

Western Gateway Flood Consequence Assessment

Wrexham County Borough Council

Final

August 2014

ATKINS

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Table of contents

Chapter	Pages
1. Introduction	6
1.1. Proposal	6
1.2. National planning policy	6
1.3. Natural Resources Wales Requirements	6
2. Existing Site	7
2.1. Introduction	7
2.2. Watercourses	7
2.3. Groundwater	8
2.4. Structures Affecting Local Hydraulics	8
2.5. Flood Defence Infrastructure	8
3. Proposed Development	9
3.1. Overview	9
4. Flood Consequence Assessment	11
4.1. Introduction	11
4.2. Potential flood hazards	11
4.3. Further work	16
5. Opportunities and Constraints Plan – Housing Development East	17
5.1. Overview	17
5.2. Potential Options	17
6. Conclusions and Recommendations	20
Appendix A. Access Road Layout	22
Appendix B. Modelling Report	23
Appendix C. Correspondance	24

GLOSSARY OF TERMS

<i>Term</i>	<i>Meaning / Definition</i>
AEP	Annual Exceedence Probability (of a flood event expressed as a percentage)
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
DAM	Development Advice Map (published by the Welsh Assembly Government)
Development Advice Zone A	Used to indicate that justification test is not applicable and no need to consider flood risk further
Development Advice Zone B	Used as part of a precautionary approach to indicate where the site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further
Development Advice Zone C	Used to indicate that flooding issues should be considered as an integral part of a decision making by the application of the justification test including the assessment of consequence
Development Advice Zone C1	Used to indicate that development can take place subject to the application of the justification test including acceptability of consequences.
Development Advice Zone C2	Used to indicate that less vulnerable developments should be considered subject to the application of the justification test, including the acceptability of consequences. Emergency services and highly vulnerable developments should not be considered.
EA	Environment Agency
EAW	Environment Agency Wales
EFO	Extreme Flood Outline (Boundary of floodplain associated with a flood event with a probability of occurrence of 0.1%)
FCA	Flood Consequence Assessment
FFL	Finished Floor Level
LPA	Local Planning Authority
m AOD	metres above Ordnance Datum
PPS	Planning Policy Statement
PPW	Planning Policy Wales
S105	Section 105 of the Water Resources Act 1991
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SuDS	Sustainable Drainage Systems
TAN 15	Technical Advice Note 15: Development and Flood Risk (July 2004)

1. Introduction

1.1. Proposal

Wrexham County Borough Council (WBCB) seeks to develop an area of land (Wrexham Western Gateway) along Ruthin Road, Wrexham. The development proposals are for both residential and non residential use including the provision of:

- A new link road
- Office development
- Housing

This report is an update to the previously developed FCA for the original proposals set out in 2010.

1.2. National planning policy

The land use planning system regulates development and land use in the public interest, with the aim of ensuring sustainable development which balances environmental, economic and social needs of society both now and in the future. In Wales, a series of planning policy technical advice notes provide advice on a number of subjects. Technical Advice Note 15 (TAN 15) aims to reduce, or at the very least avoid increasing, flood risk by ensuring an integrated approach to land use planning and flood risk management. To achieve this, local authorities are responsible for controlling development, including that in the floodplain which may be affected by flooding, or where changes in runoff may increase flood risk elsewhere.

Developers are required to provide an assessment demonstrating the following (after TAN15):

- ◆ The consequences of flooding on the development
- ◆ The consequences (i.e. the overall impacts) of the development on flood risk elsewhere within the catchment for a range of potential flooding scenarios up to that flood having a probability of 0.1%.
- ◆ That appropriate mitigation measures can be incorporated within the design of the development to ensure that development minimises risk to life, damage to property and disruption to people living and working on the site or elsewhere in the floodplain.

1.3. Natural Resources Wales Requirements

As a statutory consultee, Natural Resource Wales (NRW) has been consulted as part of the original proposals by the Local Planning Authority (LPA) regarding the proposed development. NRW has advised that portions of the proposed development site are partially within Development Advice Zone C2 of the Development Advice Map (DAM) and that a Flood Consequence Assessment (FCA) is required for this part of the site.

NRW state that the criteria for undertaking the FCA are contained within Section 7 and Appendix 1 of TAN15.

The FCA should be forwarded by the LPA to NRW for further consultation.

Copies of the correspondence with EAW from the previous study in 2010 are included in Appendix C.

2. Existing Site

2.1. Introduction

The Wrexham Western Gateway development area lies immediately east the A483 at the junction with the A525. The area lies approximately 0.5km west of Wrexham.

The site is currently open fields but has recently undergone some residential development immediately south east of the development boundary as part of a Redrow Development (pre 2010).

The site location is shown in Figure 2-1.

Figure 2-1 Site Location Plan



2.2. Watercourses

There are 2 watercourses that flow through the proposed development site; the River Gwenfro north of the proposed development site and the small unnamed brook that drains into the Gwenfro in the southern portions of the proposed development site.

The River Gwenfro drains in a south east direction towards Wrexham before confluenting with the River Clywedog. The catchment is considered to be steep and is characterised by grazed pasture land. The catchment is predominately rural.

The small unnamed brook rises within an area bound by Ruthin Road, A483 and the disused railway. Another small tributary joins this unnamed watercourse along the right bank at the junction of Ruthin Road and Croesnewydd Road.

Examination of the published Environment Agency Flood Map (2014) (See Figure 4-1) suggests that the flood risk posed by this unnamed watercourse has been omitted from this map. This has been examined as part of this FCA.

2.3. Groundwater

There has been no detailed ground investigation undertaken for this FCA.

2.4. Structures Affecting Local Hydraulics

There are a number of structures along both the River Gwenfro and the unnamed watercourse which have been examined as part of this FCA. These include;

- Structure running under the dismantled railway, River Gwenfro
- Structure underneath Croesnewydd Road, River Gwenfro
- Croesnewydd Road bridge, unnamed watercourse

2.5. Flood Defence Infrastructure

Examination of the Natural Resource Wales Development Advise Map suggests that this area is not served by any formal flood defence asset.

