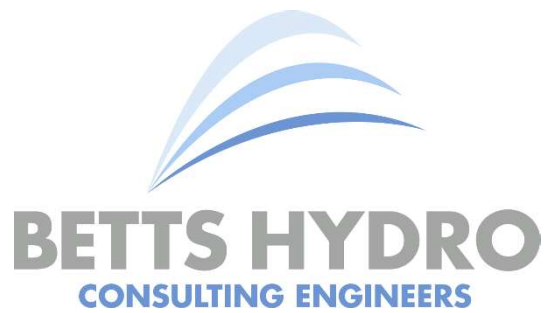




**LAND OFF ROSSETT ROAD
ROSSETT**

FLOOD CONSEQUENCE ASSESSMENT



For

Castle Green
Unit 20
St Asaph Business Park
St Asaph
Denbighshire
LL17 0LJ

The logo for Castle Green, featuring the text 'Castle' followed by four vertical bars of increasing height and then 'Green', all in white on a dark green background.

Castle |||| Green

AUGUST 2021

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LAND OFF ROSSETT ROAD ROSSETT

FLOOD CONSEQUENCE ASSESSMENT

Document Tracking Sheet

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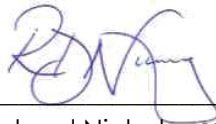
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EXECUTIVE SUMMARY

This Flood Consequence Assessment and Drainage Management Strategy was commissioned by Castle Green, referred to hereafter as 'the client'. This report has been prepared to support a planning application for residential development on land off Rossett Road in Rossett. The site is located mostly within Flood Zone A on the Development Advice Map, with a small slither of Flood Zone B shown to encroach into the northern development parcel. The proposals are residential in nature, which is classified as 'highly vulnerable' within Welsh Government Planning Policy and this nature of development is acceptable when located within Flood Zone A and B (in accordance with TAN15).

The Development Advice Map notes that most of site is located within Flood Zone A and means there is little or no fluvial flood risk. The small part of the site shown to be in Flood Zone B is an area which historically flooded, and this assessment has concluded that this historical flooding was likely to be associated with the existing land drainage system to the north of the site. It should be noted that no historical flooding has been identified through our various consultations as part of this assessment.

This Flood Consequence Assessment has reviewed all the potential sources of flood risk both to and resulting from the development proposals, including fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources. The nearest Main River to the site is the River Alyn which is located 180m to the south of site, the Alyn flows east and eventually outfalls into the River Dee. Although the potential direct flood risk from the south is low, discussion with NRW has identified that there is the potential for upstream exceedance and routing towards the site in the extreme 1 in 1000yr plus 30% Climate Change event and the residual 1 in 100yr plus 80% blockage event.

A separate Hydraulic Modelling Assessment has been undertaken to assess the potential flood risk more accurately. The hydraulic modelling work was commissioned to help steer the mitigation measures required to ensure the development remains flood free for its lifetime and to help identify the potential impacts, that the requirement mitigation levels might have elsewhere in the floodplain (including changes to the flood flow route where this is identified). To conclude, the site remains flood free in all events up to and including the 0.1% AEP (1 in 1000 year) event, 1% AEP (1 in 100 year) plus 45% CC event and in the 1% AEP plus 20% climate change with 25% blockage at Chester Road bridge. Flooding does occur onsite in the 0.1% AEP with 25% blockage at Chester Road bridge with onsite flood depths of up to 0.32m in this residual event.

The hydraulic modelling assessment has also addressed the post development scenario in the key design events. As summarised, the proposed scenario hydraulic modelling has demonstrated that flood flows can continue to pass through the site via the proposed roads in extreme events. The proposed dwelling levels have also been set to channel flood flow through the site in the extreme event towards a basin within the POS area within the Southern Development Parcel.

As part of the northern parcel is located in Flood Zone B, it has been assumed that this historical flooding must be associated with the and drainage system adjacent to the north. This system takes overland flow from the site and surrounding land drainage systems, along with some flows from the formal surface water infrastructure serving the residential development to the

west of the site. Historically due to prolonged rainfall events, downstream blockages or inconsistent maintenance, this system is thought to have exceeded capacity and due to the existing low-lying ground levels in the northern part of site some onsite flooding was assumed to have occurred.

Overall, the site is at 'low' flood risk from most of the flood sources reviewed including surface water flooding. There are some parts of the site more susceptible to flooding due to the existing topography and the existing land drainage ditch systems although the planning proposals show that those areas at greatest risk from surface water (or neighbouring the land drainage system) will consist of minimum development where practical. Residual flood risks can however be reduced and effectively managed as part of the proposals, through the implementation of mitigation measures proposed, along with ensuring space for water is incorporated into the development layout.

This Flood Consequence Assessment is commensurate with the site and in summary, the development can be considered appropriate in accordance with TAN15, providing the mitigation measures proposed within are included within the development proposals.

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Specialist Software

-  Flood Estimation Handbook FEH– Determination of Catchment Descriptors and depths of rainfall.
-  MicroDrainage WinDES (v.14.1) – Calculation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability
BGS	British Geological Survey
CC	Climate Change
CFMP	Catchment Flood Management Plan
DAM	Development Advice Map
FCA	Flood Consequence Assessment
FEH	Flood Estimation Handbook
Ha	Hectare
LDP	Local Development Plan
LFRDP	Local Flood Risk Development Plan
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
NGR	National Grid Reference
NRW	National Resources Wales
NSRI	National Soil Resource Institute
OS	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
PPW	Planning Policy Wales
QSE	Quick Storage Estimate
SFCA	Strategic Flood Consequence Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan

TAN15	Technical Advice Note 15
UKCIP	United Kingdom Climate Impacts Programme
WW	Welsh Water
WCBC	Wrexham County Borough Council

1.0 INTRODUCTION

1.1 Planning Policy Context

- 1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. Planning Policy Wales (PPW) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the PPW, Technical Advice Note 15, (TAN15) 'Development and Flood Risk' issued in July 2004.

Technical Advice Note 15

- 1.1.2 TAN15 provides technical guidance to supplement the policy's set out in PPW with regards to 'development and flood risk', a framework is provided to enable new development to be considered appropriately with regards to risks from fluvial and tidal flooding along with risks associated with additional run-off from development in all locations (see **Appendix A**).

Sustainable Drainage Approving Body (SAB) Requirements

- 1.1.3 From January 2019, all new developments of at least 2 properties or over 100m² in Wales will be required to have Sustainable Drainage Systems (SuDS) to manage surface water run-off generated by the proposals. These SuDS must be designed and constructed in accordance with the Welsh Government standards for sustainable drainage. Schedule 3 of the Flood and Water Management Act 2010 (FWMA) establishes Wrexham County Borough Council as a SuDS Approving Body (SAB).
- 1.1.4 The SAB have statutory responsibility for approving and where appropriate adopting the proposed drainage systems on new developments. The SAB application is undertaken separately to the planning permissions and developers are required to obtain both planning approval and SAB approval prior to commencement of any proposed construction works.
- 1.1.5 This Flood Consequence Assessment and Drainage Management Strategy is to support the proposed planning application and full SAB approval will need to be sought separately by the developer once more details are available for the drainage proposals. As part of the proposals initial pre-application SAB discussion is underway to identify their preferences for the surface water management regime and those SuDS features being proposed.

