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CERTAIN ASSETS OF DAWNHILL AND WINDHILL LIMITED

Lands at Kilbride, Arklow, Co. Wicklow

Site Specific Flood Risk Assessment

(LRD Application Submission)

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1 Introduction

Donnachadh O'Brien & Associates Consulting Engineers Ltd. (DOBA) have been instructed by the Client, Certain Assets of Dawnhill and Windhill Limited, to prepare a Site-Specific Flood Risk Assessment (SSFRA) to accompany an LRD Application Submission for an application to Wicklow County Council (WCC) for a proposed residential Development at lands at Kilbride, Arklow, Co. Wicklow. This Flood Risk Assessment has addressed the risk of fluvial, Pluvial and coastal flooding to the proposed site development.

2 Existing Site

The site is located in the area of Kilbride on the northern side of the Avoca river in Arklow, Co. Wicklow. The site is bounded by open fields to the west and to the north by the Kilbride Industrial estate and Kilbride Road L-6179. The site slopes in a broadly north / south direction to the town marsh and Avoca river. The Pyramid of Arklow; national monument, and its associated graveyard are located to the north west of the ownership area but outside of the subject site. The site is also adjacent to the KWETB proposed school site (Planning Ref. 22/213), which has received planning permission by Wicklow County Council. The site is also adjacent to a recently granted 84 units scheme which was submitted by the same client as this application relates to (ABP Ref. ABP-319604-24 & Wicklow Co. Co. Ref. 23/756) as outlined in Figure 1

This submission consists of the initial phase of a large residential development, to be provided over the coming years. The overall proposed masterplan seeks to provide c.1500 residential units, creches, local centre, the first phase of a future regional road for Arklow town, new roads connecting the site to the surrounding areas and a pedestrian / cycle paths.

Figure 1: Indicative Application Lands outlined in Red

3 Proposed Development

Certain Assets of Dawnhill and Windhill Limited intend to apply for a 7-year planning permission for a Large Scale Residential Development at this site of c.25.07ha on "Lands at Kilbride", Arklow, Co. Wicklow. The site is generally bounded by the town marsh to the south, M11 to the west, housing at Avondale Crescent/Murrell Drive and St Joseph's School to the east and the Kilbride Industrial estate and Kilbride Road L-6179 to the north.

The proposed mixed use Large scale Residential Development will result in the demolition of an existing dwelling and 2 no. sheds/outbuildings and the construction of 666 no. residential units with a mix of semidetached and terraced houses along with duplex apartments and apartments. These will comprise 1, 2, 3 and 4 bed units. All residential units will have associated private open space facing north/ south/ east/ west. The proposal will also deliver a local centre containing 3 no. retail units, 3 no. community/ medical units and 1 no. creche unit.

A new road providing vehicular access is also proposed connecting to the north to Kilbride Road along with road improvements in the surrounding area. The development will also provide for landscaping, public open spaces and all associated site development works to enable the development including boundary treatments, attenuation storage area and other service provision including ESB works.

A significant part of the development will be the provision of a greenway pedestrian and cyclist boardwalk between the proposed development at Kilbride, across the Arklow marshlands and Avoca River connecting to the proposed Arklow to Shilelagh Greenway on the southern bank of the Avoca River. This Greenway starts adjacent to the public Cark Park in Arklow town centre. A River Walkway is being delivered by Wicklow County Council (WCC) as part of the Arklow Flood Relief Scheme and the Boardwalk will tie into the proposed levels of the River Walkway. There has been significant consultation and engagement between the applicant and Wicklow County Council prior to the application to co-ordinate the boardwalk design.

The proposed Boardwalk extends form the southern side of the residential development, through the internal cycle and pedestrian network of the residential development. The boardwalk is elevated and across the marshlands (approximately 650m) after which it crosses the Avoca River. Debris trap columns constructed in reinforced concrete are being provided by Wicklow County Council as part of the Avoca River Flood Relief scheme, and following extensive consultation with Wicklow County Council, the boardwalk will extend across the debris trap columns and will tie into the proposed levels

of the Greenway on the southern side of the Avoca River. The Debris Trap piers and Greenway are approved works as part of WCC's Arklow Flood Relief Scheme

Figure 2: Proposed Development (Source: BKD Architects)

4 The Planning System and Flood Risk Management Guidelines

In September 2008 "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (Guidelines) were published by the Department of Environment, Heritage and Local Government in Draft format. In November 2009, the adopted version of the document was published. The Guidelines provide guidance on flood risk and development. A precautionary approach is recommended when considering flood risk management in the planning system. The core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for river and coastal flooding.

The objective of a site-specific Flood Risk Assessment (FRA) is to assess all types of flood risk to a development. The assessment should investigate potential sources of flood risk and include for the effects of climate change. The assessment is required to examine the impact of the development and the effectiveness of flood mitigation and management procedures proposed. It should also present the residual risks that remain after those measures are put in place.

This approach is based on the identification of flood zones for river and coastal flooding. "Flood Zones" are geographical areas used to identify areas at various levels of flood risk. It should be noted that these do not consider the presence of flood defences, as the risks remain of overtopping and breach of the defences. There are three flood zones defined (refer to 3):

Flood Zone A (high probability of flooding) is for lands where the probability of flooding is greatest (greater than 1% or 1 in 100 for river flooding and 0.5% or 1 in 200 for coastal flooding).

Flood Zone B (moderate probability of flooding) refers to lands where the probability of flooding is moderate (between 0.1% or 1 in 1,000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 and 0.5% or 1 in 200 for coastal flooding).

Flood Zone C (low probability of flooding) refers to lands where the probability of flooding is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).

Figure 3: Indicative Flood Zone Maps

Once a flood zone has been identified, the guidelines set out the different types of development appropriate to each zone. Exceptions to the restriction of development due to potential flood risks are provided for through the use of the Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated. This recognises that there will be a need for future development in existing towns and urban centres that lie within flood risk zones, and that the avoidance of all future development in these areas would be unsustainable.

The current Arklow and Environs Local Area Plan, 2018 – 2024 was adopted following the publication of the Guidelines and includes a Strategic Flood Risk Assessment.

The Guidelines set out a stage approach to assessment. The stages of assessment are:
Flood Risk Identification (Stage 1) – Identification of any issues relating to the site that will require further investigation through a Flood Risk Assessment.

Initial Flood Risk Assessment (Stage 2) – Involves establishment of the sources of flooding, the extent of the flood risk, potential impacts of the development and possible mitigation measures.

Detailed Flood Risk Assessment (Stage 3) – Assess flood risk issues in sufficient detail to provide quantitative appraisal of potential flood risk to the development, impacts on flooding elsewhere and the effectiveness of any proposed mitigation measures.

This report addresses the requirements of a Stage 1 and 2 Site Specific Flood Risk Assessment.

5 Flood Risk Identification

The subject site is located close to the Avoca River and the Irish Sea, therefore the potential flood risk to the proposed development site has been assessed.

5.1 History of Flooding

As part of the overall exercise to establish the potential flood risk to the subject site, Donnachadh O'Brien & Associates carried out a review of available and recorded information on flooding in the area. The following sources were consulted as part of the review:

• OPW Flood Records,

• Historic Flood Records.

5.1.1 OPW Flood Hazard Mapping

The Office of Public Works (OPW) collates available reports of flooding from all sources (e.g. fluvial, pluvial, coastal, etc.) on a nationwide basis. The OPW's website (www.floodmaps.ie) was consulted to obtain reports of recorded flooding within and surrounding the site. The information available on this website indicates there is a history of flooding in the area.

Figure 4 is an extract from the mapping available on the OPW database and illustrates the location of recorded flood events and reported extents of flooding in relation to the development location (Site boundary indicatively outlined in Red). This information notes that there have been records of flooding within the vicinity of the Marsh area to the south of the site previously, however there are no records of flooding within the subject site. The records available are included in Appendix A.

