

Vale Road, Arklow Flood Risk Assessment

April 2025

Prepared for:
Wicklow County Council

www.jbaconsulting.ie



Document Status

Issue date 02 April 2025
Issued to Sean Keane
BIM reference PFU
Revision A3-C01

Prepared by Fiona Byrne BSc (Hons), MSc
Analyst

Reviewed by Ross Bryant BSc MSc CEnv MCIWEM C.WEM
Director

Authorised by Ross Bryant BSc MSc CEnv MCIWEM C.WEM
Director

Carbon Footprint

The format of this report is optimised for reading digitally in pdf format. Paper consumption produces substantial carbon emissions and other environmental impacts through the extraction, production and transportation of paper. Printing also generates emissions and impacts from the manufacture of printers and inks and from the energy used to power a printer. Please consider the environment before printing.

Contract

JBA Project Manager	Ross Bryant
Address	24 Grove Island, Corbally, Limerick
JBA Project Code	2024s0296

This report describes work commissioned by Sean Keane of Wicklow County Council by an instruction dated 24/02/2025. Fiona Byrne of JBA Consulting carried out this work.

Purpose and Disclaimer

JBA Consulting (“JBA”) has prepared this Report for the sole use of Wicklow County Council and its appointed agents in accordance with the Agreement under which our services were performed.

JBA has no liability for any use that is made of this Report except to Wicklow County Council for the purposes for which it was originally commissioned and prepared.

No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by JBA. This Report cannot be relied upon by any other party without the prior and express written agreement of JBA.

The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by JBA has not been independently verified by JBA, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by JBA in providing its services are outlined in this Report. The work described in this Report was undertaken between March and April 2025 and is based on the conditions encountered and the information available during the said period. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

JBA disclaims any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to JBA’s attention after the date of the Report.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. JBA specifically does not guarantee or warrant any estimates or projections contained in this Report.

Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Where field investigations are carried out, these have been restricted to a level of detail required to meet the stated objectives of the services. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in issuing this Report.

Copyright

© Jeremy Benn Associates Limited 2025

Contents

1	Introduction	1
	1.1 Terms of Reference	1
	1.2 Flood Risk Assessment Aims and Objectives	1
	1.3 Development	1
	1.4 Report Overview	2
2	Site Background	3
	2.1 Location and Watercourses	3
	2.2 Local Topography	5
	2.3 Site Geology	6
	2.4 Local Groundwater Vulnerability	8
	2.5 Groundwater and Surface Water	8
3	Flood Risk Identification	10
	3.1 Flood History	10
	3.2 Predictive Flood Mapping	11
	3.3 Sources of Flooding	17
4	Flood Risk Assessment	19
	4.1 Mitigation	19
5	Conclusion	21
A	Understanding Flood Risk	22
	A.1 Probability of Flooding	22
	A.2 Flood Zones	23
	A.3 Consequence of Flooding	23

List of Figures

Figure 2-1:Site Location	4
Figure 2-2 Local Topography	5
Figure 2-3 Site Topography	6
Figure 2-4 GSI Bedrock 100k	7
Figure 2-5: Teagasc Soils map	7
Figure 2-6 Groundwater Vulnerability (GSI)	8
Figure 2-7 GSI Historic Groundwater and Surface Water	9
Figure 3-1: Past Flood Event Points	11
Figure 3-2 CFRAM Present Day	12
Figure 3-3 Arklow Flood Relief Scheme: Fluvial - Current Scenario	14
Figure 3-4 Arklow Flood Relief Scheme: Coastal- Current Scenario	15
Figure 3-5 NCFHM Current Scenario	16
Figure 3-6 NCFHM HEF Scenario	17
Figure 4-1 Drainage Layout	20

List of Tables

Table A-1: Conversion between return periods and annual exceedance probabilities	22
Table A-2: Flood Zones	23

Abbreviation

AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
CFRAM	Catchment Flood Risk Assessment and Management
DoHELG	Department of the Environment, Heritage and Local Government
DTM	Digital Terrain Model
FB	Freeboard
FFL	Finish Floor Levels
FRA	Flood Risk Assessment
FSR	Flood Studies Report
GSI	Geological Survey of Ireland
LiDAR	Light Detection and Ranging
NIFM	National Indicative Fluvial Mapping
OPW	Office of Public Works
PFRA	Preliminary Flood Risk Assessment
RR	Rainfall-Runoff
RMS	Root Mean Square
SAAR	Standard Average Annual Rainfall (mm)
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Urban Drainage System
LDP	Limerick Development Plan
WL	Water Level

1 Introduction

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009), the development must undergo a Flood Risk Assessment (FRA) to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference

JBA Consulting was appointed by Sean Keane of Wicklow County Council to prepare an FRA for the construction of 2no. dwellings on Vale Road, Arklow, Co. Wicklow.

This report will confirm the existing flood risk to the site and ensure that an appropriate design is configured for the site that complies with the relevant Planning Guidelines for Flood Risk Management.

1.2 Flood Risk Assessment Aims and Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify and communicate to Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives of this FRA are to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess the impact that the development has on flood risk;
- Develop an appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the OPW / DECLG planning guidance, "The Planning System and Flood Risk Management". A review of the likely effects of climate change, and the long-term impacts this may have on any development has also been undertaken.

For general information on flooding, the definition of flood risk, flood zones and other terms see 'Understanding Flood Risk' in Appendix A.

1.3 Development

The development involves the construction of one three-bedroom and one two-bedroom houses, which will be linked to a septic tank and soakaway system. Additionally, there will be a designated area for a caravan along the southeast boundary of the development and the existing access road will be extended through the site. The part of the site where buildings and roads are to be located is brownfield and currently hardstanding. An area to the northeast has been included in the site boundary map to encompass part of the existing and proposed drainage network. The site layout is displayed in Figure 1-1.



Figure 1-1: Site Layout

1.4 Report Overview

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 contains background information on flood risk. Section 4 provides initial assessment of flood risk and mitigation measures, while conclusions are provided in Section 5.

2 Site Background

This section describes the development site, including watercourses, geology, and wider geographical area.

2.1 Location and Watercourses

The site is located on Vale Road in Arklow, Co. Wicklow. The site is located on the outskirts of Arklow Town and is bound to the northeast by greenfield land and a railway line, to the northwest by residential properties, the southeast by the M11 and to the southwest by the Vale Road and greenfield land. Access to the site is provided by Vale Road along the southwestern boundary, which passes under the M11 to the south and connects the site to Arklow Town to the southeast. The railway line runs parallel to the northeast boundary of the development

The Avoca River flows c. 220 meters northeast of the development, in a southeasterly direction towards Arklow Town. The river flows into the Arklow Estuary and then the Irish Sea, approximately 1 km and 3.1 km downstream of the development, respectively. There are also several other minor watercourses in the area including the Ballyduff stream to the west, the Sheepwalk Stream to the northeast and a stream relating to marshlands to the northeast.

The site is located on the outskirts of Arklow Town, surrounded primarily by industrial, residential, and recreational areas.

Refer to Figure 2-1 below.

