

FLOOD RISK ASSESSMENT & SuDS REPORT FOR PENGUIN, WARGRAVE ROAD, HENLEY, RG9 3JD

DOCUMENT NUMBER: C3571-R1-REV-A

PREPARED BY



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1. SITE DETAILS

Site Name	Penguin
Site Address	Penguin, Wargrave Road, Henley, RG9 3JD
Purpose of Development	Residential
Existing Land Use	Brownfield
Country	England
Local Planning Authority	Wokingham Borough Council

1.1 Site Location

The location of the project site is provided in Appendix A.

1.2 Proposed Development

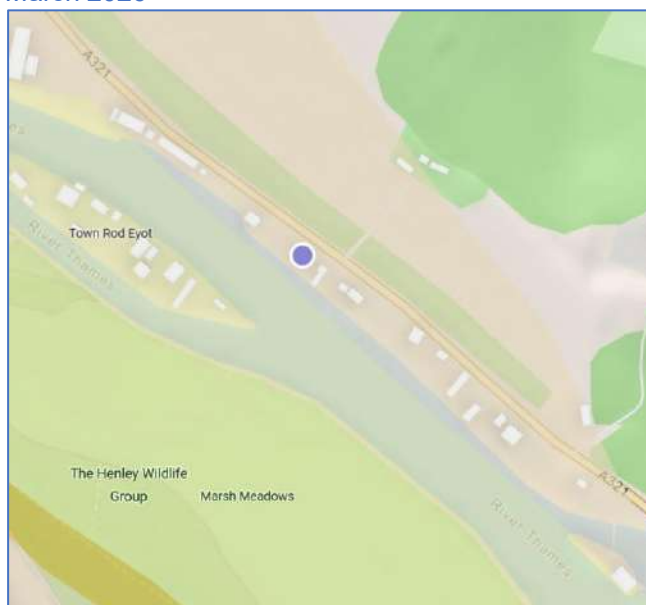
Our client intends to build a replacement dwelling and garage, with associated car parking and landscaping areas.

1.3 Geology of The Area

According to the British Geological Survey, the superficial deposits at the site are a member of the Kempton Park Gravel, consisting of sand and gravel, as shown in Figure 1 overleaf. The bedrock at site consists of chalk, as shown in Figure 2 overleaf.

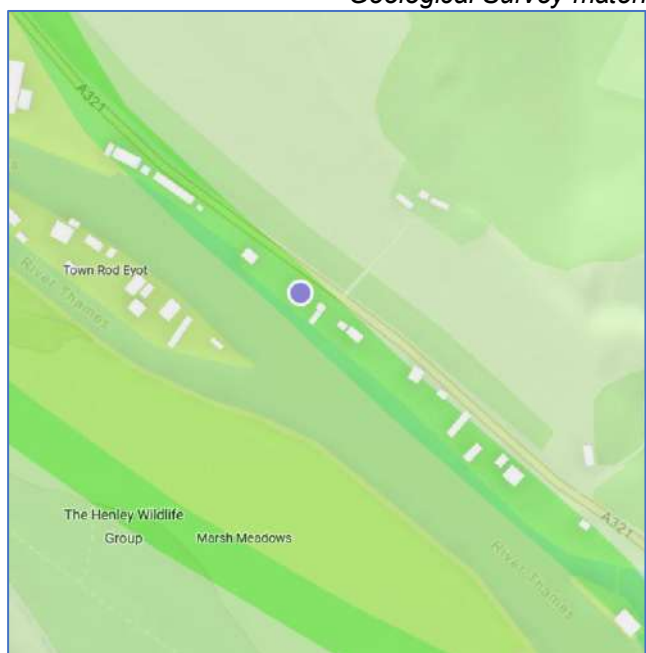
Penguin, Wargrave Road, Henley, RG9 3JD

Nimbus Engineering Consultants Ltd
Flood Risk Assessment & SuDS Report
March 2026



Kempton Park Gravel Member-Sand and gravel

Figure 1 - Superficial Deposits at the site. (Source: British Geological Survey website (contains British Geological Survey materials © NERC2026)).



Chalk Rock Member-Chalk

Figure 2 - Bedrock at the site. (Source: British Geological Society Website (contains British Geological Survey materials © NERC2026)).

2. PLANNING POLICIES

2.1 National Planning Policies

The report has been written in conjunction with the following national planning policies:

- National Planning Policy Framework (December 2024)
- National Planning Practice Guidance Suite (August 2022)
- CIRIA SuDS Manual C753

2.2 Local Planning Policy

The report has been written in conjunction with the following local planning policies:

- Wokingham Borough Council Strategic Flood Risk Assessment Report
- Wokingham Borough Council Local Flood Risk Management Strategy

3. FLOOD RISK

The probable causes of flooding set out in NPPF are considered in this section in relation to flood risk to the site itself and the effects of the development of the site on the flood risk elsewhere.

3.1. Flood Zones

As described by the Flood risk and coastal change Technical Guidance to the National Planning Policy Framework, “inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.”

The document defines areas at risk of flooding as meaning “land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems, and which has been notified to the local planning authority by the Environment Agency”.

The document describes flood risk as meaning “risk from all sources of flooding – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.”

Flood zones for planning purposes refer to the probability of flooding from the sea and rivers only.

Table 1 summarises the flood zones used in the Flood risk and coastal change

Technical Guidance:

Flood Zone	Description
Zone 1 – low probability	Land assessed as having a less than 1 in 1,000 annual probabilities of river or sea flooding (<0.1%).
Zone 2 – medium probability	Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year.
Zone 3a – high probability	Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b – the functional floodplain	Land where water has to flow or be stored in times of flood, as identified by local planning authorities in their Strategic Flood Risk Assessments, in agreement with the Environment Agency.

Table 1- Flood risk and coastal change Flood Zone Guidance

3.2. Vulnerability Classification

The Flood risk and coastal change guidance outlines flood risk vulnerability classifications for a range of development types.

The document describes the classification as being “based partly on Department for Environment, Food and Rural Affairs and Environment Agency research on Flood

Risks to People (FD2321/TR2) and on the need of some uses to keep functioning during flooding.

Based on the Flood risk and coastal change guidance, Table 2 summarises the vulnerability classification of the proposed site:

Site Use	Vulnerability Classification
• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons, and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs, and hotels. • Non-residential uses for health services, nurseries, and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.	More Vulnerable

Table 2- Flood risk and coastal change guidance, Flood Risk Vulnerability Classification (More Vulnerable).

3.3. Development Planning Background and Environment Agency Data

Figure 3 overleaf, shows the indicative flood map for flood risk from rivers or the sea, which was downloaded from the Environment Agency's website, March 2026.

This indicative map suggests the site is located within Flood Zone 3. Flood Zone 3 is an area where there is a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding.

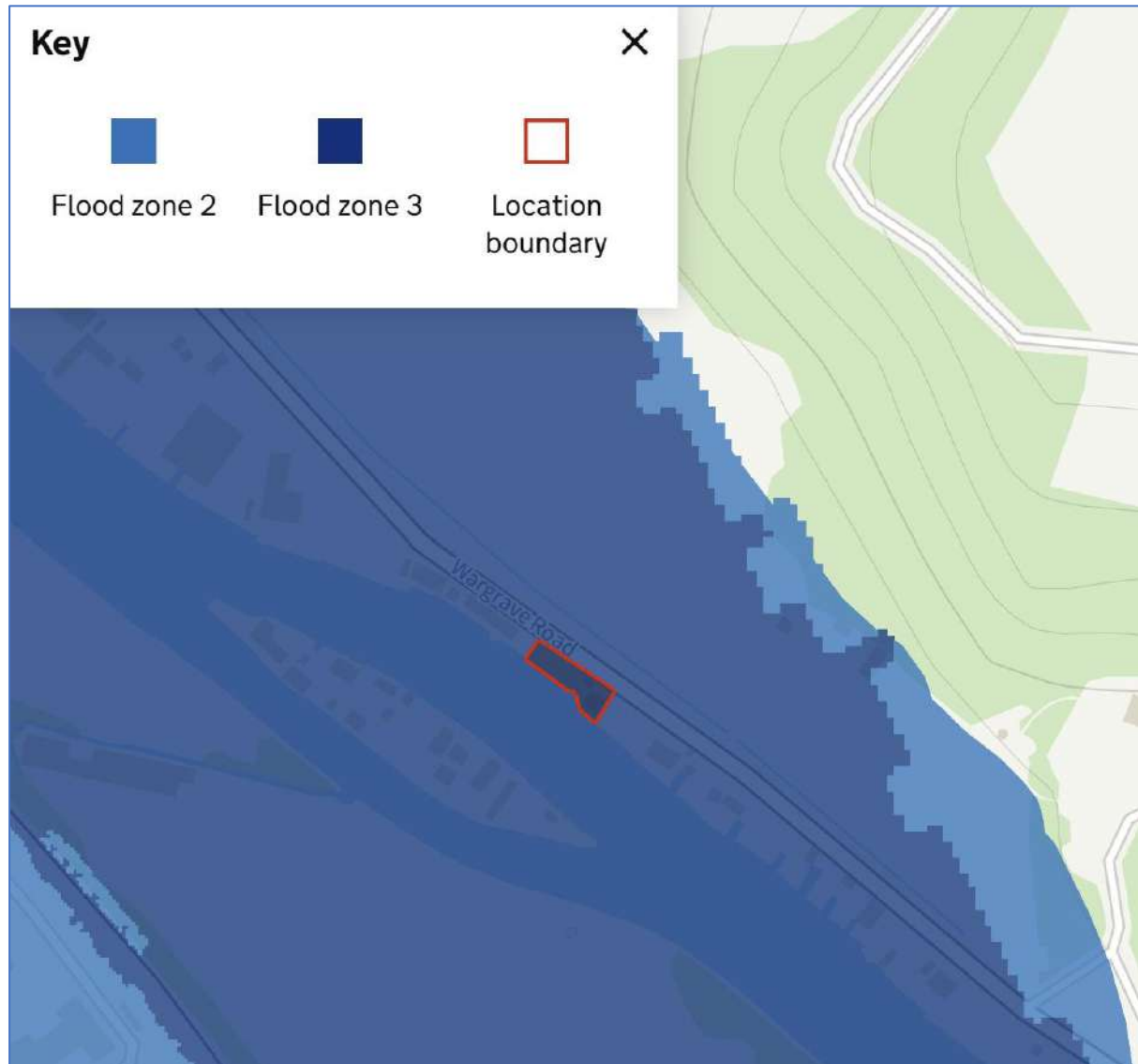


Figure 3 – Environment Agency Flood Map for flooding extent from rivers and sea for the proposed development

The Environment Agency were contacted to obtain site specific modelled flood levels, in order to ascertain the risk of flooding from the Rivers and the Sea to the site.

These modelled flood levels show that the proposed development site is within a Flood Zone 3, with a 1 in 100 annual probability of fluvial flooding in any year.

The site is not protected by flood defences, and there is a history of fluvial flooding at the site. That said the client is looking to build a replacement dwelling on their own land to replace their existing home, as well as a replacement garage.

Flood point data was provided at the location of the proposed replacement dwelling with a modelled flood level for the 1 in 100 years plus 35% climate change event of 33.510mAOD. Therefore, the client has proposed the finished floor level of the proposed replacement dwelling to be raised 290mm above this flood level, to 33.800mAOD. Whilst stairs are provided, these will be slatted and not obstruct and flood flow routes.

Flood point data was provided at the location of the proposed replacement garage with a modelled flood level for the 1 in 100 years plus 35% climate change event of 33.500mAOD. Therefore, the client has proposed the finished floor level of the proposed replacement dwelling to be raised 300mm above this flood level, to 33.800mAOD. Whilst stairs are provided, these will be slatted and not obstruct and flood flow routes.

In order to ensure that the proposals do not obstruct any flood flow routes and decrease any flood storage capacity at the site, we have provided a plan highlighting the volumes of flood storage gained by removal of the existing building, as well as the flood storage volumes lost by the proposals. This information can be found on drawing number C3571-04, provided in Appendix A, and show that there is an overall volume

gain of 2.175m^3 , therefore there are no issues by loss of flood storage capacity caused by these development proposals.

The fabric of the buildings will be safe, as well as there will be no risk of flooding to the proposed dwelling or garage and no risk to life due to the accommodation being located 290mm above the modelled flood level.

Furthermore due to the finished floor level of the building being located 300mm above the modelled flood level, no mitigation or resilience measures will be required for the main house, the walls, brick plinths and slatted stairs, below the 1 in 100 year plus 35% climate change flood level will be formed of flood resistant material. As an area of safe refuge is provided within the dwelling, the residents will be advised to remain within the dwelling unless notified otherwise by the emergency services.

3.4 Flooding from Land (Overland Flow)

There is a very low risk of surface water flooding at the proposed development site, as can be seen in the 1 in 1000 year surface water flood map, extracted from the Environment Agency's website in figure 4 overleaf.

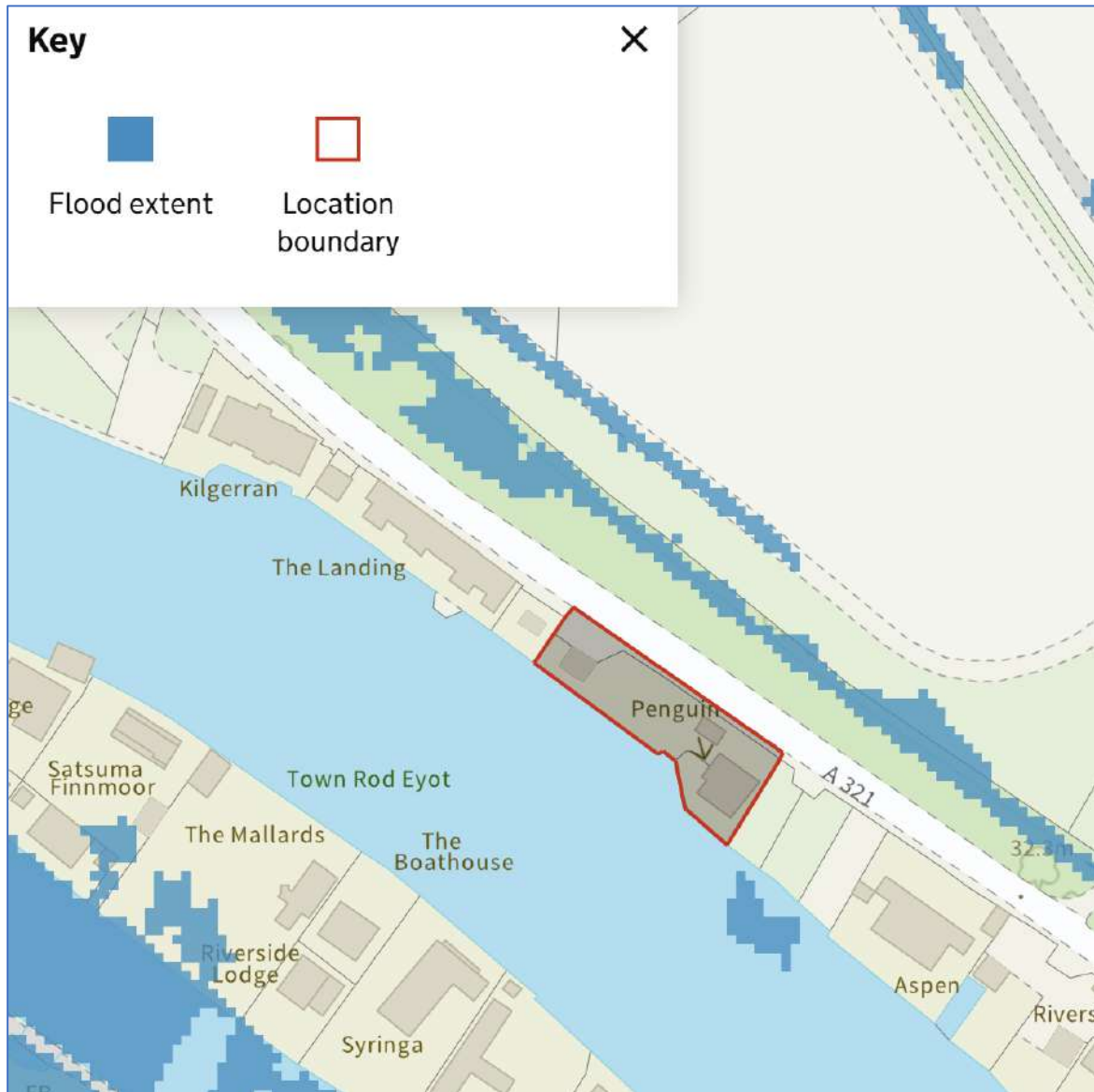


Figure 4 – Environment Agency Surface Water Flood Map (1 in 1000 year event) for the proposed development.

3.5 Flooding from Groundwater

The Environment Agency's website confirms that groundwater flooding is unlikely in this area, however due to the River Thames being in close proximity of the proposed development site, there will be a 50% susceptibility to groundwater flooding as confirmed by the Strategic Flood Risk Assessment report. However both proposed building are raised above the external ground level, and therefore the only issues will

be with the foundation of these buildings. Therefore the client will undertake groundwater monitoring prior to construction stage in order to ascertain the standing groundwater levels and to understand if over pumping will be required during the construction stage.

3.6 Flooding from Sewers

There is no risk of flooding from any sewers at the proposed development site, and there has been no history of sewer flooding at the proposed development site.

3.7 Flooding from Reservoirs, Canals, or Other Artificial Sources

The Environment Agency's Flood map shown in Figure 5 overleaf, shows the site to be at risk of reservoir, when there is also flooding from reservoirs, however flood warnings are in place, and there has been no loss of life from reservoir flooding.

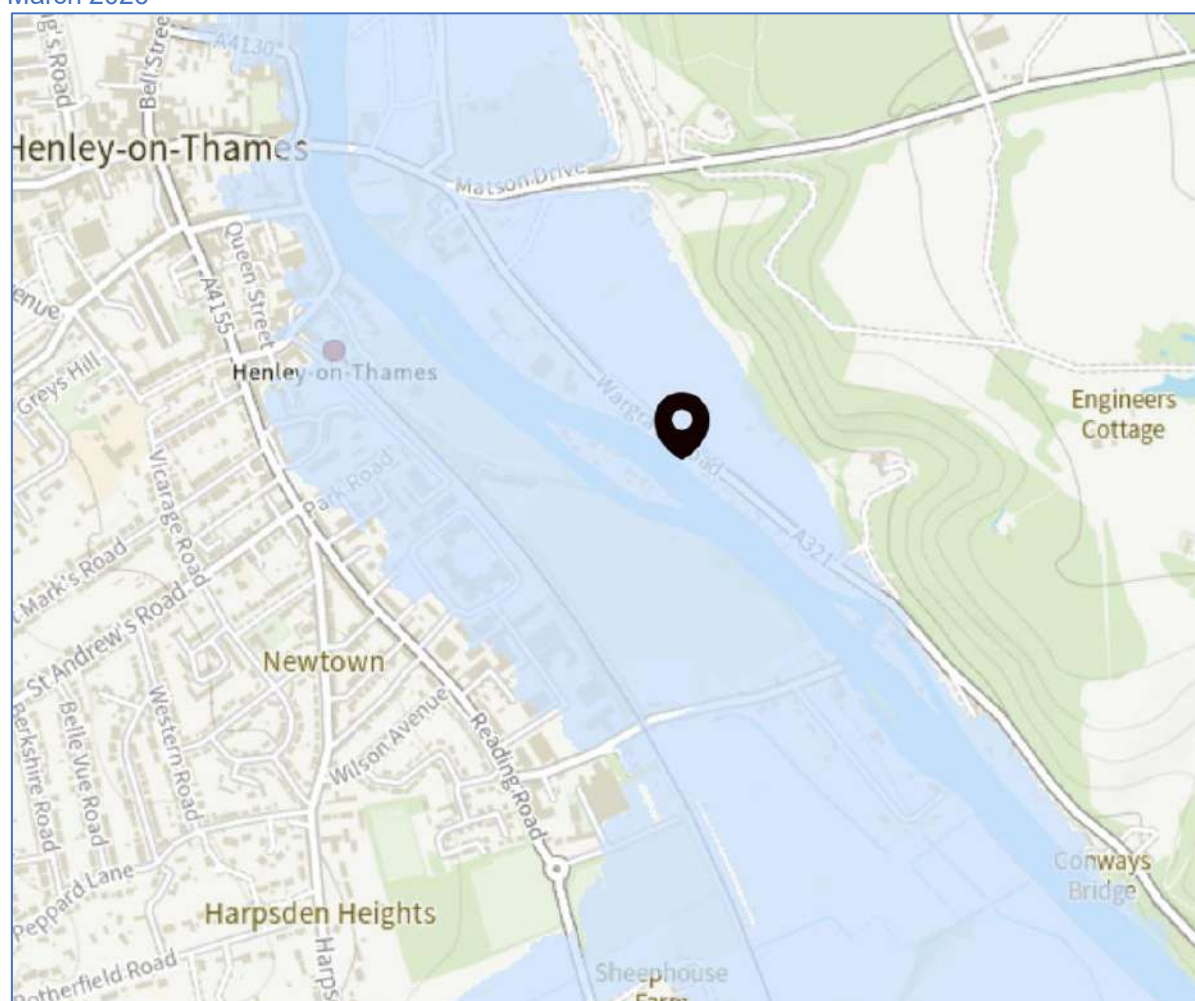


Figure 5 – Environment Agency Flood Map from reservoirs for the proposed development

4. RESIDUAL RISK AND MITIGATION MEASURES

4.1. Residual Risks

As discussed in this report, the site is located within the Environment Agency's fluvial Flood Zone 3, which comprises land assessed as having a 1% (1 in 100) annual probability of fluvial flooding in any year.