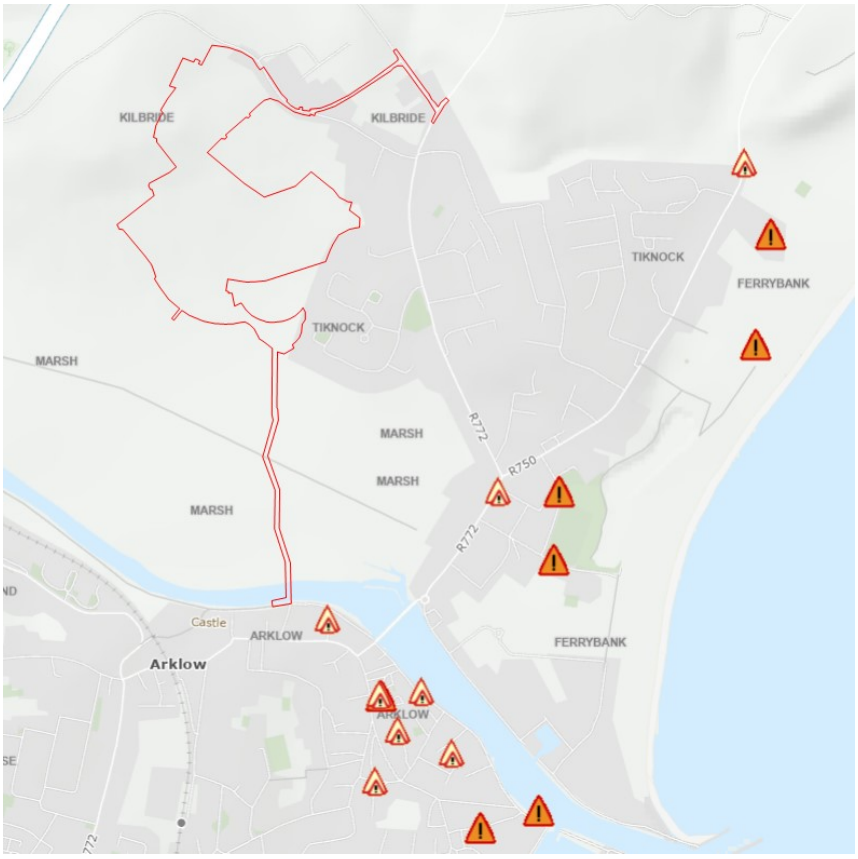


Figure 4: Historic Flood Events

5.1.2 Historic Mapping- OSI

Historical mapping available on OSi.ie was reviewed to identified historic flood plains and areas liable to flooding. There are no records of historic flooding within or surrounding the subject site available on this website.

5.1.3 Indicative Flood Risk Mapping

Predictive flood risk mapping published by the OPW was reviewed to establish the potential flood risk to the subject site.

5.1.4 OPW PFRA Mapping

The CFRAM (Catchment Flood Risk Assessment and Management) programme is a national programme which produced a series of Preliminary Flood Risk Assessment (PFRA) which cover the entire country. This assessment was carried out based on available and readily derivable information to identify areas where there may be a significant risk of flooding. The objective of the PFRA is to identify areas where the risks associated with flooding might be significant.

The PFRA was undertaken by:

- Reviewing records of flood that have happened in the past;
- Undertaking analysis to determine which areas might flood in the future, and what the impacts might be; and
- Consulting with Local Authorities and other Government departments and agencies. The PFRA mapping available for the area surrounding the development indicates that there may be a risk of fluvial and coastal flooding at the southern end of the subject site. Figure 5 is an extract from the mapping published on myplan.ie and shows the site location.

Figure 5: PFRA Mapping

5.1.5 Arklow and Environs LAP Flood Risk Mapping

Predictive flood risk mapping published as part of the Arklow and Environs Local Area Plan has been reviewed to establish the potential flood risk in the vicinity of the subject site. Figure 6 is taken from Arklow and Environs LAP (Map C1 Flood Map) and provides a comparison of the PFRA and CFRAM predicted flood extents. This mapping indicates that the majority of the proposed development is located within Flood Zone C with no risk of flooding, with a minimal portion of the site to the south located in Flood Zone A/ B including the boardwalk routed to the south of the Avoca River through the Avoca Marsh.

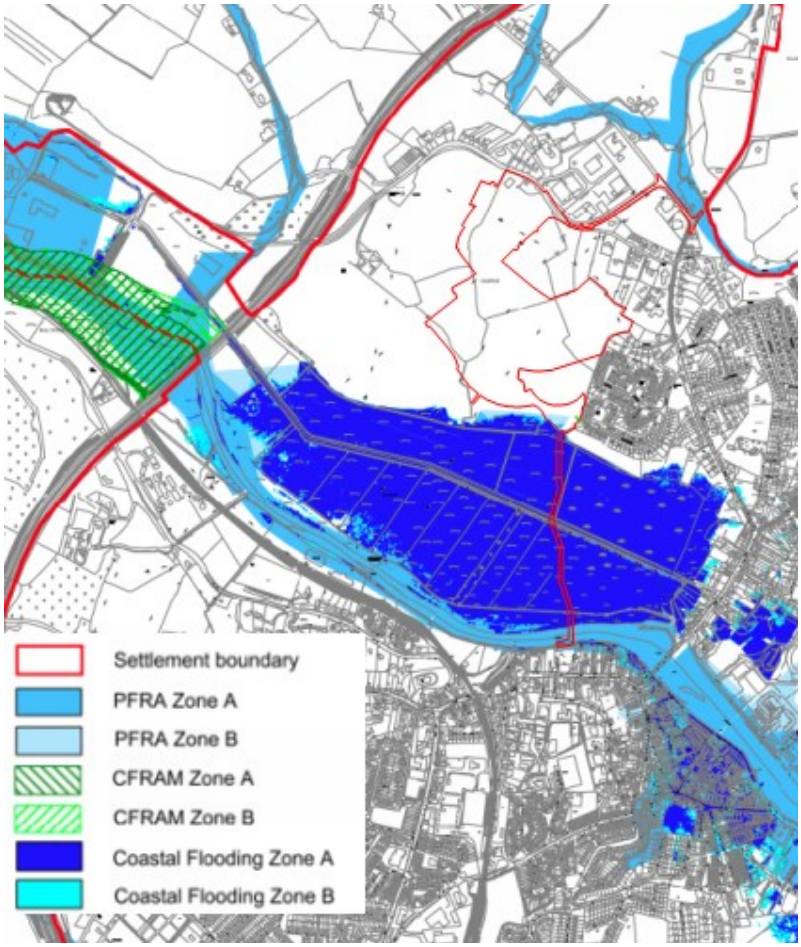


Figure 6: Map C1- Arklow & Environs LAP

Figure 7 below is taken from Arklow and Environs LAP (Map SFRA1 – Indicative Flood Zones) and provides the predicted Flood Zone A and B developed as part of the River Avoca (Arklow Town) Flood Relief Study. Similar to Figure 6, This mapping indicates that the majority of the proposed development is located within Flood Zone C with no risk of flooding, with a minimal portion of the site to the south located in Flood Zone A/ B, including the boardwalk routed to the south of the Avoca River through the Avoca Marsh.

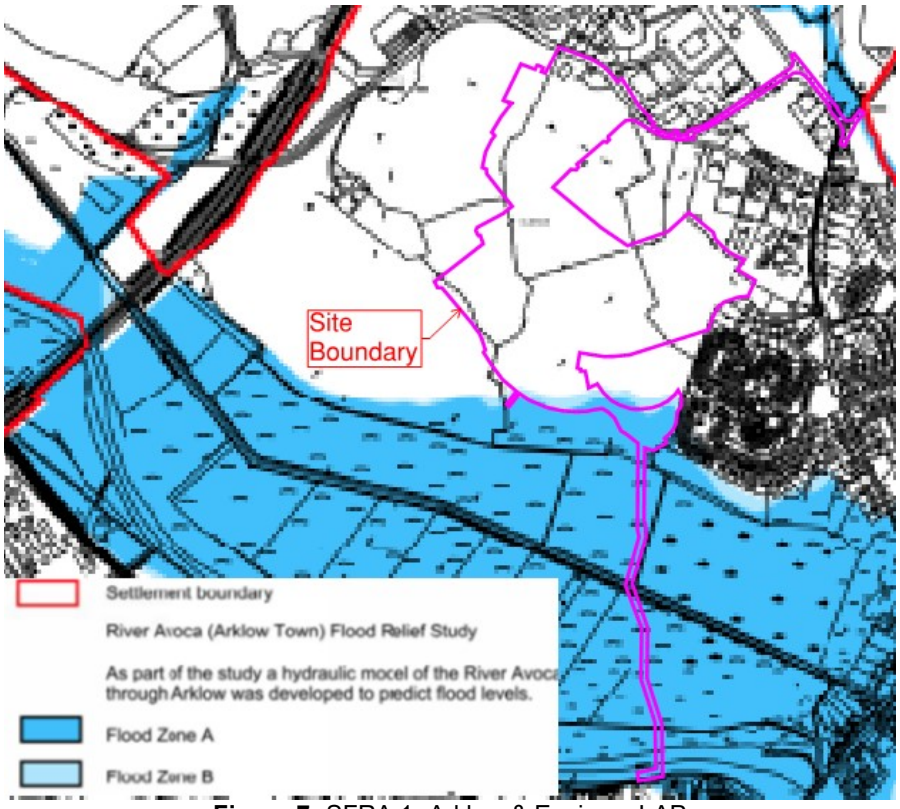


Figure 7: SFRA 1- Arklow & Environs LAP

5.1.6 CFRAM Mapping

The objective of the PFRA was to identify areas where the risk associated with flooding might be significant. These areas, which are referred to as 'Areas for Further Assessment' or AFAs, are where a more detailed assessment was then undertaken to more accurately assess the extent and degree of flood risk.

