Comptroller and Auditor General
Special Report

Strategic Planning for Flood Risk Management

Report number 92 **December 2015**

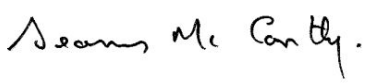
Report of the Comptroller and Auditor General

Strategic Planning for Flood Risk Management

I have, in accordance with the provisions of Section 9 of the Comptroller and Auditor General (Amendment) Act 1993, carried out an examination of strategic planning for flood risk management.

This report was prepared on the basis of information, documentation and explanations obtained from the bodies and persons referred to in the report. The Office of Public Works, Fingal County Council, Dublin City Council, Meath County Council, Cork City Council and Cork County Council were asked to review and comment on the draft report. Where appropriate, the comments received were incorporated in the final version of the report.

I hereby submit my report for presentation to Dáil Éireann in accordance with Section 11 of the 1993 Act.



Seamus McCarthy
Comptroller and Auditor General

24 December 2015

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Abbreviations and Definitions

AEP	Annual exceedance probability
CFRAM	Catchment Flood Risk Assessment and Management
EPA	Environmental Protection Agency
OPW	Office of Public Works
ESB	Electricity Supply Board
River basin/river catchment	A river basin or river catchment is the area of land from which all surface water run-off flows through a sequence of streams, rivers or lakes into the sea at a single river mouth, estuary or delta.
River basin district	A river basin district is an area of land and sea consisting of a number of neighbouring river basins together with their associated ground waters and coastal waters.
Flood hazard map	A flood hazard map shows the annual exceedance probability and likely extent of flood events. It can also show occurrences associated with floods that can cause and/or influence the damage.
Flood risk map	A flood risk map shows the potential adverse consequences of flooding in terms of the number of people affected, the impact on economic activity and environmental risk.
Flood types:	**Fluvial -** due to overflow of rivers
	Pluvial - due to heavy rain, in excess of what drainage systems can absorb
	Tidal - due to tidal movements

Summary

Summary

Climate-related flooding is a natural phenomenon which can at times be unpreventable. However, it may be possible to reduce the impact of such flood events with the installation of effective drainage systems or more targeted intervention in the form of flood relief schemes. The projected future impacts of climate change include increases in the likelihood and intensity of flooding. It is critical that decisions taken to address flood risk at a national level are informed by long-term strategic planning to ensure that the maximum benefit is delivered from limited resources.

The Office of Public Works (OPW) is the lead State body for the co-ordination and implementation of Government policy on the management of flood risk nationally. OPW works in partnership with local authorities on structural flood defence and relief schemes and on strategic studies.[1]

Policy Context

Current policy on flood risk management in Ireland has its origins in a review carried out by an interdepartmental group established in 2003. The group's report – published in 2004 – recommended that future policy should be based on managing flood risk at a river basin level. It also recommended the development of flood risk maps and flood risk management plans. Between 2005 and 2008, OPW commenced a series of pilot projects in advance of, and to inform, a planned national programme that would involve the preparation of flood maps and risk management plans for all river basins.

EU Floods Directive

The EU Floods Directive, published in 2007, established a common approach across the EU to the assessment and management of flood risks. Because the approach proposed in the Floods Directive was consistent with the policy approach that had been adopted in Ireland, OPW was able to adapt the work already underway to meet the Directive's requirements.

In January 2009, OPW prepared an implementation strategy for a national 'catchment flood risk assessment and management' (CFRAM) programme. The CFRAM programme was to produce the required flood hazard maps, flood risk maps and flood risk management plans within the timeframe set out in the Floods Directive.

This examination considered the project management arrangements in respect of the pilot projects and the first of the national CFRAM studies, which commenced in the Shannon River Basin District in January 2011. It also assessed the management of the programme by OPW and reviewed progress to date on the overall CFRAM programme.

Governance and Oversight

While OPW established structures to monitor project implementation, it was found that, in the case of the pilot projects, there was a lack of clarity over the precise roles of those oversight bodies. A steering group established to oversee the national CFRAM programme met regularly at the start of the process, but did not meet at all during a four year period up to November 2014. Similarly, a high level Interdepartmental Co-Ordination Group set up to oversee national coordination of flood risk management and flooding response met in the period 2006 to 2009, but did not meet thereafter until the group was reactivated in July 2015.

1 Other bodies with roles in managing flood risk include An Garda Síochána, the Health Service Executive, Met Éireann, the Environmental Protection Agency, the Department of the Environment, Community and Local Government, ESB, Waterways Ireland and Irish Water.

Pilot Testing

The aim of the pilot phase that commenced in 2005 was to test the proposed approach in advance of the rollout of a national flood risk management programme. Two pilot projects were managed by OPW, and two were managed by local authorities. While there is some evidence of learning from the pilots being transferred to the national CFRAM programme, this did not happen in a formalised manner.

Where funding is provided by a department/office to a third party to carry out or oversee a project, a service level agreement should be put in place specifying the services to be provided and the standards to be met. In the case of the two pilot projects managed by local authorities, the examination found that no service level agreement had been put in place between OPW and the relevant local authorities prior to commencing the projects. The absence of such agreements can lead to difficulties in resolving project issues that may arise and can also increase the exposure of public bodies to costs in excess of those agreed at the outset.

Project Delivery

An implementation plan prepared by OPW in March 2006 envisaged that the pilot testing phase would finish in 2007, and that the national programme would be complete by the end of 2011. The examination found that all four pilot projects reviewed ran significantly over their original schedules, with delays in relation to the aerial and ground survey work being a feature in each case.

The current status of the pilot projects reviewed is that final flood risk management plans have been published in two cases (river Lee and river Dodder) while a draft final plan has been published for another project (Fingal/East Meath). OPW has indicated that the remaining pilot (river Suir) will be completed as part of the South Eastern CFRAM study.

CFRAM Programme Targets

OPW met the first deadline set under the Floods Directive and incorporated into the CFRAM programme. This was to prepare and submit preliminary flood risk assessments to the EU Commission by March 2012. However, by the second deadline of March 2014, OPW had only submitted the required flood hazard maps for 50 of the 300 areas that had been identified at the preliminary assessment stage.

In relation to the completion of flood risk management plans, OPW has stated that it does not expect to meet the submission deadline of March 2016 but aims instead to finalise the flood risk management plans for all river basins by the end of 2016. It is recommended that OPW should set revised milestones for the CFRAM programme.

Budgets and Expenditure

OPW estimated in 2009 that the cost of implementing the national CFRAM programme (but not including the cost of the pilot projects) would be €30 million (excluding VAT). Expenditure on the CFRAM programme to end December 2014 was €22.8 million, with OPW estimating that a further €4.6 million will be needed to complete it. OPW currently expects that the CFRAM process will be completed by end 2016.

Indicative cost estimates for pilot projects were produced, distinguishing between those that might be carried out in-house and those contracted out. Detailed project budgets were not formally approved in advance by OPW for the individual pilot projects which commenced. While it was originally envisaged that nine pilot projects would be undertaken, only four proceeded. Indicative cost estimates for the four pilot projects totalled €3.5 million. Expenditure to the end of 2014 was €8.9 million. In all cases, expenditure to date on the pilots has significantly exceeded the indicative estimates.

In three of the four pilot projects, the expenditure to the end of 2014 also exceeded the contract value. The fourth project is now subsumed into the broader CFRAM study.

Smaller scale pilot projects are potentially useful in removing some uncertainty where novel approaches or innovative technologies are being tried out. As a result, it is acknowledged that there may be some uncertainty in relation to the potential cost of the pilot projects. Nevertheless, it is difficult to exercise cost control over individual project elements and the project as a whole, without a detailed project budget.

Investment in Flood Management Works

Since 2004, national policy on managing flood risk has recognised that flood defence measures are likely to be more effective and to deliver better value for money when coordinated throughout a river basin district. That approach is consistent with the 2007 EU Floods Directive.

Capital expenditure on flood risk management over the period 2005 to 2014 was €329 million, comprising major works at a cost of €242 million, strategic studies that cost €52 million and minor works that cost €35 million. In September 2015, the Government announced details of a €430 million six year programme of capital investment on flood defence measures as part of the Government's overall Capital Investment Plan 2016 – 2021.

OPW has adopted a strategic approach to its capital expenditure programme for flood risk management. The Accounting Officer has stated that projects are only approved following detailed and comprehensive analysis, including public consultation on possible engineering solutions, their associated costs and benefits and environmental impact. In recent years, the consistency of proposed mitigation measures with the emerging flood risk management plan for an area, where applicable, has been taken into account when deciding whether to initiate a new scheme. With regard to other scheme proposals, OPW's general policy has been to await the completion of the relevant CFRAM study.

In order to derive maximum value from the limited funds available, it is essential that funding allocation decisions are evidence-based. However, twelve years on from the report of the Flood Policy Review Group and eight years after the EU Floods Directive, substantial capital expenditure continues to be incurred on an annual basis, without the full benefit of the comprehensive analysis and strategic plans that will emerge from the CFRAM programme.

Strategic Planning for Flood Risk Management

1 Introduction

1.1 Climate-related flooding is a natural phenomenon that is sometimes unpreventable. Inland flooding may occur when heavy rain causes rivers or streams to overflow their banks. In coastal areas, flooding can occur when weather conditions combine with high tides to cause seawater to surge inland.

1.2 Research carried out by the Environmental Protection Agency (EPA) indicates that Ireland's climate has changed over the past century, in line with similar changes globally.[1] There have been increases in average annual temperatures as well as more intense and more frequent rainfall. The projected future impacts of climate change include increases in the likelihood and magnitude of flooding.

1.3 As this report is being completed, storms and heavy rainfall are causing widespread flooding and damage in many parts of the country. Other recent significant flood events include widespread coastal and inland flooding that occurred in January and February 2014, and more localised flood events that occurred in Cork (June 2012) and Dublin (October 2011). A timeline of major flooding events in Ireland since 2005 is provided in Figure 1.1 (over).

1.4 In addition to damage to property, flooding may result in loss of life, and distress, hardship and disruption for householders and businesses in affected areas. The adverse impacts of flooding in particular locations may be increased by human activity such as settlement patterns and economic development in floodplains as well as the reduction of natural water retention by land use. However, the likely severity of flood events can be reduced in certain cases through the installation of effective drainage systems as well as targeted intervention in the form of flood relief schemes.[2]

Managing Flood Risk

1.5 Figure 1.2 sets out the main roles played by each of the bodies involved in managing flood risk in Ireland. Effective flood risk management involves identifying areas at risk of flooding, assessing the likelihood and potential impact of flood events and developing appropriate responses. In some instances, the most appropriate response is deemed to be structural e.g. flood defence works which seek to prevent a flood occurring, or reduce its impact should it occur.

1.6 Non-structural measures do not generally prevent flood events but are designed to reduce or respond to the impacts. Such measures can include

- promoting awareness of flood risks among the public and businesses and advising on appropriate responses
- forecasting and warning of impending floods
- effective emergency responses and recovery plans following flood events
- planning controls to ensure future developments do not increase flood risk.

1.7 The effectiveness of measures taken to address flood risk is dependent on coherent planning. In particular, long term strategic planning is required to ensure that capital expenditure decisions deliver the maximum benefit from limited resources.

1 ***The Status of Ireland's Climate 2012***, published by the EPA in 2013.

2 Pluvial flooding and urban drainage systems are not the responsibility of OPW.

Figure 1.1 Major flooding events in Ireland, 2005 to 2015

December 2006

Mayo: Severe flood damage in Crossmolina when the River Deel burst its banks.

July 2008

West Limerick: Severe flood damage, with Newcastle West being the worst affected area.

August 2008

Kildare, Dublin and Carlow: Severe flood damage affecting businesses, homes and public property.

July 2009

Mayo and Dublin: Heavy rainfall and thunderstorms cause flooding.

November 2009

Cork and Galway: Severe flooding in many parts of the country causes extensive damage. Flooding in Cork classified by the International Red Cross as being on the scale of a world disaster.

October 2011

Greater Dublin Area and Wicklow: Flooding in many parts of Dublin and the East coast leads to Dublin City Council activating a major emergency plan. Two people lose their lives as a result of the flooding. Significant damage to homes, businesses and infrastructure

Figure 1.1 (Continued)

June 2012

Cork: Several parts of Cork affected by flash floods, with particularly severe flooding in Douglas.

January/February 2014

Limerick, Clare, Galway City, Cork and Waterford: An exceptional series of storms in the winter of 2013/2014 causes serious coastal damage and flooding.

December 2015

Storm Desmond: Heavy rainfall and gale force winds cause severe flooding and damage. Areas along the Shannon river basin, western and midland areas worst affected. Loss of life also as a result of the flooding.

Source: Photos courtesy of the Office of Public Works except for 2009 and 2015, which are courtesy of the Irish Defence Forces.

Figure 1.2 Bodies involved in managing flood risk in Ireland

OPW

- OPW is the lead State body for the co-ordination and implementation of Government policy on the management of flood risk nationally. OPW works in partnership with local authorities on structural flood defence and relief schemes and on strategic studies. It also undertakes a range of non-structural response measures.

Local Authorities

- Local authorities are responsible for implementing policy and guidelines on flood risk in the context of planning and development, as well as developing flood-related aspects of emergency response plans and undertaking some flood relief works directly. They are the lead agencies in coordinating responses to flood events, working with An Garda Síochána, Defence Forces, Civil Defence and the Health Service Executive. In addition, local authorities are responsible for managing urban storm water flooding and they cooperate with the ESB, Waterways Ireland and Irish Water to manage flood risk associated with water-related built infrastructure e.g. reservoirs.

Other Bodies

- Other bodies with significant roles in flood risk management include Met Éireann (weather forecasting and flood warning), the Department of the Environment, Community and Local Government (planning regulations and oversight of local authority financing), the ESB and the EPA.

Flood Policy Review Group

1.8 Historically, flood management in Ireland was focused on improving agricultural land through OPW-managed arterial drainage schemes on a river catchment basis. The enabling legislation in this area was amended in 1995 to allow OPW to implement localised flood relief schemes aimed at providing flood protection for cities, towns and villages.[1] Subsequently, the prioritisation of urban flood relief schemes over arterial drainage has been influenced by significant flooding events that have occurred in urban areas.

1.9 An interdepartmental group was established in 2003 to undertake a review of national flood policy. The group's report set out the policy, funding, structural and organisational challenges that existed at that time and made recommendations on how these could be addressed.[2] It recommended, inter alia, that

- OPW should be the lead agency with responsibility for flood risk management in Ireland
- there should be a focus on managing flood risk rather than relying on flood protection measures
- future policy should be based on a river basin approach rather than concentrating on localised points
- flood risks should be proactively assessed and managed through the preparation of flood maps and flood risk management plans

1 Arterial Drainage (Amendment) Act 1995

2 ***Report of the Flood Policy Review Group***, 2004. This report addressed fluvial and tidal flood risks. Assessments required under the 2007 EU Floods Directive also consider pluvial flood risks.

1.10 During 2005 and 2006, OPW developed proposals to implement the recommendations of the Flood Policy Review Group. The proposals set out a recommended management structure and 15 work programmes which aimed to deliver on the recommendations by 2011.

1.11 One of the work programmes involved the development of a river basin flood risk management planning framework. The proposed framework involved the development of flood hazard maps and the preparation of catchment-based flood risk management plans. The work programme provided for, inter alia, a research phase, a pilot testing phase and a national programme.

1.12 As part of the pilot testing phase, four pilot projects commenced in the period 2005 to 2008 to develop river basin flood risk management plans for the Suir, Lee and Dodder catchments and in the Fingal/East Meath area.

EU Floods Directive

1.13 The evolution of flood risk management programming in Ireland has been influenced both by directives at EU level and national policy developments (see Figure 1.3). The key directive is the 2007 EU Floods Directive which established an EU-wide common approach to the assessment and management of flood risks.[1] OPW is the national competent authority for the implementation of the Floods Directive in Ireland.

1.14 The requirements of the Floods Directive corresponded closely with the policy direction that had already been adopted in Ireland. Consequently, OPW was able to adapt the work already underway to meet some of the requirements of the Directive.

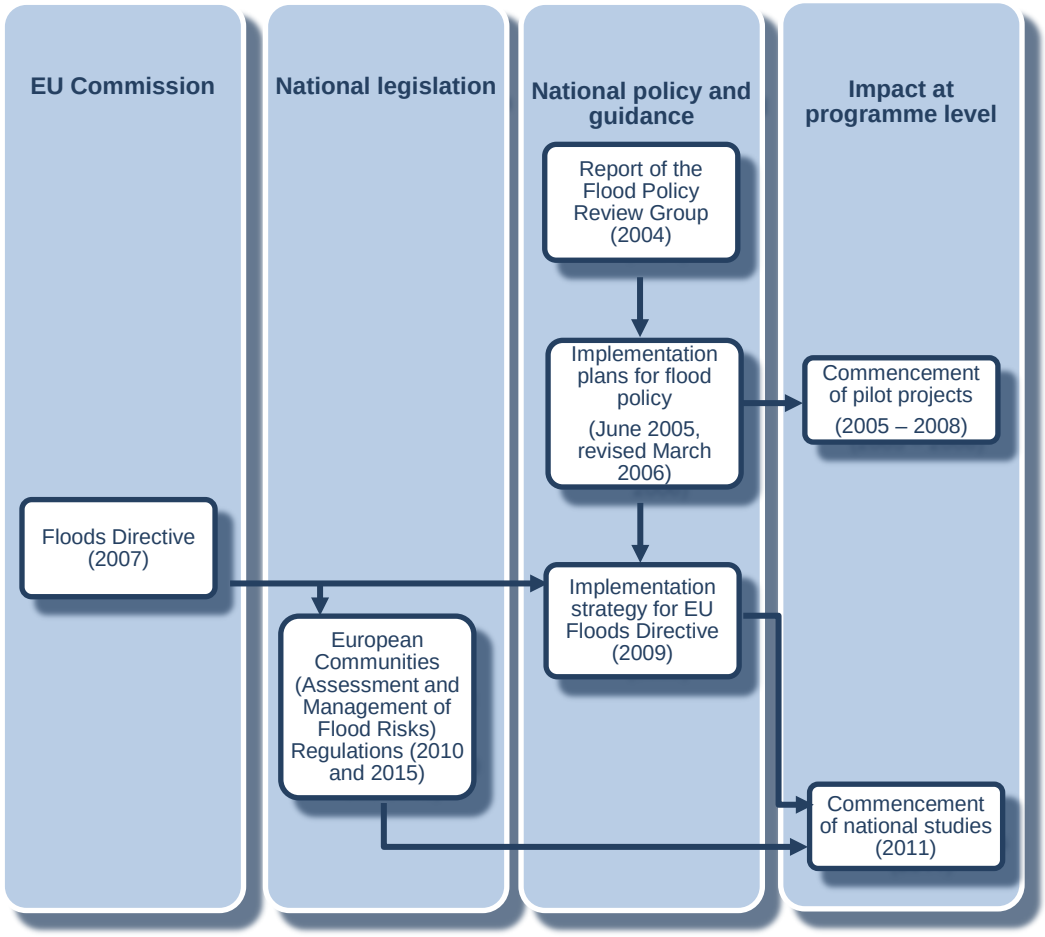
1.15 In January 2009, OPW prepared an implementation strategy specifically focused on meeting the requirements of the EU Floods Directive. It set out the broad implementation processes and management structures to apply for a national catchment flood risk assessment and management (CFRAM) programme. OPW has pointed out that the Floods Directive implementation strategy took account of lessons that had been learnt from the pilot testing phase of the Flood Policy Review Group programme.

