

Northwich Area Flood Risk Assessment
Northwich Vision

Vale Royal Borough Council
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Northwich Area Flood Risk Assessment

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Executive Summary

Executive Summary

Northwich is located in the centre of Cheshire within the north west of the UK. The town is within a rural catchment with the River Dane flowing from the foothills of the Peak District to the east and the River Weaver flowing south to north through the Borough. Northwich town centre is situated on the confluence of the rivers Weaver and Dane.

Northwich has been identified specifically through the outcomes of the West Cheshire Strategic Flood Risk Assessment as an area that is both at risk of flooding and part of a large scale regeneration programme. This Area Flood Risk Assessment identifies the level of flood risk to the development sites, their vulnerability, applies the Sequential Test to each site and recommends mitigation measures for them.

Initial modelling showed that eight of the proposed development sites were either all (or have elements that are at) at high probability of flooding (within Flood Zone 3), four are at medium flood probability (within Flood Zone 2) and one is at low probability (within Flood Zone 1). During the study, more detailed flood modelling was undertaken which supersedes these indications, and which provided the basis for all analysis of the flood risk.

It was actually found that only parts of the following sites are at greatest risk of flooding (within Flood Zone 3a and 3b):

- Barons Quay Development Area (GS9A)
- Marina Development Site (GS9E)
- Lock Street Site (GS9I)
- Land West of Queen Street (GS9L)

The extents of Flood Zone 2 were also reduced, and more development allocations were found to be at low probability of flooding.

Intensified development of these sites would result in a reduction in the volume of floodplain storage available in the event of a flood. Therefore, part of the study looked at potential local storage options to compensate for this loss in floodplain. A 2-Dimensional river model was used to raise ground levels in the area of the development. It was discovered that the development had a minor impact upon water levels and flood extent; however, at specific locations flood routes were constricted increasing the flood risk and hazard. Two mitigation scenarios were simulated; however, both options did not reduce flood levels significantly. Further analysis of the results highlighted that the Marina development site effectively blocks a potential floodplain flow route and leads to the constriction of flow from the River Dane to the Weaver. Therefore, replacing lost storage downstream with the tested storage sites is not an appropriate solution.

We concluded that rather than pursuing the more costly engineering schemes, the most practicable way forward is to re-visit the development layout of the Marina development site. This site has the greatest impact on flood risk as new development (i.e. raised land) here would constrict flows, increase flood levels and increase flood hazard to people. It is therefore necessary to accept that the Marina site needs to flood, and to design accordingly to minimise the impacts of this.

The final chapter of the Area Flood Risk Assessment sets out guidelines for developers when preparing their FRAs for each development site. This includes a summary of the Sequential and Exception Test and outlines recommendations for land uses, Finish Floor Levels (FFL) for buildings and potential access and egress routes.

In summary, the Area FRA provides a strategic and holistic approach to managing flood risk for the Northwich Vision development areas.

Introduction

1 Introduction

1.1

Reason for the report

Faber Maunsell was commissioned by Vale Royal Borough Council in August 2007 to undertake an Area Flood Risk Assessment (Area FRA) for Northwich. For large scale regeneration schemes or multiple development sites, Area FRAs should be carried out as the step between a Strategic Flood Risk Assessment (SFRA) and a site specific Flood Risk Assessment (FRA). Northwich has been identified specifically through the outcomes of the West Cheshire SFRA as an area that is both at risk of flooding and part of a large scale regeneration programme.

Vale Royal Borough Council is working in partnership with Cheshire County Council, Northwest Development Agency, English Partnerships, British Waterways, Environment Agency and the Learning and Skills Council to develop a 15-20 year regeneration strategy for Northwich town centre.

The report looks at the associated flood risk in the Northwich Vision proposed development sites and determines the development vulnerability that should be permitted in accordance with Planning Policy Statement (PPS) 25¹ (i.e. the Sequential Test and identify the parameters of the Exception Test). The purpose of the Sequential Test is to drive development towards lower flood risk areas.

The Sequential Test can be applied at a regional, local and site specific level. The West Cheshire SFRA has applied the Sequential Test to all the development allocations across the local authority, and this Area FRA seeks to carry out the test to the development area as a whole and to the individual development sites.

The report considers the competing needs of housing development (PPS3) and planning for town centres (PPS6) while considering development and flood risk (PPS25).

In March 2008 Faber Maunsell's original commission was extended to carry out a flood risk and flood mitigation study for Northwich Town Centre. This was made up of two stages:

- Assessing potential flood mitigation options for Northwich
- Preparing guidance notes for future developers

1.2

Requirements for PPS25

PPS25 defines four zones of flood risk. These zones are based on different levels of flood probability. The PPS25 flood probability zones and their associated fluvial flood risk characterisations are summarised in Table 1.1.

The PPS25 flood zones give a broad indication of the susceptibility of flooding. Flood risk includes both the probability of flooding and the consequences of flooding. Most areas which fall within the high probability zone (Zone 3) are on floodplains unless they have been developed as is the case in most urban areas. The actual degree of flood risk to which these areas are subject may well be significantly less than that implied by their PPS25 classification, provided that those defences are maintained and improved to reflect the impact of climate change.

¹ PPS 25, Development and Flooding, Communities and Local Government 2006

Table 1.1 – PPS25 Flood Zones

Zone 1 Low Probability This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Zone 2 Medium Probability This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
Zone 3a High Probability This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b The Functional Floodplain This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

PPS25 requires LPAs to adopt a risk-based approach to development in areas at risk of flooding, and to apply a Sequential Test to such areas. This means that, other factors being equal, the LPA would favour development in areas with a lower flood risk. It is clear that study areas within the PPS25 high risk zone may be at very different risks of flooding.

As shown in Table 1.1; PPS25 Zone 3 is subdivided into two areas, 3a and 3b. PPS25 also states that the following types of development should be allowed.

3a: Water-compatible and less vulnerable uses of land in Table D.2 of PPS25 are appropriate in this zone. More vulnerable development is allowed subject to the Exception Test. Table 1.2 describes the types of development.

3b: Only the water-compatible uses and the essential infrastructure listed in Table 1.2 that has to be there should be permitted in this zone. Essential infrastructure in this zone should pass the Exception Test.

Table 1.2 – Flood Risk Vulnerability Classification from PPS25

Essential Infrastructure	<ul style="list-style-type: none"> ■ Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	<ul style="list-style-type: none"> ■ Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. ■ Emergency dispersal points. ■ Basement dwellings. ■ Caravans, mobile homes and park homes intended for permanent residential use. ■ Installations requiring hazardous substances consent.
More Vulnerable	<ul style="list-style-type: none"> ■ Hospitals. ■ Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. ■ Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. ■ Non-residential uses for health services, nurseries and educational establishments. ■ Landfill and sites used for waste management facilities for hazardous waste. ■ Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	<ul style="list-style-type: none"> ■ Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. ■ Land and buildings used for agriculture and forestry. ■ Waste treatment (except landfill and hazardous waste facilities). ■ Minerals working and processing (except for sand and gravel working). ■ Water treatment plants. ■ Sewage treatment plants (if adequate pollution control measures are in place).
Water Compatible Development	<ul style="list-style-type: none"> ■ Flood control infrastructure. ■ Water transmission infrastructure and pumping stations. ■ Sewage transmission infrastructure and pumping stations. ■ Sand and gravel workings. ■ Docks, marinas and wharves. ■ Navigation facilities. ■ MOD defence installations. ■ Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. ■ Water-based recreation (excluding sleeping accommodation). ■ Lifeguard and coastguard stations. ■ Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. ■ Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

1.3**Scope of services**

A Flood Risk Assessment should consider the risks to the development, the risks to others offsite and all forms of flooding. In preparing the Area FRA we have achieved this by:

- Obtaining data from the Environment Agency (EA), Vale Royal Borough Council (Vale Royal BC) and United Utilities (UU).
- Reviewing the West Cheshire SFRA.
- Reviewing the Weaver Gowy Catchment Flood Management Plan (CFMP).
- Considering the source and pathways of flooding within Northwich.
- Assessing flood risk sequentially for the Northwich Vision development sites.
- Considering the impact of climate change.
- Advising on mitigation measures to alleviate flooding.
- Commenting on suitable surface water arrangements for the site.
- Outlining flood risk management requirements for each development site.
- Consultation with the EA and Vale Royal BC to look at flood storage options.
- Site visit to assess viability of storage areas.
- Using the EA's ISIS-TUFLOW model to generate two flood mitigation scenarios.
- Preparing for each development site a guide for developers when carrying out site specific FRAs.

1.4**Sources of information**

Table 1.3 summarises the consultees that were contacted to gather the necessary information required for the Area FRA.

Table 1.3: Data received

Description	Provider
Northwich Vision, Interim Planning Guidance, Feb 2004	Vale Royal BC
Adopted Vale Royal Borough Local Plan and Proposals Maps, 2006-2016	Vale Royal BC
Flood Incident Response Plan for Northwich, Nov 2006 (revised August 2008)	Vale Royal BC
Public sewers in Northwich town centre	Vale Royal BC / United Utilities
Barons Quay, Northwich. Flood Risk Assessment - Scoping Study, Oct 2006	Vale Royal BC / Waterman Civils
Notes of meeting for Barons Quay FRA, June 2006	Vale Royal BC / Waterman Civils
Northwich Urban Regeneration - Outline Drainage Strategy (Draft)	Vale Royal BC / Waterman Civils
Minutes of Northwich Vision Environment Agency meeting, Nov 2006	Vale Royal BC
Northwich Flood Alleviation Scheme, Pre-feasibility Study, Arup (Nov 2006) and Addendum Report (Nov 2007).	Environment Agency
DG5 Register for Northwich – past sewer flooding incidents	United Utilities
Weaver Gowy CFMP	Environment Agency
ISIS-TUFLOW model	Environment Agency

Background Information

2

Background Information

2.1

Catchment description

Northwich is located in the centre of Cheshire on the confluence of the rivers Weaver and Dane and is located within the north west of the UK (see Figure A1 in Appendix A). The population of Northwich is approximately 55,000 (2003 Census). The town is within a rural catchment with the River Dane flowing from the foothills of the Peak District to the east and the River Weaver flowing south to north through the Borough. The River Weaver has been made navigable (Weaver Navigation) from Winsford and flows northwards to the Manchester Ship Canal at Runcorn. The River Dane is a fast flowing natural river which brings high peak flows through Northwich. In contrast, the Weaver Navigation is slower and carries a greater volume of flow.

Parts of the proposed development sites lie adjacent to the Weaver Navigation and the River Dane, within Northwich town centre, as shown in Figure A2 and A2a in Appendix A.

2.2

Proposed development sites

The Adopted Vale Royal Local Plan First Review Alteration (2006-2011) outlines the basis for the Northwich Vision re-development programme, and is summarised in the extract below:

'In March 2003, the Borough Council in partnership with the North West Development Agency, British Waterways, Cheshire County Council and English Partnerships commissioned the preparation of a comprehensive regeneration framework to guide the redevelopment of the town centre over the next 15 to 20 years. This comprehensive regeneration will be facilitated by the stabilisation of abandoned salt mines which have, for a number of years, prevented new significant development from taking place (see policies GS7 and GS8). It is anticipated that the stabilisation works will be completed in 2007.'

Following extensive consultation, the Northwich Vision was approved by the Borough Council as Interim Planning Guidance (Northwich Vision IPG) in February 2004. It gives guidance on the implementation of development, public realm and transportation projects throughout the town centre. The strategy seeks to expand and enhance the town centre's offer in terms of shopping, tourism and leisure. Significant new residential development is proposed along with employment development, particularly offices. It aims to build upon the town's key assets including the waterfront, its historic buildings and the natural setting of the town adjacent to the Northwich Community Woodlands. Underpinning the strategy is a focus on good urban design through new high quality buildings, spaces and routes.

The Northwich Vision IPG identifies the creation of two distinctive, but overlapping, town centre 'offers' which can be described in physical terms as town centre circuits. The first is a market town circuit based on an east-west axis (Witton Street/Watling Street). It incorporates all the functions of the market town: shopping, employment, civic and administrative services, community and cultural facilities. The second is the visitor destination circuit that incorporates the visitor and cultural attractions: the historic hub of the town. It harnesses the potential of waterside sites and is a focus for a range of leisure uses. These circuits overlap and intersect at the Bull Ring and confluence of the River Dane and the Weaver Navigation. The creation of these circuits provides an overarching rational for the encouragement of new development across a range of sites within the town centre.'

The Northwich Regeneration Partnership comprises eight regional and national bodies: English Partnerships, North West Development Agency, British Waterways, Visit Chester and Cheshire and the Learning and Skills Council.

In summary, Northwich Vision plans to regenerate brownfield land, which is focussed within the town centre over the next 20 years. This involves reviving key sites in the town centre and will include:

- The provision of 1,000 new homes in the centre of Northwich.
- Providing 2,000 new jobs.
- The utilisation of the rivers Weaver and Dane, by creating a mixed-use waterfront activity.

- Two new retail areas covering approximately 400,000 square feet.
- A newly designed market square in the centre of the town.
- The Barons Quay site, which is a mixed-use development comprising residential, leisure, retail, offices and a new cultural centre.

Table 2.1 below lists the key development sites and the type of development proposed. The Barons Quay Development Area (GS9A) is planned to be developed first, followed by the other sites.

Table 2.1: Northwich Vision proposed development sites

Allocation	Development sites	Description
GS9A	Barons Quay Development Area	Allocated for a comprehensive mixed use regeneration including principally retail with some residential, leisure, commercial and office uses. The site is the principal focus for the whole regeneration framework and will provide the stimulus for the regeneration of all of the other sites allocated in the Northwich Vision. It has been allocated principally for retail development as it a natural redevelopment of the primary shopping area and will bring in the much needed investment into the town centre.
GS9B	Weaver Shopping Centre Development Area	This site is allocated for a retail led regeneration with offices and residential development possible on the upper floors of the development. New multi story car park for 350 cars.
GS9C	Land north of Leicester Street	This site is allocated for bulky goods retail development. The site is on the edge of the existing town centre and therefore an appropriate location in terms for bulky goods retail development.
GS9D	Northwich Market	This site is allocated for a remodelling of the market. This is the only suitable location for a new, high quality market which is a vital part of the regeneration scheme.
GS9E	Marina Development area	This site is allocated for a comprehensive redevelopment including residential and leisure uses. One of the main issues is that the site is so expensive to redevelop and it is such a key site to opening up of the waterfront and providing a new resource to Northwich that residential land values are essential to ensure the site remains viable. British Waterways are considering development options for the site and some initial proposals have been discussed with the Environment Agency.
GS9F	County Council Office site	This site is allocated for mixed use development including retail, food and drink and residential. The site does have some flexibility over uses in terms of the residential element although residential is likely to be above ground floor.
GS9G	Magistrates Court	This site is allocated for a replacement Magistrates Court. This allocation is a like for like replacement building.
GS9H	British Waterways site	This site is allocated for residential development with complementary mixed use potentially to incorporate leisure, hotel and offices. The site is likely to be extremely difficult to develop and residential is necessary to generate sufficient capital receipts to make the redevelopment of the site viable. British Waterways are considering development options for the site and some initial

Allocation	Development sites	Description
		proposals have been discussed with the Environment Agency.
GS9I	Lock Street site	<p>This site is allocated for a mixed use scheme including residential and food and drink. It is likely that the residential element of this site would be at first floor level and above. The site is likely to be expensive to redevelop as it is potentially contaminated and residential land values are required to make the redevelopment viable.</p> <p>However, recent proposals indicate that a Multi Storey Car park (approx 500 spaces) is most preferable here.</p> <p>In February 2008 a site specific FRA was prepared to accompany a demolition order for ten derelict builds on this site. This reduced the risk of flooding as additional floodplain was made available.</p>
GS9J	Memorial Hall site	This site is allocated for residential development. The Borough Council will be discussing proposals with the Environment Agency in due course. The capital receipt from this site will be used to subsidise the provision of a cultural centre and replacement for the Memorial Hall in another location.
GS9K	West of Old Warrington Road	This site is allocated for residential development.
GS9L	Land west of Queen Street	This site is allocated for residential development but is flexible in terms of its usage and potential allocation.
GS9M	Land adjacent to Victoria Bridge	This site has extant planning permission for residential development and elderly person's accommodation.

2.3

Consultation and data collection

Information and relevant data was collated from the key consultees so that flood risk could be assessed appropriately. The information gathered is summarised in the following sections below.

2.3.1

Environment Agency

The Environment Agency's flood maps (Figure 2.1) show the estimated flood extent across Northwich. The flood maps show the flood zones and the level of risk (low, medium and high) associated with them. The level of risk within each flood zone takes account of the existing development.

A large area of Northwich town centre is shown to be within Flood Zone 2 and is therefore considered at low to medium risk of fluvial flooding, with an annual probability of between 0.1% and 1%. Northwich town centre is also within Flood Zone 3 and considered at a high risk of fluvial flooding. The flood extents produced for the CFMP also confirmed that there is a high current risk of flooding in Northwich. The more recent modelling used for this study (see section 2.3.6) indicates different extents.

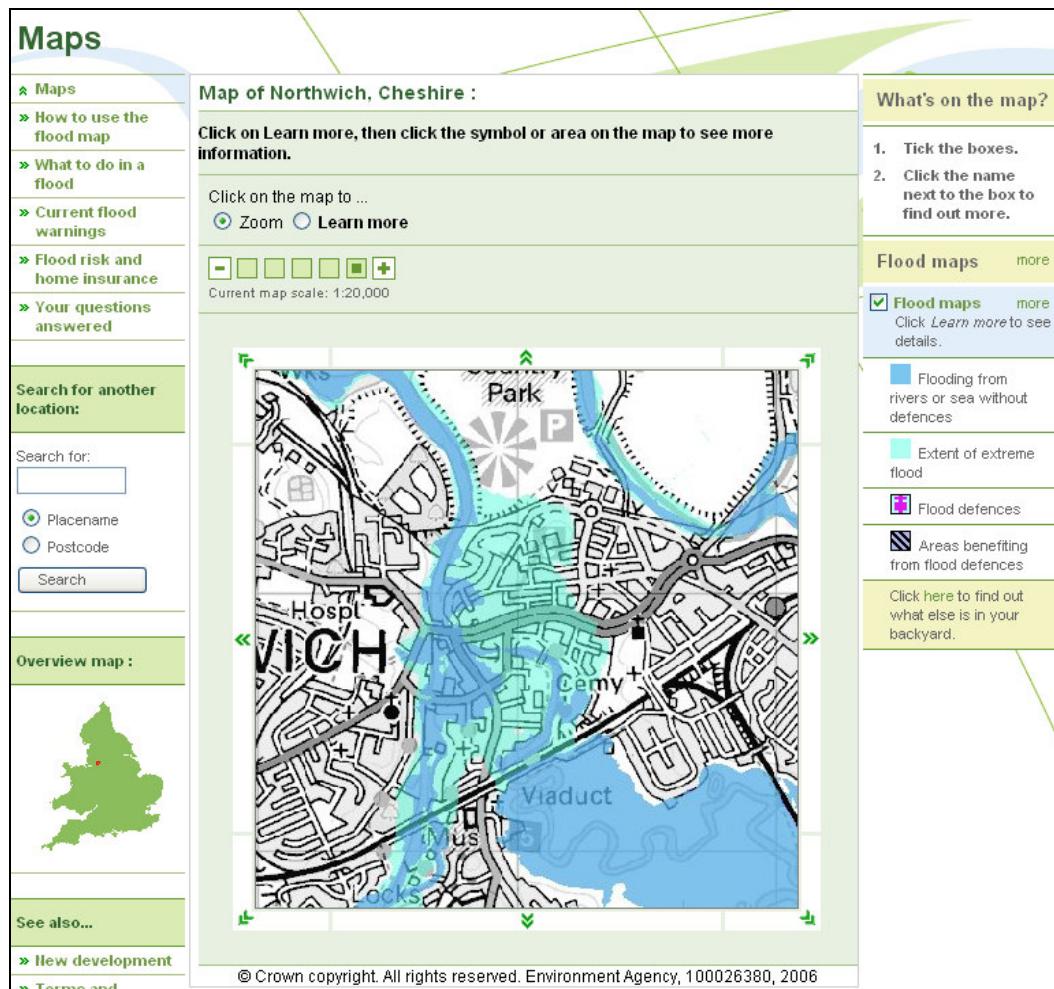


Figure 2.1: Extract from the Environment Agency's website

Existing flood risk management

The River Weaver from Winsford to Northwich has been canalised forming the Weaver Navigation. Downstream of Northwich there is generally an original channel with adjacent canalised sections. Although there are no significant official flood defences in Northwich, a canalised section of the Weaver Navigation adjacent to Barons Quay ensures that flow stays in-bank up to approximately a 1 in 80 year flood (1.25% a.p. event).

In the Environment Agency's National Flood and Coastal Defence Database (NFCDD) the Standard of Protection (SoP) allocated to sections of the Weaver Navigation through Northwich are given, with values ranging from 1 in 25, to 1 in 50, to 1 in 80 years. There is one small section of the River Dane in Northwich where there is a masonry flood wall. However, the NFCDD states that the majority of the Weaver Navigation and River Dane through Northwich are below the required 1 in 100 year SoP. The indicative standards of protection are given in Defra FCDPAG3 [1]. Northwich is classified as Land Use band A with a target standard of protection of 50 – 200 years (2% - 0.5% a.p.) as shown in Table 2.3 below.

Table 2.3: Indicative Standards of Protection (Defra FCDPAG3)

Land Use Band	Description	Return Period (years)
A	Typically intensively developed urban areas at risk from flooding and/or erosion.	50 - 200

British Waterways operate the sluice gates along the Weaver Navigation during flood events which provide some flood risk protection but only for the smaller flood events (the gates were designed for navigational purposes). When certain river levels are reached on the River Dane and Weaver, the gates at Winnington, Barnton and Saltersford are automatically raised to their maximum extent. Gates at Vale Royal, Hunt's Lock, Dutton and Sutton operate independently according to water levels monitored local to the structures. The Weaver Navigation at Northwich is monitored at Hayhurst Bridge and controlled by British Waterways operating Winnington sluices.

Northwich Pre-feasibility Study

A Flood Alleviation Scheme Pre-Feasibility Study has recently been carried out for the Environment Agency (Arup, July 2006 and Addendum Report, November 2007), which reviewed the options for providing flood alleviation to Northwich. A series of possible solutions included flood storage, flood defences within the town centre and alterations to existing structures.

The 1 in 100 year linear defence scheme remains the most economically viable option. However due to changes in the Multi-Coloured Manual (since the pre-feasibility study was originally produced) the benefit cost ratio has dropped from 6.5 to 5.6 and the LDW13 priority score has dropped from 16.5 to 14.5. A Defra priority score of 24 is required which indicates that the likelihood of the scheme going ahead is low.

Preliminary modelling and costing work has been carried out to investigate the option of storage on the River Dane upstream of the A556. The study found that although storage could limit the extent of defences in Northwich for lower probability flood events, storage is not sufficient in reducing flood levels or the extent of defences for the 1% a.p. event.

The Dane Storage scheme option cost benefit scores are very close to the 1 in 100 year linear defence scheme scores. It is therefore impossible at this point in time to say which would be the "preferred option", as there are a number of uncertainties, opportunities and risks associated with both options.

The most economically viable storage option is a 1 in 50 year scheme. This scheme would still require some raised defences to be constructed in the centre of Northwich. The benefit cost ratio of this option is 5.2 and the LDW13 priority score is 13.5, again significantly below the required Defra priority score.

A list of potential flood storage locations that were discarded in the Pre-feasibility report are shown below:

- Winsford Bridge
- Canal Aqueduct on Wincham Brook
- Leftwich/Dane Meadows on River Dane (between railway viaduct and A556 Dane bridge)
- River Weaver upstream of A556

The wide use of demountable defences to reduce flood risk was not considered appropriate because of the intensive manpower required. These would not be suitable along the River Dane because it is a fast responding river. However, in strategic areas along the Weaver Navigation it could be an option if sufficient flood warning times (~9hrs) were in place.

This study aims to mitigate flooding as a result of the proposed Northwich Vision development sites rather than provide a flood alleviation scheme for the whole of Northwich.

Threshold levels for Barons Quay

In November 2006 the Environment Agency met with Vale Royal BC to discuss flood threshold levels specifically for the Barons Quay (GS9A) masterplan. At the meeting it was agreed that FFL's in the Baron's Quay area for less vulnerable developments, such as commercial, could be reduced if necessary. Appropriate flood resilience measures would need to be built in. This applies to the Baron's Quay area only and was intended to be an exception (see Appendix C for meeting minutes).

These levels were based on the previous river modelling (Section 105) that has been undertaken on the rivers Weaver and Dane. The following levels were taken at the Weaver Dane confluence:

- 100 year flood level: 12.5m AOD
- 100 year flood level plus climate change: 12.9m AOD
- 100 year flood level plus climate change and 600mm freeboard: 13.5m AOD

For more vulnerable development, such as residential, a Finished Floor Level (FFL) of 13.5m AOD should be used as a minimum. For less vulnerable developments, such as commercial, it may be possible to use FFLs of 13.2m AOD; however, flood resilience measures would need to be built in. Where there are mixed use proposals, such as retail with residential above, the vulnerability class for the building will be the highest of the uses, i.e. residential at 13.5m AOD.

Access and egress, including roads, pedestrian and parking areas must be safe and should also be at a minimum level of 13.2m AOD. Undercroft or external car parking and access at 13.2 m AOD would be considered acceptable providing this was protected and safe dry access was available for the lifetime of the development.

The Environment Agency has stated that the loss of floodplain storage from the development will not be significant as the floodplain is wide downstream of Barons Quay.

The threshold flood levels will be slightly different upstream of the Weaver Dane confluence depending on the 1 in 100 year water level and the effect of any downstream development, which may cause flood flows to back up. The levels should be agreed with the Environment Agency in the planning stage. These issues have recently been confirmed with the Environment Agency (Graham Bate, 15/10/07).

2.3.2

Vale Royal Borough Council

Vale Royal BC provided the following information:

- Northwich Vision development proposals.
- Barons Quay Development Area masterplan.
- West Cheshire SFRA.
- Extracts from map of Northwich public sewers.
- Flood Incident Response Plan for Northwich (Nov 2006, revised in Aug 2008).
- History of flooding in Northwich.
- Northwich Urban Regeneration, Outline Drainage Strategy, Waterman Civils (Dec 2006).
- Barons Quay FRA Scoping study, Waterman Civils (Oct 2006).
- Reasons for the selection of the development sites (see Appendix C).

Flood warning

The Flood Incident Response Plan for Northwich has been developed as a scheme to provide a framework for responding to flooding (from the River Weaver and the River Dane). The plan outlines how partner organisations should work together in response to a flood in order to mitigate the effects of a flood. There are three designated flood warning target areas across Northwich:

Target area A is the most vulnerable to flooding and covers 104 properties including those on Watling Street and adjacent to Flotel, lower part of Dane Street, London Road, High Street, Weaver Way, and the lower part of Castle Street.

Target area B covers 448 properties including the Market Halls, Chester Way, Percy Street, Witton Church Walk Primary School, Heber Walk, Queen Street and properties off Weir Street and Yarwood Close.

Target Area C covers 189 properties across the Water Street and Whalley Road area.

There are 17 electricity sub-stations, two pumping stations and one gas pumping station that are located within the flood warning areas and therefore at flood risk. If these utility assets are flooded it would have a high impact on society with disruption to utility services and communication links. Proposals for how to protect critical infrastructure are currently being considered especially at the Dane/Weaver confluence where two sub-stations are located. Any critical assets should be moved or made resilient at these locations. Northwich Vision plan to develop Northwich with the location and protection of critical infrastructure as a priority.

Flood history

An extreme flood event occurred in February 1946, when a combination of excessive rainfall and snowmelt across the catchment resulted in flood flows on both the rivers Weaver and Dane. It is estimated that 256 houses and 70 shops were flooded by this extreme event, which was in excess of a 1 in 100 year return period (>1% annual probability event).

More recently, flooding occurred twice in autumn 2000. As a result of these events, the lower parts of the town centre were flooded and a number of roads were closed. Although only two major flood events have occurred in the last 50 years, events also occurred in 1919, 1920, 1925, 1940, 1946, 1960, 1964, 1965 and 1977 within Northwich.

2.3.3

United Utilities

United Utilities were consulted to discuss existing and future sewer and drainage issues within the Northwich Vision development sites. For a summary of this discussion refer to Appendix C.

The DG5 Register of external incidents shows that 1 property (in CW9 5) to the east of the Weaver Navigation and 4 properties (in CW8 1) to the west of the Weaver Navigation have previously flooded. These small incidents include sewer blockages which have now been cleared by normal reactive maintenance. There are no records of flooding from the public sewerage system in the Barons Quay area. However, from extreme flood events the sewer systems can become overloaded and is not designed to cope with the additional surface water.

The Barons Quay area is currently drained on a separate system with surface water being discharged into the River Weaver. Foul drainage is discharged to the Barons Quay Pumping Station (PS). Barons Quay PS is an important asset and serves an extensive drainage area. The PS includes open storm storage tanks and pumped overflow discharging to the Weaver Navigation. There is the normal duty/standby pumping facilities for dry weather flow, storm tank filling and overflow to the river. A fixed electricity generator is also installed. United Utilities is concerned about the proximity of proposed development adjacent to the existing Barons Quay PS.

United Utilities does not have any proposals for significant investment in capital maintenance in the existing drainage networks or Barons Quay PS.

2.3.4

Weaver Gowy CFMP

The CFMP was used to gain an understanding of the history of flooding as well as current and future flood risk in Northwich. The management policy chosen for Northwich was 'Policy Option 5', which is *to take further action to reduce flood risk both now and in the future*. The CFMP highlighted that current risk is too high, and therefore, new flood risk management measures are required to reduce flood risk in Northwich. The relevant actions within the CFMP Action Plan are:

- Use Northwich Flood Alleviation Scheme Pre-feasibility study (2007) to inform a Strategy Plan for Northwich. This should be used to understand the level of flood risk and look for opportunities and actions to reduce flood risk in Northwich and further downstream. Use to inform planning process and future national bids for funding.
- Encourage and assist the Regional Assembly and Local Planning Authorities to produce Regional and Strategic Flood Risk Assessments. Use these to inform future development and minimise flood risk from all sources.
- Influence the planning system to ensure that inappropriate development is guided away from flood risk areas and where development is permitted, the risks are adequately mitigated.
- Where development must, exceptionally, take place in areas at risk of flooding, ensure that floor levels are raised to an appropriate level (incorporating increases due to climate change), flood resilience is incorporated into buildings and it is demonstrated that safe access and evacuation can be provided during flood events.

2.3.5

West Cheshire Strategic Flood Risk Assessment

Strategic Flood Risk Assessments (SFRA) provide an evidence base to inform the Local Development Documents (LDDs) in relation to the allocation of land with respect to all forms of flooding, including flooding from rivers and the sea, flooding from groundwater, land drainage, sewerage and other artificial forms of flooding (i.e. reservoirs and canals etc.). An SFRA for West Cheshire including Vale Royal Borough Council was completed in August 2008.

The outcomes and recommendations of the SFRA relevant to Northwich include:

- A more detailed assessment of the levels of flood risk within the Flood Zones should be undertaken within Northwich. This should be used to identify the areas least at risk and in turn inform the major developments that are planned in Northwich.
- In general, higher probabilities of flooding and flood hazards are found in central Northwich and the Winnington area. Less vulnerable development should be located in these areas with more vulnerable development further back from the rivers Dane and Weaver.
- Development at Barons Quay should take into account the flood extents and flood risk profile.
- Extensive mitigation measures such as raising ground levels, ground floor parking, flood resilience/resistant designs, emergency access and egress considerations as well as flood defence improvements along the Weaver and Dane will need to be implemented in order for development to take place in Northwich. The feasibility of these measures on a site by site basis has not been considered in the SFRA.
- The guidance and flood risk matrix in the SFRA report should be used for all developments in order to find the correct consultation process and requirements for a FRA.