Predictive flood risk mapping published as part of the OPW Avoca River Flood Relief Scheme (FRS) was reviewed to establish the flood risk to the proposed development. This mapping was prepared based on the output of hydraulic modelling carried out as part of the flood relief scheme design. The hydraulic model developed as part of the Avoca River FRS includes four nodes south of the subject site. Predicted water levels for three fluvial flood events are provided at each of these four nodes. Based on the predicted water levels at these nodes, fluvial flood extents associated with the 10% AEP event, 1% AEP event (Flood Zone A), and the 0.1% AEP event (Flood Zone B) are mapped. Figure 8 illustrates the locations of each of the four nodes and the predicted extent of fluvial flood risk south of the subject site.

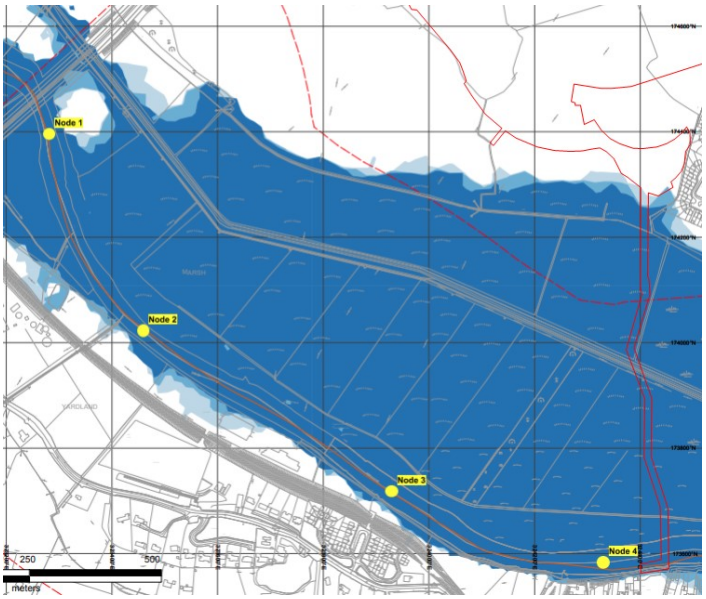


Figure 8: Fluvial Flood Risk Node Locations

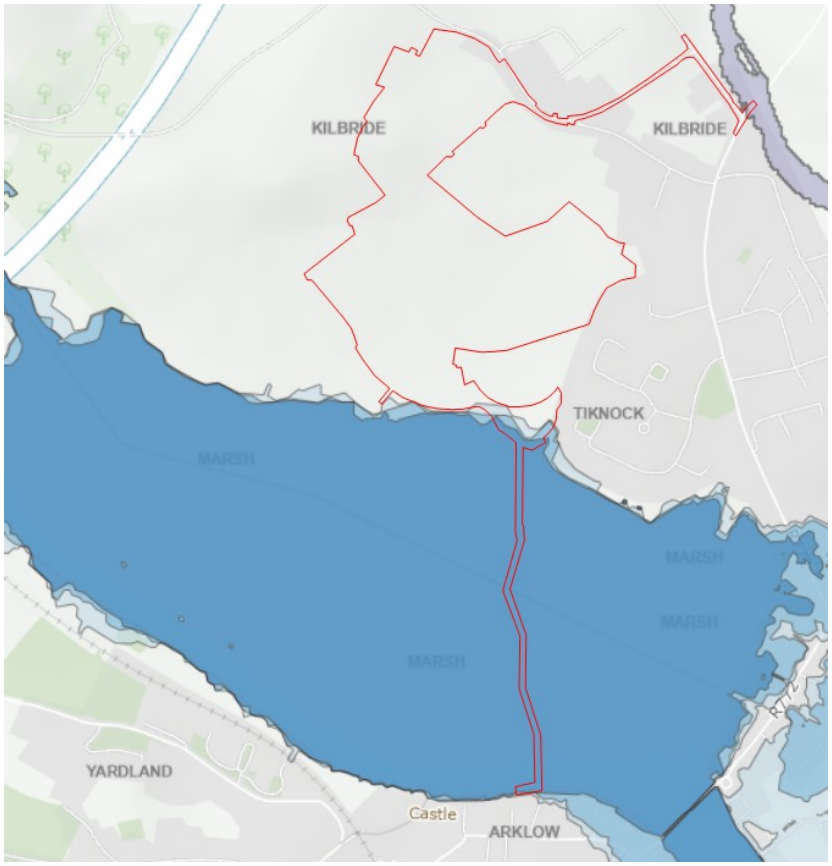


Figure 9: Fluvial Flood Risk Mapping

Figure 10 includes the predicted flood water levels at the four hydraulic model nodes south of the subject site. It can be seen from this information that the predicted flood water levels reduce moving from upstream (Node 1 at western end) to downstream (Node 4 at eastern end). Given the location of the proposed development in relation to the Avoca River; Node 4, which is located to the south of the proposed site which is seen in figure 8, has been determined as the appropriate node to assess the flood risk to the development.

	10% AEP		1% AEP		0.1% AEP
Node	Water Level (mOD)	Flow (m3/s)	Water Level (mOD)	Flow (m3/s)	Water Level (mOD)
1	3.13	375.00	3.49	560.00	3.87
2	2.59	375.00	3.11	560.00	3.58
3	2.23	375.00	2.84	560.00	3.34
4	2.03	375.00	2.72	560.00	3.24

Figure 10: Predicted Fluvial Flood Water Levels

5.1.6.1 Fluvial Flood Risk- Site

Based on a review of the fluvial flood risk mapping available, it can be seen that the southernmost end of the subject site is located within Flood Zone A or B with the housing, roads and majority of infrastructures located within Flood Zone C and not in an area predicted to flood during a 1 in 100 year return period fluvial flood (1% AEP) event, or Flood Zone A. The extent of site located within Flood Zone A and B has been limited to a portion of greenway embankments/ Amenity open area/ landscaping within the southeastern corner of the site. This portion of the site to the site is considered to be water compatible development.

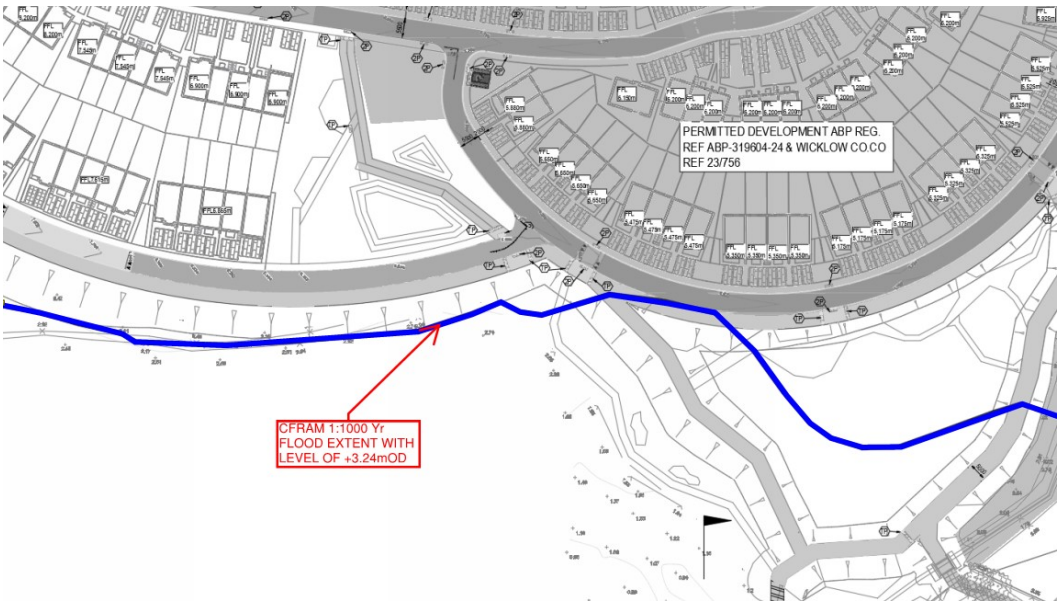


Figure 11: Proposed Flood Extents relating to proposed development

5.1.6.2 Compensatory Storage

The proposed greenway and associated embankments located within the flood zone have been calculated to displace approximately 1825m3 of flood volume during the 1:1000-year event. It is proposed to provide compensatory storage in the southern greenspace to account for any displaced volume lost to the greenway embankments. An area of approximately 1046m2 and located outside the flood zone has been identified as being suitable to regrade the ground 1.35m lower to approximately 1.89mOD to allow for lost flood volume to be catered for as can be seen in figure 12. Channels/ drainage shall be installed in the embankments to hydraulically link the existing flood extents to the proposed regraded area to the north of the greenway embankments. These areas have been identified as being located in Flood Zone C, as such suitable provision of compensatory storage. The volume of displaced water by the embankments may be considered relatively minimal when compared to the extent of the full Avoca River Flood Catchment.