1.16 The overall objective of the national CFRAM programme is the reduction and management of flood risk in Ireland. A component of this objective is to produce the required flood hazard maps, flood risk maps and flood risk management plans within the timeframe set by the Floods Directive. OPW estimates that a total of approximately 40,000 individual maps will be produced as a result of the CFRAM programme, underpinned by large scale surveying and modelling work. Around 13,000 maps will be submitted to the EU Commission, to meet Floods Directive reporting requirements.

1.17 The key output from the CFRAM programme will be a set of flood risk management plans which will provide recommended options, both structural and non-structural, to manage flood risk optimally. The plans will also set out an estimated cost for each of the proposed measures. However, implementation of the suggested programme of works will be subject to budget availability. OPW has stated that the programme of works will be prioritised.

1 Transposed into Irish law in March 2010, by SI No. 122 of 2010, and amended by SI No 495 of 2015.

Figure 1.3 Flood management regulatory and national policy framework, 2000 – 2015



Source: Analysis by the Office of the Comptroller and Auditor General

River Basin Districts

1.18 For flood risk planning purposes, seven river basin districts have been defined across the State. Three of the seven districts fall within the definition of international river basin districts because they span the border with Northern Ireland.[1] In these districts, OPW is working in partnership with the Rivers Agency in Northern Ireland.[2] It has been agreed that each agency will undertake the necessary mapping work in its own jurisdiction, but will co-ordinate the production of cross-border flood risk management plans for each international river basin district.

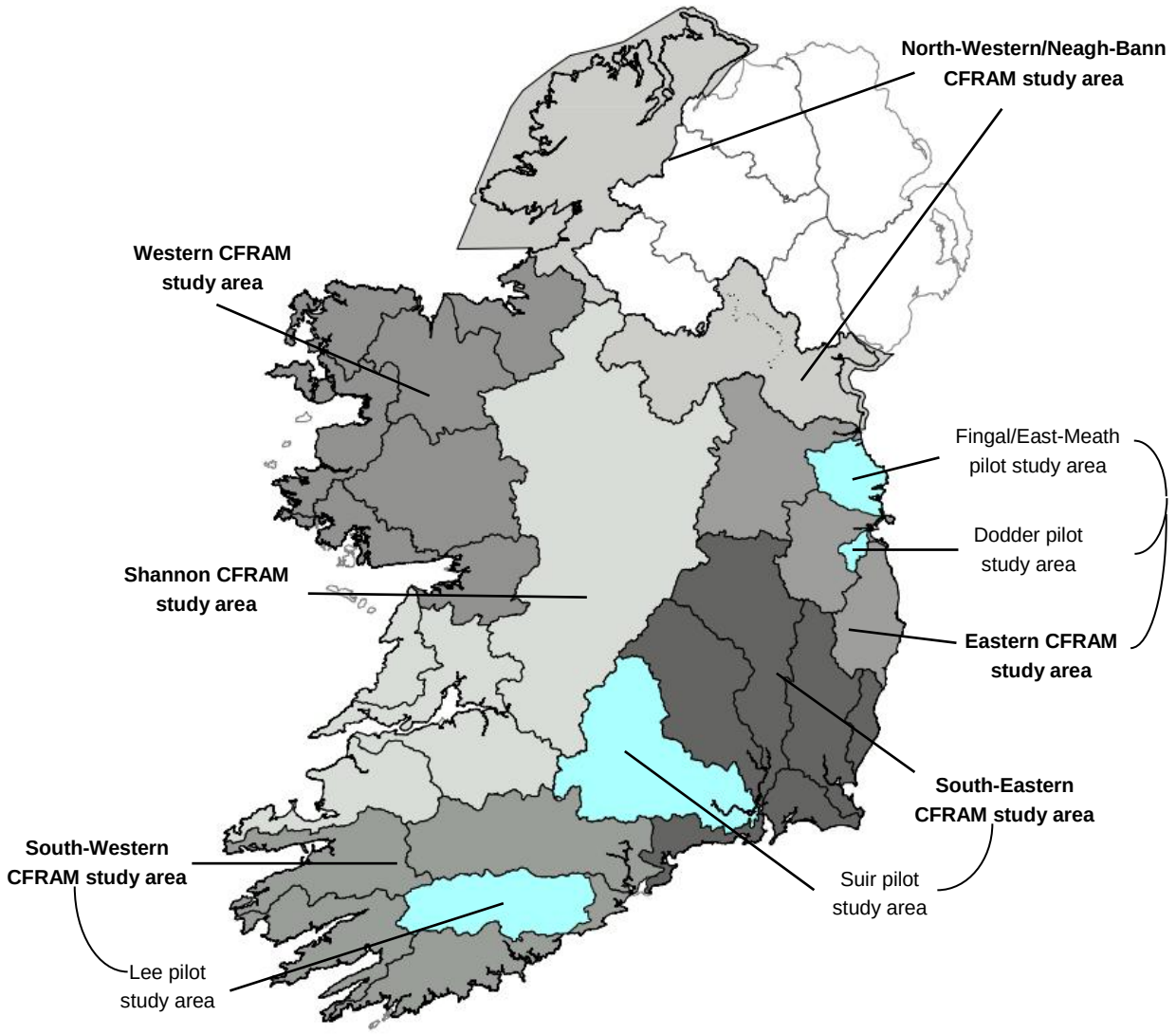
1.19 Figure 1.4 shows the areas covered by each of the national CFRAM studies[3] and the locations of the pilot projects.

1 One river basin district (North Eastern) falls entirely within Northern Ireland and is consequently outside the scope of this report.

2 The Rivers Agency is an executive agency of the Northern Ireland Department of Agriculture and Rural Development.

3 Flood management plans for two river basin districts - North Western and Neagh Bann are being prepared under a single CFRAM contract.

Figure 1.4 Location of CFRAM national studies and pilot projects



Source: Office of Public Works

Focus of Examination

1.20 This examination considers the project management arrangements in place in respect of the pilot projects, and for the first of the CFRAM national studies, which commenced in the Shannon area in January 2011. It also assesses the management of the programme by OPW and reviews progress to date on the overall programme.

1.21 In reviewing progress at the programme level, the focus is on the progress made by OPW towards achieving the deadlines set in the EU Floods Directive. For the purposes of this report, a pilot project or regional study is considered to be complete when the associated flood risk management plan has been finalised and published. A series of interim outputs may also have been produced e.g. flood hazard and risk maps, environmental reports, hydrology reports and hydraulics reports, all of which contribute to the development of the flood risk management plans.

Report Structure

1.22 The report is structured as follows.

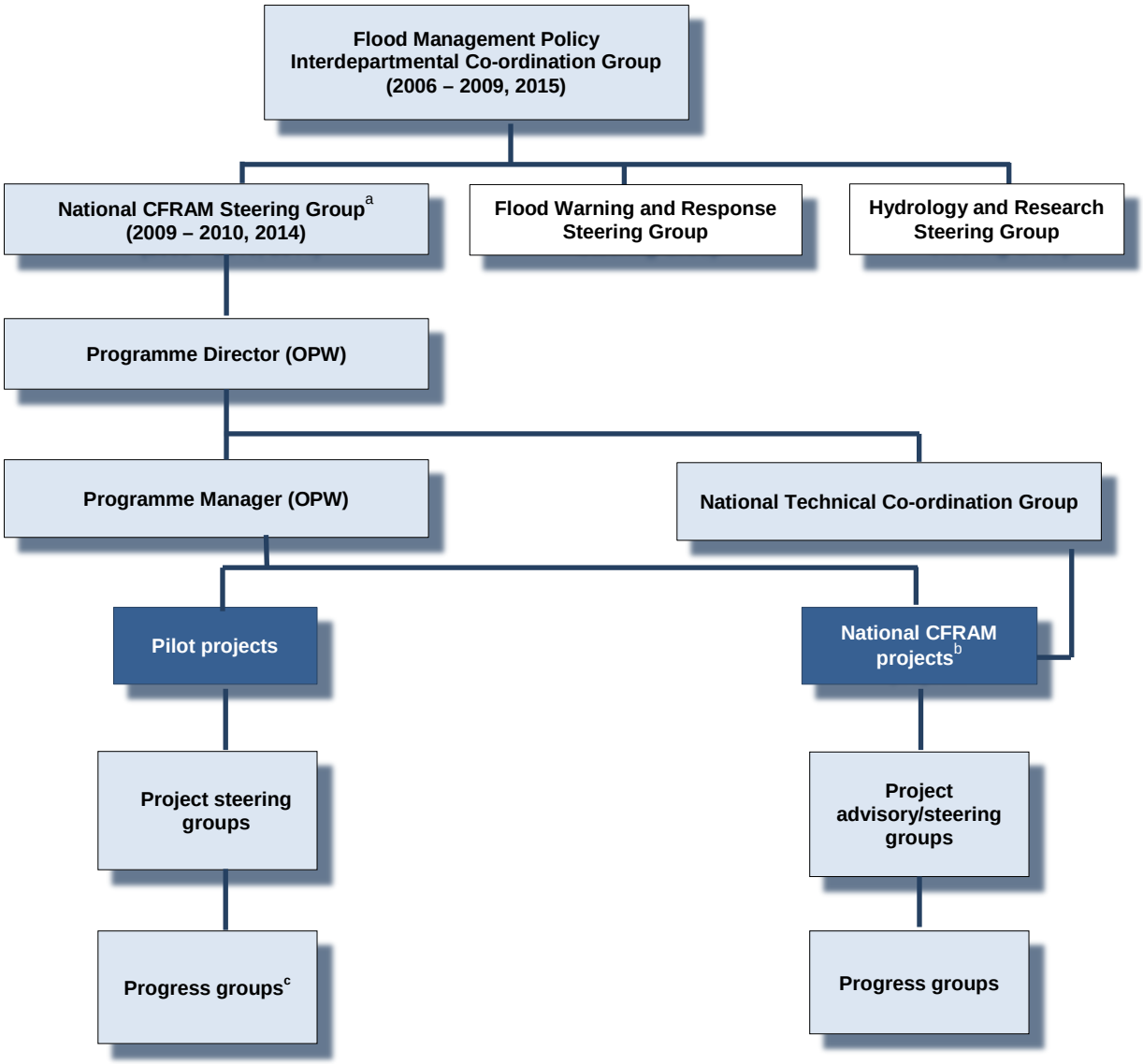
- Chapter 2 examines the programme and project governance structures in place for the pilot projects and the national CFRAM programme.
- Chapter 3 examines the delivery and timeliness of outputs from the pilot projects and assesses progress on the overall CFRAM programme.
- Chapter 4 examines the extent to which programme and project budgets were established and considers the actual cost of the programme to date.
- Chapter 5 sets out general conclusions and recommendations.

2 Programme and Project Governance

2.1 This chapter examines the programme governance arrangements for the pilot phase and national CFRAM programme. It also examines project governance arrangements for each of the pilots and the first of the national studies (Shannon CFRAM).

2.2 Figure 2.1 presents an overview of the governance and management structures established for the pilot projects and the national CFRAM programme.

Figure 2.1 Flood risk management governance and management structures



Source: Analysis by the Office of the Comptroller and Auditor General

Notes:

a The role of a proposed Flood Hazard Mapping Steering Group was incorporated with that of the National CFRAM Steering Group.

b In addition to the bodies shown, there is a national stakeholder group that provides a forum to inform stakeholders on progress and provide them with an opportunity to influence the programme. There are also regional (study-specific) stakeholder groups.

c The river Lee and river Suir projects did not have progress groups in place.

Programme Co-ordination and Steering Groups

2.3 An Interdepartmental Co-ordination Group was established to co-ordinate implementation of the policy recommended by the Flood Policy Review Group. A National CFRAM Steering Group reporting to the Interdepartmental Co-ordination Group was also established.

2.4 As part of this examination, details in respect of the Interdepartmental Co-Ordination Group and the National CFRAM Steering Group were requested from OPW. Figure 2.2 provides a summary of the information provided.

Figure 2.2 Details of oversight groups

	Membership	Terms of reference[a]	Dates of meetings
Interdepartmental Co-ordination Group	Minister of State with special responsibility for OPW Representatives (at Principal Officer level) from • OPW • Department of the Environment, Community and Local Government	No	• Mar 2006 • Feb 2008 • Sep 2008 • Sep 2009
	• Department of Communications, Energy and Natural Resources • Department of Public Expenditure and Reform • Department of Finance • Department of Transport, Tourism and Sport • Department of Agriculture, Food and the Marine • Department of Defence • Department of Arts, Heritage and the Gaeltacht • Department of Social Protection • Local authorities (some)	Yes	• Jul 2015 • Nov 2015
National CFRAM Steering Group	Representatives from • OPW • Department of the Environment, Community and Local Government • Environmental Protection Agency • County and City Managers Association • Waterways Ireland • ESB • Office of Emergency Planning	No	• May 2009[b] • Jun 2009 • Oct 2009 • Feb 2010 • Jul 2010 • Nov 2010
	• Rivers Agency (NI) • Mét Eireann • Irish Water • Department of Agriculture, Food and the Marine • Department of Arts, Heritage and the Gaeltacht • Department of Communications, Energy and Natural Resources	Yes	• Nov 2014

Source: Office of Public Works

Notes: a While proposed roles for each group were set out in OPW's implementation plan (2005) and implementation strategy (2009), terms of reference were not adopted when the groups were established. Terms of reference were agreed when the groups reconvened (in November 2014 and July 2015).

b OPW was unable to provide minutes for this meeting.

Interdepartmental Co-ordination Group

2.5 On its establishment, it was envisaged that the Interdepartmental Co-ordination Group would meet bi-annually. In practice, it only met on four occasions between March 2006 and September 2009. Terms of reference for its operations in that period were not provided to the audit team.

2.6 In May 2015, the Government agreed to reconvene the Interdepartmental Co-ordination Group. Terms of reference were adopted by the reconvened group. They are

- to explore the impact on individuals and communities of the OPW's flood risk management plans
- to recommend, to Government, policies and measures that would reduce the impact of flood risks on individuals and communities
- to recommend to Government policies and measures that would support individuals and communities to be prepared and respond effectively to flood risk
- to identify the lead department and/or agency for each recommended policy measure and
- to estimate the financial and other resource implications of their recommendations.

2.7 The Accounting Officer stated that the purpose of the Interdepartmental Co-Ordination Group is to have regard to the extent of non-structural solutions that will inform a ten year implementation strategy and to ensure that policies that impact on individuals directly to enable them to be prepared for, respond to and live with flood risk, are carefully considered; and to make costed recommendations to Government (by spring 2016) to support smooth implementation of a viable ten year flood risk management implementation plan.

National CFRAM Steering Group

2.8 A National CFRAM Steering Group was one of three such groups established to address specific areas of policy implementation at a more detailed level. One of the stated roles of the CFRAM Steering Group is to report to the Interdepartmental Co-ordination Group on programme progress.

2.9 The first meeting of the national CFRAM steering group took place in May 2009. The group did not meet between November 2010 and November 2014. OPW stated that the initial stages of the national CFRAM programme involved technical work that did not necessitate a meeting of the group.

Programme Management Roles

2.10 The roles of Programme Director and Programme Manager have been assigned to two individuals within OPW. The Programme Manager reports to the Programme Director. Both the Programme Director and Programme Manager are members of the National CFRAM Steering Group.

National Technical Co-Ordination Group

2.11 The stated aim of the National Technical Co-Ordination Group was to ensure consistency of outputs and to promote the exchange of concepts, ideas and technologies between different CFRAM studies. Details of the group and how it would operate were set out in the project brief that issued for the national CFRAM studies in May 2010. The project brief noted that the group would comprise representatives of OPW, the relevant CFRAM consultants and technical representatives of key stakeholders. The group is chaired by the OPW Programme Director.

2.12 It was originally envisaged that the group would meet six times between 2011 and 2015 with meetings typically lasting two days. In practice, the group met on four occasions between June 2012 and June 2013. While no formal meetings have taken place since June 2013, OPW stated that it held a topic–specific workshop for engineering consultants, who are members of the group, in January 2015 in relation to the Habitats Directive. E-mail communication has been used. It is open to the group to organise further formal meetings, if required, in the future.

Project Governance

Pilot Projects

2.13 The pilot projects use a number of different approaches to project delivery. The river Suir pilot project was substantially undertaken and managed in-house by OPW, while the others were carried out using contracted services. The Lee pilot project was managed in-house by OPW. The two remaining pilots were managed by local authorities – Dublin City Council managed the Dodder pilot and Fingal County Council managed the Fingal/East Meath pilot.

2.14 Each of the four pilot projects is overseen by a steering group, with a progress group also in place in two cases. The steering groups are chaired by OPW. While a governance structure was established to oversee the implementation of each pilot project, their precise roles and responsibilities are unclear. OPW was unable to provide terms of reference for any of the project steering or progress groups.

2.15 Meetings of the steering and progress groups are generally attended by representatives of OPW, the relevant local authorities and the principal contractor responsible for producing the flood risk management plan. Figure 2.3 shows the dates of the latest meeting for each group. OPW has stated that there has been no requirement for subsequent meetings of the steering and progress groups for those pilot projects because the projects were substantially complete at the time of the last meetings. Final flood risk management plans have been published in two cases while a draft final plan has been published in another. A (draft) flood risk management plan for the river Suir is not yet available.

Figure 2.3 Progress and steering group meetings for pilot projects

Pilot project	Latest steering group meeting	Latest progress group meeting	Date draft flood risk management plan prepared	Date flood risk management plan published
River Suir	Nov 2009	n/a[a]	–[b]	–
River Lee	Jan 2010	n/a[a]	Feb 2010	Jan 2014
Fingal/ East Meath	Feb 2011	Oct 2011	Oct 2011	–
River Dodder	Oct 2011	Oct 2010	Feb 2012	Nov 2014

Source: Office of Public Works

Notes: a No progress groups were established for the river Suir and river Lee pilot projects.

b The river Suir project has been subsumed into the South East CFRAM programme.

CFRAM Projects

2.16 At the outset of the national CFRAM programme, it was decided to establish an advisory/steering group and a progress group for each study. Terms of reference were produced for all groups. The terms of reference for the advisory/steering groups overseeing the national studies states that they are primarily focused on high level issues, with detailed and technical activities to be addressed by the progress groups which will support and report to the advisory/steering groups.

2.17 The advisory group for the Shannon CFRAM study is chaired by OPW and its membership includes representatives from the principal contractor and the relevant local and regional authorities. Its stated objectives include providing advice, input and local knowledge, on the overall direction and outputs of the Shannon CFRAM study and related EU Floods Directive matters. On its establishment, it was envisaged that the group would meet at six-monthly intervals. The group has met on nine occasions since March 2011, with the latest meeting taking place in September 2015. At those meetings, the group received regular progress updates, particularly in relation to the survey work taking longer than anticipated.

2.18 The Shannon CFRAM progress group meetings are chaired by OPW and are attended by representatives of OPW, the principal contractor and the relevant local authorities. As envisaged in its terms of reference, the progress group has met on a six-weekly basis.

3 Output Delivery and Timeliness

3.1 The Floods Directive contained a number of key requirements for member states.

- Prepare and submit **preliminary flood risk assessments by March 2012**. Areas where potentially significant flood risks exist should be identified and prioritised for further assessment.
- Prepare and submit **flood hazard maps and flood risk maps by March 2014**. The flood hazard maps should show the probability and likely extent of future flood events and the flood risk maps should show the potential adverse consequences in terms of the number of people affected and the impact on economic activity.
- Prepare and submit **flood risk management plans by March 2016**. The plans should set out and prioritise measures to achieve flood risk management objectives and details of the public consultation process undertaken.