3. Proposed Development

3.1. Overview

Wrexham County Borough Council proposed to develop the Wrexham Western Gateway site for both non residential use and residential use. Included in these proposals is the addition of a new access road running adjacent to the site, along the disused railway embankment across the River Gwenfro and to a new road junction immediately north of the site. The proposed development conceptual designs are illustrated below.

Figure 3-1 Conceptual Design – Overall Layout

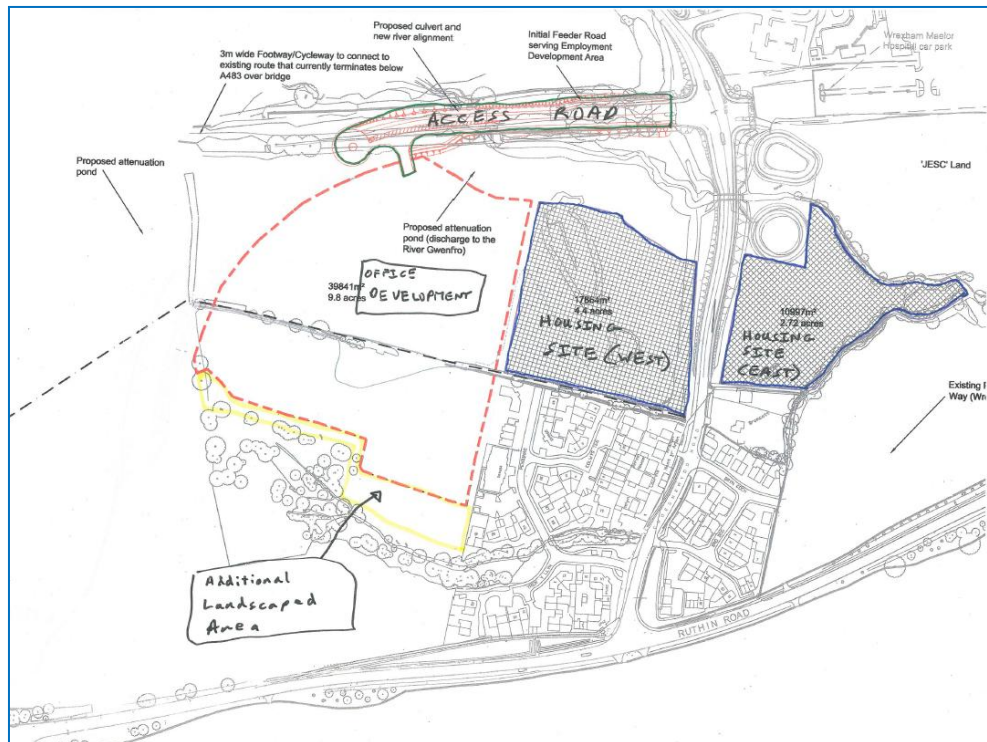


Figure 3-2 Conceptual Design – Office Development and Access Road



The development proposals being put forward for planning include 4 elements (See Figure 3.1) which have all been discussed separately where appropriate. These elements include the following;

- Access Road (Including a crossing of the River Gwenfro)
- Office Development
- Housing Development West
- Housing Development East

Planning Policy Wales Technical Advice Note 15 (TAN 15): Development and Flood Risk sets out the policy in relation to the developments and flooding. This document categorizes land use based on the consequences of flooding to a particular site. TAN 15 classifies industrial, employment and commercial development as less vulnerable and residential use as highly vulnerable.

4. Flood Consequence Assessment

4.1. Introduction

A Flood Consequence Assessment, based on the currently available information, has been undertaken in accordance with TAN 15 which specifies a number of criteria that must be met to justify development within the floodplain.

This FCA examines each of the proposed development sites separately, assessing the justification and acceptability criteria in accordance with TAN15.

The FCA will identify:

- ◆ The flooding hazards which may affect the proposed developments or where the developments may increase flood risk elsewhere;
- ◆ Whether the proposed developments could affect the integrity of a flood defence, or obstruct access to watercourses or flood defence assets for operation and maintenance;
- ◆ Whether the developments could increase runoff;
- ◆ Suggest appropriate mitigation measures, where appropriate, to manage any flood risk resulting from the proposed development options.

4.2. Potential flood hazards

The potential flood hazards identified within this FCA, their impact on flood risk at the site and possible mitigation measures that could be implemented to manage or reduce the flood risk is given in the sections below.

4.2.1. Fluvial Flood Risk

Inspection of the available flood risk mapping published by NRW and the Environment Agency indicates portions of the overall footprint of the proposed development site are within zone C2 and zone B (See Figure 4.1).

The extent of the 0.1% AEP outline (shown in Figure 4.2) show that portions of the site are categorised as being within flood zone 2 of the Environment Agency Flood Map, indicating that there is a 0.1% AEP of flooding in any given year. This zone is categorised as 'low' meaning that each year, this area has a chance of flooding between 1 in 1000 and 1 in 100.

In September 2005 Faber Maunsell undertook a FCA for Redrow Homes as part of a proposed residential housing development immediately south of the overall Western Gateway site. This development has since been constructed.

As part of the Faber Maunsell FCA the report examined the fluvial flood risk to the site posed by the unnamed watercourse.

In combination with the current masterplan proposals for the Western Gateway development and the conclusions of the 2005 Faber Maunsell FCA it is apparent that there is no direct fluvial flood risk to any element of the proposed development inside the development boundary from the unnamed watercourse.

The Faber Maunsell FCA suggests that any overtopping of this watercourse will occur along its left bank downstream of Croesnewydd Road and not in the upstream portions of the unnamed watercourse which lie within the overall development boundary.

