

KELLS DEVELOPMENT PLAN 2013 - 2019

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Adopted 7th October 2013



comhairle chontae na mí
meath county council

Kells Development Plan 2013-2019

Flood Risk Assessment and Management Plan

Report

November 2013



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meath county council

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Contract

This report describes work commissioned by Meath County Council, by Change Control Notice No.1 under the County Development Plan SFRA contract, dated 11/07/2012. Ross Bryant and John Daly of JBA Consulting carried out this work.

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Purpose

This document has been prepared as an SFRA for Meath County Council.

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Abbreviations

1D	One Dimensional (modelling)
AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
CFRAM	Catchment Flood Risk Assessment and Management
DoEHLG.....	Department of the Environment, Heritage and Local Government
DTM	Digital Terrain Model
EPA.....	Environmental Protection Agency
FRA.....	Flood Risk Assessment
HEFS	High End Future Scenario
JFLOW.....	2-D hydraulic modelling package developed by JBA
LA.....	Local Authority
LiDAR.....	Light Detection And Ranging
MRFS.....	Medium Range Future Scenario
OPW	Office of Public Works
OS.....	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
SAC.....	Special Area of Conservation, designated under the Habitats Directive
SEA.....	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SPA.....	Special Protection Area for birds, protected under the EU Birds Directive
SPR.....	Standard percentage runoff
SUDS	Sustainable Urban Drainage Systems
Tp.....	Time to Peak

1 Background to the Study

1.1 Commission

JBA Consulting was commissioned by Meath County Council to undertake a Strategic Flood Risk Assessment (SFRA). This study is to inform the Kells Development Plan 2013-2019 currently being prepared jointly by Meath County Council & Kells Town Council.

This report details the SFRA for the development plan area and has been prepared in accordance with the requirements of the DoEHLG and OPW Planning Guidelines, The Planning System and Flood Risk Management¹.

1.2 Scope of the Study

Under the "Planning System and Flood Risk Management Guidelines for Planning Authorities", the purpose for the SFRA is detailed as being *"to provide a broad (wide area) assessment of all types of flood risk to inform strategic land-use planning decisions. SFRAs enable the LA to undertake the sequential approach, including the Justification Test, allocate appropriate sites for development and identify how flood risk can be reduced as part of the development plan process"*.

The Kells Development Plan 2013-2019 (KDP) will be the key document for setting out a vision for how Kells should develop during the plan period.

It is important that the KDP is consistent with the Meath County Development Plan 2013-2019 SFRA and therefore "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (OPW/DoEHLG, 2009) which states that flood risk management should be integrated into spatial planning policies at all levels to enhance certainty and clarity in the overall planning process.

In order to ensure that flood risk is integrated into the KDP, Meath CC has issued a brief to consultants for the provision of a Flood Risk Assessment. As laid out in the tender documents, the main requirements are:

1. Undertake a flood risk assessment for Kells,
2. Undertake flood probability mapping,
3. Prepare a flood risk management plan.

1.3 Report Structure

The SFRA considers the broader settlement strategy of the Greater Dublin Regional Planning Guidelines and the countywide policies and objectives of the County Development Plan. It is intended to be read in conjunction with the SFRA for the current County Development Plan as there is a degree of overlap between the two studies and in order to avoid excessive repetition some chapters of this study refer to the county scale SFRA report.

On a more local level, this study considers the development strategy that will form part of the Development Plan for Kells. The context of flood risk in the Kells area is considered with specific reference to people, property, infrastructure and the environment. A range of flood sources are considered including fluvial, pluvial and groundwater.

A two stage assessment of flood risk was undertaken, as recommended in 'The Planning System and Flood Risk Management' guidelines, for the area that lies within the development boundary of the Development Plan. The first stage is to identify flood risk. Historical records and recent events demonstrate that the Kells area has a very limited history of flooding and confirms that a proportion of zoned lands are at flood risk. The second stage and the main purpose of this SFRA report is to appraise the adequacy of existing information, to prepare flood zone maps, based on re-running the Kells Stormwater Drainage Study Model, and to highlight potential development areas that require more detailed assessment on a site specific level. The SFRA also provides guidelines for development within areas at potential risk of flooding, and

¹ DoEHLG and OPW (2009) The Planning System and Flood Risk Management: Guidelines for Planning Authorities 2012s6119 SFRA JBA Reportv1.2.doc

specifically looks at flood risk and the potential for development within the Frontlands and Backlands, as well as other key sites in Kells.

Section 2 of this report, provides an introduction to the study area and Section 3 discusses the concepts of flooding, Flood Zones and flood risk as they are incorporated into the Planning System and Flood Risk Management.

In Section 4, the available data related to flooding is summarised and appraised and Section 5 outlines the sources of flooding to be considered, based on the review of available data. Section 6 discusses climate change and residual risk.

Following this, Section 7 provides guidance and suggested approaches to managing flood risk and development; the contents of this section will be of particular use in informing the policies and objectives within the development plan. In Section 8, specific responses to flood risk are discussed in relation to a number of key development sites within Kells.

Finally, triggers for the ongoing monitoring and future review of the SFRA are detailed in Section 8.2.

2 Study Area

2.1 Introduction

The area of interest comprises the development plan boundary of Kells Town which covers the existing urban area and greenfield periphery sites.

The town of Ceanannas Mór (Kells) is situated in the north west of County Meath and is located at the junction of the new M3 and N3 Dublin to Cavan route and the N52 Dundalk to Mullingar National Secondary route, an important connection point to other centres. Kells is circa 64 km from Dublin City Centre and is 16 km from Navan. Kells acts as a service centre for its own population and for a large rural hinterland. There are a number of key land-use activities in the town including the Courts Service, Health Service Executive, schools and employment uses principally in the Kells Business Park.

This section of the report will provide an overview of the study area, the drainage catchment, the population and the nature of settlement, to give context to the study.

2.2 People, Property and Infrastructure

Based on the available census figures the population of the defined Town Council area has decreased to 2,208 in 2011 from 2,257 in the 2006 census. The population change demonstrates a negative level of growth of -2.2%. This is offset by the continued growth of the population in the environs of the town which increased by 23.0% during the inter censal period. The overall population of Kells increased by 12.2% during this period from 5,248 population in 2006 to 5,888 population in 2011.

Kells was founded as an ecclesiastical settlement and has a rich history. Recent years have seen a slow decline in population numbers and the settlement is identified as a Moderate Sustainable Growth Town.

Table 2-1 Census Population Figures²

Area	2006	2011	% Change
1. Kells Town	2257	2208	-2.2
2. Kells Environs	2991	3680	+23.0
Kells Combined (1+2)	5248	5888	+12.2

2.3 Drainage Catchments

Kells Town lies within the wider River Blackwater catchment which covers approximately 350 km² with a significant upper catchment area located in County Cavan that drains in to Lough Ramor before discharging and flowing into County Meath, close to Carnaross. The total length of the River Blackwater flowing through County Meath is approximately 32km. Downstream of Kells the Blackwater flows in a south westerly direction towards Navan where it joins the River Boyne.

The River Blackwater flanks the northern and eastern boundary of the settlement and intersects an area around Maudlin Bridge. There is only one other formal watercourse in Kells; the Newrath Stream, which drains the Backlands and Frontlands areas before flowing into the River Blackwater downstream of Maudlin Bridge.

Some minor field drains exist in the lands located to the south of the Kells Business Park. One of the drains is culverted under the business park and then enters the River Blackwater.

The extent of the Blackwater catchment with respect to Kells Town is illustrated in Figure 2-1 below.

² Source: Central Statistics Office, CSO; www.cso.ie
2012s6119 SFRA JBA Reportv1.2.doc

Figure 2-1 River Blackwater Catchment

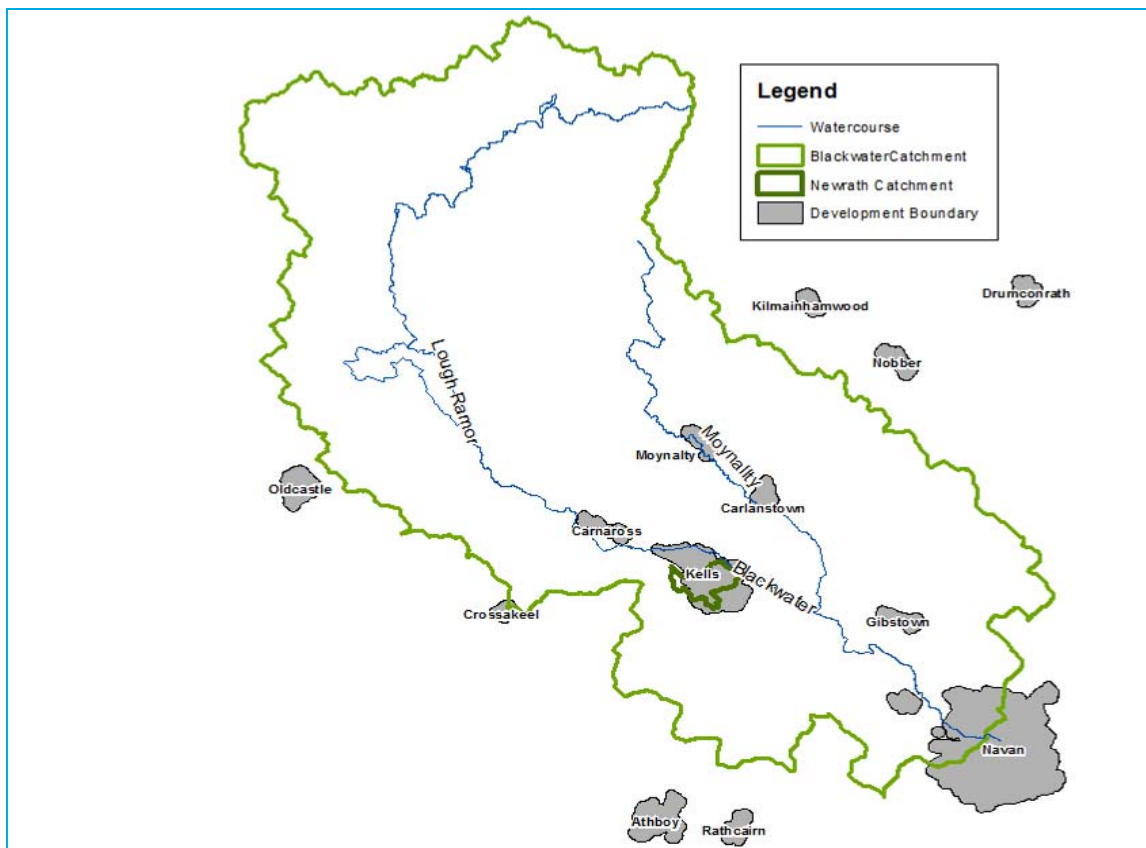
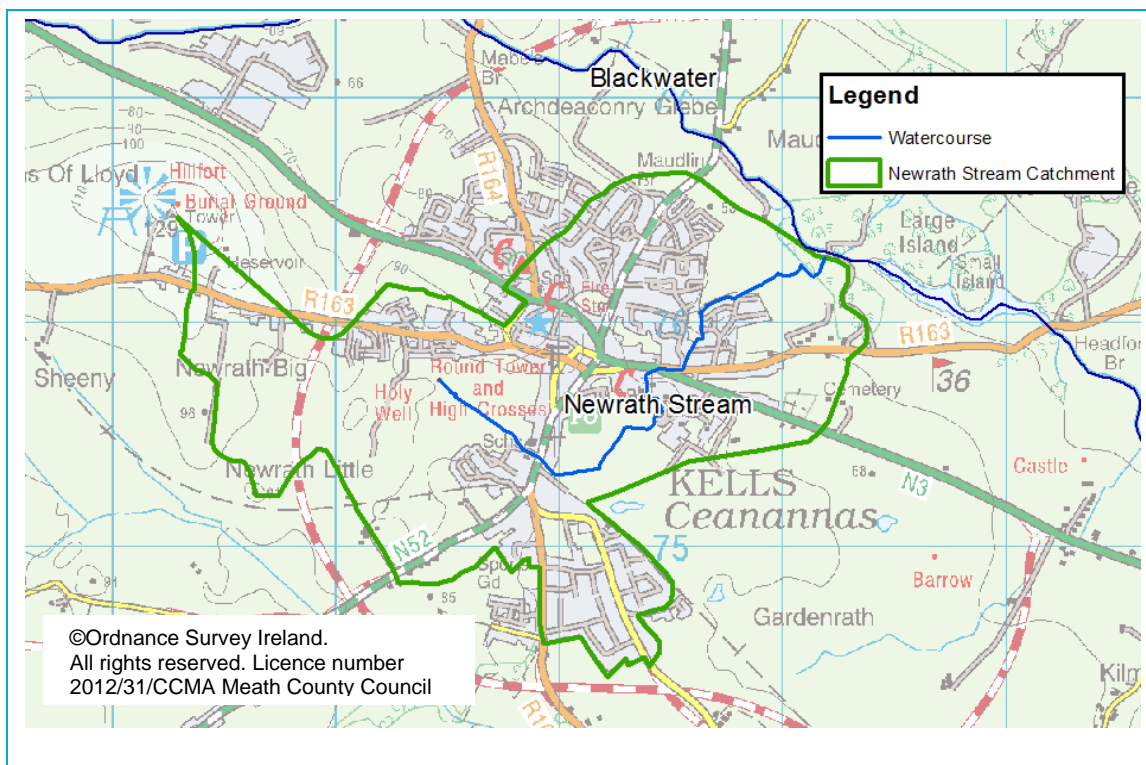


Figure 2-2 Newrath Stream Catchment



2.4 Environment

The River Blackwater (in conjunction with the River Boyne) is designated as a SPA (of high ornithological importance) from its junction with the River Boyne in Navan to the junction with Lough Ramor in Co. Cavan (SPA 004232). The designated area runs along the corridor of the River Blackwater and River Boyne.

