NENE VALLEY
Transport Planning

DECEMBER 1, 2023

FLOOD CONSEQUENCE ASSESSMENT

33 Maryport Street Usk Monmouthshire NP15 1AE

NENE VALLEY TRANSPORT PLANNING CONSULTANTS LTD

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APPENDICES

INTRODUCTION

1.1. Nene Valley Transport Planning Consultants Ltd (NVTP) has been commissioned by Jason Tadman to conduct a Flood Consequence Assessment (FCA) to accompany a planning application for the Demolition of Coach House at rear of No. 31 and Office Building at No. 33 Maryport Street and Construction of a New Dwelling at 33 Maryport Street Usk Monmouthshire NP15 1AE.

1.2. This flood risk assessment is prepared in accordance with the requirements of the Welsh Government planning policy. Zones of flood risk have been identified through Development Advice Maps (DAMs) included with the Technical Advice note 15 (TAN 15) Development and Flood Risk guidelines published in July 2004. Updated DAMs are available on the Natural Resources Wales (NRW) website.

1.3. As will be detailed within this report the site is located within Flood Zone C1 on the Natural Resource Wales (NRW) Development Advice Map (DAM) and Flood Zone 3 on the NRW Flood Map for Planning.

1.4. Given the classification, the primary driver for this report is to ensure the proposed development is suitable to the location and whether suitable measures can be incorporated to ensure that the development is as safe as possible. This is aligned to the objectives of the Welsh Government's Planning Policy Wales, Edition 11, February 2021.

PLANNING REQUIREMENT BACKGROUND

National Policy

2.1 Flood risk in Wales is considered through the following documents: planning process in the Planning Policy for Wales (PPW) (Edition 11, February 2021) and TAN15 which provides technical guidance and supplements PPW

- Planning policy for Wales (PPW, edition 11 February 2021)
- Technical Advice note 15 (TAN 15)
- Welsh National Marine Plan

2.2 The aim of the TAN 15 is:

"It provides a framework within which the flood risks arising from rivers, the sea and surface water, and the risk of coastal erosion can be assessed. It also provides advice on the consequences of the risks and adapting to and living with flood risk"

2.3 This flood risk assessment is prepared in accordance with the requirements PPW and TAN 15. In order for planning authorities to make informed decisions on the development of sites in areas at risk of flood, PPW requires the developer to carry out A Flood Consequence Assessment

Local Policy

The following local policy documents were considered as part of the preparation for this flood risk assessment:

- Monmouthshire Local Development Plan (LDP) (Adopted February 2014)
- Replacement Local Development Plan 2018 – 2033
- Supplementary Planning Guidance (April 2019)

DEVELOPMENT PROPOSALS

3.1 The site is located at 33 Maryport Street, Usk, Monmouthshir. The site has an OS grid Ref: SO 37740 00728 and is centred around OS co-ordinates: 51°42'7"N 2°54'8"W

3.2 The site is currently a brownfield site occupied by a coach house and office building. The proposals is for a new detached dwelling. Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

3.3 Appendix 1 shows details of the development plans.

3.4 The A topographical survey of the site has recently been undertaken (see Appendix 3). The site rises from east to west, with the higher ground levels being located adjacent to Maryport Street. The minimum ground level is 16.99 metres Above Ordnance Datum (mAOD) and the ground level at the location of the proposed dwelling is 17.10mAOD. Maryport Road has a ground level of 17.00mAOD.

3.5 The closest watercourse to the site is the river Usk which is located approximately 300m to the west of the site. There are no other watercourses evident either on, or within the vicinity of the site. The area has a higher average rainfall figure of 1400mm. Derived from the Flood Studies Report (FSR) rainfall ratio, the typical rainfall profile for the region, in common with much of South Wales, is a low intensity, long duration event commensurate with frontal weather systems. However, short duration high intensity rainfall events can also be experienced, particularly during the summer months.

FIGURE 1 SITE LOCATION

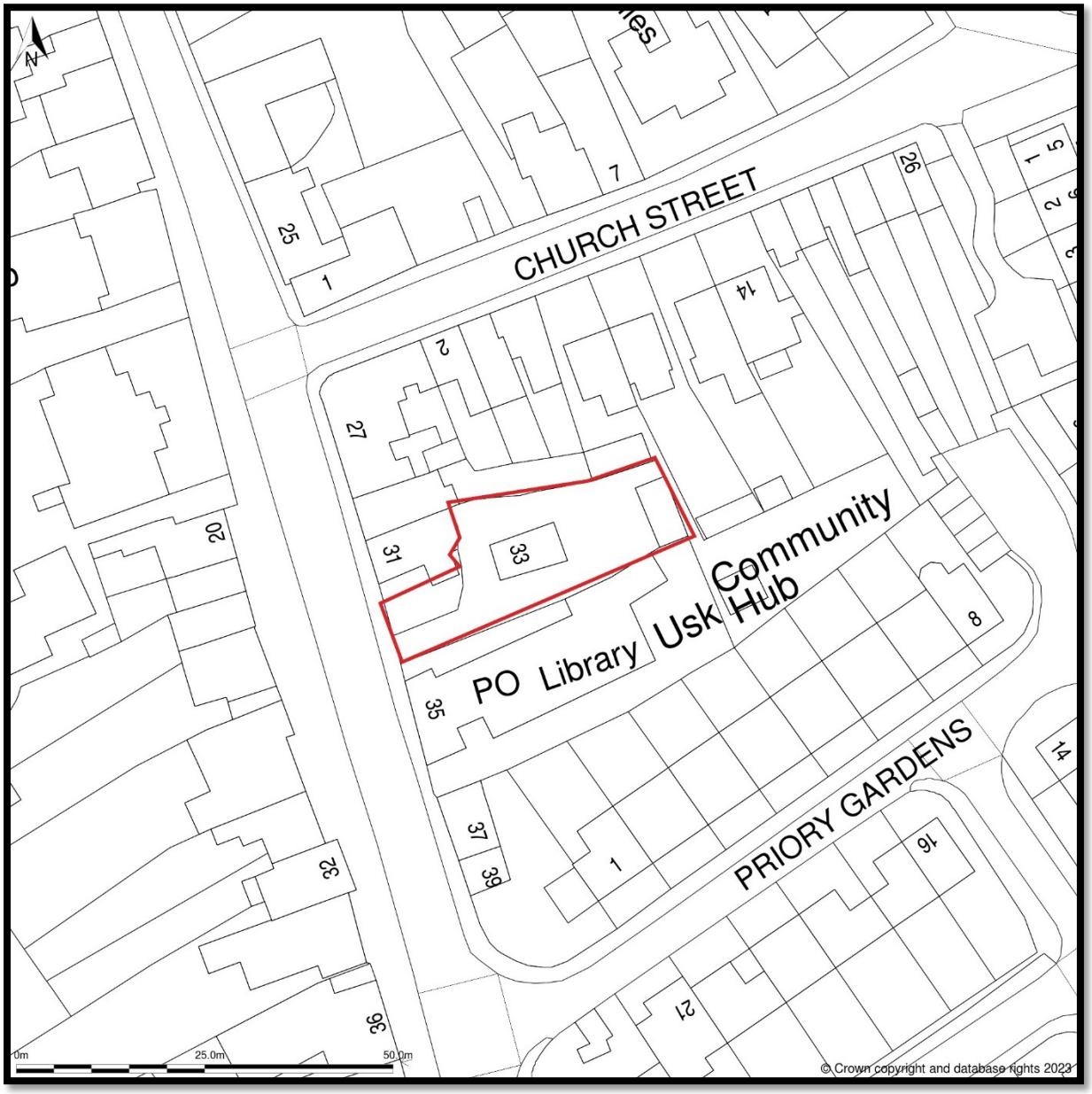
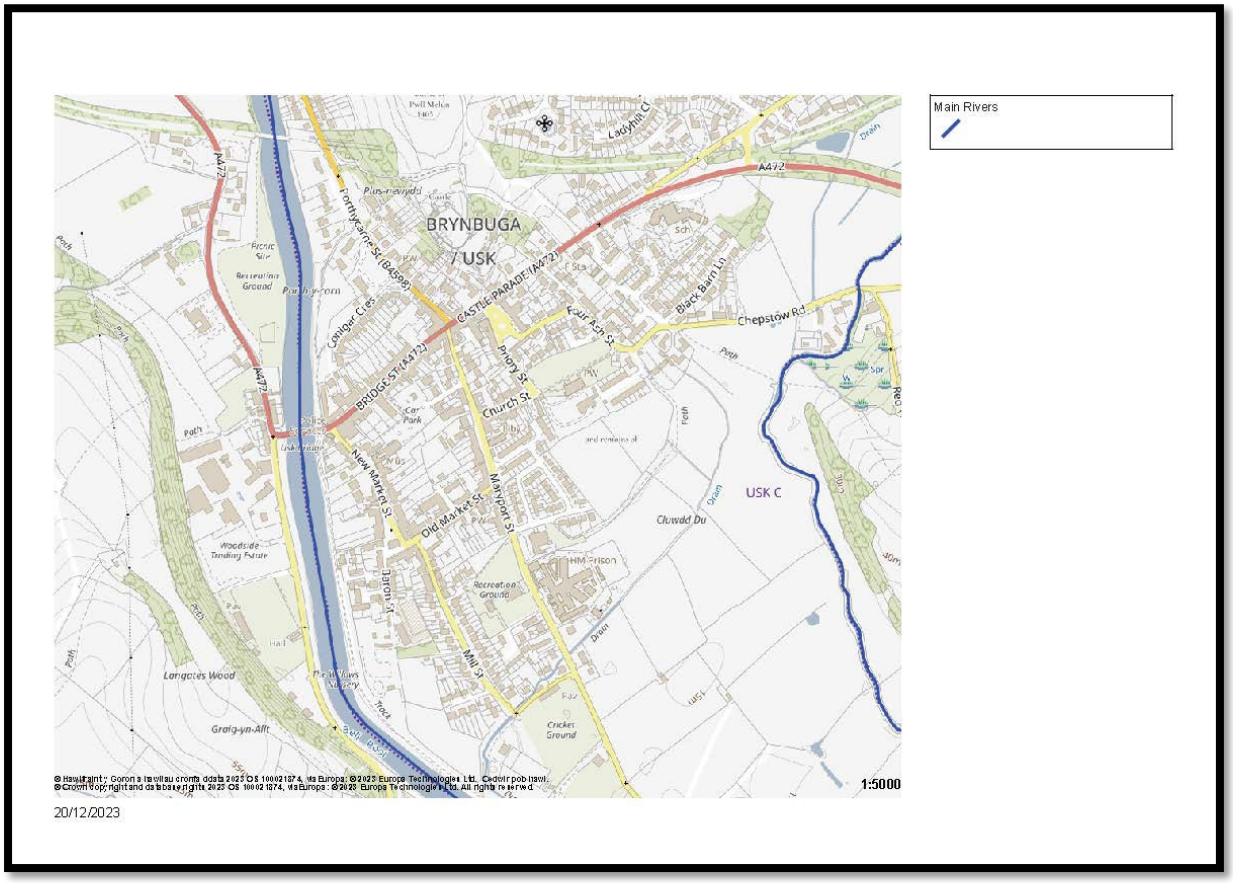


