

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY



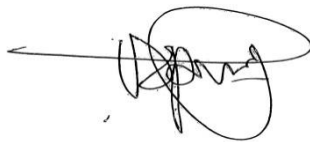
**WILLOWBRAE
THE WARREN
CAVERSHAM HEIGHTS
BERKSHIRE
RG4 7TH**

DECEMBER 2021

Issue Record

Project No.	Document Title
21008	Flood Risk Assessment & Drainage Strategy

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A	13.12.2021	First Issue
B	14.12.2021	Final Issue
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First Issue	Name	Signature	Date
Authorised	Tim Spivey		11.05.2022

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EXECUTIVE SUMMARY

The proposed development is a new build residential property in place of the existing residential property located down a shared driveway off The Warren in Caversham.

The site is located in Flood Zone 3 on the Environment Agency's (EA) flood mapping for planning. This is defined as an area with a high probability of flooding. Flood Zone 3 is split into more specific Flood Zone 3a or 3b. Specifically, the site is in Flood Zone 3b (functional floodplain). However, as the site is developed and in a residential location, the classification is Flood Zone 3a.

The site is at HIGH probability of fluvial flooding.

Flooding from other sources including groundwater, sewer and artificial water is considered to be a LOW risk.

Surface water management will concentrate on maintaining the fluvial flood plain capacity pre- and post- development, whilst providing improvements to the off-site discharge of surface water through the introduction of an attenuation tank with a restricted discharge to the River Thames. The flood plain will be maintained through the introduction of a flood plain compensation void beneath the new footprint of the building. The volume of the compensation void has been calculated from the increase of 84 sq.m between the new building footprint (268 sq.m) and the existing building footprint (184 sq.m), combined with the modelled flood level of 39.17m AOD for the 1% AEP + 35% climate change increase.

The proposed residential end use has a MORE VULNERABLE classification as detailed in NPPF Annex 3. However, given this is a replacement residential property and classified as minor development, there is no requirement for the sequential test and exception test to be applied. Flood resistance measures will be considered to mitigate future flooding.

The proposed finished floor level (FFL) is 39.00m AOD. Modelled flood levels from the EA's Product 4 stipulates at the nearest nodes, the 1 in 100 annual probability (AEP) +35% flood level is 39.17m AOD. With a recommended addition of 300mm, the FFL should be 39.47m AOD. However, planning constraints with roof heights and impact on neighbouring property means flood resistance measures will be considered on the ground floor for the first 500mm within the building design, as stipulated within Reading BC SFRA.

The development is considered to be acceptable in terms of flood risk and surface water management.

1.0 INTRODUCTION

1.1. Brief

- 1.1.1. TDS Consultancy Ltd have been appointed by Absolute Architecture on behalf of their Client to prepare a formal Flood Risk Assessment and Drainage Strategy in support of a Planning Application for the proposed replacement residential property called Willowbrae located off The Warren, Caversham Heights, Berkshire, RG4 7TH.

1.2. Report Structure

- 1.2.1. This report has been written to comply with the planning policy described in Section 2.0. The existing site is described in terms of topography, geology, hydrology and hydrogeology in Section 3.0. The proposed scheme is described in Section 6.0. The scope of this flood risk assessment is defined in Section 8.0. An assessment of relevant flood risk is recorded in Section 9.0.
- 1.2.2. This report has been prepared for exclusive use by Absolute Architecture and their Client for the purpose of assisting them in evaluating the potential risk of flooding associated with the site and in support of the planning application. TDS Consultancy accepts no liability for any use of this document other than by its client and only for the purposes, stated in the document, for which it was prepared and provided. No person other than the client may copy (in whole or in part), use or rely on the contents of this document without the prior written permission of TDS Consultancy Ltd. Any advice, opinions, or recommendations within this document should be read and relied upon only in the context of the document as a whole.
- 1.2.3. TDS Consultancy has endeavoured to assess information provided to them during this appraisal. The report summarises information from a number of external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon.
- 1.2.4. This flood risk assessment addresses the flood risk posed to and from the proposed development, outlined in Section 6.0. This report has been undertaken with the assumption that the site will be developed in accordance with the proposals shown in Appendix 5 without significant change. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

2.0 PLANNING POLICY

2.1. National Planning Policy Framework

- 2.1.1. The National Planning Policy Framework (NPPF) was revised on 20th July 2021 and identifies flood risk as a specific material consideration in the planning process and in the allocation and release of sites for development or re-development.
- 2.1.2. The framework seeks to strengthen the coordination between land use planning and development planning and the operational delivery of flood and coastal defence strategies. Through the framework, Local Planning Authorities will continue to use their existing powers to guide, regulate and control development in relation to flooding and flood risk. The NPPF places a presumption in favour of sustainable development whilst meeting the challenge of climate change, flooding and coastal erosion.
- 2.1.3 Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.
- 2.1.4 If it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3 of the NPPF. This site and proposed redevelopment is deemed 'More Vulnerable'.
- 2.1.5 When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment when in Flood Zones 2 and 3. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:
 - a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
 - b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
 - 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.
- 2.1.6 Applications for some minor development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments in Flood Zone 2 and 3.