1.2 Site Context

- 1.2.1 This Flood Consequence Assessment (FCA) has been prepared to support an outline planning application for residential development on land off Rossett Road in Rossett. The site is shown to be located within Flood Zone A and partly within Flood Zone B on the Development Advice Map (DAM).
- 1.2.2 A FCA is required to justify that the development is appropriate with reference to TAN15, this report will provide justification that;

- The consequences of flooding to the development (and elsewhere) have been fully considered and mitigated for during the lifetime of the development.
- No increase in flooding will occur to the development site or surrounding area due to the proposals including flooding from surface water and sewers.

1.3 Consultation

- 1.3.1 The report has been prepared in consultation with Natural Resources Wales (NRW), Welsh Water (WW) and Wrexham County Borough Council (WCBC). The consultations responses (where received) have been appended and can be seen in **Appendix B, C and D** respectively.
- 1.3.2 The Local Planning Authority (LPA), Wrexham County Borough Council, will make the final decision with regards to any planning permissions. The LPA should however consult with NRW who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications. WCBC also acts as the Lead Local Flood Authority and will be a key statutory consultee on the application in terms of flood risk and drainage.

2.0 EXISTING SITE BACKGROUND

2.1 Location

- 2.1.1 The site is accessed off Rossett Road in Rossett. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 337284, N: 357242 and the nearest postcode is LL12 0DZ (full location plan is included in **Appendix E**). The total site covers 6.27ha and is divided into two separate parcels by Rossett Road. The Northern Development Parcel covers 2.83ha and the Southern Development Parcel covers 3.44ha. The parcels are edged in red in **Figure 1**. The site is bounded to the north, east and south by undeveloped agricultural land. To the west of site however is the main village of Rossett with both residential and commercial development.



2.2 Existing and Historical Land Use

- 2.2.1 The site is undeveloped at present and comprises of low-density vegetation with some taller shrubs along the site boundaries. The site is currently used for agricultural purposes, and no other historical uses have been identified as part of this assessment. Review of the online historic mapping identified a historic land drain to be located within the

boundary of the Northern Development Parcel. The land drain flows north into a pond which is understood to be fed by overland run-off from the site and the surrounding undeveloped agricultural land.

2.3 Topography

- 2.3.1 TAN15 requires all sources of flood risk to be considered and analysed with reference to the current levels of the site, a full topographical survey has been carried out and is included in **Appendix F**. The survey identified the Northern Development Parcel falls from the south-western boundary at a level of 13.5mAOD, down towards the northern corner at a level of 11.25mAOD. The Southern Development Parcel also falls from the south-west at a level of 14.30mAOD down to a level of 12.85mAOD adjacent to the north-eastern corner (adjacent to Rossett Road and Lane Farm).

2.4 Site Walkover

- 2.4.1 A site walkover was undertaken by Betts Hydro in January 2021 after the region experience heavy rainfall. During the site walkover there was some areas of standing water and saturated ground in existing low-lying areas identified by the topographic survey, as shown in **Figure 2 (Appendix G)**.



2.5 Justification for Development

- 2.5.1 Planning Policy Wales (5th Ed. – November 2012) states that the Welsh Government is committed to promoting 'sustainable development' by providing for homes, infrastructure, investment and jobs in a way which is consistent with sustainable development principles PPW Sec. 2.2).
- 2.5.2 The FCA will be considerate to the nature and scale of the proposals and will review flood risk to and from the development along with considering any appropriate mitigation measures based on the identified risks.
- 2.5.3 The development proposals are of a Highly Vulnerable nature and will be located mostly within Flood Zone A with a small section of the Northern Development Parcel being located within Flood Zone B. Mitigation measures have been proposed to safeguard the development against any potential residential flood risks identified and it is considered that the proposals can be justified in accordance with TAN15 Guidance.

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

- 3.1.1 This FCA has been prepared to support a planning application for residential development, on land to the north and south of Rossett Road in Rossett. Based on the planning layout (below), the proposals will be complete with access, footpaths, car parking, external works, landscaping, external services, and drainage (**Figure 3**).



Figure 3: Proposed Planning Layout (Macbryde, 2021)

4.0 TECHNICAL ADVICE NOTE 15 (TAN15)

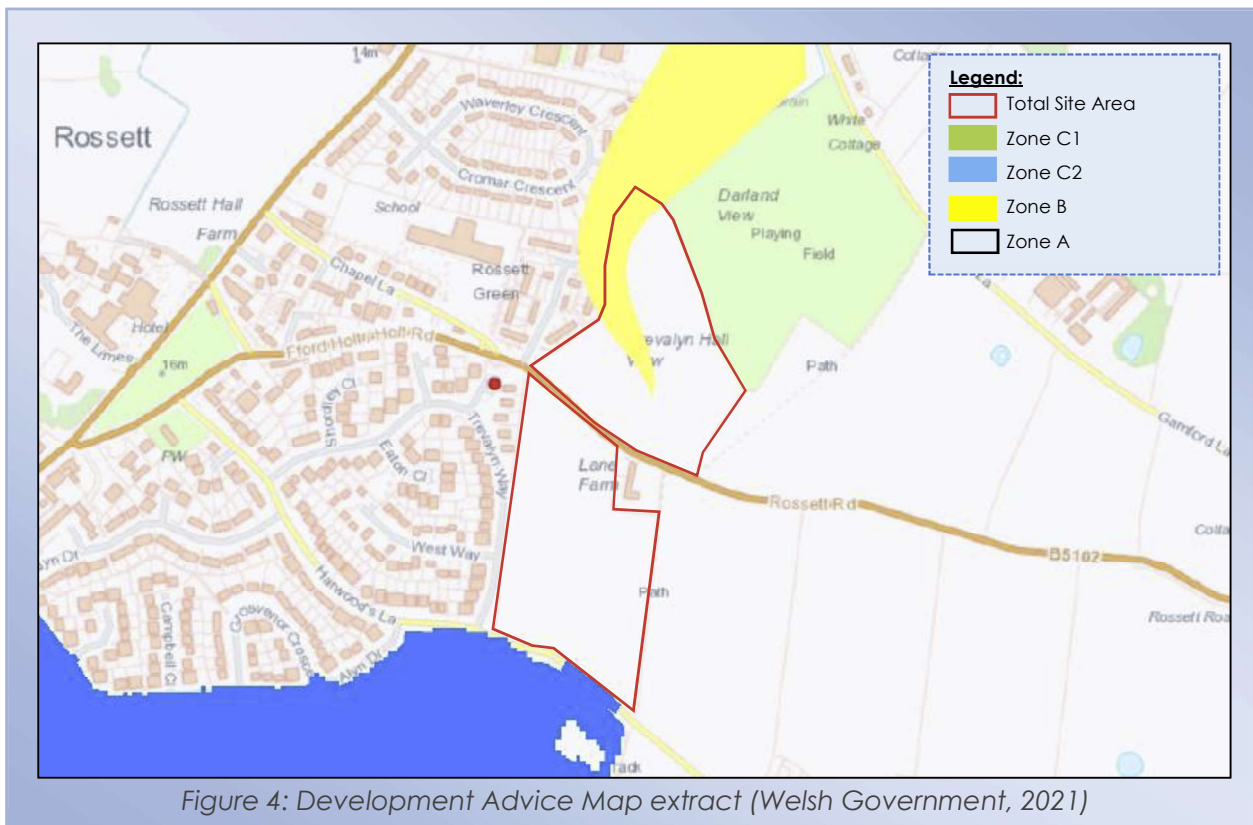
4.1 Flood Zone Classification

4.1.1 The Welsh Government Development Advice Map (DAM) is to be utilised when considering and determining flood risk associated with planning developments within Wales, these maps are based on extreme flood events outlined by the Natural Resources Wales (NRW) and British Geological Survey (BGS) data (TAN15). The DAM (**Appendix B**) identifies three keys 'Flood Zones' for consideration, which are:

- **Flood Zone A:** Areas considered to be at little or no risk of fluvial/tidal flooding.
- **Flood Zone B:** Areas known to have historically flooded based on sedimentary evidence deposits.
- **Flood Zone C:** Areas considered to be located on floodplain based on EA extreme flood outline data (equal to or greater than 0.1% fluvial/tidal flooding). This zone is subdivided into:

***Zone C1** - Areas considered to be developed and served by significant infrastructure (flood defences).*

***Zone C2** - Areas considered to be located within natural floodplain without significant flood defences.*



4.1.2 The overall site is mostly located within Flood Zone A on the DAM, as illustrated in **Figure 4**. Flood Zone A is an area considered to be at little/no fluvial and/or tidal flood risk. The Northern Development Parcel is however shown to be partially located within Flood Zone B. Flood Zone B is an area known to have historically flooded based on sedimentary evidence deposits.

- 4.1.3 Further investigation with regards to the Flood Zone B area has identified that this part of the site suffered from exceedance flooding associated with the historic land drain during extreme and prolonged rainfall events. Overland flows from the site and the surrounding undeveloped agricultural land enters the land drainage ditch located within the northern corner of the Northern Development Parcel during these extreme and prolonged rainfall events and when the land onsite is saturated, the natural drainage ditch reaches capacity downstream, so the flows exceed the channel onto the low-lying land around. This is understood to be why a small part of the site is shown to be in Flood Zone B.

4.2 Category of Development

- 4.2.1 TAN15 states that some development types may not be considered 'acceptable' based on their vulnerability to the consequences of flooding, identified on the DAM. The vulnerability of different land uses is described in detail in TAN15 however there are three key categories as summarised in **Table 1**. The development proposals are 'highly vulnerable' in nature, based on the planning proposals and TAN15 guidance above.

DEVELOPMENT CATEGORY	DESCRIPTION	TYPES
Emergency Services	Facilities which need to remain operational and accessible at all times.	❖ Hospitals & Ambulance Stations, ❖ Fire & Police Stations, ❖ Coastguard Stations.
Highly Vulnerable	Development where the ability of occupants to decide on whether they wish to accept the risk and manage the consequences associated with flooding is limited.	❖ Residential Developments, Hotels, Caravan Parks, Public Buildings. ❖ Power Stations, Chemical Plants, Waste Disposal.
Less Vulnerable	Development where the ability of occupants to decide on whether they wish to accept the risks associated with flooding is greater than 'highly vulnerable category'.	❖ General Industrial, ❖ Commercial Developments, ❖ Utilities Infrastructure, ❖ Transport.

Table 1: Development Categories of Vulnerability (Source: TAN15: Section 5)

4.3 Acceptability Criteria

- 4.3.1 Various criteria are identified within TAN15 (Section 7), these are used to determine whether residential development is 'acceptable' based on the nature and scale of proposals. Appropriate management should be considered with any proposed consequences of potential flooding.
- 4.3.2 The proposals are classified as 'highly vulnerable' in accordance with TAN15 and are located within Flood Zone A and B, therefore the proposals are not at risk from fluvial/tidal flooding. In accordance with TAN15 highly vulnerable development is considered acceptable within Flood Zone A, providing surface water is appropriately managed. Section 5.0 of this report assesses flood risk and the consequences of flooding in accordance with the above.

5.0 SOURCES OF FLOOD RISK

5.1 Fluvial Flood Risk

- 5.1.1 Information relating to the flood risk at the site has been obtained from the Welsh Government's DAM and the Natural Resources Wales (NRW) online Flood Mapping (see **Appendix B** for full details). Based on the online flood mapping the site is at low risk from flooding associated with fluvial/tidal sources.
- 5.1.2 The DAM notes the site is located mostly within Flood Zone A (with a small portion in Flood Zone B. This section of the report will however refer to the potential flood risk in terms of the more accurate NRW identified Flood Zones (Flood Zones 1, 2 and 3). NRW more accurately identifies the Flood Zones as:
- Flood Zone 1 as little or no flood risk.
 - Flood Zone 2 is the extent of the 1 in 1000yr return period.
 - Flood Zone 3 is the extent of the 1 in 100yr return period.
- Based on this mapping (**Appendix B**), the site is shown to be located wholly within Flood Zone 1 and would therefore be considered at little or no fluvial flood risk.
- 5.1.3 The long-term flood risk mapping data (also provided by NRW) has however identified some parts of the site to be at low risk from fluvial flood risk as shown in **Figure 5**. The mapping classifies areas at low risk as being at risk of flooding between the 1 in 100 year and 1 in 1000 year return period event.

Main River(s)

- 5.1.4 The nearest Main River to the site is the River Alyn which is located 180m to the south of the Southern Development Parcel. The River Alyn flows east and eventually outfalls into the River Dee located 2.8km east of site. The flood risk associated with these sources is mostly very low to low given their location in relation to site and the wider catchment topography (see mapping in **Appendix B**).
- 5.1.5 Based on the mapping, it is understood that the exceedance in the upstream River Alyn channel, has the potential to direct naturally with ground levels towards the site via the adjacent residential development (Trevalyn Way). Flows would potentially enter the site on the western boundary in some events and convey through the site, from the southern parcel to the northern parcel, with the natural low-lying levels before exiting the site into the land drainage network to the north.
- 5.1.6 When the existing topographic levels onsite in those areas shown to be at low risk from fluvial flooding are considered these low-risk areas coincide with the natural conveyance routes (low-lying corridors) present through the site. It should also be noted that this online flood mapping data only considers the existing ground levels (LiDAR) and direct rainfall within the catchment to identify potential flood extents. There are other elements which would potentially influence the level of flooding that are not considered by this type of mapping including the existing ground conditions, formal or land drainage in place or any engineering changes which would result as part of future development.

National Resources Wales Flood Data Review

- 5.1.7 NRW have been consulted to ascertain the potential flood risk to the site from the River Alyn in these potential exceedance events (see Rossett Road Flood Risk Study within **Appendix B**). They have provided additional information on the flood risk. The modelling outputs provided by NRW identify Top Water Levels (TWL) onsite during key flood events.
- 5.1.8 The information provided identifies that the site remains flood free during the defended and undefended 1 in 100yr, 1 in 1000yr and 1 in 100yr plus 30% Climate Change (CC) events (see mapping outputs included within **Appendix B**). The site is however identified to be at low risk of flooding during the more extreme defended 1 in 1000yr plus 30% CC event and in the residual 1 in 100yr plus 80% blockage (Chester Road Bridge) event.