FIGURE 2 DATA MAP WALES: MAIN RIVERS



3.6 Information from the National Soil Resources Institute1 details the site area as being situated on freely draining floodplain soils. The Flood Studies Report WRAP soil map classification is Type 2: i) Very permeable soils with shallow ground water; ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. The layer is low in organic matter, mottled and slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material); and iii) Moderately permeable soils, some with slowly permeable subsoils.

3.7 In determining the future surface runoff from the site, the potential of using soakaways/infiltration devices has been considered. The general ground conditions suggest that the permeability and infiltration rate of the site will be low to moderate. The depth of any soakaways should not normally exceed 2.00m and will not intersect the water table. A minimum of 1.00 unsaturated zone will be maintained between the base of any soakaway and the maximum seasonal water table. Therefore, SuDS methods such as soakaways may work at the site.

3.8 The implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open spaces and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

ASSESSMENT OF FLOOD RISK AND IMPACT

4.1 This section will assess Development advice mapping, historical flood mapping, Flood risk zones and areas benefiting from flood defence. When considering flood risk, the most vulnerable land use must be considered. As the proposed development includes residential use is classified as a 'Highly vulnerable development' according to Technical Advise Note 15 (TAN 15 2004).

4.2 The assessment is carried out in accordance with TAN 15, which provides technical guidance in relation to development and flooding, TAN 15 supplements planning policy Wales in this regard. TAN 15 development advice maps and Natural Resources Wales (NRW) flood maps and data have been considered within this report.

4.3 The mapping and data used to compile this report This is considered to provide the latest information, in terms of flood classification areas, and may be used to inform Flood Consequence Assessments for proposed development since December 2021. Natural Resources Wales have been granted authority by Welsh Government to consider the Flood map for planning data in addition to the Development advice map flood zone classifications when reviewing submitted FCA reports.

4.4 All sources of flooding have been considered, these are; fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

4.5 Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within TAN15 recommends that the effects of climate change are incorporated into FCA. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the CL-03-16 - Climate change allowances for Planning purposes.

4.6 Table 1 show the peak river flow allowances by river basin district. There is reasonable level of certainty that the future impacts of climate change will lie somewhere between the central and upper allowances. The 9th January 2014 Welsh Government letter to all Chief Planning Officers (CPO) in Wales and CL-03-16 - Climate change allowances for Planning purposes clarifies and refers to the Natural Resources Wales recommendations that the lifetime of development for residential development is 100 years (i.e. 2123), and for other development it is considered to be 75 years (i.e. 2098). Therefore, the design flood event is the 1 in 100 year (+25%) event.

TABLE 1 PEAK RIVER FLOW ALLOWANCES

Severn	Maximum change expected by 2030 (%)	Maximum change expected by 2050 (%)	Maximum change expected by 2080 (%)
Upper estimate	25	40	70
Central estimate	10	20	25
Lower estimate	0	5	5

4.7 Table 2 shows projections of relative mean sea level rise for each epoch (period of time) is provided for the Welsh coastline. These projections are consistent with the latest global predictions for sea level rise. The rate of change is projected to increase in each epoch. The lifetime of the development it is considered to be 100 years i.e. 2123. Therefore, the design flood event is the 1 in 200 year in 2123 event.

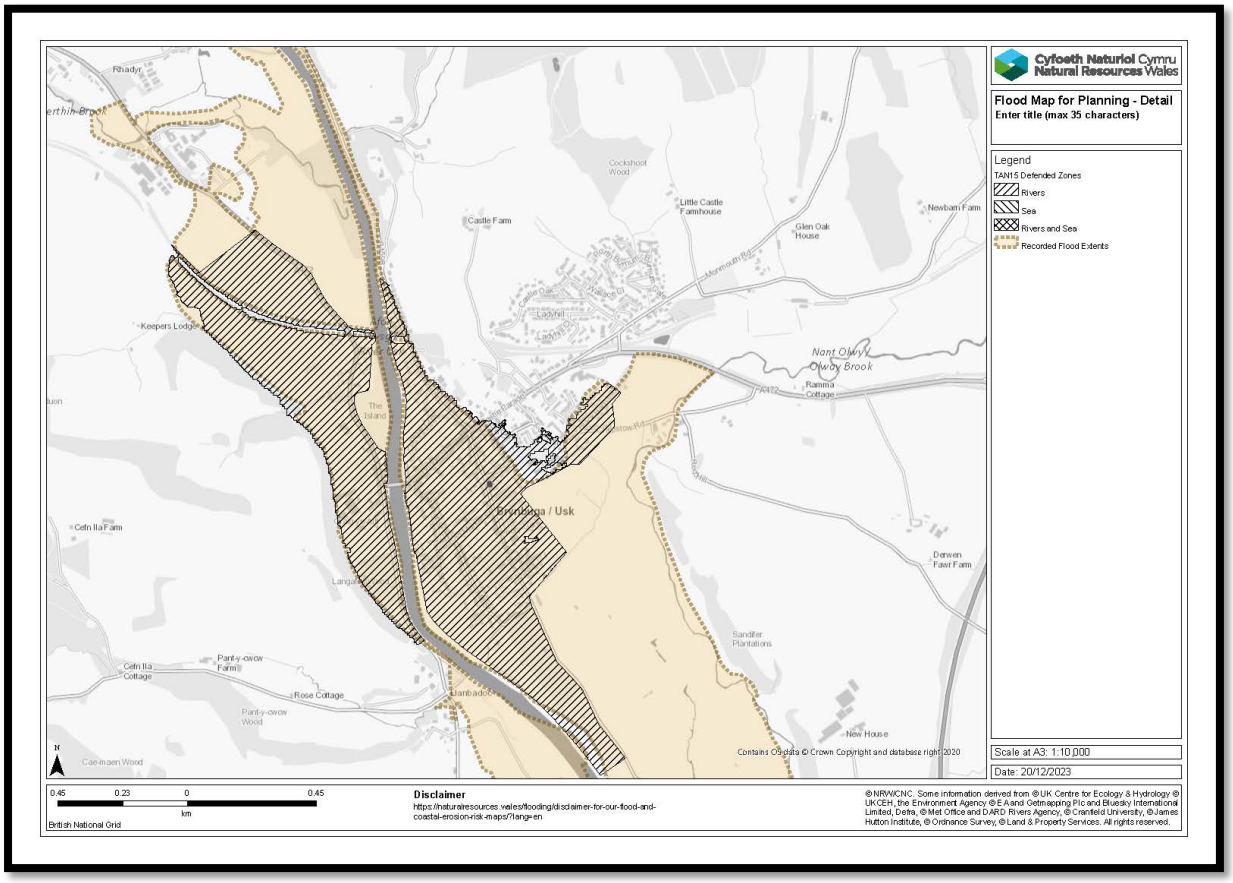
TABLE 2 SEA LEVEL ALLOWANCE FOR EACH EPOCH IN MILLIMETRES (MM) PER YEAR (USING SEA LEVELS PUBLISHED IN 2008 AS THE BASELINE)

Period	**2013-2029**	**2030-2060**	**2061-2090**	**2091-2123**
Annual Change (mm/yr)	3.50	8.00	11.50	14.50

Historic Flooding

4.8 Figure 3 below shows that the site has historically been flooded, figure 3 shows the approximate extent of flooding for the major December 1979 event on the River Usk.

