	55.91	56.05	56.16	56.48	56.19

This flood model has represented the floodplain as a grid.
The flood water levels have been calculated for each grid cell.

Note:
Due to changes in guidance on the allowances for climate change, the percentage increase in river flows above should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Detailed FRA Map centred on OX1 4TQ
Created on 16/12/2022 REF: THM285812



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Main River
- Site
- Model Nodes
- 20% AEP Flood Outline
- 5% AEP Flood Outline
- 1% AEP Flood Outline
- 1%+25% CC AEP Flood Outline
- 1%+35% CC AEP Flood Outline
- 1%+70% CC AEP Flood Outline
- 0.1% AEP Flood Outline

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occuring in any given year

Where available climate change extents have been calculated with an additional flow added to an AEP event. An example of how this is written is 1%+20% AEP.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Historic flood data

THM285812

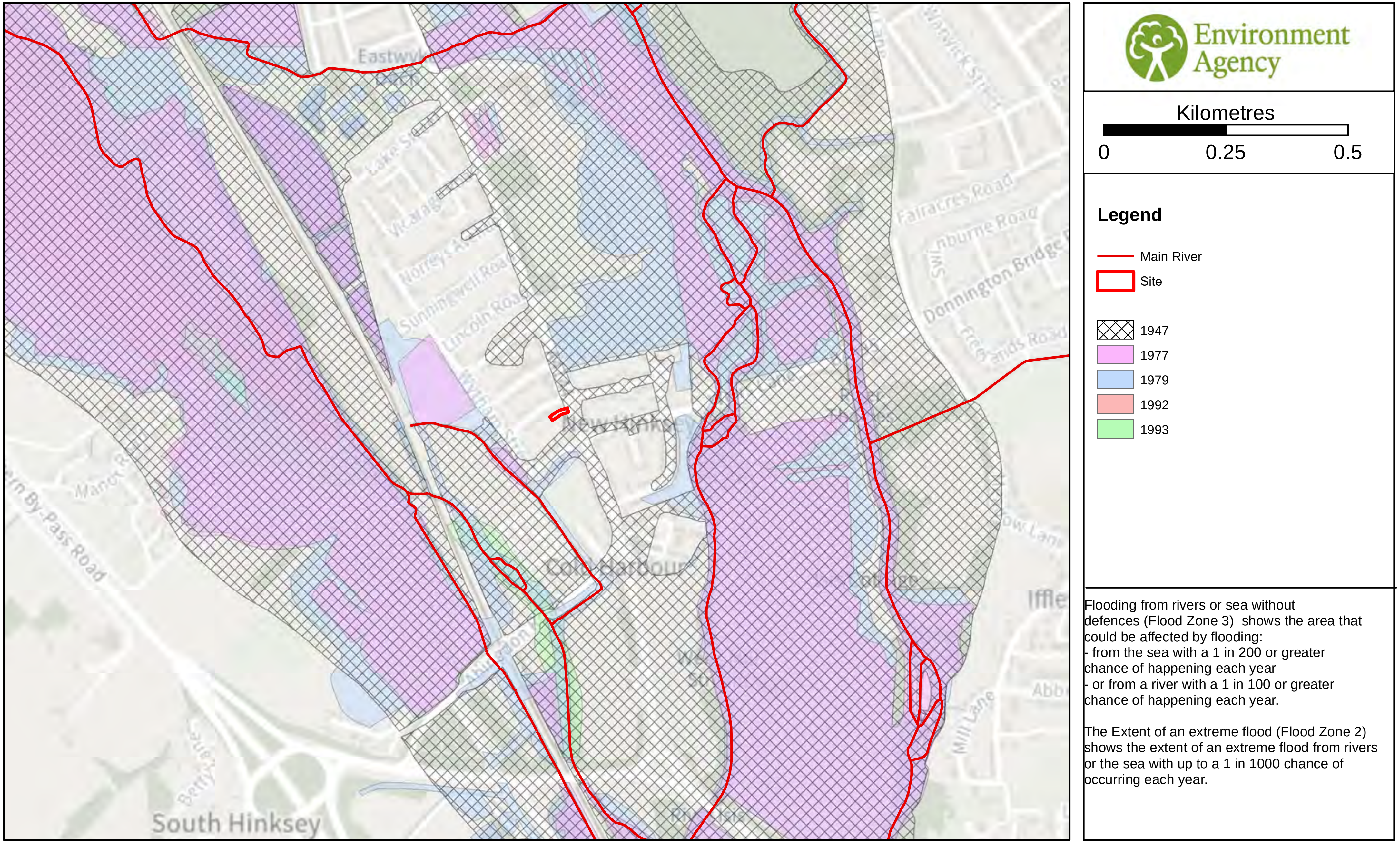
Our records show that the area of your site has been affected by flooding.
Information on the floods that have affected your site is provided in the table below:

Flood Event Code	Flood Event Name	Start Date	End Date	Source of Flooding	Cause of Flooding
EA0619470300039	06MarchSpring1947	01/01/1947	12/12/1947	main river	channel capacity exceeded (no raised defences)
EA0619770800415	06AugustSummer1977	01/01/1977	12/12/1977	main river	channel capacity exceeded (no raised defences)
EA0619790200072	06FebruaryWinter1979	01/01/1979	12/12/1979	main river	channel capacity exceeded (no raised defences)
EA0619920900340	06SeptemberAutumn1992	01/01/1992	12/12/1992	main river	channel capacity exceeded (no raised defences)
EA0619931000158	06OctoberAutumn1993	01/01/1993	12/12/1993	main river	channel capacity exceeded (no raised defences)
EA0619980400033	06AprilEaster1998	01/04/1998	30/04/1998	main river	channel capacity exceeded (no raised defences)
EA0620001200825	06DecemberWinter2000	01/01/2000	12/12/2000	main river	channel capacity exceeded (no raised defences)
EA0620030105155	06JanuaryNewYear2003	23/12/2002	12/01/2003	main river	channel capacity exceeded (no raised defences)
ea061162844	South Hinksey CP_Fluvia	19/07/2007	29/07/2007	main river	channel capacity exceeded (no raised defences)
ea061161045	South Hinksey CP_Fluvia	12/01/2008	20/01/2008	ordinary watercours	channel capacity exceeded (no raised defences)

Please note the Environment Agency maps flooding to land not individual properties. Floodplain extents are an indication of the geographical extent of a historic flood. They do not provide information regarding levels of individual properties, nor do they imply that a property has flooded internally.

Start and End Dates shown above may represent a wider range where the exact dates are not available.