- 2.1.7. The Water Resources Act 1991 [Section 105] also requires the Environment Agency to exercise a general supervision over all flood defence matters, including flood plains and washlands which accommodate waters during periods of flood. In discharging their functions, the Agency from time to time carries out comprehensive surveys and flood studies, largely of 'main rivers' within its jurisdiction.
- 2.1.8. A Section 105 Study involves the Agency topographically surveying the subject watercourse (or parts of it) and obtaining details of the flow mechanics within the watercourse. These data then enable them to generate a comprehensive hydraulic computer model for the watercourse. From this hydraulic model the EA are able to define the approximate extent of the fluvial floodplain associated with the 1 in 100 year (1% annual probability) flooding event or the extent of tidal floodplain associated with the 1 in 200 year (0.5% annual probability) flooding event.
- 2.1.9. The extents of the modelled floodplain are provided to Local Planning Authorities to enable them to make informed decisions when considering proposed development in flood-susceptible areas. If development is proposed in a flood-susceptible area, or in an area where there is a history of flooding, the EA, as a statutory consultee in the Planning Process, will generally recommend that the risk of flooding be formally assessed, in accordance with the National Planning Policy Framework, and that a site-specific Flood Risk Assessment report be produced to support the Planning Application. The broader modelled flood extents are also indicated on the EA's Flood Zone Maps, with further supporting flood level information and predicted future flood level information and climate change impact provided in Products available on request.

2.2. **Local Policy**

- 2.2.1. Reading Core Strategy was adopted in January 2008 and revised January 2015.

The Council's approach to flood risk is set out in Policy CS35 'Flooding' as detailed below:

Policy CS35: Flooding

Planning permission will not be permitted for development in an area identified as being at high risk of flooding, where development would reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding.

- 2.2.2 The explanatory text accompanying the policy sets out that the general approach of the policy is in line with the (then) national policy set out in the PPS25. It also confirms that the policy will exclude small-scale householder developments and appropriate weight will be given to the redevelopment of land at risk of flooding that provides significant regeneration benefits on previously developed land.
- 2.2.3 While PPS25 has been replaced by the NPPF, there is consistency in the overarching principles of PPS25 to avoid inappropriate development in areas at risk of flooding, direct development away from areas at highest risk, and where development is necessary make it safe without increasing flood risk elsewhere.

2.3. Strategic Flood Risk Assessment (SFRA)

- 2.3.1. Local Planning Authorities are required to produce Local Development Frameworks, which are a portfolio of Local Development Documents (LDD's) that collectively deliver the spatial planning strategy for the Authority area. The LDD's undergo a Sustainability Appraisal which assists Planning Authorities in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments are one of the documents to be used as the evidence base for planning decisions and are a component of the Sustainability Appraisal process. Therefore, SFRAs should be used in the review or production of LDD's.
- 2.3.2. To assist Local Planning Authorities in their strategic land-use planning, SFRA's should present sufficient information to enable Local Authorities to apply the Sequential Test to their proposed development sites: "Decision-makers should use the SFRA to inform their knowledge of flooding, refine the information on the Flood Map and determine the variations in flood risk from all sources of flooding across and from their area. These should form the basis for preparing appropriate policies for flood risk management for these areas."
- 2.3.3. Reading BC's Strategic Flood Risk Assessment (SFRA) was produced by Peter Brett Associates dated June 2017. The SFRA notes that properties along the The Warren adjacent to the River Thames lie in Flood Zone 3b, functional floodplain. However, as the site at Willowbrae, The Warren, Caversham Heights, Berkshire, RG4 7TQ is already developed and in a residential location, the Flood Zone 3b classification is considered Flood Zone 3a.
- 2.3.4. The SFRA indicates that Flood Zone 3a is land having a 1 in 100 (1%) or greater annual probability of river flooding; or land having a 1 in 200 (0.5%) or greater annual probability of sea flooding.

3.0 SITE CONTEXT

3.1. Site Location

- 3.1.1. The site is located off The Warren, Caversham Heights, Berkshire, RG4 7TH. The National Grid Reference for the site is centred on 469648E, 175159N. A site location plan is provided in Appendix 1.

3.2. Site Characterisation / Land-Use

- 3.2.1. The site contains a detached house with an attached on a large plot of 0.2 hectares. The property is accessed via a private steep shared access off The Warren, and enjoys direct river access at the bottom of the garden. This garden is generally laid to lawn with mature shrubs lining the borders.
- 3.2.2. The building is residential and currently unoccupied.
- 3.2.3. The site is located within a functional floodplain.

