



Wrexham County Borough Council

RESIDENTIAL DEVELOPMENT AT PLAS MADOC, WREXHAM

Flood Consequences Assessment and Drainage
Strategy





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Flood Consequences Assessment and Drainage Strategy

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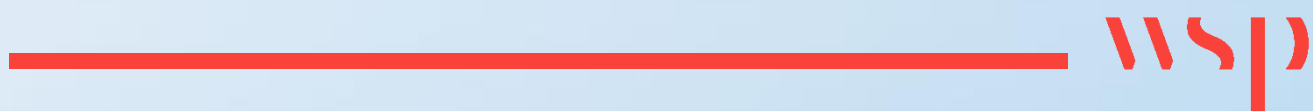
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1

INTRODUCTION



INTRODUCTION

1.1 COMMISSION

WSP were commissioned by Wrexham Borough Council (WCBC) to undertake a Flood Consequences Assessment (FCA) and outline surface water drainage design for three proposed residential development plots at Plas Madoc, Wrexham.

This FCA focuses on assessing the flood risk at the site and includes the following:

- Liaison with Natural Resources Wales, Wrexham County Borough Council and Dwr Cymru Welsh Water to obtain information relating to local flood consequences for the sites.
- Assessment of the existing consequences of flooding at the sites and the potential impact of the development proposals.
- Identification of all the potential sources of flooding at the sites (i.e. fluvial, tidal, highways, groundwater, reservoir, sewers, canal and surface water).
- Consideration of the flood consequence implications, taking into account an allowance for climate change.

The drainage strategy is intended to review options for foul and surface water drainage from the proposed development areas.

1.2 POLICY CONTENT

This FCA has been prepared in accordance with the relevant national, regional and local requirements and guidance of the following publications and organisations, where applicable:

- Technical Advice Note (TAN) 15: Development and Flood Risk dated October 2004 issued by The Welsh Government;
- Wrexham County Borough Council;
- Building Regulations 2010 (Part H3);
- Sewers for Adoption 7th Edition;
- Planning Policy Wales (Edition 10, December 2018) issued by Welsh Government;
- Welsh Ministers Standards for Foul Sewers and Lateral Drains;
- The new Sustainable Drainage Systems (SuDs) Manual C753, CIRIA;
- RainScape - Dwr Cymru Welsh Water; and
- SuDs Wales.

To complete this FCA, the following stakeholders have been consulted:

- Natural Resources Wales (NRW).
- Dwr Cymru Welsh Water (DCWW).
- Wrexham County Borough Council (WCBC) as Lead Local Flood Authority (LLFA).

1.3 PLANNING POLICY WALES VULNERABILITY TESTING AND TECHNICAL ADVICE NOTE 15

The general approach of the Planning Policy Wales (PPW), supported by the Technical Advice Note 15 (TAN15), is to follow a precautionary framework approach when determining the suitability of land

for development in flood risk areas, with the intention of steering development away from areas of high risk of flooding to the lowest flood risk areas.

Where development has to be considered in high risk areas (Flood Zone C) only those developments which can be justified on the basis of the tests outlined in Section 6 and Section 7 of the TAN15 guidance are to be located within such areas.

Table 2 of TAN15 guidance confirms the 'Flood risk vulnerability classification' of a site, depending on the proposed usage. This classification is subsequently applied to Development Advice Map (DAM) containing three fluvial flood zones (A, B and C with subdivision into C1 and C2) to determine whether:

- The proposed development is suitable for the zone in which it is located; and
- The appropriate planning tests have been demonstrated in relation to the proposed development.

1.4 LIMITATIONS

The findings and opinions conveyed via this report are based on information obtained from a variety of sources, as detailed, which WSP believes are reliable. Nevertheless, WSP cannot and does not guarantee the authenticity or reliability of the information it has relied upon from these sources.

This report has been written on behalf of the Client and no responsibility is accepted to any Third Party for all or any part. This report should not be relied upon or transferred to any or other parties without the express written authorisation of WSP. If any unauthorised third party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill. WSP disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above contract.

This report has been prepared by WSP with all reasonable skill and care within the terms of the Contract with the Client and taking into account of the information made available by the Client, as the manpower and resources devoted to it by agreement with the Client.

It should be noted that the insurance market applies different tests to properties in relation to both determining premiums and, more fundamentally, determining the insurability of properties for flood risk. Those undertaking development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurance (ABI) to seek further guidance prior to commencing development.

The findings of this FCA have been based on data available at the time of the study and on the review of available information that has been undertaken to date. Should the development proposals change, then the findings of this report would need to be reviewed and updated accordingly.

2 EXISTING SITE AND DEVELOPMENT PROPOSALS

2.1 SITE LOCATION

The proposed development is comprised of three land parcels which have previously been utilised for residential development. The residential developments have been demolished and the land is now brownfield. Two of the land parcels are located along Gwynant (road) and the third is located further east on Glaslyn (road), Plas Madoc, Wrexham. Figure 2-1 below shows the locations of the three proposed development sites within the development area.

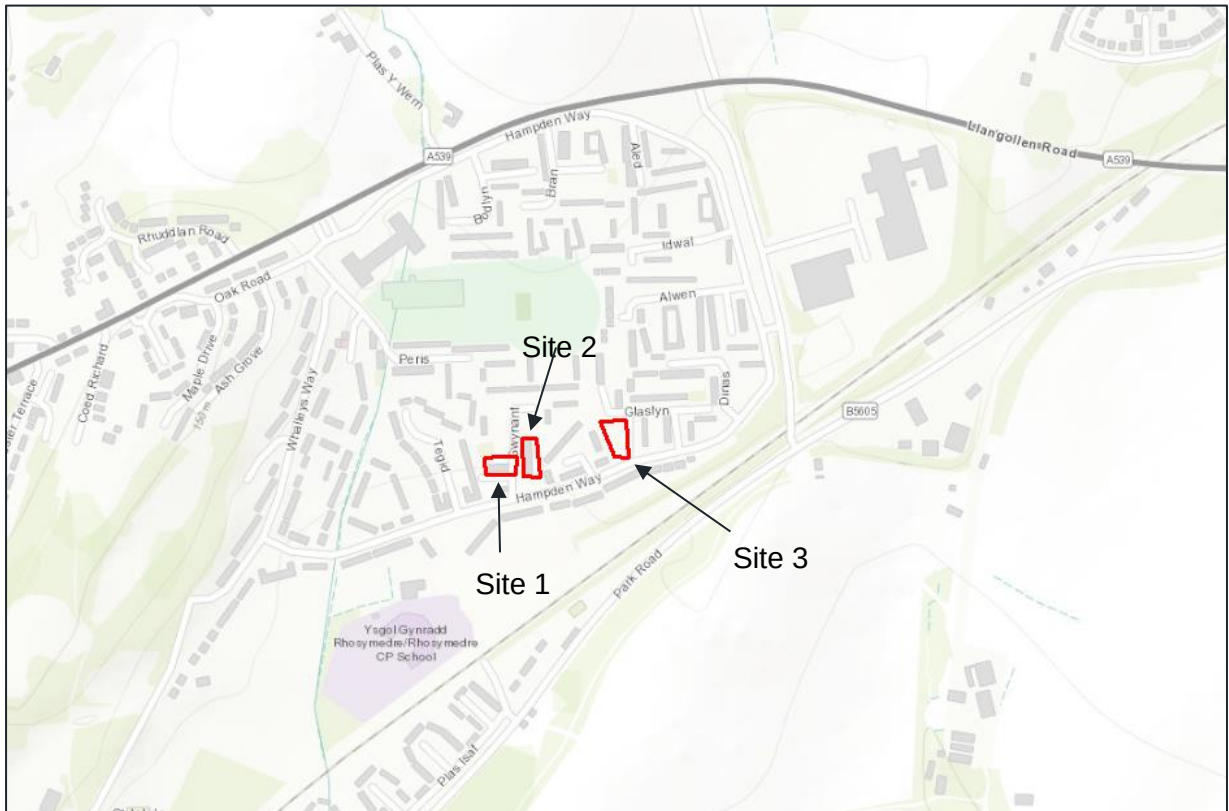


Figure 2-1 - Site location Plan

■ Site 1

Site 1 is centred on Grid reference 328838E, 328838N and has an approximate area of 814m² of which 526m² is hardstanding area and therefore impermeable.

