

# Plean um Bainistiú Priacal Tuile

# Flood Risk Management Plan

An Bhóinn  
**Boyne**

2018

# Plean um Bainistiú Priacal Tuile

## Flood Risk Management Plan

### Amhantrach (07) An Bhóinn

### River Basin (07) Boyne

*Limistéir um Measúnú Breise a chuimsítear sa phlean seo:*  
*Areas for Further Assessment included in this Plan:*

<i>Baile Átha Buí</i>	<i>Athboy</i>
<i>Baile Trá</i>	<i>Baltray</i>
<i>Baile Íomhair</i>	<i>Ballivor</i>
<i>Droichead Átha</i>	<i>Drogheda</i>
<i>Éadan Doire</i>	<i>Edenderry</i>
<i>Droichead Mhic Eoin</i>	<i>Johnstown Bridge</i>
<i>Maigh Dearmhaí</i>	<i>Longwood</i>
<i>Baile Uí Mhornáin</i>	<i>Mornington</i>
<i>An Uaimh</i>	<i>Navan</i>
<i>Baile Átha Troim</i>	<i>Trim</i>

Ullmhaithe ag Oifig na nOibreacha Poiblí 2018  
Prepared by the Office of Public Works 2018

*De réir* In accordance with

*Rialacháin na gComhphobal Eorpach (Measúnú agus Bainistiú Priacal Tuile) 2010 agus 2015*  
*European Communities (Assessment and Management of Flood Risks) Regulations 2010 and 2015*

## **Séanadh Dlíthiúil**

Tugadh na Pleananna um Bainistiú Priacal Tuile chun cinn mar bhonn eolais le céimeanna indéanta agus molta chun priacal tuile in Éirinn a fhreagairt agus le gníomhaíochtaí eile pleanála a bhaineann leis an rialtas. Ní ceart iad a úsáid ná brath orthu chun críche ar bith eile ná um próiseas cinnteoireachta ar bith eile.

## **Legal Disclaimer**

The Flood Risk Management Plans have been developed for the purpose of informing feasible and proposed measures to address flood risk in Ireland and other government related planning activities. They should not be used or relied upon for any other purpose or decision-making process.

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- Offaly County Council
- South Dublin County Council
- Westmeath County Council
- Wexford County Council
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- Met Éireann
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# ACHOIMRE FHEIDHMEACH

## RÉAMHRÁ

Is é seo an Plean um Bainistiú Priacal Tuile (an ‘Plean’) d’Abhantrach An Bhóinn. Tá cur síos ar an Abhantrach i Rannán 2 den Phlean.

Is cuspóir don Phlean straitéis, ar a n-áirítear sraith céimeanna molta, um bainistiú costéifeachtach inbhuanaithe fadtéarnmach an phriacail tuile ins an Abhantrach a leagan amach, ar a n-áirítear limistéir inar cinneadh go bhfuil an priacal tuile dóchúil suntasach.

Tá an Plean seo, don tréimhse 2018-2021, ar cheann de 29 bPlean atá dá bhfoilsiú; leagann gach ceann acu amach an réimse indéanta de chéimeanna um bainistiú priacal tuile atá molta dá nAbhantracha ar leith. Céim shuntasach chun tosaigh is ea ullmhú na bPleananna seo maidir le feidhmiú pholasaí an Rialtais um bainistiú priacal tuile, mar atá leagtha amach i dTuarascáil an Ghrúpa um Athbhreithniú ar Pholasaí Tuile (OPW, 2004<sup>1</sup>), agus freagraíonn sé oibleagáidí na hÉireann faoi Threoir ‘Tuile’ an AE 2007 (EU, 2007<sup>2</sup>).

Cuimsíonn an Plean céimeanna indéanta a tugadh chun cinn trí réimse clár agus tionscnamh polasaí ar a n-áirítear:

- Céimeanna neamhstruchtúrtha um chosc agus ullmhacht priacal tuile atá infheidhme ar bhonn náisiúnta, dírithe ar thionchair thuilte a laghdú, a tugadh agus atá á dtabhairt chun cinn chun polasaí Rialtais um bainistiú priacal tuile a fheidhmiú (OPW, 2004).
- Céimeanna struchtúrtha um chosaint tuile atá molta do phobail atá ar phriacal suntasach tuile, dírithe ar dhóchúlacht agus/nó céim thuilte a laghdú, a léiríodh tríd an Chlár Náisiúnta um Measúnú agus Bainistiú Priacal Tuile Abhantraí (MBPTA).

Scrúdaigh an Clár MBPTA an priacal tuile, agus céimeanna féideartha um an priacal a fhreagairt, in 300 pobal ar fud na tíre atá ar phriacal dóchúil suntasach tuile. Léiríodh na pobail seo ins an Réamh-Mheasúnú um Priacal Tuile (RPT); measúnú náisiúnta scagtha a bhí anseo. I dTábla ES-1 thíos tugtar liosta na bpobal atá léirithe tríd an phróiseas RPT mar phobail atá faoi phriacal dóchúil suntasach tuile in Abhantrach An Bhóinn chomh maith leis na foinsí tuile a cinneadh a bheith suntasach maidir le gach pobal. Tugadh chun cinn agus foilsíodh sraith mapaí tuile le haghaidh gach pobal díobh, ag léiriú na limistéir atá ar phriacal tuile.

Tógann an Plean ar an chlár náisiúnta oibreacha cosanta tuile a críochnaíodh roimhe seo, orthu san atá faoi dhearadh agus faoi thógáil um an dtaca seo nó atá leagtha amach trí thionscadail nó pleananna eile, agus ar chothabháil leanúnach ar scéimeanna dhraenála agus faoiseamh tuile.

Rinneadh Measúnú Straitéiseach Comhshaoil, agus Measúnú Cuí faoin Treoir um Ghnáthóga mar ba chúil, mar chuid den ullmhú, agus tá siad folisithe i dteannta leis an Phlean.

<sup>1</sup> Tuarascáil an Ghrúpa um Athbhreithniú ar Pholasaí Tuile, OPW, 2004 ([www.floodinfo.ie](http://www.floodinfo.ie))

<sup>2</sup> Treoir faoi mheasúnú agus bainistiú priacal tuile, 2007/60/EC

**Táble ES-1 Pobail atá ar Phriacal Dóchúil Suntasach Tuile taobh istigh d'Abhantrach An Bhóinn**

CONTAE	AINM an PHOBAIL	FOINSÍ PRIACAL TUILE
An Mhí	Baile Átha Buí	Abhann
An Mhí	Baile Íomhair	Abhann
Lú	Baile Trá	Abhann & Cósta
Lú & An Mhí	Droichead Átha	Abhann & Cósta
Cill Dara	Droichead Mhic Eoin	Abhann
An Mhí	An Uaimh	Abhann
An Mhí	Baile Átha Troim	Abhann
Uíbh Fhailí	Éadan Doire	Abhann
An Mhí	Baile Uí Mhornáin	Abhann & Cósta
An Mhí	Maigh Dearmhaí	Abhann

## CUSPÓIRÍ AN PHLEAN

Is é cuspóir foriomlán an Phlean ná tionchair tuilte a bhainistiú agus a laghdú, agus aird ar shochair agus éifeachtaí eile, ar fud réimse leathan earnála, ar a n-áirítear sláinte daoine, an comhshaol, an oidhreacht chultúrtha agus gníomhaíocht eacnamaíoch, trí scéimeanna inmharthana cosanta tuile agus céimeanna eile, bunaithe ar thuiscint chruinn ar phriacal tuile mar atá léirithe in ullmhú mapáí tuile.

Maidir le gach ceann ar leith de na hearnála seo tugadh chun cinn sraith cuspóirí a bhí comhsheasmhach ar bhonn náisiúnta. Tugtar liosta de na cuspóirí ar leith seo agus an tábhacht a bhaineann le gach ceann díobh i Rannán 1.4 den Phlean.

## RAON AN PHLEAN

Leagtar amach raon an Phlean thíos:

- **Raon Spásúil:** Leagann an Plean amach céimeanna inmharthana, scéimeanna cosanta tuile go hiondúil, atá molta chun priacal tuile a bhainistiú agus a laghdú ins na pobail sin a léiríodh tríd an RPT a bheith faoi phriacal dóchúil suntasach tuile. Leagtar amach freisin réimse polasaí agus céimeanna neamhstruchtúrtha, atá in áit nó faoi fhorbairt, a thacaíonn le laghdú agus bainistiú priacal tuile ar fud na hAbhantraí.
- **Foinsí Priacal Tuile:** Freagraíonn na céimeanna cosanta tuile atá leagtha amach sa Phlean priacal tuile ó na foinsí tuile mar a léiríodh i dTábla ES-1 i bpobal amháin nó níos mó, mar cinneadh tríd an RPT go raibh na foinsí seo dóchúil suntasach ins na pobail seo. Féadfaidh an réimse polasaí agus céimeanna neamhstruchtúrtha tacú le laghdú agus le bainistiú priacal tuile ó fhoinsí uile priacal tuile.
- **Leibhéal Sonraí:** Leagtar amach sa Phlean na céimeanna atá léirithe mar na céimeanna is cuí ag an phointe seo measúnaithe. Is dearadh imlíneach iad na céimeanna cosanta tuile a leagtar amach sa Phlean; níl siad réidh um thógáil ag an am seo. Beidh gá le dearadh breise mionsonraithe, ar a n-áirítear athbhreithniú ar chostais agus tairbhí, measúnú comhshaoil agus comhairliúchán roimh a bhfeidhmiú.

## COMHAIRLIÚCHÁN AGUS PLÉ LE POBAL AGUS LE PÁIRTITHE LEASMHARA

Rinneadh comhairliúchán poiblí ar scála leathan le linn do na mapaí tuile agus na Pleananna a bheith dá n-ullmhú. Cuireadh suíomhanna gréasáin don Chlár MBPTA agus do na Tionscadail ar fáil chun eolas faoin phróiseas iomlán agus faoi na tionscadail bhainteacha a sholáthar agus chun torthaí na dtionscadal a fhoilsiú (tá an t-eolas a bhí ar fáil ar na suíomhanna gréasáin sin ar fáil anois ag [www.floodinfo.ie](http://www.floodinfo.ie)).

Thionól an OPW breis agus 200 Lá Comhairliúcháin Phoiblí maidir leis na mapaí tuile ins na pobail bhainteacha; bhí deis ag daoine tuilte staitiúla agus cruinneas na mapaí a phlé leis na hinnealtóirí ón OPW agus a gcuid comhairleoirí. Tharla comhairliúchán reachtúil poiblí faoi na mapaí tuile go déanach sa bhliain 2015. In ullmhú na mapaí críochnaithe tugadh aird ar na tráchtas, tuairimí agus agóidí ó na Laethanta Comhairliúcháin Phoiblí agus ón chomhairliúchán foirmiúil chun eolas áitiúil ar thuilte agus tuairimí an phobail a chuimsiú ins na mapaí.

Tionóladh dhá bhabhta de Laethanta breise Comhairliúcháin Phoiblí ins na pobail maidir leis na roghanna dóchúla agus ansin maidir leis na Dréacht-Phleananna um bainistiú an phriacail tuile. Tionóladh comhairliúchán reachtúil poiblí eile maidir leis na Dréacht-Phleananna. Breathnaíodh an réimse leathan tuairimí agus aighneachtaí a tháinig trí na comhairliúcháin seo agus tugadh san áireamh iad de réir mar ba chuí nuair a bhí na Pleananna dá gcríochnú.

Tiomsaíodh Grúpaí Náisiúnta agus Réigiúnacha Páirtithe Leasmhara chun deis a thabhairt do pháirtithe leasmhara páirt a ghlacadh in ullmhú na mapaí tuile agus na bPleananna. Bhí cruinnithe comhordaithe leis na húdaráis atá freagrach as an Creat-Treoir Uisce a fheidhmiú agus, maidir le habhantracha a roinntear i bpáirt le Tuaisceart Éireann, leis na húdaráis chuí ansin.

Tá cur síos ar na gníomhaíochtaí maidir le comhairliúchán leis an bpobal agus le páirtithe leasmhara i Rannán 4 den Phlean.

## MEASÚNÚ TEICNIÚIL

In ullmhú an Phlean bhí anailís agus measúnú forleathan teicniúil chun an priacal tuile a léiriú tríd an PBT a chinneadh agus ansin chun céimeanna roghnaithe inmharthana um fhreagairt an phriacail a léiriú. Ar an measúnú teicniúil seo bhí:

- **Suirbhé ón Aer:** Suirbhé ón aer ar thopagrafaíocht na dtuilemhánna, chun anailís a dhéanamh ar chonas a scaipeann uiscí tuile trasna na dtuilemhánna.
- **Suirbhé Topagrafaíoch:** Suirbhé de thalamh ar leagan amach na n-aibhneacha agus na sruthán a ritheann trí na limistéir agus ansin anuas chun na farraige, ar a n-áirítear suirbhéanna ar chruth ghrinill abhann, na bruacha agus na struchtúir atá in aice leis na cainéil nó os a gcionn nó iontu.
- **Anailís Hidreolaíoch:** Anailís chun sruthanna tuile isteach agus trí na haibhneacha agus na sruthán a chinneadh, chomh maith leis na géirleibhéil farraige is cúis le tuilte. Bhí tuairiscí ar leibhéil agus srutha stairiúla abhann mar bhonn eolais leis seo, maraon le meastachán ar thionchair dhóchúla athrú aeráide ar shrutha tuile agus géirleibhéil farraige.
- **Samhaltú Hiodrálach:** Tugadh chun cinn samhaltuithe ríomhaire de na haibhneacha, srutháin agus tuilemhánna chun leibhéil tuile um shrutha tugtha tuile a mheas agus a fhiosrú conas a rithfeadh agus a leathnódh tuilte ar fud na dtuilemhánna, ag tabhairt aird

ar chosanta tuile atá ann cheana. Bhí na samhaltuithe mar bhonn eolais um éifeacht céimeanna dóchúla chun an priacal tuile a bhainistiú agus a laghdú.

- **Mapáil Tuile:** Maidir leis na limistéir shamhaltaithe, ullmhaíodh mapáil tuile chun réimse, doimhneacht agus luas srutha na n-uiscí tuile a thaispeáint, chomh maith le réimse mapáil guaise (chun baol agus tionchair dhóchúla tuilte a thaispeáint) agus mapáil Creasa Tuile mar bhonn eolais ar phleanáil agus forbairt inbhuanaithe. Don chás reatha agus don chás amach anseo, ullmhaíodh mapáil ócáidí tuile le réimse dóchúlachtaí tarlaithe (ó ócáidí le seans 1 as 2 in aon bhliain ar leith, chuig ócáidí le seans 1 as 1000 in aon bhliain ar leith), ag tabhairt aird ar thionchair dhóchúla ón athrú aeráide.
- **Measúnú Priacail:** Measúnú ar thionchair dhóchúla tuilte ins na pobail, ag tabhairt san áireamh an díobháil a fhéadfadh tuilte a dhéanamh maidir le tithe cónaithe, sócmhainní pobail agus sochaí, gnóthais, talmhaíocht, bonneagar, an comhshaoil agus an oidhreacht chultúrtha áitiúil. Rinneadh measúnú priacail eacnamaíoch (díobháil) chun impleachtaí eacnamaíocha tuilte ins na pobail a chinneadh.
- **Measúnú agus Breithmheas ar Chéimeanna Dóchúla um Bainistiú Priacal Tuile:** Rinneadh réimse leathan céimeanna dóchúla um bainistiú priacal tuile ins na pobail a bhí ar phriacal suntasach tuile a fhorbairt, a mheasúnú agus a bhreithmheas chun céim dóchuil roghnaithe a léiriú um a mholadh sa Phlean. Bhí roinnt ceimeanna i gceist anseo:
  - o **Scagadh:** Measúnú ar mhodhanna dóchúla um bainistiú priacal tuile chun iad san a fhéadfadh bheith éifeachtach agus inmharthana a léiriú.
  - o **Céimeanna Dóchúla Inmharthana a Fhorbairt:** Cumadh modhanna dóchúla éifeachtacha i gcéimeanna dóchúla; rinneadh iad san a fhorbairt chuig dearadh imlíneach agus ríomhadh an costas dóchuil ar an chéim sin a fheidhmiú agus a chothabháil.
  - o **Breithmheas faoi ‘Anailís Ilchritéir’ (AI):** Rinneadh measúnú agus breithmheas ar na céimeanna indéanta trí AI chun a n-éifeacht um bainistiú priacal tuile agus na sochair agis tionchair dhóchúla faoi réimse aidhmeanna ar leith a chinneadh.
  - o **Breithmheas Eacnamaíoch:** Rinneadh anailís eacnamaíoch costais tairbhe ar na céimeanna indéanta chun inmharthanacht aon chéimeanna molta a chinntiú.
  - o **Plé le Pobail agus le Páirtithe Leasmhara:** Chuathas i gcomhairle leis na pobail áitiúla, ionadaithe tofa agus páirtithe leasmhara eile san áireamh, chun tuairimí ar aon chéim mholta a ghlacadh ar bord.
  - o **Céimeanna Roghnaithe a Léiriú:** Ceim roghnaithe do na pobail a chinneadh, ag tabhairt aird ar shochair agus ar thionchair eacnamaíocha, comhshaoil agus foriomlána, tuairimí an phobail áitiúil agus páirtithe leasmhara agus costais tuartha na céime.

Maidir le cuid de na pobail, chinn an anailís mionsonraithe teicniúil go bhfuil leibhéal íseal priacal tuile don phobal ó aibhneacha agus/nó an fharraige. Ins na cásanna sin, níorbh fhiú céimeanna um bainistiú priacal tuile (i.e. scéimeanna áitiúla um fhaoiseamh tuile) a fhorbairt dírithe ar na pobail sin ar leith a chosaint. Le haghaidh pobail eile, fuarthas amach nach mbeadh sé indéanta scéimeanna um chosaint tuile a chur chun cinn. Ach féadfaidh polasaithe agus céimeanna neamhstruchtúrtha atá infheidhme ins na limistéir uile an priacal reatha agus dóchuil a bhainistiú agus a laghdú ins na pobail seo.

Tá cur síos ar na measúnaithe teicniúla i Rannáin 5 agus 7 den Phlean.

## MEASÚNAITHE COMHSHAOIL

Rinneadh Measúnú Straitéiseach Comhshaoil (MSC) agus, nuair ba ghá, Measúnú Cuí (MC) ar Phleanleibhéal faoin Treoir um Ghnáthóga, chun sochair agus tionchair dhóchúla na bPleananna ar an chomhshaoil a chinneadh, agus chun céimeanna maolaithe agus monatóireachta a léiriú um thionchair dá leithéid a sheachaint nó a íoslaghú.

Ba chóir a thabhairt faoi deara nach ionann faomhadh an Phlean agus cead a thabhairt um oibreacha fisiciúla ar bith a thógáil. Ní foláir Measúnú Tionchair Chomhshaoil agus Measúnú Cuí ar leibhéal tionscadail a dhéanamh, de réir na reachtaíochta bainteach mar is cuí, mar chuid de chur chun cinn céimeanna molta lena mbaineann oibreacha fisiciúla.

Tá cur síos ar na ceisteanna agus measúnaithe comhshaoil a ndearnadh i Rannán 6 den Phlean.

## CÉIMEANNA MOLTA

Tá achoimre ar na céimeanna atá molta sa Phlean, agus na scéimeanna agus oibreacha um bainistiú priacal tuile atá curthe chun cinn nó á moladh trí thionscadail nó pleananna eile, leagtha amach anseo thíos.

Is ar dhearadh imlíneach, nach bhfuil réidh ag an bpointe seo um thógáil, atá na hoibreacha fisiciúla um fhaoiseamh tuile nó ‘Scéimeanna’ a tugadh chun cinn tríd an Chlár MBPTA. Roimh a bhfeidhmiú, is gá dearadh breise mionsonraithe trí mheasúnú ar leibhéal tionscadail le haghaidh oibreacha dóchúla dá leithéid, ar a n-áirítear suirbhéanna áitiúla, comhairliúcháin breise poiblí agus le páirtithe leasmhara agus measúnú comhshaoil.

## CÉIMEANNA ATÁ MOLTA SA PHLEAN

### *Céimeanna is Infheidhmithe do gach Limistéar*

**Bainistiú Pleanála agus Forbartha Inbhuanaithe:** Tá feidhmiú cóir na dTreoirínte ar an Chóras Pleanála agus Bainistiú Priacal Tuile (RTPRA/OPW, 2009) ag na húdaráis phleanála fíor-riachtanach chun forbairt mhí-oiriúnach i limistéir atá ar phriacal tuile a sheachaint, agus mar sin méadú nach gá ar phriacal tuile a sheachaint amach anseo. Soláthróidh an mhapáil tuile a tháinig tríd an Chlár MBPTA bonn fianaise níos mó um chinntí inbhuanaithe pleanála.

**Córais Inbhuanaithe um Dhraenáil Uirbeach (CIDU):** De réir na dTreoirínte ar an Chóras Pleanála agus Bainistiú Priacal Tuile (RTPRA/OPW, 2009), ba cheart do na húdaráis phleanála féachaint chuig cruadhromchlú agus cruaphábháil a laghdú agus teicnící inbhuanaithe draenála a fheidhmiú chun tionchar dóchúil forbartha ar phriacal tuile le sruth anuas a laghdú.

**Pleanáil um Oiriúnú:** Tar éis don Rialtas an Creat Náisiúnta um Oiriúnú d’Athrú Aeráide a fhaomhadh, is gá do phríomhearnálacha agus do na húdaráis Áitiúla pleananna earnála agus áitiúla um oiriúnú a thabhairt chun cinn. Mar sin is gá don OPW plean athchóirithe earnála a ullmhú, a chlúdaíonn an earnáil um bainistiú priacal tuile. Caithfidh earnálacha eile a léiriú sa Chreat agus Údaráis Áitiúla aird a thabhairt ar phriacal tuile nuair atá a gcuid pleananna earnála agus áitiúla um oiriúnú á n-ullmhú acu.

**Bainistiú Talamhúsáide agus Bainistiú Nádúrtha Priacal Tuile:** Oibreoidh an OPW leis an Ghníomhaireacht um Chaomhnú Comhshaoil, leis na húdaráis Áitiúla agus le gníomhaireachtaí eile le linn measúnaithe ar leibhéal tionscadail ar oibreacha fisiciúla agus níos leithne ar leibhéal abhantraí, chun céimeanna ar bith mar chéimeanna nádúrtha um choinneáil uisce a léiriú, a thairbheoidh aidhmeanna faoin Treoir um Chreat Uisce, bainistiú priacal tuile agus bithéagsúlacht.

**Scéimeanna um Dhraenáil Artaireach:** Tá dualgas reachtúil ar an OPW faoin Acht um Dhraenáil Artaireach 1945, agus Leasú 1995 an Achta sin, cothabháil a dhéanamh ar na

Scéimeanna um Dhraenáil Artaireach agus um Fhaoiseamh Tuile a thóg an OPW faoi na hAchtanna sin.

**Ceantair Dhraenála:** Is ar na hÚdaráis Áitiúla cuí a luíonn an dualgas reachtúil cothabhála maidir leis an 4,600 km de chainéil abhann a thairbhíonn ó na Scéimeanna Ceantair Dhraenála.

**Cothabháil Cainéal nach cuid de Scéim iad:** Taobh amuigh de na Scéimeanna um Dhraenáil Artaireach agus na Scéimeanna Ceantair Dhraenála, is ar úinéirí talún a bhfuil cúrsaí uisce ar a gcuid tailte a luíonn cúram a gcothabhála. Tá treoir faoi chearta agus dualgaís úinéirí talún, maidir le cothabháil cúrsaí uisce ar a gcuid tailte nó ina gcóngar, ar fáil ag [www.flooding.ie](http://www.flooding.ie).

**Réamhaisnéis agus Foláireamh Tuile:** Ar 5 Eanáir 2016 chinn an Rialtas ar Sheirbhís Náisiúnta um Réamhaisnéis agus Foláireamh Tuile a bhunú. Pléifidh an seirbhís le réamhaisnéis tuile ó thuille abhann agus cósta; nuair a bheidh sé ag feidhmiú ina iomlán eiseofar réamhaisnéisí agus foláirimh ginearálta ar scálaí náisiúnta agus abhantraí araon. Tá clár cúig bliana aontaithe chun an seirbhís seo a bhunú.

**Pleanáil um Fhreagairt Éigeandála:** Tá doiciméad *Bainistiú Straitéiseach Éigeandála (BSE): Struchtúir agus Creat Náisiúnta* á dhréachtadh faoi láthair ag Tascfhórsa Rialtais um Pheanáil Éigeandála. Beidh Caibidil ann maidir le Téarnamh, a chuimseoidh conas a phléifear le cistiú um éigeandálacha, agus um chostais téarnaimh ach go háirithe, amach anseo.

**Díonacht Aonair agus Phobail a Chothú:** Tá taighde ar bun ag an Roinn Tithíochta, Pleanála agus Rialtais Áitiúil (RTPRA) maidir le conas is féidir Díonacht Phobail a chur chun cinn mar chuid den athbheithniú foriomlán ar an Chreat um Bhainistiú Móréigeandála.

**Cosaint Mhaoine Aonair:** Tá dhá scéim phíolótach um Chosaint Mhaoine Aonair (CMA) ar bun faoi láthair agus beidh a dtorthaí seo mar bhonn eolais don Rialtas maidir le tacú indéanta ar bith a fhéadfaí a sholáthar do mhaojne atá ar phriacal.

**Bailiú Sonraí maidir le Tuille:** Tá bailiú sonraí ar thuille agus, nuair is cuí, a bhfoilsíú, ar siúl ar bhonn leanúnach; is céim í seo a chuideoidh um ullmhú agus um fhreagairt ar thuiliú.

**Athlonnú Deonach Tí Cónaithe:** Ins na cúinsí is géire, féadfaidh an priacal tuile do theach cónaithe a bheith chomh mór sin go gceapfadh úinéir an tí nach bhfuil sé inbhuanaithe fanacht ann agus go gcinneadh sé ar athlonnú. Ar 11 Aibreán 2017 d'aontaigh an Rialtas na socruithe riaracháin do Scéim aonuaire um Athlonnú Deonach d'Úinéirí Tí Cónaithe, maidir leis na príomhthithe cónaithe sin a bhí faoi thuille le linn na tréimhse ó 4 Nollaig 2015 go 13 Eanáir 2016.

### **Céimeanna ar Leibhéal Abhantraí / Fo-Abhantraí**

Mar chuid den Seirbhís Náisiúnta um Réamhaisnéis Tuile a fhorbairt, tá sé molta gur cóir córas réamhaisnéis tuile a fhorbairt d'Abhantrach na Bóinne, ar a n-áirítear Baile Átha Troim.

### **Céimeanna ar Leibhéal Pobail**

Do na pobail seo a leanas, moltar sa Phlean go dtabharfar scéim um fhaoiseamh tuile chun cinn chuig forbairt agus measúnú ar leibhéal tionscadail, ar a n-áirítear measúnú comhshaoil mar is gá agus tuilleadh comhairliúcháin phoiblí, um mionchoigeartú agus ullmhú um a phleanáil agus a thaispeáint agus, más agus nuair is cuí, um fheidhmiú:

- Baile Trá
- Droichead Átha
- Baile Uí Mhornáin

Do na pobail seo a leanas rinneadh scrúdú ar chéimeanna struchtúrtha dóchúla indéanta um fhaoiseamh tuile dar léiríodh scéim um fhaoiseamh tuile atá inmharthana ar bhonn teicniúil. Ach beidh gá le measúnú níos mionsonraithe ar chostais agus ar thairbhí a chríochnú um a chinneadh an bhfuil an Scéim atá molta indéanta:

- An Uaimh

### **Scéimeanna agus Oibreacha um Fhaoiseamh Tuile atá Tugtha Chun Cinn nó Molta trí Thionscadail nó trí Phleananna Eile**

Tá Scéim um Fhaoiseamh Tuile ann cheana féin a dhéanann cosaint ar mhaoine ins na pobail seo a leanas. Déanfar cothabháil leanúnach ar na scéimeanna seo.

- Baile Uí Mhornáin
- Baile an Bhiataigh

## **FEIDHMIÚ, MONATÓIREACHT AGUS ATHBHREITHNIÚ AN PHLEAN**

Is gá infheistíocht chaipitiúil suntasach chun na céimeanna uile, mar atá leagtha amach sa Phlean seo agus ins na Pleananna uile, a fheidhmiú. Mar sin is gá tosaíocht a thabhairt don infheistíocht is gá chun an sraith náisiúnta de chéimeanna molta a fheidhmiú.

I dteannta le foilsiú an Phlean seo agus na bPleananna eile, fógraíodh an chéad sraith d'oibreacha cosanta tuile dar tugadh tosaíocht dóibh atá leagtha amach sa Phlean seo agus san 28 bPlean eile. Oibreoidh an OPW agus na hÚdaráis Áitiúla go dlúth lena chéile chun feidhmiú éifeachtach na dtionscadail tosaigh seo a thabhairt chun críche agus ina dhiaidh sin ar na tionscadail eile.

Léirítear sa Phlean an dream/na dreamanna atá freagrach as feidhmiú na gcéimeanna molta um bainistiú priacal tuile ar bhonn tosaíochta mar atá leagtha amach thuas.

Is é an tAire Stáit le cúram speisialta um Oifig na nOibreacha Poiblí agus Faoiseamh Tuile atá ina Chathaoirleach ar an An Ghrúpa Idir-Rannach um Chomhordú Pholasaí Tuile. Is é an Grúpa seo a chomhordaíonn agus a dhéanann monatóireacht ar dhul chun cinn maidir le feidhmiú na moltaí atá leagtha amach in Athbhreithniú Pholasaí Tuile an Rialtais 2004, ar a n-áirítear na céimeanna atá leagtha amach ins na Pleananna.

Is don tréimhse 2018-2021 na Pleananna seo. Athbhreithneoidh an OPW agus páirtithe leasmhara eile iad, maidir leis an dul chun cinn atá déanta, agus déanfar iad a uasdhátú in 2021.



# EXECUTIVE SUMMARY

## INTRODUCTION

This is the Flood Risk Management Plan (the 'Plan') for the Boyne River Basin. A description of the River Basin is provided in Section 2 of the Plan.

The purpose of the Plan is to set out the strategy, including a set of proposed measures, for the cost-effective and sustainable, long-term management of flood risk in the River Basin, including the areas where the flood risk has been determined as being potentially significant.