Figure 4-1 NRW Development Advise Map

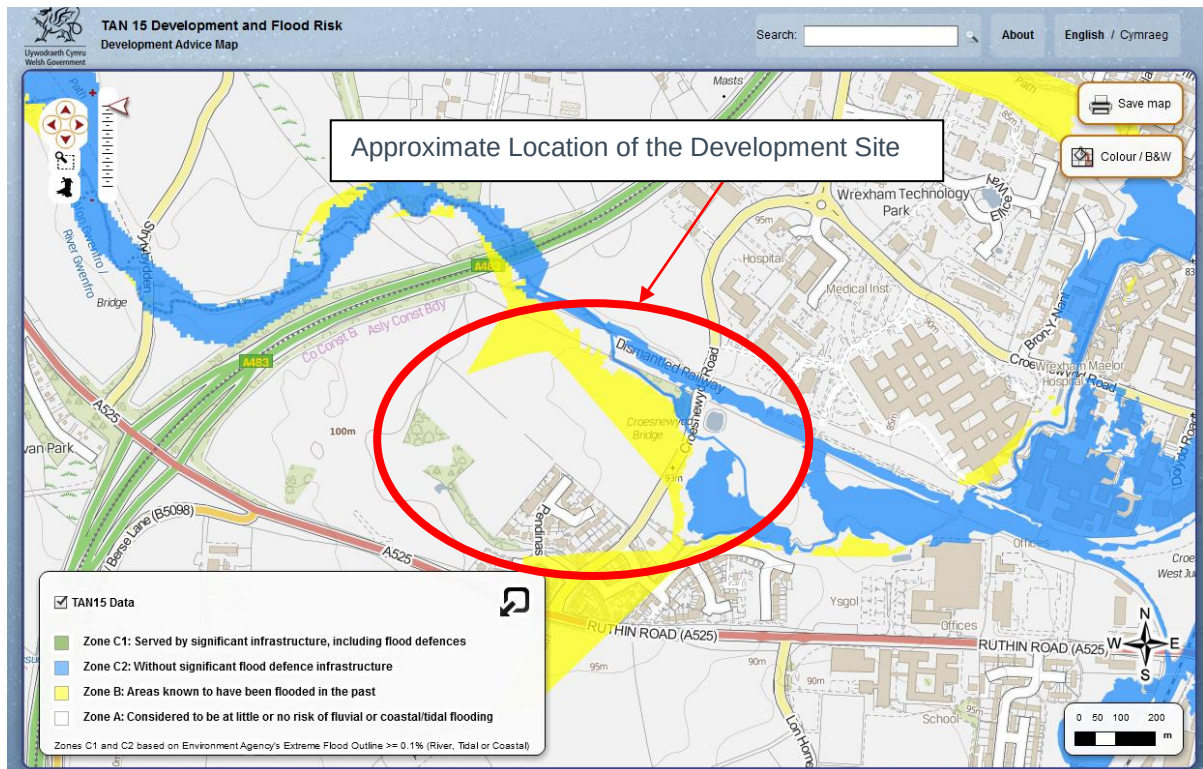
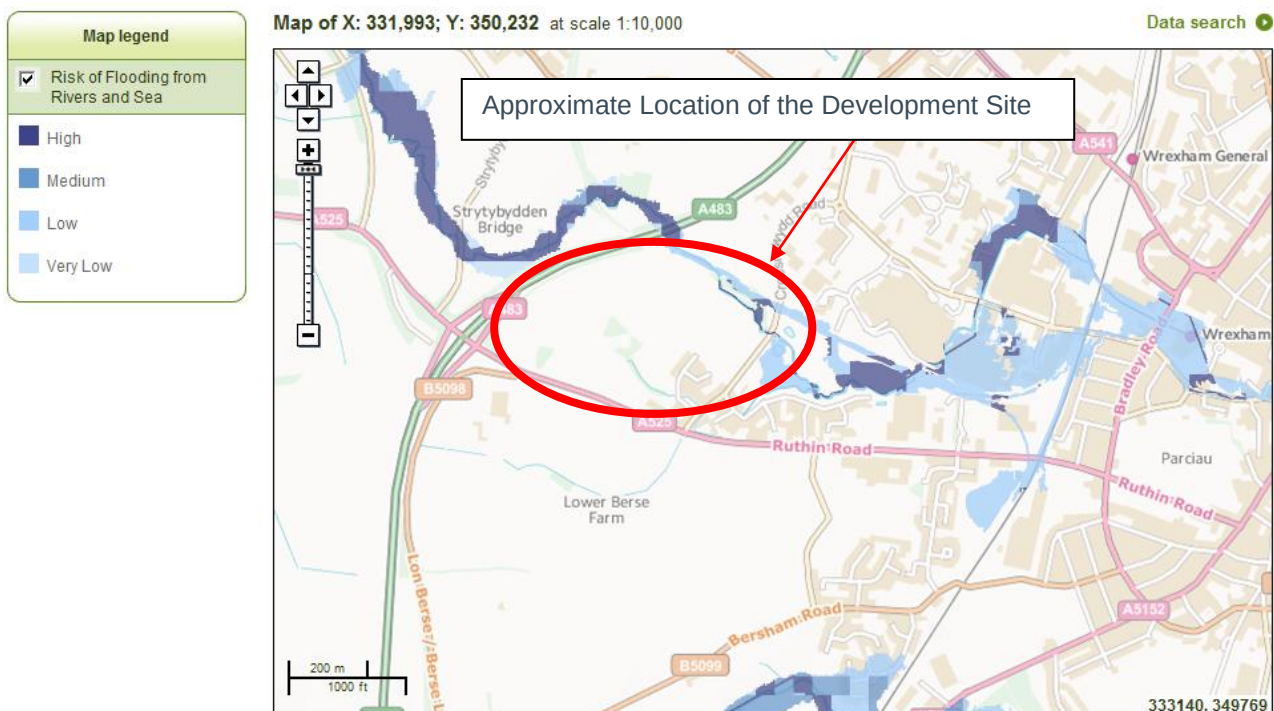


Figure 4-2 EA Flood Risk Map



Customers in Wales - From 1 April 2013 Natural Resources Wales (NRW) will take over the responsibilities of the Environment Agency in Wales.
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Office Development

The vulnerability classification of the development type (employment and carparks) is categorised as a 'less vulnerable' development in TAN 15. The footprint of the 'office development' site also

falls within zone B of the DAM which indicates that it is an area known to have flooded in the past evidenced by sedimentary deposits.