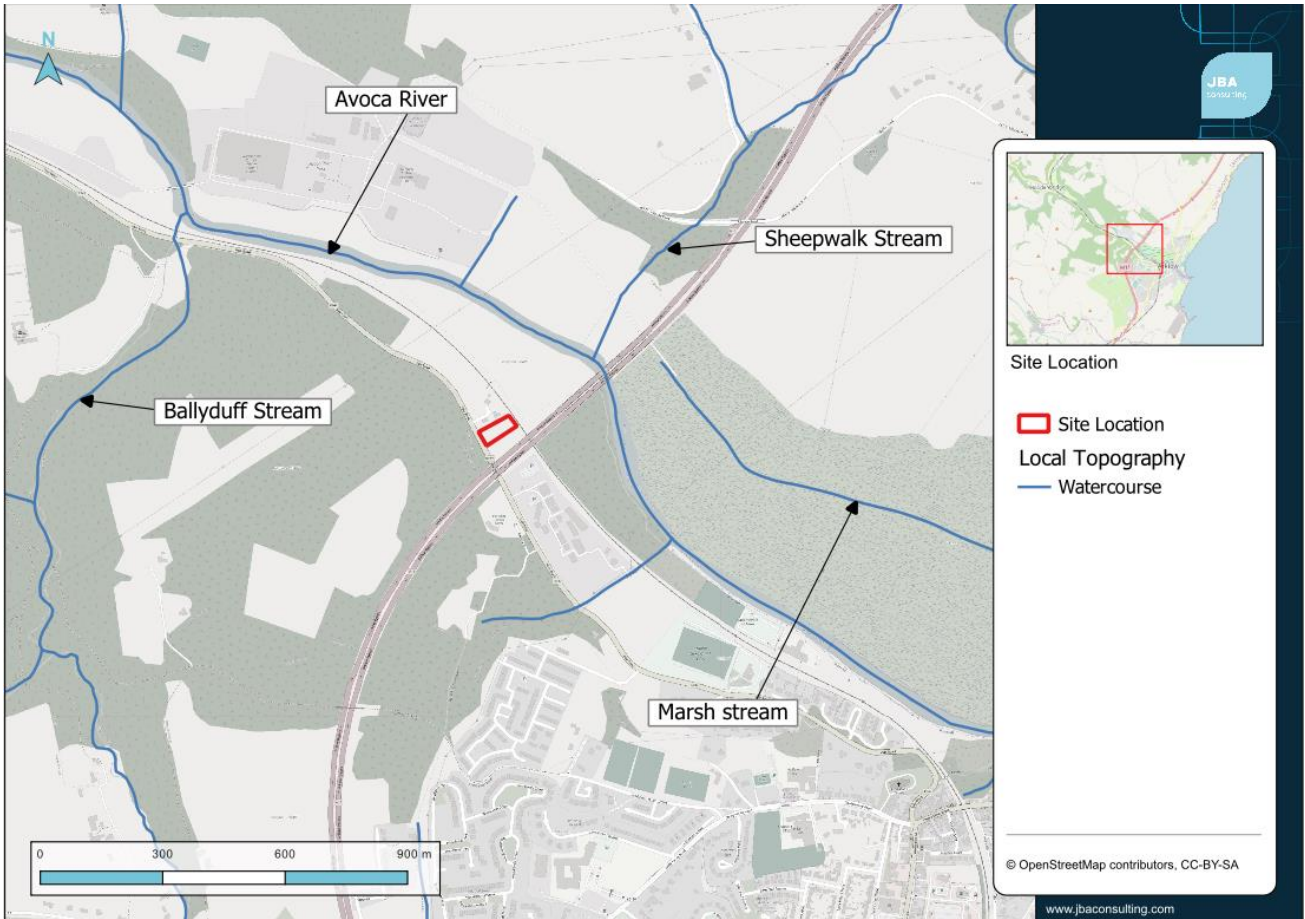


Figure 2-1: Site Location

2.2 Local Topography

Local topography generally falls towards the Avoca River with low points of c. 2-3mOD along the banks northeast of the site. A survey was carried out to measure ground levels at the site. The site has a general fall from southwest to northeast, following local topography towards the Avoca. The site has a high point of approximately 10.7mOD along the border to the Vale Road in the southwest, and a low point of c. 5.7mOD at the northeast of the site. There is a total fall of c. 4.3m between property levels and the banks of the Avoca. Refer to Figure 2-2 for wider local topography and Figure 2-3 for site topography.