FIGURE 3 HISTORIC FLOODING

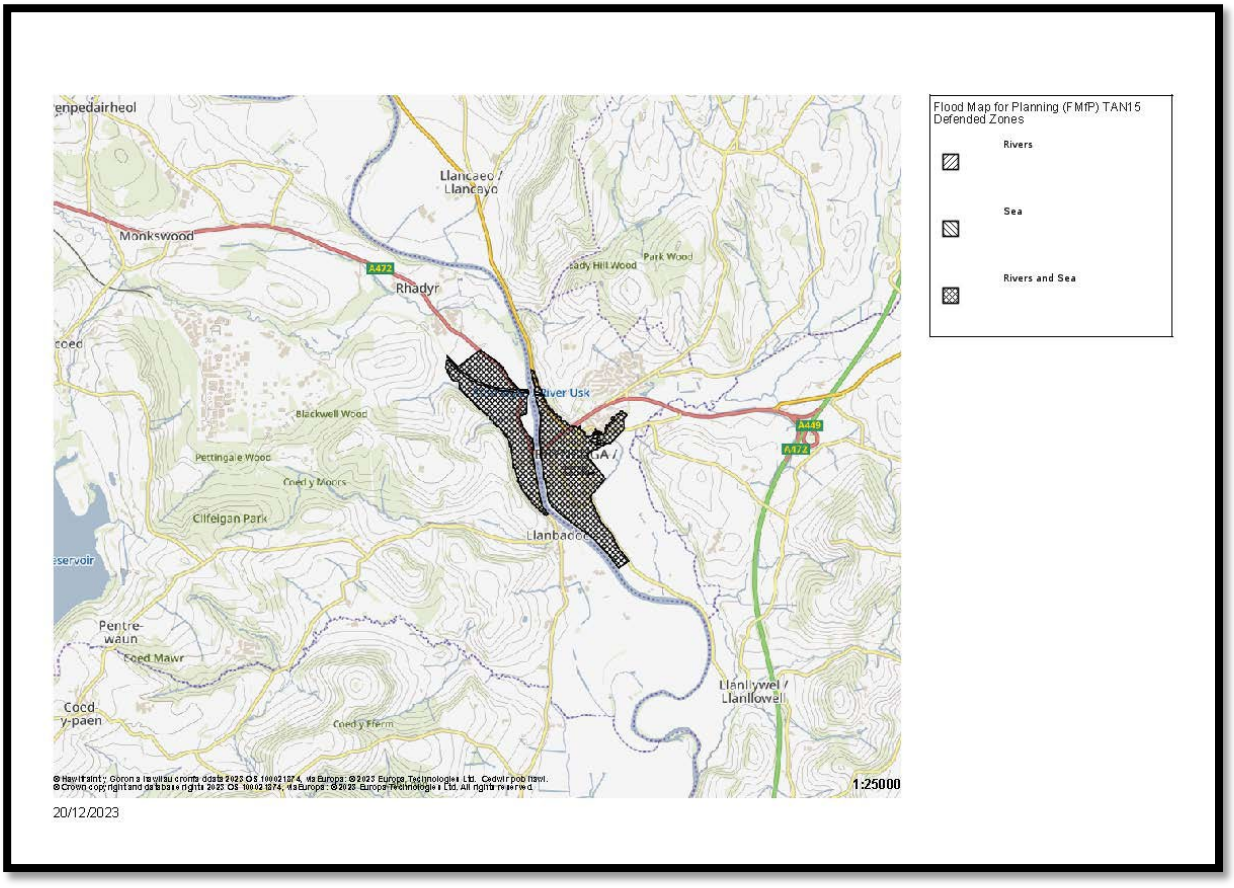


4.9 The Monmouthshire County Council SFCA states that the 1979 event was the most notable event in Wales over the last forty years and caused the River Usk to overtop its defences. The Monmouthshire County Council SFCA states that the return period of the event is believed to be approximately 1 in 50 years (2% AEP). A comparison of Natural Resources Wales peak flow data for the 1979 event at Chainbridge and Llandetty gauging stations with their respective design flows was undertaken for this FCA. Based on this, the 1979 event is estimated to have a return period of between a 1 in 75 years (1.3% AEP) and 1 in 200 years (0.5% AEP). Therefore, the site would not be inundated with floodwater during a flood event of a similar magnitude. No other historical records of flooding for the site have been recorded

Existing Flood Defence Measures

4.10 Figure 4 below shows existing flood defences within the vicinity of the site, which provide the site and the wider area with protection from flooding from the river Usk.

FIGURE 4 EXISTING FLOOD DEFENCES



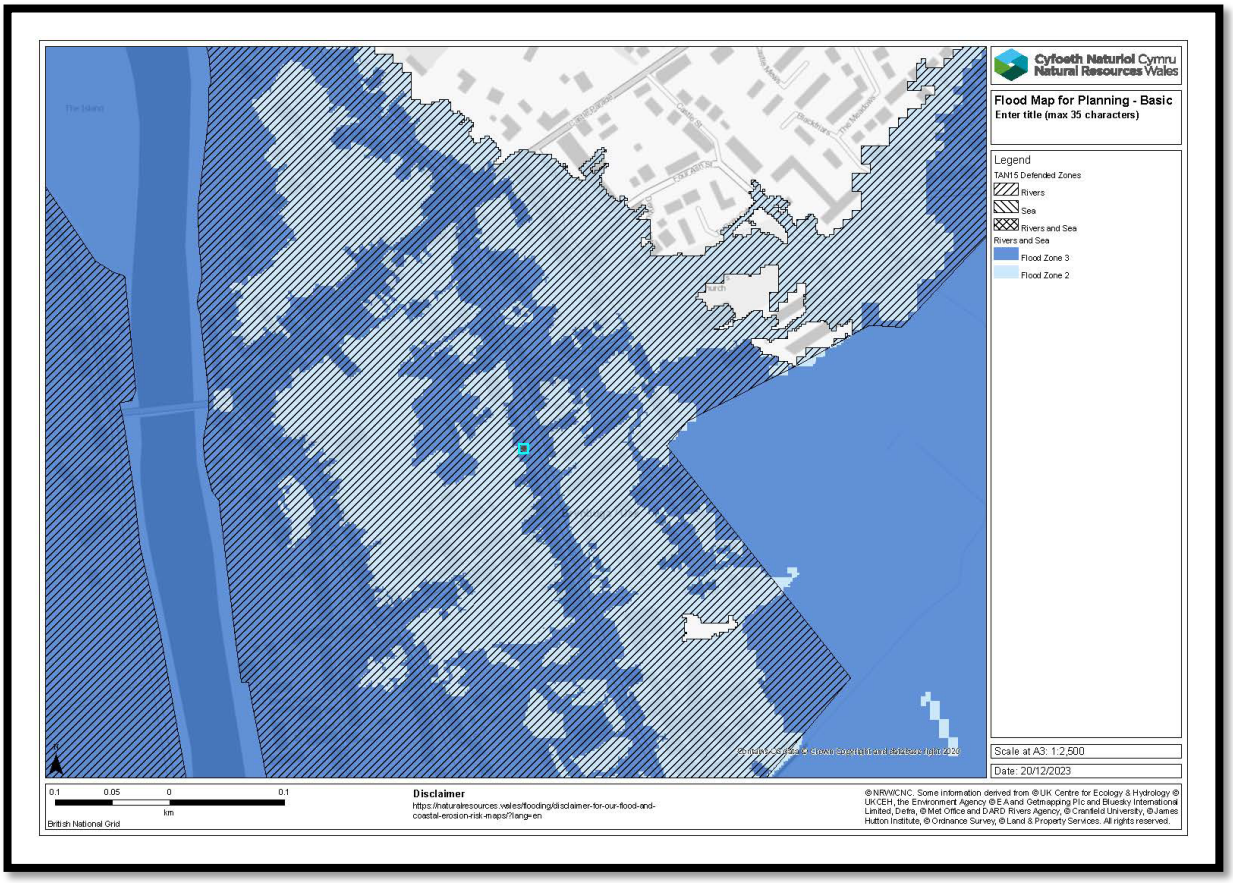
4.11 In response to past flood events, there have been significant improvements to the main flood defences along the River Usk through Usk Town; the last major improvements took place after the 1979 event. The main defences consist of a combination of earth embankments and concrete walls.

4.12 The embankment in the vicinity of the site is a significant structure that protects the south of Usk from the worst flood events. The flood defences have Standard of Protection (SoP) of 1 in 100 years, as with any flood defence measures the defences have been designed to be structurally sound during an exceedance event and this is the purpose of the Natural Resources Wales inspection and maintenance programme to maintain the structures to their target grade. Furthermore, the flood defences would not be overtopped, and a freeboard would exist of approximately 100mm to 300mm. Therefore, the site will not be inundated with floodwater for all events up to and including the 1 in 100 year event.