As discussed previously in this report, the proposed finished floor level of the ground floor accommodation of the proposed dwelling is raised 290mm above the modelled flood level for the 1 in 100 year plus 35% event, and the building will be raised on plinths to allow flood water to flow through, including the stairs which will be slatted, therefore there is no obstruction to flood flow routes and flood storage compensation has been provided in addition to this by the removal of existing buildings.

A safe area of refuge is available on the ground floor as this is above the modelled flood level, and the owners of the dwellings will be asked to sign up to Flood Warnings direct, which they are currently signed up to, so that the residents can remain in the building once a flood warning has been received.

4.2. Mitigation Measures

The ground floor and the first floor of the building are not at risk of flooding, therefore no mitigation or resilience measures will be required.

4.3. Safe Access and Egress

As discussed, safe access and egress to the site is not feasible during an extreme fluvial, therefore once a flood warning has been received, the residents will be advised to remain in their properties unless notified otherwise by the emergency services. To further ensure safety, the flood action plan overleaf will be placed visibly in the house for all household members to reference.

FLOOD ACTION PLAN

The house has been designed, built and equipped to keep its occupants safe throughout any flooding event over the next 100 years. Therefore it isn't anticipated that the house will need to be evacuated.

Below is the guidance for ensuring all occupants remain safe

When selling the house

- *Ensure the new owners are aware of the risk of flooding*
- *Provide a copy of this action plan to the new owners*

Annually

- *Ensure all full time residents are signed up to receive Environment Agency's flood warnings on their phone*
- *Review how the situation has changed in the last 12 months and consider if the emergency food and medical supplies should be updated*
- *Review the emergency food and medical supplies, replacing anything with a best-by date of less than 12 months*
- *Check the state of the walkway and complete any repairs*

When water is forecast to breach the banks

- *Assume the household will need to be self-sufficient for 30 days*
- *Procure any final items that the household feel would be useful to have*
- *While it remains safe to do so, relocate any garden and outbuilding items that would require moving or protecting in a severe flood situation.*

However, the occupants would be advised to sign up to the Environment Agency's flood warnings direct, in order to receive a flood warning and seek refuge in their dwelling and stay there until the flooding stops. Unless they are informed otherwise by the emergency services.

The owners of the dwellings would receive a copy of this report as a part of their deeds and therefore would be also asked to keep an emergency supply bag of tinned and dry food in the event of an extreme flood event where they cannot leave this building. Should a flood warning be received whilst they are away from their building, they will be advised to remain away until told otherwise by the Environment Agency.

5. SUSTAINABLE URBAN DRAINAGE SYSTEMS

The total site area is 931m², and the impermeable areas of the site prior to development are 309m². Following the development at this site, the proposed impervious space will be 552m².

Pre and post development surface water runoff calculations showing the peak flow rate leaving the site can be found in Appendix C.

Surface water arising from a developed site should, as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

Reducing the rate of surface water discharge from Urban Sites is one of the most effective ways of reducing and managing flood risk.

Traditional piped surface water systems work by removing the surface water from our developments as quickly as possible, however this can cause various adverse impacts:

- Increased downstream flooding, and sudden rises in flow rates and water levels in local water courses.
- Reduction in groundwater levels dry weather flows in watercourses.
- Reduce amenity and adversely affect biodiversity due to the surface water run-off containing contaminants such as oil, organic matter, and toxic materials.

SuDS are defined as a sequence of management principles and control structures designed to drain surface water in a more sustainable fashion than conventional piped drainage techniques. SuDS should utilise the environmental, ecological and social benefits.

These include:

- Protection and enhancement of water quality – As well as providing on-site attenuation, SuDS treat the water, resulting in an improved quality of water leaving the site. This is achieved when the water passes through the fine soils and the roots of specially selected plants, pollutants washed off the hard landscaping by rainfall will be safely removed before the water reaches the natural water course.

- A sympathetic approach to the environmental setting by providing the opportunities to create habitats for flora and fauna in urban watercourses and open spaces.
- Meeting the amenity and social needs of the local community and residents in the creation of attractive green spaces.

The various types of SuDS include:

Permeable paving	
Soakaways	
Swales and basins	
Bioretention/ rain gardens	
Green roofs and rainwater re-use	

Infiltration trenches and filter drains	
Ponds and wetlands	

Preferably a combination of these techniques should be used as part of the surface water management train, and it is important for all stakeholders, such as developers, architects, landscape architects and engineers, to work together at the planning stage in order to determine a feasible solution.

The SuDS management train is shown in Figure 6 below, this has been followed when proposing the proposed Sustainable Urban Drainage Systems for this site.

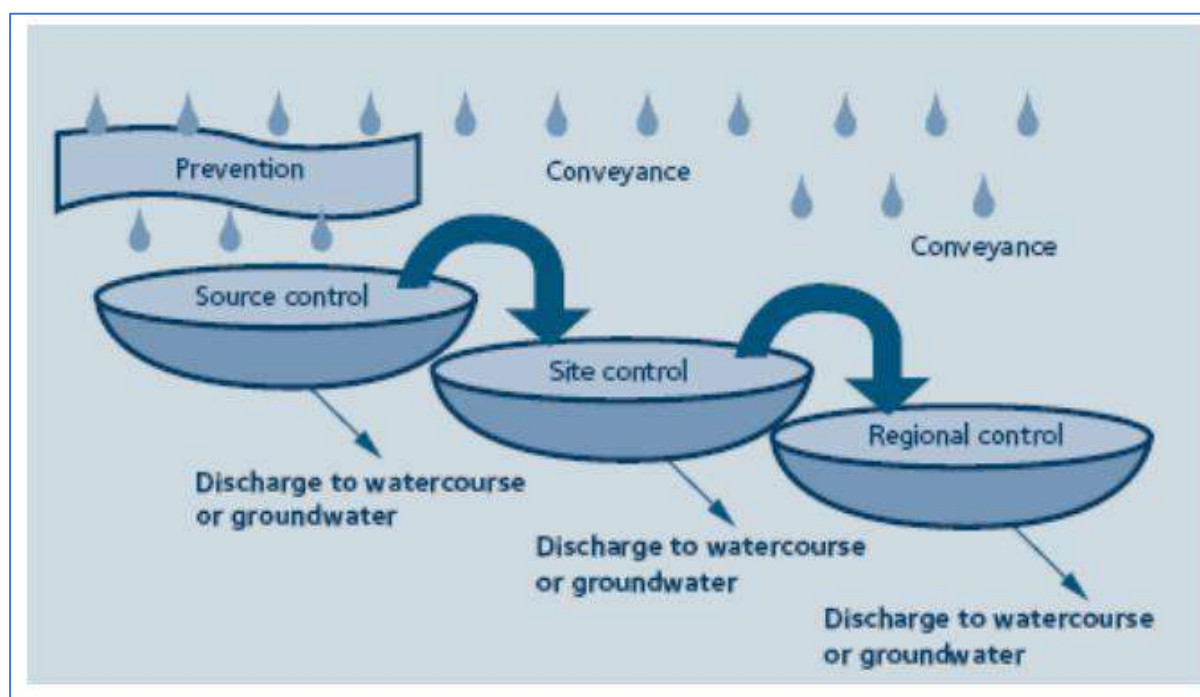


Figure 6 – SuDS Management Train

6. PROPOSED SuDS SOLUTION

In order to ensure that the SuDS management train has been followed, two wall mounted rainwater harvesting tanks will be provided at the dwelling. The roof is pitched, therefore green or sedum roofing could not be provided.

All proposed hardstanding areas will be formed of porous surfacing, with the new driveway to be formed of gravel, underlain by a hydrocarbon removing geotextile membrane and the road and carparking areas, with the surface water runoff from any sloped areas to be caught by slot drains.

The preferred method of dealing with remaining surface water from the above SuDS components would be to treat and deal with it at source using soakaways, however due to the geological makeup of the soils these are not possible on this site.

Therefore, the remaining surface water runoff will be conveyed into a below ground crate system attenuation tank with restricted flow leaving the site and discharging into the creek at a rate of 0.5 l/s which is higher than the existing site's greenfield rate, in order to avoid blockages, as per the calculations provided in Appendix C.

Hydrograph storage calculations were carried out for the 1 in 100 year storm event plus 45% climate change event. These show that, 41.04m³ of storage is required within the site, with the restricted discharge to be conveyed by gravity to the river.

We believe the Sustainable Urban Drainage System hierarchy has been considered fully, with as much of the surface water runoff to be treated at source, and any overflows from these SuDS components being dealt with at source also, which represents a 98% reduction in surface water run off for the 1 in 100 year storm event. A SuDS layout and location plan has been provided in Appendix A.

7. SuDS PROPOSALS FOR DEVELOPMENT

In accordance with the CIRIA SuDS Manual C753, the SuDS hierarchy has been considered in relation to the site-specific constraints and its surroundings. Table 3 below outlines the hierarchical approach considered for the development at Penguin, Wargrave Road, Henley, RG9 3JD.

Sustainable Drainage Proposal	Description	Constraints/Comments	Appropriate
Rainwater Use as a Resource	Use of rainwater runoff for reuse, e.g. Rainwater harvesting tanks, Blue Roofs for irrigation	Two wall mounted rainwater harvesting tanks will be provided at the new building.	Yes
Rainwater Full Infiltration to Ground (Source Control)	Infiltration devices and/or soakaways. Surface water runoff stored on site and gradually percolating into receiving ground	Due to the geological makeup of the ground Infiltration on this site is not an option.	No
Rainwater Partial Infiltration to Ground (Source Control)	Installation of permeable/porous surfacing	Porous surfacing has been proposed at all new hardstanding areas to deal with surface water run off for low storm event.	Yes
Rainwater attenuation in green infrastructure features for gradual release	The onsite storage of all surface water runoff which can then be gradually conveyed to a nearby watercourse, sewer, or infiltration into the ground. Forms of green infrastructure features: Green Roofs,	The roof is pitched therefore green, or sedum roofing cannot be provided and due to the site levels, any discharge from ponds would have to be pumped, therefore we have proposed an underground tank.	No

	Raingardens, Ponds, Swales, Detention basins, Infiltration Trenches, and Raingarden Planters		
Rainwater discharge direct to a watercourse	All surface water runoff on site discharged at a restricted rate to a nearby watercourse	The remaining surface water runoff will be attenuated and discharged into the adjacent river at restricted rate of 0.5 l/s.	Yes
Controlled rainwater discharge to a surface water sewer or drain	All surface water runoff on site is discharged at a restricted rate to a nearby surface water sewer or drain, all rainwater runoff stored in below ground attenuation features. E.g. oversized pipes or geo-cellular tanks	N/A	N/A
Controlled rainwater discharge to a combined sewer	All surface water runoff on site discharged at a restricted rate to a nearby surface water sewer all rainwater runoff stored in below ground attenuation features. E.g. oversized pipes or geo-cellular tanks	N/A	N/A

Table 3: SuDS hierarchy

8. TIMESCALE AND MAINTENANCE OF DRAINAGE WORKS

All drainage works shall be completed prior to first occupation and there shall be no adoption of any of the drainage works within the site, and the homeowner will be responsible to oversee the long-term maintenance of the communal drains.

The following outline maintenance strategy sets out recommended timescales for maintenance of the proposed drainage works, in line with CIRIA SuDS Design Guide:

- Regular inspection will comprise the inspection and cleaning of catchment, gutters, filters, and tanks to reduce the likelihood of contamination, this is recommended to be carried out every 3 to 6 months.
- The catch pit chamber to the attenuation should be checked and emptied regularly to ensure there is no silting up of the system.
- Regular jet-washing of permeable block paving can be used to keep joints and voids clear; this should be carried out every 3 to 6 months.

The following table outlines the maintenance requirements for the porous paving:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations, or clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this is the most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48hr after large storms in six months
	Inspect slit accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 4: Operation and maintenance requirements for pervious pavements.

The following table outlines the maintenance requirements for the Attenuation Tank:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockages by sediment, algae, or other matter: remove and replace surface infiltration medium, as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/ rehabilitate inlets, outlet, overflows, and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Table 5: Operation and maintenance requirements for attenuation storage tanks.

The following table outlines the maintenance requirements for the rainwater harvesting systems:

Maintenance schedule	Required action	Typical Frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdraw devices, overflow areas, pumps, filters.	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters. Withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional maintenance	Cleaning and/ or replacement of any filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Table 6: Operation and maintenance requirement for RWH systems.

The following table outlines the maintenance requirements for the flow control chambers:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect from surface and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then 6 monthly intervals
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Orifice plates within plastic chambers or vortex controls to be jetted from the surface after heavy rainfall events to remove any debris or silt	As required
	Empty catchpits upstream of SuDS features to ensure no debris is passed downstream	3 months or as required
Remedial actions*	In the event of a blockage, a vortex flow control can be removed from the chamber via the lifting cabled located at the access, this will be cleaned at surface level and reinstalled into its original location	As required
	In the event of a blockage, the orifice plate should be jetted from surface, and if blockage is not cleared the orifice plate can be removed by removing fixing bolts. These fixing bolts should be checked and replaced if needed.	As required
Monitoring	Following installation, it is important that any extraneous materials i.e. building materials: granular backfill, in-situ pour concrete etc are removed from the unit and the new flow control chamber is fully jetted down	Upon installation
	Inspect/check chamber channel for any debris or silt build-up. Upstream chambers should be checked at the same time as these monitoring works to ensure network is operating at full capacity.	Annually

Table 7: Operation and maintenance requirement for flow control chambers

*All Remedial Works should be carried out by a competent and certified contractor, with no entry or removal of parts to be undertaken by landowner.

If upstream network of flow control chamber is regularly maintained, little maintenance is required within the chamber as there are no moving part.

9. CONCLUSIONS

This report has been produced to demonstrate that the proposed development will not increase risk to life and will not increase flood risk to the site itself or areas adjacent to the site.

The ground floor level of the proposed dwelling will be raised 290mm above the modelled flood level, including an allowance for climate change of 35% in line with the requirements of the Environment Agency. We have also provided appropriate flood storage compensation via the removal of existing buildings. This results in an approximate 2.175m³ gain in flood storage.

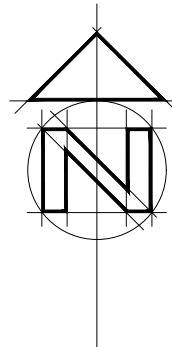
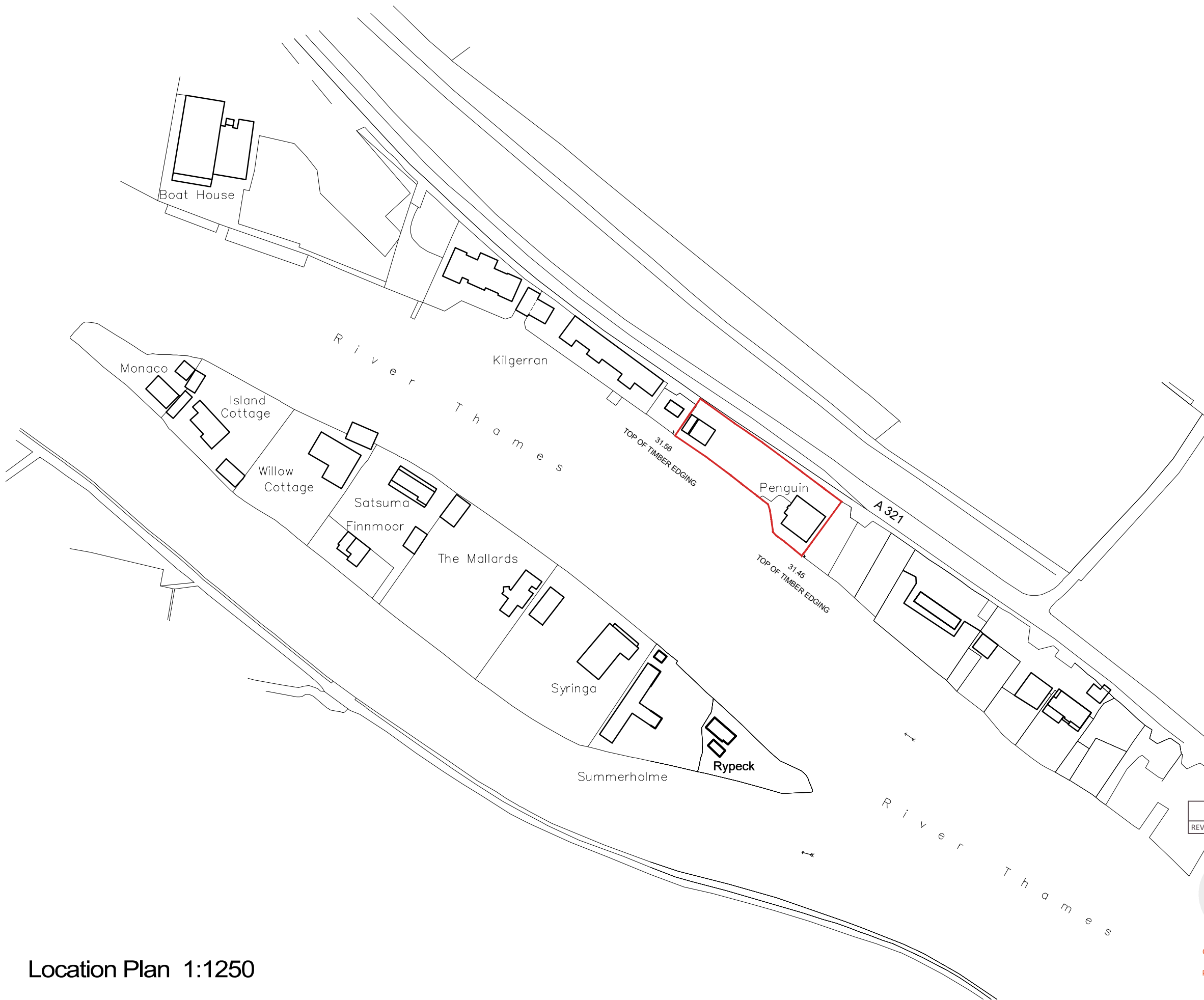
There is a risk of fluvial flooding, to the site, however the proposed dwelling will not be at risk of flooding and provides protection to the residents as well as the fabric of this new build. Which cannot be said about the existing dwelling, which is not safe from fluvial flooding.

It should also be noted that two properties adjacent to this site have had their planning application approved for similar proposals, with the buildings realised above the modelled flood levels.

It can therefore be concluded that the proposed development will be safe for the lifetime of the development, will not increase risk to life and will reduce the risk of flooding at the site itself and elsewhere by controlling runoff generated by the site.

A suitable Sustainable Urban Drainage systems solution has been proposed which follows the SuDS hierarchy and represents a 98 % reduction in surface water run off for the 1 in 100-year storm event.

APPENDIX A – DRAWINGS



Location Plan 1:1250

1:1250 scale Bar
This Drawing has been produced for printing onto A3 size paper,
If printing on any other size please use the scale bar below.



