



# Strategic Flood Risk Assessment for the Waterford City and County Development Plan 2022-2028

Final Report

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Comhairle Cathrach & Contae Phort Láirge

Waterford City and County Council

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## Contract

This report describes work commissioned by Hugh O'Brien, on behalf of Waterford County Council, by a letter dated 23rd June 2015. Elizabeth Russell of JBA Consulting carried out this work.

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## Abbreviations

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
FRA.....	Flood Risk Assessment
FRMP .....	Flood Risk Management Plan
GIS.....	Geographical Information System
HEFS .....	High End Future Scenario
ICPSS .....	Irish Coastal Protection Strategy Study
LA.....	Local Authority
LAP .....	Local Area Plan
mOD.....	Meters above Ordnance Datum
MRFS.....	Medium Range Future Scenario
OPW .....	Office of Public Works
OS.....	Ordnance Survey
PFRA .....	Preliminary Flood Risk Assessment
SAC.....	Special Area of Conservation, protected under the EU Habitats Directive
SFRA .....	Strategic Flood Risk Assessment
SPR.....	Standard percentage runoff
SUDS.....	Sustainable Urban Drainage Systems
Tp.....	Time to Peak

# 1 Study Background

JBA Consulting was appointed by Waterford City and County Council (WCCC) to carry out the Strategic Flood Risk Assessment (SFRA) for the Waterford County Development Plan 2022-2028.

This report details the SFRA for the county and has been prepared in accordance with the requirements of the DoEHLG and OPW Planning Guidelines, The Planning System and Flood Risk Management<sup>1</sup>; these guidelines were issued under the Planning and Development Act 2000, as amended, and recognise the significance of proper planning to manage flood risk.

The SFRA has been reviewed and updated to have regard to the proposed Material Alterations to the County Development Plan.

## 1.1 Scope of Study

Under the "Planning System and Flood Risk Management" guidelines, 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 Waterford City and County Development Plan 2022-2028 (DP) will be the key document for setting out a vision for the development of the county during the plan period.

It is important that the DP fulfils the requirements of the document "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 DP, the main requirements of this document are to:

- Produce flood zone mapping.
- Prepare a Stage 2 - Flood Risk Assessment of County Waterford in particular in relation to location and type of zoning and land-use proposals. Where required, undertake a Stage 3 Detailed FRA.
- Advise on zonings/land use-proposals, assess and report on any submissions received as part of both the preparation and the public consultation stage of the plan, as they relate to flood risk.

## 1.2 SFRA Approach

This study considers the development strategy that will form part of the Development Plan for County Waterford. The context of flood risk in Waterford is considered with specific reference to a range of flood sources, including fluvial, tidal, pluvial, groundwater, sewer and artificial reservoirs and canals.

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 and is based on a variety of data sources, which are detailed in Section 4. There are numerous settlements which have an extremely limited risk of flooding and development can be progressed without regard to fluvial or coastal flooding. However, historical records and recent events demonstrate that parts of the county have a risk of flooding and confirm 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 an indicative flood zone map, based on available data, 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 specifically looks at flood risk and the potential for development within the county settlements.

## 2 The Planning System and Flood Risk Management Guidelines

### 2.1 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 natural processes 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 as a planning tool; a discussing of the principles of the planning guidelines and the management of flood risk in the planning system will follow.

### 2.2 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 2-1 illustrates this and is a widely used environmental model to assess and inform the management of risk.

Figure 2-1: Source Pathway Receptor Model

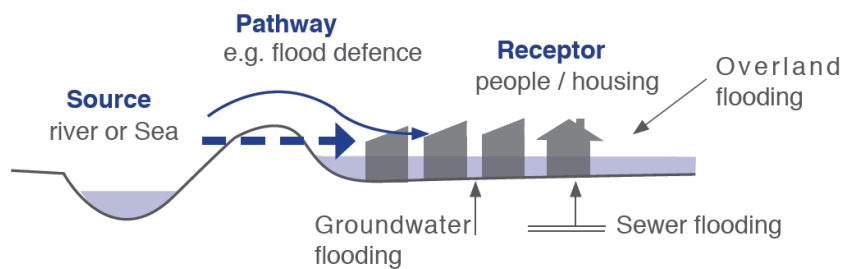


Fig. A1: Sources, pathways and receptors of flooding

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.

## 2.3 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 2-1.

Table 2-1: 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.

### 2.3.1 Consequences of Flooding

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

## 2.4 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 2-2. They do not take other sources of flood water, such as groundwater or pluvial, into account, so an assessment of risk arising from such sources should also be made.

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.



Table 2-2: Definition of Flood Zones

Zone	Description
<b>Zone A</b> 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).
<b>Zone B</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).
<b>Zone C</b> 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).

## 2.5 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:

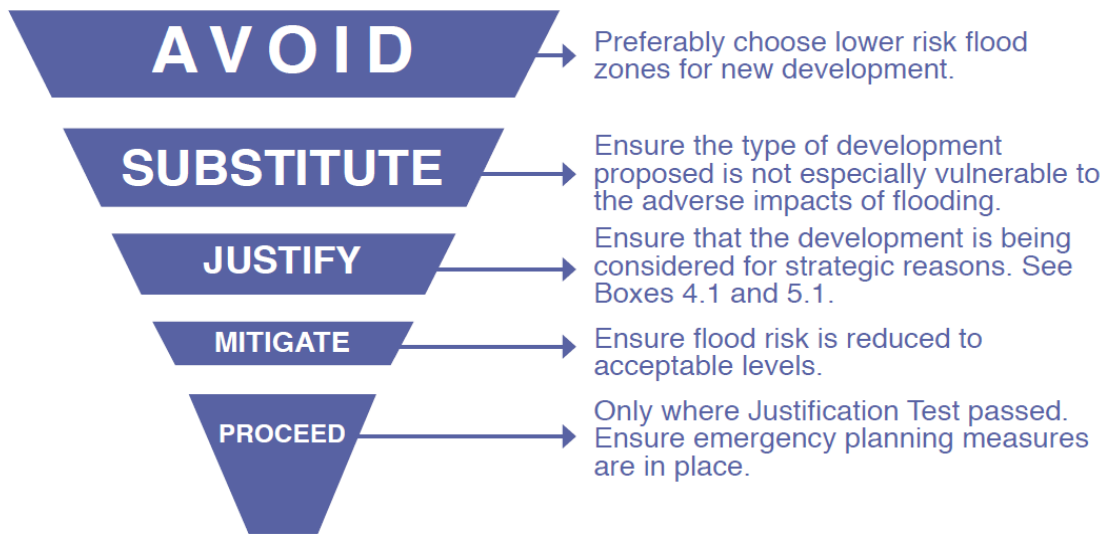
- Adopting a staged and hierarchical approach to the assessment of flood risk;
- Adopting a sequential approach to the management of flood risk, based on the frequency of flooding (identified through Flood Zones) and the vulnerability of the proposed land use.

## 2.6 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 plan boundary. 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 2-2: 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 application of 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 assess 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 2-3 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 2-3: Matrix of Vulnerability versus Flood Zone

Vulnerability	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 within the variation settlements is discussed in Section 7.

## 2.7 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 comprise of:

- **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 and 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 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 (SSFRA)** – 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 SSFRA will require detailed channel and site survey, and hydraulic modelling.

## 3 Waterford City and County Study Area

### 3.1 Study Area

The study area is the whole of Waterford City and County, with a focus on a number of key settlements, which are identified in Table 4-3. Of these settlements, Waterford City, Tramore, Aglish, Ballyduff, Tallow, Dungarvan and Ringphuca, Dunmore East and Ballymacarbry have been subject to detailed flood risk assessment through the Suir and the South-Eastern CFRAM studies. Furthermore, Waterford City has been subject to detailed assessment as part of the flood relief scheme design, and masterplanning flood risk assessment for the North Quays SDZ. A review of documents relating to both of these studies formed part of the SFRA for the City.

County Waterford covers an area of 1,839km<sup>2</sup> and includes a range of topographies, soil and rock types, water bodies and a coastal length of 147km. In west Waterford the limestone-floored valley of the Blackwater runs eastwards from the county boundary through Ballyduff and Lismore as far as Cappoquin where it turns abruptly south and cuts its way through several ridges of sandstone rock forming a steep-sided valley by Villierstown, Clashmore and Aglish and flowing into the Blackwater Estuary at Youghal. The River Bride flows north of Tallow and joins the Blackwater at Camphire. The upper Waterford tributaries of the Blackwater flow from the Knockmealdown Mountains which form the northern boundary of west Waterford. The eastern end of the Dungarvan valley contains the small Colligan River which empties into the estuary at Dungarvan and the Finnisk, a tributary of the Blackwater. A number of river valleys occur between Dungarvan and Bunmahon namely the Dalligan River, River Tay, River Mahon and Anne Stream. East Waterford is very low-lying and has a concentration of lakes and wetlands. Sheltered bays along this coastline provide some of the county's most extensive beaches at Passage East, Woodstown and Tramore. The County boundary between Waterford and South Tipperary is formed by the River Suir flowing by Clonmel, Carrick on Suir and Portlaw where it is joined by the River Clodiagh.

County Waterford is covered in the main by the South Eastern River Basin District, including the catchments of the rivers Mahon, Clodiagh, Suir and Waterford Estuary. West Waterford and the Blackwater River are within the South Western River Basin District.

### 3.2 Planning Policy

#### 3.2.1 Southern Region Regional Spatial & Economic Strategy

The Regional Spatial & Economic Strategy (RSES) for the Southern Region includes a significant focus on sustainability and flood management, encapsulated in Water Resource and Flooding National Policy Objective (NPO) 57, which "*seeks to enhance water quality and resource management by:*

*Ensuring flood risk management informs placemaking by avoiding inappropriate development in areas at risk of flooding in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities".*

This policy objective is supported by a range of objectives which include implementation of the Flood's Directive and the Planning System and Flood Risk Management as well supporting capital investment in flood relief schemes and measures for managing flooding and coastal erosion.

#### 3.2.2 Waterford County Development Plan 2011-2017 (as extended)

The Waterford County Development Plan was supported by an SFRA which undertook a high level review of available datasets and levels of flood risk. The impact of flood risk within the context of the County Development Plan and decisions regarding future directions of growth was recognised and was incorporated into the policies of the County Development Plan Section 8 (Environment and Heritage Chapter). These policies aimed to ensure that flood risk areas targeted for development will follow the sequential approach and will be planned, designed and constructed to reduce and manage flood risk and be adaptable to changes in climate.

Development Objectives for the settlements of Ballyduff West, Ballymacarbry, Cappoquin, Carrick on Suir, Cheekpoint, Clashmore, Clonmel Environs, Dungarvan Environs, Lismore, Pilltown and Tallow included the protection of the floodplain in those settlements.

The SFRA stated that as more up to date information and spatial data becomes available through Flood Risk Mapping, CFRAMS and the National Coastal Protection Strategy and where lands are

already zoned for housing or other vulnerable development in the flood risk areas identification of flood zones in relevant settlements will be applied through a Stage 2 Strategic Flood Risk Assessment applying the sequential approach and justification test as per the DoEHLG Guidelines (2009).

### 3.2.3 Waterford City Development Plan 2013-2019 (as extended)

The Waterford City Development Plan was also supported by an SFRA which included a stage 3 assessment of flood risk. The Justification Test was also applied to sites located within Flood Zones A and B. Where the Justification Test was not passed (sites on the periphery of the city), it was found that the majority of the site was within Flood Zone C and local risks could be mitigated through development management and a site specific Flood Risk Assessment.

### 3.2.4 Dungarvan Town Council Plan 2012-2018 (as extended)

Consideration of flood risk also formed part of the Dungarvan Town Council Plan, including production of a floodmap and environmental objectives as a result of SFRA. The plan did not include a screening of risk to specific development sites but did require development within areas shown to be at risk of flooding to undertake site specific flood risk assessment.

## 4 Identification of Flood Risk

### 4.1 Data Collection and Review

This section reviews the data collection and the flood history for the settlements so that any additional information on flooding can be included within this SFRA. It will confirm the extent of extreme flooding (through the Flood Zone mapping) key sources of flood risk.

There are a number of valuable sources of flood data for County Waterford, including major projects such as the CFRAM, and broadscale flood mapping such as the national PFRA study.

The sources of information from the previous iterations of the SFRAs have been reviewed and relevant updates have been made using the CFRAM flood mapping.