■ Site 2

Site 2 is centred on Grid reference 328874E, 343221N and has an approximate area of 1257m² of which 805m² is considered impermeable.

■ Site 3

Site 3 is centred on Grid reference 328986E, 343246N and has an approximate area of 1246m² of which 759m² is considered impermeable.

The sites are all located within an existing area of residential housing and are bound by roads, paved areas and open green spaces.

2.2 SITE DESCRIPTION

A topographical survey provided by the Wrexham County Borough Council was reviewed as part of this assessment and is included in Appendix 7.1. Sites 1 and 2 are former plots of residential development which have been demolished. They are currently flat areas of prepared ground with Site 1 having a ground elevation between 119.55mAOD and 119.65mAOD. Site 2 has a ground elevation of 120.20mAOD to the north and 119.10mAOD to the south. Site 3 consists of an existing grass bund area and former garage plots. The ground levels on site vary between 121.15mAOD and 122.45mAOD.

2.3 PROPOSED DEVELOPMENT

The proposed developments consist of a range of residential plots. Site 1 will consist of three detached four bed houses. Site 2 will comprise of two semi-detached two bedroom houses, a detached three bedroom house and four one bedroom flats. Site 3 will provide two semi-detached three bedroom bungalows and one detached two bedroom bungalow. All plots will have surrounding gardens and associated off street parking.

The proposed development plans are included in Appendix 7.2.

2.4 GEOLOGY AND HYDROGEOLOGY

A desktop review was undertaken using the British Geological Survey (BGS) online geology maps. The BGS records report that the site is underlain by the following:

- *Bedrock geology: Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation (undifferentiated) - Mudstone, Siltstone And Sandstone. Sedimentary Bedrock formed approximately 310 to 319 million years ago in the Carboniferous Period. Local environment previously dominated by swamps, estuaries and deltas.*
- *Superficial Deposits: Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions (U).*
- *The site is deemed to have a low groundwater vulnerability.*
- *The depth of groundwater beneath the site is unknown.*

There is no information about the infiltration potential of this site for surface water management. It is recommended that prior to the detailed design stage, soakaway testing is undertaken in accordance with BRE365 guidance to verify the on-site infiltration potential of the underlying ground.

2.5 SOILS

Cranfield University Soilscape Viewer was reviewed to determine soils across the development area. The sites are predicted to consist of loamy and clayey soils. These soils are classified as having impeded drainage which refers to soils with a tight, compact deep subsoil that impedes downward water. After heavy rainfall, particularly during the winter, the subsoil becomes waterlogged and results in very wet ground conditions.

2.6 HYDROLOGY

The Rhosymedre Brook flows in a southerly direction extending through the villages of Plas Madoc, Cefn Mawr and Rhosymedre to its confluence with the River Dee. This partially culverted ordinary watercourse, is located approximately 250m to the west of the proposed development site. Figure 2-2 shows the proximity the watercourse.

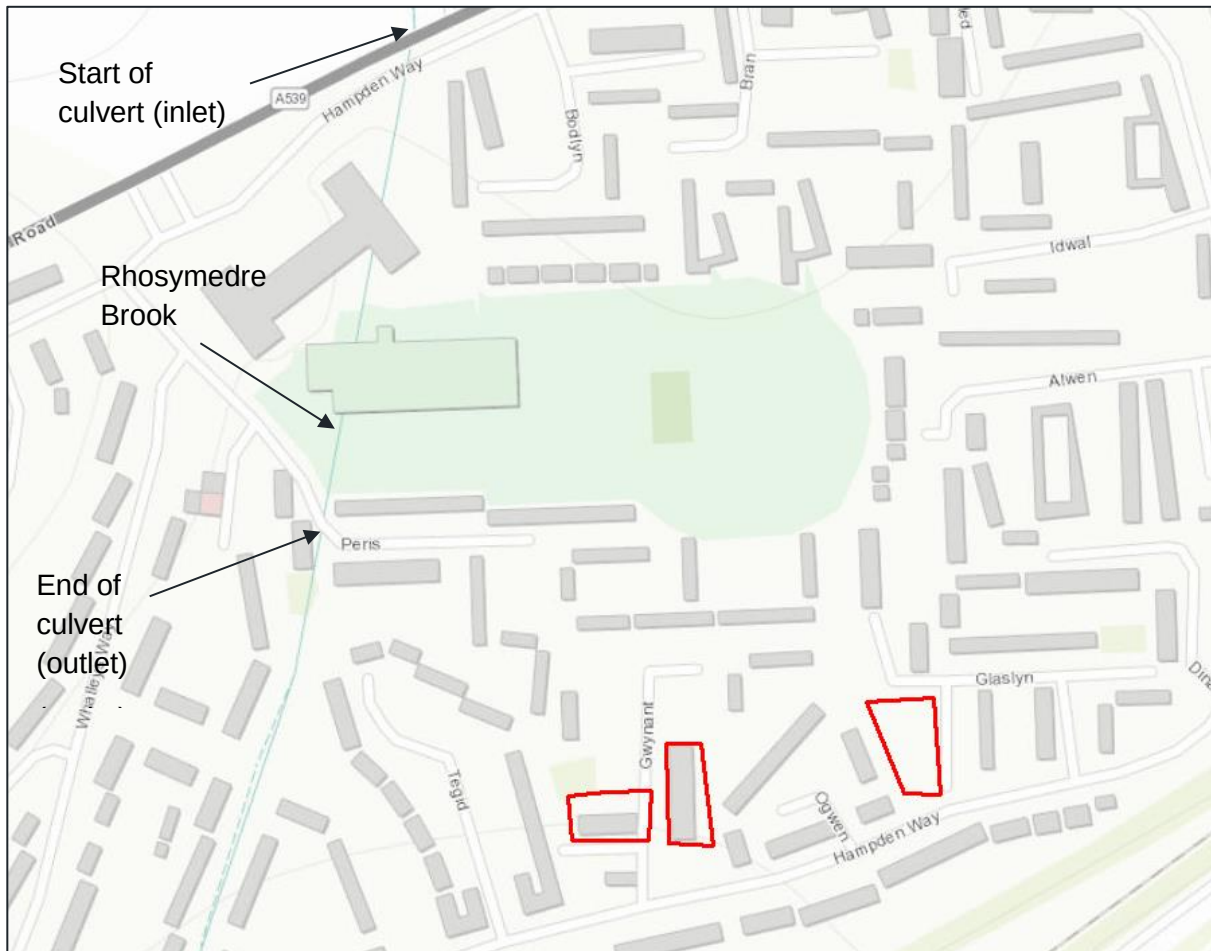


Figure 2-2 - Watercourse Location Map

2.7 EXISTING DRAINAGE

2.7.1 PUBLIC SEWERS

DCWW provided a sewer plan as part of the response from the pre-development enquiry for this development. The existing sewer record is included within Appendix 7.2 and the following summarises the content of the sewer records:

Site 1

Site 1 has a surface water and foul sewer located to the north of the site. There is a live 150mm vitrified clay (VC) foul sewer which runs to the east of Site 1 and connects into a combined system to the south.

Site 2

A 300mm VC surface water sewer is located along Gwynant adjacent to site 2. There is also a surface water (450mm VC) and foul sewer (100mm VC) located to the east of the site.

Site 3

There is a 100mm VC surface water and 100mm VC foul sewer running through the centre of Site 3 from a north to south direction. The foul sewer connects into a combined system on Hampden Way.