In general flood hazard through Northwich centre is classed as high, the flood extent is also at its greatest through Northwich town centre. In Northwich the lower flood risk areas (in hazard rating and frequency of flooding) are to the north and south of the town centre. The area around the confluence with the Dane and Weaver is at a particularly high risk. This area has a wide, high probability floodplain and a high hazard rating. The allocations with the greatest level of risk associated with them are as follows:

- Barons Quay allocation near the Weaver Navigation.
- The Council offices site.
- Lock Street allocation near to the Weaver Navigation.
- Other areas of high risk include: Chester Way, London Road, Navigation Road and Weaver Way

The SFRA summarised that within Vale Royal BC major development programmes are planned for Northwich town centre, which could potentially put more properties at risk of flooding.

2.3.6

ISIS-TUFLOW Model

An ISIS-TUFLOW model was provided by the Environment Agency which had previously been used to simulate a number of annual probability events up to the 0.1% a.p. event (1000yr) plus climate change for the purposes of flood mapping.

Initially this study was based on the Environment Agency Flood Zone maps (derived from a 1D ISIS model). However, since more detailed modelling has been undertaken we have updated our assessment based on the flood extents produced by the ISIS-TUFLOW 2D model. This has been agreed by the Environment Agency (with Graham Bate 03/06/08). The new flood extents, particularly the 0.1% a.p. outline is less extensive than the Environment Agency's Flood Zone 2 across Northwich (compare Figure A2 and A2a).

For the purpose of this study, the ISIS-TUFLOW component of the model was modified to account for the loss of floodplain storage as a result of the proposed Northwich Vision development.

The ISIS model simulated the River Weaver between Ashbrook Gauging Station to the Manchester Shipping Canal and the River Dane between Rudheath gauging station and its confluence with the River Weaver in Northwich. This is an area of just under 3.5km² with approximately (see Figure E1 in Appendix E).

The ISIS-TUFLOW model was run to assess the 'footprint' of the development and also to give an indication of the mitigation potential at different sites. Therefore a number of scenarios were simulated which are outlined in Chapter 6.

Assessment of Flood Risk

3 Assessment of Flood Risk

3.1

Sources of flooding

As Table 3.1 indicates, the predominant source of flooding within Northwich is fluvial. This is because of the confluence of the River Dane and Weaver Navigation in the town centre. The risk of flooding is increased because of additional surface water and drainage issues. In extreme rainfall and flood events the drainage system cannot cope with the additional surface water run-off which causes drains and culverts to become blocked and back-up.

Table 3.1: Sources of flooding

Source of flooding	Level of risk	Development sites impacted
Fluvial	<p>High risk to properties in Northwich town centre, which are adjacent to the Weaver/Dane confluence. Approximately 565 properties and 900 residents are thought to be at risk. 739 properties are within the flood warning areas.</p> <p>Risk from inundation of areas inside natural floodplain due to low banks, influence of bridges and Dane embankments that artificially raise water levels (e.g. Dane Bridge).</p>	All except GS9K
Surface water	<p>High risk to areas from sheet run-off from adjacent impermeable surfaces. Limited open space or greenfield areas.</p> <p>Risk from drains becoming blocked and surcharging/backing up.</p>	All
Sewer	<p>All areas have some level of flood risk but this is hard to quantify without modelling the whole network.</p> <p>Risk from combined, foul and surface water sewers.</p>	All
Infrastructure failure	Risk from industrial processes, burst water mains, blocked sewers or failed pumping stations.	All
Groundwater	<p>Low as mudstone geology (impermeable, non-aquifer).</p> <p>Moderate risk from brine streams above salt mines, however, these have recently been filled in.</p>	None
Tidal	Not applicable.	None

3.2

Site visit

A site visit was carried out on 26th September 2007 in order to visually assess the development sites, potential flood routes and flood barriers. Appendix B shows photographs of the existing development for each of the proposed development sites.

3.2.1

Fluvial flooding

The Weaver Navigation has relatively low banks along Weaver Way and Barons Quay Road as shown by Figures 3.1 - 3.3. During high river flow conditions, overtopping would be expected at this location. Figure 3.3 illustrates that currently a number of commercial properties (making up the High Street) back on to the Weaver Navigation. The High Street (proposed Northwich Market site) would act as a natural flood route for the Weaver Navigation if overtopping occurred.



Figure 3.1: Weaver Navigation (upstream)



Figure 3.2: Weaver Navigation (downstream)



Figure 3.3: Shops at Barons Quay (right bank)



Figure 3.4: Weaver Dane confluence (downstream)



Figure 3.5: Ribbed wall along Dane (right bank)



Figure 3.6: Graded banks along Dane (right bank)

Figure 3.4 shows the confluence of the Weaver Navigation and River Dane. Dane Bridge is located just upstream of the confluence and is low and fairly narrow. This could act as a potential flood barrier if it became blocked by vegetation or debris carried by high river flows. There is a ribbed wall for a length of approximately 20m upstream of Dane Bridge (see Figure 3.5). Upstream of the wall the River Dane has steep banks of 3m which increase to approximately 6m further upstream. Figure 3.6 shows that some sections of the River Dane

appear to have been graded (sloped embankment) which offers a 50 years Standard of Protection. Although this section of the River Dane has higher banks it is narrow and fast flowing creating a high fluvial flood risk in more extreme events.

Across Northwich there are 17 electricity sub-stations, 2 sewage pumping stations and a gas pumping station within the flood warning area. In a flood event there would be widespread disruption to these services if flood warning and emergency planning procedures were not followed.

3.2.2

Surface water and sewer flooding

To the east of the River Weaver topography increases and therefore the risk of fluvial flooding reduces. However, surface water and drainage issues are a significant risk to the development sites. In the Barons Quay area to the north of the town centre, foul drainage is discharged to the Barons Quay Pumping Station as shown in Figure 3.7.



Figure 3.7: UU Pumping Station (right bank)

3.3

Flood probability

As the Environment Agency's Flood Maps indicate (see Figure 2.1 and Figure A2 in Appendix A), the majority of Northwich town centre is within Flood Zone 2. This suggests that the annual probability of flooding within Northwich is between 1% and 0.1%. There is also a large portion of the town centre within Flood Zone 3 which means that there is a greater than 1% annual probability of flooding. Refer to Table 4.2 and Figure A2a in Appendix A to see the flood extent and probability of flooding for each of the proposed development sites according to more detailed river modelling.

Northwich town centre is located on the Weaver Navigation and River Dane's natural floodplain. The land level rises to the north and east away from the Weaver Navigation. Figure A3, in Appendix A shows low areas of topography, which are below the 1 in 100 year flood level plus climate change of 12.9m AOD. This makes up 3.8 hectares, which is 11% of the proposed regeneration area.

3.4

Climate change

The Environment Agency flood maps do not currently allow for climate change allowances; PPS25 requires that spatial planning process should (i.e. SFRAs). In the SFRA an upper limit of 20% increase in river flows (over the next 100 years) has been used in accordance with Defra and PPS25 guidance.

When designing surface water drainage for a new development, the impact of climate change should also be taken into account. It is predicted that climate change will increase the intensity of storms and the volume of rainwater. The existing guidance for assessing the impact of climate change on peak rainfall is summarised in Table 3.2 below.

Table 3.2: Recommended climate change increases (from Table B.2 PPS25)

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+ 5%	+ 10%	+ 20%	+ 30%
River flows	+10%		+20%	

The accepted norm design life for commercial and retail development is 60 years and for 100 years for residential development. Therefore we will use an increase of 20% increase in flows and rainfall intensities for climate change allowances.

The agreed Finished Floor Level (FFL) for Barons Quay (GS9A) takes climate change into consideration as shown below:

- 1 in 100 year flood = 12.5m AOD
- Climate change allowance (over 100 years) = 0.4m
- Design freeboard = 0.6m

More vulnerable development FFL = **13.5m AOD**

For less vulnerable development the freeboard element is reduced to 0.3m giving 13.2m AOD as the FFL. These FFLs has been used for all the developments sites in this study, however, for development further upstream than Barons Quay the FFLs will be slightly different depending on the 1 in 100 year water level and the effect of any downstream development, which could cause flood flows to back up.

Run-off rates will also be affected by climate change and are expected to increase in line with the increase in peak rainfall depending on the type and level of development. A 20% increase should be applied to commercial and retail development over the next 60 years. For residential development an increase of 30% should be considered over the next 100 years.

A site specific FRA should consider this when assessing the changes in existing and proposed run-off for each development site.

3.5

Flood risk to people

The flood risk to people has been assessed using the Defra Flood Risk to People document (R&D Technical Report FD2321: Flood Risk to People, Phase 2, Defra 2006). This will inform the Sequential Test by recommending where certain types of development should be put, depending on the hazard rating attributed. The flood risk profile (flood risk to people) was calculated as a function of flood velocity and flood depth using the following equation:

$$\text{HR} = d \times (v + 0.5)$$

HR = flood hazard rating

d = depth of flooding (m)

v = velocity of floodwaters (m/sec)

A grid was created covering the Weaver and Dane floodplain to look at the flood hazard across the development sites. Nodes were plotted on the rivers adjacent to the development sites and interpolated across the Flood Zone 3. The topographic LiDAR data was used to obtain the elevation (note - this has not been verified by a site survey) and used with the river stage levels and flood velocities from the Environment Agency's ISIS model for the 1% a.p. flood event. Therefore the potential flood depth for points adjacent to the development sites could be estimated. The degree of hazard (low, moderate, significant and extreme) was then attributed to the hazard rating values as shown in Table 3.3.

Table 3.3: Hazard to people as a function of velocity and depth (from Table 3.2 in Defra Flood Risk to People Guidance Document)

$d \times (v + 0.5)$	Degree of Flood Hazard	Description
<0.75	Low	Caution <i>“Flood zone with shallow flowing water or deep standing water”</i>
0.75 - 1.25	Moderate	Dangerous for some (i.e. children) <i>“Danger: Flood zone with deep or fast flowing water”</i>
1.25 - 2.5	Significant	Dangerous for most people <i>“Danger: flood zone with deep fast flowing water”</i>
>2.5	Extreme	Dangerous for all <i>“Extreme danger: flood zone with deep fast flowing water”</i>

Figure A4 (in Appendix A) shows the flood hazards zones across the proposed development sites. The degree of flood hazard is low for a number of the development sites as you move away from the higher flood risk areas. There should be caution in these areas which potentially could have shallow flowing or deep standing water. Flood waters would reduce in depth and velocity as they dissipate across the town centre.

There is an extreme to significant flood hazard around the Weaver Dane confluence because of the high flood depth and velocities. This means that there is danger for all or most people because of potentially deep fast flowing water.

Along the River Dane the flood hazard reduces upstream from extreme to low as the River Dane is embanked along this stretch of the river, which reduces the hazard.

Following analysis of the more detailed ISIS-TUFLOW modelling (outlined in Chapter 6) the actual degree of flood hazard across Northwich is reduced to between ‘moderate’ and ‘significant’, as is shown in Figure A4a.

3.6

Loss of floodplain

PPS25 states that FRAs should consider the risk caused by additional buildings. Any new buildings within the floodplain will cause a loss in floodplain volume and result in the displacement of flood waters. A loss in volume would occur if new buildings are built on an existing floodplain or when there is any associated land raising. However, if an existing building is replaced like for like then it is not considered as a loss in floodplain.

The Barons Quay (GS9A) masterplan (see Figure A5) shows that additional buildings are proposed in Flood Zone 3, which would result in a loss in the volume of floodplain. The volume of lost floodplain was crudely calculated by the area of new buildings subtracted from the existing buildings (net development) and the amount of potential land raising. This has been calculated as approximately 771m³ (see Table 3.5).

This loss in floodplain would have a relatively small affect on the surroundings both locally and further downstream. The impact on local properties can be mitigated and is outlined in section 5. As there is little development downstream of Barons Quay and given the size of the Weaver Navigation floodplain further downstream this loss in volume is thought to have a minimal impact on floodplain storage (confirmed by Graham Bate, Environment Agency, 15/10/07).

Table 3.4: Loss of floodplain volume

Development site	Area in Flood Zone 3 (m ²)			Land raising estimate* (m)	Loss in floodplain volume (m ³)
	Existing buildings	Proposed buildings	Net development		
Weaver floodplain d/s confluence					
GS9A	1,078	2,620	1,542	0.5	771
GS9B	0	0	0	0	No effect
GS9D	133	400	267	0.5	134
GS9I	923	3,000	2,077	0.5	1,039
GS9K	0	0	0	0	No effect
Total					1,944
Weaver / Dane floodplain u/s confluence					
GS9B	0	0	0	0	No effect
GS9E	3,487	5,000	1,513	1.5	2,270
GS9F	0	0	0	0	No effect
GS9G	0	0	0	0	No effect
GS9H	0	0	0	0	No effect
GS9J	0	0	0	0	No effect
GS9L	4,463	9,000	4,537	0.5	2,269
GS9M	0	0	0	0	No effect
Total					4,539
Total	10,084	20,020	9,936		6,483

Note: * we are not endorsing land raising but have used it in order to crudely calculate the potential loss in floodplain.

For the other development sites with planned development inside Flood Zone 3 the loss of floodplain volume was also broadly assessed. The development sites were divided according to their location on the Weaver and Dane floodplains as shown by Table 3.4. The total lost floodplain volume across Northwich is estimated at **6,483m³**. This loss of floodplain has not been modelled, however an additional study looking at storage options (including modelling) was commissioned and the findings of this study can be found in chapter 6 of this report.

Although the loss in floodplain for Barons Quay may have a relatively negligible impact, the cumulative effect of the proposed development within the floodplain would have a significant effect on flood risk. The floodplain most affected is the Weaver upstream of the Dane confluence. The Marina site (GS9E) and land west of Queen Street (GS9L) take up a largest area of the floodplain. Raising ground levels above the flood level for these developments would produce a throttling effect on the Weaver Navigation and significantly increase flooding to upstream properties as the river would back up (afflux). To compensate for this loss in floodplain compensatory storage would need to be provided in suitable upstream locations along the Weaver Navigation and River Dane. Any compensatory storage must be relatively nearby and "level for level" i.e. the volume lost at different water levels must be directly replaced in the storage to ensure that the river behaves in the same way pre and post development. A site specific FRA would confirm the effect of loss of floodplain.

Any upstream development could have a significant influence on water levels and flood risk downstream in Northwich. Winsford is approximately 8km upstream and has a planned regeneration programme on a smaller scale than Northwich Vision. However, it is estimated that the amount of development within the River Weaver floodplain around Winsford will be minimal. As only a small volume of the floodplain will be lost the downstream effect is believed to be negligible.

3.7

Run-off

PPS25 states that FRAs should consider the risk to others caused by new developments. New developments can lead to increased run-off of surface water which increases the risk of flooding elsewhere.

Developers should consider the existing run-off rates across the development sites and whether the proposed development is likely to increase or reduce run-off. As Northwich Vision is based on the regeneration of brownfield sites, it is expected that there will not be a significant increase in surface run-off. The development sites should be designed in a way that maximises soft landscaping which could reduce rather than increase run-off rates. The run-off for the development sites should be considered as a whole so that any landscaping and open spaces would reduce total run-off rates benefiting the entire site. An assessment of the impact of increased rainfall intensity on the proposed runoff rates will need to be considered in line with PPS25.

An outline drainage strategy for each site should be prepared to justify the way development has dealt with this issue. This would inform the site specific FRA when it assesses the impact of run-off to other areas.

Sequential Testing

4 Sequential Testing

4.1

Introduction

PPS25 states that development should be directed to Flood Zone 1 wherever possible, and then sequentially to Flood Zones 2 and 3, as identified by the SFRA. The Flood Zone maps show current best estimates of the risk of flooding from rivers and the sea and does not consider other sources. Therefore this principle of locating development in lower risk areas should be applied to other forms of flooding. The sequential test can then be applied to steer new development away from these higher risk areas. This can be applied at a regional, local and site specific level.

Once the Sequential Test has been completed the following should be considered:

- Development in Flood Zone 3 should be seen as a last resort and that certain uses (as identified in PPS25 Table D1) are inappropriate in high risk areas and should not be permitted at all.
- Development in Flood Zone 2 should not be seen as without risk of flooding.
- Appropriate measures to manage residual risk must be applied to any developments which are exceptionally constructed in flood risk areas. These measures must take into account the effects of climate change.

In exceptional circumstances there may be valid reasons for a development type to be considered even if it is not compatible with the level of flood risk. In this case, the site must pass all elements of the Exception Test, which include:

- a) The development must provide wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA.
- b) The development must be on developable previously developed land.
- c) A site specific FRA must demonstrate that the development will be safe, reduce flood risk and not increase flood risk elsewhere.

4.2

Sequential Test

The first step of the Sequential Test is to verify whether there are any other suitable and readily available locations that would be appropriate for the Northwich Vision development sites. This can be applied by looking at the regional, local and site specific level.

When considering the surrounding region it is clear that while there are other available locations outside Northwich, none of them could provide the necessary social and economic regeneration that is required for Northwich (refer to Appendix C for the unsuitable sites and for consultation with Vale Royal BC on this issue).

At a local level, the Sequential Test is passed as development is essential specifically within Northwich town centre. The proposed development sites are found within the Adopted Vale Royal Local Plan First Review Alteration (2006-2011), which sets a general strategy for developments across Northwich town centre (GS1 - GS11). The policies GS9A-GS9M (see Table 2.1 for details) make up the Northwich Vision proposed sites. They have been appointed in these locations for a number of reasons as shown below (refer to Appendix C for full justification):

- Northwich is identified as a 'key town' in the region (SD3 RPG for Northwest)
- Regeneration of the town meets the Regional Economic Strategy (2003)
- Planning Policy Statement 6: Planning for Town Centres
- Policy H2 – Housing allocations (GS9A, GS9E, GS9F, GS9H, GS9I, GS9J, GS9K, GS9L, GS9M)
- Policy E5 – Employment land allocation in town centre 2.2 Ha (GS9A, GS9B, GS9I, GS9M)
- Policy STC2 – Primary shopping areas (GS9A - GS9F)

The next step in the Sequential Test is to determine whether the development types conflict with the flood zone in which it resides. If there is a conflict it must be resolved by either moving the development to a safer zone or carrying out the Exception Test.

The Council were aware that the sites, when allocated, were located in flood risk areas but they have been working with the Environment Agency as a partner on the Northwich Vision Board to ensure that the flood risk issues are addressed at an early stage of the process and to the Environment Agency's satisfaction.

The Sequential Test has been applied to each of the development sites. This was carried out by updating the flood risk matrix, produced for the SFRA, with additional information gathered for this study. The flood risk matrix can be found in Appendix A, Figure A6. Each Northwich Vision development area has been colour coded based on the level of flood hazard. It should be possible, using the colour code key, to identify which are the higher and lower risk sites. For each of the development sites minimum recommendations have been proposed, which comply with PPS25 and the Environment Agency expectations. It should be noted that development plans / layouts have not been made available for the sites (except for Barons Quay) and therefore this limits the detail of the sequential approach for the individual sites.

The development sites have been summarised in the section below for the suitability of their location, whether the sites conflict with the flood zones and our initial recommendations.

4.2.1

Barons Quay Development Area (GS9A)

The site is the principle focus for the whole regeneration framework and will provide the stimulus for the regeneration of all of the other sites allocated in the Northwich Vision. The western side of the site falls within Flood Zone 3b. PPS25 states that the only appropriate development within Flood Zone 3b is water-compatible and essential infrastructure. Therefore this site should undergo the Exception Test.

Barons Quay has an area of riverside roadway and open space which makes up most of the functional floodplain. This should be retained to provide important flood storage.

The Barons Quay masterplan (Figure A5) shows that this area is proposed for residential (riverside apartments and a hotel) and commercial development (new cultural centre, bars and restaurants). These types of development should be cited in a lower flood risk area. Only 7 residential units are planned within Flood Zone 3 so these could easily be incorporated within the other residential areas slightly to the east in the lower flood risk area. The hotel is also a more vulnerable development which should be moved to a lower flood risk area. Alternatively, the hotel could be moved to a lower flood risk area by implementing undercroft parking. This would be acceptable as long as the hotel was protected from flooding through emergency planning and with safe dry access. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised.

The less vulnerable development could only remain in the higher risk flood zones if the development is raised above the agreed flood threshold levels and appropriate flood mitigation measures were in place.

4.2.2

Weaver Street Shopping Centre (GS9B)

This site is allocated for a retail led regeneration with offices and residential development possible on the upper floors of the development. The site is located entirely in Flood Zone 2 and therefore deemed acceptable for commercial and residential development.

4.2.3

Land North of Leicester Street (GS9C)

This site is allocated for bulky goods retail development and is located in Flood Zone 2. The site is on the edge of the existing town centre and therefore an appropriate location in terms of bulky goods retail development. There is no conflict with the development type and Flood Zone.

4.2.4

Northwich Market (GS9D)

This site is allocated for a remodelling of the market and is located in Flood Zone 2 and 3. This is the only suitable location for a new, high quality market which is a vital part of the regeneration scheme. The commercial properties are classed as less vulnerable development and should be located in the lower flood risk areas where possible and raised above the threshold flood level.

4.2.5

Marina Development Area (GS9E)

This site is allocated for a comprehensive redevelopment including residential and leisure uses. The site is located on the right bank of the Weaver Navigation and is entirely within Flood Zone 3a and 3b. Therefore this site should undergo the Exception Test.

Only water compatible development should be pursued within the area that is functional floodplain. If any residential development is permitted, in Flood Zone 3a, it should adhere to the threshold flood levels for more vulnerable development. This could be achieved by implementing undercroft parking and having the residential development above the flood level. This would only be acceptable if the development was adequately flood proofed and protected from flooding through emergency planning demonstrating safe dry access. In addition, compensatory storage would be required if there is a loss in floodplain. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised. Residential development would not be permitted under any circumstance in Flood Zone 3b.

Refer to Chapter 7 for further recommendations for the Marina Development Area.

4.2.6

County Council Offices Site (GS9F)

This site is allocated for mixed use development including retail, food and drink and residential and is located in Flood Zone 2 and 3. Therefore this site should undergo the Exception Test.

The site should plan the residential element to be cited in the lower flood risk areas away from the banks of the River Dane with safe dry access. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised.

4.2.7

Magistrates' Court Site (GS9G)

This site is allocated for a replacement Magistrates' Court and is in Flood Zone 2. As this allocation is a like for like replacement building and within Flood Zone 2 there is no conflict and development is appropriate.

4.2.8

British Waterways Site (GS9H)

This site is allocated for residential development with complementary mixed use potentially to incorporate leisure, hotel and offices. The site is located in Flood Zone 2 and a small part of Flood Zone 3. Therefore this site should undergo the Exception Test.

Any residential development should be cited in the lower flood risk areas away from the banks of the Weaver Navigation with safe dry access. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised.

4.2.9

Lock Street Site (GS9I)

This site is allocated for a mixed use scheme including residential and food and drink. It is located in Flood Zone 2 and 3. Therefore this site should undergo the Exception Test.

The residential element of this site should be cited in the lower flood risk areas away from the banks of the Weaver Navigation with safe dry access. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised.

Recent proposals indicate that if feasible the site will be developed as a Multi Storey Car Park (500 spaces), which would reduce the vulnerability class.

4.2.10

Memorial Hall Site (GS9J)

This site is allocated for residential development and a new Memorial Hall, and is located in Flood Zone 2 and partly in Flood Zone 3. Therefore this site should undergo the Exception Test.

Residential development should be kept to the lower flood risk areas away from the banks of the River Dane with safe dry access. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised.

4.2.11

Land West of Old Warrington Road (GS9K)

This site is allocated for residential development and is located in Flood Zone 1. Development is therefore appropriate at this site.

4.2.12

Land West of Queen Street (GS9L)

This site is allocated for residential development, although this is flexible, and is located in Flood Zone 3. Therefore this site should undergo the Exception Test.

This site should consider the development type avoiding residential development in this high flood risk location and adhere to the agreed threshold flood levels for less vulnerable development. Any permitted residential development would have to be raised above flood levels by having undercroft parking. This would be acceptable as long as the development was protected from flooding through emergency planning and with safe dry access. In addition, compensatory storage would be required if there is a loss in floodplain. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised.

4.2.13

Land Adjacent to Victoria Bridge (GS9M)

The previous planning applications for this site have included Flood Risk Assessments that show the site is Flood Zone 2, with only a small area that is Flood Zone 3. The proposed layouts have shown new buildings away from the Zone 3 area.

4.3

Exception Test

The Sequential Test concluded that eight of the development sites need to undergo the Exception Test. Table 4.3 below shows that these development sites all passed the test as they fulfil the necessary criteria. The development sites will provide social and economic regeneration for the town centre that outweighs the flood risk. Therefore development should be permitted providing:

- a site specific FRA is completed
- satisfactory flood mitigation measures are in place (e.g. compensatory storage)
- residual risks to existing and proposed development are managed.

Table 4.3: Exception Test

Development area	Reason for Exception Test	Conditions (Table D.9 of PPS25)		
		A Sustainability benefits	B On developable previously developed land	C Requires site specific FRA
Barons Quay Development Area (GS9A)	More vulnerable development within FZ 3a and FZ 3b.	Town centre regeneration programme.	Existing commercial properties.	Yes
Marina Development Area (GS9E)	More vulnerable development within FZ 3a and FZ 3b.	Town centre regeneration programme.	Existing Marina and car dealerships/commercial properties.	Yes
County Council Office site (GS9F)	More vulnerable development within FZ 3a.	Town centre regeneration programme.	Existing Vale Royal County Council offices.	Yes
British Waterways Site (GS9H)	More vulnerable development within FZ 3a and FZ 3b.	Town centre regeneration programme.	Existing BW offices and Boat repair yard.	Yes
Lock Street Site (GS9I)	More vulnerable development within FZ 3a and FZ 3b.	Town centre regeneration programme.	Existing commercial property and brownfield land.	Yes
Memorial Hall site (GS9J)	More vulnerable development within FZ 3a and FZ 3b.	Town centre regeneration programme.	Existing Memorial Hall, restaurant and car park.	Yes
Land west of Queen Street (GS9L)	More vulnerable development within FZ 3a and FZ 3b.	Town centre regeneration programme.	Existing commercial and residential properties.	Yes
Land adjacent to Victoria Bridge (GS9M)	More vulnerable development within FZ 3a and FZ 3b.	Town centre regeneration programme.	Dane House, Inland Revenue office.	Yes

Flood Mitigation Measures

5 Flood Mitigation Measures

5.1

Fluvial measures

Fluvial flood risk can be managed by a number of mitigation measures. This section outlines possible approaches which would either reduce flood levels or prevent the flood waters reaching and adversely affecting the development sites.

5.1.1

Land raising

When it is not possible to locate vulnerable development in lower flood risk areas, it may be necessary to raise the land so that the development is above the threshold flood levels. However, this measure would have to be undertaken in conjunction with providing compensatory floodplain storage elsewhere (see Chapter 6 for analysis). At the Barons Quay development site any land raising should be based on the threshold levels agreed with the Environment Agency as shown in Table 5.1. For the other development sites, Finished Floor Levels (FFL) would need to be agreed according to the 1 in 100 year water levels and the effect of any downstream development, which could cause flood flows to back up (see Chapter 8).

Another option would be to use the ground floor of the residential development as undercroft parking. This would position the more vulnerable residential development above any potential flood levels in a safer location. Any cars should be evacuated from the car park and emergency planning procedures should be followed when the fluvial flood warning is issued. The evacuation of cars will be dependent on owners/drivers being able to move them and does not allow for people being away or breakdowns etc. This measure also means that there is no resulting loss in floodplain or compensatory storage required.

Figure A3 shows the area of Northwich town centre that is under the threshold flood level for the 1% a.p. flood plus climate change of 12.9m AOD. This compares closely with Flood Zone 3 and provides a guide as to the scale of land raising that potentially is required in each development area. Land raising will cause the water levels to increase upstream of the development sites as backing up occurs (afflux). This will increase the risk of flooding upstream and should be considered in the site specific FRA when proposing the mitigation measures.

Table 5.1: Threshold levels for Barons Quay

Development type	Finished Floor Levels m AOD
More vulnerable - residential	13.5
Less vulnerable - commercial	13.2
Evacuation routes (access/egress) e.g. roads, car parks and pedestrian areas.	13.2

Note: For mixed used proposals the FFL should be based on the higher vulnerability class within the development

5.1.2

Upstream Storage

PPS25 requires the provision of compensatory storage if there is a loss in floodplain volume due to development (e.g. due to land raising). Although the storage opportunities are limited in Northwich town centre, attenuation has been investigated in locations further upstream. The Northwich Pre-feasibility Study found that attenuation storage would be most beneficial along the River Dane upstream of the A556 Dane Bridge. However, given the size of the potential storage areas, this would only provide a Standard of Protection (SoP) up to 50 years in Northwich and a small reduction in water levels of 300mm.

In addition to considering water levels, the impact of the proposed development sites on floodplain storage and flood depths needs to be modelled to consider how beneficial upstream storage would be. This has been done as part of this study in Chapter 6.

5.1.3

Increase the Standard of Protection (SoP)

Flood risk could be managed by raising the SoP along the banks of the Weaver Navigation and River Dane. The Northwich Pre-feasibility Study proposed that the construction of flood walls through the town centre would be the most appropriate alleviation scheme; however, this produced a low cost-benefit and priority score. This form of flood defence would also bring adverse landscape impacts and in the event of overtopping can result in extreme flood hazards. Riverside defences can also increase the risk of surface water flooding by interrupting the drainage regime. However, this could be alleviated by appropriate use of Sustainable Drainage Systems.

5.1.4

Landscaping

Soft landscaping can be used to provide natural looking flood barriers such as bunds and graded riverside embankments. This would be suitable along the Weaver Navigation for the Barons Quay (GS9A) and Lock Street site (GS9I). There are also opportunities to landscape along the River Dane as a way of providing natural and attractive protection measures. However, this option is likely to reduce the floodplain volume and therefore would require compensatory storage elsewhere.

5.2

Foul and surface water arrangements

Through consultation with United Utilities (UU) it was confirmed that they will not allow building over public sewers or rising mains. On request from the developer, UU will consider diversion of these existing assets at the expense of the developer.

For Barons Quay, UU requires the drainage of the development to be on the separate system. The design of the proposed sewers should be in accordance with the current Sewers For Adoption. Foul flows should be discharged to the Barons Quay pumping station, which currently has capacity to deal with the foul flows. United Utilities expects surface water to be discharged into the Weaver Navigation, subject to the approval of the Environment Agency.

5.2.1

Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) is the collective term for a number of drainage methods which can be used in various combinations to provide an effective but sustainable drainage system in place of, or in conjunction with, a traditional drainage system.

SuDS schemes aim to improve on traditional drainage methods by attempting to replicate natural land drainage systems and processes. These schemes reduce the risk of flooding, by more effectively managing the flow rates of surface water to watercourses.

Through natural processes, they also reduce the amount of pollution transmitted to watercourses, stabilising or improving water quality. In addition to this, SuDS schemes can actively enhance the developed environment by improving landscaping, wildlife habitats, and community facilities.

Table 5.1 shows some typical SuDS mechanisms available. Some of these are more suitable than others and more detailed ground investigation will be needed to establish the effectiveness of these measures on each development site.