3.3. Topography

- 3.3.1. A level survey of the site was undertaken by Surveybase on 24th May 2021. The survey is provided in Appendix 2 as an overlay to the site layout.
- 3.3.2. The existing property has a threshold level at the front of 38.63m AOD stepping down at the rear to 38.10m AOD with access out on to the patio area. The patio area has steps down to the rear lawned garden with a level of 37.80, falling gradually to a level of 37.30 at the bottom adjacent to the river.

3.4. Geology

- 3.4.1. At the time of preparing this report, a site specific ground investigation had not been carried out. However, from a review of the British Geological Surveys mapping, the site is likely to be underlain by Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk. Sedimentary Bedrock formed approximately 72 to 90 million years ago in the Cretaceous Period. Local environment previously dominated by warm chalk seas.

3.5. Hydrogeology

- 3.5.1. Based on information obtained through the British Geological Surveys website the site is located on a Secondary A Aquifer associated with the Alluvial deposits, with the Newhaven Chalk formation being classed as a Principal Aquifer.
- 3.5.2. There are a number of groundwater abstractions located within 1km of the site and the site is not within a Source Protection Zone (SPZ).

3.6. Hydrology

- 3.6.1. The River Thames is located to the south at the bottom of the rear garden of the site.

3.7. **Public Sewers**

3.7.1. Foul Sewers

There are no public foul sewers within the vicinity of the site.

3.7.2. Surface Water Sewers

There are no public surface water sewers in the vicinity of the site.

3.8. **Site Drainage**

3.8.1. No survey has been carried out of the on-site foul and surface water drainage. However, a building survey has been undertaken, and this identified that the foul drainage currently discharges to a cesspit located beneath the right hand boundary hedge. No access chambers were visible on site. The current cesspit location requires access to the neighbouring property for emptying.

3.8.2 Surface water drainage is currently collected in rainwater pipes and gullies and connected to below ground drainage. Given the waterlogged nature of the rear garden / lawn area, it is unlikely that soakaways exist on site. Therefore, whilst no outfall to the river could be identified, it is reasonable to believe the surface water from this property discharges to the River Thames.

4.0 FURTHER GUIDANCE

4.1. CIRIA Guidance

4.1.1. CIRIA publication 'C624 Development and Flood Risk – Guidance for the Construction Industry', defines three levels of FRA which can be undertaken:

FRA Level	Description / Scope
Level 1	Screening Study to identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information, including the SFRA, Environment Agency Flood Map and Standing Advice. The Screening Study will ascertain whether a FRA is required.
Level 2	Scoping Study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding or that the site may increase flood risk due to increased run-off. This Study should confirm the sources of flooding which may affect the site and should include the following: - an appraisal of the availability and adequacy of existing information; - a qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; - an appraisal of the scope of possible measures to reduce the flood risk to acceptable levels. The Scoping Study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development.
Level 3	Detailed Study to be undertaken if the Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The Study should include: - quantitative appraisal of the potential flood risk to the development; - quantitative appraisal of the potential impact of development site on flood risk elsewhere; - quantitative demonstration of the effectiveness of any proposed mitigation measures.

Table 1: Levels / Scope of Flood Risk Assessment

This is a Level 2 report.

5.0 SOURCES OF INFORMATION

5.1. Records Reviewed

5.1.1. The information contained in this report is based on a review of existing information.

5.1.2. The following key reports and websites have been reviewed as part of this study:

Report/Website	Author	Date
Reading Borough Council Strategic Flood Risk Assessment (SFRA)	Peter Brett Associates	June 2017
Reading Borough Council – Local Flood Risk Management Strategy (LFRMS)	Peter Brett Associates	October 2015
Environment Agency Product 4 Data	Environment Agency	Created: May 2021
Flood map for planning on the Environment Agency's website	Environment Agency	Accessed: May 2021

6.0 DEVELOPMENT PROPOSALS

6.1. Proposed Scheme

- 6.1.1. Demolition of existing dwelling and erection of a replacement dwelling with integrated garage associated driveway and landscaping.
- 6.1.2. The topography of the rear lawn will remain as existing, with the benefit of enhanced landscaping to compliment the design of the new house.
- 6.1.3. For the ground floor annexe, it is considered that this would be classified as MORE VULNERABLE in accordance with the Technical Guidance to the National Planning Policy Framework.
- 6.1.4. Refer to the Design & Access Statement produced by Absolute Architecture for a more detailed report on the development proposals.
- 6.1.5 Details of the flood plain compensation void proposals can be viewed in Appendix 6.