2.7.2 EXISTING SITE DRAINAGE ARRANGEMENTS

Invek Surveys Ltd undertook a drainage survey in December 2018 to ascertain the current drainage arrangements on site. The surveyed drainage layout and manhole records are included within Appendix 7.4. The drainage survey was generally consistent with the sewer plan provided by DCWW, however, some additional notes were provided by the surveyors with regards to the existing condition of the sewers. These are summarised below:

- It was noted the previous connections to Site 1 from the north of the site were filled with concrete which was suspected as part of the demolition process of the former site.
- Site 2 appeared to be connected to the foul and surface water network on the eastern side of the site.
- Concrete filled downpipes were observed at Site 3 where the former garages were located and it was assumed these previously provided a water supply.

2.8 CONSULTATION WITH STATUTORY AUTHORITIES

2.8.1 CONSULTATION WITH WREXHAM BOROUGH COUNCIL (WCBC)

The Lead Local Flood Authority (LLFA) was consulted as part of this assessment. A summary of the information is provided below, the full response is included in Appendix 7.5.

- *There is minimal surface water issues at this location.*
- *No known historical surface water flooding issues at the site.*
- *There is no data regarding groundwater flooding or emergence issues or information about local groundwater infiltration potential of the general area.*
- *There are no known highway flooding issues.*
- *There are no known culvert watercourses on it or in the vicinity.*
- *The site does not lie near or within a Critical Drainage Area*
- *We have no information regarding feasibility for soakaways.*
- *Please refer to WCBC's local planning guidance note "Management of Surface Water Generated from New Development" for guidance on potential surface water discharge rate to local watercourse, use of SuDS and climate change allowance for use if future surface water drainage design.*

Flood risk maps are available from the NRW's website which show there are no defences or storage areas in this area.

2.8.2 CONSULTATION WITH NATURAL RESOURCES WALES (NRW)

Natural Resources Wales provided the following response, the full response is included within Appendix 7.6:

'Half of the properties which have been proposed on this development are at risk of flooding. There is a partially culverted ordinary watercourse, which is 150m away from the development site. The 3x four bed houses, and the 4x one bed flats are at risk of flooding from the ordinary watercourse.

According to TAN 15, only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. This development would come under the development category 'Highly Vulnerable Development', according to TAN 15. NRW recommend that the applicant submits a Flood Consequence Assessment (FCA) for this application. Including the minimum assessments included in an FCA (as described in section A.1.17 of TAN 15), the applicant should also include:

- A plan of the area showing access/evacuation routes from the proposed development site giving existing levels relative to Ordinance Datum*
- An assessment of the source of potential flooding*
- A plan and description of any structures which may influence local hydraulics, including culverts. This will also include an assessment of the likelihood of such structures becoming blocked and the flooding consequences. Of this on the development.*
- A clear definition of what a "fore bed house/gore flat" is.*

We recommend that you familiarise yourself with sections 1, 6 and 7 of TAN 15 in relation to this application and use these sections to inform the FCA. Please could you also verify the current housing presence and number of units, as this will determine whether the development will involve an intensification of use. Section 13.4.1 of the Planning Policy Wales Edition 9 (PPW) states that development proposals in areas defined as being of high flood hazard should only be considered where the development proposal would not result in the intensification of existing development which may itself be at risk. If the number of housing units remain, or ideally reduce, then NRW would recommend flood resilience/resistance measures are installed, and suitable safe flood routes during a range of flood return periods.

The FCA should use the modelling found in the 'Cefn Mawr and Acrefair Flood Risk Mapping Project' (JBA, 2013). The flood extent at this location is based on this detailed hydraulic model and should be available to inform any required FCA. You will need to contact Data Distribution (datadistribution@cyfoethnaturiolcymru.gov.uk) about any data requests you may have. NRW would also recommend that you refer to the information submitted by your colleague Neil Taunt which advises of the risks and requirements.

We recognise that before deciding a planning application, the Local Planning Authority needs to be satisfied that the foul drainage arrangements are suitable.

We refer you to the hierarchical approach to foul drainage and requirements for non-mains drainage assessment described in Planning Policy Wales (PPW) and Welsh Office Circular 10/99 (Planning Requirement in respect of the Use of non-Mains Sewerage incorporating Septic Tanks in New Development).

You should be aware that where a property has a septic tank or package sewage treatment plant, it is a legal requirement for the discharge to be registered with NRW. Subject to certain criteria being satisfied, the applicant may be able to register for an exemption. However, if this criteria is not met then an Environmental Permit should be obtained from us.

An owner might be eligible for an exemption rather than an Environmental Permit, where:

- treated sewage effluent is discharged to a river, stream, estuary or the sea and the volume is 5 cubic metres per day or less; or*
- sewage effluent is discharged to groundwater via a drainage field or infiltration system and the volume is 2 cubic metres per day or less.*

Any waste excavation material or building waste generated in the course of development must be disposed of satisfactorily in accordance with duty of care requirements under section 34 of the Environmental Protection Act 1990. The waste shall be transported using registered waste carriers to suitably permitted or exempt sites. Transfer notes shall be kept for each load for a minimum of 2 years.'

2.8.3 CONSULTATION WITH DWR CYMRU WELSH WATER (DCWW)

Dwr Cymru Welsh Water (DCWW) provided the following response (full details available in Appendix 7.7):

Asset Protection

The proposed development site is crossed by 100mm and 150mm diameter public foul gravity sewers and 100mm, 150mm, 300mm and 450mm diameter public surface water gravity sewers with their approximate position being marked on the attached Statutory Public Sewer Record. Under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times. No part of any building will be permitted within 3 metres either side of the centreline of the public sewers.

Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

Sewage

Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account.

However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

Surface Water

With reference to the surface water flows from the proposed development, you are required to fully exhaust all technical options outlined under Sections 3.2 and 3.4 of Part H of the publication 'Building Regulations 2000; Disposal should be made through the hierarchical approach, preferring infiltration

and, where infiltration is not possible, disposal to watercourses in liaison with the Land Drainage Authority and/or Natural Resources Wales. Discharge of surface water to the public sewer is only to be made as a last resort.

Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note.

SEWAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

3 ASSESSMENT OF FLOOD RISK

3.1 FLOODING HISTORY

NRW, WCBC and DCWW were consulted regarding historic flooding in this area. There is no record of historic flooding from any sources.

3.2 FLUVIAL FLOOD RISK

The NRW's fluvial flood risk maps indicate that Site 1 and part of Site 2 are situated within Flood Zone C2, see **Figure 3-1**. Site 3 lies fluvial flood zones A. The source of the predicted flooding is from the nearby watercourse, the Rhosymedre Brook, which is located to the west of the site.