Table 5.1: SuDS Options

Category	Techniques	Purpose
Preventive Measures	Rain-water recycling, good-practice design and maintenance	Reduces the amount of rainfall leaving a site.
Filter strips and swales	Vegetated landscape features (smooth surfaces, gentle downhill gradient).	Drains water evenly off impermeable surfaces, mimicking natural drainage patterns.
Filter drains and permeable and porous pavements	Permeable surfaces	Allow rainwater and run-off to infiltrate into permeable material placed below ground to store water prior to discharge.
Infiltration devices	Soakaways, infiltration trenches, swales with infiltration and infiltration basins	Below-ground or surface structures that drain water directly into the ground can be installed at source or the run-off may be conveyed to the infiltration area in a pipe or swale.
Basins and ponds	Detention basin Balancing/attenuation ponds Flood storage reservoirs Lagoons Retention ponds Wetlands/reed beds	Structures designed to hold water when it rains. Basins are empty in dry weather. Ponds contain water at all times and are designed to hold more when it rains.
Manufactured Retention Systems	Pre-designed systems by manufacturers such as Stormcell, Atlantis and Hoofmark	Manage the heavy rainfall events as they are set for design storm events.
Engineered Solutions	Tank Sewers, Detention Tanks	Provides solution if the above ones are not feasible, and where adoption is required under the Water Industry Act.

5.3

Flood proofing

There may be circumstances when for less vulnerable development temporary disruption is acceptable as long as flood warning is provided. Flood proofing are suitable measures which can provide either flood resistance or flood resilience. Flood resistance (dry proofing) prevents flood water entering a property, whereas, flood resilience (wet proofing) accepts entry of flood water and allows for the situation through careful internal design. Tables 5.2 – 5.4 outline a variety of flood resilience, resistance and avoidance measures, which should be considered by developers when proposing their final masterplans.

For more information on Flood Resistance and Flood Resilience Techniques refer to the EA/Defra Document 'Improving the Flood Performance of New Buildings'.

Table 5.2: Flood resilience measures

Resilience measures
<ul style="list-style-type: none"> Building materials <ul style="list-style-type: none"> - Denser materials such as concrete and engineering bricks have good resilience characteristics Foundations <ul style="list-style-type: none"> ➤ for flood depths less than 0.3m (water exclusion strategy): <ul style="list-style-type: none"> - Minimise the entry of water through permeable elements of the foundation. Concrete blocks used in foundation should be sealed with an impermeable material or encased in concrete to prevent water movement from the ground to the wall construction. ➤ for flood depths more than 0.3m (water entry strategy): <ul style="list-style-type: none"> - Provide durable materials that will not be affected by water and use construction methods and materials easy draining and drying. ➤ Basement can provide an effective barrier to flood water (not preferred for living accommodations) • Floors <ul style="list-style-type: none"> ➤ for flood depths more than 0.3m (water exclusion strategy): <ul style="list-style-type: none"> - Ground supported floors and concrete slabs of at least 150mm thickness are the preferred option for non-

Resilience measures
<p>reinforced construction.</p> <ul style="list-style-type: none"> - Suspended floors may be necessary where ground supported floors are not suitable, namely in shrinkable /expanding solid or where depth of fill is greater than 600mm. - Suspended timber floors are not a preferred option. - Hardcore and blinding is necessary to reduce the risk of settlement and consequential cracking - Damp proof membranes should be included to minimise the passage of water through ground floors. - Floor insulation should be of the closed-cell type to minimise the impact of flood water. - Suitable floor finishes include ceramic tiles or stone floor finishes and skirting board. - When the expected probability of flooding in any year is 20%, the provision of a sump and small capacity automatic pump at a low point of the ground floor is recommended. - Under floor services using ferrous materials should be avoided. <p>➤ for flood depths more than 0.6m (water entry strategy):</p> <ul style="list-style-type: none"> - Materials that retain their integrity and properties when subjected to flood water (such as concrete) or those that can be easily replaced (sacrificial materials), should be specified. - Construction should allow easy access for cleaning, (e.g. below suspended floors), and drainage - the applications of water exclusion strategy and water entry strategy are quite similar <ul style="list-style-type: none"> • Walls <p>➤ for flood depths up to 0.3m or up to 0.6m (water exclusion strategy):</p> <ul style="list-style-type: none"> ● Masonry walls: <ul style="list-style-type: none"> - Engineering bricks up to predicted flood level plus one course of bricks to provide freeboard; this will increase resistance to water penetration. - Aircrete blocks allow less leakage than typical concrete blocks but concrete blocks dry more quickly. - Do not use highly porous bricks such as hand made clay bricks. - Clear cavity walls, i.e. with no insulation in the cavity, have better flood resilience characteristics than filled or part filled cavity walls as they dry more quickly. ● Framed walls: <ul style="list-style-type: none"> - Avoid timber framed walls should be avoided (poor performance in floods) ● Reinforced concrete wall/floor <ul style="list-style-type: none"> - should be considered for flood-prone areas ● External renders <ul style="list-style-type: none"> - effective barriers to water penetration ● Insulation: <ul style="list-style-type: none"> - External insulation is better than cavity insulation because it is easily replaced if necessary. ● Internal linings: <ul style="list-style-type: none"> - Internal cement renders (with good bond) are effective at reducing flood water leakage into a building and assist rapid drying of the internal surface of the wall. - Avoid standard gypsum plasterboard as it tends to disintegrate when immersed in water. <p>➤ for flood depths above 0.3m or above 0.6m (water entry strategy):</p> <ul style="list-style-type: none"> ● Masonry walls: <ul style="list-style-type: none"> - Use good quality facing bricks for the external face of cavity walls. - Do not use soft bricks which can easily crumble when subjected to water. - Concrete blocks dry more quickly than Aircrete blocks. However, Aircrete blocks allow less leakage. - Clear cavity walls, i.e. with no insulation, have better resilience characteristics than filled or part filled cavity walls as they dry more quickly ● Framed walls: <ul style="list-style-type: none"> - Avoid timber framed walls should be avoided (poor performance in floods) ● External renders <ul style="list-style-type: none"> - Should not be used as they provide a barrier to water penetration and may induce excessive differences in depth between outside and inside of the property resulting in possible structural problems. ● Insulation: <ul style="list-style-type: none"> - External insulation is better than cavity insulation because it is easily replaced if necessary; however it is generally protected by rigid lining which may create a barrier to water. ● Internal linings: <ul style="list-style-type: none"> - Avoid internal cement renders as these can prevent effective drying. - Use standard gypsum plasterboard up to the predicted flood level (plus freeboard of 50mm) as a sacrificial material. - Above predicted flood level (plus freeboard) the use of plasterboard or internal cement renders is appropriate. <ul style="list-style-type: none"> • Doors and Windows <ul style="list-style-type: none"> ● Doors: <ul style="list-style-type: none"> - Raising the threshold as high as possible, while complying with level access requirements, should be considered as the primary measure - Hollow core timber internal doors should not be used where the predicted frequency of flooding is high. ● Windows/patio doors: <ul style="list-style-type: none"> - Windows and patio doors are vulnerable to flood water and similar measures to those used for doors should be taken. ● Air vents:

Resilience measures
<ul style="list-style-type: none"> - special designs of air vent are available in the market to prevent water ingress in circumstances where the predicted flood depth is low • Fittings <ul style="list-style-type: none"> ➢ water exclusion strategy <ul style="list-style-type: none"> - use durable fittings that are not significantly affected by water and can be easily cleaned - Place fittings (e.g. electrical appliances, gas oven) on plinths as high as practicable above floor so that they are out of reach of flood water. - Ensure adequate sealing of joints between kitchen units and surfaces to prevent any penetration of water behind fittings. ➢ water entry strategy <ul style="list-style-type: none"> - Specify durable fittings that are not appreciably affected by water and can be easily cleaned. - Place fittings (e.g. electrical appliances, gas oven) as high as practical above floor to minimise the risk of being affected by flood water. - Providing gaps behind kitchen units will facilitate drainage and will allow access for forced drying, if proved to be necessary. • Services <ul style="list-style-type: none"> ● Pipework: <ul style="list-style-type: none"> - Closed cell insulation should be used for pipes which are below the predicted flood level. ● Drainage services: <ul style="list-style-type: none"> - Non-return valves are recommended in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging. ● Water, electricity and gas meters: <ul style="list-style-type: none"> - Should be located above predicted flood level. ● Electrical services: <ul style="list-style-type: none"> - electrical sockets should be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation ● Heating systems: <ul style="list-style-type: none"> - Boiler units and ancillary devices should be installed above predicted flood level and preferably on the first floor of two-storey properties. ● Communications wiring: <ul style="list-style-type: none"> - Wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

Table 5.3: Flood Resistance Measures

Resistance measures
<ul style="list-style-type: none"> • Aiming to prevent floodwater ingress into building • Designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents • Use of low permeability materials that reduce the rate of water ingress into a property. • Effective for short duration, low depth flooding

Table 5.4: Flood Avoidance Measures

Avoidance measures
<ul style="list-style-type: none"> • Not building in flood risk areas wherever possible • Raising ground or floor level or re-designing to a location outside the flood area, and provision of replacement storage. • Local bunds can be designed to protect individual or groups of buildings from flooding. It is unlikely that these can be made fully watertight and pumps may be necessary to remove or re-direct any seepage water within the protected area. Bunds may be effective where the predicted duration and depth of flooding is low. Advice should be sought from a Qualified Engineer/Professional to ensure the bunds can withstand predicted water pressures. • Landscaping of a development site or building curtilage to direct or divert floodwater away from buildings can be effective particularly where the predicted duration of flooding is short i.e. hours rather than days. Landscaping is an integral component of sustainable drainage systems (SuDS). They can be designed to manage flood risk and water quality, and also environmentally acceptable to communities. • Boundary walls and fencing could be designed with high water resistance materials and/or effective seals to minimise water penetration for low depth, short duration floods (but not for groundwater flooding).

5.4

Access and egress

PPS25 requires that safe access and egress is available to and from new developments in flood risk areas. This includes access by roads, pedestrian and parking areas. Emergency services should be able to reach developments in flood conditions. Access routes should be above the minimum 13.2m AOD design level. Undercroft or external car parking and access at 13.2m AOD would also be considered acceptable. This would be acceptable as long as the development was protected from flooding through emergency planning (removing cars in advance, lift operation procedures etc.) and with safe dry access.

The Emergency Services have no statutory duty to enter floodwater, and Emergency service vehicular access depends on the nature of the flood event, flood depths, flood velocities and the risk of debris in floodwater. The equivalent of "snow poles" (as used at high elevations during heavy snow to delineate the edges of roads, driveways etc) would help ensure that the emergency services are able to enter the site safely. The fire service also offer a bank side response to flood incidents (shout, reach and throw) and can mobilise boats for search and rescue. However, this would be difficult in extreme flood events when there is hazardous fast flowing water, which could contain large and partly submerged debris such as trees.

In areas where surface flooding is likely, manhole covers should be bolted down to protect against trips and falls. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised.

Landscaping of public areas that are at risk of flooding should allow easy access to higher ground as flood waters rise, avoiding local features that could become isolated and which could cause obstructions to escape routes.

A site specific FRA should be carried out to assess the velocity of floodwaters and flood pathways in relation to the layout of roads and pedestrian routes to maintain safe and dry access and egress for the lifetime of the development.

5.5

Residual risks

Residual risks are those that remain after applying the Sequential Test and mitigation measures. Flood risk to people and property can be minimised but never completely removed.

A site specific FRA would look at these residual risks in more detail once the development plans and the appropriate mitigation measures are confirmed. For the proposed development sites the likely residual risks include:

- An extreme flood event (such as the 0.1% a.p. flood). Emergency planning by responsible authorities should identify measures to tackle this risk.
- Uncertainty regarding exact flood routes and speeds. Two-dimensional modelling (ISIS-TUFLOW) can demonstrate this but does not consider blockages.
- Uncertainty regarding the impact of land raising on existing development.
- Failure of surface water conveyance systems. The production of Surface Water Management Plans by local authorities should help manage this risk.
- Failure of any upstream flood management measure (upstream attenuation sites).
- Failure of upstream reservoirs / dams (e.g. due to terrorism). Local Authorities will be responsible from June 2009 for preparing reservoir flood plans to assess the extent and severity of flooding from an uncontrolled release of water.

5.6

Evacuation overview

Strategic evacuation routes and emergency planning need to be co-ordinated across all of the development sites. Consideration should be given to where evacuation will be to and what the impact of evacuation of town centres sites would have on the local traffic infrastructure. The current emergency evacuation routes and reception centres are found in the Northwich Flood Incident Response Plan developed by the Council (Aug 2008). This is currently being updated as the Multi Agency Flood Response Plan for Northwich in line with the Defra / EA Multi Agency Flood Plan Checklist. These are listed below in relation to the proposed development areas, and are shown on Figure A7.

A. Northwich and District Youth Club: Development sites on the west bank of the Weaver.

B. Northwich Salt Museum: Development sites on the east bank of the Weaver and to the south of the River Dane.

C. Saint Wilfred's Church Hall: Development sites on the east bank of the Weaver and to the north of the River Dane.

While the Northwich Flood Incident Response Plan is the main document to be consulted for the detail of evacuation, further analysis of the implications of flooding need highlighting.

Sites for Northwich and District Youth Club

- **GS9H** - This site is generally not flooded by the 1% a.p. flood, and only partially by a 0.1% a.p. event, and will therefore not usually require evacuation. During more extreme floods, the route to the refuge centre could be flooded and so alternative routes via Chester Road and Moss Road should be used.
- **GS9I** - The site is noticeably flooded by the 0.1% a.p. flood, during which the route to the refuge centre should be passable. This becomes flooded by more extreme events. The time of evacuation should therefore be considered.
- It may be necessary to prevent people from moving eastwards across the Town Bridge to avoid other flooded areas.

Sites for Northwich Salt Museum

- **GS9M** - This site will not generally flood, although if evacuation was necessary during floods greater than the 1% a.p. flood, the main route to the museum could be flooded.
- **GS9L** - Although only the riverside margins of this site flood during the 1% a.p. flood, routes along Chester Way may be blocked, and so time of evacuation may need to be considered. Other routes from the site will also be flooded during greater events.
- **GS9E** - The Marina site is at greatest flood hazard. As discussed elsewhere, parts of the site are functional floodplain, and so will be flooded relatively frequently. Careful planning and design should avoid the need for evacuation of these areas. Almost all of the site will be flooded by the 1% a.p. flood. Additionally, both Chester Way and London Road, which form the landward borders (and therefore evacuation routes) of the site will also be affected by the 1% a.p. flood. All evacuation would need to be undertaken before these roads became impassable. Residential use is planned for this site, and so evacuation could be required at any time (other sites will be more commercial and so are less likely to need consideration during the night).
- During an extreme event (0.1% a.p.), London Road forming the only route to the refuge centre will also be flooded. The River Dane would overtop and floodwaters would pass along Water Street. Late evacuation would therefore be problematic. During such an extreme event, many other properties situated between Chester Street and the railway would also need evacuating. Higher levels of traffic would converge on the refuge centre, and so more official control would be needed.

Sites for Saint Wilfred's Church Hall

- **GS9A** - While this site is the largest development area, it is mostly not at risk. Only targeted evacuation could be necessary. Watling Street, at the south end of the site is passable for longer than the more direct Witton Street, but this also becomes flooded during extreme floods.
- **GS9B, C, G and K** - No evacuation due to flooding is expected at these sites. Therefore access to the refuge is clear.
- **GS9F and J** - These sites may only experience minor flooding, and so evacuation is not expected. However traffic routes to the west and south should be avoided and the presence of the dual carriageway (Chester Way) could mean traffic from GS9J has to make U-turns through the available junction if evacuation did become necessary.

Figure A7 also shows how the routes to the evacuation centres could be affected by flooding. Surface water ponding has not been mapped, but localised low spots may also become impassable, whatever the flood level from the river.

The ISIS-TUFLOW modelling of the flood hazard around all the sites and the evacuation routes (Figure A4a) shows that the hazard arising from the 1% a.p. flood plus climate change scenario. This shows that the majority of the town centre has 'danger to some' and 'danger to most' people, which is between a 'moderate' and 'significant' flood hazard rating. Vehicle movement could also be hindered and potentially unsafe. Therefore emergency planning between the local authority, emergency services and land owners is paramount.

5.7

Flood warning procedures

To manage any residual risk flood warning and evacuation measures can be implemented. The Flood Incident Response Plan for Northwich has been developed as a scheme to provide a framework for responding to flooding (from the rivers Weaver and Dane). This plan is updated regularly and should be referred to by all relevant parties in the event of a flood.

The plan should include actions to be taken when the Environment Agency issues the various flood warnings (which may not necessarily be in a progressive sequence), including:

- Flood Watch - Flooding possible. Be aware! Be prepared! Watch out!
- Flood Warning - Flooding expected affecting homes, businesses and main roads. Act now!
- Severe Flood Warning - Severe flooding expected. Imminent danger to life and property. Act now!
- All Clear - An all clear will be issued when flood watches or warnings are no longer in force.

Actions to be taken during a flood would include:

Flood watch - flooding is possible, and the situation could worsen, so:

- Watch water levels.
- Stay tuned to local radio or TV.
- Ring Floodline on 0845 988 1188.
- Make sure you have what you need to put your flood plan into action.
- Alert your neighbouring buildings.
- Reconsider travel plans.

Flood warning - flooding is now expected, so put your flood plan into action (as with flood watch) plus:

- Move vehicles, food, valuables and other items to safety.
- Put sandbags or flood-boards etc in place.
- Prepare to turn off gas and electricity.
- Be prepared to evacuate your building.
- Protect building occupants that need your help.

Severe Flood Warning - severe flooding is now expected (action as with Flood Warning) plus:

- Be prepared to lose power supplies - gas, electricity, water, telephone.
- Try to keep calm and reassure others.
- Co-operate with emergency services and local authorities.
- You may be evacuated.

A Flood Plan Checklist should be prepared and should include:

- A list of useful numbers to hand.
- Ensure sandbags/flood boards are available and prepared.
- Ensure flood kits are prepared and available.
- Inform colleagues about possible flooding.
- Identify locations for turning off the gas and electricity etc.
- Identify where vehicles should be moved to in the event of a Flood Warning.
- Store valuable documents etc. in upper floors or in a high place on lower floors.

During a flood event watch what is happening, move vehicles to higher ground, check neighbouring properties, do as much possible in daylight, block doors, air bricks, windows etc., move valuable items above the potential flood levels, turn off electricity and gas, and secure rubbish and chemicals.

Storage Feasibility

6

Storage Feasibility

6.1

Overview

Parts of the following sites are at greatest risk of flooding and if developed would reduce the volume of floodplain storage:

- Barons Quay Development Area (GS9A)
- Northwich Market (GS9D)
- Marina Development Site (GS9E)
- Lock Street Site (GS9I)
- Land West of Queen Street (GS9L)

6.2

Current baseline

The Northwich Vision masterplan involves the development of 13 sites, including the Marina site at the confluence of the River Weaver and Dane. The development is likely to result in the loss of potential floodplain storage volume. This loss of floodplain storage will affect the flood risk both locally and downstream. In order to assess the 'footprint' of the development, an ISIS-TUFLOW model was developed to simulate the effect of the loss of floodplain storage volume. Refer to Appendix E for the technical modelling report.

In Chapter 3, Table 3.4 showed the loss in floodplain storage volume associated with each development site. Added to this is the loss of approximately 24,000m³ at the Marina site which assumes the complete removal of the floodplain up to a level of 13.5m AOD. Therefore a total of 30,483m³ of floodplain storage is lost due to the Northwich Vision development.

In order to simulate the effect of the proposed Northwich Vision development sites the elevation of the sites was changed within the ISIS-TUFLOW software. Table 6.1 provides the appropriate values for the 5 sites which will need to be raised as they fall within Flood Zone 3. The Marina site (GS9E) is entirely within Flood Zone 3 and therefore its elevation was set to a uniform 13.5m AOD.

It should be noted that the specification of a uniform elevation across the development areas is not a true reflection of the future level of the development, which will be spatially distributed. However, in the absence of any detailed development layouts this is the most appropriate way to represent the potential footprint.

Table 6.1: Revised floodplain elevation

Development Site	Floodplain Volume Lost due to Development (m ³)	Average Ground Level (m)	Area of Development (m ²)	Required Change in Elevation (m)	Revised Floodplain Elevation (m AOD)
GS9A	771	14.09	17020	0.05	14.14
GS9D	134	15.55	5608	0.02	15.57
GS9E	2270	13.5	19610	0.12	13.62
GS9I	1039	13.05	7235	0.14	13.19
GS9L	2269	13.27	12160	0.19	13.46

Figure E2 (see Appendix E for modelling report figures and tables) shows the 1% a.p. flood extent with and without the proposed development. As can be seen there is not a great deal of increase in the inundation area. However, downstream water levels are influenced by the development as shown in Figures E3 and E4. This afflux increases the risk of flooding in the specific locations. A number of potential mitigation approaches were simulated in order to reduce this increase in flood risk.

The average difference in water levels was 0.006m whilst the maximum difference was 0.152m. This shows that the footprint of the development is relatively small. However, it is an increase in flood risk and a number of mitigation proposals were simulated to assess their feasibility.

Table E3 indicates that most significant increase in water level is on the River Dane near Victoria Bridge. This suggests that attenuation on the River Dane is more appropriate than mitigation on the Weaver.

6.3

Site visit

A site walkover was carried out on 11th June 2008 in order to visually assess potential storage areas local to Northwich. We identified two potential areas which would provide the necessary compensatory storage. These sites were added to the model to see the impact on flood flows with the proposed development in place.

Figures 6.1 – 6.3 show the potential storage areas that have been identified.



Figure 6.1: Site 1 – Dane Meadows at Leftwich



Figure 6.2: Site 2 – Recreational land adjacent to Dane



Figure 6.3: Pre-feasibility study proposed storage location (u/s of A556)

6.4

Scenario 1 – Dane Meadows

A potential location has been identified on the River Dane (east of Riverside, just off Old Hall Road) which may compensate for the loss of floodplain storage due to the Northwich Vision development. The mitigation involved excavating 1.5m below the existing ground level over the site (shown in Figure E5).

With an area of 39,000m² this provides a potential flood storage volume of 58,500m³. A weir was introduced so that flood water would spill into the storage area at the most beneficial time in the flood event. Although some areas of inundation on the right bank of the River Dane are reduced as well as peak water levels in the channel adjacent to the storage site; there is not a significant reduction in peak water levels or flood risk further downstream in Northwich (see Table E4).

6.5

Scenario 2 – Recreational area

The second tested site was situated in recreational grounds adjacent to the Dane (off Whalley Road shown in Figure E7). The ground level (original level was 13.51m AOD) was excavated by 1.5m to an average level of 12.01m AOD. A weir level was set to 'cap off' the top of the stage hydrograph and reduce peak water levels downstream. By reducing the ground elevation by 1.5m over an area of 11,250m² it provides a potential extra floodplain storage volume of 16,875m³. This mitigation scenario was added in conjunction with the initial mitigation outlined above.

During the event the site was inundated up to a depth of 1.06m providing storage for approximately 11,925m³ of water. This did not affect the inundation extent anywhere other than the storage site (see Figure E8). The reduction in water levels is relatively small both locally and downstream.

6.6

Flood mechanisms

A closer look at the mechanisms of flooding gives some explanation as to why the proposed mitigation scenarios do not have as much influence as was desired. Figure E9 shows the flow path for the original 1% a.p. basecase scenario. It can be seen that at the confluence of the River Dane and River Weaver that the floodplain transfers flow from the Dane to the Weaver. With the proposed Marina development in place this effectively blocks off this route which means the flow is constrained to the channel and the right bank floodplain (see Figure E10). This leads to the constriction of flow which creates a backwater effect. This backwater effect increases water levels within the River Dane as more inflow is forced through the channel.

For the existing baseline, the peak flow near the confluence is 127m³s⁻¹, whereas, with the proposed development this rises to 143m³s⁻¹. This is due to the constriction of flow which leads to increased velocity values at this location, which in turn increase the flood hazard.

As the Marina site is a floodplain flow route rather than a storage area, merely accounting for the loss of storage will only have a limited impact upon the levels.

6.7

Summary

The ISIS-TUFLOW model was run with the Northwich Vision development 'footprint' represented by a loss of potential floodplain storage. The development was represented using model commands to raise ground levels in the area of the development. It was discovered that the development had a minor impact upon water levels and flood extent; however, at specific locations flood routes were constricted increasing the flood risk and hazard. A number of mitigation proposals have been simulated and the results have been presented. The mitigation proposals involved the increase of floodplain storage by excavating the floodplain thereby reducing the ground level and compensating for the loss of flood storage.

The initial mitigation at site 1 showed that although the site was inundated and stored flow, the mitigation only removed flow from the local area and did not reduce downstream water levels. A test was conducted to enhance this storage potential to assess how much of an influence site 1 could have and the results showed that the mitigation would have very little impact on the downstream flood risk due to the amount of floodplain storage already in the area. Another site (site 2) was added to further mitigate the effects of development. Again the proposed mitigation showed that the reduction in water levels was not significant.

Further analysis of the results highlighted the Marina development site effectively blocks a potential floodplain flow route and leads to the constriction of flow from the River Dane to the Weaver. Therefore, replacing lost storage downstream with the tested storage sites is not an appropriate solution.

This reduction in flow route, by approximately 80%, leads to increased flow rates as well as higher water levels at the downstream end of the Dane. Therefore alternative mitigation measures are likely to be required to either widen the channel to account for the increase in flow or a much larger floodplain storage option to reduce flows at the bottom of the River Dane.

Marina Development Area

7 Marina Development Area

7.1

New approach

As concluded in the previous chapter, local compensatory storage does not sufficiently reduce the flood levels through Northwich Town Centre. Further modelling of additional storage sites would conclude, similar to the Pre-feasibility study, that a very large storage area would be required to offset flooding in Northwich. The scale of such a scheme would provide flood alleviation for the whole of Northwich rather than mitigation just for the development sites.

A scheme of this scale, or an alternative river engineered scheme (e.g. flood culvert, widening confluence), would be expensive to construct and maintain (storage area in Pre-feasibility study was estimated at £3-7million), and be disruptive, even assuming a suitable route could be identified.

We have concluded that rather than pursuing the more costly engineering schemes, the most practicable way forward is to re-visit the development layout of the sites (refer to briefing note, Appendix C, Figure C5). A 'Sequential Approach' will be used (outlined in Chapter 8) for the development sites that are within Flood Zone 3 to ensure that inappropriate development is avoided and flood risk is not increased. The proposed Marina site has the greatest impact on flood risk as new development here would constrict flows and increase flood hazard to people.

7.2

Development layout and design mitigation

With the above in mind, the issue of flood risk becomes one of the leading design parameters. In addition to ruling out the flood storage options which aimed to reduce the flood flows arriving at the site, it is also necessary not to cause any constraint to the current floodplains. Defending the site as a whole is also not an option, as new flood walls could cause this effect.

It is therefore necessary to accept that the Marina site needs to flood, and to design accordingly to minimise the impacts of this. While there is currently no masterplan for the site, the design and phasing of construction should take account of this, after the architects are appointed (expected early 2009).

Planning Policy Statement 25 makes provision for this, according to the severity of the flooding. The ISIS TUFLOW modelling indicated that all of the site would be affected by a 1% a.p. event and so is in Flood Zone 3. The north and west parts of the site would, however, be expected to flood even more frequently, and so are classed as functional floodplain or zone 3b.

Different categories of building are defined in PPS25 as being suitable for construction in these different areas, as shown in Appendix D (Table D.3).

PPS25 also specifies the types of use within these categories (see Table 1.2). Of most relevance to this development, residential use is more vulnerable, commercial use is broadly less vulnerable, and public open space is water compatible. Zone 3b can also contain roads, paths and landscaping to allow access to and along the river, providing flooding here would not completely restrict movement around the site. By stepping development back from the river, different levels, with different flooding and land use can be created.

The marina itself is obviously a suitable use, and there is little constraint to it remaining in the worst flood zone. However, variable mooring and pontoon levels would be of benefit during flooding, and all associated buildings should be as resilient as possible (bearing in mind that normally water should not be totally excluded beyond the depths shown in Table 5.2).

Discussion with the operators is necessary, but raising machinery or materials which may be damaged from floor level can be beneficial, careful siting of tanks can avoid oil pollution during flooding, and moving offices to floors above the workshop buildings may also be useful.

It is normal and preferable to keep the lowest parts of the site for water compatible uses, and following the guidelines from PPS25 for the other flood zones (see Table D1.1 in Appendix D). However, by designing vertically, and incorporating suitable flood defences or resilient building techniques, it may be possible that development categories can be moved out of a particular

flood zone, i.e. by having a less vulnerable use at ground level with a more vulnerable use above.

If such measures are permitted, this may mean some sort of useable undercroft or unusable void spaces are created in Flood Zone 3b, while in Flood Zone 3a shops or cafes could be planned for street level, with residential uses above. There is a wish (and current general planning principle) to avoid development with nothing at street level and the associated aesthetic and social drawbacks. Incorporating a range of more flood compatible uses will avoid this.

Phase 1 of the development will include a standard hotel, to replace the current floating building. In addition to flood resilience or protection, avoiding bedrooms on the ground floor reduces the risk to people.

The floor level at the existing JS Motorcycles premises (east side of the Marina site) is raised above ground level, with a ramped access. If these premises were to be relocated the arrangement could be maintained, with floor levels above flood level. Flood defence and security measures could also possibly be combined where necessary; with waterproof barriers and doors for example.

Within the site there is a ridge of higher ground through the car parks and curving around the cinema. While this is still within flood zone three, its presence should be utilised to best advantage during the design of the site. One possibility is to maintain an access road along here for emergency purposes, although this may need further consideration, not least to ensure that access to the wider area is possible. This is discussed further in Chapter 5. Alternatively, it may form the location for the most vulnerable land uses planned in order to minimise mitigation costs.

The above solutions have been implemented in other flood risk areas, as shown in the examples below. In addition to the overall design though, the flood resilience measures outlined in section 5.3 should also be incorporated to minimise the impacts of flooding to the fabric of the new buildings.

In addition to designing for flood levels, it is also necessary to consider flood flows. Figure A9 shows the modelled flows, which generally show the River Dane flowing across the whole site towards the Weaver, especially around the confluence and the Flotel. A site walkover confirmed that there were no major channels or routes, except this. See also Figure A8. In general, the Dane will spill to the A533 London Road, then rise through the site. Care should be taken in the design of the new hotel to avoid doorways being unprotected, or other risk such as glass panels to ground level, as the flow routes in the north west corner of the site will be greatest.

The ridge of higher ground through the current public car park will delay flooding from the road, but after water levels crest this, they will pass to the Weaver, although flooding from this river is also likely to be affecting the site. The marina buildings should not form a continuous barrier to these flows. It is also important that this ridge is not raised, as this will contain floods on London Road, causing a potential worsening of flooding to other properties outside the site.

During extreme flooding, flows may also come from the south, crossing Chester Way, then through the marina and car sales, and between the cinema and motorcycle showroom. These are likely to coincide with floods from the road anyway.

Example 1 Open areas and raised buildings

Buildings can be set back and upwards to allow access to the river side and maintain some flood plain. Open space can be allowed to flood at various levels while eventually providing a level of protection. The riverside areas can also be set at differing levels as required.

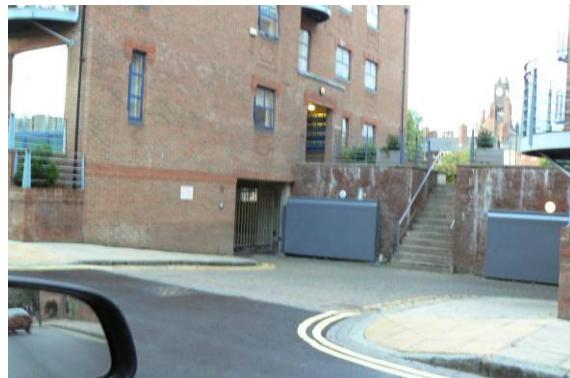


After flooding, the buildings remain unaffected.