As part of a previous flood risk modelling study undertaken by JBA in 2010 (See Appendix B) for the proposed development site suggests the ground levels within the Office Development site are above the 0.1% AEP (See Figure 4.7) and as such is considered to be an acceptable development proposal in this zone and no further consequences of flooding is required, other than that of surface water drainage.

Housing Development West

The vulnerability classification of this development type (residential premises) is categorised as a 'highly vulnerable development' in TAN 15. The footprint of the Housing Development West site falls within zone B which indicates that it is an area known to have flooded in the past evidenced by sedimentary.

The detailed flood risk modelling undertaken for this entire Western Gateway (See Figure 4.7) site suggests the ground levels within the Housing Development West site are above the 0.1% AEP and as such is considered to be an acceptable development proposal in this zone and no further consequences of flooding is required, other than that of surface water drainage.

Housing Development East

The vulnerability classification of this development type (residential premises) is categorised as a 'highly vulnerable development' in TAN 15. The footprint of the Housing Development East site falls partially within zone C2 – Areas of floodplain without significant flood defence infrastructure and, zone B, although the detailed flood risk modelling undertaken for this entire Western Gateway (See Figure 4.7) site suggests the ground levels within the Housing Development East site within zone B are above the 0.1% AEP and as such is considered to be an acceptable development proposal in this zone. Zone C2 is used to indicate that only 'less vulnerable' development should be considered. Therefore, at present, only approximately 30% of the proposed site is available for residential development.

Opportunities for reducing flood risk to the development site area have been detailed in Section 5.

Access Road

As part of the overall development proposals for the site, WCBC propose to construct a new access road linking the overall development site with Croesnewydd Road. The proposals are yet to be finalised, including the option to either retain the existing culvert or replace it with a new culvert.

In September 2010 JBA Consulting was commissioned by WCBC to provide detailed hydrodynamic modelling of the River Gwenfro in the vicinity of the proposed development site, more specifically to assess the impact on flood risk of the proposed changes of the River Gwenfro culvert structure and access road alignment as they traverse the River Gwenfro. The output of this work has formed the basis of this FCA assessment.

The modelling work utilised an existing 2d hydrodynamic model undertaking updates to incorporate proposed changes to the 2 structures (**Error! Reference source not found.**).

Details of the dimension changes can be found in the Afon Gwenfro Western Gateway FCA Modelling Report undertaken by JBA 2010. This report forms part of the Appendix to this FCA report.

The JBA modelling exercise set out to establish base line conditions of the existing flood risk to the proposed development and the resultant changes made as a result of the proposed works.

It is clear from the JBA modelling assessment that changes in both flood flow route and flood extent area are apparent, particularly for the 0.1% AEP event.

The proposals also include the option to retain the existing River Gwenfro culvert. It is considered that under this design proposal, the flood risk prevalence described above would still be applicable.

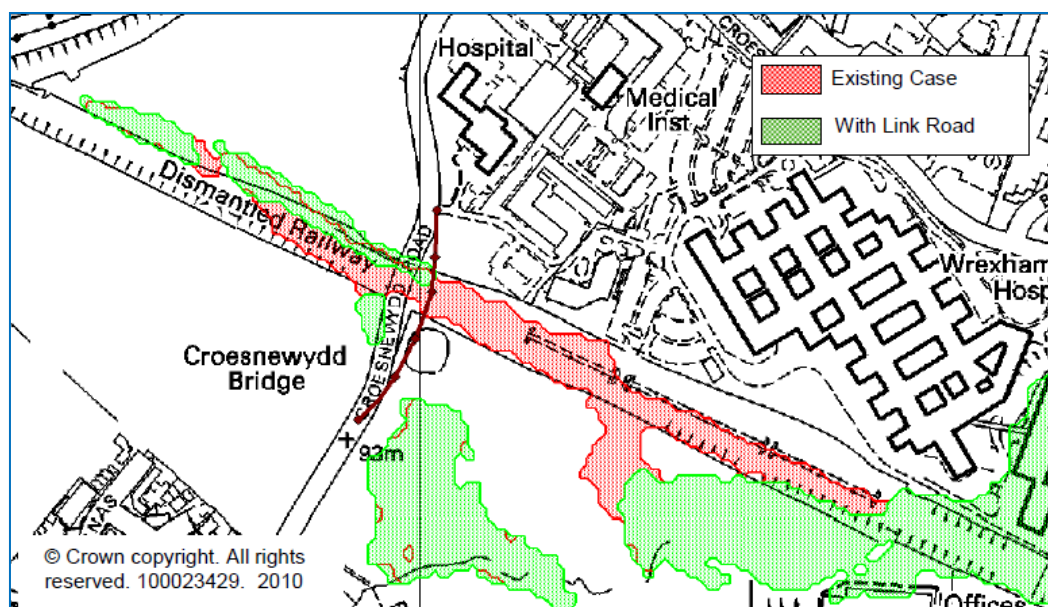
below illustrates the change in flood flow path associated with the proposed changes associated with access road. The modelling of the addition of the access road along the disused railway embankment shows only small localised changes to the flood extent at the 0.1% AEP and again these changes are concentrated within the development boundary (Figure 4-3). The flood risk envelope at the 0.1% AEP is predominantly confined to the north of the proposed access road.

The JBA modelling report indicates that for the 1% and 1%+CC AEP events there is no difference to the flood extent as a result of the access road.

JBA have also provided indications on proposed levels of the access road. In order to provide dry access and egress from the development area, road levels along the link road should be set at a minimum of 96.05m AOD.

The proposals also include the option to retain the existing River Gwenfro culvert. It is considered that under this design proposal, the flood risk prevalence described above would still be applicable.

Figure 4-3 Predicted Flood Extents for the 0.1% AEP Event – Existing Case with new Croesnewydd Road Embankment with Access Road (JBA 2010)



The proposed flood extents for the 1%, 1%+CC and 0.1% AEP events are shown in the figures below. The predicted flood extent includes the additions of the access road proposals.