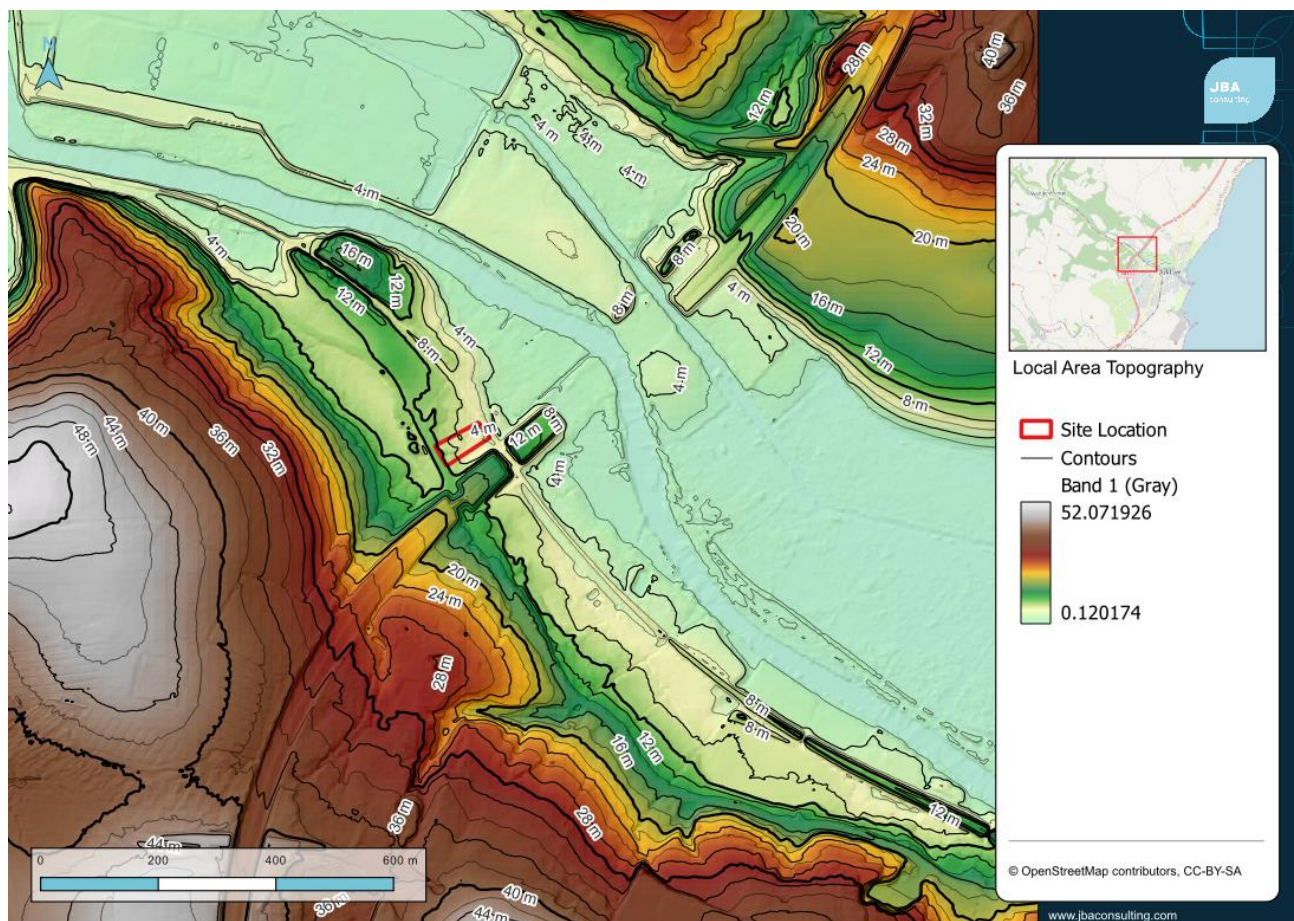


Figure 2-2 Local Topography

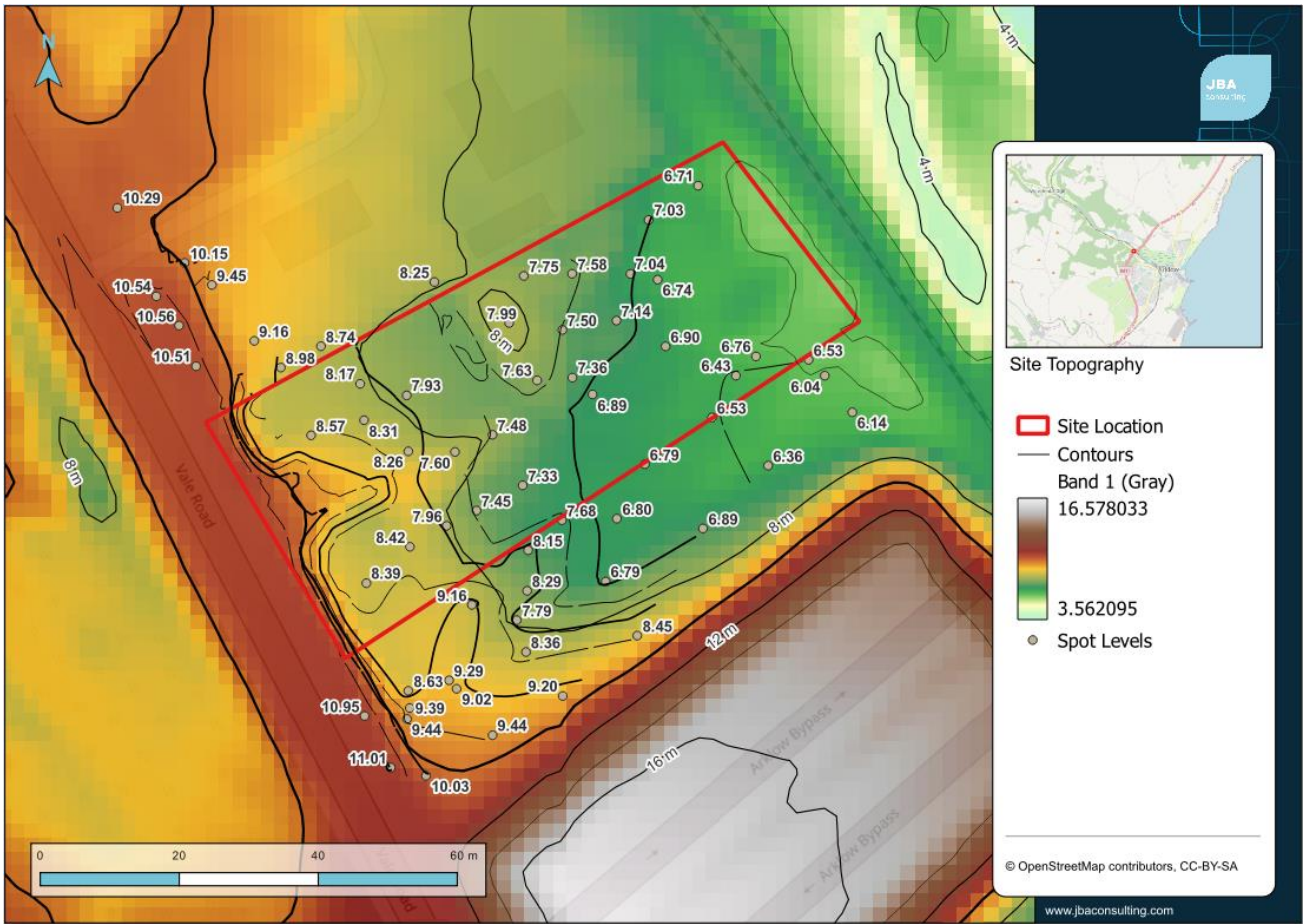


Figure 2-3 Site Topography

2.3 Site Geology

The groundwater and geological maps of the site, provided by the Geological Survey of Ireland (GSI), have been studied. The underlying bedrock at the site is Kilmacross Formation which is described as dark grey slate, minor pale sandstone (refer to Figure 2-4). The subsoil present under the garage is sandstone and shale till lower Palaeozoic. There are no alluvium soils present at the site that would indicate historic flooding. There are no karst features at or close to the site.

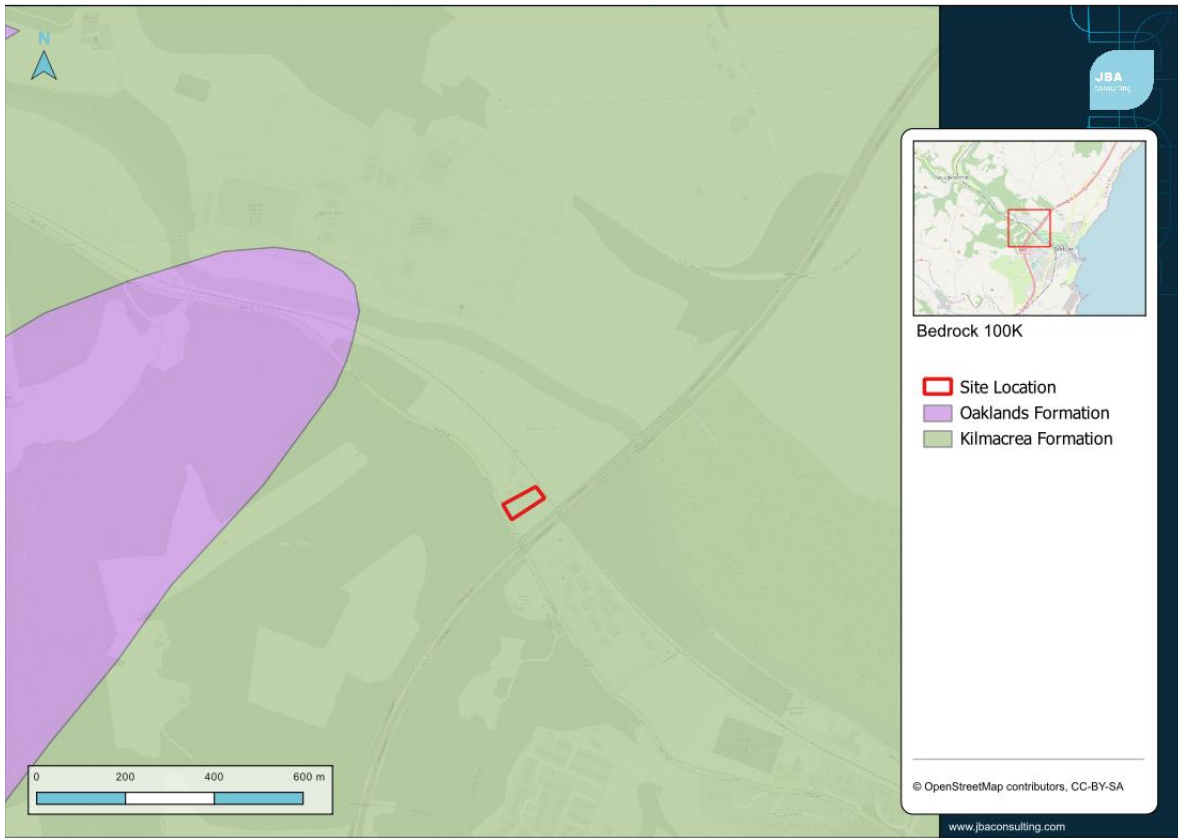


Figure 2-4 GSI Bedrock 100k

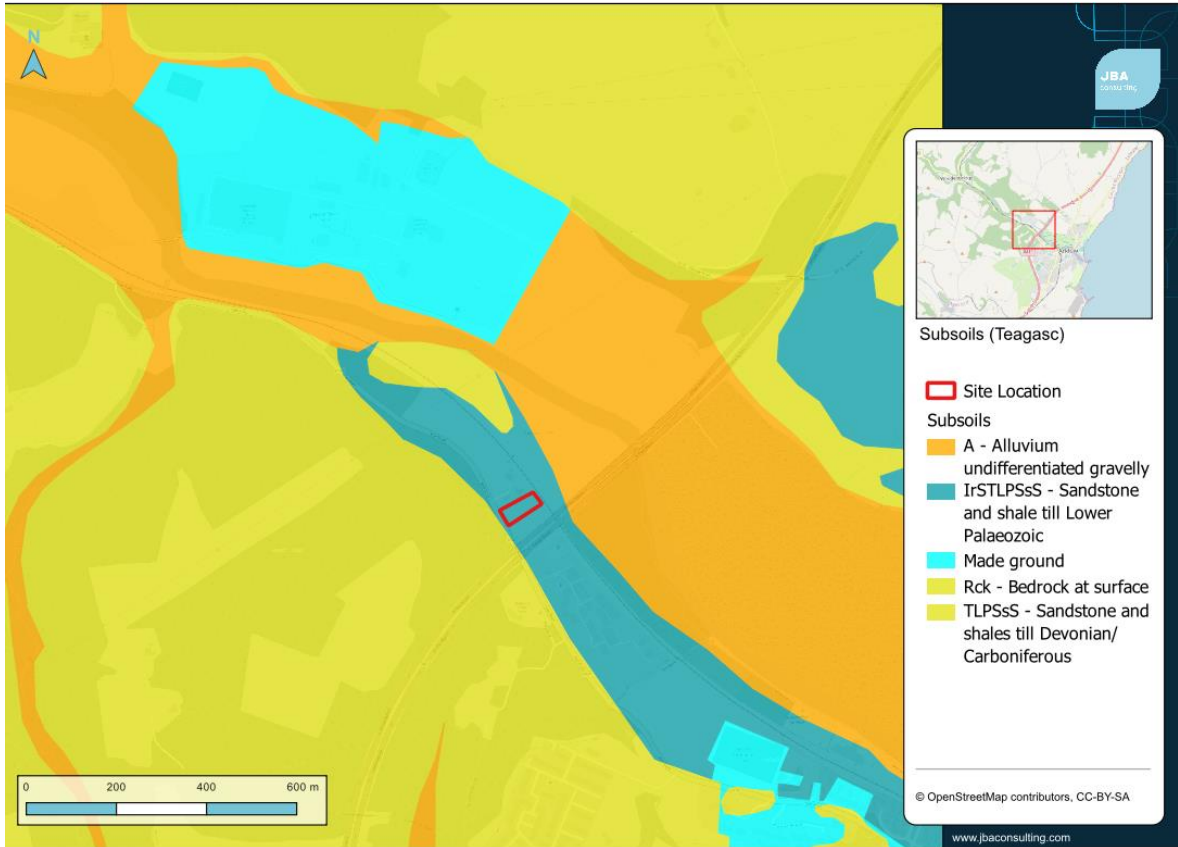


Figure 2-5: Teagasc Soils map

2.4 Local Groundwater Vulnerability

The GSI groundwater vulnerability maps were available for review. The groundwater vulnerability on site has been classified as 'Moderate', meaning there is a moderate risk to the groundwater.