7.0 FOUL & SURFACE WATER MANAGEMENT

- 7.1.1. Foul drainage from the new house will connect to a new packaged sewage treatment plant with an outfall discharging to the River Thames, subject to the necessary approval and consent from the Environment Agency. The entire foul drainage system will be sealed to prevent ingress of surface water during any flood event. The outfall will be fitted with a flap valve to prevent any surface water from the River Thames from backing up through the system and flooding the packaged sewage treatment plant. Non return valves will be fitted in the inspection chambers to prevent any foul water backing up and overflowing internally.
- 7.1.2 Surface water roof run-off will be collected in gutters and rainwater pipes and connected to a below ground drainage system. The external hardpaved areas (driveway / footpaths and patios) will be permeable paving. These will discharge to an attenuation tank with a flow control chamber discharging through an outfall to the River Thames. The attenuation tank will be designed to accommodate the 1 in 100 year storm event plus an allowance for climate change of 40%. Whilst no agreement, at this stage, has been reached on the permitted rate of discharge to the River Thames, it is proposed to apply the greenfield run-off rate of 5 litres per second per hectare to the overall site and pro-rata this down to the total area of this site of 0.2 hectares. This calculates as a restricted discharge rate of 1 litre per second. Refer to calculations in Appendix 4.
- 7.1.4 The foul and surface water drainage detailed design will be undertaken after planning approval has been granted.
- 7.1.5 Refer to Appendix 5 for the Foul & Surface Water Drainage Strategy Layout.

NOTE:

There is a large Ash tree located towards the bottom of the rear garden. As this tree has a tree root protection zone, all drainage runs that pass through this zone must follow the methodology as advised by the Arboricultural Consultant.

8.0 SCOPE OF FLOOD RISK ASSESSMENT

8.1. Scope of Assessment

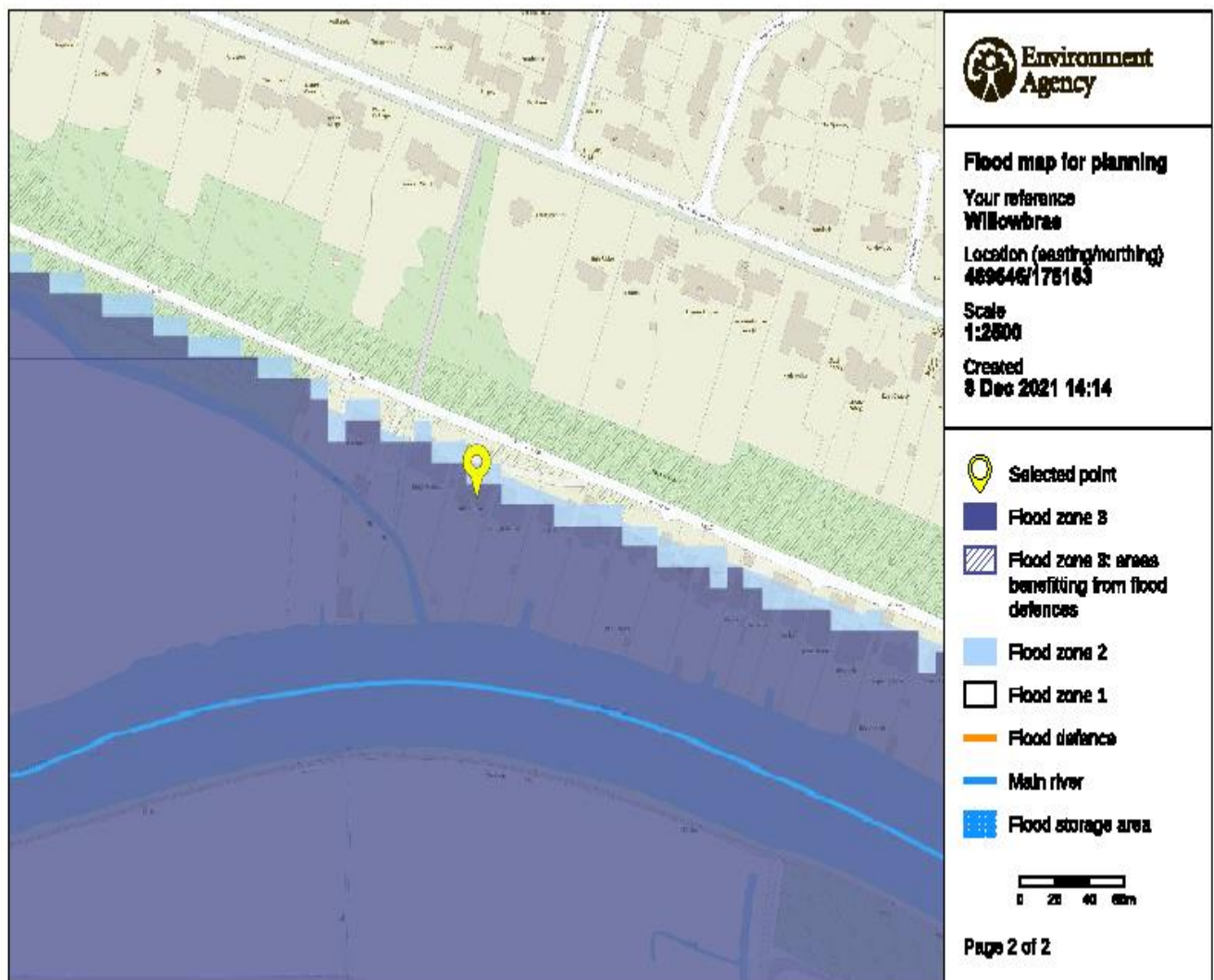
8.1.1. The detail and complexity of a Flood Risk Assessment should reflect the level of risk to the site and:

- be proportionate to the risk and appropriate to the scale, nature and location of the site;
- consider the risk of flooding arising from development in addition to the risk of flooding to the site;
- take the impacts of climate change into account;
- consider both the potential adverse and beneficial effects of flood risk management infrastructure including raised defences, flow channels, flood storage areas and other artificial features together with the consequences of their failure;
- consider the vulnerability of those that could occupy and use the site, taking account of the vulnerability, including arrangements for safe access;
- consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made;
- consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;
- include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development or land use;
- consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of development may affect drainage systems;
- be supported by appropriate data and information, including historical information on previous events.