Historic Flood Map centred on OX1 4TQ
Created on 16/12/2022 REF: THM285812

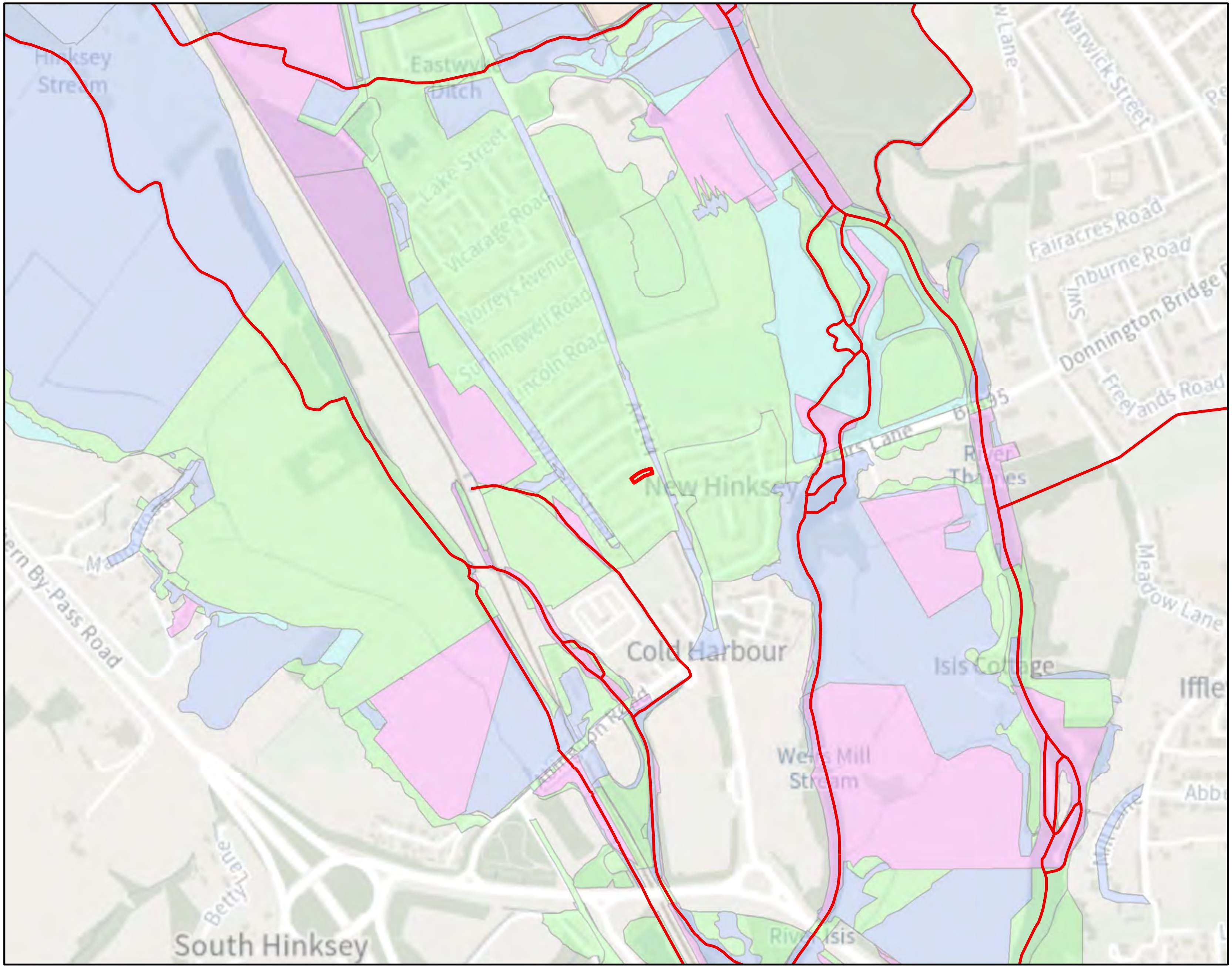


Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Historic Flood Map centred on OX1 4TQ
Created on 16/12/2022 REF: THM285812



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Main River
- Site
- 1998
- 2000
- 2002/3
- 2007
- 2008

Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Hazard Mapping (for the 1%+35% climate change scenario) THM285812

Hazard Mapping methodology:

To calculate flood hazard with the debris factor we have used the supplementary note to Flood Risk to People Methodology (see below).
The following calculation is used:

HR = d x (v+0.5) + DF

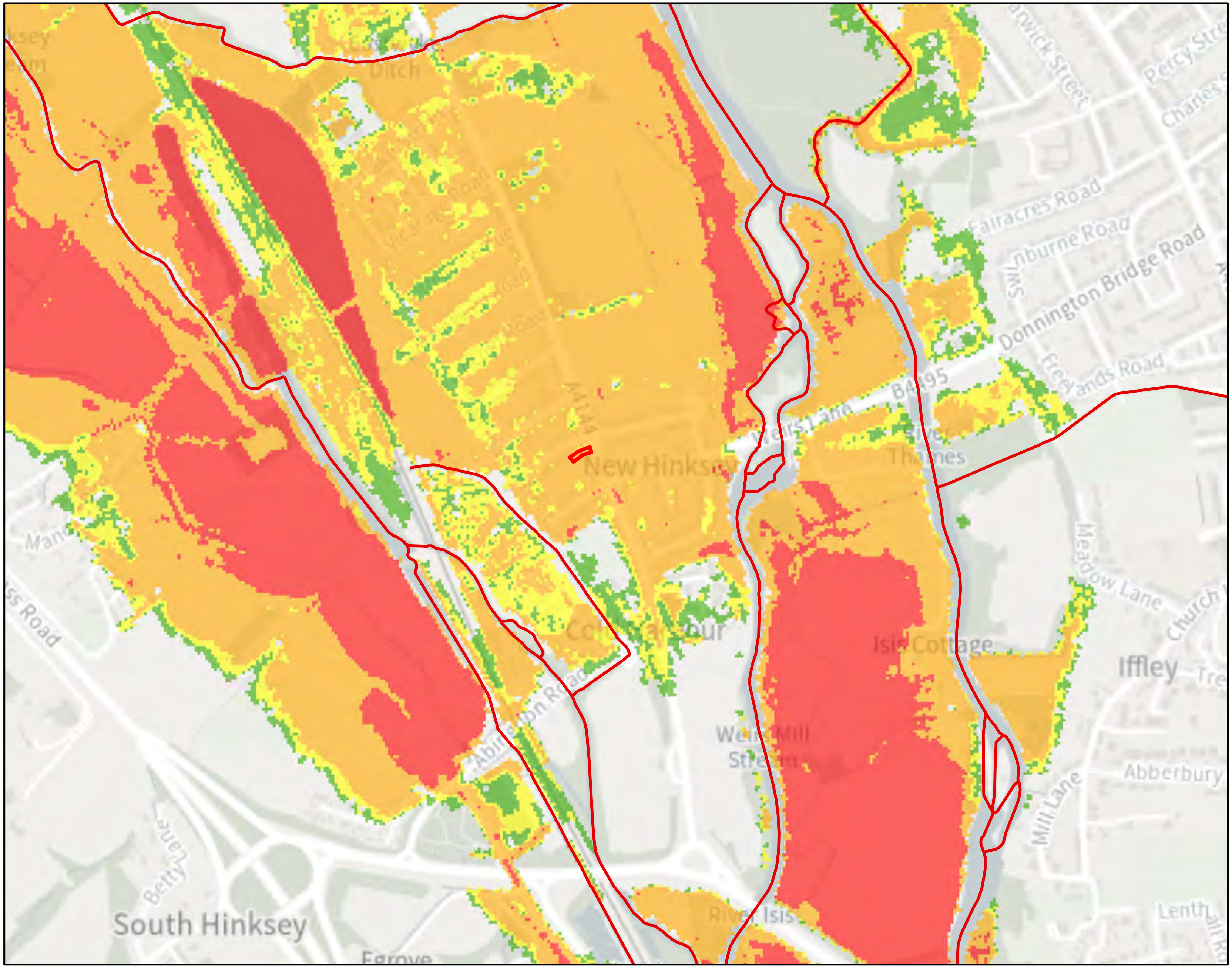
Where HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

The resultant hazard rating is then classified according to:

Flood Hazard	Colour	Hazard to People Classification	
Less than 0.75	(green)	Very low hazard	- Caution
0.75 to 1.25	(yellow)	Danger for some	- includes children, the elderly and the infirm
1.25 to 2.0	(orange)	Danger for most	- includes the general public
More than 2.0	(red)	Danger for all	- includes the emergency services

REF: HR Wallingford and Environment Agency (May 2008) Supplementary note of flood hazard ratings and thresholds for development planning and control purpose – Clarification of the Table 113.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1

Hazard Map centred on OX1 4TQ
Created on 16/12/2022 REF: THM285812



Environment Agency

Legend

- Main River
- Site
- Very low hazard
- Danger for some
- Danger for most
- Danger for all

For hazard and debris factor we used HR Wallingford and Environment Agency (May 2008) supplementary note on flood hazard ratings and thresholds for development planning and control purpose. The following calculation is used:

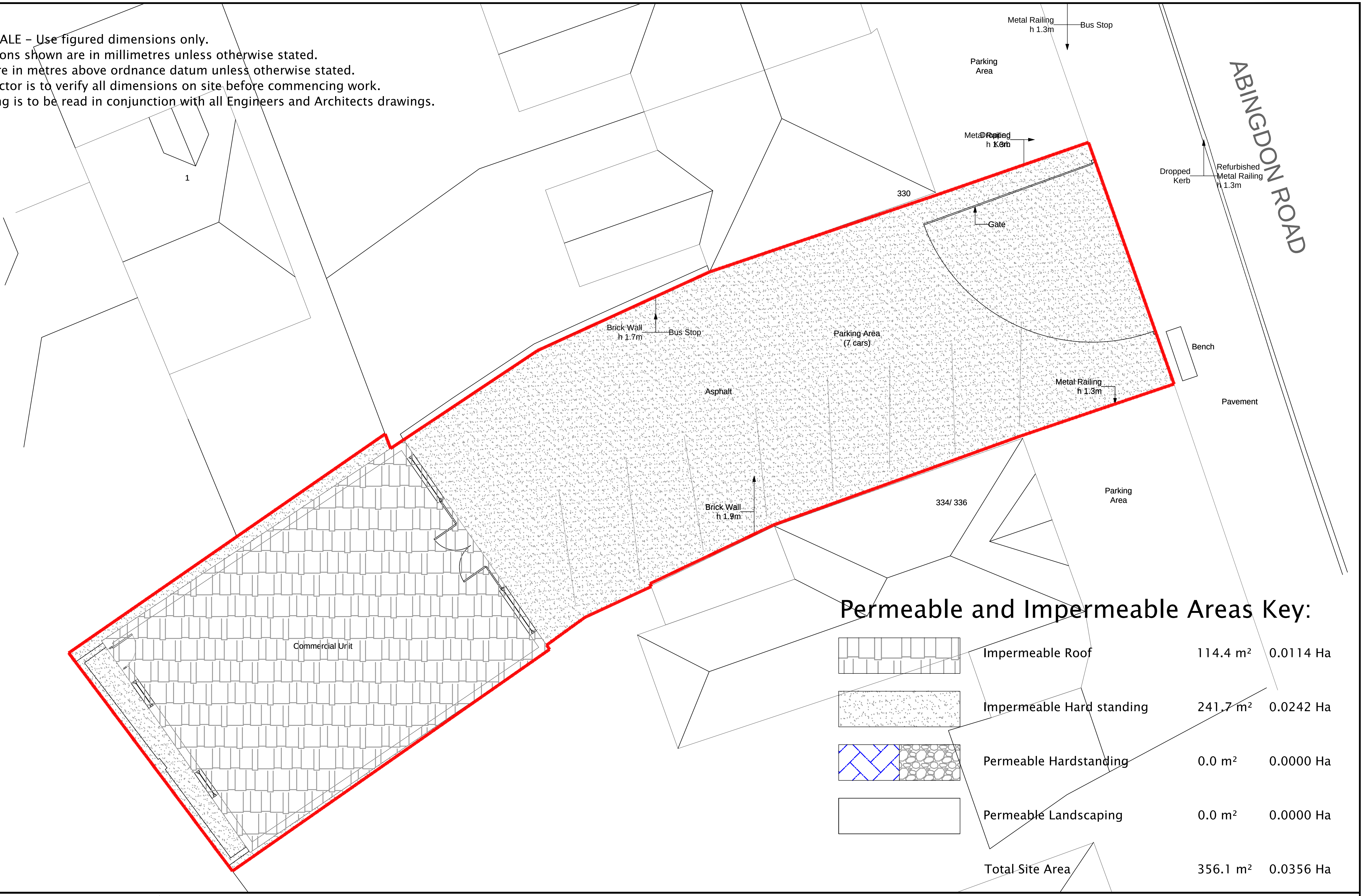
HR = d x (v+0.5) + DF
HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

APPENDIX 2

NOTES:

1. DO NOT SCALE - Use figured dimensions only.
2. All dimensions shown are in millimetres unless otherwise stated.
3. All levels are in metres above ordnance datum unless otherwise stated.
4. The Contractor is to verify all dimensions on site before commencing work.
5. This drawing is to be read in conjunction with all Engineers and Architects drawings.



Permeable and Impermeable Areas Key:

[hatch]	Impermeable Roof	114.4 m²	0.0114 Ha
[hatch]	Impermeable Hard standing	241.7 m²	0.0242 Ha
[hatch]	Permeable Hardstanding	0.0 m²	0.0000 Ha
[blank]	Permeable Landscaping	0.0 m²	0.0000 Ha
	Total Site Area	356.1 m²	0.0356 Ha

Client: Mr A Hassan

Project: 332 Abingdon Road, OX1 4TQ

Project Ref: FEDS-222106

Title: Existing Site Layout

Drawn by: DKP

Checked by: SLD

Size: A3

Date: 23.10.23

Scale: 1:125

Dwg.no: FEDS-222106-001

Rev: D

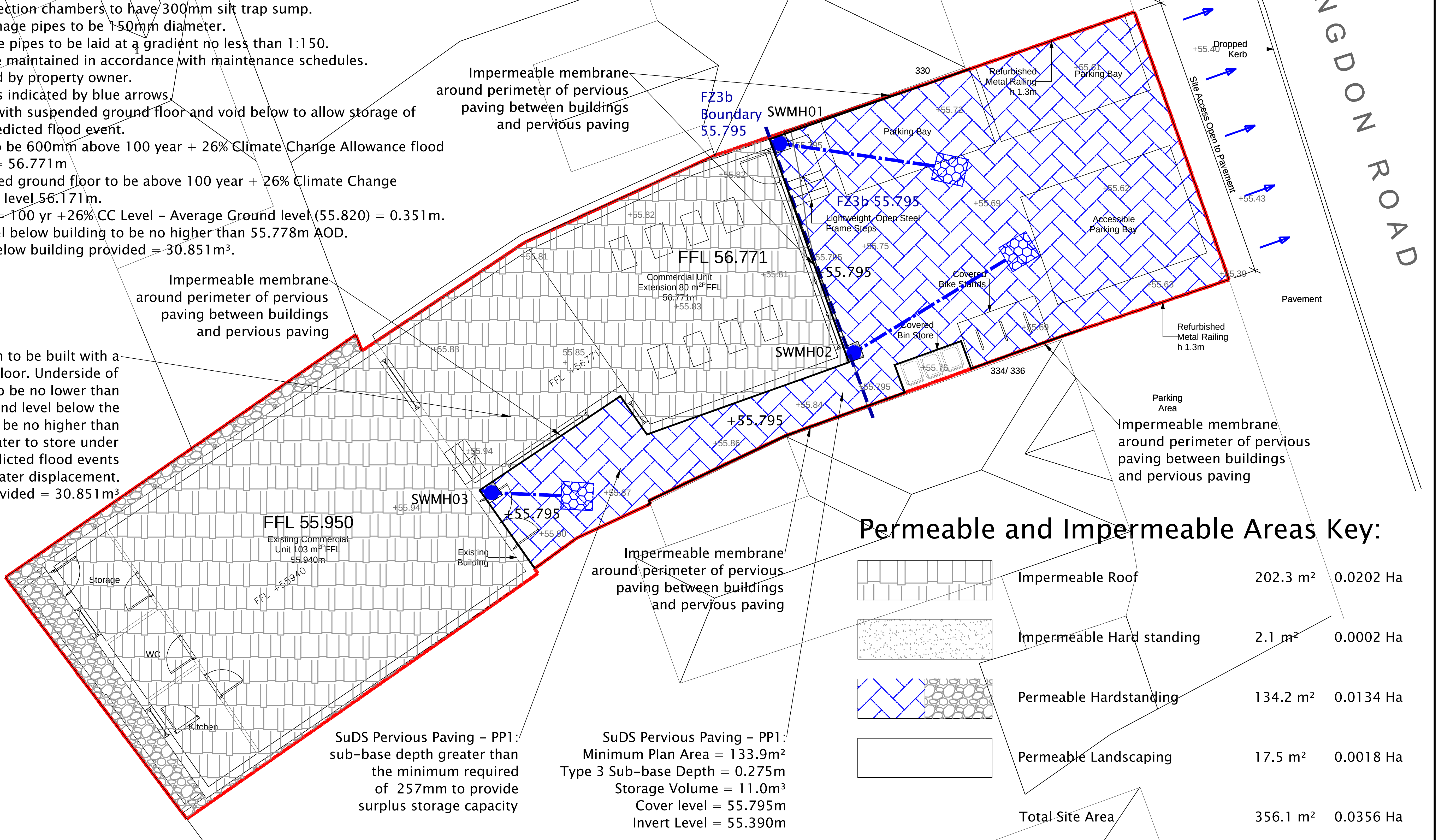
Forge Engineering Design Solutions
Forge House
30 Digging Lane
Fyfield, Abingdon
Oxfordshire, OX13 5LY
tel: 01865 362 780
info@f-eds.co.uk
www.f-eds.co.uk

NOTES:

1. DO NOT SCALE – Use figured dimensions only.
2. All dimensions shown are in millimetres unless otherwise stated.
3. All levels are in metres above ordnance datum unless otherwise stated.
4. The Contractor is to verify all dimensions on site before commencing work.
5. This drawing is to be read in conjunction with all Engineers and Architects drawings.
6. Site investigation indicates soakaway infiltration rate is 0.078 m/hr
7. All surface water inspection chambers to have 300mm silt trap sump.
8. All surface water drainage pipes to be 150mm diameter.
9. Surface water drainage pipes to be laid at a gradient no less than 1:150.
10. SuDS techniques to be maintained in accordance with maintenance schedules.
11. SuDS to be maintained by property owner.
12. Exceedance flow paths indicated by blue arrows.
13. Extension to be built with suspended ground floor and void below to allow storage of flood water during predicted flood event.
14. Finished Floor Level to be 600mm above 100 year + 26% Climate Change Allowance flood event level 56.171m = 56.771m
15. Underside of suspended ground floor to be above 100 year + 26% Climate Change Allowance flood event level 56.171m.
16. Depth of flood water = 100 yr +26% CC Level - Average Ground level (55.820) = 0.351m.
17. Maximum ground level below building to be no higher than 55.778m AOD.
18. Flood water volume below building provided = 30.851m³.