Figure 4-4 Predicted Flood Extent for 1% AEP Event (JBA 2010)

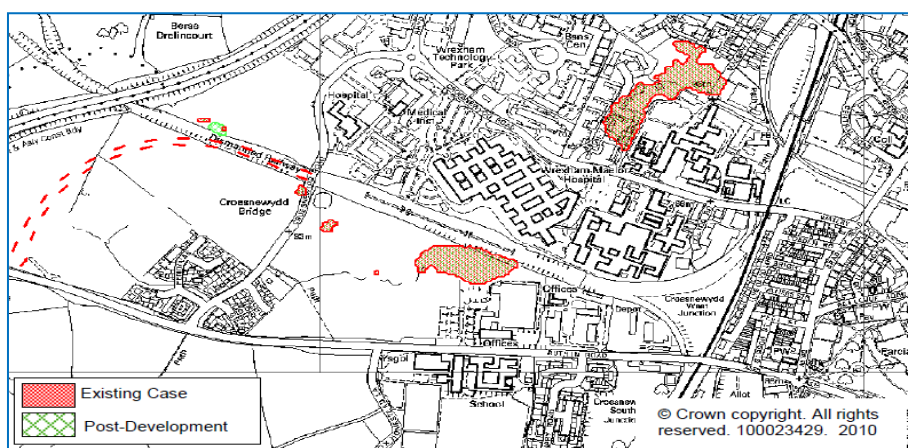


Figure 4-5 Predicted Flood Extent for 1%+CC AEP Event (JBA 2010)

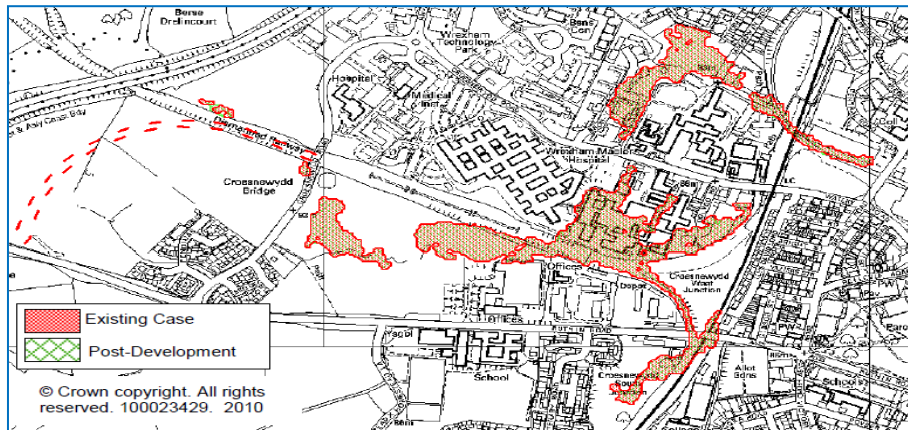
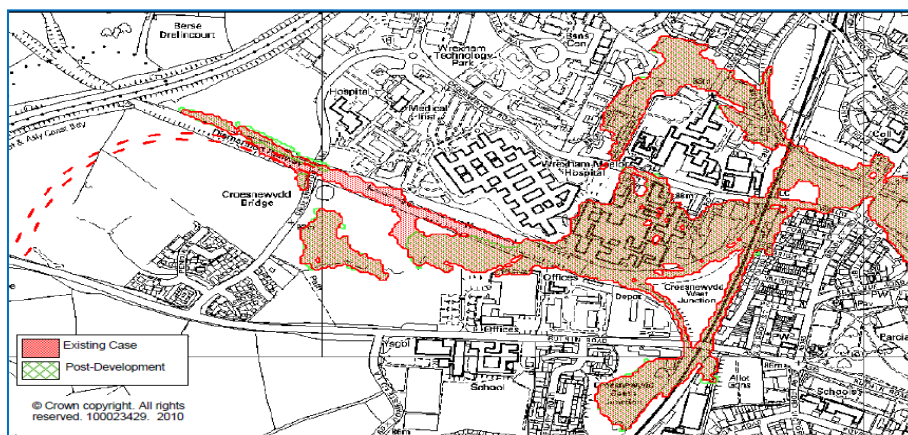


Figure 4-6 Predicted Flood Extent for 0.1% AEP Event (JBA 2010)



The JBA modelling suggests that for the 1% and the 1%+CC AEP events only very localised water levels changes in the vicinity of the proposed structures are predicted.

Fluvial Flood Risk (Unnamed Watercourse)

In September 2005 Faber Maunsell undertook a FCA for Redrow Homes as part of a proposed residential housing development immediately south of the site. This development has since been constructed.

As part of the Faber Maunsell FCA the report examined the fluvial flood risk to the site posed by the unnamed watercourse. The upstream limits of this watercourse are located within the development boundary of the Western Gateway development boundary from the unnamed watercourse.

In combination with the current masterplan proposals for the Western Gateway development and the conclusions of the 2005 Faber Maunsell FCA it is apparent that there is no direct fluvial flood risk to any proposed development inside the Western Gateway development boundary from the unnamed watercourse.

The Faber Maunsell FCA suggests that any overtopping of this watercourse will occur along its left bank downstream of Croesnewydd Road and not in the upstream portions of the unnamed watercourse which lie within the Western Gateway development boundary.

4.2.2. Increased runoff

There are no detailed proposals available for the surface water drainage systems for any of the development proposals that will service the proposed development sites. There are also no details available at this stage on both housing numbers for both the Housing Development Site East and Housing Development Site West so detailed calculation of post development runoff cannot be calculated. There will however be an increase in impermeable area and potential

surface water runoff. The development must seek to provide storage or flow attenuation for any additional runoff associated with development.

Access Road

It is intended that any increase in surface water runoff above and beyond that currently experienced on the site will be attenuated before discharge into the watercourse.

The drainage strategy proposals are yet to be finalised but will be submitted as part of the overall application for planning.

Office Development

Detail design of the proposed drainage strategy has yet to be finalised but it is envisaged to discharge via an overflow and or control outlet into the un-named watercourse to the south-south west of the office development site. There are also plans for the provision of SUDs on the site in the form of a pond/wetland areas which will be utilised prior to site outfall.

Housing Development West

There are no detailed proposals available for the surface water drainage systems that will service the development. Therefore, unless infiltration systems are proposed, it can be assumed that the proposed development will drain to the adjacent watercourse.