Example 2 Undercrofts

During normal conditions, undercrofts can be utilised, providing this use is appropriate and controlled as necessary to prevent permanent damage during flooding. Smaller void spaces, with public access being prevented may also be possible.

Example 3 Flood Barriers



Flood gates can be installed to openings such as basement parking (where this is permitted) or entrances, although consideration has to be given to their suitability and operation. These barriers can be either permanent as shown, or demountable, and can have various configurations.

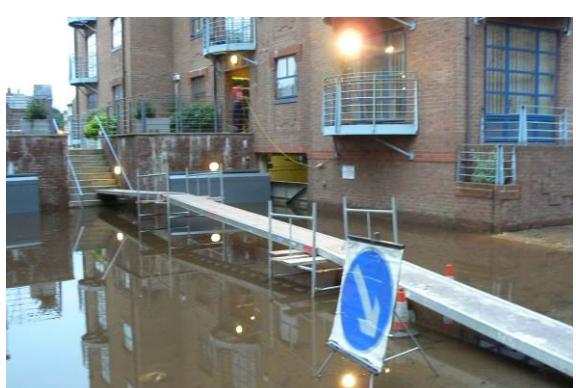


Example 4 Raised areas



Note raised parking and residential areas.

Example 5 - Design



During flooding temporary access may be required. Features such as seating or planters could be designed to be linked together to replace the scaffolding shown.



Sample 6 – other defences

Specific areas can be protected if required. In marginal areas, even well placed kerbs and landscaping can add protection. There are also examples of semi-permanent defences being incorporated to commercial properties without significantly altering outward appearance.

Guide for Developers

8

Guide for Developers

8.1

Introduction

This section briefly describes each of the Northwich Vision proposed development areas and provides guidance for those preparing site specific Flood Risk Assessments (FRAs).

Recommended land uses are provided based on the ISIS-TUFLOW modelling flood extents and according to guidance in PPS25.

Finish Floor Levels (FFL) for buildings, access and egress routes and roads have also been recommended. These recommended levels have been found by selecting the model node that represents the majority of the site and flooding flow routes. The levels comprise of:

- 1% a.p. event (1 in 100 year return period)
- Climate change allowance of +400mm
- Standard freeboard allowance of +600mm for development or +300mm for all access and egress routes and roads.

The potential flood hazard to people in each development area has also been broadly assessed. Flood hazard mapping has been produced using a function in the ISIS-TUFLOW modelling. The mapping shows the areas with the greatest flood hazard (velocity*depth values).

Figure A2a (in Appendix A) shows the development allocations along with the new flood extents and Figure A4a (in Appendix A) shows the development areas with the flood hazard mapping.

8.2

Barons Quay Development Area (GS9A)

Table 8.1 shows the site allocation.

Table 8.1: Allocation

Allocation	Development sites	Description
GS9A	Barons Quay Development Area	<p>Allocated for a comprehensive mixed use regeneration including principally retail with some residential, leisure, commercial and office uses. The site is the principal focus for the whole regeneration framework and will provide the stimulus for the regeneration of all of the other sites allocated in the Northwich Vision. It has been allocated principally for retail development as it a natural redevelopment of the primary shopping area and will bring in the much needed investment into the town centre.</p> <p>Largely within Flood Zone 1, with some elements in Flood Zones 2 and 3</p>

Recommended land use

There is a small section of Flood Zone 3b within the south part of the Barons Quay development area. This extends into the site a maximum of 10m from the River Weaver. Only water compatible land uses and essential infrastructure is appropriate here. It is therefore advised that a 10m buffer is retained here to avoid loss in floodplain volume. This buffer could be a public walkway and used as open green space. Further clarification of Zone 3b will be required in the site specific FRA.

The Barons Quay masterplan shows that part of the development area is proposed for residential (riverside apartments and a hotel). These types of development are classed as more vulnerable and should not be located in Flood Zone 3. This means that this type of development should be kept out of the Weaver Way area. For a riverside location, the most acceptable place would be adjacent to the U-bend on Barons Quay Road which is just within Flood Zone 2.

Commercial development, a new cultural centre, bars and restaurants are also proposed. This can be allocated in Flood Zone 3 if a FRA shows that flood risk can be effectively managed. The Weaver Way area could be acceptable for this type of development if a FRA can justify it.

The flood extents (in Figure A2a) show that the majority of the site is outside Flood Zones 2 and 3 so there should be no major flood risk problems in developing here.

Table 8.2: Sequential and Exception Test

Development area	Reason for Exception Test	Conditions (Table D.9 of PPS25)		
		A <i>Sustainability benefits</i>	B <i>On developable previously developed land</i>	C <i>Requires site specific FRA</i>
Barons Quay Development Area (GS9A)	If more vulnerable development is proposed within FZ 3a.	Town centre regeneration programme.	Existing commercial properties.	Yes

Table 8.3: Required levels for the site

Development type	Finished Floor Levels m AOD
All developments	13.5
Evacuation routes (access/egress) e.g. roads, car parks and pedestrian areas.	13.2

Flood hazard mapping

Figure A4a shows that due to flood depth and velocities, there is 'danger to all' in the section of the site that is within Flood Zone 3. The danger to people is greatest adjacent to the River Weaver. This means that residential development would not be appropriate here. Elsewhere in Flood Zones 2 and 3 the risk varies between risk to all and risk to some.

Access and egress routes

Access and egress routes should be set at 13.2m AOD. The most appropriate access and egress route during a flood would be north via the existing Barons Quay Road. Provision could also be made to the south part of the site via Watling Street as high ground rises to the east.

8.3

Weaver Street Shopping Centre (GS9B)

Table 8.4 shows the site allocation.

Table 8.4: Allocation

Allocation	Development sites	Description
GS9B	Weaver Shopping Centre Development Area	This site is allocated for a retail led regeneration with offices and residential development possible on the upper floors of the development. New multi story car park for 350 cars. Within Flood Zone 1

Recommended land use

The new modelling shows that none of this site is at risk of fluvial flooding from the River Dane or Weaver. All types of development are therefore appropriate subject to a FRA as the site is greater than 1 hectare. The FRA should focus on other potential sources of flooding and ensure runoff is not increased through the new development.

Sequential and Exception Test

This is not required as the development is now shown to be in Flood Zone 1 not 2.

8.4

Land North of Leicester Street (GS9C)

Table 8.5 shows the site allocation.

Table 8.5: Allocation

Allocation	Development sites	Description
GS9C	Land north of Leicester Street	<p>This site is allocated for bulky goods retail development. The site is on the edge of the existing town centre and therefore an appropriate location in terms for bulky goods retail development.</p> <p>Within Flood Zone 1. Small marginal area may be in Flood Zone 2</p>

Recommended land use

The new modelling shows that none of this site is at risk of fluvial flooding from the River Dane or Weaver. All types of development are therefore appropriate subject to a FRA as the site is greater than 1 hectare. The FRA should focus on other potential sources of flooding and ensuring runoff is not increased through the new development.

Sequential and Exception Test

This is not required as the development is now shown to be in Flood Zone 1 not 2.

8.5

Northwich Market (GS9D)

Table 8.6 shows the site allocation.

Table 8.6: Allocation

Allocation	Development sites	Description
GS9D	Northwich Market	<p>This site is allocated for a remodelling of the market. This is the only suitable location for a new, high quality market which is a vital part of the regeneration scheme.</p> <p>Within Flood Zone 1 and 2</p>

Recommended land use

The new modelling shows that the east third of the site is not at risk of flooding from the Weaver or Dane. The remainder, west side, of the site is within Flood Zone 2.

These commercial properties are classed as less vulnerable development and are therefore appropriate in Flood Zones 1 and 2. Finish floor levels should be set 600mm above the 1 in 100 year plus climate change level, access and egress routes should be set 300mm above this level (see the Table 8.7 below for these levels).

Sequential and Exception Test

This is not required as less vulnerable development is proposed in Flood Zone 1 and 2.

Table 8.7: Required levels for the site

Development type	Finished Floor Levels m AOD
All development	13.8
Evacuation routes (access/egress) e.g. roads, car parks and pedestrian areas.	13.5

Flood hazard mapping

The section of the site that is within Flood Zone 2 would have flooding conditions that put most or some people at risk of harm.

Access and egress routes

The most appropriate access and egress route is eastwards, following the existing Applemarket Street.

8.6**Marina Development Area (GS9E)**

Table 8.8 shows the site allocation.

Table 8.8: Allocation

Allocation	Development sites	Description
GS9E	Marina Development area	<p>This site is allocated for a comprehensive redevelopment including residential and leisure uses. This site is being actively promoted for redevelopment by British Waterways and the Environment Agency is commenting on proposals to manage the flood risk issues. One of the main issues is that the site is so expensive to redevelop and it is such a key site to opening up of the waterfront and providing a new resource to Northwich that residential land values are essential to ensure the site remains viable. The EA are aware of this issue and are working with British Waterways to come up with a suitable approach to redevelopment.</p> <p>Within Flood Zone 2 and 3</p>

Recommended land use

The new modelling flood extents show that the north and far west of this site are within Flood Zone 3b (functional floodplain). Only water compatible development should be permitted here. Ideally, this area should be reserved for open space perhaps recreation or green space within the development.

The remainder of the site is predominantly within Flood Zone 3a (a small part is within Flood Zone 2). If residential development was to be approved here, the Exception Test would need to be completed. But ideally, less vulnerable development should be put here.

As part of the Exception Test, a FRA should demonstrate that flooding can be safely managed including identifying emergency access and egress routes as well as mitigation measures.

Any development would need to be set 600mm above the 1 in 100 year plus climate change level (see the Table 8.10 below) and compensatory flood storage would also have to be provided. Access roads should be set 300mm above this level to be able to be linked with the emergency evacuation procedures.

Mitigation measures that allow residential development could include implementing undercroft parking and having the residential development above the flood level. This would only be acceptable if the development was adequately flood proofed and protected from flooding through emergency planning demonstrating safe dry access.

Sequential and Exception Test

If more vulnerable development is proposed in Flood Zone 3a the Exception Test will need to be completed. Only essential infrastructure could be permitted in Flood Zone 3b following completion of the Exception Test. However, as stated previously, this area should be kept free from development.

Table 8.9: Sequential and Exception Test

Development area	Reason for Exception Test	Conditions (Table D.9 of PPS25)		
		A Sustainability benefits	B On developable previously developed land	C Requires site specific FRA
Marina Development Area (GS9E)	More vulnerable development within FZ 3a or essential infrastructure in FZ 3b.	Town centre regeneration programme.	Existing Marina and car dealerships/commercial properties.	Yes

Table 8.10: Required levels for the site

Development type	Finished Floor Levels m AOD
All development	14
Evacuation routes (access/egress) e.g. roads, car parks and pedestrian areas.	13.7

Flood hazard mapping

Figure A4a shows that the north and west of the site would have flooding conditions that present a hazard for all people. Outside of this, flooding conditions would be a hazard for most people. Access and egress should be directed away from this area of high hazard.

Access and egress routes

As the River Dane is to the north and west and the River Weaver is to the east, the most appropriate emergency access and egress route is to the south. This could follow the existing London Road route and should be set at 13.7m AOD.

8.7

County Council Offices Site (GS9F)

Table 8.11 shows the site allocation.

Table 8.11: Allocation

Allocation	Development sites	Description
GS9F	County Council Office site	<p>This site is allocated for mixed use development including retail, food and drink and residential. The site does have some flexibility over uses in terms of the residential element although residential is likely to be above ground floor.</p> <p>Within Flood Zone1. Marginal areas may be affected by flooding</p>

Recommended land use

This site is next to the River Dane. The new flood extents show that only the southern periphery is at risk of flooding from the Dane. If this southern boundary of the site is move north by a maximum 15m it would be outside of Flood Zones 2 and 3. Alternatively, a 10-15m buffer could be designed into the development as open space.

Sequential and Exception Test

This is not required if the boundary is moved slightly or a 10-15m buffer is preserved as open space.

8.8

Magistrates Court Site (GS9G)

Table 8.12 shows the site allocation.

Table 8.12: Allocation

Allocation	Development sites	Description
GS9G	Magistrates Court	<p>This site is allocated for a replacement Magistrates Court. This allocation is a like for like replacement building.</p> <p>Within Flood Zone 1</p>

Recommended land use

The new modelling extents show that this entire site is within Flood Zone 1 and therefore all types of development is appropriate.

Sequential and Exception Test

This is not required as the development is located in Flood Zone 1.

8.9

British Waterways Site (GS9H)

Table 8.13 shows the site allocation.

Table 8.13: Allocation

Allocation	Development sites	Description
GS9H	British Waterways site	<p>This site is allocated for residential development with complementary mixed use potentially to incorporate leisure, hotel and offices. The site is likely to be extremely difficult to develop and residential is necessary to generate sufficient capital receipts to make the redevelopment of the site viable. British Waterways are working with the EA to address this issue.</p> <p>Partially within Flood Zones 2 and 3 adjacent to the river and remainder in Flood Zone 1</p>

Recommended land use

The majority of this site is within Flood Zone 1. The north east part of the site is within Flood Zone 2 and on the east boundary there are very narrow sections in Flood Zones 3a and b. Maintaining a 10-15m buffer on the east boundary would leave all of the site within Flood Zone 1 or 2. This would avoid a loss in floodplain volume. This buffer could become a public walkway and used as open green space. Further clarification of Zone 3b will be required in the site specific FRA.

Residential development could therefore take place within the rest of the site, subject to a FRA.

Sequential and Exception Test

This is not required if more vulnerable development is proposed within Flood Zone 2.

Table 8.14: Required levels for the site

Development type	Finished Floor Levels m AOD
All development	14
Evacuation routes (access/egress) e.g. roads, car parks and pedestrian areas.	13.7

Flood hazard mapping

Figure A4a shows that within Flood Zone 2, the flood hazard varies from danger for all to danger for most.

Access and egress routes

Emergency access and egress routes should be to the west, away from the River Weaver.

8.10

Lock Street Site (GS9I)

Table 8.15 shows the site allocation.

Table 8.15: Allocation

Allocation	Development sites	Description
GS9I	Lock Street site	<p>This site is allocated for a mixed use scheme potentially including residential and food and drink. It is likely that the residential element of this site would be at first floor level and above. The site is likely to be expensive to redevelop as it is potentially contaminated and residential land values are required to make the redevelopment viable. However, recent proposals indicate that a Multi Storey Car park (500 spaces) is most preferable here.</p> <p>Within Flood zones 1,2 and 3</p>

Recommended land use

The east part of this site is located in Flood Zone 2 and 3a. If residential development is proposed within Flood Zone 3a, then the site should undergo the Exception Test.

Ideally, residential development should be cited in the lower flood risk areas away from the banks of the Weaver Navigation on the high ground to the west. This would mean that there is safe dry access. However, as the high ground rises steeply over a short distance, caution is required and a site specific FRA would determine suitable access/egress routes. If riverside housing is proposed then the FRA should prove that flooding can be safely managed.

Undercroft parking is one possible mitigation measure which may be able to tie into the local topography. These issues should be identified in the site specific FRAs once the layout and form of the development has been finalised. A buffer zone could be retained along the east boundary of the site, which is in Flood Zone 3a, to avoid loss in floodplain volume. This buffer could become a walkway and used as open green space.

Table 8.16: Sequential and Exception Test

Development area	Reason for Exception Test	Conditions (Table D.9 of PPS25)		
		A Sustainability benefits	B On developable previously developed land	C Requires site specific FRA
Lock Street Site (GS9I)	More vulnerable development within FZ 3a.	Town centre regeneration programme.	Existing commercial, residential and derelict properties.	Yes

Table 8.17: Required levels for the site

Development type	Finished Floor Levels m AOD
All development	13.8
Evacuation routes (access/egress) e.g. roads, car parks and pedestrian areas.	13.5

Flood hazard mapping

Figure A4a shows that within Flood Zone 2, the flood hazard varies from danger for all to danger for most.

Access and egress routes

Emergency access and egress routes should be to the west, away from the River Weaver.

8.11

Memorial Hall Site (GS9J)

Table 8.18 shows the site allocation.

Table 8.18: Allocation

Allocation	Development sites	Description
GS9J	Memorial Hall site	<p>This site is allocated for residential development. The Borough Council are working with the EA on addressing the issue of flood risk on this site. The capital receipt from this site will be used to subsidise the provision of a cultural centre and replacement for the Memorial Hall.</p> <p>Within Flood Zone 1. Marginal areas may be affected by flooding</p>

Recommended land use

The new modelling shows that the site is now within Flood Zone 1 and is therefore not at risk of flooding from the Dane or Weaver. All types of development are therefore appropriate.

Sequential and Exception Test

This is not required as the site is located in Flood Zone 1.

8.12

Land West of Old Warrington Road (GS9K)

Table 8.19 shows the site allocation.

Table 8.19: Allocation

Allocation	Development sites	Description
GS9K	West of Old Warrington Road	This site is allocated for residential development. Within Flood Zone 1

Recommended land use

This site is allocated for residential development and is located in Flood Zone 1. Development is therefore appropriate at this site.

Sequential and Exception Test

This is not required as the site is located in Flood Zone 1.

8.13

Land West of Queen Street (GS9L)

Table 8.20 shows the site allocation.

Table 8.20: Allocation

Allocation	Development sites	Description
GS9L	Land west of Queen Street	This site is allocated for residential development but is flexible in terms of its usage and potential allocation. Within Flood Zones 2, 3a and 3b

Recommended land use

The majority of this site is within Flood Zone 2, so all types of development should be appropriate subject to a FRA. To the northwest of the site, there is a small area within Flood Zone 3a and 3b. Flood zone 3b does not extent more than 10m into the site. This should be kept clear from development and left as open space. The remaining Flood Zone 3a adjacent to the Weaver could be used for less vulnerable development. However, if more vulnerable development were proposed here the Exception test would need to be completed.

Table 8.21: Sequential and Exception Test

Development area	Reason for Exception Test	Conditions (Table D.9 of PPS25)		
		A <i>Sustainability benefits</i>	B <i>On developable previously developed land</i>	C <i>Requires site specific FRA</i>
Land west of Queen Street (GS9L)	More vulnerable development within FZ 3a.	Town centre regeneration programme.	Existing commercial and residential properties.	Yes

Table 8.22: Required levels for the site

Development type	Finished Floor Levels m AOD
All development	14
Evacuation routes (access/egress) e.g. roads, car parks and pedestrian areas.	13.7

Flood hazard mapping

Figure A4a shows that within Flood Zone 2, the flood hazard varies from danger for all to danger for most.

Access and egress routes

Similar to the Marina site, the River Dane is to the north and west and the River Weaver is to the west. The most appropriate emergency access and egress route is therefore to the south. This could also follow the existing London road route and should be set at 13.7m AOD.

8.14**Land Adjacent to Victoria Bridge (GS9M)**

Table 8.23 shows the site allocation.

Table 8.23: Allocation

Allocation	Development sites	Description
GS9M	Land adjacent to Victoria Bridge	<p>This site has planning permission for residential development and elderly person's accommodation.</p> <p>Within Flood Zone 1. Marginal areas may be affected by flooding in Flood Zone 2 and 3</p>

Recommended land use

The new modelled flood extents show that only a small part of the site is within Flood Zone 2 and 3. The site boundary could be easily moved, or the Flood Zone could be left as open space. This would allow all types of development to be appropriate.

Previous planning applications for this site have included FRAs that show the site is Flood Zone 2, with only a small area that is Flood Zone 3. The proposed layouts have shown new buildings away from the Zone 3 area.

Sequential and Exception Test

This is not required as the site is located in Flood Zone 1.

8.15**Trade-off**

In order to enable Northwich to receive the economic and social regeneration there may be a degree of 'trade-off' necessary. Some sites may only be able to be brought forward if other sites are designated as storage areas thereby compensating for any loss in floodplain storage. The need and viability of trade-off will become more apparent as the development master plans are produced and as the site specific FRAs are carried out.

References

- *Adopted Vale Royal Local Plan First Review Alteration (2006-2011)*
- *Barons Quay, Northwich, Flood Risk Assessment – Scoping Study, Waterman Civils, Oct 2006.*
- *Draft policies for inclusion in redraft Local Plan alteration, Vale Royal BC, Jan 2005.*
- *Flood Incident Response Plan for Northwich, Vale Royal BC, Nov 2006.*
- *Flood and Coastal Defence Project Appraisal Guidance (FCDPAG3), Economic Appraisal, Defra.*
- *Flood & Coastal Defence R&D Programme, Technical Report FD2321: Flood Risk to People, Phase 2, Defra 2006.*
- *Improving the Flood Performance of New Buildings, Flood Resilient Construction, Department for Communities and Local Government: London, May 2007*
- *Interim Planning Guidance, Vale Royal BC, Feb 2004.*
- *Northwich Flood Alleviation Scheme, Pre-Feasibility Study, Environment Agency/Arup, July 2006.*
- *Northwich Urban Regeneration, Outline Drainage Strategy, Waterman Civils, Dec 2006.*
- *Northwich Vision Environment Agency Meeting Minutes, Vale Royal BC, Nov 2006.*
- *Weaver Gowy CFMP, Environment Agency, August 2008.*
- *West Cheshire SFRA, Faber Maunsell, Sept 2007.*
- *Northwich Flood Alleviation Scheme, Additional Mapping and Modelling, Addendum to Pre-Feasibility Report, Environment Agency/Arup, Nov 2007.*

Glossary

Above Ordnance Datum (AOD)

This is the vertical datum used for defining altitude above sea level. In the UK, the datum refers to mean sea level at Newlyn in Cornwall.

Catchment

A surface water catchment is the total area that drains into a river. A groundwater catchment is the total area that contributes to the groundwater component of the river flow.

Climate Change Allowance

Due to climate change the predicted levels of bodies of water are set to rise. Therefore a prediction of river or sea levels are required for the expected life of the new development

DEFRA

Department for Environment, Food and Rural Affairs. The central government department responsible for flood management policy in England.

DEFRA FCDPAG documents

Defra's FCDPAG (Flood and Coastal Defence Project Appraisal Guidance) documents set out the criteria which show whether or not a scheme is eligible for grant-aid. FCDPAG3 relates to economic appraisal (based on cost of the scheme verses the damages that the scheme will avoid). The full list of PAG documents is;

- FCDPAG1 Overview
- FCDPAG2 Strategic planning and appraisal
- FCDPAG3 Economic appraisal
- FCDPAG4 Approaches to risk
- FCDPAG5 Environmental appraisal
- FCDPAG6 Post project evaluation

DG5 Register

Register held by water companies on the location of properties at risk of / have suffered from sewage flooding problems.

Environment Agency

Non-departmental public body responsible for the delivery of government policy relating to the environment and flood risk management in England and Wales.

Finished Floor Level (FFL)

Level at which new building ground floors should be constructed at.

Flood Alleviation Scheme (FAS)

A scheme designed to reduce the risk of flooding in a specific location.

Flood Defence

A structure (or system of structures) for the alleviation of flooding from rivers or the sea.

Flood Estimation Handbook

Flood Estimation Handbook provides the current methodologies for estimation of flood flows for the UK.

Floodplain

Any area of land over which water flows or is stored during a flood event or would flow but for the presence of flood defences.

Flood Risk

The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).

Flood Risk Assessment (FRA)

A more detailed report illustrating the effects of flood on and of new developments. The assessment is written following the guidance of PPS25.

Flood Risk Management

The activity of modifying the frequency or consequences of flooding to an appropriate level (commensurate with land use), and monitoring to ensure that flood risks remain at the proposed level. This should take account of other water level management requirements, and opportunities and constraints. It is not just the application of physical flood defence measures.

Flood Warning Areas

Within Flood Warning Areas, warnings of impending flooding are issued by the Environment Agency to business and the public to enable people to take preventative action to protect themselves and their property. Formal procedures are followed to guide when and how warnings are issued.

Fluvial

Pertaining to a watercourse (river or stream).

Hydraulic Modelling

A computational model that simulates how water flows through the physical characteristics of a river channel and floodplain. The model can be used to determine peak water levels, peak flows, discharge volumes and flood event durations along a river system for a specific modelled event.

LiDAR

Light Detection and Ranging (LiDAR) is an airborne mapping technique which uses a laser to measure the distance between the aircraft and the ground. This technique results in the production of a cost effective terrain map suitable for assessing flood risk

Main River

Watercourses defined on a 'main river' map designed by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for main rivers only. Responsibility for maintenance however rests with the riparian owner (the land owner).

Planning Policy Statement 25: Development and Flood Risk (PPS25)

PPS25 sets out government policy on development and flood risk. This replaces PPG Note 25 (published July 2001). Its aims are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.

For further information please refer to the communities and local government website:

<http://www.communities.gov.uk/index.asp?id=1504640>

Probability of Flooding

The probability of a flood event being met or exceeded in any one year.

Sustainable Drainage Systems (SuDS)

A sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques (may also be referred to as sustainable drainage techniques).

Section 105

Section of the Water Resources Act (1991) under which Floodplain Mapping is carried out. Level A was the initial Section 105 river modelling, level B river modelling has been undertaken to look at key areas in more detail.

Appendix A – Figures and Plans

- Figure A1: Location map - Northwich
- Figure A2: Flood outlines with proposed development sites (1D model)
- Figure A2a: Flood outlines with proposed development sites (2D model)
- Figure A3: Potential land raising areas
- Figure A4: Flood hazard profile for development sites (1D model)
- Figure A4a: Flood hazard profile for development sites (2D model)
- Figure A5: Barons Quay Development Area Masterplan
- Figure A6: Flood risk matrix
- Figure A7: Emergency evacuation centres and roads affected by flooding up to 0.1% event
- Figure A8: Observed flow paths for extreme events
- Figure A9: Modelled flow paths for 1% a.p.

Figure A1: Location map - Northwich

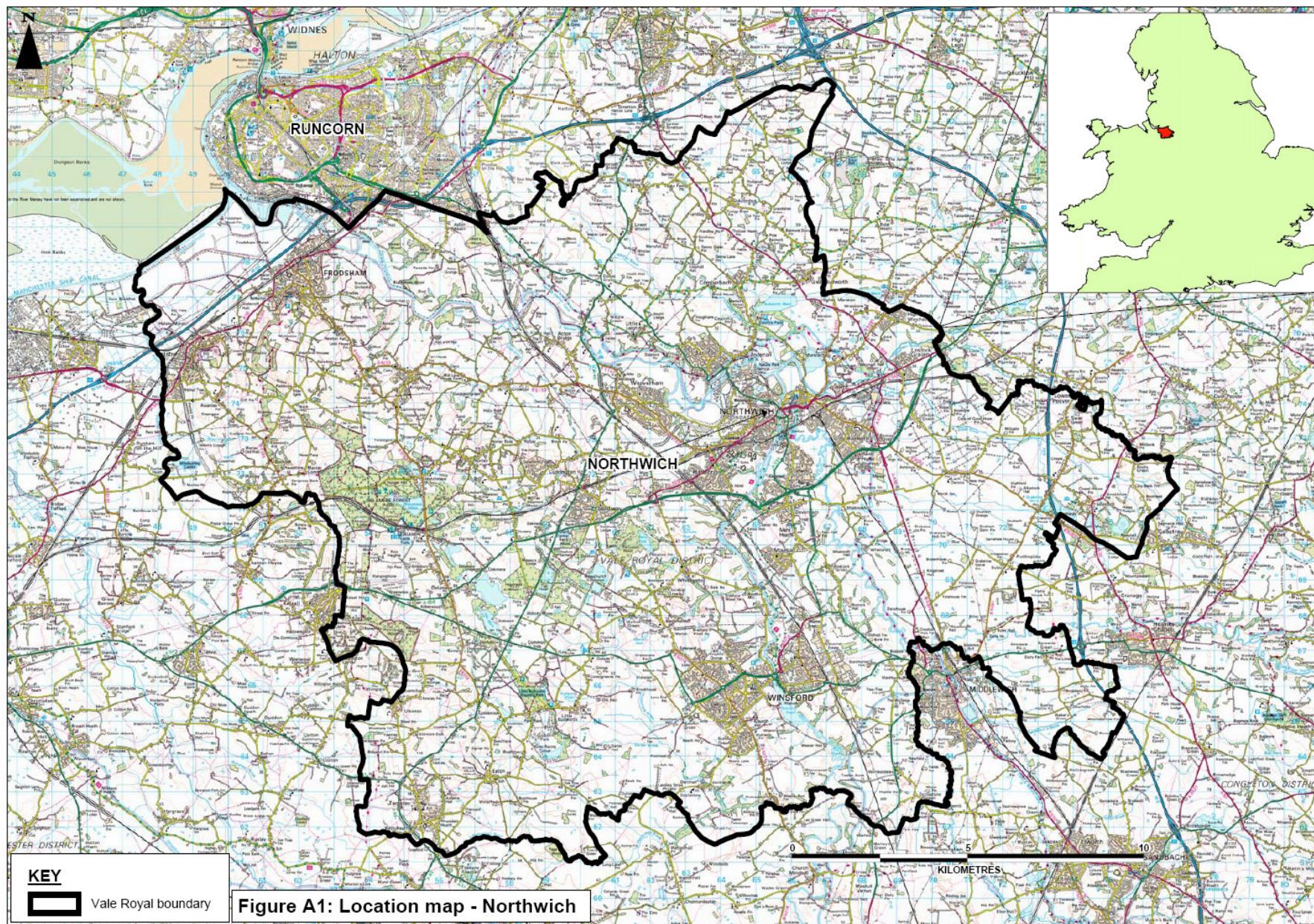


Figure A2: Flood outlines with proposed development sites
(Extents taken from ISIS 1D model used for the SFRA)