Table 4-1: Available flood risk data

Description	Coverage	Robustness	Comments on usefulness
Suir CFRAM Study	<p>Areas for further assessment (AFAs), or settlements falling along modelled lengths, in County Waterford are:</p> <ul style="list-style-type: none"> <li>Waterford City (Model 9)</li> <li>Portlaw (model 7)</li> <li>Ballymacarbry (model 5D)</li> </ul>	<p>Flood Zones and flood extents for current and future scenarios provided by OPW.</p>	<p>Very useful but undertaken at a catchment level. In general, CFRAM provided all information needed to apply the JT for Plan Making under the SFRA.</p>
South Western CFRAM Study	<p>Areas for further assessment (AFAs), or settlements falling along modelled lengths, in County Waterford are:</p> <ul style="list-style-type: none"> <li>Aglish</li> <li>Ballyduff</li> <li>Tallow</li> </ul>	<p>Depth, velocity and risk to life, and defended areas are also available. Modelling is 'best of breed' and outputs will allow informed decisions on zoning objectives. Design water levels will inform decisions relating to raising land and setting finished floor levels.</p>	<p>Site specific FRAs will still be required for planning applications, but information on water levels can form the basis of decision in relation to finished floor levels. However, it is important to note that CFRAM outputs should not be relied upon without review and consideration of appropriateness to the site in question.</p>
South Eastern CFRAM Study	<p>Areas for further assessment (AFAs), or settlements falling along modelled lengths, in County Waterford are:</p> <ul style="list-style-type: none"> <li>Dungarvan and Ringphuca</li> <li>Dunmore East</li> <li>Tramore</li> </ul>	<p>High, but does not include wave overtopping /breaking so doesn't represent storm damage.</p>	<p>In SFRA, used to define the tidal risk element of Flood Zone A and B, where CFRAM not available, or ICPSS indicates greater risk. For site specific FRA, where direct translation of tide levels inshore is appropriate (i.e. where the town is on the coast, not up an estuary) these levels can be used to set</p>
Irish Coastal Protection Study (ICPSS)	<p>Still water tidal extents for 200 year and 1000 year events for the whole coastline.</p>	<p>High, but does not include wave overtopping /breaking so doesn't represent storm damage.</p>	<p>In SFRA, used to define the tidal risk element of Flood Zone A and B, where CFRAM not available, or ICPSS indicates greater risk. For site specific FRA, where direct translation of tide levels inshore is appropriate (i.e. where the town is on the coast, not up an estuary) these levels can be used to set</p>

Description	Coverage	Robustness	Comments on usefulness
			finished floor levels.
County Development Plan Flood Map (2011-2017)	Based largely on the on the PFRA with some adjustment following walkover and local knowledge. Covers nearly all rivers (including non-CFRAM) and included validation so used for development of base Flood Zones with validation for SFRA.	Low to Moderate	Not used as based data has been superseded.
National Indicative Fluvial Mapping (NIFM)	Produced by the OPW, these maps are 'predictive' flood maps for watercourse with a catchment area greater than 5km <sup>2</sup> .	Moderate	Used for all watercourses not covered by CFRAM / ICPSS and replaces the County DP mapping discussed above.
OPW Preliminary Flood Risk Assessment (PFRA) flood maps - Fluvial	The PFRA was a national screening exercise that was undertaken by OPW to identify areas at potential risk of flooding. Fluvial, coastal, pluvial and groundwater risks were identified at an indicative scale.	Low	Superseded by the National Indicative Fluvial Mapping
PFRA Maps - Coastal		Moderate	This was based on ICPSS flood extents
PFRA Maps - Pluvial and Groundwater		Low	Not used as withdrawn by OPW. See GSI mapping.
Historical event outlines and point observations and reports	Various, taken from <a href="http://www.floodinfo.ie">www.floodinfo.ie</a>	Indicative	Used indirectly used to validate flood zones and identify non-fluvial and tidal flooding in the SFRA. Useful background information for site specific FRAs, but note the database is not exhaustive absence of a record does not necessarily mean absence of flood risk.
Arterial Drainage Benefitting land maps	Show land which would (or have) benefitted from a drainage scheme. This is not based on a 'design flood' (i.e. the events do not have a return period), but indicate low-lying, poorly drained land. It is not the same as lands which are protected by a flood relief scheme.	Low	Superseded by the data sources listed above, although may be used to cross check Flood Zones. Limited benefit to site specific FRAs.
Flood relief scheme details, including locations and	Defences in Waterford, Dungarvan, Portlaw and to the east of Tramore have all been included in the CFRAM modelling and	High (outputs from the CFRAM and/or detailed scheme design	Flood Zones are defined without the benefit of defences, but the benefits have been considered when establishing the

Description	Coverage	Robustness	Comments on usefulness
lengths, standard of protection and areas which are protected	defended areas defined.	documents provide this information).	specific risk to a site and considering the appropriateness of land zoning. Will be helpful in informing the site specific FRA, which will need an assessment of residual risks, and possibly breach analysis.
ICPSS Coastal Erosion Maps	National coverage, highlighting areas which area particularly vulnerable to coastal erosion.	Moderate	Erosion risks within settlements are generally low, so has not influenced the SFRA.

Table 4-2: Other Data Available

Description	Coverage	Robustness	Comment on usefulness
Alluvial Soil Maps	Full Study Area	Low	Used in the Regional FRA to provide initial assessment of risks. Not used in SFRA and little or no value to FRA.
Groundwater vulnerability maps	Broadscale, County wide	Moderate	Initial assessment of groundwater vulnerability. Provides a screening tool for use in FRA.
Historic Flood Records including photos, aerial photos and reports.	Broad, spot coverage	Various	Yes indirectly to validate Flood Zones & identify other flood sources. Review of such sources will be required for all site specific FRAs.

## 4.2 Flood Zone Map Development

As can be seen from Table 4-2, a range of data, including hydraulic modelling and historical reports was used to inform this SFRA.

The OPW CFRAM maps were reviewed as part of the data collection exercise and have been used to inform the land use zonings contained in the Development Plan. Settlements covered with detailed mapping (termed High Priority Watercourses, or HPW) under the Suir, South-West and South-East CFRAM programmes are: Waterford City, Portlaoigh, Ballymacarbray, Aglish, Ballyduff, Dungarvan and Ringphuca, Dunmore East, Tallow and Tramore.

Medium Priority Watercourse (MPW) mapping also provided flood information for a number of other settlements within the county, and for the watercourse lengths between the urban settlements. Where HPW outputs were not available, MPW was used in preference.

For many of the other watercourses, the OPW's NIFM mapping was used. The least robust dataset used was the Flood Zone mapping from the previous County Development Plan. As detailed above, this was based on the PFRA with some localised changes made as appropriate.

Around the coast and to represent tidal inundation up estuaries, the ICPSS provided flood extents.

It should be noted that, regardless of the origin of the background data, the Flood Zone Maps have been developed as a spatial planning tool to guide WCC in making land zoning and development management decisions and it is recognised that site specific information may contradict the Flood



Zones, either to demonstrate a greater or lesser level of flood risk. However, the data has been deemed appropriate for the planning decisions being made at this stage of the plan making process.

In general, where HPW modelling has been carried out, flood levels and flows are available at selected node points along the watercourse. Once an appropriate level of validation has been undertaken as part of the site specific FRA, these flood levels may be used to form the basis of the development design.

For MPW and NIFM map outputs, water levels are not available, and the mapping provides an indicative extent only. Additional assessment through a Stage 3 FRA may be needed to demonstrate the level of flood risk.

### 4.3 Unmapped Fluvial Risk

The Flood Zones have been derived for watercourse with a catchment area greater than 5km<sup>2</sup>, which captures the majority of sources of fluvial flood risk in the Waterford settlements. However, there may be cases where a watercourse is been identified, either through mapping or through site visit and local knowledge, but due to the size of the catchment, the Flood Zone has not been delineated. In these cases, it is the responsibility of the applicant to undertake an appropriately detailed FRA and to then apply the sequential approach as the Plan Making Justification Test has not been satisfied in these cases.

### 4.4 Sources of Flooding

This SFRA has reviewed flood risk from fluvial, pluvial, tidal and groundwater sources. It also considers flooding from drainage systems, reservoirs and canals and other artificial or man-made systems as appropriate.

Flooding events have become more pronounced in Ireland, and County Waterford, in recent years. Low lying parts of Waterford City are prone to both river and tidal flooding and sometimes a combination of both when certain meteorological conditions arise, given its location on tidal estuary of the River Suir. This demonstrates the need to consider all sources of flood risk, alone and in combination, when considering development within the county.

Climate change risks also need to be considered at a strategic and site specific scale. Climate change is discussed in Section 5.8 in relation to incorporation of climate change into the flood risk assessment. A comment on the likely impacts of climate change, on a settlement basis, has been provided in Section 7.3.

#### 4.4.1 Fluvial Flooding

Flooding from rivers and streams is associated with the exceedance of channel capacity during higher flows. The process of flooding from watercourses depends on numerous 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. Generally, there are two main types of catchments: large and relatively flat or small and steep, both giving two very different responses during large rainfall events.

In a large, relatively flat catchment, flood levels will rise slowly and natural floodplains may remain flooded for several days or even weeks, acting as the natural regulator of the flow. This is typical of the River Suir. In small, steep catchments local intense rainfall can result in the rapid onset of deep and fast-flowing flooding with little warning. Such “flash” flooding, which may only last a few hours, can cause considerable damage and possible risk 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. These structures are also vulnerable to blockage by natural debris within the channel or by fly tipping and waste.

Flood risk to specific settlements is discussed in Section 6 and has been used to inform the zoning objectives for the Development Plan.

#### 4.4.2 Tidal and Coastal Flooding

County Waterford's southern boundary is formed by the Celtic Sea. There are numerous settlements along this coastal margin, including Baile na nGall, Heilbhic, Cheekpoint, Dungarvan, Dunmore East, Passage East, Portlaw and Waterford City.

The coastline of County Waterford is experiencing both erosion and deposition and some flooding through normal coastal processes. Parts of the coast in Waterford are low lying and vulnerable to flooding in the long-term from sea level rise and it is essential that current and future plans and development now do not create significant problems in the future. Continued investment needs to be made in research on long term options for the protection of coastal towns from long term sea level rise and increased storm activity.

A strategic level erosion risk assessment for the coastline has also been completed and predictive erosion maps prepared for the years 2030 and 2050. A review of the erosion risk maps shows that primary erosion risk areas identified included Tramore. In contrast to the assessment of coastal flood risk, the coastal erosion risk assessment along the south coast has indicated that there is generally little risk from erosion in the larger urbanised areas. This is primarily due to the fact that the urbanised coastline is mostly either naturally resilient or protected by man-made defences.

The Government has recently established an Inter-Departmental Group on Coastal Change Management to scope out an approach for the development of a national coordinated and integrated strategy to manage the projected impact of coastal change to our coastal communities, economies, heritage, culture and environment. The Inter-Departmental Group is jointly chaired by the Department of Housing, Planning and Local Government and the OPW and will bring forward options and recommendations for the Government to consider. Should these recommendations be available during the lifetime of the plan they will be given due consideration and assessed for impacts on the SFRA.

#### 4.4.3 Flooding from Flood Defence Overtopping or Breach

There are a number of flood relief schemes in County Waterford, including walls and / or embankments in Waterford City, Dungarvan, Portlaw and an area to the east of Tramore. The defences have been examined in more detail through the CFRAM Studies, which has included an assessment of physical condition, height and the standard of protection provided. The CFRAM also looked at the likelihood of a defence failing, and if considered significant, investigated the consequences through breach modelling.

The Waterford City Flood Alleviation Scheme consists of the containment of floodwaters in the John's River and the River Suir within their respective channels through the urban area of Waterford. The works protect the city from flooding from both rivers for events up to the 0.5% AEP in tidal areas, and up to 1% AEP in non-tidal areas. This has been achieved through the construction of flood defences, in the form of concrete walls, glass walls, sheet piled walls, embankments, storm water pumps etc<sup>1</sup>.

It should be noted that whilst existing development clearly benefits from the construction of defences, it is against sustainability objectives, and the general approach of the OPW, to construct defences with the intension of releasing land for development. It is also not appropriate to consider the benefits of schemes which have not been constructed, and which may only be at pre-feasibility or design stage.

Residual risk is the risk that remains after measures to control flood risk have been carried out. Residual risk can arise from overtopping of flood defences and / or from the breach from structural failure of the defences. Residual

The concept of residual risk is explained in 'The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009' as follows:

"Although flood defences may reduce the risk of flooding, they cannot eliminate it. A flood defence may be overtopped by a flood that is higher than that for which it was designed or be breached and allow flood water to rapidly inundate the area behind the defence. In addition, no guarantee can be given that flood defence will be maintained in perpetuity. As well as the actual risk, which may be reduced as a result of the flood defence, there will remain a residual risk that must be considered in determining the appropriateness of particular land uses and development. For these reasons,

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<sup>1</sup> Suir CFRAM Study Hydraulics Report, Final, July 2016

flooding will still remain a consideration behind flood defences and the flood zones deliberately ignore the presence of flood defences."

Overtopping of flood defences will occur during flood events greater than the design level of the defences. Overtopping is likely to cause more limited inundation of the floodplain than if defences had not been built, but the impact will depend on the duration, severity and volume of floodwater. However, and more critically, overtopping can destabilise a flood defence, cause erosion and make it more susceptible to breach or fail. Recovery time and drainage of overtopping quantities should also be considered. Overtopping may become more likely in future years due to the impacts of climate change and it is important that any assessment of defences includes an appraisal of climate change risks.

Breach or structural failure of flood defences is hard to predict and is largely related to the structural condition and type of flood defence. 'Hard' flood defences such as solid concrete walls are less likely to breach than 'soft' defence such as earth embankments. Breach will usually result in sudden flooding with little or no warning and presents a significant hazard and danger to life. There is likely to be deeper flooding in the event of a breach than due to overtopping.

The assessment of breach should be proportionate to the likelihood of the defence failing, taking into account the age, maintenance regime, construction type and the presence of any demountable or mechanically operated components.

Whilst it is important that residual risks are recognised and appropriate management measures put in place, it is also important to acknowledge the benefits that a flood relief scheme provides to those living and working behind it. In this regard, although 'The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009' requires flood zones to be undefended, consideration should be given to the benefit provided by flood defences, but only once the Justification Test has been applied and passed.

#### 4.4.4 Pluvial Flooding

Flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. The resulting water follows along natural valley lines, creating flow paths along roads and through and around developments and ponding in low spots, which often coincide with fluvial floodplains. Any areas at risk from fluvial flooding will almost certainly be at risk from surface water flooding.

An overall strategy for the management of pluvial risk is presented, and should be implemented across all development proposals. This, and recommendations for the assessment of surface water risks, are provided in Section 5.4.

As a longer term strategy, it is recommended that surface water management plans be prepared for the larger settlements in County Waterford. These should consider the applicability of different SuDS techniques for managing surface water run-off at key development sites, and also identify where integrated and area based provision of SuDS and green infrastructure are appropriate in order to avoid reliance on individual site by site solutions.

#### 4.4.5 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. In the larger events that are less frequent but have a higher consequence, surface water will exceed the sewer system and flow across the surface of the land, often following the same flow paths and ponding in the same areas as overland flow.

Foul sewers and surface water drainage systems are spread extensively across the urban areas with various interconnected systems discharging to treatment works and into local watercourses.

#### 4.4.6 Groundwater Flooding

Groundwater flooding is caused by the emergence of water originating from underground and is particularly common in karst landscapes. This can emerge from either point or diffuse locations. The occurrence of groundwater flooding is usually very local and unlike flooding from rivers and the sea, does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, groundwater flooding can cause significant damage to property, especially in urban areas and pose further risks to the environment and ground stability. Groundwater flooding is not considered to be a significant risk in Waterford; the OPW's PFRA study did not identify any groundwater flood risk locations.

#### 4.5 Climate Change

In addition to the current level of flood risk (either fluvial or coastal), the SFRA has identified a number of settlements which could be at significantly greater risk when future (climate change) scenarios are considered. These settlements are mainly located along the coast, where between a 0.5m (medium range future scenario) and 1m (high end future scenario) rise in sea level should be allowed for, based on current OPW guidance. This appraisal has not included storm damage which occurs currently or may occur in the future; it is based on still sea levels only.

Where land is to be zoned for development, it is important that the long term viability of the area is understood and can be managed. In the main, this will involve moving zoning objectives inland, rather than targeting new development along the areas at high future risk of flooding.