This Plan, which is for the period of 2018-2021, is one of 29 Plans being published; each setting out the feasible range of flood risk management measures proposed for their respective River Basins. The preparation of these Plans represents a significant milestone in the implementation of Government policy on flood risk management, as set out in the Report of the Flood Policy Review Group (OPW, 2004<sup>3</sup>), and addresses Ireland's obligations under the 2007 EU 'Floods' Directive (EU, 2007<sup>4</sup>).

The Plan includes feasible measures developed through a range of programmes and policy initiatives including:

- Non-structural flood risk prevention and preparedness measures that are applicable nationally, aimed at reducing the impacts of flooding, that have been and are being developed to implement Government policy on flood risk management (OPW, 2004).
- Structural flood protection measures proposed for communities at significant flood risk, aimed at reducing the likelihood and/or degree of flooding, identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme.

The CFRAM Programme has examined the flood risk, and possible measures to address the risk, in 300 communities throughout the country at potentially significant flood risk. These communities were identified through the Preliminary Flood Risk Assessment (PFRA - See Section 3 of the Plan), which was a national screening assessment of flood risk. The communities identified through the PFRA process as being at potentially significant flood risk in the Boyne River Basin are listed in Table ES-1 below, along with the sources of flood risk that were deemed to be significant for each community. A set of flood maps, indicating the areas prone to flooding, has been developed and published for each of the communities.

The Plan builds on and supplements the national programme of flood protection works completed previously, that are under design and construction at this time or that have been set out through other projects or plans, and the ongoing maintenance of existing drainage and flood relief schemes.

A Strategic Environmental Assessment, and an Appropriate Assessment under the Habitats Directive where appropriate, have been undertaken as part of the preparation of, and have been published with, the Plan.

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<sup>3</sup> Report of the Flood Policy Review Group, OPW, 2004 ([www.floodinfo.ie](http://www.floodinfo.ie))

<sup>4</sup> Directive on the assessment and management of flood risks, 2007/60/EC

**Table ES-1 Communities at Potentially Significant Flood Risk within the Boyne River Basin**

COUNTY	COMMUNITY NAME	SOURCE(S) OF FLOOD RISK
Meath	Athboy	Fluvial
Meath	Ballivor	Fluvial
Louth	Baltray	Fluvial & Coastal
Louth & Meath	Drogheda	Fluvial & Coastal
Kildare	Johnstown Bridge	Fluvial
Meath	Navan	Fluvial
Meath	Trim	Fluvial
Offaly	Edenderry	Fluvial
Meath	Mornington	Fluvial & Coastal
Meath	Longwood	Fluvial

## OBJECTIVES OF THE PLAN

The overall objective of the Plan is to manage and reduce the potential consequences of flooding, recognising other benefits and effects across a broad range of sectors including human health, the environment, cultural heritage and economic activity, through viable flood protection schemes and other measures informed by a sound understanding of the flood risk established through the preparation of flood maps.

A nationally consistent set of specific objectives relating to each of these sectors was developed for the preparation of the Plans. These specific objectives and the importance given to each are listed in Section 1.4 of the Plan.

## SCOPE OF THE PLAN

The scope of the Plan is set out below:

- **Spatial Scope:** The Plan sets out viable measures, typically flood protection schemes, proposed to manage and reduce flood risk in the communities that were identified through the PRFA as being at potentially significant flood risk. The Plan also sets out a range of non-structural policies and measures, which are in place or under development, that contribute to the reduction and management of flood risk throughout the River Basin.
- **Sources of Flood Risk:** The flood protection measures that are set out in the Plan address flood risk from the sources of flooding as identified in Table ES-1 in one or more communities, as these sources were determined through the PFRA to be potentially significant in these communities. The range of non-structural policies and measures set out in the Plan can contribute to the reduction and management of flood risk from all sources of flood risk.
- **Level of Detail:** The Plan sets out the measures that have been identified as the most appropriate at this stage of assessment. The flood protection measures set out in the Plan are to an outline design, and are not at this point ready for construction. Further detailed design, including a review of costs and benefits, environmental assessment, and consultation will be required for such works before implementation.

## PUBLIC AND STAKEHOLDER CONSULTATION AND ENGAGEMENT

Extensive public consultation has been undertaken throughout the preparation of the flood maps and the Plans. Websites for the CFRAM Programme and Projects were also maintained throughout the process to provide information on the overall process and the relevant projects and to provide access to project outputs (the information that was available from these websites is now available through [www.floodinfo.ie](http://www.floodinfo.ie)).

Over 200 Public Consultation Days were held by the OPW in or near the relevant communities in relation to the flood maps, where residents and the engineers of the OPW and its consultants could discuss past floods and the accuracy of the maps. A statutory public consultation on the draft maps was also undertaken late in 2015. The preparation of the final maps have taken the comments, observations and objections from the Public Consultation Days and formal consultation on board to reflect the local knowledge of flooding and people's views of the maps.

Two rounds of further Public Consultation Days were held in or near the communities in relation to potential options and then the Draft Plans for managing the flood risk. A further statutory public consultation was held in relation to the Draft Plans. The extensive comments and submissions made through these consultations have all been considered and taken into account as appropriate in finalising the Plans.

National and Regional Stakeholder Groups were formed to provide an opportunity for input by stakeholders to participate in the preparation of the flood maps and the Plans. Coordination and engagement meetings were held with the authorities responsible for implementing the Water Framework Directive and, for river basins that are shared with Northern Ireland, with the relevant authorities in the North.

The public and stakeholder consultation and engagement activities are described in Section 4 of the Plan.

## TECHNICAL ASSESSMENT

The preparation of the Plan has involved extensive technical analysis and assessment to determine the flood risk in the communities identified through the PFRA, and then to identify preferred, viable measures to address the risk. This technical assessment has included:

- **Aerial Survey:** Airborne survey of the physical topography of the floodplains to facilitate an analysis of how flood waters spread across the floodplains.
- **Topographical Survey:** Ground-based survey of the geometry of the rivers and streams running through the communities, between the communities and then down to the sea, including surveys of the shape of the river bed and banks and of structures in, over or alongside the channels.
- **Hydrological Analysis:** An analysis to determine flood flows into and through the rivers and streams, and extreme sea levels that can cause flooding. This analysis has been informed by records of past river levels and flows and an estimation of the potential impacts of climate change on flood flows and extreme sea levels.
- **Hydraulic Modelling:** The development of computer models of the rivers, streams and floodplains to determine the flood levels for given flood flows and how floods would flow and spread over the floodplains, taking into account existing flood defences. The models informed the assessment of the effectiveness of possible measures to manage and reduce the flood risk.

- **Flood Mapping:** The preparation of flood maps to indicate the extent, depth, flow velocity (speed) of flood-waters and a range of risk maps (showing the potential dangers and impacts of flooding) for the modelled areas, along with Flood Zone maps to inform sustainable planning and development. Maps of flood events with a range of likelihoods of occurrence (from events with a 1 in 2 chance of occurring in any year, to those with a 1 in a 1000 chance in any year) have been developed for the current scenario and for future scenarios taking into account the potential impacts of climate change.
- **Risk Assessment:** An assessment of the potential impacts of flooding in the communities, taking account of the homes, community and society assets, businesses, agriculture, infrastructure, the environment and the local cultural heritage that could be damaged by flooding. An economic risk (damage) assessment was undertaken to determine the economic implications of floods in the communities.
- **Assessment and Appraisal of Possible Flood Risk Management Measures:** The development, assessment and appraisal of a wide range of possible measures to manage flood risk in the communities at significant flood risk to identify a potentially preferred measure to be proposed in the Plan. This involved a number of steps:
  - o **Screening:** The assessment of possible methods to manage flood risk to identify those that might be effective and potentially viable.
  - o **Development of Potentially Viable Measures:** Potentially effective methods were formed into possible measures, which were then developed to outline design, and the likely cost of implementing and maintaining the measure calculated.
  - o **Appraisal by 'Multi-Criteria Analysis' (MCA):** The possible measures were assessed and appraised through a MCA to determine their effectiveness in reducing flood risk and their potential benefits and impacts across the range of specific objectives.
  - o **Economic Appraisal:** The possible measures were also subject to an economic cost-benefit analysis to ensure the viability of any proposed measures.
  - o **Public and Stakeholder Engagement:** The local communities, including elected representatives and other stakeholders, were consulted with to take on board views and opinions on any proposed measure for the community it would protect.
  - o **Identification of Preferred Measures:** Determination of a preferred measure for the communities, taking account of the economic, environmental and overall benefits and impacts, the observations of the local community and stakeholders and the foreseen costs of the measure.

For some communities, the detailed technical analysis has determined that there is currently a low level of flood risk to the community from rivers and/or the sea. In such cases, the development of flood risk management measures aimed specifically at protecting such communities (i.e. local flood relief schemes) was not merited. For some other communities, it was found that it would not be feasible to progress flood protection schemes. However, the non-structural policies and measures applicable across all areas can reduce and manage the existing and potential future risk in these communities.

The technical assessments are described in Sections 5 and 7 of the Plan.

## ENVIRONMENTAL ASSESSMENTS

The Plans have been subject to Strategic Environmental Assessment (SEA), and, where necessary, Plan-level Appropriate Assessment (AA) under the Habitats Directive, to determine the potential benefits and impacts of the Plans on the environment, and to identify mitigation and monitoring measures necessary to avoid or minimise such impacts.

It should be noted that approval of the Plan does not confer consent to the construction of any physical works. Environmental Impact Assessment and Project-level Appropriate Assessment

must be undertaken in accordance with the relevant legislation where relevant as part of the progression of proposed measures that involve physical works.

The environmental issues and assessments undertaken are described in Section 6 of the Plan.

## PROPOSED MEASURES

A summary of the measures proposed in the Plan and the flood relief schemes and works that have been progressed or proposed through other projects or plans are set out below.

The proposed physical flood relief works or 'Schemes' set out in the Plans that have been developed through the CFRAM Programme are to an outline design, and are not at this point ready for construction. Further detailed design through a project-level of assessment will be required for such potential works before implementation, including local surveys, further public and stakeholder consultation and environmental assessment.

### MEASURES PROPOSED IN THE PLAN

#### Measures Applicable for all Areas

**Sustainable Planning and Development Management:** The proper application of the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009) by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future. The flood mapping produced through the CFRAM Programme will provide an even greater evidential basis for sustainable planning decisions.

**Sustainable Urban Drainage Systems (SUDS):** In accordance with the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009), planning authorities should seek to reduce the extent of hard surfacing and paving and require the use of sustainable drainage techniques to reduce the potential impact of development on flood risk downstream.

**Adaptation Planning:** Following approval by Government of the National Climate Change Adaptation Framework key sectors and Local Authorities are required to develop sectoral and local adaptation plans. This will require a revised sectoral plan to be prepared by the OPW, covering the flood risk management sector. Other sectors identified in the Framework and Local Authorities will also be required to take account of flood risk when preparing their own sectoral and local adaptation plans.

**Land Use Management and Natural Flood Risk Management:** The OPW will work with the Environment Protection Agency, Local Authorities and other agencies during the project-level assessments of physical works and more broadly at a catchment-level to identify any measures, such as natural water retention measures, that can have benefits for Water Framework Directive, flood risk management and biodiversity objectives.

**Arterial Drainage Schemes:** The OPW has a statutory duty under the Arterial Drainage Act, 1945, and the Amendment of the Act, 1995, to maintain the Arterial Drainage and Flood Relief Schemes constructed by it under those Acts.

**Drainage Districts:** The statutory duty of maintenance for 4,600 km of river channel benefitting from Drainage District Schemes rests with the relevant Local Authorities.

**Maintenance of Channels not part of a Scheme:** Outside of the Arterial Drainage and Drainage District Schemes, landowners who have watercourses on their lands have a responsibility for their maintenance. Guidance to clarify the rights and responsibilities of landowners in relation to the maintenance of watercourses on or near their lands is available at [www.flooding.ie](http://www.flooding.ie).

**Flood Forecasting and Warning:** A Government decision was taken on 5 January 2016 to establish a National Flood Forecasting and Warning Service. The service will deal with flood forecasting from fluvial (river) and coastal sources and when fully operational will involve the issuing of flood forecasts and general alerts at both national and catchment scales. A 5-year programme has been agreed to oversee the establishment of this new service.

**Emergency Response Planning:** A Government Task Force on Emergency Planning is currently drafting a *Strategic Emergency Management (SEM): National Structures and Framework* document. This is to include a Chapter on Recovery to include how funding for emergencies, particularly recovery costs, may be handled in the future.

**Promotion of Individual and Community Resilience:** The Department of Housing, Planning & Local Government (DHPLG) is researching how Community Resilience may be advanced as part of the overall review of the Framework of Major Emergency Management.

**Individual Property Protection:** The outcomes of two Individual Property Protection (IPP) pilots currently underway will inform the Government on any feasible support it could provide to at risk properties.

**Flood-Related Data Collection:** The ongoing collection and, where appropriate, publication of flood-related data is a measure that will help to continually improve preparation for, and response to, flooding.

**Voluntary Home Relocation:** In extreme circumstances, the flood risk to a home may be such that the homeowner may consider that continuing to live in the property is not sustainable and would choose to relocate. On 11 April 2017, the Government agreed the administrative arrangements for a once-off Homeowners Voluntary Relocation Scheme for those primary residential properties that flooded during 4 December 2015 to 13 January 2016.

### **Catchment / Sub-Catchment-Level Measures**

It is proposed that, as part of the development of the National Flood Forecasting Service, a flood forecasting system should be developed for the Boyne Catchment, including for Trim.

### **Community-Level Measures**

For the following communities, it is proposed in the Plan that a flood relief scheme is progressed to project-level development and assessment, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / exhibition and, if and as appropriate, implementation:

- Baltray
- Drogheda
- Mornington

Potentially viable structural flood relief measures have been investigated for the following communities for which a technically viable flood relief scheme has been identified. However,



a more detailed assessment of the costs and benefits will need to be completed to determine if the proposed Scheme is feasible:

- Navan

### **Flood Relief Schemes and Works Progressed or Proposed through Other Projects or Plans**

There is an existing Flood Relief Scheme providing protection to properties in the following communities. Ongoing maintenance will be undertaken of these schemes.

- Mornington
- Bettystown (Northlands)

## **IMPLEMENTATION, MONITORING AND REVIEW OF THE PLAN**

Implementing all of the measures, set out in this and all Plans, requires a significant capital investment. It has therefore been necessary to prioritise the investment required to implement the national set of proposed measures.

A prioritised initial tranche of flood protection works set out within this and the 28 other Plans to be advanced to the more detailed project level of assessment has been announced in conjunction with the publication of this and the other Plans. The OPW and Local Authorities will work closely to bring about the effective implementation of these initial projects and then subsequent projects.

The Plan identifies the body/bodies responsible for implementing the proposed flood risk management measures in a prioritised manner as above.

The Minister of State with special responsibility for the Office of Public Works and Flood Relief chairs the Interdepartmental Flood Policy Co-ordination Group. This Group co-ordinates and monitors progress in the implementation of the recommendations set out in the Government's 2004 Flood Policy Review, including the measures set out in the Plans.

These Plans are for the period 2018 - 2021. They will be reviewed in terms of progress made and be updated by the OPW and other stakeholders in 2021.

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# 1 INTRODUCTION AND BACKGROUND

## 1.1 OVERVIEW

This is the Flood Risk Management Plan (the 'Plan') for the Boyne (UoM07) River Basin.

The purpose of the Plan is to set out the strategy, including a set of measures, for the cost-effective and sustainable, long-term management of flood risk in the Boyne River Basin, including the areas where the flood risk has been determined as being potentially significant. The Plan includes feasible measures developed through a range of programmes or policy initiatives including:

- Non-structural flood risk prevention and preparedness measures that are applicable nationally, aimed at reducing the impacts of flooding, to implement the recommendations of the Report of the Flood Policy Review Group, 2004<sup>1</sup>
- Structural flood protection measures for communities at significant flood risk, aimed at reducing the likelihood and/or degree of flooding, identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme

The Plan builds on and supplements the programme of flood protection works completed previously, that are under design and construction at this time or that have been set out through other projects or plans, and the ongoing maintenance of existing drainage and flood relief schemes.

The Objectives and scope of the Plan are set out in Sections 1.4 and 1.5 respectively.

This Plan is one of 29 Plans being published; each setting out the feasible range of flood risk management measures for their respective River Basins. The preparation of these Plans is a central part of the implementation of Government policy on flood risk management (OPW, 2004), and meets Ireland's obligations under the 2007 EU 'Floods' Directive (EU, 2007<sup>2</sup>). A Strategic Environmental Assessment, and an Appropriate Assessment under the Habitats Directive, have been undertaken as part of the preparation of the Plan.

The Government's National Development Plan 2018-2027 has provided the capital envelope for a prioritised programme of investment for the advancement and implementation of ongoing flood relief projects and the flood protection measures set out within this and the 28 other Plans.

## 1.2 FLOODING AND FLOOD RISK

Flooding is a natural event that can happen at any time in a wide variety of locations.

Flood *hazard* is the potential threat posed by flooding to people, property, the environment and our cultural heritage. Flooding only presents a *risk* however when people, property, businesses, farms, infrastructure, the environment or our cultural heritage can be potentially impacted or damaged by floods.

Flood risk is the combination of the probability of flood events of different magnitudes and the degree of the potential impact or damage arising from a flood.

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<sup>1</sup> Report of the Flood Policy Review Group, OPW, 2004 ([www.floodinfo.ie](http://www.floodinfo.ie))

<sup>2</sup> Directive on the assessment and management of flood risks, 2007/60/EC

### **1.2.1 Types and Causes of Flooding**

Flooding can occur from a range of sources, individually or in combination, including:

- Coastal flooding (from the sea or estuaries)
- Fluvial flooding (from rivers or streams)
- Pluvial flooding (from intense rainfall events and overland flow)
- Groundwater flooding (typically from turloughs in Ireland)
- Other sources, such as from water-bearing infrastructure

A description of each of these sources of flooding is provided in Appendix A.

### **1.2.2 Impacts of Flooding**

Flooding can cause damage, loss or harm in a number of ways, including:

- Impacts of people and society, including physical injury, illness, stress and even loss of life
- Damage to property, such as homes and businesses
- Damage to, and loss of service from, Infrastructure (such as water supply or roads)
- Impacts on the environment, such as damage or pollution of habitats
- Damage to our cultural heritage, such as monuments and historic buildings

A description of each of these potential impacts of flooding is provided in Appendix A.

### **1.2.3 Potential Impacts of Future Change**

Climate change is likely to have a considerable impact on flood risk in Ireland, such as through rising mean sea levels, increased wave action and the potential increases in winter rainfall and intense rainfall events. Land use change, for example through new housing and other developments, can also increase potential future flood risk.

## **1.3 BACKGROUND**

### **1.3.1 Flood Policy and Legislative Background**

Flood risk to urban areas in Ireland has been addressed, since the 1995 Amendment to the Arterial Drainage Act (1945), through the use of structural or engineered solutions (flood relief schemes). In line with internationally changing perspectives, the Government adopted a new policy in 2004 that shifted the emphasis in addressing flood risk towards:

- A catchment-based context for managing risk and the identification of solutions to manage existing and potential risks
- More pro-active flood hazard and risk assessment and management, with a view to avoiding or minimising future increases in risk, e.g., from development on floodplains,
- Increased use of non-structural and flood impact mitigation measures

Notwithstanding this shift, engineered solutions to manage existing and potential future risks will continue to form a key component of the overall national flood risk management programme and strategy.

Specific recommendations arising from the policy review included:

- the preparation of flood maps, and,
- the preparation of flood risk management plans.

A further influence on the management of flood risk in Ireland is the EU 'Floods' Directive [2007/60/EC]. The aim of this Directive is to reduce the adverse consequences of flooding on human health, the environment, cultural heritage and economic activity. The 'Floods' Directive was transposed into Irish law by Statutory Instrument SI No. 122 of 2010<sup>3</sup> and amended by SI No. 495 of 2015<sup>4</sup>.

Under the 'Floods' Directive, Ireland, along with all other Member States, are required to undertake a Preliminary Flood Risk Assessment (PFRA) to identify areas of potentially significant flood risk (referred to in Ireland as Areas for Further Assessment, or 'AFAs'), and then for these areas to prepare flood maps in relation to the sources of flood risk deemed to be significant. Ireland is then required to prepare Plans for each River Basin, focussed on managing and reducing the risk within the AFAs. The PFRA, flood maps and the Plans need to be reviewed on a 6-yearly cycle.

### 1.3.2 Competent and Responsible Authorities for the 'Floods' Directive

The Office of Public Works (OPW) was designated following the Government approval of the Report of the Flood Policy Review Group (OPW, 2004) as the lead agency for flood risk management in Ireland. As lead agency, the OPW was designated as the Competent Authority under SI No. 122 of 2010 for the implementation of the Directive.

The following authorities may be designated by the OPW under SI Nos. 122 of 2010 and 495 of 2015 as being responsible for the implementation of key requirements of the EU 'Floods' Directive (Preliminary Flood Risk Assessment, preparation of flood maps, and identification of flood risk management measures) with respect to infrastructure for which they have responsibility:

- All local authorities
- Electricity Supply Board (ESB)
- Waterways Ireland
- Irish Water

### 1.3.3 The 'CFRAM' Programme

The purpose of the CFRAM Programme is to assess the existing fluvial and coastal flood risk, and the potential increase in risk due to climate change, ongoing development and other pressures that may arise in the future, and develop a Plan setting out a sustainable, long-term strategy to manage this risk. The OPW in conjunction with the CFRAM Study Consultants (the 'Consultants', being RPS for the Boyne River Basin), are undertaking the National Catchment-based Flood Risk Assessment and Management (CFRAM) Programme.

The objectives of the CFRAM Programme are to:

- Identify and map the existing and potential future fluvial and coastal flood hazard and flood risk in the Areas for Further Assessment (AFAs),
- Identify viable structural and non-structural options and measures for the effective and sustainable management of flood risk in the AFAs,

<sup>3</sup> SI No. 122 of 2010 (<http://www.irishstatutebook.ie/eli/2010/si/122/made/en/pdf>)

<sup>4</sup> SI No. 495 of 2015 (<http://www.irishstatutebook.ie/eli/2015/si/495/made/en/pdf>)

- Prepare a set of Plans, and associated Strategic Environmental and Habitats Directive (Appropriate) Assessments, that sets out the proposed strategies, measures and actions that should be pursued by the relevant bodies, including the OPW, local authorities and other Stakeholders, to achieve the most cost-effective and sustainable management of existing and potential future flood risk, taking account of environmental plans, objectives and legislative requirements and other statutory plans and requirements.

The CFRAM Programme has been implemented for seven large areas called River Basin Districts (RBDs) that cover the whole country. Each RBD is then divided into a number of River Basins (Units of Management, or 'UoMs'), where one Plan has been prepared for each River Basin. A map of the RBDs and the UoMs is provided in Figure 1.1.

The CFRAM Programme is focused on a number of areas where the risk has been determined through the PFRA to be potentially significant, which are referred to as Areas for Further Assessment, or 'AFAs', and on the sources of flooding within these areas that were determined to be the cause of significant risk.

Further details on the CFRAM Programme can be found on the OPW website: [www.floodinfo.ie](http://www.floodinfo.ie).

### **1.3.4 Pilot CFRAM Projects**

Following the adoption of the new policy by Government in 2004, the OPW commenced a series of pilot CFRAM Projects to test and develop the approach before rolling-out the Programme nationally. None of the pilot CFRAM projects were located within the Boyne River Basin.

### **1.3.5 Other Relevant Flood Risk Management Projects**

The National CFRAM Programme is delivering on the requirements of the Government Policy and the EU 'Floods' Directive for most of the AFAs. In some areas however, other parallel or preceding projects have delivered on these requirements. In relation to this Plan, this project is:

- Mornington Flood Relief Scheme.
- The Northlands Flood Relief Scheme

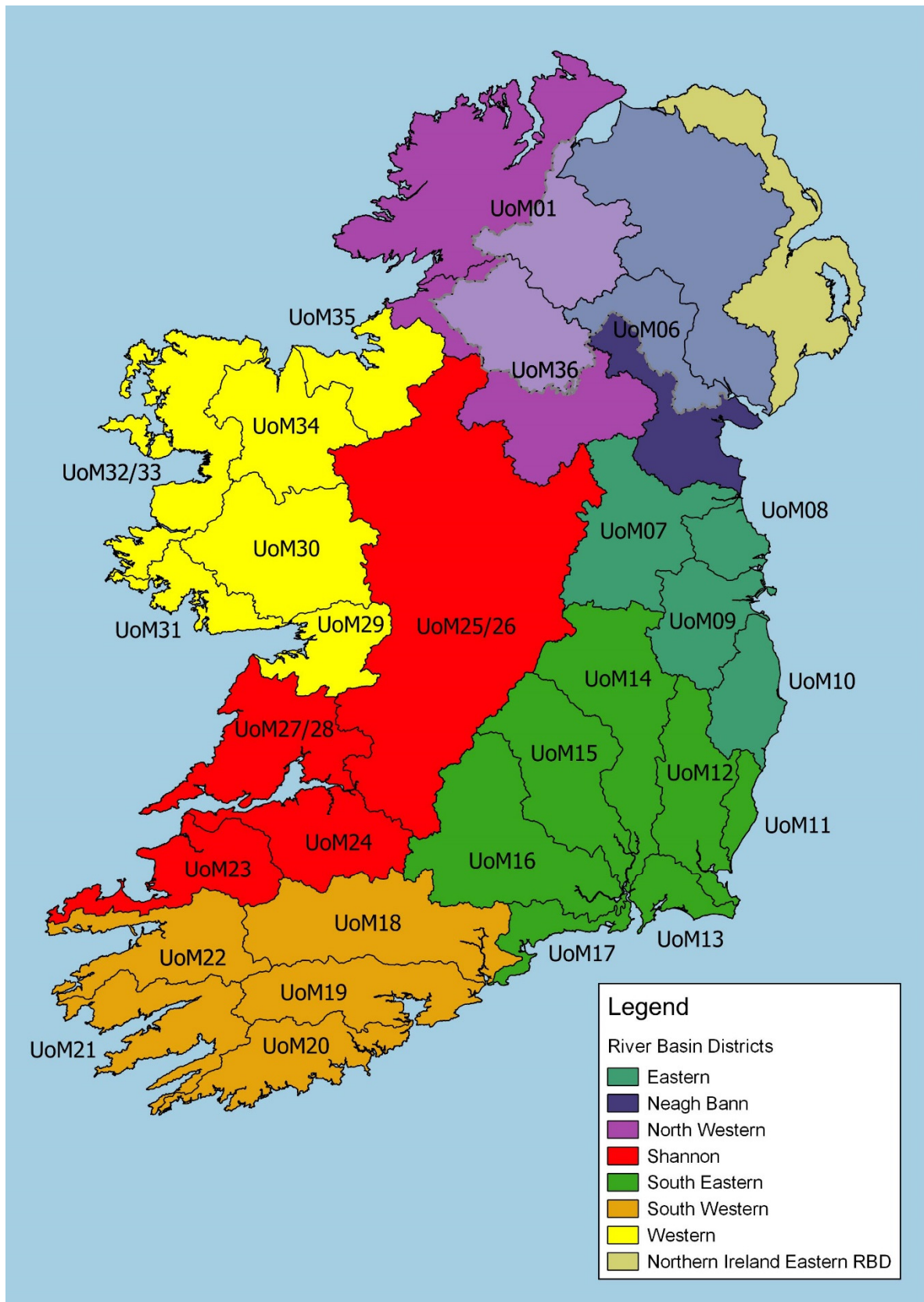
The process undertaken in preparing the flood maps and/or determining suitable flood risk management options under these projects would be generally similar to those undertaken for the CFRAM Programme, and are set out in the project reports available from the OPW website<sup>5</sup>:

This Plan includes the measures undertaken or proposed through the above Projects, including an update on their current status.

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<sup>5</sup> <http://www.opw.ie/en/flood-risk-management/operations/flooddefenceschemes/#d.en.23394>





*Figure 1.1: River Basin Districts (RBDs) and River Basins (UoMs) in Ireland*

### 1.3.6 Other Relevant Policies and Plans

The 2004 Report of the Flood Policy Review Group and SI Nos. 122 and 495 of 2010 and 2015 respectively are the policy and legislation that directly relate to the preparation of this Plan. However, a wide range of legislation, policies and plans are relevant to, or may be impacted by, this Plan. The relevant legislation, policies and plans (as of June 2017) are listed in Table 1.1.

**Table 1.1** *Legislation, Policies and Plans Relevant to the Plan*

Legislation / Policy / Plan	Description
<b>Legislation</b>	
Arterial Drainage Act, 1945, and Amendment Act, 1995	Acts empowering the Commissioners of Public Works to implement Arterial Drainage Schemes (1945) and Flood Relief Schemes (1995), which must then be maintained.
Commissioners of Public Works (Functions and Powers) Act, 1996	Act to make further provision in relation to the functions and powers of the Commissioners of Public Works including in relation to flooding. The Minor Works Programme (to fund local authorities to implement local flood relief schemes) is an administrative scheme operated by the OPW under its general powers and functions to make schemes to address flood risk.
Coast Protection Act, 1963	Act to provide for the making and execution of coast protection schemes and to provide for other matters connected with the matters aforesaid.
Local Government (Works) Act, 1949	Enables local authorities to execute works affording relief or protection from flooding
SI Nos. 122 and 495 of 2010 and 2015	Transposing Instruments for the EU 'Floods' Directive - European Communities (Assessment and Management of Flood Risks) Regulations 2010 & 2015
SI Nos. 722 and 350 of 2003 and 2014,	Transposing Instruments for the EU Water Framework Directive: - European Communities (Water Policy) Regulations, 2003 & 2014
SI Nos. 435 and 200 of 2004 and 2011	Transposing Instruments for the EU Strategic Environmental Assessment Directive: - European Communities (Environmental Assessment of Certain Plans and Programmes) (Amendment) Regulations 2004 & 2011
SI No. 477 of 2011	Transposing Instruments for the EU Birds and Habitats Directives: - European Communities (Birds and Natural Habitats) Regulations 2011
Planning and Development Act, 2000 (No. 30 of 2000) and associated regulations	Principal Planning Act (and amendments) - Planning and Development Regulations 2001 to 2015 Provides for the adoption of Guidelines under Section 28 Sets out planning requirements for certain flood relief works by local authorities
Climate Action and Low Carbon Development Act, 2015	Provides for the making of a National Adaptation Framework to specify the national strategy for the application of adaptation measures in different sectors and by local authorities to reduce the vulnerability of the State to the negative effects of climate change, including potential increases in flood risk.