The River Blackwater (in conjunction with the River Boyne) is also designated as a Special Area of Conservation (SAC 002299).

3 The Planning System and Flood Risk Management Guidelines

This chapter is replicated from the Meath County Development Plan 2013-2019 SFRA document, it is fundamental to understanding the SFRA process and has therefore been repeated.

3.1 Introduction

Prior to discussing the management of flood risk, it is helpful to understand what is meant by the term. It is also important to define the components of flood risk in order to apply the principles of the Planning System and Flood Risk Management in a consistent manner.

The Planning System and Flood Risk Management: Guidelines for Planning Authorities, published in November 2009, describe flooding as a natural process that can occur at any time and in a wide variety of locations. Flooding can often be beneficial, and many habitats rely on periodic inundation. However, when flooding interacts with human development, it can threaten people, their property and the environment.

This Section will firstly outline the definitions of flood risk and the Flood Zones used as a planning tool; a discussion of the principles of the planning guidelines and the management of flood risk in the planning system will follow.

3.2 Definition of Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship:

$$\text{Flood Risk} = \text{Probability of Flooding} \times \text{Consequences of Flooding}$$

The assessment of flood risk requires an understanding of the sources, the flow path of floodwater and the people and property that can be affected. The *source - pathway - receptor model*, shown below in Figure 3-1, illustrates this and is a widely used environmental model to assess and inform the management of risk.

Figure 3-1 Source Pathway Receptor Model

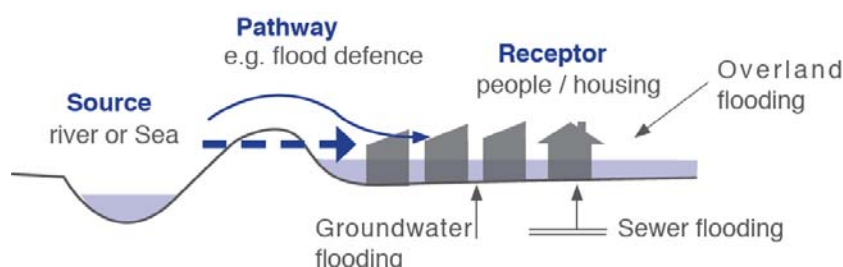


Fig. A1: Sources, pathways and receptors of flooding

Source: Figure A1 The Planning System and Flood Risk Management Guidelines Technical Appendices

Principal sources of flooding are rainfall or higher than normal sea levels while the most common pathways are rivers, drains, sewers, overland flow and river and coastal floodplains and their defence assets. Receptors can include people, their property and the environment. All three elements must be present for flood risk to arise. Mitigation measures, such as defences or flood resilient construction, have little or no effect on sources of flooding but they can block or impede pathways or remove receptors.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk.

3.3 Likelihood of Flooding

Likelihood or probability of flooding of a particular flood event is classified by its annual exceedance probability (AEP) or return period (in years). A 1% AEP flood indicates the flood event that will occur or be exceeded on average once every 100 years and has a 1 in 100 chance of occurring in any given year.

Return period is often misunderstood to be the period between large flood events rather than an average recurrence interval. Annual exceedance probability is the inverse of return period as shown in Table 3-1.

Table 3-1 Probability of Flooding

Return Period (Years)	Annual Exceedance Probability (%)
2	50
100	1
200	0.5
1000	0.1

Considered over the lifetime of development, an apparently low-frequency or rare flood has a significant probability of occurring. For example:

- A 1% flood has a 22% (1 in 5) chance of occurring at least once in a 25-year period - the period of a typical residential mortgage;
- And a 53% (1 in 2) chance of occurring in a 75-year period - a typical human lifetime.

3.3.1 Consequences of Flooding

Consequences of flooding depend on the hazards caused by inundation (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc).

The Planning System and Flood Risk Management guidelines provide three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- **Highly vulnerable**, including residential properties, essential infrastructure and emergency service facilities;
- **Less vulnerable**, such as retail and commercial and local transport infrastructure;
- **Water compatible**, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

3.4 Definition of Flood Zones

In the Planning System and Flood Risk Management guidelines, Flood Zones are used to indicate the likelihood of a flood occurring. These Zones indicate a high, moderate or low probability of flooding from fluvial or tidal sources and are defined below in Table 3-2.

It is important to note that the definition of the Flood Zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.

It is also important to note that the Flood Zones indicate flooding from fluvial and tidal sources and do not take other sources, such as groundwater or pluvial, into account, so an assessment of risk arising from such sources should also be made.

Table 3-2 Definition of Flood Zones

Zone	Description
Zone A High probability of flooding.	This zone defines areas with the highest risk of flooding from rivers (i.e. more than 1% probability or more than 1 in 100) and the coast (i.e. more than 0.5% probability or more than 1 in 200).
Zone B Moderate probability of flooding.	This zone defines areas with a moderate risk of flooding from rivers (i.e. 0.1% to 1% probability or between 1 in 100 and 1 in 1000) and the coast (i.e. 0.1% to 0.5% probability or between 1 in 200 and 1 in 1000).
Zone C Low probability of flooding.	This zone defines areas with a low risk of flooding from rivers and the coast (i.e. less than 0.1% probability or less than 1 in 1000).

3.5 Objectives and Principles of the Planning Guidelines

The 'Planning System and Flood Risk Management' describes good flood risk practice in planning and development management. Planning authorities are directed to have regard to the guidelines in the preparation of Development Plans and Local Area Plans, and for development control purposes.

The objective of the 'Planning System and Flood Risk Management' is to integrate flood risk management into the planning process, thereby assisting in the delivery of sustainable development. For this to be achieved, flood risk must be assessed as early as possible in the planning process. Paragraph 1.6 of the Guidelines states that the core objectives are to:

- *"avoid inappropriate development in areas at risk of flooding;*
- *avoid new developments increasing flood risk elsewhere, including that which may arise from surface run-off;*
- *ensure effective management of residual risks for development permitted in floodplains;*
- *avoid unnecessary restriction of national, regional or local economic and social growth;*
- *improve the understanding of flood risk among relevant stakeholders; and*
- *ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management".*

The guidelines aim to facilitate *'the transparent consideration of flood risk at all levels of the planning process, ensuring a consistency of approach throughout the country.'* SFRAs therefore become a key evidence base in meeting these objectives.

The 'Planning System and Flood Risk Management' works on a number of key principles, including:

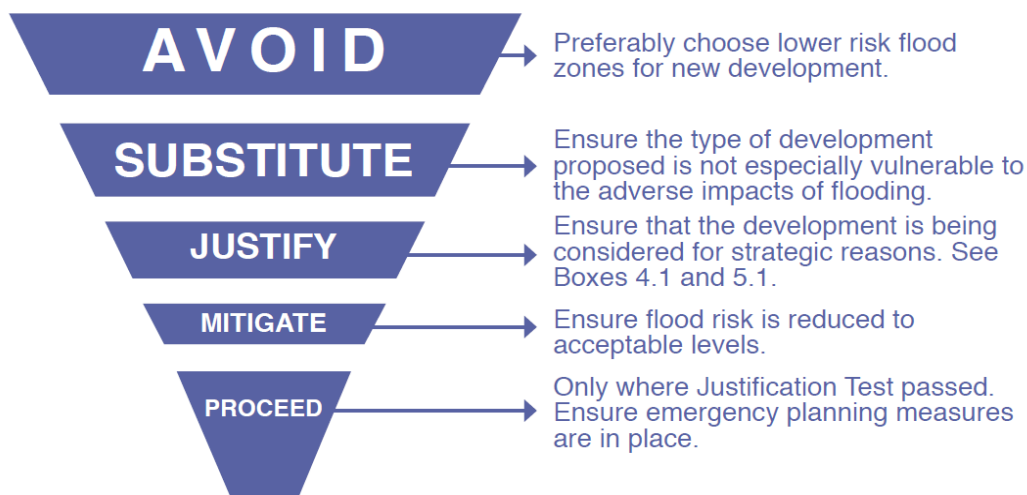
- Adopting a staged and hierarchical approach to the assessment of flood risk;
- Adopting a sequential approach to the management of flood risk, based on the frequency of flooding (identified through Flood Zones) and the vulnerability of the proposed land use.

3.6 The Sequential Approach and Justification Test

Each stage of the FRA process aims to adopt a sequential approach to management of flood risk in the planning process.

Where possible, development in areas identified as being at flood risk should be avoided; this may necessitate de-zoning lands within the development plan. If de-zoning is not possible, then rezoning from a higher vulnerability land use, such as residential, to a less vulnerable use, such as open space may be required.

Figure 3-2 Sequential Approach Principles in Flood Risk Management



Source: The Planning System and Flood Risk Management (Figure 3.1)

Where rezoning is not possible, exceptions to the development restrictions are provided for through the Justification Test. Many towns and cities have central areas that are affected by flood risk and have been targeted for growth. To allow the sustainable and compact development of these urban centres, development in areas of flood risk may be considered necessary. For development in such areas to be allowed, the Justification Test must be passed.

The Justification Test has been designed to rigorously assesses the appropriateness, or otherwise, of such developments. The test is comprised of two processes; the Plan-making Justification Test, and the Development Management Justification Test. The latter is used at the planning application stage where it is intended to develop land that is at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be considered inappropriate for that land.

Table 3-3 shows which types of development, based on vulnerability to flood risk, are appropriate land uses for each of the Flood Zones. The aim of the SFRA is to guide development zonings to those which are 'appropriate' and thereby avoid the need to apply the Justification Test.

Table 3-3 Matrix of Vulnerability versus Flood Zone

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (Including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Source: Table 3.2 of The Planning System and Flood Risk Management

The application of the Justification Test in the context of specific development sites in Kells is discussed in Section 8.

3.7 Scales and Stages of Flood Risk Assessment

Within the hierarchy of regional, strategic and site-specific flood-risk assessments, a tiered approach ensures that the level of information is appropriate to the scale and nature of the flood-risk issues and the location and type of development proposed, avoiding expensive flood

modelling and development of mitigation measures where it is not necessary. The stages and scales of flood risk assessment are shown in Table 3-4 and comprise:

- **Regional Flood Risk Appraisal (RFRA)** – a broad overview of flood risk issues across a region to influence spatial allocations for growth in housing and employment as well as to identify where flood risk management measures may be required at a regional level to support the proposed growth. This should be based on readily derivable information and undertaken to inform the Regional Planning Guidelines.
- **Strategic Flood Risk Assessment (SFRA)** – an assessment of all types of flood risk informing land use planning decisions. This will enable the Planning Authority to allocate appropriate sites for development, whilst identifying opportunities for reducing flood risk. This SFRA will revisit and develop the flood risk identification undertaken in the RFRA, and give consideration to a range of potential sources of flooding. An initial flood risk assessment, based on the identification of Flood Zones, will also be carried out for those areas, which will be zoned for development. Where the initial flood risk assessment highlights the potential for a significant level of flood risk, or there is conflict with the proposed vulnerability of development, then a site specific FRA will be recommended, which will necessitate a detailed flood risk assessment.
- **Site Specific Flood Risk Assessment (FRA)** – site or project specific flood risk assessment to consider all types of flood risk associated with the site and propose appropriate site management and mitigation measures to reduce flood risk to and from the site to an acceptable level. If the previous tiers of study have been undertaken to appropriate levels of detail, it is highly likely that the site specific FRA will require detailed channel and site survey, and hydraulic modelling.

Table 3-4 Flood risk stages required per scale of study undertaken

Scale of Assessment	Flood Risk Identification	Initial Flood Risk Assessment	Detailed Flood Risk Assessment
Regional Flood Risk Appraisal	✓	U	U
Strategic Flood Risk Assessment - County	✓	P	U
Strategic Flood Risk Assessment - City / town	✓	✓	P
Site Specific Flood Risk Assessment	✓	✓	✓
Key: P = Probably needed to meet the requirements of the Justification Test U = Unlikely to be needed ✓ = Required to be undertaken			
Source: The Planning System and Flood Risk Management (Table A3)			

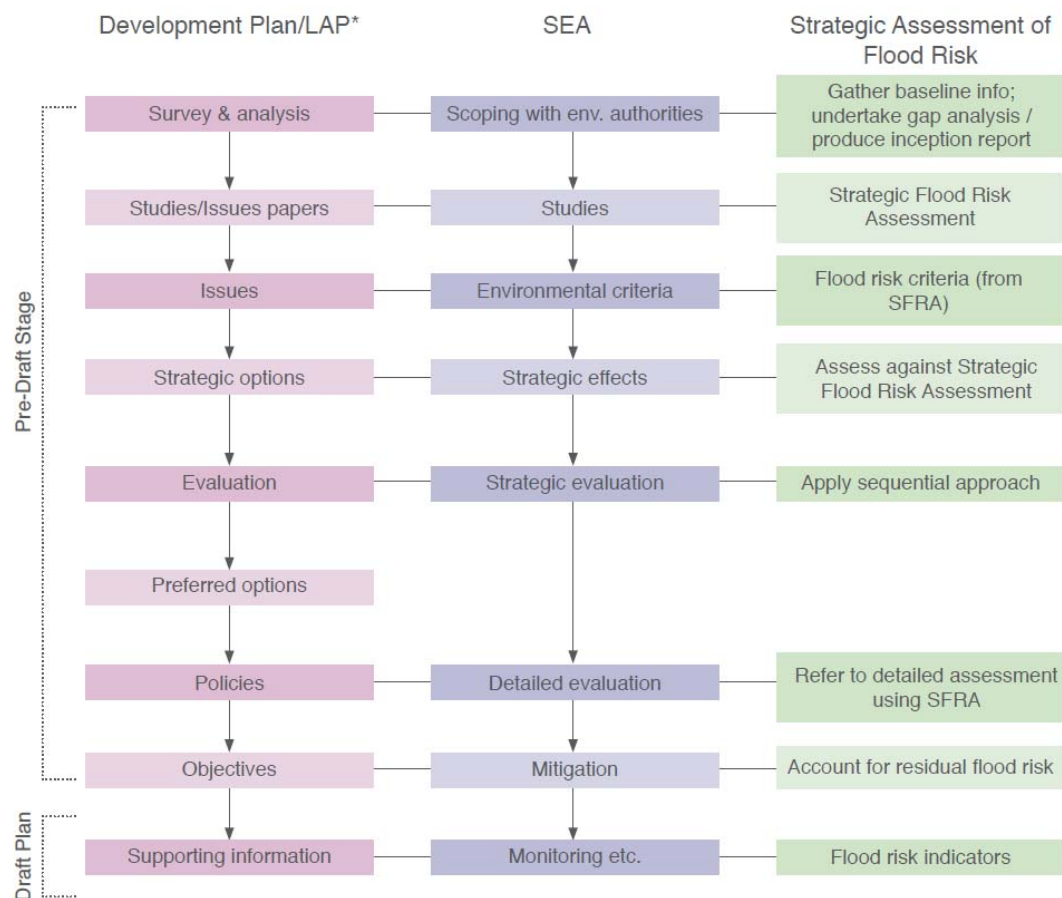
3.8 SFRA and SEA

As detailed in the Planning System and Flood Risk Management guidelines, the steps in the development plan process and its Strategic Environmental Assessment (SEA) need to be supported by appropriate analysis of flood risk. The SEA process addresses any likely significant effects on the environment and their amelioration, from the implementation of development plans through all stages of the plan-making process.