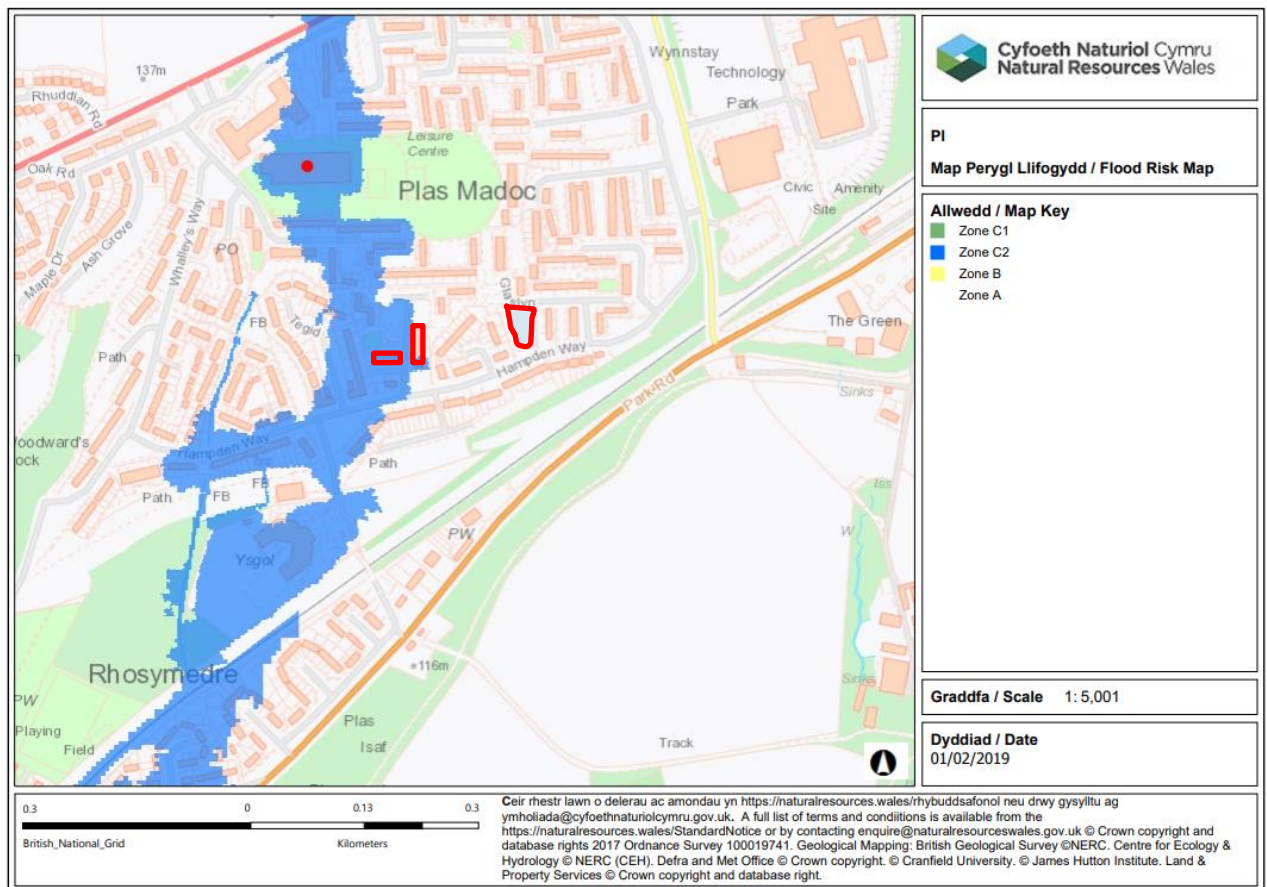


Figure 3-1 - NRW Fluvial Flood Risk Map

Flood Zone C2 is 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). Flood Zone C2 is also known as “Areas of the floodplain without significant flood defence infrastructure”.

A hydraulic model has been developed for the area to assess the risk of fluvial flooding in more detail. Further information is contained within Section 4 of this report.

3.3 SURFACE WATER FLOODING

Surface water flooding occurs because of rainwater not being able to drain away through the normal drainage systems or infiltrate into the ground, it therefore lies on or flows over the ground instead. NRW define “High”, “Medium” and “Low” surface water flood risk as:

- “Low” risk means that each year, the area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%).
- “Medium” risk means that each year, the area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%)
- “High” risk means that each year, this area has a chance of flooding of greater than 1 in 30 (3.3%).

According to NRW’s Flood Risk Maps for Surface Water, Sites 1, 2 and 3 are not directly at risk of surface water flooding. Therefore, the surface water risk is considered “Low”. However, parts of the surrounding road network are at a “Medium” to “Low” risk of flooding from surface water sources.

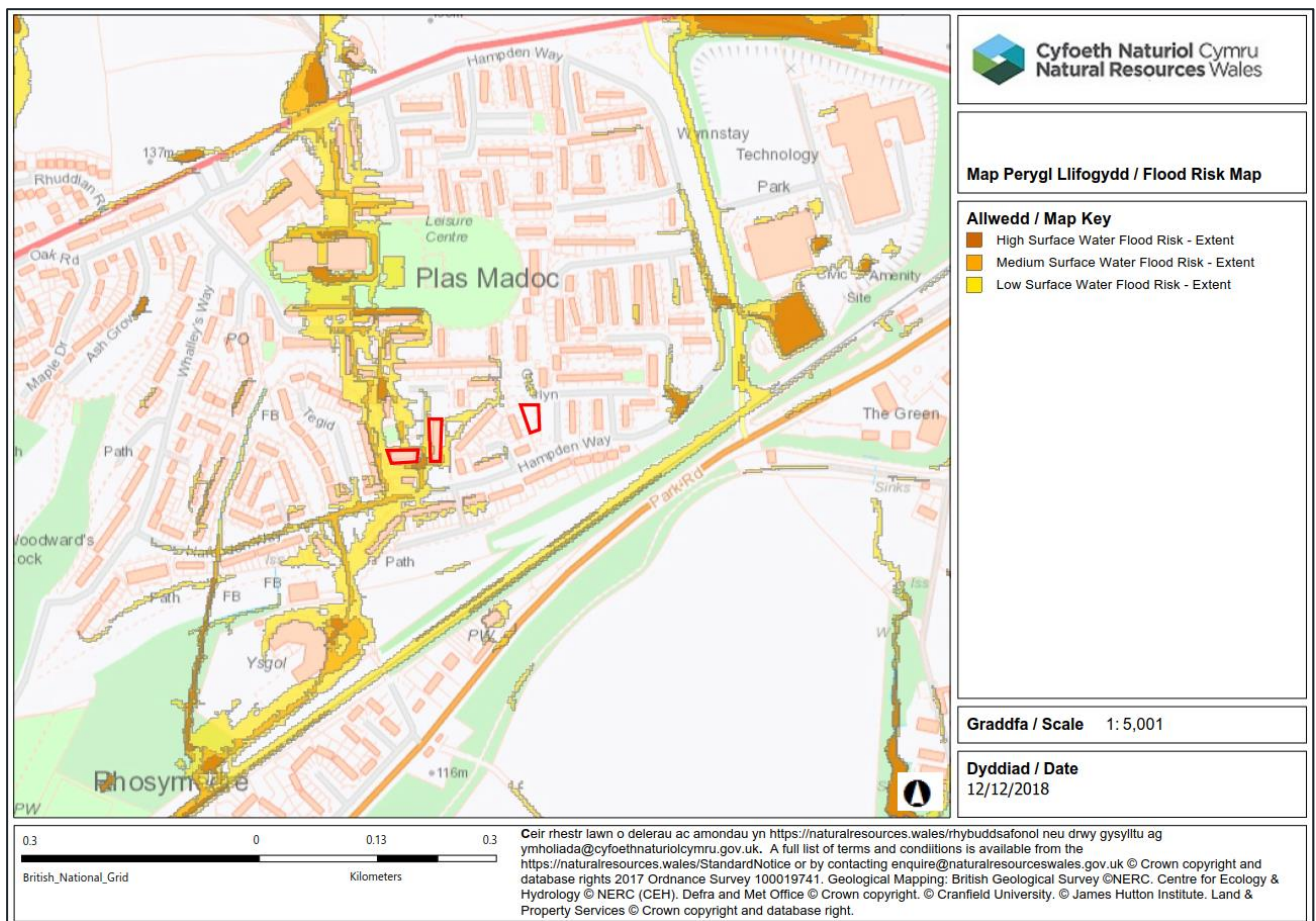


Figure 3-2 - NRW Surface Water Flood Map

3.4 FLOODING FROM THE SEA

The site is located inland and is not within proximity of a tidally influenced watercourse. On this basis, the risk of flooding from the sea or high tides to the proposed development is “Negligible”.

3.5 FLOODING FROM CANAL

There are no canals within the vicinity of the site. On this basis, the risk of canal flooding to the proposed development is considered to be “Negligible”.