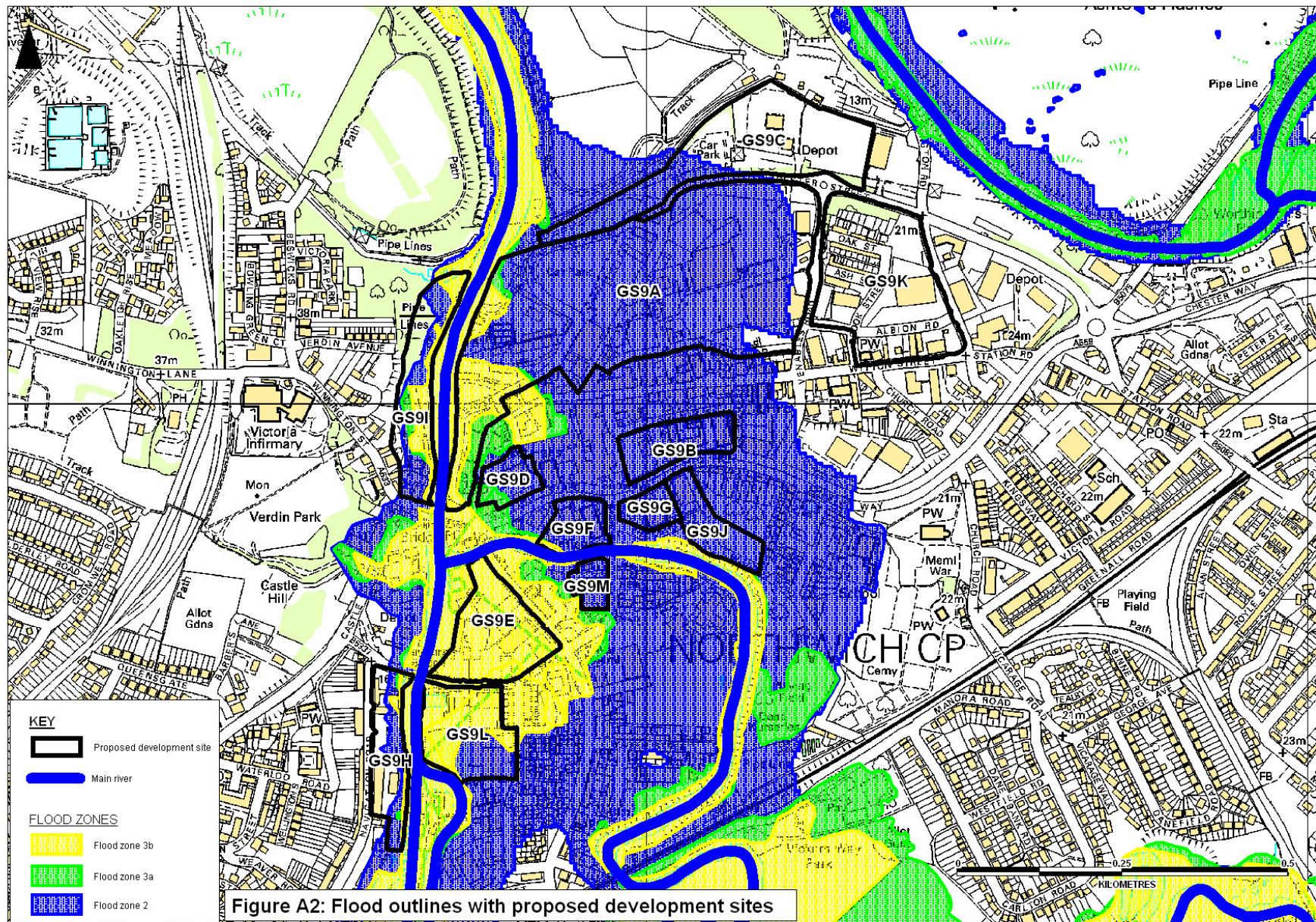


Figure A2a: Flood outlines with proposed development sites
(Extents taken from ISIS-TUFLOW 2D modelling)

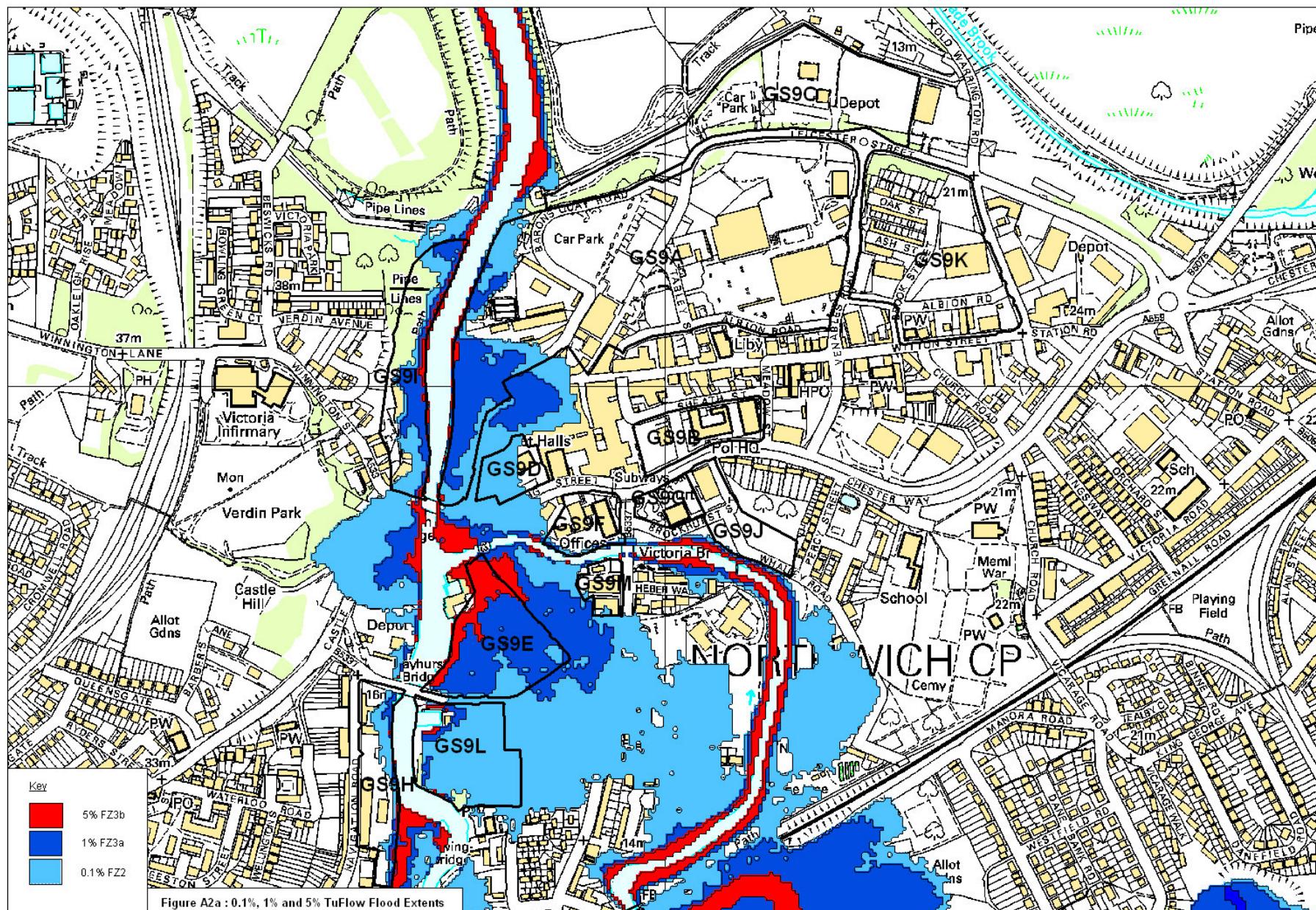


Figure A2a : 0.1%, 1% and 5% TuFlow Flood Extents

Figure A3: Potential land raising areas

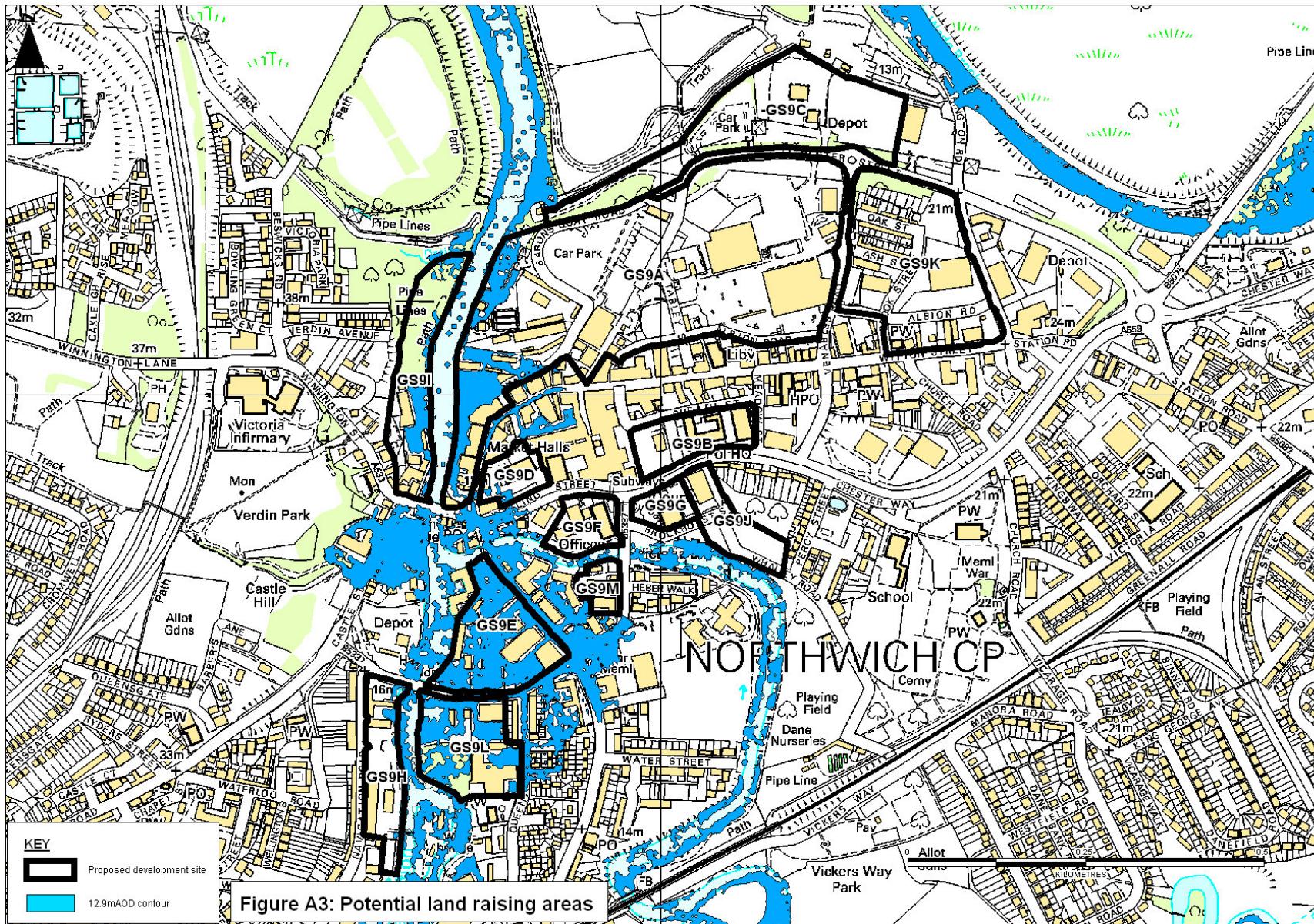


Figure A3: Potential land raising areas

Figure A4: Flood hazard profile for development sites
(Based on 1D modelling)

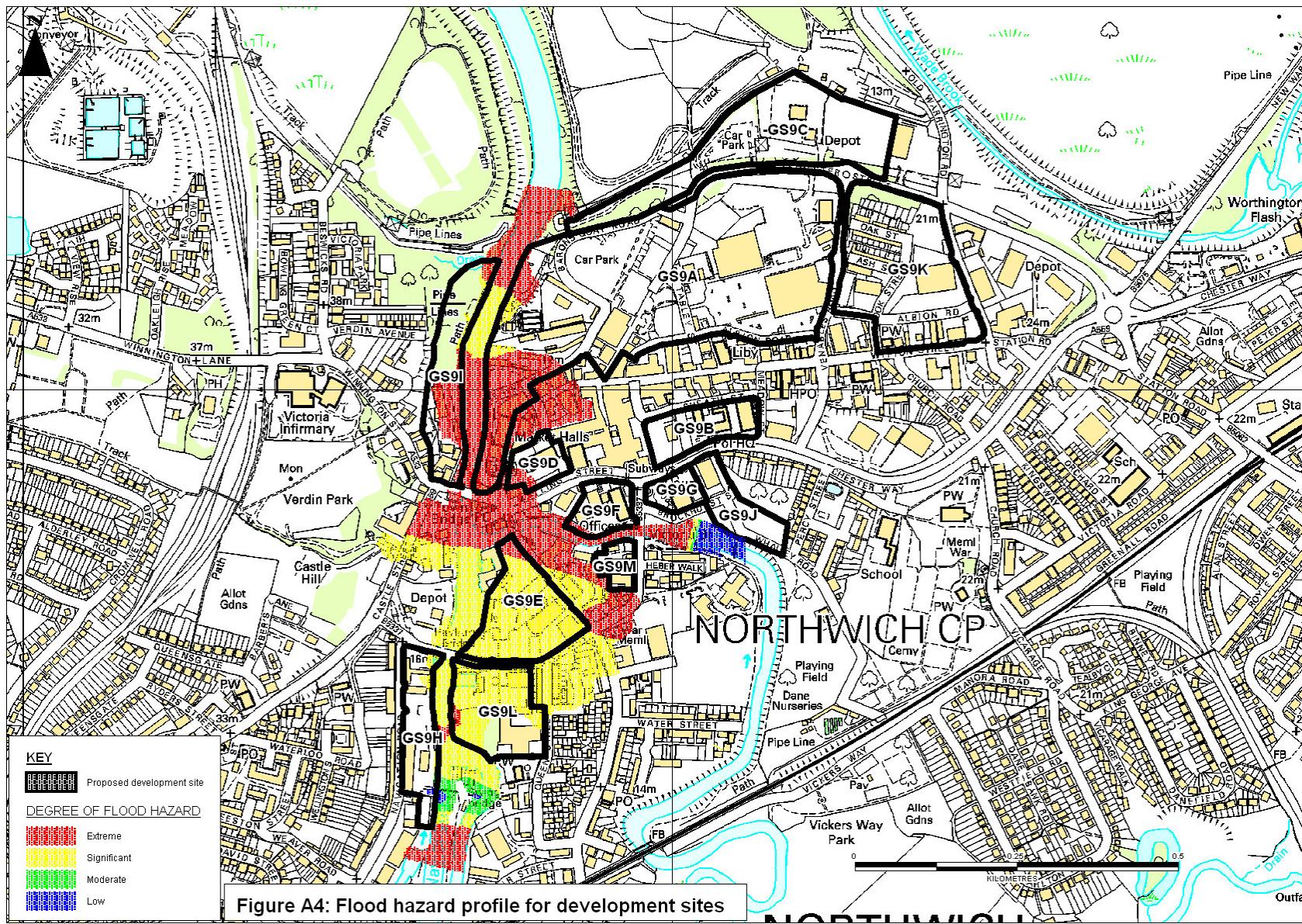


Figure A4a: Flood hazard profile for development sites
(Based on ISIS-TUFLOW 2D modelling)

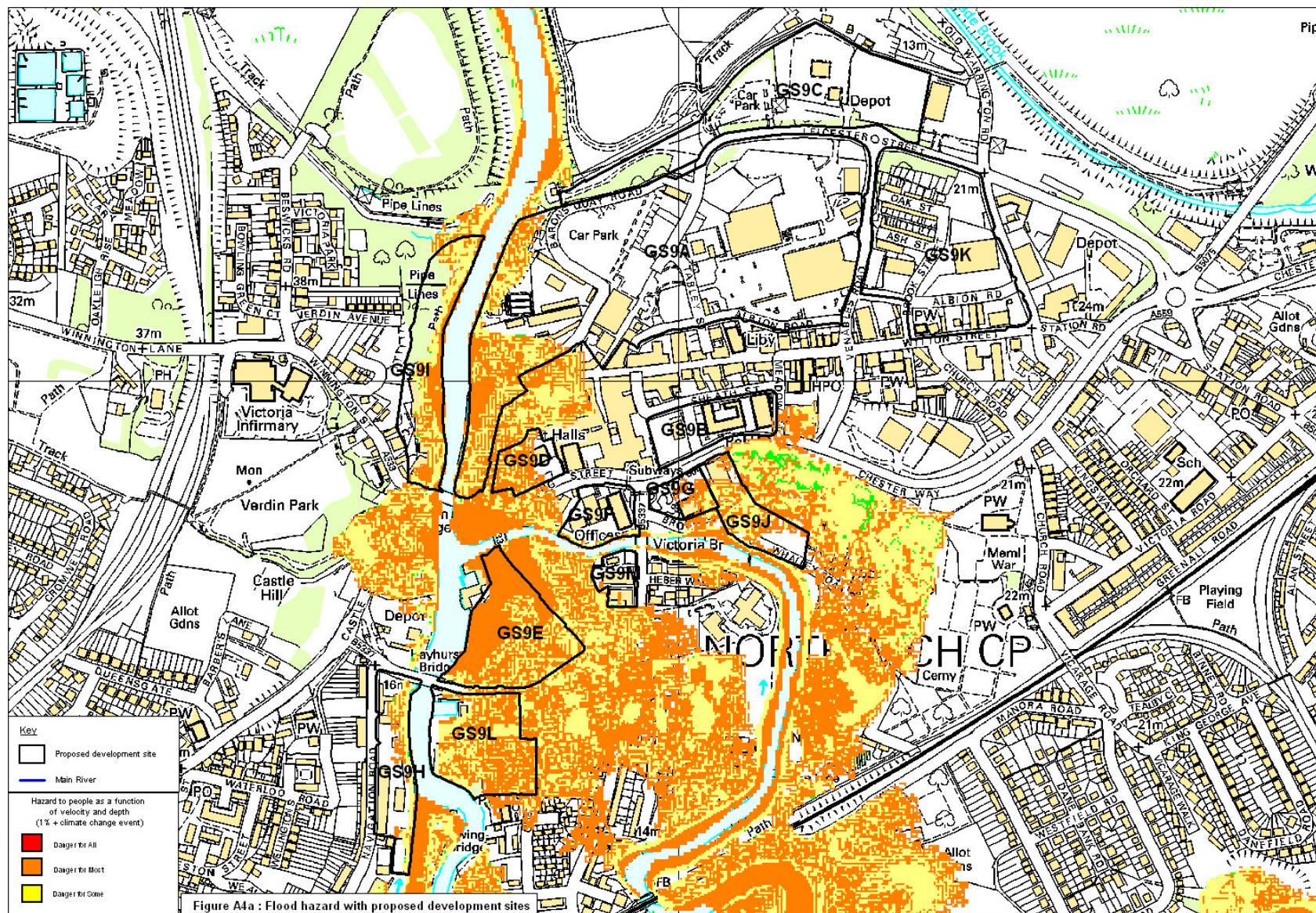


Figure A4a : Flood hazard with proposed development sites

Figure A5: Barons Quay Development Area masterplan

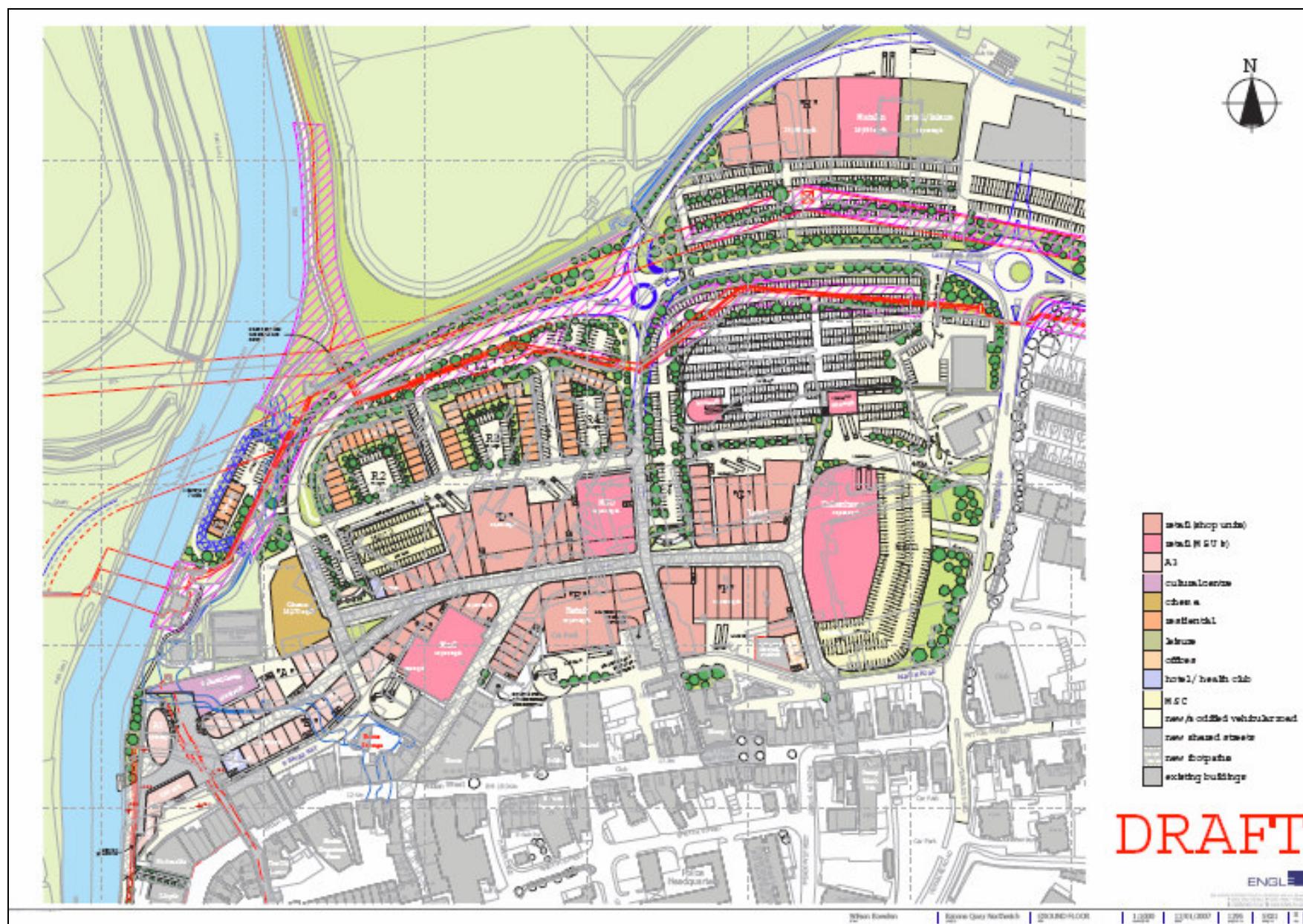
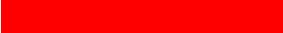


Figure A6: Flood hazard matrix

Key for flood hazard rating:

Hazard rating	Colour code
Low	
Moderate	
Significant	
Extreme	

Allocation	Development site	Site description	Other influences	Area Ha	More vulnerable (residential) dwellings	Less vulnerable (commercial) m ²	Car parking spaces	Flood Zone	Indicative SoP	Suitable alternative and available site?	Hazard level	Exception test	Flood risk management requirements	Hazard rating (based on 1D modelling)		
GS9A	Barons Quay Development Area	Mixed use scheme: primary shopping area, new cultural centre, waterfront activities, cinema, hotel/health club, residential, multi story car park.	Within historic flood events for Northwich. Brownfield land. Adjacent to a Main River (Weaver).	12.4	220	29,311	650	3b, 3a, 2	80	No	Extreme	Required	Apply Sequential Approach within the site. Residential development direct to Flood Zone 2 at agreed threshold level of 13.5m AOD. Less vulnerable development and access/egress could be reduced if necessary. Mixed use proposals should use the highest vulnerability class as FFL. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS			
GS9B	Weaver Shopping Centre Development Area	Retail-led scheme: shopping centre extension, upper floor offices and residential. New multi story car park.	Within historic flood events for Northwich. Brownfield land. Adjacent to a Main River (Weaver).	1.1		10,590	350	2	80	No	Extreme	Not required	Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS			
GS9C	Land north of Leicester Street	Bulky goods retail development	Brownfield and Greenfield land Small area adjacent to Main river (Weaver)	5.6		5,574		2	80	No	Low to extreme	Not required	Apply Sequential Approach within the site. Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS			

Allocation	Development site	Site description	Other influences	Area Ha	More vulnerable (residential) dwellings	Less vulnerable (commercial) m ²	Car parking spaces	Flood Zone	SoP	Suitable alternative and available site?	Hazard level	Exception test	Flood risk management requirements	Hazard rating (based on 1D modelling)			
GS9D	Northwich Market	Redevelopment of the market area: covered public square, retail, food and drink facilities, car parking.	Within historic flood events for Northwich. Brownfield land	0.6		2,044		3a, 2	80	No	Extreme	Not required	<p>Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard.</p> <p>Provide compensatory storage for any loss in floodplain volume.</p> <p>Implement appropriate flood mitigation and flood proofing measures.</p> <p>Incorporate SuDS</p>				
GS9E	Marina Development area	Leisure and residential development: waterside activities, restaurants, bars and leisure facilities, car parking, marina facilities, residential.	Within historic flood events for Northwich. Brownfield land Adjacent to a Main River (Dane).	2	156	4,785	300	3b, 3a	80	No	Significant	Required	<p>Apply Sequential Test within the site.</p> <p>Pursue water compatible development in Flood Zone 3b.</p> <p>Residential development direct to Flood Zone 2 at agreed threshold level of 13.5m AOD or use undercroft parking.</p> <p>Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard.</p> <p>Provide compensatory storage for any loss in floodplain volume.</p> <p>Implement appropriate flood mitigation and flood proofing measures.</p> <p>Incorporate SuDS</p>	Red	Yellow		

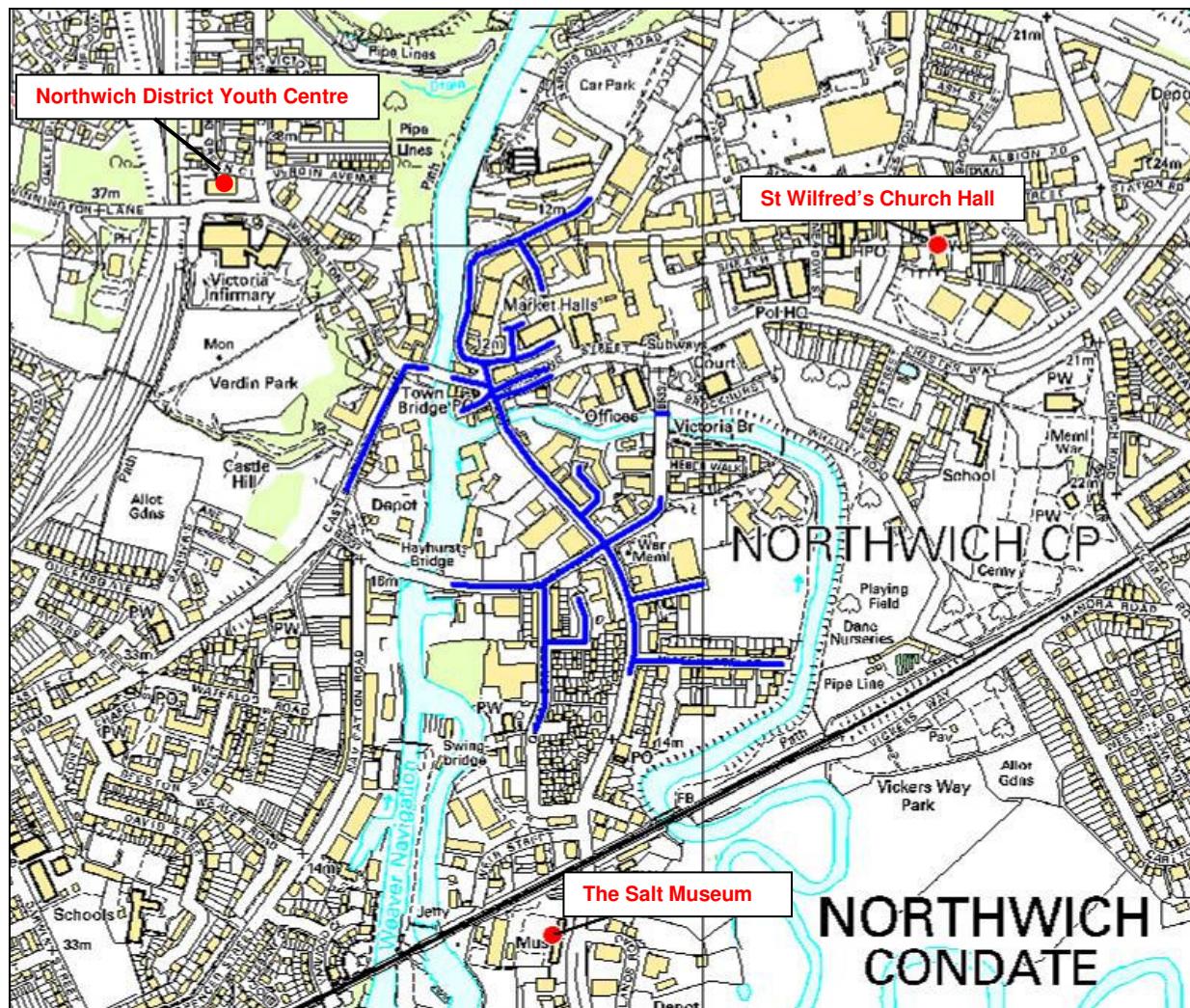
Allocation	Development site	Site description	Other influences	Area Ha	More vulnerable (residential) dwellings	Less vulnerable (commercial) m ²	Car parking spaces	Flood Zone	SoP	Suitable alternative and available site?	Hazard level	Exception test	Flood risk management requirements	Hazard rating (based on 1D modelling)			
GS9F	County Council Office site	Mixed use development: Retail, food and drink, residential along the Dane waterfront.	Within historic flood events for Northwich. Brownfield land Adjacent to a Main River (Dane).	0.7	20	2,045		3b, 3a, 2	50	No	Extreme	Required	Residential development direct to Flood Zone 2 and as it is upstream of Barons Quay should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Provide compensatory storage for any loss in floodplain volume. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS				
GS9G	Magistrates Court	New magistrates court building.	Within historic flood events for Northwich. Brownfield land Adjacent to a Main River (Dane).	0.4		1,858		2	50	No	Extreme	Not required	Implement appropriate flood mitigation measures (flood proofing). Incorporate SuDS				
GS9H	British Waterways site	Mixed use scheme: BW offices, hotel, residential, mooring facilities on Weaver Navigation.	Within historic flood events for Northwich. Brownfield land. Adjacent to a Main River (Weaver).	1.3	56 + 80 bed hotel			3b, 3a, 2	25	No	Significant	Required	Apply Sequential Test within the site. Residential development direct to Flood Zone 2 and as it is upstream of Barons Quay should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard.				