Manhole Schedule:

Reference:	Invert Level	Cover Level	Depth (m)	Diameter	Cover Grade
SWMH01	55.4416667	55.795	0.353	0.450	B125
SWMH02	55.4416667	55.795	0.353	0.450	B125
SWMH03	55.4416667	55.795	0.353	0.450	B125



Permeable and Impermeable Areas Key:

(hatch)	Impermeable Roof	202.3 m²	0.0202 Ha
(hatch)	Impermeable Hard standing	2.1 m²	0.0002 Ha
(hatch)	Permeable Hardstanding	134.2 m²	0.0134 Ha
(hatch)	Permeable Landscaping	17.5 m²	0.0018 Ha
	Total Site Area	356.1 m²	0.0356 Ha

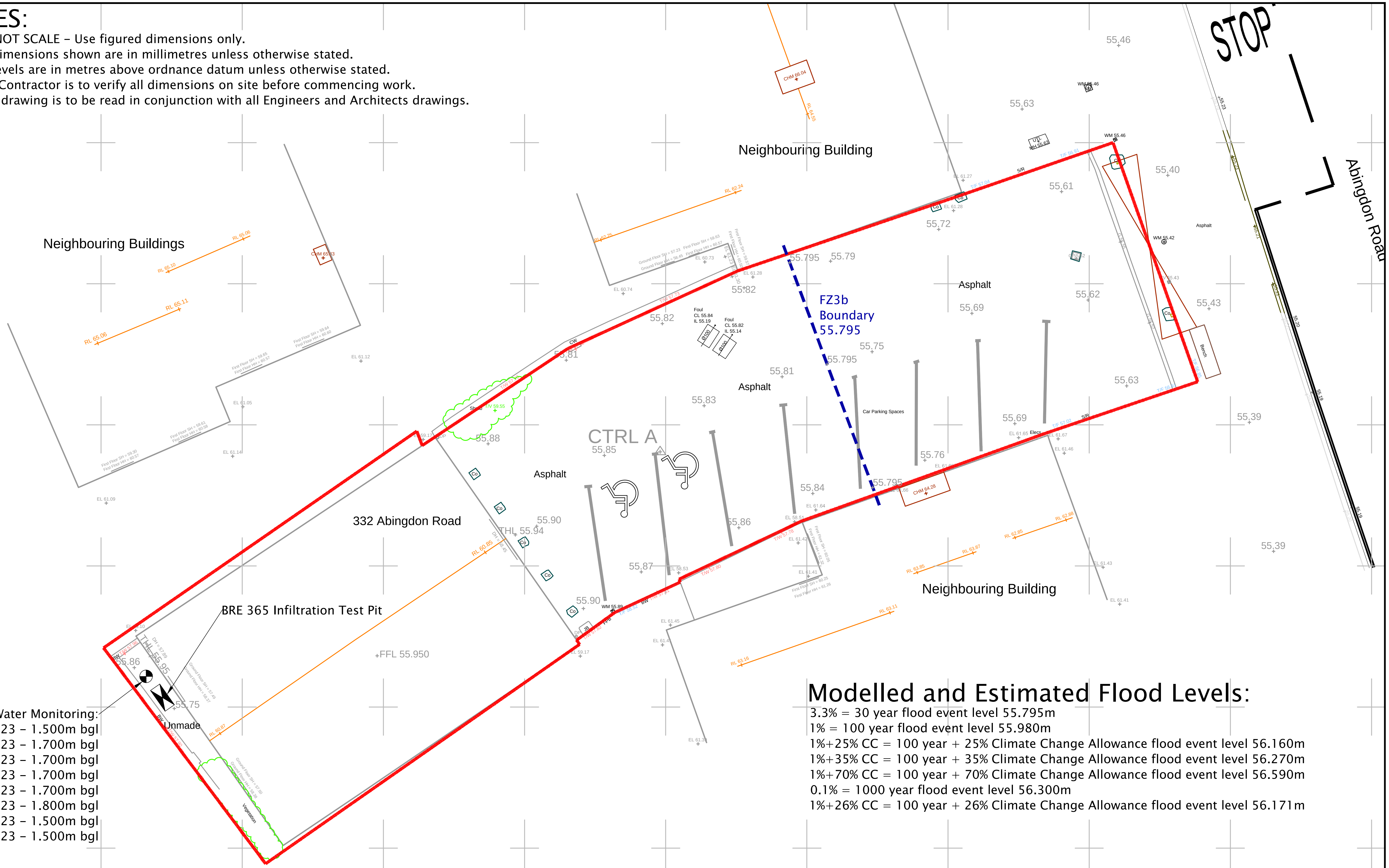
Client:	Project:	Title:	Drawn by:	Checked by:	Size:
Mr A Hassan	332 Abingdon Road, OX1 4TQ	Proposed Site Layout and SuDS	DKP	SLD	A3
	Project Ref: FEDS-222106		Date: 23.10.23	Scale: 1:125	
			Dwg.no: FEDS-222106-002	Rev: D	

Forge Engineering Design Solutions
Forge House
30 Digging Lane
Fyfield, Abingdon
Oxfordshire, OX13 5LY
tel: 01865 362 780
info@f-eds.co.uk
www.f-eds.co.uk

APPENDIX 3

NOTES:

1. DO NOT SCALE – Use figured dimensions only.
2. All dimensions shown are in millimetres unless otherwise stated.
3. All levels are in metres above ordnance datum unless otherwise stated.
4. The Contractor is to verify all dimensions on site before commencing work.
5. This drawing is to be read in conjunction with all Engineers and Architects drawings.



Ground Water Monitoring:
- 24.04.23 – 1.500m bgl
- 23.07.23 – 1.700m bgl
- 04.08.23 – 1.700m bgl
- 12.08.23 – 1.700m bgl
- 18.08.23 – 1.700m bgl
- 06.10.23 – 1.800m bgl
- 13.10.23 – 1.500m bgl
- 20.10.23 – 1.500m bgl

Modelled and Estimated Flood Levels:

3.3% = 30 year flood event level 55.795m
1% = 100 year flood event level 55.980m
1%+25% CC = 100 year + 25% Climate Change Allowance flood event level 56.160m
1%+35% CC = 100 year + 35% Climate Change Allowance flood event level 56.270m
1%+70% CC = 100 year + 70% Climate Change Allowance flood event level 56.590m
0.1% = 1000 year flood event level 56.300m
1%+26% CC = 100 year + 26% Climate Change Allowance flood event level 56.171m

Client: Mr A Hassan	Project: 332 Abingdon Road, OX1 4TQ	Title: Topographical Survey	Drawn by: DKP	Checked by: SLD	Size: A3	
	Project Ref: FEDS-222106		Date: 23.10.23	Scale: 1:125		
			Dwg.no: FEDS-222106-003		Rev: D	

Forge Engineering Design Solutions
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Oxfordshire, OX13 5LY
tel: 01865 362 780
info@f-eds.co.uk
www.f-eds.co.uk

APPENDIX 4

Asset location search

Thames Water Property Searches

Sarah Drew
Forge Engineering Design Solutions Ltd
FYFIELD
ABINGDON
OX13 5LY

Search address supplied	332 Abingdon Road Oxford OX1 4TQ
Your reference	N\A
Our reference	ALS/ALS Standard/2022_4724328
Search date	26 September 2022

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0800 009 4540

Asset location search

Thames Water Property Searches

Search address supplied: 332, Abingdon Road, Oxford, OX1 4TQ

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

An invoice is enclosed. Please send remittance to Thames Water Utilities Ltd., PO Box 3189, Slough, SL1 4WW.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