Housing Development East

There are no detailed proposals available for the surface water drainage systems that will service the development. Therefore, unless infiltration systems are proposed, it can be assumed that the proposed development will drain to the adjacent watercourse.

With an increase in impermeable area the runoff rate at all the sites is likely to increase. SUDs, for example porous car parking, dry swales and attenuation ponds can be incorporated into the surface water drainage system for all the development proposals and these will reduce the volume of water discharged to any existing sewer system and reduce the overall flood risk in the area. The selection of appropriate techniques will depend on the soil conditions across the entire site but are likely to include one or more devices that either store runoff to reduce the rate of discharge to the sewer system or watercourse or allow infiltration into the ground to replicate the natural drainage of the existing site. Site investigations and soakaway tests should be carried out at the detailed design stage to identify the ground conditions and the most appropriate sustainable drainage technique. Soakaway tests should be carried out in accordance with BRE 365 and water treatment elements will be included in the detailed design of the site using C697 - The SUDS Manual.

If infiltration is not feasible then attenuation ponds located in public areas can be used to store and attenuate runoff, as is proposed for the Office Development site.

Based upon the information available at this time, it is likely that standard SUDs techniques, such as those identified within this section, will be appropriate for the sites and can be adopted in full or part to manage surface water runoff from the entire Western Gateway site.

4.3. Further work

The FCA is based on the information currently available. Further work is required to assess flood risk at the Housing Development sites when development proposals are confirmed.

5. Opportunities and Constraints Plan – Housing Development East

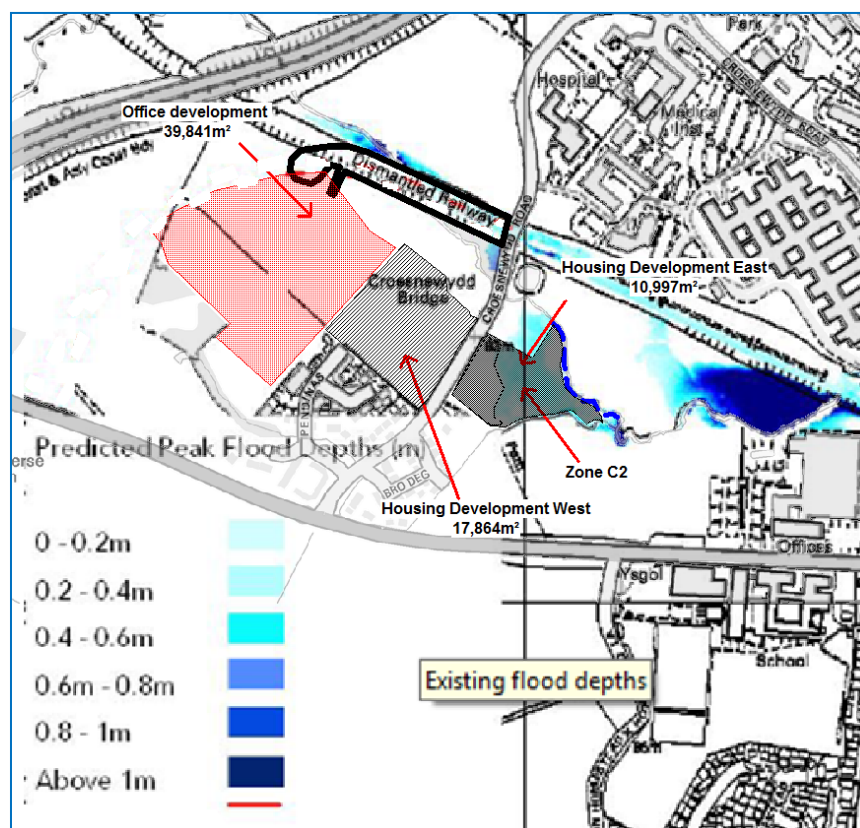
5.1. Overview

Wrexham County Borough Council is keen to reduce flood risk and flood risk prevalence throughout the Western Gateway site with the aim to increase the land available for residential accommodation.

The previous section has demonstrated that only a small portion of the area within the 'Housing Development East' is currently available for residential development due to the current level of flood risk.

Only approximately 30% of the site area of Housing Development East is available for residential development.