9.0 FLOOD STATUS

9.1. Fluvial Flooding

- 9.1.1. Based on the flood map for planning contained within the Product 4 data received from the Environment Agency, the site is shown to be in Flood Zone 3 which has a 1 in 100 (1%) or greater annual probability of river flooding; or land having a 1 in 200 (0.5%) or greater annual probability of sea flooding.
- 9.1.2. The 'Flood Map for Planning' website shows that the site is located entirely within Flood Zone 3. See Figure 1 below.



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Figure 1 – EA Flood Map for Planning

9.1.3. Using the EA's Product 4, the closest modelled node for in channel flood and level within the River Thames is given in Table 2 below. A copy of the node map can be viewed in Appendix 3.

	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
NODE LABEL			
061_00_2018_002_36.06	39.16	39.50	39.38

Table 2 - levels are to m AOD.

9.1.4. Using THE EA's Product 4, the modelled floodplain flood level for the closest model grid cell is given in Table 3 below. A copy of the cell location can be viewed on the map in Appendix 3.

2D grid cell reference	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
Flood Point 2	39.17	39.51	39.40

Table 3 - levels are to m AOD.

9.1.5. From the EA's recorded historic flood events database, they have no specific record of the site and existing house flooding from the river. However, this could mean that either the site has not flooded, or that the site has flooded and the EA is not aware of the fact the site has flooded. Reading BC Local Flood Risk Management Strategy also does not hold specific flooding data for this site.

9.1.6. As the building is entered from an existing access road, the ground floor level will be set initially by consideration of this access, together with neighbouring properties and roof ridge heights. The proposed ground floor level is 39.00m AOD, some 890mm higher than the existing property.

9.1.7. For the 1% AEP+35%, the proposed ground floor level of 39.00m AOD is 160mm lower than for the closest in channel flood and level of 39.16m AOD in Table 2 above and 170mm lower than the modelled floodplain flood level of 39.17m AOD in Table 3 above. To mitigate against internal damage to the property, flood resistance measures will be incorporated into the building design to a level of 500mm above the proposed ground floor level. Flood gates / barriers will be designed into all doorway openings.

9.1.8 To mitigate against the partial loss of the natural floodplain given the increase of the new building footprint of 84 sq.m, a flood plain compensation void is proposed beneath the rear of the new property. The volume of this void has been calculated from the increased footprint area and the modelled floodplain level of 39.17m AOD for the 1% AEP + 35% shown in Table 3 above. Details of the proposed floodplain compensation void layouts can be viewed in Appendix 6.

9.2. Surface Water Flooding

9.2.1. The site is considered to be at a LOW RISK of surface water flooding.

9.3. Groundwater Flooding

- 9.3.1. Groundwater flooding is the emergence at surface level of water originating from a permeable sub surface stratum where the groundwater rises above the local ground level.
- 9.3.2. Given the underlying geology of chalk, there is the potential for groundwater flooding to occur as a consequence of a rising water table. In addition, where the ground conditions are favourable, the various rivers may be in hydraulic continuity with the adjacent soils and groundwater levels will fluctuate with river levels.
- 9.3.3. No groundwater flooding incidents are noted in the immediate vicinity of the site.
- 9.3.4. The proposed development does not have any basement structures which could be affected by a shallow water table.
- 9.3.5. It is considered that the development is at a LOW risk of groundwater flooding.

9.4. Sewer Flooding

- 9.4.1. Sewer flooding occurs when the local drainage system (foul or surface water) is overwhelmed by run off or foul water due to either lack of capacity or maintenance issues such as blockages.
- 9.4.2. There are no records of sewer flooding in the vicinity of the site.
- 9.4.3. It is considered that the site is at a LOW risk of sewer flooding.

9.5. Artificial Sources

- 9.5.1. From the long term Flood Risk website, the site is not affected by flooding from any reservoirs.
- 9.5.2. The site is considered to be at a LOW risk of flooding from artificial sources.