As with the other areas of risk, the CFRAM and IPCSS both provided future flood extents for its AFAs and coastal margins. As sea level rise will have potentially damaging consequences, the impact of this for both the MRFS and HEFS should be understood for coastal settlements.

Where the OPW and WCCC are designing flood relief schemes for an area consideration will be given to the management of climate change risks within the scheme design. However, this may follow an adaptive approach whereby the defence height is based on current design levels but the foundations of the walls and embankments are designed to take additional loading should the defences be raised in the future.

#### 4.6 Settlement Classification

The Flood Zones were overlaid on the settlement boundaries to allow a preliminary review to be made of those towns and villages which are removed from flood risk, or where flood risk can be managed through surface water and drainage system design.

A number of the higher tier settlements have zoning objectives and have been subject to detailed review. All other settlements will be indicated by reference by a settlement boundary but no specific zoning objectives (see Table 4-3). A number of criteria are specified with the Development Plan to determine the appropriateness of a site for a specific development, and one of these is the Flood Zone in which the site is located; the sequential approach shall be applied within those settlements to avoid development in areas of flood risk. In these cases, the Plan Making Justification Test has not been applied so it is not possible for the Development Management Justification test to be passed and all new development should be located in Flood Zone C, with the exception of minor development (Section 5.28 of the Planning Guidelines).

Of the settlements that have zoning objectives and showed some level of risk of flooding (from fluvial, groundwater or coastal sources) a more detailed assessment of the quality and coverage of the flood data available was made, including overlaying the current zoning objectives and considering the required level of intensification of development that will be required to meet the Core Strategy. A comment on all sources of flood risk has been provided in the following tables, although it is the fluvial and tidal risks which are the main focus of the Flood Zones and zoning objective review process.

Table 4-3: Settlement hierarchy and approach within SFRA

Class	Category	Place	Level of assessment with this SFRA
1	City-Metropolitan Area	Waterford City	Zoning objectives have been reviewed in light of the Flood Zone mapping.
2	Key Town	Dungarvan, including Ballinroad	Zoning objectives have been

Class	Category	Place	Level of assessment with this SFRA
		Clonmel Environs	reviewed in light of the Flood Zone mapping.
3A	Large Urban Town	Tramore	Zoning objectives have been reviewed in light of the Flood Zone mapping.
3B	Urban Town	Dunmore East, Portlaw, Lismore	
4A	Rural Towns	Cappoquin, Kilmacthomas, Tallow, Ardmore, Gaeltacht na nDéise (inc Sean Phobal), Passage East/Crooke, Stradbally,	A screening of risk has been carried out within the settlement boundary. Plan Making Justification Test has not been applied or passed so the sequential approach shall be followed and development within Flood Zone A will be avoided, whilst in Flood Zone B only less vulnerable uses will be appropriate, subject to site specific FRA.
4B	Rural Villages	Aglish, Ballyduff Upper, Ballymacarbry, Bonmahon/Knockmahon, Cheekpoint, Clashmore, Clonea Power, Dunhill, Kill, Kilmeaden/Ballyduff, Lemybrien/Kilrossanty, Rathgormuck, Touraneena, Villierstown.	
5	Rural Nodes	Annestown, Ballylaneen, Ballymacaw, Butlerstown, Faithlegg, Fenor, Grange, Kilbrien, Knockanore, Mellary, Modeligo, Piltown, Whitechurch.	A screening of risk has been carried out with the settlement boundary. Plan Making Justification Test has not been applied or passed so the sequential approach shall be followed and development within Flood Zone A will be avoided, whilst in Flood Zone B only less vulnerable uses will be appropriate, subject to site specific FRA.

## 5 Approach to Flood Management

### 5.1 The Strategic Approach

A strategic approach to the management of flood risk is important in County Waterford as the risks are varied and disparate, with scales of risk and scales of existing and proposed development varying greatly across the county.

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 may then be given to factors which moderate risks, such as defences, and finally consideration of suitable flood risk mitigation and site management measures is necessary.

It is important to note that whilst it may be technically feasible to mitigate or manage flood risk at site level, strategically it may not be a sustainable approach.

A summary of flood risks associated with each of the zoning objectives has been provided in Table 5-1, below. It should be noted that this table is intended as a guide to be used in the Plan Making stage, and should be read in conjunction with the detailed assessment of risks for each settlement. The Flood Risk Commentary indicates whether a certain land zoning, in Flood Zone A or B, will need to have the Plan Making Justification Test (JT) applied and passed.

When carrying out a site specific FRA, or when planning applications are being considered, it is important to remember that not all uses will be appropriate on flood risk grounds, hence the need to work through the Justification Test for Development Management on a site by site basis and with reference to Section 6. For example, the Town / Village Centre zoning objective is "to include for an integrated mix of residential, commercial, community and social uses" which have varying vulnerabilities and would not be equally permissible within Flood Zone A and B.

Table 5-1: Zoning objective vulnerability

USE	Zoning	Indicative Primary Vulnerability	Flood Risk Commentary
Residential	New Residential	Highly Vulnerable	JT required for within Flood Zone A and B.
	Residential		
	Residential: Strategic Reserve		
Urban/ Town	Town Core	Less / highly vulnerable	JT required for within Flood Zone A and B, and for highly vulnerable development in Flood Zone B.
	General Business		
	Regeneration		
Community Services and Infrastructure	Community Infrastructure	Less / highly vulnerable	JT required for within Flood Zone A and B, and for highly vulnerable development in Flood Zone B.
	Open Space and Recreation	Water compatible	JT not needed for water compatible uses, but consideration to be given to flood risks and sequential use of land.
	Transport and Utilities infrastructure	Less / highly vulnerable	JT required for within Flood Zone A and B, and for highly vulnerable development in Flood Zone B.
Rural	High Amenity	Water	JT not needed for water

USE	Zoning	Indicative Primary Vulnerability	Flood Risk Commentary
	Rural Village	compatible	compatible uses, but consideration to be given to flood risks and sequential use of land.
Employment	Special Industry	Less / highly vulnerable	JT required for within Flood Zone A and B, and for highly vulnerable development in Flood Zone B.
	Light Industry/ High Technology/ Manufacturing Campus Development	Less vulnerable	Appropriate use in Flood Zone B, but JT will be needed in Flood Zone A.
	Tourism	Less vulnerable	Appropriate use in Flood Zone B, but JT will be needed in Flood Zone A.
White lands	White lands	Water compatible / less / highly vulnerable	JT has not been applied and sequential approach to avoid development in areas at risk of flooding.

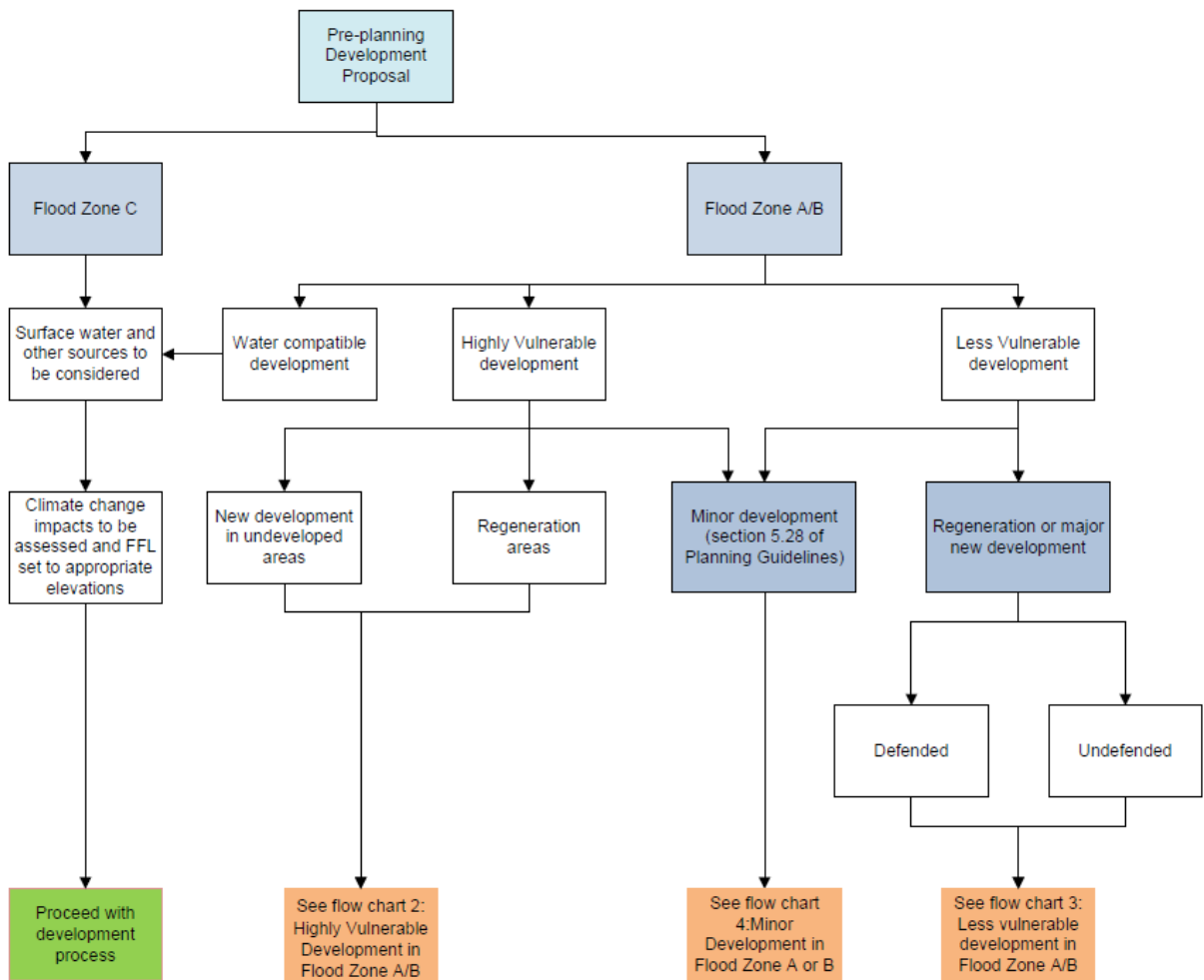
## 5.2 Development Scenarios and Flow Charts

To guide applicants and planning officials through the process of planning for and mitigating flood risk at a site level, the key features of a range of development scenarios have been identified (relating the flood zone, development vulnerability and presence or absence of defences). For each scenario, a number of considerations relating to the suitability of the development are summarised below. The scenarios identified are:

- Development wholly within Flood Zone C and Drainage Impact Assessment
- Minor developments in Flood Zone A or B
- Highly vulnerable development in Flood Zone A or B
- Less vulnerable development in Flood Zone A or B
- Water compatible uses in Flood Zone A or B
- Climate change

Each of these scenarios is also supported by a flow chart which summarises the decision-making process with regard to flood risk and different vulnerabilities of development. The flow charts are referenced through the following pages and are located in Appendix A, with Flow Chart 1 reproduced below.

Flow Chart 1: Development Management Process



It should be noted that this section of the SFRA applies only to land that has passed the Justification Test for Development Plans, and therefore Part 1 of the Justification Test for Development Management. Where this is not the case then further guidance, provided on a site by site basis, will be required from Waterford County Council and in accordance with Section 5.27 of the Planning Guidelines.

### 5.3 Requirements for a Flood Risk Assessment

Assessment of flood risk is required in support of any planning application. The level of detail will vary depending on the risks identified and the proposed land use. As a minimum, all proposed development, including that in Flood Zone C, must consider the impact of surface water flood risks on drainage design. In addition, flood risk from sources other than fluvial and tidal should be reviewed. The assessment may be a qualitative appraisal of risks, including drainage design. Alternatively, the findings of the CFRAM, or other detailed study, may be drawn upon to inform finished floor levels. In other circumstances a detailed modelling study and flood risk assessment may need to be undertaken. Further details of each of these scenarios, including considerations for the flood risk assessment are provided in the following sections.

For sites within Flood Zone A or B, a site specific "Stage 2 - Initial FRA" will be required and may need to be developed into a "Stage 3 - Detailed FRA". The extents of Flood Zone A and B are delineated through this SFRA. However, future studies may refine the extents (either to reduce or enlarge them) so a comprehensive review of available data should be undertaken once a SSFRA has been triggered.



Within the SSFRA the impacts of climate change and residual risk (including culvert/structure blockage) and more extreme scenarios (such as the 0.1% AEP fluvial and tidal event) should be considered and modelled or remodelled where necessary. Further information on the required content of the SSFRA is provided in the Planning System and Flood Risk Management Guidelines.

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 (where required) the proposal will demonstrate that appropriate mitigation and management measures are put in place.

Although there are many locations where development may, in the future, benefit from a flood relief scheme, the assessment must progress on the basis of the current level of protection and any risks to the development itself or third party land must be managed as part of the development design.

## 5.4 Drainage impact assessment

All proposed development, including that in Flood Zone C, must consider the impact of surface water flood risks on drainage design. All development must pass through this stage before completing the planning and development process and should be accompanied by an appropriately detailed flood risk assessment, or drainage impact assessment, as appropriate.

Areas vulnerable to ponding are indicated on the OPW's PFRA mapping. However, this mapping is not exhaustive and more general consideration should be given to surface water management for development in low-lying areas which may act as natural ponds for collection of runoff.

The drainage design should ensure no increase in flood risk to the site, or the downstream catchment. Considerable detail on the process and design of SUDS is provided in the Greater Dublin Strategic Drainage Study (which in the absence of other guidance may be applied in County Waterford).

Where surface water attenuation forms part of the system, consideration should be given to the level of the outfall to the watercourse or sea. If this outfall will be below flood levels, an assessment of the additional storage required for the period when the outfall is submerged and free discharge is not possible, will need to be made. It is recommended that this is done on the basis of joint probability, with the worst case selected. For example, in a tidal situation this might be the 10% AEP tide with the 1% AEP rain storm and the 0.5% AEP tide with the 10% AEP rain event. Similar combinations of events should be tested for the fluvial situation.

For larger sites (i.e. multiple dwellings or commercial units) 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. Where this is not possible, an alternative design appropriate to the location may be prepared.