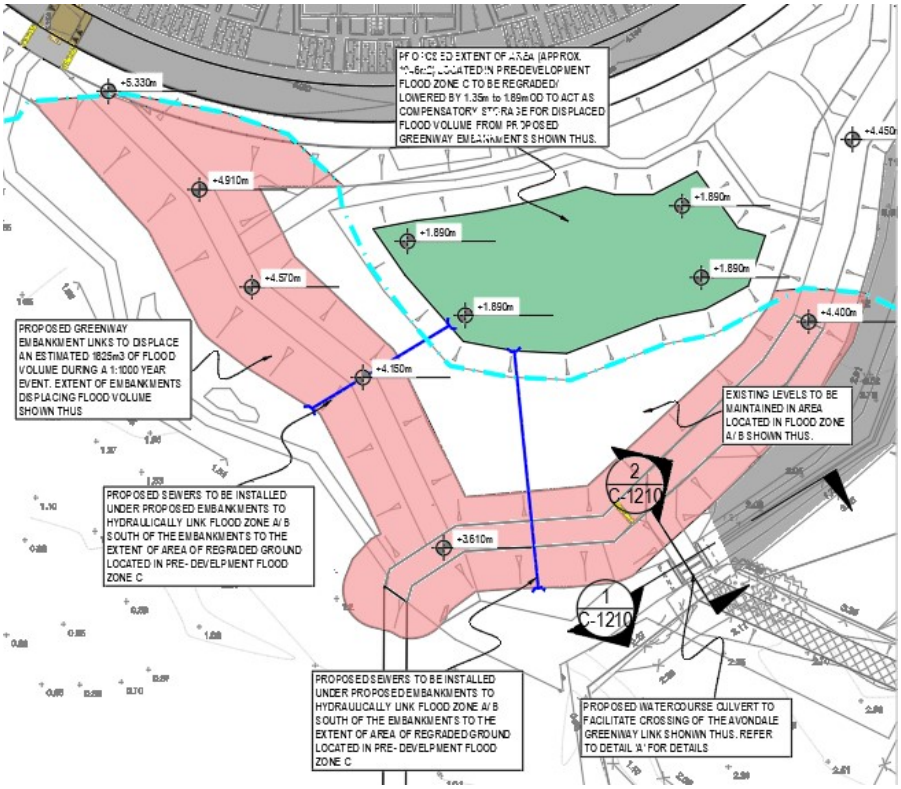


Figure 12: Proposed Area identified as suitable for regrading to provide compensatory storage of displaced flood water.

5.1.6.3 Fluvial Flood Risk- Boardwalk

In addition to this, the entirety of the raised boardwalk. routed to the south of the Avoca River through the Avoca Marsh has also been identified as being located within Flood Zone A/B as can be seen in figure 8 and 9.

The proposed boardwalk has been carefully designed to minimise impact on the Avoca Marsh including the Environmental, Biodiversity Hydrology and Hydrogeology aspects of the marsh. As a result the boardwalk deck level has been set at +4.00mOD, significantly above the 1 in 1000 year flood level of 3.24mOD, and also above the 1 in 100 year flood level of 3.03mOD considered by the OPW for the Avoca River Flood Relief Scheme. The underside of the deck construction has also been designed with a sufficient freeboard as can be seen in figure 13 below. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Flood Zone A/B Flood Levels.

For full details relating to the boardwalk elevation relating to the flood level, please refer to DOBA Engineering drawings **2432-DOB-XX-XX-SI-DR-C-0940** and **C-0950.**

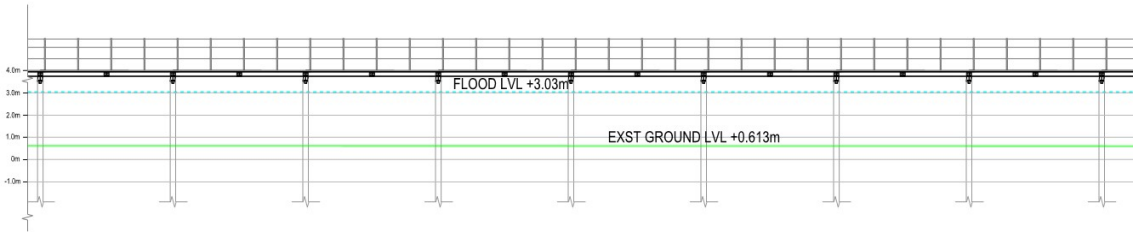


Figure 13: Proposed Boardwalk Infrastructure constructed above the Flood Zone A/B Flood Levels.

5.1.6.4 Coastal Flood Risk- Site

Figure 14 illustrates the extent of coastal flood risk in the vicinity of the subject site. The predicted extent of coastal flooding associated with the 10% AEP event, 0.5% AEP event (Flood Zone A), and the 0.1% AEP event (Flood Zone B) are mapped and indicate that the majority of the subject site of the development is not located within an area predicted to flood. The extent of site located within Flood Zone A and B has been limited to a minimal portion of green open area/ landscaping. During coastal flooding events, these areas have been identified as not being in use. An area of approximately 1825m2 and located outside the flood zone has been identified as being suitable to regrade the ground 1.35m lower to approximately 1.89mOD to allow for lost flood volume to be catered for. Channels/ drainage shall be installed in the embankments to hydraulically link the existing flood extents to the proposed regraded area to the north of the greenway embankments.

5.1.6.5 Coastal Flood Risk- Boardwalk

In addition to the portion of landscape to the south of the site, the entirety of the raised boardwalk. routed to the south of the Avoca River through the Avoca Marsh has also been identified as being located within the Coastal Flooding Extent as can be seen in figure 14.

The proposed boardwalk has been carefully designed to minimise impact on the Avoca Marsh including the Environmental, Biodiversity Hydrology and Hydrogeology aspects of the marsh. As a result the boardwalk deck level has been set at +4.00mOD, significantly above the coastal 0.1% 1 in 1000 year flood level of 1.66mOD. The underside of the deck construction has also been designed

with a freeboard to the flood level. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Coastal Flood Levels.

For full details relating to the boardwalk elevation relating to the flood level, please refer to DOBA Engineering drawings **2432-DOB-XX-XX-SI-DR-C-0940** and **C-0950**

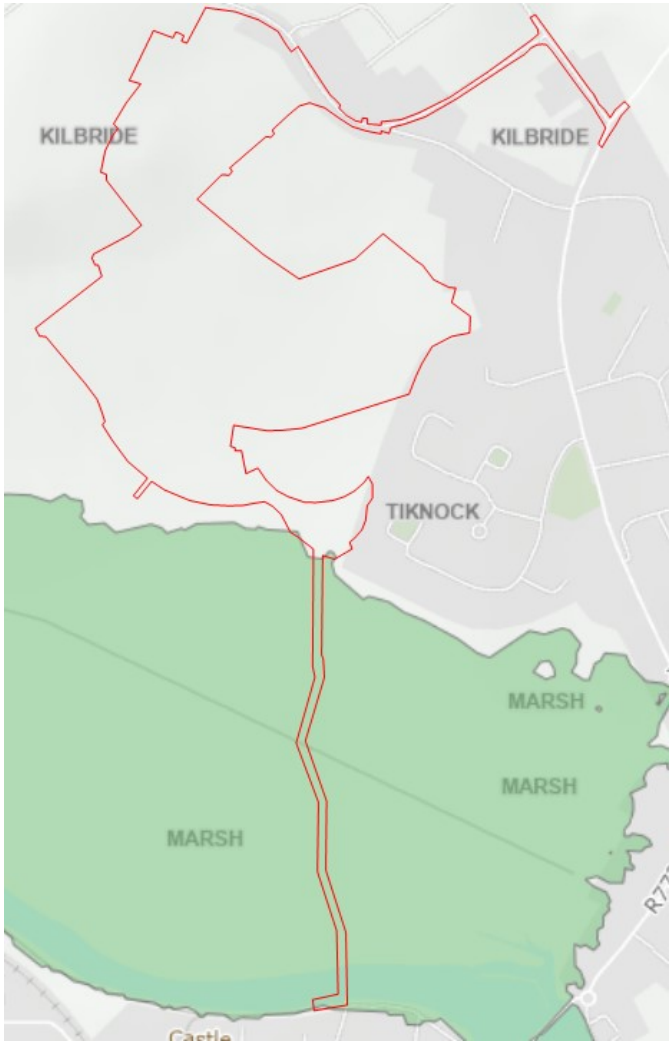


Figure 14: Coastal Flood Risk Mapping

5.1.7 Irish Coastal Protection Strategy Study (ICPSS) Phase 2 Mapping

The OPW commissioned RPS to carry out a study to assess coastal flooding and erosion extents in Ireland, known as the Irish Coastal Protection Strategy Study (ICPSS). This study has produced predictive flood maps and levels for flood events with various probability of occurrence (e.g. the 1% AEP event). Work packages 2 and 3 were commissioned to establish an extreme flood extent for the coastline and to derive predictive coastal flood extent maps for a range of probabilities, particularly for

the 0.1% and 0.5% annual exceedance probabilities (AEPs). The predictive flood risk mapping published includes the Arklow area and the subject site. Figure 15 below illustrates the predicted coastal flood extents for the 10%, 0.5% and 0.1 % AEP events.