3.2 The targets specified in the Floods Directive were incorporated in the statutory instrument that gave effect to the Directive in Ireland.

Flood Risk Assessment

CFRAM Process

3.3 The key stages in the CFRAM process and the principal outputs from each stage are summarised in Figure 3.1. For the purpose of illustration, the process is presented as a series of discrete and sequential stages. In practice, some of the tasks within different stages are inter-related and may be ongoing at the same time.

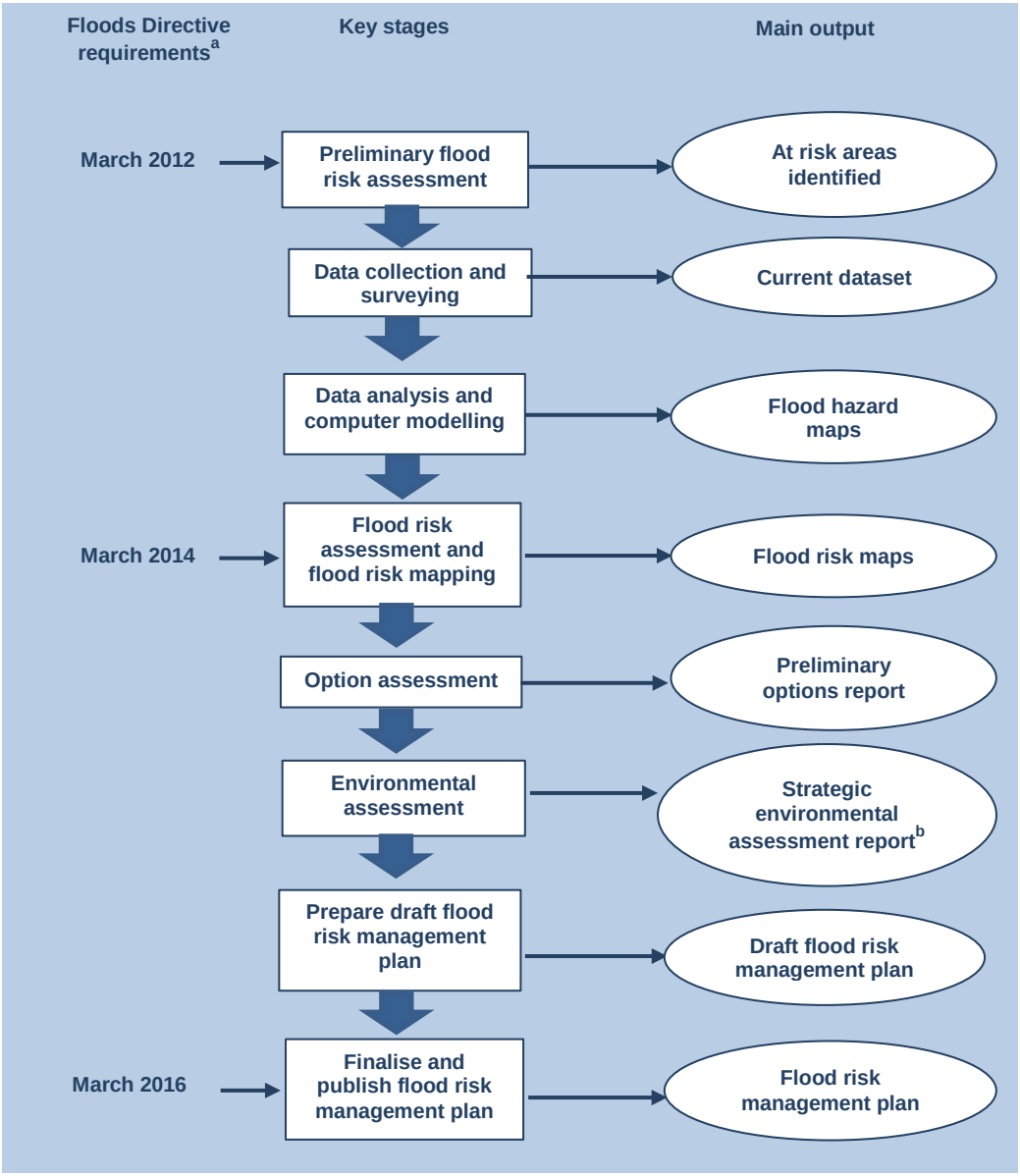
3.4 The key outputs from each CFRAM study will be flood hazard maps, flood risk maps, a strategic environmental report and a flood risk management plan. Each flood risk management plan will identify a programme of prioritised measures (both structural and non-structural) to manage flood risk over the long term, in the relevant area.

3.5 The Floods Directive requires that certain outputs (e.g. the flood hazard and risk maps and the draft flood risk management plan) be made 'available to the public'. National legislation provides that, where practical, documents and maps produced by OPW in relation to the CFRAM programme should be displayed on a website.[1] Outputs published to date are accessible through www.cfram.ie .

3.6 Public consultation is being undertaken at various stages in the process. OPW has engaged in extensive informal public consultation in relation to the preliminary flood risk assessment and the flood maps. OPW has stated that the level of consultation has been resource and time intensive but that the process has improved the quality of the flood maps produced. National legislation requires that public consultation on flood maps is undertaken when the full suite of maps has been prepared. In tandem with the statutory consultation undertaken between 20 November and 23 December 2015, OPW is carrying out a further informal public consultation in local areas.

1 SI No. 122 of 2010, as amended by SI No, 495 of 2015.

Figure 3.1 Key stages and outputs of the CFRAM process



Source: Analysis by the Office of the Comptroller and Auditor General

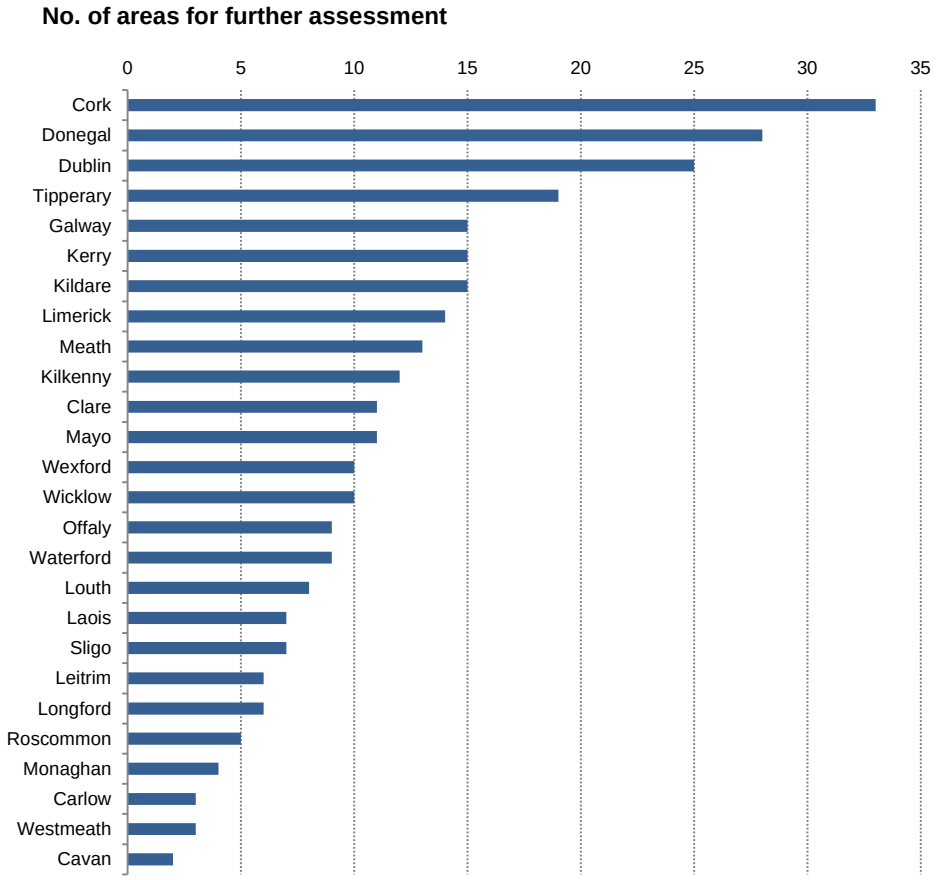
Note: a Targets in each case are to complete outputs by the preceding end of December and to submit outputs to the EU by the end of March, as indicated.

b The environmental assessment stage includes screening under the Habitats Directive. Where necessary, a Natura 2000 site impact statement is required.

Timeliness of Programme Delivery

3.7 OPW submitted the preliminary flood risk assessments to the EU Commission as required in March 2012. The preliminary assessment process identified 300 areas for further assessment (see Figure 3.2).

Figure 3.2 Number of flood risk areas identified for further assessment, by county



Source: Office of Public Works

3.8 The flood mapping exercise involves detailed mapping of the 300 risk areas identified during the preliminary assessment process, surveying and modelling of 6,700 kilometres of watercourses and the production of approximately 40,000 individual flood maps. Such maps include flood extent, flood depth, 'risk-to-life' and other risks (an illustrative set of maps for one area – Gort in County Galway – is shown at Appendix B.)

3.9 By the target date of March 2014, OPW had submitted sets of flood hazard and flood risk maps for 50 of the 300 target areas to the EU Commission. No further maps have been submitted to the Commission since March 2014. OPW has stated that all flood risk and flood hazard maps have now been produced in draft format and OPW expects to submit the 13,000 maps, required under the Directive, to the EU Commission at the end of 2015.

3.10 The statutory target for completion of the flood risk management plans is end December 2015. OPW now expects to finalise the management plans by the end of 2016. It does not expect to meet the March 2016 deadline for submission of plans to the EU Commission.

Accounting Officer's Views

3.11 The Accounting Officer stated that the national CFRAM programme is without precedent in its scale and complexity. She stated that OPW could have submitted indicative flood maps to the EU Commission in order to comply with the March 2014 deadline set out in the Floods Directive. However, rather than submit indicative maps for the sake of compliance, OPW considered it would be more beneficial to report later with more detailed and reliable maps, exceeding the requirements of the Floods Directive. OPW wrote to the EU Commission in both March 2014 and March 2015 to set out Ireland's progress on producing the required maps.

3.12 The Accounting Officer explained that the CFRAM programme involves mapping for a range of flood event probabilities such as flood event scenarios and for velocity and flood zones, which go beyond the compulsory requirements of the Directive. OPW has also modelled for two scenarios for climate change impact which is also not a requirement of the Directive. OPW believes that the work undertaken beyond the requirements of the Directive is essential to fully inform future investment in feasible solutions.

Timeliness of Pilot Projects

3.13 Final flood risk management plans have been published for two of the four pilot projects – the river Lee and the river Dodder. A draft flood risk management plan has been published for the Fingal/East Meath pilot. The plan for the river Suir pilot project is being completed in parallel with the South Eastern CFRAM study.

River Lee

3.14 Work on the river Lee pilot was contracted out by OPW. A project plan prepared by OPW in November 2005 set out the objectives, scope and risks, as well as indicative costings for the project. The project commenced in November 2005 with the appointment of a contractor to carry out aerial survey work. The principal contractor was appointed in August 2006.[1]

3.15 A number of project schedules have been prepared over the lifetime of the river Lee pilot. A schedule developed in September 2006 envisaged that the project would be completed by February 2008. The flood risk management plan for the river Lee pilot was completed in January 2014 and was submitted to OPW in March 2014.[2] Figure 3.3 sets out the planned and actual dates of delivery for the contracted survey work on the river Lee project and for completion of the overall project.

1 For the Lee, Dodder and Fingal/East Meath pilot projects, principal contractors were engaged to coordinate all aspects of the process to produce flood risk management plans.

2 The plan is available at www.opw.ie/en/leecframs

Figure 3.3 Key dates on the river Lee pilot project, 2005 to 2014

	Delivery date		Overrun (months)
	Planned	Actual	
Aerial survey of Cork	Dec 2005	Dec 2006	12
Ground survey	Apr 2007	Oct 2007	6
Aerial survey of Cork City	Sep 2007	May 2008	8
Aerial survey of defence assets	Nov 2007	May 2008	6
Publication of the flood risk management plan	Feb 2008	Mar 2014	73

Source: Analysis by the Office of the Comptroller and Auditor General

3.16 The work to be carried out by the principal contractor was dependent on the timely availability of survey data. The completion of the surveys took longer than expected, which had knock-on implications for the overall project timeline.

Flooding in Cork City, November 2009

3.17 The significant flooding that occurred in Cork city and surrounding areas in November 2009 also caused additional time to be spent on the river Lee pilot project. Following that flooding, OPW requested the principal contractor to carry out a validation exercise, comparing actual flood data to the hydraulic model developed as part of the river Lee pilot.

3.18 The final validation report (November 2010) indicated that the model was operating within acceptable limits for areas upstream of Cork city. However, it was found that observed water levels in Cork city in November 2009 were significantly below those predicted by the model. The report recommended that data collected on the 2009 flooding event be used to calibrate the model through Cork city. The validation exercise was reflected in key project outputs.

River Dodder

3.19 The river Dodder project, managed by Dublin City Council, commenced in February 2007 with the appointment of the consulting engineers. The initial project schedule of January 2007 envisaged that the project would be completed in August 2008. A draft flood risk management plan was prepared and made available for public consultation in February 2012. The final flood risk management plan was published in November 2014.

3.20 Figure 3.4 sets out the planned and actual dates of delivery for the ground survey work on the river Dodder project and for completion of the overall project. There were no details on OPW files regarding the planned delivery of aerial survey work of the Dodder.

Figure 3.4 Key dates on the Dodder pilot project, 2007 to 2014

	Delivery date		Overrun (months)
	Planned	Actual	
Ground survey	Jan 2007	Oct 2007	9
Aerial survey	n/a	July 2006	n/a
Publication of flood risk management plan	Aug 2008	Nov 2014	75

Source: Analysis by the Office of the Comptroller and Auditor General

3.21 Dublin City Council stated that while the ground survey work was completed in March 2007, it was not available to the principal contractor until October 2007 as extra work and checks needed to be carried out.

River Suir

3.22 The river Suir project was undertaken and managed directly by OPW. An initial project schedule developed in October 2007 envisaged that the river Suir pilot project would be completed in April 2010. An internal memorandum prepared in March 2012 indicated that, based on the resources allocated to the project at that time, it would not be completed until early in 2017.

3.23 The 2012 internal memorandum noted that the estimated completion date would not comply with the requirements of the Floods Directive and it included possible measures and options to address the resource problem. No evidence was found on OPW files reviewed as part of this examination of action taken arising from that report. However, OPW stated that many of the suggested options were progressed, such as cutting back on the scope of work to be undertaken, outsourcing work and allocating more OPW staff time to the project. It noted that as a result of the action taken, the timeline for the river Suir pilot (which has been subsumed into the South Eastern CFRAM study) is now in line with the other studies in the national CFRAM programme i.e. completion expected by the end of 2016.

3.24 A number of surveys were required as part of the pilot project. Delivery of the survey data took longer than anticipated and affected the timeline for delivery of the overall project. However, all of the survey work had been completed by November 2009.

3.25 Figure 3.5 sets out the planned and actual completion dates of the survey contracts and for the overall project.

Figure 3.5 Key dates on the river Suir pilot project, 2007 to 2015

	Delivery date		Overrun (months)
	Planned	Actual	
Ground survey	Apr 2007	Mar 2008	11
Aerial survey	Jan 2008	Mar 2009	14
Digitisation of 1960s Suir survey data	Mar 2008	Sep 2008	6
Orthoimagery survey	Apr 2008	Aug 2009	16
Flood defence asset survey[a]	Mar 2009	Nov 2009	8
Publication of flood risk management plan	Apr 2010	Ongoing[b]	80

Source: Analysis by the Office of the Comptroller and Auditor General

Notes: a The planned date of delivery indicated in the tender documentation has been adjusted to reflect a delay in commencing this contract.

b Target as at November 2015 is end 2016.

Fingal/East Meath

3.26 The Fingal/East Meath pilot project commenced in June 2008 and was managed by Fingal County Council. The principal contractor completed work on the project in August 2012, with work taking longer than anticipated in several areas. Figure 3.6 sets out the key dates on the project.

Figure 3.6 Key dates on the Fingal/East Meath pilot project, 2008 to 2014

	Delivery date		Overrun (months)
	Planned	Actual	
Aerial survey	Oct 2008	Apr 2009	6
Ground survey	Apr 2009	Jul 2010	15
Publication of flood risk management plan[a]	Dec 2010	Nov 2011[b]	n/a

Source: Analysis by the Office of the Comptroller and Auditor General

Notes: a The planned date of delivery indicated in the tender documentation has been adjusted to reflect a delay in commencing this contract.

b A draft flood risk management plan was issued for public consultation in November 2011.

3.27 The period required to undertake and complete the ground survey was significantly longer than expected. Originally expected to take four months to complete, the survey took nineteen months. Since the principal contractor was reliant on survey data to complete its own analysis, this additional time had a direct impact on the timeline for the overall project, and on project costs.

3.28 Fingal County Council stated that there were a number of outstanding tasks to be completed following a conciliation process and the termination of the contract with the principal contractor.[1] It was decided that some of these issues would be dealt with as part of the Eastern CFRAM study and that Fingal County Council would work on the remainder. Fingal County Council has stated that the remaining tasks were completed by it in September 2014 and have been incorporated into the documents sent to OPW for final approval.

1 Details of the conciliation process between Fingal County Council and the principal contractor are provided in Chapter 4.

3.29 OPW have stated that there are outstanding tasks in relation to this project, which have been discussed with Fingal County Council. A final flood risk management plan for the catchment has not yet been published.

CFRAM Programme Status

3.30 Figure 3.7 shows the status of the six national CFRAM studies as at December 2014, with reference to the requirements of the EU Floods Directive.

Figure 3.7 Status of national CFRAM studies, at December 2014

Target	Outputs	Shannon	Eastern	South Eastern	Western	South Western	North Western
Submit by March 2014[a]	Current dataset	●	●	●	●	●	●
	Flood hazard maps	○	○	○	○	○	○
	Flood risk maps	○	○	○	○	○	○
Submit by March 2016[b]	Preliminary options report	○	○	○	○	○	○
	Strategic environmental assessment report	✘	○	○	✘	○	✘
	Draft flood risk management plan	✘	○	○	✘	○	✘
	Flood risk management plan	✘	○	✘	✘	○	✘

Source: Analysis by the Office of the Comptroller and Auditor General

Notes:

a The Directive states that flood hazard maps and flood risk maps are to be completed by 22 December 2013, and submitted to the EU by the end of March 2014.

b The Directive states that flood risk management plans are to be completed and published by 22 December 2015, and submitted to the EU by the end of March 2016.

● Achieved for all areas within the study.

○ Achieved for some areas within the study.

✘ Not achieved for any areas within the study.

3.31 OPW has stated that it now expects all of the national CFRAM projects to be completed by the end of 2016.

Publication of Flood Maps

3.32 The Floods Directive required EU member states to produce flood hazard and flood risk maps by 22 December 2013, and to make them available to the public for all target areas. The CFRAM website was examined, for a sample of areas, at October 2015, to identify if the required maps were available.

3.33 At October 2015, flood extent maps were available online for all of the areas sampled. Flood depth maps were available for four of the six areas, but not for the two areas in the Shannon catchment. The required flood risk maps were not available on the CFRAM website (see Figure 3.8).