Figure 5-1 Proposed Development Footprint



5.2. Potential Options

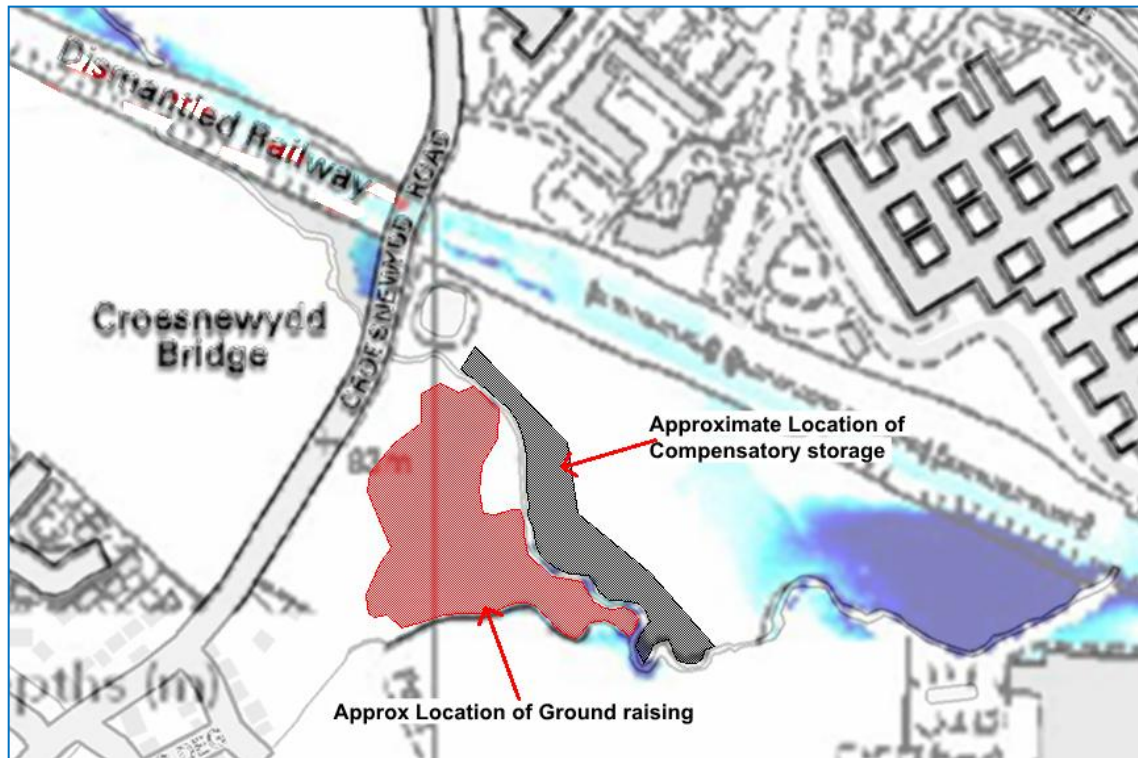
Ground Raising

This option examines raising the ground levels across the proposed development site within the area delineated by DAM zone C2. Ground levels would have to be raised above the modelled 0.1%AEP (See Figure 4.4 – Existing Case) allowing the site to stay dry during times of flood. This option would require compensatory storage to mitigate against the potential loss of flood plain storage.

The modelled flood depth map illustrated in Figure 5.1 above and Figure 1.2 of the JBA model report suggests that the average depth of flooding across the site during a 0.1%AEP is

approximately 0.3m. Therefore, the raising of ground levels would require compensatory storage volumes of approximately 2000m³. The location of the compensatory storage would have to be at a similar ground level to that which currently floods, therefore locations for compensatory storage are limited and would be confined to areas along the left bank of the River Gwenfro, opposite to the existing flood risk zone.

Figure 5-2 Ground Raising – Compensatory Storage

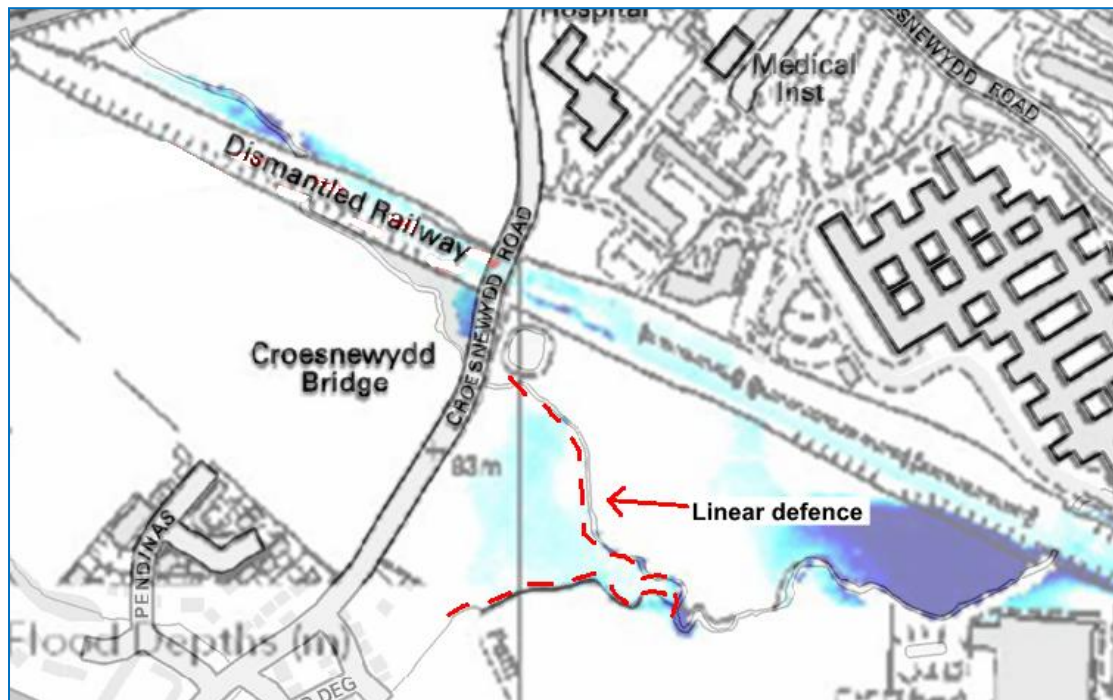


The location and areas are indicative only and will need to be confirmed during a detailed hydraulic modelling exercise to examine their effectiveness and impact on overall flood risk both upstream and downstream of the proposed development site.

Linear Raised Defence

The linear flood defence option would aim to provide a standard of protection of 0.1%AEP. The raised embankment would be located along the right bank of the River Gwenfro adjacent to the north west boundary of the development site. The effectiveness of the option would need to be confirmed during a detailed hydraulic modelling exercise to examine its effectiveness and impact on overall flood risk both upstream and downstream of the proposed development site.