Allocation	Development site	Site description	Other influences	Area Ha	More vulnerable (residential) dwellings	Less vulnerable (commercial) m ²	Car parking spaces	Flood Zone	SoP	Suitable alternative and available site?	Hazard level	Exception test	Flood risk management requirements	Hazard rating (based on 1D modelling)
													Provide compensatory storage for any loss in floodplain volume. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS	
GS9I	Lock Street site	Waterfront residential apartments and a public house. Multi Storey Car park (500 spaces).	Within historic flood events for Northwich. Greenfield and brownfield land. Adjacent to a Main River and a drain passes through the site.	1.8	128	929	500	3b, 3a, 2	50	No	Extreme to Significant	Required	Apply Sequential Test within the site. Residential development direct to Flood Zone 2 and as it is upstream of Barons Quay should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Provide compensatory storage for any loss in floodplain volume. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS	
GS9J	Memorial Hall site	Residential.	Within historic flood events for Northwich. Brownfield land. Adjacent to a Main River (Dane).	0.9	65			3a, 2	80	No	Extreme	Required	Residential development direct to Flood Zone 2 and as it is upstream of Barons Quay should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Provide compensatory	

Allocation	Development site	Site description	Other influences	Area Ha	More vulnerable (residential) dwellings	Less vulnerable (commercial) m ²	Car parking spaces	Flood Zone	SoP	Suitable alternative and available site?	Hazard level	Exception test	Flood risk management requirements	Hazard rating (based on 1D modelling)			
													storage for any loss in floodplain volume. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS	 			
GS9K	Land west of Old Warrington Road	Residential development and parking	Brownfield land.	4.1	133	12,541		1	None	No	Low	Not required	Apply Sequential Test within the site. Implement appropriate flood mitigation measures. Incorporate SuDS				
GS9L	Land west of Queen Street	Riverside residential development including a hotel.	Within historic flood events for Northwich. Brownfield land. Adjacent to a Main River.	1.8	171			3b, 3a, 2	50	No	Significant	Required	Apply Sequential Test within the site. Residential development direct to Flood Zone 2 and as it is upstream of Barons Quay should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Less vulnerable development and access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Provide compensatory storage for any loss in floodplain volume. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS	 	 		
GS9M	Land adjacent to Victoria Bridge	Mixed use development: ground floor offices and residential above, alongside the River Dane.	Within historic flood events for Northwich. Brownfield land. Adjacent to a Main River (Dane).	0.4	20	465		3a, 2	50	No	Extreme	Required	Residential development direct to Flood Zone 2 and as it is upstream of Barons Quay should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Less vulnerable development and	 			

Allocation	Development site	Site description	Other influences	Area Ha	More vulnerable (residential) dwellings	Less vulnerable (commercial) m ²	Car parking spaces	Flood Zone	SoP	Suitable alternative and available site?	Hazard level	Exception test	Flood risk management requirements	Hazard rating (based on 1D modelling)			
													access/egress should be set at the appropriate 1 in 100 years design river flood level plus climate change plus 600mm freeboard. Provide compensatory storage for any loss in floodplain volume. Implement appropriate flood mitigation and flood proofing measures. Incorporate SuDS				

Figure A7: Emergency evacuation centres and roads affected by flooding up to 1% a.p. flood



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Figure A8: Observed flow paths at Marina Site from extreme events

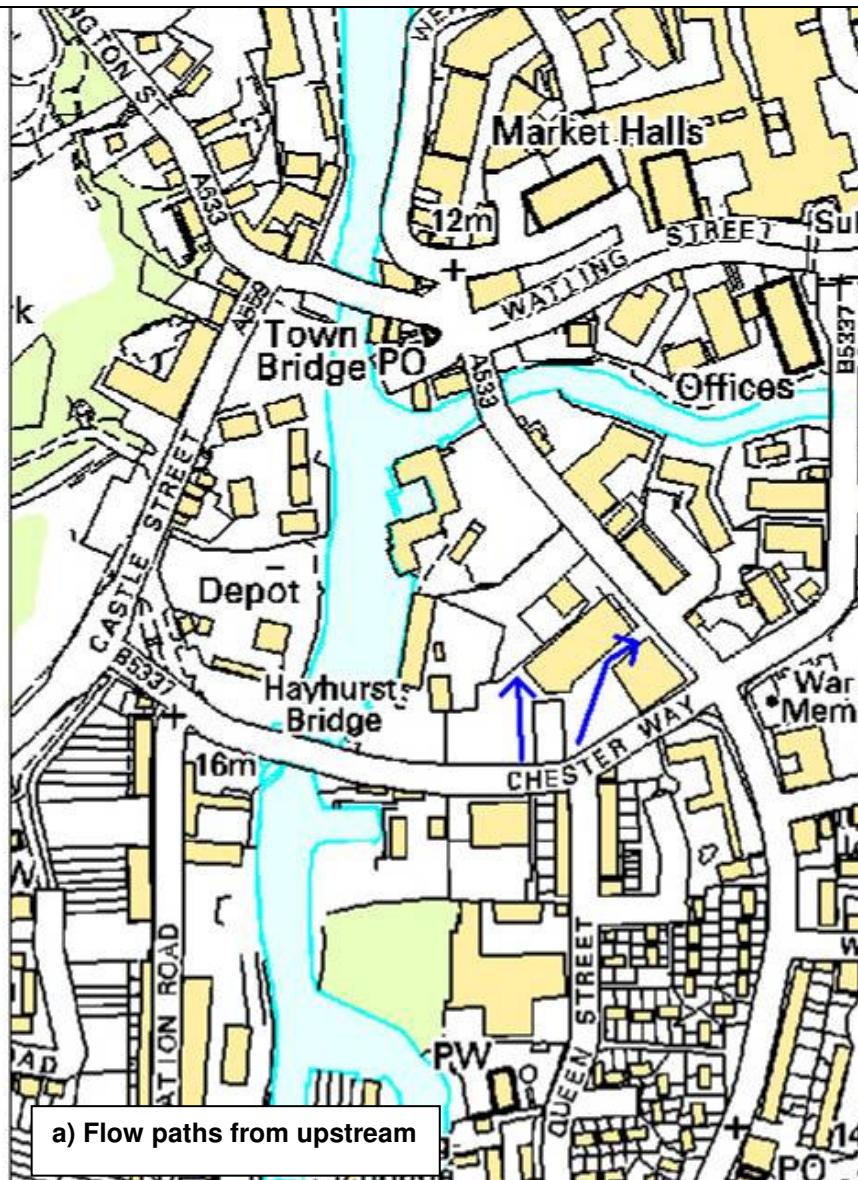
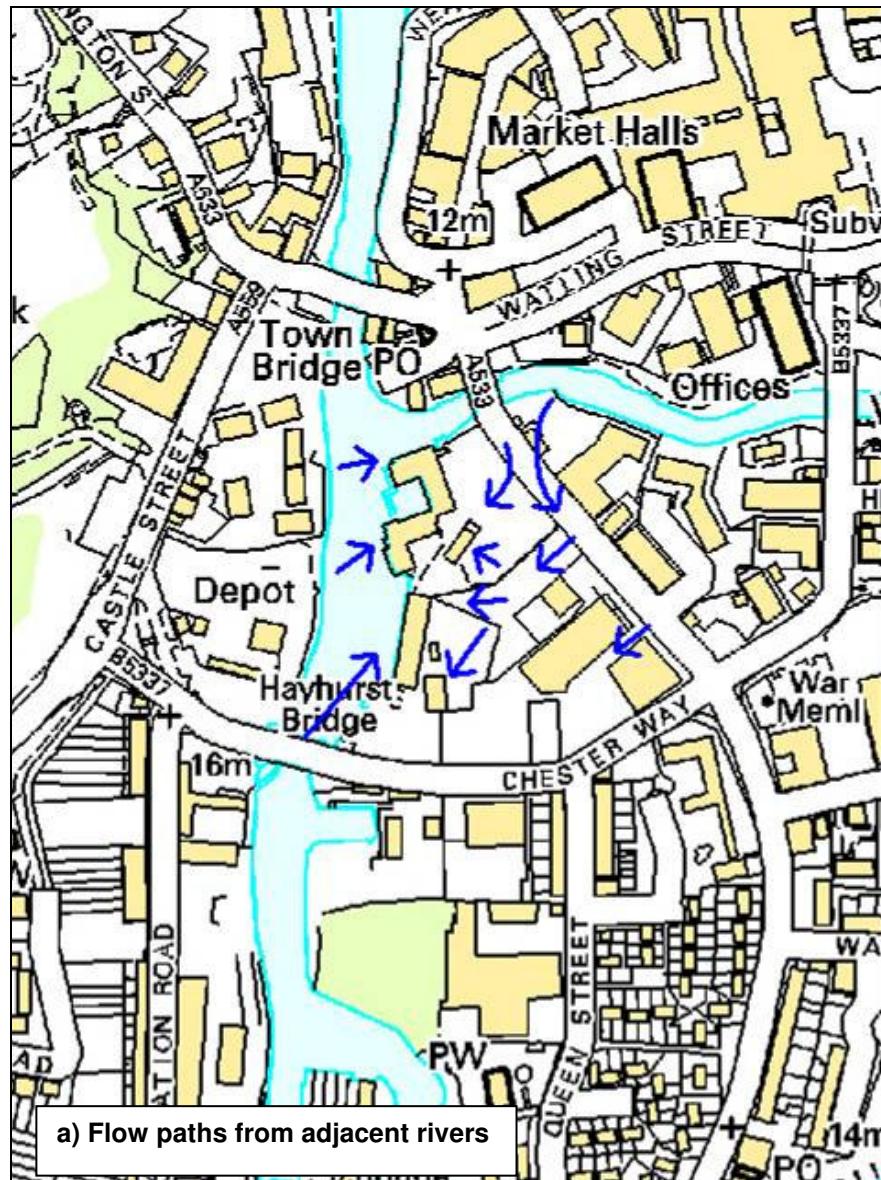
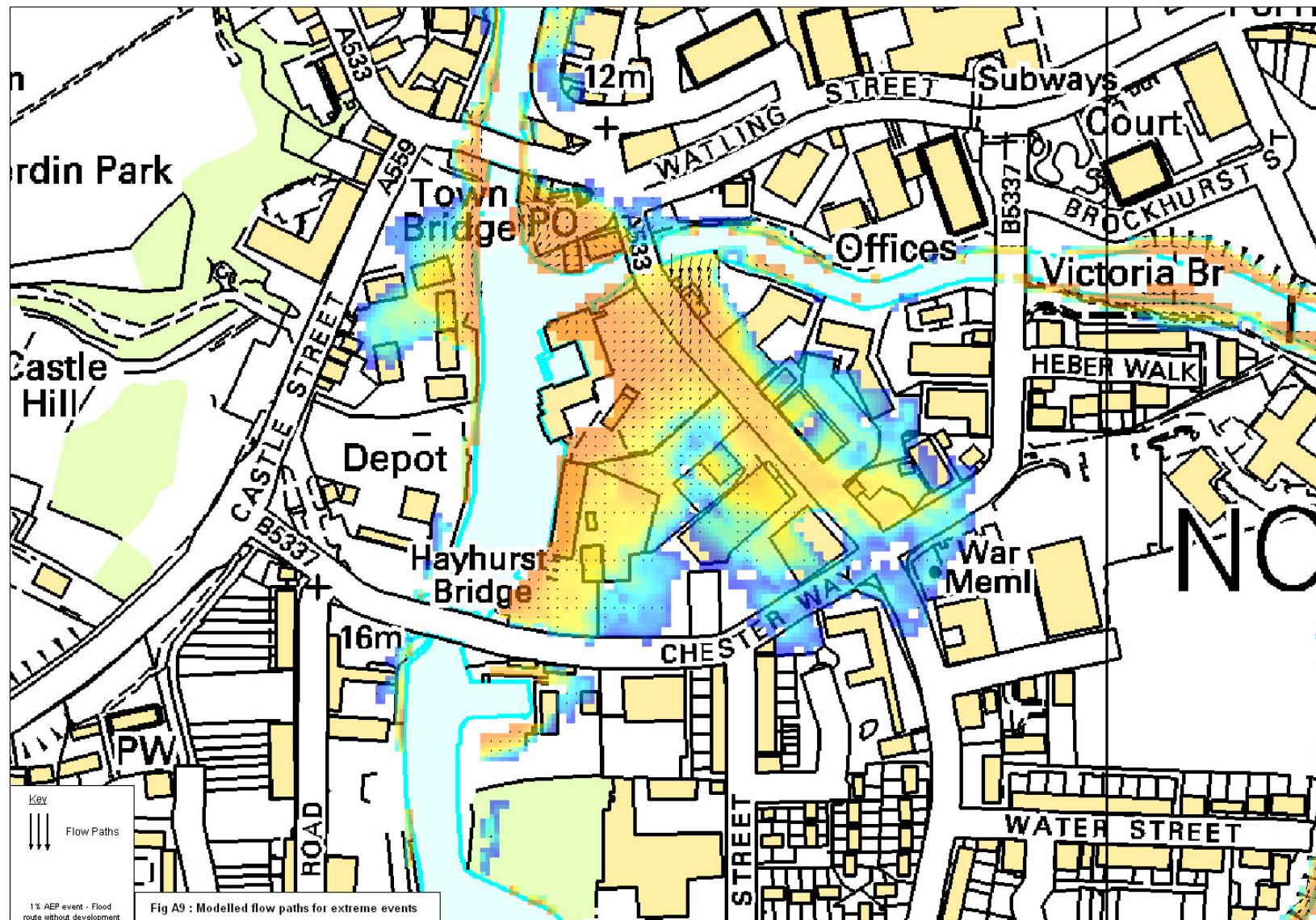


Figure A9: Modelled flow paths



Appendix B - Photographs

GS9A - Barons Quay Development Site

The Barons Quay development is located to the north of the town centre, on the east bank of the Weaver Navigation. The west side of the proposed site falls within flood zone 3b according to the Environment Agency flood maps. Land north of Leicester Street (GS9c) is also part of the Barons Quay development. To the west of the area the site falls within Flood Zone 3b, however, this is planned to be a soft landscaped areas. On the higher ground to the north east bulky goods retail developments are proposed.



Figure B1: Shops at Barons Quay



Figure B2: UU Pumping Station

GS9B - Weaver Shopping Centre Development Area

Figure B3 shows the existing entrance to the primary shopping precinct. This area is approximately 50m north of the River Dane and 250m to the east of the Weaver Navigation. The shopping area is accessed by pedestrian subways.



Figure B3: Weaver Shopping Centre

GS9C – Land North of Leicester Street

This development area has been incorporated within the Barons Quay site as bulky retail goods shown in Figure B4.



Figure B4: Land north of Leicester Street

GS9D – Northwich Market

This site covers the commercial buildings off the High Street and Watling Street, and is 50m from the Weaver Navigation and River Dane. No photographs were taken.

GS9E - Marina Site

The Flotel (Quality Hotel) is next to the proposed Marina development site and is located adjacent on the Weaver/Dane confluence. This development area includes land to the east and is bounded by the A533.

**Figure B5: Marina site****Figure B6: Marina forecourt****GS9F - County Council Offices Site**

This site includes the existing council offices as shown in Figure B7.

**Figure B7: Current County Council Offices****GS9G - Magistrates Courts Site**

This site includes the existing Magistrates Court

**Figure B8: Current Magistrates Court****GS9H - British Waterways Site**

This site lies on the west bank of the Weaver Navigation and currently includes some new offices and a boat repair yard.



Figure B9: Weaver u/s BW site



Figure B10: British Waterways Offices

GS9I - Lock Street Site

This site runs northwards along the west bank of the Weaver Navigation from Town Bridge for 350m. It is heavily vegetated north of some derelict buildings (see Figure B12a).



Figure B11: Lock Street Site



Figure B12: Vegetation on Lock Street Site



Figure B12a: Demolition Site

GS9J - Memorial Hall Site

This site includes the existing Memorial hall site and a large car park which is adjacent to the River Dane. The Dane has graded banks at this location as shown by Figures B14 and B15.



Figure B13: Memorial Hall site



Figure B14: Graded banks along River Dane



Figure B15: Graded banks along River Dane (d/s)

GS9K - Land West of Old Warrington Road

This land lies on higher ground approximately 500m east of the Weaver Navigation and 350m north of the River Dane. It is currently comprised of light industrial, commercial and residential developments.



Figure B16: Commercial properties off Old Warrington Road

GS9L - Land West of Queen Street

This land lies directly adjacent to the Weaver Navigation and is currently comprised of small commercial and residential properties.



Figure B17: Commercial Properties on Chester Way

GS9M - Land Adjacent to Victoria Bridge

The site is south of the River Dane's left bank and consists of vegetated open land and a commercial building.



Figure B18: Offices, Victoria Bridge



Figure B19: Land adjacent to Victoria Bridge

Appendix C - Consultation

Figure C1: Consultation meeting with United Utilities

Project:	Northwich Area Flood Risk Assessment (AFRA)	Job No/Ref:	55928 IBKR
Purpose:	Sewer flooding in Northwich	Date held:	21/09/2007
Held at:	Thirlmere House, Lingley Mere	Made by:	Christoff Power
Present:	Brian Morrow (UU) Christoff Power (FM)	Distribution: Project team	

No.	Item	Action By
1	<p>Overview of AFRA</p> <p>Northwich is known to be a significant flood risk area that has been identified by the SFRA and requires an AFRA to accompany NV planning proposals. The AFRA will focus on all sources of flooding to the proposed development allocations and assess the flood risk providing appropriate policies/mitigation measures (to comply with PPS25).</p>	
2	<p>UU approach to SFRAs/AFRAs</p> <p>Every property/urban area has 'some' level of flood risk.</p> <p>The DG5 register does not show the level of flood risk for properties but only those areas that have had past flood incidents. Therefore we should not assume a higher level of risk for those DG5 properties/areas. The DG5 register is a 'live' register which is updated every month. The number of properties on the register is reducing as remedial works improve systems.</p> <p>Not all public sewers have been mapped. Therefore it can be difficult to assess and quantify the level of flood risk from public sewers.</p> <p>Nobody has full responsibility for surface water – UU, EA, LA and property owners are all in part responsible. Therefore the issue of surface water runoff is not being dealt with effectively.</p> <p>SFRAs and FRAs should be cautious when assessing flood risk from sewers. They could mention past sewer flood incidents but should note that they are not indicative of the level of risk. More detailed approaches should be used before categorising risk areas. This should be considered in the client brief/proposals. E.g. Digital Terrain Model with overland routing to show areas of ponding and potential sewer flooding risk areas.</p>	
3	<p>Cause of flooding</p> <p>Combination of factors including rainfall (from catchment) and inadequate sewer capacity to cope with this. However, sewers are only required to deal with foul water and surface water from the individual property rather than for all surface water runoff from the catchment.</p>	
4	<p>Proposed development sites at risk</p> <p>Barons Quay Development Area – Contact Terrance Rathbone (catchment manager) for Northwich specifics.</p>	

	<p>UU would probably advise:</p> <ul style="list-style-type: none">- a separate system to deal with the development.- attenuation run-off if required by EA- propose SuDS and consult with UU for design guidance- require access to Pumping Station and any rising mains/sewers on the development site- sustainable homes in design expected (green roofs, water re-cycling etc.)
5	<p>Future risk considering climate change</p> <p>UU uses the standard climate change estimate of a 20% increase in flows. However, an increase in summer thunderstorms is the main cause for concern.</p> <p>UU has identified which of their assets are within the floodplain and the consequences of flooding; they plan to consider options for mitigation/management.</p> <p>By the end of 2007 sewer models for the north west will be complete for different return periods (including CC scenarios) but as yet UU are unsure who will be given access to this data/information.</p>

Figure C2: Vale Royal BC - Justification of Northwich Vision sites to support the Sequential Test**Summary**

1. There are other development sites that are available, suitable and fulfil criteria for residential development contained in Government guidance. However, these sites are located outside of the Town Centre of Northwich and away from the focus of the regeneration programme. The Town Centre sites are a priority in terms of the Council delivering regeneration in the Town Centre and any threat to these allocations could mean that the Regeneration proposal for the Town is not delivered.
2. The Council were aware that the sites, when allocated, were located in Flood Risk Areas but they have been working with the Environment Agency (EA) as a partner on the Northwich Vision Board to ensure that the Flood Risk issues are addressed at an early stage of the process to EA's satisfaction. All of the sites provide a vital element of the regeneration proposals and it needs to be recognised in the AFRA report that although these sites are located in Flood Risk areas the Council has done all it can at this stage to ensure the issues are addressed and that all of the sites pass the exceptions test.
3. Without the sites that are allocated in The Northwich Vision area it would be impossible to deliver any regeneration in the Town Centre where considerable public investment (£32 million) has been spent underpinning the mines and making the Town Centre stable.
4. The alternative sites that exist lie outside of the Town Centre and in less sustainable locations in terms of proximity to services and facilities and accessibility by sustainable forms of transport. Although some of the alternative sites would contribute something to regeneration in Northwich (principally through contributions in terms of transportation infrastructure) they would not deliver the economic and social regeneration that is needed in the Town and that the Northwich Vision sites would deliver.
5. The sites have been allocated for a number of uses through the Vale Royal Borough Local Plan First Review Alteration 2006. The sites are principally a mix of uses and some flexibility is built into each allocation. However, there are reasons why certain uses are located on certain sites which are explained below. This will mean that it is not possible to reallocate some sites without jeopardising the entire regeneration package.

Context

The Northwich Vision comprises a series of proposals to regenerate Northwich Town Centre through a range of new mixed-use development. The aim is to deliver a 'step change' improvement to strengthen and enhance Northwich's position as an important market town and retail and visitor destination and secure its vitality and viability in the long term, fitting of a key town within the region. The policies build upon extensive analysis, research and community engagement which has been undertaken over more than ten years. These policies and proposals have been developed in partnership with a number of key organisations who remain committed to facilitating their implementation through the Northwich Regeneration Partnership. The Council is seeking to plan positively and proactively in bringing about this change. It has sought to move forward development proposals in an integrated and strategic way, looking at wider development opportunities and ensuring that land use and transport planning is carried out together and ensuring that the issue of flood risk in Northwich Town Centre is approached strategically.

The Northwich Vision proposals promote all aspects of sustainable development – environmental, social and economic well-being at the same time and therefore comply with all aspects of the Government's national and regional planning policies and particularly those relating to town centres, urban renaissance and transport.

The key to the success of regenerating Northwich Town Centre will be through the implementation of a concentration and mix of main town centre uses, the creation of a new residential community and an emphasis on high quality urban design. Incorporating offices, residential, retail, leisure and culture into the town centre will help to keep it alive both day and night, contributing to urban regeneration and social inclusion and reducing the need to travel.

Achieving a step change improvement is fundamental to the success of the Northwich Vision. Only through comprehensive proposals and the quantum of development envisaged will the town centre be able to move forward and fulfil its proper role and function in the network of centres in this part of the

region. It is essential to attracting sufficient investment to create developments that will, in turn, attract quality retail occupiers to the town centre. It is also essential to achieving the quality of urban design that the Northwich Vision aspires to. Again, this is only achievable by the creation of value through this type and amount of new development. This value will also support the implementation of a range of transport proposals which, in turn, will improve accessibility and allow sustainable travel choices that will help to reduce dependency on the private car. All these considerations and benefits are linked parts of the integrated, holistic package that the Council and its partners are aiming to drive forward in the town centre.

The Northwich Vision brings into effect a number of key Government planning policies.

In terms of PPS1 it will:

- support the creation of sustainable communities by delivering improvements in social, environmental and economic well being at the same time;
- deliver mixed-use development;
- deliver new development that generates a high number of trips to the town centre where there are real travel choices allowing everyone to gain access to jobs, shops and leisure facilities;
- promote the vitality and viability of the town centre and social inclusion;
- involve solely the redevelopment of previously developed land;
- enhance the historic environment and townscape character;
- take forward a key part of the Community Plan for Vale Royal; and
- ensure good urban design is a key requirement of new development.

In terms of PPS6 it will:

- meet the Government's headline objective of promoting town centre vitality and viability through proactive planning for its growth and enhancement in the form of appropriate new development;
- involve proactive planning through the use of the Council's compulsory purchase powers where necessary to facilitate this positive change;
- be supported by a robust assessment of need and capacity for further retail and leisure development; and
- result in new development that is well related to Northwich's role and function within the wider hierarchy of centres and the catchment that it serves.

In terms of PPG13 it will:

- be delivered through integrated land use and transport planning; and
- promote sustainable transport choices and accessibility to jobs, shopping and leisure facilities.

Regional Planning Guidance for the North West (RSS)

The Northwich Vision also has strong support in the RSS. Northwich is identified as a key town in policy SD3 and is therefore a focus for new development in Cheshire. The Vision is completely aligned with both the Core Development Principles and Sustainable Development Framework. Part of the evidence base for the review of the RSS has identified that Northwich is a key component centre of the regional network. It promotes the positive and proactive approach that the Council is seeking to take and stresses that this will be necessary across the region.

All of the five priorities within the Regional Economic Strategy are taken forward through the Northwich Vision.

There is specific support for the Northwich Vision at a sub-regional policy level; in the Sub-Regional Economic Strategy, Investing in Success and in the Cheshire (2016) Structure Plan Alteration.

Northwich also lies at the heart of the Weaver Valley Regional Park which itself has strong regional and strategic policy support.

As part of its preparation for the review of RSS, the North West Regional Assembly (NWRA) have undertaken a range of research and studies. This has included a Town Centre Assessment Study carried out for the NWRA by consultants published in June 2005. The Study seeks to provide an overview of retail and leisure patterns at the regional and sub-regional level. It sets out a network of centres that will be the primary focus for future growth and development at the regional and sub-regional level. Within the sub region of Cheshire, the key component centres of the regional network are given

as Chester, Crewe, Macclesfield and Northwich. The research provides support for regeneration through retail-led mixed-use development in Northwich town centre.

Investing in Success – Working Towards a Sub- Regional Economic Strategy for Cheshire and Warrington

The Strategy was published in April 2004 by the Cheshire and Warrington Economic Alliance. It seeks to ensure that Cheshire and Warrington plays its full part in delivering economic success and prosperity in the North West.

It identifies seven geographical packages of interconnected projects. These include the Weaver Valley Regional Park. Northwich is specifically identified as a town which will be improved as a business location. The Regional Park is also seen as a new visitor destination.

The Strategy expresses a commitment to targeting channels of public sector investment in the longer term to a number of transport projects. These include 'Northwich Vision Transportation'. Significantly, the strategy makes it clear that in the Weaver Valley Regional Park, activity will focus on the implementation of the Northwich Vision.

Overall, therefore, the Sub-Regional Economic Strategy lends strong support to the implementation of the Northwich Vision.

Cheshire 2016 Structure Plan Alteration

The Northwich Vision is now explicitly recognised and supported in the Cheshire 2016 Structure Plan Alteration. It states that the provision of new housing within Vale Royal reflects the Structure Plan strategy of regeneration and in particular the implementation of the Northwich Vision. Within policy T3, the implementation of the Northwich Vision, is promoted as a major transport scheme. It is highlighted that the Northwich Vision through the regeneration of the town and its surroundings, including a Regional Park in the Weaver Valley, has implications for transport in the area that may include major transport infrastructure schemes.

Cheshire Local Transport Plan 2006-2011

The Cheshire Local Transport Plan directly supports the delivery of the Northwich Vision and includes a number of initiatives to assist with the regeneration of the Town Centre. Urban Traffic Control is proposed for the town centre and together with improved walking and cycling routes will assist with reducing congestion and increasing accessibility. The Local Transport Plan also includes a proposal for a Major Scheme to provide comprehensive transportation infrastructure improvements.

Weaver Valley Regional Park

Northwich lies at the heart of the Weaver Valley Regional Park. The concept of regional parks in the North West originated in the Regional Economic Strategy in 1999. It referred to the creation of regional scale resources for countryside recreation close to urban areas. They are also seen as an opportunity to promote regeneration.

Northwich is at the heart of the Regional Park. The third objective of the Regional Park in the Vision document is to:

'Support and enhance regeneration activities in and around the Cheshire towns of Frodsham, Northwich, Winsford, Middlewich, Sandbach, Nantwich and Crewe.'

It notes that the implementation of Northwich Vision sites is required to successfully deliver this objective. Northwich is also identified as an important 'gateway' point of access into the Park. The Vision also highlights the potential significance of Northwich town centre in tourism terms within the Park.

The Vale Royal Borough Local Plan First Review Alteration

The Vale Royal Borough Local Plan First Review Alteration (Local Plan) provides the key building block for the delivery of the Northwich Vision. The policies contained in the Local Plan set out the key requirements for all developments related to the Northwich Vision and also allocate the various sites within the Vision for specific uses. The Plan and its policies give the proposals significant weight in terms of the determination of future planning applications that are in accordance with the Plan and they also give certainty and confidence to the market over the whole regeneration initiative.

Policy GS11 makes it clear that all development must embody high quality urban design. The policy reflects the principles for new development within the Northwich Vision Regeneration Framework has

been formulated in the light of Government guidance within PPS1 Delivering Sustainable Development, RSS and a number of good practice guides.

The new Cheshire West and Cheshire Unitary Authority which includes Vale Royal, Ellesmere Port and Neston Borough Councils and Chester City Council have been successful in being awarded Growth Point status by Central Government.

Growth Points are being led by the Department of Communities and Local Government (DCLG) to identify areas where significant housing and economic growth will be focussed in the next 9 years to 2017. The aim is to relieve pressure on high demand areas and to tackle key issues such as affordability whilst also delivering on the Government's ambitious targets for housing growth. The West Cheshire Growth Point area will deliver an additional 2,700 homes more than is indicated in the latest Regional Spatial Strategy figures and will deliver long term sustainable growth without major negative environmental, economic and social impacts.

A 9 year Programme of Development is currently being prepared by the West Cheshire Growth Point which will set out, in detail, how the area will deliver the level of proposed development and in which locations. The focus in Vale Royal is for significant additional growth to be delivered through the Northwich Vision as well as on the edge of Northwich and in Winsford.

The following large sites around Northwich were considered at the Inquiry into the current Adopted Local Plan.

- Wincham Urban Village
- Middlewich Road
- Land West of Old Warrington Road
- The Salt Museum
- Elm Street
- Lostock Works

These sites will not however, bring about the regeneration of the town centre that is needed within Northwich to fulfil the quantum of development planned for the town centre as explained above.

Figure C3: Environment Agency Northwich Vision meeting minutes

Environment Agency Meeting	
21st November 2006	
Wyvern House, WINSFORD	
Attendees:	Graham Bate (GB) (EA) Jenny Bringloe (JB) (EA) Ian Broad (IB) (EA) Emma Williams (EW) (EA) Andrew Wallace (AW) (EA) Mike Crowther (MC) (EA) Brendan McCarthy (BM) (EA) Mark Furness (MF) (EA) David Ward (DW) (EA) John Grinnell (JG) (EA) Patrick Arthurs (PA) (EA)
Apologies:	Mark Chadwick (Mc) (EA) Environment Agency (EA)

NORTHWICH VISION ENVIRONMENT AGENCY MEETING
ACTION LIST

Agenda item	Action/Detail	By Whom	Status
1. Introduction	<ul style="list-style-type: none"> The meeting was arranged to: <ul style="list-style-type: none"> 1. Update the Environment Agency (EA) on the Barons Quay Masterplan 2. Confirm the EA's advice given at a previous meeting in May 2006 remains valid 3. Discuss the outcomes of the Northwich Flood Alleviation Scheme and their potential impact on the Masterplan 		
2. Masterplan update	<ul style="list-style-type: none"> Revised Masterplan was tabled; development will be a retail led, mixed-use scheme. Leisure and residential development will mainly be along the River Weaver on the west of the site and Leicester Street on the north. Masterplan designed to reduce flood risk by raising finished floor levels (FFLs) to 13.5m AOD for residential and commercial/leisure buildings; EA confirmed this is acceptable. FFLs for commercial buildings could be reduced to a minimum of 13.2m AOD if necessary, however flood resilience measures would need to be built in. Access and egress must be 'safe'. This should ideally mean dry, at a minimum level of 13.2m AOD. For any reduction the depth and velocity of water should be taken into account and the emergency services should be consulted on what is considered 'safe'. Residential block proposed next to the river was specifically discussed. EA agreed that FFL at 13.5m AOD and undercroft/external car parking 		

	<p>and access at 13.2m AOD would be acceptable. Any reduction in level of car park below this would require demountable barriers and flood warning system to ensure barriers can be operated effectively. This would require a named individual as a single point of contact, e.g. Centre Manager, or a flood warden, managed by VRBC in the absence of a suitable site-based contact.</p> <ul style="list-style-type: none"> EA agreed to the principle of the development but confirmed detailed evidence of mitigation would need to be provided with the Flood Risk assessment (FRA). PPG25 Appendix F is current guidance on FRAs but proposals need to consider the imminent publication of PPS25, which will replace PPG25. EA consider that loss of floodplain storage will not be significant because the floodplain of the River Weaver is wide downstream of the site. Since this will be a large scale redevelopment floodplain storage compensation will not be necessary. Land drainage consent will be required from the EA for any works within 8 metres of the Weaver. Any proposals that hinder access to the watercourse would not receive consent because the EA cannot carry out maintenance from the river. The proposals include a walkway along the bank of the river, which could be allowed to flood, as long as the standard of flood protection for buildings behind this was not reduced. EA confirmed flood levels are as previously advised but pointed out that flood levels downstream of the confluence will be lower. This information can be provided from the Section 105 model and information requests are to go through IB. 	BM	
3. <u>Flood Alleviation Scheme Pre-</u>	<ul style="list-style-type: none"> DEFRA attach priority scores to flood schemes. A score of 24 is needed, Northwich only achieves 16.5. The redevelopment will reduce the risk of 		3

Feasibility Study Report	<p>flooding to a number of properties, affecting the cost-benefit analysis and further reducing the likelihood of funding.</p> <ul style="list-style-type: none"> EA confirmed that flood levels from the study are very conservative and the Section 105 model levels should be used to assess flood risk. EA stressed importance of ensuring that the development does not increase flood risk to areas outside the Vision e.g. Bullring area. Although improvements cannot be made to this area within the application, BM will discuss how the existing hydraulic model could be updated with the EA so any adverse impacts can be reported. EA do not have a problem with the pontoon proposal 	BM	
4. Requirements for Surface water drainage outlets to River Weaver	<ul style="list-style-type: none"> EA do not have a problem with the proposed outfall Developers should consider potential of ponding behind defences if flooding occurs at same time as heavy rainfall. Valves and surcharge provisions should be maintained Sustainable drainage must be considered. Water quality and source control more important than reducing runoff volume The abutments of the proposed bridge must be set back as far as possible Canalised River Weaver has limited ecological value but developers should consider environmentally sensitive issues 		

Figure C4: Storage Option Meeting

Project:	Flood Risk and Flood Mitigation Study for Northwich Town centre	Job No/Ref:	60038192
Purpose:	Storage solutions	Date held:	28/05/08
Held at:	Appleton House, Birchwood	Made by:	CP
Present:	<u>EA</u> Chris Waring Graham Bate Andy Cameron <u>Vale Royal BC</u> Charlotte Aspinall Mike Crowther <u>FM</u> Sam Wingfield Christoff Power		
No.	Item	Action By	
1	Northwich AFRA status CP summarised that draft 2 of Northwich AFRA is ready for issue EA. CP has incorporated comments from CW. However, sequential test is limited due to lack of site layouts/plans etc.	CP	
2	Northwich Next Phase brief CP summarised the brief for this work commissioned by Vale Royal.		
3	Storage solutions CP - Main problem is that parts of dev sites fall in FZ 3. This means compensatory storage is difficult within Northwich. River corridor idea is therefore less effective in reducing flood levels. GB - Residential development in FZ 3 places a burden on the Flood Warning service, emergency services and council etc. Escape to higher levels of residential development is not considered viable as floods can last 12hrs and people can be without water, electricity and sanitation. GB - Compensatory storage may not be possible on Marina site as this is already functional floodplain. Possibly could use the Queen Street site as storage instead. CP will propose 3 scenarios to model in agreement with EA considering the following options: <ul style="list-style-type: none"> • Set back development and thereby increasing river corridor/functional floodplain where possible. • Compensatory storage within Town Centre e.g. Queens Street, Barons Quay, Lock Street. • Create a washland along River Dane between the railway line and the A556. Cf. to a recent proposal for Keckwick Brook with wide parallel channels dug out to store floodwaters in combination with control structures. This could result in habitat creation and be part of a high level stewardship / wetland scheme. • Additional upstream storage along Dane by lower agricultural defences. CP to check location. 		
	MC - check the land use constraints for the floodplain area along the River Dane.	MC	
	GB - Must consider the residual risk. E.g. from structures failing, to existing development and as a result of raising land to develop the sites.		