Figure 3.8 Publication of floods maps[a] for sample areas, October 2015

CFRAM Study	Sample area	Flood hazard maps			Flood risk maps		
		Flood extent	Flood depth or level	Velocity	Indicative number of inhabitants affected	Type of economic activity potentially affected	Environmental
Lee pilot study	Cork City Centre	●	●	●	✘	✘	✘
	Blarney/Tower	●	●	●	✘	✘	✘
Suir pilot/South Eastern CFRAM	Clonmel	●	●	○	✘	✘	✘
	Tramore	●	●	○	✘	✘	✘
Shannon CFRAM	Newcastle West, Limerick	●	✘	○	✘	✘	✘
	Athlone	●	✘	○	✘	✘	✘

Source: Analysis by the Office of the Comptroller and Auditor General

Note: a The Directive requires that each map type is prepared according to three scenarios; low, medium and high probability of flooding.

● Maps publicly available.

○ Maps not publicly available but only required by the Directive, where appropriate.

✘ Maps not publicly available.

3.34 A full set of flood risk maps, as required by the Floods Directive, was not prepared as part of the river Lee pilot project. The final flood risk management plan states that flood risk maps were prepared on the basis of aggregated annual average economic damages, which is not one of the categories of risk map specified in the Directive. The pilot project commenced in 2007 prior to the adoption of the Floods Directive but the plan states that the likely requirements of the Directive were known to OPW at that time. As the preparation of flood risk maps follows on from the preparation of hazard maps, there should have been scope within the management of the project to fulfil the requirements of the Directive.

3.35 As at October 2015, OPW had made a full suite of flood hazard and flood risk maps available to the public in the case of the Western CFRAM – the only area for which a full set of maps was publicly available.[1] These maps comply with the requirements of the Directive in terms of the categories of maps available and the probability scenarios covered (see Appendix B).

Flood Risk Management Plans

3.36 The aim of each flood risk management plan is to identify viable structural and non-structural measures and options for managing the risk of floods in the relevant area. The final plan should set out the measures required to achieve the most cost effective and sustainable management of flood risk.

3.37 The river Lee pilot was the first project for which a flood risk management plan was published. A final flood risk management plan has also been published for the Dodder pilot project and a draft final flood risk management plan has been published for the Fingal/East Meath area pilot. Figure 3.9 sets out details of the measures included in the flood risk management plans published to date.

Figure 3.9 Flood risk management plans for pilot projects

Pilot area	Date published	Number of measures recommended	Estimated cost to implement
			€m
River Lee – final plan	Jan 2014	17	200
Fingal/East Meath – draft plan	Nov 2011	16	20
River Dodder – final plan	Nov 2014	6	16
Total			**236**

Source: Published final and draft flood risk management plans.

3.38 The implementation of the programme of works proposed for each pilot area is subject to budget availability and the national prioritisation of proposed works. OPW has developed a multi-criteria analysis framework for appraising schemes with potential to reduce or manage flood risk. A benefit-to-cost ratio is calculated for each option, comparing its potential to reduce flood risk or other related benefits to the cost of implementation. Once completed nationally, the framework should enable prioritisation of measures across the national CFRAM programme on a systematic and objective basis to maximise the return on early investment.

3.39 Regarding implementation of the river Lee flood risk management plan, OPW stated that many elements have been progressed. It stated that consultants have been appointed and procurement processes have commenced on several of the major schemes. In addition, funding has been provided to Cork City Council and Cork County Council for minor works. It stated that advancement of the elements underway will involve investment of over €100 million over the next six years.

1 The national consultation period on the draft maps had not yet started.

3.40 In relation to the Fingal/East Meath area, OPW stated it has approved a number of applications for minor works that are included under the draft flood risk management plan. In relation to the river Dodder, OPW stated that it has undertaken all of the proposed tidal works up to New Bridge (at Lansdowne Road) and works are currently ongoing through Ballsbridge and Donnybrook.

4 Expenditure on Flood Risk Management

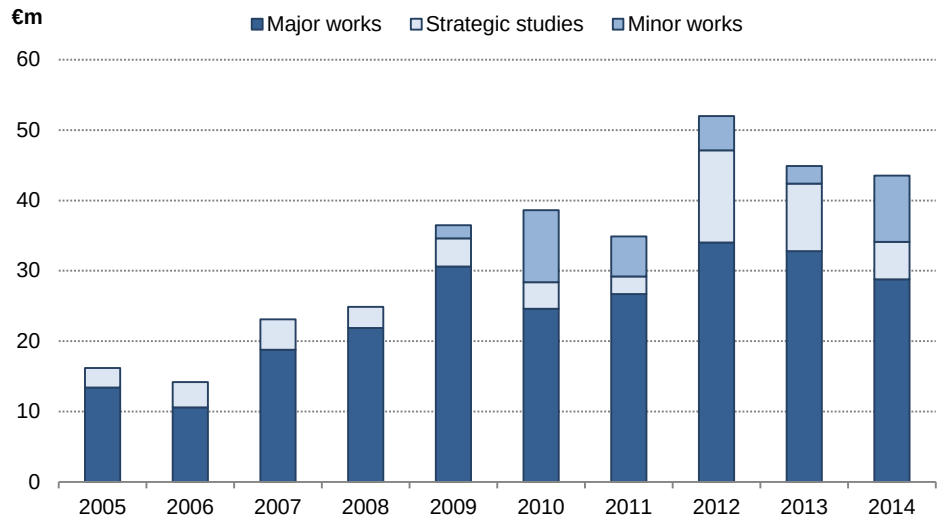
4.1 In the context of structural programmes, OPW expenditure on flood risk management generally relates to either strategic studies or capital works. The majority of the expenditure on strategic studies is in connection with the CFRAM programme.

4.2 OPW allocates funding for capital works through either the minor works scheme or the major flood defence scheme.

- Under the minor works scheme, OPW can allocate funding to local authority projects, costing €500,000 or less, involving minor flood mitigation works or studies to address localised flooding and coastal protection problems within a local authority's administrative areas.
- Larger projects, under the programme of major flood defence schemes are, in the main, delivered by civil engineering works contractors either engaged and paid by OPW directly or engaged by local authorities with OPW funding and technical input. Some of the larger schemes are undertaken directly by OPW staffed teams.

4.3 Capital expenditure on flood risk management over the period 2005 to 2014 was €329 million, comprising major works at a cost of €242 million, strategic studies that cost €52 million and minor works that cost €35 million. Annual OPW capital expenditure on flood risk management since 2005 is shown in Figure 4.1.

Figure 4.1 OPW capital expenditure on flood risk management, 2005 – 2014[a]



Source: Office of Public Works appropriation accounts 2005 – 2014.

Note: a Minor works expenditure in 2014 includes €7.68 million for the repair of coastal protection and flood defence infrastructure, following severe storms in December 2013 and January 2014.

Prioritisation of Capital Expenditure

4.4 In recognition of the need for a systematic and objective basis to prioritise proposed flood relief schemes, OPW began work in 1996 to develop a national priority programme of locations to be considered for future flood mitigation measures. Proposed schemes were ranked into high, medium and low priority categories based on analysis of the best available flood risk information at that time. Over subsequent years, additional at-risk locations were brought to OPW's attention.

4.5 The Accounting Officer stated that since 2004, OPW has adopted a strategic approach to its capital expenditure programme for flood risk management. Projects are only approved following detailed and comprehensive analysis, including public consultation on possible engineering solutions, their associated costs and benefits and environmental impact. In recent years, the consistency of proposed mitigation measures with the emerging flood risk management plan for an area, where applicable, has been taken into account when deciding whether to initiate a new scheme. With regard to other scheme proposals, OPW's general policy has been to await the completion of the relevant CFRAM study.

4.6 The Accounting Officer stated that major schemes have been advanced to deal with the most serious known flood risks in cities and large towns. Pending the completion of the national CFRAM programme, OPW's analysis informing the prioritisation of feasible flood relief schemes in known high risk areas has proven to be both strategically and socially acceptable.

4.7 She stated that OPW assesses major schemes having regard to the cost and expected benefits of the proposed measures as well as environmental factors. In this regard, a benefit/cost ratio of at least 1:1 is required before a project is considered. Once deemed economically and environmentally viable, approval is sought from the Department of Public Expenditure and Reform. The same standards apply to flood schemes undertaken by local authorities on OPW's behalf.

4.8 The Accounting Officer stated that in relation to the availability of budgets to implement the flood risk management plans, on 29 September 2015, the Government announced details of a €430 million six year programme of capital investment on flood defence measures as part of the Government's overall Capital Investment Plan 2016 – 2021. This is a substantial increase on the level of capital investment provided in the last multi-year programme (2012 – 2016) and will allow OPW to implement flood relief schemes which are already at an advanced stage of readiness such as Skibbereen, Claregalway, Bandon and Templemore. It will also allow OPW to continue the design and planning work for flood relief schemes in the pipeline such as for Cork city, Enniscorthy, Arklow, Clonakilty and Crossmolina. These schemes are in designated areas for further assessment and given the levels of risk identified, OPW has acted expeditiously to start flood defence schemes in these areas ahead of the CFRAM programme being completed. In addition and importantly, the enhanced investment programme will enable OPW, in collaboration with the relevant local authorities, to begin the process of preparation and planning for the structural works and schemes that are expected to be recommended under the CFRAM plans.

CFRAM Budgets and Expenditure

4.9 Figure 4.2 compares actual expenditure to the end of December 2014 on the pilot projects and the national CFRAM studies, with initial cost estimates and contract values.

Figure 4.2 Cost of pilot projects and national CFRAM programme[a]

	Indicative cost estimates[b]	Contracted value	Outturn at end 2014
	€m	€m	€m
Pilot projects			
River Lee	1.0	1.8	3.0
River Suir	0.5	2.4	2.3
River Dodder	1.0	1.1	1.3
Fingal/East Meath	1.0	1.5	2.3
	3.5	**6.8**	**8.9**
National CFRAM programme[c]			
Shannon	n/a	5.6	5.8
Eastern	n/a	4.0	3.9
South Eastern	n/a	3.3	3.2
Western	n/a	2.3	2.0
South Western	n/a	2.3	2.2
North West/Neagh Bann	n/a	2.3	2.3
Other contracts[d]	n/a	3.3	3.5
	30.0	**23.1**	**22.8**

Source: Office of Public Works

Notes:
a Figures in the initial cost estimate column are VAT exclusive. Figures in the contracted value and outturn at end 2014 columns are VAT inclusive. Any apparent differences in totals are due to rounding.
b Indicative costs for pilots, as stated in OPW's Outline Implementation Plan, June 2005 (see Appendix C).
c The estimates for the national programme are from the 2009 implementation strategy.
d Includes contracts for aerial survey work, technical advisory services and project engineer support, digital height modelling and technical support with preparation of the preliminary flood risk assessment.

4.10 The June 2005 outline implementation plan prepared by OPW proposed nine pilot projects to be undertaken.[1] For large catchments, it envisaged expenditure of an average of €500,000 each on in-house managed pilots, and an average of €1 million each on externally commissioned pilots was envisioned (see Appendix C).

4.11 Up to December 2014, €8.9 million (including VAT) had been spent on the four pilot projects and OPW estimated that a further €340,000 would be required to complete them.

4.12 OPW's 2009 implementation strategy for the EU Floods Directive estimated that the cost of implementing the national CFRAM programme would be €30 million. The estimate was not broken down by region, did not cover the cost of the pilot projects and did not include VAT. Up to the end of December 2014, actual expenditure on the national programme was €22.8 million, with OPW estimating the additional cost to completion at €4.6 million (including VAT).

1 Parts of this plan were revised in December 2005. OPW's Flood Policy Review: Overview Plan for Policy Implementation (March 2006) proposed eight pilot studies to be undertaken.

4.13 In the case of the pilot projects, while indicative expenditure levels were set in advance in the outline implementation plan, these did not constitute project budgets.

4.14 For two of the pilot projects, the funding arrangement involved OPW making payments to local authorities. In those cases, it was found that OPW had made payments on the basis of cost estimates received, but evidence of detailed supporting documentation was not presented to the examination team. In both cases, large sums were paid to the local authorities in advance of work commencing.

Project Cost Overruns

4.15 The expenditure outturn to date has exceeded the contract value for the pilot projects. By end 2014, the expenditure on the CFRAM projects had almost reached the aggregate contract value, but work remained to be completed, and the expected final cost will exceed the contract value. The majority of the additional costs incurred fall under two general headings.

Agreed Additional Work

4.16 OPW stated that it has made payments of over €1.1 million across the pilot projects in respect of certain additional work agreed in advance

- €554,000 – river Lee pilot
- €270,000 – river Suir pilot
- €179,000 – Fingal/East Meath pilot
- €141,000 – river Dodder pilot.

4.17 OPW stated that the requirement for additional work generally reflects the fact that the pilot projects were innovative and testing new methodologies. This gave rise, as the projects evolved, to requirements for new work and services over and above the scope of what was contracted for. OPW believes that this extra work was necessary and of value in terms of using the pilot projects to inform the scope of the national studies. The additional work approved included the development of project websites, newsletters, a methodology for uncertainty mapping and the multi-criteria analysis framework for appraising flood risk management options.

4.18 In terms of the national CFRAM programme, OPW has made payments totalling €3.2 million to the end of December 2014 in respect of agreed additional work.

- South Eastern – €709,000
- Shannon – €692,000
- Eastern – €679,000
- South Western – €435,000
- North West/Neagh Bann – €411,000
- Western – €229,000.

4.19 About half (€1.7 million) of the additional work on the national studies relates to survey requirements that had not been identified prior to contract signing. The remaining €1.5 million relates to additional work agreed between OPW and the principal contractors, some of which (€0.45 million) represents foreseeable variations which are priced in accordance with fixed rates set out in the contract.

Validation of Cork Flooding Model

4.20 OPW requested the principal contractor to carry out a validation exercise following the significant flooding that affected Cork city and surrounding areas in November 2009.

4.21 Arising from the validation report, the principal contractor carried out additional work on the hydraulic model. The overall cost of the additional work was around €170,000, comprising

- re-calibration of model – €77,400
- update of project outputs (final report, final flood maps, flood risk management plan) – €44,100
- completion of post-event analysis report – €30,600
- validation work – €17,700.

Compensation for Project Delays

4.22 OPW has also made payments totalling €1.24 million to principal contractors on two of the pilot projects in compensation for project delays and some additional works that had not been agreed in advance

- €636,000 – river Lee pilot
- €603,000 – Fingal/East Meath pilot.

4.23 The compensation payments principally related to the completion of the survey work taking longer than anticipated. Since the work of the principal contractors was dependent on the timely availability of survey data, delays with the surveys had implications for the principal contractors on both pilot projects, in terms of time and cost.

4.24 The compensation payment on the Fingal/East Meath pilot project relates to the outcome of a conciliation process between Fingal County Council and the principal contractor. Figure 4.3 sets out the background to the conciliation settlement.

4.25 In terms of the national programme, OPW has made compensation payments to contractors, totalling €305,000 to the end of December 2014 in relation to the Shannon CFRAM study. The compensation also related primarily to delays in the availability of survey data relative to what was anticipated.

Figure 4.3 Conciliation settlement on Fingal/East Meath pilot project

During the period from the start of 2009 to late 2011, the principal contractor on the Fingal/East Meath CFRAM pilot project submitted a number of claims to Fingal County Council totalling €1.3 million (excluding VAT). The claims related to

- longer than anticipated timeframes and additional work related to the ground survey
- delays by OPW and Fingal County Council in responding to work submitted by the contractor
- additional work required that had not been specified in the project brief.

In December 2011, Fingal County Council issued a formal response to the principal contractor offering to make a payment of around €117,700 in settlement of all outstanding claims.

Having failed to reach agreement, the parties entered into a conciliation process, facilitated by an agreed third party. Representatives from the principal contractor, Fingal County Council and OPW attended the conciliation meeting in July 2012.

The conciliator recommended that Fingal County Council should complete the remaining work on the contract and pay the contractor €602,700 (including VAT) in full settlement of all outstanding claims.

5 Conclusions and Recommendations

5.1 Since 2004, national policy on managing flood risk has recognised that flood defence measures are likely to be more effective and to deliver better value for money when coordinated throughout a river basin district. That approach is consistent with the 2007 EU Floods Directive.

5.2 In order to derive maximum value from the limited funds available, it is essential that funding allocation decisions are evidence-based. However, twelve years on from the report of the Flood Policy Review Group and eight years after the EU Floods Directive, substantial capital expenditure continues to be incurred on an annual basis, without the full benefit of the comprehensive analysis and strategic plans that will emerge from the CFRAM programme.

5.3 Significant delays noted on each of the projects reviewed during this examination suggest that the availability of flood risk management plans on a national basis is still some way off.

Timeliness of Pilot Projects

5.4 The implementation plan prepared by OPW in March 2006 envisaged that the pilot testing phase would finish in 2007 and that the national programme would be complete by the end of 2011. While the implementation strategy (January 2009) developed to meet the requirements of the EU Floods Directive set target dates for the national CFRAM studies, it did not contain a revised timeline for completion of the pilot studies.

5.5 All of the pilot projects examined have run significantly over the original schedules, with longer than anticipated time periods in relation to aerial and ground survey work being a feature in all cases. Since the survey data is required to inform the development of flood risk management plans, additional time on the surveys had a knock-on effect on the overall project timelines.

5.6 The current status of the programme is that final flood risk management plans were published in 2014 for two (river Lee and river Dodder) of the four pilot projects and a draft plan was published in 2011 for Fingal/East Meath. OPW has indicated that the remaining work on the river Suir pilot project will be completed as part of the South Eastern CFRAM study.

CFRAM Programme Targets

5.7 The EU Floods Directive set target dates for each of the main outputs required to develop comprehensive flood risk management plans. The preliminary flood risk assessment was completed and submitted by OPW to the EU Commission by the required deadline of March 2012. This identified 300 areas at significant risk of flooding.

5.8 In March 2014, OPW submitted flood hazard and flood risk maps for only 50 of the 300 areas to the Commission. It intends to present the remaining maps at the end of 2015. OPW does not expect to meet the March 2016 deadline for submission of flood risk management plans to the EU Commission. It now intends to finalise the plans by the end of 2016.

5.9 OPW states that the national CFRAM programme is without precedent in its scale and complexity. The flood mapping exercise involved detailed modelling and mapping of 300 areas of potentially significant flood risk, the surveying and modelling of 6,700 km of watercourse and the production of approximately 40,000 individual flood maps. Of the 40,000 flood maps produced, 13,000 of these are required under the EU Floods Directive requirements. OPW did not consider it would be of benefit to submit the remaining maps to the EU Commission by the deadline when it could report more detailed and reliable mapping at a later date, exceeding the requirements of the Floods Directive. Informal discussions between OPW and the EU Commission, including written correspondence, have taken place in this regard.

Recommendation 5.1

Where project or programme targets are not met, or it is anticipated that they may not be met, the OPW should set revised milestones to be achieved to enable the CFRAM process to be completed promptly, including production of a set of comprehensive flood risk management plans covering all national river basins.

Response of the Accounting Officer, Office of Public Works

Agreed. The OPW has detailed its CFRAM Programme and an individual plan for each of the six study areas. This programme and these plans include milestones from commencement to the delivery of the flood risk management plans. Milestones are a critical aspect to these plans not just for project management, including, for example, the coordination of delivery across all six projects where national consultation activities are required, but also as half of the contracted payment to engineering consultants engaged under the CFRAM programme is triggered by successful milestone delivery alone. The role of the management structures for the CFRAM, in part, is to manage and co-ordinate progress and the delivery of these study plans and the national programme. Managing revision to programme delivery involves appropriate remedial actions, ensuring an efficient and timely delivery of the overall programme within budget. The role of the overall governance structures for the programme is to inform, co-ordinate and oversee this programme in line with the integrated plans in place. The report by the Interdepartmental Committee due in spring 2016 will set out a whole of government implementation plan that will be required when this CFRAM programme is complete and the flood risk management plans have been prepared. Hence the OPW is not only delivering CFRAM through an integrated plan leading to the delivery of flood risk management plans, it is also co-ordinating the development of an integrated whole of government flood risk management plan.