The SEA report will consider the environmental effects of the Development Plan, including flood management policies and recommendations. These will be assessed against environmental criteria for the plan area and the SEA will detail mitigation measures and future monitoring requirements.

A summary of the likely effects of the plan on the environment, through exposing new development and their occupants to potential flood risks and any adverse impacts as a result, will be addressed in the SEA process and summarised in the environmental report element of the overall development plan. The integration of the SFRA with the SEA and wider Development Plan process is shown in Figure 3-3 below.

Figure 3-3 Development Plan Preparation where flood risk is scoped as an issue



*Where an Environmental Report is required

Source: Fig 4.2 of the Planning Guidelines and Flood Risk Management

4 Flood Risk in Kells

4.1 Overview

There are a number of valuable sources of flood data available for the Kells area. The following table lists the core datasets used to compile the flood map for the Kells Development Plan area and gives an assessment of the data quality and the confidence in its accuracy.

Under the current Meath County Development Plan SFRA a number of additional sources of flood risk were initially screened for applicability, these included the Regional Flood Risk Appraisal, JFlow flood mapping, alluvial soils maps, benefitting land maps and several others. The table below represents the final source of flood data used to compile the Flood Zone mapping.

Table 4-1 Flood Data Used to Compile Flood Zone Mapping

Description	Coverage	Quality	Confidence	Used
Combined ISIS and JFLOW® flood extents using the Kells Stormwater Drainage Study (2006) hydraulic model and new OSi LiDAR	Newrath Stream as it flows from the Frontlands area upstream of Bective Street, to the confluence with the Blackwater River.	Good	Good	Yes - for the Newrath Stream Flood Zones
Kells Stormwater Drainage Study (2006) and Kells TCD Newrath Stream Assessment (2007)	Newrath Stream as it flows from the Frontlands area upstream of Bective Street, to the confluence with the Blackwater River.	Good	Moderate	As verification and to inform the JFLOW® model run - original studies do not provide sufficient detail
OPW PFRA flood extent maps	Full Study Area	Moderate	Moderate	Yes; for the River Blackwater
Historic Flood Records and Consultation with Area Engineer	Whole county and Kells (Area Engineer specific input)	Various	Various	Yes indirectly to validate Flood Zones & identify other flood sources
Walkover Survey	Kells Town	Moderate	Low	Yes, to validate outlines and flow paths at key locations

When compiling the Flood Zone mapping, the outlines (from the different sources listed above) have been reviewed against each other and any additional available data and have been refined where appropriate. In particular the datasets that have been used for this purpose are combined ISIS and JFLOW® flood outlines, the draft OPW PFRA flood outlines, records of historic flood events including extents, design flood levels, local surveyed ground levels, walkover survey and consultation with local area engineers. The resultant Flood Zones for Kells are presented in Appendix A.

4.2 Kells Stormwater Drainage Study (2006)³ & Kells-TCD Newrath Stream Assessment (2007)⁴

Designed to reduce un-necessary urban/sub-urban expansion around Kells and consolidate central development, KS 5 of the 2001-2007 Kells Development Plan paved the way for a significant flood study in Kells:

KS 5: To prepare a comprehensive environmental study, incorporating a flood detail/relief study of the area of potential development, within the vicinity of the Kells Town Centre. This study will be required to be undertaken prior to any development taking place.

The specific objective resulted in the completion of the 2006 Kells Stormwater Drainage Study and the subsequent 2007 update to include specific channel diversion assessment for the lands to the east of Bective Street (but assuming all recommendations from the 2006 study are implemented).

The studies resulted in a clear definition of existing flood risk for the Newrath Stream, highlighting areas of significant flooding both up and downstream of Bective Street for the 1 in 200 year return period only. The study then provides a mitigation solution that upgrades culverts, channel sections and employs land raising in order to allow development in both land parcels. The studies include a Kells sustainable drainage masterplan which provides a management strategy for coping with surface water runoff from all potential development lands within Kells.

It is noted that none of the improvement work noted under the studies has been completed and the present situation reflects the existing condition study results.

The model results presented in the study only provide flood mapping for the 1 in 200 year flood event. Due to the requirement of the Planning Guidelines to assess flood risk in relation to Flood Zones A and B (1 in 100 and 1 in 1000 year flood extents) the Kells Stormwater Drainage Study outputs will be used to produce Flood Zone A and B extents.

4.3 JBA Indicative Fluvial Flood Mapping & Methodology

As noted in the previous section, the assessment of flood risk on the Newrath Stream has been undertaken in some detail by the Kells Stormwater Drainage Study. The former model was made available for use in the SFRA by Meath County Council and was subject to a thorough review by JBA to assess potential use in the production of Flood Zone mapping in line with current best practise.

The model review noted the following issues regarding update for use in 2013:

- The model did not represent a fully hydrodynamic model solution and contained some instabilities. As such the model required updates to include for full hydrographs and a hydrodynamic model solution in order to appropriately consider the attenuation and conveyance of flow volumes through the system.
- Many of the model cross sections did not extend across the full width of the floodplain and OSi LiDAR data was used to extend the cross sections to the appropriate width.
- Manning's N values were reviewed and subsequently increased.
- The representation of the Bective Street culvert was that prior to the current HSE building (former car showroom) and significant extension to the Bective Street culvert has since been constructed. As built details of the culvert extension were provided and the culvert is now fully represented.
- The model did not accurately represent the surcharging and potential bypassing of flow at the 650mm culvert close to the swimming pool. As a result an ISIS spill unit was added and the volume of surcharging flow was used to run a 2D model (JFLOW) representation of the resulting overland flow paths.
- The lengthy 650mm culvert did not include for a key stormwater inflow midway along its length. A hydrological input location was added to represent this.

³ Kells Stormwater Drainage Study (2006), Carl Bro.

⁴ Kells-TCD Newrath Stream Assessment (2007), Grontmij.
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With the above alterations in place the revised ISIS and JFLOW® models have been used to derive flood extents for the Newrath Stream.

ISIS is a one dimensional (1D) open channel and culverted flow simulation hydraulic model that allows the accurate representation of complex structures such as found along the Newrath Stream. The model is unable to represent complex out of bank flow paths such as found at the surcharging 650mm culvert. For this reason JFLOW®, has been used in combination with ISIS to provide an accurate estimation of the Flood Zone extents for the Newrath Stream.

JFLOW® is a two dimensional (2D) hydraulic modelling software package, developed by JBA Consulting. 2D models are well suited to modelling complex flow paths across floodplains. Surcharging culvert flows, output by ISIS, were routed over a digital terrain model (high quality OSi LiDAR) by the model and used to create flood outlines for the various model scenarios. The outlines were combined with the ISIS outlines and OPW PFRA mapping of the Blackwater River in the production of the final outlines.

The quality of data used for the model run is good. The impact of culvert capacity is the main trigger for flooding on the Newrath Stream and the model updates described above fully take the impacts of the respective culverts into account in a robust and comprehensive manner. The result is that the combined ISIS and JFLOW® models represent flood extents with greater detail and accuracy than any of the former studies and provide the best available information currently available for Kells.

4.4 National PFRA Study Fluvial Flood Outlines

The Preliminary Flood Risk Assessment (PFRA) is a national screening exercise that was undertaken to identify areas at potential flood risk. The PFRA is a requirement of the EU Floods Directive and the publication of this work will lead to, and inform, more detailed assessment that is being undertaken as part of the Catchment Flood Risk Assessment and Management (CFRAM) studies. The PFRA study considered flooding from a number of sources; fluvial, tidal, pluvial and groundwater and prepared a suite of broadscale flood maps.

For the preparation of the PFRA fluvial flood maps, flood flow estimates were calculated at nodes every 500m along the entire river network. (The river network is the EPA 'blue-line' network, which, for the most part, matches the rivers mapped at the 1:50,000 scale Discovery Series OS mapping). This flow estimation was based on the OPW Flood Studies Update research programme. An assumption was made that the in-channel flow equates to the mean annual flood and so the out of bank flow for a particular AEP event was determined by deducting the mean annual flood from the flood flow estimate for that probability event.

Using the OPW's 5m national digital terrain model (DTM) a cross section was determined at 100m spacing's. The Manning's equation, a hydraulic equation for normal flow was used to calculate a flood level which was then extrapolated across the DTM to determine the flood extent. This exercise was completed for all river catchments greater than 1km².

This methodology does not take into account defences, channel structures or channel works. Potential sources of error in the mapping include local errors in the DTM or changes to the watercourse flow route due to an error in mapping or new development. In Kells, the PFRA mapping only covers the River Blackwater, but was considered the most appropriate of the flood mapping sources for this watercourse.

4.5 Historic Flood Review and Consultation with Area Engineer

Records of past flooding are useful for looking at the sources, seasonality, frequency and intensity of flooding. Historical records are mostly anecdotal and incomplete, but are useful for providing background information.

4.5.1 OPW Floodmaps.ie

The OPW hosts a National Flood Hazard Mapping website⁵ that makes available information on areas potentially at risk from flooding. This website provides information on historical flood events across the country and formed the basis of the Regional Flood Risk Appraisal.

⁵ www.floodmaps.ie
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Information is provided in the form of reports and newspaper articles which generally relate to rare and extreme events. Since the establishment of the hazard mapping website, more records are available which identify more frequent and often recurring events. These tend to include memos and meeting records from local authority area engineers, often relating to road flooding.

4.5.2 Consultation

A consultation with the Kells Area Engineer was conducted and this helped to clarify and improve on the general appreciation of flood risk in Kells. The Newrath Stream was confirmed as the largest source of risk and the associated Drainage Study provides a useful capture of existing risk.

It was confirmed that;

- The 650mm pipe at the rear of the swimming pool and HSE Offices is the largest single contributing factor to flood risk;
- The culvert and general pipe work (varies over the culvert length) is undersized and also prone to blockage both at the trash screen and along its length;
- During periods of heavy rainfall the trash screen is cleared at regular intervals;
- Although the inlet is 1000mm the culvert diameter drops to 650mm at a point downstream of Murphy's Service Station, at this point there is also a 450mm storm-water inflow from the town;
- There have been a number of previous incidents of blockages and resulting scouring/damage to the culvert in the vicinity of Murphy's Service Station, and the Service Station itself flooded previously due to a localised blockage at that location;
- Previous blockage and flooding instances have resulted in the culvert joints degrading and leakage of flow, leading to the degradation of the road and also mini-springs appearing along the line of the culvert;
- There used to be a historic flooding problem at the R164 Bective Street culvert, but this is now mitigated by the installation of the current 1200mm pipe;
- There is a section of a field drain that is culverted under the Kells Business Park, however there were no reported incidents of flooding of fields or the business park itself.