Figure 5-3 Linear Defence

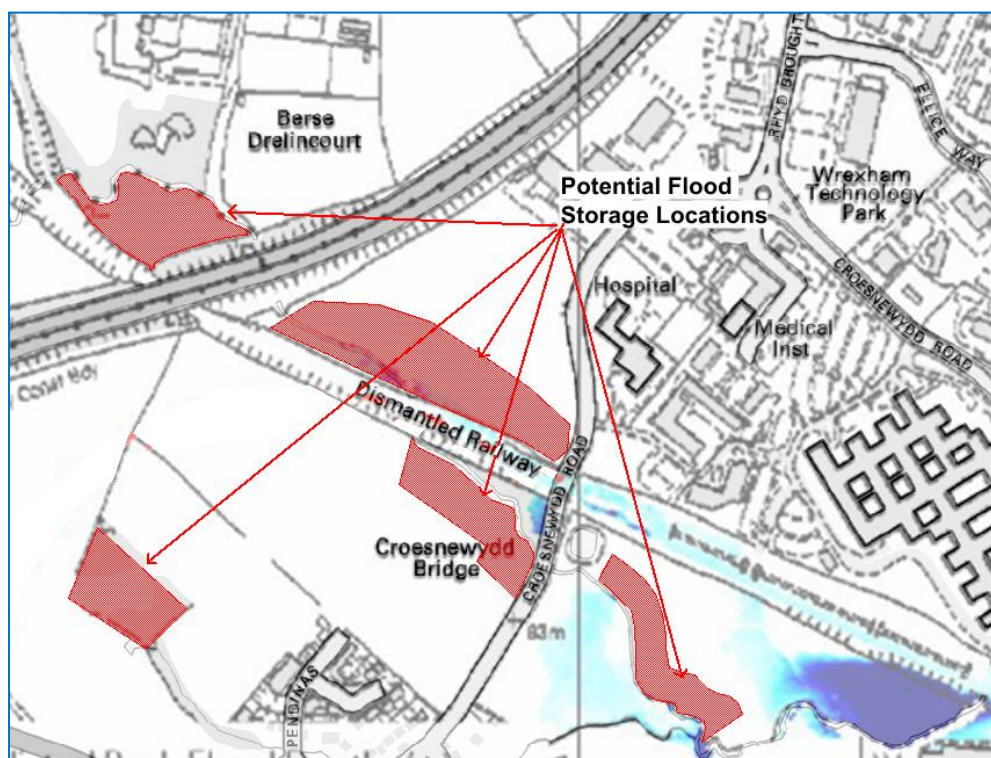


Upstream Flood Storage

There are several options available to examine upstream storage provision. These areas have been delineated in Figure 5.4 below.

The linear flood defence option would aim to provide a standard of protection of 0.1%AEP. The raised embankment would be located along the right bank of the River Gwenfro adjacent to the north west boundary of the development site. The effectiveness of the option would need to be confirmed during a detailed hydraulic modelling exercise to examine the storage required and its effectiveness and impact on overall flood risk both upstream and downstream of the proposed development site.

Figure 5-4 Potential Flood Storage Provision



6. Conclusions and Recommendations

A Flood Consequence Assessment has been carried out for the Wrexham Western Gateway site and the 4 elements detailed in Section 3, to determine the potential flood risk associated with proposals. The process has followed TAN 15, 'Development and Flood Risk'.

The following conclusions can be drawn from the work completed:

- ◆ Portions of the total development area are within Zone C2 and Zone B
- ◆ Both 'Highly Vulnerable' development and 'Less Vulnerable' developments are proposed for the development site
- ◆ Any changes to the flood extent are contained within the development site boundary.
- ◆ The JBA modelling suggest that for the 1% and the 1%+CC AEP events only very localised water levels changes in the vicinity of the proposed structures are predicted for both the access road proposals.
- ◆ JBA have also provided indications on proposed levels of the access road. In order to provide dry access and egress from the development area, road levels along the access road should be set at a minimum of 96.05m AOD.
- ◆ In combination with the current development proposals and the conclusions of the 2005 Faber Maunsell FCA, it is apparent that there is no direct fluvial flood risk to any proposed development inside the development boundary from the unnamed watercourse.
- ◆ The Faber Mausell FCA suggests that any overtopping of this watercourse will occur along its left bank downstream of Croesnewydd Road and not in the upstream portions of the unnamed watercourse which lie within the development site boundary.
- ◆ The proposals also include the option to retain the existing River Gwenfro culvert. It is considered that under this design proposal, the flood risk prevalence is the same as that of installing a new culvert.
- ◆ It is intended that any increase in surface water runoff above and beyond that currently experienced on the site will attenuated before discharge into the watercourse.
- ◆ The ground levels within the Office Development site are above the 0.1% AEP and as such is considered to be an acceptable development proposal in this zone and no further consequences of flooding is required, other than that of surface water drainage.
- ◆ It is envisaged that surface water runoff from the proposed Office Development proposals are to discharge via an overflow and or control outlet into the un-named watercourse to the south-south west of the office development site. There are also plans for the provision of SUDs on the site in the form of a pond/wetland areas which will be utilised prior to site outfall.
- ◆ The vulnerability classification of this Housing Development West (residential premises) is categorised as a 'highly vulnerable development' in TAN 15. The footprint of the Housing Development West site falls within zone B.
- ◆ Ground levels within the Housing Development West site are above the 0.1% AEP and as such is considered to be an acceptable development proposal in this zone and no further consequences of flooding is required, other than that of surface water drainage.
- ◆ There are no detailed proposals available for the surface water drainage systems that will service Housing Development West. Therefore, unless infiltration systems are proposed, it can be assumed that the proposed development will drain to the adjacent watercourse.
- ◆ The vulnerability classification of the Housing Development East site is categorised as a 'highly vulnerable development' in TAN 15. The footprint of the Housing Development East site falls partially within zone C2 – Areas of floodplain without significant flood defence infrastructure and, zone B, although the detailed flood risk modelling undertaken by JBA suggests the ground levels within the Housing Development East site within zone

B are above the 0.1% AEP and as such is considered to be an acceptable development proposal in this zone. Zone C2 is used to indicate that only 'less vulnerable' development should be considered. Therefore, at present, only approximately 30% of the proposed site is available for residential development.

- ◆ There are no detailed proposals available for the surface water drainage systems that will service Housing Development East. Therefore, unless infiltration systems are proposed, it can be assumed that the proposed development will drain to the adjacent watercourse.
- ◆ Opportunities for reducing flood risk to the development site area have been detailed in Section 5.
- ◆ Ground levels within the Office Development site are above the 0.1% AEP (See Figure 4.7) and as such is considered to be an acceptable development proposal in this zone and no further consequences of flooding is required, other than that of surface water drainage.
- ◆ Detail design of the proposed drainage strategy has yet to be finalised but it is envisaged to discharge via an overflow and or control outlet into the un-named watercourse to the south-south west of the office development site. There are also plans for the provision of SUDs on the site in the form of a pond/wetland areas which will be utilised prior to site outfall.

Appendix A. Access Road Layout

Appendix B. Modelling Report

Appendix C. Correspondance



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