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REV	COMMENTS	DATE



SHAUN TANNER
ARCHITECTURE & PLANNING

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CLIENT Mr & Mrs M. Crisp
PROJECT Penguin, Wargrave Road,
Henley-On-Thames RG9 3JD
DRAWING LOCATION PLAN

STATUS os survey **DATE** June 2025

SCALE 1:1250 @ A3 **DRAWN** ST **CHECKED** NO 3993/100 **REV** .

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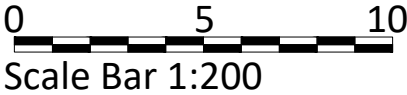
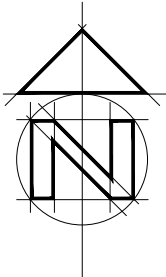
FOOT PRINT
EXISTING HOUSE = 116 sqm
EXISTING OUTBUILDINGS = 34 sqm
EXISTING GARAGE = 38.72 sqm

GIA
EXISTING HOUSE = 123.7 sqm
EXISTING OUTBUILDINGS = 29.20sqm
EXISTING GARAGE = 33.90 sqm

VOLUME
EXISTING HOUSE = 385.12 m3
EXISTING OUTBUILDINGS = 87.30 m3
EXISTING GARAGE = 107.4 m3

KEY:

- 200x50mm EKKI wood edging
- 150mm concrete path



REV	COMMENTS	DATE



SHAUN•TANNER
ARCHITECTURE & PLANNING
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CLIENT	Mr & Mrs M. Crisp		
PROJECT	Penguin, Wargrave Road, Henley-On-Thames RG9 3JD		
DRAWING	EXISTING SITE PLAN		
STATUS	Planning	DATE	Oct 2025
SCALE	1:200@ A3	DRAWN	CD
	CHECKED	NO	3993/101
	REV	F	

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RIDGE LVL
38.32

FFL LVL
32.02



ELEVATION 1

DATUM 30m

RIDGE LVL
38.32

FFL LVL
32.02

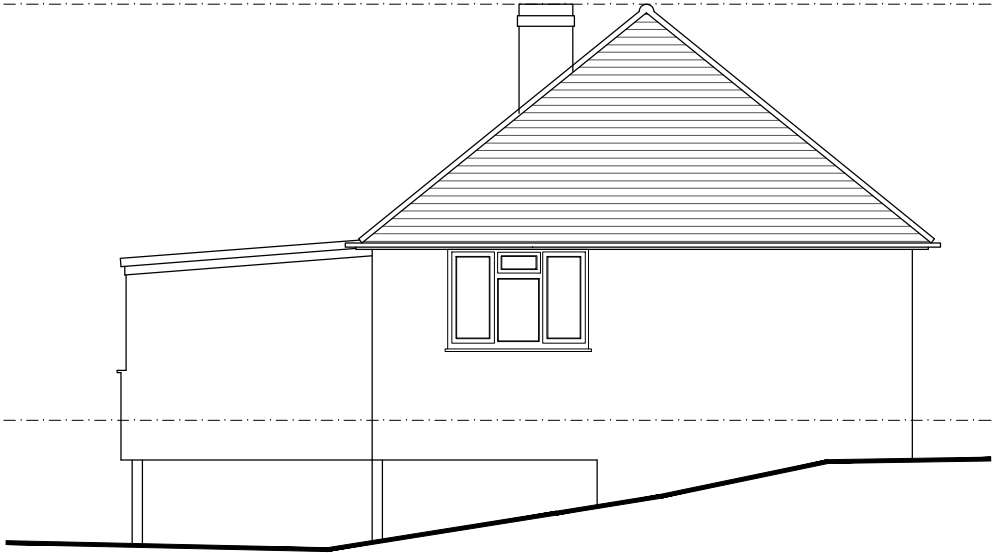


ELEVATION 2

DATUM 30m

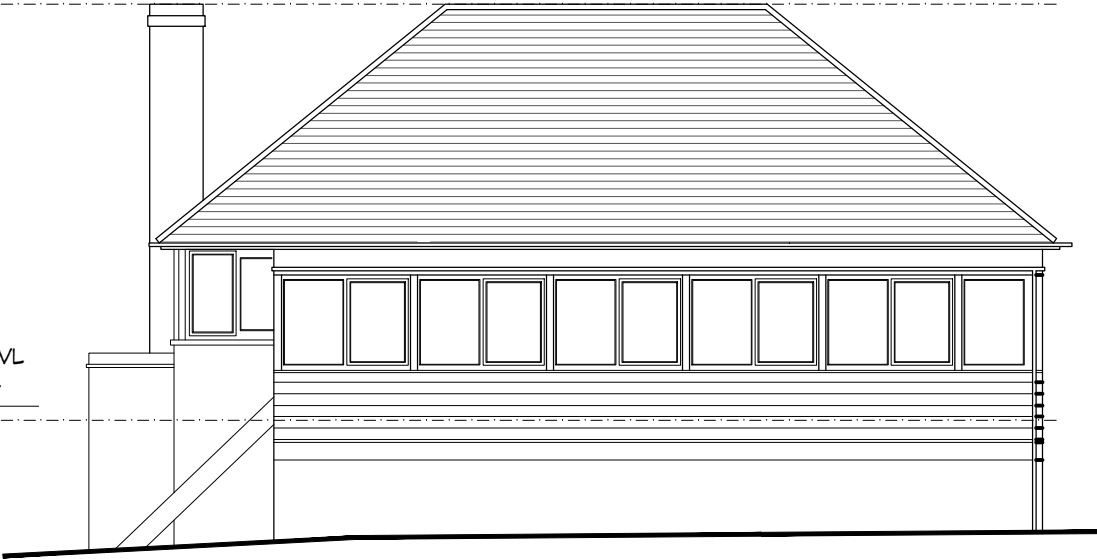
RIDGE LVL
38.32

FFL LVL
32.02

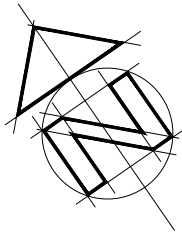


RIDGE LVL
38.32

FFL LVL
32.02



REV	COMMENTS	DATE



0 1 2 3 4 5
Scale Bar 1:100



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CLIENT	Mr & Mrs M. Crisp		
PROJECT	Penguin, Wargrave Road, Henley-On-Thames RG9 3JD		
DRAWING	EXISTING ELEVATIONS		
STATUS	survey	DATE	June 2025
SCALE	1:100@ A3	DRAWN	ST
	CHECKED	NO	3993/103
	REV	.	

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SITE
PLAN - 1:200

1:200 scale Bar
This Drawing has been produced for printing onto A3 size paper,
if printing in another paper size, use the scale bar below for ref.:



FOOT PRINT PROPOSED:
NEW HOUSE : 221.74 sqm
TERRACE : 55.56 sqm
OUTBUILDING : 62 sqm
OUTBUILDING TERRACE = 8.8 sqm

GIA PROPOSED:
NEW HOUSE : 249.7 sqm
OUTBUILDING : 94.25 sqm

VOLUME CALCULATIONS:
NEW HOUSE : 1035.32 m3
OUTBUILDING : 322.24 m3

REV	COMMENTS	DATE
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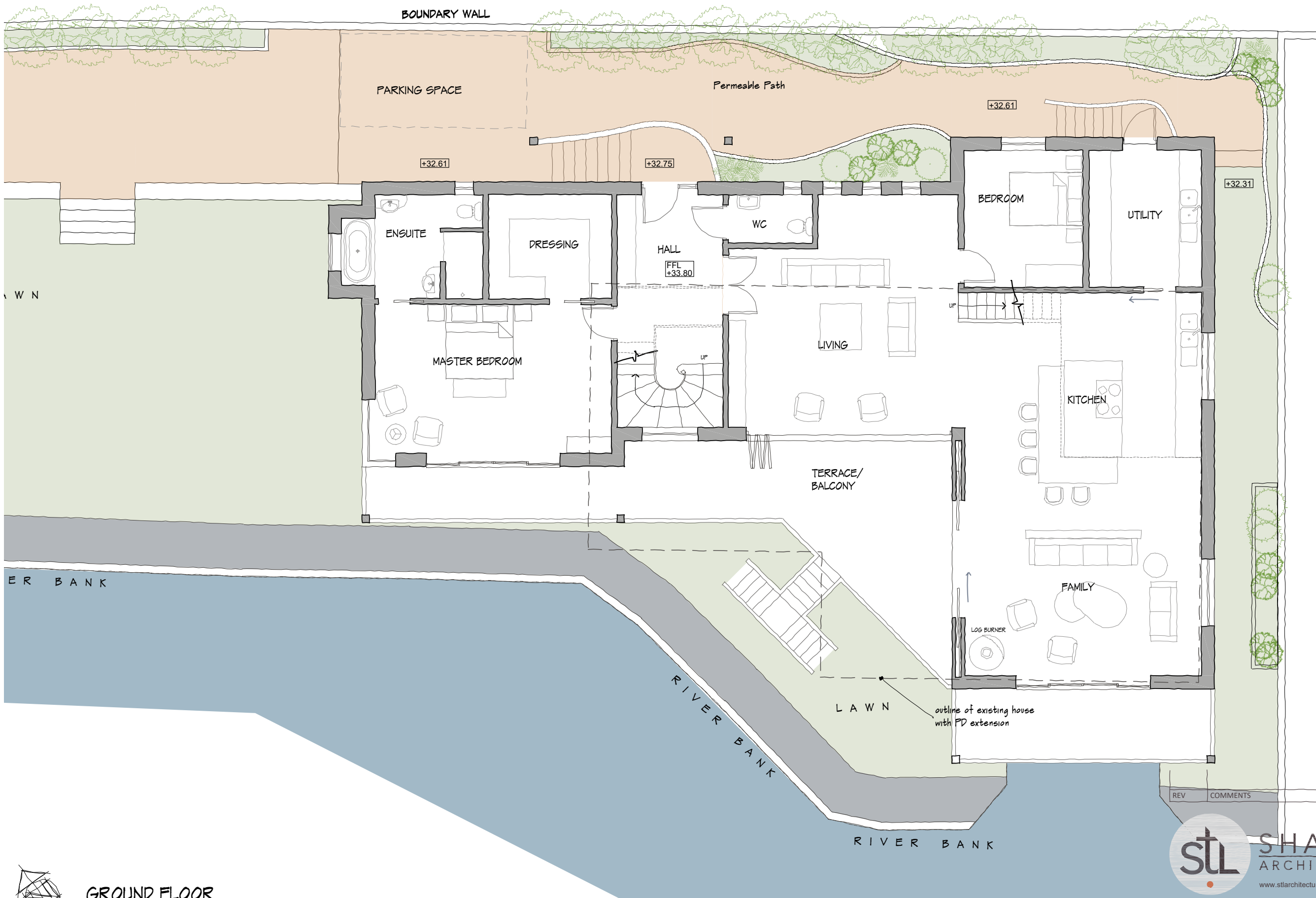


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CLIENT Mr & Mrs Crisp
PROJECT Penguin
Wargrave Road, Henley-on-Thames - RG9 3JD
DRAWING Proposed Site Plan

STATUS Planning
SCALE 1:200 @ A3 DRAWN RC CHECKED NO 3993/221 REV G
DATE Oct 2025

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GROUND FLOOR PLAN - 1:100

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,
if printing in another paper size, use the scale bar below for ref.:



REV	COMMENTS	DATE
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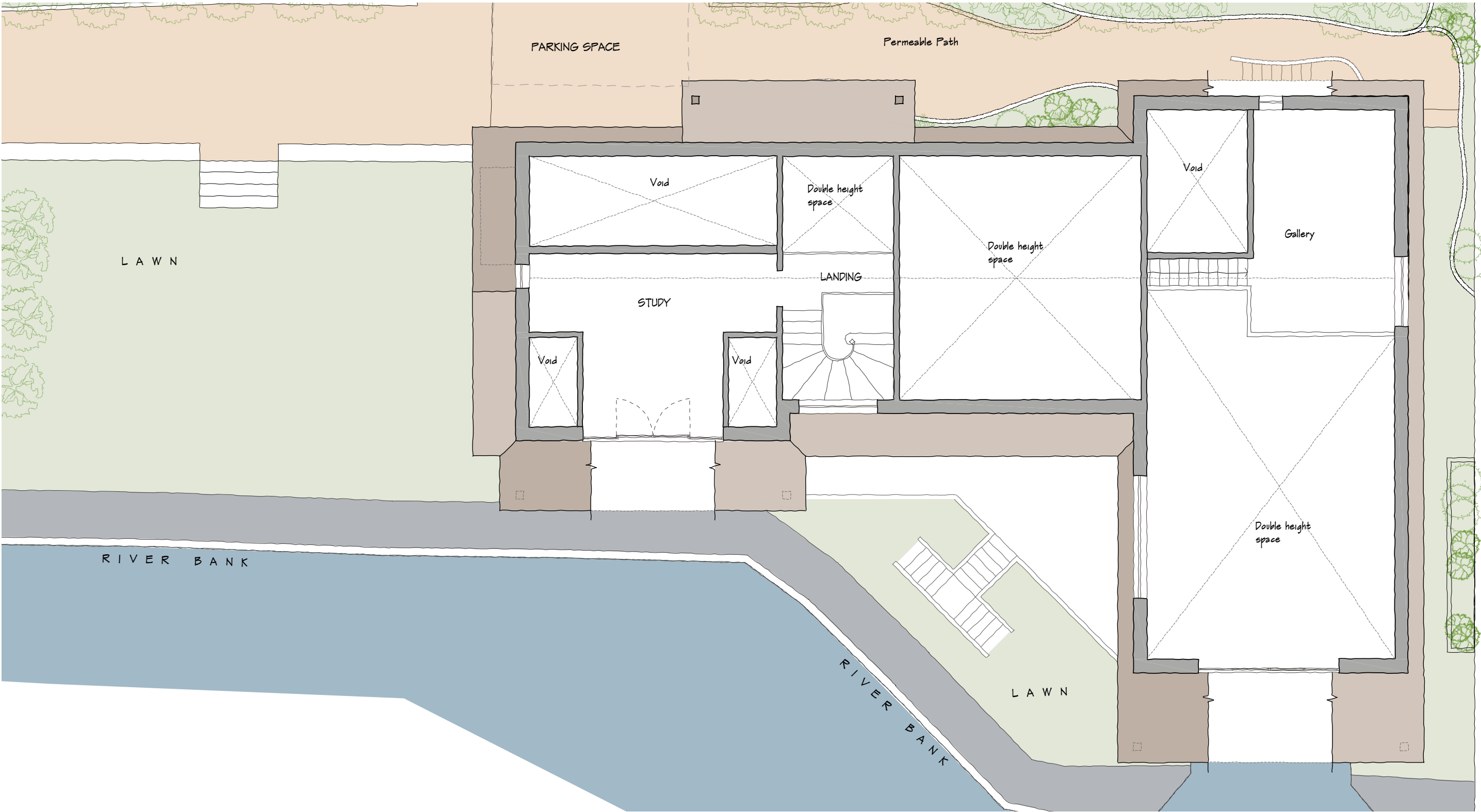
SHAUN TANNER
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CLIENT Mr & Mrs Crisp
PROJECT Penguin
Wargrave Road, Henley-on-Thames - RG9 3JD
DRAWING Proposed Upper and Lower GF Plans - HOUSE

STATUS Planning
SCALE 1:100 @ A3 DRAWN CD CHECKED NO 3993/222 REV G DATE Oct 2025

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FIRST FLOOR PLAN - 1:100

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,
if printing in another paper size, use the scale bar below for ref.:



REV	COMMENTS	DATE
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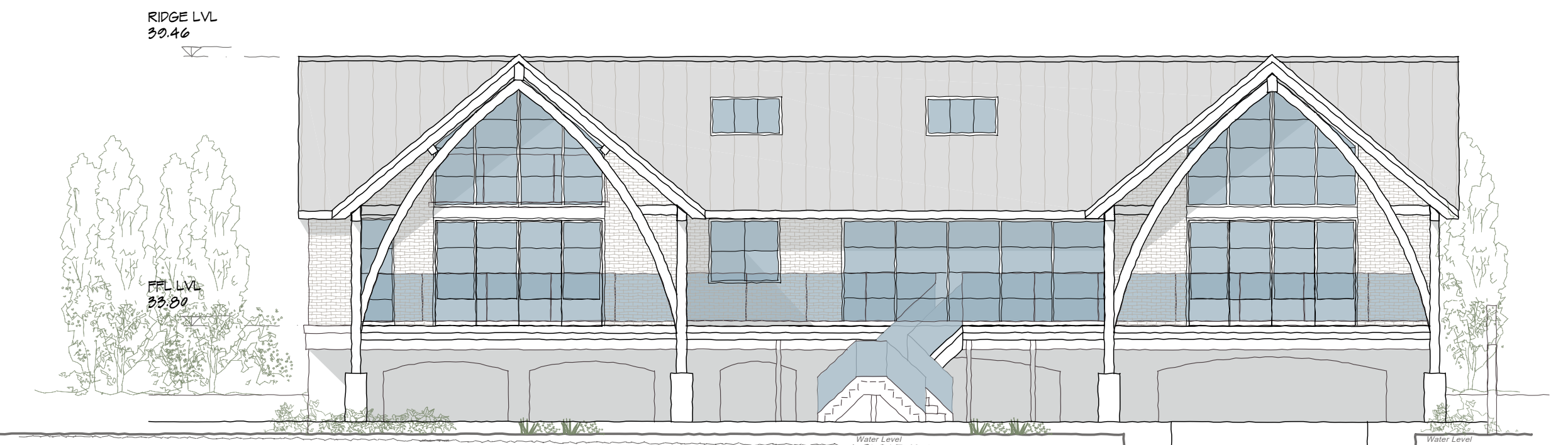
CLIENT Mr & Mrs Crisp
PROJECT Penguin
Wargrave Road, Henley-on-Thames - RG9 3JD
DRAWING Proposed First Floor Plan - HOUSE

STATUS Planning
SCALE 1:100 @ A3
DRAWN CD
CHECKED
NO 3993/223
REV D
DATE Oct 2025

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SIDE ELEVATION
NORTH WEST - 1:100



REAR ELEVATION
SOUTH WEST - 1:100

- MATERIALS:**
- WALLS - GREY LONG BRICKS
 - DOORS & WINDOWS - CRITTAL STYLE STEEL WINDOWS
 - ROOF - ZINC
 - BASEMENT PIERS AND ARCHES - BLACK ENGINEERING BRICK PLINTH