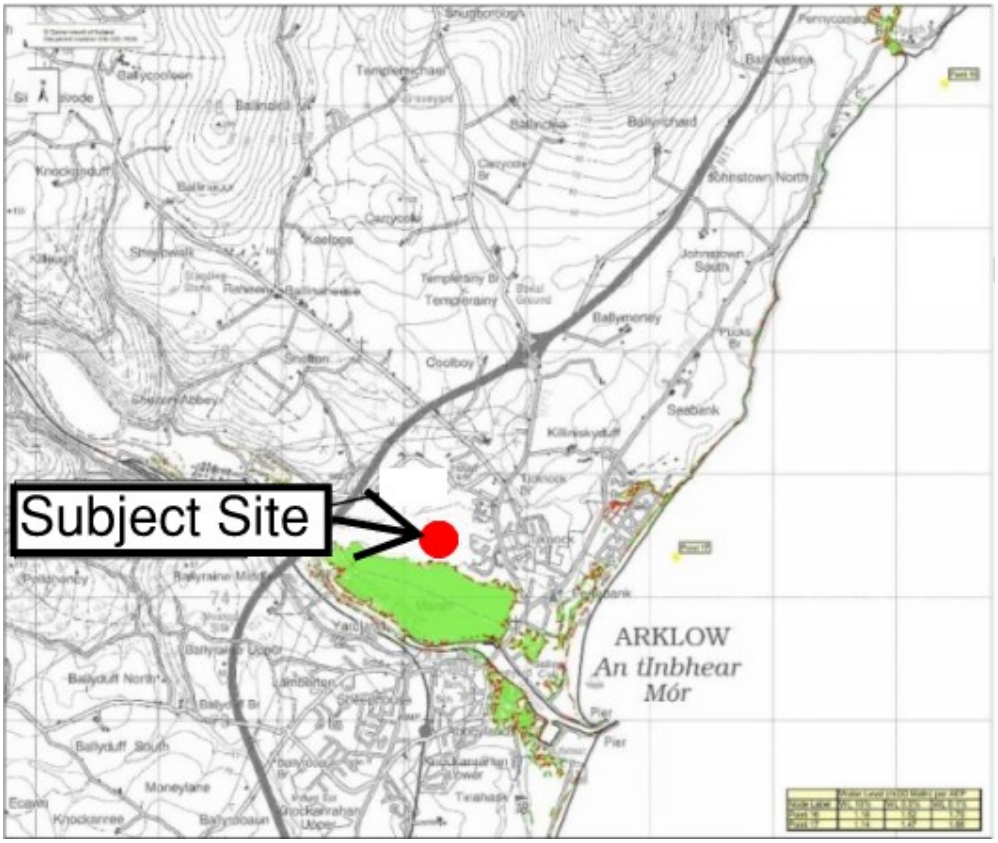


Figure 15: ICPSS Coastal Flood Risk Mapping

Predicted flood water levels are also provided for these events and are included in Table 1.

Table 1: Coastal Flood Risk Mapping

Node	10% AEP Water Level (m OD Malin)	0.5% AEP Water Level (m OD Malin)	0.1% AEP Water Level (m OD Malin)
17	1.14	1.47	1.66

The lowest proposed road level within the future masterplan site is approx. 4.710m OD Malin. Comparing the predicted coastal flood water levels with the topographical survey of the subject site indicates that the proposed site is not at risk from flooding.

6 Initial Flood Risk Assessment (Stage 2)

6.1 Potential Sources of Flooding

The potential risk to the proposed development associated with each of the following sources of flooding is presented in this section.

- Fluvial flooding,
- Coastal/ Tidal flooding,
- Pluvial flooding,
- Groundwater flooding.

6.1.1 Fluvial Flooding

Fluvial flooding is the result of a river exceeding its capacity and excess water spilling out on to the adjacent floodplain. Mapping published as part of the OPW Avoca River Flood Relief Scheme is used to evaluate the fluvial flood risk to the proposed development. From a review of this mapping and predicted flood water levels, it can be seen, the majority of the proposed site is located within Flood Zone C and not at risk from fluvial flooding. Minimal portions of greenway link/ open space/ landscaped areas are identified in Zone A and B.

The proposed greenway and associated embankments located within the flood zone have been calculated to displace approximately 1825m3 of flood volume during the 1:1000 year event. It is proposed to provide compensatory storage in the southern greenspace to account for any displaced volume lost to the greenway embankments. An area of approximately 1042m2 has been identified as being suitable to regrade the ground 1.35m lower to approximately 1.89mOD existing to allow for lost flood volume to be catered for as described in Section 5.1.6 above. These areas have been identified as being located in Flood Zone C, as such, suitable for the provision of compensatory storage.

In addition to this, the entirety of the raised boardwalk. routed to the south of the Avoca River through the Avoca Marsh has also been identified as being located within Flood Zone A/B as can be seen in figure 8 and 9.

The proposed boardwalk has been carefully designed to minimise impact on the Avoca Marsh including the Environmental, Biodiversity Hydrology and Hydrogeology aspects of the marsh. As a result the boardwalk deck level has been set at +4.00mOD, significantly above the 1:100 year flood level. The underside of the deck construction has also been designed with a freeboard of approximately 800mm as can be seen in figure 13. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Flood Zone A/B Flood Levels.

6.1.2 Coastal/ Tidal Flooding

Coastal flooding is the result of sea levels which are higher than normal and result in sea water overflowing on to the land. Mapping published as part of the OPW Avoca River Flood Relief Scheme is used to evaluate the coastal flood risk to the proposed development. From a review of this mapping and predicted flood water levels, the majority of the proposed site is located within Flood Zone C and not at risk from coastal flooding. Minimal portions of green space/ landscaped areas are identified in Zone A and B. It is proposed to provide compensatory storage in the southern greenspace to account for any displaced volume lost to the greenway embankments. An area of approximately 1046m2 has been identified as being suitable to regrade the ground 1.35m lower to approximately 1.89mOD to allow for lost flood volume to be catered for. These areas have been identified as being located in Flood Zone C, as such, suitable for the provision of compensatory storage.

In addition to the portion of landscape to the south of the site, the entirety of the raised boardwalk. routed to the south of the Avoca River through the Avoca Marsh has also been identified as being located within the Coastal Flooding Extent.

The proposed boardwalk has been carefully designed to minimise impact on the Avoca Marsh including the Environmental, Biodiversity Hydrology and Hydrogeology aspects of the marsh. As a result the boardwalk deck level has been set at +4.00mOD, significantly above the coastal 0.1% 1 in 1000 year flood level of 1.66mOD. The underside of the deck construction has also been designed with a freeboard to the flood level. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Coastal Flood Levels.

6.1.3 Pluvial Flooding

Pluvial flooding is the result of rainfall-generated overland flows which arise before run-off can enter any watercourse or sewer. It is usually associated with high intensity rainfall. The PFRA mapping available for the site indicates that the proposed site Is located outside of an area predicted to flood and not at risk from pluvial flooding. The proposed development includes a separate surface water drainage network to collect run-off generated within the site, **(Please refer to Engineering Drawing 2432-DOB-XX-SI-DR-C-0200, 0210, 0220, 0230, 0240 & 0250).** This system will collect rainfall generated run-off within the site and convey flows through the proposed network. As the run-off that currently generates the predicted pluvial flood risk within the existing site will now be collected by the proposed network, the risk of pluvial flooding is reduced further.

The proposed surface water drainage network has been designed in compliance with the Greater Dublin Strategic Drainage Study (GDSDS). It is proposed to restrict surface water run-off from each

area to existing greenfield run-off rates by providing a hydro brake flow control system (or similar approved). It is proposed to attenuate run-off in excess of greenfield run-off rates by providing storage tanks and retention basins within the drainage networks. The proposed storage tanks and basins have been designed using a 1 in 100-year return period rainfall event, with a 20% increase in intensities to allow for the impact of climate change on rainfall, and in accordance with the Greater Dublin Strategic Drainage Study (GDSDS).

It is also proposed to incorporate a number of Sustainable Urban Drainage Systems (SuDS) to further attenuate and treat run-off generated within the proposed development. It is proposed to provide permeable pavements and tree pits/ bio retention areas to further reduce the rate of surface water run-off discharged from the development site. By restricting the rate of run-off from the development site to the greenfield run-off rate, there will not be an increase in the flow discharged from the site following its development, therefore there will be no increase in flood risk as a result of run-off discharged from the site.

6.1.4 Groundwater Flooding

The OPW's PFRA includes an assessment of groundwater flood risk. The PFRA flood risk mapping does not predict any groundwater flooding within or surrounding the subject site.