3.6 FLOODING FROM RESERVOIRS

The NRW reservoir flooding map indicated that the site does not lie within a reservoir flood outline. On this basis, the risk of reservoir flooding to the proposed site is “Negligible”.

3.7 GROUNDWATER FLOODING

Groundwater flooding is caused by unusually high groundwater levels. It occurs as excess water emerging at the ground surface or within manmade structures such as basements. Groundwater flooding tends to be more persistent than surface water flooding, in some cases lasting for weeks or months, and can result in significant damage to property. The risk of groundwater flooding depends on the nature of the geological strata underlying the site, as well as on local topography. There are no available borehole records and historical data on groundwater flooding in the area. It is recommended to undertake long term groundwater monitoring at the site to ascertain the risk of groundwater flooding, and any mitigation measures required. The proposed floor levels are proposed to be set at 150mm above the 1 in 100year + climate change level for Sites 1 and 2. At this floor level, the risk of groundwater flooding to the proposed development is considered to be “Low”.

3.8 FLOODING FROM SEWERS

Flooding from artificial drainage systems occurs when flow entering a system exceeds its conveyance capacity. The system becomes blocked or it cannot discharge due to high water levels in the receiving watercourse or sewer.

The DCWW sewer records indicate that there are a number of surface and foul water sewers in the area as outlined in Section 2.7.1. It is assumed that the sewers in the area currently meet the standards required by the relevant authorities and in the event of exceedance, all flows will follow the natural terrain and route south towards Hampden Way which runs perpendicular to Gwynant and Glaslyn. Once on Hampden Way water would route west back towards Rhosymedre Brook. DCWW have no records of sewer flooding occurring in the area.

Surface water flooding has been considered within the design of the site to ensure that any additional surface water and overland flows are managed correctly and to minimise flood risk to the site and the surrounding area. The proposed surface water network on the site has been designed to ensure exceedance of the network has been considered.

All new sewer infrastructure for the site will be designed to the latest best practice.

On the basis of the above, the risk from sewer flooding is considered “Low”.

3.9 FLOODING FROM HIGHWAY

At this stage, there is no detailed highway drainage survey information serving this site and additional correspondence with WCBC has stated that within the site:

- *There are no known highway flooding issues.*

The surface water flood risk map highlighted that the flowpaths are along roads and not into the proposed development. Therefore, on this basis the risk of highway flooding to the proposed development is considered to be “Low”.

3.10 FLOOD RISK SUMMARY

Based on information contained within the NRW fluvial flood maps, Site 1 and part of Site 2 are located within Flood Zone C2. Therefore, they are considered are at risk of flooding from fluvial sources with a 0.1% AEP and further modelling has been undertaken to ascertain the flood risk (see Section 4). Site 3 lies in Flood Zone A.

As outlined in the above sections, flood risk to the proposed development from all other sources is considered to be “Low”.

extent and Sites 2 and 3 remain completely outside of the flood extent. In the 100 year + climate change event, Site 1 and part of Site 2 lies within the flood outline (Figure 4-2 and 4-3).

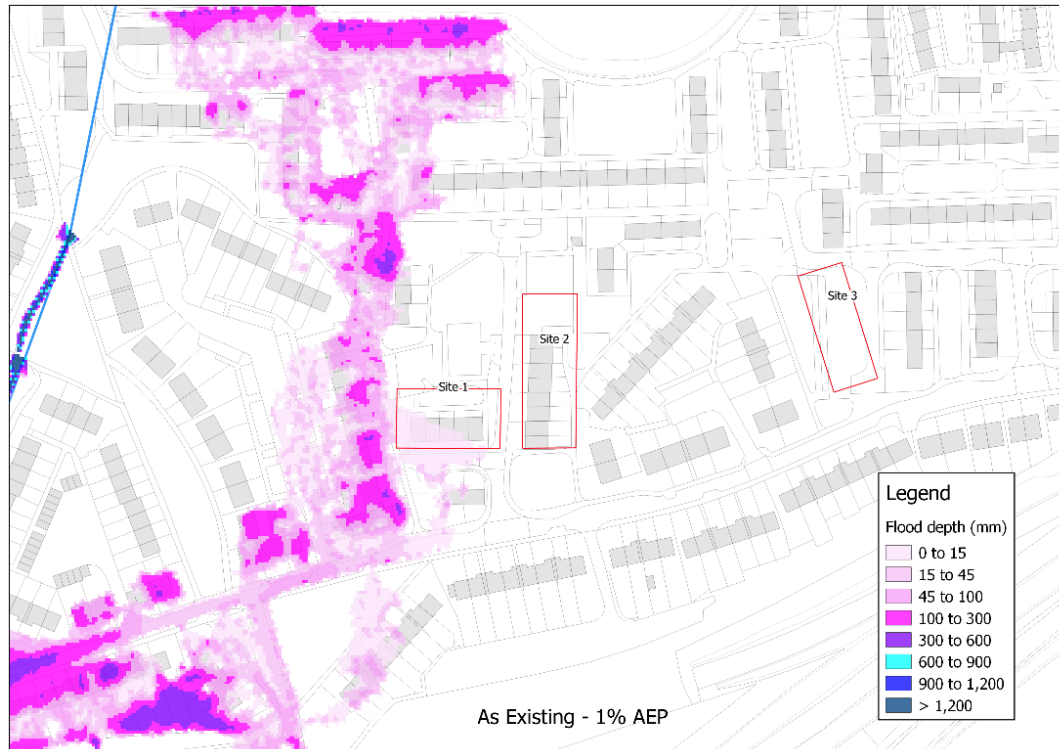


Figure 4-2 – 1% AEP Pre-development flood map, 1% AEP (1 in 100yr)

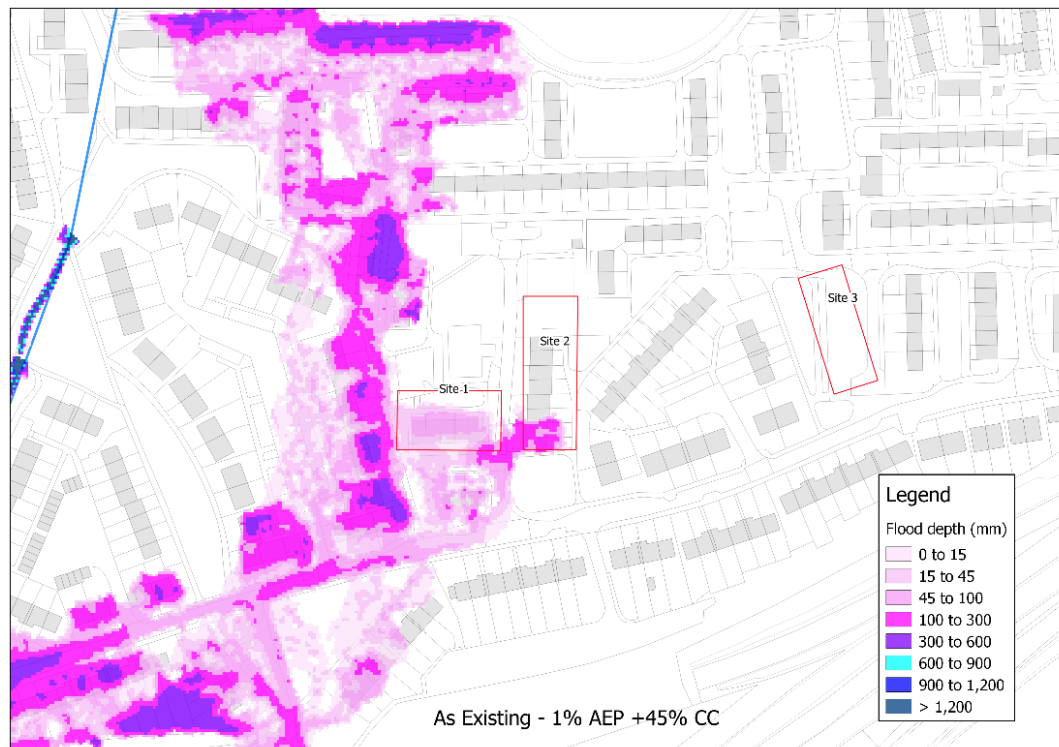


Figure 4-3 - 1% AEP Pre-development flood map, 1% AEP +45%CC (1 in 100yr +CC)