Policies	
Report of the Flood Policy Review Group, 2004	Report, approved by Government in September 2004, that sets out recommendations for flood risk management policy in Ireland, including roles and responsibilities.
Guidelines on the Planning System and Flood Risk Management, 2009	Guidelines published under Section 28 of the Planning and Development Acts that provide a transparent and robust framework for the consideration of flood risk in planning and development management.
Major Emergency Management Framework, 2006	Sets out common arrangements and structures for front line public sector emergency management in Ireland to facilitate the co-ordination of the individual response efforts of the Principal Response Agencies to major emergencies.
National Adaptation Framework, 2012 & 2018	Set out Government policy for addressing climate change adaptation in Ireland, focusing on key climate sensitive sectors and mandating certain Government Departments, other public sector bodies and Local Authorities to prepare sectoral and local climate change adaptation plans.  A new statutory Framework was introduced in January 2018 under the Climate Action and Low Carbon Development Act, 2015.
Plans	
Climate Change Sectoral Adaptation Plan for Flood Risk Management, 2015	Sets out the policy on climate change adaptation of the OPW, the lead agency for flood risk management in Ireland, based on a current understanding of the potential consequences of climate change for flooding and flood risk in Ireland, and the adaptation actions to be implemented by the OPW and other responsible Departments and agencies in the flood risk management sector.  A revised statutory Sectoral Adaptation Plan will be prepared under the 2018 National Adaptation Framework.
National Spatial Strategy, 2002 - 2020	A 20-year coherent national planning framework for Ireland that aims to achieve a better balance of social, economic and physical development across Ireland, supported by more effective and integrated planning.
River Basin Management Plans	Plans (RBMPs) prepared under the Water Framework Directive (2000/60/EC) that summarise the waterbodies that may not meet the environmental objectives of the WFD and identify which pressures are contributing to the environmental objectives not being achieved. The plans describe the classification results and identified measures that can be introduced in order to safeguard waters and meet the environmental objectives of the WFD. <ul style="list-style-type: none"> <li>• Eastern River Basin District - River Basin Management Plan: 2009 – 2015</li> <li>• SEA for the WFD River Basin Management Plans and Programmes of Measures – Eastern RBD (2009)</li> </ul> The second cycle (2018-2021) represents a new approach to river basin management planning. Ireland is now taking a single river basin district approach with a much improved evidence base to underpin decision making at both national and local level. <ul style="list-style-type: none"> <li>• River Basin Management Plan for Ireland (2018-2021) (Draft)</li> <li>• SEA for the Draft River Basin Management Plan for Ireland (2018-2021)</li> </ul>
Regional Planning Guidelines	Planning strategies at the regional level to provide the link between the national and local planning frameworks, which work within the overall approach taken in the National Spatial Strategy, while providing more detail and establishing a development and

	<p>spatial framework that can be used to strengthen local authority development plans and other planning strategies at county, city and local level.</p> <ul style="list-style-type: none"> <li>Regional Planning Guidelines for the Border Region 2010-2022, Regional Planning Guidelines Office, 2010)</li> </ul>
Development Plans	<p>The development plan sets the agenda for the development of the local authority's area over its six year lifespan. Development, whether it be residential, industrial, commercial or amenity, must generally take place in accordance with the development plan. The plan is therefore a blueprint for the economic and social development of the city, town or county for which it has been made.</p> <ul style="list-style-type: none"> <li>Cavan County Development Plan 2014-2020 (Cavan County Council, 2014)</li> <li>Kildare County Development Plan 2011-2017 (Kildare County Council, 2011)</li> <li>Louth County Development Plan 2015-2021 (Louth County Council, 2015)</li> <li>Meath County Development Plan 2013-2019 (Meath County Council, 2013)</li> <li>Offaly County Development Plan 2014-2020 (Offaly County Council, 2014)</li> <li>Westmeath County Development Plan 2014-2020 (Westmeath County Council, 2014)</li> </ul>
Local Areas Plans	<p>Local Area Plans provide more detailed planning policies at a local level for either urban areas or wider urban and rural areas where significant development and change is anticipated.</p> <ul style="list-style-type: none"> <li>Athboy Local Area Plan 2009 – 2015</li> <li>Edenderry Local Area Plan 2011-2017 (Offaly County Council, 2011)</li> <li>Longwood Local Area Plan 2009 – 2015</li> <li>East Meath Local Area Plan 2014 - 2020</li> </ul>
Other Spatial / Development Plans for UoM	<ul style="list-style-type: none"> <li>Louth County Council Landscape Character Assessment (LCC, 2002)</li> <li>The Geological Heritage of Cavan (GSI, 2013)</li> <li>Offaly Historic Landscape Characterisation (Offaly County Council, 2006)</li> <li>County Offaly Wind Strategy (Offaly County Council, 2009)</li> <li>Cavan Local Economic Plan 2016-2021 (Cavan County Council, 2016)</li> <li>Kildare Local and Economic &amp; Community Plan 2016-2021 (Kildare County Council, 2015)</li> <li>Meath Economic Development Strategy 2014-2022 (Meath County Council, 2014)</li> <li>Offaly Local and Economic &amp; Community Plan 2016-2021 (Offaly County Council, 2015)</li> <li>Greater Dublin Strategic Drainage Strategy (DCC, 2005)</li> <li>County Cavan Groundwater Protection Scheme (GSI, 2008)</li> <li>Couth Offaly Groundwater Protection Scheme (GSI and Offaly County Council, 1998)</li> <li>County Kildare Groundwater Protection Scheme (GSI and Kildare County Council, 2002)</li> </ul>

	<ul style="list-style-type: none"> <li>• County Meath Groundwater Protection Scheme (GSI and Meath County Council, 1996)</li> <li>• Ballmakenny Group Water Scheme (GSI and Louth County Council, 2011)</li> <li>• Cavan Draft Heritage Plan 2016-2021 (Cavan County Council, 2015)</li> <li>• Kildare Heritage Plan 2014-2018 (Kildare County Council, 2013)</li> <li>• Louth Heritage Plan 2015-2020 (Louth County Council, 2014)</li> <li>• Draft County Meath Heritage Plan 2016-2021 (Meath County Council, 2015)</li> <li>• Offaly Heritage Plan 2012-2016 (Offaly County Council, 2011)</li> <li>• Westmeath Heritage Plan 2010-2015 (Westmeath County Council, 2009)</li> <li>• Offaly Housing Strategy 2008-2015 (Offaly County Council, 2007)</li> <li>• Local Biodiversity Action Plan Louth (Louth County Council, 2014)</li> <li>• (Draft) County Meath Biodiversity Action Plan 2015-2021 (Meath County Council, 2015)</li> <li>• Westmeath Biodiversity Action Plan 2014-2020 (Westmeath County Council, 2013)</li> <li>• Kildare Biodiversity Plan 2009-2014 (Kildare County Council, 2008)</li> </ul>
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## 1.4 FLOOD RISK MANAGEMENT OBJECTIVES

### 1.4.1 Overview

The Flood Risk Management Objectives set out the goals the Plan is aiming to achieve. They have a key role in the preparation of the Plan, and the identification of appropriate measures, as the options that are available to manage flood risk within a given area are appraised against these Objectives to determine how well each option contributes towards meeting the defined goals. Establishing such Objectives is also a requirement of the EU 'Floods' Directive [Art. 7(2)].

The Flood Risk Management Objectives are aimed at considering potential benefits and impacts across a broad range of sectors including human health, the environment, cultural heritage and economic activity. The Flood Risk Management Objectives are well aligned with the objectives defined for the Strategic Environmental Assessment (see Section 6.3), as both are aimed at defining sustainable measures providing benefits to a wide range of sectors.

### 1.4.2 Definition of the Flood Risk Management Objectives

A set of Flood Risk Management Objectives was developed and applied through the Pilot CFRAM Studies, with stakeholder consultation to ensure the Objectives set were appropriate. In commencing the National CFRAM Programme, the Objectives developed for the Pilot Studies were reviewed and refined. The OPW considered it appropriate to publicly consult on the proposed Objectives, and launched a public consultation in October 2014. Seventy one submissions were received which informed amendments then made to define the final Objectives. The final set of Objectives are set out in Table 1.2.

**Table 1.2** *Flood Risk Management Objectives and Global Weightings for the National CFRAM Programme*

CRITERIA		OBJECTIVE		SUB-OBJECTIVE		GLOBAL WEIGHTING
1	Social	a	Minimise risk to human health and life	i)	Minimise risk to human health and life of residents	27
				ii)	Minimise risk to high vulnerability properties	17
		b	Minimise risk to community	i)	Minimise risk to social infrastructure and amenity	9
				ii)	Minimise risk to local employment	7
2	Economic	a	Minimise economic risk	i)	Minimise economic risk	24
		b	Minimise risk to transport infrastructure	i)	Minimise risk to transport infrastructure	10
		c	Minimise risk to utility infrastructure	i)	Minimise risk to utility infrastructure	14
		d	Minimise risk to agriculture	i)	Minimise risk to agriculture	12
3	Environmental	a	Support the objectives of the WFD	i)	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	16
		b	Support the objectives of the Habitats Directive	i)	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	10
		c	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	i)	Avoid damage to or loss of, and where possible enhance, nature conservation sites and protected species or other known species of conservation concern.	5
		d	Protect, and where possible enhance, fisheries resource within the catchment	i)	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	13

CRITERIA		OBJECTIVE		SUB-OBJECTIVE		GLOBAL WEIGHTING
3	Environmental (Continued)	e	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	i)	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	8
		f	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	i)	Avoid damage to or loss of features, institutions and collections of architectural value and their setting.	4
				ii)	Avoid damage to or loss of features, institutions and collections of archaeological value and their setting.	4
4	Technical	a	Ensure flood risk management options are operationally robust	i)	Ensure flood risk management options are operationally robust	20
		b	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	i)	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	20
		c	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	i)	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	20

Sets of Objectives, similar to those adopted for the National CFRAM Programme, have also been adopted for other flood relief scheme projects undertaken in parallel to the CFRAM Programme. Details of these are set out in the relevant project reports (Section 1.3.5).

The purpose of the Global Weightings referred to in Table 1.2 is set out in Section 7.3.4.

## **1.5 SCOPE OF THE PLAN**

This Plan sets out a sustainable, long-term strategy to manage the flood risk within the Boyne River Basin, focused on the areas of potentially significant flood risk (AFAs), and the sources of flooding giving rise to that risk.

### **1.5.1 Spatial Scope of the Plan**

The Plan is focussed on the areas, the 'AFAs', where the risk was determined through the PFRA as being potentially significant. There are 300 AFAs, which are typically communities (villages, towns and cities) where the flood risk is concentrated, throughout the country. The areas covered by this Plan are set out in Section 3.2 (Table 3.1).

Some flood risk mitigation measures developed for the AFAs will have benefits for other areas, and so areas outside of the AFAs may also benefit from the proposed specific measures set out in the Plan.

While the Plan does not include locally specific flood protection measures to address the flood risk in areas outside of the AFAs, it does set out the range of policies and measures, which are in place or under development, that can contribute to the reduction and management of flood risk throughout the River Basin, including areas outside of the AFAs, such as spatial planning, emergency response planning and maintenance of drainage schemes.

### **1.5.2 Sources of Flooding Addressed in the Plan**

The Plan for the Boyne River Basin addresses fluvial and coastal flooding in one or more communities (AFAs), as these sources were determined through the PFRA to be potentially significant in one or more communities within the area covered by the Boyne River Basin Plan. The sources of flooding addressed for each of the AFAs are indicated in Table 3.1.

Other sources of flood risk within these communities, which were not deemed to have been significant for those communities within the scope of the PFRA, have not been specifically addressed (i.e., through locally specific flood protection measures). The Plan does however set out a range of policies and measures that can contribute to the reduction and management of flood risk for all sources of flood risk throughout the River Basin, including areas outside of these communities, such as spatial planning, emergency response planning and maintenance of drainage schemes.

### **1.5.3 Level of Detail of the Plan**

The Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment, which has involved detailed modelling and appraisal of possible options for managing and reducing flood risk, including environmental assessment to the degree of detail appropriate for the Plan.

The observations and views submitted as part of the consultation on the Draft Plan (See Section 4.4.6) have been reviewed and taken into account in the preparation of this Plan.

It should be noted that the flood relief works or 'Schemes' set out in the Plans that have been developed through the CFRAM Programme are to an outline design, and are not at this point

ready for construction. Further detailed design through a project-level of assessment will be required for such works before implementation, along with project-level environmental assessment and appraisal (including the consideration of alternatives), further public and stakeholder consultation and engagement and a statutory planning process such as planning permission or Public Exhibition and confirmation (Ministerial approval), where relevant. Local information that can not be captured at the Plan-level of assessment, such as ground investigation results and project-level environmental assessments, may give rise at that stage to some amendment of the proposed works to ensure that they are fully adapted, developed and appropriate within the local context, and that they are compliant with environmental legislation.

The works set out in the Plan may therefore be subject to some amendment prior to implementation.

## 1.6 STRUCTURE OF THE PLAN

The structure of the Plan is set out below.

### Flood Risk Management Plan

Section 1	Provides an introduction and background to the Plan, including the flood risk management Objectives the Plan is aiming to achieve, and sets out the scope of the Plan
Section 2	Provides an overview of the catchment and coastal areas covered by the Plan, including a summary of the flood history and existing flood risk management measures
Section 3	Describes the PFRA undertaken to identify the AFAs that are the focus of this Plan
Section 4	Outlines the public and stakeholder consultation and engagement undertaken throughout the National CFRAM Programme and other relevant projects.
Section 5	Details the existing and potential future flood hazard and risk in areas covered by the Plan
Section 6	Describes the environmental assessments undertaken to ensure that the Plan complies with relevant environmental legislation and inform the process of identifying the suitable strategies that will, where possible, enhance the environment
Section 7	Sets out the measures to manage the flood risk in the area covered by the Plan, and how these were developed and assessed, and provides a summary of the measures proposed in the Plan
Section 8	Outlines how the implementation of the Plan will be monitored and reported, and then reviewed and updated at regular intervals
APPENDIX A	Provides an overview of flooding and flood risk
APPENDIX B	Describes in more detail a physical overview of the River Basin
APPENDIX C	Summarises the process in undertaking the Preliminary Flood Risk Assessment
APPENDIX D	Provides details on certain aspects of the stakeholder and public engagement and consultation
APPENDIX E	Sets out the flood risk in each AFA
APPENDIX F	Provides a summary of the different methods of flood risk management
APPENDIX G	Describes the potential flood risk management works

### Strategic Environmental Assessment Statement

### Natura Impact Statement

The flood maps that have informed and form part of this Plan are available from the OPW website: [www.floodinfo.ie](http://www.floodinfo.ie).



## **2 OVERVIEW OF THE RIVER BASIN**

### **2.1 THE BOYNE RIVER BASIN**

The Eastern CFRAM Study covers an area of approximately 6,250 km<sup>2</sup> and includes four River Basins; the Boyne (UoM07), the Nanny-Delvin (UoM08), the Liffey-Dublin Bay (UoM09) and the Avoca-Vartry (UoM10).

There is a high level of flood risk within some locations in the Boyne River Basin with significant coastal and fluvial flooding events having occurred in the past. The Boyne River Basin, shown in Figure 2.1, covers an area of approximately 2,695 km<sup>2</sup> and includes parts of counties Louth, Cavan, Meath, Westmeath, Offaly, and Kildare. It is a predominantly rural catchment, but with major urbanised areas such as Drogheda and Navan as well as a number of smaller settlements.

### **2.2 TOPOGRAPHY, GEOLOGY, SOILS AND GROUNDWATER**

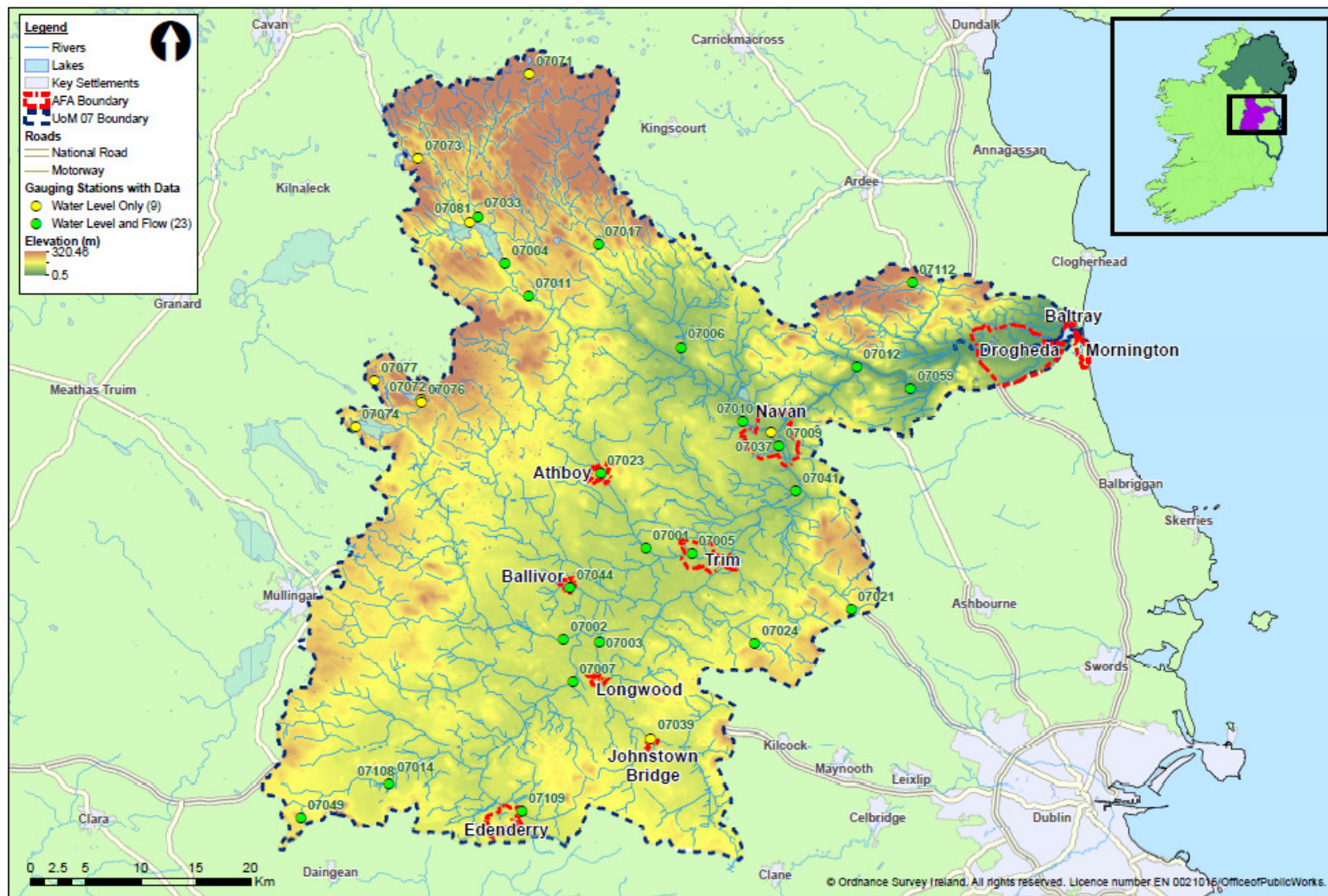
The topography of the Boyne River Basin reveals a generally easterly drainage pattern of the area towards the discharge of the River Boyne, via the Boyne Estuary, to the Irish Sea eastward of Drogheda. Areas of high ground are located mainly to the north west of the River Basin, as well as north west of Drogheda.

The geology of the area consists of a geological foundation comprised of mostly dark limestone and shale, while massive unbedded lime-mudstone has a large presence in the southern half of the River Basin. Other major formations include dark quartz greywacke and conglomerate, fine to coarse grained turbidite, and calcareous red-mica greywacke have large formations in the north, and oolitic limestone in the south. The geology is highly varied in the east.

Locations where aquifers are generally unproductive are located in the east of the River Basin. Bedrock which is generally unproductive except for local zones is distributed throughout the River Basin, with significant areas in the north, north east and east, while smaller unproductive aquifers are present centrally within the study area.

In terms of soil, the most predominant types in the River Basin are deep well drained mineral soils derived from mainly calcareous parent materials including grey brown podzolics and brown earth soils. These are distributed over significant parts of the River Basin (particularly the southern two thirds of the River Basin). Deep poorly drained mineral soils including surface water and ground water gleys derived from mainly non-calcareous parent materials, have significant presence in the north and north east.

Further details on the topography, geology, soils and groundwater in the Boyne River Basin is provided in Appendix B.



*Figure 2.1: Boyne River Basin Location Map*

## 2.3 LAND USE AND LAND MANAGEMENT

The 2011 census data held by the Central Statistics Office (CSO, 2011) show a total population for the Eastern CFRAM Study Area of approximately 1.83 million, of which 1.18 million are in County Dublin and 0.5 million in Dublin City. The 2011 census recorded Drogheda (one of the most densely populated areas within the eastern region, with a population of 38,578) as having increased by 10% in population since 2006 (CSO, 2011).

The Eastern CFRAM Study Area is the most highly urbanised basin district in Ireland, with discontinuous urban fabric covering 6% of the area, which includes the greater Dublin area. Agricultural lands comprise over 70% of the area with the majority used for pasture (55%) as well as large areas of arable land. Peat bogs also comprise a relatively large portion of the area, covering around 7% of the land area.

**Table 2.1** *Zoned Lands within Key Urban Areas in the Boyne River Basin*

NAME	AREA ZONED (km <sup>2</sup> )	DEVELOPMENT PLAN DATE
Athboy	1.72	28/08/09 – 28/08/15
Ballivor	0.97	28/04/09 - 28/04/15
Baltray	0.11	26/03/12 - 16/11/15
Drogheda	6.69	07/02/11 - 07/02/17
Johnstown Bridge	0.04	02/05/11 – 02/05/17
Navan	11.20	02/11/09 – 02/11/15
Trim	6.40	13/11/06 – 13/11/14
Edenderry	1.92	20/06/11 – 20/06/17
Mornington	2.26	07/11/05 – 07/11/11
Longwood	0.69	28/04/09 – 28/04/15

Increases in population also can pose development pressures resulting in changes in land use. Data from the 2000-2006 CORINE database showed an increase in urbanisation in the order of 40% with urban development increasing from 56km<sup>2</sup> to 79km<sup>2</sup>. Population increase and associated urbanisation within the Boyne River Basin is centralised around Mornington, Drogheda and Baltray.

The areas of land zoned for development, under extant development plans, in the key urban areas within the Boyne River Basin are summarised in Table 2.1. These include areas of infill alongside existing development.

Further details on land use and land use management in the Boyne River Basin are provided in Appendix B.

## 2.4 HYDROLOGY

There are two principal rivers within River Basin, the River Boyne itself, which rises in the south west of the area and flows north eastwards through Trim and Navan to its estuary at Drogheda, and the River Blackwater, which rises in the north west of the area and joins the Boyne in Navan. Other significant rivers within the River Basin are the Skane River, River Deel, Stonyford River, Athboy/Tremblestown River and a second Blackwater River in Co Kildare.

Within the Boyne River Basin the OPW has implemented and maintains the Boyne Arterial Drainage Scheme, undertaken by the OPW between 1967 and the mid-1980's, under the 1945 Arterial Drainage Act. The OPW continues to have statutory responsibility for

inspection and maintenance of the Scheme, which includes much of the main Boyne channel and a large number of designated tributaries. The primary focus of arterial drainage schemes is not for flood relief but for the improvement of agricultural land. Whilst not intended as a flood alleviation scheme the arterial drainage works have undoubtedly reduced the fluvial flood risk in certain parts of the Boyne River Basin.

Drainage Districts represent areas where the Local Authorities have responsibilities to maintain watercourse channels and therefore contribute to maintaining the existing regime. In relation to the six Drainage Districts located within Boyne River Basin, none are located directly on the key watercourses where fluvial and coastal flood risk is being considered within Ireland's first cycle assessment under the Floods Directive.

The main channel of the Boyne River from Drogheda, downstream to the mouth of the estuary is maintained by Drogheda Port Company. As this maintenance regime results in increased channel capacity it is considered to result in a decrease in fluvial flood risk. Flood risk would be likely to increase if these existing maintenance activities were discontinued.

Hydrometric data is available at 33 hydrometric gauge station locations within the Boyne River Basin. Fourteen stations, which are located on watercourses to be modelled, have data available within the River Basin and nine of these stations were rated under FSU as having confidence in their ratings at flood flows.

Meteorological data is available from a number of Met Éireann daily and hourly rain gauges within the Eastern CFRAM Study Area and beyond which was used within the hydrological analysis.

In addition to the observed historical rainfall data available, further meteorological information is required as input to hydrological models namely observed evaporation, soil moisture deficits and potential evapotranspiration data.

Full details of the methodology, datasets used and outcomes of the hydrological analysis for the Eastern CFRAM Study Area can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

Further details on the hydrology of the Boyne River Basin is provided in Appendix B.

## **2.5 FLOOD HISTORY**

The historical flood events which occurred in the various AFAs in the Boyne River Basin are summarised in Table 2.2.

The majority of the flood history data collection results yielded from searches on the OPW National Flood Hazard Mapping website ([www.floodinfo.ie](http://www.floodinfo.ie)) related to floods which had occurred pre-2005. An internet search was carried out for information on the more recent flood events to supplement the records for each AFA in the River Basin. During the Study information was brought forward by local authorities, particularly in relation to events which occurred in the intervening period between the flood event analysis and verification of the hydraulic modelling. Information on flood events which occurred during the Study was also collected through the Flood Event Response task. Details of the most recent and more widely reported events are summarised below with additional information available in the inception and hydraulics reports.

Information on these past floods, such as flood flows, levels, depths, extents and mechanisms, has been used as appropriate in the CFRAM Programme to inform the preparation of the flood maps and Plans, where such information has been available at the relevant stage of the Programme and has been considered adequately reliable.



**Table 2.2 Summary of Historical Flood Events for each AFA**

Event	Drogheda	Navan	Trim	Johnstown Bridge	Ballivor	Athboy	Baltray	Edenderry	Mornington	Longwood (lands upstream)
Jan-2016	✓									
Dec-2015		✓	✓	✓						
Nov-2014	✓			No dates given for floods –states that flooding is recurring						
Jan-2014	✓									
Oct-2011	✓								✓	
Nov-2009		✓								
Aug-2008		✓	✓		✓	✓		✓		✓
Jan-2005			✓							
Oct-2004	✓						✓			
Nov-2002	✓	✓	✓				✓	✓		✓
Oct-2002	✓									
Feb-2002	✓						✓	✓	✓	
Nov-2000	✓	✓	✓				✓	✓	✓	
Feb-1995			✓		✓					
Jan-1995										✓
Jun-1993		✓	✓		✓					
Jan-1991		✓								
Dec-1981	✓	✓								
Dec-1978	✓		✓			✓	✓		✓	
Jan-1969		✓								
Dec-1968		✓	✓							
Nov-1965	✓	✓	✓							
Jan-1965		✓	✓							
Dec-1954	✓	✓	✓			✓			✓	
Mar-1947		✓	✓		✓	✓				
Aug-1905			✓							

Flood Event of January 2016 – Widespread flooding occurred in Drogheda on the 3rd January 2016 causing inundation of Drogheda's North Quay, Wellington Quay, the Mall, North Strand and Ship Street and the Marsh Road towards Mornington with footage indicating these routes were impassable.

Flood Event of December 2015 – Flooding, which occurred on the 12th December 2015, was reported to be causing problems on roads around County Meath following persistent rainfall. Part of the Commons Road in Navan experienced flooding and there was also flooding on the N51 Slane-Drogheda road. Also under water was a section of the Trim-Kildalkey road.

Flood Event of November 2014 - A flood event response report details how flooding upstream of a culvert headwall on the Ushers Stream affected four ground floor apartments at Flaxmill Lane in Drogheda.

Flood Event of January 2014 - Flooding occurred on the 3rd January 2014 causing significant damage to Drogheda town centre and properties in the vicinity of the quays. Approximately 100 residential and 63 non-residential properties were affected. Flood extents during the Jan 2014 event included Greenhills Industrial Estate, Merchant's Quay, North Quay, Wellington Quay, Ship Street and Marsh Road. The Flood Event Report compiled by Louth County Council reported that the event was coastal in nature with a peak flood level recorded of 3.42m OD Malin. Louth County Council reported that this was as a result of a combination of storm surge and high tides.

Flood Event of October 2011 - The results of the internet search indicated that flooding occurred in Drogheda on 24<sup>th</sup> October following a day of heavy rainfall. Both the Boyne and Curly Hole rivers overflowed and floodwaters became contaminated with sewage. Press articles reported that worst hit areas were the Donore Road, Greenhills and John Street, while at one stage one lane of the dual carriageway (R132) was completely submerged. The same articles report how the water level was up to the waist level of fire fighters at Drogheda bus station, where the ground level is approximately 3.32mOD Malin.

Flood Event of November 2009 - The review indicated that flooding occurred in Navan on 19th-20th November following torrential rainfall on November 19th. A press article states how firemen in Navan pumped water from Academy Street and on the Commons Road throughout the night to keep floodwaters at bay. However, no information on flooding of the other AFAs was available, nor were there any details of flood extents, levels or the source of flooding.

Flood Event of August 2008 - Review of the historical data indicated that flooding occurred in Navan, Trim, Ballivor, Athboy and Edenderry in August 2008.

Heavy rainfall on 16<sup>th</sup> August resulted in the River Boyne overtopping its banks in Navan. Flooding also resulted due to sewers being overwhelmed by the rainfall. The Newgrange Hotel in Navan was flooded and some roads/streets including Cannon Row, Circular Road, Commons Lane and roads at Ardsallagh, Cannistown and Bloomsbury Bridge were also flooded.

At Trim, the heavy rainfall on the Boyne catchment resulted in the River Boyne overtopping its banks. The level reading at Trim Hydrometric Station was the 7<sup>th</sup> highest on record. Trim Pitch and Putt course flooded; however no further information on properties flooded or resultant damage was available.