Governance and Oversight

5.10 Oversight bodies were established to monitor the implementation of each pilot project and national CFRAM study. However, in the case of the pilot projects, there is a lack of clarity over precise roles and responsibilities. OPW was unable to provide terms of reference for the steering and progress groups. [1]

1 Terms of reference were agreed for the National CFRAM Steering Group and the Interdepartmental Co-ordination Group when they were reconvened in November 2014 and July 2015 respectively.

5.11 In addition to project management and oversight arrangements, it is critical to the success of large scale programmes that progress is actively managed at the programme level. A detailed programme governance structure was established to oversee progress on the CFRAM programme. The national CFRAM steering group met on a number of occasions during 2009 and 2010, but no meetings took place between November 2010 and November 2014.

5.12 Similarly, a high level Interdepartmental Co-Ordination Group set up to oversee national coordination of flood risk management and flooding response met in the period 2006 to 2009, but did not meet thereafter until the group was reactivated in July 2015.

Pilot Testing Phase

5.13 The strategy adopted by OPW in 2006 for implementation of flood risk management policy involved undertaking a series of pilot studies at selected locations prior to the rollout of a national programme.

5.14 When a pilot phase is initiated at the outset of a programme rollout, it is important that the objectives of the pilot are clearly stated and that the pilot phase is formally concluded in advance of commencing the full programme. Ideally, a report should be prepared to formally document lessons from the pilot phase with the aim of informing decisions regarding rollout of the full scale programme. In the case of the CFRAM programme, there is some evidence of knowledge gained on the pilot projects informing decisions in relation to the national studies. However, this did not happen in a formalised manner.

Views of the Accounting Officer

5.15 The Accounting Officer stated that the Government's 2004 flood risk policy fundamentally changed the direction and approach to flood risk management in Ireland. It was necessary to carefully plan and test the new strategic approach to ensure that future investment yielded the highest possible return. The need for pilot testing was highlighted in the Report of the Flood Policy Review Group, published in 2004. The group prescribed that pilot testing should be used to develop expertise within OPW to manage the proposed development of national flood risk management plans. The Accounting Officer stated that while not formally documented at the time, the learning from the pilot projects was critical to informing the development of the national CFRAM programme. Comprehensive governance and management structures were put in place for each pilot. Initial plans and budgets for the pilots formed part of the outline implementation plan for flood policy prepared by OPW in 2005. The implementation plan provided that the river Suir pilot project should be undertaken by OPW in-house in order to develop experience, knowledge and skills internally to enable effective management of contracted services.

Relationship with Local Authorities

5.16 Where funding is provided by a department/office to a third party to carry out a project or oversee its completion, a service level agreement should be in place specifying the services to be provided and the standards to be met.

5.17 The river Suir and river Lee pilot projects were managed directly by OPW. The other pilots – Dodder and Fingal/East Meath – were managed by the relevant local authorities and carried out using contracted services. The local authorities were the respective contracting authority for the work being carried out, or have carried out some of the work directly. OPW, as the funding body, has a responsibility to oversee the projects and ensure that they progress as efficiently as possible.

5.18 While it is acknowledged that OPW was represented on the project steering and progress groups, there is no evidence that OPW entered into a service level agreement with either of the relevant local authorities prior to commencing the projects. In the absence of such agreements, it is more difficult to establish who is responsible for resolving problems that arise on a project. Lack of a service level agreement also increases the exposure of the funding authority to costs in excess of those agreed at the outset as it is not clear who is responsible for funding additional costs.

5.19 In 2014, the Department of Public Expenditure and Reform issued Circular 13/2014, Management of and Accountability for Grants from Exchequer Funds. It states that the default position in relation to a grant[1] is that it should be paid based on vouched expenditure. If pre-funding is required, prior approval must be sought from the Department of Public Expenditure and Reform. The circular also addresses the use of service level agreements and notes that an agreement should be in place between the Department and the body or agency receiving the grant, setting out details of the resources which are being provided and the outputs to be achieved.

Recommendation 5.2

Where OPW is providing funding to a third party in support of a project, a service level agreement should be put in place between the two parties. The agreement should set out the roles and responsibilities of both parties, the total funding being provided and the purposes for which it is being provided.

Response of the Accounting Officer, Office of Public Works

It is agreed that service level agreements should inform the relationship between OPW and local authorities in the future. OPW has previously highlighted that, at the times of the pilots, the structures adopted informed our roles and responsibilities through the close working relationship between OPW and the local authorities. At that time, these structures provided the greatest certainty and confidence to inform the learning from the pilots to transfer to the national programme, including the governance structures to apply.

In line with Department of Public Expenditure and Reform Circular 13/2014, the OPW is currently working actively with some local authorities to develop and put in place service level agreements on the lines recommended to govern the relationship between OPW and the local authorities in the implementation and maintenance of flood relief schemes. Indeed, such agreements are already in place and working in certain areas in regard to the operation and maintenance procedures of certain completed flood relief schemes.

Budgets and Expenditure

5.20 OPW estimated in 2009 that the cost of implementing the national CFRAM programme (but not including the cost of the pilot projects) would be €30 million (excluding VAT). Expenditure on the CFRAM programme to end December 2014 was €22.8 million, with OPW estimating that a further €4.6 million will be needed to complete it. OPW currently expects that the CFRAM process will be completed by end 2016.

1 A grant is defined in the circular as a financial provision, originating in a Vote, for a particular activity or service administered or undertaken by an outside body, including agencies, companies, committees, advisory groups, charities or individuals.

5.21 Indicative cost estimates for pilot projects were produced, distinguishing between those that might be carried out in-house and those contracted out. Detailed project budgets were not formally approved in advance by OPW for the individual pilot projects which commenced. While it was originally envisaged that nine pilot projects would be undertaken, only four proceeded. Indicative cost estimates for the four pilot projects totalled €3.5 million. Expenditure to the end of 2014 was €8.9 million. In all cases, expenditure to date on the pilots has significantly exceeded the indicative estimates.

5.22 In three of the four pilot projects, the expenditure to the end of 2014 also exceeded the contract value. The fourth project is now subsumed into the broader CFRAM study.

5.23 The Accounting Officer has stated that clear procedures and protocols are in place to assess costs for each project and project costs and budgets are reviewed monthly at meetings chaired by the relevant member of OPW's management advisory committee. She pointed out that the additional time and costs that have arisen on the pilot projects must be viewed in the context of the learning and development that has taken place for the innovative national CFRAM programme. She further stated that the national CFRAM programme is now delivering on key milestones through robust project management and governance structures.

5.24 Smaller scale pilot projects are potentially useful in removing some uncertainty where novel approaches or innovative technologies are being tried out. As a result, it is acknowledged that there may be some uncertainty in relation to the potential cost of the pilot projects. Nevertheless, it is difficult to exercise cost control over individual project elements and the project as a whole, without a detailed project budget.

Recommendation 5.3

A detailed project budget, including provision for any VAT payable, should be developed and approved at the appropriate level before significant funds are committed to any project.

Response of the Accounting Officer, Office of Public Works

I do not agree that the recommended procedures were not in place in the OPW. Project details and budgets were included in the 2005 outline implementation plan, approved by OPW senior management. Provision is made within the OPW budgetary process for approved projects and associated budgeted expenditure. The overall budgetary provisions are subject to the approval of OPW senior management.

Appendices

Appendix A

Cost of Pilot Projects and Shannon CFRAM Study

Project costs, as at December 2014, are set out below.

Figure A1 Costs for river Lee pilot project, as at December 2014

	Contract value	Outturn to date
	€000	€000
Principal contractor	1,048	2,199
Ground survey	460	487
Aerial survey of Cork	86	89
Aerial survey of defence assets	81	92
Orthimagery and aerial survey of upper Lee	68	68
Aerial survey of Cork city	31	30
University College Cork data	42	42
Other[a]	31	31
Total	**1,847**	**3,038**

Source: Office of Public Works

Note: a Includes about €26,000 for advertising, printing and translation costs and just over €5,000 for room hire and catering.

Figure A2 Costs for river Suir pilot project, as at December 2014

	Contract value	Outturn to date
	€000	€000
Technical support[a]	1,165	1,015
Ground survey	322	496
Flood defence asset survey	233	255
Aerial survey	176	232
Hydraulic modelling software (purchase, support and maintenance)[b]	203	157
Strategic environmental assessment and consultation plan[b]	132	26
Digitisation of 1960s river Suir survey data	41	59
Other[c]	100	80
Total	**2,372**	**2,320**

Source: Office of Public Works

Notes: a Includes three contracts with separate companies to provide technical support to OPW at different intervals. One contract remains ongoing.

b Contract is currently ongoing. OPW plans that it will be completed in 2016.

c Includes six contracts ranging from about €1,000 to €35,000 and expenses of just over €3,000.

Figure A3 Costs for river Dodder pilot project, as at December 2014

	Contract value	Outturn to date
	€000	€000
Principal contractor	507	648
Ground survey work	600	600
Aerial survey work	33	33
Other costs/expenses[a]	4	2
Total	**1,144**	**1,283**

Source: Office of Public Works

Notes: a It is expected that further costs/expenses of approximately €2,300 will be incurred.

Figure A4 Costs for Fingal/East Meath pilot project, as at December 2014

	Contract value	Outturn to date
	€000	€000
Principal contractor[a]	848	1,554
Ground survey	473	534
Aerial survey	122	137
Other[b]	33	33
Total	**1,476**	**2,258**

Source: Office of Public Works

Notes: a The expenditure to date includes a payment of €602,700 to the principal contractor in connection with a conciliation process that concluded in July 2012.

b Includes conciliation fee (€13,000), contract advice (€7,000), steering group meeting expenses (€5,000) and advertising (€4,000).

Figure A5 Costs for Shannon CFRAM study, as at December 2014

	Contract value	Outturn to date
	€000	€000
Principal contractor	2,729	2,629[a]
Ground survey contracts[b]	2,759	3,083
Expenses[c]	125	40
Total	**5,613**	**5,752**

Source: Office of Public Works

Notes: a The expenditure to date includes payments for additional work totalling just over €692,000 and payment of compensation claims of just over €305,000. There is also just over €15,000 of additional work approved as at December 2014 but yet to be paid.

b Includes the six contracts in place for ground survey work.

c OPW has estimated that it will incur a further €85,000 in expenses to complete the study.

Appendix B

Example of flood hazard and flood risk maps: Western CFRAM, Galway Bay South East, Gort

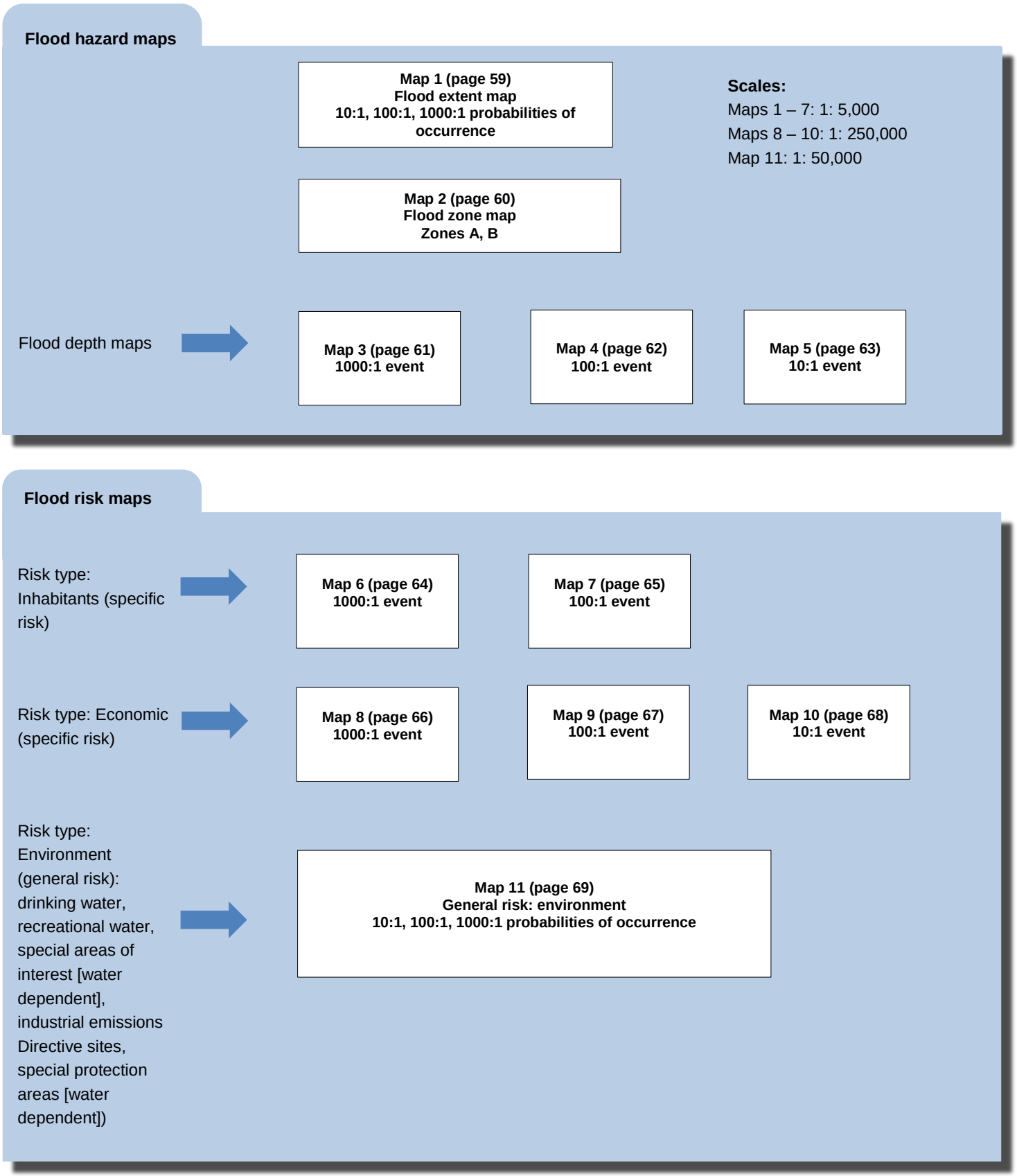
Extract from Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks

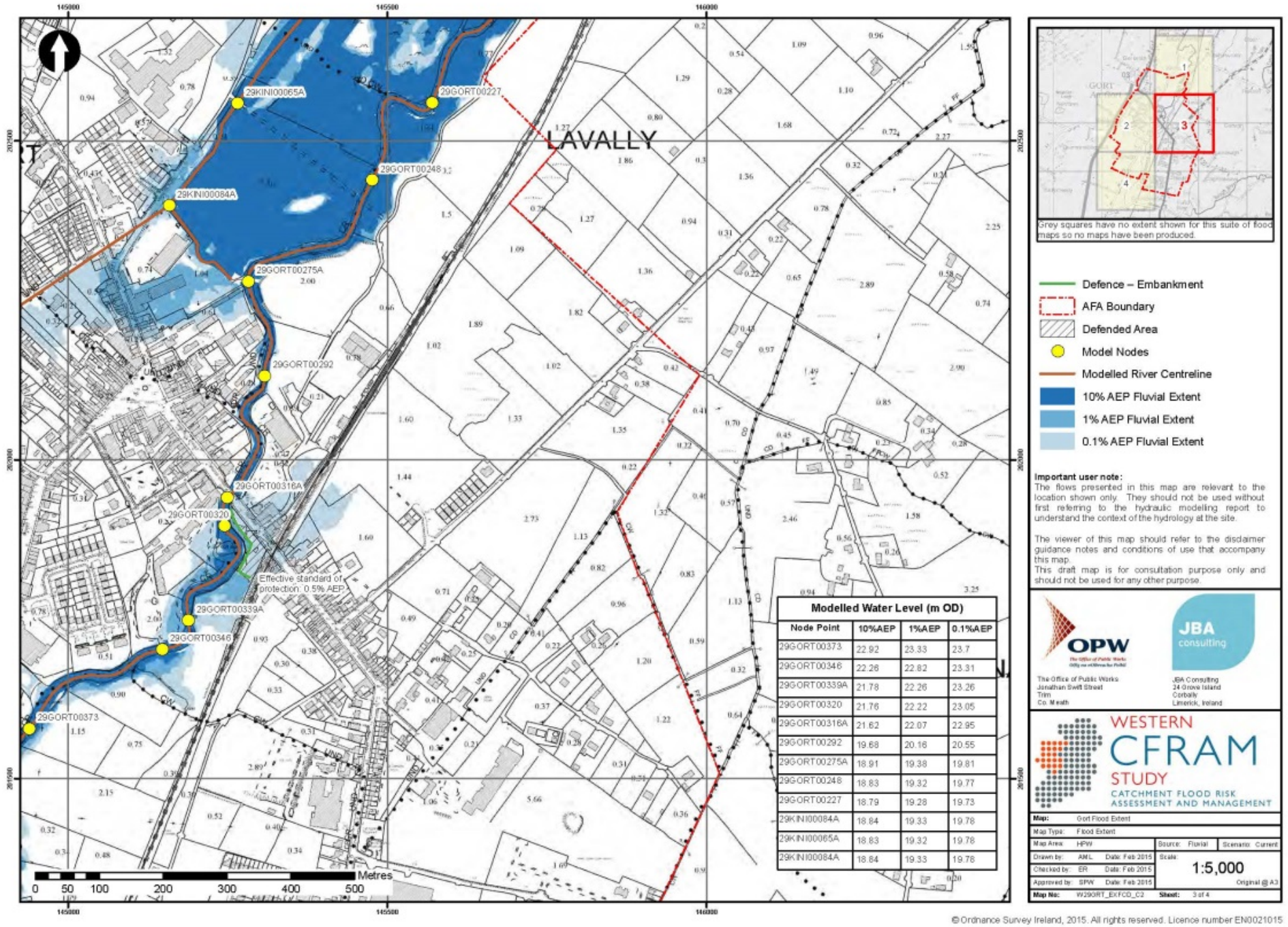
Chapter III
Flood hazard maps and flood risk maps
Article 6

1. Member States shall, at the level of the river basin district, or unit of management referred to in Article 3(2)(b), prepare flood hazard maps and flood risk maps, at the most appropriate scale for the areas identified under Article 5(1).
2. The preparation of flood hazard maps and flood risk maps for areas identified under Article 5 which are shared with other Member States shall be subject to prior exchange of information between the Member States concerned.
3. Flood hazard maps shall cover the geographical areas which could be flooded according to the following scenarios:
    (a) floods with a low probability, or extreme event scenarios;
    (b) floods with a medium probability (likely return period ≥ 100 years);
    (c) floods with a high probability, where appropriate.
4. For each scenario referred to in paragraph 3 the following elements shall be shown:
    (a) the flood extent:
    (b) water depths or water level, as appropriate;
    (c) where appropriate, the flow velocity or the relevant water flow.
5. Flood risk maps shall show the potential adverse consequences associated with flood scenarios referred to in paragraph 3 and expressed in terms of the following:
    (a) the indicative number of inhabitants potentially affected;
    (b) type of economic activity of the area potentially affected;
    (c) installations as referred to in Annex 1 to Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control[1] which might cause accidental pollution in case of flooding and potentially affected protected areas identified in Annex IV(1)(i), (iii) and (v) to Directive 2000/60/EC;
    (d) other information which the Member State considers useful such as the indication of areas where floods with a high content of transported sediments and debris floods can occur and information on other significant sources of pollution.
6. Member States may decide that, for coastal areas where an adequate level of protection is in place, the preparation of flood hazard maps shall be limited to the scenario referred to in paragraph 3 (a).
7. Member States may decide that, for areas where flooding is from groundwater sources, the preparation of flood hazard maps shall be limited to the scenario referred to in paragraph 3(a).
8. Member States shall ensure that the flood hazard maps and flood risk maps are completed by 22 December 2013.