NRW Flood Zones

4.13 Figure 5 below indicates that the site lies within flood zone 3. Flood Zone 3 has a 'high probability' of flooding and shows the extent of a flood from rivers with a 1% (1 in 100) chance or greater of happening in any given year and the extent of a flood from the sea with a 0.5% (1 in 200) chance or greater of happening in any given year.

FIGURE 5 FLOOD MAP FOR PLANNING: FLOOD ZONES



4.14 The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The Natural Resources Flood Zones show the worst-case scenario.

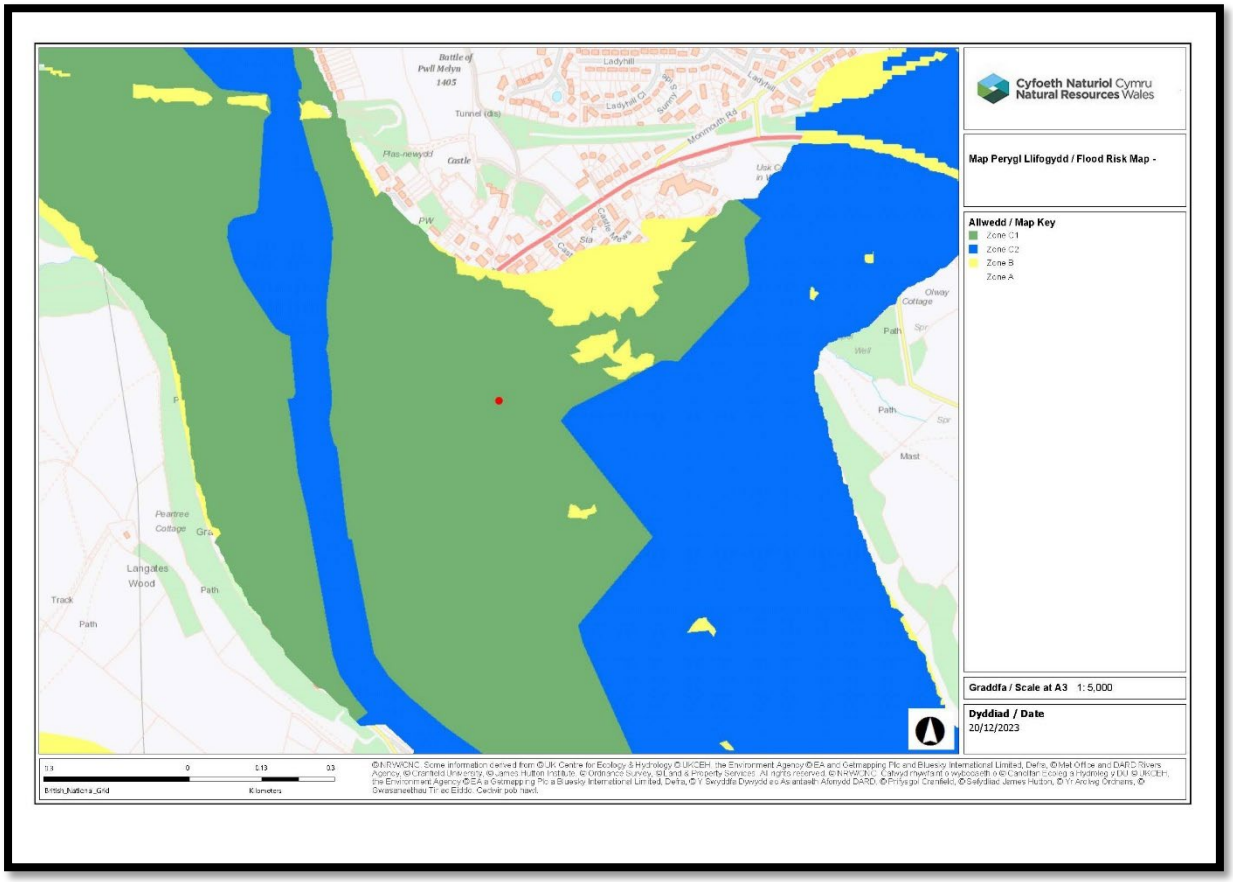
TABLE 3 NRW FLOOD ZONES

Flood Zone	Probability	Explanation
Zone 1	Low	• the extent of a flood from rivers or from the sea with less than a 0.1% (1 in 1000) chance of happening in any given year
Zone 2	Medium	• the extent of a flood from rivers or from the sea with up to a 0.1% (1 in 1000) chance of happening in any given year • contains areas recorded to have flooded in the past • Flood Zone 2 is important from a planning context as it forms the basis of Zone C in the Welsh Government Development Advice Map (DAM)
Zone 3	High	• the extent of a flood from rivers with a 1% (1 in 100) chance or greater of happening in any given year • the extent of a flood from the sea with a 0.5% (1 in 200) chance or greater of happening in any given year

Development Advice Map

4.15 Figure 6 below shows the site to be located within zone C1 of the development advice map. Zone C1 refers to areas of the floodplain which are developed and served by significant infrastructure such as flood defences. Zone C1 is used to indicate that development can take place subject to application of justification test, including acceptability of consequences. It is important to note that the proposed development would be classed as 'highly vulnerable' as per the risk vulnerability classification in TAN15.

FIGURE 6 NRW DEVELOPMENT ADVICE MAP



4.16 Table 4 below summaries the TAN15 Flood zones

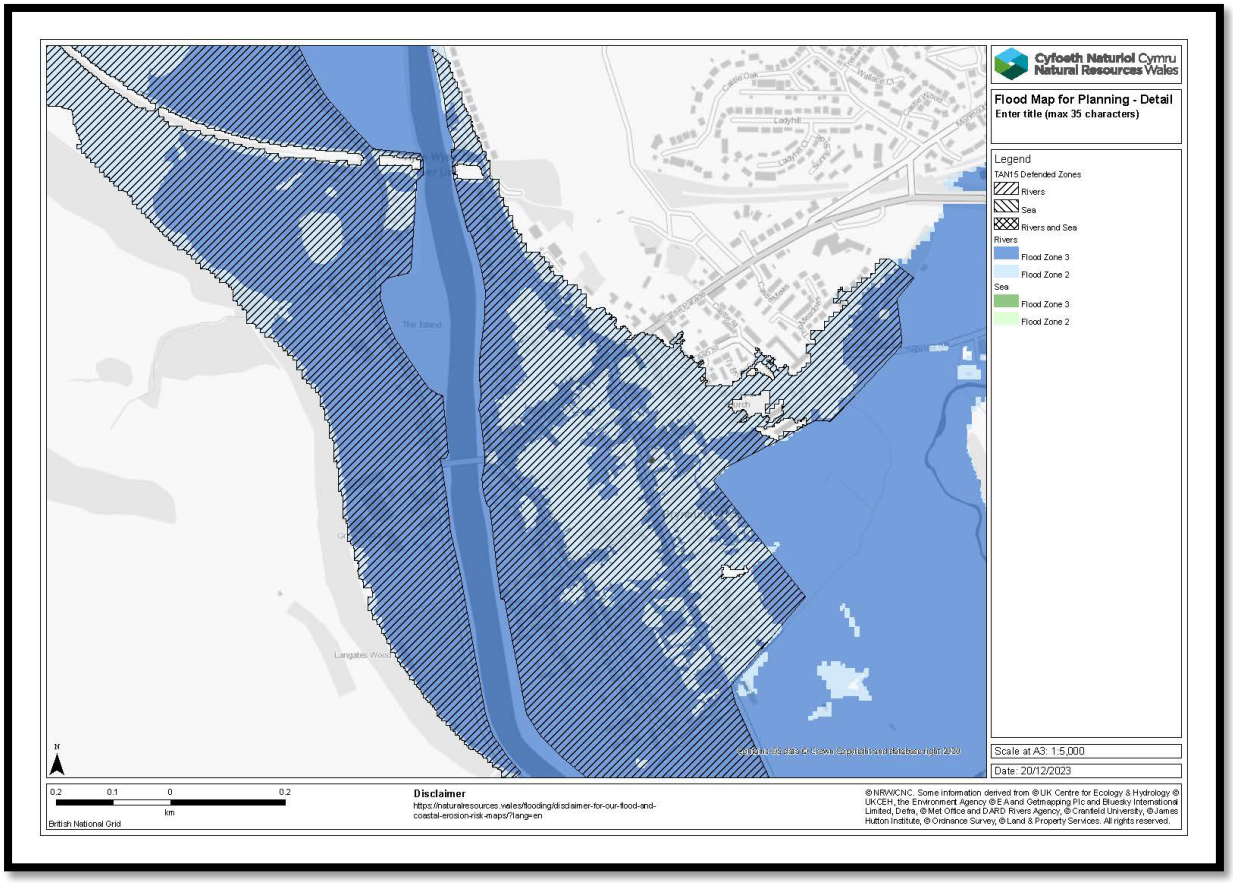
TABLE 4 TAN15 FLOOD ZONES

Description of Zone	Zone	Use within the precautionary Framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

Fluvial Flooding

4.17 The main source of Fluvial flooding to the site is from the river Usk. Figure 7 below confirms that the site is within Flood zone 3 when considering risk from rivers.