4.5.3 Results

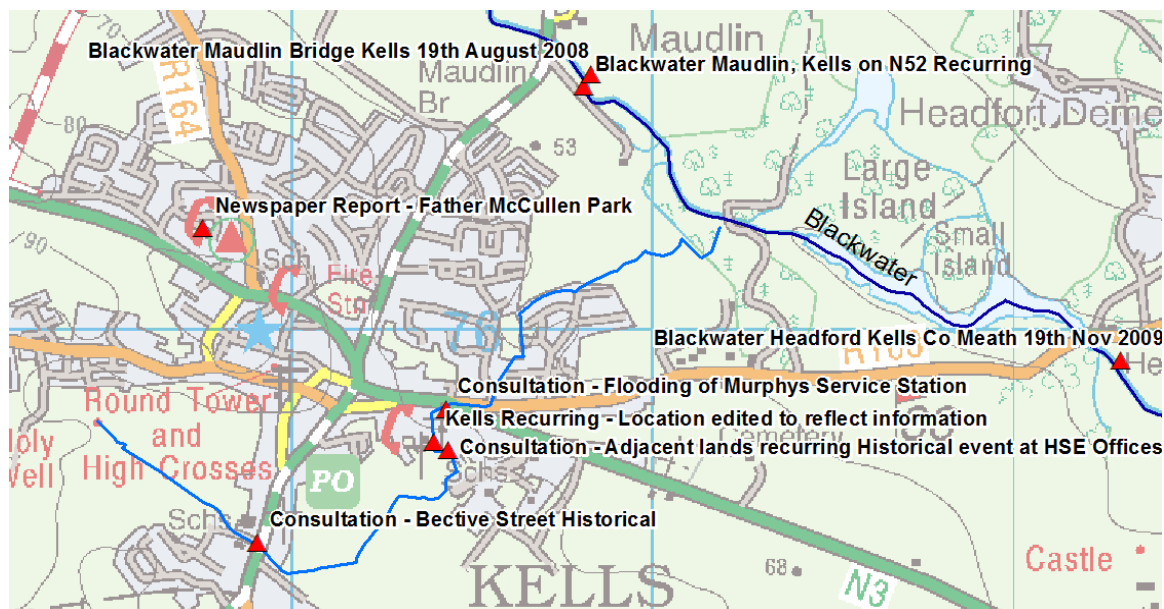
The pertinent flood risk history from both the consultation and OPW floodmaps.ie sources are summarised in the table below and also in Figure 4-1 .

Table 4-2 Historic Flooding Information

Date of Flood	Description
Recurring	Low lying land adjacent to the Newrath Stream floods every year after heavy rain. Source - Floodmaps.ie.
Recurring	Flooding of the lands adjacent to the 650mm culvert inlet at the lands to the rear of the swimming pool. HSE Offices historically flooded. Source - Consultation.
Unknown	Flooding of Murphy's Service Station - cause likely to be the under-capacity pipe work and presence of 450mm diameter storm-water drainage inflow at this point. Source - Consultation.
Recurring	Formation of mini springs leading to ground and road degradation in the region of the buried pipe work. Source - Consultation.
Unknown	Bective Street (R164) culvert crossing previously lead to flooding, this

	has now been mitigated by a 1200mm culvert. Source - Consultation.
Recurring	Father McCullen Park - surface water ponding during high intensity rainfall events, no houses reported as flooded, only access routes ⁶ .

Figure 4-1 Historic Flood Mapping; Spatial Representation



4.6 Walkover Survey

A walkover survey of the Newrath Stream and River Blackwater sites was conducted to help assess flood risk and provide a local understanding of the site. Information collated on the site visits was used to inform the Flood Zone mapping process.

Photographs taken on site are presented below in Figure 4-2.

Figure 4-2 Site Walkover Photographs



Photo 1: View of Newrath Stream, upstream of Bective Street



Photo 2: 1200mm diameter culvert inlet, Bective Street

⁶ The Meath Chronicle, 9th September 2009: <http://www.meathchronicle.ie/news/kells/articles/2009/09/09/391028-flooding-traps-family-in-fr-mccullen-park-kells/>
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Photo 3: View across the lands downstream of Bective Street, along the path of the Newrath Stream



Photo 4: Newrath Stream, upstream of 650mm culvert inlet, adjacent to swimming pool



Photo 5: Culvert manhole cover, adjacent to HSE Offices and Church



Photo 6: Newrath Stream channel downstream of culvert outlet, Grand Priory Estate



Photo 7: Newrath Stream channel at the downstream end of Grand Priory Estate



Photo 8: River Blackwater, downstream view from Maudlin Bridge (towards the confluence with Newrath Stream)



Photo 9: River Blackwater, upstream view from Maudlin Bridge

4.7 Summary

Building on the initial review of flood risk presented in the current County Development Plan SFRA the Kells Development Plan SFRA has focussed upon the five sources of flood extent data described in Table 4-1 to provide a best available estimate of the Flood Zones for the Newrath Stream and the River Blackwater and these are displayed in Appendix A.

The Flood Zones are compiled from PFRA mapping of the River Blackwater and ISIS + JFLOW mapping of the Newrath Stream, as informed by the Kells Stormwater Drainage Study (2006) and the Kells-TCD Newrath Stream Assessment (2007).

5 Sources of Flooding

In conjunction with the current Meath County Development Plan SFRA this study has reviewed flood risk from fluvial, pluvial and groundwater sources, conducted some additional fluvial hydraulic modelling of the Newrath Stream and presented fluvial Flood Zones in Appendix A. It also considers flooding from drainage systems, and other artificial or man-made systems.

The focus of the study is on risk from fluvial flooding from the Newrath Stream and the River Blackwater. There are two main reasons for this decision. Firstly, the review of historical floods shows rivers to be the most common and most damaging. Secondly, Flood Zones in the 'Planning System and Flood Risk Management' are defined on the basis of fluvial, and where appropriate, tidal flood risk. In addition, the SFRA should be based on readily derivable information, and records and indicators for fluvial flood risk are generally more abundant than for other sources of flooding.

The main sources of flood risk relevant to Kells are described below.

5.1 Fluvial Flooding

Flooding of watercourses is associated with the exceedance of channel capacity during higher flows. The process of flooding on watercourses depends on a number of characteristics associated with the catchment including; geographical location and variation in rainfall, steepness of the channel and surrounding floodplain and infiltration and rate of runoff associated with urban and rural catchments.

In large, relatively flat catchments such as the River Blackwater, flood levels will rise relatively slowly and natural floodplains may remain flooded for several days, acting as the natural regulator of the flow. In smaller catchments, such as the Newrath Stream, local intense rainfall can result in the rapid onset of deep and relatively fast-flowing flooding with little warning - as we have seen upstream of the swimming pool. Such "flash" flooding, which may only last a few hours, can cause considerable damage and possible threat to life.

The form of the floodplain, either natural or urbanised, can influence flooding along watercourses. The location of buildings and roads can significantly influence flood depths and velocities by altering flow directions and reducing the volume of storage within the floodplain. Critical structures such as bridge and culverts can also significantly reduce capacity creating pinch points within the floodplain and this is clearly an issue for the 650mm culvert inlet to the rear of the swimming pool (adjacent to R147/Headfort Place). This structure (and culverts in general) are also vulnerable to blockage by natural debris within the channel or by fly tipping and waste.

In Kells, both the Newrath Stream and the River Blackwater have caused flooding in the past, however there has been a relatively small impact to existing development because the lands at highest probability of flooding (adjacent to open sections of the Newrath Stream) have largely been kept free of development, although they have been historically zoned for potential development. In the past it has been the HSE offices and Murphy's Service station that have been most severely affected.

However, the Flood Zone mapping presented in Appendix A provides an indication of what might happen during extreme flood events of a magnitude that have not been witnessed in recent years, but could feasibly occur. The results clearly indicate that there is a significant risk of flooding upstream and downstream of the 650mm culvert adjacent to the Swimming Pool and HSE offices. The flooding is largely due to the limited capacity of the culvert and results in overland flow routes that divert excess flow from the culvert in two distinct directions.

1. The northern flow route passes through the HSE Offices, St Colmcille's Church and Murphy's Service Station, across and down the R147 Headfort Place before passing into the Headfort and Grand Priory Estates, following the pattern of the streets and also before flowing back into and around the existing channel before flowing into the River Blackwater.
2. The southern flow route passes through the Swimming Pool lands and Kells Community College and down the approach road to the junction with the R147 before continuing

adjacent to the Grand Priory housing estate and towards the River Blackwater and the waste water treatment plant.

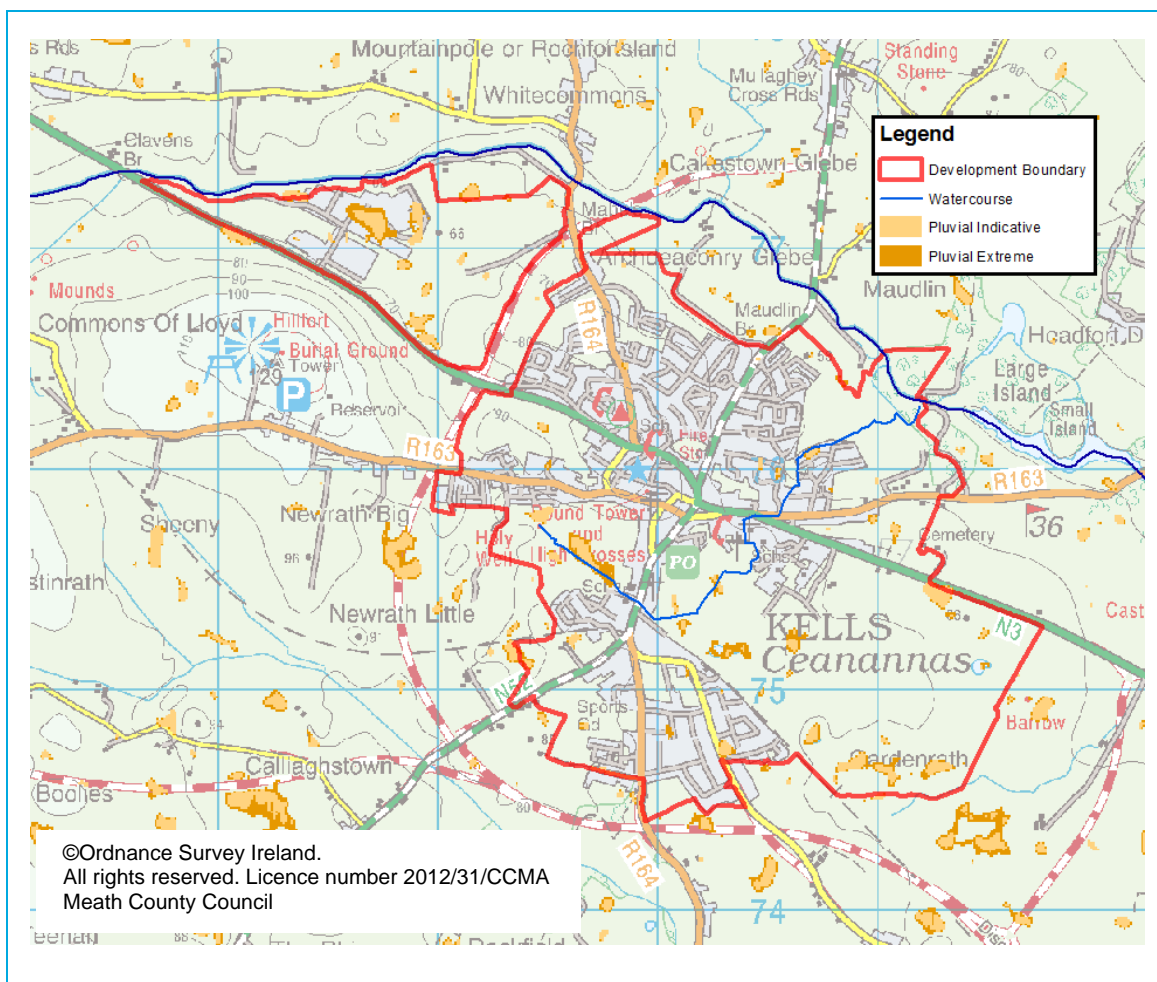
Flood risk to specific potential development sites is discussed in Section 7, and has been used to inform the zoning objectives for the Kells Development Plan. Where particular development is proposed within Flood Zones A or B, the Justification Test must be applied, and passed.

5.2 Pluvial Flooding

Flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. Areas at risk from fluvial flooding will almost certainly be at risk from surface water flooding, in Kells this will be more prevalent for the Newrath Stream rather than the River Blackwater.

The OPW PFRA study considered pluvial flood risk and produced a national set of pluvial flood maps. The indicative pluvial map from the PFRA study is presented in Figure 5-1 below it has been used to identify development areas at particular risk of surface water and pluvial flooding

Figure 5-1 PFRA Indicative Pluvial Flood Map⁷



SFRAs require a strategic assessment of the likelihood of surface water flooding for which overland routing is suitable and appropriate. This includes consideration of the following:

- Are there zoned lands which may need to accommodate and retain surface water flow routes?
- Are there zoned lands which might discharge upstream of an area vulnerable to surface water flooding?

⁷ Source: OPW, PFRA Study Draft Data, licensed to South Tipperary County Council
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The review of historical flood extents, and the PFRA pluvial mapping, indicates that the centre of Kells is not particularly vulnerable to surface water flooding, with the exception of Father McCullen Park (however this might be more related to a drainage issue).

The events recorded in the town centre have been attributed to fluvial flooding and pipe failure from the Newrath Stream. However it should be noted that during a large flood event it is often difficult to identify the individual sources of flooding, so the extent to which water from the rivers and pluvial sources combine is unknown.

On this basis, whilst the potential for surface water flow paths or ponding should not necessarily impede or restrict development, applications in such areas need to consider drainage thoroughly to ensure risks do not increase in the future.

Of particular note is Kells Business Park which is identified as being at risk from pluvial flooding. The pluvial modelling does not take into account the design of surface water management systems during the relatively recent construction of this site and during our consultation it was confirmed that the business park has adequate surface water management measures. Recommendations for the management of surface water are provided in Section 7.3.

5.3 Flooding from Drainage Systems

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity, it becomes blocked or it cannot discharge due to a high water level in the receiving watercourse.

Flooding in urban areas can also be attributed to sewers. Sewers have a finite capacity which, during certain load conditions, will be exceeded. In addition, design standards vary and changes within the catchment areas draining to the system, in particular planned growth and urban creep will reduce the level of service provided by the asset. Sewer flooding problems will often be associated with regularly occurring storm events during which sewers and associated infrastructure can become blocked or fail. This problem is exacerbated in areas with under-capacity systems.