1 in 1000yr plus 30% Climate Change Event

- 5.1.9 During the extreme 1 in 1000yr plus 30%CC event, flows are shown to exceed the River Alyn upstream and convey towards the site through the residential development to the west. It is also understood that flows enter the site from the south via Hardwood's Lane. The TWL's identified by NRW's dataset (illustrated in **Figure 5**) during the 1 in 1000yr plus 30%CC event have been compared against the existing ground levels identified by the topographic survey.
- 5.1.10 **Table 2** shows the existing levels against the potential TWL's in the 1 in 1000yr plus 30%CC event and has identified that the site is generally at risk of flood depths between 10mm to 80mm. There is however a naturally low-lying area within the Northern Development Parcel (**Node D**) which based on the TWLs compared to existing ground potentially has flood depths up to 290mm.
- 5.1.11 The NRW model provided however only includes data for simulating the 1 in 100yr and 1 in 1000yr events, with up to 30% allowance for CC. The current guidelines for CC on the River Dee catchment (in which the River Alyn falls under) is for an allowance of 25% for the Higher Central (70th percentile) estimate and 45% for the Upper (90th percentile) estimate on top of the 1 in 100yr return period event. To accurately assess the flood risk to the site both in the present and future, simulations are required in the 1 in 100yr and 1000yr event with up to 45% allowance for CC. In order to accurately understand the flood risk posed by the River Alyn, a hydraulic modelling assessment is currently being undertaken.



Figure 5: Defended 1 in 1000yr plus 30%CC Flood Risk Map Extract (NRW and Betts Hydro, 2021)

Node	Flood Risk based on the Nodes in Figure 5 in the 1 in 1000yr plus 30% CC event				
	A	B	C	D	E
TWL (mAOD)	12.94	12.85	12.94	12.14	11.70
Existing Ground Level (mAOD)	12.89	12.80	12.86	11.85	11.69
Flood Depth (mm)	50mm	50mm	80mm	290mm	10mm

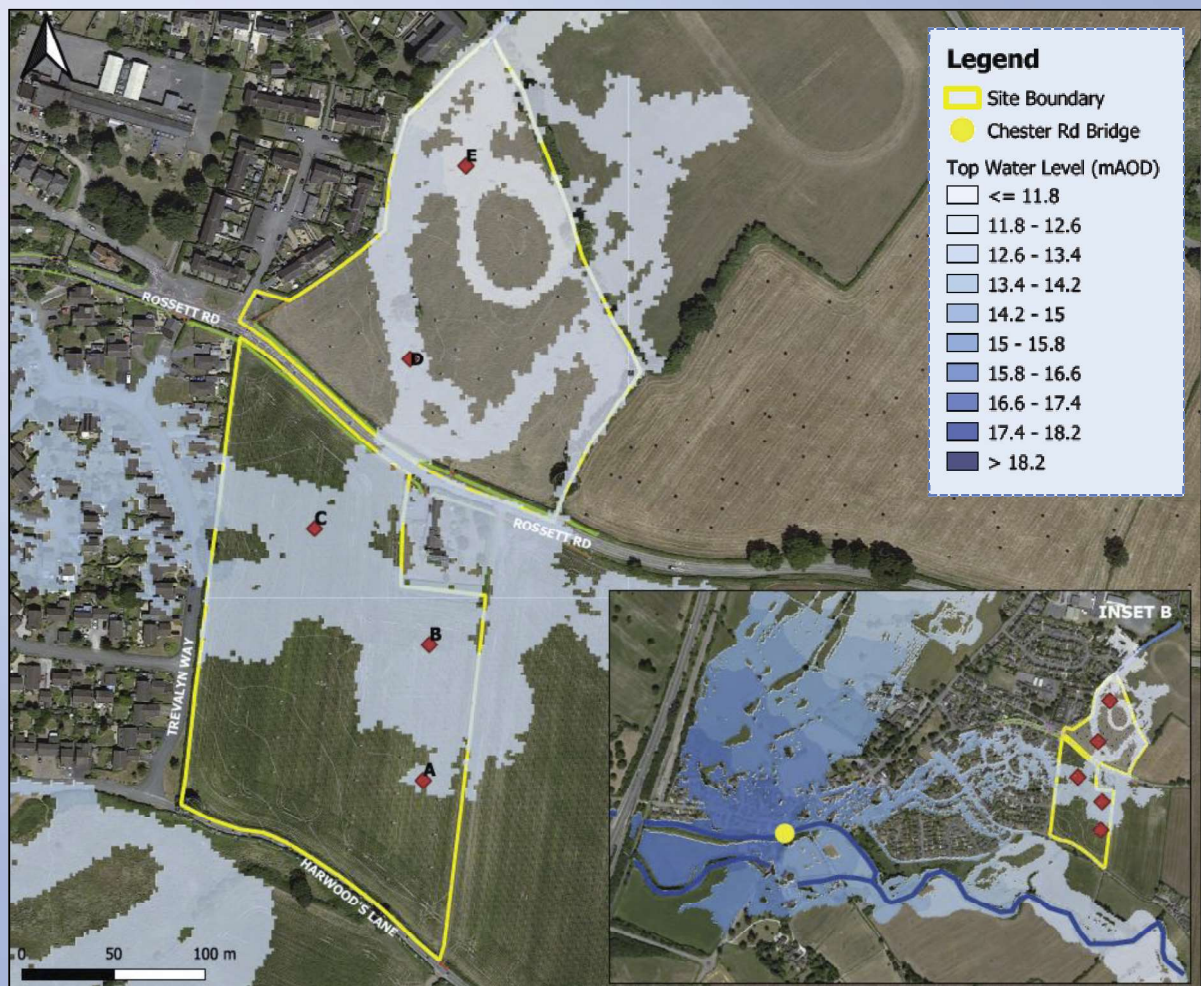
Table 2: Proposed Flood Risk to the Development Site in the 1 in 1000yr plus 30% CC (Betts Hydro, 2021)

1 in 100yr plus 80% Blockage Event

5.1.12 During the residual 1 in 100yr event plus 80% blockage of Chester Road Bridge, both the Northern and Southern Development Parcel are shown to be impacted by low levels of flooding, as shown within **Figure 6**. Exceedance in the upstream channel of the River Alyn, has the potential to direct naturally towards the site area via the adjacent residential development Trealyn Way. Flows would potentially enter the site on the western boundary and covey through the site, from the Southern parcel to the

Northern parcel with the natural levels before exiting into the land drainage network. This is however considered to be a residual risk event.

- 5.1.13 During this residual flood risk event the development site would be generally at risk of flood depths between 10mm to 150mm, when compared to the existing ground levels (see **Table 3**). There is however a naturally low-lying area within the Northern Development Parcel that is identified to be at risk of flood depths up to 350mm, however this is an isolated area of site and the risk to the rest of site is understood to be significantly lower.



Node	Flood Risk based on Nodes in Figure 6 in the 1 in 100yr plus 80% Blockage of Chester Road Bridge				
	A	B	C	D	E
TWL (mAOD)	12.86	12.86	13.01	12.20	11.79
Existing Ground Level (mAOD)	12.89	12.80	12.86	11.85	11.69
Flood Depth (mm)	-	60mm	150mm	350mm	10mm

Table 3: Proposed Flood Risk to the Development Site in the 1 in 100yr plus 80% Blockage of Chester Rd Bridge. (Betts Hydro, 2021)

- 5.1.14 As noted previously this flood risk mapping is based on a pre-development scenario and uses the existing ground levels to ascertain flow routes and risk. For sites such as this (undeveloped) the mapping does not consider factors such as levels changes and incorporation of formal surface water management infrastructure. These factors will often provide improvement and reduce the level of potential flood risk identified; therefore, a separate Hydraulic Modelling Assessment (included in **Appendix I**) has been undertaken to assess the potential flood risk.