6.2 Estimate of Flood Levels and Flood Zone

Following review of the predictive flood risk mapping published as part of the Avoca River Flood Relief Scheme, it is concluded that the primary risk to the site is associated with fluvial flooding. As the predicted fluvial flood water levels are significantly higher than the predicted coastal flood water levels, coastal flood risk is not considered further in this assessment. The estimated water levels at the node adjacent to the site is included in Table 2 below

Table 2: Predicted Fluvial Flood Water Levels

Node	Flood Zone	Return Period	Water Level
4	Flood Zone A	1 in 100- year return period	2.72 m OD Malin
	Flood Zone B	1 in 1000- year return period	3.24 m OD Malin

The predicted fluvial flood water levels at node4 was compared with the topographical survey of the existing site and it was determined that the majority of the proposed site which would be considered vulnerable is located outside both Flood Zones A and B. As the predicted fluvial flood water levels have been compared with the topographical survey of the existing site, this is considered to provide an accurate extent of flood risk within the subject site.

All residential units within the proposed development are located outside of the predicted 1% and 0.1% AEP event flood extents. The lowest proposed Finished Floor Levels of the residential units are

6.865m OD Malin, which are above the predicted fluvial flood water levels at Node 4. These units are located within Flood Zone C and are therefore the flood risk to the development is low.

The lowest proposed Finished Road Level of the site is approximately 5.250m OD Malin, which is above the predicted fluvial flood water levels at Node 1 and Node 4, therefore the risk is considered low. It is proposed to regrade a portion of existing ground/ landscaped areas to the south of the site provide compensatory storage in the southern greenspace to account for any displaced volume lost to the proposed greenway embankments. An area of approximately 1492m2 has been identified as being suitable to regrade the ground 1.35m lower than existing to allow for lost flood volume to be catered for. The regraded ground will result in no increase in flood risk as a result of the proposed development or any adjacent developments.

In addition to the residential element of the development, The deck of the boardwalk infrstructure which is routed to the south across the Avoca Marsh has been set at +4.00mOD, significantly above the 1:100-year flood level. The underside of the deck construction has also been designed with a freeboard of approximately 800mm. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Flood Zone A/B Flood Levels and will result in no increase in flood risk as a result of the proposed development or any adjacent developments.

6.3 Climate Change

Advice on the expected impacts of climate change and the allowances to provide for future flood risk management in Ireland is given in the "OPW Assessment of Potential Future Scenarios, Flood Risk Management Draft Guidance", 2009. Two climate change scenarios are considered, the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS).

The MRFS is intended to represent a 'likely' future scenario based on the wide range of future predictions available. The HEFS represents a more 'conservative' future scenario at the upper boundaries of future projections. Based on these two scenarios, the OPW recommended allowances for climate change are given in Table 3.

Table 3: Recommended Allowances for Climate Change

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+20%	+30%
Flood Flows	+20%	+30%
Mean Sea Levels Rise	+500mm	+1000mm
Land Movement	-0.5mm/year	-0.5mm/year
Forestation	-1/6 Tp	-1/3 Tp +10% SPR

As set out in Section 6.2, the predicted 1 in 100-year return period event fluvial flood water level is 2.72m OD Malin while the 1 in 1000-year return period event fluvial flood water level is 3.24m OD Malin. The recommended allowance for climate change is a 20% increase in fluvial flow rates. The predictive flood risk mapping prepared for the Arklow area does not include mapping for the Mid-Range Future Scenario.

The lowest finished floor level (residential unit) within the masterplan development is 5.175m OD Malin, Which is significantly above the predicted 1 in 1000-year return period event fluvial flood level, it is therefore considered that this provides adequate freeboard on the predicted fluvial flood water levels (current) in order to accommodate an increase as a result of climate change without being at risk of flooding.

7 Flood Risk Management

7.1 Sequential Approach and Justification Tests

The sequential approach and Justification tests procedures are outlined in 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' 2009 and is summarised and adopted below.

7.1.1 Sequential Approach

A sequential approach is a key tool in ensuring that development, particularly new development, is first and foremost directed towards land that is at low risk of flooding. The philosophy used in this approach is:

1. Avoid – preferably choose lower risk flood zones for new development
2. Substitute – Ensure the type of development proposed is not especially vulnerable to the adverse impact of flooding
3. Justify – Ensure that the development is being considered for strategic reasons
4. Mitigate – Ensure flood risk is reduced to minimal levels
5. Proceed – Only where Justification Test passed and emergency planning measures are in place

Figure 16 sets out the mechanism for the use of the sequential approach to development in flood areas from the planning perspective.

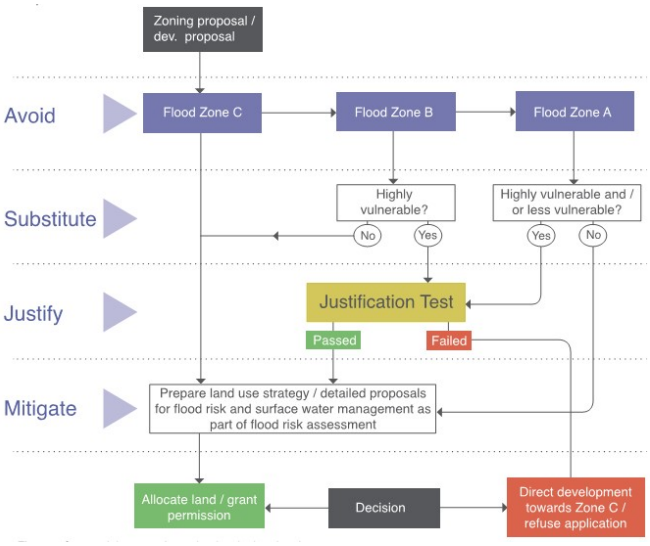


Figure 16: Sequential Approach Mechanism in the Planning Process

The sequential approach makes use of flood risk assessment and of prior identification of flood zones for river and coastal flooding and classification of the vulnerability to flooding of different types of development as outlined in the sections below.

7.1.2 Flood Zones

Flood zones are geographical areas within which the probability of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined for the purposes of the guidelines:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);

Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1 or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding);

Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

7.1.3 Vulnerability Classes

Table 3.1 of The Planning System and Flood Risk Management Guidelines for Planning Authorities provides a classification of vulnerability of different types of development. Figure 17 is taken from the Guidelines (Table 3.1) and sets out the Vulnerability Classifications of different types of land uses. Figure 18 (Table 3.2 of the Guidelines) describes the vulnerability of developments relative to the identified Flood Zone and when the requirements of the Justification Test must be satisfied.

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

*Uses not listed here should be considered on their own merits

Figure 17: Classification of Vulnerability of Different Types of Development

Figure 18 illustrates those types of development which would be appropriate to each flood zone and those which would be required to meet the Justification test.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Figure 18: Vulnerability of Development vs Flood Zone

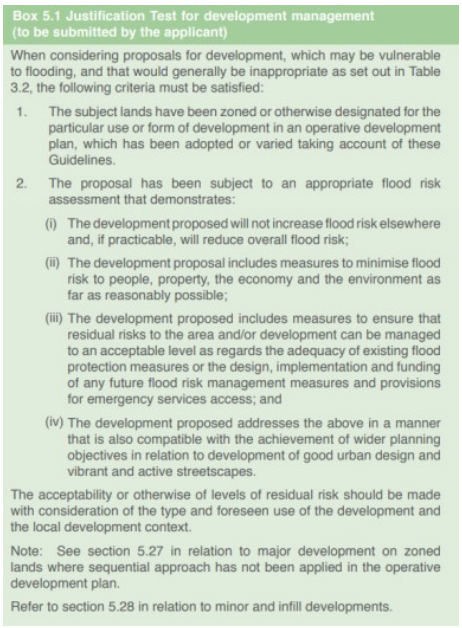
The proposed land use for the development is predominantly residential which falls within the 'Highly Vulnerable Development' classification, as shown in Figure 18. Based on the review carried out of the

predicted flood water levels and the topographical survey, the proposed residential units have been located outside Flood Zones A and B and the vulnerable development is located within Flood Zone C (Low probability of flooding). It can be seen from Figure 18 that Flood Zone C is a suitable land use for Highly Vulnerable Developments. The proposed access roads within the masterplan development layout are located within Flood Zone C. While the access roads themselves would not be considered highly vulnerable, the residential development they serve does fall within this vulnerability classification. The proposed levels of the access roads are above the 1 in 100-year return period event and 1 in 1000-year return period event water levels, therefore in the event of a flood event occurring in the Avoca River catchment, access/ egress will be available to the units served by the road.