FIGURE 7 NRW FLOOD MAP FOR PLANNING SHOWING THE SITE TO BE WITHIN FLOOD ZONE 3



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4.18 Modelled flood levels confirm that the site would remain flood fee during the following scenarios:

- Defended 1 in 100 year (+20%)

- Defended 1 in 200 year events

4.19 Table 5 below provides a summary of the defended modelled flood levels for the site. 'Null' indicates the site is flood free during this scenario. The site may only be inundated with floodwater during the defended 1 in 1000 year event. Figure 7 shows the Natural Resources Wales defended 1 in 1000 year flood outline and Figure 8 shows the hazard rating during the 1 in 1000 year event. Figure 7 shows the water depth on the site will be less than 0.60m.

TABLE 5 DEFENDED LEVEL DATA

	20	75	100	100 +20%	200	1000
Mean Water Level (mAOD	NULL	NULL	NULL	NULL	NULL	17.74
Max Water Level (mAOD)	NULL	NULL	NULL	NULL	NULL	17.82
Mean Depth (m)	NULL	NULL	NULL	NULL	NULL	0.63
Max Depth (m)	NULL	NULL	NULL	NULL	NULL	0.80
Mean Velocity (m/s)	NULL	NULL	NULL	NULL	NULL	0.19
Max Velocity (m/s)	NULL	NULL	NULL	NULL	NULL	0.61
Mean Hazard	NULL	NULL	NULL	NULL	NULL	1.44
Max Hazard	NULL	NULL	NULL	NULL	NULL	1.84

4.20 The site may only be inundated with floodwater during the defended 1 in 1000 year event the water depth on the site will be less than 0.60m.

4.21 The likelihood of a rapid water level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event.

4.22 The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2.

4.23 The earth embankment in the vicinity of the site are significant structures that protect the south of Usk from flooding. Although the defences have a 1 in 100 year SoP, as with any flood defences they will have been designed to be structurally sound during an exceedance event and this is the purpose of the Natural Resources Wales inspection and maintenance programme to maintain structures to their target condition grade. Therefore, overtopping of the defences is unlikely.

4.24 The other flood defences within Usk, to the north of the flood embankment, consistently meet the target inspection condition or better. Therefore, there is a low risk of structural failure due to overtopping/breaching.

4.25 Table 6 shows the undefended modelled water levels.

TABLE 6 UNDEFENDED LEVEL DATA

	100	1000
Mean Water Level (mAOD	17.21	17.98
Max Water Level (mAOD)	17.25	18.09
Mean Depth (m)	0.11	0.88
Max Depth (m)	0.23	1.06
Mean Velocity (m/s)	0.08	0.25
Max Velocity (m/s)	0.39	0.69
Mean Hazard	0.59	1.66
Max Hazard	0.94	2.18

4.26 Climate change scenarios have not been provided however it inferred due to the very small difference to be expected between the 1 in 100 year and 1 in 100 year (+25%) events that there would not be much change in water levels during the 1 in 100 year (+25%) event compared to the 1 in 100 year event.

4.27 Therefore, it can be inferred that the undefended 1 in 100 year (+25%) event will have a similar water level to the 1 in 100 year event. A nominal allowance of 300mm has therefore been used and the undefended 1 in 100 year (+25%) event will have a water level of 17.55mAOD.

4.28 A degree of proportionality should be applied during an assessment of climate change impacts. The proposed development will be raised above the 1 in 100 year (+25%) event and will be located well within the Usk settlement boundary. The defences along the River Usk are regularly inspected both on a routine basis and following significant events, therefore the risk of failure is considered to be low.

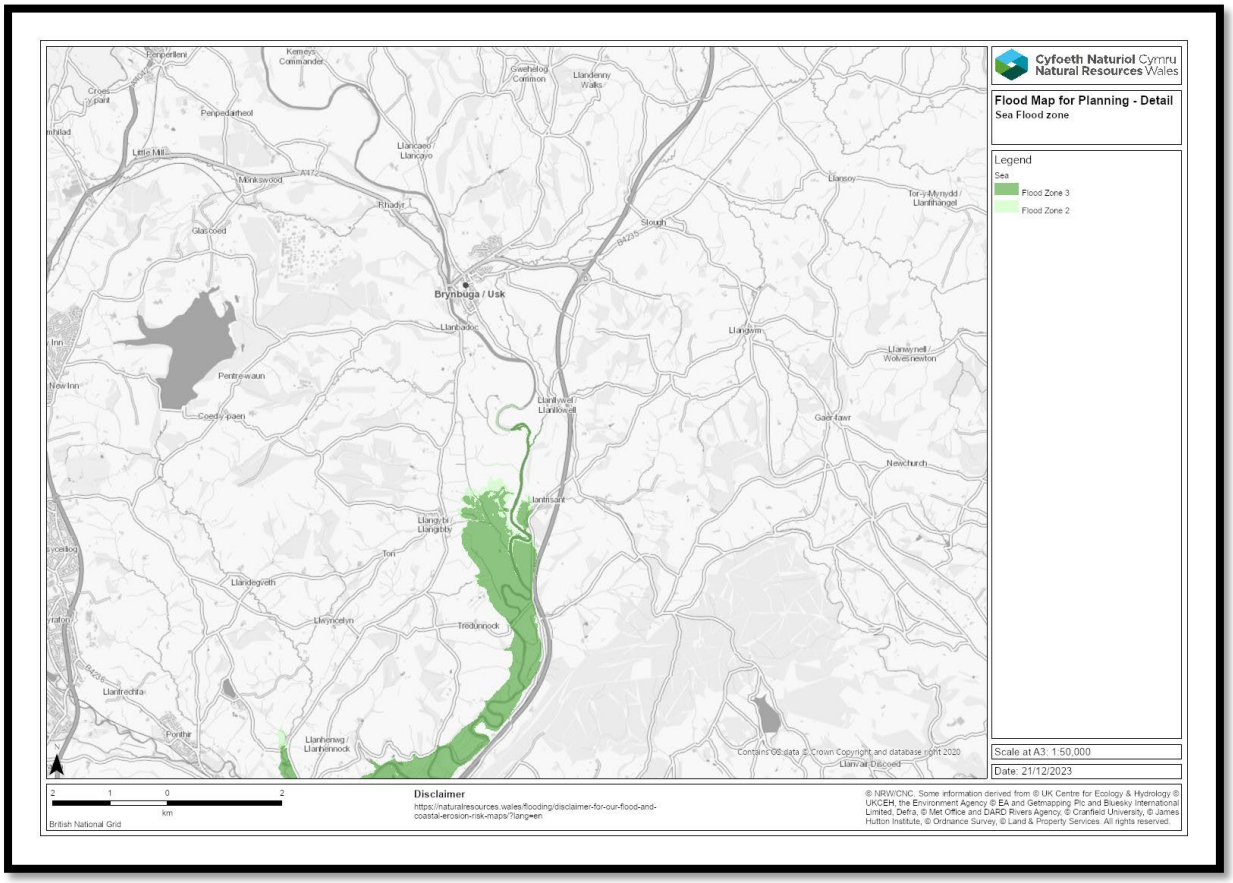
4.29 In accordance with TAN15 the proposed development will have a finished floor level above that of the predicted 1 in 100 year (+25%) water level.

4.30 It can be concluded that flooding from the River Usk poses a very low actual and residual risk to the site. Therefore, the risk of flooding from the River Usk is considered to be of **medium significance**. The risk from the River Usk will be further mitigated by using a number of risk management measures to manage and reduce the overall flood risk at the site.