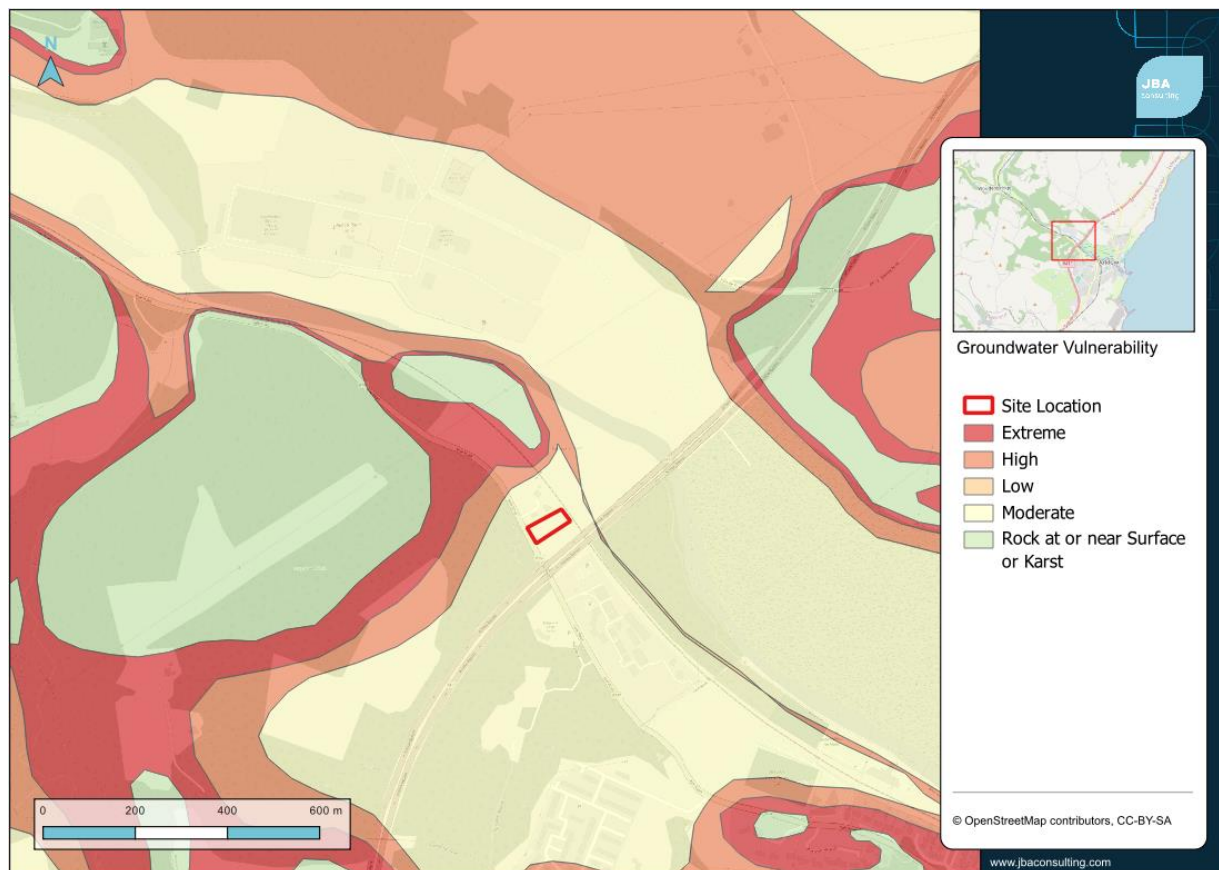


Figure 2-6 Groundwater Vulnerability (GSI)

2.5 Groundwater and Surface Water

There is no surface water flooding from the Winter 2015 / 2016 flood event identified within the site boundary. The surface water mapping detects water along the Avoca, but it does not extend further than the immediate banks of the river. The Winter 2015 / 2016 Surface Water Flooding mapping shows fluvial (rivers) and pluvial (rain) floods during the Winter 2015 / 2016 flood event and was developed as a by-product of the historic groundwater flood map.

The GSI Groundwater probability mapping were created using groundwater levels measured in the field, satellite images and hydrological models. The maps show no predicted groundwater flooding at or near the site. Refer to Figure 2-7.

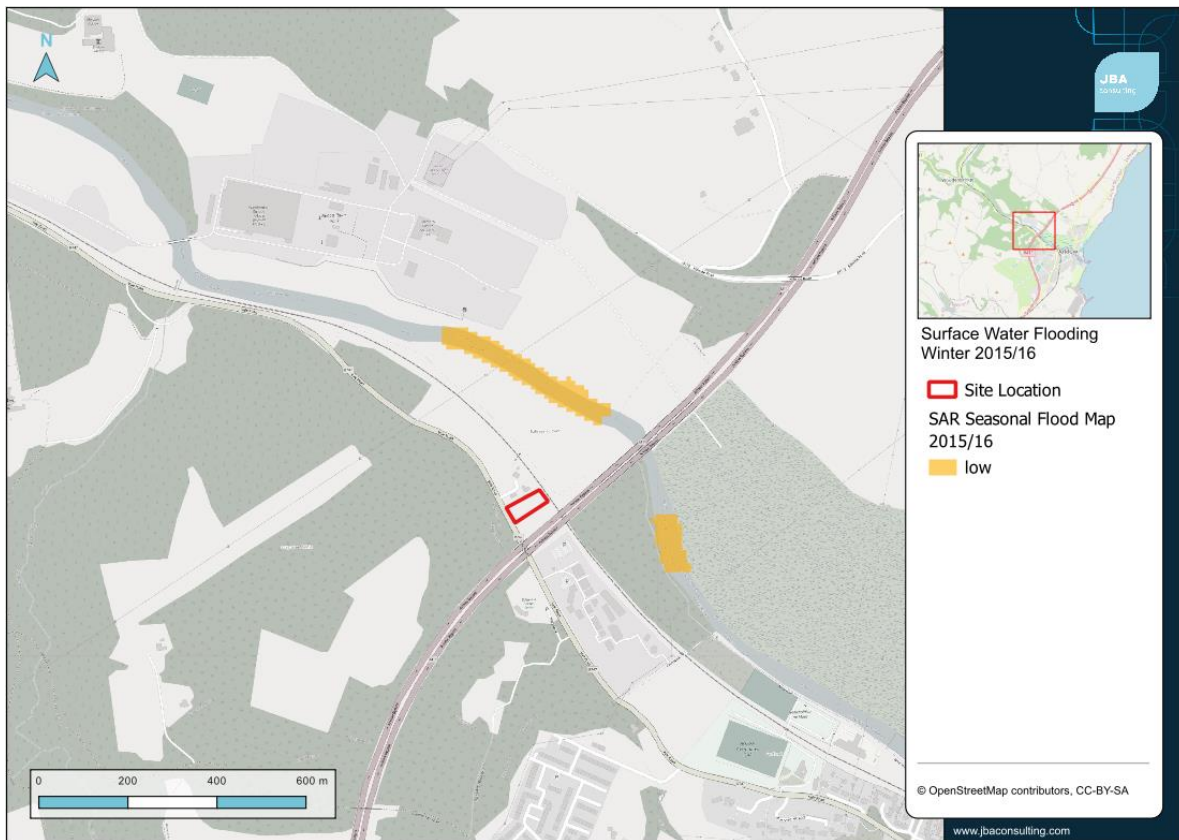


Figure 2-7 GSI Historic Groundwater and Surface Water

3 Flood Risk Identification

An assessment of the potential for and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historical flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections. Further detail on the Planning Guidelines and technical concepts are provided in Appendix A.

3.1 Flood History

A number of sources of flood information have been reviewed to establish any recorded flood history at, or near the site. This includes the OPWs national flood information portal, www.floodinfo.ie, and general internet searches.

3.1.1 Floodinfo.ie

The OPW have established a National Flood Risk Hazard Mapping website, www.floodinfo.ie, which highlights areas at flood risk through the collection of recorded data and observed flood events. The website provides significant national data that there are no reports of flooding within 1km of the site location. The closest recorded Flood Event to the site is:

- Flood ID-448: This flooding is indicated by the polygon in Figure 3-1. Relating to flooding of the Avoca dated 24/08/1986 due to extremely heavy rainfall.

Other events further to the east include:

- Flood ID-3717: Ferrybank Arklow Recurring. Road impassable once or twice a year. Particularly bad in February 2002.
- Flood ID 3724: Recurring. The Brooke/Lower Main St. Flooded twice in 2005 due to insufficient drainage capacity. High tide backs up drains