4	Marina Site MC - arrange a meeting with David McLean Homes to discuss the site in relation to the strategic Northwich study.	MC
5	Site visit MC and CP will arrange a site visit to see the potential for storage along the Dane.	CP

Figure C5: New approach

Project:	Flood Risk and Mitigation Study for Northwich Town Centre	Job No:	60038192
Subject:	New approach to mitigation	Date:	26 September 2008

This note clarifies our approach to mitigating the affect of the proposed Northwich Vision development sites on Northwich Town Centre.

Modelled scenarios

The ISIS-TUFLOW model was run with the Northwich Vision development 'footprint' represented by a loss of potential floodplain storage. We modelled a number of scenarios to test the benefit of upstream storage at two locations. This would provide the compensatory storage needed as a result of intensified development in the floodplain as a result of development primarily at the Marina site, Queen Street site and to some extent at Barons Quay.

It was discovered that the developments had an impact upon water levels which thus increased the flood risk especially in Northwich. The mitigation proposals involved the increase of floodplain storage by excavating the floodplain thereby reducing the ground level and increasing the flood storage potential.

The initial mitigation at site 1 (at Dane Meadows, Leftwich) showed that although the site was inundated and stored flow, the mitigation only removed flow from the local area and did not reduce downstream water levels. A test was conducted to enhance this storage potential to assess how much of an influence site 1 could have and the results showed that the mitigation would have very little impact on the downstream flood risk due to the amount of floodplain storage already in the area. Another site (recreational ground,) was added to further mitigate the effects of development. Again the proposed mitigation showed that the reduction in water levels was not significant.

Further analysis of the results highlighted the Marina development site effectively blocks a potential floodplain flow route and leads to the constriction of flow from the River Dane into the Weaver. This reduction in flow route, by approximately 80%, leads to increased flow rates as well as higher water levels at the downstream end of the Dane. Therefore, replacing lost storage downstream with the tested storage sites is not appropriate.

Other river engineering options

Further modelling of additional storage sites would conclude, similar to the Pre-feasibility study, that a very large storage area would be required to offset flooding in Northwich. The scale of such a scheme would provide flood alleviation for the whole of Northwich rather than mitigation just for the development sites.

A scheme of this scale, or an alternative river engineered scheme (e.g. flood culvert, widening confluence), would be expensive to construct and maintain (storage area in Pre-feasibility study was estimated at £3-7million), and be disruptive, even assuming a suitable route could be identified.

Marina development

We have concluded that rather than pursuing the more costly engineering schemes, the most practicable way forward is to re-visit the development layout of the Marina site. The proposed Marina site has the greatest impact on flood risk as new development (raised land) here would constrict flows and increase flood hazard to people.

With close consultation with the EA, BW and the developers a workable solution could be found. However, this is likely to reduce the residential footprint of the site (although this could be mitigated with suitable design features) and would be dependent on necessary flood resilience and resistance measures.

Appendix D – PPS25 Extracts

Annex E: Assessment of Flood Risk

General Principles

E1. Properly prepared assessments of flood risk will inform the decision-making process at all stages of development planning. There should be iteration between the different levels of flood risk assessment.

E2. Any organisation or person proposing a development must consider whether that development will not add to and should where practicable reduce flood risk. The future users of the development must not be placed in danger from flood hazards and should remain safe throughout the lifetime of the plan or proposed development and land use.

E3. At all stages of the planning process, the minimum requirements for flood risk assessments are that they should:

- be proportionate to the risk and appropriate to the scale, nature and location of the development;
- consider the risk of flooding arising from the development in addition to the risk of flooding to the development;
- take the impacts of climate change into account (see Annex B);
- be undertaken by competent people, as early as possible in the particular planning process, to avoid misplaced effort and raising landowner expectations where land is unsuitable for development;
- consider both the potential adverse and beneficial effects of flood risk management infrastructure including raised defences, flow channels, flood storage areas and other artificial features together with the consequences of their failure;
- consider the vulnerability of those that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification (see Annex D), including arrangements for safe access;
- consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made;
- consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;
- include the assessment of the remaining (known as 'residual') risk (see Annex G) after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development or land use;
- consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of development may affect drainage systems; and
- be supported by appropriate data and information, including historical information on previous events.

Site-specific Flood Risk Assessments (FRAs)

E8. At the planning application stage, an appropriate FRA will be required to demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others will be managed now and taking climate change into account. Policies in LDDs should require FRAs to be submitted with planning applications in areas of flood risk identified in the plan.

E9. Planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 (see Table D.1, Annex D) should be accompanied by a FRA. This should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed, taking climate change into account. For major developments in Flood Zone the FRA should identify opportunities to reduce the probability and consequences of flooding. A FRA will also be required where the proposed development or change of use a more vulnerable class may be subject to other sources of flooding (see Annex C) or

where the Environment Agency, Internal Drainage Board and/or other bodies have indicated that there may be drainage problems.

E10. The FRA should be prepared by the developer in consultation with the LPA. The FRA should form part of an Environmental Statement when one is required by the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 as amended.

Annex D: The Sequential Test and Exception Test

The Sequential Test

D1. The risk-based Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding (Zone 1).

D2. The Flood Zones are the starting point for the sequential approach. Zones 2 and 3 are shown on the Environment Agency Flood Map18 with Flood Zone 1 being all the land falling outside Zones 2 and 3. These Flood Zones refer to the probability of sea and river flooding only, ignoring the presence of existing defences.

D3. Regional Flood Risk Appraisals (RFRAs) (see Annex E) will refer to Environment Agency Flood Maps and will utilise further information such as Strategic Flood Risk Assessments to allow flood risk to be taken into account in a broad regional context (see Annex E para. E4).

D4. Strategic Flood Risk Assessments (SFRA) (see Annex E) will refine information on the probability of flooding, taking other sources of flooding (see Annex C) and the impacts of climate change into account. The SFRA will provide the basis for applying the Sequential Test, on the basis of the Zones in Table D.1. Where Table D.1 indicates the need to apply the Exception Test, the scope of the SFRA will be widened to consider the impact of the flood risk management infrastructure on the frequency, impact, speed of onset, depth and velocity of flooding within the Flood Zones considering a range of flood risk management maintenance scenarios. Where a SFRA is not available, the Sequential Test will be based on the Environment Agency Flood Zones.

D5. The overall aim of decision-makers should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, decision-makers identifying broad locations for development and infrastructure, allocating land in spatial plans or determining applications for development at any particular location should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision-makers consider the suitability of sites in Flood Zone 3, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

D6. Within each Flood Zone, new development should be directed first to sites at the lowest probability of flooding and the flood vulnerability of the intended use matched to the flood risk of the site, e.g. higher vulnerability uses located on parts of the site at lowest probability of flooding.

D7. The preparation and review of Regional Spatial Strategies (RSSs) and Local Development Documents (LDDs) should be used to review existing and proposed development in order to allocate land in lower flood risk zones suitable for existing vulnerable uses already in medium and high flood zones, and in doing so, to realise opportunities arising through redevelopment to improve the sustainability of communities.

D8. When seeking planning permission for individual developments on sites allocated in development plans through the application of the Sequential Test, informed by a SFRA, developers need not apply the Sequential Test, but should apply the sequential approach (see para. 14) to locating development within the site. The plan should specify requirements for Flood Risk Assessment (see Annex E).

Table D.1: Flood Zones

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

<p>Zone 1 Low Probability: This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)</p> <p>Appropriate Uses: All uses of land are appropriate in this zone</p> <p>FRA Requirements: For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. See Annex E for minimum requirements.</p> <p>Policy Aims: In this zone, developers and local authorities should seek to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.</p>
<p>Zone 2 Medium Probability: This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year.</p> <p>Appropriate Uses: The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test is passed.</p> <p>FRA Requirements: All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.</p> <p>Policy Aims: In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable urban drainage techniques.</p>
<p>Zone 3a High Probability: This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.</p> <p>Appropriate Uses: The water-compatible and less vulnerable uses of land in Table D.2 are appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test (see para. D.9) is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.</p> <p>FRA Requirements: All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.</p> <p>Policy Aims: In this zone, developers and local authorities should seek opportunities to:</p> <ul style="list-style-type: none"> i) reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable urban drainage techniques; ii) relocate existing development to land in zones with a lower probability of flooding; and iii) create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b Functional Floodplain:

This zone comprises land where water has to flow or be stored in times of flood. SFRA should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme event (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

Appropriate Uses

Only the water-compatible and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

FRA Requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy Aims

In this zone, developers and local authorities should seek opportunities to:

- i) reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable urban drainage techniques; and
- ii) relocate existing development to land with a lower probability of flooding.

Table D.2: Flood Risk Vulnerability classification

(See page 4 of Report)

Table D.3: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification (see Table D2)	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓
	Zone 3a	Exception Test required	✓	✗	Exception Test required
	Zone 3b 'Functional Floodplain'	Exception Test required	✓	✗	✗

Key:

- ✓ Development is appropriate
- ✗ Development should not be permitted

The Exception Test

D9. For the Exception Test to be passed:

- a) it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;
- b) the development should be on developable²³ previously-developed land or, if it is not on previously developed land²⁴, that there are no reasonable alternative sites on developable previously-developed land; and
- c) a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

D10. The Exception Test should be applied by decision-makers only after the Sequential Test has been applied and in the circumstances shown in Table D.1 when 'more vulnerable' development and 'essential infrastructure' cannot be located in Zones 1 or 2 and 'highly vulnerable' development cannot be located in Zone 1. It should not be used to justify 'highly vulnerable' development in Flood Zone 3a, or 'less vulnerable'; 'more vulnerable'; and 'highly vulnerable' development in Flood Zone 3b.

D11. The Exception Test should be applied to LDD site allocations for development and used to draft criteria-based policies against which to consider planning applications. Where application of the Sequential Test indicates it needs to be applied, this should be done as early in the planmaking process as possible – in LDDs, including Supplementary Planning Documents (such as site development briefs). This will minimise the need to apply it to individual planning applications.

D12. Where the Exception Test has been applied in LDD allocations or criteria-based policies, the local planning authority should include policies in its LDDs to ensure that the developer's FRA satisfies criterion c) in para. D9. The Environment Agency and other appropriate operating authorities such as Internal Drainage Boards should be consulted on the drafting of any policy intended to apply the Exception Test at a local level.

D13. Compliance with each part of the Exception Test should be demonstrated in an open and transparent way.

D14. Criterion b) of para. D9 reflects the Government's commitment to making the most efficient and effective use of land in line with the principles of sustainable development. Reflecting this, Planning Policy Statement 3 (PPS3): *Housing* sets out the Government's objectives for a flexible, responsive supply of land for housing which gives priority to the use of previously developed land for development. However, flood risk should be taken into account in determining the suitability of the land for development.

Minor Development and Changes of Use

D15. Applications for minor development²⁶ and changes of use should not be subject to the Sequential or Exception Tests but will still have to meet the requirements for FRAs and flood risk reduction set out in Table D.1.

D16. Minor developments are unlikely to raise significant flood risk issues unless they would:

- a) have an adverse effect on a watercourse, floodplain or its flood defences;
- b) would impede access to flood defence and management facilities; or
- c) where the cumulative impact of such developments would have a significant effect on local flood storage capacity or flood flows.

D17. Developers should refer to Environment Agency's Standing Advice²⁷ for requirements regarding a FRA before designing their development and such extensions or alterations should be designed and constructed to conform to any flood protection already incorporated in the property being extended and should include flood resilience measures in the design.

Removal of Permitted Development Rights

D18. Where permitted development (that is, development granted a general planning permission by the Secretary of State) threatens to have a direct, significant and adverse effect on a flood risk area, or its flood defences and their access, or the permeability and management of surface water, or flood risk to occupants, the local planning authority should consider whether to make a direction under article 4 of the Town and Country Planning (General Permitted Development) Order 1995 (S.I. 1995/418). An article 4 direction would require a planning application to be made for specific permission to carry out the development. This would enable the local planning authority to assess the possible impacts of the works or change of land-use, and decide whether to grant permission, if necessary subject to conditions, or refuse it.

Caravans and Camping; Chalets and Mobile Homes (including Gypsy and Traveller Sites)

D19. Land used for holiday or short-let caravans and camping, other temporary occupancy sites and permanently occupied caravan, mobile home and 'park home' sites that use similar structures give rise to special problems in relation to flooding. Caravan or park-home sites intended for permanent occupation are regarded as 'highly vulnerable'. The instability of such structures places their occupants at special risk and they are likely to be occupied during periods when flood risk is likely to be higher.

D20. Sites intended for temporary occupation are classified as 'more vulnerable' because they are usually occupied at times of the year when flood events are less likely to occur, although they may be located for amenity and recreational reasons on coastal or riverside sites with a high residual risk of flooding. However, the attractiveness of waterside sites for holiday accommodation also has to be

recognised, provided that proper warning and evacuation arrangements are put in place through appropriate planning conditions.

D21. In either case, the Sequential Test and Exception Test should be used by decision-makers (where applicable, – remembering that 'highly vulnerable' development should not be permitted in Zones 3a and 3b and 'more vulnerable' development should not be permitted in Zone 3b). FRAs should pay particular attention to the management of residual risk, flood warning arrangements and evacuation plans should be considered (see Annex G).

Appendix E – Storage Feasibility: Modelling Report

Introduction

As part of the Northwich Storage feasibility Study (following on from Northwich AFRA), a coupled ISIS-TUFLOW model was run to assess a number of scenarios. The ISIS-TUFLOW model was provided to Faber Maunsell (by the Environment Agency) and had previously been used to simulate a number of annual probability (a.p.) events up to 1000yr plus climate change for the purposes of flood mapping. For the purpose of this study, the TUFLOW component of the model was modified to account for the loss of floodplain storage as a result of the proposed Northwich Vision development.

ISIS-TUFLOW

ISIS-TUFLOW is a coupled model which combines the 1-Dimensional ISIS code for simulation of channel hydraulics with a 2-Dimensional TUFLOW code for simulation of the floodplain hydraulics. This allows the rapid simulation of flow hydrographs whilst also providing the precision and accuracy required for the simulation of floodplain flows. The model was provided to Faber Maunsell and no parameters have been altered within this current study. Therefore the grid size was kept at 5m resolution and Manning's n was set to the uniform default value of 0.05. The ISIS model simulated the River Weaver between Ashbrook Gauging Station to the Manchester Shipping Canal and the River Dane between Rudheath gauging station and its confluence with the River Weaver in Northwich. The TUFLOW domain was centred upon Northwich between ISIS nodes WEAN03_5757c (36498, 36890) and WEAN02_4379 (36553, 37487) on the River Weaver and as far upstream as DANE01_5855 on the River Dane (GR 36678, 37179). The TUFLOW domain simulated an area of just under 3.5km² with approximately 130,881 grid cells of 5m resolution shown in Figure E1.

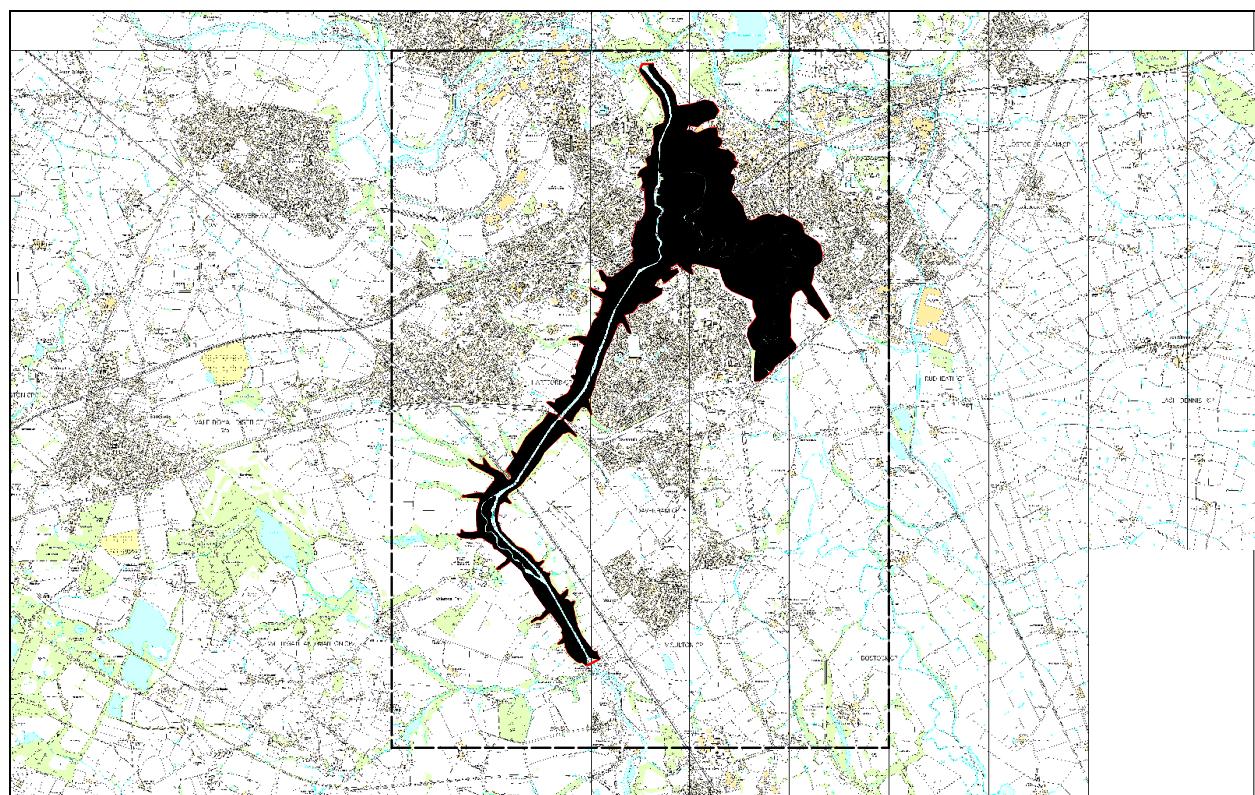


Figure E1: TUFLOW Model Domain

The Northwich Vision masterplan seeks to develop a number of sites within Northwich. Under PPS25, the risk posed by this development should be considered and for this purpose the ISIS-TUFLOW model was run to assess the 'footprint' of the development and also to give an indication of the mitigation potential at different sites. Therefore a number of scenarios were simulated which are outlined in the following sections.

Scenario 1

The Northwich Vision masterplan involves the development of 13 sites, including the Marina site at the confluence of the River Weaver and Dane. The development is likely to result in the loss of potential floodplain storage volume. This loss of floodplain storage is likely to affect the flood risk both locally and

downstream. In order to assess the 'footprint' of the development, an ISIS-TUFLOW model was developed to simulate the effect of the loss of floodplain storage volume.

Table E1 highlights the loss in floodplain storage volume associated with each development site. Added to this is the loss of approximately 24,000m³ at the Marina site which assumes the complete removal of the floodplain up to a level of 13.5m AOD. Therefore a total of 30,483m³ of floodplain storage is lost due to the Northwich Vision development.

Development site	Area in Flood Zone 3 (m ²)			Land raising estimate (m)	Loss in floodplain volume (m ³)
	Existing buildings	Proposed buildings	Net development		
Weaver floodplain d/s confluence					
GS9A	1,078	2,620	1,542	0.5	771
GS9B	0	0	0	0	No effect
GS9D	133	400	267	0.5	134
GS9I	923	3,000	2,077	0.5	1,039
GS9K	0	0	0	0	No effect
Total					1,944
Dane floodplain u/s confluence					
GS9B	0	0	0	0	No effect
GS9E	3,487	5,000	1,513	1.5	2,270
GS9F	0	0	0	0	No effect
GS9G	0	0	0	0	No effect
GS9H	0	0	0	0	No effect
GS9J	0	0	0	0	No effect
GS9L	4,463	9,000	4,537	0.5	2,269
GS9M	0	0	0	0	No effect
Total					4,539
Total	10,084	20,020	9,936		6,483

Table E1: Floodplain Storage Volume lost as a Result for the Northwich Vision Development

In order to simulate the effect of the Northwich Vision the elevation of the development sites was changed within the TUFLOW software. Polygons were produced where the development sites and Flood Zone 3 coincided. The average elevation of these polygon areas was determined from the LiDAR data using the MapInfo Vertical Mapper extension. The area of each development site in Flood Zone 3 was determined and using the volume of floodplain storage lost, an average height value could be determined. When added to the average elevation within the site this gave a revised elevation which represented the loss of floodplain storage volume. Table E2 provides the appropriate values for the 5 sites which coincided with Flood Zone 3. The Marina site had its elevation set to a uniform 13.5m AOD.

Development Site	Floodplain Volume Lost due to Development (m ³)	Average Ground Level (m ²)	Area of Development (m ²)	Required Change in Elevation (m)	Revised Floodplain Elevation (m AOD)
GS9A	771	14.09	17020	0.05	14.14
GS9D	134	15.55	5608	0.02	15.57
GS9E	2270	13.5	19610	0.12	13.62
GS9I	1039	13.05	7235	0.14	13.19
GS9L	2269	13.27	12160	0.19	13.46

Table E2: Required Change in Average Ground Level to Account for Loss of Floodplain Storage Volume as a Result of the Northwich Vision Development

Obviously the specification of a uniform elevation within the development areas is not a true reflection of the development which will be spatially distributed but in the absence of any detailed plans it is the most appropriate way to gain an insight into the potential footprint.

Figure E2 shows the model results for the original flood mapping runs (without any development) and the new baseline run which includes the development 'footprint' for the 1% a.p. event. As can be seen there is not a great deal of increase in the inundation area. However, downstream water levels are influenced by the development as shown in Figure E3 and E4. This afflux increases the risk of flooding in the specific locations. A number of potential mitigation approaches were simulated in order to reduce this increase in flood risk.

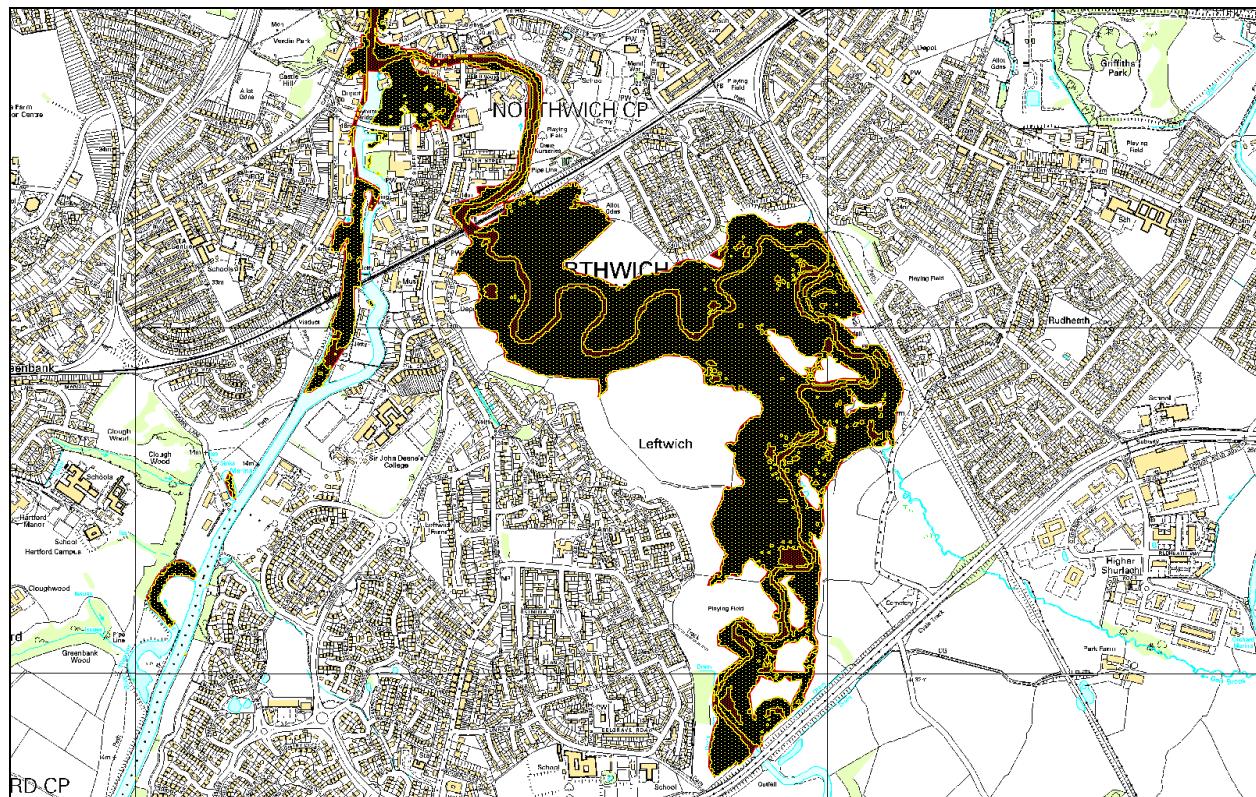


Figure E2: 1% Flood Extent for the Current (in Yellow) and the With Development Baseline (in Red)

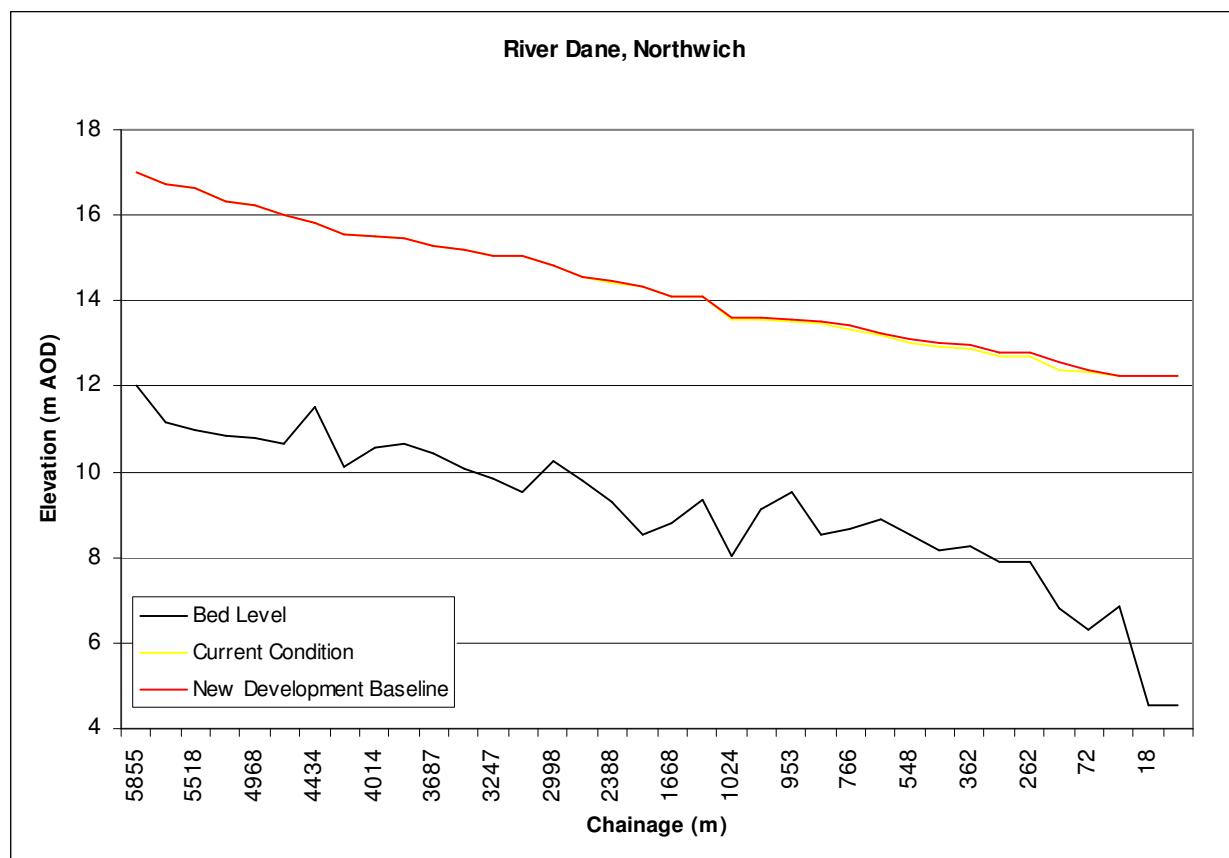


Figure E3: Simulated Peak Water Levels on the River Dane for the Current (in Red) and With Development Baseline (In Blue)



Figure E4: Simulated Peak Water Levels on the River Weaver for the Current (in Red) and With Development Baseline (In Blue)

The average difference in water levels was 0.006m whilst the maximum difference was 0.152m at Dane01_0167. Table E3 provides the values for the 1% a.p. events for selected nodes within Northwich. This shows that the footprint of the development is relatively small. However, it is an increase in flood risk and a number of mitigation proposals were simulated to assess their feasibility.