REV	COMMENTS	DATE



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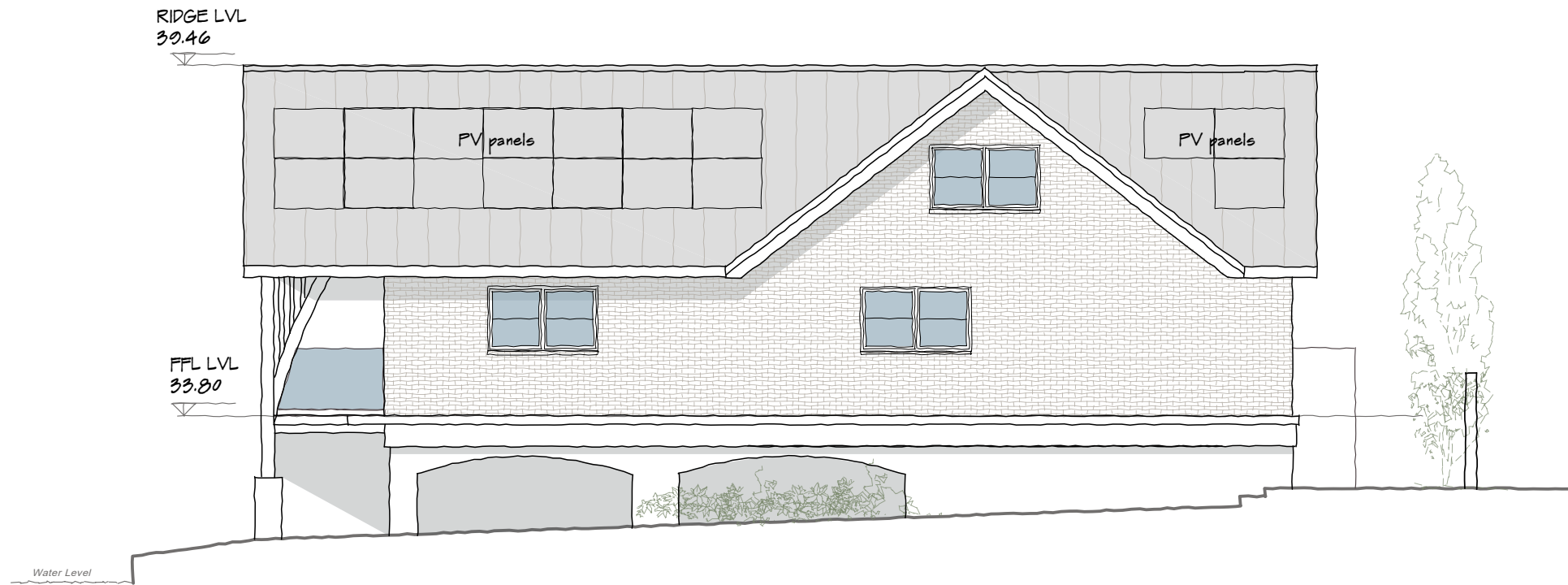
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1:100 scale Bar
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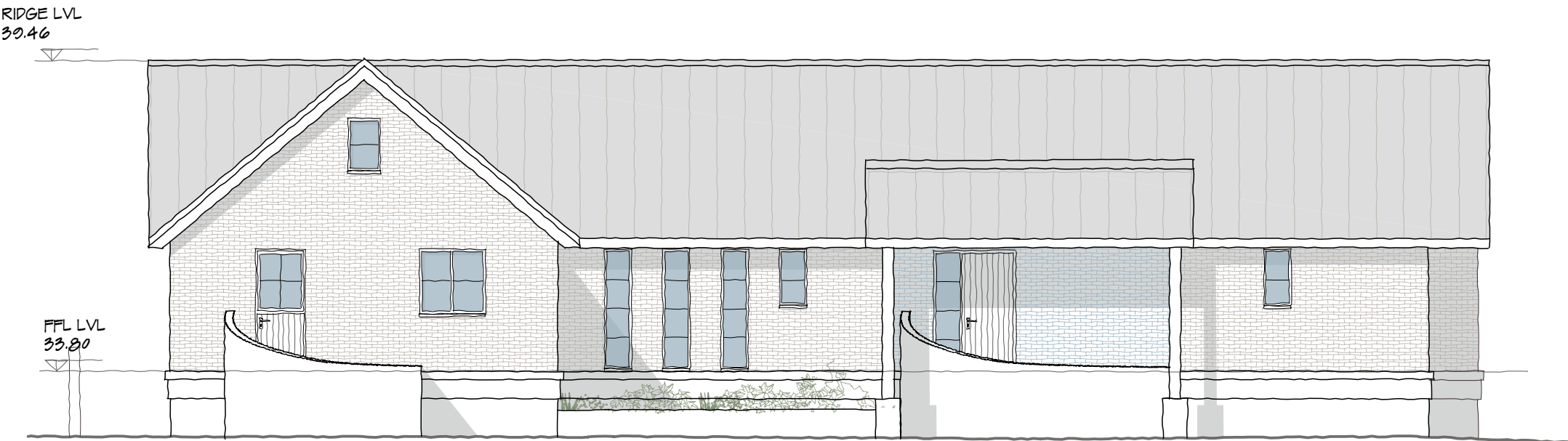


CLIENT	Mr & Mrs Crisp			DATE	Oct 2025
PROJECT	Penguin			SCALE	1:100 @ A3
	Wargrave Road, Henley-on-Thames - RG9 3JD			DRAWN	CD
	Proposed Elevation 1of2 - HOUSE			CHECKED	NO 3993/224
				REVF	

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SIDE ELEVATION
SOUTH EAST - 1:100



FRONT ELEVATION
NORTH EAST - 1:100

- MATERIALS:**
- WALLS - GREY LONG BRICKS
 - DOORS & WINDOWS - CRITTAL STYLE STEEL WINDOWS
 - ROOF - ZINC
 - BASEMENT PIERS AND ARCHES - BLACK ENGINEERING BRICK PLINTH

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,
if printing in another paper size, use the scale bar below for ref.:
0m 1m 4m
0.5m 2m 8m

REV	COMMENTS	DATE



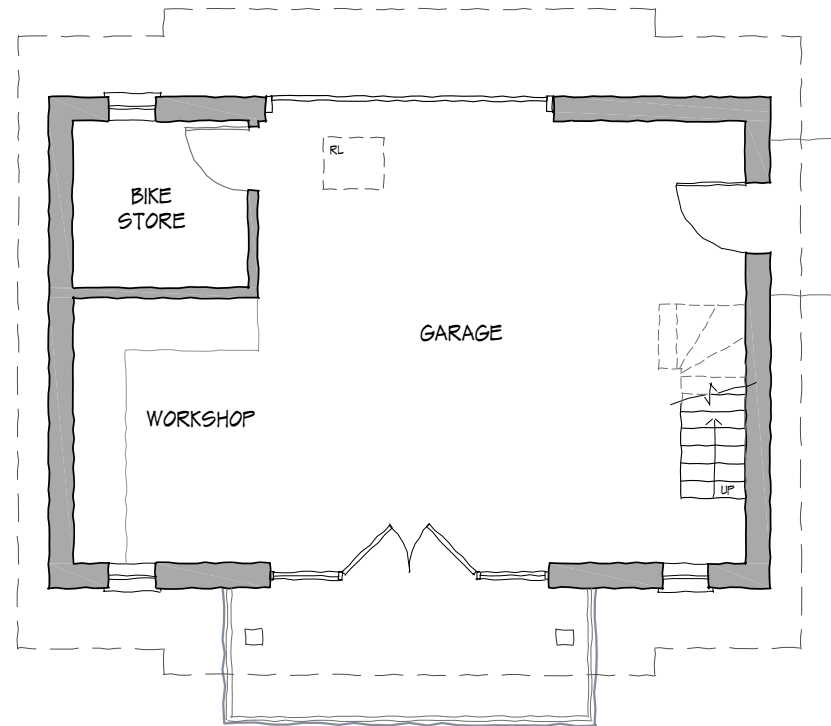
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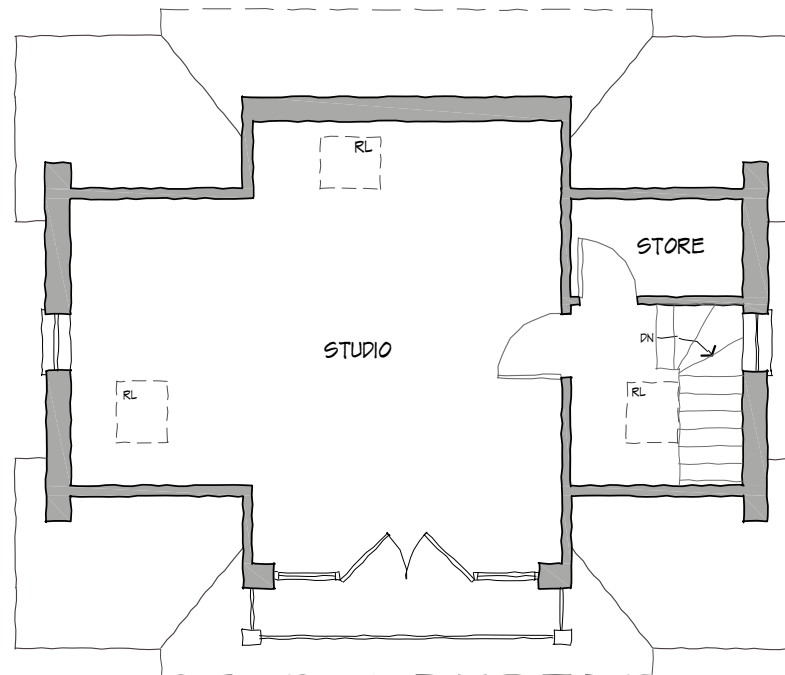
CLIENT Mr & Mrs Crisp
PROJECT Penguin
Wargrave Road, Henley-on-Thames - RG9 3JD
DRAWING Proposed Elevation 2of2 - HOUSE

STATUS Planning
SCALE 1:100 @ A3 DRAWN CD CHECKED NO 3993/225 REV F DATE Oct 2025

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GROUND FLOOR
PLAN - 1:100



1st FLOOR
PLAN - 1:100



1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,
if printing in another paper size, use the scale bar below for ref.:



FOOT PRINT PROPOSED:
OUTBUILDING : 62 sqm

GIA PROPOSED:
94.25 sqm

VOLUME CALCULATIONS:
OUTBUILDING : 247.12 m³

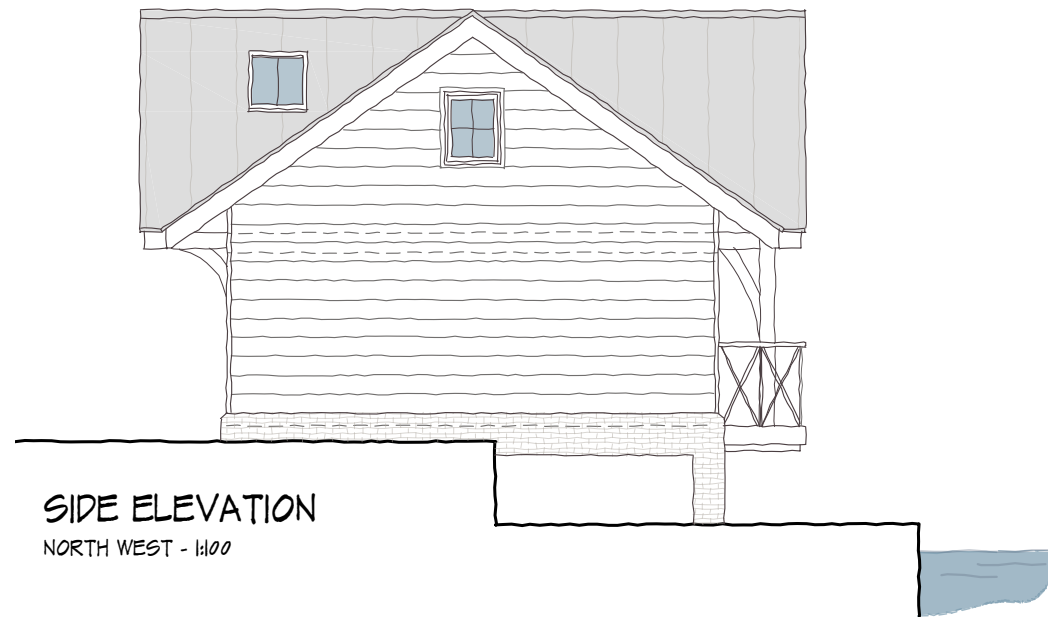
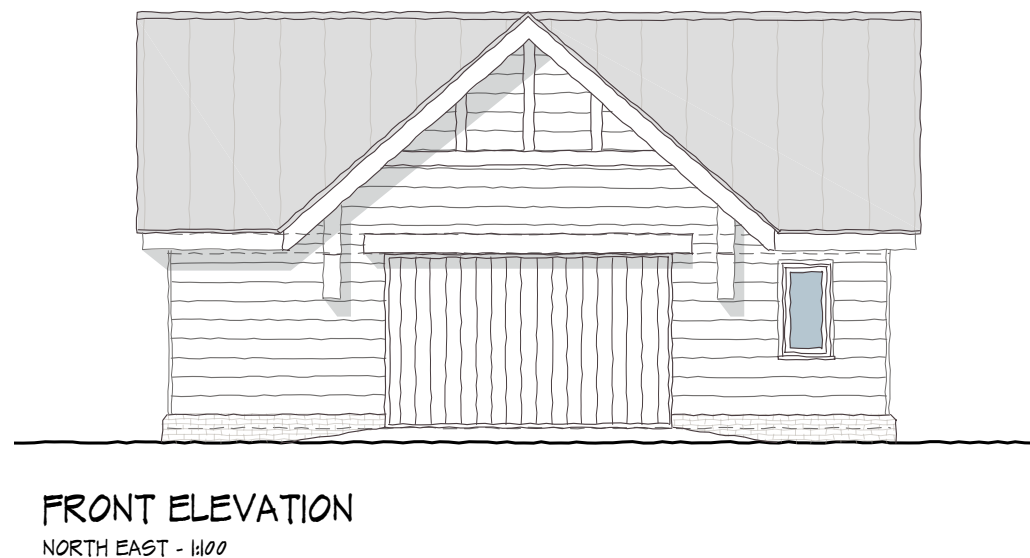
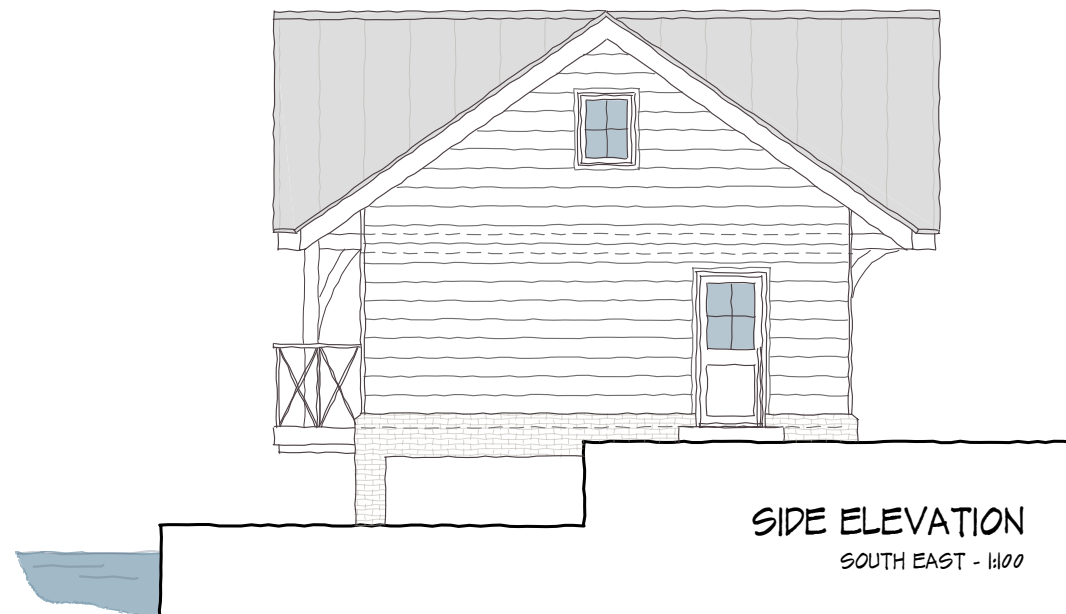
REV	COMMENTS	DATE
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CLIENT Mr & Mrs Crisp
PROJECT Penguin
Wargrave Road, Henley-on-Thames - RG9 3JD
DRAWING Proposed Plans - OUTBUILDING

STATUS Planning
SCALE 1:100 @ A3
DRAWN RC
CHECKED
NO 3993/226
REV C
DATE Oct 2025

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MATERIALS:

- WALLS - TIMBER CLADDING/COMPOSITE CLADDING
- DOORS & WINDOWS - CRITTAL STYLE STEEL WINDOWS
- ROOF - ZINC
- PLINTH - BLACK ENGINEERING BRICK PLINTH

REV	COMMENTS	DATE
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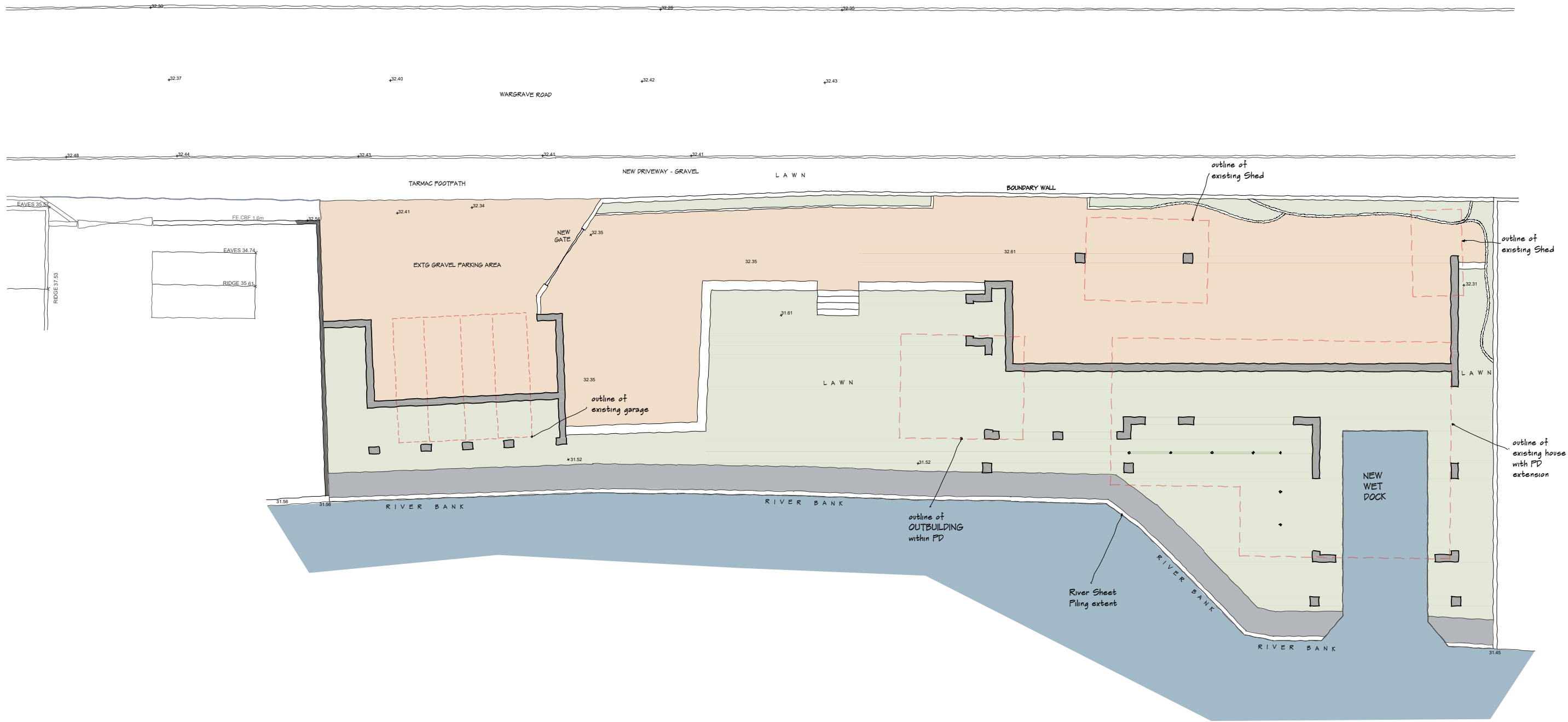
CLIENT Mr & Mrs Crisp
 PROJECT Penguin
 Wargrave Road, Henley-on-Thames - RG9 3JD
 DRAWING Proposed Elevations - OUTBUILDING

STATUS Planning
 SCALE 1:100 @ A3
 DRAWN RC
 CHECKED
 NO 3993/227
 REV C
 DATE Oct 2025

1:100 scale Bar
 This Drawing has been produced for printing onto A3 size paper,
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SITE
PLAN - 1:200

1:200 scale Bar
This Drawing has been produced for printing onto A3 size paper,
if printing in another paper size, use the scale bar below for ref.:



REV	COMMENTS	DATE
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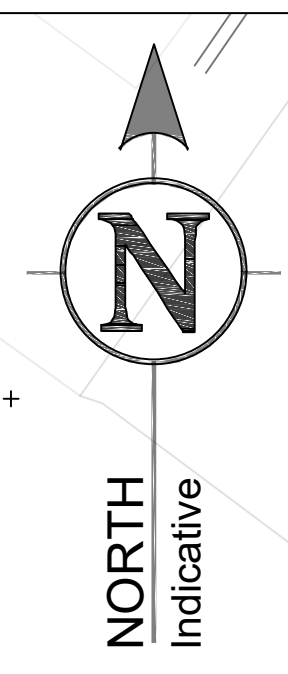


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CLIENT Mr & Mrs Crisp
PROJECT Penguin
Wargrave Road, Henley-on-Thames - RG9 3JD
DRAWING Proposed SUB-Structure Plan

STATUS Planning
SCALE 1:200 @ A3 DRAWN CD CHECKED NO 3993/228 REV -
DATE Oct 2025

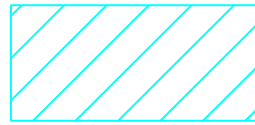
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Existing Red Boundary Total Area is Approx. 931m ²
Existing Impermeable Total Area is Approx. 309m ²
Existing Permeable Total Area is Approx. 622m ²
Existing Impermeable Area represent Approx. 33% from Total Considered Area.