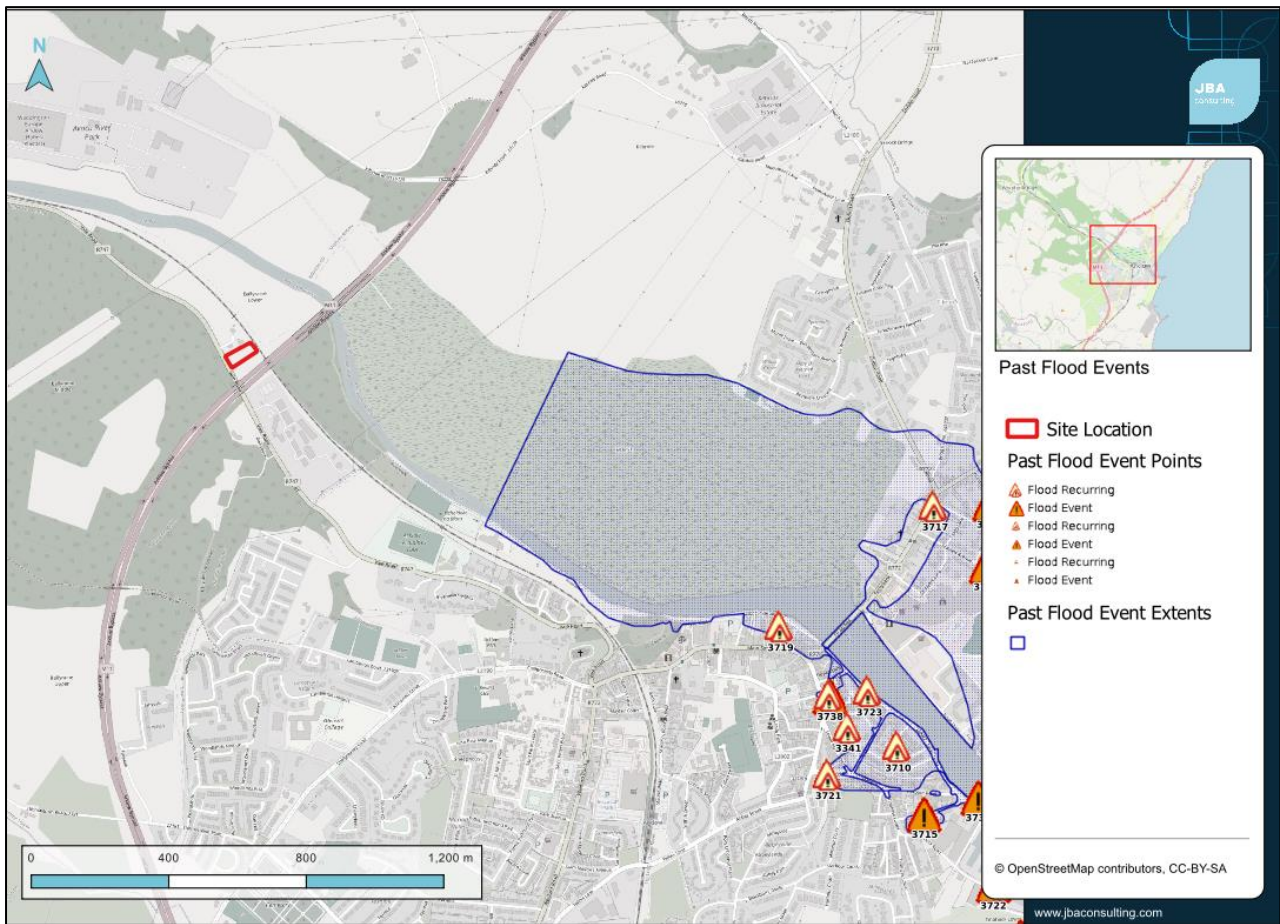


Figure 3-1: Past Flood Event Points

3.1.2 Internet Searches

An internet search was conducted to gather information about whether the site was affected by flooding previously. No reports of previous flooding could be found for the site specifically, however the AA reported flooding and road closure on 30/12/2015 on the Vale Road from Woodenbridge to Pearse Park during Storm Frank due to the Avoca bursting its banks. This is a long stretch of road with Woodenbridge located c. 5.5km to the northwest of the site, and Pearse Park c. 850m to the southeast of the site. Although it is not known which parts of the road were flooded, it is likely that areas of the road that were affected by flooding lie in closer proximity to the Avoca than the site and at low points along the road.

3.2 Predictive Flood Mapping

The wider area has been subject to predictive flood mapping or modelling studies and other related studies and plans.

- Catchment Flood Risk Assessment and Management Study (Eastern CFRAMS)
- National Coastal Flood Hazard Mapping (NCFHM)
- Arklow Flood Relief Scheme
- Arklow and Environs Local Area Plan 2018-2024

3.2.1 Catchment Flood Risk Assessment and Management Study (Eastern CFRAMS)

The Eastern CFRAM study is one of the most detailed mapping undertaken in the Wicklow region. It commenced in June 2011 with final flood maps issued during 2016. The Eastern CFRAM involves detailed hydraulic modelling of rivers and their tributaries, including coastal waterbodies. Only fluvial flood risk has been modelled for the Arklow area as most of the flood risk is covered by the Arklow Flood Relief Scheme study.

Following the detailed hydraulic modelling, flood maps were produced for the 10%, 1%, and 0.1% AEP flood events.

The available flood maps have been reviewed and confirm that the site is not within 1% AEP or 0.1% AEP flood extents, refer to Figure 3-2. Flooding originates from the River Avoca north of the site. Note that the below mapping comprises both the CFRAM study and extents resulting from the Arklow Flood Relief Scheme. The site lies just outside of the AFA for Arklow that the flood relief scheme covers. The Arklow Flood Relief Scheme will be discussed further below.

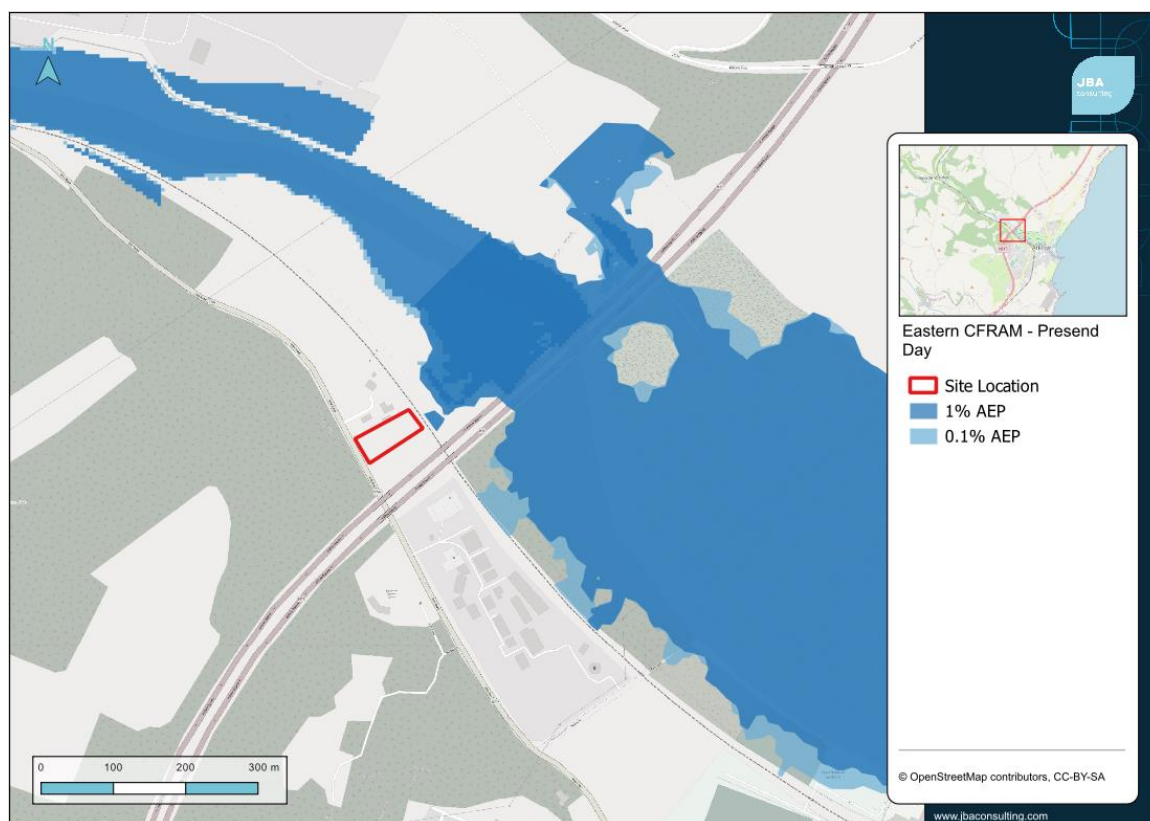


Figure 3-2 CFRAM Present Day

3.2.2 Arklow Flood Relief Scheme

Arklow is the focus of a flood risk management scheme aimed at reducing the risk of flooding to people, property, and the environment. Under the Government's National Development Plan 2018-2027, €1 billion has been allocated for flood relief measures across Ireland. As part of this initiative, a steering group was formed between the Office of

Public Works (OPW) and Wicklow County Council to advance a flood relief scheme aimed at reducing flood risk in Arklow.

The Hydrology and Hydraulics Report, Avoca River (Arklow) Flood Relief Study (Cawley, 2007) was prepared for the Office of Public Works (OPW) and provided flood flow data to support the development of the Arklow Flood Relief Scheme. Since then, several studies and projects have been carried out.

Key developments include:

- 2012: The OPW commissioned a 2D hydraulic model of the Avoca River in Arklow (Cawley, 2012) to assist with the preliminary design of the flood relief scheme, focusing on how Arklow Bridge affects flood levels.
- 2012: Wicklow County Council, with funding from the OPW, carried out interim works, including the construction of a flood protection wall along the Riverwalk and Town Centre area.
- 2013: The Avoca River Flood Relief Feasibility Study – Preliminary Report (BLP, 2013) compiled previous hydrological studies and outlined the proposed design flows for the scheme.
- 2017: The Avoca River Flood Relief Scheme Feasibility Report was scheduled for completion by the end of 2017. Its objective was to identify and recommend a preferred flood relief scheme and prepare a preliminary design for implementation.