10.0 RESIDUAL RISKS

- 10.1. The development is generally free from significant flood risks, as the primary location of flooding from the River Thames will be within the functioning floodplain / rear lawned garden.
- 10.2. The ground floor level of the proposed house is proposed to be 890mm higher than the existing house. Given the predicted flood levels, this provides a level of protection against severe flooding and the property being breached.
- 10.3. Where the natural floodplain is being encroached by the increased footprint of the new building, a floodplain compensation void is proposed to accommodate the volume required for the 1% AEP plus 35% climate change increase.
- 10.4. Should the 1% AEP +35% occur, the proposed finished floor level of 39.00m AOD will be breached by max. 170mm. For this reason, the design of the ground floor will incorporate flood resistance measures within the building design up to 39.50m AOD, as outlined in RBC SFRA. Flood resilient measures may also be considered where practicable. Doorways will be designed to incorporate a permanent system to install temporary flood gates / barriers.
- 10.5. There is suitable emergency access on to The Warren and given the shared access to the house rises up steeply to The Warren, safe escape is available to the residents. It is deemed a very LOW risk.
- 10.6. Owners / occupiers of the property will be advised to register with the Environment Agency's flood warning / advanced notification. This will provide the owner / occupier sufficient prior flood warning and enable them to evacuate or prepare the properties flood barriers and other mitigating measures.
- 10.7. Emergency vehicles will be able to access the site from The Warren.

11.0 CONCLUSIONS

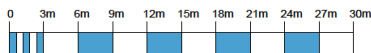
- 11.1. The site is located in Flood Zone 3a where there is a 1% or greater chance of fluvial flooding occurring each year.
- 11.2. The site is located on a functioning floodplain. The increased footprint of the new building encroaches into this floodplain, so a floodplain compensation void beneath the building is proposed. Details of this can be viewed in Appendix 6.
- 11.3. Flooding from other sources including groundwater, sewer and artificial water is considered to be a LOW risk.
- 11.4. The new house will have a completely new surface water drainage system analysed for the 1 in 1, 1 in 30 and 1 in 100 year storm event plus 40% for climate change. All new surface water run-off will be managed using an attenuation tank to store flows from a 1 in 100 year storm event plus 40% CCF with a vortex controlled chamber to restrict the discharge rate to 1 litre per second through an outfall to the River Thames.
- 11.5. Foul drainage will be managed through a below ground sealed drainage system, connected to a new packaged sewage treatment plant discharging through an outfall fitted with a flap valve into the River Thames. Inspection chambers will be fitted with non-return valves to prevent any foul sewage backing up through the system and flooding the house.
- 11.6. The proposed ground floor annex is classified as MORE VULNERABLE which is appropriate in Flood Zone 3a, so long as flood resistance measures are incorporated in the building design, as outlined in RBC SFRA.
- 11.7. The proposed house is sited over the location of the existing house, at the high point of the site. The ground floor level of the proposed house is proposed to be 890mm higher than the existing house. In addition, the property will be eligible for the flood alert system, raising the alarm in the event of a forecast flood and the safe evacuation from the property will not be affected.
- 11.8. The development is considered to be acceptable in terms of flood risk and surface water management.