## 5.5 Development in Flood Zone C

Where a site is within Flood Zone C, but adjoining or in close proximity to Flood Zone A or B, there could be a risk of flooding associated with factors such as future scenarios (climate change) or in the event of failure of a defence, blocking of a bridge or culvert. Risk from sources other than fluvial and coastal must also be addressed for all development in Flood Zone C. As a minimum in such a scenario, a flood risk assessment should be undertaken which will screen out possible indirect sources of flood risk. Where they cannot be screened out the FRA should present mitigation measures. The most likely mitigation measure will involve setting finished floor levels to a height that is above the 1% AEP fluvial or 0.5% AEP tidal flood level, with an allowance for climate change and freeboard, or to ensure a step up from road level to prevent surface water ingress. Design elements such as channel maintenance or trash screens may also be required. Evacuation routes in the event of inundation of surrounding land should also be detailed.

The impacts of climate change should be considered for all proposed developments. This is particularly important for development near areas at risk of tidal flooding. A development which is currently in Flood Zone C may be shown to be at risk when 0.5m is added to the extreme (0.5% AEP) tide. Details of the approach to incorporating climate change impacts into the assessment and design are provided in Section 5.8.

## 5.6 Development in Flood Zone A and B

Within Flood Zone A and B, potential development has been classed as either minor (typically extensions and changes of use) or major new development. When considering major development, whether the site is in Flood Zone A or B becomes important and will guide the approach to be taken.

### 5.6.1 Minor Developments

Section 5.28 of the Planning Guidelines on Flood Risk Management identifies certain types of development as being 'minor works' and therefore exempt from the Justification Test. Such development relates to works associated with existing developments, such as extensions, renovations and rebuilding of the existing development, small scale infill and changes of use. The assessment process for this form of development is provided in Flow Chart 4.

As the proposal relates to existing buildings, the 'Sequential Approach' and 'Justification Test' cannot apply, but an assessment of the risks of flooding should accompany such applications. This must demonstrate that the development would not increase flood risks by introducing significant numbers of additional people into the flood plain and/or putting additional pressure on emergency services or existing flood management infrastructure. The development must not have adverse impacts or impede access to a watercourse, floodplain or flood protection and management facilities. Where possible, the design of built elements in these applications should demonstrate principles of flood resilient design (See 'The Planning System and Flood Risk Management Guidelines for Planning Authorities Technical Appendices, 2009', Section 4 - Designing for Residual Flood Risk).

In many situations, the approach to deal with flooding would involve raising the ground floor levels above the level of extreme river levels. This is likely to cause problems for infill development sites and existing buildings. It is therefore recognised that some flexibility could be allowed, in limited circumstances and on a site by site basis, and depending on the level of risk presented. In these cases, the detailed design of the development should reflect the vulnerability of the site in terms of internal layout, materials, fixtures and fittings and internal layout. For high risk areas, less vulnerable uses are encouraged at ground floor levels. A site specific FRA will inform appropriate uses and detailed design and layout.

It should be noted that for residential buildings within Flood Zone A or B, bedroom accommodation is more appropriate at upper floor levels.

For commercial operations, business continuity must be considered, and steps taken to ensure operability during and recovery after a flood event for both residential and commercial developments. Emergency access must be considered as in many cases flood resilience will not be easily achieved in the existing built environment.

### 5.6.2 Highly vulnerable development

Highly vulnerable development in Flood Zones A or B needs to have passed both the Plan Making Justification Test and the Justification Test for Development Management. Development which is highly vulnerable to flooding, as defined in The Planning System and Flood Risk Management, includes (but is not limited to) dwelling houses, hospitals, emergency services and caravan parks. Such development has been divided into new builds and existing developed areas. The assessment process for this form of development is provided in Flow Chart 2.

#### 5.6.2.1 New development

It is not appropriate for new, highly vulnerable development to be located on greenfield land in Flood Zones A or B, particularly outside the core of a settlement and where there are no flood defences. Such proposals do not pass the Justification Test. Instead, a less vulnerable use should be considered.

In some cases, land use objectives which include for a highly vulnerable use have been justified in the Development Plan. In the main, this would be town centre zonings, which allow for a mix of residential, commercial and other uses. In such cases, a sequential approach to land use within the site must be taken. This is illustrated in Flow Chart 2, and must consider the presence or absence of defences, land raising and provision of compensatory storage, safe access and egress in a flood and the wider development area.

### 5.6.2.2 Existing developed areas

In cases where development has been justified through the Plan Making process, the outline requirements for a flood risk assessment and flood management measures have been detailed in the following sections. Of prime importance are the requirement to manage risk to the development site and not to increase flood risk elsewhere. This should give due consideration to safe evacuation routes and access for emergency services during a flood event.

### 5.6.3 Less vulnerable development

This section applies to less vulnerable development in Flood Zone A which has passed the Justification test for development plans, and less vulnerable development in Flood Zone B, where this form of development is appropriate, and the Justification Test is not required.

Less vulnerable development includes retail, leisure and warehousing and buildings used for agriculture and forestry. This category includes less vulnerable development in all forms, including refurbishment or infill development, and new development both in defended and undefended situations. The assessment process for this form of development is provided in Flow Chart 3.

The design of less vulnerable development should generally begin with 1% AEP fluvial or 0.5% tidal events as standard, with climate change and a suitable freeboard included in the setting of finished floor levels.

The presence or absence of flood defences informs the level of flood mitigation recommended for less vulnerable developments in areas at risk of flooding. In contrast with highly vulnerable development, there is greater scope for the developer of less vulnerable uses to accept flood risks and build to a lower standard of protection, which is still high enough to manage risks for the development in question. However, any deviation from the design standard of 1%/0.5% AEP, plus climate change, plus freeboard, needs to be fully justified within the FRA.

### 5.6.4 Water compatible uses

Water compatible uses can include the non-built environment, such as open space, agriculture and green corridors. These uses do not require a flood risk assessment and are appropriate for Flood Zone A and B. However, there are numerous other uses which are classified as water compatible, but which involve some kind of built development, such as lifeguard stations, fish processing plants and other activities requiring a waterside location. The Justification Tests are not required for such development, but an appropriately detailed flood risk assessment is required. This should consider mitigation measures such as development layout and finished floor levels, access, egress and emergency plans. Climate change and other residual risks should also be considered within the SSFRA.

## 5.7 Checklist for Applications for Development in Areas at Risk of Flooding

This section applies to both highly and less vulnerable development in Flood Zone A and highly vulnerable development in Flood Zone B that satisfy the following:

- Meet the definition of Minor Development; or
- Pass the Justification Test for Development Plans and Justification Test for Development Management to the satisfaction of the Planning Authority.

The following checklist is required for all development proposals:

- The SSFRA be carried out by an appropriately qualified Engineer with relevant FRA experience (as deemed acceptable by the Planning Authority), in accordance the Waterford County SFRA and the Flood Risk Guidelines.
- Demonstration that the specific objectives or requirements for managing flood risk set out in this SFRA have been complied with, including an assessment of residual risks.
- Preparation of access, egress and emergency plans which are appropriate to the vulnerability of the development and its occupiers, the intensity of use and the level of flood risk.
- An assessment of the potential impacts of climate change and the adaptive capacity of the development.
- Compliance with C753 CIRIA SUDS guide, GDSDS and inclusion of SuDS.

## 5.8 Climate Change

Ireland's climate is changing and analysis of the potential impacts of future climate change is essential for understanding and planning. 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 failure. As laid out in the Climate Adaptation Strategy, new development should include consideration of climate change impacts on fluvial, pluvial and tidal source of flooding.

The Planning Guidelines recommend that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects. 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 guidance<sup>2</sup>. However, this guidance is over 10 years old now and climate science, particularly in relation to sea level rise, has developed rapidly. There are many coastal related climate change impacts, these include:

- continued sea level rise;
- potentially more severe Atlantic storms, which could generate more significant storm surges and extreme waves;
- increased water depths lead to larger waves reaching the coast.

The OPW guidance recommended two climate change scenarios are considered. These are the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). The allowances should be applied to the 1% AEP fluvial or 0.5% AEP tidal levels. Where a development is critical or extremely vulnerable (see Table 5-2) the impact of climate change on 0.1% AEP flows should also be applied, and greater climate change allowances tested for resilience purposes.

These climate change allowances are particularly important at the development management stage of planning and will ensure that proposed development is designed and constructed according to current local and national Government advice.

Table 5-2: Climate change allowances by vulnerability and flood source

Development vulnerability	Fluvial climate change allowance (increase in flows)	Tidal climate change allowance (increase in sea level)	Storm water / surface water
Less vulnerable	20%	0.5m (MRFS)	20% increase in rainfall
Highly vulnerable	20%	0.5m (MRFS)	
Critical or extremely vulnerable (e.g. hospitals, major sub-stations, blue light services)	30%	1.0m (HEFS)	
Note: there will be no discounting of climate change allowances for shorter lifespan developments.			

Further work on the impacts of climate change on flood levels was undertaken as part of the various CFRAM Studies and the ICPSS. The studies provided flood extents for both fluvial and coastal risk, which are available on [www.floodinfo.ie](http://www.floodinfo.ie).

Assessment of climate change impacts can be carried out in a number of ways. For watercourses that fall within the CFRAM study areas, flood extents and water levels for the MRFS and HEFS have been developed. For other fluvial watercourses a conservative approach would be to take the 0.1% AEP event levels and extent as representing the 1% AEP event plus climate change. Where access to the hydraulic river model is readily available a run with climate change could be carried out, or hand calculations undertaken to determine the likely impact of additional flows on river levels. In a coastal or tidal scenario, a 0.5 or 1m increase to the 0.5% AEP sea level can be assessed based on topographic levels.

<sup>2</sup> OPW Assessment of Potential Future Scenarios, Flood Risk Management Draft Guidance, 2009

## 5.9 Flood Mitigation Measures at Site Design

For any development proposal in an area at moderate or high risk of flooding that is considered acceptable in principle (i.e. has passed the Plan Making Justification Test), the site specific FRA must demonstrate that appropriate mitigation measures can be put in place and that residual risks can be managed to acceptable levels. This may include 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.

Various mitigation measures are outlined below and 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<sup>3</sup>.

It should be emphasised that measures such as those highlighted below should only be considered once it has been deemed 'appropriate', to allow development in a given location or the Justification Test for Development Plans has been passed. The Planning Guidelines do not advocate an approach of engineering solutions in order to justify the development which would otherwise be inappropriate.

### 5.9.1 Site Layout and Design

To address flood risk in the design of new development, a risk-based approach should be adopted to locate more vulnerable land use to higher ground while water compatible development i.e. car parking (with appropriate flood management plan) and recreational space can be located in higher flood risk areas.

The site layout should identify and protect land required for current and future flood risk management. Waterside areas or areas along known flow routes can be used for recreation, amenity and environmental purposes to allow preservation of flow routes and flood storage, while at the same time providing valuable social and environmental benefits.

At an individual building level, assigning a water compatible use, such as open public realm, or less vulnerable use to the ground floor level, along with suitable flood resilient construction, is an effective way of raising vulnerable living space above design flood levels. It can however have an impact on the streetscape. The provision of safe access and egress is a critical consideration in allocating ground floor uses.

### 5.9.2 Ground levels, floor levels and building use

Modifying ground levels to raise land above the design flood level is a very effective way of reducing flood risk to the site. However, in most areas of fluvial flood risk, conveyance or flood storage would be reduced locally and could increase flood risk off site. There are a number of criteria which must all be met before this is considered a valid approach:

- Development at the site must have been justified through this SFRA based on the existing (unmodified) ground levels.
- The FRA should establish the function provided by the floodplain. Where conveyance is a prime function then a hydraulic model will be required to show the impact of its alteration.
- The land being given over to storage must be land which does not flood in the 1% AEP fluvial event (i.e. Flood Zone B or C).
- Compensatory storage should be provided on a level for level basis to balance the total area that will be lost through infilling where the floodplain provides static storage.
- The provision of the compensatory storage should be in close proximity to the area that storage is being lost from (i.e. within the same flood cell).
- The land proposed to provide the compensatory storage area must be within the ownership / control of the developer.
- The compensatory storage area should be constructed before land is raised to facilitate development.

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<sup>3</sup> The Planning System and Flood Risk Management Guidelines for Planning Authorities, Technical Appendices, November 2009

- Compensatory storage is generally not required for loss of floodplain in a tidal scenario, or in locations behind defences.

In some sites it is possible that ground levels can be re-landscaped to provide a sufficiently large development footprint. However, it is likely that in other potential development locations there is insufficient land available to fully compensate for the loss of floodplain. In such cases it will be necessary to reconsider the layout or reduce the scale of development or propose an alternative and less vulnerable type of development. In other cases, it is possible that the lack of availability of suitable areas of compensatory storage mean the target site cannot be developed and should remain open space.

Raising finished floor levels within a development is an effective way of avoiding damage to the interior of buildings (i.e. furniture and fittings) in times of flood. Finished floor levels should be assessed in relation to the specific development, but the minimum levels set out in Table 5-3 should apply. It should be noted that in certain locations it may be appropriate to adopt a more precautionary approach to setting finished floor levels, for example where residual risks associated with bridge blockage occur or the 0.1% AEP event is more extreme, and this should be specifically assessed in the SSFRA. It is also noted that typically finished floor levels should be set a minimum of 300mm above surrounding ground levels to prevent ingress of surface water.

Table 5-3: Recommended minimum finished floor levels

Scenario	Finished floor level to be based on
Fluvial, undefended	1% AEP flood + climate change (as Table 5-2) + 300mm freeboard
Tidal, undefended	0.5% AEP flood + climate change (as Table 5-2) + 300mm freeboard.
Fluvial, defended	1% AEP flood + 300mm freeboard. Climate change does not need to be included, provided it is included in the defence height or adaption plan for the scheme.
Tidal, defended	0.5% AEP flood + 300mm freeboard. Climate change does not need to be included, provided it is included in the defence height or adaption plan for the scheme.

### 5.9.3 Raised Defences

Construction of raised defences (i.e. flood walls and embankments) has traditionally been the response to flood risk. However, this is not a preferred option on an ad-hoc basis and where the defences to protect the development are not part of a strategically led flood relief scheme. Where a defence scheme is proposed as the means of providing flood defence, the impact of the scheme on flood risk up and downstream must be assessed and appropriate compensatory storage must be provided.

A site is considered to be defended if the standard of protection is 1% AEP (fluvial) or 0.5% AEP (tidal), within which a freeboard of at least 300mm is included. The FFL of the proposed development needs to include for the impacts of climate change and other residual risks, including overtopping in the 0.1% event, unless this has also been incorporated into the defence design. This may be assessed through breach analysis, overtopping analysis or projection of water levels across the floodplain.