In December 2023, Ayesa was appointed as Engineering and Environmental Consultants to design a flood relief scheme that meets technical, social, environmental, and economic standards. The project officially began in January 2024.

3.2.2.1 Fluvial

The modelling that took place as part of the flood relief scheme has a slight overlap with the CFRAM mapping as can be seen in Figure 3-2. An extract from the flood relief scheme mapping can be seen in Figure 3-3. The Arklow Flood Relief Scheme mapping shows the site at low risk from fluvial flooding. The closest node to the site is Node 1 and gives peak water levels of 3.49mOD and 3.87mOD for 1% and 0.1% AEP events respectively.

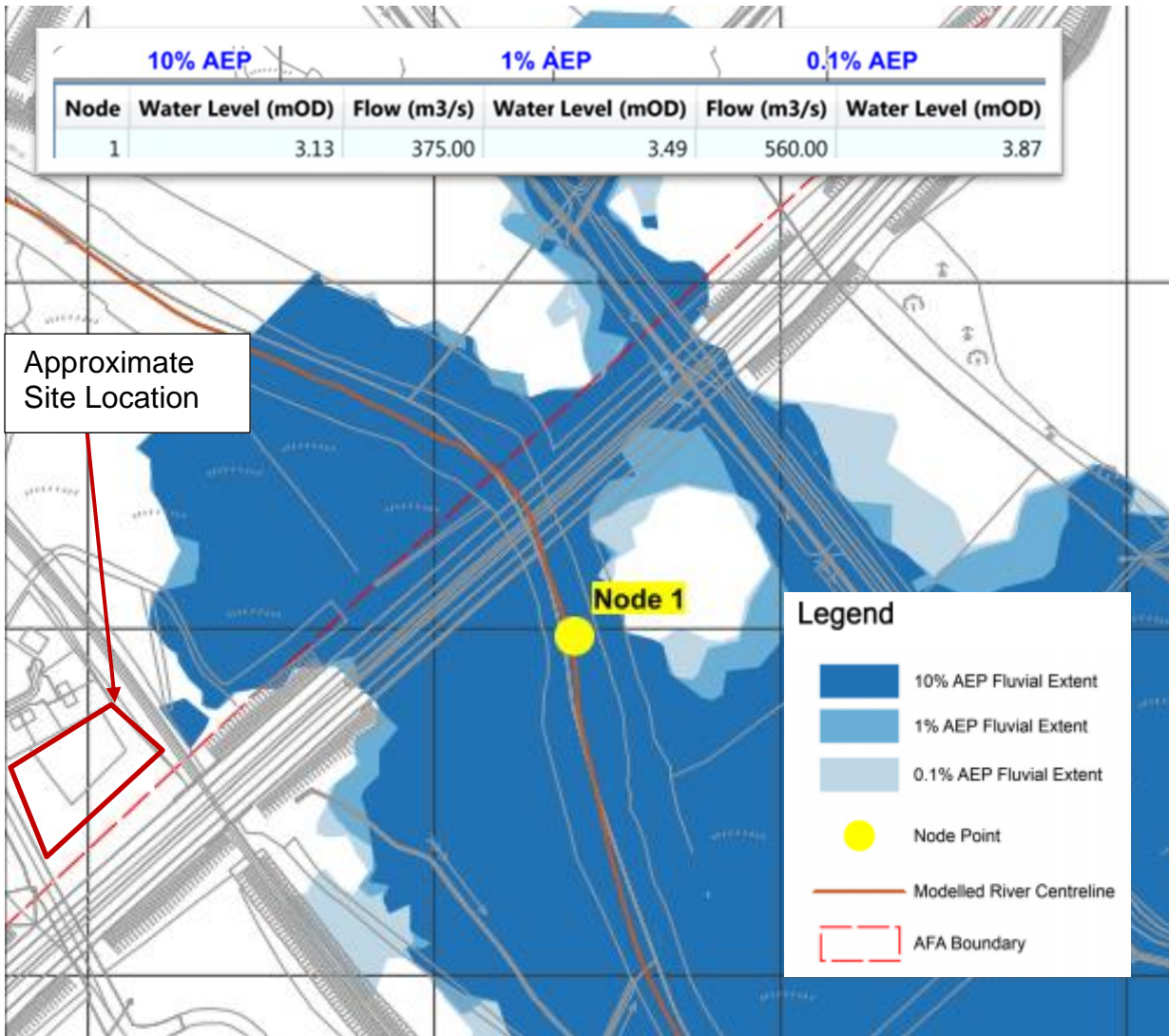


Figure 3-3 Arklow Flood Relief Scheme: Fluvial - Current Scenario

3.2.2.2 Tidal

Flood modelling for the Arklow Flood Relief Scheme also produced maps for coastal flooding. This was not covered by the CFRAM study. Figure 3-4 shows the site outside of the 0.5% AEP and 0.1% AEP extents. There are no flood levels for coastal scenarios as the site lies over 2.5km away from the coastline.

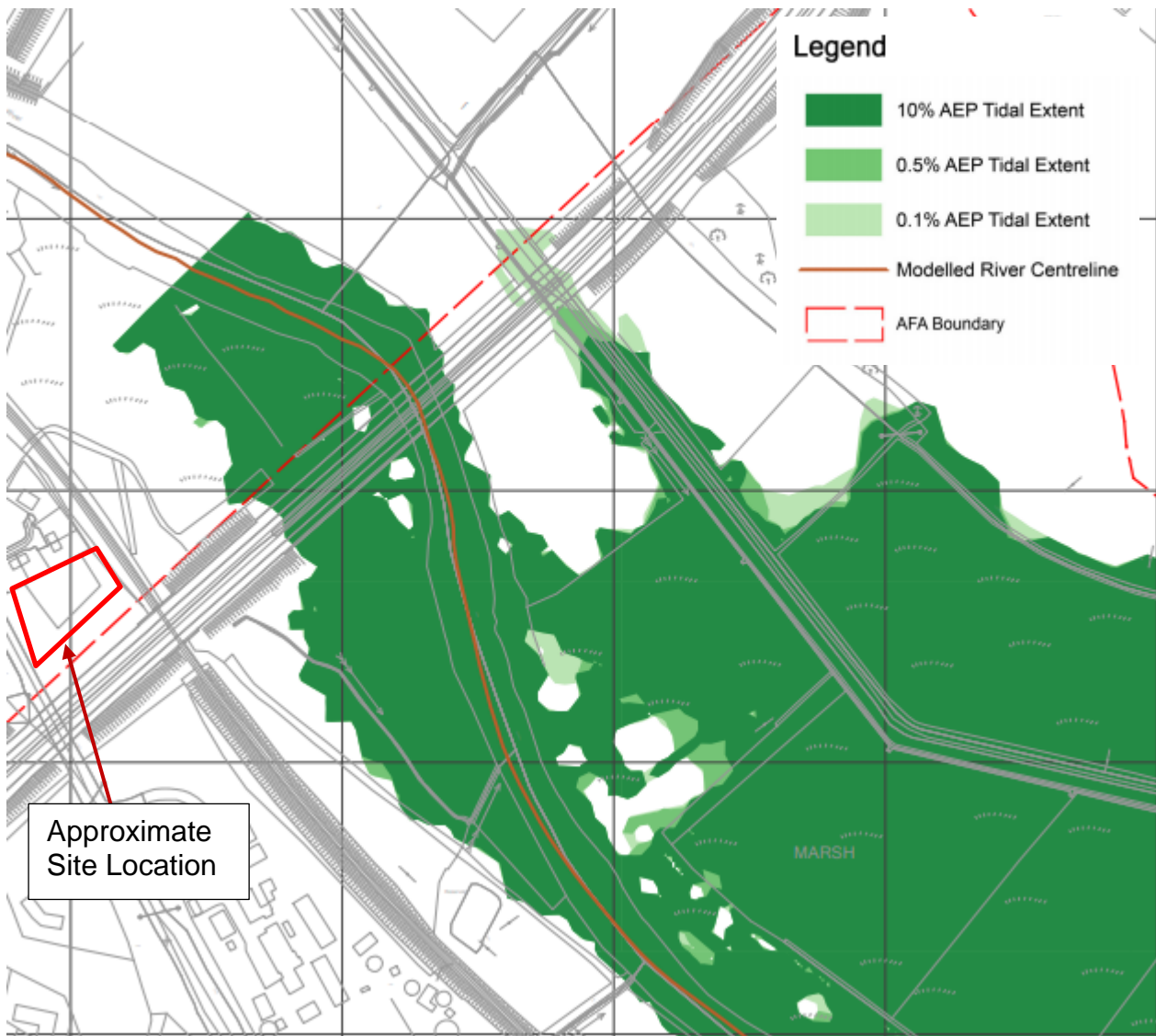


Figure 3-4 Arklow Flood Relief Scheme: Coastal- Current Scenario

3.2.3 National Coastal Flood Hazard Mapping

The National Coastal Flood Hazard Mapping (NCFHM) was published in 2021 and is based on the still water sea levels estimated as part of the Irish Coastal Wave and Water Level Modelling Study (ICWWS). The nearest ICWWS node to the site is SE17 and provides the water levels for each of the AEP events at SE17. The 0.5% AEP flood level at 1.59mOD and the 0.1% AEP flood event flood levels are 1.77mOD. The Mid-Range Future Scenario (MRFS) and High End Future Scenario (HEFS) flood levels are also provided in the table. These are 2.09 and 2.59mOD, for the 0.5% and 0.1% AEP events respectively.