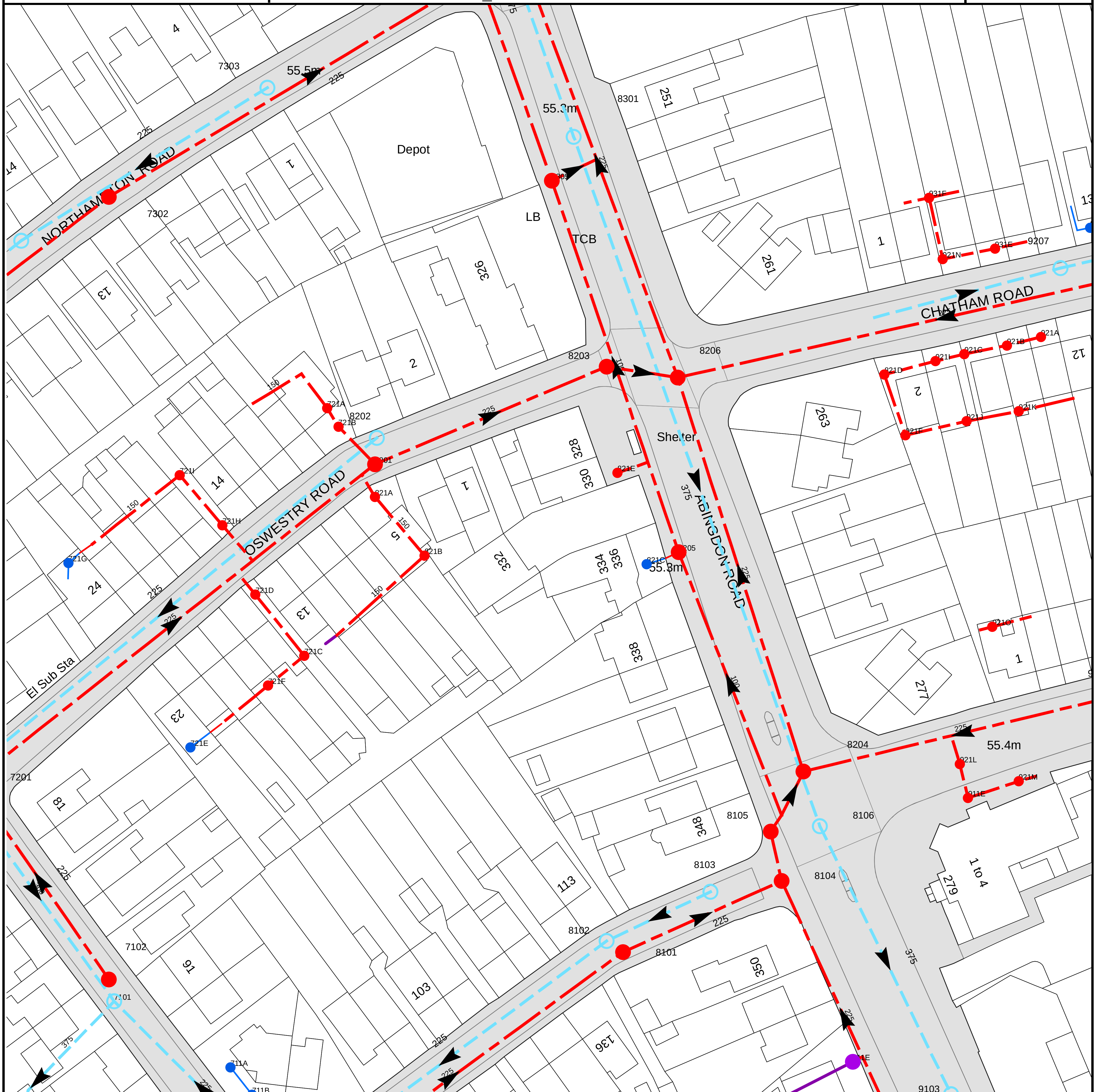
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2022_4724328



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 451835,204247

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
8301	55.43	54.06
7303	55.56	54.72
8205	55.21	54.46
821A	n/a	n/a
821E	n/a	n/a
8201	55.57	53.58
8202	55.61	54.68
821F	n/a	n/a
721B	n/a	n/a
921J	n/a	n/a
921K	n/a	n/a
721A	n/a	n/a
8206	55.47	52.75
821D	n/a	n/a
8203	55.41	53.44
921I	n/a	n/a
921C	n/a	n/a
921B	n/a	n/a
921A	n/a	n/a
9207	n/a	n/a
921N	n/a	n/a
931E	n/a	n/a
931G	n/a	n/a
931F	n/a	n/a
8305	n/a	n/a
7301	55.71	54.57
721G	n/a	n/a
7302	55.68	53.65
7102	56.01	54.57
7101	55.99	53.97
721I	n/a	n/a
721E	n/a	n/a
721H	n/a	n/a
711A	n/a	n/a
721D	n/a	n/a
9103	55.31	53.96
811E	n/a	n/a
8101	55.37	53.36
8102	55.37	54.42
8103	55.33	54.48
8104	55.38	53.13
8105	55.41	53.11
8106	55.4	53.98
911E	n/a	n/a
921M	n/a	n/a
8204	55.34	52.99
921L	n/a	n/a
721F	n/a	n/a
721C	n/a	n/a
921O	n/a	n/a
821C	n/a	n/a
821B	n/a	n/a

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

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

Sewer Fittings

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

- Air Valve
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- Weir

End Items

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

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

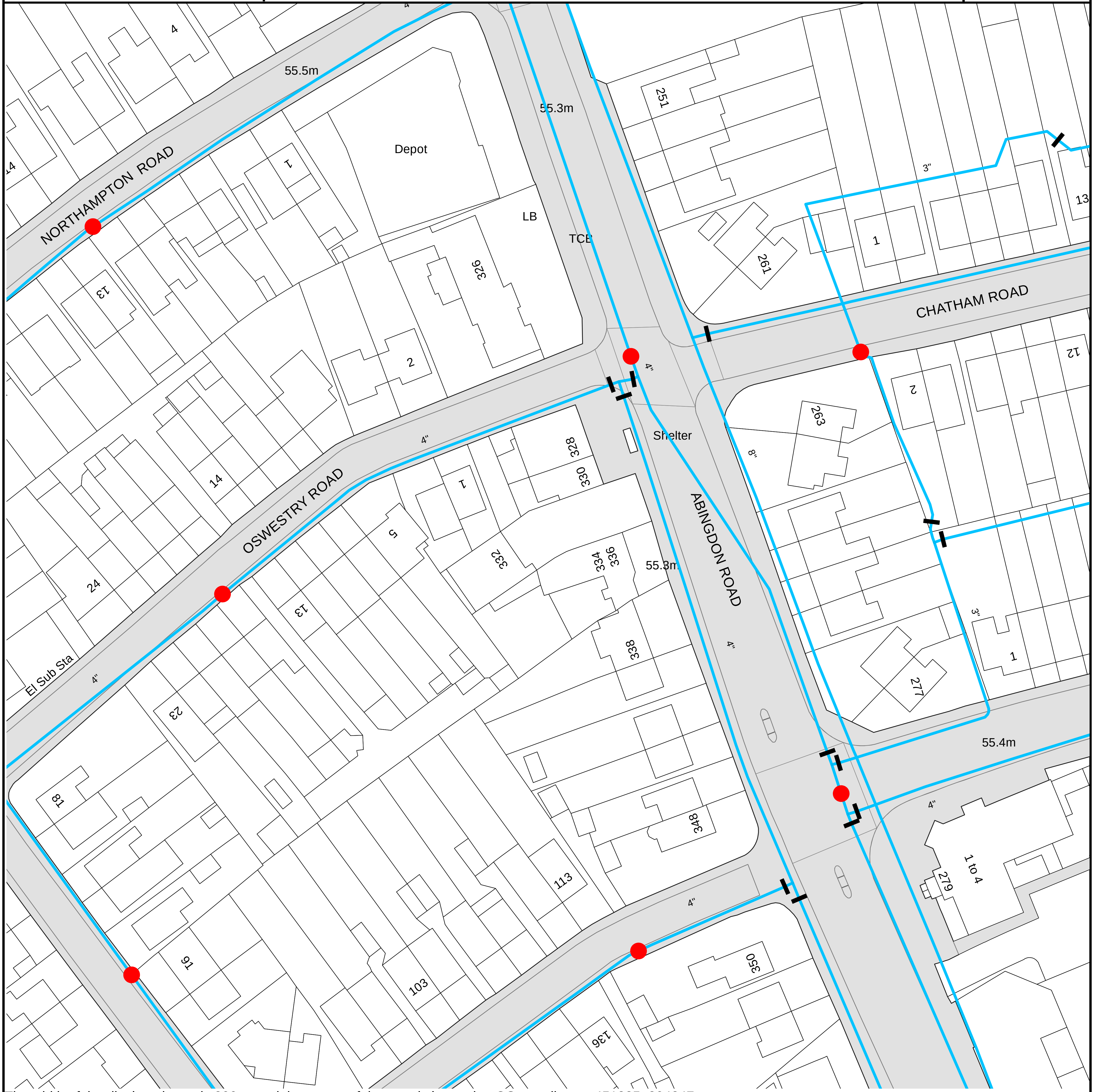
Ducts or Crossings

- Casement
- Conduit Bridge
- Subway
- Tunnel

Ducts may contain high voltage cables. Please check with Thames Water.

Notes:
1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Asset Location Search Water Map - ALS/ALS Standard/2022_4724328



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 451835, 204247.

Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

Casement: Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call **0800 009 4540** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

INVOICE

Sarah Drew
Forge Engineering Design Solutions Ltd
30 Forge House
Digging Lane
Abingdon
OX13 5LY

Thames Water Utilities Ltd.
PO Box 3189
Slough
SL1 4WW

Customer Reference: N\A

Customer Number: ADS128186
Purchase Order No:

Invoice No: ADS22410150
Our Ref: ALS/ALS Standard/2022_4724328
Posting Date: 26-09-2022
Due Date: 10-10-2022

Search Address Supplied: 332, Abingdon Road, Oxford, OX1 4TQ

Description of Charges	Qty	Unit Price	VAT (20%)	Amount (Inc VAT)
Asset Location Search	1	£49.80	£9.96	£59.76

OUTSTANDING AMOUNT (Inc. VAT) £59.76

Please send any outstanding amount to Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.