In the Ballivor area, the Clonycavan channel overflowed resulting in adjacent lands becoming flooded. Photographs taken in the area did not show any houses within the flooded lands.

In Athboy, at least one house in the Castletown area was flooded on 16th August.

In Longwood, historical information indicates flooding of low lying lands adjacent to Ashfield Bridge.

The River Boyne overflowed in the Edenderry area during this flood event and flooded low lying land near the river. From available information, the flooding appeared to mostly affect agricultural land, although parts of Edenderry Golf Club were flooded also. Aerial photographs taken during the flood do not indicate flooding in the town itself or flooding of roads or houses.

Flood Event of January 2005 - Review of the historical data indicated that on 7th January 2005, the River Boyne overflowed into low lying ground and subsequently flooded the swimming pool and children's play area in Trim.

Flood Event of October 2004 - The historical data indicated that flooding occurred in Drogheda and Baltray in October 2004. This was a coastal flooding event caused by rainfall and high tides/low barometric pressure. However, no details were available on flood extents, damage caused, etc, at either of these locations.

Flood Event of November 2002 - Information was found for a flood event which occurred in Drogheda, Navan, Trim and Edenderry in November 2002.

In Drogheda, flash flooding occurred which was a result of heavy rainfall, reportedly exacerbated by blocked gullies. Roads, housing estates and an industrial estate were flooded. However, there were no reports of properties being flooded.

In Navan and in Trim, more extensive fluvial flooding occurred as a result of the River Boyne overflowing in both towns, while in Navan, the River Blackwater also overflowed. Flooding occurred in the Townparks, Academy Street, Claremont and Moatlands areas of Navan.

From available photos, it appears the flooding in Trim affected mostly low lying areas adjacent to the flood plain, although the swimming pool and Mill Street area were flooded.

In Edenderry, the only available information is a photo which indicates flooding at Kishawanny Bridge. It appears as though only low lying lands adjacent to the river were flooded and that no flooding of properties, or in the town itself, occurred.

## **2.6 EXISTING FLOOD RISK MANAGEMENT MEASURES**

### **2.6.1 Mornington Flood Relief Scheme**

The Mornington Flood Relief Scheme, which comprises flood defence walls and embankments along the Mornington Stream and a pumping station upstream of Lady's Finger Bridge, provides protection against a 100-Year fluvial flood (1% Annual Exceedance Probability) and a 200-Year tidal flood (0.5% Annual Exceedance Probability) for 162 properties.

### **2.6.2 Northlands Flood Relief Scheme**

The Northlands Flood Relief Scheme was initiated in 2013 following major flooding in 2008 and 2012, and has been substantially completed. The Scheme, which comprises of flood defence walls and a non-return flap valve, provides protection against a 100-Year flood (1% Annual Exceedance Probability) for 27 properties against flooding from the Mornington stream and its tributary.

### **2.6.3 Arterial Drainage Schemes and Drainage Districts**

The following Arterial Drainage Schemes and Drainage Districts have been completed, and are maintained by the OPW or local authority respectively, in the River Basin.

- Boyne ADS
  - Unit of Management (Hydrometric Area): 07
  - Scheme Name: Boyne
  - Years of Works: Started 1969 Completed 1987
  - Length of Channel: 2132 Km
  - Length of Embankment: 0 Km

- Benefitting Area (km<sup>2</sup>): 482
- Owenroe & Moynalty DD
- Lough Crew DD
- Ballycowan DD
- Carbury Hill Stream DD
- Foranwell DD
- Garr DD

#### **2.6.4 Minor Works**

The Minor Flood Mitigation Works and Coastal Protection Scheme (the 'Minor Works Scheme') is an administrative scheme introduced in 2009 and operated by the OPW under its general powers and functions to provide funding to local authorities to enable the local authorities, to address qualifying local flood problems with local solutions.

Under the scheme, applications from local authorities are considered for projects that are estimated to cost up to €750,000 in each instance. Funding of up to 90% of the cost is available for approved projects, with the balance being funded by the local authority concerned. Local authorities submit funding applications in the prescribed format, which are then assessed by the OPW having regard to the specific technical, economic, social and environmental criteria of the scheme, including a cost benefit assessment. With regard to the latter, proposals must meet a minimum benefit to cost ratio of 1.35 or 1.5 : 1 (depending on cost) in order to qualify. Full details are available on [www.opw.ie](http://www.opw.ie)

By the end of 2017, over 650 applications for flood relief works under the Minor Works Scheme have been approved since the inception of the Scheme in 2009. Details of the Scheme and works for which funding under the Scheme have been approved are available from the OPW Website:

- <http://www.opw.ie/en/floodriskmanagement/operations/minorfloodworkscoastalprotectionscheme/>



## 3 PRELIMINARY FLOOD RISK ASSESSMENT

### 3.1 INTRODUCTION

The Preliminary Flood Risk Assessment (PFRA) was a national screening exercise, based on available and readily-derivable information, to identify areas where there may be a significant risk associated with flooding.

The PFRA in Ireland was finalised in December 2011, following public consultation. A summary of how the PFRA was undertaken is provided in Appendix C.

### 3.2 OUTCOMES OF THE PFRA

The OPW designated 300 AFAs around Ireland, informed by the PFRA, the public consultation outcomes and the Flood Risk Reviews (further details available in Appendix C of this Plan and from the OPW website: [www.floodinfo.ie](http://www.floodinfo.ie)). The AFAs were the focus of the CFRAM Studies and parallel detailed studies.

A list of all AFAs is provided in Appendix C of the Report on the Designation of the Areas for Further Assessment (OPW, 2012). Table 3.1 identifies the AFAs that are within the area covered by this Plan, and the sources of flood risk that were deemed to be significant for each AFA, which are also shown in Figure 3.1.

**Table 3.1** *List of the AFAs within the Boyne River Basin*

ID No.	COUNTY	NAME	SOURCE(S) OF FLOOD RISK
70028	Meath	Athboy	Fluvial
70029	Meath	Ballivor	Fluvial
70030	Louth	Baltray	Fluvial & Coastal
70033	Louth & Meath	Drogheda	Fluvial & Coastal
70035	Kildare	Johnstown Bridge	Fluvial
70039	Meath	Navan	Fluvial
70041	Meath	Trim	Fluvial
70849	Offaly	Edenderry	Fluvial
70880	Meath	Mornington ( <i>reported under UoM07</i> )	Fluvial & Coastal
70888	Meath	Longwood	Fluvial

### 3.3 FURTHER INFORMATION

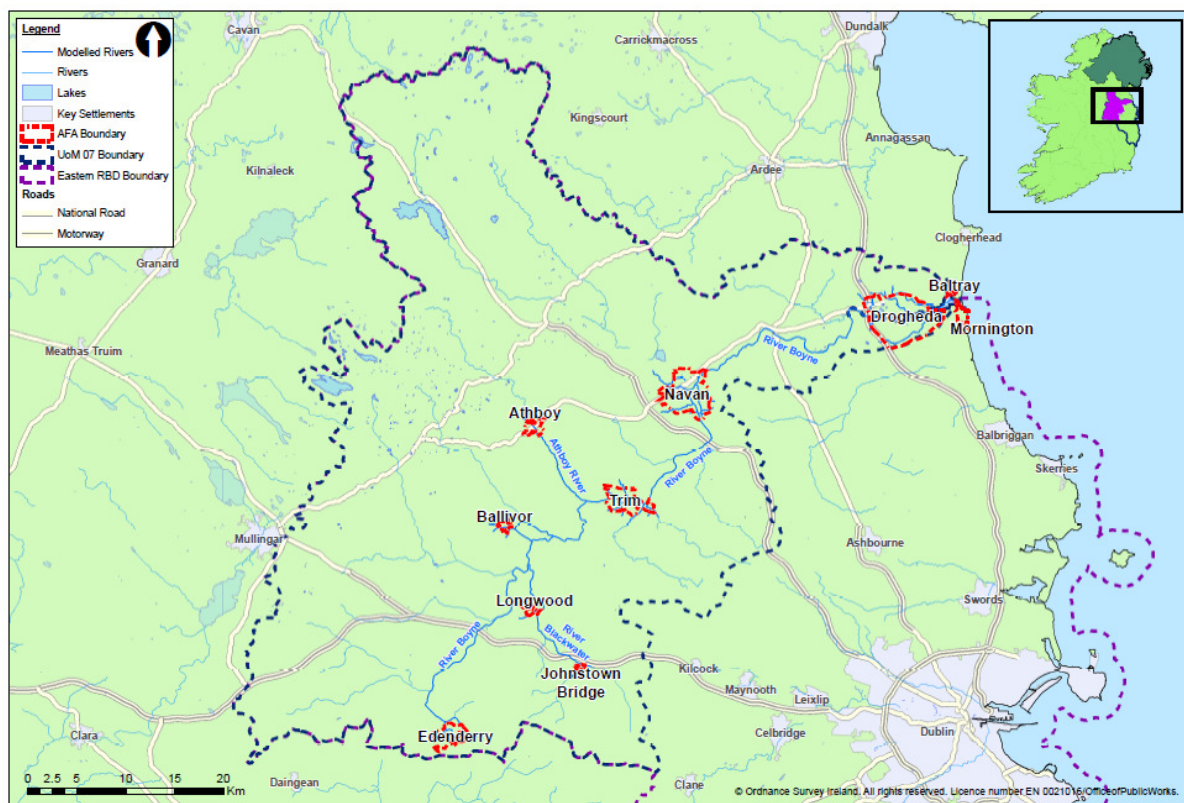
The Main Report on the PFRA, the Report on the Designation of the Areas for Further Assessment and a number of technical reports are available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)). These reports describe the process followed in the first cycle of the PFRA, describe how the AFAs were designated and provide a full national list of the AFAs.

The PFRA will be reviewed as required under the relevant legislation. It is anticipated that the review of the PFRA will consider and support a range of issues in more detail than in the first cycle of the implementation of the 'Floods' Directive, and other issues that were not

possible to consider in the first cycle given the information that was available or readily-derivable at the time. Such issues may include:

- Rural and dispersed flood risk: The CFRAM Programme has focused on communities at potentially significant flood risk (the AFAs) where the risk was understood to be concentrated and where it is more likely that viable measures could be identified. In the second cycle, it is foreseen that there will be a greater level of assessment of rural and dispersed risk.
- The potential impacts of climate change: The OPW has supported research commissioned by the EPA to investigate potential impacts of climate change on extreme rainfall patterns and hence on flood flows. This should support future assessments of potential future changes in flood risk.
- Critical Infrastructure: Assets that are critical to normal societal function and that may be at risk from flood events need to be identified. This will enable assessments of the potential 'knock-on' effects for other assets and services, such that appropriate risk management measures can be implemented to help ensure Ireland's resilience to severe flood events.

The outcomes of the PFRA undertaken in the second cycle of the 'Floods' Directive implementation, which will include environmental screening / assessments as appropriate, will inform the need for further detailed assessment and flood mapping and the review of the Plans.



**Figure 3.1: Map of the AFAs within the Boyne River Basin**

## **4 PUBLIC AND STAKEHOLDER CONSULTATION AND ENGAGEMENT**

### **4.1 OVERVIEW**

Public and stakeholder engagement is a critical component to the process of developing a sustainable, long-term strategy for flood risk management. This engagement is necessary to ensure that flood risk management measures are suitable and appropriate, as well as technically effective.

This section describes the public and stakeholder consultation and engagement that has been undertaken under the CFRAM Study for the Boyne River Basin in the development of this Plan. An overview of the CFRAM consultation stages and structures is provided diagrammatically in Figure 4.1.

### **4.2 AVAILABILITY OF PROJECT INFORMATION**

A website for the National CFRAM Programme and the PFRA was established in 2011, and a Project-specific website was developed upon inception of the Eastern CFRAM Project. Relevant information from these websites is now available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)) which provides information on the 'Floods' Directive and SI Nos. 122 of 2010 and 495 of 2015, the PFRA and the CFRAM Programme, and provides access to view and download reports, the Plans and other project outputs.

Information on OPW flood relief schemes and other, parallel projects is provided through the OPW Website, [www.opw.ie](http://www.opw.ie).

Flood maps prepared through the CFRAM Programme and through other projects are available through the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

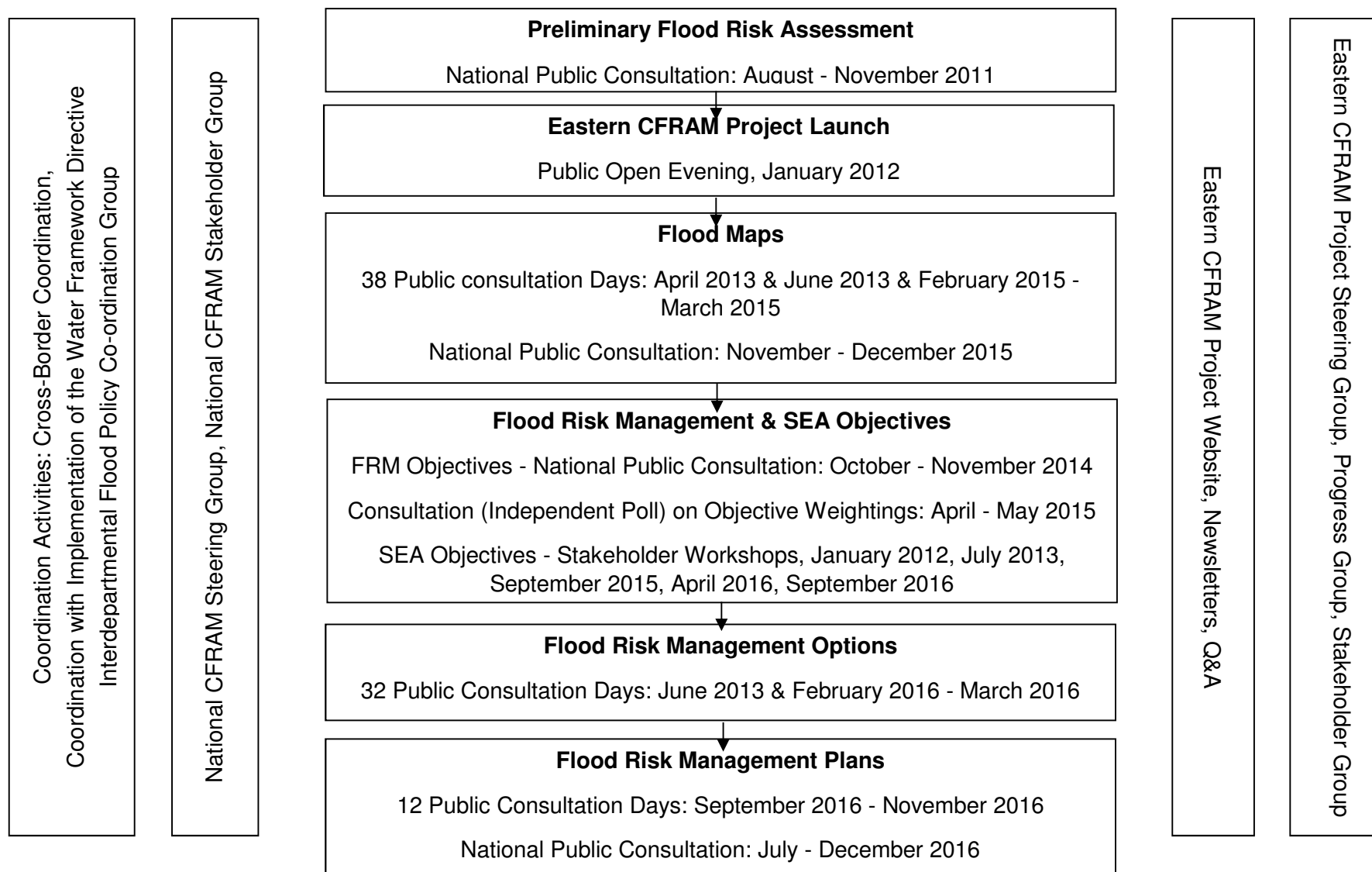
### **4.3 STAKEHOLDER ENGAGEMENT**

#### **4.3.1 The CFRAM Steering and Progress Groups**

##### *4.3.1.1 The National CFRAM Steering Group*

The National CFRAM Steering Group was established in 2009, and met on nine occasions to the date of publication of this Plan. It was established to provide for the engagement of key Government Departments and other state stakeholders in guiding the direction and the process of the implementation of the 'Floods' Directive, including the National CFRAM Programme. The membership of this Group is provided in Appendix D.1.

The National CFRAM Steering Group reported, through the OPW, to the Interdepartmental Co-ordination Group (now the Interdepartmental Flood Policy Co-ordination Group).



*Figure 4.1: Overview of the CFRAM Consultation Stages and Structures*

#### *4.3.1.2 Eastern CFRAM Project Steering Group*

A Project Steering Group was established for the Eastern CFRAM Project, that includes the Boyne River Basin, in 2011. This Group, which included senior representatives of the members, provided for the input of the members to guide the CFRAM Programme and act as a forum for communication between the CFRAM Programme and senior management of key stakeholders. The Project Steering Group typically met twice a year.

The membership of this Group is provided in Appendix D2.

#### *4.3.1.3 Eastern CFRAM Project Progress Group*

A Project Progress Group was established for the Eastern CFRAM Project in 2011. This group was a working group that supported the Project Steering Group and met approximately every six weeks. The Group was established to ensure regular communication between key stakeholders and the CFRAM Project and to support the successful implementation of the Project.

The membership of this Group was largely the same as for the Eastern CFRAM Project Steering Group.

### **4.3.2 Stakeholder Consultation Groups**

Stakeholder Groups were formed at national and regional level to provide an opportunity for input by non-governmental stakeholder groups to participate in the 'Floods' Directive and CFRAM processes.

#### *4.3.2.1 National CFRAM Stakeholder Group*

The National CFRAM Stakeholder Group was established in 2014, and met three times to the date of publication of this Plan. It was established to provide for the engagement of key national non-governmental stakeholder organisations at key stages in the process of the implementation of the National CFRAM Programme. Members of the organisations listed in Appendix D.3 were invited to meetings of this Group.

#### *4.3.2.2 Project (Regional) CFRAM Stakeholder Group*

The Eastern CFRAM Stakeholder Group was established in 2012, and met on five occasions to the date of publication of this Plan. It was established to provide for the engagement of local non-governmental stakeholder organisations at key stages in the process of the implementation of the Eastern CFRAM Project. The organisations listed in Appendix D.4 attended meetings of this Group, although many other organisations were also invited to attend.

### **4.3.3 Coordination with the Implementation of the Water Framework Directive**

The Water Framework Directive (WFD) is concerned with the protection of the ecological quality of our waters. While the 'Floods' Directive is concerned with the protection of people and society from our waters, both Directives are concerned with water and river basin management, and hence coordination is required between the two processes to promote integrated river basin management, achieve joint benefits where possible and address potential conflicts.



There has been, and will continue to be, coordination with the authorities responsible for the implementation of the WFD through a range of mechanisms, including bi-lateral meetings and cross-representation on various management groups, as set out in Section 6.5.

## **4.4 PUBLIC CONSULTATION AND ENGAGEMENT**

In addition to the structured engagement with relevant stakeholders through the Steering, Progress and Stakeholder Groups, the public have also been given the opportunity and encouraged to engage with the implementation of the 'Floods' Directive and the CFRAM process. These engagement and consultation steps are set out in Figure 4.1, and are described in the sub-sections below.

### **4.4.1 Consultation on Preliminary Flood Risk Assessment**

The public and stakeholder consultation and engagement in the Preliminary Flood Risk Assessment (PFRA) is described in Section 3.

### **4.4.2 Launch of the Eastern CFRAM Project**

The Eastern CFRAM Project commenced in June 2011, and a public open evening event was held in The Red Cow Hotel on 26/01/2012 from 6 pm onwards.



The public open evening was attended by approximately 60 people. The majority of the attendees were homeowners and landowners who have experienced flooding of their homes and lands. The event was also attended by elected members and members of non-governmental environmental organisations.

Many of the attendees at the open evening had seen and/or heard newspaper and radio advertisements on the day of the event. Some had been informed of the event by their local elected representative or had seen the event advertised on local authority websites.

### **4.4.3 Consultation on Flood Maps**

The preparation of the flood maps, which serve a range of functions (see Section 5.3) is the second key requirement of the 'Floods' Directive. The initial preparation of the flood maps involved extensive consultation with the Eastern Progress Group and planners within the various relevant local authorities. This led to the development of draft flood maps that were then consulted upon with the public through local Public Consultation Days and a national, statutory consultation.

#### 4.4.3.1 Public Consultation Days

The OPW identified that effective consultation and public engagement would require local engagement at a community level, and hence determined that Public Consultation Days (PCDs) would be held in each AFA (where possible and appropriate) to engage with the communities at various stages of the Projects, including during the production of the flood maps.

The PCDs were advertised locally in advance, and were held at a local venue in the community during the afternoon and early evening. OPW, Local Authority and RPS staff were present to explain the maps that were displayed in the venue and answer any questions on the maps and the CFRAM process, and to collate local information to refine or confirm the maps. The PCDs in the Boyne River Basin were held for consultation on the flood maps at the venues listed in Appendix D.5.

While the number of attendees at the PCDs was variable, overall the PCDs were very useful in updating and validating the flood maps. The PCDs were also useful as a means to raise awareness of flooding and flood risk in the community, and to begin the discussion on potential measures to manage or reduce the risk.



#### 4.4.3.2 National Flood Map Consultation

The Government considered it appropriate to stipulate in SI No. 122 of 2010 that a national consultation exercise should be undertaken<sup>6</sup>. The consultation on the flood maps for all areas was launched in November 2015. Observations and Objections submitted through the consultation process have been assessed and the flood maps amended accordingly, where appropriate.

<sup>6</sup>

Sections 12, 13 and 14, SI No. 122 of 2010

#### **4.4.4 Consultation on Flood Risk Management Objectives**

The Flood Risk Management Objectives of the National CFRAM Programme define what the process is trying to achieve in terms of reduction of flood risk, and where possible provide wider benefits, to human health, the environment, cultural heritage and economic activity. The Objectives are described further in Section 1.4.

The OPW considered it appropriate to publicly consult on the proposed flood risk management Objectives, and launched a public consultation in October 2014. Submissions received were duly considered and amendments made to the Objectives where appropriate. The Objectives were finalised in March 2015.

A Multi-Criteria Assessment (MCA) is used as part of the process for assessing potential options for reducing or managing flood risk for each AFA. The MCA and this process are described in Section 7 herein. The MCA makes use of weightings to rank the importance of the Objectives. The OPW considered it appropriate to consult on the weightings that would be assigned to each Objective, and commissioned an independent poll of over 1000 members of the public on the weightings through a structured questionnaire. The results of this poll were analysed by UCD<sup>7</sup>, and the weightings for each of the Objectives then set.

#### **4.4.5 Consultation on Options**

Based on the flood hazard and risk identified in the flood maps, options for reducing or managing flood risk in each AFA were developed and assessed. This process is described in Section 7 herein.

PCDs, similar to those held for the consultation on the flood maps were held during the development and assessment of options. These were an opportunity to engage with the community and for the community to set out what local issues were particularly important and what measures they considered would be most suitable and comment on which identified options might be effective and appropriate, or otherwise. The PCDs in the Boyne River Basin were held during the option development stage at the venues listed in Appendix D.6.

#### **4.4.6 Consultation on Draft Plans**

The Draft Plan for the Boyne River Basin as published for the purposes of public consultation on 22/09/16. Observations from the public and from relevant Councils were to be submitted to the OPW by 02/12/16 and 23/12/16 respectively. Presentations were made to Councils during the public consultation period.

In parallel and complementary to the formal public consultation process, a series of PCDs, similar to those held for the consultation on the flood maps (Section 4.4.3 above), were held to engage locally and directly with the community and provide people with opportunity to discuss and fully understand the Draft Plans. A total of 143 elected representatives and members of the public attended. The PCDs in the Boyne River Basin were held in relation to the Draft Plans at the venues listed in Appendix D.7.

The observations submitted to the OPW through the public consultation processes were considered and the Plans amended accordingly where appropriate. A synopsis of the observations submitted and amendments made to the Plan arising from the observations is available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

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<sup>7</sup> (UCD, 2015): Weighting the Perceived Importance of Minimising Economic, Social and Environmental/ Cultural Risks in Flood Risk Management, University College Dublin, 2015



## **4.5 CROSS-BORDER COORDINATION**

No cross-border co-ordination was required for the Boyne River Basin as the catchments for all relevant watercourses are located within the Republic of Ireland.

## **5 FLOOD HAZARD AND RISK ASSESSMENT**

A general description of flooding and flood risk has been provided in Section 1.2 of this Plan. This Section describes the assessment processes followed under the CFRAM Programme to determine the extent and nature of flooding in the AFAs within the Boyne River Basin, and the resultant flood risk. A description of these processes and outcomes for other projects is provided in the relevant project reports (see Section 1.3.5).

To ensure consistency in approach where required, a National Technical Coordination Group was established under the National CFRAM Programme to bring together all of the Consultants with the OPW, and other organisations as necessary, to determine common standards and methodologies.

### **5.1 HYDROLOGICAL ANALYSIS**

For AFAs where fluvial flooding is a potentially significant risk, the hydrological assessment under the CFRAM Programme has been limited to rivers and streams with a catchment area of more than 1km<sup>2</sup>. Smaller streams may also give rise to some flood risk, and such risk would need to be considered where relevant at the project-level of assessment (see Section 8.1), when the interaction between urban storm water drainage systems, fluvial flooding and preferred measures would also need to be considered in detail.

Comprehensive hydrometric and meteorological data exists for application in the hydrological analysis of Boyne River Basin. Initially only daily rainfall data was available within the River Basin but, following the processing of the Dublin Airport radar data as part of the Study, high accuracy, hourly, rainfall data was made available for application in the hydrological analysis across the area. A comprehensive methodology has been applied combining the latest FSU statistical flow analysis methods and rainfall run-off modelling, techniques (utilising the processed radar data) for analysis. This is not to say that traditional techniques have been abandoned where catchment rainfall run-off modelling has been applied but rather that both techniques have been applied and the results from both cross checked against one another such as to provide the most robust analysis possible to take forward for design flow estimation. There is a degree of potential uncertainty within the ungauged catchments (smaller tributaries of the Boyne) where estimates of flood flow are derived from catchment descriptor based estimates. The effect of the Boyne arterial drainage scheme could also cause some uncertainty and as such the analysis is based on the more onerous, post arterial drainage scheme period where appropriate. Run-off modelling also improves certainty in this scenario as the model produces a consistent record for analysis, representative of the present day catchment.

There are many potential future changes to the catchment, margins of error and uncertainties which must be considered within the study. However the cumulative application of worst case scenarios, one on top of the other could lead to erroneous flood extents which do not take into account the diminishing cumulative joint probability of these factors. For this reason this report has separated future Boyne River Basin changes that have a high degree of certainty in the projections from those changes which are less certain. Future changes which have a high degree of uncertainty, along with margins of error and other uncertainties have been risk assessed individually. This risk assessment was taken forward and built upon through the hydraulic modelling phase to provide a single error margin for the flood extent maps on an AFA by AFA basis.

The Boyne River Basin catchment can be characterised hydrologically as follows:

- The catchment has a fair range of climatic and physiographic characteristics. It is relatively 'dry' compared to other Irish catchments with SAAR values ranging from 650mm to 1100mm
- There is good observation data in the catchment both hydrometric and meteorological.
- Flood behaviour when defined in terms of the growth curve, i.e. in orders of magnitude greater than the median event, is relatively more extreme in the upper catchment than would have been thought based on older methodologies (Flood Studies Report). This is in line with other more recent, catchment specific studies such as the Greater Dublin Strategic Drainage Study or Fingal East Meath FRAM Study.
- The 1% AEP flood event ranges from approximately 2 (Boyne main channel) to 3.4 (small tributary catchments less than 10km<sup>2</sup> in area) times larger than the median flood flow. This compares to approximately 2 under the Flood Studies Report.
- There is evidence that the arterial drainage scheme has increased the median flood flow by approximately 50%.

The primary output of the hydrological analysis was a design flow dataset, which was based on historical data and best practice estimation / modelling techniques. This is reflective of best practice in hydrology / hydraulic modelling for flood risk assessment.

The main potential source of catchment specific uncertainty in the analysis (over and above standard statistical error in the estimation techniques) is due to the arterial drainage scheme and the fluctuating drainage characteristics of the catchment over its record period. As discussed this risk has been mitigated through the use of the more robust, and more reflective of the present day scenario, post arterial drainage dataset for design flow estimation. One added benefit of the catchment rainfall run-off modelling is that a simulated record can be produced that reflects the present day catchment more accurately.

Analysis of the hydrological elements which contribute to coastal flood risk had previously been undertaken at a national level through the Irish Coastal Protection Strategy Study (ICPSS) and the Irish Coastal Wave and Water level Study (ICWWS). The CFRAM studies did not seek to re-analyse these elements of coastal flood risk but rather sought to combine them, along with the fluvial elements where applicable, such that the total combined fluvial and coastal flood risk was assessed on an AFA by AFA basis. None of the AFAs / HPWs identified as at coastal flood risk in the Boyne River Basin experience only coastal flood risk, i.e. they all experience combined coastal / fluvial flood risk. In relation to the Boyne Estuary no levels are available within the estuary but one node NE\_09 is located just over 1km to the north of the mouth of the estuary. The levels are applied through an oscillating dynamic tidal boundary within the 2D portion of the model and detailed in the Hydraulic Modelling report.