Tidal Flooding

4.31 Figure 8 below confirms that the site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be not significant.

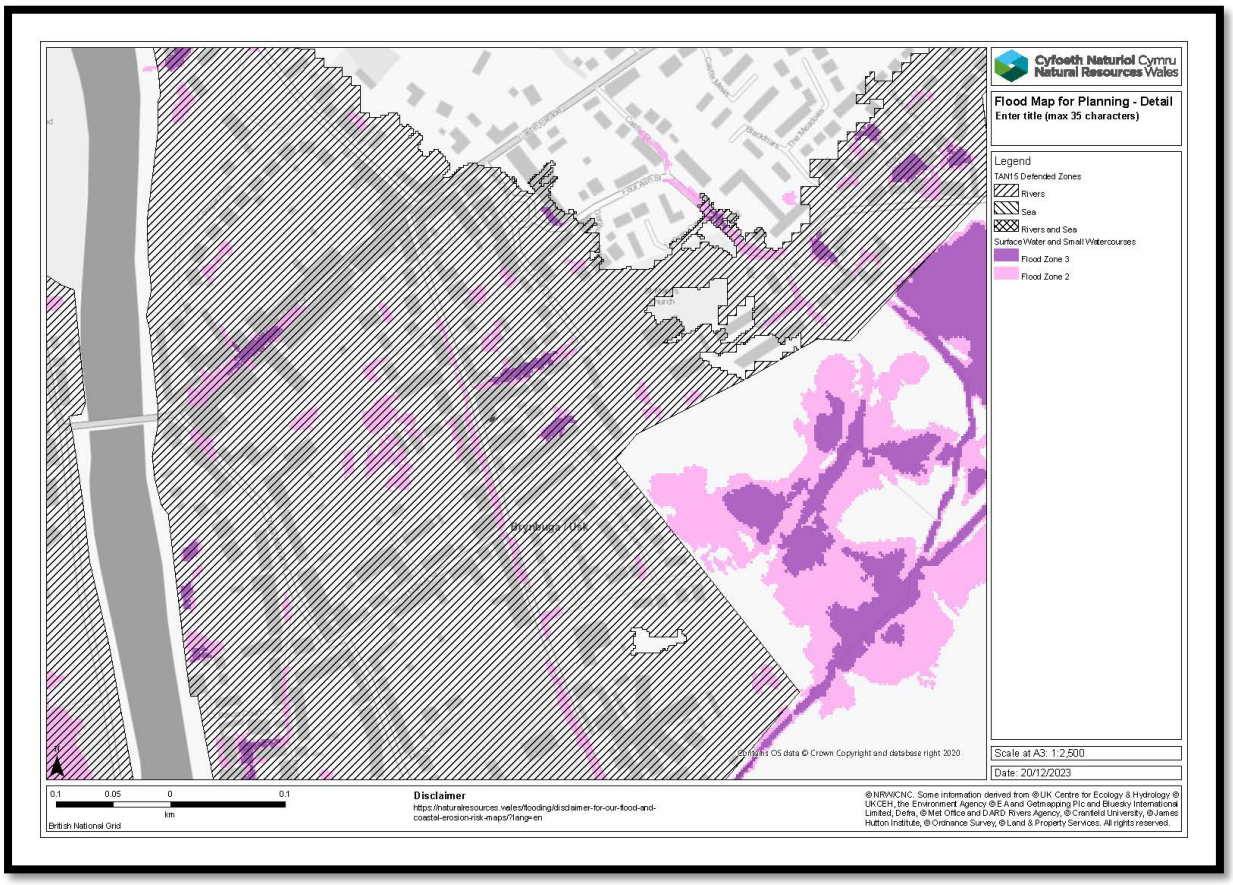
FIGURE 8 TIDAL FLOOD RISK



Surface water Flooding

4.32 The site is not situated near to large areas of poor permeability or areas with the geology and/or topography which may result in surface water flooding. Figure 9 below shows that the site is at a very low risk of surface water flooding with a chance of surface water flooding of less than 1 in 1000 (0.1%) years. Surface flooding poses a very low flood risk to the site therefore, the risk of flooding from surface water flooding is considered to be not significant.

FIGURE 9 SURFACE WATER FLOOD RISK



Groundwater Flooding

4.33 Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded. Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers).

4.34 Site conditions suggest a low probability of groundwater flooding. No below surface infrastructure and buildings are located or are proposed for the site. The risk of flooding from groundwater flooding is considered to be **not significant**.

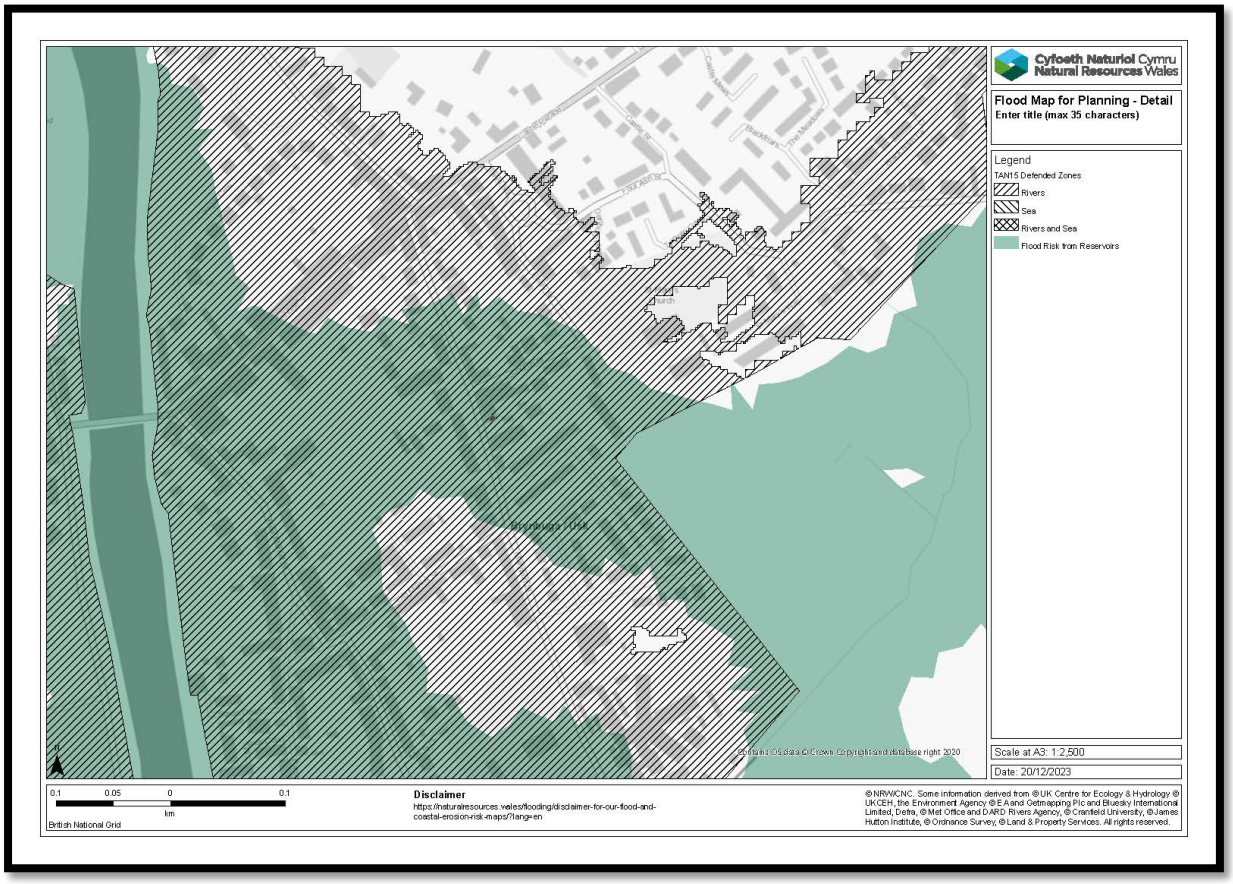
Reservoir Flooding

4.35 Figure 10 below shows that the site is at risk of flooding as a result of flooding from reservoirs. This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds.

4.36 It's important to note that the NRW map has been prepared for emergency planning purposes and for this reason they reflect a worst-case scenario. Since this is a prediction of a worst-case scenario, it's unlikely that any actual flood would be this large.

4.37 The risk of flooding from reservoir flooding is considered to be not significant.

FIGURE 10 RESERVOIR FLOOD RISK



Other sources of Flooding

4.38 Another consideration is flooding as a result of sewer. Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development.

4.39 The provision of adequate level difference between the ground floors and adjacent ground level would reduce the annual probability of damage to property from this source to 1 in 100 years or less. Sewer flooding poses a flood risk to the site therefore, the risk of flooding from sewer flooding is considered to be of low significance.

DRAINAGE IMPLICATIONS

5.1 A SuDS Strategy for the site proposals has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the development compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

5.2 The requirement for managing surface water runoff from developments depends on the pre-developed nature of the site. If it is an undeveloped greenfield site, then the impact of the development will need to be mitigated so that the runoff from the site replicates the natural drainage characteristics of the pre-developed site. In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site, although it is preferable for solutions to provide runoff characteristics that are similar to greenfield behaviour.

5.3 The table below provides projections of the peak rainfall intensity taking into account climate change. Typically in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall.

TABLE 7 PEAK RAINFALL INTENSITY ALLOWANCE IN SMALL AND URBAN CATCHMENT (USE 1961 TO 1990 BASELINE)

Parameter	2010 to 2039	2040 to 2059	2060 to 2119
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%
Lower end	0%	+5%	+10%

5.4 There are three options for the discharge of surface water (including rainwater), these are:

1. an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,
2. a watercourse; or where that is not reasonably practicable,

3. a sewer

5.5 Soakaway: The general ground conditions suggest that the permeability and infiltration rate of the site will be low to moderate. Soakaways/infiltration systems may work at the site. If an infiltration system is proposed, it is recommended that a series of infiltration/soakaway tests are carried out on site to BRE Digest 365 Guidelines.

5.6 Watercourse: Should infiltration be found to be unsuitable, the next option is discharge to a watercourse. There are no watercourses evident on, or within the vicinity of the site. Therefore, discharge to a watercourse will not be possible.

5.7 Sewer: In the event that discharge of surface water via infiltration or discharge to a watercourse is deemed unsuitable, then discharge to a sewer would be possible. All surface water runoff that cannot be discharged via infiltration or to a watercourse will be managed on site and then discharged to the public sewers. Discharge to the public sewers would be at Greenfield runoff rates.

Surface water run off rates

5.8 An estimation of surface water runoff is required to permit effective site water management and prevent any increase in flood risk to off-site receptors. In accordance with The SUDS Manual, the Greenfield runoff from the site has been calculated using the IoH124 method.

TABLE 8 GREENFIELD RUNOFF RATES

Rainfall Event	Runoff Rate (l/s)
1	**0.05**
QBAR (rural)	**0.06**
30	**0.10**
100	**0.12**

suDs

5.9 Guidance promotes sustainable water management through suDs. SuDS measures should be used to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from surface water runoff.