Your payment terms are within 14 days. Please see previous page for ways to pay.

For queries please contact the Property Searches Customer Support Team on Tel: 0800 009 4540.

VAT Reg. No GB 537456915

Girobank Trans cash

Girobank plc Bootle Merseyside GIR 0AA

Payment slip

bank giro credit

138
208
70

Reference (customer account number): ADS128186 / ADS22410150

Credit account number: 257 1706

Amount due (40p fee payable at PO counter): £ 59.76

Cheque NOT acceptable at Post Office

By transfer from Alliance and Leicester Giro account number

Cashiers stamp and initials

Signature

Date

Forge Engineering Design Solutions Ltd
30 Forge House
Digging Lane
Abingdon
OX13 5LY

NatWest
Collection Account
Thames Water
Utilities Ltd

Cash

Cheques

£

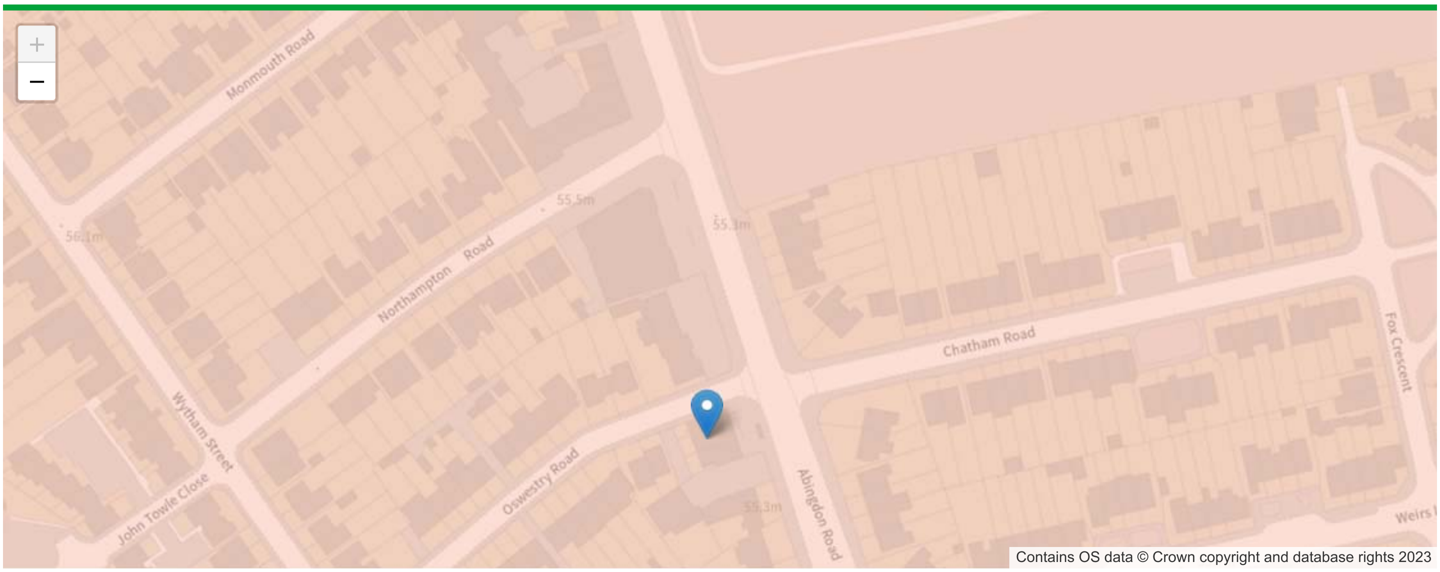
57-17-06

Items Fee

Paragon 9530 01/2004

Please do not write or mark below this line and do not fold this counterfoil

APPENDIX 5



Gloucestershire and the Vale Management Catchment peak river flow allowances

	Central	Higher	Upper
2020s	11%	17%	33%
2050s	11%	19%	43%
2080s	26%	41%	84%

This map contains information generated by UK Centre for Ecology and Hydrology using UK Climate projections.

Project No.	FEDS-222106	By:	SD	Chkd:	DKP
Title	332 Abingdon Road, Oxford OX1 4TQ				
Sheet No.	1	Date:	January 2022		

Test Date: 11th January 2022

Weather conditions: Light rain

1. INPUTS

Trial Pit Dimensions

Length	0.800	m
Width	0.900	m
Depth	1.000	m
Inlet Depth	0.640	m
Effective Depth	0.360	m

Soil Infiltration Rate = $\frac{Vp_{75-25}}{ap_{50} \times tp_{75-25}}$

Vp_{75-25} the effective storage volume of water in the trial pit between 75% and 25% effective depth = 0.130 m^3

ap_{50} the internal surface area of the trial pit up to 50% effective depth and including the base = 1.332 m^2

tp_{75-25} the time for the water level to fall from 75% and 25% effective depth = 75.2 minutes 4509.9 seconds (lowest)

f = **Soil Infiltration Rate for Design** = **2.2E-05** m/s (lowest)

= **0.078** m/hr (lowest)

2. INPUT OF PERMEABILITY TEST DATA

TEST 1

Time	Water level	Water Depth
0	570	430
4	670	330
9	710	290
14	740	260
19	770	230
24	790	210
29	800	200
34	810	190
38	810	190
45	870	130
52	920	80
55	940	60
60	1000	0

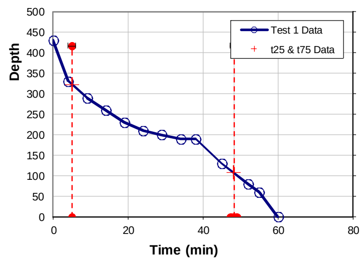
TEST 2

Time	Water level	Water Depth
0	650	350
7	705	295
13	740	260
17	750	250
21	760	240
25	770	230
33	775	225
36	780	220
42	790	210
46	800	200
51	805	195
56	815	185
64	820	180
67	855	145
70	880	120
75	910	90
80	950	50
89	1000	0

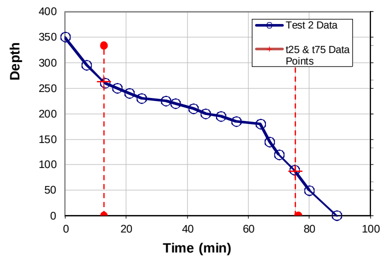
TEST 3

Time	Water level	Water Depth
0	640	360
5	720	280
10	735	265
15	750	250
23	760	240
26	770	230
32	780	220
35	790	210
41	795	205
45	800	200
51	830	170
55	850	150
61	860	140
65	870	130
71	880	120
77	895	105
80	905	95
87	915	85
92	925	75
95	930	70
101	940	60
103	950	50

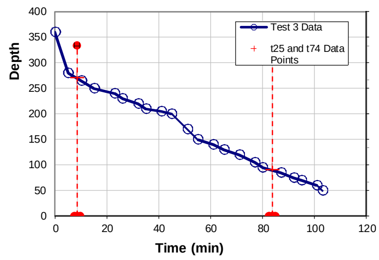
3. DATA ANALYSIS



Depth at t=	430			
Depth 75%	322.5			
Depth 25%	107.5			
5	322.5			
48	107.50			
tp75-25	43	minutes	2593	seconds
f1 =	3.75E-05	m/s		



Depth at t=0	350			
Depth 75%	262.5			
Depth 25%	87.5			
13	262.50			
75	87.50			
tp75-25	63	minutes	3764	seconds
f2 =	2.58E-05	m/s		

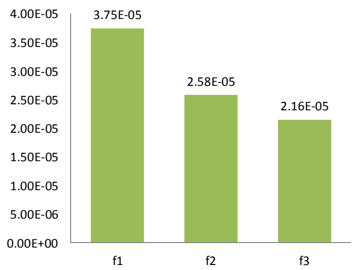


Depth at t=C	360			
Depth 75%	270			
Depth 25%	90			
8.3	270.00			
83.5	90.00			
tp75-25	75	minutes	4510	seconds
f3=	2.16E-05	m/s		