Table 4.1 below shows a summary of the modelled flood levels in the existing predevelopment scenario:

AS EXISTING				
Fluvial Flood Event	Site	Lowest site levels / mAOD	Modelled Water level /mAOD	Flood depth/mm
1% AEP	Site 1	119.55	119.733	183
	Site 2	119.10	n/a	n/a
	Site 3	121.15	n/a	n/a
1% AEP +45% CC	Site 1	119.55	119.786	236
	Site 2	119.10	119.228	128
	Site 3	121.15	n/a	n/a
0.1% AEP	Site 1	119.55	119.818	268
	Site 2	119.10	119.269	169
	Site 3	121.15	n/a	n/a

Table 4-1 - Summary of Modelled Flood Levels for Sites 1, 2 and 3 (As Existing Scenario)

The modelled flood depths on Site 1 are 183mm in the 1%AEP event and 236mm in the 1%AEP+45% climate change event. The flood depth is 128mm on part of Site 2 in the 1%AEP+45% climate change scenario. Site 3 is unaffected in the modelled flood scenarios.

4.3 POST DEVELOPMENT FLUVIAL FLOOD RISK

The post development flood extents presented in **Figure 4-4** illustrates that the flood extent is not predicted to change as a result of the proposed development. Sites 2 and 3 remain completely outside of the flood risk area and one property on Site 1 is partially located within the 1% AEP extent.

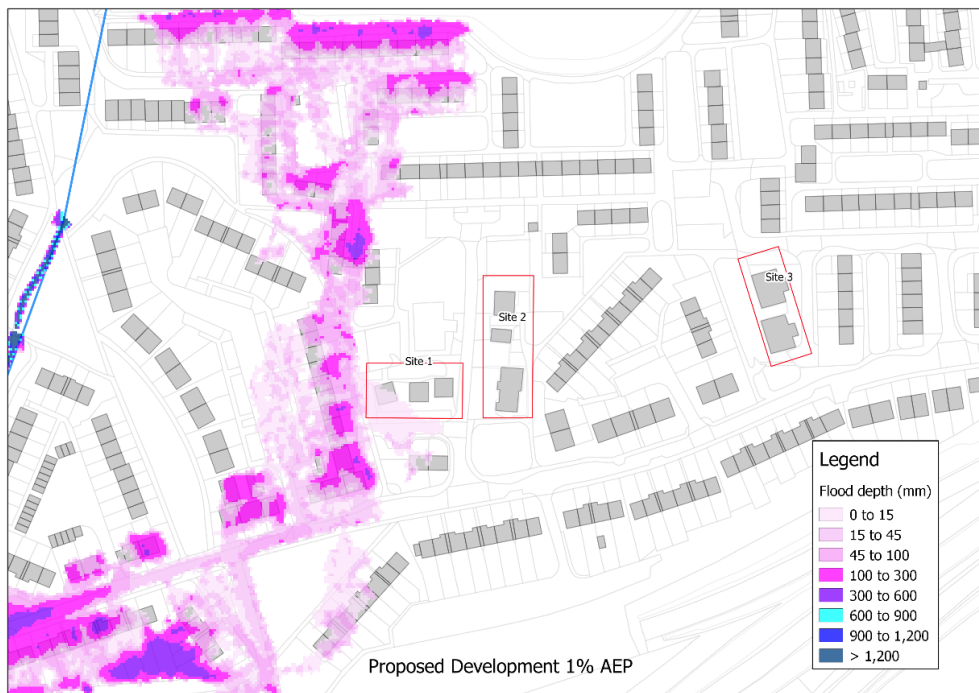


Figure 4-4 - 1% AEP Post development flood map

Figure 4.5 below shows the proposed development scenario with 1% AEP + 45% climate change allowance. This shows part of the Site 2 to be affected by the flood outline.

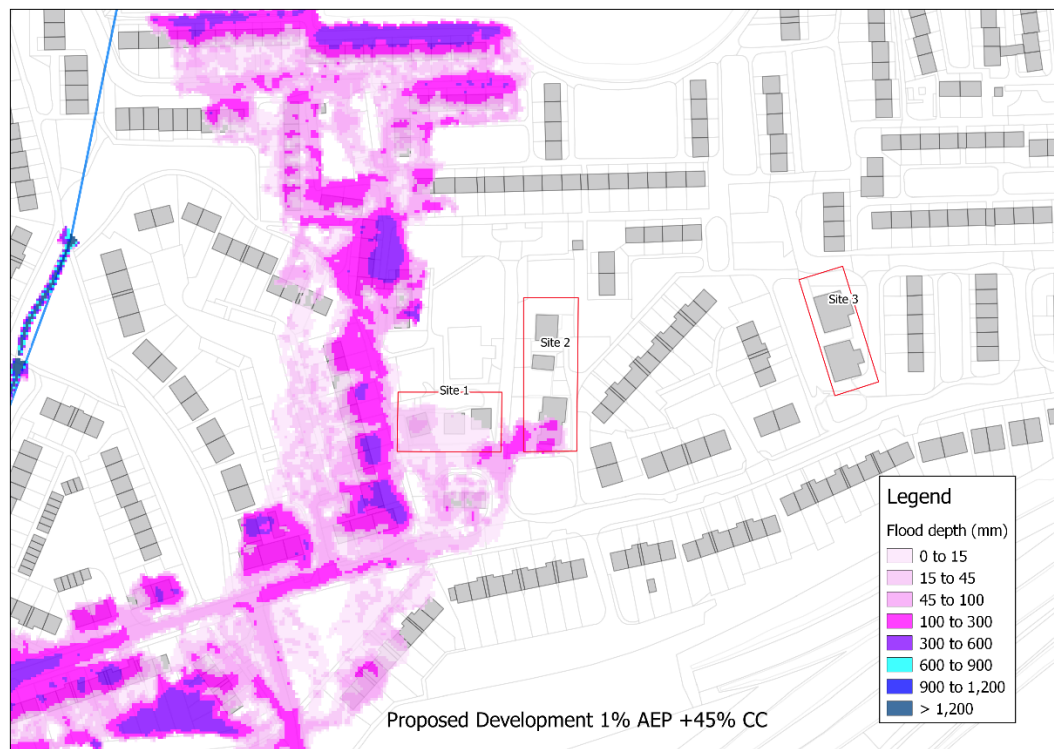


Figure 4-5 - 1% AEP Post development flood map, 1% AEP + 45%CC (1 in 100yr + CC)

Table 4.2 below shows a summary of the modelled flood levels in the proposed scenario:

Proposed Development				
Fluvial Flood Event	Site	Lowest site levels/mAOD	Modelled Water level /mAOD	Flood depth/mm
1% AEP	Site 1	119.55	119.732	182
	Site 2	119.10	n/a	n/a
	Site 3	121.15	n/a	n/a
1% AEP +45% CC	Site 1	119.55	119.789	239
	Site 2	119.10	119.213	113
	Site 3	121.15	n/a	n/a
0.1% AEP	Site 1	119.55	119.829	279
	Site 2	119.10	119.257	157
	Site 3	121.15	n/a	n/a

Table 4-2 - Summary of Modelled Flood Levels for Sites 1, 2 and 3 (Proposed Development)

The modelled flood depths on Site 1 are 182mm in the 1%AEP event and 239mm in the 1%AEP +45% climate change event. The flood depth is 113mm on part of Site 2 in the 1%AEP+45% climate change scenario. Site 3 is unaffected in the modelled flood scenarios.