DRAWING TO BE PRINTED IN COLOUR.

KEY:

-  Existing Roof & Hardstanding Areas
-  Proposed Site Boundary
-  Exceedance Route Arrow

NOT FOR CONSTRUCTION

IMPORTANT
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REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
A	11-03-26	M.HAM	For Information.	SL	SL

PROJECT:
Penguin, Wargrave Road, Henley, RG9 3JD

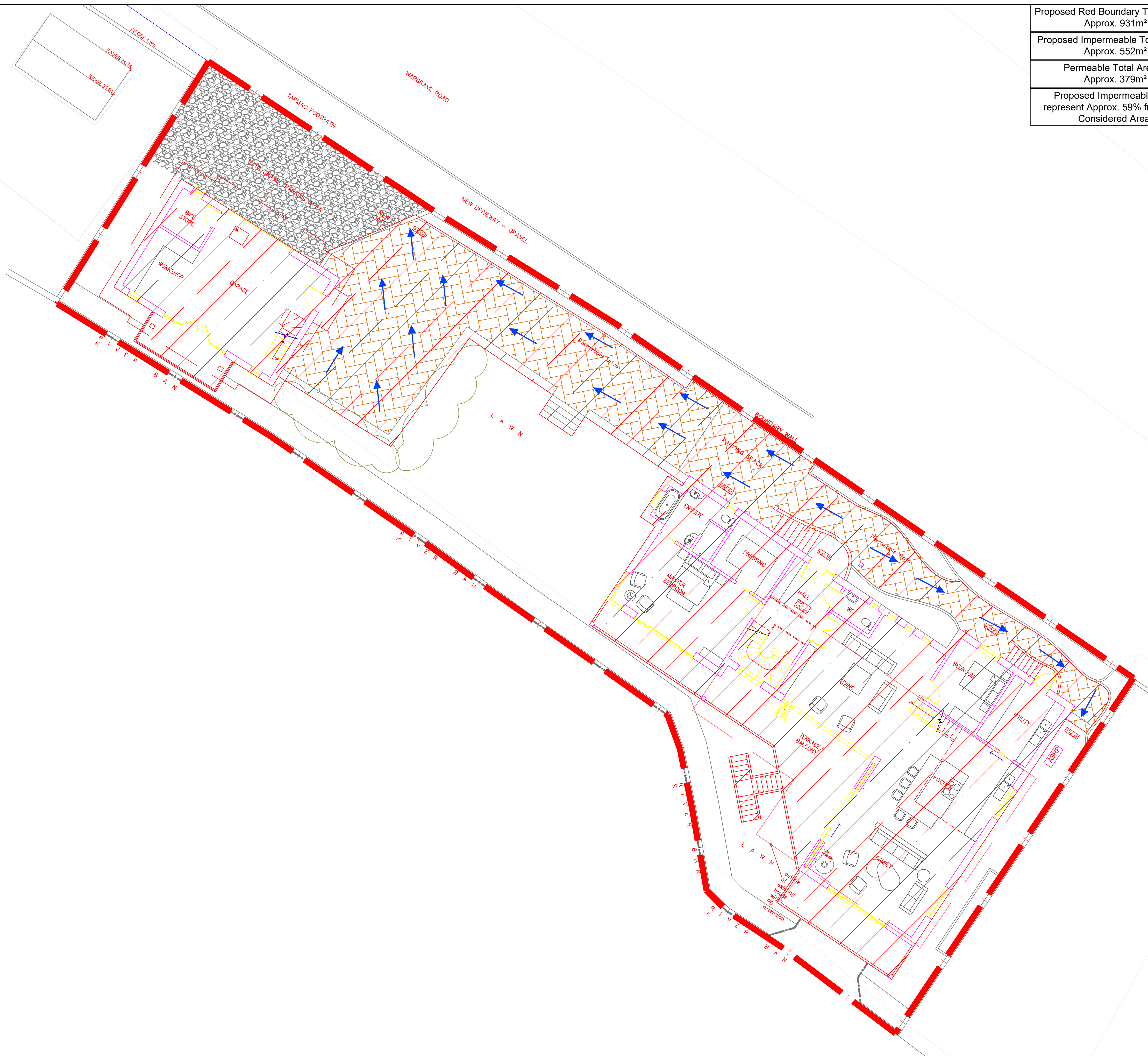
TITLE:
Pre-Development Impermeable Areas & Exceedance
Routes Plan

CLIENT:
Mr & Mrs Crisp

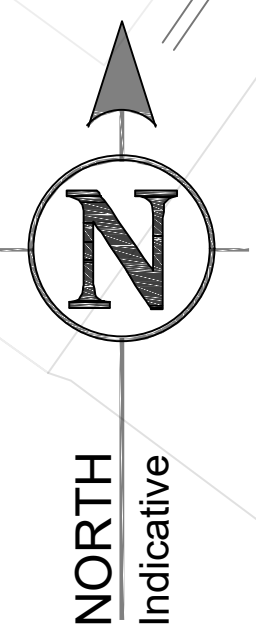
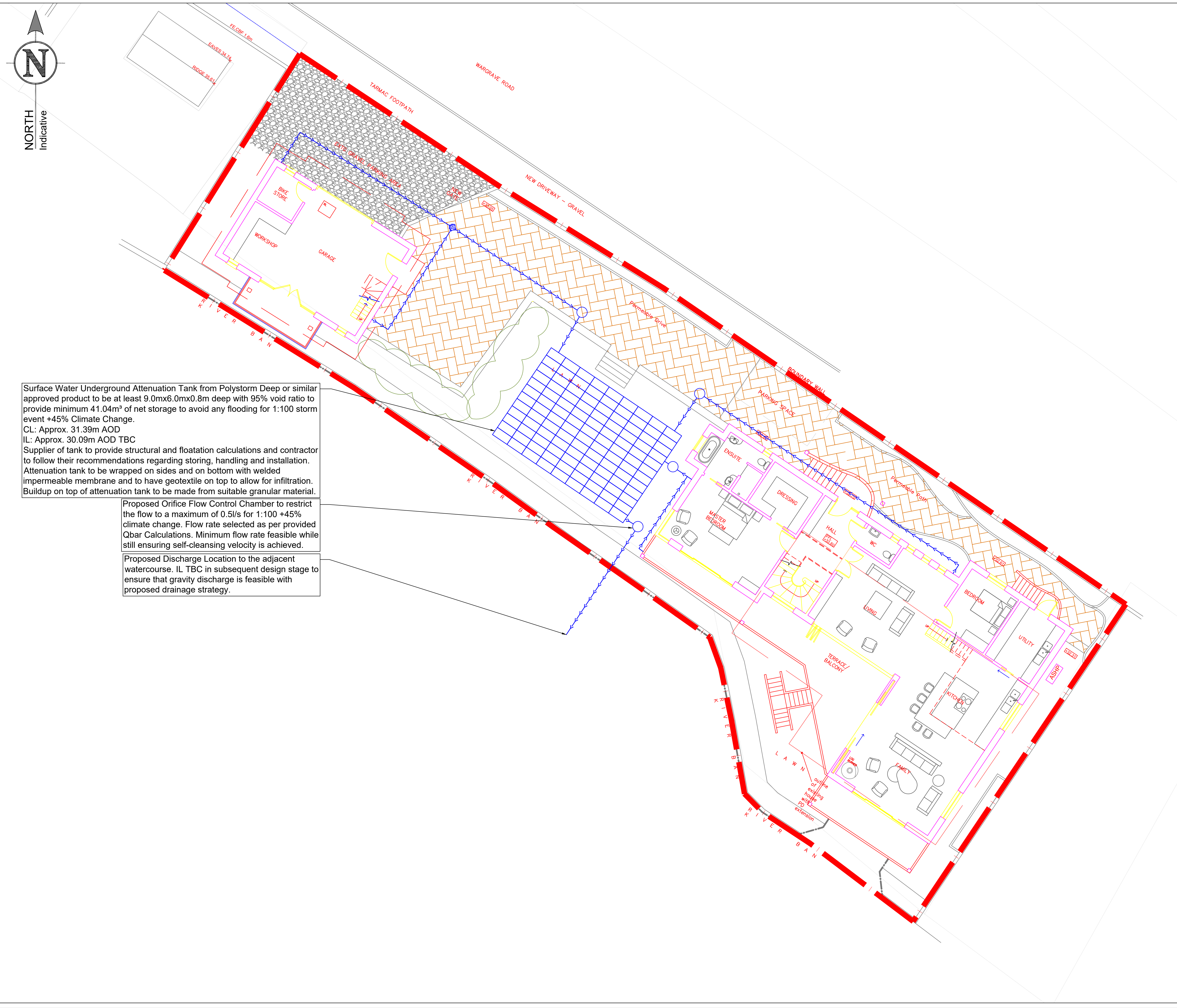


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ENGINEERING CONSULTANTS
www.nimbusengineering.co.uk
info@nimbusengineering.co.uk

CHECKED BY: S.L	DATE: 11-03-26	APPROVED BY: S.L	DATE: 11-03-26
DRN BY: M.HAM	SCALE: 1:100	DRAWING NUMBER: C3571-01	REV: A
DATE: 11-03-26	SIZE: A1		



CHECKED BY: S.L		DATE: 11-03-26		APPROVED BY: S.L		DATE: 11-03-26	
DRN BY: M.HAM		SCALE: 1:100		DRAWING NUMBER: C3571-02		REV: A	
DATE: 11-03-26		SIZE: A1					



Surface Water Underground Attenuation Tank from Polystorm Deep or similar approved product to be at least 9.0mx6.0mx0.8m deep with 95% void ratio to provide minimum 41.04m³ of net storage to avoid any flooding for 1:100 storm event +45% Climate Change.
CL: Approx. 31.39m AOD
IL: Approx. 30.09m AOD TBC
Supplier of tank to provide structural and floatation calculations and contractor to follow their recommendations regarding storing, handling and installation.
Attenuation tank to be wrapped on sides and on bottom with welded impermeable membrane and to have geotextile on top to allow for infiltration.
Buildup on top of attenuation tank to be made from suitable granular material.

Proposed Orifice Flow Control Chamber to restrict the flow to a maximum of 0.5l/s for 1:100 +45% climate change. Flow rate selected as per provided Qbar Calculations. Minimum flow rate feasible while still ensuring self-cleansing velocity is achieved.

Proposed Discharge Location to the adjacent watercourse. IL TBC in subsequent design stage to ensure that gravity discharge is feasible with proposed drainage strategy.

DRAWING TO BE PRINTED IN COLOUR.

KEY:

- Proposed Permeable Paving
- Proposed Site Boundary
- SW Inspection / Catchpit Chambers
- Surface Water UPVC Pipes
- Proposed Attenuation Tank

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REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
A	11-03-26	M.HAM	For Information.	SL	SL

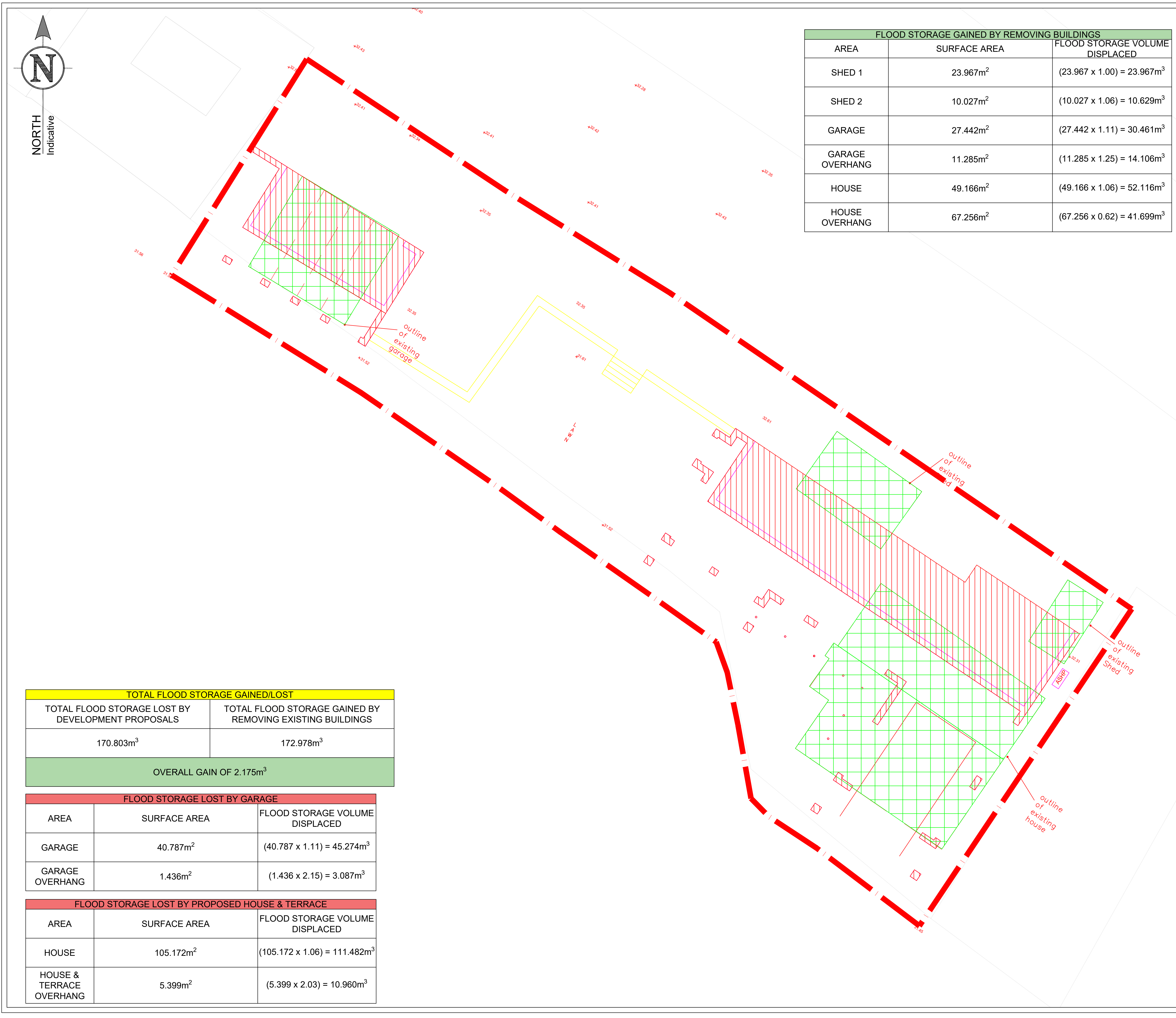
PROJECT:
Penguin, Wargrave Road, Henley, RG9 3JD

TITLE:
Outline SuDS Layout & Location Plan

CLIENT:
Mr & Mrs Crisp

www.nimbusengineering.co.uk
info@nimbusengineering.co.uk

CHECKED BY: S.L	DATE: 11-03-26	APPROVED BY: S.L	DATE: 11-03-26
DRN BY: M.HAM	SCALE: 1:100	DRAWING NUMBER: C3571-03	REV: A
DATE: 11-03-26	SIZE: A1		



FLOOD STORAGE GAINED BY REMOVING BUILDINGS		
AREA	SURFACE AREA	FLOOD STORAGE VOLUME DISPLACED
SHED 1	23.967m ²	(23.967 x 1.00) = 23.967m ³
SHED 2	10.027m ²	(10.027 x 1.06) = 10.629m ³
GARAGE	27.442m ²	(27.442 x 1.11) = 30.461m ³
GARAGE OVERHANG	11.285m ²	(11.285 x 1.25) = 14.106m ³
HOUSE	49.166m ²	(49.166 x 1.06) = 52.116m ³
HOUSE OVERHANG	67.256m ²	(67.256 x 0.62) = 41.699m ³

TOTAL FLOOD STORAGE GAINED/LOST	
TOTAL FLOOD STORAGE LOST BY DEVELOPMENT PROPOSALS	TOTAL FLOOD STORAGE GAINED BY REMOVING EXISTING BUILDINGS
170.803m ³	172.978m ³
OVERALL GAIN OF 2.175m ³	

FLOOD STORAGE LOST BY GARAGE		
AREA	SURFACE AREA	FLOOD STORAGE VOLUME DISPLACED
GARAGE	40.787m ²	(40.787 x 1.11) = 45.274m ³
GARAGE OVERHANG	1.436m ²	(1.436 x 2.15) = 3.087m ³

FLOOD STORAGE LOST BY PROPOSED HOUSE & TERRACE		
AREA	SURFACE AREA	FLOOD STORAGE VOLUME DISPLACED
HOUSE	105.172m ²	(105.172 x 1.06) = 111.482m ³
HOUSE & TERRACE OVERHANG	5.399m ²	(5.399 x 2.03) = 10.960m ³

DRAWING TO BE PRINTED IN COLOUR.

KEY:

- Flood Storage Area Lost
- Flood Storage Area Gained
- Proposed Site Boundary

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REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
A	11-03-26	M.HAM	For Information.	SL	SL

PROJECT:
Penguin, Wargrave Road, Henley, RG9 3JD

TITLE:
Indicative Flood Compensation Volumes for Pre & Post Development

CLIENT:
Mr & Mrs Crisp



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CHECKED BY: S.L	DATE: 11-03-26	APPROVED BY: S.L	DATE: 11-03-26
DRN BY: M.HAM	SCALE: 1:100	DRAWING NUMBER: C3571-04	REV: A
DATE: 11-03-26	SIZE: A1		

APPENDIX B – MODELLED FLOOD LEVELS FROM THE ENVIRONMENT AGENCY

Product 4 (Detailed Flood Risk) for **RG9 3JD**

Our Ref: **EIR2025/10319**

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 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 separately)
- 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:

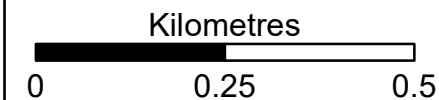
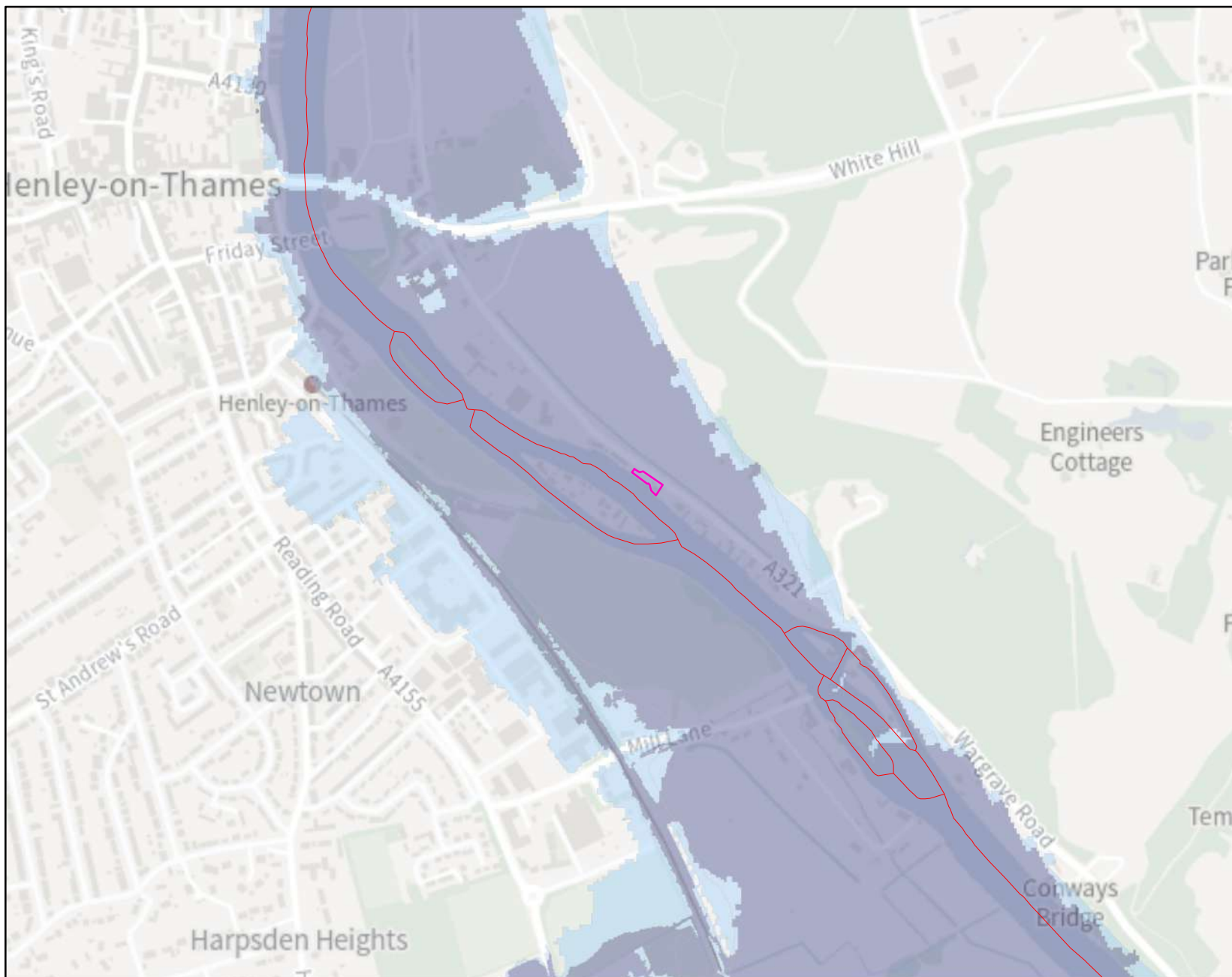
<https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities>

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>

Flood Map for Planning centred on RG9 3JD

Created on 10/06/2025 REF: EIR2025/10319



Legend

- Site
- Statutory Main Rivers
- Flood Zone 3
- Flood Zone 2

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.