Hydraulic Modelling

- 5.1.15 A separate Hydraulic Modelling Assessment has been undertaken to assess the potential flood risk more accurately. The full modelling methodology has been included within the Hydraulic Assessment report included within **Appendix I**, but this a short summary is provided subsequently for context. The hydraulic modelling work was commissioned to help steer the mitigation measures required to ensure the development remains flood free for its lifetime and to help identify the potential impacts, that the requirement mitigation levels might have elsewhere in the floodplain (including changes to the flood flow route where this is identified).

Existing Scenario

- 5.1.16 Betts Hydro has updated the NRW with the site topographical survey and the climate change allowances to meet the current standard of 25% and 45% increases over the next 100 years. To give a full picture of flood risk to the site of a wide range of annual exceedance probabilities (AEP) and scenarios have been assessed. In all simulations, the defended scenario has been used to provide the real flood risk. The following simulations have been undertaken:

- 50% AEP (1 in 2 year)
- 10% AEP (1 in 10 year)
- 5% AEP (1 in 20 year)
- 3.3% AEP (1 in 30 year)
- 2% AEP (1 in 50 year)
- 1% AEP (1 in 100 year)
- 0.1% AEP (1 in 1000 year)
- 1% AEP plus 20% climate change
- 1% AEP plus 45% climate change
- 1% AEP plus 20% climate change with 25% blockage at Chester Road bridge
- 0.1% AEP with 25% blockage at Chester Road bridge

- 5.1.17 The results (peak flood depth and flood level plans) have been presented within the Hydraulic Modelling Assessment (HYD554_ROSSETT.ROAD_HA) included within **Appendix I**. In summary, the site remains flood free in all events up to and including the 0.1% AEP (1 in 1000 year) event, 1% AEP (1 in 100 year) plus 45% CC event and in the 1% AEP plus 20% climate change with 25% blockage at Chester Road bridge. Flooding does occur onsite in the 0.1% AEP with 25% blockage at Chester Road bridge with flood depths of up to 0.32m in this residual event.

Safeguarding New Development

- 5.1.18 Based on the potential fluvial flood water levels in the extreme scenario events discussed above. As there is no onsite flooding during the design event, the proposals are to raise the FFL of the proposed dwellings 150mm above the existing ground levels.

A proposed FFL drawing has been included within **Appendix J**, which shows the FFLs for each individual property. Furthermore, the site layout has also been designed to provide overland flood flow routes through the site towards a basin located within the POS area of the Sothern Development Parcel.

5.1.19 These proposed FFL and overland flows routes have then been included within the proposed hydraulic modelling works to assess potential flood risk to others. In summary, the proposed FFLs shown in **Appendix J**, ensure the properties are flood free during the design event and they also do not increase flood risk to others.

5.1.20 Along with raising the FFL's, some developers look to incorporate other flood resilience measures to reduce the vulnerability of the proposed residential dwellings, to future residual flooding. Flood resilience measures can assist the future occupants in preparing for future flooding and the dwelling in recovering after a possible flood event.

Proposed Scenario

5.1.21 The hydraulic modelling work has also considered the post development scenario in terms of flood risk. The events identified that pose a flood risk to the site were:

 0.1% AEP with 25% blockage at Chester Road bridge

5.1.22 The results, both peak flood depth and flood levels, have been presented within the Hydraulic Modelling Assessment (HYD554_ROSSETT.ROAD_HA), included in **Appendix I**. In summary, proposed levels in the development have been designed to facilitate flood flow through the site, whilst keeping the dwellings flood free.

5.1.23 Levels in the proposed development have been designed to facilitate flood flow through the site in the 0.1% AEP (1 in 1000 year) flood with blockage. The site design directs flow water to the south of the site via lowered roads and garden areas to a basin feature within the POS area of the site, containing flood water in this event.

5.1.24 As in the existing scenario, the proposed scenario was tested with a blockage of 25% at Chester Road bridge. The proposed scenarios show flood flows entering the Southern Development Parcel via the western boundary and flooding is directed to south towards the proposed basin. In the proposed scenario there is also a reduced flood risk to the northern site area, as well as additional areas to the north of the site (including school playing fields) during the 1 in 1000yr plus blockage of 25% at Chester Road bridge.

5.1.25 The peak flood depths in the Southern Development Parcel would be approximately 0.55m in rear gardens. The basin feature within the POS is predicted to flood to a depth of 0.40m. No properties onsite are predicted to flood by more than 600mm with the majority of properties remaining flood free in accordance with TAN 15. A1.15. A full summary of the results can be found within the Hydraulic Modelling Assessment (HYD554_ROSSETT.ROAD_HA) included within **Appendix I**.

Depth Difference

- 5.1.26 A comparison of flood depth between the existing and proposed scenarios has been undertaken in the 0.1% AEP (1 in 1000 year) flood event with 25% blockage at Chester Road bridge.
- 5.1.27 As the design of the site prevents flood flow to the north of Rossett Road, it is predicted that dwellings located off Broadoaks and land to the north of the site, including the school field will no longer be at flood risk in the 0.1% AEP plus 25% climate change event. Flood risk is also shown to be removed from the farm building located adjacent to the Southern Development Parcel. These areas previously flooded to depths of 0.03m and 0.02m respectively in the 1 in 1000 year plus 25% blockage event, this event is classed as a residual risk event. Further information and mapping can be found within the Hydraulic Modelling Assessment (HYD554_ROSSETT.ROAD_HA) in **Appendix I**.
- 5.1.28 In conclusion, the proposed scenario hydraulic model has demonstrated that there is positive change in flood risk elsewhere with a reduction in the number of dwellings at risk in the residual 1 in 1000 year plus 25% blockage event as a result of flood flow being contained onsite.

Sensitivity Analysis

- 5.1.29 A sensitivity analysis was undertaken on the following key parameters in the model:
  1% AEP plus 25% Climate Change with 80% blockage of Chester Road bridge
- 5.1.30 The design event has been reviewed with an associated sensitivity test. The 20% increase in flow has been increased to 25% and the area blocked increased from 25% to 80% as requested by NRW. The site is shown to be inundated in the Southern Development Parcel with minor flooding also predicted within the Northern Development Parcel.
- 5.1.31 Flows are predicted to enter the site from the western boundary within the southern portion, similar to the 1 in 1000 year event with 25% blockage. The onsite storage basin is not shown to overtop in this event. The predicted flood level in the southern parcel is 13.53mAOD and 12.65mAODm in the northern parcel. These levels would result in onsite flood depths of 0.78m in the Southern Development Parcel and 0.45m in the Northern Development Parcel. In terms of predicted flood depths and velocities the proposed development is compliant with TAN 15 A1.15.