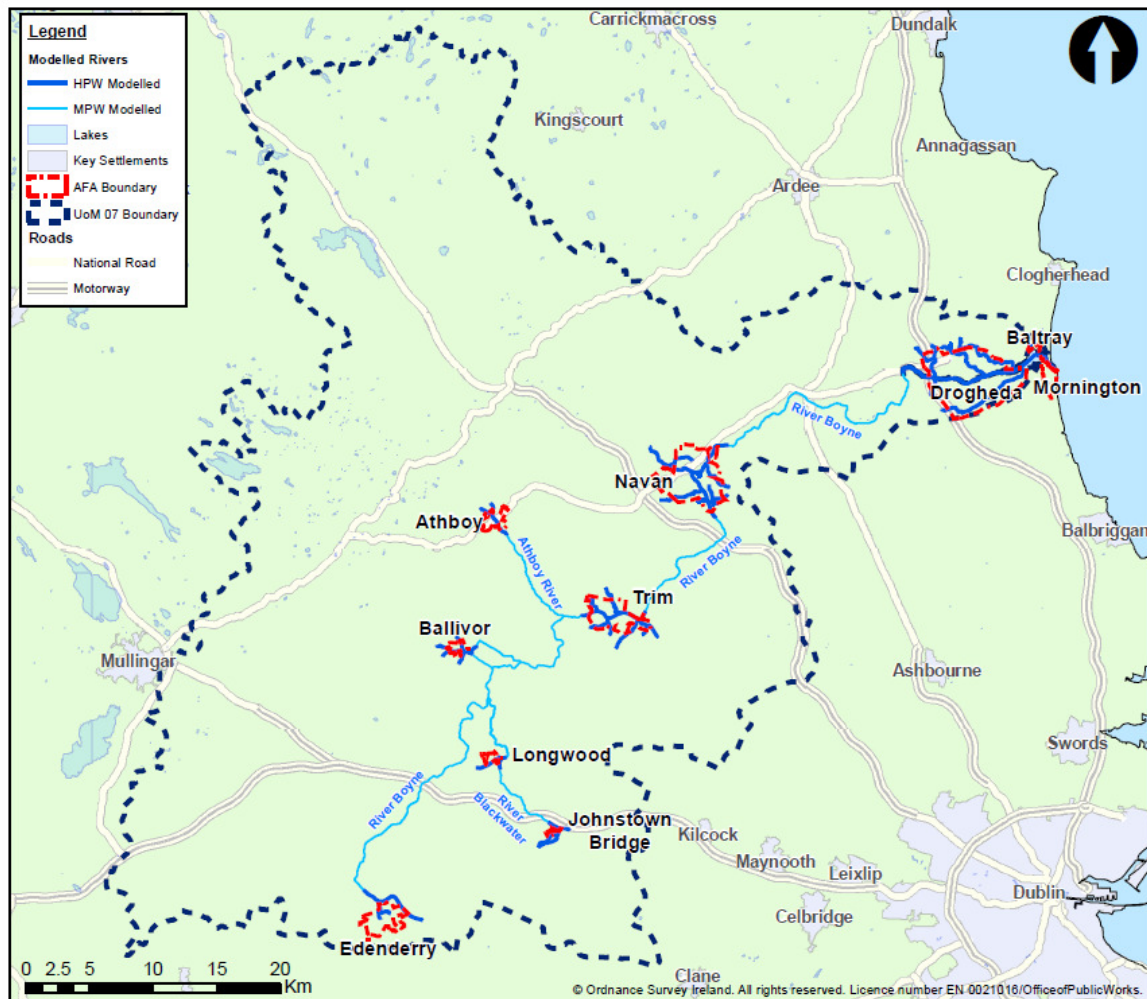
The main potential adverse impacts on the future flood hydrology within the catchment are the effects of climate change and urbanisation (section 5.5).

Full details of the methodology, datasets used and outcomes of the hydrological analysis for the Eastern CFRAM Study Area can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

## 5.2 HYDRAULIC MODELLING

For AFAs where fluvial flooding is a potentially significant risk, the hydraulic assessment and modelling under the CFRAM Programme has been limited to rivers and streams with a catchment area of more than 1km<sup>2</sup>. Smaller streams may also give rise to some flood risk, and such risk would need to be considered where relevant at the project-level of assessment (see Section 8.1), when the interaction between urban storm water drainage systems, fluvial flooding and preferred measures would also need to be considered in detail.

Hydraulic analysis was undertaken in order to identify the location and frequency of flooding within the extents of the Boyne River Basin modelled watercourses (Figure 5.1). The analysis utilised computational modelling software informed by detailed topographical (channel sections, in-channel/flood defence structures, bathymetric and floodplain) survey information, combined with hydrological inputs (riverine inflows and sea levels) and water-level control parameters (such as channel-roughness), to determine flood hazard. A series of flood extent, zone, depth, velocity and risk-to-people maps known collectively as flood hazard maps were generated based on the model results.



**Figure 5.1: Map showing the modelled watercourses and AFAs within the Boyne River Basin**

The principal modelling software package that has been used is the MIKE FLOOD software shell, which was developed by the Danish Hydraulics Institute (DHI). This provides the integrated and detailed modelling required at a river basin scale and provides a 1-/2-dimensional interface for all detailed hydraulic model development thus enabling seamless integration of fluvial and coastal models in the AFAs for which this is required. There is one model in the River Basin (of the lower Boyne incorporated Drogheda, Baltray and Mornington) in which Infoworks ICM (Integrated Catchment Modelling) was used in order to represent culverted watercourses with a high degree of coastal influence. Infoworks ICM is a 1D/2D dynamically linked modelling package developed by Innovyze and is an integrated platform which enables both above and below ground drainage systems to be modelled in one package. Infoworks ICM has also been utilised for modelling coastal flood risk within

the same AFAs for which it was used to model fluvial flood risk. This enables seamless integration of both models for flood mapping.

The influence of coastal water levels has been modelled by applying an appropriate water level boundary profile to the downstream extent of the River Boyne model. Tidal data has been taken from the Irish Coastal Protection Strategy Study (ICPSS). The effects of the sea levels are propagated upstream by the modelling software allowing the interaction of river flows and coastal water levels to be modelled accurately. The subsequent combined water level profiles are then applied as the downstream boundaries for each of the tributaries i.e. Baltray and Mornington ensuring both coastal and fluvial flooding mechanisms are investigated. Model tests included variation in fluvial-tidal joint probability and temporal variations, along with parameters such as eddy viscosity and bed resistance. In some AFAs, relative timings between fluvial and coastal peaks were adjusted to establish the worst case flood outlines, for a particular combination of events.

RPS assessed the potential for wave overtopping leading to coastal flooding in selected AFAs using calculated overtopping rates for relevant coastal structures under a range of combined tidal levels and wave heights of known joint return period using the EurOtop application. This identified the critical structure/overtopping rate/event combination for the frontage. The temporal variation in overtopping rate is subsequently determined to analyse the performance of the critical structure, under the critical wave conditions and a range of tidal levels associated with a generic storm profile derived from a combination of the normal astronomical tidal profile and an appropriate sinusoidal surge profile with a duration of 48 hours. The instantaneous overtopping rates resulting from this analysis were combined to create boundary “hydrographs” that can be applied to the coastal flood models at the locations of the overtopping defences to facilitate simulation of the flood pathways and flood extents resulting from overtopping of the defences. The results of the coastal modelling were then combined with the output of the direct tidal inundation mapping to establish the coastal flood hazard maps.

Key flood events were used where available in the calibration of each model whereby the model is reviewed in order to make sure historic flooding is accurately represented; the principal model parameters that are reviewed and amended during the model calibration process are:

- Bed and floodplain roughness coefficients;
- Structure roughness and head loss coefficients;
- Timing of hydrographs;
- Magnitude of hydrographs;
- Incorporation of additional survey information (e.g. additional cross-sections or missed structures).

The accuracy of the models representing existing conditions in terms of flood level, depth, extent and flow velocity allows potential flood options to be meaningfully assessed, enabling the appropriate actions/decisions to be taken. The calibrated models were used to simulate present day and future flood hazard conditions and potential options to facilitate the appraisal of possible flood risk management actions and measures.

Defence failure scenarios (where relevant) and sensitivity tests were conducted for each model. The parameters selected were dependent on the specific model but generally include:

- roughness coefficients
- 2D domain grid cell size
- critical structure coefficients

- flow inputs
- operation of dynamic structures.

Future potential changes which may affect the outputs of the CFRAM Study were also assessed:

- The climate change allowances are applied to all models. Urbanisation allowances are applied on a case by case basis as required, the factors themselves having been derived during the hydrology analysis by looking at historic urbanisation growth indicators and estimating appropriate growth factors for Mid-Range Future Scenario and High-End Future Scenario.
- Arterial Drainage was identified as a potential future scenario that required further consideration in Boyne River Basin. The analysis of gauge stations in the River Basin which have data from both pre- and post- arterial drainage scheme implementation shows that the Boyne Catchment Drainage Scheme has on average increased the Qmed by 50%. The hydrological analysis and design flow estimation are largely based on post arterial drainage scheme gauge data and as such can be considered to represent the average of the post arterial drainage scheme average. As the post arterial drainage scheme increases peak flows, this can be considered to be a robust approach; if maintenance of the scheme were to lapse then the attenuation characteristics of the rural catchment would increase and the peak flood flows would be reduced. As such it is not considered necessary to make any additional flow allowances for the future scenarios in relation to the arterial drainage scheme.

There are inherent assumptions, limitations and uncertainty associated with hydraulic modelling, which are detailed for each hydraulic model within the UoM07 Hydraulic Report. The issues addressed include:

- schematisation decisions regarding out-of-bank flow routes;
- culvert/bridge schematisation (including skew angle considerations);
- sweetening flow assumptions;
- comments and notes throughout to reflect data sources; changes to parameters from default;
- explanation of parameters used that are outside of the expected ranges; and
- any other atypical assumptions made.

The UoM07 Hydraulic Report describes the overall conceptualised models and details the key aspects of each modelling software package used, including model inputs, how channel structures are represented and model parameters selected. The integration of hydraulic analysis with previously undertaken hydrology analysis is also outlined, with AFA/HPW specifics provided. Full details of the methodology, datasets used and outcomes of the hydraulic analysis for the Eastern CFRAM Study Area can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

### 5.3 FLOOD HAZARD MAPPING

The flood maps serve a range of functions:

#### **Public Awareness:**

Flood maps, and in particular flood extent maps and flood depth maps, inform the public, home owners, business owners, landowners and farmers, landlords and tenants about the likely risk of flooding in their areas, including the likely frequency of occurrence and depth. This knowledge can help people make decisions and prepare for flood events to reduce the potential impacts of flooding.

***Planning & Development Management:***

The flood maps should inform the Spatial Planning processes and support Planning Development decisions to avoid unnecessary development in flood-prone areas, in line with the 2009 Guidelines on The Planning System and Flood Risk Management<sup>8</sup>.

***Emergency Response Management:***

The flood maps should aid in the preparation and implementation of flood event emergency response plans, by providing information on areas prone to flooding, the potential depths of flooding and what might be at risk in the event of a flood.

***Flood Risk Management Decision Support:***

Flood maps, and in particular various flood risk maps, are intended to be used as a decision support tool in the identification, planning, development, costing, assessment and prioritisation of flood risk management options, such as flood defence schemes, flood warning systems, public awareness campaigns etc.

Based on extensive survey and analysis of river flows and the development of computer models to determine how flooding occurs, a range of flood hazard maps has been produced for each AFA within the Boyne River Basin.

Flood hazard maps include maps of the projected extent of flooding for a range of flood events of different severity or probability, and the depth of flooding that would be expected for these events. The range of flood event probabilities include frequent events that may have recently been observed, up to very extreme events that may not have been previously seen, but which could occur at some point in the future.

The mapping also provides tabulated information on water level and flow for key points during the mapped flood event probabilities. These key locations include AFA boundaries / centres, river confluences, gauging stations along the watercourses and other locations approximately every 5km along a modelled watercourse. Model flows were validated against the estimated flows at hydrological estimation check points to determine if the model is well anchored to the hydrological estimates. The comparisons indicated that the models were generally well anchored to the hydrological estimates with very good correlation during the high frequency events where little flow is lost to overland flow. Any differences there may be between model flows and hydrological estimates during the medium to low frequency events can be attributed to the loss of flow from the watercourse to the floodplain. There is a change in the shape of the hydrograph due to attenuation, the higher return period hydrographs become longer as the attenuated flow makes its way through the system.

Extensive consultation on the draft hazard mapping was undertaken during 2015 as described in Section 4.4.3 via local authority workshops, stakeholder workshops, public consultation days, elected members' briefings, project level website correspondence and a period of formal consultation.

In excess of 750 members of the public attended the series of public consultation days in their local AFAs across the Eastern CFRAM Study Area.

Many property and land owners expressed concern in relation to, either the impact of, or conversely the lack of impact of, the flood maps on local authority planning decisions and zoning. The information obtained was used to verify the hydrological and hydraulic modelling outputs based on the degree to which participants presented with local knowledge in agreement or disagreement with the draft mapping. As a result many of the models were updated in order to better represent the flood hazard and risk.

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<sup>8</sup> DHPLG/OPW 2009: Guidelines on The Planning System and Flood Risk Management



The formal consultation resulted in three additional observations/comments pertaining to the Boyne River Basin, these provided information relating to the maintenance and extent of the recent Mornington Flood Alleviation Scheme and confirmed extents at Ballivor. No objections were received in relation to the flood maps in the River Basin via the formal consultation process.

The flood maps will be reviewed on an ongoing basis as new information becomes available (e.g. in relation to future or recent floods), with a formal review to be completed by the end of 2019 (see Section 8.4).

The final flood hazard mapping for the Eastern CFRAM Study Area can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

## **5.4 FLOOD RISK ASSESSMENT AND MAPPING**

The Flood Risk Analysis is undertaken to assess and map the existing and potential future flood risk within the Study Area.

The analysis focuses on the receptors at risk from flooding and are categorised as social (including risk to people), environmental, cultural heritage or economic receptors. The risk to a receptor can be affected by its location within the flood extent or the proportion of the receptor within the flood extent, the depth to which it floods, the velocity of the water adjacent to the receptor and the receptors' vulnerability to flooding.

The clearest way to present the flood risk within an area being studied is through flood risk maps. The flood risk maps show the potential consequences of flooding. These maps detail the source of the risk and the receptors at risk. The flood risk maps include:

- Social Risk map
- Environmental Risk map
- Cultural Heritage Risk map
- Economic Risk map
- Economic Activity map
- Number of Inhabitants map
- Economic Risk Density map.

Receptors were determined to be at risk from flooding if they were located within the flood extent, or with any part of their footprint intersecting with the flood extent. The degree of flood risk within buildings depends on the internal floor levels in comparison to simulated flood levels; internal floor levels were established by adjusting topographical ground levels outside the building, by allowance for threshold level change (based on the number of external steps visible externally).

The risk mapping presents risk to number of inhabitants, environment and types of economic activity and these were also consulted on alongside the draft hazard mapping for each AFA. The final flood risk mapping for the Eastern CFRAM Study Area can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

As set out in Section 1.2.2 there are flooding impacts where receptors are located within the floodplain. During a flood event, there is a heightened risk to people in both rural and urban environments. However such risks are considered to be more severe particularly at locations where high velocities have been predicted (which is in all of the AFAs within the Boyne River Basin) or known vulnerable properties have been identified within the floodplain (which is in



Drogheda, Mornington, Navan and Trim AFAs commencing at the 10% AEP present day event and similarly Longwood AFA at the 1%AEP event).

**Table 5.1: Summary of Flood Risk in the Boyne River Basin**

AFA / Area	No. of Residential Properties at Risk		No. of Non-Residential Properties at Risk		NPVd <sup>2</sup> (€ millions)
	1% / 0.5% AEP <sup>1</sup>	0.1% AEP	1% / 0.5% AEP <sup>1</sup>	0.1% AEP	
Athboy	0	4	0	1	0.02
Ballivor	0	3	0	3	<0.01
Baltray	40 Coastal 1 26 Fluvial	44 Coastal 1 30 Fluvial	5 Coastal 1 2 Fluvial	5 Coastal 1 2 Fluvial	17.76
Drogheda	104 Coastal 1 79 Fluvial	116 Coastal 1 143 Fluvial	120 Coastal 1 78 Fluvial	168 Coastal 1 192 Fluvial	111.48
Johnstown Bridge	2	39	1	1	0.26
Navan	104	219	21	54	14.41
Trim	6	24	6	23	1.67
Edenderry	0	6	0	2	0.05
Mornington	10 Coastal 1 40 Fluvial	162 Coastal 1 202 Fluvial	0 Coastal 1 1 Fluvial	8 Coastal 1 8 Fluvial	2.92
Longwood	0	79	1	2	0.82
D/S of Johnstown Bridge AFA - U/S of Longwood AFA	0	0	0	0	0
D/S of Longwood AFA – Boyne Confluence	0	0	0	0	0
D/S of Ballivor AFA – Boyne Confluence	1	3	0	3	0.20
D/S of Athboy AFA – Boyne Confluence	5	7	2	7	3.55
D/S of Edenderry AFA - U/S of Trim AFA	3	9	4	20	0.92
D/S of Trim AFA - U/S of Navan AFA	0	0	0	0	0
D/S of Navan AFA - U/S of Drogheda AFA	2 Coastal 1 6 Fluvial	2 Coastal 1 8 Fluvial	3 Coastal 1 2 Fluvial	3 Coastal 1 2 Fluvial	73.69

Notes: 1: AEP Flood Event Probabilities: 1% for Fluvial Flooding, 0.5% for Coastal / Tidal Flooding = Coastal 1

2: NPVd = Net Present Value Damages (accumulated, discounted damages over 50 years)

The numbers of properties at risk and the damage values set out in Table 5.1 are as determined at this stage of assessment under current conditions. The numbers and values may change when the risk is assessed in more detail at the project-level of development of

measures and/or due to the potential impacts climate change, future development and price inflation.

Table 5.1 presents a summary of the current risk within the Boyne River Basin, including the number of residential and non-residential properties at risk in each AFA and in the floodplains of other river reaches modelled outside of the AFA. The numbers of properties presented are determined independently for each source of flooding. For AFAs which are affected by more than one source of flooding, some properties may be at risk by more than one source, and as such properties may have been included in the numbers for both sources.

Further details of properties and assets (receptors) at risk in each AFA are given in Appendix E.

## 5.5 CONSIDERATION OF FUTURE CHANGES

It is likely that climate change will have a considerable impact on flood risk in Ireland.

- Sea level rise is already being observed and is projected to continue to rise into the future, increasing risk to our coastal communities and assets, and threatening damage to, or elimination of, inter-tidal habitats where hard defences exist (referred to as 'coastal squeeze').
- It is projected that the number of heavy rainfall days per year may increase, which could lead to an increase in both fluvial and pluvial (urban storm water) flood risk, although there is considerable uncertainty associated with projections of short-duration, intense rainfall changes due to climate model scale and temporal and spatial down-scaling issues.
- The projected wetter winters could give rise to increased fluvial flood risk and groundwater flood risk associated with turloughs.

These potential impacts could be significant for Ireland, where most of the main cities are on the coast and many of the main towns are on large rivers.

While there is considerable uncertainty associated with most aspects of the potential impacts of climate change on flood risk, it is prudent to take the potential for change into account in the development of Flood Risk Management policies and strategies and the design of Flood Risk Management measures.

Other changes, such as in land use, farming practices and future development could also have an impact on future flood risk through increased runoff and a greater number of people and number and value of assets within flood prone areas.

**Table 5.2: Allowances in Flood Parameters for the Mid-Range and High-End Future Scenarios**

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 750 mm	+ 1000 mm
Land Movement	- 0.5 mm / year <sup>1</sup>	- 0.5 mm / year <sup>1</sup>
Urbanisation	<i>No General Allowance – Review on Case-by-Case Basis</i>	<i>No General Allowance – Review on Case-by-Case Basis</i>
Forestation	- 1/6 Tp <sup>2</sup>	- 1/3 Tp <sup>2</sup> + 10% SPR <sup>3</sup>

Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this)

Note 2: Reduction in the time to peak (Tp) to allow for potential accelerated runoff that may arise as a result of drainage of afforested land

Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for temporary increased runoff rates that may arise following felling of forestry.

The National CFRAM Programme and parallel projects include the assessment of risk for two potential future scenarios; the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). These scenarios include for changes as set out in Table 5.2.

The impacts on flooding and flood risk under the MRFS and HEFS for the AFAs within the Boyne River Basin are outlined in Appendix E.

Section 7.3.3 briefly describes how climate change was taken into account in the assessment of flood risk management options, which is detailed further in the relevant project reports.

## 5.6 COMMUNITIES (AFAS) OF LOW RISK

The AFAs were determined through the PFRA, as described in Section 3. The flood hazard and risk analysis undertaken through the Boyne River Basin CFRAM Project has been significantly more detailed than the analysis undertaken for the PFRA.

For certain AFAs, this more detailed analysis has determined that there is in fact currently a low level of flood risk to the community from rivers and/or the sea. In such cases, the development of flood risk management measures aimed specifically at reducing the risk in such AFAs (i.e., local flood protection schemes) has not been pursued. Some of the River Basin-level measures will however still be relevant and applicable as some infrastructure, such as roads, may nonetheless be prone to flooding, and land around the AFA may be prone to flooding.

In the Boyne River Basin, the level of risk has been determined as being low in the following AFAs:

- Athboy
- Ballivor
- Edenderry
- Johnstown Bridge
- Longwood.

The level of risk in the AFAs where the CFRAM process has determined that there is currently a low level of flood risk will be reviewed, along with all areas, as part of the review of the PFRA (see Section 3.3). This includes AFAs where the current level of risk may be low, but where the level of risk may increase in the future due to the potential impacts of climate change and so action in the future may be required to manage such impacts.

It is important to note that a low level of existing risk does not infer that undeveloped lands around the community are not prone to flooding, only that a limited number of existing properties are prone to flooding. When considering planning and development management, the potential for flooding in undeveloped areas needs to be fully considered for the AFAs where the risk to the existing community is low, as well as for all other communities, in accordance with the Guidelines on the Planning System and Flood Risk Management (see Section 7.4.1.1).

## 6 ENVIRONMENTAL CONSIDERATIONS

### 6.1 OVERVIEW

The Plan for the Boyne River Basin has been the subject of a Strategic Environmental Assessment (SEA) and an Appropriate Assessment (AA) to meet the requirements of the Irish Regulations transposing the EU SEA and Habitats Directive respectively<sup>9</sup>. This Section provides a description of the process used to ensure that the environmental considerations within the River Basin were addressed appropriately in the preparation of this Plan. The considerations with respect to each AFA, and the overall Plan, are summarised below and are detailed in the accompanying environmental documents.

The Draft Plan issued for consultation was accompanied by an SEA Environmental Report, which documented the SEA process. The Environmental Report identified, evaluated and described the likely significant effects on the environment of implementing the potential measures set out in the Draft Plan, with a view to avoiding adverse effects, and also, where appropriate, to set out recommendations as to how any identified adverse effects can be mitigated, communicated and monitored.

A Natura Impact Statement also accompanied the Draft Plan, to set out the potential impacts of possible measures on Natura 2000 sites (core breeding and resting sites for rare and threatened species, or sites for some rare natural habitat types)<sup>10</sup>.

Following consideration of observations made in response to the public consultation on the Draft Plan, including comments received on the SEA Environmental Report and the Natura Impact Statement, the final Plan has been prepared. The Plan has been published with a SEA Conclusion Statement, which documents changes made to the Plan and its overall effects, and an Appropriate Assessment Conclusion Statement.

It is emphasised that the Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment.

It should be noted that potential flood relief works or 'Schemes' set out herein will need to be further developed at a local, project level before Public Exhibition or submission for planning approval. Local information that can not be captured at the Plan-level of assessment, such as ground investigation results and project-level environmental assessments, may give rise at that stage to some amendment of the proposed works to ensure that it is viable and fully adapted, developed and appropriate within the local context, and that it is compliant with environmental legislation.

While the degree of detail of the assessment undertaken to date would give confidence that any amendments should generally not be significant, the potential works set out in the Plan may be subject to amendment prior to implementation.

In this context, it should be noted that the SEA and AA undertaken in relation to the Plan are plan-level assessments. The Plan will inform the progression of the proposed measures, but project-level assessments will need to be undertaken as appropriate under the relevant legislation for consenting to a Scheme or works that involves physical works and that may progress in the future. The approval / adoption of the Plan has not and does not confer approval or permission for the installation or construction of any physical works. EIA and/or AA Screening, and, where so concluded from the screening, Environmental Impact

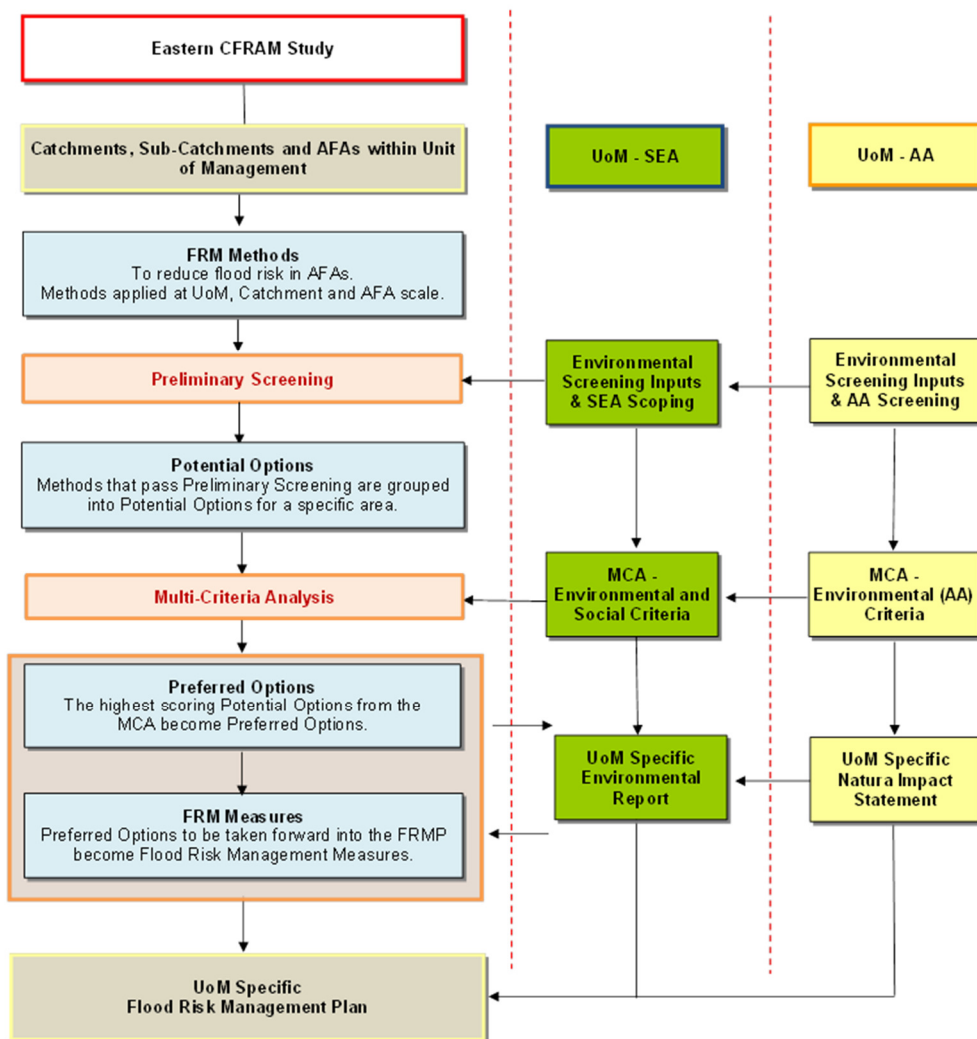
<sup>9</sup> SI No. 435 of 2004 (SEA Directive) and SI No. 477 of 2011 (Habitats Directive)

<sup>10</sup> [http://ec.europa.eu/environment/nature/natura2000/index\\_en.htm](http://ec.europa.eu/environment/nature/natura2000/index_en.htm)

Assessment and / or Appropriate Assessment, must be undertaken in accordance with the relevant legislation where relevant as part of the progression of measures that involve physical works. The body responsible for implementation of such measures (see Section 7) is required to ensure that these requirements will be complied with.

The environmental assessments set out herein relate to the Plan, and measures set out and proposed under the Plan (see Table 7.7). Flood relief schemes and works proposed or progressed through other projects and plans (see Table 7.8) are not the focus of the environmental assessments of the Plan, but are considered in terms of their in-combination or cumulative effects with the measures set out within the Plan.

Figure 6.1 shows the Interaction and stages of the optioneering, SEA and AA Processes.



**Figure 6.1: Interaction and stages of the optioneering, SEA and AA Processes**

Particular issues such as knowledge gaps or mitigation measures that are expected to be necessary are set out in Section 6.6.3 and Section 7.4 for each preferred measure.

## 6.2 ENVIRONMENTAL CONSTRAINTS AND OPPORTUNITIES IN THE BOYNE RIVER BASIN

There are areas of high environmental value within the Boyne River Basin, particularly in terms of its protected areas, WFD Annex IV sites, heritage features and its sensitive landscapes. The maintenance and protection of these areas was taken into consideration when considering potential FRM options.

There are eight SACs and two SPAs located within the River Basin (Figure 6.2). These sites contain either freshwater, wetland or peatland habitats, along with their associated flora and fauna. Wetland habitats including estuaries play a vital role in flood management, as they act as sponges – holding water and allowing a gradual release over time. Peatlands purify water and reduce flooding by their capacity to absorb, hold and slowly release water.

The WFD, similar to the Floods Directive, supports the management of water resources on a catchment wide basis, however it focuses on water status rather than flood risk management. All waterbodies are classified under the WFD according to their chemical, biological and hydromorphological status. In the Boyne River Basin, 29% of rivers, 55% of lakes, and 100% of coastal and transitional water bodies were classified as being of satisfactory condition in the WFD first cycle Eastern River Basin Management Plan.

The WFD register of protected areas (Figure 6.2) also incorporates the following:

- Five lakes and sections of six different rivers in the Boyne River Basin are designated as Drinking Water Lakes/Rivers.
- One designated bathing water, which is inland (freshwater) at Lough Lene.
- 28 Industrial Emission Directive (IED) sites within the area, flooding of which has the potential to generate new pathways for pollutants to reach rivers and other waterbodies and result in failure to achieve WFD objectives.
- 93 km of the River Boyne is designated as a Salmonid River.

All waterbodies within the River Basin need to either remain at Good/High Status or improve to at least Good Status under the WFD. Furthermore, it is vital that designated drinking waters and salmonid water bodies are not negatively impacted upon by the development of FRM Options.

There are also highly sensitive landscapes within the Boyne River Basin, mainly designated by the Meath Landscape Character Assessment. The Boyne and Mattock Valleys, located within Baltray and Drogheda AFAs, are considered to be sensitive landscapes of international importance that are to be conserved. Also, the Meath coastal plain in the vicinity of the Mornington AFA is cited as a highly sensitive area. The landscape upstream of the Drogheda AFA contains the Brú na Bóinne complex of megalithic sites, including the prehistoric monument at Newgrange. This is a World Heritage Site and is on the UNESCO<sup>11</sup> “tentative list<sup>11</sup>” for future recognition. Conservation of these sites is of international importance.