Defence information

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

EIR2025/10319

Model: Thames (Sonning to Hurley) 2019

Description: The information provided is taken from the Thames Mapledurham to Hurley Modelling Study – Final Report, undertaken by JBA in March 2019. The study was carried out using 1D-2D modelling software (Flood Modeller Pro-TUFLOW). Prior to May 2022, this model was known as Thames (Mapledurham to Hurley) 2019 - in May 2022 this model was re-named to Thames (Sonning to Hurley) to replicate the shortened extent of this modelling due to the model being partially superseded by a new model upstream. If you require modelled data upstream of Sonning, please use the Thames (Pangbourne to Sonning) 2019 model.

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 30 / 3.3% AEP; 1 in 50 / 2% AEP; 1 in 75 / 1.33% AEP; 1 in 100 / 1% AEP; 1 in 100+25% / 1% AEP with 25% climate change; 1 in 100+35% / 1% AEP with 35% climate change; 1 in 100+70% / 1% AEP with 70% climate change; 1 in 200 / 0.5% AEP; 1 in 200 / 0.5% AEP; 1 in 200+25% / 0.5% AEP with 25% climate change; 1 in 200+35% / 0.5% AEP with 35% climate change; 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 30 / 3.3% AEP; 1 in 50 / 2% AEP; 1 in 75 / 1.33% AEP; 1 in 100 / 1% AEP; 1 in 100+25% / 1% AEP with 25% climate change; 1 in 100+35% / 1% AEP with 35% climate change; 1 in 100+70% / 1% AEP with 70% climate change; 1 in 200 / 0.5% AEP; 1 in 200 / 0.5% AEP; 1 in 200+25% / 0.5% AEP with 25% climate change; 1 in 200+35% / 0.5% AEP with 35% climate change; and 1 in 1000 / 0.1% AEP.

Modelled in-channel flood flows and levels

EIR2025/10319

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:

				Flood Levels (mAOD)										
Node label	Model	Easting	Northing	20% AEP	5% AEP	3.3% AEP	1% AEP	1% AEP (+10% increase in flows)	1% AEP (+15% increase in flows)	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2019_32.092E	Thames (Sonning to Hurley) 2019	476755	182190	32.07	32.42	32.56	32.90				33.32	33.44	33.97	33.57
061_00_2019_32.096	Thames (Sonning to Hurley) 2019	476914	182072	32.11	32.47	32.62	32.95				33.38	33.50	34.03	33.63
061_00_2019_32.098	Thames (Sonning to Hurley) 2019	476968	182036	32.12	32.48	32.62	32.95				33.38	33.51	34.04	33.64
061_00_2019_32.101	Thames (Sonning to Hurley) 2019	477107	181941	32.15	32.51	32.66	32.99				33.42	33.58	34.10	33.70

				Flood Flows (m3/s)										
Node label	Model	Easting	Northing	20% AEP	5% AEP	3.3% AEP	1% AEP	1% AEP (+10% increase in flows)	1% AEP (+15% increase in flows)	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2019_32.092E	Thames (Sonning to Hurley) 2019	476755	182190	280.71	356.08	369.85	420.41				475.20	486.02	523.78	488.65
061_00_2019_32.096	Thames (Sonning to Hurley) 2019	476914	182072	270.21	337.35	352.00	404.95				464.00	474.00	474.29	474.22
061_00_2019_32.098	Thames (Sonning to Hurley) 2019	476968	182036	266.54	330.75	345.21	395.01				444.81	452.41	452.64	452.59
061_00_2019_32.101	Thames (Sonning to Hurley) 2019	477107	181941	256.04	304.38	314.24	348.18				376.57	379.58	389.35	379.73

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

EIR2025/10319

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

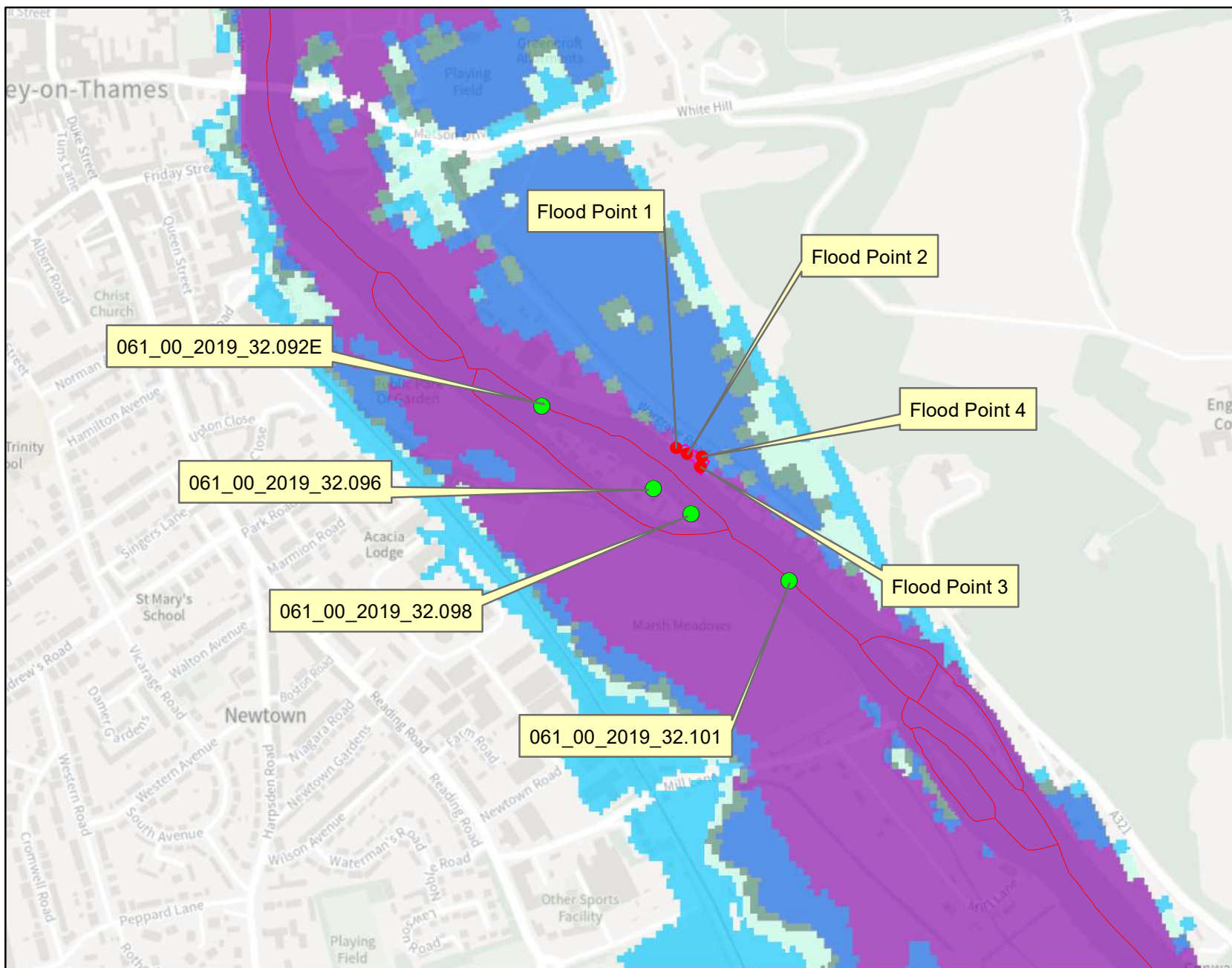
2D grid cell reference	Model	Easting	Northing	flood levels (mAOD)										
				20% AEP	5% AEP	3.3 AEP	1% AEP	1% AEP (+10% increase in flows)	1% AEP (+15% increase in flows)	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
Flood Point 1	Thames (Sonning to Hurley) 2019	476,947	182,129	32.11	32.47	32.62	32.95				33.37	33.50	34.03	33.63
Flood Point 2	Thames (Sonning to Hurley) 2019	476,962	182,120	32.11	32.48	32.62	32.95				33.38	33.51	34.03	33.63
Flood Point 3	Thames (Sonning to Hurley) 2019	476,981	182,103	32.12	32.48	32.62	32.95				33.38	33.51	34.03	33.64
Flood Point 4	Thames (Sonning to Hurley) 2019	476,982	182,116	No Data	32.47	32.62	32.95				33.38	33.51	34.03	33.64

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 RG9 3JD
Created on 10/06/2025 REF: EIR2025/10319



A horizontal scale bar labeled 'Kilometres' at the top. The bar has a black segment from 0 to 0.2 and a white segment from 0.2 to 0.4. Numerical labels '0', '0.2', and '0.4' are placed below the bar at their respective positions.

Legend

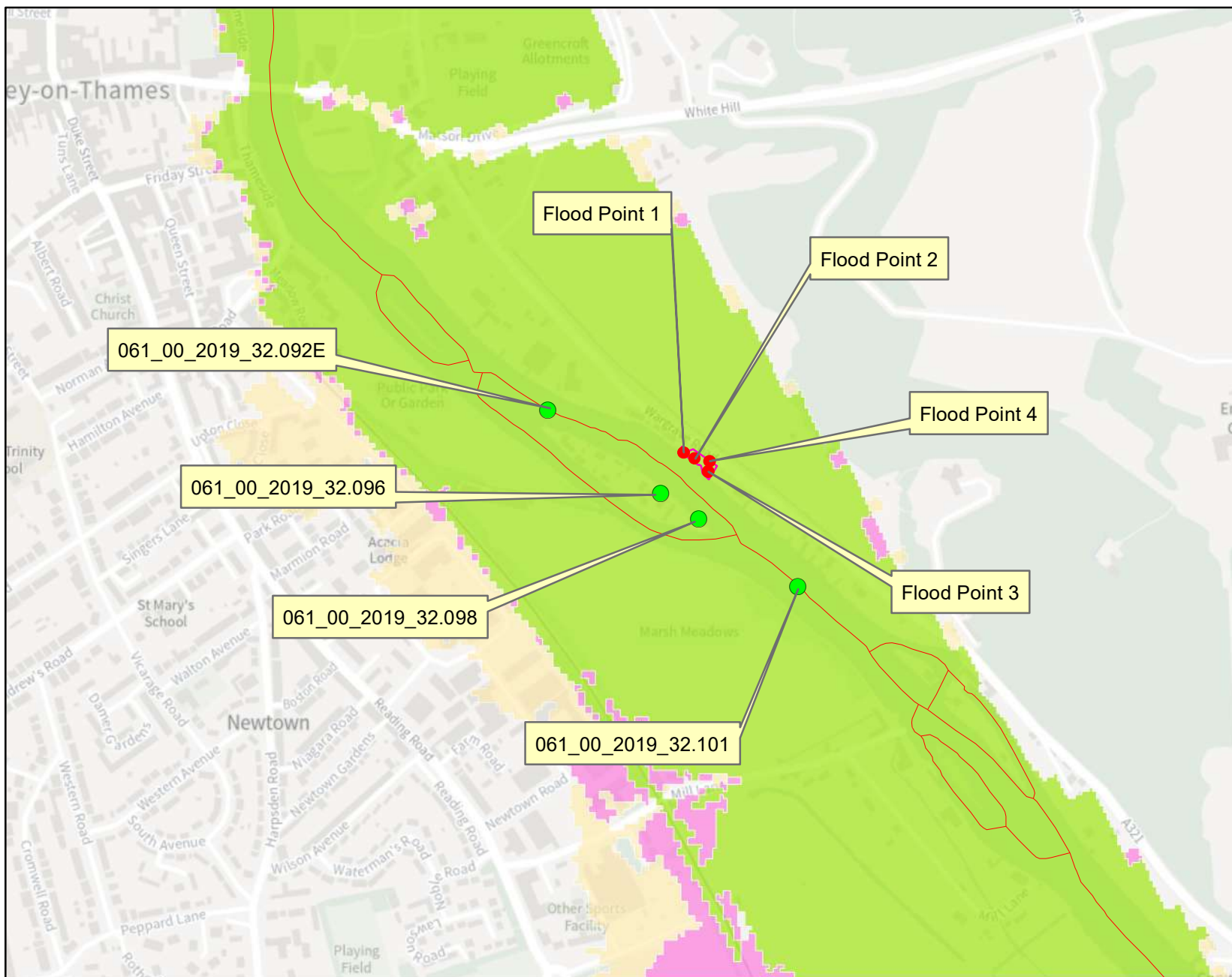
-  Model Nodes
-  Site
-  Statutory Main Rivers
-  20% AEP Flood Outline
-  5% AEP Flood Outline
-  3.3% AEP Flood Outline
-  1% AEP Flood Outline
-  0.1% AEP Flood Outline
-  Floodplain Node

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occurring 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.

Detailed FRA Map centred on RG9 3JD

Created on 10/06/2025 REF: EIR2025/10319



Legend

- Model Nodes
- Site
- Statutory Main Rivers
- 1%+25% CC AEP Flood Outline
- 1%+35% CC AEP Flood Outline
- 1%+70% CC AEP Flood Outline
- Floodplain Node

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occurring 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.

Historic flood data

EIR2025/10319

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:

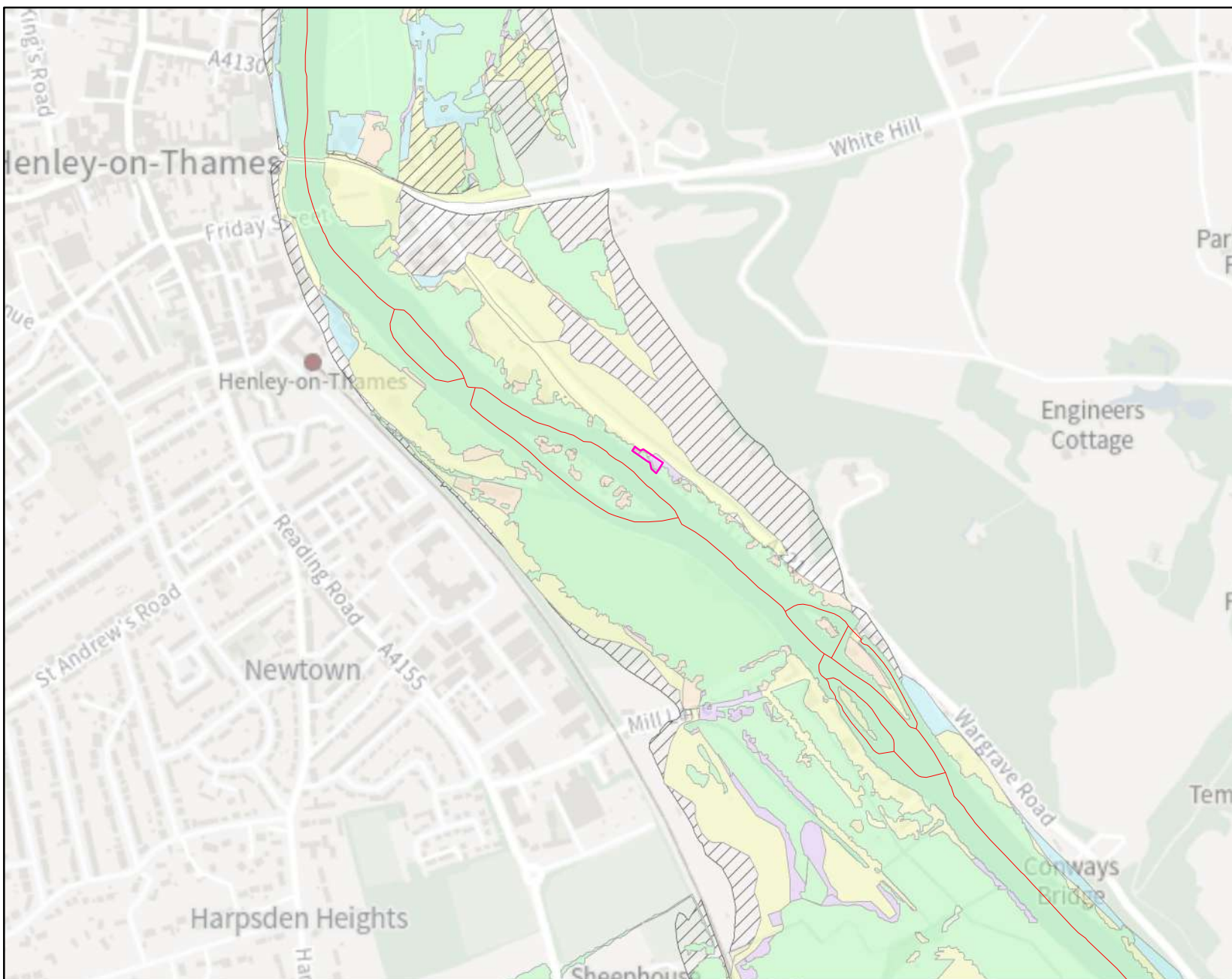
Flood Event Code	Flood Event Name	Start Date	End Date	Source of Flooding	Cause of Flooding
EA0619470300119	06MarchSpring1947	01/01/1947	12/12/1947	main river	channel capacity exceeded (no raised defences)
EA0619741100520	06NovemberAutumn1974	01/01/1974	12/12/1974	main river	channel capacity exceeded (no raised defences)
EA0620001200529	06DecemberWinter2000	01/01/2000	12/12/2000	main river	channel capacity exceeded (no raised defences)
EA0620030101899	06JanuaryNewYear2003	23/12/2002	12/01/2003	main river	channel capacity exceeded (no raised defences)
ea061231490	Shiplake CP_Fluvial Wate	19/07/2007	29/07/2007	main river	channel capacity exceeded (no raised defences)
EA0120144097369	Winter 2013/2014	23/11/2013	28/02/2014	main river	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 Flooding Map centred on RG9 3JD

Created on 10/06/2025 REF: EIR2025/10319



Legend

- Site
- Statutory Main Rivers
- 1947
- 1974
- 1990
- 2000
- 2002/3
- 2007
- 2009
- 2014

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.