The proposed boardwalk deck level has been set at +4.00mOD, significantly above the 1:1000 year flood level. The underside of the deck construction has also been designed with a sufficient freeboard. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Flood Zone A/B Flood Levels. Therefore in the event of a flood event occurring, in the Avoca River Catchment, access across the boardwalk will be available to and from the development

7.1.4 Justification Test

As highlighted in Section 5.1.6, A minimal portion of Amenity open space within the overall development is located within the extents of Flood Zone A and B. The proposed Greenway infrastructure to the south has been proposed at a level of +4.00mOD at the southernmost end which is above the 1 in 1000-year flood level and out of risk from flooding during the severe flood events. A portion of the water compatible elements of the development such as the Amenity open space, landscaping and embankments associated with the greenway infrastructure are susceptible to flood risk, however, as such, the justification test (Figure 19 below) has been applied to these areas



Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
   - (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
   - (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
   - (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
   - (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 19: Development Justification Test

The response to the Justification Test is as follows:

1. Subject Lands, have been zoned as Residential led, Mixed Use
2. (i) The proposed greenway and associated embankments located within the flood zone have been calculated to displace approximately 1825m3 of flood volume during the 1:1000-year event. It is proposed to provide compensatory storage in the southern greenspace to account for any displaced volume lost to the greenway embankments. An area of approximately 1046m2 and located outside the flood zone has been identified as being suitable to regrade the ground 1.35m lower to approximately 1.89mOD to allow for lost flood volume to be catered for. Channels/ drainage shall be installed in the embankments to hydraulically link the existing flood extents to the proposed regraded area to the north of the greenway embankments. These areas have been identified as being located in Flood Zone C, as such suitable provision of compensatory storage.

   The development will not increase flood risk elsewhere as the proposed regraded compensatory storage shall compensate for flood volumes displaced by the proposed greenway embankments,

   (ii) Proposed finished floor and road levels have been designed to provide a minimum freeboard of 500mm and 300mm respectively. The proposed alignment of the access road has also been designed to avoid the 1 in 1000-year flood extents and will not increase flood risk.

Compensatory storage has been provided to cater for any displaced flood volumes as a result of the proposed greenway embankments. A suitable area of ground located within Flood Zone C shall be regarded by approximately 1.35m to 1.89mOD to minimise the risk of flooding to people, property, the economy and the environment as far as reasonably possible.

(iii) The proposed development proposes finished floor and road levels with minimum freeboards of 500mm and 300mm respectively. The proposed alignment of the access roads has also been designed to avoid the 1 in 1000-year flood extents, as such being located in Flood Zone C and will not increase flood risk.
The proposed embankments have been designed to have a minimum freeboard of 300mm to the 1 in 1000-year flood level, providing flood risk management measures and provisions for emergency services access through the adjacent Avondale Cresent and the South Eastern Greenway route as seen in figure 20 below.

Figure 20: Proposed Greenway providing emergency access to be constructed above flood levels.

The proposed boardwalk has been carefully designed to minimise impact on the Avoca Marsh including the Environmental, Biodiversity Hydrology and Hydrogeology aspects of the marsh. As a result, the boardwalk deck level has been set at +4.00mOD, above the 1:1000-year flood level of 3.24mOD. The underside of the deck construction has also been designed with a freeboard exceeding the required 300mm. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Flood Zone A/B.

(iv) The proposed development and associated infrastructure will serve the first phase of the residential development in addition to the wider planned masterplan.

It is clear from the above responses to the justification test that the subject development works within Flood Zone A/ B do not increase the risk of flooding. No further mitigation measures are deemed necessary.

7.1.5 Flood Risk Management

Flood risk management under the EU Floods Directive aims to minimise the risks arising from flooding to people, property and the environment. Minimising risk can be achieved through structural measures that block or restrict the pathways of floodwaters, such as river defences or non-structural measures that are often aimed at reducing the vulnerability of people and communities such as flood warning, effective flood emergency response, or resilience measures for communities or individual properties.

As part of the development, it is proposed to set minimum road levels a minimum freeboard of 300mm above the 1 in 100-year event, with finished floor levels a minimum of 500mm above the 1 in 100-year event. Given the proposed minimum road and finished floor level of 5.250mOD and 6.865mOD respectively, the minimum recommended freeboard to the 1 in 100-year flood level (2.72mOD as highlighted in figure 10) is satisfied to significantly reduce the vulnerability of people and communities.

7.2 WCC Opinion

The applicant engaged with Wicklow County Council regarding the proposed development during the S247 meeting on 15th May 2024, the Section 32B meeting 18th December 2024 and the LRD Opinion received on 21st January 2025. As part of the LRD Opinion from Wicklow County Council, queried the the applicant regarding the Flood Risk to the Boardwalk crossing the Avoca River, The LRD Opinion document received by the applicant states the following:

'Flood modelling to identify impact of bridging works on the Avoca River Flood Scheme'

Flood modelling has been undertaken by the OPW as part of the Avoca Flood Relief scheme which identified that the 1 in 100 year flood level was +3.03mOD at the Avoca River. The applicant has liaised and coordinated the proposals for the Avoca crossing with Wicklow County Council, OPW and the Design Team of the Flood Defence works including the Debris Traps and have agreed that the Deck level of the Boardwalk crossing shall be set at +4.00mOD over the Avoca River and to tie into the OPW Design levels at the Southern Bank. (Please refer to DOBA Engineering drawings **2432-XX-XX-DR-C-0940** & **C-0950).** With a deck level of +4.00mOD, the level of the underside of the boardwalk structure/ Top of the granted OPW debris traps is approximately 3.73mOD, providing a freeboard of 700mm to the 1 in 100 year flood level. Therefore, the proposed boardwalk crossing is at low risk of flooding.

8 Conclusions

This site-specific Flood Risk Assessment has been carried out to assess the impact of flooding on a masterplan development. This report was written with The Planning System and Flood Risk Management Guidelines for Planning Authorities in mind and generally follows the requirements of a Stage 1 and 2 Flood Risk Assessment. The proposed development comprises 750 no. residential units at a greenfield site in Arklow.

All existing information has been reviewed regarding the flood risk in the area and the Avoca Flood Relief Scheme flood risk mapping is considered to have the most up to date and reliable estimates of extreme water levels. This mapping provides estimated water levels associated with a 10% AEP event, 1% AEP event (Flood Zone A) and 0.1% AEP event (Flood Zone B), 2.03 m OD Malin, 2.72 m OD Malin, and 3.24 m OD Malin, respectively. The lowest proposed Finished Floor (6.865 m OD Malin) and Road (5.250 m OD Malin) Levels within the development are above the predicted 1% AEP and 0.1% AEP water levels.

The proposed Finished Floor and Road levels and the surface water drainage network associated with the developed site will result in the risk of pluvial flooding within the site being reduced further from that indicated by the PFRA. In addition, the proposed SuDS measures and restriction of run-off to greenfield run-off rates mean that there will not be an increase in flood risk as a result of the proposed development.

The majority of the proposed development is classified as Highly Vulnerable Development by the Planning System and Flood Risk Management Guidelines and would be best suited to Flood Zone C. The proposed Finished Floor Levels are above the estimated 1 in 1000-year return period fluvial flood event placing the units within Flood Zone C. The proposed finished road levels are also above the estimated 1 in 1000-year return period fluvial flood level which means that access to and from the residential units is at a low risk of flooding.

The proposed boardwalk has been carefully designed to minimise impact on the Avoca Marsh including the Environmental, Biodiversity Hydrology and Hydrogeology aspects of the marsh. As a result, the boardwalk deck level has been set at +4.00mOD, above the 1:1000-year flood level of 3.24mOD. The underside of the deck construction has also been designed with a freeboard exceeding the required 300mm. As a result, the entirety of the Boardwalk element of the proposed development has been raised above the Flood Zone A/B and it is considered that it is at low-risk from flooding.

The proposed greenway and associated embankments located within the flood zone to the south of the site have been calculated to displace approximately 1825m3 of flood volume during the 1:1000-year event. It is proposed to provide compensatory storage in the southern greenspace (located in Flood Zone C) to account for any displaced volume lost to the greenway embankments. An area of

approximately 1046m2 has been identified as being suitable to regrade the ground 1.35m lower to approximately 1.89mOD to allow for lost flood volume to be catered for. Section 7.1.4 outlines the justification test for the minimal portion of embankments/ landscaping located within Flood Zone A/ B, identifying these areas such as Amenity Open Space as Water Compatible which concludes that the proposals outlined do not increase the risk of flooding on the subject site or adjacent developments.

Flood modelling has been undertaken by the OPW as part of the Avoca Flood Relief scheme which identified that the 1 in 100 year flood level was +3.03mOD at the Avoca River. The applicant has liaised and coordinated the proposals for the Avoca crossing with Wicklow County Council, OPW and the Design Team of the Debris Traps and have agreed that the deck level of the Boardwalk crossing shall be set at +4.00mOD over the Avoca River. The level of the underside of the boardwalk structure/ Top of the granted OPW debris traps is approximately 3.73mOD, providing a freeboard of 700mm to the 1 in 100 year flood level. Therefore, the proposed boardwalk crossing is at low risk of flooding.