4.4 BLOCKAGE SCENARIOS

The analysis of the culvert blockage scenarios have shown that the increases in flood risk for the 30% and 67% culvert blockage scenarios are negligible compared to the existing and proposed scenarios. Table 4.3 below shows a summary of the flood levels during the modelled culvert blockage scenarios:

BLOCKAGE SCENARIO			
Fluvial Flood Event	% culvert blockage	Site	Modelled Water level /mAOD
1% AEP +45% CC	30%	Site 1	119.737
		Site 2	n/a
		Site 3	n/a
1% AEP +45% CC	67%	Site 1	119.789
		Site 2	119.213
		Site 3	n/a

Table 4-3 - Summary of Modelled Flood Levels for Sites 1, 2 and 3 (Blockage Scenario)

4.5 THIRD PARTY IMPACTS

TAN15 requires that proposed development should not increase the flood risk to others (third parties). The development was previously utilised for residential development and this has since been demolished and the site is currently brownfield. The total footprint of the proposed development is contained within the existing boundary of the brownfield site and there are no major ground works proposed which alter the ground elevations on site. Therefore, the risk to third parties as a result of redevelopment of these sites is “Low” and no further mitigation is deemed to be required.

4.6 MITIGATION MEASURES

The flood modelling has identified that one property partially lies within the 1% AEP extent therefore mitigation is required to raise the property above the maximum flood level. Based on detailed hydraulic modelling elevations, the following measures are recommended to ensure that the proposed development is safe and acceptable in respect to flooding:

- Finished floor levels for the property within Site 1 and Site 2 partially at risk of flooding in the 1% and 1%AEP+45% climate change scenarios should be designed with raised floor levels. It is recommended to raise the floor levels of those properties by 150mm above the modelled 1%AEP+45% climate change to ensure that those properties remain unaffected by internal flooding in that flood event for the lifetime of the development. The proposed floor levels will also ensure that the proposed developments are not affected by the 1000 year fluvial flood events. The proposed floor levels will also ensure that any risk of groundwater flooding is eliminated. Table 4.4 below shows a summary of the proposed floor levels for Sites 1, 2 and 3:

Flood event	Site	Lowest site levels/mAOD	Modelled flood level /mAOD	Recommended floor level /mAOD
1%AEP	1	119.55	119.732	119.939
	2	119.10	n/a	119.363
	3	121.15	n/a	As existing ground level + 150mm
1% AEP+45% AEP	1	119.55	119.789	119.939
	2	119.10	119.213	119.363
	3	121.15	n/a	As existing ground level + 150mm
0.1% AEP	1	119.55	119.829	119.939
	2	119.10	119.257	119.363
	3	121.15	n/a	As existing ground level + 150mm

Table 4-4 - Summary of Recommended Floor Levels for Sites 1, 2 and 3 (Proposed Development)

The following should also be implemented:

- The residents need to be made aware of local flood risk and flood risk management measures.
- A Flood Action Plan should be developed and adopted to ensure the correct action is taken in the event of a flood alert being issued. This should include details of the safe access and egress which is available to the north east of the site where there is no flooding predicted. Escape/evacuation routes are required to be operational under all conditions.
- It is recommended to incorporate flood resilient and resistant measures to the proposed buildings on Sites 1 and 2. Development should be designed to minimise structural damage during a flooding event and be made to be flood proof to enable it to be returned to its prime use quickly in the aftermath of the flood

5 DRAINAGE PROPOSALS

5.1 FOUL DRAINAGE

The foul drainage disposal is proposed to be in compliance with the requirements of Building Regulations 2010 Part H (2015 Edition), Drainage and Waste Disposal and Sewers for Adoption 7th Edition.

Part H1 of the above document contains the following requirements:

“An adequate system of drainage shall be provided to carry foul water from appliances within the building on to the following, listed in order of priority.”

- a) A public sewer or where that is not reasonably practicable,
- b) A private sewer communicating with a public sewer, or where that is not reasonably practicable,
- c) Either a septic tank which has appropriate form of secondary treatment or another wastewater treatment system; or, where that is not reasonably practicable,
- d) A cesspool

5.1.1 CONNECTION TO A PUBLIC SEWER

It is likely that the peak foul flows from the proposed development will be similar to those of its previous use.

A pre-development enquiry response has been received from DCWW, which confirmed foul flows from the proposed development can be accommodated within the public sewerage system (Appendix 7.7). DCWW advised that the flows for Site 1 should be connected to the foul sewer at or beyond manhole SJ28438215. Site 2 flows should be connected to or beyond manhole SJ28438221 and Site 3 to or beyond manhole SJ28439228.

5.2 SURFACE WATER DRAINAGE

5.2.1 SURFACE WATER DRAINAGE GUIDANCE AND POLICY

The Welsh Government Planning Policy Wales guidance states the following “*flood risk is a material planning consideration*” and the Technical Advice Note 15: Development and Flood Risk (TAN15, 2004) also states that “*surface water is a material consideration and explains that development should not create additional runoff compared with the undeveloped situation and re-development schemes should also aim to reduce run-off where possible.*”

The aim of a surface water drainage strategy is to focus on the capture and management of surface water within the site boundary and ensure compliance with the requirements and guidance of the following publications and organisations:

- Technical Advice Note (TAN) 15: Development and Flood Risk dated October 2004 issued by Welsh Government;
- Wrexham County Borough Council;
- Building Regulations 2010 (Part H3);
- Sewers for Adoption 7th Edition;
- Planning Policy Wales (Edition 10, December 2018) issued by Welsh Government;

- Wrexham County Borough Council's local planning guidance note "Management of Surface Water Generated from New Development";
- Wrexham County Borough Council Local Flood Risk Management Strategy April 2013;
- Welsh Ministers Standards for Foul Sewers and Lateral Drains;
- The new Sustainable Drainage Systems (SuDS) Manual C753, CIRIA;
- RainScape – Dwr Cymru Welsh Water; and
- SuDS Wales.

In accordance with the above, surface water drainage systems are required to consider quantity, quality, amenity and biodiversity whilst preventing any likelihood of flooding to the site or adjacent sites. Part H3 of the Building Regulations 2010 guidance recommends that surface water runoff shall discharge to one of the following, listed in order of priority:

- Discharge to the ground
- Discharge to a surface water body
- Discharge to a surface water sewer
- To a combined sewer where there are absolutely no other options and only where agreed in advance with the relevant sewerage undertaker.

It is necessary to identify the most appropriate method of controlling and discharging surface water.

The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

5.3 DISCHARGE TO THE GROUND

As mentioned in Section 2 of this report, there is no soakaway test information available for the site. It is therefore recommended to undertake BRE365 soakaway tests prior to detailed design stage for this development. At this stage, use of infiltration techniques to drain the site is therefore discounted until its suitability can be proven

5.4 DISCHARGE TO SURFACE WATER BODY

Assuming that use of infiltration techniques is not suitable, the next option in order of priority is to consider discharge to a surface water body. The nearest watercourse to the site is the Rhosymedre Brook which flows in a southerly direction and lies approximately 250m to the west of the site. As the watercourse is not in direct proximity to the site and there is hardstanding and residential properties between the site and the watercourse, the option to discharge to a surface water body is discounted.

5.5 DISCHARGE TO SEWER

As previously mentioned, it is not possible to discharge to an existing watercourse. The surface water will be required to discharge to the existing surface water network. The sewer records show existing surface water networks adjacent to the proposed development site, indicating that the existing properties in the wider area do not drain to the ground via infiltration. The DCWW surface water sewers appear to be the most appropriate means to discharge surface water in this area.

5.6 EXISTING GREENFIELD RUNOFF RATE

The surface water drainage system for the development will discharge to the existing sewer network at a maximum rate to be confirmed with Welsh Water.