Hazard Mapping

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:

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

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)

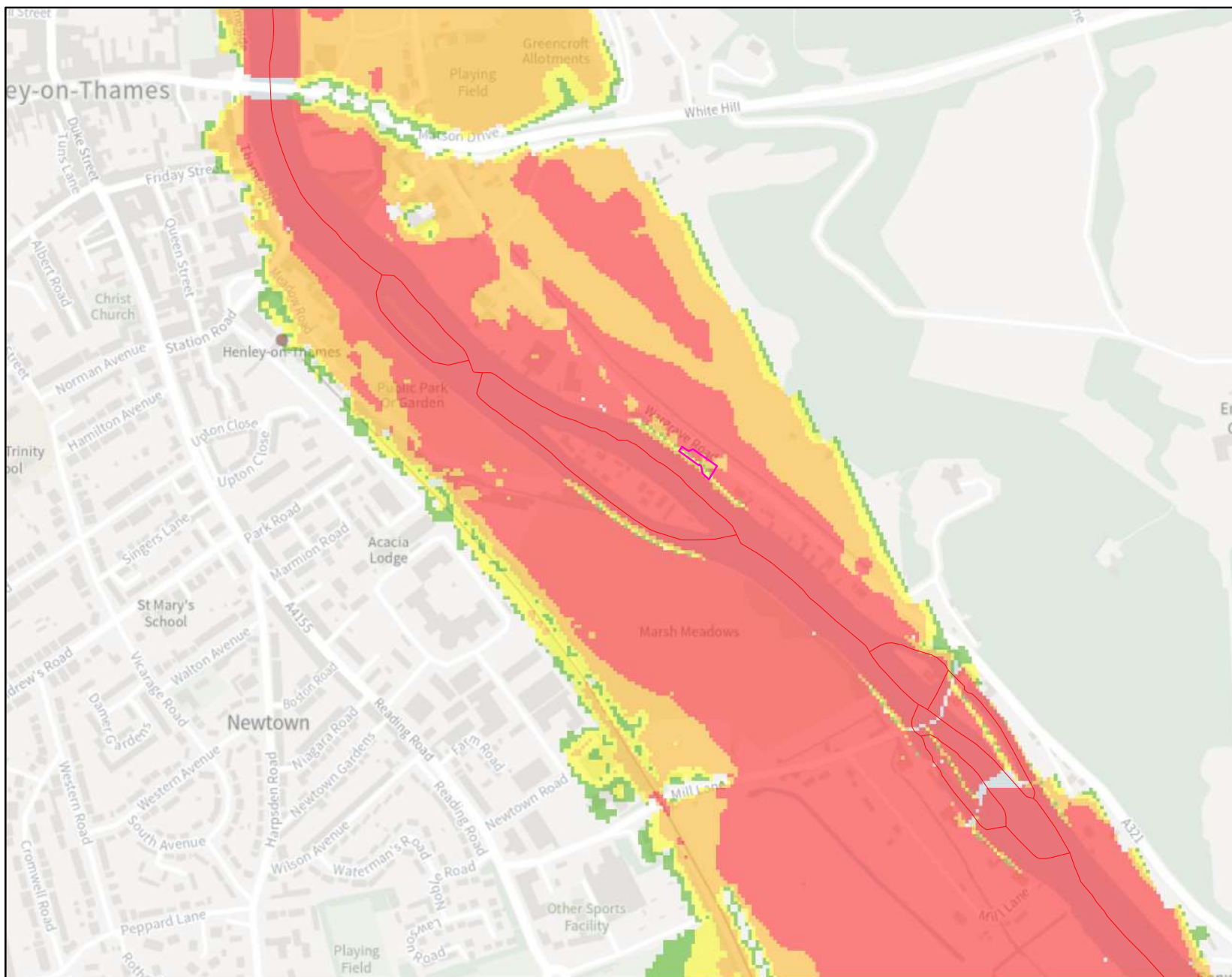
The resultant hazard rating is then classified according to:

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

1% + 35% CC AEP Hazard Map centred on RG9 3JD

Created on 10/06/2025 REF: EIR2025/10319



Kilometres

0 0.2 0.4

Legend

- Site
- Statutory Main Rivers
- Very low hazard – Caution
- Danger for some – includes children, the elderly and the infirm
- Danger for most – includes the general public
- Danger for all – includes the emergency services

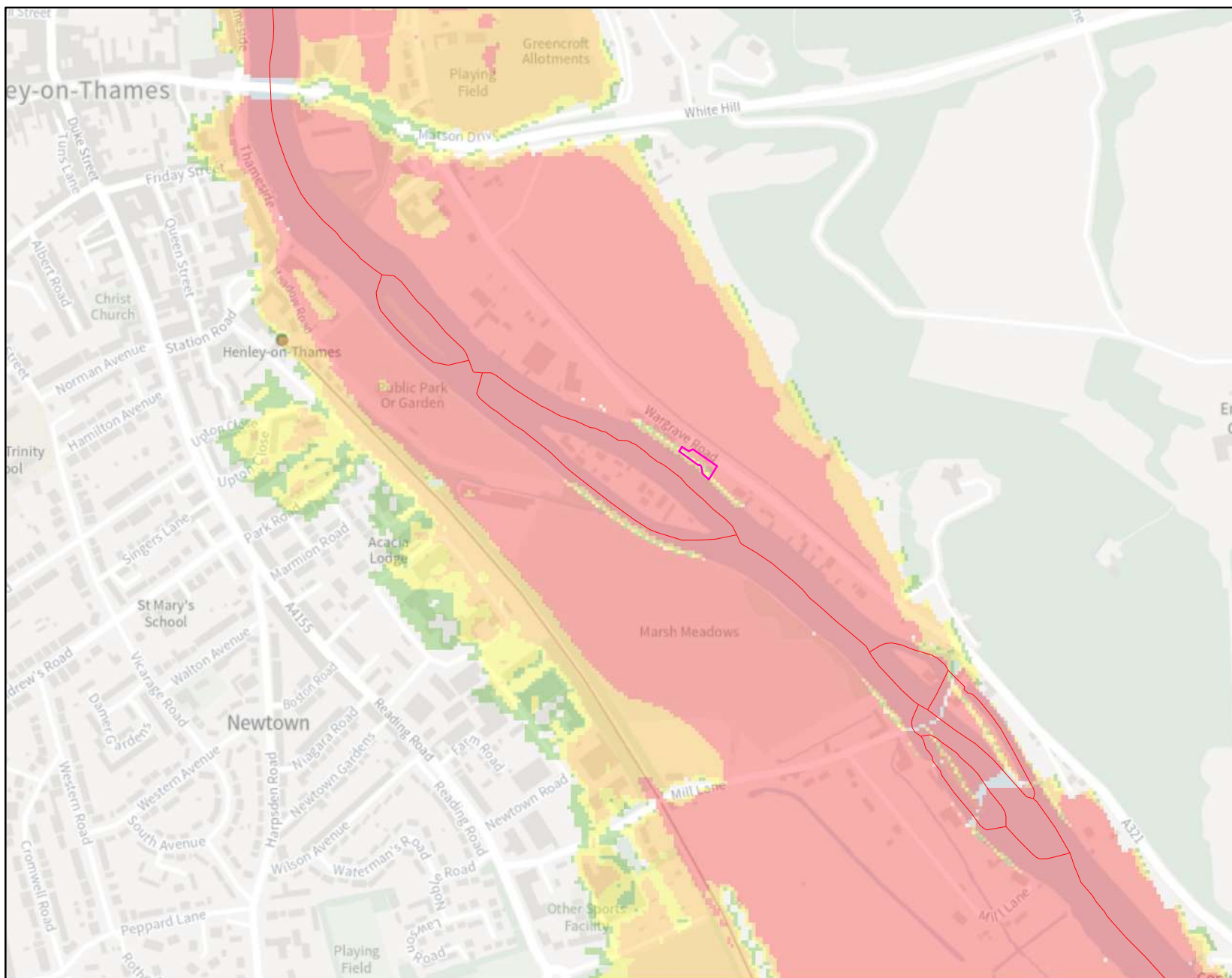
For hazard and debris factor we used HR Wallingford and Environment Agency (May 2008) supplementary note on flood hazard ratings and thresholds for development planning and control purpose. The following calculation is used:

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

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)

1% + 70% CC AEP Hazard Map centred on RG9 3JD

Created on 10/06/2025 REF: EIR2025/10319



Kilometres

0 0.2 0.4

Legend

- Site
- Statutory Main Rivers
- Low hazard
- Hazard to some
- Hazard to most
- Hazard to 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:

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

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)

APPENDIX C – SURFACE WATER RUNOFF CALCULATIONS



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Job No.	C3571		
Sheet no.	1		
Date	11/03/26		
By	M.HAM	Checked	Reviewed

MasterDrain
HY 10.01

Project	Penguin, Wargrave Road, Henley, RG9 3JD
Title	Pre & Post Development SW Runoff Calcs Prior to SuDS

Data:-

Hydrology (FSR):-

Location = HENLEY ON THAMES

Long reference = 476182

M5-60 (mm) = 20

r = 0.40

Hyd. area = 6

Hydrograph = Winter

WRAP = 1

Grid reference = SU7682

SAAR (mm/yr) = 750

Soil = 0.10

Hyd. zone = 8

Area = England & Wales

Site values used in design:-

Total site area = 0.0931 ha

Pre-dev area drained = 0.0309 ha

Imperm runoff factor = 100%

Climate change factor = 45%

Post-dev area drained = 0.0552 ha

Perm runoff factor = 20%

Pre-development

Area to soakaways = 0.0000 ha

Perv. area to SU DS = 0.0000 ha

Area to other SU DS = 0.0000 ha

Pre-dev flow to drain = 0.00 l/s

Post-development

Area to soakaways = 0.0000 ha

Perv. area to SU DS = 0.0000 ha

Area to other SU DS = 0.0000 ha

Post-dev flow to drain = 0.00 l/s

Calculations:-

Revised Post-dev Imperm. area = 0.055 ha

Equiv. Post-dev Imperm. area = 0.055 ha

Equiv. Post-dev Perm. area = 0.008 ha

Total Pre-dev equiv. area ha = 0.043 ha

Total Post-dev equiv. area ha = 0.063 ha

100 yr 6 hour mean intensity = 10.42mm/hr

Results:-

Pre-dev peakflow runoff (l/s) (m^3/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	9.4	6.2	3.9	2.4	1.5	1.1	0.9	0.8	9.4	N/A	9.4	1
30	22.9	14.9	9.3	5.6	3.3	2.4	1.9	1.6	22.9	N/A	22.9	30
100	29.7	19.5	12.2	7.4	4.3	3.1	2.5	2.1	29.7	N/A	29.7	100

Post-dev peakflow runoff (l/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	13.6	9.0	5.6	3.5	2.1	1.6	1.3	1.1	13.6	45	19.7	1
30	33.1	21.6	13.4	8.1	4.8	3.5	2.8	2.4	33.1	45	48.1	30
100	43.0	28.2	17.7	10.7	6.3	4.5	3.6	3.0	43.0	45	62.4	100

100 year 6 hour (x Climate Change Factor) storm gives:-

Pre-dev runoff volume m^3 = 27.1 m^3

Post-dev rainfall volume = 56.9 m^3

Post-dev volume m^3 (excess above SU DS) = 56.9 m^3

100 yr 6 hour mean intensity = 10.42mm/hr

Pre-dev volume to drain at 0 l/s = 0.0 m^3

Post-dev volume to drain at 0 l/s = 0.0 m^3

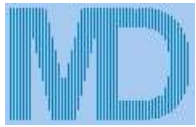
Post-dev storage volume = 56.9 m^3

Post-dev 5mm imperm volume = 2.8 m^3

Post-dev 5mm perm volume = 1.9 m^3

$Q_{BAR(rural)}$ = 0.017 l/s or 0.182 l/s/ha or 0.000 cumecs - from IoH 124.

The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.



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Job No. C3571		
Sheet no. 2		
Date 11/03/26		
By M.HAM	Checked	Reviewed

Project Penguin, Wargrave Road, Henley, RG9 3JD
Title Pre & Post Development SW Runoff Calcs Prior to SuDS

Data summary.

Use the data below for the SUR1 form

Site areas:-

Total site area	=	0.0931 ha ;931.0 m ² [3A]
Pre-development impermeable area	=	0.0309 ha [3B]
Pre-development permeable area	=	0.0622 ha
Post-development impermeable area	=	0.0552 ha [3C]
Post-development permeable area	=	0.0379 ha

Peak runoff:-

Pre-development 1 year storm (15min)	=	9.4 l/s [6A]
Pre-development 100 year storm (15min)	=	29.7 l/s [6C]
Post-development 1 year storm (15min)	=	13.6 l/s [6B]
Post-development 100 year storm (15min)=		43.02 l/s [6D]

Greenfield runoff:-

$Q_{BAR(rural)} = 0.017 \text{ l/s}$ or 0.182 l/s/ha or 0.000 cumecs - from IoH 124.

Climate change factor:-

CCF = 45%

Volumes:-

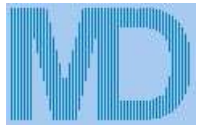
Pre-development 100 yr/6hr storm [12A]	=	39.3m ³
Post-development 100 yr/6hr storm (add. volume with no SUDS) [12B]	=	56.9m ³
Post-development 100 yr/6hr storm (add. volume with SUDS)	=	56.9m ³
Post-development add. predicted volume (No SUDS) [12C]	=	17.6m ³

You may also require

Data relating to the infiltration test calculations (if applicable)
Evidence to show runoff reduction (if applicable)
Information on calculation methods (if applicable see next sheet)

Note

Numbers in square brackets relate to the
Nov. 2010 v1.1 / issued 11/02/10 copy of SUR1



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Job No. C3571		
Sheet no. 3		
Date 11/03/26		
By M.HAM	Checked	Reviewed

Project **Penguin, Wargrave Road, Henley, RG9 3JD**

Title **Pre & Post Development SW Runoff Calcs Prior to SuDS**

Definitions and methods

Hydrology

The hydrological constants are derived from the Wallingford maps. They are used to calculate location specific rainfall figures.

Site values and factors

Areas of the site should be entered in hectares (10000 m²). If the Pre-development site is a green field, this box is blank.

Climate Change Factor is initially set at 20% - this may be changed as required.

Greenfield runoff is calculated using the method described in loH 124.

Runoff factors

The impermeable runoff factor is initially set at 98%

The permeable runoff factor is initially set at 20%

Note: the CCF and the runoff factors may be changed by the user to suit the development

The areas draining to soakaways and other SUDS are entered in the appropriate box (in hectares)

Calculations

The post-development area is reduced by subtracting the areas that drain to soakaways or other SUDS, to give a revised figure.

All areas are then multiplied by the appropriate runoff factor to give an equivalent area with 100% runoff.

These are then summated.

This gives a total pre-development equivalent area, and a similar figure for the post-development area.

The 'Post-dev volume to drain (no SUDS)' gives the total runoff to drain if no SUDS were used.

Results

The pre- and post-development areas are subjected to 1,30 and 100 year return period storms with a duration of 15 to 600 minutes.

The Revised Post-dev Imperm. area is the area (in ha) that is not going to SUDS x impervious runoff factor.

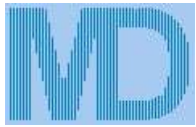
The runoff rates are calculated for the chosen hydrograph (Summer or Winter) as l/s. Figures in red indicate m³/s

The peak value is measured, multiplied by the CCF and the total maximum rate is shown.

The pre- and post-development volumes for a 100 year / 6 hour storm are calculated from the area under the hydrograph curve.

Post-dev volume (i.e. excess above SUDS) is that volume produced by the drained area that does not go to SUDS.

Qbar(rural) is calculated in accordance with the procedure laid down in loH 124



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Sheet no.	1	
Date	11/03/26	
By	Checked	Reviewed
M.HAM		

Project **Penguin, Wargrave Road, Henley, RG9 3JD**

Title **IoH 124 (Qbar(urban))Runoff Calcs**

Hydrological Data:-

FSR Hydrology:-

Location = HENLEY ON THAMES
M5-60 (mm) = 20
Soil runoff = 0.15
WRAP = 1
Hydrological area = 6

Grid reference = SU7682
r = 0.40
SAAR (mm/yr) = 750
Area = England & Wales
Hydrological zone = 8

Soil classification for WRAP type 1

- i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
- ii) Earthy peat soils drained by dykes and pumps;
- iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

Design data:-

Area = 0.000931 Km² - 0.093 Ha - 931 m² % Urbanisation = 33.00%

Calculation method:-

Runoff is calculated from:-

$$Q_{\text{BAR(urban)}} = Q_{\text{BAR(rural)}} (1 + \text{URBAN})^{2\text{NC}} [1 + \text{URBAN} \{ (21/\text{CIND}) - 0.3 \}]$$

where:-

NC varies with the value of SAAR:-

for 500<SAAR<1100 mm then NC = 0.92 - 0.00024SAAR

for 1100<SAAR<3000 mm then NC = 0.74 - 0.000082SAAR

CIND = 102.4SOIL + 0.28(CWI - 125)

CWI = Catchment Wetness Index

so

CIND = 2.885 (see note below)

CWI = 80.446

NC = 0.740

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
Reducing factor used for these calculations is 0.002

$$Q_{\text{BAR(rural)}} = 0.041 \text{ (l/s)}$$

$$Q_{\text{BAR(urban)}} = 0.206 \text{ (l/s)}$$

$Q_{\text{BAR(urban)}}$ is then multiplied by a growth factor - GC(T) - for different storm return periods derived from EA publication W5-074/A.



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Calculated data:-

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				Sheet no. 2		
				Date 11/03/26		
Project Penguin, Wargrave Road, Henley, RG9 3JD				By M.HAM	Checked	Reviewed
Title IoH 124 (Qbar(urban))Runoff Calcs						

Mean Annual Peak Flow $Q_{BAR(urban)} = 0.21 \text{ l/s}$

Values for $Q_{BAR(urban)}$

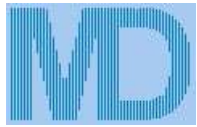
Ret. per.	m ³ /hr	l/s	l/s/ha	Ret. per.	m ³ /hr	l/s	l/s/ha
1yr	0.000	0.175	1.880	100yr	0.001	0.649	6.967
2yr	0.000	0.181	1.946	100yr+20%	0.001	0.778	8.360
5yr	0.000	0.264	2.831	100yr+30%	0.001	0.843	9.057
10yr	0.000	0.334	3.583	200yr	0.001	0.762	8.183
30yr	0.000	0.459	4.932	200yr + 30%	0.001	0.990	10.638
50yr	0.001	0.539	5.795	500yr	0.001	0.925	9.930
				1000yr	0.001	1.062	11.412

Growth factors -

1yr	2yr	5yr	10yr	30yr	50yr	100yr	200yr	500yr	1000yr
0.85	0.88	1.28	1.62	2.23	2.62	3.15	3.70	4.49	5.16

The above is based on the Institute of Hydrology Report 124 to which you are referred for further details (see Sect 7). Note that the 200 year growth curve was taken from W5-074/A.

For WRAP type 1 soils, CIND can become negative for lower values of SAAR. In this case the CIND value is multiplied by -1 to return a positive value (CIND is very small at this point).