Foul sewers and surface water drainage systems are spread extensively across the urban area of Kells with various interconnected systems discharging to the treatment works and potentially into the Newrath Stream or the River Blackwater. The network is not well understood and many of the linkages are currently unknown. It is noted that the Father McCullen Park estate has experienced recent and recurring road flooding as a result of this flood source. The most significant issue is with the 650mm culvert to the rear of the swimming pool which is under capacity (maximum conveyance of 1.1 m³/s) and has suffered from structural failure and scouring in the past, leading to leakage and the formation of mini springs in the area local to the service station (see Table 4-2).

Maintenance activities, i.e. cleaning gullies, repairing pipes are vital in order to manage this risk. Recommendations for the improvement of the system in Kells is provided by the Kells Stormwater Drainage Study and this has been used to inform the management of the risk as described in Section 7.

5.4 Groundwater Flooding

Groundwater flooding is caused by the emergence of water originating from underground, and is particularly common in karst landscapes. This source of flooding can persist over a number of weeks and poses a significant but localised issue that has attracted an increasing amount of public concern in recent years. In most cases groundwater flooding cannot be easily managed or lasting solutions engineered, however the impact on buildings can be mitigated against through various measures.

The draft PFRA groundwater flood maps⁸, which entailed an evidence-based approach and considered the hydro-geological environment, such as the presence of turloughs, did not show any significant risk in the Kells area. Based on the PFRA study the risk of groundwater flooding is not considered significant enough to warrant further investigation in this SFRA.

⁸ Reference: Preliminary Flood Risk Assessment Groundwater Flooding, June 2010
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6 Climate Change & Residual Risk

Residual risk is the risk that remains after measures to control flood risk have been carried out, or from extreme events that are greater than the level of flooding anticipated by the Flood Zone A and B mapping - therefore Climate Change. Residual risk can arise from overtopping of flood defences and / or from the breach from structural failure of the defences. In Kells there are no formal flood defence structures but there are structures that are subject to blockage and have an associated residual risk of flooding.

6.1 Climate Change

Climate change should be considered when assessing flood risk and in particular residual flood risk. Areas of residual risk are highly sensitive to climate change impacts as an increase in flood levels will increase the likelihood of defence or culvert blockage and/or failure.

The 'Planning System and Flood Risk Management' recommends that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects. A significant amount of research into climate change has been undertaken on both a national and international front. This section will briefly examine some of the key findings of the research to date.

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 and its first report in 1990 justified concern about the effects of climate change on a scientific basis. The more recent IPCC Fourth Assessment Report 2007⁹ concludes that climate change is unequivocal. It projects a global average sea level rise of between 0.18m and 0.59m for different SRES emissions scenarios, up to the end of the century. (SRES refers to the IPCC Special Report on Emissions Scenarios, published in 2000. The scenarios explore different demographic, economic and technological forces and resultant greenhouse gas emissions.)

Table 6-1 Allowances for Future Scenarios (100 Year Time Horizon)

Criteria	MRFS	HEFS
Extreme Rainfall Depths	+20%	+30%
Flood Flows	+20%	+30%
Mean Sea Level Rise	+500mm	+1000mm
Land Movement	-0.5mm / year*	-0.5mm / year*
Urbanisation	No General Allowance - Review on Case by Case Basis	No General Allowance - Review on Case by Case Basis
Forestation	-1/6 Tp**	-1/3 Tp** +10% SPR***

Notes:

* Applicable to the southern part of the country only (Dublin - Galway and south of this)

** Reduce the time to peak (Tp) by a third; this allows for potential accelerated runoff that may arise as a result of drainage of afforested land

*** Add 10% to the Standard Percentage Runoff (SPR) rate; this allows for increased runoff rates that may arise following felling of forestry

More specific advice on the expected impacts of climate change and the allowances to be provided for future flood risk management in Ireland is given in the OPW draft guidance¹⁰. Two climate change scenarios are considered. These are the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). The MRFS is intended to represent a "likely" future scenario based on the wide range of future predictions available. The HEFS represents a more "extreme" future scenario at the upper boundaries of future projections. Based on these two scenarios the OPW recommended allowances for climate change are given in Table 6-1.

Climate Change flood extent has been supplied using the MRFS and this is included within Appendix B using the 1% AEP flow as the baseline for increase. Results indicate that there is not a significant sensitivity to flow increases due to Climate Change.

⁹ Inter-Governmental Panel on Climate Change (IPCC), 4th assessment report. "Climate Change 2007".

¹⁰ OPW Assessment of Potential Future Scenarios, Flood Risk Management Draft Guidance, 2009

6.2 Residual Risk due to Culvert Blockage or Structural Failure

Blockage or structural failure of culverts and bridges is hard to predict and is largely related to the structural condition and type of the structure. Blockage risk is higher for culverts compared to clear span or arched bridges. Within Kells the flood history and consultation with the Town Engineer has suggested that the Newrath Stream structures and in particular the 650mm culvert at the rear of the swimming pool is at risk of blockage and failure. Maintenance teams regularly clear the culvert trash screen of debris during periods of increased flow but blockage can still occur.

Blockage or failure will usually result in sudden flooding with little or no warning and presents a significant hazard. The volume and impact of flooding will depend on a number of factors including:

- Degree of blockage or failure
- The time that the blockage or failure develops; if this is early on during the flood event the impacts will be more hazardous compared to a blockage or failure at the end of a flood event while level/flow is receding.
- How long the blockage or failure occurs for, leaving those at risk vulnerable to secondary flood peaks on a watercourse.

Flood mitigation and management measures to deal with flood risk are discussed in Section 7.

Residual risk (blocked) flood extent has been supplied and this is included within Appendix C where both the Bective Street and 650mm culvert at the rear of the swimming pool have been subject to 66% blockage at the 1% AEP flow. Results indicate that there are significant residual risk impacts as a result of potential culvert blockage, particularly just upstream of each culvert inlet, respectively.

7 Flood Risk Management

The approach to flood risk management and the planning system within County Meath is defined under the SFRA contained in Volume 6 Appendix A of the County Development Plan 2013-2019. Section 9 of the Development Plan SFRA highlights the general approach to flood risk management and makes recommendations for policy and objectives within the County Development Plan. The formal policies and objectives are contained within the County Development Plan; Written Statement, Volume 1, Chapter 7.

This SFRA is intended to build on the overview of flood risk contained within the County Development Plan and consider flood risk within the Kells Development Plan area in an appropriate level of detail. More specifically this must seek to inform zoning objectives (through the application of the Justification Test) and develop policies and objectives that are tailored to Kells, taking into account all relevant information.

7.1 Overview

Following the Planning Guidelines, development should always be located in areas of lowest flood risk first, and only when it has been established that there are no suitable alternative options should development (of the lowest vulnerability) proceed. Consideration of suitable flood risk mitigation and site management measures, as well as residual risk and climate change is necessary in all areas. It may be technically feasible to mitigate or manage flood risk at site level, however the potential impacts on the surrounding community must also be considered.

The recommendations in this section are based on current readily available information, but in certain situations may require some additional and more detailed assessment to be carried out. Whilst the Newrath Stream has been investigated using outputs from the revised Kells Stormwater Drainage Study ISIS model and JFLOW® model, it would require further review and investigation prior to being deemed suitable for the design and investigation of detailed mitigation measures.

This section will discuss how flood risk can be managed from a spatial planning perspective and will also outline measures that may be adopted at a site specific level.

7.2 Management of Flood Risk from a Planning Perspective

The Planning Guidelines recommend a sequential approach. This works well where there are no constraints to development and there is an ample source of developable land.

The pattern of development in Kells has historically avoided lands at high probability of flooding despite the lands being zoned for development under historic Development Plans. This is evident from the 'hourglass' development pattern that has generally avoided zoned land adjacent to the Newrath Stream and also lands adjacent to the Blackwater River.

Where proposed land use zoning objectives for Kells Development Plan are screened to be inappropriate as a result of the risk of flooding, the Justification Test has been applied and a full review of this, along with a discussion on the vulnerability of land use to flooding is completed in Section 8.

7.2.1 Flood Risk Policies and Objectives

The policies and objectives in the Development Plan will include consideration of the following:

- The Planning System and Flood Risk Management, Guidelines for Planning Authorities;
- The policies and objectives as set out in the County Development Plan 2013 to 2019;
- The strategy and recommendations of the Kells Stormwater Drainage Study (2006);
- The content of this SFRA; the Flood Zones and their use as a planning tool;
- The triggers for review of the SFRA as set out in Chapter 8.2;
- The recommendations of the Eastern CFRAM upon completion, if relevant to Kells. Although Kells was not identified as an Area for Further Assessment (AFA) the CFRAM study could result in recommended mitigation and management measures that impact the wider area. The expected publication date by end 2015.

The third policy recommendation above relates to the Kells Stormwater Drainage Study (2006). This was completed prior to the publication of The Planning System and Flood Risk Management: Guidelines for Planning Authorities, in November 2009 and although the study has contributed a robust management strategy for the Newrath Stream the preferred engineering mitigation options should be re-appraised in accordance with The Guidelines, prior to proceeding to detailed design stage or the formal planning application.

7.2.2 Specific Development Planning Applications

The following outlines the key requirements relating to the management of development and flood risk;

- All development proposals, regardless of location, will require an appropriately detailed flood risk assessment. As a minimum this will include a "Stage 1 - Identification of Flood Risk"; where flood risk is identified a "Stage 2 - Initial FRA" will be required and depending on the scale and nature of the risk a "Stage 3 - Detailed FRA" may be required. The requirement for all applications to have an accompanying stage 1 assessment is important, as for example a large site located in flood zone C may be appropriate in terms of vulnerability, but might be at potential risk of surface water flooding or residual risk of culvert failure, it is noted that this SFRA effectively assesses risk in accordance with Stage 1 and 2 and the information (on existing conditions) can be used within any site specific FRAs..
- Under the FRA the impacts of climate change (Appendix B map) as well as the specific residual risk relating to culvert blockage (Appendix C map) should be considered and re-modelled where necessary, using an appropriate level of detail, in the design of Finished Floor Level (FFL).
- All development proposals will require the FRA to consider surface water management.
- All development proposals, within or incorporating areas at moderate to high flood risk, that are vulnerable to flooding will require the application of the development management justification test in accordance with Box 5.1 of the Planning Guidelines, The Planning System and Flood Risk Management.
- The planning authority will explore opportunities to include flood alleviation proposals and upgrades that benefit the wider Kells area, as part of specific development applications.

Any proposal that is considered acceptable in principle shall demonstrate the use of the sequential approach in terms of the site layout and design and, in satisfying the Justification Test, the proposal will demonstrate that appropriate mitigation and management measures are put in place.

7.3 Policy on the Management of Surface Water

Development has the potential to cause an increase in impermeable area and an associated increase in surface water runoff rates and volumes. This can lead to potential increase in flood risk downstream due to overloading of existing drainage infrastructure, this is a key issue in Kells and the Kells Stormwater Drainage Study includes a specific management strategy that should be applied to all potential development sites and is summarised below:

- All developments in the Newrath Stream catchment must comply with the recommendations of the Greater Dublin Strategic Drainage Study¹¹ (GDSDS);
- Surface water drainage infrastructure should be provided by the developer/s as the initial phase of development in this area, to facilitate orderly development and to ensure that the 'developed state' is properly served;
- There should be pre-planning consultation regarding surface water drainage requirements for all development in the Newrath Stream catchment area so that applications for development are fully aware of the requirements;

¹¹ Greater Dublin Strategic Drainage Study (2005) <http://www.greaterdublindrainage.com/>
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- Developers shall submit maintenance and management plans for their surface water drainage proposals as part of relevant planning applications.

Managing surface water discharge from new development is crucial in managing and reducing flood risk to other development downstream, in line with appropriate land use zoning objectives, adherence to the above points will ensure the effective management of risk.

7.3.1 Overland Flow Routes

Underground drainage systems have a finite capacity and regard should be given to events larger than the design capacity of the network. This should be considered along with potential surface water flows that may enter a development site from the surrounding area. Master planning should ensure that existing flow routes are maintained, through the use of green infrastructure. Where possible, and particularly in areas of new development, floor levels should at a minimum be 300mm above adjacent roads and hard standing areas to reduce the consequences of any localised flooding.

7.3.2 Sustainable Drainage Systems (SUDS)

A specific requirement of the EU Water Framework Directive is that surface water discharge is controlled and managed so that any impact on its receiving environment is mitigated. This can be achieved through the use of Sustainable Drainage Systems (SUDS). SUDS can reduce the rate of runoff through a combination of infiltration, storage and conveyance (slowing down the movement of water). Sustainable drainage can be achieved through the use of green infrastructure such green roofs and pervious pavements, rainwater harvesting, soakaways, swales and detention basins, ponds and wetlands.

The effectiveness of a flow management scheme within a single site is heavily limited by the land use and site characteristics including (but not limited to) topography, geology and available area. As such, surface water design and management must be carried out at a site specific level for any proposed development.

7.3.3 Run-off Rates and the GDSDS

As suggested in Section 7.3 above the GDSDS provides comprehensive guidance on the design of drainage systems, which are applicable across the country. It is recommended that drainage design for any site is carried out in accordance with the GDSDS, and in particular the following compliance requirements for development in greenfield lands are noted:

- Demonstrate compliance with limiting discharge requirements for flow rates and volumes;
- Demonstrate no flooding nuisance for the 30yr events;
- Demonstrate no property flooding for the 100yr (1% AEP events);
- Show 100 year (1% AEP) site routing and temporary storage for high intensity events;
- Show that temporary 100 year (1% AEP) flooding is retained on site.

7.4 Flood Mitigation Measures at Site Design

Any development proposal in an area at moderate or high risk of flooding that is considered acceptable in principle must demonstrate that appropriate mitigation measures can be put in place and that residual risks can be managed to acceptable levels.