1 OJ L 257, 10.10.1996, p.26. Directive as last amended by Regulations (EC) No 166/2006 of the European Parliament and of the Council (OJ L 33, 4.2.2006, p.1).

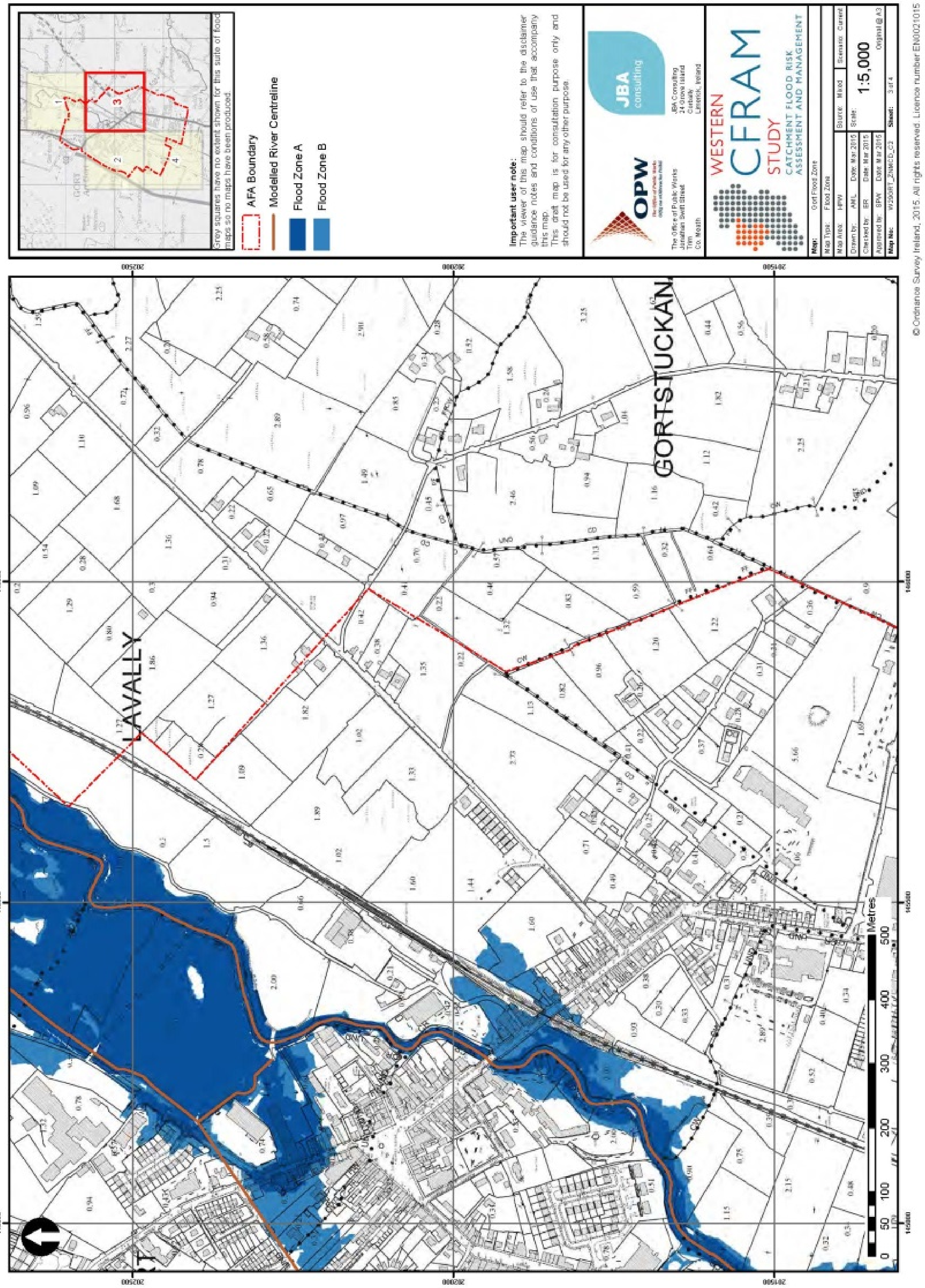
Overview of Gort Flood Maps, Pages 59-69





Modelled Water Level (m OD)

Node Point	10%AEP	1%AEP	0.1%AEP
29GORT00373	22.92	23.33	23.7
29GORT00346	22.28	22.82	23.31
29GORT00339A	21.78	22.26	23.26
29GORT00320	21.76	22.22	23.05
29GORT00316A	21.62	22.07	22.95
29GORT00292	19.68	20.16	20.55
29GORT00275A	18.91	19.38	19.81
29GORT00248	18.83	19.32	19.77
29GORT00227	18.79	19.28	19.73
29KINI00084A	18.84	19.33	19.78
29KINI00065A	18.83	19.32	19.78
29KINI00084A	18.84	19.33	19.78


Grey squares have no extent shown for this suite of flood maps so no maps have been produced.
AFA Boundary
Modelled River Centreline
Flood Zone A
Flood Zone B
Important user note:
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WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT
1:5,000
LAVALLY
GORTSTUCKAN
Metres
0 50 100 200 300 400 500
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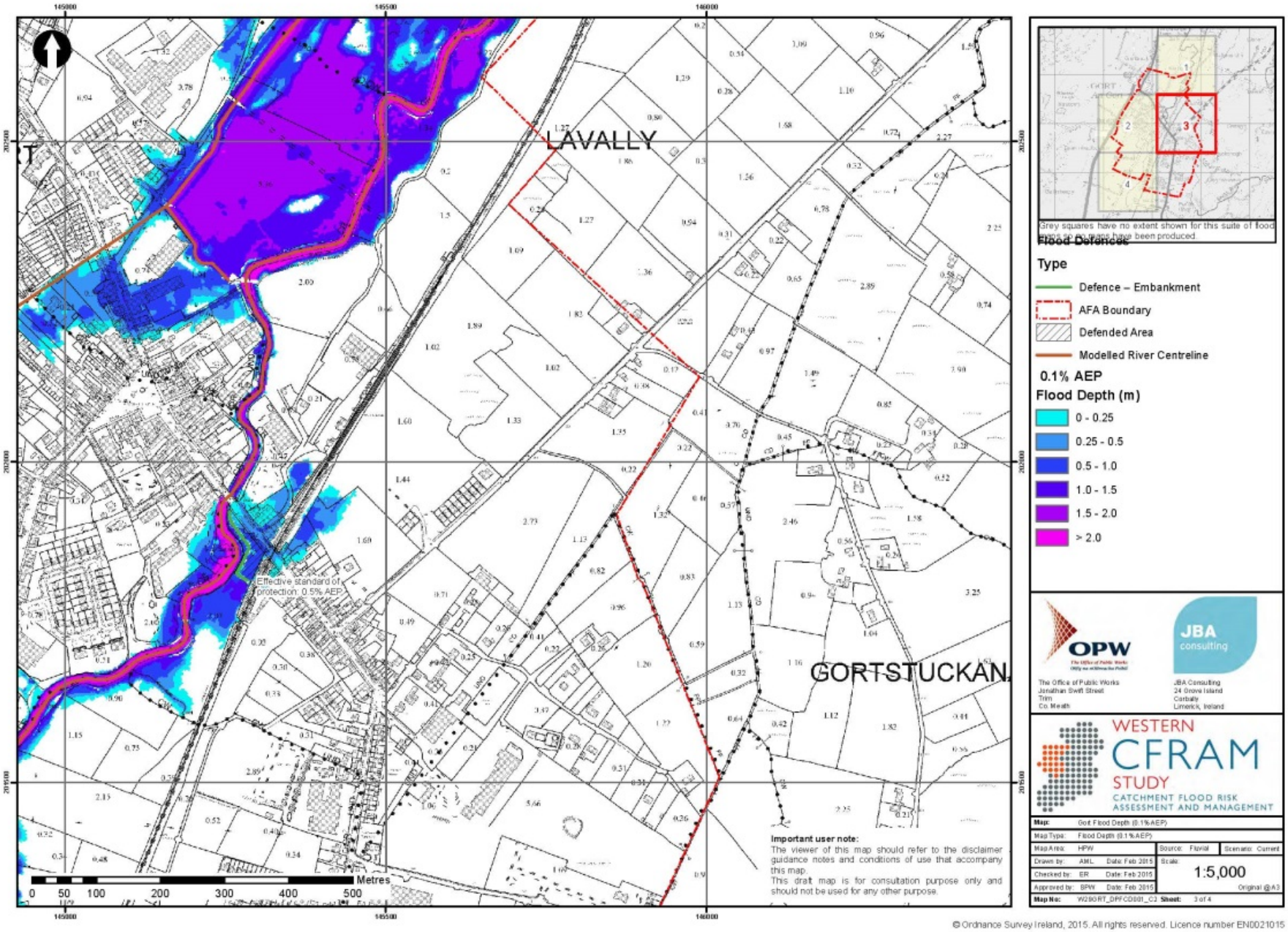
LAVALLY
GORTSTUCKAN
Effective standard of protection: 0.5% AEP
Metres
0 50 100 200 300 400 500
Grey squares have no extent shown for this suite of flood maps as no maps have been produced.
Flood Defences
Type
Defence – Embankment
AFA Boundary
Defended Area
Modelled River Centreline
0.1% AEP
Flood Depth (m)
0 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
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JBA Consulting
24 Grove Island
Corbally
Limerick, Ireland
WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT
Map: GotFlood Depth (0.1%AEP)
Map Type: Flood Depth (0.1%AEP)
Map Area: HPW
Source: Fluvial
Scenario: Current
Drawn by: AML Date: Feb 2015
Checked by: ER Date: Feb 2015
Approved by: BPW Date: Feb 2015
Scale: 1:5,000
Original @ A3
Map No: W2BORT_DFFCD001_C2
Sheet: 3 of 4
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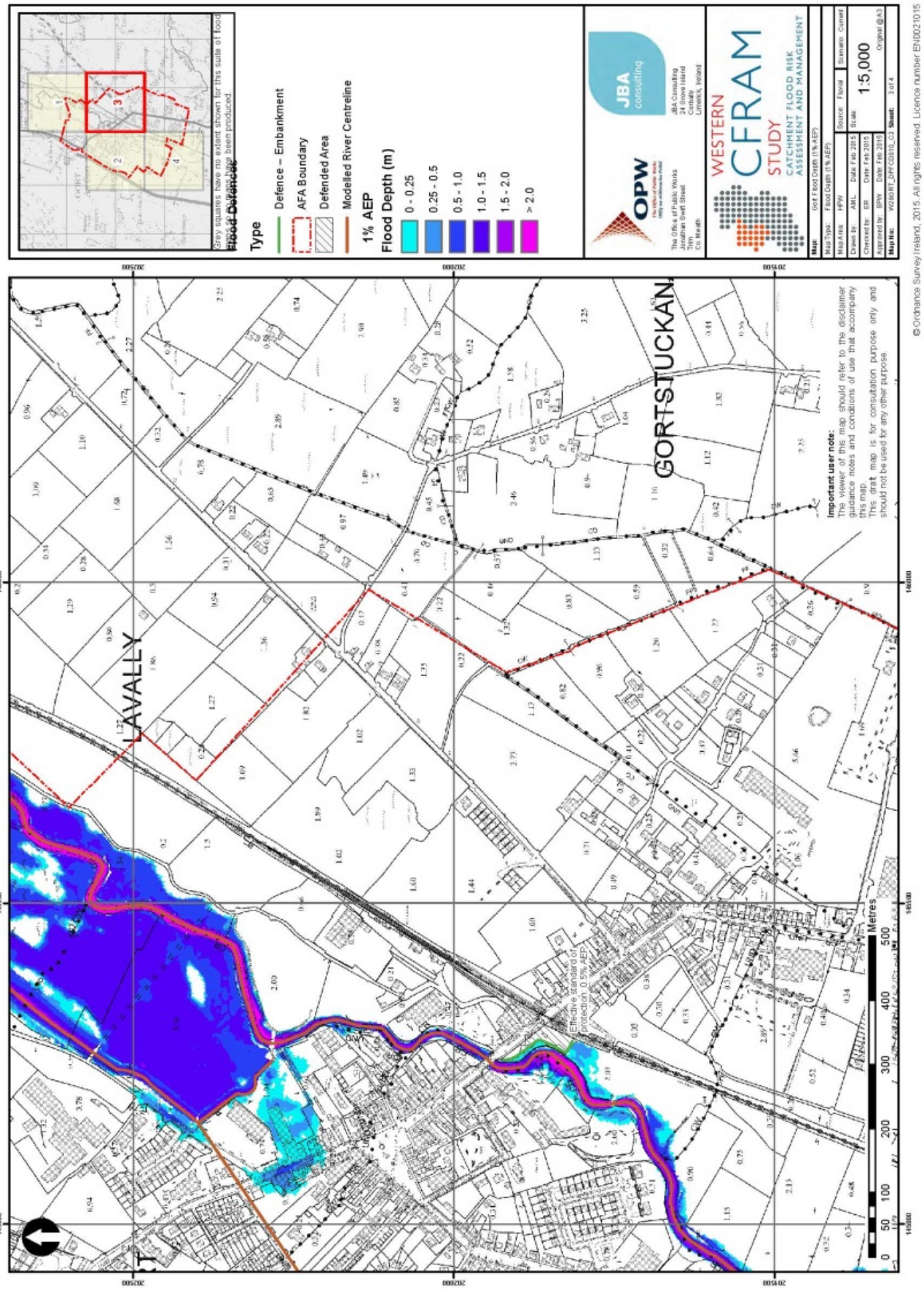
Flood Defences
Grey squares have no extent shown for this suite of flood maps as no defences have been produced
Type
Defence – Embankment
AFA Boundary
Defended Area
Modelled River Centreline
1% AEP
Flood Depth (m)
0 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
> 2.0
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STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT
Map: CorkFlood Depth (1% AEP)
Map Type: Flood Depth (1% AEP)
Map Area: HPW
Source: Fluvial
Scenario: Current
Drawn By: AMcL
Date: Feb 2015
Scale: 1:5,000
Checked by: ER
Date: Feb 2015
Original @ A3
Approved by: BPW
Date: Feb 2015
Sheet: 3 of 4
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Effective Standard of protection 0.5% AEP
Metres
0 50 100 200 300 400 500
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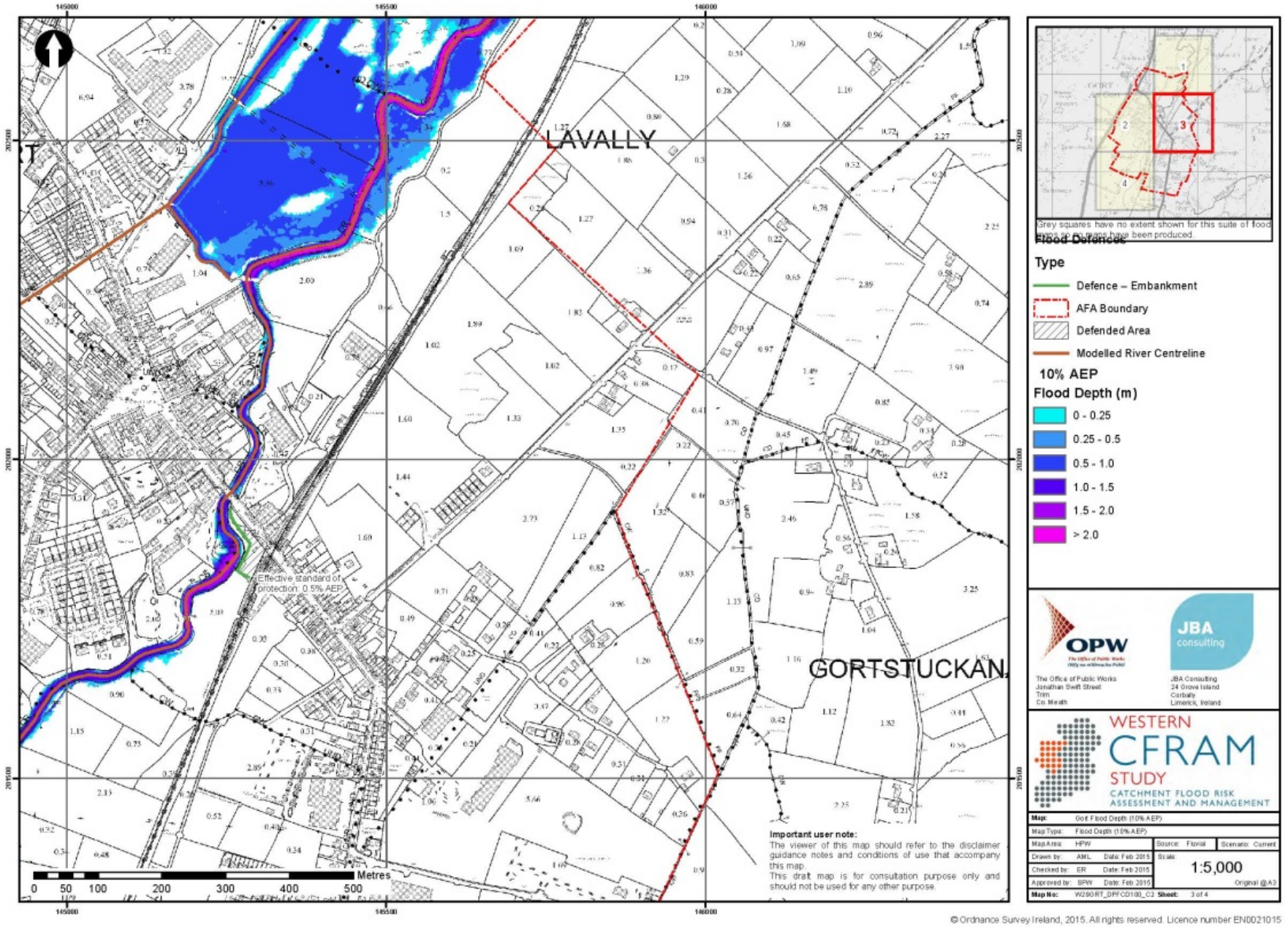