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Job No. C3571		
Sheet no. 1		
Date 11/03/26		
By M.HAM	Checked	Reviewed

Project Penguin, Wargrave Road, Henley, RG9 3JD		
Title Hydrograph Storage Calcs @ 0.5l/s Discharge		

Data:-

Location = HENLEY ON THAMES Grid reference = SU7682
M5-60 (mm) = 20 r = 0.40
Soil index = 0.15 SAAR (mm/yr) = 750
Return period = 100 WRAP = 1
UCWI = 0.0 Climate change = 45%

- i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
- ii) Earthy peat soils drained by dykes and pumps;
- iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

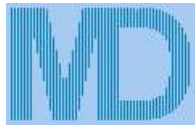
Pipeline storage = 0.0 m³ Available MH storage = 0.0 m³
Offline storage = 0.0 m³

Percentage runoff = 100.0% (manual setting)

Imperv. area = 552 m² Pervious area = 0 m²
Total area = 552 m² Equiv area = 552 m² (Tot. area x % runoff).
Total runoff = 51.7 m³ Discharge rate = 0.500 l/s
Storage (m³) = 40.6 m³ (Sum of all balance quantities)
Total rainfall depth = 93.6 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.070	20.0	2.7	0.103	0.126	0.000	0.000
0.140	20.0	2.7	0.103	0.126	0.000	0.000
0.210	21.0	2.8	0.109	0.126	0.000	0.000
0.280	21.0	2.8	0.109	0.126	0.000	0.000
0.350	22.0	2.9	0.114	0.126	0.000	0.000
0.420	23.0	3.1	0.119	0.126	0.000	0.000
0.490	24.0	3.2	0.124	0.126	0.000	0.000
0.560	26.0	3.5	0.134	0.126	0.008	0.008
0.630	27.0	3.6	0.140	0.126	0.014	0.022
0.700	29.0	3.9	0.150	0.126	0.024	0.046
0.770	31.0	4.1	0.160	0.126	0.034	0.080
0.840	32.0	4.3	0.165	0.126	0.039	0.120
0.910	33.0	4.4	0.171	0.126	0.045	0.164
0.980	34.0	4.5	0.176	0.126	0.050	0.214
1.050	36.0	4.8	0.186	0.126	0.060	0.274
1.120	38.0	5.1	0.196	0.126	0.070	0.344
1.190	39.0	5.2	0.202	0.126	0.076	0.420
1.260	40.0	5.4	0.207	0.126	0.081	0.501
1.330	42.0	5.6	0.217	0.126	0.091	0.592
1.400	45.0	6.0	0.233	0.126	0.107	0.698
1.470	49.0	6.6	0.253	0.126	0.127	0.826
1.540	53.0	7.1	0.274	0.126	0.148	0.974
1.610	57.0	7.6	0.295	0.126	0.169	1.142
1.680	62.0	8.3	0.320	0.126	0.194	1.337
1.750	66.0	8.8	0.341	0.126	0.215	1.552
1.820	71.0	9.5	0.367	0.126	0.241	1.793
1.890	77.0	10.3	0.398	0.126	0.272	2.065
1.960	84.0	11.2	0.434	0.126	0.308	2.373
2.030	91.0	12.2	0.470	0.126	0.344	2.717
2.100	98.0	13.1	0.507	0.126	0.381	3.098
2.170	105.0	14.0	0.543	0.126	0.417	3.515
2.240	114.0	15.3	0.589	0.126	0.463	3.978
2.310	125.0	16.7	0.646	0.126	0.520	4.498
2.380	135.0	18.1	0.698	0.126	0.572	5.070
2.450	143.0	19.1	0.739	0.126	0.613	5.683
2.520	154.0	20.6	0.796	0.126	0.670	6.353



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By
M.HAM

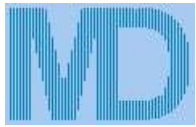
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Title **Hydrograph Storage Calcs @ 0.5l/s Discharge**

Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
2.870	204.0	27.3	1.054	0.126	0.928	10.468
2.940	212.0	28.4	1.096	0.126	0.970	11.438
3.010	219.0	29.3	1.132	0.126	1.006	12.444
3.080	226.0	30.2	1.168	0.126	1.042	13.486
3.150	233.0	31.2	1.204	0.126	1.078	14.565
3.220	239.0	32.0	1.235	0.126	1.109	15.674
3.290	244.0	32.6	1.261	0.126	1.135	16.809
3.360	248.0	33.2	1.282	0.126	1.156	17.965
3.430	249.0	33.3	1.287	0.126	1.161	19.126
3.500	250.0	33.4	1.292	0.126	1.166	20.293
3.570	250.0	33.4	1.292	0.126	1.166	21.459
3.640	249.0	33.3	1.287	0.126	1.161	22.620
3.710	248.0	33.2	1.282	0.126	1.156	23.776
3.780	244.0	32.6	1.261	0.126	1.135	24.911
3.850	239.0	32.0	1.235	0.126	1.109	26.020
3.920	233.0	31.2	1.204	0.126	1.078	27.099
3.990	226.0	30.2	1.168	0.126	1.042	28.141
4.060	219.0	29.3	1.132	0.126	1.006	29.147
4.130	212.0	28.4	1.096	0.126	0.970	30.117
4.200	204.0	27.3	1.054	0.126	0.928	31.045
4.270	194.0	26.0	1.003	0.126	0.877	31.922
4.340	183.0	24.5	0.946	0.126	0.820	32.742
4.410	173.0	23.1	0.894	0.126	0.768	33.510
4.480	164.0	21.9	0.848	0.126	0.722	34.232
4.550	154.0	20.6	0.796	0.126	0.670	34.902
4.620	143.0	19.1	0.739	0.126	0.613	35.515
4.690	135.0	18.1	0.698	0.126	0.572	36.087
4.760	125.0	16.7	0.646	0.126	0.520	36.607
4.830	114.0	15.3	0.589	0.126	0.463	37.070
4.900	105.0	14.0	0.543	0.126	0.417	37.487
4.970	98.0	13.1	0.507	0.126	0.381	37.868
5.040	91.0	12.2	0.470	0.126	0.344	38.212
5.110	84.0	11.2	0.434	0.126	0.308	38.520
5.180	77.0	10.3	0.398	0.126	0.272	38.792
5.250	71.0	9.5	0.367	0.126	0.241	39.033
5.320	66.0	8.8	0.341	0.126	0.215	39.248
5.390	62.0	8.3	0.320	0.126	0.194	39.443
5.460	57.0	7.6	0.295	0.126	0.169	39.611
5.530	53.0	7.1	0.274	0.126	0.148	39.759
5.600	49.0	6.6	0.253	0.126	0.127	39.887
5.670	45.0	6.0	0.233	0.126	0.107	39.993
5.740	42.0	5.6	0.217	0.126	0.091	40.084
5.810	40.0	5.4	0.207	0.126	0.081	40.165
5.880	39.0	5.2	0.202	0.126	0.076	40.241
5.950	38.0	5.1	0.196	0.126	0.070	40.311
6.020	36.0	4.8	0.186	0.126	0.060	40.371
6.090	34.0	4.5	0.176	0.126	0.050	40.421
6.160	33.0	4.4	0.171	0.126	0.045	40.466
6.230	32.0	4.3	0.165	0.126	0.039	40.505
6.300	31.0	4.1	0.160	0.126	0.034	40.539
6.370	29.0	3.9	0.150	0.126	0.024	40.563
6.440	27.0	3.6	0.140	0.126	0.014	40.577
6.510	26.0	3.5	0.134	0.126	0.008	40.585
6.580	24.0	3.2	0.124	0.126	0.000	40.583
6.650	23.0	3.1	0.119	0.126	0.000	40.576
6.720	22.0	2.9	0.114	0.126	0.000	40.564
6.790	21.0	2.8	0.109	0.126	0.000	40.546
6.860	21.0	2.8	0.109	0.126	0.000	40.529
6.930	20.0	2.7	0.103	0.126	0.000	40.506
7.000	20.0	2.7	0.103	0.126	0.000	40.484

Storage volume (m³) = 40.6 m³ (Sum of all balance quantities)



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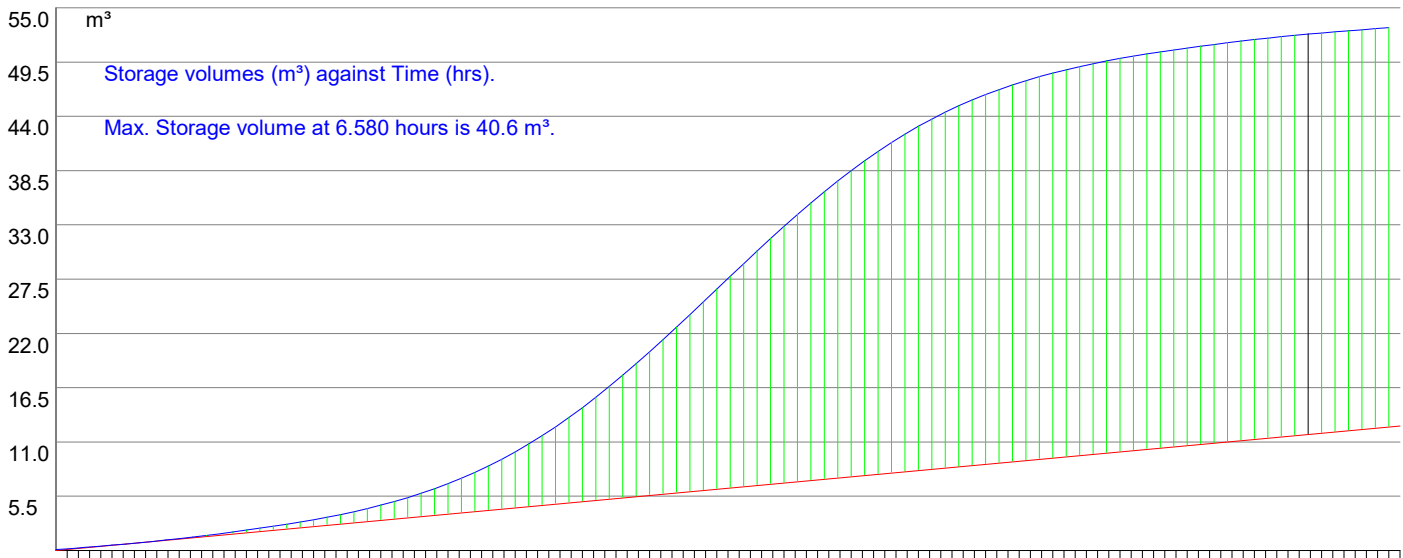
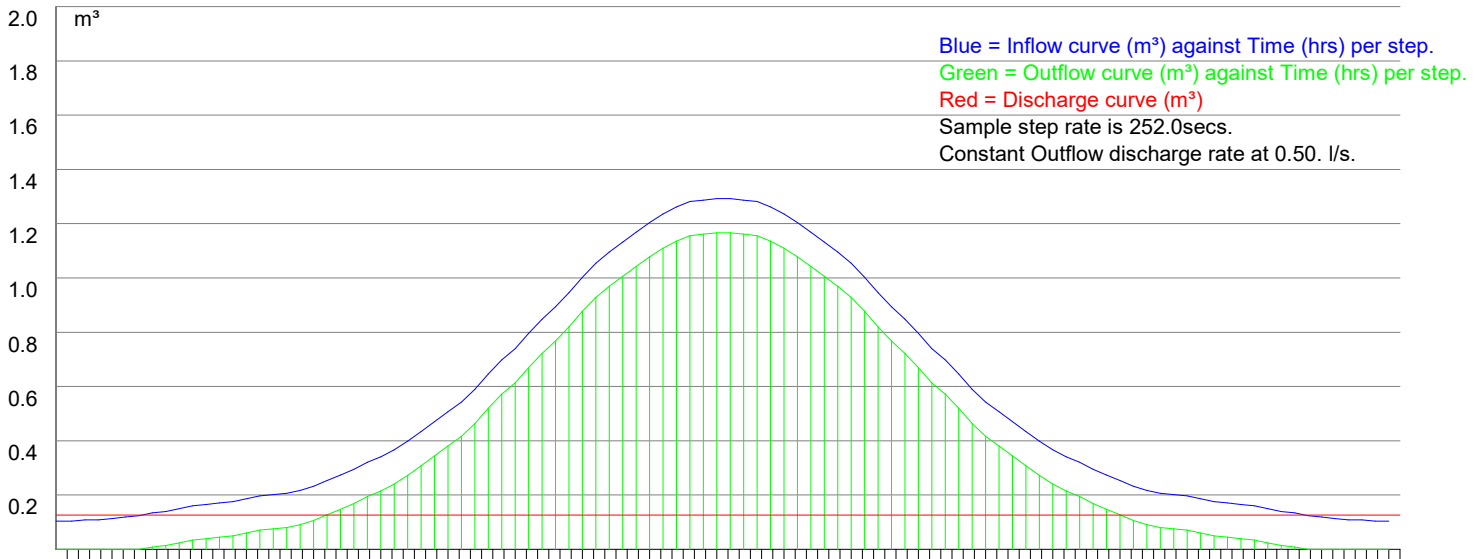
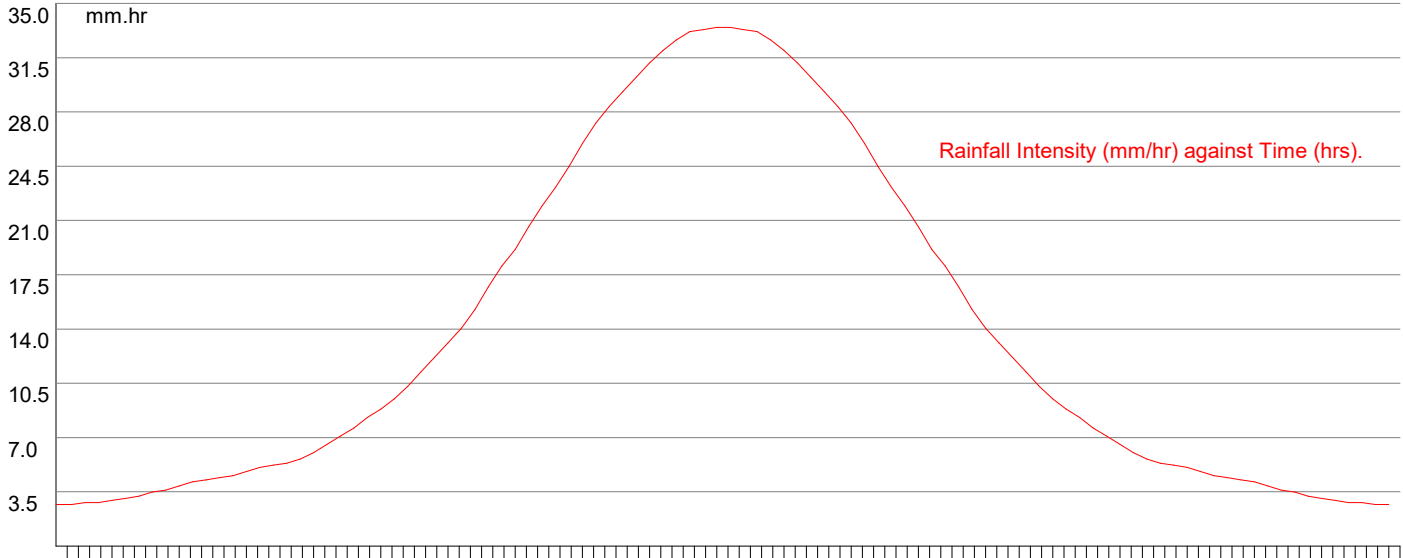
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Title **Hydrograph Storage Calcs @ 0.5l/s Discharge**

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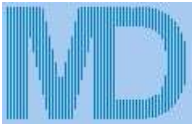
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Title **Hydrograph Storage Calcs @ 0.5l/s Discharge**

Maximum storage volumes for varying duration storms.

Storm length (hrs)	Max. Vol (m ³)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	19.79	0.25	143.09	0.2	
0.5	25.68	0.50	93.94	0.3	
1	31.43	1.00	58.74	0.6	
2	36.54	2.00	35.47	1.2	
3	38.81	3.00	26.05	1.8	
4	39.86	4.00	20.80	2.4	
5	40.32	5.00	17.43	3.0	
6	40.52	6.00	15.11	3.6	
7	40.59	7.00	13.38	4.2	Peak found
8	40.51	---	12.04	4.8	
9	40.34	---	10.97	5.4	
10	40.09	---	10.09	6.0	
12	39.51	---	8.73	7.2	
15	38.49	---	7.30	9.0	
18	37.32	---	6.31	10.8	
20	36.46	---	5.80	12.0	
24	34.65	---	5.01	14.4	
30	31.85	---	4.19	18.0	
36	29.00	---	3.62	21.6	
42	26.20	---	3.19	25.2	
48	23.47	---	2.86	28.8	
54	20.81	---	2.60	32.4	
60	18.24	---	2.39	36.0	
66	15.80	---	2.21	39.6	
72	13.47	---	2.06	43.2	
84	9.23	---	1.82	50.4	
96	5.57	---	1.63	57.6	
120	0.54	---	1.36	72.0	
150	0.00	---	1.13	90.0	
175	0.00	---	1.00	105.0	
200	0.00	---	0.89	120.0	
250	0.00	---	0.74	150.0	
300	0.00	---	0.64	180.0	
375	0.00	---	0.53	225.0	
500	0.00	---	0.42	300.0	
750	0.00	---	0.30	450.0	
1000	0.00	---	0.24	600.0	
1250	0.00	---	0.20	750.0	
1500	0.00	---	0.17	900.0	
1570	0.00	---	0.17	942.0	
2000	0.00	---	0.14	1200.0	
2500	0.00	---	0.12	1500.0	
3000	0.00	---	0.10	1800.0	
3500	0.00	---	0.09	2100.0	
4000	0.00	---	0.08	2400.0	



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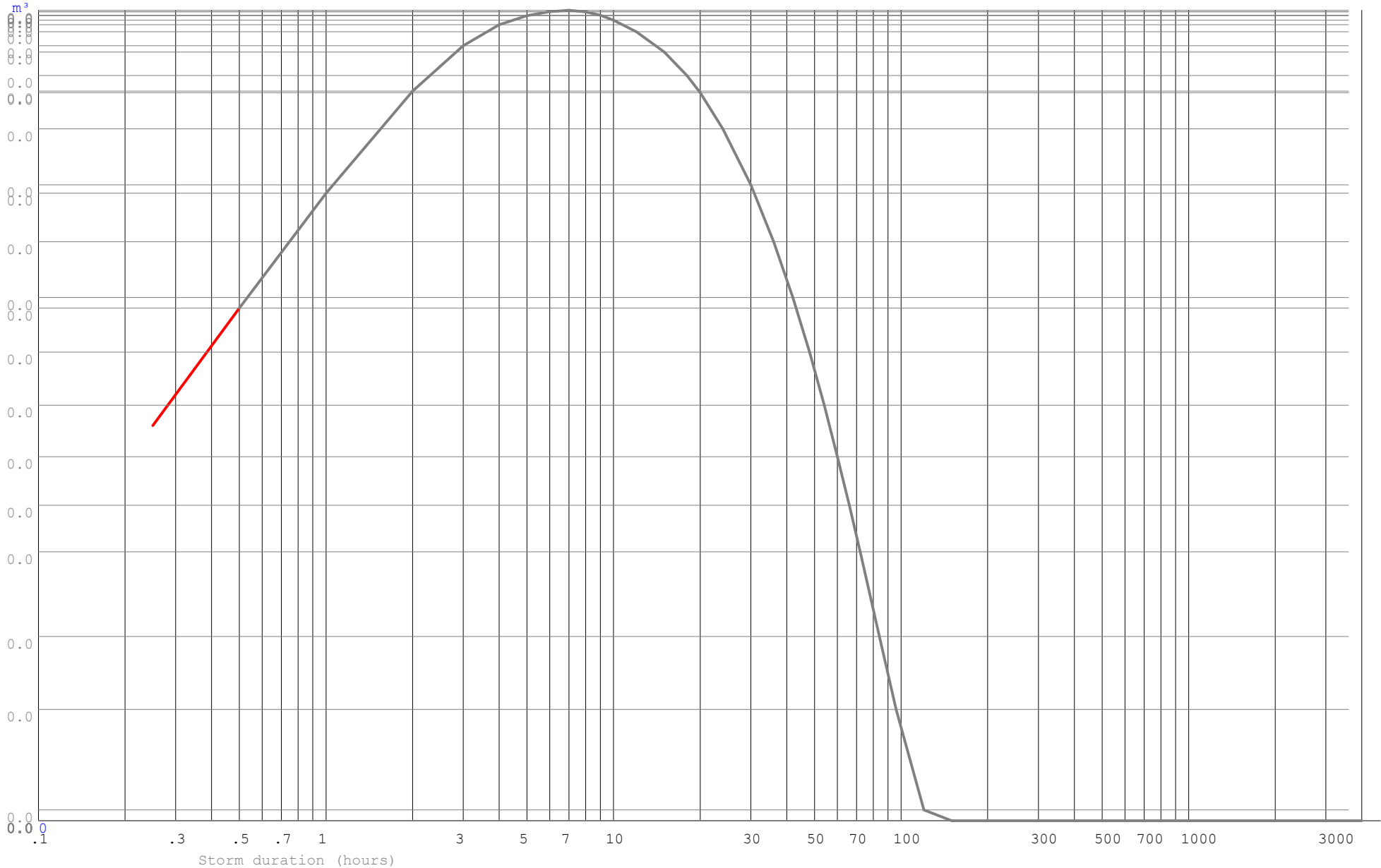
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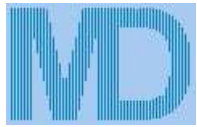
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Title **Hydrograph Storage Calcs @ 0.5l/s Discharge**

Sequential storage volume at specific storm durations.





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Title **Hydrograph Storage Calcs @ 0.5l/s Discharge**

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.