Environmental considerations must be taken into account while assessing FRM options, in order to ensure that the key sites, features and landscapes located in the River Basin remain protected.

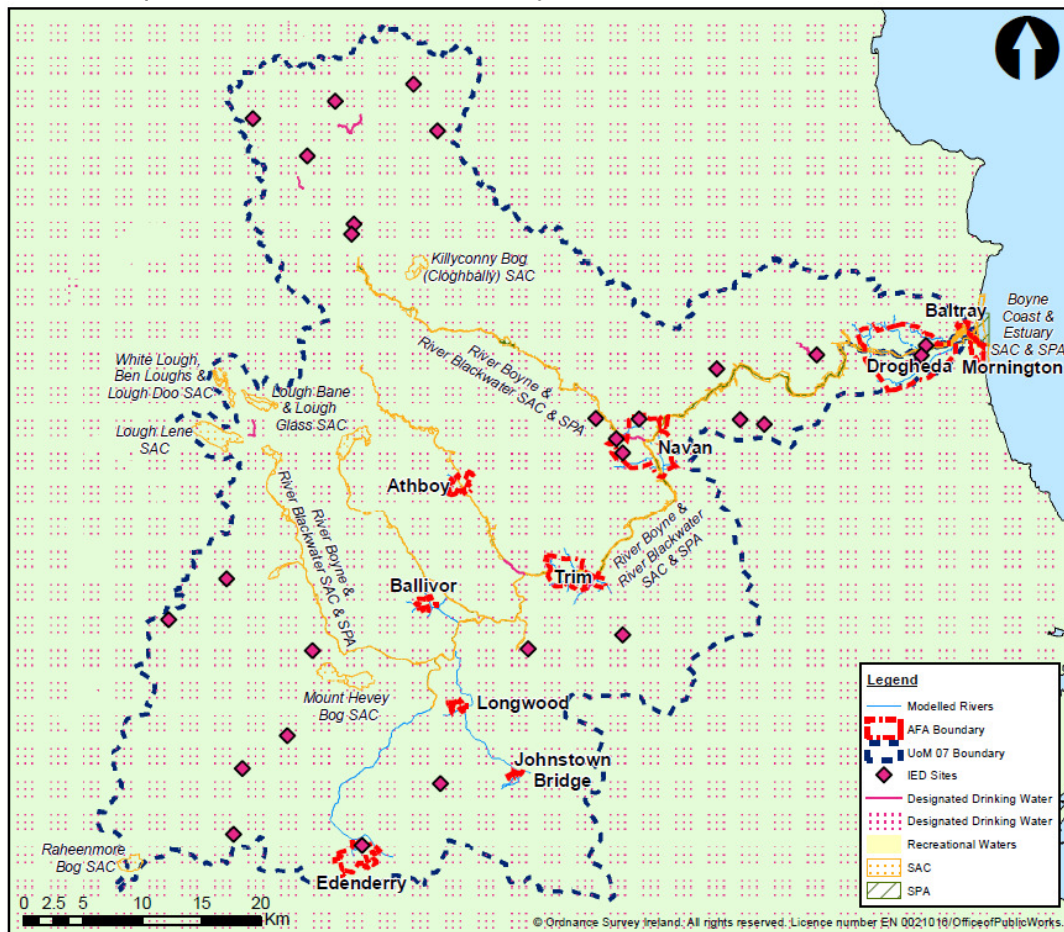
Throughout the development and assessment of FRM Methods and Options environmental criteria were taken into consideration through the inputs from environmental professionals; initially at the methods screening stage, then via the weighting and scoring of relevant

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<sup>11</sup> UNESCO (2015) Tentative Lists <http://whc.unesco.org/en/tentativelists/state=ie> accessed 12/08/2015



objectives in the MCA options phase and ultimately by the SEA and AA of the draft Plan in order that mitigation measures could be developed for inclusion in further detailed studies recommended by this Plan. Examples of the strong and ongoing environmental influence are; development of alternatives, positional improvements of methods and incorporation of methods into options to enhance sustainability.



**Figure 6.2** Environmental sites / features

## 6.3 STRATEGIC ENVIRONMENTAL ASSESSMENT

A Strategic Environmental Assessment (SEA) Environmental Report for the draft Plan has been prepared in accordance with the European Communities (Environmental Assessment of Certain Plans and Programmes) (Amendment) Regulations 2011 [S.I. 200/2011] and the Planning and Development (Strategic Environmental Assessment) (Amendment) Regulations 2011 [S.I. 201/2011]. The purpose of this Environmental Report is to provide a formal and transparent assessment of the likely significant impacts on the environment as a result of implementing the measures contained in this Plan for the Boyne River Basin under the Eastern CFRAM Study.

The OPW carried out a SEA Screening in 2011 for all the CFRAM Studies in Ireland and determined that SEA of the Plans would be required. A SEA Scoping Report, a SEA Scoping Summary Report, an Environmental Constraints Report and a table of High Level Impacts of FRM Methods were produced as part of the scoping phase of the SEA for the Eastern CFRAM Study in 2015. The purpose of the Scoping Report and associated documents was to provide sufficient information on the Eastern CFRAM Study to enable the consultees to form an opinion on the appropriateness of the scope, format, level of detail, methodology for assessment and the consultation period proposed for the Environmental Report. All SEA



Scoping documentation was made available to the public and formal consultations were undertaken with statutory bodies, local authorities and project stakeholders.

The MCA framework adopted to assist the decision making in the Plan (presented in Section 6 and 8.3), has environmental and social objectives on an equal weighting and importance as the technical and economic objectives. The wider environment has therefore been considered in the development of the Plan, as the MCA framework objectives cover a range of topics that were matched to the SEA Directive requirements. This meant that many of the MCA framework objectives could therefore be used directly within the SEA as they are directly compatible. The data used in the SEA process had to be nationally consistent and at a strategic level, to reflect the strategic nature and national scale of the CFRAM studies. Site visits and walkovers were however also undertaken throughout the CFRAM Studies by various technical, environmental and surveying staff, to gain an appreciation of local issues.

The SEA further informed the development of the Plan through the recommendation of mitigation measures to minimise or eliminate any potential negative environmental impacts of the options and the recommendation of environmental monitoring, to measure any wider environmental impacts of the Plan. All SEA documents published in support of the Plan for the Boyne River Basin can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

## 6.4 APPROPRIATE ASSESSMENT

The Habitats Directive (Council Directive 92/43/EEC) on the conservation of natural habitats and of wild fauna and flora obliges member states to designate, protect and conserve habitats and species of importance in a European Union context. Article 6(3) of the Habitats Directive requires that *“Any plan or project not directly connected with or necessary to the conservation of a site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site’s conservation objectives.”* This Directive was initially transposed into Irish Law through several pieces of legislation; however these have now been consolidated into the European Communities (Birds and Natural Habitats) Regulations 2011. Any proposed plan or project in Ireland that has potential to result in a significant effect on a designated European Site will require an Appropriate Assessment (AA). A key outcome of the Habitats Directive is the establishment of Natura 2000, an ecological infrastructure developed throughout Europe for the protection of sites that are of particular importance for rare, endangered or vulnerable habitats and species. In Ireland, Special Areas of Conservation (SACs), together with Special Protection Areas (SPAs) designated under the ‘Birds Directive’ (Council Directive 2009/147/EC - codified version of Directive 79/409/EEC on the Conservation of Wild Birds, as amended), are included in the Natura 2000 network, and are the ‘European sites’.

An AA Screening was undertaken for the Eastern CFRAM Study in late 2015 / early 2016, which demonstrated there were five European sites (two SACs and three SPAs) assessed as having the potential to experience an impact from the implementation of FRM methods in the catchments of ten of the AFAs in the Boyne River Basin. The findings of the AA Screening were used to guide the development of the alternatives to be considered as part of the SEA. A Stage 2 AA was also undertaken in parallel with the SEA process. The outputs of the Stage 2 AA were integrated into the SEA Environmental Report and subsequently into this Plan. A source – pathway – receptor model approach was taken in the assessment of potential impacts on European sites, taking into account their qualifying interests, conservation objectives and condition. The AA further impacted upon the development of the Plan through the abandonment of particular methods, development of alternatives, positional improvements of methods and incorporation of methods into options to enhance sustainability having regard for the objectives of the particular protected areas.

Relevant mitigation measures are discussed in Section 6.6.3.

All AA documents published in support of the Plan for the Boyne River Basin can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

## **6.5 COORDINATION WITH WATER FRAMEWORK DIRECTIVE**

The Water Framework Directive (WFD) is concerned with the protection of the ecological quality of our waters. While the 'Floods' Directive is concerned with the protection of people and society from our waters, both Directives are concerned with water and river basin management, and hence coordination is required between the two processes to promote integrated river basin management, achieve joint benefits where possible and address potential conflicts.

### **6.5.1 Bi-Lateral Meetings**

The Department of Housing, Planning and Local Government (DHPLG) is the lead Government Department for the WFD, and the nominated Competent Authority for establishing the environmental objectives and preparing a programme of measures and the River Basin Management Plans. The OPW has held bi-lateral meetings with senior representatives in DHPLG to establish the appropriate methods and approaches to coordination, which were agreed to be primarily through cross-representation on management / governance groups.

For the second cycle of implementation of the WFD, the Environmental Protection Agency (EPA) has been defined as the Competent Authority for undertaking the characterisation and reporting of same to the Commission, and is also required to assist the DHPLG in its assigned duties. The OPW has held bi-lateral meetings with the EPA since 2013 to determine the suitable approaches to the practical aspects of implementation, which were agreed to be through cross-representation on management / governance groups, and ongoing bi-lateral meetings. These meetings have included workshops to share relevant data.

### **6.5.2 Cross-Representation on Management Groups**

The governance structure for the WFD in Ireland was restructured for the second cycle under SI No. 350 of 2014, with a number of groups subsequently set up in 2014 and 2015.

#### **6.5.2.1 WFD: Water Policy Advisory Committee**

The Water Policy Advisory Committee (WPAC) was formally established in 2014 as the 'Tier 1' management committee. Its role is to provide strategic direction and advise the Minister for Housing, Planning and Local Government on the implementation of the WFD.

The OPW is represented on the WPAC to help ensure coordination in the implementation of the WFD and the 'Floods' Directive at a strategic level.

#### **6.5.2.2 WFD: The National Implementation Group**

The 'Tier 2' management committee is the National Implementation Group (NIG), which was established in March 2015. The purpose of the NIG is to assist the EPA and DHPLG with the technical and scientific implementation aspects of the WFD to ensure effectiveness, consistency and efficiency. The Group has also been established to provide a mechanism for coordination with the implementation of the 'Floods' Directive.

Working Groups have been established by the NIG to assist with the implementation of certain aspects of the WFD, including characterisation and hydromorphology. A working group on the programme of measures has also been established under the WPAC.

The OPW is represented on the NIG, and also on the characterisation and hydromorphology working groups, to promote coordination on the technical and scientific aspects of mutual relevance in implementation.

#### **6.5.2.3 WFD: Catchment Management Network**

The Catchment Management Network was convened to provide a forum for the organisations involved in implementation of the WFD, and other key stakeholders, at the regional and local level, including the local authorities. The Network first met at a launch event and workshop in November 2014, which the OPW attended. The OPW has since continued to engage with the Network to consider the coordination issues in implementation at a local level.

##### *Local Authorities Water and Communities Office*

The Local Authority Water and Communities Office (LAWCO) was established in 2015 and is led jointly by Kilkenny and Tipperary County Councils on behalf of the local authority sector. LAWCO's functions include supporting communities to take action to improve their local water environment and provision of coordination at a regional level across public bodies involved in water management. The OPW has been kept aware of the development of the LAWCO through the WPAC and NIG. This local level of activity may provide a suitable point of coordination for local flood risk management activities such as flood protection works being implemented under the Minor Works Scheme or the promotion of natural water retention measures.

#### **6.5.2.4 'Floods' Directive: Steering and Progress Groups**

The EPA are represented on the National CFRAM Steering Group, as described in Section 4.3.1.1 above, and have advised on coordination matters, such as defining Objectives relevant to the WFD (see Section 1.4). EPA representatives and the WFD Project Coordinators (appointed in the first cycle of WFD implementation, and to be replaced by LAWCO officers) are also represented on the Project Steering and Progress Groups as described.

### **6.5.3 Exchange of Information**

Relevant information was exchanged between the Competent Authorities relating the 'Floods' Directive and the WFD as necessary.

### **6.5.4 Coordination on Measures**

One of the Flood Risk Management Objectives (Objective 3.a, Table 1.2) is to support the objectives of the WFD. This required an assessment of potential flood risk management measures against the objectives and requirements of the WFD to determine which measures might have a benefit or cause an impact in terms of the objectives of the WFD, varying in scale and duration. In this way, the potential contribution of flood risk management measures towards, or potential impacts on, the objectives of the WFD are embedded into the process for the identification of proposed measures.

Following approval of the Plans, the next stage to progress the proposed flood risk management measures will be to undertake more detailed assessment and design at a project-level, before submitting the proposals for Public Exhibition (under the Arterial Drainage Acts) or planning permission. This assessment will normally include an Environmental Impact Assessment (EIA) and, where necessary, a project-level Appropriate Assessment (AA) in line with the Birds and Habitats Directives.

The assessment at the project-level will also enable a detailed appraisal of the potential impacts of the final measure on the water body hydromorphology, hydrological regime and

status to be undertaken including, where necessary (if impacts can not be avoided or mitigated), a detailed appraisal under Article 4(7) of the WFD (derogation related to deterioration caused by new modifications). This will build on the initial work done during the preparation of the Plans.

The work planned by EPA to improve assessment methods for river morphology has the potential to assist in:

- assessing the potential impact of flood management measures on WFD objectives,
- identifying the most appropriate mitigation measures, and,
- supporting decisions on the application of Article 4(7) derogations.

The EPA and OPW will work together to develop technical methods to assist in the assessment of impacts from flood protection schemes.

The OPW is also liaising with the EPA on the potential impact of WFD measures on flood risk, which are typically neutral (no impact), or may have some benefit in reducing runoff rates and volumes (e.g., through agricultural measures such as minimising soil compaction, contour farming or planting, or the installation of field drain interception ponds).

The OPW will continue to work with the EPA and other agencies implementing the WFD to identify, where possible, measures that will have benefits for both WFD and flood risk management objectives, such as natural water retention measures. It is anticipated that this is most likely to be achieved in areas where phosphorous loading is a pressure on ecological status in a sub-catchment where there is also an identified potentially significant flood risk (i.e., an AFA). This coordination will also address measures that may otherwise cause potential conflict between the objectives of the two Directives.

## **6.6 PROGRESSION OF MEASURES AND ASSESSMENT OF FUTURE WORKS**

### **6.6.1 Approval of the Plan**

As set out in Section 6.1 above, the approval / adoption of the Plan has not and does not confer approval or permission for the installation or construction of any physical works.

The progression of any measure towards the implementation of flood relief works or a 'Scheme' must, where applicable, include EIA and/or AA Screening, and, where so concluded from the screening, Environmental Impact Assessment and / or Appropriate Assessment, in accordance with the relevant legislation, and taking into account new information available at that time (e.g., as available from the Environmental Monitoring Framework and from the [www.catchments.ie](http://www.catchments.ie) website).

As part of the EIA, alternatives to the potential works set out in the Plan must be considered. It is emphasised that the Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment. Potential flood relief works or 'Schemes' set out herein will need to be further developed at a local, project level before Exhibition under the Arterial Drainage Acts 1945 and 1995 (OPW managed schemes) or submission for planning approval under the Planning and Development legislation/regulations (Local Authority managed schemes). The project-level assessment will include the consideration of alternatives, taking into account local information that can not be captured at the Plan-level of assessment, such as ground investigation results and project-level environmental assessments. The project-level assessment may give rise at that stage to amendment of the proposed works to ensure that the works:

- are viable and fully adapted, developed and appropriate within the local context,
- comply with environmental legislation,
- consider at a project-level of detail the potential impacts and benefits related to the objectives of the Water Framework Directive (see Section 6.5.4)
- provide benefits with regards to other objectives (e.g., water quality, biodiversity) where reasonably possible and viable, such as through the use of natural water retention measures, removing barriers to fish migration or the creation of habitat features.

No measure in the Plan has been considered for, or been subject to an assessment under, the 'Imperative Reasons of Over-riding Public Interest (IROPI)' procedure under the Birds and Habitats Directive (Article 6[4]).

In addition to planning or confirmation, licences may be required by the implementing body to progress certain physical works, such as those that may cause damage or disturbance to protected species or their habitats, and the granting of such licences during or following the project-level assessment would be required before such works could proceed.

The body responsible for the implementation of such measures (typically the OPW or a local authority - see Section 8) is required to ensure that the requirements above, and the requirements of all relevant environmental legislation (such as the Environmental Liability and Water Framework Directives), are complied with.

## **6.6.2 Implementation Routes for Physical Works**

### **6.6.2.1 Works Requiring Planning Consent or Confirmation**

As set out above, the body responsible for the implementation of measures that will involve physical works, such as a flood relief scheme, will typically be either the OPW or the relevant Local Authority. There are three primary legislative routes by which such works may progress to construction stage, as set out in Figure 8.1, are:

- Project led by OPW (or by a Local Authority on behalf of the OPW), under the Arterial Drainage Acts.
- Project led by the relevant Local Authority under the Planning and Development Regulations.
- Project led by the relevant Local Authority under the Strategic Infrastructure Act.

As noted above, while the Plans have conducted a Strategic Environmental Assessment and Appropriate Assessment, the progression of any measure by either the OPW or a local authority will include all applicable 'project level' assessments, such as:

- Environmental Impact Assessment: For a project above the thresholds specified under Article 24 of the European Communities (Environmental Impact Assessment) Regulations, 1989 as amended or a project likely to have significant effects on the environment, having regard to the criteria specified for under Article 27 of the same EIA Regulations 1989 as amended.
- Appropriate Assessment: All projects will be screened for Appropriate Assessment and, where there is a potential for a significant effect on a European (Natura 2000) site, an Appropriate Assessment will be undertaken in accordance the European Communities (Birds and Natural Habitats) Regulations 2011.



### 6.6.2.2 Exempted Development

For some measures, the physical works involved are of limited scale and scope. These will typically be works that would be progressed by the Local Authority, with funding provided by the OPW through the Minor Flood Mitigation Works and Coastal Protection Scheme (the 'Minor Works Scheme' - see Section 2.6.5), that are deemed as exempted development in accordance with the Planning and Development Act 2000 (as amended).

As public bodies, the Local Authorities are required to comply with all relevant legislation, and hence must undertake EIA and/or AA screening for physical works where relevant (i.e., where the works are not exempt or below relevant thresholds) and as required by legislation. As a condition of the provision of funding for such works, the OPW requires written confirmation from the local authority of compliance with all relevant environmental legislation.

## 6.6.3 Mitigation Measures

Projects stemming from the Flood Risk Management Plans (FRMPs) will apply a range of standard processes and measures that will mitigate potential environmental impacts. While the applicability of processes and particular measures will be dependent on the nature and scale of each project, examples of typical processes and measures that will be implemented where applicable at the different stages of project implementation are set out below.

### 6.6.3.1 Project Mitigation: Consenting Process

As set out in Section 6.6.2 above, the consenting process for the progression of measures involving physical works will require the applicable environmental assessments. Also, the consenting authorities may set out specific environmental conditions as part of the project approval.

### 6.6.3.2 Project Mitigation: Pre-Construction / Detailed Design

For the detailed design of projects, where options are available, the design uses a hierarchy to mitigation measures along the following principles:

- Avoidance: avoid creating the potential impact where feasible.
- Mitigation: minimise the potential impact through mitigating measures
- Enhancement: Enhance the environment to better than pre-project conditions, where reasonably possible

The progression of a flood management project through the detailed design phase can entail a series of surveys to inform the design, where the scale of surveys would be proportionate to the complexity and potential impacts of the project. These can include:

- engineering structure surveys,
- topographical surveys,
- habitat & species surveys<sup>12</sup>

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<sup>12</sup> In the context of ecological mitigation, the habitat and species surveys are conducted as required to assess the various aspects for the project, such as ecological surveys for:

- protected or notable habitats and species, including Annex 1 habitats, Annex II and Annex IV species,
- species protected under the Wildlife Acts,
- species protected under the Flora Protection Order,
- the resting and breeding places of relevant species and,
- invasive species, both plant and animal.

- ornithological surveys,
- bat surveys,
- fish surveys,
- water quality surveys,
- archaeological surveys,
- landscape and visual assessments,
- land valuation surveys and
- other surveys as deemed necessary to prepare a project.

Where necessary, Wildlife Derogation Licences and archaeological licences will be sought from Dept. of Culture, Heritage and the Gaeltacht.

The scope of the EIS will include a hydro-morphological assessment to more clearly consider and support the Water Framework Directive (WFD) objectives (see Section 6.5.4).

The potential role for non-structural measures for each flood risk area, including natural type flood management measures will be examined in more detail and incorporated into the scheme design if deemed appropriate.

#### *6.6.3.3 Project Mitigation: Construction Stage*

For large and complex projects and sites, where environmental management may entail multiple aspects, a project specific Construction Environmental Management Plan (CEMP) may be developed. This will form a framework for all environmental management processes, mitigation measures and monitoring and will include other environmental requirements such as invasive species management measures, if applicable.<sup>13</sup>

A designated environmental officer, project ecologist and project archaeologist will be appointed, as appropriate for the project.

#### *6.6.3.4 Project Monitoring*

The Plan, with its associated SEA and plan-level AA, sets out a series of monitoring requirements, in connection with the SEA objectives and the predicted effects of the Plan. For measures involving physical works, the project-level EIA and AA, where conducted, will set out the specific monitoring required for each measure.

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<sup>13</sup> There are a range standard type mitigation measures consisting of good construction practices and good planning of works, that are used within flood management projects such as for example: Refuelling of plant and vehicles away from watercourses, Installation of wheel-wash and plant washing facilities, working only within environmental windows e.g. in-stream works in salmonid channels from May to September, Integrate fisheries in-stream enhancement through the Environmental River Enhancement Programme



## **7 MANAGING FLOOD RISK**

### **7.1 OVERVIEW**

The purpose of the Plan is to set out the strategy for the sustainable, long-term management of flood risk in the Boyne River Basin, focussed on the AFAs. The strategy comprises a set of potential measures, that may be actions, physical works or 'Schemes', further assessments or data collection. For each area or location, a number of options would typically have been available as to what measures could be brought forward and proposed as part of the Plan.

This Section describes the process pursued under the National CFRAM Programme and other policies, projects or initiatives for identifying what flood risk management measures might be suitable for a given area or location, and then how the options for such measures were appraised to determine which options would be most effective and appropriate for each area or location. This process makes use of the flood mapping (Section 5), information provided through public consultation events and processes, and a range of other data and information, as appropriate. Similar processes were followed for the Pilot CFRAM Projects and other projects undertaken in parallel with the CFRAM Programme. The Section concludes with a summary of the measures proposed under this Plan.

Further information on the process set out within this Section on the identification and appraisal of options for managing flood risk within the Boyne River Basin is set out in the Preliminary Options Report for the Eastern CFRAM Project, and in similar reports for parallel studies. These reports are available from the OPW website; [www.floodinfo.ie](http://www.floodinfo.ie).

### **7.2 METHODS OF FLOOD RISK MANAGEMENT**

There are a wide range of different approaches, or methods, that can be taken to reduce or manage flood risk. These can range from non-structural methods, that do not involve any physical works to prevent flooding but rather comprise actions typically aimed at reducing the impacts of flooding, to structural works that reduce flood flows or levels in the area at risk or that protect the area against flooding. The range of methods for managing flood risk that are considered include those outlined below.

#### **7.2.1 Flood Risk Prevention Methods**

Flood risk prevention measures are aimed at avoiding or eliminating a flood risk. This can be done by not creating new assets that could be vulnerable to flood damage in areas prone to flooding, or removing such assets that already exist. Alternatively, prevention can be achieved by completely removing the potential for flooding in a given area, although in practice this is rarely possible (the frequency or magnitude of flooding can be reduced by flood protection measures, but it is generally not possible to remove the risk of flooding entirely).

Flood prevention is hence generally focussed on sustainable planning and / or the re-location of existing assets, such as properties or infrastructure, and includes:

- Sustainable Planning and Development Management
- Sustainable Urban Drainage Systems (SUDS)
- Voluntary Home Relocation
- Preparation of Local Adaptation Planning
- Land Use Management and Natural Flood Risk Management Measures

### 7.2.2 Flood Protection Methods

Flood protection measures are aimed at reducing the likelihood and/or the severity of flood events. These measures, typically requiring physical works, can reduce risk in a range of ways, such as by reducing or diverting the peak flood flows, reducing flood levels or holding back flood waters.

Protection measures typically considered include:

- Enhance Existing Protection Works
- Flood Defences
- Increasing Channel Conveyance
- Diverting Flood Flows
- Storing Flood Waters
- Implementing Channel Maintenance Programmes
- Maintenance of Drainage Schemes
- Land Commission Embankments

The preferred Standard of Protection offered by flood protection measures in Ireland is the current scenario 1% Annual Exceedance Probability (AEP) flood for fluvial flooding and 0.5 % AEP flood for tidal flooding (also referred to as the 100-year and 200-year floods respectively), although these standards can increase or decrease depending on local circumstances.

### 7.2.3 Flood Preparedness (Resilience) Methods

In some instances, it may not be possible to reduce the likelihood or severity of flooding to an area at risk. However, actions and measures can be taken to reduce the consequences of flooding, i.e., reduce the risk to people and of damage to properties and other assets, and make sure that people and communities are resilient to flood events. This can be achieved by being aware of and preparing for the risk of flooding, knowing when floods are going to occur, taking actions immediately before, during and after a flood. The actions and measures of this type include:

- Flood Forecasting and Warning
- Emergency Response Planning
- Promotion of Individual and Community Resilience
- Individual Property Protection
- Flood-Related Data Collection

### 7.2.4 Continue Existing Regime / Do Nothing / Minor Measures

In some circumstances the existing programme of works may be sufficient to effectively manage the existing flood risk. For instance, the OPW Arterial Drainage Maintenance Programme ensures that some towns and villages around the country have already been afforded a significantly reduced level of flood risk, and in some communities, the 1% AEP flood is contained within the river channel and so there is very little flood risk. In such circumstances, there may be no need to implement additional measures, and so continuing the existing regime of works may be sufficient to adequately meet the flood risk management Objectives.

### **7.2.5 Maintain Existing Flood Risk Management Works**

Flood protection works require maintenance to keep them in good order and able to offer the Standard of Protection they were designed to provide (subject to further works that may be necessary arising from the impacts of climate change). If the level of maintenance is inadequate, the condition can deteriorate and the likelihood of failure of the measure during flood events, including those below the standard of protection, can increase. Maintenance of existing flood risk management works, such as flood relief schemes, should therefore be undertaken by the owner of the works to ensure their performance as designed.

## **7.3 DEVELOPMENT AND APPRAISAL OF FLOOD RISK MANAGEMENT OPTIONS**

This Section describes the process, or steps, pursued under the National CFRAM Programme for identifying the measures that would be most effective and appropriate for each area and location. Section 7.3.8 describes how other measures were identified through other policies, projects and initiatives.

### **7.3.1 Spatial Scales of Assessment**

Measures to manage flood risk can be applied at a range of spatial scales, namely the whole River Basin, at a catchment- or sub-catchment level, or at an AFA or local level. The assessment of possible flood risk management measures has been undertaken at each of these spatial scales of assessment under the CFRAM Programme, to ensure that a catchment-based approach is taken. This is to ensure that a measure that may benefit multiple areas or AFAs is fully considered, and that potential impacts of measures elsewhere in the catchment (e.g., up- and down-stream) are assessed and understood.

Identifying the appropriate spatial scale of assessment (SSA) informs the optioneering process by ensuring that only flood risk management methods appropriate to the spatial scale are considered, to identify measures that may benefit multiple areas, and to ensure measures proposed for smaller SSAs are not redundant or do not conflict with other areas within a catchment.

The following SSAs are defined within the Eastern CFRAM Study Area:

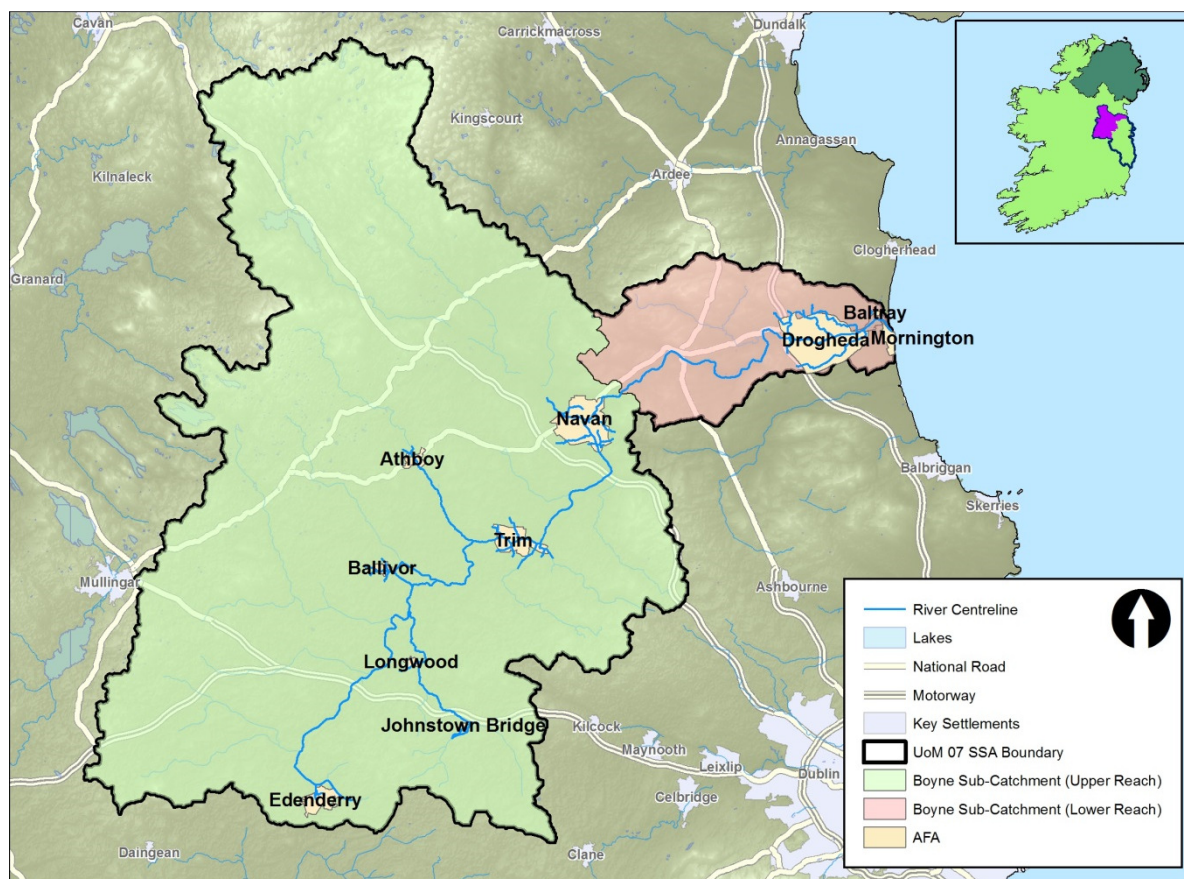
- Unit of Management SSA - refers to a hydrometric area. There are four Units of Management within the Eastern CFRAM Study Area one of which is the Boyne River Basin;
- Sub-Catchment SSA - refers to the catchment of the principle river on which multiple AFAs sit;
- AFA SSA - refers to the individual AFA being considered only;
- IRR SSA - refers to Individual Risk Receptor. There are no such IRRs identified in the Eastern CFRAM Study Area.