### 5.9.4 Emergency Flood Response Plans

In some instances, and only when all parts both the Plan Making and Development Management Justification Tests have been passed, it may be necessary for an emergency flood response plan to be prepared to support other flood management measures within the context of a less vulnerable or water compatible development. An emergency response plan may be required to trigger the operation of demountable flood defences to a less vulnerable development, evacuation of a car park or closure of a business or retail premises.

The emergency plan will need to detail triggers for activation, including receipt of a timely flood warning, a staged response and to set out the management and operational roles and responsibilities. The plan will also need to set out arrangements for access and egress, both for pedestrians, vehicles and emergency services. The details of the plan should be based on an

appropriately detailed assessment of flood risk, including speed of onset of flooding, depths and duration of inundation.

However, just because it is possible to prepare an emergency plan does not mean this is advisable or appropriate for the nature and vulnerability of development and WCCC will not accept an emergency response plan as part of a residential development.

## 5.10 'Green Corridor'

It is recommended that, where possible, and particularly where there is greenfield land adjacent to the river, a 'green corridor', is retained on all rivers and streams. 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;
- Allows access to the river for maintenance works;
- 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 (i.e. all of Flood Zone A).

## 6 Application of the Justification Test

Having reviewed the level of flood risk within the County and determined appropriate measures for assessing and managing risks to high and low vulnerability development in Flood Zones A, B and C, a more detailed assessment of sites and areas was carried out. The aim of this assessment was to apply the Plan Making Justification Test, taking into account circular PL02/2014 in relation to existing development. The tables in the following sections detail the assessment of risk in relation to all zoned land. The recommendations and observations have been adopted by Waterford City and County Council and used to inform the settlement zoning objectives which are detailed in the County Development Plan.

### 6.1 Risk to existing, highly vulnerable, development

Circular PL02/2014 states that *“In some instances, particularly in older parts of cities and towns, an existing land use may be categorised as a “highly vulnerable development” such as housing, be zoned for residential purposes and also be located in flood zone A/B. Additional development such as small scale infill housing, extension or changes of use that could increase the risk or number of people in the flood-prone area can be expected in such a zone into the future. In these instances, where the residential/vulnerable use zoning has been considered as part of development plan preparation, including uses of the Justification Test as appropriate, and it is considered that the existing use zoning is still appropriate, the development plan must specify the nature and design of structural or non-structural flood risk management measures prior to future development in such areas in order to ensure that flood hazard and risk to the area and to other adjoining locations will not be increased or, if practicable, will be reduced”*.

#### 6.1.1 Settlements with Zoning Objectives

There are a number of such areas in the County identified on the Flood Zone maps, including existing housing and established development in Waterford City and Dungarvan. It is considered that it would be unrealistic to down zone these lands as they are fully developed and constitute core areas of the settlements.

In applying the Justification Test Part 3, consideration has been given to structural and non-structural measures which may be required prior to further development taking place. In most locations, future opportunities for development are likely to be limited to small extensions, infill houses or small commercial units and changes of use. As such, in most areas flood risk can be addressed through non-structural responses, such as requiring a site specific flood risk assessment which will identify appropriate mitigation measures such as retaining flow paths, flood resilient construction and emergency planning.

#### 6.1.2 Settlements without Zoning Objectives

There are a number of such areas in the County identified on the Flood Zone maps, including existing housing and established development in settlements such as Ballinroad and Clonea Power, where existing residential development is within Flood Zone A and B. Several other settlements also show predicted flood risk to harbour or coastal areas. These settlements do not have specific zoning objectives and have not been subject to the Justification Test, but with careful planning the sequential approach can be applied.

In Aglish and Ballyduff Upper, flood risk is greater and non-structural (planning based) responses to major new development are not appropriate to the scale of risks. In these locations, structural measures, generally in the form of flood defences, will be required prior to future development occurring within Flood Zone A and B. Further detail on the specifics of the flood management measures in these locations are available in the various CFRAM Study reports.

The following sections provide more detail on flood risk to settlements within County Waterford and gives details of the outcome of the Justification Test where this is required.



## 7 Settlement Based Flood Risk Assessment

Within Waterford the various settlements have differing levels of flood risk and a screening exercise has been carried out to ensure an appropriate level of assessment is provided in each settlement.

### 7.1 Settlements in Flood Zone C

An initial screening of flood risk was undertaken to identify which settlements were located wholly within Flood Zone C. In the settlements listed below no fluvial or tidal flood risk was identified through the Flood Zone mapping, and development proposals should proceed following the approach laid out in Sections 5.4 and 5.5 to ensure all other sources of flood risk, including surface water, groundwater and unmapped drains, have been appropriately assessed and, where required, mitigated.

It should be noted that of the settlements listed below, only Lismore has land use zoning objectives and the others have a settlement boundary in place of land use zoning.

- Annestown
- Ballinroad
- Ballyduff
- Ballylaneen
- Ballymacaw
- Bawnfune
- Buttlerstown
- Croke
- Faithleg
- Grange
- Kill
- Kilbrien
- Kilrossanty
- Knockanore
- Lismore
- Melleray
- Modeligo
- Piltown
- Rathgormack
- Stradbally
- Tooraneena
- Villerstown
- Whitechurch

### 7.2 Settlements in Flood Zone A and B

The sites below were identified as lying partly within Flood Zones A, B and C, and have zoning objectives detailed within the Development Plan. The following sections provide further detail of the risks within each of the listed settlements, including consideration of the need for the Plan Making and Development Management Justification Tests. It should be noted that in all cases, part of the settlement is also within Flood Zone C and for these areas, development proposals should proceed following the approach laid out in Sections 5.4 and 5.5 to ensure all other sources of flood risk, including surface water, groundwater and unmapped drains, have been appropriately assessed and, where required, mitigated.

- Clonmel Environs
- Dungarvan (inc Ballinroad)
- Dunmore East
- Gaeltacht na nDéise
- Portlaw
- Tramore
- Waterford

#### 7.2.1 Waterford City and Environs

Waterford City benefits from existing defences on John's River and the right bank of the River Suir. The defences were recently completed and provide protection against the 0.5% AEP event, with a 500mm freeboard. A climate change allowance has not been built into the freeboard level. The 0.1% AEP event is also contained within the design crest height by virtue of the freeboard allowed, but for the formal standard of protection is the 0.5% AEP event. This means lands behind the defences remain in Flood Zone A.

Behind the defences is much of the town centre, mixed use zonings and a number of opportunity sites and areas with the potential for new or infill development. Although defended, residual risks to these developments need to be assessed, including defence overtopping and climate change impacts.

The North Quays SDZ has been subject to a recent SFRA, which proposed tidal risk be managed through raising FFL above 4.42m OD<sup>4</sup>.

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<sup>4</sup> Waterford North Quays Strategic Development Zone - Strategic Flood Risk Assessment, February 2018

The Justification Test is required for all opportunity sites and areas for potential development, whether located behind defences or not. This has been divided into five key areas, plus existing residential, and the Justification Test is provided below.

Climate change impacts have the potential to be high as Waterford is at risk from sea level rise. Although there is a freeboard of 500mm, this should not be confused with a climate chance allowance. A climate change adaptation strategy is recommended for the city, which should be undertaken for the whole of the scheme rather than on a site by site basis. Climate change in the North Quays SDZ is to be addressed through FFL.

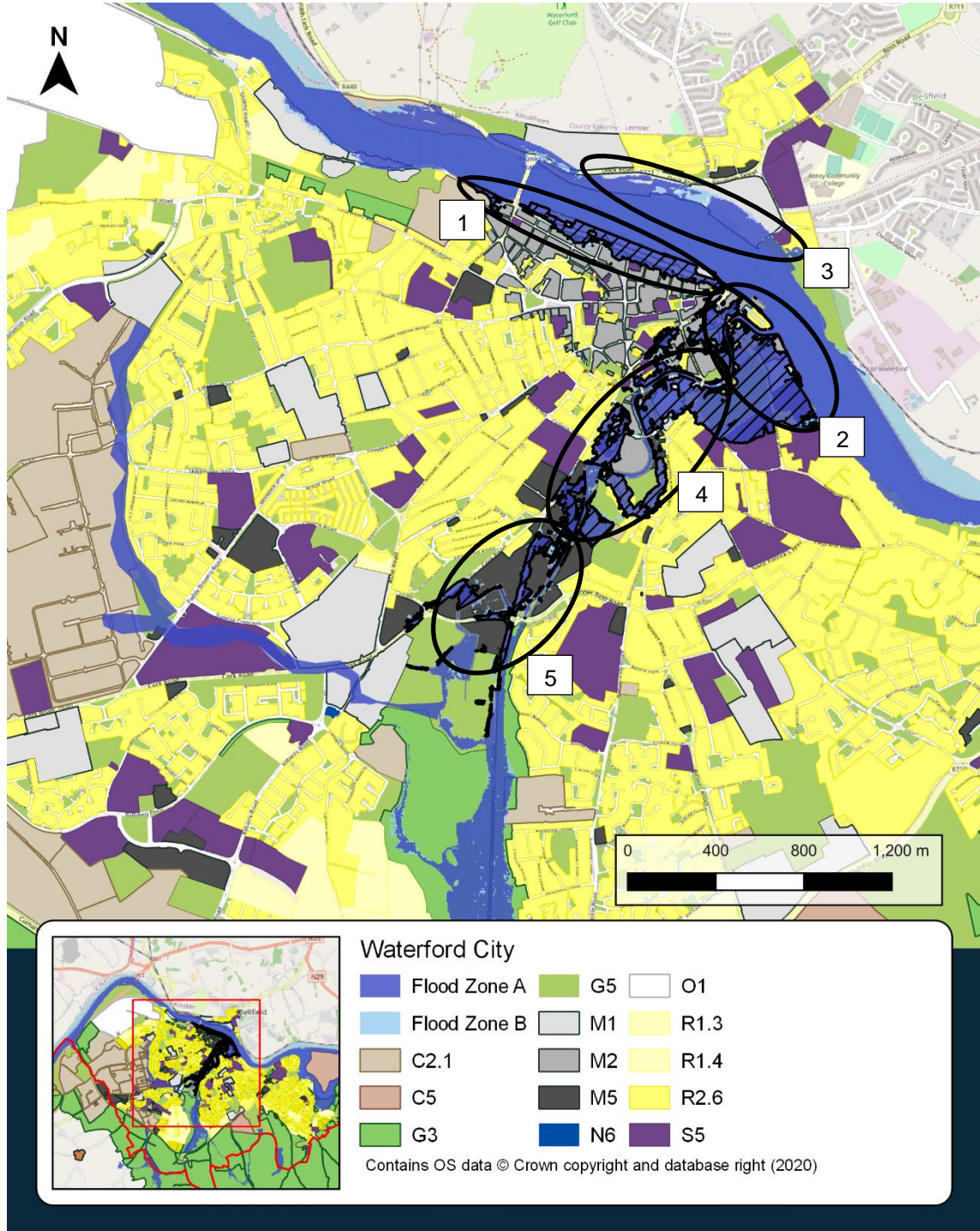


Figure 7-1: Waterford City and Environs Zoning

Table 7-1: Waterford City Justification Test table 1

Justification test for sites within Flood Zone A and / or B	Area 1 - Waterfront mixed use zoning (Carparking)	Area 2 - Waterfront mixed use zoning	Area 3 - North Quays
The urban settlement is targeted for growth	Yes	Yes	Yes
The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement	Lands in the city centre have a historic port use/car park use. The Draft Development Plan has identified that these lands have the capacity to deliver an area of significant amenity for the city centre along with limited commercial mixed uses. The development of this area will assist in achieving the principles of compact city centre first development as provided for in the NPF and RSES.	Lands to the east of the city centre are occupied by a mix of uses, dominated by open space and amenity of the Peoples Park, Water park School and sports fields and built out areas on the periphery of the city centre. Some regeneration and redevelopment lands are located within the floodzone which are either vacant or occupied by mixed commercial premises. The Draft Development Plan has identified that these lands have the capacity to deliver additional mixed use commercial development on brownfield lands and as such the development of this area will assist in achieving the principles of compact city centre first development as provided for in the NPF and RSES.	Lands in the city centre have a historic port use but have been vacant and underutilised for a number of years since the relocation of the Port of Waterford to Belview. The lands have been identified as an SDZ and a Planning Scheme has been prepared in this regard. The Planning Scheme and the Draft Development Plan both identify the potential of this area to deliver significant mixed use regeneration north of the River Suir and thereby contribute to achieving the concentric city as envisaged in the RSES and MASP. The development of this area will also assist in achieving the principles of compact city centre first development as provided for in the NPF and RSES.
Is essential to facilitate regeneration and / or expansion of the centre of the urban settlement.	The development of these lands will form an important element of the enhancement of amenity in the city centre and will assist in linking the north and south quays and lands east and west of the city centre along with relocation of car parking to a more appropriate out of centre or edge of centre location.	The development of these lands will be important in terms of facilitating addition commercial development on the edge of the city centre with possible above ground floor residential uses and associated car parking in support of enhancing the choice and availability of residential units close to the city centre.	The development of these lands will form an important element of the enhancement of amenity in the city centre and will assist in linking the north and south quays and creating a fulcrum north of the river on which to focus the concentric city as envisaged in the RSES and MASP.
Comprises significant previously developed and/ or under-utilised lands	Development opportunities are limited to brownfield sites which are either vacant, or underutilised.	Development opportunities are limited to brownfield sites which are either vacant, or underutilised.	Development opportunities are limited to brownfield sites which are either vacant, or underutilised.
Is within or adjoining the core of an	Redevelopment lands are located at	Redevelopment lands are located on the	Redevelopment lands are located on the

Justification test for sites within Flood Zone A and / or B	Area 1 - Waterfront mixed use zoning (Carparking)	Area 2 - Waterfront mixed use zoning	Area 3 - North Quays
established or designated urban settlement	the centre of the historic city core.	periphery of the historic city centre.	periphery of the historic city centre.
Will be essential in achieving compact and sustainable urban growth	The redevelopment of the brownfield sites will contribute to compact and sustainable growth in a way that will enable Waterford City to meet its designated function as set out in the NPF and RSES.	The redevelopment of the brownfield sites will contribute to compact and sustainable growth in a way that will enable Waterford City to meet its designated function as set out in the NPF and RSES.	The redevelopment of the brownfield sites will contribute to compact and sustainable growth in a way that will enable Waterford City to meet its designated function as set out in the NPF and RSES.
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.	These undeveloped brownfield sites are the only vacant and undeveloped lands in the immediate vicinity of the city centre and as such their redevelopment will support the consolidation of Waterford City and enhancement of amenity and connectivity.	These undeveloped brownfield sites are the only vacant and undeveloped lands in the immediate vicinity of the city centre and as such their redevelopment will support the consolidation of Waterford City.	These undeveloped brownfield sites are the only vacant and undeveloped lands in the immediate vicinity of the city centre and as such their redevelopment will support the consolidation of Waterford City, delivery of the concentric city and enhancement of amenity and connectivity across the city and city centre.
A flood risk assessment to an appropriate level of detail has been carried out	Risks to this area are from direct inundation, based on tidal levels, from the Suir. The current car park use is surface level and considered water compatible, even within the mixed use zoning. The area is defended, and residual risks associated with this particular use are low. However, any change of use / new development in this area must be subject to SSFRA.	Risks to this area are from direct inundation, based on tidal levels, from the Suir. This area is currently developed and benefits from defences which protect against the 0.5% AEP tide (with adequate freeboard) and the 0.1% AEP tide (freeboard level unknown). SSFRA will be needed for future development here, following the flow charts for defended development.	Risks to this area are from direct inundation, based on tidal levels, from the Suir. The North Quays SDZ has been subject to a recent SFRA, which proposed tidal risk be managed through raising FFL above 4.42m OD <sup>5</sup> . Any development proposal will need to be supported by a SSFRA which should the FFL to ensure this is still appropriate, and also consider current climate science with regards to allowances for climate change.
Result	Pass	Pass	Pass
Recommendation for zoning	Retain current zoning and land use.	Retain current zoning and land use.	Retain current zoning and land use.