To ensure that adequate measures are put in place to deal with residual risks, proposals should demonstrate the use of flood-resistant construction measures that are aimed at preventing water from entering a building and that mitigate the damage floodwater causes to buildings. Alternatively, designs for flood resilient construction may be adopted where it can be demonstrated that entry of floodwater into buildings is preferable to limit damage caused by floodwater and allow relatively quick recovery.

Further detail on flood resilience and flood resistance are included in the Technical Appendices of the Planning Guidelines, The Planning System and Flood Risk Management.¹²

¹² The Planning System & Flood Risk Management Guidelines for Planning Authorities, Technical Appendices, Nov 2009
2012s6119 SFRA JBA Reportv1.2.doc

7.5 'Green Corridor'

It is recommended that, where possible, and particularly where there is greenfield land adjacent to the Newrath Stream, Blackwater River or other minor watercourse, a 'green corridor', is retained. This will have a number of benefits, including:

- Retention of all, or some, of the natural floodplain;
- Potential opportunities for amenity, including riverside walks and public open spaces;
- Maintenance of the connectivity between the river and its floodplain, encouraging the development of a full range of habitats;
- Natural attenuation of flows will help ensure no increase in flood risk downstream;
- Retention of clearly demarcated areas where development is not appropriate on flood risk grounds, and in accordance with the Planning System and Flood Risk Management.

The width of this corridor should be determined by the available land, and topographically constraints, such as raised land and flood defences, but would ideally span the fully width of the floodplain.

8 Development Zoning and the Justification Test

The purpose of zoning is to indicate to property owners and members of the public the types of development, which the Planning Authority considers most appropriate in each land use category.

Zoning is designed to reduce conflicting uses within areas, to protect resources and, in association with phasing, to ensure that land suitable for development is used to the best advantage of the community as a whole.

The zoning objectives can be related to the vulnerability classifications in the 'Planning System and Flood Risk Management'; highly vulnerable, less vulnerable and water compatible. The vulnerability of the land use, coupled with the Flood Zone in which it lies, guides the need for application of the Justification Test.

Table 8-1 Land Zoning Objectives and Vulnerabilities

Objective/Use	Vulnerability*	Justification Test Required
A1 - Existing Residential	High	For development in Flood Zone A or B
A2 - New Residential	High	For development in Flood Zones A or B
B1 - Commercial/Town or Village Centre	High / Less	For highly vulnerable development in Flood Zone A or B For less vulnerable development in Flood Zone A
B2 - Retail Warehouse	Less	For development in Flood Zone A
C1 - Mixed Use	High / Less	For highly vulnerable development in Flood Zone A or B For less vulnerable development in Flood Zone A
D1 - Tourism	High / Less / Water Compatible	For highly vulnerable development in Flood Zone A or B For less vulnerable development in Flood Zone A Or appropriate - if water compatible
E2 - General Enterprise & Employment	High / Less	For highly vulnerable development in Flood Zone A or B For less vulnerable development in Flood Zone A
F1 - Open Space	Water Compatible	Development is generally appropriate
F1/D1 - Open Space & Tourism	Water Compatible	Open space areas used for Tourism purposes will generally include water compatible land uses and is therefore appropriate.
G1 - Community Infrastructure	High / Less	For highly vulnerable development in Flood Zone A or B For less vulnerable development in Flood Zone A
WL - White Lands	High / Less	For highly vulnerable development in Flood Zone A or B For less vulnerable development in Flood Zone A
* Land Use Vulnerability is expressed in relation to Table 3.1 (p25) of the Planning System and Flood Risk Management Guidelines for Planning Authorities. Some Zoning Objectives include a mix of different vulnerabilities of land use and are therefore presented as such in the table above.		

The land zoning objectives and their respective vulnerabilities are shown in Table 8-1. It is important to note that this table is provided as a general guide and the specific development types within the zoning objective must be considered individually, and with reference to Table 3-1 of the 'Planning System and Flood Risk Management'.

It is noted that whilst the Justification Test has been applied to land use zoning objectives in determining their applicability there is some degree of variance in the vulnerability of the land uses under certain of the objectives in Table 8-1 above. For example the B1, C1, D1, E2 and G1 zonings can include for high or less vulnerable development. This results in a varying requirement for the application of the Justification Test and potential suitability of the development.

Where such conditions exist the draft zoning map provides clarification of the suitability of land use vulnerability within individual land zonings.

8.1 Development Land Use Zoning Review in Kells

This review will look at each of the land use zonings in turn and discuss the associated flood risk issues in each area. The screenshots presented in the following sub-sections are based on draft Development Plan zoning objectives.

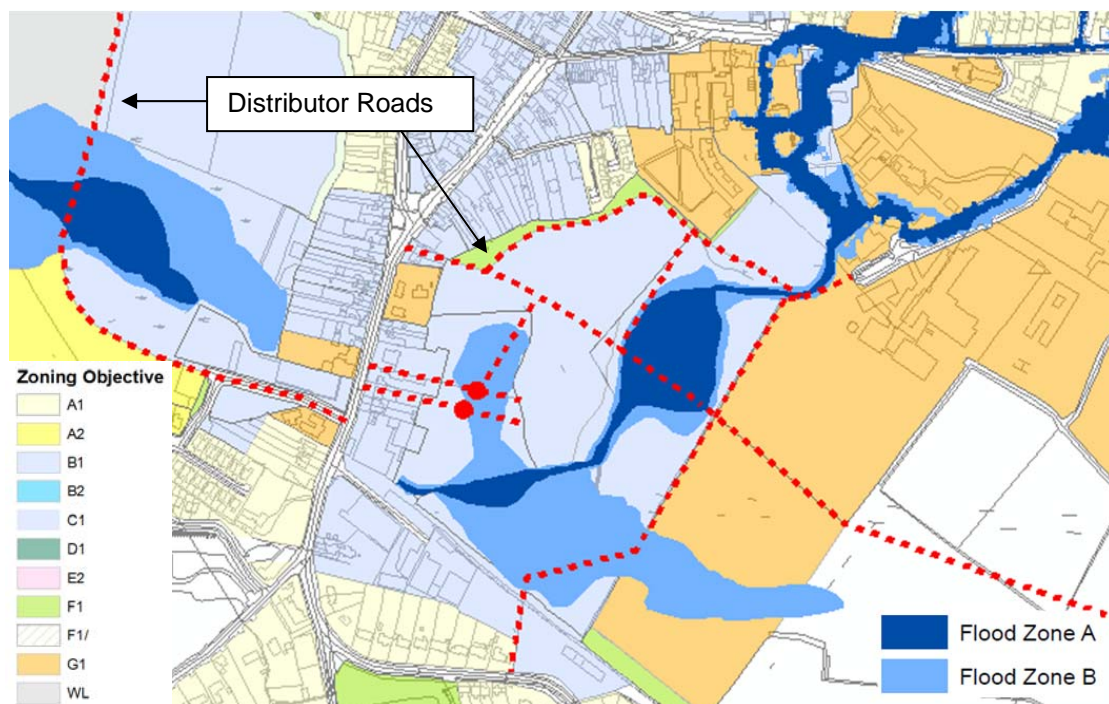
Whilst preparing the Draft Kells Development Plan zoning objectives a number of sites have been re-zoned to an Open Space zoning on the basis of the application of the Justification Test. Appendix D includes more detail on site specific applications of the Test.

Table 8-2 Land Use Zoning and Flood Risk in Kells

Land Use Zoning	Intersects Flood Zones?	Area of flood risk
A1 - Existing Residential	Yes	<i>Downstream of R147/R163 in the Grand Priory and Headfort Housing Estates as well as individual properties on R163.</i>
A2 - New Residential	No	
B1 - Commercial/Town or Village Centre	No	
B2 - Retail Warehouse	No	
C1 - Mixed Use	Yes	<i>Existing HSE building and some lands to the rear on R147/Headfort Place adjacent to the church.</i>
D1 - Tourism	No	
E2 - General Enterprise & Employment	No	
F1 - Open Space	Yes	<i>Concentrated along the immediate environs of the Newrath Stream - as such the land zoning is an appropriate use in flood risk areas.</i>
D1/F1 - Open Space & Tourism	No	
G1 - Community Infrastructure	Yes	<i>Concentrated in the Backlands and the area close to the R147/Headfort Place. Also on eastern edge of Kells, close to the River Blackwater.</i>
WL - White Lands	No	
Distributor Roads	Yes	<i>Concentrated within the Backlands and Frontlands</i>

8.1.1 Distributor Roads

Various Distributor Roads to access Frontlands & Backlands



A link road from Bective Street to the R147 crosses Flood Zone A and is considered as essential to the provision of sustainable urban expansion of the town centre. Link roads also cross Flood Zone A adjacent to the swimming pool. The Justification Text has been passed for these routes (see Appendix D.1).

A local distributor road is also proposed within the Frontlands and this is similarly passed under the Justification Test presented in D.2.

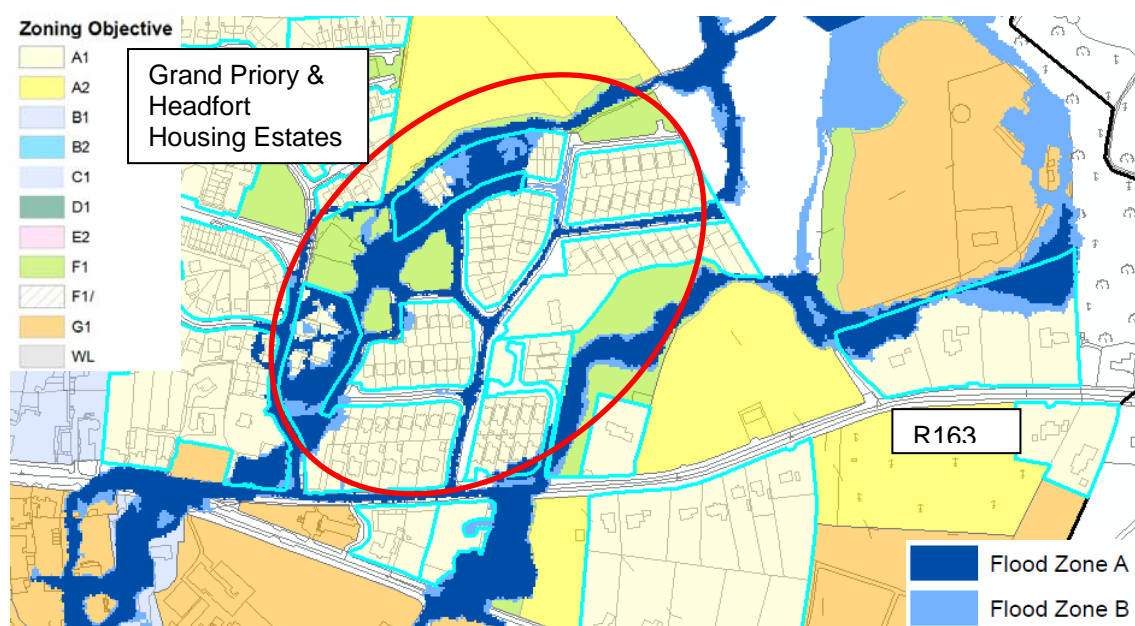
It remains for a site specific FRA to provide for the management and mitigation of any risks to and resulting from the infrastructure works.

Conclusions

Proposed distributor roads are appropriate at these locations, a site specific FRA is required to manage the risk and to demonstrate there will be no impact on adjacent lands.

8.1.2 Existing Residential (A1)

Grand Priory and Headfort Housing Estates (existing development)



This zoned land covers the exiting residential housing estates of Grand Priory and Headfort which includes some significant areas at high or moderate risk of flooding as a result of overland flow paths from the Newrath Stream. Some individual properties are impacted on the R163 (on the eastern edge of the map above) but it is noted that the dwellings themselves are within Flood Zone C and at low risk of flooding.

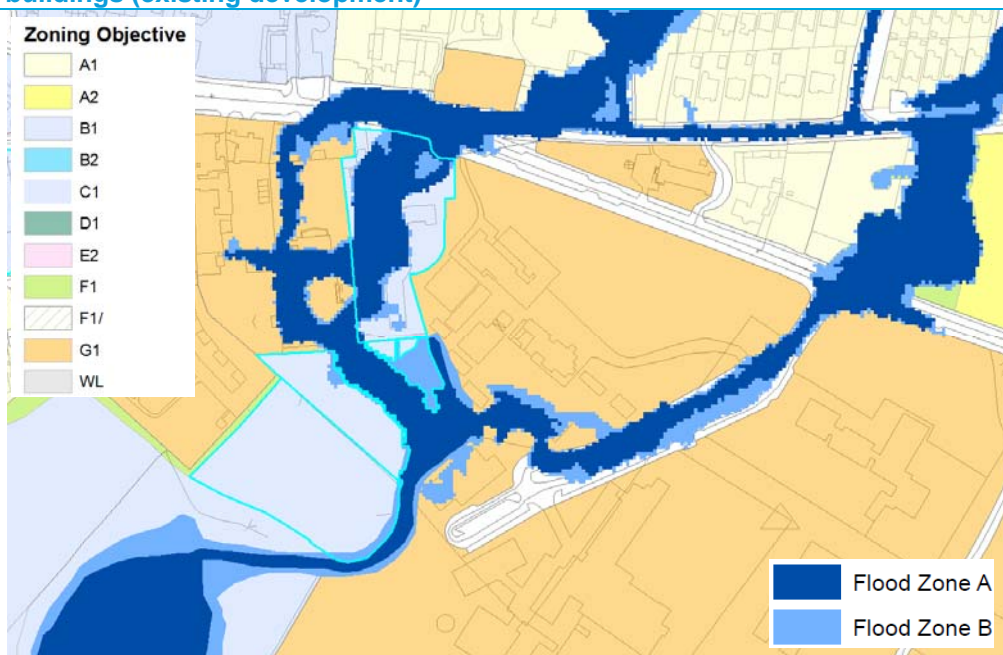
A proportion of established residential land are shown to be at high to moderate risk of flooding (within Flood Zones A and B). Only development that does not increase exposure to flood risk should be permitted. Redevelopment that incorporates less vulnerable land uses within Flood Zone A and B is preferable. Any future development at this site will require an FRA.