The NCFHM current scenario flood maps that were produced as part of the study are shown in Figure 3-5 below. As seen from the figure, the site is at low risk of flooding from coastal sources according to the NCFHM study. The HEFS mapping also shows the site at low risk during extreme climate change scenarios (refer to Figure 3-6).

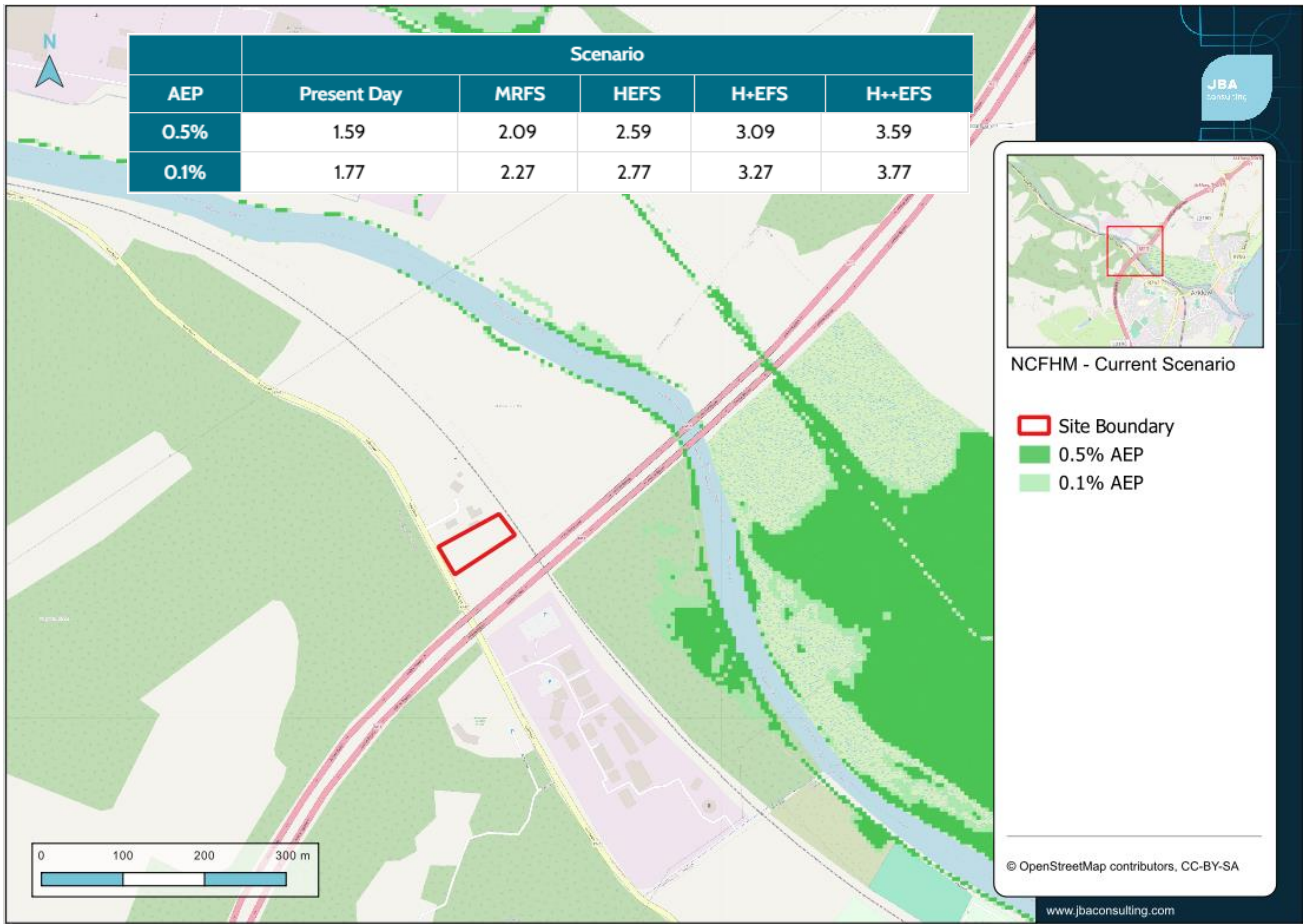


Figure 3-5 NCFHM Current Scenario

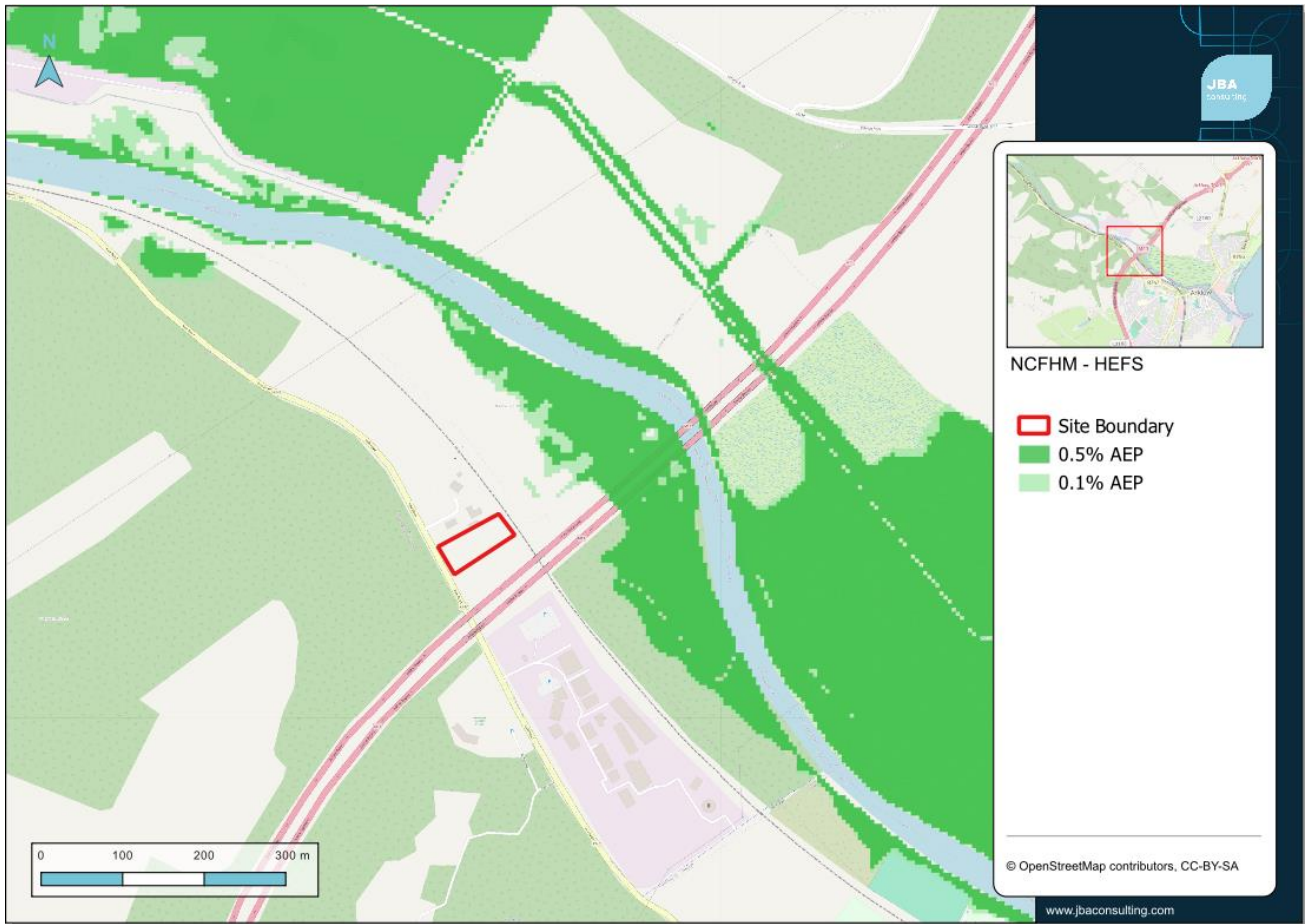


Figure 3-6 NCFHM HEF Scenario

3.2.4 Wicklow County Development Plan 2022-2028

The Wicklow County Development Plan has sought to manage flood risk in the county in accordance with the EU Flood Directive 2007/60/EC. A Strategic Flood Risk Assessment for the Wicklow County Development 2022-2028 was carried out by JBA Consulting in accordance with the requirements of 'The Planning System and Flood Risk Management - Guidelines for Planning Authorities' (2009). The SFRA provides an assessment of all types of flood risk within the county. Although the site lies outside of the Arklow LAP boundary and images included in the Wicklow CDP SFRA, Flood Zones in this area were created using CFRAM and the Arklow Flood Relief Scheme which both show the site to be in Flood Zone C.