Table 7-2: Waterford City Justification Test table 2

Justification test for sites within Flood Zone A and / or B	Area 4 - Town centre and mixed use	Area 5 - Upstream mixed use development
The urban settlement is targeted for growth	Yes	Yes
The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement	Lands to the south of the city centre running along the line of the John's River and the Manor to the Cork Road are occupied by a mix of uses including retail, business, open space/ amenity and older historic residential areas/ streets. As with other areas of the historic city, there are some regeneration and redevelopment lands located within the floodzone which are either vacant or occupied by mixed commercial premises. The development of these regeneration sites will assist in achieving the principles of compact city centre first development as provided for in the NPF and RSES.	Lands lying further south of Area 4 running along the line of the John's River and the Cork Road are occupied by a mix of uses including retail, business, open space/amenity and older historic residential areas/streets. The area is predominantly built out and any regeneration will require the displacement of existing uses.
Is essential to facilitate regeneration and / or expansion of the centre of the urban settlement.	The development of these lands will be important in terms of facilitating addition commercial development on the edge of the city centre with possible above ground floor residential uses and associated car parking in support of enhancing the choice and availability of residential units close to the city centre.	The development of these lands will be important in terms of facilitating addition commercial development with possible residential uses and associated car parking in support of enhancing the choice and availability of residential units close to the city centre.
Comprises significant previously developed and/ or under-utilised lands	Development opportunities are limited to brownfield sites which are either vacant, or underutilised.	Development opportunities are limited to brownfield sites which are either vacant, or underutilised.
Is within or adjoining the core of an established or designated urban settlement	Redevelopment lands are located on the approach to the city centre and potential for redevelopment within the floodzone is limited in terms of scale and opportunity.	Redevelopment lands are removed from the city centre but are located along a historic arterial route into the city. Potential for redevelopment within the floodzone is limited in terms of scale and opportunity.
Will be essential in achieving compact and sustainable urban growth	The redevelopment of the brownfield sites will contribute to compact and sustainable growth in a way that will enable Waterford City to meet its designated function as set out in the NPF and RSES.	The redevelopment of the brownfield sites will contribute to compact and sustainable growth in a way that will enable Waterford City to meet its designated function as set out in the NPF and RSES.
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.	These undeveloped brownfield sites are located along the historic arterial route to the city centre. As such their redevelopment will support the consolidation of Waterford City in support of the RSES and MASP.	These undeveloped brownfield sites are limited in number and are located along the historic arterial route to the city centre. As such their redevelopment will support the consolidation of Waterford City in support of the RSES and MASP.
A flood risk assessment to an appropriate level of detail has been carried out	Risks to this area are from a combination of fluvial and tidal risks arising from the Suir and John's River . This area is currently developed and benefits from defences which protect against the	Risks to this area are from fluvial risks arising from John's River, with some influence of the Suir on the flood levels. This area is currently developed and benefits from defences which protect

Justification test for sites within Flood Zone A and / or B	Area 4 - Town centre and mixed use	Area 5 - Upstream mixed use development
	1% AEP fluvial / 0.5% AEP tide (with adequate freeboard) and the 0.1% AEP event (freeboard level unknown). SSFRA will be needed for future development here, following the flow charts for defended development.	against the 1% AEP fluvial / 0.5% AEP tide (with adequate freeboard) and the 0.1% AEP event (freeboard level unknown). SSFRA will be needed for future development here, following the flow charts for defended development.
Result	Pass	Pass
Recommendation for zoning	Retain current zoning and land use.	Retain current zoning and land use.

Table 7-3: Waterford City Justification Test table 3

Justification test for sites within Flood Zone A and / or B	Scattered areas of Existing residential	Ballybeg / Kilbarry
The urban settlement is targeted for growth	Yes	Yes
The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement	These scattered areas of development lands are predominantly under residential use with some commercial uses in and around the city centre/quays. It is likely that redevelopment will be confined to minor development types.	Lands lying further south of Area 5 running partially along the line of the John's River and the Cork Road are occupied by a mix of uses including retail, business, open space/amenity and older historic residential areas/streets. The lands are also zoned for regeneration uses and offer potential for development to support the expansion of WIT and improvement of this main artery into the city centre. Scope also exists for significant enhancement of general amenity and open space. The development of these regeneration sites will assist in achieving the principles of compact, sequential development as provided for in the NPF and RSES.
Is essential to facilitate regeneration and / or expansion of the centre of the urban settlement.	There is limited opportunity for minor development, small infill development or residential extensions.	The development of these lands will be important in terms of facilitating addition commercial development with possible residential uses and associated amenity areas car parking in support of enhancing the choice and availability of residential units and possible student accommodation on the main arterial access route to the city centre.
Comprises significant previously developed and/ or under-utilised lands	Development opportunities are limited to brownfield sites which are either vacant, or underutilised.	Development opportunities are limited to brownfield sites which are either vacant, or underutilised.
Is within or adjoining the core of an established or designated urban settlement	Redevelopment lands are removed from the city centre but are located along a historic arterial route into the city. Potential for redevelopment within the Flood Zone is limited in terms of scale and opportunity.	Redevelopment lands are removed from the city centre but are located along a historic arterial route into the city. Potential for redevelopment within the Flood Zone is limited in terms of scale and opportunity. This route will likely be a high capacity public transport corridor given its location between WIT and the city

Justification test for sites within Flood Zone A and / or B	Scattered areas of Existing residential	Ballybeg / Kilbarry
		centre.
Will be essential in achieving compact and sustainable urban growth	The lands have been predominantly developed out to date with potential for only limited infill and minor development. Development will assist in achieving sustainable compact growth.	The redevelopment of the brownfield sites will contribute to compact and sustainable growth in a way that will enable Waterford City to meet its designated function as set out in the NPF and RSES.
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.	The lands have been predominantly built out for residential uses. Redevelopment will however support the consolidation of Waterford City in support of the RSES and MASP.	These undeveloped brownfield sites are limited in number and are located along the historic arterial route to the city centre. As such their redevelopment will support the consolidation of Waterford City in support of the RSES and MASP.
A flood risk assessment to an appropriate level of detail has been carried out	Risks to this area are from a combination of fluvial and tidal risks arising from the Suir and John's River . This area is currently developed and benefits from defences which protect against the 1% AEP fluvial / 0.5% AEP tide (with adequate freeboard) and the 0.1% AEP event (freeboard level unknown). Minor developments should be supported by an appropriately detailed SSFRA. Mayor future redevelopment will need to be informed by a detailed SSFRA and include application of the sequential approach.	Risks to this area are indicated in the OPW's PFRA mapping, which indicates risk from the John River. It is recognised that this mapping is broadscale and indicative in nature. Development proposals should be accompanied by and appropriately detailed FRA. Once the Flood Zones have been reviewed, and if appropriate refined, the sequential approach should be applied to locate development within Flood Zone C.
Result	Pass	Pass, subject to sequential approach.
Recommendation for zoning	Retain current zoning and land use.	Retain current zoning and land use

### 7.2.2 Dungarvan

The river and estuary in Dungarvan are wide, but flood extents are relatively contained, with the clear exception of the lands north of the town centre and the Duckspool area. Dungarvan and Environs have been listed as one of the settlements to benefit from the OPW's 10 year investment programme, but the timeframe for these works are unknown. It should be noted that although the Duckspool area benefits from some level of protection, this is through informal defences which are infrequently maintained and do not have a certified standard of protection. For the purposes of the SFRA this land is considered to be undefended.

There is some encroachment of Flood Zones A and B into lands zoned for new and existing residential development. In these areas new development here should be limited to Minor Development (Section 5.28 of the Planning Guidelines). There is also risk to some town centre lands (1). The Justification Test has been applied to these areas, along with the existing residential development to the east of Dungarvan (2). Where other lands, including mixed use, strategic reserve and residential zoned lands, lie within Flood Zone A and / B, the sequential approach shall be applied and development within Flood Zone A will be avoided, whilst in Flood Zone B only less vulnerable uses will be appropriate, subject to site specific FRA.

To the west of Dungarvan an area zoned for N6 (other networks and basic infrastructure / utilities, and is currently a petrol filling station with car dealership and shop (3) is partly within Flood Zone A and B. However, the building footprint is within Flood Zone C. Further development of this site should be focused within Flood Zone C.

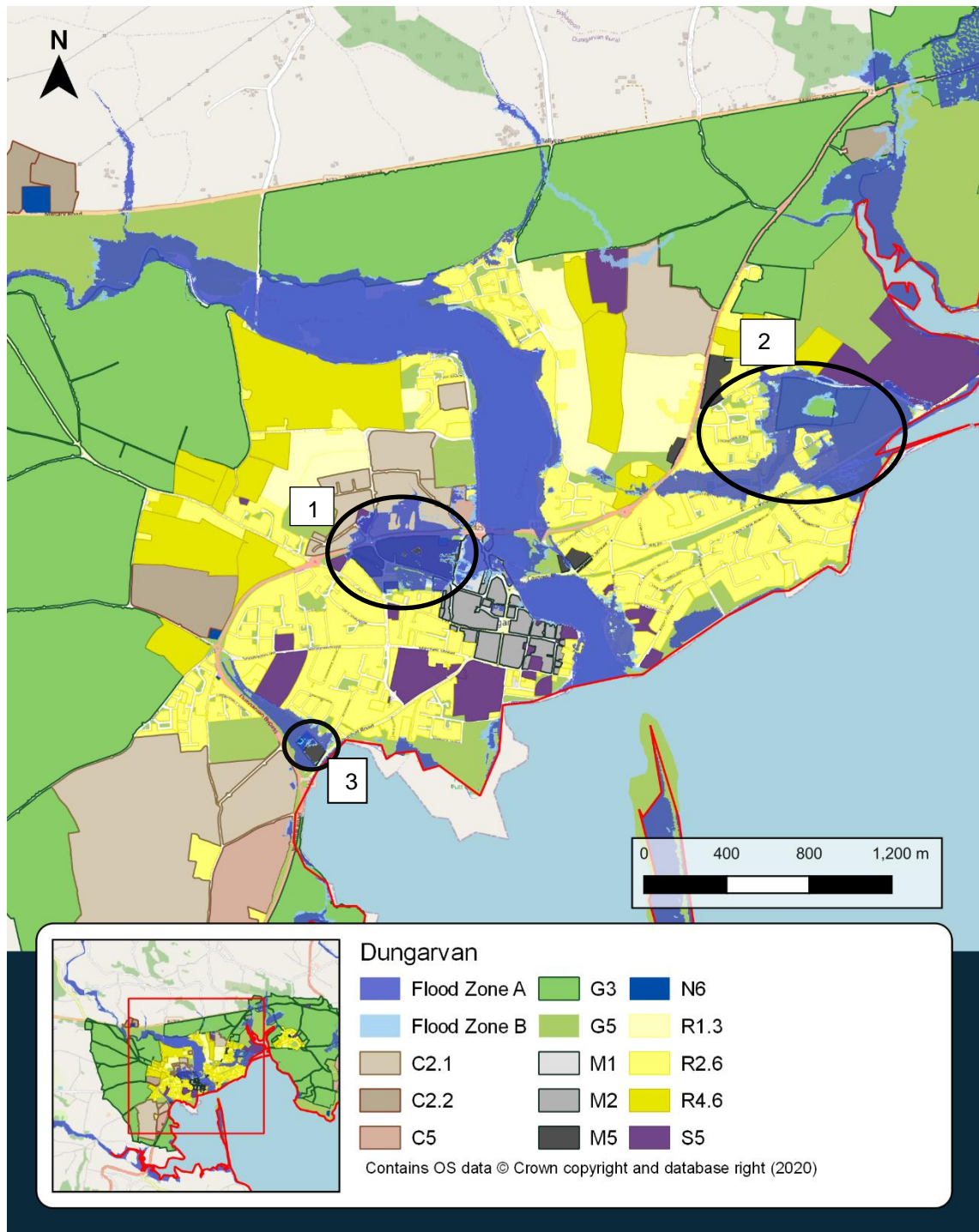


Figure 7-2: Dungarvan Zoning

Table 7-4: Dungarvan Justification Test

Justification test for sites within Flood Zone A and / or B	Area 1 - Town Centre, Mixed Use and Industrial	Area 2 - Existing Residential
The urban settlement is targeted for growth	Yes	Yes
The zoning or designation of the lands for the particular use or	Lands in the town centre consist predominantly of brownfield redevelopment sites and their development will assist in	With the exception of lands which have been identified for green belt/amenity purposes in the Draft Development Plan, the remaining lands have been