Node	Grid Reference	1% Baseline Level	1% Baseline Level with Development	Difference
DANE01_1010	36595, 37330	13.541	13.588	0.047
DANE01_0953	36596, 37335	13.519	13.568	0.049
DANE01_0871	36603, 37338	13.484	13.532	0.048
DANE01_0766	36611, 37344	13.342	13.404	0.062
DANE01_0719	36612, 37349	13.189	13.262	0.073
DANE01_0548	36616, 37365	13	13.086	0.086
DANE01_0421	36611, 37375	12.904	13.01	0.106
DANE01_0362	36605, 37378	12.859	12.964	0.105
DANE01_0276	36596, 37378	12.683	12.812	0.129
DANE01_0262	36594, 37378	12.683	12.811	0.128
DANE01_0167	36585, 37377	12.396	12.548	0.152
DANE01_0072	36577, 37379	12.35	12.386	0.036
DANE01_0062	36575, 37378	12.265	12.267	0.002
DANE01_0018	36571, 37377	12.258	12.263	0.005
DANE01_0000c	36569, 37377	12.263	12.268	0.005
WEAF05_0342	3567, 37315	13.583	13.565	0.018
WEAF05_0326	36566, 37316	12.327	12.326	0.001
WEAF05_0228	36567, 37326	12.297	12.294	0.003
WEAF05_0136	36570, 37335	12.271	12.269	0.002
WEAN03_0401	36565, 37346	12.276	12.274	0.002
WEAN03_0324	36565, 37353	12.272	12.271	0.001
WEAN03_0274	36566, 37358	12.278	12.276	0.002
WEAN03_0263	36566, 37359	12.265	12.263	0.002
WEAN03_0212	36567, 37364	12.267	12.266	0.001
WEAN03_0117	36568, 37376	12.263	12.268	0.005
WEAN03_0060	36568, 37379	12.239	12.245	0.006
WEAN03_0021	36568, 37383	12.189	12.185	0.04
WEAN03_0021c	36568, 37385	12.152	12.147	0.005

Table E3: Simulated Differences in Peak Water Levels for the Current and With Development Baseline Within Northwich

It can also be seen that the increase in water levels is more significant on the River Dane with the largest increases in water level occurring between Dane01_0421 and Dane01_167 which are near Victoria Bridge (GR36595, 37378). This suggests that attenuation on the River Dane is more appropriate than mitigation on the Weaver.

Mitigation at Site 1

A potential location has been identified on the River Dane (east of Riverside, just off Old Hall Road) which may compensate for the loss of floodplain storage due to the Northwich Vision development. The mitigation involved excavating 1.5m below the existing ground level over the site (shown in Figure E5).

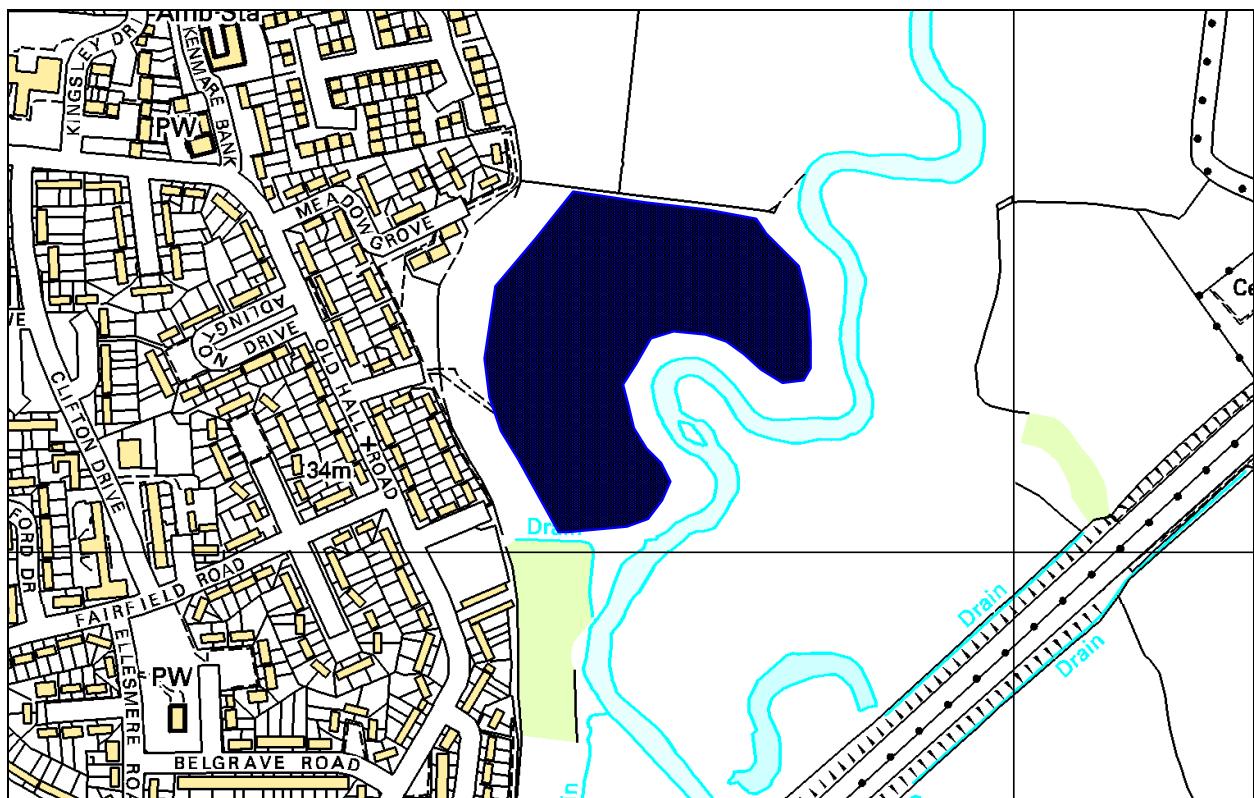


Figure E5: Location of the Proposed Storage Site for the Initial Mitigation

The existing ground level was taken as the average over the site as calculated using Vertical Mapper (16.97m AOD) and the modified ground level was 15.47m AOD. With an area of 38,970m² this provides a potential flood storage volume of 58,455m³. The weir level into the storage area was tested by simulating a run with no Weir and just allowing spill to overtop freely into the storage area, and a run with a spillway set to 15.47m. These weir levels were specified by editing the topography using TUFLOW commands. Figure E6 shows that the storage area is used within the event. Some areas of inundation on the right bank of the River Dane near site 1 are reduced as well as peak water levels in the channel adjacent to the storage site (see Table E4). However, there is not a significant reduction in peak water levels or flood risk downstream in Northwich.

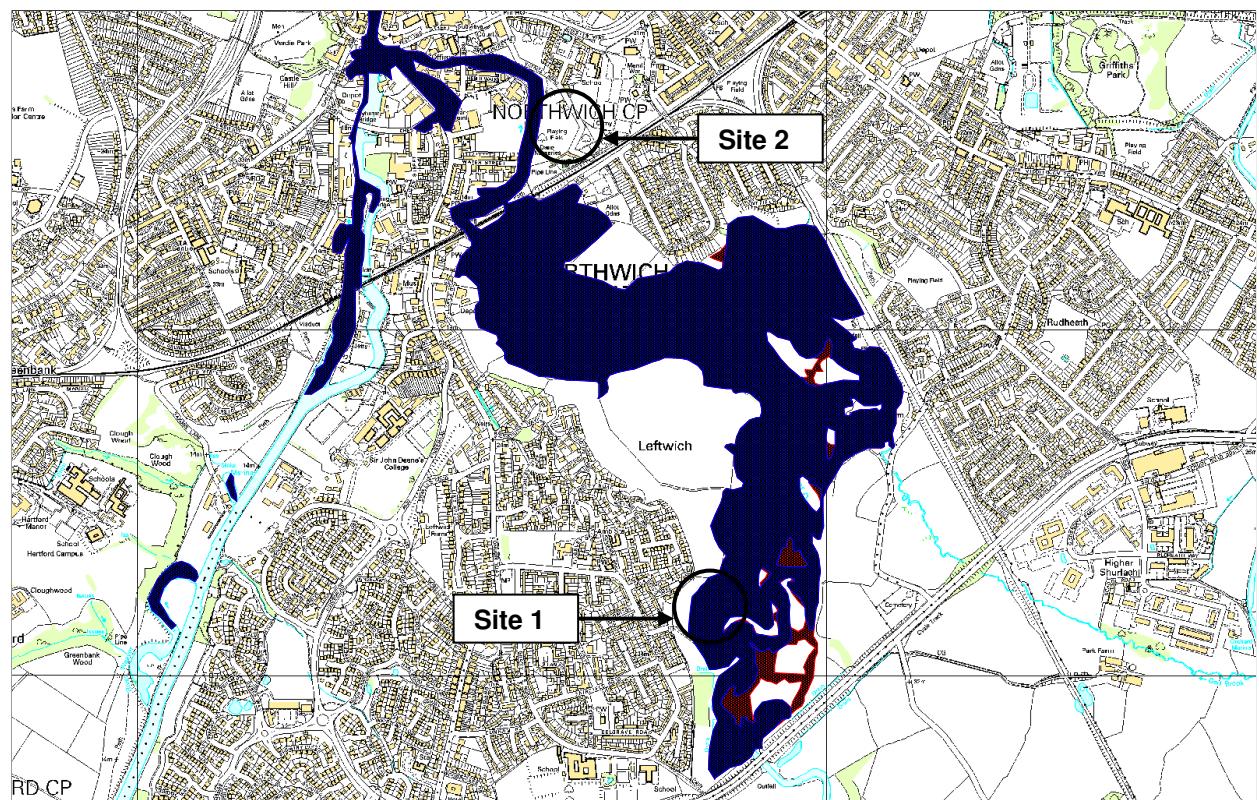


Figure E6: 1% Flood Extent for the With Development (in Red) and the Initial Mitigation (in Blue)

Node	1% Baseline Level	1% Baseline Level with Development	Mitigation 1 without Spillway	Mitigation 1 with Spillway
DANE01_1010	13.541	13.588	13.588	13.583
DANE01_0953	13.519	13.568	13.568	13.564
DANE01_0871	13.484	13.532	13.532	13.53
DANE01_0766	13.342	13.404	13.404	13.401
DANE01_0719	13.189	13.262	13.262	13.258
DANE01_0548	13	13.086	13.086	13.082
DANE01_0421	12.904	13.01	13.01	13.008
DANE01_0362	12.859	12.964	12.964	12.959
DANE01_0276	12.683	12.812	12.812	12.806
DANE01_0262	12.683	12.811	12.811	12.805
DANE01_0167	12.396	12.548	12.548	12.545
DANE01_0072	12.35	12.386	12.386	12.384
DANE01_0062	12.265	12.267	12.267	12.265
DANE01_0018	12.258	12.263	12.263	12.262
DANE01_0000c	12.263	12.268	12.268	12.267
WEAF05_0342	13.583	13.565	13.565	13.565
WEAF05_0326	12.327	12.326	12.322	12.323
WEAF05_0228	12.297	12.294	12.291	12.292
WEAF05_0136	12.271	12.269	12.266	12.268
WEAN03_0401	12.276	12.274	12.271	12.273
WEAN03_0324	12.272	12.271	12.267	12.269
WEAN03_0274	12.278	12.276	12.272	12.274
WEAN03_0263	12.265	12.263	12.259	12.261
WEAN03_0212	12.267	12.266	12.262	12.264
WEAN03_0117	12.263	12.268	12.265	12.267
WEAN03_0060	12.239	12.245	12.265	12.267
WEAN03_0021	12.189	12.185	12.241	12.244
WEAN03_0021c	12.152	12.147	12.182	12.183

Table E4: Simulated in Peak Water levels for the With Development Baseline and Initial Mitigation within Northwich for the 1% a.p. Event

The mitigation was run only for the 1% a.p. event. The average flood depth at site 1 was 0.89m which stored approximately 34,685m³ of water at the peak. However, the mitigation seems to have little effect on the downstream water levels. This is likely to be due to the amount of attenuation that already exists on the River Dane upstream of the railway line. Any further attenuation in this area is not likely to have an effect on downstream water levels as the amount of floodplain storage already leads to significant attenuation of flows. To test this, a further model was run with a much larger storage volume at Site 1 however this showed no significant differences in downstream water levels.

Further Mitigation

A further site was also identified that could provide flood storage to reduce in flood risk due to the Northwich Vision development. The site was situated in recreational grounds adjacent to the Dane within Northwich (off Whalley Road shown in Figure E7). The ground level (original level was 13.51m AOD) was excavated by 1.5m to an average level of 12.01m AOD. A weir level of 13m AOD was originally set as this was thought to 'cap off' the top of the stage hydrograph and reduce peak water levels downstream. TUFLOW commands were used to edit the topography data in this location. By reducing the ground elevation by 1.5m over an area of 11,250m² gives a potential extra floodplain storage volume of 16,875m³. This mitigation scenario was added in conjunction with the initial mitigation outlined above.

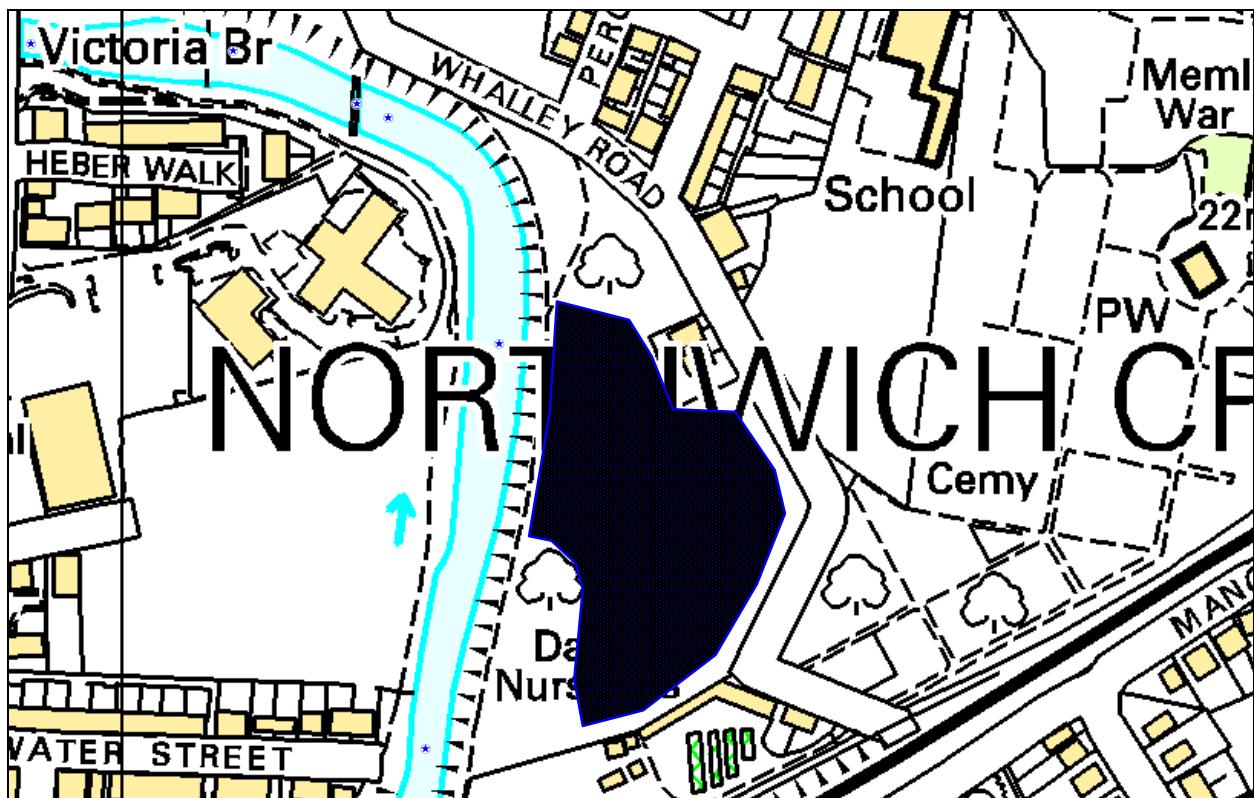


Figure B7: Location of the Potential Floodplain Storage Area as part of Further Mitigation

During the event the site was inundated up to a depth of 1.06m providing storage for approximately 11,925m³ of water. This did not affect the inundation extent anywhere other than the storage site (see Figure E8). A number of spill weir levels were simulated and the best result was achieved with a level of 13m.

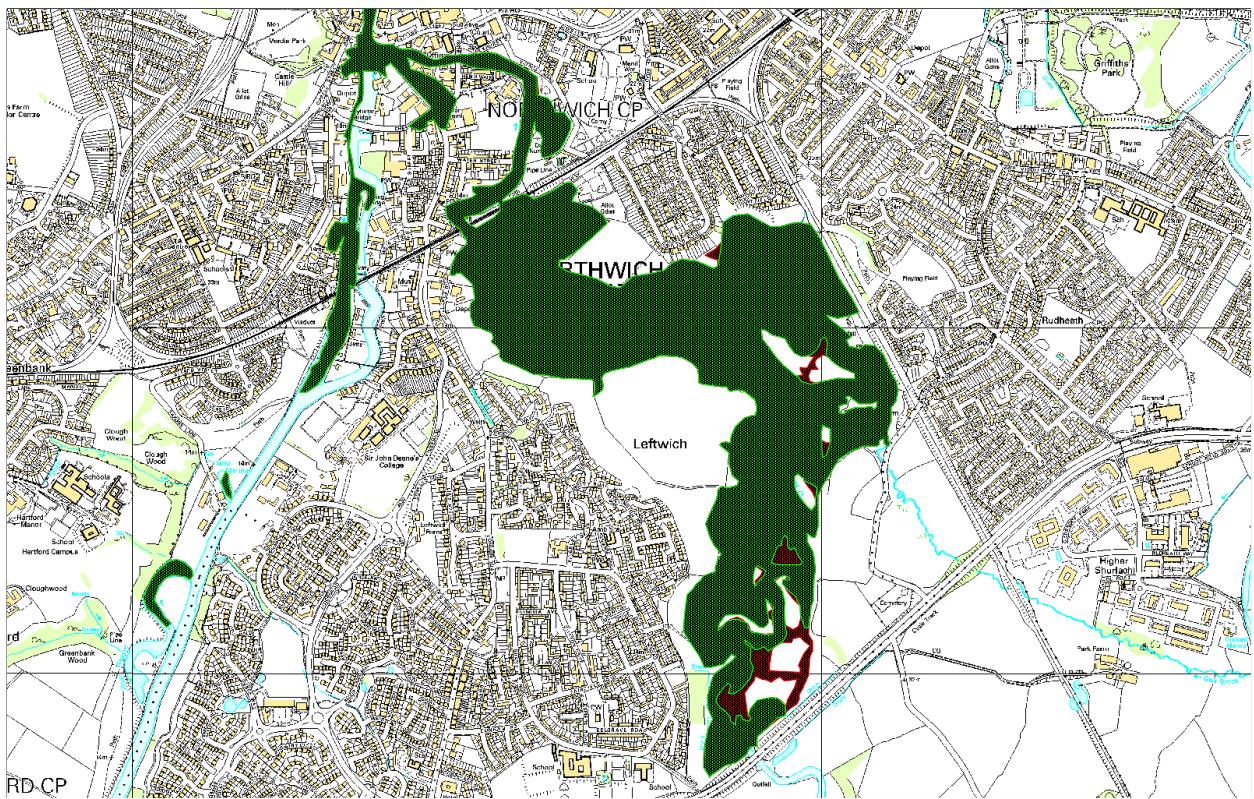


Figure E8: 1% a.p. Flood Extent for the With Development (in Red) and the Initial Mitigation (in Green)

Peak water levels for the 1% a.p. event are shown in Table E5.

Node	1% Baseline Level	1% Baseline Level with Development	Further Mitigation 2 with 13m Spill Level	Enhanced Further Mitigation 2.
DANE01_1010	13.541	13.588	13.576	13.576
DANE01_0953	13.519	13.568	13.556	13.556
DANE01_0871	13.484	13.532	13.524	13.524
DANE01_0766	13.342	13.404	13.391	13.391
DANE01_0719	13.189	13.262	13.249	13.249
DANE01_0548	13	13.086	13.071	13.071
DANE01_0421	12.904	13.01	12.998	12.998
DANE01_0362	12.859	12.964	12.947	12.947
DANE01_0276	12.683	12.812	12.796	12.796
DANE01_0262	12.683	12.811	12.796	12.796
DANE01_0167	12.396	12.548	12.538	12.538
DANE01_0072	12.35	12.386	12.376	12.377
DANE01_0062	12.265	12.267	12.259	12.259
DANE01_0018	12.258	12.263	12.256	12.257
DANE01_0000c	12.263	12.268	12.261	12.261
WEAF05_0342	13.583	13.565	13.565	13.565
WEAF05_0326	12.327	12.326	12.32	12.32
WEAF05_0228	12.297	12.294	12.287	12.287
WEAF05_0136	12.271	12.269	12.262	12.262
WEAN03_0401	12.276	12.274	12.267	12.267
WEAN03_0324	12.272	12.271	12.263	12.264
WEAN03_0274	12.278	12.276	12.268	12.268
WEAN03_0263	12.265	12.263	12.256	12.256
WEAN03_0212	12.267	12.266	12.258	12.259
WEAN03_0117	12.263	12.268	12.261	12.261
WEAN03_0060	12.239	12.245	12.238	12.238
WEAN03_0021	12.189	12.185	12.178	12.178
WEAN03_0021c	12.152	12.147	12.14	12.14

Table E5: Simulated in Peak Water levels for the With Development Baseline and Further Mitigation within Northwich for the 1% a.p. Event

The reduction in water levels is relatively small. A further run increased the amount of flood storage by reducing the ground level by an additional 1m to 11m AOD. Again this showed little effect upon downstream water levels. This suggests that providing alternative floodplain volume to that displaced by the Northwich Vision development is perhaps not the best approach to mitigate the increased flood risk. The reason for this is due to the flood mechanism and this is discussed in the section below.

Flood Mechanisms

A closer look at the mechanisms of flooding gives some explanation as to why the proposed mitigation scenarios do not have as much influence as was desired. Figure E9 shows the flow path for the original 1% a.p. basecase scenario. It can be seen that at the confluence of the River Dane and River Weaver that the floodplain transfers flow from the Dane to the Weaver. With the Marina development in place this effectively blocks off this route which means the flow is constrained to the channel and the right bank floodplain (see Figure E10). This leads to the constriction of flow which creates a backwater effect. This backwater effect leads to the increase in water levels within the River Dane. The peak flow results show the extent of this constriction; as more inflow is forced through the channel for the with-development baseline.

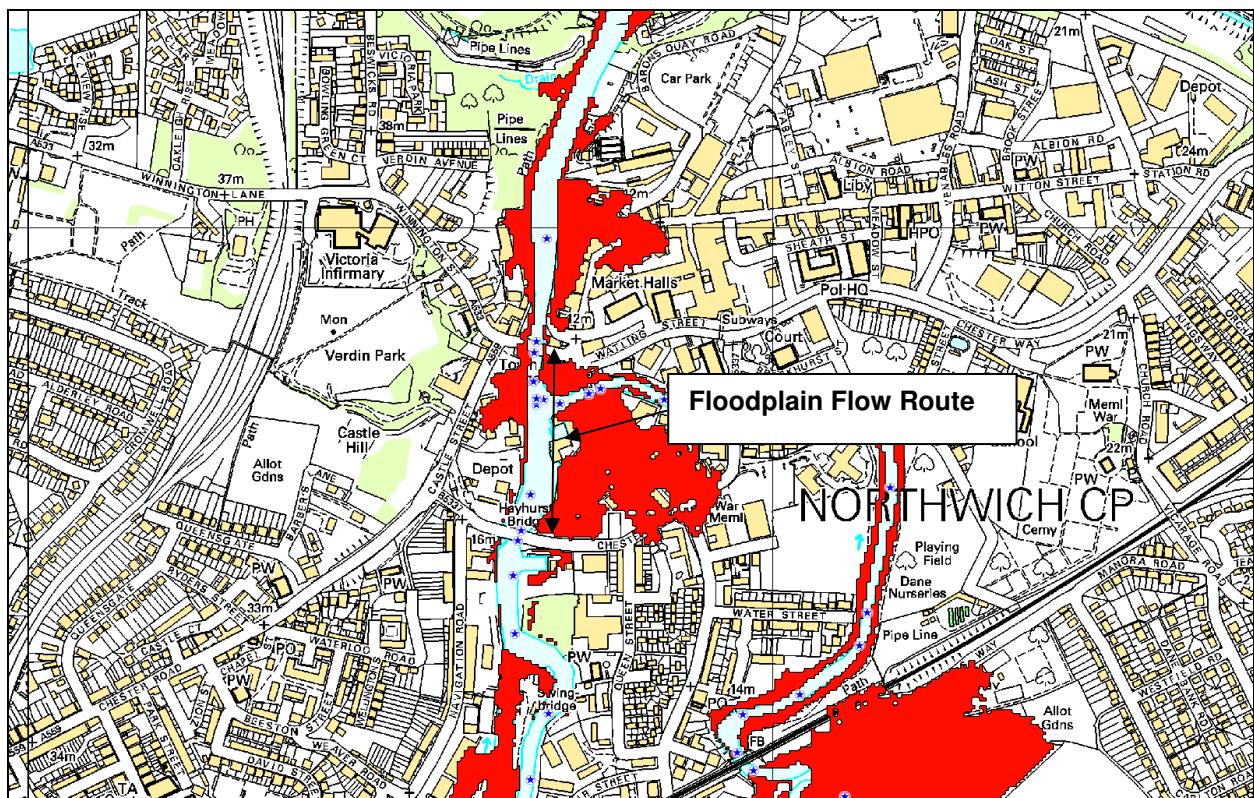


Figure E9: The original 1% Base Case without Development (inundation in red)

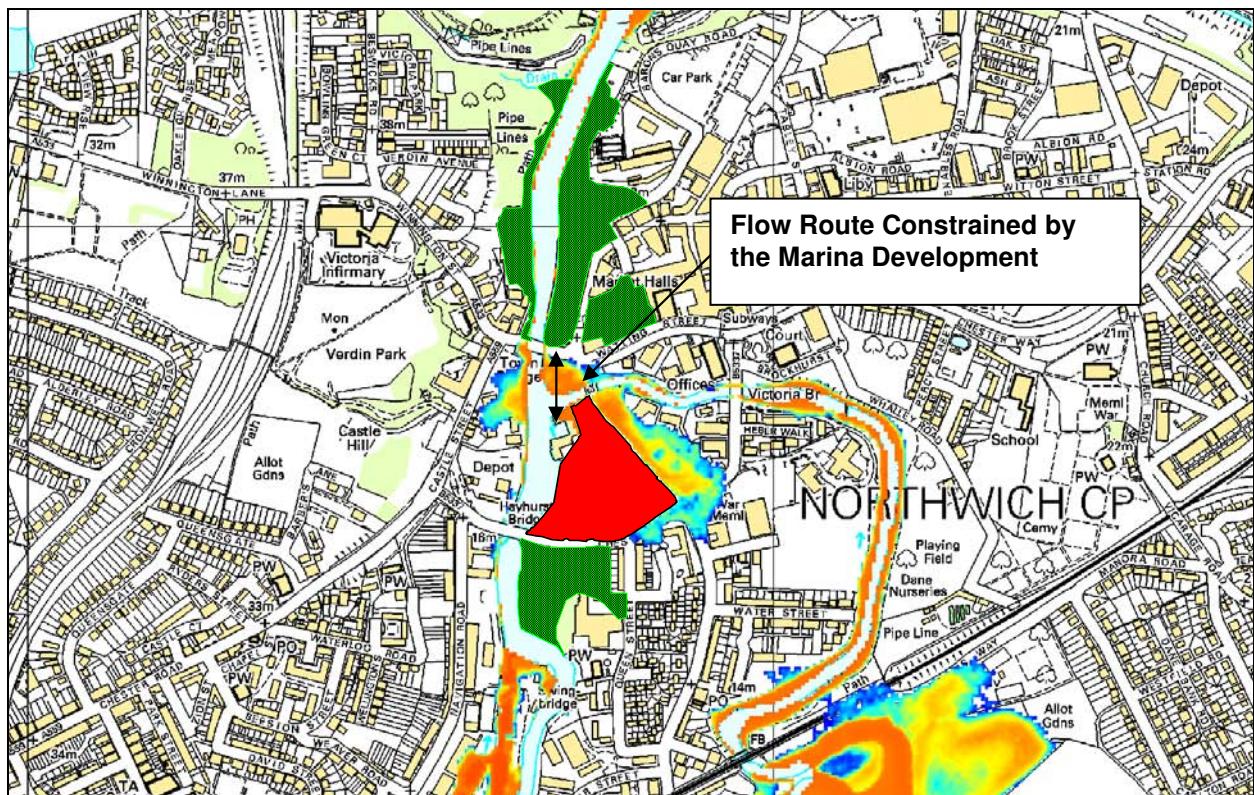


Figure E10: The 'With-Development' 1% Basecase (Marina site marked in red and other development sites in green)

For the Original baseline, the peak flow at Dane01_0018 (GR 36571, 37377 near the confluence of the River Dane and River Weaver) is $127\text{m}^3\text{s}^{-1}$, whereas, with development this rises to $143\text{m}^3\text{s}^{-1}$. This is due to the constriction of flow which leads to increased velocity values at this location (1.07ms^{-1} compared to 1.2ms^{-1}).

As the Marina site is a floodplain flow route rather than a storage area, merely accounting for the loss of storage will only have a limited impact upon the levels. In reality the loss of floodplain volume will not be uniform across the marina complex, as represented currently in the model, so this is a worse case scenario. However, to fully account for the 'footprint' of the Marina it is necessary to reduce the constriction of flow from the River Dane into the River Weaver. In order to do this it is necessary to reduce flows at Dane01_0018 to $127\text{m}^3\text{s}^{-1}$ a reduction of $16\text{m}^3\text{s}^{-1}$. Potential options may involve reducing flows or widening the channel so that flows are in-bank on the River Dane at the confluence, or possibly a flood relief culvert.

Conclusions

The ISIS-TUFLOW model was run with the Northwich Vision development 'footprint' represented by a loss of potential floodplain storage. The development was represented by using TUFLOW commands to raise ground levels in the area of the development. It was discovered that the development had a small impact upon water levels which thus increased the flood risk especially in Northwich. A number of mitigation proposals have been simulated and the results have been presented. The mitigation proposals involved the increase of floodplain storage by excavating the floodplain thereby reducing the ground level and increasing the flood storage potential. The initial mitigation at site 1 showed that although the site was inundated and stored flow, the mitigation only removed flow from the local area and did not reduce downstream water levels. A test was conducted to enhance this storage potential to assess how much of an influence site 1 could have and the results showed that the mitigation would have very little impact on the downstream flood risk due to the amount of floodplain storage already in the area. Another site (site 2) was added to further mitigate the effects of development. Again the proposed mitigation showed that the reduction in water levels was not significant.

Further analysis of the results highlighted the Northwich Vision development effectively blocks a potential floodplain flow route and leads to the constriction of flow from the River Dane into the Weaver. Therefore, replacing lost storage downstream with these storage sites is not appropriate.

This reduction in flow route, by approximately 80%, leads to increased flow rates as well as higher water levels at the downstream end of the Dane. Therefore potential mitigation measures are likely to be required to either widen the channel to account for the increase in flow or a much larger floodplain storage option to reduce flows at the bottom of the River Dane. This could possibly be achieved through a river control structure at the railway bridge, which would have a throttling effect, raising flood levels across the functional floodplain upstream.