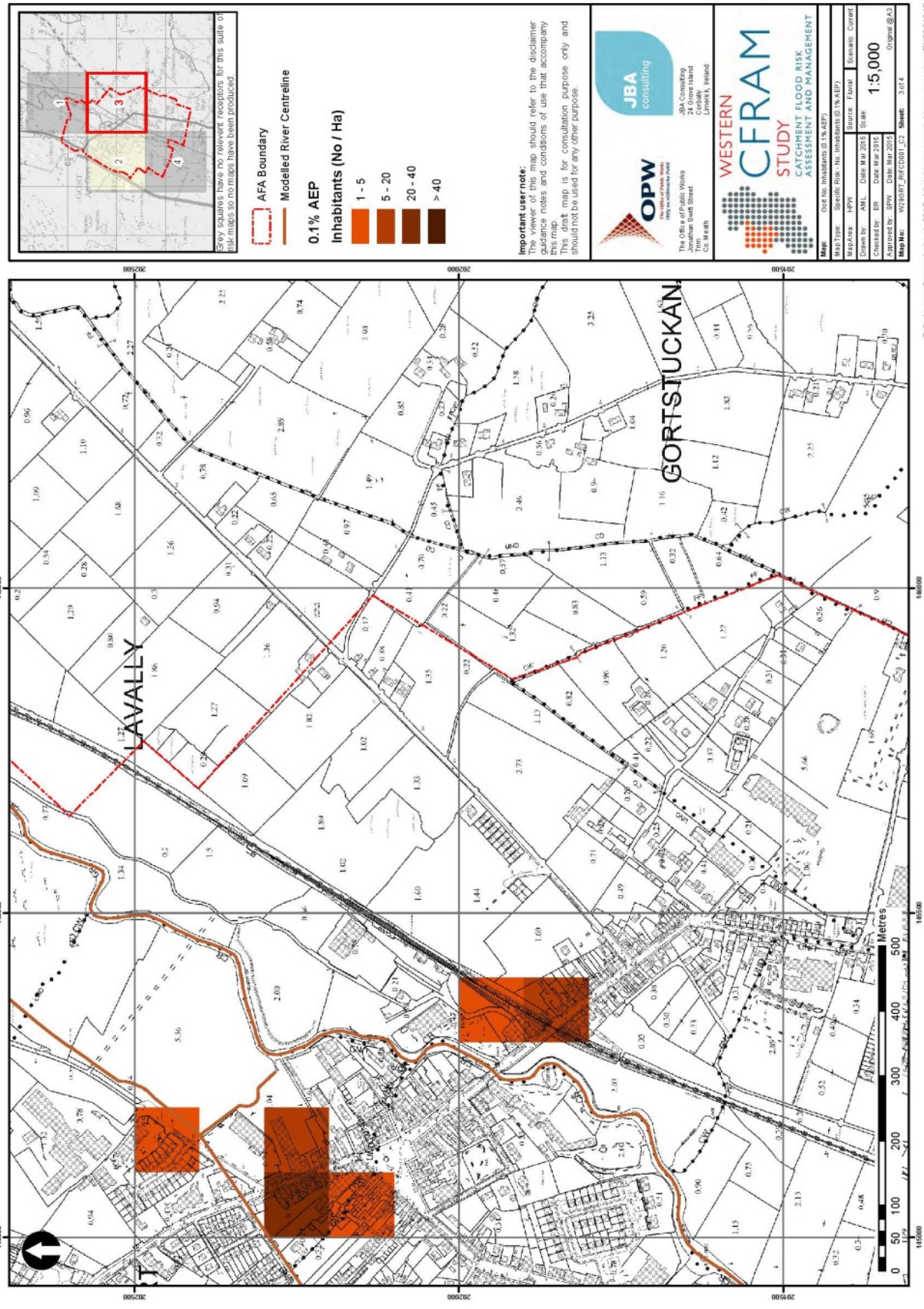
AFA Boundary
Modelled River Centreline
0.1% AEP
Inhabitants (No / Ha)
1 - 5
5 - 20
20 - 40
> 40
Grey squares have no relevent receptors for this suite of risk maps so no maps have been produced
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OPW
WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT
Map: Confi No. Inhabitants (0.1% AEP)
Map Type: Spatial Risk - No. Inhabitants (0.1% AEP)
Map Area: HPW Source: Fluvial Scenario: Current
Drawn by: AML Date: Mar 2015 Scale: 1:5,000
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Approved by: SPW Date: Mar 2015 Sheet: 3 of 4
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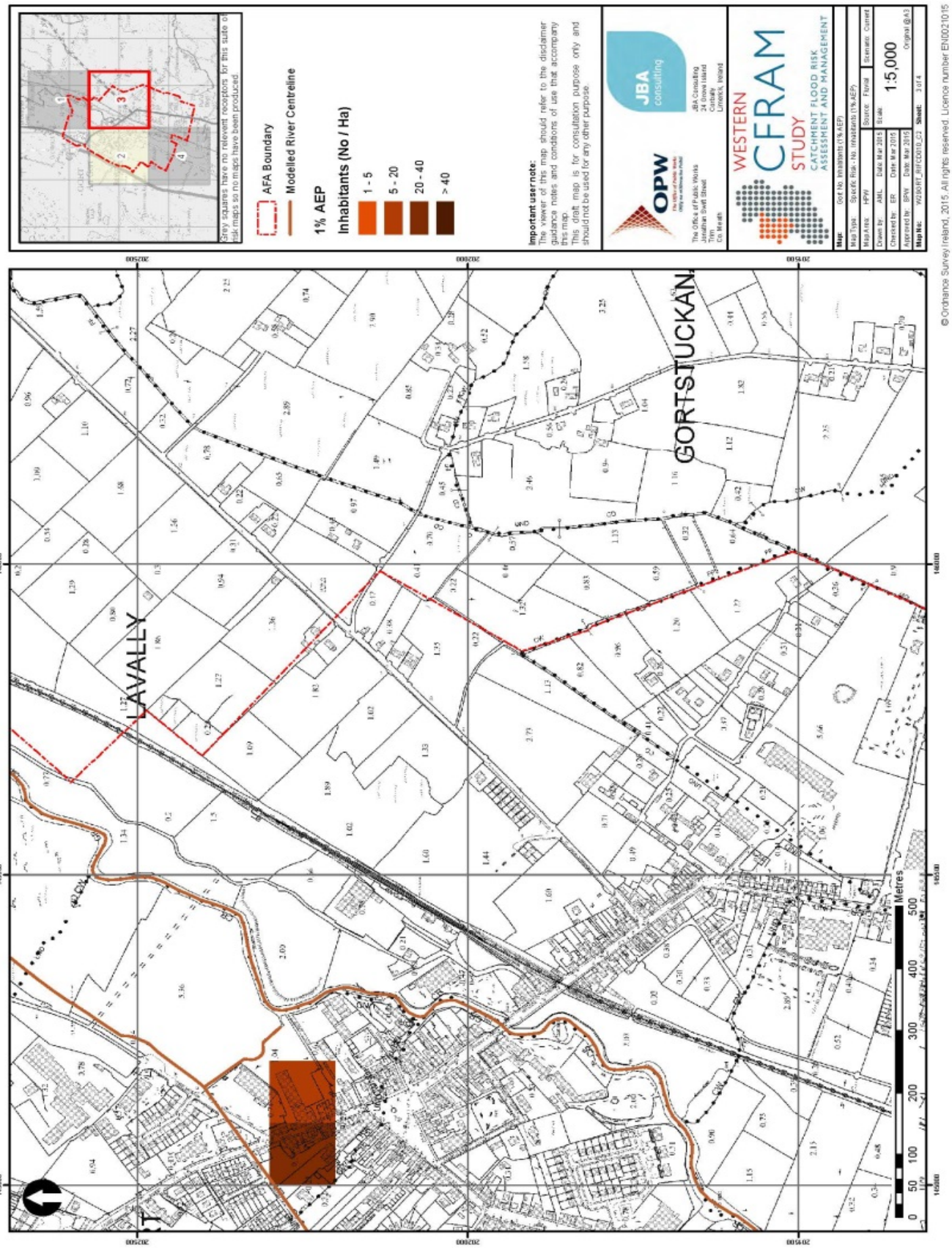

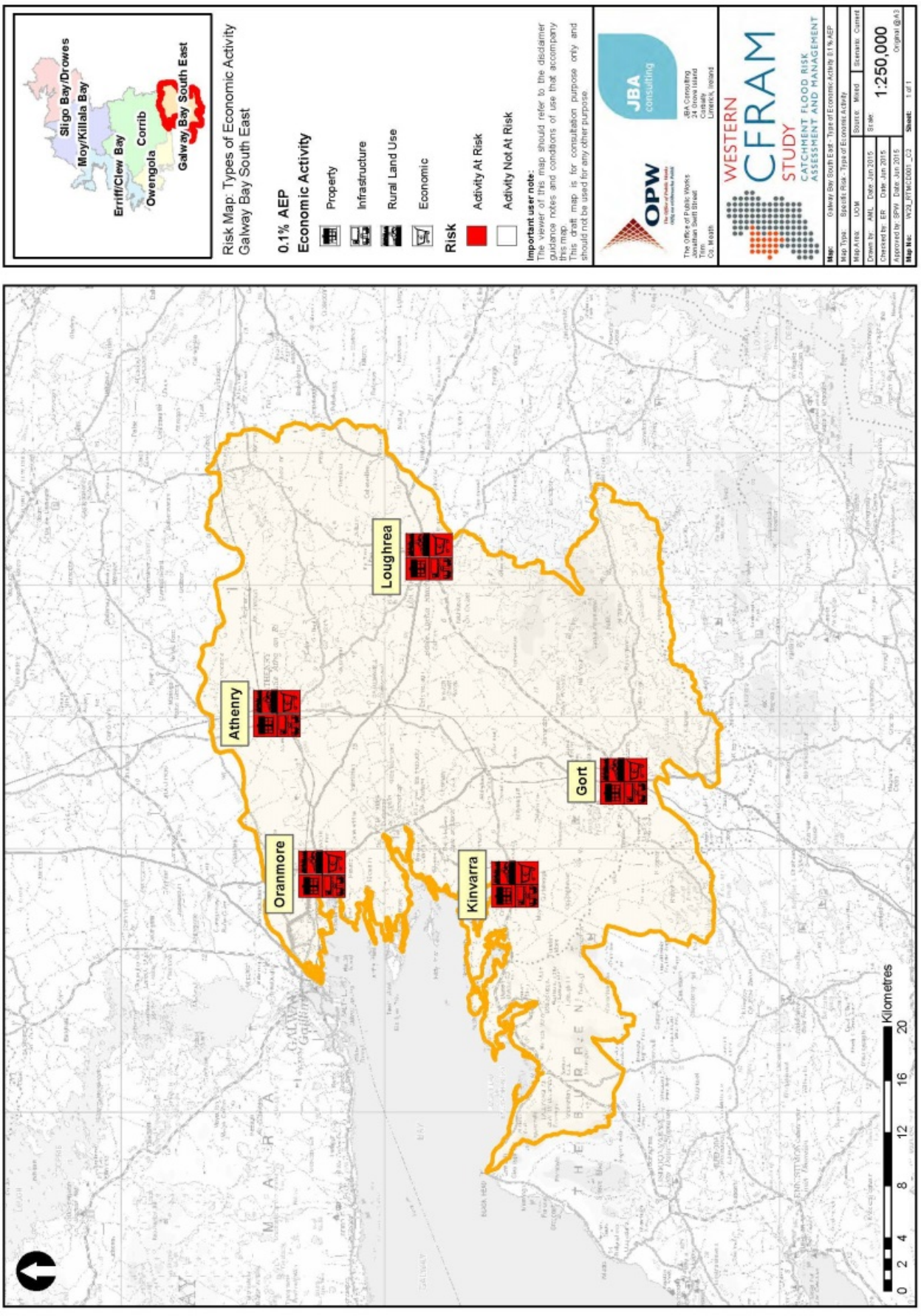
Sligo Bay/Drowes
Moy/Killala Bay
Erriff/Clew Bay
Corrib
Owengola
Galway Bay South East
Risk Map: Types of Economic Activity
Galway Bay South East
0.1% AEP
Economic Activity
Property
Infrastructure
Rural Land Use
Economic
Risk
Activity At Risk
Activity Not At Risk
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Corbally
Limerick, Ireland
WESTERN
CFRAM
STUDY
CATCHMENT FLOOD RISK
ASSESSMENT AND MANAGEMENT
Map: Galway Bay South East - Type of Economic Activity 0.1% AEP
Map Type: Specific Risk - Type of Economic Activity
Map Area: LOM
Source: Mixed
Scenario: Current
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Loughrea
Oranmore
Kinvarra
Gort
Kilometres
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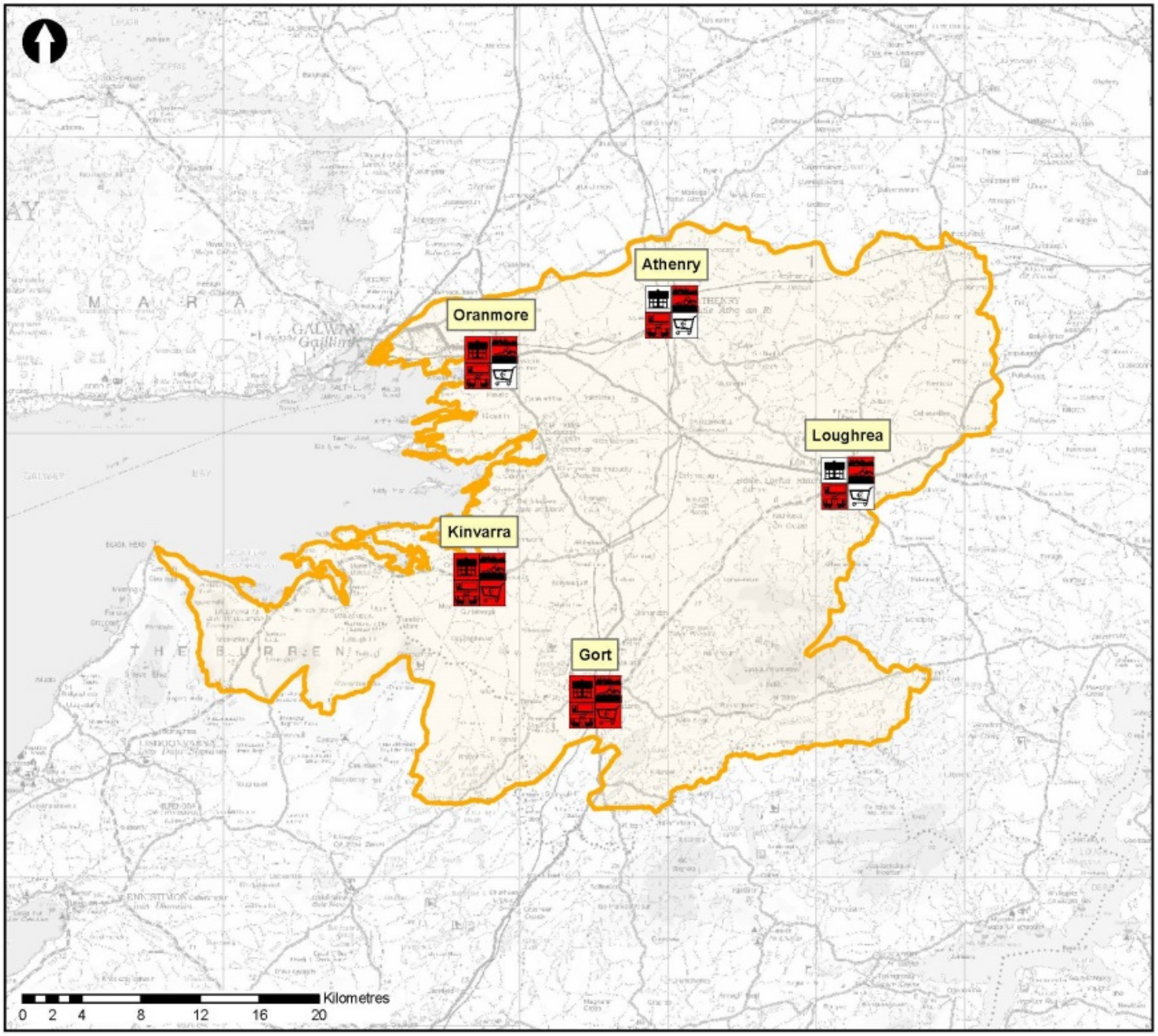

Risk Map: Types of Economic Activity
Galway Bay South East

1% Fluvial 0.5% Coastal Mixed AEP

Economic Activity

- Property
- Infrastructure
- Rural Land Use
- Economic

Risk

- Activity At Risk
- Activity Not At Risk

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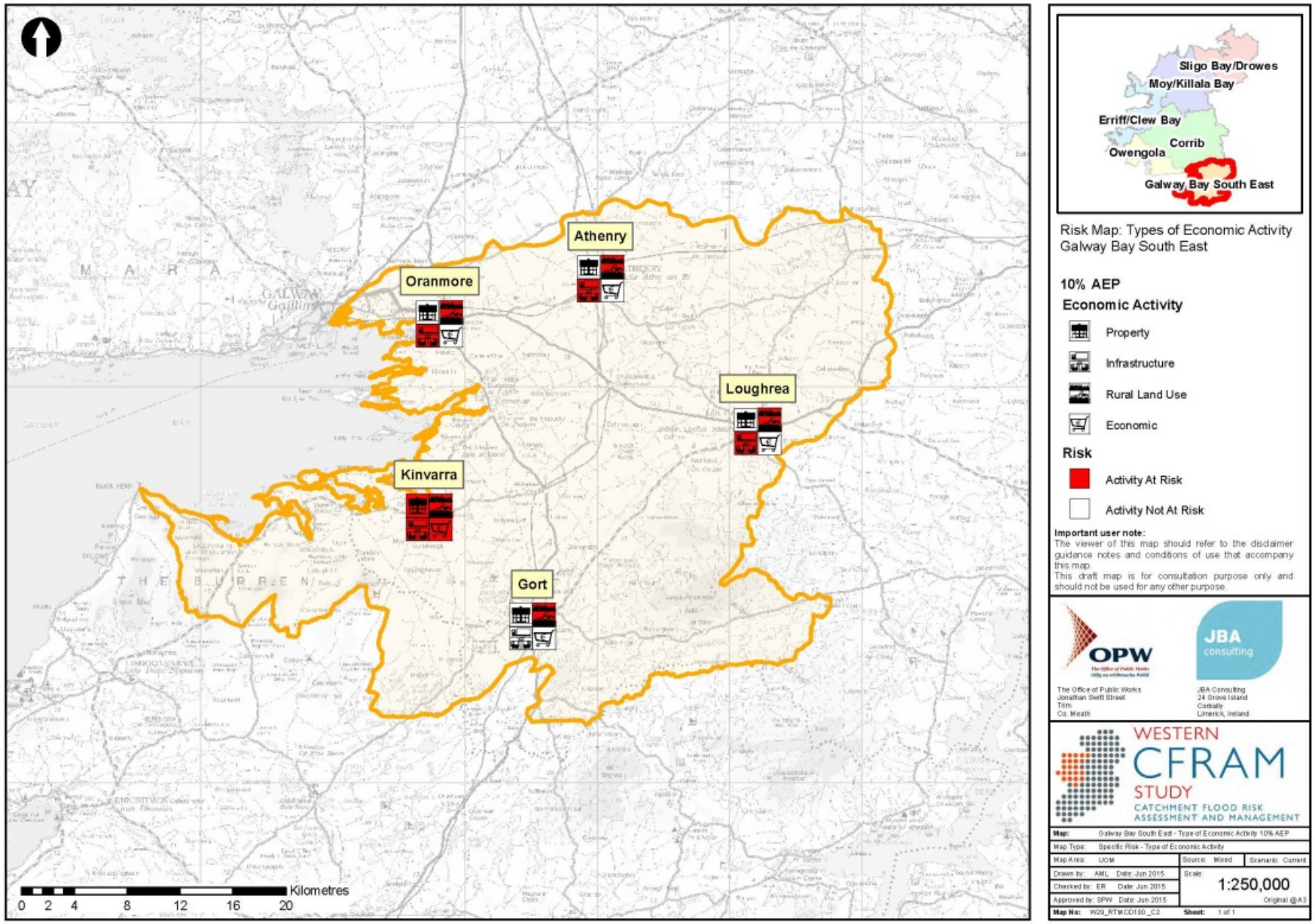
WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map:	Galway Bay South East - Type of Economic Activity 1% AEP		
Map Type:	Specific Risk - Type of Economic Activity		
Map Area:	UOM	Source: Mixed	Scenario: Current
Drawn by: AML	Date: Jun 2015	Scale: 1:250,000	
Checked by: ER	Date: Jun 2015		
Approved by: SPW	Date: Jun 2015	Original @A3	
Map No: W28_RTMCD010_C2		Sheet: 1 of 1	



Risk Map: Types of Economic Activity
Galway Bay South East

10% AEP

Economic Activity

- Property
- Infrastructure
- Rural Land Use
- Economic

Risk

- Activity At Risk
- Activity Not At Risk

Important user note:
The viewer of this map should refer to the disclaimer guidance notes and conditions of use that accompany this map.
This draft map is for consultation purpose only and should not be used for any other purpose.