5.10 The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity. CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice. The application of the SuDS Manual requires that the runoff from sites is not only restricted to meet the Greenfield runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses. The SuDS Manual and Environment Agency guidance applies a sustainability hierarchy to the various types of SuDS systems which are listed below from the most sustainable to the least:

- Living roofs
- Basin and Ponds
- Filter strips and swales
- Infiltration devices (soakaways)
- Permeable Surfaces and Filter Drains
- Tanked Systems

5.11 The usual approach is to consider the 'SuDS train' where each of the above options are considered in turn until a suitable solution is found. Thus, source control techniques such as soakaways, rainwater harvesting and/or infiltration trenches, if suitable on a site, are considered preferable to permeable conveyance and passive treatment systems such as tanks or ponds. The table below summaries the various techniques.

TABLE 9 SUDS OPTIONS

SuDS Technique	Comments	Suitability for Development
Green / Living Roofs / Living Wall	Can be used on low rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	Not a practical option for the proposed development. A green/living roof/living wall would not provide all of the attenuation storage requirements alone.

Basins / Ponds	Provides storage of runoff and flow attenuation. Vegetated surfaces can be used to support the prevention of runoff from the site for small rainfall events (interception) and improve water quality associated with the removal of sediment and buoyant materials.	Not the required area available, especially given the side slopes need to be 1 in 4 max. Without the space the volume attenuated would be very small to be virtually insignificant.
Filter Strips / Swales	Good removal of urban pollutants, reduces runoff rates and volumes.	Not enough open/green space for their workable inclusion or being able to tie in with depths of connecting buried pipes.
Infiltration Devices (e.g. soakaways)	Reduces total runoff volume from the development.	Soakaways may be suitable.
Permeable Surfaces and Filter Drains	Permeable surfaces together with their associated substructures are an efficient means of intercepting runoff, reducing the volume and frequency of runoff and providing a treatment medium.	May be used to provide betterment.
Tanked systems	Ideal for sites with insufficient space for basins etc., provide a volume of below ground storage with a high void ratio.	Potential to be installed under the site.
Flow reduction	Manages and reduces the flood risk to the local surface water sewers and watercourses	A hydrobrake can be installed downstream of attenuation tanks and control flows to the natural Greenfield run off rates.

Site storage volumes

5.12 The principle applied in the design of storage is to limit the discharge rate of surface water runoff from the developed site for events of similar frequency of occurrence to the same peak rate of runoff as that which takes place from a Greenfield site prior to development.

5.13 At this stage, ground conditions suggest that infiltration methods such as soakaways and permeable paving may work at the site. The soakaways would be sized according to onsite infiltration rates obtained during infiltration/soakaway tests. If the soakaways are sized for example the 1 in 10 year event an overflow would discharge water to another SuDS feature (e.g. permeable paving) during events larger than the 1 in 10 year event.

5.14 The concrete ring soakaways will be installed within a square pit, with side lengths of twice the ring diameter which allows the total excavation volume below the inlet invert to be used in the design storage volume and void ratio4.

5.15 The required half emptying time of 24 hours the design storm is met and therefore this method of storm water disposal is appropriate for use on this site. This is based on infiltration rate of 0.00003m/s. Additional storage would be provided within the manholes, pipes and drainage gullies which will provide betterment over and above the 1 in 100 year (+40%) event

5.16 If an infiltration system is proposed, it is recommended that a series of infiltration/soakaway tests are carried out on site to BRE Digest 365 Guidelines.

5.17 it is proposed that underground storage tanks, oversized drainage networks, cellular storage and/or surface storage will be used to provide the require attenuation storage volume of 0.60m3. Additional storage would be provided within the manholes, pipes and drainage gullies which will provide betterment over and above the 1 in 100 year (+40%) event.

suDs strategy

5.18 At this stage a detailed surface water drainage design has not been undertaken, however it is necessary to demonstrate that the surface water from the proposed development can be discharged safety and sustainably. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development

5.19 Adopting the management train strategy (outlined earlier) we recommend water is managed as close to source as possible. The strategy will take form of:

- Downpipes connected to water butts.
- Soakaway/s.

- Oversized pipes/cellular storage/storage tanks with a restricted outfall to the public sewers.
- Any areas of hardstanding areas (car parks, driveways etc.) within the development shall be constructed of a permeable surface examples include:

    - Using gravel or a mainly green, vegetated areas.
    - Directing water from an impermeable surface to a border rain garden or soakaway.
    - Using permeable block paving, porous asphalt/concrete.

5.20 The size of the storage has been calculated such that the proposed development has the capacity to accommodate the 1 in 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change. Consequently, all areas drained have been designed to accommodate a 100 year (+40% climate change) storm event. The remainder of the site that is not formally drained, i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground.

5.21 Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas. Additional storage would be provided within the manholes, pipes and drainage gullies which will provide betterment over and above the 1 in 100 year (+40%) event.

5.22 In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

MITIGATION

6.1 The goal of implementing flood risk mitigation measures is to eliminate potential flood damage and to protect the welfare of the users of the site. As the site is situated in flood zone 3 and it's proposed use as a residential development places it's classification in the 'highly vulnerable' group and emergency flood plan will be developed upon occupation of the building thus ensuring all residents are briefed

6.2 Flood resistance measures include:

- The site will have to hand temporary flood resistance measures such as flood gates or removable flood defences for all doors which will be installed before the onset of flooding
- Flood Resistant Front Door
- Non-Return Valves fitted to drainage connections
- Service Vent Covers & Seals and automatic airbricks

6.3 Flood resilience measures:

- Tiled floors with waterproof adhesive and grout
- White goods on raised plinths
- Separate electrical circuits for upper and lower floors
- All electrical wiring, switches, sockets, socket outlets, electrical, and gas meters etc. will be located a minimum of 600mm above the finished floor level at 18.25mAOD Resilient plaster or plasterboard laid horizontally
- Boiler moved to upper floor
- Safe refuge areas provided in each property above extreme flood levels

6.4 Flood warnings and flood alerts cover the area of the site, all residents will be registered to receive flood warnings and alerts. The site is covered by the River Usk, Newport NRW Flood warning area.

6.5 Finished floor levels: Raising the finished floor and threshold levels of the proposed dwellings will be used to mitigate the effects of flooding at the site. In accordance with TAN15 the proposed development will have a finished floor level above that of the predicted 1 in 100 year (+25%) water level of 17.55mAOD. In addition to this a suitable freeboard allowance is required to account for uncertainty in the analysis, a freeboard of 100mm is proposed. The finished floor level will be a minimum of 17.65mOAD.

6.6 First floor accommodation: Occupants will have the option to retreat to higher floor levels in the unlikely event of an extreme flooding event, first floor accommodation is located approximately 2.65m above the ground floor finished floor levels.

6.7 All sleeping accommodation will be located on the first floor, the levels of the first floor are located a minimum of 2.65m above the ground floor finished floor level well above any floodwater levels.

6.8 The site is located in a flood risk area therefore; the site will participate in Natural Resources Wales flood warning telephone service. The site will register contact details with the Natural Resources Wales Flood Warnings Direct Service (Floodline 0845 988 1188) in order to receive Flood Warnings.

6.9 All occupants of the site will be made aware of the Natural Resources Wales Floodline telephone number and the Flood Warning Codes and their meaning. The owner of the properties will carry out the role of Flood Warden for the site and ensure they have an understanding of the flood mechanisms of the site and will ensure that the safety of the occupants and visitors will not be compromised.

6.10 Flood Plan: A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed. Sensible precautions would include raising electrical items, irreplaceable items and sentimental items off the ground or where possible moving them to a higher floor, rolling up carpets and rugs and turning off utilities. In addition, consider what actions you would take should the property need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.

6.11 A safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot via Maryport Street to the north. The mechanism for flooding is generally prolonged episodes of rainfall, which affords good time for flood warnings to be issued. The likelihood of a rapid water level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event.

6.12 Therefore, site users would be aware of the flood risk and should have more than sufficient time to evacuate the site before flooding of the access road would be expected. Therefore, the lead time of the flooding will provide site users with more than ample time to evacuate the site and seek safe refuge outside the floodplain. People should make their way to areas outside of the flood zone. In the event of a flood warning, vital belongings, including waterproof clothing, necessary medication and essentials for infants and children will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

JUSTIFICATION TEST

7.1 Developments should be directed away from areas of flood risk however where developable land is in short supply, there can be an overriding need to build in areas that are at risk of flooding. It is impractical to suggest that there are more suitable locations for this development elsewhere. This is the only site in the ownership of the client and therefore the only site available to them to develop. The site proposals cannot be located in another site elsewhere. There are no alternative sites available to develop.

7.2 The area surrounding the proposed development site is effected by similar or in some instances higher risk of flooding. The proposed development is to be designed in a flood resilient manner and therefore exposure of property and people will be minimal

7.3 The table below provides indicative guidance as to what that frequency threshold could be for different types of development described in terms of annual probability of occurrence (see Table A1.14 of TAN15). The site will remain flood free for all events up to and including the defended 1 in 100 year (+25%) and 1 in 200 year events.