Conclusions

Where the opportunity arises, incorporate open space and amenity within residential zoned land in areas at high flood risk (i.e. Flood Zone A).

8.1.3 Mixed use (C1)

HSE buildings (existing development)



A large proportion of the HSE site and lands to the rear is at high to moderate risk of flooding (within Flood Zones A and B) as a result of overland flow from the Newrath Stream.

Any alterations/extensions/renovations to the existing building at this site will require an FRA that ensures appropriate consideration of flood risk.

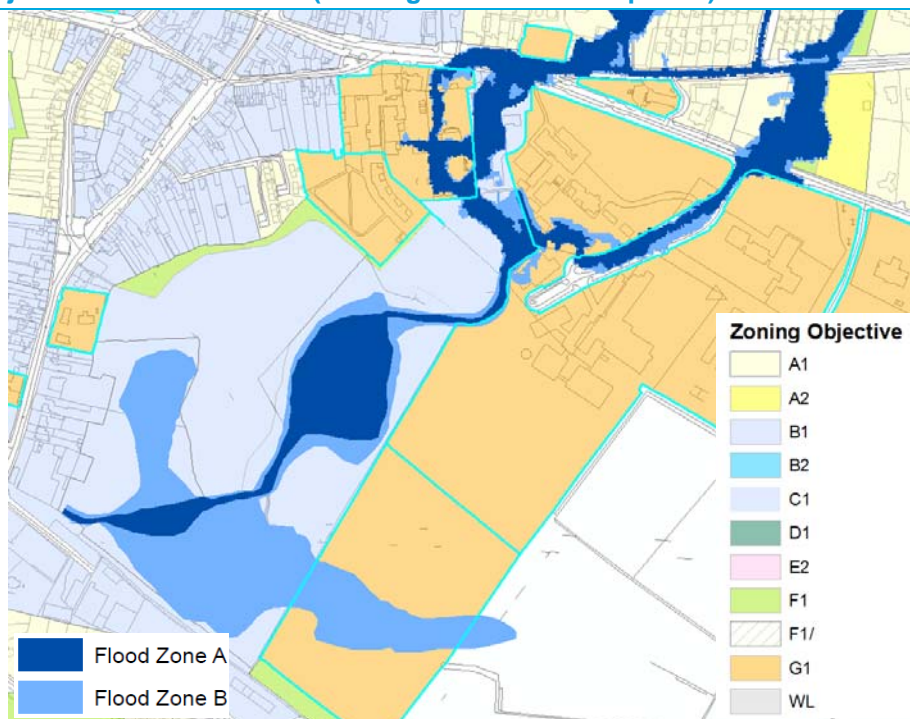
For the undeveloped lands to the rear of the HSE building flood risk is a key concern and any new development will require an appropriately detailed FRA at Development Management stage. The area of the lands within Flood Zone B should only be subject to land uses that are classed as less vulnerable by the Planning System and Flood Risk Management Guidelines or more preferably that of a water compatible land use.

Conclusions

Manage any changes to the existing building with appropriately detailed FRA at Development Management stage. For any new development within the undeveloped lands to the south of the HSE building an appropriately detailed FRA should be completed and lands within Flood Zone B should only incorporate land uses of a less vulnerable classification, or preferably water compatible land uses.

8.1.4 Community Infrastructure (G1)

Lands adjacent to the Backlands (existing and new development)



The zoned lands include the existing educational institutions of; Eureka Secondary School, St. Colmcille's National School, Kells Community College and Our Lady of Mercy National School. Kells Swimming Pool (public) is also included in this area which is subject to flooding and overland flow routes from the Newrath Stream.

The area of undeveloped land within the south of the Backlands is one of two alternative locations of the new Eureka Secondary School.

New development under the proposed land use zoning is appropriate as long as risk is managed by adopting a sequential approach to the site layout and locates the more vulnerable development in the parts of the site that are in Flood Zone C and retaining water compatible land uses for the areas within Flood Zone A, this is agreed in principle for the potential Eureka School site. Future development at this site will require an FRA and application of the justification test where appropriate, to ensure that the development fully considers and manages flood risk to itself and surrounding lands.

Within areas of existing or new development, applying the sequential approach at site level for development proposals is appropriate, along with submission of a site specific FRA.

Conclusions:	Maintain as zoned; incorporate water compatible land uses within Flood Zones A, along with site specific FRA.
--------------	---

8.2 SFRA Review and Monitoring

An update to the SFRA will be triggered by the six year review cycle that applies to Local Authority development plans. In addition there are a number of other potential triggers for an SFRA review and these are listed in the table below.

There are a number of key outputs from possible future studies and datasets, which should be incorporated into any update of the SFRA as availability allows. Not all future sources of information should trigger an immediate full update of the SFRA; however, new information should be collected and kept alongside the SFRA until it is updated. Since Kells is not included as an Area for Further Assessment (AFA) within the CFRAMS programme there will be no further update trigger from this source, however any significant updates to the Kells Stormwater Drainage Study or physical works would need to be considered as part of an update.

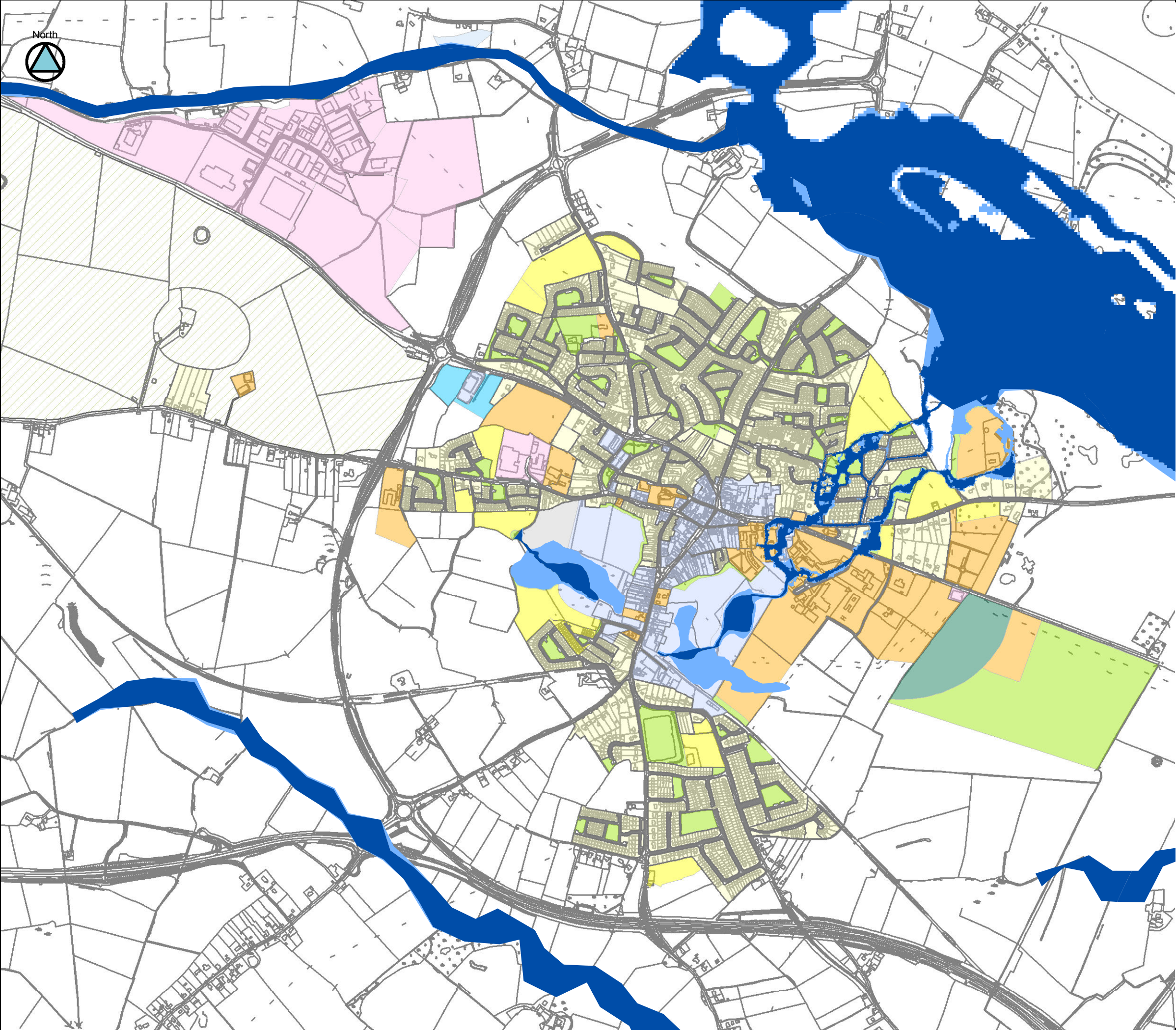
In addition, information on insurance claims from water related issues, i.e. flooding, could be compiled, if available.

Table 8-3 SFRA Review Triggers

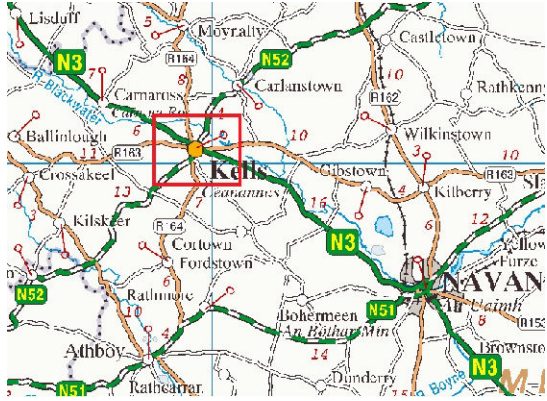
Trigger	Source	Possible Timescale
Catchment Flood Risk Assessment and Management (CFRAM) Flood Hazard Mapping	OPW under the Floods Directive	2013
Eastern River Basin Flood Risk Assessment and Management (ECFRAM) Plan	OPW	2015
Flood maps of other sources, such as drainage networks	Various	Unknown
Significant flood events	Various	Unknown
Changes to Planning and / or Flood Management Policy	DoEHLG / OPW	Unknown
Detailed FRAs	Various	Unknown
Updates to the Kells Stormwater Drainage Study (2006) or any significant physical works to the channel or structures as a result of recommendations of the study or as part of additional studies.	Likely to be local authority and/or the OPW	Unknown

Appendices

A Flood Zone Mapping



KEYPLAN



LEGEND

- Flood Zone A
- Flood Zone B

Zoning Objective

- A1
- A2
- B1
- B2
- C1
- D1
- E2
- F1
- F1/
- G1
- WL

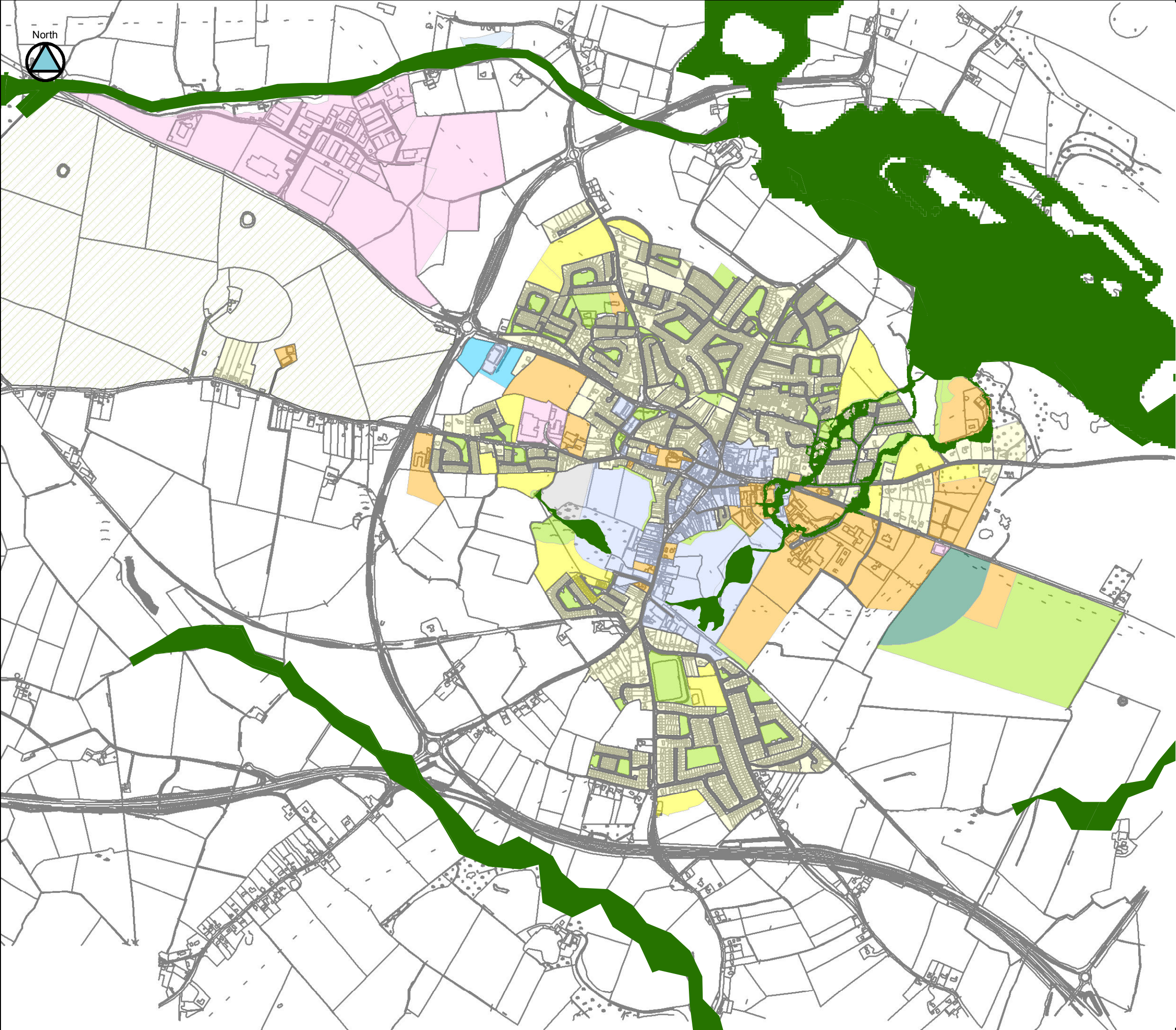
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County Council