4. SUMMARY

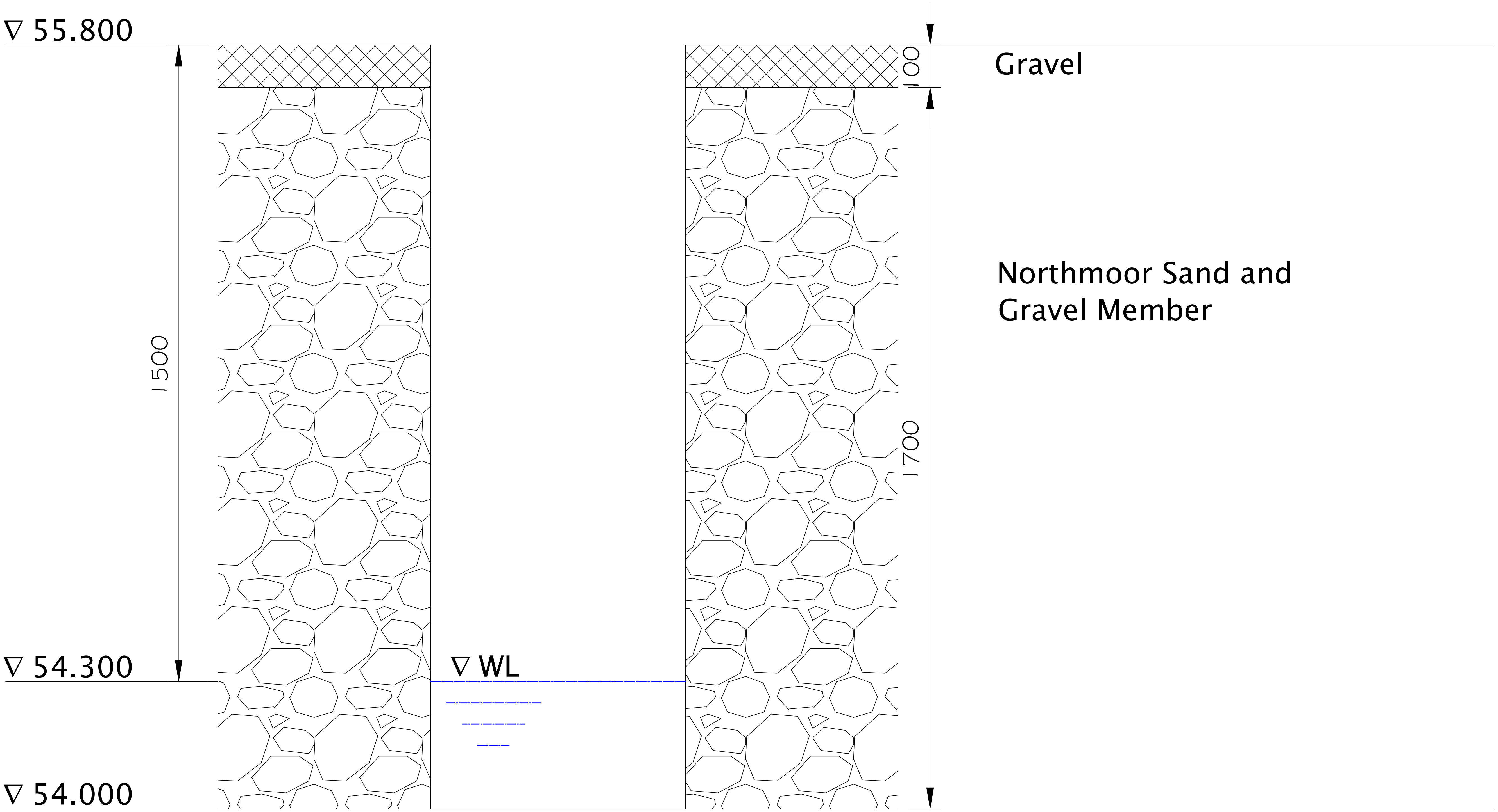
Infiltration Rate

f1	3.75E-05
f2	2.58E-05
f3	2.16E-05



NOTES:

1. DO NOT SCALE - Use figured dimensions only.
2. All dimensions shown are in millimetres unless otherwise stated.
3. All levels are in metres above ordnance datum unless otherwise stated.
4. The Contractor is to verify all dimensions on site before commencing work.
5. This drawing is to be read in conjunction with all Engineers and Architects drawings.



Client: Mr A Hassan	Project: 332 Abingdon Road, OX1 4TQ Project Ref: FEDS-222106	Title: Groundwater Trial Pit Log	Drawn by: DKP Date: 23.10.23 Dwg.no: FEDS-222106-004	Checked by: SLD Scale: 1:20 Rev: A	Size: A3

Forge Engineering Design Solutions
Forge House
30 Digging Lane
Fyfield, Abingdon
Oxfordshire, OX13 5LY
tel: 01865 362 780
info@f-eds.co.uk
www.f-eds.co.uk

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

Half Drain Time : 66 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	55.521	0.131	1.5	5.3	O K
30 min Summer	55.559	0.169	1.5	6.8	O K
60 min Summer	55.578	0.188	1.5	7.6	O K
120 min Summer	55.578	0.188	1.5	7.5	O K
180 min Summer	55.566	0.176	1.5	7.1	O K
240 min Summer	55.551	0.161	1.5	6.4	O K
360 min Summer	55.518	0.128	1.5	5.2	O K
480 min Summer	55.490	0.100	1.5	4.0	O K
600 min Summer	55.467	0.077	1.5	3.1	O K
720 min Summer	55.451	0.061	1.5	2.4	O K
960 min Summer	55.436	0.046	1.3	1.8	O K
1440 min Summer	55.423	0.033	1.0	1.3	O K
2160 min Summer	55.414	0.024	0.7	1.0	O K
2880 min Summer	55.409	0.019	0.5	0.8	O K
4320 min Summer	55.403	0.013	0.4	0.5	O K
5760 min Summer	55.401	0.011	0.3	0.4	O K
7200 min Summer	55.399	0.009	0.3	0.3	O K
8640 min Summer	55.398	0.008	0.2	0.3	O K
10080 min Summer	55.397	0.007	0.2	0.3	O K
15 min Winter	55.567	0.177	1.5	7.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	153.568	0.0	22
30 min Summer	100.695	0.0	34
60 min Summer	62.504	0.0	56
120 min Summer	37.820	0.0	88
180 min Summer	27.985	0.0	122
240 min Summer	22.480	0.0	156
360 min Summer	16.339	0.0	220
480 min Summer	12.929	0.0	280
600 min Summer	10.738	0.0	336
720 min Summer	9.204	0.0	390
960 min Summer	7.187	0.0	500
1440 min Summer	5.032	0.0	742
2160 min Summer	3.509	0.0	1104
2880 min Summer	2.721	0.0	1472
4320 min Summer	1.916	0.0	2204
5760 min Summer	1.504	0.0	2936
7200 min Summer	1.257	0.0	3624
8640 min Summer	1.091	0.0	4360
10080 min Summer	0.973	0.0	5056
15 min Winter	153.568	0.0	23

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	55.618	0.228	1.5	9.2	O K
60 min Winter	55.647	0.257	1.5	10.3	O K
120 min Winter	55.645	0.255	1.5	10.2	O K
180 min Winter	55.626	0.236	1.5	9.5	O K
240 min Winter	55.601	0.211	1.5	8.5	O K
360 min Winter	55.548	0.158	1.5	6.4	O K
480 min Winter	55.501	0.111	1.5	4.4	O K
600 min Winter	55.464	0.074	1.5	3.0	O K
720 min Winter	55.441	0.051	1.5	2.1	O K
960 min Winter	55.430	0.040	1.2	1.6	O K
1440 min Winter	55.418	0.028	0.8	1.1	O K
2160 min Winter	55.410	0.020	0.6	0.8	O K
2880 min Winter	55.406	0.016	0.5	0.6	O K
4320 min Winter	55.401	0.011	0.3	0.4	O K
5760 min Winter	55.399	0.009	0.3	0.3	O K
7200 min Winter	55.397	0.007	0.2	0.3	O K
8640 min Winter	55.396	0.006	0.2	0.2	O K
10080 min Winter	55.396	0.006	0.2	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	100.695	0.0	35
60 min Winter	62.504	0.0	60
120 min Winter	37.820	0.0	98
180 min Winter	27.985	0.0	136
240 min Winter	22.480	0.0	172
360 min Winter	16.339	0.0	240
480 min Winter	12.929	0.0	300
600 min Winter	10.738	0.0	352
720 min Winter	9.204	0.0	390
960 min Winter	7.187	0.0	504
1440 min Winter	5.032	0.0	752
2160 min Winter	3.509	0.0	1116
2880 min Winter	2.721	0.0	1464
4320 min Winter	1.916	0.0	2212
5760 min Winter	1.504	0.0	2840
7200 min Winter	1.257	0.0	3552
8640 min Winter	1.091	0.0	4256
10080 min Winter	0.973	0.0	5072

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2022
Site Location	GB 451845 204253 SP 51845 04253
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.950
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.025

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.008	4	8	0.008	8	12	0.008

Model Details

Storage is Online Cover Level (m) 55.795

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.07800	Width (m)	9.3
Membrane Percolation (mm/hr)	1000	Length (m)	14.4
Max Percolation (l/s)	37.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.390	Membrane Depth (m)	0