Justification test for sites within Flood Zone A and / or B	Area 1 - Town Centre, Mixed Use and Industrial	Area 2 - Existing Residential
development type is required to achieve the proper planning and sustainable development of the urban settlement	achieving the principles of compact town centre first development as provided for in the NPF and RSES.	developed out for residential development predominantly.
Is essential to facilitate regeneration and / or expansion of the centre of the urban settlement.	The development of these regeneration lands will form an important element of the town centre redevelopment and will link the town centre to the area around Shandon which is identified in the draft development plan as an area of future expansion close to the historic core of Dungarvan.	There is limited opportunity for development of small infill development or residential extensions only.
Comprises significant previously developed and / or under-utilised lands	The majority of lands in the flood zone are currently developed for a mix of uses typical to a County Town (Key Town) the size of Dungarvan. The remaining undeveloped lands will contribute to the completion of the north western periphery of the town centre for predominantly mixed use commercial development.	The lands have been developed out to date with potential for only limited infill development.
Is within or adjoining the core of an established or designated urban settlement	The remaining undeveloped lands lie immediately adjacent to the town core.	The lands have been developed out to date with potential for only limited infill development.
Will be essential in achieving compact and sustainable urban growth	The redevelopment of the brownfield sites will contribute to compact and sustainable growth in a way that enabled Dungarvan to meet its designated function as set out in the NPF and RSES.	The lands have been developed out to date with potential for only limited infill development.
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.	These undeveloped brownfield sites are the only vacant and undeveloped lands in the immediate vicinity of the town centre and as such their redevelopment will support the consolidation of the town, particularly between the N25 and the town centre.	The lands have been predominantly built out for residential uses. To avoid significant new development in Area 2, all lands identified for new residential development in Dungarvan lie outside the flood zone identified in Area 2.
A flood risk assessment to an appropriate level of detail has been carried out	Part of the town centre is shown to be within Flood Zone A and further examination of the CFRAM mapping shows this to be risk from tidal flooding, with depths of up to 1.5m possible in the 0.5% AEP event across lands to the south of the N25. As risk is largely tidal, mitigation measures including ground raising would be feasible and should be investigated as part of a site specific FRA, or local masterplan FRA; the FRA would need to demonstrate that risks could be managed within the development	Risk to this area is from tidally driven inundation which presents a risk to existing development. New development in this area should be limited to Minor Development (Section 5.28 of the Planning Guidelines). New, large scale development within Flood Zones A and B would be considered premature until a scheme has been completed.

Justification test for sites within Flood Zone A and / or B	Area 1 - Town Centre, Mixed Use and Industrial	Area 2 - Existing Residential
	<p>area and would need to consider residual risks including climate change and the 0.1% AEP tidal event. However, new development will also need to consider any flood relief scheme plans and ensure site specific mitigation does not impact on the scheme. Development proposals which cannot manage risks within their own boundary would be considered premature until a scheme has been completed.</p>	
Result	Pass	Pass
Recommendation for zoning	Retain current zoning and land use.	Retain current use for existing residential but no new development permitted.

### 7.2.3 Clonmel Environs

Flood Zone A covers a significant proportion of the settlement land, but the majority of land within Flood Zone A and B has been zoned for open space uses which are appropriate and should be maintained; this is supported by a development objective requiring 40m buffer between the river and development. There is a school site partially within Flood Zone A. This is a highly vulnerable use but is defended. Further development of the school will require a SSFRA to review residual risks and mitigation measures.

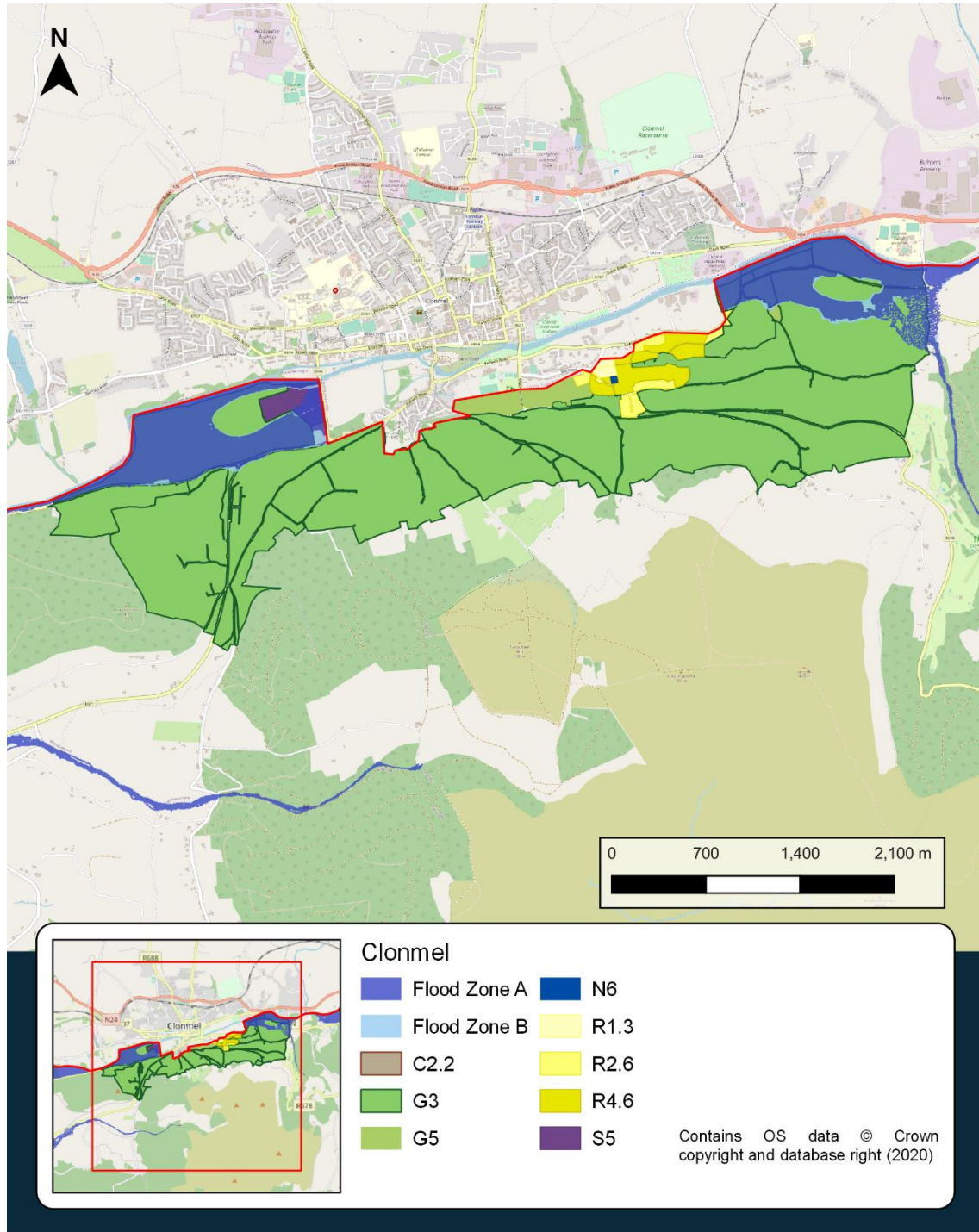


Figure 7-3: Clonmel Zoning

### 7.2.4 Tramore

The extents of flooding in Tramore are largely constrained to a narrow river corridor which has been zoned for water compatible open space use and is appropriate and should be maintained.

Where there is a small overlap between Flood Zone A and B and lands zoned for highly or less vulnerable uses, the sequential approach shall be applied and development within Flood Zone A will be avoided, whilst in Flood Zone B only less vulnerable uses will be appropriate, subject to site specific FRA.

Risk from tidal flooding is also low, but proposed development along the coastline should include a flood risk assessment which considers the impact of climate change on sea levels for the 0.5% and 0.1% AEP events, and wave overtopping should also be taken into account.

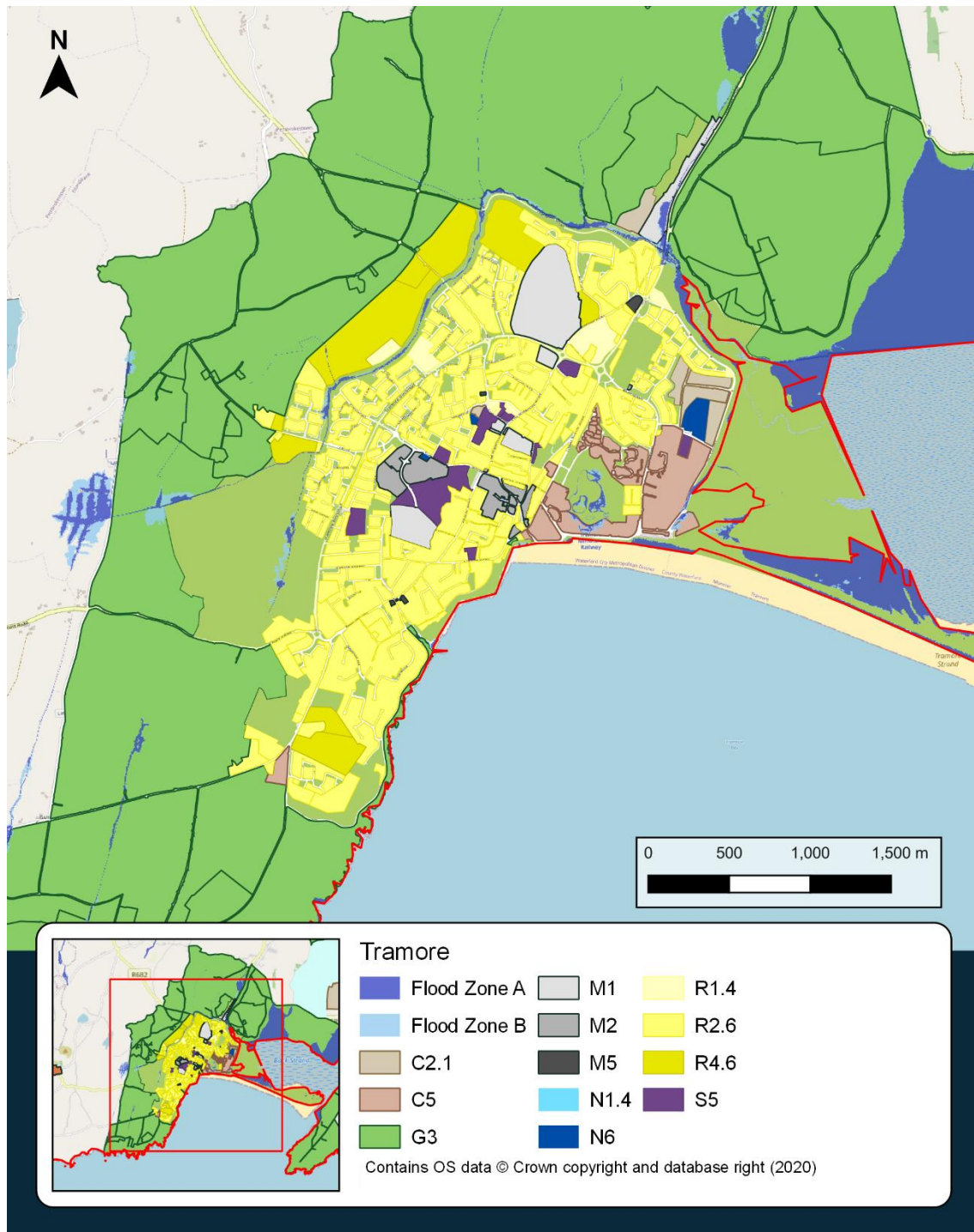


Figure 7-4: Tramore Zoning

### 7.2.5 Dunmore East

There some flood risk associated with the two watercourses in Dunmore East. Due to the steepness of the settlement, the flood extents are generally close to the watercourses. There is some inundation of lands at the junction of the two watercourses. Although zoned residential, this land is largely parkland / open space, and should be retained as such.

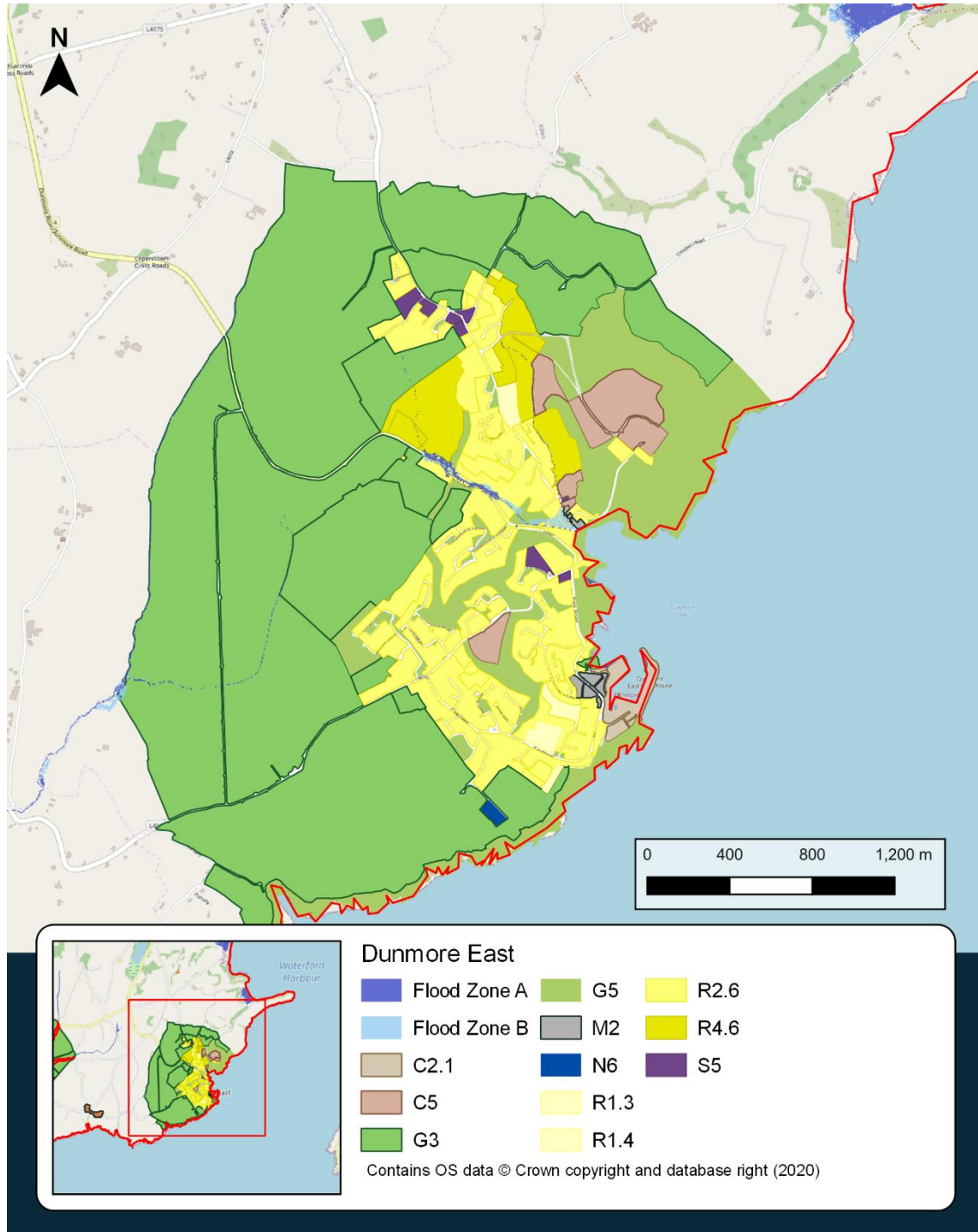


Figure 7-5: Dunmore East Zoning

There are areas New Residential, Existing Residential, Strategic Reserve and Industrial, Enterprise and Employment zoning partially within Flood Zone A and B. Although the zoning has been retained to reflect the existing land use, highly or less vulnerable development within this settlement, and within Flood Zone A and B, has not passed the Justification Test for Development Plans; the sequential approach shall be applied and development within Flood Zone A will be avoided, whilst in Flood Zone B only less vulnerable uses will be appropriate, subject to site specific FRA. Where

there is existing residential development within Flood Zone A or B, works should be limited to minor development (Section 5.28 of the Planning Guidelines).