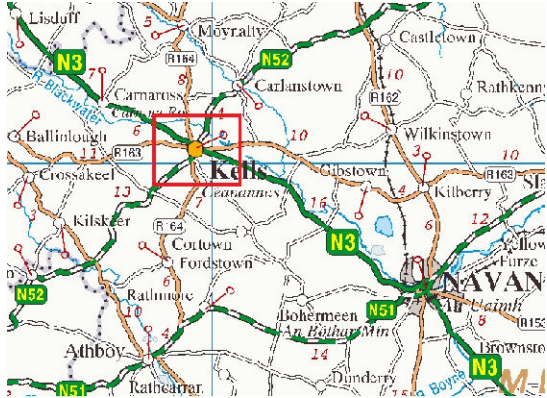
APPENDIX A

KELLS FLOOD ZONE MAPPING

B Climate Change Flood Mapping



KEYPLAN



LEGEND

1% AEP + Climate Change

Zoning Objective

- A1
- A2
- B1
- B2
- C1
- D1
- E2
- F1
- F1/
- G1
- WL

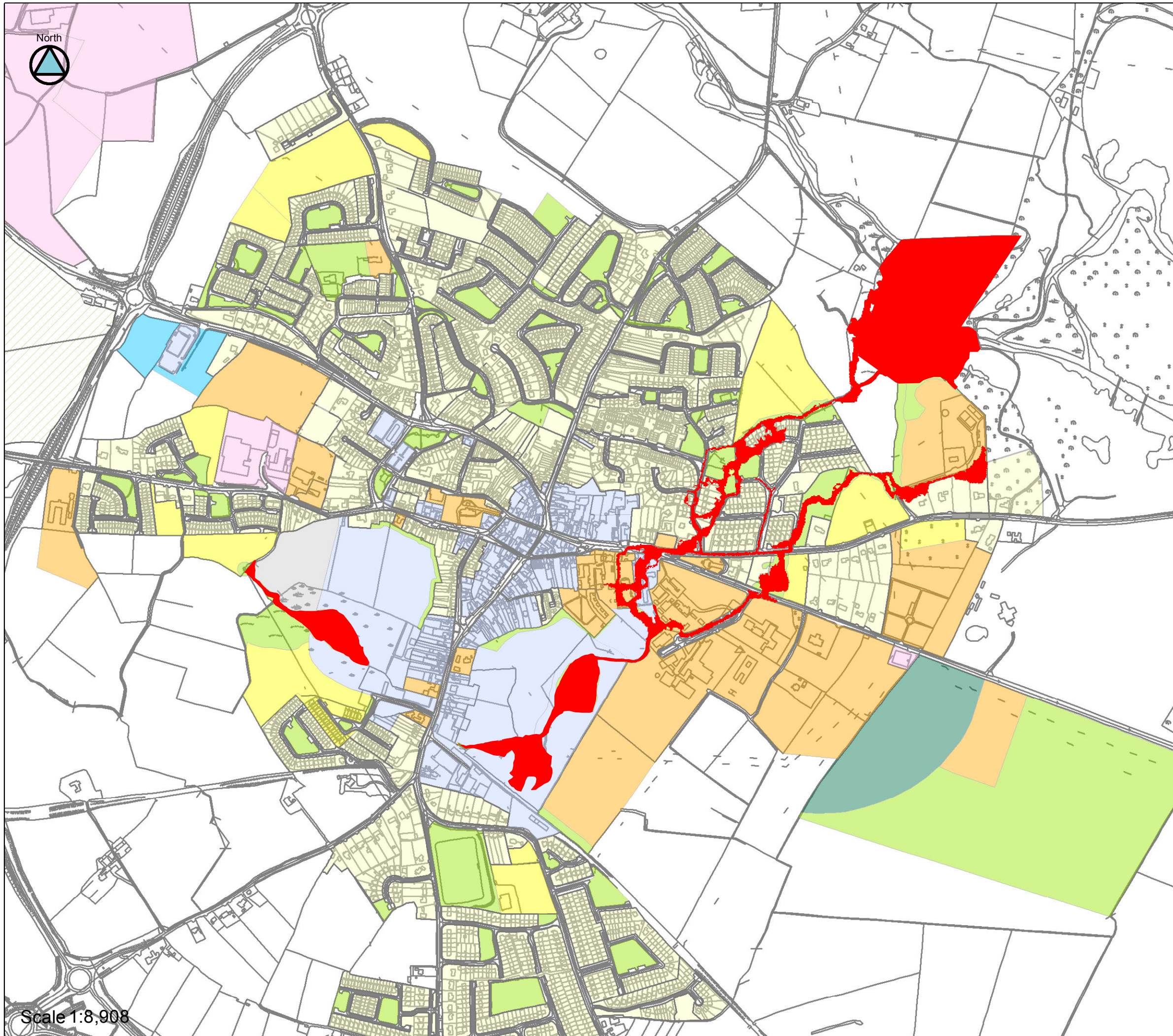
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APPENDIX B

CLIMATE CHANGE MAPPING

C Residual Risk Mapping



KEYPLAN



LEGEND

 1% AEP + Blockage

Zoning Objective

-  A1
-  A2
-  B1
-  B2
-  C1
-  D1
-  E2
-  F1
-  F1/
-  G1
-  WL

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APPENDIX C

RESIDUAL RISK MAPPING
(CULVERT BLOCKAGE)

Scale 1:8,908

D Justification Test

D.1 Road System to access the Backlands

Issue – Proposed road network may involve encroachment on lands identified within Flood Zones A, B & Residual flood Risk.

D.1.1 Justification Test

1. Urban settlement is targeted for growth – Yes.

National Spatial Strategy 2002 – 2020

Kells is categorised as a town with a population of 1,500 – 5,000 persons and presenting an urban strengthening opportunity. Kells is also positioned as a town where two national transport corridors intersect.

Such towns should cater for local growth in residential, employment and service functions through enhancing the built environment, water services, public transport links and capacity for development in these centres. Accommodating such additional growth functions must however be balanced with protecting the character & quality of such towns.

Regional Planning Guidelines for the Greater Dublin Area 2010 – 2022.

Kells is listed as a 'Moderate Sustainable Growth Town' in the settlement hierarchy within the Hinterland Area (such towns are generally 10km from a Large Town located on a public transport corridor and serve a wider rural hinterland as a market town). From an economic perspective Kells is identified as a 'Secondary Economic Growth Town' within the Navan Core Economic Area having a supporting and complimentary role to Navan which is on the same multi-modal growth corridor. Kells is also listed as a Level 3 Sub County Town in the Retail Hierarchy of the GDA.

2. Zoning is required for the particular use or development type
 - (i) Essential to facilitate regeneration and / or expansion of the centre of the urban settlement

Yes – Backlands has been the preferred site for town centre expansion since the 2001 Kells Development Plan and reinforced by the preparation of the 2005 Kells Backlands Local Area Plan. It is one of only two potential sites which are within or close to the existing commercial core of the town. The required format of modern convenience retailing cannot be accommodated within the core of the historic settlement thus requiring a greenfield development scenario. The proposed development adheres to the recommendations contained the 2012 Retail Review for Kells as completed by John Spain & Associates.

- (ii) Comprises significant previously developed and / or under utilised lands

Yes – Backlands areas is as synonymous in the local name is an area of land to the rear of the main shopping street which has been inaccessible due to the form of development in Kells. It has not been previously developed save for the preferred access point onto Farrell Street. The redevelopment of the existing roadside filling station would constitute a positive intervention in the Architectural Conservation Area.

- (iii) Is within or adjoining the core of an established or designated urban settlement.

Yes – the extent of the defined Retail Core Area of Kells includes the proposed access to the site and the site is identified as an Opportunity Site in the 2012 Retail Review for Kells as completed by John Spain & Associates.

- (iv) Will be essential in achieving compact and sustainable urban growth

Yes – As identified above, the site has been identified as the preferred site for town centre expansion for over a decade on the basis of the availability of a number of pedestrian and cyclist connections back to the existing commercial core of the town. The application of the sequential approach to retail planning would further reinforce such findings.

- (v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.

Yes – Whilst the Frontlands (area to the rear of Bective Street / Suffolk Street) is available for town centre expansion, they too are partially located within areas identified in Zones A & B.

There also remain constraints to the development of the alternative lands in the Frontlands in regard to the urban form, topography, connectivity to the defined retail core and availability of water services allied to the lands not being contiguous to the identified retail core area.

Justification Test has successfully advanced past Step 2 for Development Plans (Box 4.1 refers) and shall proceed to the carrying out of a flood risk assessment to an appropriate level of detail as part of the SEA process.

D.2 Alignment of local Distributor Road through “The Frontlands”

Issue – Arising from the consideration of submissions received, the revised configuration of Flood Zones A & B and the location of a National Monument (ref. ME017-044030 “Enclosure”), it is proposed to amend the alignment of the proposed Local Distributor Route linking Bective Street to Climber Hall / Oldcastle Road from that indicated in the draft Development Plan. This revised alignment impacts on both Flood Zones A & B. As the proposed development is considered to be a “less vulnerable development”, it is necessary to bring the proposal through a Justification Test.

D.2.2 Justification Test

1. Urban settlement is targeted for growth – Yes.

National Spatial Strategy 2002 – 2020

Kells is categorised as a town with a population of 1,500 – 5,000 persons and presenting an urban strengthening opportunity. Kells is also positioned as a town where two national transport corridors intersect.

Such towns should cater for local growth in residential, employment and service functions through enhancing the built environment, water services, public transport links and capacity for development in these centres. Accommodating such additional growth functions must however be balanced with protecting the character & quality of such towns.

Regional Planning Guidelines for the Greater Dublin Area 2010 – 2022.

Kells is listed as a ‘Moderate Sustainable Growth Town’ in the settlement hierarchy within the Hinterland Area (such towns are generally 10km from a Large Town located on a public transport corridor and serve a wider rural hinterland as a market town). From an economic perspective Kells is identified as a ‘Secondary Economic Growth Town’ within the Navan Core Economic Area having a supporting and complimentary role to Navan which is on the same multi-modal growth corridor. Kells is also listed as a Level 3 Sub County Town in the Retail Hierarchy of the GDA.

2. Zoning is required for the particular use or development type

- (i) Essential to facilitate regeneration and / or expansion of the centre of the urban settlement

Yes – The “Frontlands” has been identified through the 2006 Kells Retail Evaluation as an Opportunity Site which can accommodate town centre expansion. The site is currently zoned for town centre expansion in the 2007 -2013 Kells Development Plan subject to the preparation of a Framework Plan a draft of which is being considered presently by the Planning Authority. It is one of only two potential sites which are within or close to the existing commercial core of the town. The required format of modern convenience retailing cannot be accommodated within the core of the historic settlement thus requiring a greenfield development scenario. The proposed development adheres to the recommendations contained in the 2012 Retail Evaluation for Kells as completed by John Spain & Associates.

The lands in question require new roads infrastructure to access same. The development of said lands have the further attribute of removing unnecessary traffic from the medieval core being a further environmental benefit.

- (ii) Comprises significant previously developed and / or under utilised lands

Yes – The Frontlands, despite its misleading local name, is a backland site of significant extent (previously landlocked) to the rear of the properties on Bective Street, Suffolk Street and Cannon Street which had been inaccessible due to the form of development in Kells. It has not been previously developed save for the preferred access point onto Bective Street which was

developed originally as a car show room and has a recent grant of permission to change the use into an office development for the HSE NE.

(iii) Is within or adjoining the core of an established or designated urban settlement.

Yes – Whilst the site is not located within or contiguous to the core retail area or primary shopping streets as defined in the County Retail Strategy, it would be considered to be within the core of the settlement as defined in the “Planning System and Flood Risk Management Guidelines for Planning Authorities”. It is also possible subject to land acquisition to forge connectivity through to the periphery of the core retail area.

(iv) Will be essential in achieving compact and sustainable urban growth

Yes – As identified above, the site has been identified as a suitable site for town centre expansion since 2006. The application of the sequential approach to retail planning would further reinforce such findings.

(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.

Yes – As the proposed development objective relates to the delivery of a local road rather than a land use zoning objective and having regard to the previous alignment option identified in the draft plan potentially impacting upon a National monument and other considerable archaeological remains, there is no other suitable alignment which would not traverse Flood Zones A or B.

Justification Test has advanced past Step 2 for Development Plans (Box 4.1 refers).



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