Return Period	Sites 1 and 2 Existing Discharge Rates (l/s)	Site 3 Existing Discharge Rates (l/s)
Qbar	0.5	0.3
1 in 30 year	0.9	0.5
1 in 100 year	1.1	0.6

Table 5-1 - Summary of Existing greenfield discharge rates for Sites 1, 2 and 3

The calculations are shown in Appendix 7.9 of this report.

5.7 PROPOSED DISCHARGE RATE

In order to reduce the impact of developments on existing surface water drainage infrastructure, run-off rates for all brownfield sites should be as close as is practicably possible to the Greenfield run-off rate which in this instance is 0.5 l/s for sites 1 and 2 and 0.3l/s for site 3.

- Given the proposed development is situated within a built-up area, it is not recommended to install a drainage system which has any potential to increase flood risk elsewhere.
- HR Wallingford Civil Engineering and Environmental Hydraulics Organisation states that: “Where flow rates are less than 5l/s consents are usually set at 5l/s if blockages from vegetation and other materials is possible”.

In light of the above, a discharge rate of 5l/s is proposed for the development site. This is in accordance with the guidelines provided by WCBC’s LLFA as shown in the document titled “*Management of Surface Water Generated from New Development*”.

5.8 SCHEME PROPOSALS

As the watercourse is not in direct proximity to the development and there is hardstanding and residential properties between the site and the watercourse, there is not a practical option to discharge surface water directly into the watercourse.

Sites 1 and 2

A number of sewers will need to be abandoned and diverted as part of the development to accommodate the new properties:

- It is proposed to divert the 150mm foul sewer which runs from northwest to southeast to the north of Site 1, this is illustrated on drawing DR-70049679-001 which is contained within Appendix 7.10.
- The 100mm foul sewer located to the east of Site 2 will be required to be diverted. It is proposed to connect this sewer into a new manhole on the 225mm sewer located further to the east.
- A new surface water connection has been proposed which will manage surface water flows from Sites 1 and 2 connect directly into the surface water sewer running along Hampden Way.

Site 3

It has been proposed to abandon all the existing foul and surface water sewers currently within the site boundary. A new surface water and foul sewer arrangement has been proposed which will connect into the existing surface sewer on Hampden Way to the south. This is highlighted on drawing DR-70049679-002 which is contained within Appendix 7.10.

Surface water

The surface water drainage system should be designed in accordance with all statutory standards with all surface water flows up to a 1 in 100-year storm event plus climate change allowance attenuated on site. This discharge rate is subject to confirmation with the relevant statutory authority (DCWW) before detail design. The calculations for each area are shown in Appendix 7.9.

The attenuation requirements have been determined using Cause Flow+ software for the 100 year + 40% climate change events. It has been calculated that Sites 1 and 2 require a storage volume of approximately 55m³ which would provide storage for the impermeable area, subject to detailed design. Indicative details are shown on drawing DR-70049679-001 which is contained within Appendix 7.10.

Site 3 requires attenuation of approximately 25m³ to account for the impermeable areas. Again, this would be subject to detailed design. Indicative details are shown on drawing DR-70049679-001 which is contained within Appendix 7.10.

Although deemed unlikely in this case, following soakaway testing to BRE365 criteria, it may be possible to review the size of the required attenuation and if it is found that the ground is suitable for infiltration then possibly reduce the required volume by utilising a partial infiltration based system.

5.9 WATER QUALITY

The new Suds Manual (CIRIA C753, November 2015) introduced a slightly different approach compared to the previous version for the water quality management of surface water. The Manual describes risks posed by the surface water runoff to the receiving environment as a function of:

- The pollution hazard at a particular site (i.e. the pollution source).
- The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels (i.e. the pollutant pathway).
- The sensitivity of the receiving environment (the environment receptor).

Table 26.2 of the SuDS Manual C753 assigns pollution hazard indices for different land use classification. The roof water and car parking areas pollution have hazard levels ranging from “Very Low” to “Low”, with “Low” levels of contamination. The proposed sump gullies and catch pit manholes are deemed to be sufficient to remove the suspended sediments from the roof and car park surface water for a development of this size and nature.

5.10 RESIDUAL RISKS AND EXCEEDANCE FLOWS AND RUNOFF IN EXCESS OF DESIGN CRITERIA

The outline surface water drainage scheme for this development is proposed to comply with the requirements of Sewers for Adoption, i.e. no surcharge in the 1 in 1 year event and no flooding in the 1 in 30 year event.

It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible. It is practicable to minimise the risk by careful design of the layout of the development such that internal flooding is avoided. Areas of hardstanding can be laid to fall away from buildings with flows directed to areas where damage and disruption to buildings, assets and operations will be minimized.

The landscaped areas could also be used to accommodate residual flows beyond the design 1 in 100 year plus climate change event, without causing flooding elsewhere.

5.11 GENERAL MAINTENANCE REGIMES

The surface water drainage proposals for this site should include the following maintenance measures:

- Cleaning the sump of the gullies and any linear drainage channels to improve the quality of the water.
- Cleaning the sump of the roof sump gullies to improve the quality of water.
- Cleaning and maintenance of flow control device and its sump to maintain effective drainage.
- Cleaning and maintenance of the foul pump chamber to maintain effective drainage (if a foul pumping station is required).
- Inspection, cleaning and maintenance of the below ground attenuation systems to remove any silt and debris in accordance with the manufacturer's instructions.

The frequency of the cleaning and maintenance inspections will be agreed with the site owner / operator's maintenance team.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSION

Detailed flood modelling was undertaken as the development was observed to partially be located within Flood Zone C2, in accordance with NRW's current Development Advice Maps. Although the flood modelling confirmed that one of the properties in Site 1 is partially located within the 1% AEP, mitigation has been proposed in the form of raising the finished flood level remove the property outside of the 1% AEP.

Raised floor levels 150mm above the 1% AEP+45% climate change will ensure that the proposed properties remain unaffected by internal fluvial flooding for the lifetime of the development in the above events and in the 1000 year events. The blockage analysis undertaken has shown "Negligible" increase in fluvial flood risk.

The proposed development involves redevelopment of land previously used for residential purposes and there is no increase in the vulnerability class of the development ("Highly Vulnerable"). The proposed development will not cause an increase in flood risk elsewhere, and although the flood zone is currently given as C2, this development is considered to be appropriate at this location.

The Flood Consequence Assessment has also identified the risk of flooding from surface water, sewers, highway, canals, reservoir and groundwater to be "Low".

Subject to further surveys and finalised agreements with DCWW, NRW and WCBC's LLFA, suitable discharge locations are available for the disposal of foul effluent and surface water run-off generated from the proposed development.

The proposed development is not expected to be affected by general objections in respect to draining the site. There will be suitable conditions imposed to ensure that the drainage proposals are designed and constructed in accordance with relevant statutory requirements, including Building Regulations 2010, Sewers for Adoption and the requirements of WCBC's surface water management guidance.

6.2 RECOMMENDATIONS

Before the detailed design stage, it is recommended that soakaway testing is undertaken in accordance with BRE365 guidance to verify the on-site infiltration potential of the underlying ground. Further testing of the ground conditions, monitoring of the ground water movement and presence of any potential ground contamination is also recommended before detail design.

The diversion of the existing sewers will require further consultations with DCWW.

7 APPENDICIES

7.1 TOPOGRAPHIC SURVEY

7.2 DEVELOPMENT PLAN

7.3 SEWER RECORDS PROVIDED BY DCWW

7.4 INVEK DRAINAGE SURVEY

7.5 CONSULTATION WITH WREXHAM BOROUGH COUNCIL (WCBC)

7.6 CONSULTATION WITH NATURAL RESOURCES WALES (NRW)

7.7 CONSULTATION WITH DWR CYMRU WELSH WATER (DCWW)

7.8 TECHNICAL NOTE – WSP HYDRAULIC MODELLING

7.9 CAUSEWAY FLOW CALCULATIONS

7.10 INDICATIVE DRAINAGE PROPOSALS



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