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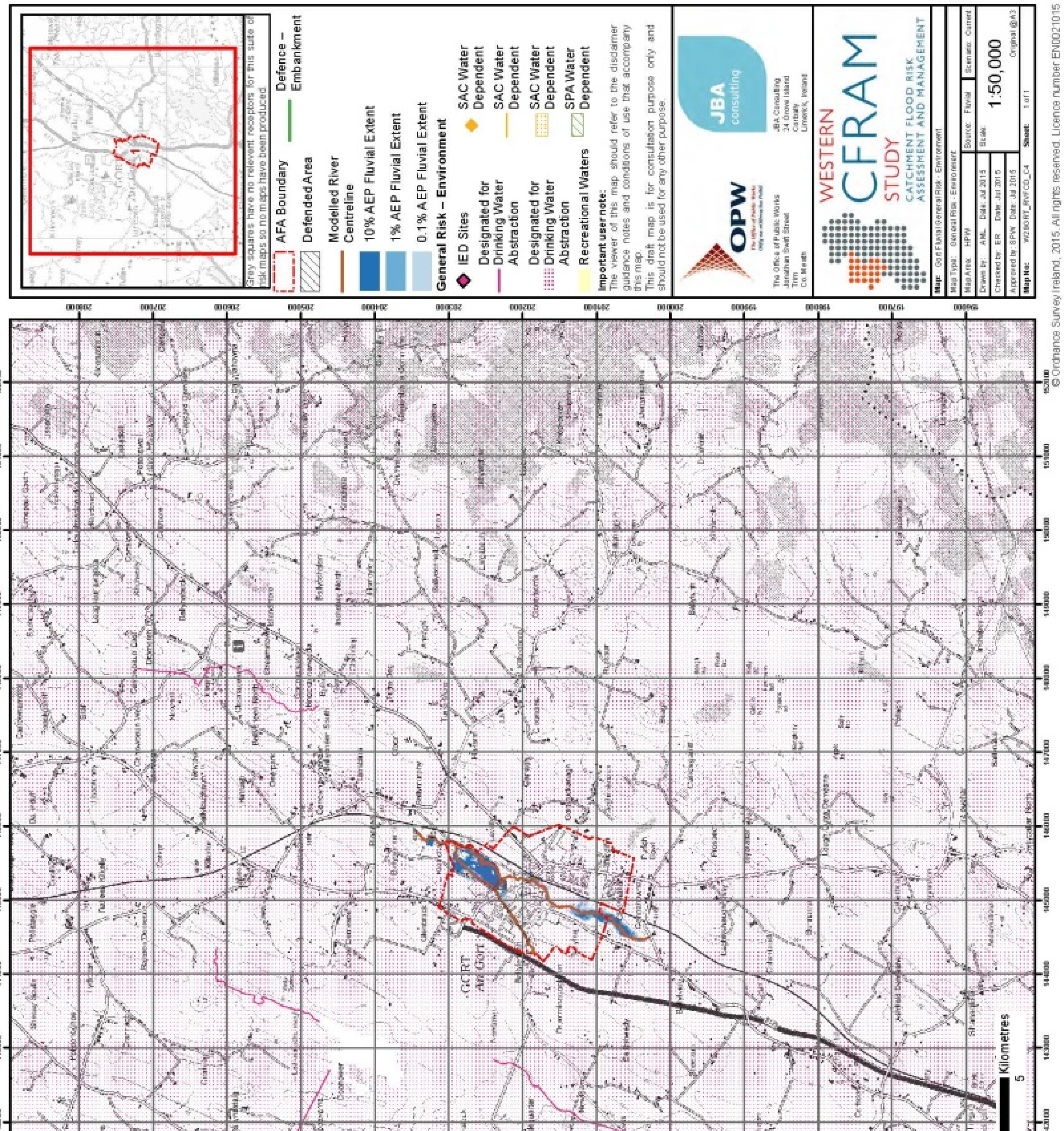
Map:	Galway Bay South East - Type of Economic Activity 10% AEP		
Map Type:	Specific Risk - Type of Economic Activity		
Map Area:	UOM	Source: Mixed	Scenario: Current
Drawn by: AML	Date: Jun 2015	Scale: 1:250,000	
Checked by: ER	Date: Jun 2015		
Approved by: SPW	Date: Jun 2015	Original @ A3	
Map No: W29_RTMCD150_C2		Sheet: 1 of 1	


Grey squares have no relevent receptors for this suite of risk maps so no maps have been produced
AFA Boundary
Defended Area
Defence – Embankment
Modelled River Centreline
10% AEP Fluvial Extent
1% AEP Fluvial Extent
0.1% AEP Fluvial Extent
General Risk – Environment
IED Sites
Designated for Drinking Water Abstraction
SAC Water Dependent
Recreational Waters
SPA Water Dependent
Important user note:
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This draft map is for consultation purpose only and should not be used for any other purpose
OPW
JBA consulting
WESTERN
CFRAM
STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT
1:50,000
Kilometres
GORT
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Appendix C

Extract from Flood Relief Policy Review – Outline Implementation Plan (June 2005)

The *Flood Relief Policy Review; Outline Implementation Plan* was published by OPW in June 2005. It contained indicative cost estimates for nine proposed pilot projects. Of the proposed pilots, only the river Lee pilot project and the river Suir pilot project progressed. Detailed project budgets were not included as part of this plan. See paragraph 3.5.5 and table 1, contained at paragraph 5.1.1, below.

The Outline Implementation Plan was amended by OPW in December 2005 as a result of fewer additional staff being sanctioned by the Department of Finance than was sought. This revised plan did not affect the overall cost contained in the plan for in-house pilot studies and contracted pilot studies.

3.5.4. Programming

The River Basin Flood Risk Management Planning Programme is central to the delivery of the policy, as it provides the framework and tools through which the policy recommendations may be delivered in an integrated, pro-active and holistic manner. The progression of the Programme is therefore a priority.

The research and review of international practice will be undertaken from late-2005 to 2006.

The pilot-testing of the Flood Risk Assessment and Management Plan development process should involve a number of studies, some of which should be undertaken internally to develop experience, knowledge and skills within the OPW to enable effective management of contracted services in this area. Based on the existing demands for flood risk assessments, the following catchment and sub-catchments are proposed as candidates for pilot testing and / or priority studies (with primary reasons for proposals given in parentheses):

Note: Bold indicates studies to be undertaken in-house, Italics indicates study due for 2006/7

- Cork City and the River Lee (high risk location – priority study)
- *Limerick City and the Shannon Estuary (high risk location - tidal flooding only – priority study)*
- **Slaney Catchment (known risk locations – ongoing studies - existing data availability – sample large catchment)**
- **Suir Catchment (known risk locations – ongoing studies - existing data availability – sample large catchment)**
- **Munster Blackwater Catchment (known risk locations – ongoing studies - existing data availability – sample large catchment)**
- **Tullamore (significant development pressure – existing data availability – OPW drainage scheme - sample small catchment)**
- Portarlington (significant development pressure – priority study)
- Matt River (significant development pressure – ongoing studies – OPW drainage scheme – sample small catchment)
- *Ward River (OPW drainage scheme – sample small catchment)*

It is proposed that the pilot studies for the catchments highlighted in bold above be undertaken internally to develop the relevant experience. The catchments for which in-house studies have been indicated are those with which the OPW Design Section have already been closely involved and / or for which some aspects of the studies have already been undertaken.

Undertaking the proposed studies for all of the locations / catchments named in the above list would constitute a significant volume of work. To phase the learning process and spread the workload, it is recommended that those in italics be delayed for commissioning until 2006. The pilot testing programme will therefore run from 2005 into early / mid-2007.

The development of the FRMP management framework, specifications, templates, etc. may be undertaken following the research and review process and in parallel with the pilot testing.

A provisional framework should however be established before commencement of the full implementation. This activity should therefore be undertaken during mid-2006 to late-2007.

The implementation of the full Programme may begin in 2007 following completion of the research and review and full or substantial completion of the majority of the pilot studies. The programme for full implementation must balance the need for the early development of information and risk management strategies with the optimisation of management resources.

It is proposed that, following development, the Plans be reviewed at regular (possibly five year) intervals, and as such the development cycle would ideally be completed when the first set of Plans require review. Based on initiation of the full programme of studies in 2007, implementation of the full Programme should be substantially completed by 2011. Reviews will then be required on an ongoing basis from 2012. As for the implementation process, the reviews will be undertaken through a balance of in-house and contracted work.

3.5.5. Costs

It is proposed that the research and review process should be undertaken internally to build on existing knowledge and further develop internal expertise. There should therefore be no significant costs associated with this activity.

As noted above, some of the pilot testing studies should be undertaken in house. Although significant work has already been undertaken within the identified pilot River Basins, they will incur further costs related to surveys and strategic environmental assessments. An average budget of €300,000 should be assigned to each of the four studies highlighted in bold (total €1.2m). A further €2.5m will be required to cover the remaining contracted pilot / priority studies (including those for Cork and Limerick Cities).

The development of the FRMP management framework will be undertaken through discussion and negotiation between OPW staff and those of the other principal stakeholders. There should not therefore be any significant financial costs associated with this activity.

The pilot test studies not in bold in the list above, and the majority of those undertaken thereafter will be undertaken by contracted services. It has been calculated that a River Basin Flood Risk Assessment and Management Study for a typical large-catchment (such as the Boyne, Nore or Corrib) will cost an average of approximately €1m for studies undertaken by contracted services and €500,000 for studies undertaken in-house (for channel, floodplain and structural survey, asset survey and environmental assessment). Studies for smaller catchments, or for areas with a series of small rivers / streams would be expected to cost less than the sum quoted above.
Excluding the pilot studies, it is estimated that there will be a requirement for the *equivalent* of 26 full (large-catchment) River Basin Flood Risk Assessment and Management Studies, allowing for the reduced costs for studies in small catchments. Of these, it is projected that only five studies will be undertaken in-house (one per year) to further enhance in-house experience and expertise that will be required to review and maintain the Plans on an ongoing basis.

A total cost of approximately €24m is therefore anticipated, which will be distributed approximately equally over the years 2006 to 2011 inclusive.

The review of the Plans will be an ongoing activity with a relatively constant workload, and is therefore best suited to the use of in-house resources. Some costs are likely to be required

for further survey work and other such work, which are provisionally estimated to be in the order of €1.6 million per annum (to provide for the review of five or six plans per year).

Due to the large number of similar studies that will be required to complete this Programme, it is proposed that a framework agreement be used to contract the work required. This will reduce procurement and administration costs and permit the development of expertise among the selected consultants / consortia (reducing learning costs and enhancing efficiencies) and of relationships and understanding between the consultants / consortia and the OPW.

3.5.6. Staff Resource Requirements

The research and review processes under the Programme are expected to require the following resources:

- Programme Director – Eng. Gr. I: 25%, late 2005 to 2006
- Programme Admin – APO: 10%, late 2005 to 2006

The pilot test studies undertaken in-house will require resources, as will the management of those contracted out. The pilot testing studies will therefore be expected to require the following resources:

- Programme Director – Eng. Gr. I: 25%, late-2005 to 2006
- Programme Manager – Eng. Gr. II: 75%, late-2005 to 2006
- 3 no. Project Engineers – Eng. Gr. III: 150% (50% each), late-2005 to 2006
- GIS Support: 50%, late-2005 to 2006
- Programme Admin – APO: 10%, late-2005 to 2006
- Programme Admin – HEO: 25%, late-2005 to 2006

The development of the FRMP management framework will require inputs from a range of staff, as estimated below:

- Programme Director – Eng. Gr. I: 25%, mid-2006 to late-2007
- Programme Manager – Eng. Gr. II: 50%, mid-2006 to late-2007
- Programme Admin - APO: 25%, mid-2006 to late-2007
- Programme Admin – HEO: 50%, mid-2006 to late-2007

The implementation of the contracted post-pilot studies will require in-house resources in project management and technical review. The resources required are:

- Programme Director – Eng. Gr. I: 50%, 2007 to 2011
- Project Manager – Eng. Gr. II: 100%, 2007 to 2011
- Project Engineers – Eng. Gr. III: 100%, 2007 to 2011
- GIS Support: 25%, 2007 to 2011
- Programme Admin – APO: 50%, 2007 to 2011
- Programme Admin – HEO: 100%, 2007 to 2011

- 2 no. Project Admin – EO 200%, 2007 to 2011

The post-pilot studies to be undertaken in-house are expected to require the following resources:

- Programme Director – Eng. Gr. I: 25%, 2007 to 2011
- Project Manager – Eng. Gr. II: 75%, 2007 to 2011
- 2 no. Project Engineers – Eng. Gr. III: 200% (100% each), 2007 to 2011
- GIS Support: 25%, 2007 to 2011
- Programme Admin – APO: 10%, 2007 to 2011
- Programme Admin – HEO: 50%, 2007 to 2011

Reviews and updates of the Plans will be an ongoing commitment from 2012 onwards. The phased initial development of the Plans will ensure that this work constitutes a steady work stream, with Plans for the equivalent of approximately six large-catchments to be reviewed per year. It is anticipated that this work will also be balanced between in-house and contracted work, and will require similar in-house resource inputs to those outlined above, from 2012 on.

5. FINANCIAL RESOURCES

5.1. SUMMARY OF FINANCIAL REQUIREMENTS

The costs of each Work Programme have been estimated within the relevant sections under Section 3. These are summarised in the Table below. The Table sets out Programme totals, and then indicative cost profiles over the period 2005 to 2011, and then totals both for the overall implementation programme.

5.1.1. Programme Cost Estimate – Full Staff Resourcing

Table 1 below sets out the financial requirements to implement the strategic elements of the Programme as set out above, assuming that the full quota for staff resources, as identified in Section 4, is provided.

Table 1: Cost Estimates by Work Programme – Full Staff Resourcing

Work Programme		**Work Programme Implementation Costs (€ 000's)**								
Title	No	TOTAL	2005	2006	2007	2008	2009	2010	2011	Ongoing[1]
Flood Studies Update Programme	1	1,940	200	600	600	240	100	100	100	*100*
Strategic Hydrometric Review[2]	2	75	75							
River Basin Modelling (Hydrology)	3	0								
Flood Hazard Mapping[3]	4	0								
River Basin Flood Risk Management	5	0								
In-House Pilot Studies	5a	1,200	600	600						
Consultancy Pilot Studies	5b	2,500	500	1,000	1,000					
Implementation	5c	21,500			4,300	4,300	4,300	4,300	4,300	*1,600*
Flood Forecasting and Warning[4]	6	450		100	150	50	50	50	50	*50*
Emergency Response Development	7	100			100					
Public Awareness and Preparedness	8	500		250	250					
Planning and Development Control	9	500		250	250					
High-Risk Channel Designation	10	250			250					
Prioritisation of Expenditure	11	50	50							
Asset Database and Management[5]	12	2,000			400	400	400	400	400	
Review of Legislation	13	0								
Communication Programme	14	300		50	50	50	50	50	50	*50*
OPW Flood Response	15	0								
TOTAL[6]		**31,365**	**1,425**	**2,850**	**7,350**	**5,040**	**4,900**	**4,900**	**4,900**	***1,800***

Notes:

1. The 'Ongoing' costs are the expected annual costs for each Work Programme from 2012 onwards. These costs are associated with the maintenance of the Policy and the Work Programmes after the implementation period of 2005 to 2011.
2. The costs for the Strategic Hydrometric Review Programme include €75,000 for the review consultancy. The further €2m cost for the procurement of the equipment that might be expected to be required (€500,000 for rainfall gauging stations, €500,000 for hydrometric gauging stations and €1m for 2 no. new weather radar stations) is a capital cost and has not been included as part of the implementation programme. An increase in the annual H1 sub-head (up to €1.8m) will also be required to provide for the management of the enhanced monitoring programme from 2007.

3. The Flood Hazard Mapping – Phase I Project is already underway (contract awarded and partially completed). The costs associated with this project have already been committed from existing resources and therefore do not constitute additional costs to be included herein.

4. The costs of flood forecasting and warning systems are considered to be capital flood relief expenditure, rather than part of the policy implementation programme, and has therefore not been included herein.

5. The costs of Phase I and II of the Asset Database and Management Programme have been incorporated into the Phase I Flood Hazard Mapping Project and the River Basin Flood Risk Management Programme respectively. No estimates have been assigned to Phase II on the basis that the scope and implementation methodology are as yet unknown.

6. The total cost makes no provision for contributions from other Departments, authorities or organisations. Some contributions might be sought for certain aspects, such as the LiDAR survey of towns / villages required under the River Basin Flood Risk Management Programme.

5.1.2. Capital Programme (H2 sub-head)

As noted under the introduction to Section 3, the Flood Relief Policy Review Report recommended that the funding of the Capital Flood Relief Programme be significantly increased from circa €20m per annum up to €30-44m per annum. This is to provide for the group of Schemes that are currently awaiting Public Exhibition and construction (including those for Carlow, Clonmel, Ennis, Fermoy, Mallow, Mornington, and Waterford).

5.1.3. Maintenance (H3 sub-head)

As noted in Section 3.10, increase in the drainage maintenance and plant budgets will be required to provide for the increased workload arising from the designation of high-risk channels. The increases required are estimated to be approximately €4m per annum.

5.2. IMPLICATIONS OF UNDER-FUNDING

5.2.1. Under-funding of Policy Implementation Programme

As noted previously, the significant majority of the work required has been identified for implementation through the use of contracted services. The implications of under-funding will therefore impact directly and proportionally to any reduction in funding below that specified above. For example, the provision of only 50% of the required annual funding streams identified above would double the length of the implementation programme from 7 to 14 years (i.e., completion in 2018). Note that these extensions to reduce financial resource requirements would not reduce staff resource requirements as set out in Section 4.

5.2.2. Under-Funding of Capital Flood Relief Programme

If the increased funding were not to be provided, then the overall implementation Programme of these Schemes would be delayed in direct proportion to the short-fall in funding. Note that at current funding levels, these Schemes would require in excess of 20 years to complete, which would be halved if the annual budget were increased to circa €40m.

The additional resources required to cope with the increase in funding and consequential increased work-load have been included in the resource requirements set out in Section 4. A short-fall in the proposed increase in funding would remove the need for some of the posts identified (from within the Regional Office and Administration Unit requirements).

5.2.3. Under-Funding of Drainage Maintenance Programme

If the increased funding for drainage maintenance and plant were not provided, a lower standard of maintenance would be provided for the designated high-risk channels. This would require raised limitations on the designation process (i.e., designation of fewer channels) or abandonment of the initiative; either of which would leave causes of flood risk unresolved.