Land Drainage Ditch

- 5.1.32 The online mapping has also identified a land drainage ditch to be located within the northern corner of the Northern Development Parcel. The currently available flood risk mapping is based predominantly on the Main River networks or watercourses with catchments greater than 2km². The now ephemeral watercourse/land drain located within the Northern Development Parcel has a catchment of less than 1km², is not likely to have been included in the national flood modelling. It is not therefore possible to provide a quantitative assessment of potential flood risk associated with this feature, without more hydraulic modelling. A qualitative assessment of the potential flood risks can still however be provided, as below.

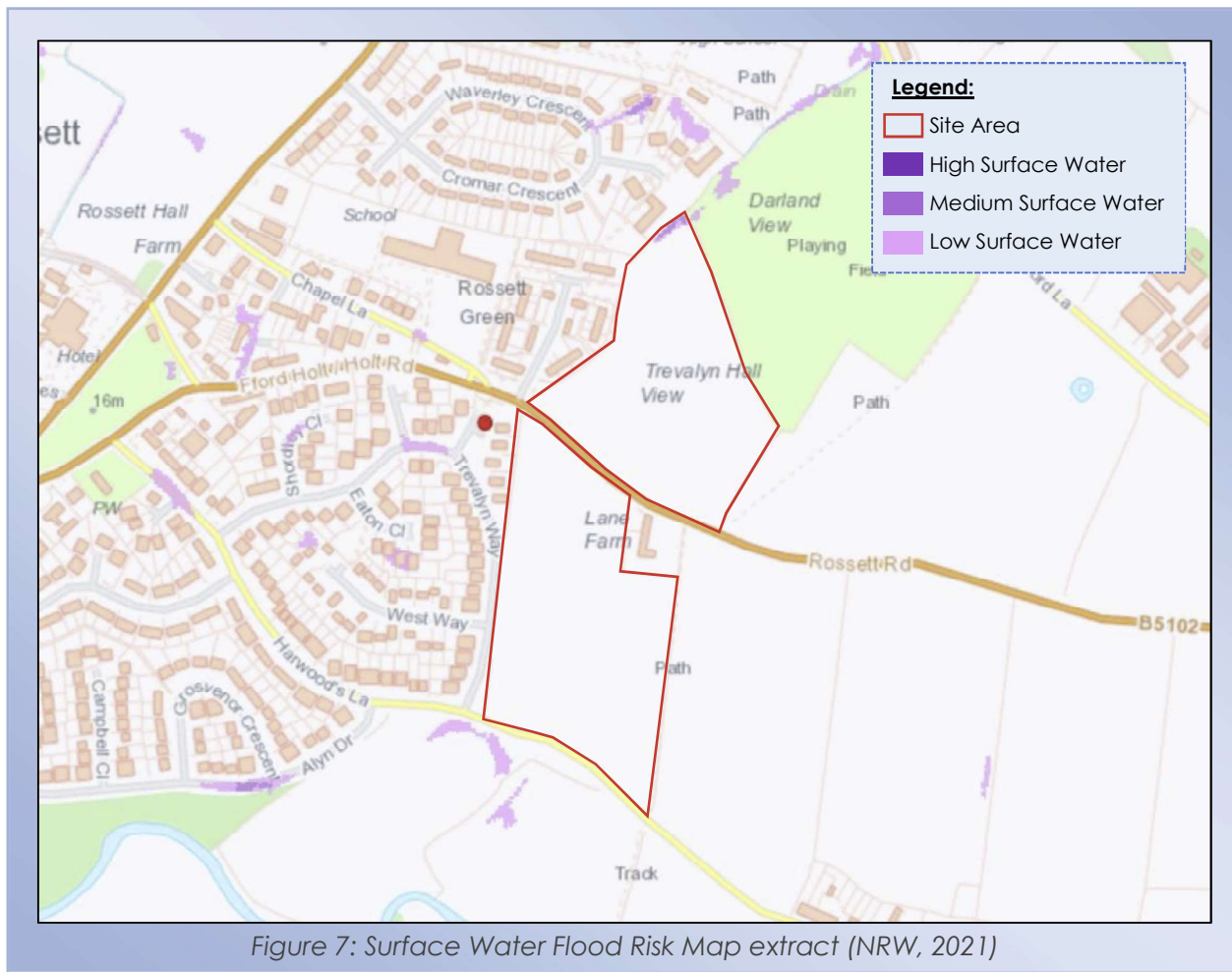
- 5.1.33 Further investigation into this land drainage ditch has identified this area of site is also located within Flood Zone B based on the DAM mapping. This area of site is therefore known to have historically suffered from flooding which is assumed to be linked to the land drainage system present in this location. It is understood that overland flows from the site and the surrounding undeveloped agricultural land enters the land drainage ditch and during extreme and prolonged rainfall events when the land drainage ditch reaches capacity, the flows have the potential to exit the channel and spill into the Northern Development Parcel given the naturally low levels in this northern corner.
- 5.1.34 The existing ground levels within the main development areas onsite have however been identified to be at least 300mm higher than the top of bank of the adjacent land drains channel. With the main development area being elevated in comparison to the natural land drain, the potential risk to the proposals from natural exceedance of the main channel would be minimal given development is offset from the northern corner. The risk will be further reduced post-development once a formal sustainable drainage management scheme is implemented onsite.
- 5.1.35 Generally, ground levels within the site area fall from the south-western boundary down to the northern corner, therefore any residual flood risks associated with exceedance would direct naturally with the existing falls towards the main channel located beyond the northern boundary. Appropriate levels design as part of the proposal can ensure external levels fall away from the proposed dwellings towards the maintained conveyance route(s) through site to mitigate for any residual flood risks associated.
- 5.1.36 Furthermore, when the ground levels within the wider area are considered, levels are shown to naturally fall away from the sites northern boundaries heading in a northerly direction with the natural watercourse catchment. Should exceedance from the land drain occur during extreme or prolonged rainfall then the natural ground levels would convey exceedance towards the north, in the natural direction of flow.
- 5.1.37 Consultation with the key statutory bodies including the Lead Local Flood Authority and the Local Planning Authorities has not identified any historical flooding at the site because of this Ordinary Watercourse/land drainage system or the requirement to undertake a more detailed assessment of flood risk at this site at this moment in time.

5.2 Tidal Flood Risk

- 5.2.1 The River Dee Estuary is located over 20km to the north of site. Due to the distance from the coast and estuarine waterways the risk of flooding from tidal sources is very low.

5.3 Surface Water Flood Risk

- 5.3.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead. An increase in impermeable areas through development can reduce percolation rates at source, therefore increasing surface water run-off. If this run-off is not controlled effectively, it can increase the frequency and extent of localised flooding in neighbouring areas of the catchment.



- 5.3.2 TAN15 states therefore that 'the aim should be for new development not to create additional run-off when compared with the undeveloped situation and re-development to reduce the overall run-off where possible' (Section 8.3).
- 5.3.3 The site is shown to be predominantly at 'very low' risk from surface water flooding based on the NRW online mapping (**Figure 7**). There is a small area within the Northern Development Parcels northern corner which is shown to be at higher risk from surface water flooding, but this is due to this area being naturally low-lying next to the land drainage ditch. This increases the likelihood of pluvial/surface water ponding in the extreme storm events when run-off is unable to convey away from the low-lying areas.
- 5.3.4 The proposals are 'highly vulnerable' in nature and not located in those parts of the wider site shown to be at some flood risk from surface water. Any residual risk associated with surface water will need to be catered for through the implementation of a sustainable surface water management regime as part of the proposals. Furthermore, the Finished Floor Levels of proposed dwellings will be elevated above external levels to allow for safe external overland flow routes in the event of exceedance from the main drainage systems (above that which they have been designed for). Any exceedance will be directed through appropriate levels design within the wider site to areas of POS and landscaping to prevent any increased risk to others.