APPENDIX 1

AERIAL VIEW OF WILLOWBRAE

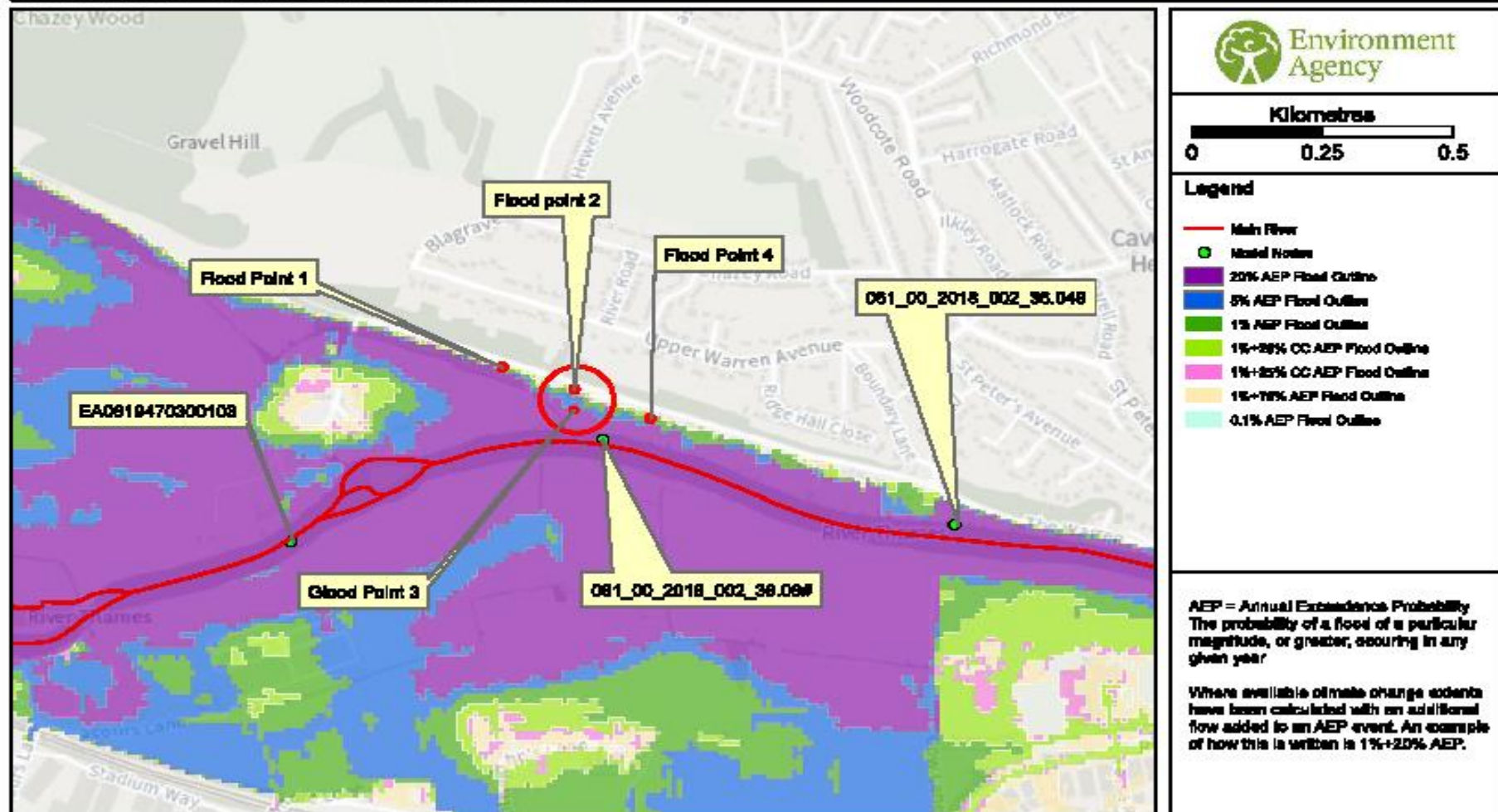


APPENDIX 2
EXISTING SITE LAYOUT & LEVELS

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APPENDIX 3
ENVIRONMENT AGENCY PRODUCT 4
NODE MAP

Detailed FRA centred on The Warren, Caversham, Reading, Berkshire. RG4 7TQ
Created on 18/05/21 REF: THM217840



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APPENDIX 4
SURFACE WATER
ATTENUATION TANK CALCULATIONS



MasterDrain
SW

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			Sheet no. 1
			Date 13/12/21
Project Willowbrae, The Warren, Caversham, Reading RG4 7TH	By TDS	Checked	Reviewed
Title Surface Water Attenuation Tank			

Data:-

Location = CAVERSHAM
 M5-60 (mm) = 18.5
 Soil index = 0.30
 Return period = 100
 UCWI = 73.7
 Grid reference = SU7174
 r = 0.40
 SAAR (mm/yr) = 694
 WRAP = 2
 Climate change = +40%

- i) Very permeable soils with shallow ground water;
- ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; The layer is low in organic matter, mottled and (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. Slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).
- iii) Moderately permeable soils, some with slowly permeable subsoils.

Percentage runoff = 75.0% calculated from:-

Percentage runoff = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

$\text{PIMP} = \text{ImpervArea} \times 100 / (\text{ImpervArea} + \text{PervArea}) = 100.0$

UCWI = Calculated value for Wetness Index = 73.7

Imperv. area = 307 m²
 Total area = 307 m²
 Total runoff = 14.6 m³

Pervious area = 0 m²
 Equiv area = 230 m² (Tot. area x % runoff).
 Discharge rate = 1.000 l/s

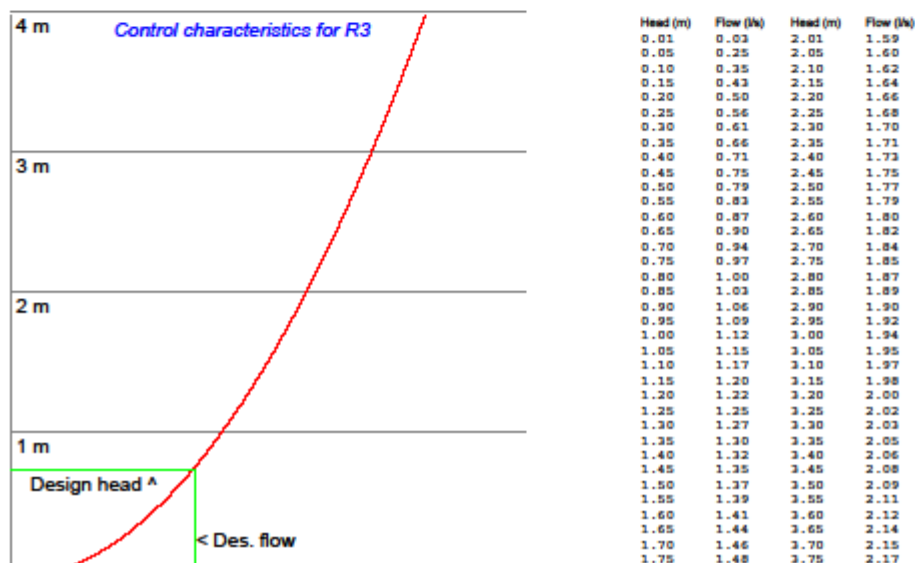
Design Head = 0.8m
 Control device = R3
 Max. calc. depth = 0.8 m