TABLE 10 FREQUENCY THRESHOLD OF FLOODING

Type of Development	Threshold of Frequency (yrs)	
	Fluvial	Tidal
Residential	1%	0.5%
Commercial/Retail	1%	0.5%
Industrial	1%	0.5%
Emergency Services	0.1%	0.1%
General Infrastructure	1%	0.5%

7.4 Natural Resources Wales data confirms that there is a freeboard of approximately 100mm to 300mm during the defended 1 in 100 year (+20%) event. The flood defences would not be overtopped, and

freeboard would exist of approximately 100mm to 300mm. Therefore, the actual flood risk posed to the site is less than 1 in 100 year (+25%) and 1 in 200 year events. The site would be flood free during the defended 1 in 100 year (+25%) and 1 in 200 year events. It is only during the undefended events that the site may be inundated with floodwater.

7.5 The finished floor level will be raised to a minimum of 17.65mAOD therefore, dwellings would not be inundated with floodwater during the 1 in 100 year (+25%) event. Therefore, the indicative requirements of A1.14 of TAN15 are passed. Water depth on the site will be less than 0.60m therefore, the probability of flooding to a depth of 600mm or more is less than 1 in 1000 years.

7.6 The maximum rate of rise of floodwaters would be less than 0.10m/hr, the maximum speed of inundation of flood risk area is less than 4 hours and the maximum velocity of floodwaters would be less than 0.15 to 0.30 metres/sec (see Figure 12). Furthermore, the typical rainfall profile for this region, in common with much of Mid-Wales, is a low intensity, long duration event commensurate with frontal weather systems. The limits of speed of inundation and rate of floodwater rise would not be exceeded, the maximum rate of rise of floodwater would be less than 0.10m/r.

7.7 The mechanism for flooding from tidal flooding is generally prolonged episodes of high rainfall, which affords good time for flood warnings to be issued. The likelihood of a rapid water level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event. Therefore, the site proposals are in accordance with A1.15 of TAN15. The development proposals should therefore be considered by the LPA to satisfy the Justification Test as set out in TAN15.

CONCLUSIONS AND RECCOMENDATIONS

8.1 The development proposes the demolition of Coach House at rear of No. 31 and Office Building at No. 33 Maryport Street and Construction of a New Dwelling at 33 Maryport Street Usk Monmouthshire NP15 1AE

8.2 The demolition of existing buildings and the construction of a new dwelling will result in a reduction of total ground floor footprint of the site. This will ensure no detriment to the flood storage capacity of the site and will provide additional flood storage capacity providing betterment compared to the existing situation.

8.3 No land raising will occur across the site and the development will not impede the movement of floodwater across the site. The proposed development will have no impact on the movement of floodwater across the site.

8.4 The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. There will be no increase in the flood water levels due to the proposed development. The proposed development will provide additional flood storage capacity and will improve the on-site and off-site flood risk.

8.5 The below table provides a summary of the potential flood risk to the site

TABLE 11 SUMMARY OF FLOOD RISK

Flood Source	Risk assessment	Comment
Fluvial	Medium	Due to the sites close proximity to the River Usk
Tidal/ Sea	Site is not at risk	
Surface water	Site is not at risk	The site is not anticipated to be at a notable risk from surface water flooding
Ground water	Site is not at risk	The site is not anticipated to be at a notable risk from ground water flooding
Sewers	Low	The site could be at risk from flooding from local sewers
Reservoirs	Site is not at risk	The site is not anticipated to be at a notable risk from any other sources of flooding

8.6 The site is unlikely to flood except in extreme conditions. The primary, but unlikely, flood risk to the site is from flooding from the River Usk. The site is located within Flood Zone 3 and therefore has a 'high probability' of flooding. The Development Advice Map which accompanies TAN15 shows that the site is partially located within Zone C1 - Areas of the floodplain which are developed and served by significant infrastructure, including flood defences. Zone C1 is used to indicate that development can take place subject to application of justification test, including acceptability of consequences. The proposed development is classified as 'highly vulnerable'. However, there are flood defences located within the vicinity of the site which provide protection to the site against flooding from the River Usk.

8.7 The 2009 version of the Usk Town model shows during the 1 in 100 year (+25%) event that the site will not be inundated with floodwater, the site would be flood free for all events up to and including the 1 in 100 year (+25%) event. The flood defences would not be overtopped, and a freeboard would exist of approximately 100mm to 300mm. The actual flood risk posed to the site is less than 1 in 100 year (+25%) and 1 in 200 year events. The site may only be inundated with floodwater during the defended 1 in 1000 year even, the water depth on the site will be less than 0.60m.

8.8 The mechanism for flooding from flooding is generally prolonged episodes of high rainfall, which affords good time for flood warnings to be issued. The likelihood of a rapid water level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal with a forewarning of two (2) days of a pending flood event. The site is located within a low risk area where the onset of flooding is very gradual (many hours

8.9 It can be concluded that flooding from the River Usk poses a very low actual and residual risk to the site. Therefore, the risk of flooding is considered to be of medium significance. A secondary flooding source has been identified which may pose a low significant risk to the site, this is from Sewer Flooding the flooding sources will only inundate the site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the proposed development site. In accordance with TAN15 the proposed development will have a finished floor level above that of the predicted 1 in 100 year (+25%) water level.

8.10 In conclusion, the proposed development would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FCA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable, and the development would be in accordance with the requirements of TAN15.

8.11 This FCA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of TAN15. The development should not therefore be precluded on the grounds of flood risk.

APPENDIX 1: PROPOSED DEVELOPMENT PLANS

FIGURE 11 PROPOSED AND EXISTING SITE PLAN

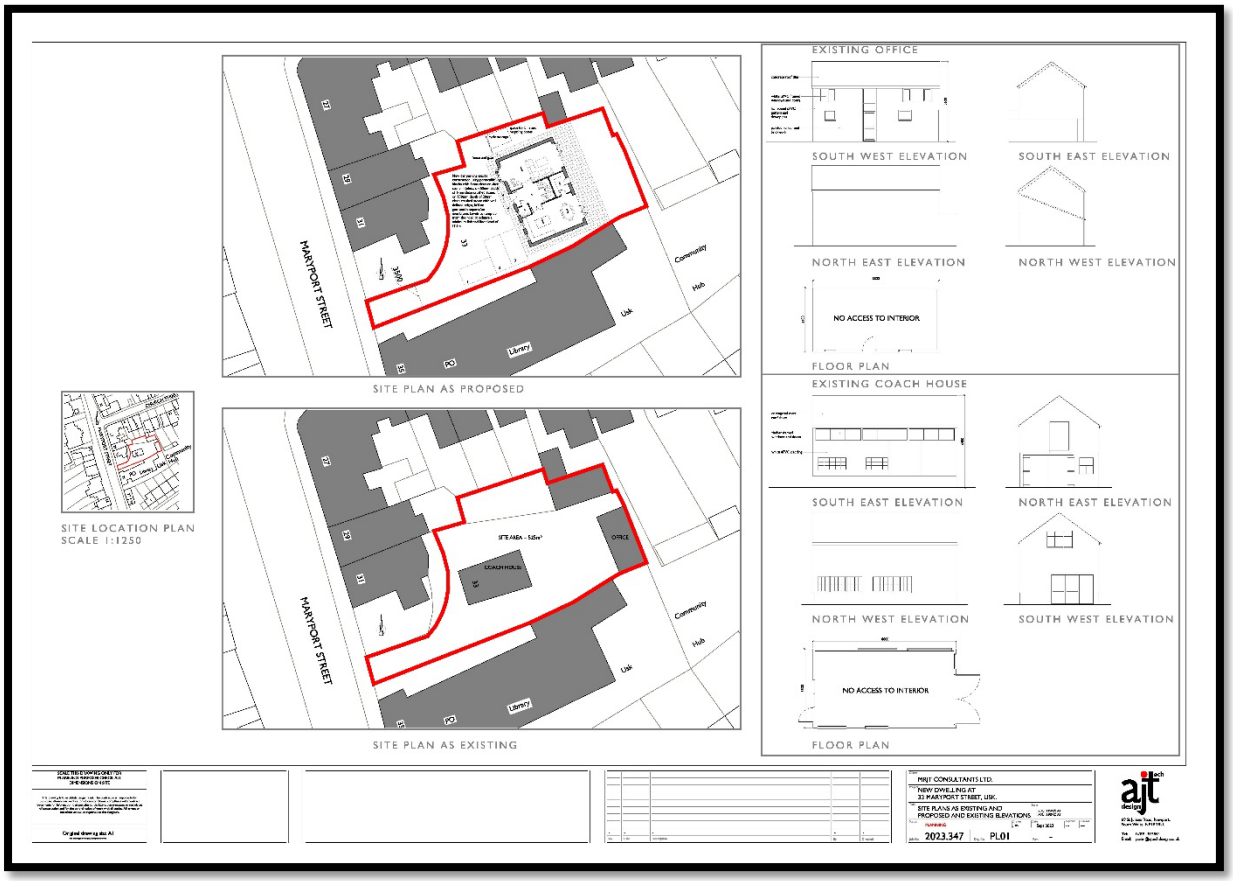


FIGURE 12 PROPOSED PLANS