Appendix A OPW Flood Hazard Mapping Record

OPW National Flood Hazard Mapping

Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Wicklow

NGR: T 246 739

Map Scale 1:47,249

Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

18 Results

1. Avoca Arklow August 1986 — Start Date: 25/Aug/1986
County: Wicklow — Flood Quality Code: 2
Additional Information: Reports (5) Press Archive (3) More Mapped Information

2. Arklow Golf Links August 1986 — Start Date: 26/Aug/1988
County: Wicklow — Flood Quality Code: 2
Additional Information: Photos (1) Reports (1) More Mapped Information

3. Arklow Harbour August 1986 — Start Date: 26/Aug/1986
County: Wicklow — Flood Quality Code: 2
Additional Information: Photos (1) Reports (1) More Mapped Information

4. Arklow Main Street August 1986 — Start Date: 26/Aug/1986
County: Wicklow — Flood Quality Code: 2
Additional Information: Photos (1) Reports (1) More Mapped Information

5. Arklow (near Leisure Centre) August 1986 — Start Date: 26/Aug/1986
County: Wicklow — Flood Quality Code: 2

Additional Information: Photos (1) Reports (1) More Mapped Information

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6. Arklow Caravan Park August 1986 — Start Date: 26/Aug/1986

County: Wicklow — Flood Quality Code:2

Additional Information: Photos (1) Reports (1) More Mapped Information

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7. South Quay Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:2

Additional Information: Photos (1) Reports (2) Press Archive (4) More Mapped Information

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8. Rockview Arklow Oct 2004 — Start Date: 26/Oct/2004

County: Wicklow — Flood Quality Code:4

Additional Information: Reports (1) More Mapped Information

9. Avoca Arklow Feb 2002 — Start Date: 01/Feb/2002

County: Wicklow — Flood Quality Code:2

Additional Information: Reports (2) Press Archive (3) More Mapped Information

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10. Lifeboat House Arklow February 2002 — Start Date: 01/Feb/2002

County: Wicklow — Flood Quality Code:4

Additional Information: Reports (1) Press Archive (2) More Mapped Information

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11. Worsboro Terrace Arklow February 2002 — Start Date: 01/Feb/2002

County: Wicklow — Flood Quality Code:4

Additional Information: Reports (1) More Mapped Information

12. Fairgreen Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:2

Additional Information: Reports (2) More Mapped Information

13. South Green Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:2

Additional Information: Reports (2) Press Archive (1) More Mapped Information

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14. Condren's Lane Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:2

Additional Information: Reports (2) More Mapped Information

15. Ferrybank Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:2

Additional Information: Reports (2) Press Archive (3) More Mapped Information

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16. Avoca River Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:2

Additional Information: Reports (2) Press Archive (10) More Mapped Information

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17. The Brooke Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:2

Additional Information: Reports (2) Press Archive (2) More Mapped Information

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18. Porter's Bridge Arklow Recurring — Start Date:

County: Wicklow — Flood Quality Code:4

Additional Information: Reports (1) Press Archive (1) More Mapped Information

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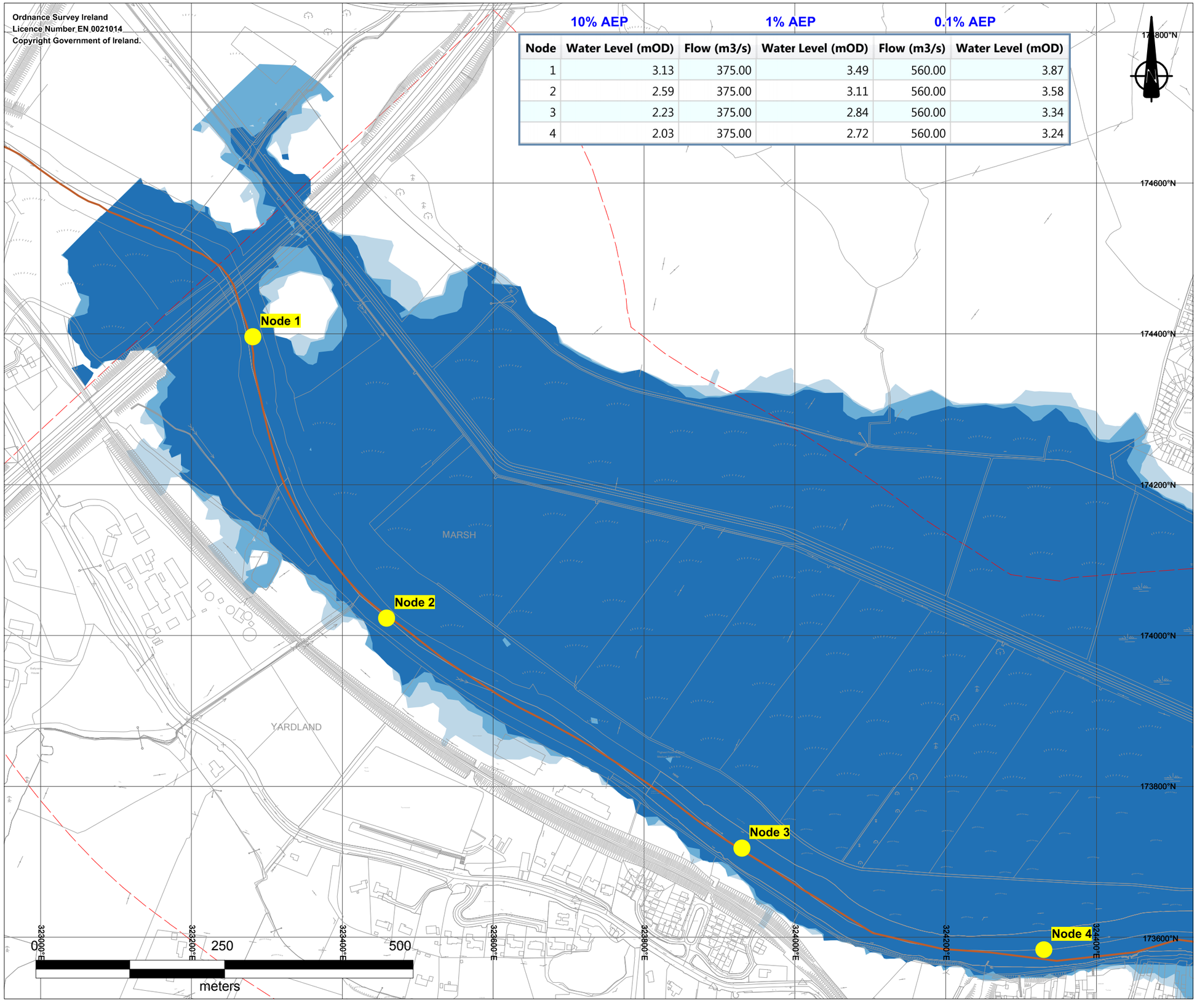
Appendix B CFRAM Fluvial Flood Risk Mapping

	10% AEP		1% AEP		0.1% AEP
Node	Water Level (mOD)	Flow (m3/s)	Water Level (mOD)	Flow (m3/s)	Water Level (mOD)
1	3.13	375.00	3.49	560.00	3.87
2	2.59	375.00	3.11	560.00	3.58
3	2.23	375.00	2.84	560.00	3.34
4	2.03	375.00	2.72	560.00	3.24



Legend

- 10% AEP Fluvial Extent
- 1% AEP Fluvial Extent
- 0.1% AEP Fluvial Extent
- Node Point
- Modelled River Centreline
- AFA Boundary

IMPORTANT USER NOTE:-
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

AVOCA RIVER (ARKLOW) FLOOD RELIEF SCHEME

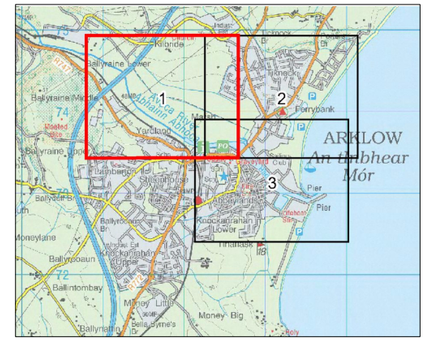
BYRNELOOBY PHMcCARTHY

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

Map Title	ARKLOW FLUVIAL FLOOD EXTENT MAP
Type:	EXTENT
Source:	FLUVIAL
Scenario:	CURRENT

Drawn	NOB	Scale	1:5,000 @ A3	Map Number: E10999_EXFCD_F0_01
Chkd.	SH	Date	27/07/16	Rev. F0
Apprd.	KT	Status	FINAL	

Appendix C CFRAM Coastal Flood Risk Mapping



Legend

- 10% AEP Tidal Extent
- 0.5% AEP Tidal Extent
- 0.1% AEP Tidal Extent
- Modelled River Centreline
- AFA Boundary

IMPORTANT USER NOTE:-
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

AVOCA RIVER (ARKLOW) FLOOD RELIEF SCHEME

BYRNELOOBY PHMcCARTHY

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

Map Title	ARKLOW COASTAL FLOOD EXTENT MAP
Type:	EXTENT
Source:	COASTAL
Scenario:	CURRENT

Drawn	NOB	Scale	1:5,000 @ A3	Map Number	Rev.
Chkd.	SH	Date	29/07/16	E10999_EXCCD_F0_01	F0
Apprd.	KT	Status	FINAL		