3.3 Sources of Flooding

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. Following this initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flood sources are described below.

3.3.1 Fluvial

Fluvial flooding is the result of river levels rising and flowing out of bank, across lands that are usually dry. The Avoca River is the closest River to the site and flows 220m to the northwest of the site. Available flood sources include both CFRAM and the Arklow Flood Relief Scheme study. Both of these sources show the site to be at low risk of flooding. This is further confirmed by the high ground levels at the section of the site where buildings will be. Ground levels outside the building at the lowest points of the main part of the site lie at 7.5mOD and flood levels as predicted by the Arklow Flood Relief Scheme are 3.49m for the 1% AEP fluvial event and 3.87m for the 0.1% fluvial event. This means the lowest part of the site lies 4.01m above the 1% AEP event, and 3.61m over the 0.1% AEP event.

3.3.2 Tidal

A study of both the Arklow Flood Relief Scheme mapping and NCFHM study for the area confirms the site is at low risk of tidal flooding during the 10%, 0.5% and 0.1% AEP events. The site lies over 2km away from the coast and all mapping shows the site to be within Flood Zone C. The site is also at low risk during HEFS climate change events.

3.3.3 Pluvial

Pluvial flooding is the result of rainfall-generated overland flows that arise before run-off can enter a watercourse or sewer. A number of sources have been researched such as floodmaps.ie, site survey and LiDAR data, and GSI mapping. Based on review of the available information there is no recorded pluvial flooding at the site or immediate surrounding area. Ground levels in the area generally fall towards the Avoca River, and pooling of floodwater is unlikely here. Further analysis of pluvial flooding at the site are included in Section 4.

3.3.4 Groundwater

Groundwater flooding results from high sub-surface water levels that impact upper levels of the soil strata and overland areas that are usually dry. Review of the GSI mapping confirms that no karst features are located in the area surrounding the site. Review of the GSI Groundwater flood maps do not show any groundwater flood risk at or near the site.

In summary, there is no known risk of groundwater flooding in this area and has been screened out at this stage.

4 Flood Risk Assessment

This section of the report will assess the likelihood of flooding at the site and mitigation. The site lies in Flood Zone C for fluvial and coastal risk, the Justification Test is therefore not required in this case.

As with all areas pluvial flooding is identified as a potential risk, but this risk is generally low. GSI surface water mapping shows the buildings at the site to be outside any historical or predicted flood extents. This includes access roads to the site. The fall towards the Avoca River floodplain in the area in general is relatively steep and this is also true for the northeastern part of the site. Therefore, most of the surface water should flow away from any buildings. The site will also be served by a Surface Water Drainage System.

4.1 Mitigation

4.1.1 Finished Floor Levels

As the site lies in Flood Zone C and well above fluvial or tidal flood levels. It is recommended that the finished floor levels (FFLs) be set to at least 150mm above hardstanding ground as standard. This will prevent ingress of surface water during any exceedance event. There will also be no increase of impermeable surfaces as the location of the proposed buildings is on an area of pre-existing impermeable surface.

It is noted that ground levels outside the building at the lowest points of the main part of the site lie at 7.5mOD and flood levels as predicted by the Arklow Flood Relief Scheme are 3.49m for the 1% AEP event and 3.89m for the 0.1% AEP event. This gives a freeboard of 3.61 over the 0.1% event. The Wicklow County Development Plan 2022-2028 recommends finished floor levels of 1% AEP + Climate Change + 300mm, however as there was no climate change levels given as part of the Arklow Flood Relief scheme, it would be recommended that FFLs be at least 0.1% AEP + 300mm freeboard which would be 4.19mOD. Ground levels at the site are already well above this, leaving a total freeboard of 3.31m.

4.1.2 Surface water management

The strategy employed for dealing with storm water should follow the principles of the Wicklow CDP. Policy CPO 14.13 states:

Ensure the implementation of Sustainable Urban Drainage Systems (SuDS) in accordance with the Wicklow County Council SuDS Policy to ensure surface water runoff is managed for maximum benefit. In particular to require proposed developments to meet the design criteria of each of the four pillars of SuDS.

As the development is small, and also on pre-existing hard standing ground, extensive use of SuDS is likely not possible. The surface water of the site will drain into a proposed 225mm drainpipe located within the proposed roadway, which will drain into a soakaway in

the east of the site. It should also be noted that both the soakaway and the proposed septic tank will lie above the lowest point of the site of 5.7mOD and will therefore be 2.21m above the 1% AEP fluvial flood level as calculated by the Arklow Flood Relief Scheme.



Figure 4-1 Drainage Layout

5 Conclusion

JBA Consulting has undertaken a Flood Risk Assessment for the construction of 2no. residential houses on the Vale Road, Arklow, Co. Wicklow. The site is currently brownfield and comprises of hardstanding ground in the southwest half of the site and greenfield space at the northeast part of the site. Buildings will be located where there is pre-existing hardstanding ground.

The available fluvial flood maps produced for the area, including CFRAM and outputs from the Arklow Flood Relief Scheme show the development in Flood Zone C. The main source of fluvial risk is from the Avoca River and the Arklow Flood Relief Scheme mapping shows 1%AEP flood levels to be at 3.49m, which gives of freeboard at hardstanding areas of the site of at least 3.31m over the 0.1% AEP + 300mm freeboard minimum requirement. Greenfield areas of the site lie at 5.7mOD at the lowest point and will therefore be 2.21m above the 1% AEP fluvial flood level. This will prevent flood waters from entering the soakway at the site, and wastewater facilities will be safely above flood levels. Finished Floor Levels are recommended to be at least 150mm above hardstanding ground to prevent ingress of surface water.

The site was also shown to be outside of all coastal flood extents including climate change.

The primary risk to the site is pluvial flooding. GSI surface water flood maps were consulted and show the site to be at low risk of pluvial flooding. Any further management of surface water is managed by the proposed surface water system on site and by setting finished floor levels to 150mm above hardstanding ground.

In summary the site is shown to lie in Flood Zone C for fluvial and tidal events. GSI surface water mapping does not show the site at risk, and surface water will be managed by the on-site surface water system which is further aided by the slope at the site towards the Avoca River. As a result of the analysis undertaken of the available data, and of review of mitigation measures, it is concluded that the development is in compliance with the core principles of the Planning System and Flood Risk Management Guidelines and appropriately manages risk.

A Understanding Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship: Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period (in years). A 1% AEP flood has a 1 in 100 chance of occurring in any given year.

In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table A-1: Conversion between return periods and annual exceedance probabilities

Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

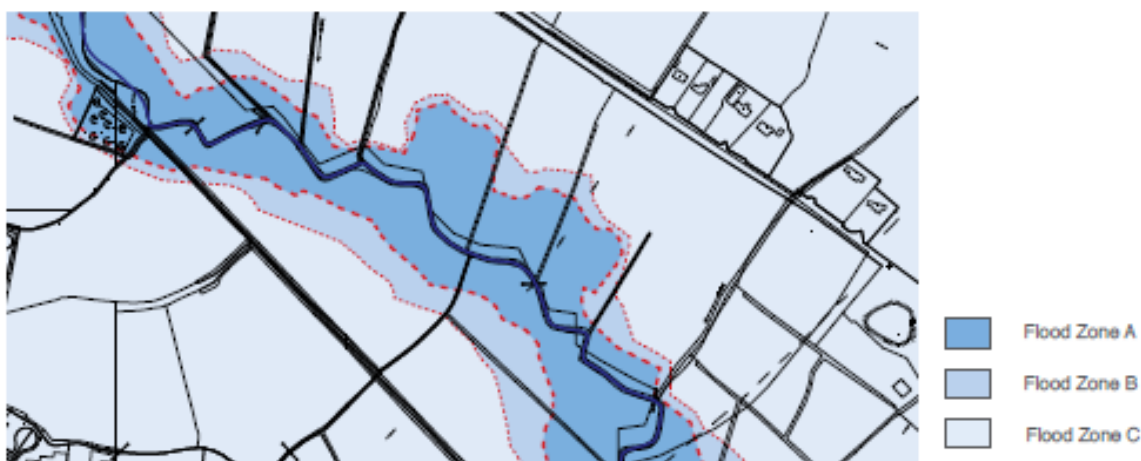
A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purposes of the Planning Guidelines, there are 3 types or levels of flood zones, A, B and C.

Table A-2: Flood Zones

Zone	Description
Flood Zone A	Where the probability of flooding is highest; greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/tidal flooding.
Flood Zone B	Moderate probability of flooding; between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/tidal.
Flood Zone C	Lowest probability of flooding; less than 0.1% from both rivers and coastal/tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.



A.3 Consequence of Flooding

Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.).

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- Highly vulnerable, including residential properties, essential infrastructure and emergency service facilities;
- Less vulnerable, such as retail and commercial and local transport infrastructure;
- Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.