Table 7.1 and Figure 7.1 detail the SSAs for the Boyne River Basin.

**Table 7.1 – List of SSAs in the Boyne River Basin**

SSA	Name	AFAs within SSA		
UoM	UoM07 (Boyne)	All		
Sub Catchment	Boyne (Upper Reach)	Johnstown Bridge <sup>1</sup>	Longwood <sup>2</sup>	Edenderry <sup>3</sup>
		Ballivor <sup>4</sup>	Athboy <sup>5</sup>	Trim
		Navan		
	Boyne (Lower Reach)	Drogheda	Baltray	Mornington
AFA	Baltray			
AFA	Drogheda			
AFA	Mornington			
AFA	Navan			
AFA	Trim			

Note: Athboy<sup>5</sup>, Ballivor<sup>4</sup>, Edenderry<sup>3</sup>, Johnstown Bridge<sup>1</sup> and Longwood<sup>2</sup> AFAs are low risk (see Section 5.6).



**Figure 7.1: The Boyne River Basin Spatial Scales of Assessment**

The process for developing and appraising potential flood risk management options as described herein was hence undertaken at the catchment- or sub-catchment level, as well as the AFA or local level.

Flood risk management measures applicable at the River Basin level are generally non-structural measures already in-place or mandated under existing legislation or policy (as set out in Table 1.1 or determined through Government Decisions). These measures are set out in the Plan for clarity, and are being kept under review.

### 7.3.2 Step 1: Screening of Flood Risk Management Methods

Not all of the available methods for flood risk management will be applicable in all areas or locations. Some may, for example, not be socially or environmentally acceptable, be excessively expensive or may not be effective in managing or reducing flood risk in a particular community.

Screening is a process that is undertaken for the catchment and AFA spatial scale to filter out flood risk management methods that are not going to provide applicable, acceptable or viable measures for managing flood risk, either alone or in combination with other methods, for a given area or location. The methods were screened, based on an initial assessment, against the following criteria:

- **Applicability:** Effectiveness in managing or reducing flood risk
- **Economic:** Indicative costs relative to economic benefits
- **Environmental:** Potential impacts for the environment
- **Social:** Potential impacts for people, the community and society
- **Cultural:** Potential impacts for assets and collections of cultural importance

The outcome of the screening process was a set of flood risk management methods that might form, alone or in combination, potentially viable options for flood risk management measures.

For some communities (AFAs), typically those where the risk is relatively low, no local flood risk protection methods were found to be applicable, acceptable and viable, based on the screening process. In such cases, the process does not move to the next steps described below. However, the River Basin-level prevention and preparedness measures will generally be applicable or available to manage the flood risk that does exist in the community. These cases are described along with other AFAs under Section 7.4.

### 7.3.3 Step 2: Development of Options for Flood Risk Management Measures

The set of flood risk management methods identified through the screening process as being potentially effective or appropriate for each area or location were considered as to how they might be used to form potential measures aimed at achieving the flood risk management Objectives. This process involved professional experience and judgement, informed and guided by local knowledge and suggestions, to develop potentially viable options that incorporate one, or more often a combination of, the screened methods.

The options for possible measures were then developed to outline design, typically to the target Standards of Protection (see Section 7.2.2), based on the information available at the time of development. This permitted an estimation of the cost of the option, and also an appraisal of the option to determine how well it would achieve the flood risk management Objectives, the potential negative impacts arising, and whether it would be economically viable.

The development of options under the CFRAM Programme, while focused primarily on existing risk, included consideration of potential future flood extents, depths and risks based on the flood mapping undertaken for the Mid-Range and High-End Future Scenarios (see Section 5.5). This was completed to identify what flood protection or other measures might be required in the future, and how adaptable measures aimed at addressing existing risks would be to meet future needs.



The development of options typically included the modelling of the measures where these include physical works. This was to determine the effectiveness of the option in reducing risk, and also to assess any impacts up- or down-stream with the objective of ensuring that any preferred measure does not increase risk up- or down-stream. Where a possible increase in risk elsewhere has been identified as being significant then the option would have been rejected or amended. Where a minor increase in risk was identified, then this will be addressed and mitigated at the project-level of assessment (see Section 8.1) to ensure that the measure would not increase risk elsewhere.

The options considered include 'No Change', which means continuing only the current flood risk management activities.

### **7.3.4 Step 3: Appraisal by Multi-Criteria Analysis**

A range of possible options for measures are typically available to manage and reduce flood risk in a given area or location, and so a method of analysis was needed to determine which of the options might be the most effective and appropriate. This analysis needed to take account of the goals of the Plan, i.e., the flood risk management Objectives (see Section 1.4), and also the general importance of each Objective (the 'Global Weighting' - see below) and the local importance or relevance of each Objective (the 'Local Weighting' - see below).

The method of analysis used to appraise the options is called a 'Multi-Criteria Analysis', or 'MCA'. This is a method for appraising an option against a weighted range of diverse Objectives, to produce a mark or score of performance, referred to as the 'MCA-Benefit Score'. To produce the overall MCA-Benefit Score, a number of steps were followed, as below:

1. Each option was scored on how it performed against each Objective in turn (i.e., its benefits in reducing risk or contributing to other objectives, or its negative impact in terms of increasing risk or causing harm or detrimental impacts)
2. This score was then multiplied by both the Global and Local Weightings (see below)
3. The weighted scores for each Objective were then added up to give the overall MCA-Benefit Score for the option.

The MCA-Benefit Score permitted the comparison of one option against another to identify which option would perform best on balance across all of the Objectives, whereby the higher the score, the better the option would perform. The MCA-Benefit Score reflects the balance of benefits and impacts across all sectors and Objectives.

A critical consideration in selecting a preferred, or best-performing, option is cost. One option may perform marginally better than another, but cost considerably more, and it would be in the best interest of the tax-payer to achieve the best performance per Euro invested. The preferred option, based on the MCA Appraisal, was hence initially determined as that which had the highest MCA-Benefit Score relative to cost.

A detailed description of the MCA Appraisal process is set out in the CFRAM Technical Methodology Note on Option Appraisal and the Multi-Criteria Analysis (MCA) Framework, which is available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

#### **7.3.4.1 Assigning Global Weightings for Each Objective**

The MCA makes use of 'Global Weightings' to rank the general importance, or level of 'societal value', for each of the Objectives. The more important the Objective, the higher the Global Weighting, and hence the more influence the Objective has in determining the overall MCA-Benefit Score and the choice of preferred flood risk management measure.

Given the key role the Objectives and their Global Weightings have in selecting preferred measures for managing flood risk, the OPW considered it appropriate to consult on the Global Weightings that would be assigned to each Objective (see Section 4.4.4).

The final Global Weightings adopted for each Objective, which are consistent nationally (i.e., do not vary between River Basins or AFAs), are included in Table 1.2.

#### **7.3.4.2 Assigning Local Weightings for Each Objective**

Local Weightings are intended to reflect the relevance of each Objective within the context of each catchment or AFA for which flood risk management measures are being considered. For example, in a given AFA there may be no Utility Infrastructural assets, or no Environmentally Protected Areas, and hence the Local Weighting for the relevant Objectives should be reduced as they are not relevant for that AFA. A Local Weighting value from 0 up to 5 was assigned for each Objective for each catchment and AFA, depending on the relevance of the Objective in the given area.

The Local Weightings were determined by the Project Consultants in consultation with the OPW and the Project Steering and Progress Groups, and informed by:

- public and stakeholder consultation through questionnaires that were available from the Project Website and issued at the PCDs and through the Project Stakeholder Group, and,
- guidance issued by the OPW to ensure a consistent approach nationally (see [www.floodinfo.ie](http://www.floodinfo.ie), CFRAM Technical Methodology Note - Option Appraisal and the Multi-Criteria Analysis (MCA) Framework).

The Local Weightings for the AFAs for the Boyne River Basin are set out in the Preliminary Options Report available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

### **7.3.5 Step 4: Economic Appraisal**

As well as an MCA, flood risk management investments must be economically viable, i.e., the economic benefits of a measure (reduction in flood damages) must outweigh the cost of the measure, to ensure value for money. This equation is called the Benefit - Cost Ratio (or 'BCR'), where the BCR should be equal to or greater than one.

The appraisal to determine whether options meet this requirement, is called a cost-benefit analysis. This analysis was undertaken to determine the economic viability of each option for each area or location. A more detailed description of the cost-benefit analysis is set out in the CFRAM Technical Methodology Note on Cost-Benefit Analysis (CBA), which is available from the OPW website, [www.floodinfo.ie](http://www.floodinfo.ie).

### **7.3.6 Step 5: Public And Stakeholder Engagement**

Public and stakeholder engagement and participation in the process to develop effective and appropriate flood risk management measures is critical. The local community typically have a wealth of knowledge about flooding in their area that can help identify possible solutions and ensure that any preferred measures are effective. Community participation is also essential to make sure that any preferred measure is locally-acceptable, addressing key areas of concern and ensuring that the measure, if structural, will fit into the community environment in a way that local people will welcome.

The engagement process with the public and stakeholders to identify potentially suitable measures began at the Public Consultation Days (PCDs) held for the flood mapping (see Section 4.4.3), where people were asked to identify what they saw as potential solutions for



the flood problems in their area, and also what was locally important to guide the identification of the Local Weightings for the MCA Appraisal (see Section 7.3.4).

As options were being considered and appraised, following the processes set out above, a further set of PCDs were held in relevant communities. Members of the local community and other stakeholders attending were presented at these events with the possible options and the findings of the appraisal processes to that time, and were asked for their opinions and input to help guide the process of identifying a preferred measure. The list of PCDs that were held at this stage of the Project is provided in Appendix D.6.

### **7.3.7 Step 6: Identification of Preferred Options**

The measures set out in this Plan have been determined based on a range of considerations, namely:

- The MCA Benefit - Cost Ratio (BCR)
- The economic viability (the economic BCR)
- The environmental considerations and assessments
- The adaptability to possible future changes, such as the potential impacts of climate change
- Professional experience and judgement of the OPW, local authorities and RPS
- Public and stakeholder input and opinion

A further series of PCDs were held to engage locally and directly with the community and provide people with opportunity to discuss and fully understand the Draft Plans (see Section 4.4.6). The PCDs in the Boyne River Basin were held during the option development stage at the venues listed in Appendix D.7.

The measures to be taken forward to project-level development through the implementation of this Plan are described in Section 7.4 below, and are summarised in Section 7.7.

### **7.3.8 Measures Identified from Other Policies, Projects and Initiatives**

In addition to the measures identified through the CFRAM Programme, a number of other measures and actions are required or have been deemed to be of benefit in managing flood risk through other policies, projects and initiatives. A range of policy and legal requirements, as identified in Table 1.1, mandate that certain measures be implemented, such as the ongoing maintenance of Flood Relief Schemes and Arterial Drainage and Drainage District Schemes, or the consideration of flood risk in planning and development management. Other measures and actions have been identified through past or ongoing projects, such as certain flood relief schemes in AFAs not addressed by the CFRAM Programme, or through other initiatives, such as policy recommendations from the Interdepartmental Flood Policy Co-ordination Group. These measures are identified within the draft Plan along with those developed through the CFRAM Programme.

## **7.4 OUTCOMES**

The application of the process and the resultant outcomes for the Boyne River Basin, and for the catchments, sub-catchments and AFAs within the River Basin are set out in the sub-sections below.

### 7.4.1 Measures Applicable for All Areas

There are certain prevention and preparedness measures related to flood risk management, as described in Section 7.2 above and in Appendix F, that form part of wider Government policy. These measures, set out below under the themes of prevention, protection and preparedness, should be applied as appropriate and as applicable across all areas of the River Basin, including properties and areas outside of the AFAs, as well as within.

#### 7.4.1.1 Prevention: Sustainable Planning and Development Management

The application of the Guidelines on the Planning System and Flood Risk Management by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future. The flood mapping produced through the CFRAM Programme and parallel projects will facilitate the continued application of the Guidelines.

<b>Measure Name:</b>	Application of the Guidelines on the Planning System and Flood Risk Management (DHPCLG/OPW, 2009)
<b>Code:</b>	IE07-UoM-9011-M21
<b>Measure:</b>	The Planning Authorities will ensure proper application of the Guidelines on the Planning System and Flood Risk Management (DHPCLG/OPW, 2009) in all planning and development management processes and decisions, including where appropriate a review of existing land use zoning and the potential for blue/green infrastructure, in order to support sustainable development, taking account of the flood maps produced through the CFRAM Programme and parallel projects.
<b>Implementation:</b>	Planning Authorities
<b>Funding:</b>	Existing duties (Planning Authorities)

#### 7.4.1.2 Prevention: Sustainable Urban Drainage Systems

Sustainable Urban Drainage Systems (SUDS) can play a role in reducing and managing run-off from new developments to surface water drainage systems, reducing the impact of such developments on flood risk downstream, as well as improving water quality and contributing to local amenity.

<b>Measure Name:</b>	Implementation of Sustainable Urban Drainage Systems (SUDS)
<b>Code:</b>	IE07-UoM-9012-M34
<b>Measure:</b>	In accordance with the Guidelines on the Planning System and Flood Risk Management (DHPCLG/OPW, 2009), planning authorities should seek to reduce the extent of hard surfacing and paving and require, subject to the outcomes of environmental assessment, the use of sustainable drainage techniques.
<b>Implementation:</b>	Planning Authorities
<b>Funding:</b>	Existing duties (Planning Authorities)

#### 7.4.1.3 Prevention: Voluntary Home Relocation

In extreme circumstances, the flood risk to a home may be such that the homeowner may consider that continuing to live in the property is not sustainable and would choose to relocate.

In response to the floods of Winter 2015/2016, the Government has agreed to the administrative arrangements for a voluntary homeowner relocation scheme, to provide humanitarian assistance for those primary residences worst affected by these floods. At present, there is no Scheme to provide financial assistance to other home-owners choosing to relocate due to their flood risk.

The Interdepartmental Flood Policy Co-ordination Group is considering the future policy options for voluntary home relocation for consideration by Government.

<b>Measure Name:</b>	Voluntary Home Relocation Scheme
<b>Code:</b>	IE07-UoM-9052-M22
<b>Measure:</b>	Implementation of the once-off Voluntary Homeowner Relocation Scheme that has been put in place by Government in 2017. The Interdepartmental Flood Policy Co-ordination Group is considering the policy options around voluntary home relocation for consideration by Government
<b>Implementation:</b>	Home-Owners with humanitarian assistance to those qualifying under the Voluntary Homeowners Relocation Scheme, 2017
<b>Funding:</b>	Homeowners and the OPW, under the 2017 Scheme

#### 7.4.1.4 Prevention: Local Adaptation Planning

The National Climate Change Adaptation Framework recognises that local authorities also have an important role to play in Ireland's response to climate adaptation. Given the potential impacts of climate change on flooding and flood risk, the local authorities should take fully into account these potential impacts in the performance of their functions, in particular in the consideration of spatial planning and the planning and design of infrastructure, in line with the Local Authority Adaptation Strategy Development Guidelines (EPA, 2016).

<b>Measure Name:</b>	Consideration of Flood Risk in local adaptation planning
<b>Code:</b>	IE07-UoM-9013-M21
<b>Measure:</b>	Local authorities should take into account the potential impacts of climate change on flooding and flood risk in their planning for local adaptation, in particular in the areas of spatial planning and the planning and design of infrastructure.
<b>Implementation:</b>	Local Authorities
<b>Funding:</b>	Existing duties (Local Authorities)

#### *7.4.1.5 Prevention: Land Use Management and Natural Flood Risk Management Measures*

The OPW has been liaising with the EPA on the potential impact of WFD measures on flood risk, which are typically neutral (no impact), or may have some benefit in reducing runoff rates and volumes (e.g., through agricultural measures).

The OPW will work with the EPA, local authorities and other agencies to identify, where possible, measures that will have benefits for both WFD and flood risk management objectives, such as natural water retention measures, and also for biodiversity and potentially other objectives. This will form part of the project-level assessment required to progress physical works and flood relief schemes towards planning or Exhibition and confirmation (see Section 8.1), where potential works may be amended or enhanced by the introduction of natural water retention and similar measures. The work will include seeking, and where possible implementing, pilot studies in coordination with the Local Authority WFD Offices and other relevant agencies. It is anticipated that this is most likely to be achieved in areas where there are pressures on the ecological status of a water body in a sub-catchment where there is also an identified potentially significant flood risk (i.e., an AFA). This coordination will also facilitate the resolution of issues for measures that may otherwise cause potential conflict between the objectives of the two Directives in certain water bodies.

<b>Measure Name:</b>	Assessment of Land Use and Natural Flood Risk Management Measures
<b>Code:</b>	IE07-UoM-9021-M31
<b>Measure:</b>	The OPW will work with the EPA, local authorities and other agencies during the project-level assessments of physical works and more broadly at a catchment-level to identify, where possible, measures that will have benefits for both WFD and flood risk management objectives, such as natural water retention measures, and also for biodiversity and potentially other objectives, including the use of pilot studies and applications, where possible.
<b>Implementation:</b>	Local Authority WFD Offices, OPW, EPA, Others
<b>Funding:</b>	Existing Duties (OPW, Others)

#### *7.4.1.6 Protection: Minor Works Scheme*

The Minor Flood Mitigation Works and Coastal Protection Scheme (the 'Minor Works Scheme') is an administrative scheme operated by the OPW under its general powers and functions to support the local authorities through funding of up to €750k to address qualifying local flood problems with local solutions.

<b>Measure Name:</b>	Minor Works Scheme
<b>Code:</b>	IE07-UoM-9051-M61
<b>Measure:</b>	The OPW will continue the Minor Works Scheme subject to the availability of funding and will keep its operation under review to assess its continued effectiveness and relevance.
<b>Implementation:</b>	OPW, Local Authorities
<b>Funding:</b>	OPW, Local Authorities

#### *7.4.1.7 Protection: Maintenance of Arterial Drainage Schemes and Existing Flood Relief Schemes*

There is one Arterial Drainage Scheme and one existing flood relief scheme within the Boyne River Basin, namely the Boyne Arterial Drainage Scheme and the Mornington Flood Relief Scheme respectively. These are set out in Section 2.6. The OPW has a statutory duty under the Arterial Drainage Act, 1945, and the Amendment of the Act, 1995, to maintain the Arterial Drainage and the flood relief Schemes. The Local Authorities should also maintain those flood relief schemes for which they have maintenance responsibility. This Plan does not amend these responsibilities to provide additional flood relief. The Plan therefore does not set out additional measures in this regard.

The Arterial Drainage Maintenance service has developed and adheres to a suite of Environmental Management Protocols and Standard Operating Procedures which minimise the potential environmental impact of operations. A Strategic Environmental Assessment (SEA) was conducted for the national Arterial Drainage Maintenance activities for the period 2011-2015 and a further SEA process was again carried out for the national Arterial Drainage Maintenance activities for the period 2016-2021. Appropriate Assessments are also carried out on an ongoing basis for Arterial Drainage Maintenance operations. Operations outside the scope of the SEA or AA processes are subject to Ecological Assessment to consider environmental sensitivities around Arterial Drainage Maintenance.

#### *7.4.1.8 Protection: Maintenance of Drainage Districts*

There are six Drainage Districts within the Boyne River Basin, namely the Owenroe & Moynalty DD, Lough Crew DD, Ballycowan DD, Carbury Hill Stream DD, Foranwell DD and Garr DD. The local authorities have a statutory duty to maintain the Drainage Districts, and this Plan does not amend these responsibilities to provide additional flood relief. The Plan therefore does not set out additional measures in relation to the maintenance of Drainage Districts.

#### *7.4.1.9 Maintenance of Channels Not Part of a Scheme*

Outside of the Arterial Drainage and Drainage District Schemes, landowners who have watercourses on their lands have a responsibility for their maintenance. Guidance to clarify the rights and responsibilities of landowners in relation to the maintenance of watercourses on or near their lands is available at [www.flooding.ie](http://www.flooding.ie).

#### *7.4.1.10 Preparedness: Flood Forecasting - National*

The Government decided in January 2016 to establish a National Flood Forecasting and Warning Service. When fully operational, this will be of significant benefit to communities and individuals to prepare for and lessen the impact of flooding. The Government decision has provided the opportunity to proceed with a first stage implementation of the service and will involve the following elements:

- establishment of a National Flood Forecasting Service as a new operational unit within Met Éireann, and
- establishment of an independent Oversight Unit within the Office of Public Works (OPW).

The service will deal with flood forecasting from fluvial (river) and coastal sources and when established it will involve the issuing of flood forecasts and general alerts at both national and catchment scales.

A Steering Group, including representatives from the OPW, the Department of Housing, Planning and Local Government (DHPLG), Met Éireann and the Local Authorities has been

established to steer, support and oversee the establishment of the new service. A number of meetings have taken place to progress this complex project.

Given the complexities involved in establishing, designing, developing and testing this new service, it is anticipated that the first stage of the service will take at least 5 years before it is fully operational. In the interim period, existing flood forecasting and warning systems and arrangements will continue to be maintained.

<b>Measure Name:</b>	Establishment of a National Flood Forecasting and Warning Service
<b>Code:</b>	IE07-UoM-9031-M41
<b>Measure:</b>	The establishment of a new operational unit in Met Éireann to provide, in the medium term, a national flood forecasting service and the establishment of an independent Oversight Unit in the OPW.
<b>Implementation:</b>	OPW, DHPLG, Met Éireann and Local Authorities
<b>Funding:</b>	OPW, DHPLG

#### *7.4.1.11 Preparedness: Flood Forecasting - Boyne River Basin*

##### **Description of the Proposed measure**

Flood Forecasting and Warning was assessed as a method of flood risk management throughout the Boyne River Basin. Through existing and proposed gauging stations this method would utilise data from the existing hydrometric and meteorological networks to develop predictive models enabling alerts/warnings to be issued in sufficient time to flood prone receptors for action to be taken to manage the consequences of the flood event.

Forecasting and Warning systems provide reduction in impact as residual damage occurs even if action is taken. The method was assessed to support managing the fluvial risk from the River Boyne upstream, within and downstream of Trim. Whilst other AFAs in Boyne River Basin such as Navan and Drogheda would also benefit during fluvial flood events from a warning alert, these downstream AFAs (when assessed at their AFA spatial scale of assessment) have proposed solutions which provide the full proposed standard of protection. However, no such measure was identified for Trim.

Consequently the proposed measure in relation to Trim (and the surrounding medium priority watercourses) is Flood Forecasting and Warning. Downstream AFAs which have structural proposed measures identified at AFA level would derive benefit from the Flood Forecasting and Warning in the interim period between installation of the Flood Forecasting and Warning system and the completion of AFA level structural measures. A Forecasting and Warning system could be implemented as a stand-alone measure for the Boyne system as a whole if found to be appropriate /desirable in the future.

The potentially viable Flood Forecasting and Warning system which, at this stage of assessment is deemed to be proposed, is set out in Appendix G (noting that this will be subject to further assessment and possible amendment).

##### **Public Consultation Outcomes**

No submissions were received in relation to this measure.



### **Measure Appraisal**

As shown in Table 7.2, the MCA appraisal scores are positive for the technical and economic aspects of the evaluation and environmentally/culturally neutral. The proposed measure is considered to be environmentally neutral providing that the installation of the new gauge follows best practice however the majority of the measure would relate to analysis of data from existing gauges.

**Table 7.2** *Appraisal of the Flood Risk Management Measure/Potential Works*

Option	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Flood Forecasting and Warning for the Boyne (UoM07) River Basin	1200	0	55	0	55	1.06	51.9	1.87

### **Climate Change Adaptability**

Climate Change has been reviewed for the Boyne River Basin and the proposed measure was found to be readily adaptable at negligible cost.

### **Conclusion**

<b>Measure Name:</b>	Flood Forecasting and Warning
<b>Code:</b>	IE07-UoM-0799-M41
<b>Measure:</b>	Progression of a Flood Forecasting and Warning System for the Boyne (UoM07) River Basin, comprising of gauging stations (existing and new) and a forecasting model system, to project-level development and assessment for refinement and preparation for planning / Exhibition and, as appropriate, implementation.
<b>Implementation:</b>	OPW, DHPLG, Met Éireann and Local Authorities
<b>Funding:</b>	OPW, DHPLG

The development of a flood forecasting system for the Boyne River Basin will progress as part of the development of the National Flood Forecasting Service (see Section 7.4.1.10).

#### **7.4.1.12** *Preparedness: Review of Emergency Response Plans for Severe Weather*

Section 4.7 of the Major Emergency Management (MEM) Framework introduces the concept of self-appraisal as part of the systems approach to emergency management. The purpose of the appraisal process is to assist agencies and regions to review, monitor and assess their activities and to identify issues which may need to be addressed and consider what measures they could adopt to improve preparedness, as part of the major emergency development programmes.

The regional appraisal, which is undertaken annually, is based on a self-assessment questionnaire, for which the answers are evidence-based and supported with references to documentary support (e.g. document dates, exercise reports, etc.). The process is supported by meetings of the National Steering Group project team with Regional Steering Group Chairs (2 per annum) to shape future MEM developments and identify challenging issues and areas for improvement. It is the task of the National Steering Group to review and validate these appraisals and provide appropriate feedback.



Flood planning and inter-agency co-ordination are included in appraisals and remains a key objective for National Steering Group and Regional Steering Groups.

The local authorities should, in particular, review their flood event emergency response plans, making use of the information on flood hazards and risks provided through the CFRAM Programme and this Plan.

<b>Measure Name:</b>	Ongoing Appraisal of Flood Event Emergency Response Plans and Management Activities
<b>Code:</b>	IE07-UoM-9032-M42
<b>Measure:</b>	Ongoing, regular appraisal of emergency management activities to improve preparedness and inter-agency coordination and to shape future MEM developments as part of the major emergency development programmes, taking into account in particular the information developed through the CFRAM Programme and this Plan.
<b>Implementation:</b>	Principal Response Agencies, Regional Steering Groups, National Steering Group
<b>Funding:</b>	Existing duties (Implementation Bodies)

#### 7.4.1.13 *Preparedness: Individual and Community Resilience*

While the State, through the OPW, local authorities and other public bodies can take certain actions (subject to environmental assessment, where relevant) to reduce and manage the risk of flooding, individual home-owners, businesses and farmers also have a responsibility to manage the flood risk to themselves and their property and other assets to reduce damages and the risk to personal health in the event of a flood.

Research by the DHPCLG is informing a review of the national emergency framework and the supports that can be provided to communities to help them respond to all emergencies, including flooding emergencies. This will build on past initiatives and existing support, such as that provided through the 'Plan, Prepare, Protect' programme (<http://www.flooding.ie/>) and the 'Be Winter Ready' Campaigns (<http://winterready.ie/>).

<b>Measure Name:</b>	Individual and Community Action to Build Resilience
<b>Code:</b>	IE07-UoM-9033-M43
<b>Measure:</b>	All people at flood risk should make themselves aware of the potential for flooding in their area, and take long-term and short-term preparatory actions (subject to environmental assessment, where relevant) to manage and reduce the risk to themselves and their properties and other assets.
<b>Implementation:</b>	Public, business owners, farmers and other stakeholders
<b>Funding:</b>	N/A

#### 7.4.1.14 *Preparedness: Individual Property Protection*

Individual Property Protection can be effective in reducing the damage to the contents, furniture and fittings in a house or business, but are not applicable in all situations (for

example, they may not be suitable in areas of deep or prolonged flooding, or for some types of property with pervious foundations and flooring). Property owners considering the use of such methods should seek the advice of an appropriately qualified expert on the suitability of the measures for their property, and consider the possible requirements for environmental assessment.