5.4 Pluvial Flood Risk

- 5.4.1 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area.
- 5.4.2 Given the neighboring topography and that of the development, there is likelihood of significant pluvial flows impacting on the potential development or on adjacent land/property because of the proposals. Any pluvial flows generated by the site will need to be catered for within the proposals through appropriate management and surface water infrastructure. Any overland flows generated by the potential development must be carefully controlled; safe avenues directing overland flow away from the proposed or existing adjacent buildings are advised.

5.5 Artificial Sources of Flood Risk

- 5.5.1 TAN15 suggests that for development to be 'justified' then all sources of flood risk must be considered both to the development site and arising from the proposals.
- 5.5.2 NRW identify reservoirs as those holding over 25,000cu.m of water; an extract of NRW's online reservoir flood map is included in **Appendix B**. The NRW mapping illustrates that the site is not located within the predicted extents of flooding associated with any local reservoirs. There are also no canals within the immediate vicinity of the development site considered to present a flood risk to the site.

5.6 Groundwater Flood Risk

- 5.6.1 Groundwater flooding is caused by unusually high groundwater levels, it occurs as excess water emerges at the ground surface (or within manmade underground structures). Groundwater flooding tends to be more persistent typically lasting for weeks or months and it can result in significant damage to property.
- 5.6.2 In general terms groundwater flooding can occur from three main sources:
- If groundwater levels are naturally close to the surface, then this can present a flood risk during times of intense rainfall.
 - Seepage and percolation occur where embankments above ground level hold water. In these cases, water travels through the embankment material and emerges on the opposite side of the embankment.
 - Groundwater recovery/rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level.
- 5.6.3 No groundwater flood risk has been identified during onsite investigations however shallow groundwater was identified during soakaway testing undertaken by Betts Geo in October 2020. The likelihood of flooding from this source is therefore considered to

be low. Should groundwater be encountered during any future construction phase(s) then suitable land-drainage will need to be installed to intercept groundwater flows.

5.7 Sewer Flood Risk

- 5.7.1 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and wastewater known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away. It can also occur when the sewer becomes blocked or is of inadequate capacity, this could lead to there being a high risk of internal property flooding with contaminated water.
- 5.7.2 Welsh Water (WW) sewer records have identified public sewer networks to the west in the residential areas and within Rossett Road (refer to sewer records extract in **Appendix C**). Consultation with Welsh Water did not identify any existing sewer flood risk issues or historical flooding of the site, refer to **Appendix C**.

5.8 Historical and Anecdotal Flooding Information

- 5.8.1 An internet-based search for flooding identified that parts of the Northern Development Parcel have been known to have historically flooded, where exceedance encroached on site the northern part of the site due to upstream capacity constraints in land drainage system during prolonged rainfall events. There are also online reports of incidents of flooding to the wider Rossett area in 2000, 2003 and 2019 due to an extreme and prolonged rainfall event that caused the River Alyn to burst its banks and flood the neighbouring highways and fields.
- 5.8.2 Consultation with the various interested parties including WCBC, WW and NRW however failed, to highlight any recorded historical flooding in the immediate vicinity of the site. Review of WCBC's Preliminary Flood Risk Assessment (PFRA) and the Strategic Flood Risk Assessment (SFRA) also did not highlight any historic flooding at or near to the site (some general mapping data is included in **Appendix K**).

5.9 Mitigation Measures and Residual Risks

- 5.9.1 As the site is located within Flood Zone A and partially within Flood Zone 1 on the NRW detailed mapping, the site is at little or no risk from fluvial/tidal flooding. Some mitigation measures have however been discussed below to consider the residual risks associated with other flood sources in compliance with TAN 15.

Mitigation Measures

- 5.9.2 Based on the potential fluvial flood water levels in the extreme scenario events discussed above, it is proposed that the FFL of the residential dwelling are raised above the onsite top water levels in the design event. As flood levels onsite have been identified to vary in the depths, the proposed FFL of the proposed properties also varies. A proposed FFL drawing has therefore been included within **Appendix J**, which shows the FFLs for each individual property. These proposed FFL have then been included within the proposed hydraulic modelling works to assess potential flood risk to others. In

summary, the proposed FFLs shown in **Appendix J**, ensure the properties are flood free during the design event and they also do not increase flood risk to others.

- 5.9.3 Any overland flows generated by the development must be carefully controlled and safe avenues directing overland flows away from any proposed properties is advised. Any natural conveyance routes should be maintained through the site, where practical. Where this is not practical then provision will need to be made to intercept and convey flows safely through the proposals to outfall as they would naturally.
- 5.9.4 The Northern Development Parcel is located partially within Flood Zone B. Flood Zone B is an area known to have historically flooded based on sedimentary evidence deposits. Although consultations with various parties have not identified any historical flooding records for the site itself, it is understood that those parts of site shown to be within Flood Zone B are potentially susceptible to exceedance flooding associated with the upstream land drainage system when there are capacity issues during prolonged rainfall events or other scenarios (blockages or poor maintenance). It is therefore advised that this northern-most corner of site remain free from highly vulnerable development to cater for the potential residual risks of future exceedance events.
- 5.9.5 To minimise the flood risk to the neighbouring properties and conform to the guidance set out in TAN15, it is proposed that surface water run-off be managed effectively and sustainably in accordance with best practice and standard guidance. It is recommended that the peak rates of surface water run-off generated by the proposals be restricted to the equivalent of the pre-development greenfield situation.
- 5.9.6 A separate Drainage Management Report will be prepared based on the detailed initial drainage discussions carried out with the Local Planning Authority and the sub. The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