#### 7.2.6 Gaeltacht na nDéise

The primary source of flood risk in Gaeltacht na nDéise is from coastal sources. Within the area defined as Flood Zone A and B along the coast are two land parcels zoned for seaport / harbour. This is a water compatible use and can be retained. However, the sequential approach should be applied with respect to development within the harbour areas.

There is also a watercourse which passed through the eastern boundary of An Rinn. The extent of Flood Zone A from this watercourse crosses land zoned for Industrial, enterprise, employment and for mixed use. Any future development in the vicinity of this watercourse should be supported by a site specific flood risk assessment, which may refine the flood extents in this area. The sequential approach should then be applied to ensure highly and less vulnerable development is located within Flood Zone C.

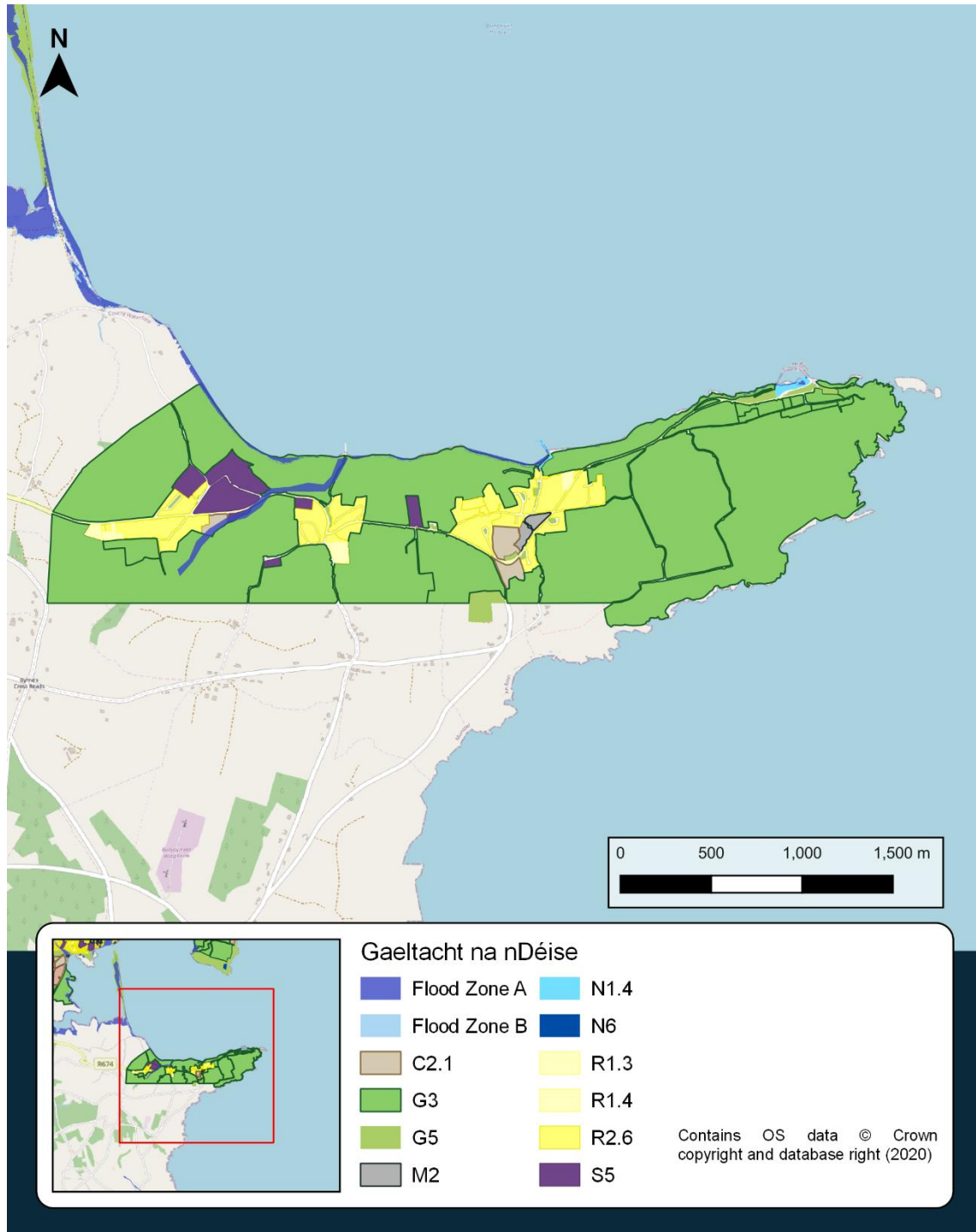


Figure 7-6 Gaeltacht na nDéise Zoning

7.2.7 Portlaw

Flood Zone A is extensive within Portlaw but is largely across land zoned for water compatible open space uses which is appropriate and should be retained. The watercourses, in the form of a mill system, flow through an area zoned for mixed use (1) Where there is a small overlap between Flood Zone A and B and existing residential development or the strategic reserve (2), the sequential approach shall be applied and development within Flood Zone A will be avoided, whilst in Flood Zone B only less vulnerable uses will be appropriate, subject to site specific FRA.

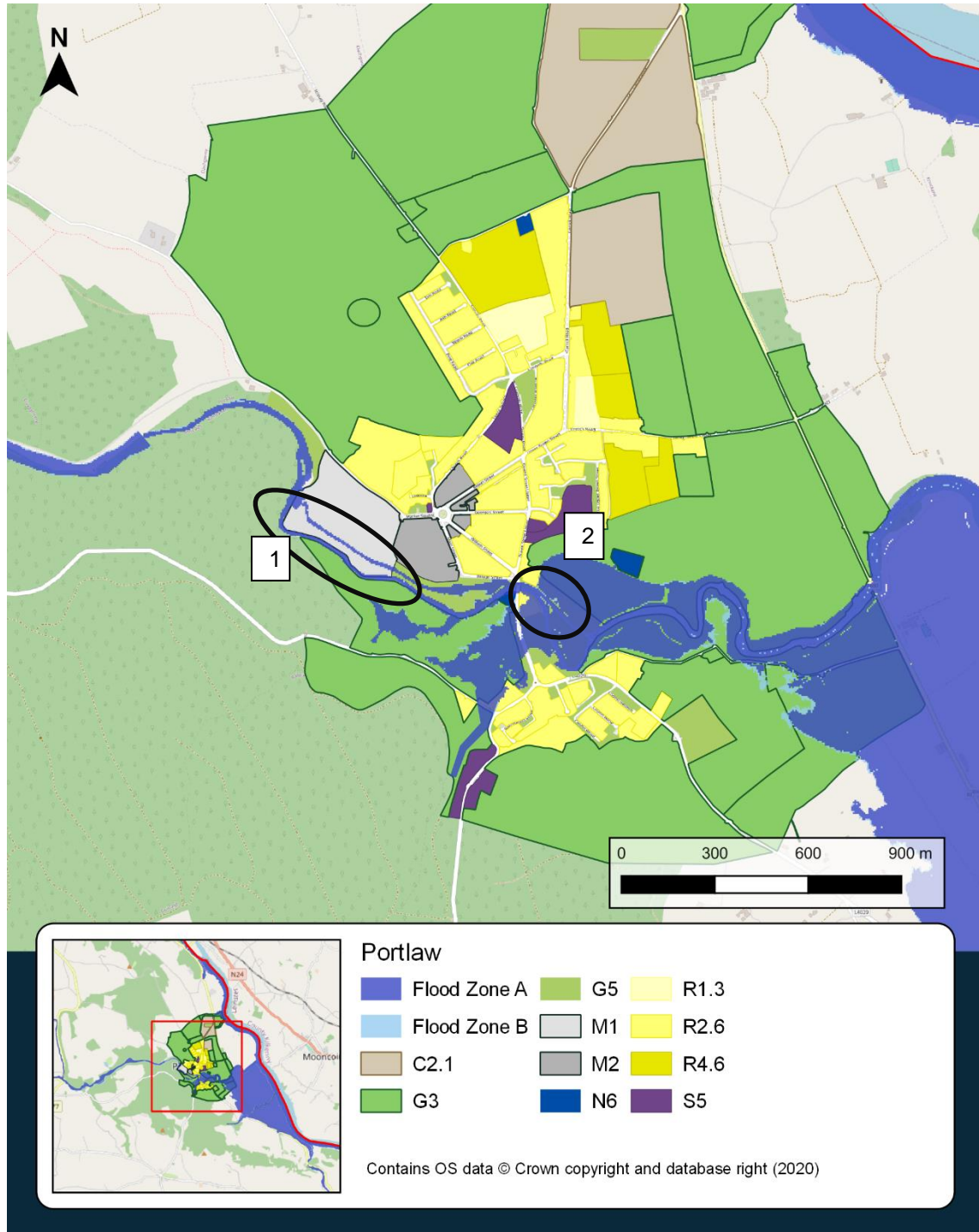


Figure 7-7: Portlaw Zoning



### 7.2.8 Rural Towns, Villages and Nodes

As part of the screening assessment, fluvial and/or tidal risk has been identified in a number of Rural Towns, Rural Villages and Rural Nodes. These settlements are covered by the Rural Village (RV) zoning objective, which is to "protect and promote the character of the Rural Village and promote a vibrant community appropriate to available physical and community infrastructure".

- Aglish
- Ardmore
- Ballyduff upper
- Ballymacarbry
- Bonamahon / Knockmahon
- Cappoquin
- Cheekpoint
- Clashmore
- Clonea Power
- Dunhill
- Fenor
- Kilmacthomas
- Kilmeaden / Ballyduff
- Lemybrien / Kilrossanty
- Passage East
- Tallow

The Justification Test has not been applied, or passed, in these settlements. Therefore, highly and vulnerable development should be avoided in Flood Zones A and B, and less vulnerable development should be avoided in Flood Zone A. In Flood Zones A and B, only minor development (Section 5.28 as amended) and water compatible uses will be permitted, and will be subject to site specific flood risk assessment..

### 7.2.9 Open Countryside and White Land

All areas outside of the settlements listed in the hierarchy have been classed as white land in the settlement hierarchy of the Development Plan.

The Development Plan itself generally does not provide for land use zonings and the Plan Making Justification Test has not been applied or passed. Therefore, in line with the Flood Risk Guidelines, the sequential approach should be applied. In these areas new, highly and less vulnerable development should be located in Flood Zone C. In Flood Zones A and B, only minor development (Section 5.28 as amended) and water compatible uses will be permitted.

To support the assessment of site specific risk and application of the sequential approach, a Flood Zone map for the rural area has been prepared, covering all watercourses with a catchment area of greater than 5km<sup>2</sup>. Where there are local watercourses present, but not included in the Flood Zone map, a site specific flood risk assessment should be carried out with a view to defining the Flood Zones and then applying the sequential approach.

## 7.3 Climate change risk identified

In addition to the current level of flood risk (either fluvial or coastal), this SFRA has identified a number of settlements which could be at significantly greater risk when future (climate change) scenarios are considered. These settlements are mainly located along the coast, where between a 0.5m (medium range future scenario) and 1m (high end future scenario) rise in sea level should be allowed for, based on current OPW guidance. This appraisal has not included storm damage which occurs currently, or may occur in the future. It is based on still sea levels only.

Settlements which have a medium to high level of climate change risk have been identified as:

- Ardmore
- Bunmahon / Knockmahon
- Cheekpoint
- Dungarven and Environs
- Dunmore East
- Passage East
- Portlaw
- Tramore
- Waterford City

In these settlements it is essential that the impacts of climate change, and in particular sea level rise are assessed for developments in Flood Zone A and B, and those in proximity to Flood Zone A

and B, to ensure long term sustainability can be maintained. Guidance on climate change assessments is provided in Section 5.8.

## 8 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 Table 8-1.

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.

Additional information will arise from the OPW flood relief schemes in Dungarvan and Environs, Aglish and Ballyduff. Not only will these studies revisit the CFRAM assessment, but once schemes are in place the definition of risk will change significantly for existing development, and possibly also for undeveloped lands.

The CFRAM Studies themselves also run on a six yearly cycle, so updates arising from future iterations and extensions of the CFRAM should be incorporated into SFRA updates.

Detailed, site specific FRAs may be submitted to support planning applications. Whilst these reports will not trigger a review of the Flood Zone maps or SFRA, they should be retained and reviewed as part of the next cycle of the Development Plan.

Table 8-1: SFRA Review Triggers

Trigger	Source	Possible Timescale
EU Floods Directive required review of the PFRA, the FRMPs and the flood maps	OPW	Six yearly cycle
Updates to predictive flood mapping	OPW	Unknown
OPW Flood Relief Scheme outputs	OPW	Unknown
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
Construction / completion of flood relief schemes	OPW / DLRCC	Unknown

## Appendices

### A Development Flow Charts





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