Peak flow = 0.99 l/s
 Orifice diam = 29.6 mm
 Available depth = 0.0 m³

Pipeline storage = 0.0 m³
 Offline storage = 0.0 m³
 Total storage = 11.0 m³

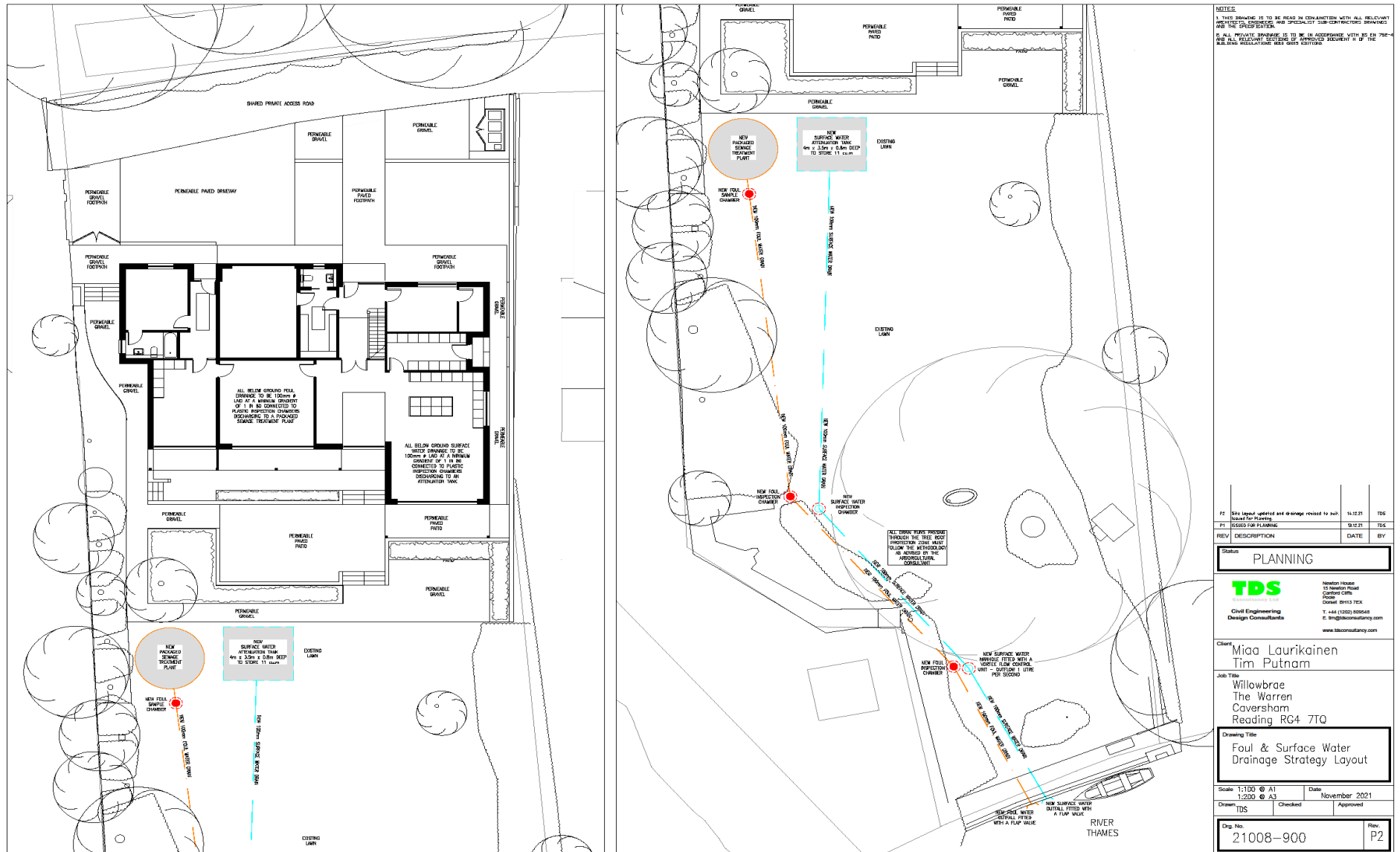
Available MH storage = 0.0 m³

Peak input flow = 5.08 l/s



APPENDIX 5

DRAINAGE STRATEGY LAYOUT



APPENDIX 6

FLOODPLAIN COMPENSATION LAYOUTS

Area Analysis - Dwg ref: 453 SK04

Flood Compensation – Plan – Dwg Ref: 453 SK05

Flood Compensation – Section – Dwg Ref: 453 SK06