APPENDIX 6

Flood Action Plan

On Receipt of the Environment Agency's Early Flood Warning – Flood Alert

1. **Mr Hassan** notified by Environment Agency of potential flood event.
2. **Mr Hassan** to inform staff and Patrons of potential flood event.
3. Provide awareness/refresher training to staff of evacuation plan.
4. New patron reservations/meetings should be postponed to limit the number of people at the site.
5. Monitor the flood event and local weather up-dates using local media channels, e.g. BBC Radio
6. Regularly obtain **Environment Agency Floodline** up-dates on **0345 988 1188**, press **Option 1** then enter **Mr Hassan's quick dial number** _ _ _ _ _ _ _ . The Environment Agency's Flood Warning Codes are shown below:

Severe Flood Warning – Severe flooding. Danger to life

Flood Warning – Flooding is expected. Immediate action required

Flood Alert – Flooding is possible. Be prepared

Warning no longer in force. Flood warnings and flood alerts that have been removed in the last 24 hours

When the Flood Warning and Severe Flood Warnings are given

1. **Mr Hassan** to notify Staff and Patrons of Flood Warning and potential implementation of evacuation plan.
2. Inform Patrons with reservations that reservations are to be postponed or cancelled.
3. Inform staff to minimise water use as much as possible to minimise foul water production.
4. If flood event is predicted **Mr Hassan** should contact its staff and Patrons to confirm a safe evacuation facility location or route to their permanent residence.
5. **Mr Hassan** to inform staff and patrons of evacuation procedure, and evacuate the building if required.
6. Designated staff to install flood mitigation barriers to doors and low level windows after patrons and staff have been evacuated.
7. Turn off all main incoming services, e.g. water, gas and electricity.

After A Flood Event When the All Clear has been given:

1. Assess the condition of the barge showboat and confirm that there is no risk from re-occupation.
2. Arrange for cleaning and servicing of foul and surface water drainage system.
3. Turn on the all main incoming services e.g. water, gas and electricity.
4. Contact all staff and inform them that flooding has subsided.
5. Inform patrons that reservations can resume or be re-scheduled as appropriate.

OWNER Flood Action Plan Information & Training Advice

Before Flood Occurs:

What the Property's *staff and relevant Owner's staff should know:*

- The Property will be evacuated prior to a predicted flood event.
- The type of flooding that can happen is fluvial flooding and surcharging of public and site foul and surface water drainage systems, which could enter the building via doors and low level windows.
- A Flood Action Plan (FAP) has been prepared and will be implemented in the event of potential or actual flooding.
- The FAP is posted on every assembly point and is updated periodically.
- The Property Owner's emergency team members (appointed persons) should have a copy of the emergency FAP.

In particular, the staff at the Property should know:

- What to do on receipt of the Environment Agency's Floodlines Warning Direct Message.
- The extent and severity of flooding and available Flood Warning time using the Flood Warning Codes issued by the Environment Agency, as shown below:

Severe Flood Warning – Severe flooding. Danger to life

Flood Warning – Flooding is expected. Immediate action required

Flood Alert – Flooding is possible. Be prepared

Warning no longer in force. Flood warnings and flood alerts that have been removed in the last 24 hours

- How to inform the patrons of the Property and the rest of the staff of a predicted flood event.
- Know who to contact and how – list of important contacts such as
  - Floodline on 0345 988 1188
  - Utility Companies to explain the potential flood situation.
- How to notify the staff that they should try to minimise water usage and foul water production.
- Know where the service shut-off points are and, if required, how to or arrange to turn off the gas, electricity and water mains supplies (mark taps and switches with stickers to help you remember).
- If during a very severe flood event the Property has to be evacuated, know where you need to go, which is the nearest route to follow and how many people can be found/placed within the designated refuge location or can return to their permanent residence.
- How to inform staff and residents when a flood event has ended and normal operations can be resumed.

OWNER Flood Action Plan Information & Training Advice

During A Flood Event:

The appointed persons should:

- Know how to implement the Flood Action Plan
- Know what they are doing and not put their or others lives at risk.
- Know who to notify of the flood event, such as staff, patrons and Utility Companies
- Know where and how flood mitigation equipment is deployed. E.g. check that Showboat is securely moored

Management of the Flood Action Plan (FAP):

Owner Name Appointed person(s):

• Managers and staff	Flood Action Plan Implementation
• Managers & Deputy Managers	Safety Inspections
• Receptionist & First Aiders	First Aid & Flood Kit of Essential Items (torch, battery radio, warm waterproof clothes)

Owners, staff and patrons have legal duties too:

- Take reasonable care for their own safety
- Cooperate with other staff and patrons
- Not interfere with anything provided for their safety and welfare.

More information about Flooding is set out in:

- http://www.environment-agency.gov.uk
- http://www.oxfordshire.gov.uk
- Sign up for Floodline Warning Direct by calling the Floodline on 0345 988 1188
- Thames Water Utilities (Water/Sewerage) – tel: 08459 200800
- Oxfordshire County Council Highways – tel: 08453 101 111
- National Flood Forum – tel: 01299 403055
- Emergency Services responsible for flooding
    - Oxfordshire Fire & Rescue Services – non-emergency on 01865 842999
    - electricity & gas & telecommunications
    - water & sewerage companies – emergency help on 08459 200800
    - police, ambulance – emergency help on 999

After A Flood Event:

The appointed persons should assess that there is no risk before they:

- Turn on the utilities that have been turned off at the start of the flood event, e.g. gas, electricity and water mains supply.
- Contact the staff and patrons and inform them that the flooding has subsided.
- Inform patrons and other members of staff that normal operations can be resumed.
- If required, use the central register of tradesmen and suppliers: builders, plumbers, decorators, etc to remedy/repair any damage caused by the flooding.
- Arrange for maintenance and servicing of surface water and foul drainage system.

APPENDIX 7

General Advice for Flood Resilient Design

Ground supported floors are the preferred option and concrete slabs of at least 150mm thickness should be specified for non-reinforced construction. Hollow slabs are not suitable if the elements are not effectively sealed.

Suspended floors may be necessary where ground supported floors are not suitable, namely in shrinkable/expanding soils (e.g. clay) or where the depth of fill is greater than 600mm. Uplift forces caused by flood water may affect the structural performance of a floor. Suspended floors are generally not recommended in flood-prone areas, for the following reasons:

1. the sub-floor space may require cleaning out following a flood, particularly a sewer flood. In order to aid this process and where accumulation of polluted sediment is expected, the sub-floor space should slope to an identified area and be provided with suitable access
2. if cleaning is required, floor finishes may need to be removed to provide access to the sub-floor space. Cheaper, sacrificial, finishes would be the best option.
3. the steel reinforcement in the concrete beams of 'beam and block' floors may be affected by corrosion and its condition may need to be assessed following repeated or prolonged floods.

Suspended timber floors, particularly when including timber engineered joists, are not generally recommended in flood prone areas because most wooden materials tend to deform significantly when in contact with water and therefore may require replacement. Rapid drying can also cause deformation and cracking.

Hardcore and blinding: good compaction is necessary to reduce the risk of settlement and consequential cracking.

Damp Proof Membranes (DPM) should be included in any design to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are overlaps of 300mm, and also taping (mastic tape with an overlap of 50mm minimum). Care should be taken not to stretch the membrane in order to retain a waterproof layer. Experience in Scotland has indicated that welted joints in the DPM are an effective jointing solution.

Insulation materials: Water will lower the insulation properties of some insulation materials. Floor insulation should be of the closed-cell type to minimise the impact of flood water. The location of insulation materials, whether above or below the floor slab, is usually based on either achieving rapid heating of the building or aiming for more even temperature distribution with reduced risk of condensation. Insulation placed above the floor slab (and underneath the floor finish) rather than below would minimise the effect of flood water on the insulation properties and be more easily replaced, if needed. However, water entry may cause insulation to float and lead to de-bonding of screeds.

No firm guidance can be provided on best location for insulation where the primary source of flooding is from groundwater. For other types of flooding, placing insulation below the floor slab may be adequate but it is important to recognise that the characteristics of the insulation may be affected by the uplift forces generated by the flood water.

Floor finishes: suitable floor finishes include ceramic or concrete-based floor tiles, stone, and sand/cement screeds. All tiles should be bedded on a cement-based adhesive/bedding compound and water resistant grout should be used. Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material. Suitable materials for skirting boards include ceramic tiles and PVC. Ceramic tiles are likely to be more economically viable and environmentally acceptable.

Floor sump: provision of a sump and small capacity automatic pump at a low point of the ground floor is recommended in cases where the expected probability of flooding in any one year is 20% or a frequency of flooding of more than once in five years (see Section 4). This system will help the draining process and speed up drying but it may only be effective for shallow depth flooding. The dimensions of the sump and its operational procedure would be calculated and agreed with the planning authority based on the predicted volumes of water to be drained.

Services: under floor services using ferrous materials should be avoided.