6.0 SUMMARY AND CONCLUSIONS

- 6.1 This report has been prepared to support a planning application for residential development on land off Rossett Road in Rossett. The site is located mostly within Flood Zone A on the Development Advice Map, with a small slither of Flood Zone B shown to encroach into the northern development parcel. The proposals are residential in nature, which is classified as 'highly vulnerable' within Welsh Government Planning Policy and this nature of development is acceptable when located within Flood Zone A and B (in accordance with TAN15).
- 6.2 The Development Advice Map notes that most of site is located within Flood Zone A and means there is little or no fluvial flood risk. The small part of the site shown to be in Flood Zone B is an area which historically flooded, and this assessment has concluded that this historical flooding was likely to be associated with the existing land drainage system to the north of the site. It should be noted that no historical flooding has been identified through our various consultations as part of this assessment.
- 6.3 This Flood Consequence Assessment has reviewed all the potential sources of flood risk both to and resulting from the development proposals, including fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources. The nearest Main River to the site is the River Alyn which is located 180m to the south of site, the Alyn flows east and eventually outfalls into the River Dee. Although the potential direct flood risk from the south is low, discussion with NRW has identified that there is the potential for upstream exceedance and routing towards the site in the extreme 1 in 1000yr plus 30% Climate Change event and the residual 1 in 100yr plus 80% blockage event.
- 6.4 The National Resource Wales Mapping shows the site remains flood free in the 1 in 100yr, 1 in 1000yr and 1 in 100yr plus 30% Climate Change events. The NRW modelling outputs that flooding onsite occurs in the 1 in 1000yr plus 30% Climate Change event and in the 1 in 100yr event with 80% blockage applied to Chester Road Bridge. It is understood that those parts of site shown to be at risk are generally at risk of flood depths between 10mm to 80mm in these events based on the current onsite topographic survey. There is however a naturally low-lying area within the Northern Development Parcel which is at greater risk and has potential depths between 290mm and 350mm.
- 6.5 The National Resource Wales model provided however only includes data for simulating the 1 in 100yr and 1 in 1000yr events, with up to 30% allowance for Climate Change. The current guidelines for Climate Change on the River Dee catchment (in which the River Alyn falls under) is for an allowance of 25% for the Higher Central (70th percentile) estimate and 45% for the Upper (90th percentile) estimate on top of the 1 in 100yr return period event. To accurately assess the flood risk to the site both in the present and future, a separate Hydraulic Modelling Assessment has been undertaken.
- 6.6 The hydraulic modelling work was commissioned to help steer the mitigation measures required to ensure the development remains flood free for its lifetime and to help identify the potential impacts, that the requirement mitigation levels might have

elsewhere in the floodplain (including changes to the flood flow route where this is identified).

- 6.7 To conclude, the site remains flood free in all events up to and including the 0.1% AEP (1 in 1000 year) event, 1% AEP (1 in 100 year) plus 45% CC event and in the 1% AEP plus 20% climate change with 25% blockage at Chester Road bridge. Flooding does occur onsite in the 0.1% AEP with 25% blockage at Chester Road bridge with onsite flood depths of up to 0.32m in this residual event.
- 6.8 The hydraulic modelling assessment has also addressed the post development scenario in the key design events. As summarised, the proposed scenario hydraulic modelling has demonstrated that flood flows can continue to pass through the site via the proposed roads in extreme events. The proposed dwelling levels have also been set to channel flood flow through the site in the extreme event towards a basin within the POS area within the Southern Development Parcel. The hydraulic modelling also demonstrates that there is no increase in flood risk to surrounding properties because of the proposals.
- 6.9 As part of the northern parcel is located in Flood Zone B, it has been assumed that this historical flooding must be associated with the and drainage system adjacent to the north. This system takes overland flow from the site and surrounding land drainage systems, along with some flows from the formal surface water infrastructure serving the residential development to the west of the site. Historically due to prolonged rainfall events, downstream blockages or inconsistent maintenance, this system is thought to have exceeded capacity and due to the existing low-lying ground levels in the northern part of site some onsite flooding was assumed to have occurred.
- 6.10 Overall, the site is at 'low' flood risk from most of the flood sources reviewed including surface water flooding. There are some parts of the site more susceptible to flooding due to the existing topography and the existing land drainage ditch systems although the planning proposals show that those areas at greatest risk from surface water (or neighbouring the land drainage system) will consist of minimum development where practical. Residual flood risks can however be reduced and effectively managed as part of the proposals, through the implementation of mitigation measures proposed, along with ensuring space for water is incorporated into the development layout.
- 6.11 This Flood Consequence Assessment is commensurate with the site and in summary, the development can be considered appropriate in accordance with TAN15, providing the mitigation measures proposed within are included within the development proposals.

7.0 RECOMMENDATIONS

- 7.1 Based on the potential fluvial flood water levels in the extreme scenario events discussed above, it is proposed that the FFL of the residential dwelling are raised above the onsite top water levels in the design event. As flood levels onsite vary, the proposed FFL of the properties also varies. A proposed FFL drawing has therefore been included within **Appendix J**, which shows the FFLs for each individual property. These proposed FFL have then been included within the proposed hydraulic modelling works to assess potential flood risk to others. In summary, the proposed FFLs shown in **Appendix J**, ensure the properties are flood free during the design event and they also do not increase flood risk to others.
- 7.2 Any overland flows generated by the development must be carefully controlled and safe avenues directing overland flows way from any proposed properties is advised. Any natural conveyance routes should be maintained through the site, where practical. Where this is not practical then provision will need to be made to intercept and convey flows safely through the proposals to outfall as they would naturally.
- 7.3 The Northern Development Parcel is located partially within Flood Zone B. Flood Zone B is an area known to have historically flooded based on sedimentary evidence deposits. Although consultations with various parties have not identified any historical flooding records for the site itself, it is understood that those parts of site shown to be within Flood Zone B are potentially susceptible to exceedance flooding associated with the upstream land drainage system when there are capacity issues during prolonged rainfall events or other scenarios (blockages or poor maintenance). It is therefore advised that this northern-most corner of site remain free from highly vulnerable development to cater for the potential residual risks of future exceedance events.
- 7.4 To minimise the flood risk to the neighbouring properties and conform to the guidance set out in TAN15, it is proposed that surface water run-off be managed effectively and sustainably in accordance with best practice and standard guidance. It is recommended that the peak rates of surface water run-off generated by the proposals be restricted to the equivalent of the pre-development greenfield situation.
- 7.5 A separate Drainage Management Report will be prepared based on the detailed initial drainage discussions carried out with the Local Planning Authority and the sab. The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

BIBLIOGRAPHY & REFERENCES

Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities – Environment Agency/DEFRA 2016

CIRIA 522: Sustainable urban drainage systems – design manual for England and Wales (2000).

CIRIA 523: Sustainable urban drainage systems – best practice manual (2001).

CIRIA 609: Sustainable drainage systems. Hydraulic, structural and water quality advice (2004).

CIRIA 624: Development and flood risk – guidance for the construction industry (2004).

CIRIA 635: Designing for Exceedance in urban drainage: Good practice (2006).

CIRIA 644: Building Greener (2007).

CIRIA 753: The SUDS manual (2015).

Flood Risk to People – Phase 2 (FD2321/TR2), DEFRA and the Environment Agency (2006).

Flood estimation for small catchments: Institute of Hydrology Report No.124, NERC (1994).

Flood Estimation Handbook, Centre for Ecology and Hydrology (1999).

Planning Policy Statement 25: Development and Flood Risk (2006).

Sewers for Adoption 7th Edition, WRc (2012).

Web-based References

Bingmaps – <http://www.bing.com/Maps/>

British Geological Survey – <http://www.bgs.ac.uk/opengeoscience/home.html>

Chronology of British Hydrological Events – www.dundee.ac.uk/

CIRIA – <http://www.ciria.org/>

Cranfield University – <http://www.landis.org.uk/soilscapes/>

FloodProBE – <http://www.floodprobe.eu/>

Flood Forum – <http://www.floodforum.org.uk/>

Flood London – <http://www.floodlondon.com/>

Flood Resilience Group – <http://www.floodresiliencegroup.org/frg/>

Google Maps – <http://maps.google.co.uk/>

Natural Resources Wales – <https://naturalresources.wales/?lang=en>

Streetmap – <http://www.streetmap.co.uk/>

US Army Corps of Engineers – <http://www.hec.usace.army.mil/software/hecras/>

Watertight International – <http://www.watertightinternational.com/>

Welsh Water – <http://www.dwrcymru.com/>