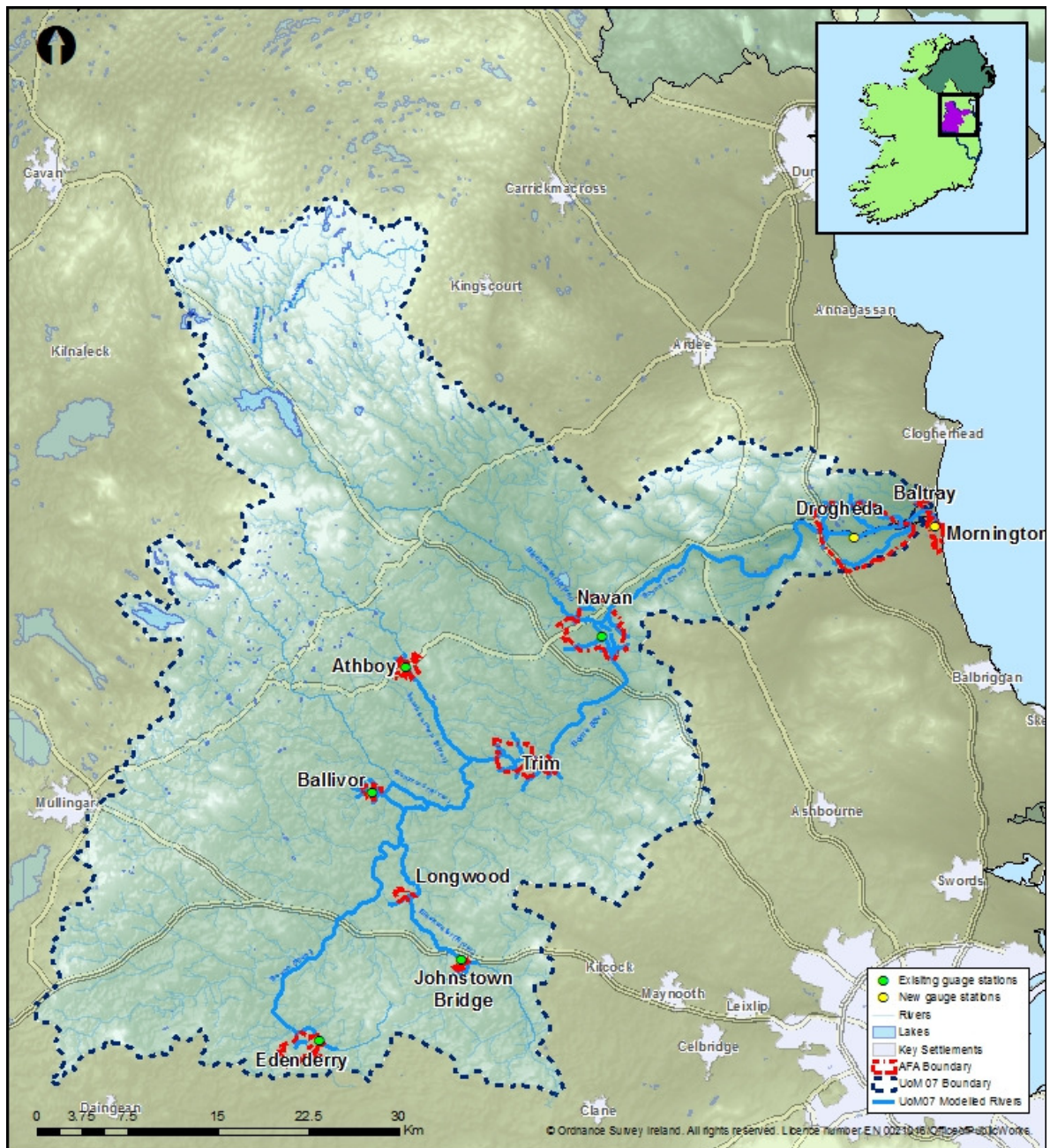
While there may be some existing tax relief for some homeowners works on their homes which are aimed at preventing the risk of flooding, the Interdepartmental Flood Policy Co-ordination Group is considering the administrative arrangements, for consideration by Government, of any appropriate assistance to home owners, where it is suitable, to install Individual Property Protection measures for their property.

<b>Measure Name:</b>	Individual Property Protection
<b>Code:</b>	IE07-UoM-9053-M43
<b>Measure:</b>	Property owners may consider the installation of Individual Property Protection measures. The Interdepartmental Flood Policy Co-ordination Group is considering the policy options around installation of Individual Property Protection measures for consideration by Government.
<b>Implementation:</b>	Home owners, Interdepartmental Flood Policy Co-ordination Group
<b>Funding:</b>	Home owners, N/A

#### 7.4.1.15 *Preparedness: Flood-Related Data Collection*

Ongoing collection and, where appropriate, publication of hydrometric and meteorological data, and data on flood events as they occur, will help us to continually improve our preparation for, and response, to flooding.

<b>Measure Name:</b>	Flood-Related Data Collection
<b>Code:</b>	IE07-UoM-9041-M61
<b>Measure:</b>	The OPW, Local Authorities / EPA and other organisations collecting and, where appropriate, publishing hydro-meteorological data and post-event event flood data should continue to do so to improve future flood risk management.
<b>Implementation:</b>	OPW, Local Authorities / EPA and other hydro-meteorological agencies
<b>Funding:</b>	Existing duties (Implementation Bodies)



**Figure 7.2: Location of potential gauge stations for flood related data collection**

The measure will improve the rating and record length of data at the existing gauge stations located on / upstream / downstream of AFAs, particularly at Athboy, Ballivor, Edenderry, Johnstown Bridge and Navan where existing stations could potentially be upgraded to flood flow rated stations and the existing records utilised for the analysis of extreme floods.

AFAs, which are presently ungauged but are considered to have significant flood risk, and as such would significantly benefit from the installation of new gauge stations are identified as Drogheda (Ushers Stream) and Mornington (Mornington River). The existing and proposed new gauging stations are presented spatially in Figure 7.2.

#### 7.4.2 Boyne Sub-Catchment Measures

No methods were found to be feasible from the Boyne Sub-catchment screening. Storage and improvement of channel conveyance were screened and found to be technically

feasible; however these were not found to be economically viable. As no methods have been deemed potentially viable, the next steps in the process, such as development of options or MCA appraisal have not been completed.

### 7.4.3 Baltray AFA Measure

#### **Description of the Proposed measure**

Potentially viable flood relief works for Baltray that may be implemented after project-level assessment and planning or Exhibition and confirmation might include physical works, such as a series of hard defences (flood embankments and walls), largely constructed along a new line set back from the existing line of defences. The proposed hard defences would protect to the 1% AEP fluvial flood event and to the 0.5% AEP coastal flood event, with an average height of 1.33m and a total length of 1.05km. The proposed hard defences avoid impinging on the qualifying habitats for which the SPA / SAC were designated but does not protect a local recreational area. The potentially viable flood relief works, which at this stage of assessment are deemed to be preferred, are set out in Appendix G, noting that these will be subject to project-level assessment and possible amendment.

#### **Public Consultation Outcomes**

Local details of drainage issues and ground conditions were provided however there was no overall consensus regarding a preferred line for the defences nor were any alternative options suggested.

The consultation process provided information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the proposed measure at this stage.

**Table 7.3 Appraisal of the Flood Risk Management Measure/Potential Works**

Option	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Progress the development of a Flood Relief Scheme for Baltray AFA	1000	1050	1208	-183	2074	1.93	1072.5	6.25

#### **Measure Appraisal**

Table 7.3 outlines the MCA appraisal scores against the technical, social, economic and environmental/cultural objectives for the proposed measure. The proposed measure scores better environmentally (as the hard defences are not located within the qualifying habitats of the SPA/SAC designation) and has a significantly higher benefit cost ratio than the other potential measure that was assessed.

The proposed measure will deliver several key flood protection benefits; reducing risk to numerous local properties and commercial properties, NIAH buildings, transport links and social infrastructure/amenity sites in the medium and long term. There is potential for an increase in the extent of estuarine and wetland habitat, due to the setting back of defences from the estuary.

The Strategic Environmental Assessment identified a number of potential negative impacts associated with the proposed measures, but these are predominantly short term in nature.



They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for minor visual impacts from flood defences in the medium to long term. As the measure involves a new line of flood defences set further back from the estuary than the existing defences, there is potential for loss of an amenity area; however, should this occur, it will be replaced with a more natural amenity area.

As Boyne Coast and Estuary SAC and Boyne Estuary SPA are adjacent to and downstream of Baltray and several other European sites are located in the vicinity, with the potential for indirect impacts on the qualifying habitats and/or species, Appropriate Assessment was required. This assessed the proposed new line of hard defences at Baltray in addition to a second option encompassing a series of flood walls constructed along the existing line of defences. The new route avoids impinging on qualifying wetland and estuarine habitats for which the Boyne Coast and Estuary SAC was designated, and creates potential for their expansion. The direct impacts relate to the disturbance of protected birds, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.

Specific mitigation measures will be identified at project-level stage. A list of potential mitigation measures are outlined in Section 6.6.3 and Appendix G.

### **Climate Change Adaptability**

An assessment of climate and catchment changes shows Baltray to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the proposed measure would require additional lengths and heights (circa 1m) of hard defences to maintain the level of protection as provided by the proposed measure. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

### **Conclusion**

<b>Measure Name:</b>	Progress the development of a Flood Relief Scheme for Baltray AFA
<b>Code:</b>	IE07-IE-AFA-070030-0107-M33
<b>Measure:</b>	Progress the project-level development and assessment of a Flood Relief Scheme for Baltray, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation.
<b>Implementation:</b>	OPW and/or Louth CoCo - To be confirmed
<b>Funding:</b>	OPW

Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

## **7.4.4 Drogheda AFA Measure**

### **Description of the Proposed measure**

Potentially viable flood relief works for Drogheda that may be implemented after project-level assessment and planning or Exhibition and confirmation might include physical works, such as a series of hard defences (flood embankments and walls) along the River Boyne and

improvement of conveyance, hard defences and a flow diversion channel on various tributaries. Some sealing of manholes and localised raising of roads would also be required, as would automated defences to allow continued operation of port activities. The hard defences would protect to the 1% AEP fluvial flood event and to the 0.5% AEP coastal flood event, with an average height of 1.95m and a total length of 4.3km. The improvement of channel conveyance consists of 215m of additional 1.5m diameter twin culvert within the vicinity of the old Usher's Mill at Greenhills and 91m of dredged and widened channel. The potentially viable flood relief works, which at this stage of assessment are deemed to be preferred, are set out in Appendix G, noting that these will be subject to project-level assessment and possible amendment.

### **Public Consultation Outcomes**

The consultation process indicated a particular concern regarding flooding to the port area over the existing ineffective hard defences and through the drainage network.

The continued operations, and role of the port company in terms of supporting flood risk management, was also raised. As a result the indicative line of the hard defences was reviewed and automated barriers incorporated to accommodate port activities; the specifics of these are to be identified during subsequent project-level assessment.

The consultation process provided further information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the proposed measure at this stage.

### **Measure Appraisal**

Table 7.4 outlines the MCA appraisal scores against the technical, social, economic and environmental/cultural objectives for the proposed measure. The proposed measure has the best combination of the MCA appraisal scores and has the highest MCA Score/Cost compared to the other potential measures that were assessed.

**Table 7.4 Appraisal of the Flood Risk Management Measure/Potential Works**

Option	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Progress the development of a Flood Relief Scheme for Drogheda AFA	600	1012	663	-1020	654	16.83	38.9	2.98

The proposed measure will deliver several key flood protection benefits; reducing risk to numerous local properties and commercial properties, NIAH buildings, monuments and other architectural heritage, transport links and social infrastructure/amenity sites in the medium and long term.

The Strategic Environmental Assessment identified a number of potential negative impacts associated with the proposed measures, but these are predominantly short term in nature. They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for disturbance or loss of habitats and/or species in the direct footprint of the hard defences, and minor visual impacts in the medium to long term.

As the proposed works will be located immediately adjacent to the River Boyne and River Blackwater SAC and SPA, and upstream of the Boyne Coast and Estuary SAC and SPA, with the potential for direct and indirect impacts on the qualifying habitats and/or species, Appropriate Assessment was required. The direct impacts relate to the footprint of hard defences, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.

Specific mitigation measures will be identified at project-level stage. A list of potential mitigation measures are outlined in Section 6.6.3 and Appendix G.

### **Climate Change Adaptability**

An assessment of climate and catchment changes shows Drogheda to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the proposed measure to maintain the level of protection as provided by the proposed measure would require significant additional lengths and heights (over 1m) of hard defences along the Boyne and where specified along the tributaries, increasing the proposed channel widening and excavation, increasing the size of proposed culverts or adding additional culverts and increasing the channel size of the proposed flow diversion where measures are applicable on the tributaries. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

### **Conclusion**

<b>Measure Name:</b>	Progress the development of a Flood Relief Scheme for Drogheda AFA
<b>Code:</b>	IE07-IE-AFA-070033-0207-M61
<b>Measure:</b>	Progress the project-level development and assessment of a Flood Relief Scheme for Drogheda, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation.
<b>Implementation:</b>	OPW and/or Louth/Meath CoCo - To be confirmed
<b>Funding:</b>	OPW

Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

### **7.4.5 Mornington AFA Measure**

It should be noted that works have been carried out in Mornington (see Section 2.6.1 for a summary of the previous works). The CFRAM Study has assessed measures to augment the existing works, in order to provide a 1% AEP fluvial and 0.5%AEP coastal standard of protection throughout the AFA.

### **Description of the Proposed measure**

Potentially viable flood relief works for Mornington that may be implemented after project-level assessment and planning or Exhibition and confirmation might include physical works, such as a series of hard defences (flood embankments and walls). The hard defences would protect to the 1% AEP fluvial flood event and to the 0.5% AEP coastal flood event, with an average height of 1.04m and a total length of approximately 530m. The potentially viable flood relief works, which at this stage of assessment are deemed to be preferred, are set out



in Appendix G, noting that these will be subject to project-level assessment and possible amendment.

### **Public Consultation Outcomes**

The consultation process provided further information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the proposed measure at this stage.

### **Measure Appraisal**

Table 7.5 outlines the MCA appraisal scores against the technical, social, economic and environmental/cultural objectives for the proposed measure. Only one measure was identified for Mornington as being viable, and consequently this is the proposed measure.

**Table 7.5 Appraisal of the Flood Risk Management Measure/Potential Works**

Option	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Progress the development of a Flood Relief Scheme for Mornington AFA	800	770	719	-447	1042	0.53	1977.3	3.52

The proposed measure will deliver several key flood protection benefits; reducing risk to numerous local properties, transport links, utilities, agricultural land and social infrastructure/amenity sites in the medium and long term.

The Strategic Environmental Assessment identified a number of potential negative impacts associated with the proposed measures, but these are predominantly short term in nature. They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for disturbance or loss of habitats and/or species in the direct footprint of the hard defences, and minor visual impacts in the medium to long term.

As the proposed works will be located adjacent to and upstream of the Boyne Coast and Estuary SAC and Boyne Estuary SPA, with the potential for direct and indirect impacts on the qualifying habitats and/or species, Appropriate Assessment was required. The direct impacts relate to the disturbance of protected bird species of Boyne Estuary SPA, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.

Specific mitigation measures will be identified at project-level stage. A list of potential mitigation measures are outlined in Section 6.6.3 and Appendix G.

### **Climate Change Adaptability**

An assessment of climate and catchment changes shows Mornington to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the proposed measure would require significant additional lengths of hard defences and raising of the existing Mornington defences (circa 1m) to maintain the level of protection as provided by the proposed measure. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

## **Conclusion**

<b>Measure Name:</b>	Progress the development of a Flood Relief Scheme for Mornington AFA
<b>Code:</b>	IE07-IE-AFA-070880-0307-M61
<b>Measure:</b>	Progress the project-level development and assessment of a Flood Relief Scheme for Mornington, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation.
<b>Implementation:</b>	Typically Meath CoCo under the OPW Minor Works Scheme
<b>Funding:</b>	Typically OPW Minor Works Scheme

Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

### **7.4.6 Navan AFA Measure**

#### **Description of the Proposed measure**

Potentially viable flood relief works for Navan that may be implemented after project-level assessment and planning or Exhibition and confirmation might include physical works. However the proposed measure has a BCR below unity. It is considered that the costs for certain works, or smaller schemes, is likely to be conservative in the Unit Cost Database. It is therefore recommended that the proposed measure for Navan progress to include a detailed assessment of the costs to determine if an economically viable measure may exist that could justify the progression to full project-level assessment. Further information on Measures with a Benefit – Cost Ratio below Unity is presented in Section 7.4.8, with Navan detailed in Section 7.4.8.1.

### **7.4.7 Trim AFA Measures**

#### **Description of the Proposed measure**

The assessment for Trim found no viable measures with a benefit-cost ratio greater than 0.5, and so no further assessment at an AFA-scale was carried out (see Section 7.4.8). The low benefit-cost ratio is due to the relatively low risk to properties during the 1% AEP fluvial flood event in Trim, resulting in a small benefit value. However, Trim could benefit from the implementation of the Boyne Flood Forecasting and Warning System (see Section 7.4.1.11).

#### **Public Consultation Outcomes**

No submissions during the statutory consultation in relation to Trim were received.

#### **Measure Appraisal**

As no viable option was identified that provided the preferred standard of protection in Trim, no measure appraisal was undertaken. It should be noted that the Minor Works Scheme is available to the local authorities to address any local flood problems with local solutions.

There is no viable option identified therefore no associated environmental assessment was undertaken.

### **Climate Change Adaptability**

An assessment of climate and catchment changes shows Trim to be moderately vulnerable to the increases as modelled in the mid-range and highly vulnerable to the increases as modelled in the high end future scenarios. No viable measure was identified for Trim. However, the proposed measure at River Basin (UoM) level (please refer to Section 7.4.1.11), Preparedness: Flood Forecasting would benefit Trim and this measure would be readily adaptable to future scenarios.

### **7.4.8 Northlands Flood Relief Scheme Measures**

A flood relief scheme is currently under construction for Northlands as described in Section 2.6.2. No additional measures specific to Northlands are proposed.

### **7.4.9 Measures with a Benefit - Cost Ratio below Unity**

For some AFAs, no economically viable measure (i.e., a measure with a benefit - cost ratio of greater than 1.0) has been found through the analysis undertaken to date, but a technically viable measure has been identified with a benefit - cost ratio of between 0.5 and 1.0. A more detailed assessment of the costs of such measures may indicate that the measure could be implemented at a cost below that determined through the analysis undertaken to date.

While it would not be prudent to progress such measures to full project-level assessment towards planning / Public Exhibition based on the information available at present, a more detailed assessment of the costs can be progressed to determine if an economically viable measure may in fact exist that could justify the progression to full project-level assessment.

#### ***7.4.9.1 Navan AFA Measures***

### **Description of the Proposed measure**

Potentially viable flood relief works for Navan that may be implemented after project-level assessment and planning or Exhibition and confirmation might include physical works, such as a series of hard defences (flood embankments and walls), road raising and clearance of a 750m reach of the Abbeylands Tributary. The hard defences would protect to the 1% AEP fluvial flood event with a total wall length of 889m, a total embankment length of 340m and a total length of 986m of road to be raised. The potentially viable flood relief works, which at this stage of assessment are deemed to be preferred, are set out in Appendix G, noting that these will be subject to project-level assessment and possible amendment.

### **Public Consultation Outcomes**

The consultation process provided further information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the proposed measure at this stage.

### **Measure Appraisal**

Table 7.6 outlines the MCA appraisal scores against the technical, social, economic and environmental/cultural objectives for the proposed measure. Only one measure was identified for Navan as being technically viable and consequently this is the proposed measure, while noting it was not found to be economically viable.

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**Table 7.6 Appraisal of the Flood Risk Management Measure/Potential Works**

Option	MCA Appraisal Scores				TOTAL - MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
	Technical	Social	Economic	Environ / Cultural				
Undertake a Detailed Assessment of the Costs of the Potential Measure for Navan AFA	1000	1147	1097	-870	1373	6.32	217.1	0.71

The proposed measure will deliver several key flood protection benefits; reducing risk to numerous local properties, NIAH buildings, transport links, utilities and social infrastructure/amenity sites in the medium and long term.

The Strategic Environmental Assessment identified a number of potential negative impacts associated with the proposed measures, but these are predominantly short term in nature. They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for disturbance or loss of habitats and/or species in the direct footprint of the hard defences.

As the proposed works will be located within, upstream of and downstream of the River Boyne and River Blackwater SAC and SPA, with the potential for direct and indirect impacts on the qualifying habitats and/or species, Appropriate Assessment was required. The direct impacts relate to the footprint of hard defences and disturbance of protected birds, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.

Specific mitigation measures will be identified at project-level stage. A list of potential mitigation measures are outlined in Section 6.6.3 and Appendix G.

### **Climate Change Adaptability**

An assessment of climate and catchment changes shows Navan to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the proposed measure would require significant additional lengths and heights (circa 1m) of hard defences to maintain the level of protection as provided by the proposed measure. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

### **Conclusion**

<b>Measure Name:</b>	Undertake a Detailed Assessment of the Costs of the Potential Measure for Navan AFA
<b>Code:</b>	IE07-IE-AFA-070039-0407-M25
<b>Measure:</b>	Undertake a detailed assessment of the costs to determine if an economically viable measure may exist that could justify the progression to full project-level assessment.
<b>Implementation:</b>	OPW and/or Meath CoCo - To be confirmed

<b>Funding:</b>	OPW
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Section 8.1 sets out the routes for the progression of measures and future assessments, including environmental assessments, of any potential future physical works.

## 7.5 PRIORITISATION OF PROPOSED PROTECTION MEASURES

Implementing all of the proposed measures as set out in this, and all, Plans would require a significant capital investment as well as substantial resources to manage the implementation process. The Government's National Development Plan 2018 to 2027 has committed up to €1 billion over the lifetime of the Plan for flood relief measures. This will enable the OPW to continue with the implementation of its existing flood relief capital works programme and will also facilitate the phased implementation of the proposed measures within the Plans. Within this period, it is necessary to prioritise the investment of resources in the delivery of the flood relief capital investment programme.

The basis on which measures in the Plans have been prioritised for implementation is a key consideration in planning the investment of the significant public resources made available for flood relief over the next 10 years. The prioritisation primarily relates to the protection measures to be implemented by the OPW or funded by the OPW but implemented by a local authority.

For the purposes of prioritisation, the measures have been divided into three streams as follows:

1. Large Schemes: Measures costing in excess of €15m
2. Medium and Small Schemes: Measures costing in between €750k/€1m and €15m
3. Minor Schemes: Measures costing less than €750k/€1m

There are only a small number of Large Schemes, all of which will be advanced at an early stage due to their scale and their long lead in period.

It is anticipated that the Minor Schemes will be brought forward by the local authorities, with OPW funding, and so may be advanced at an early stage.

The measures in the remaining stream (Medium and Small Schemes) will be prioritised on a regional basis, by reference to the six CFRAM study areas. The management objective for this €1billion ten year programme of flood relief works is to efficiently utilise available capacity to plan progression and completion of schemes that deliver greatest protection and maximise return.

## 7.6 FLOOD RISK MANAGEMENT IN OTHER AREAS

This Plan identifies a series of flood risk management measures for the entire River Basin and also viable, locally-specific flood protection measures for the AFAs identified through the PFRA.

While it is considered that the PFRA identified the areas of significant flood risk throughout Ireland, the PFRA will be reviewed in line with legislation, and other areas can be considered for detailed assessment at that stage.

In the interim, local authorities may avail of the OPW Minor Flood Mitigation Works and Coastal Protection Scheme (Section 2.6.5 and 7.4.1.6), where the relevant criteria are met, to implement local solutions to local flood problems, including in areas outside of the AFAs.

**7.7 SUMMARY OF PREFERRED MEASURES**

Table 7.7 provides a summary of the measures that are to be progressed through the implementation of the Plan for the Boyne River Basin, while Table 7.8 sets out the flood relief schemes and works that have been progressed or proposed through other projects or plans.



*Table 7.7: Summary of Flood Risk Management Measures*

Measure	Implementation	Funding
Measures Applicable for All Areas		
Application of the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009)	Planning Authorities	Planning Authorities
Implementation of Sustainable Urban Drainage Systems (SUDS)	Planning Authorities	Planning Authorities
Voluntary Home Relocation	Interdepartmental Flood Policy Co-ordination Group	OPW (2017 Scheme)
Consideration of Flood Risk in Local Adaptation Planning	Local Authorities	Local Authorities
Assessment of Land Use and Natural Flood Risk Management Measures	EPA, OPW, Others	OPW, Others
Minor Works Scheme	OPW, Local Authorities	OPW, Local Authorities
Establishment of a National Flood Forecasting and Warning Service	OPW, DHPLG, Met Éireann and local authorities	OPW, DHPLG
Ongoing Appraisal of Flood Event Emergency Response Plans and Management Activities	Principal Response Agencies, Regional Steering Groups, National Steering Group	Implementation Bodies
Individual and Community Action to Build Resilience	Public, business owners, farmers and other stakeholders	N/A
Individual Property Protection	Home Owners, Interdepartmental Flood Policy Co-ordination Group	Homeowners
Flood-Related Data Collection	OPW, Local Authorities / EPA, and other hydro-meteorological agencies	Implementation Bodies

Catchment / Sub-Catchment Measures		
Establishment of a Boyne River Basin Flood Forecasting and Warning Service	OPW, DHPLG, Met Éireann and local authorities	OPW, DHPLG
No Sub-Catchment methods were found to be feasible		
Community-Level (AFA) Measures		
Progress the project-level development and assessment of a Flood Relief Scheme, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation, for the Communities set out below.		
Baltray AFA	OPW and/or Louth CoCo - To be confirmed	OPW
Drogheda AFA	OPW and/or Louth/Meath CoCo - To be confirmed	OPW
Mornington AFA	Typically Meath CoCo under the OPW Minor Works Scheme	Typically OPW Minor Works Scheme
Undertake a Detailed Assessment of the Costs of the Potential Measure for the Communities set out below.		
Navan AFA	OPW and/or Meath CoCo - To be confirmed	OPW

*Table 7.8: Summary of Flood Relief Schemes and Works Progressed or Proposed through Other Projects or Plans*

Flood Relief Schemes and Works Progressed or Proposed through Other Projects or Plans		
Community (AFA)	Scheme or Works	Status
Mornington AFA	Mornington Flood Relief Scheme	Completed
Bettystown AFA	Northlands Flood Relief Scheme	Completed

## **8 IMPLEMENTATION, MONITORING AND REVIEW OF THE PLAN**

### **8.1 IMPLEMENTATION OF THE PLAN**

The Plan sets out the strategy, actions and measures that are considered to be the most appropriate at this stage of assessment, including a programme of structural and non-structural measures to be implemented and has identified the responsible body/bodies for implementing those measures.

#### **8.1.1 River Basin Level Measures**

The River Basin level measures, i.e., those applicable in all areas (Section 7.4.1), typically do not involve physical works, and represent the implementation of existing policy and/or the development of new policies or Schemes.

Many prevention and preparedness measures are already in-hand with the relevant implementing bodies or are being proactively progressed by the Interdepartmental Flood Policy Co-ordination Group. Other such measures requiring new action should be proactively and urgently progressed and implemented by the relevant implementing bodies, subject to any licences and/or environmental assessments required, through normal business practices.

#### **8.1.2 Catchment and AFA-Level Physical Measures**

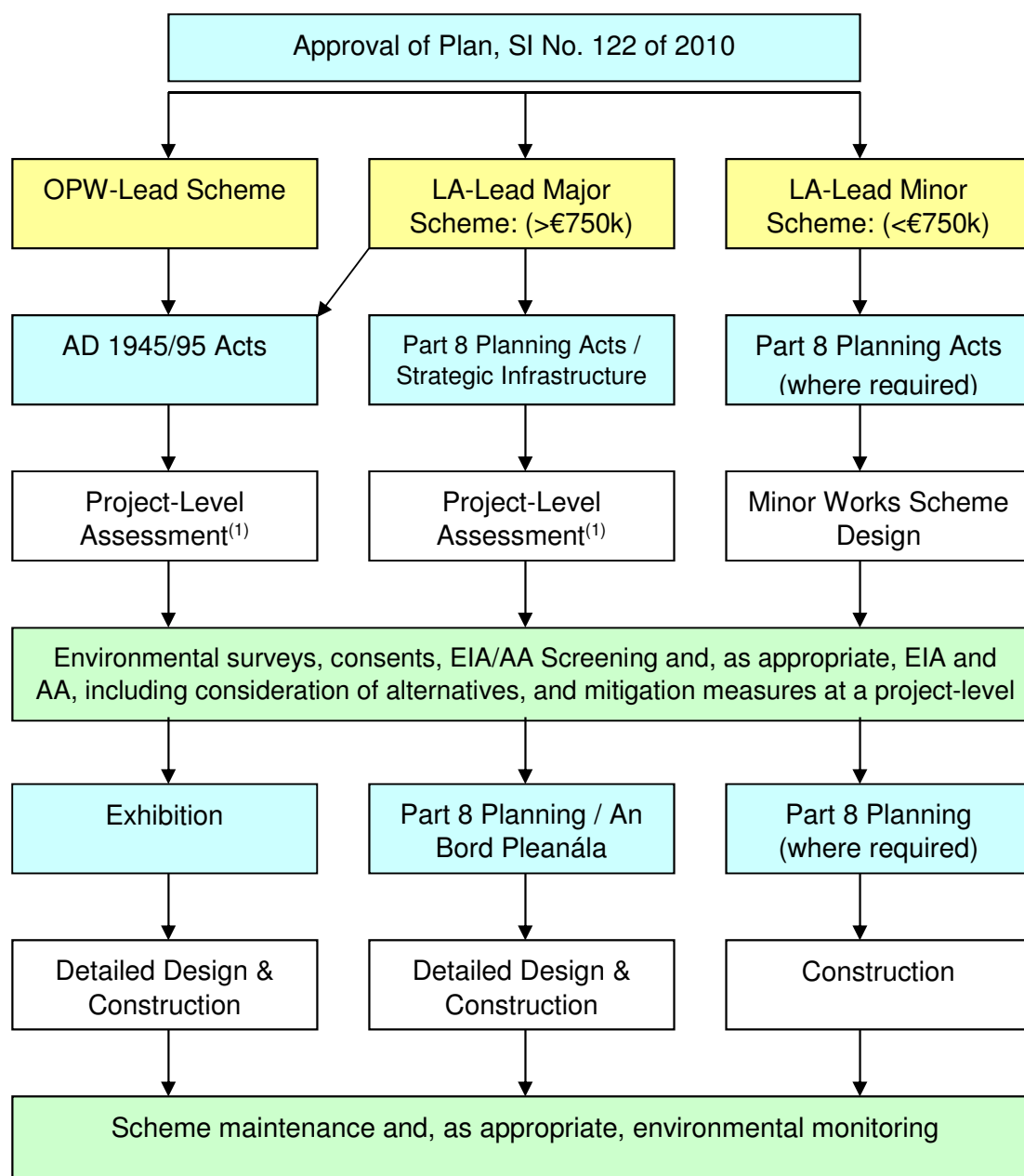
Most of the measures at the catchment and/or AFA-level involve physical works. The body responsible for the implementation of measures that will involve physical works, such as a flood relief scheme, will typically be either the OPW or the relevant local authority (see Table 7.7).

The potential physical flood relief works or 'Schemes' set out in the Plans that have been developed through the CFRAM Programme are to an outline design, and are not at this point ready for construction. Further detailed design through a project-level of assessment will be required for such works before implementation, including more detailed adaptation planning for the potential impacts of climate change along with:

- Project-level environmental assessment and appraisal (e.g., EIA and Appropriate Assessment where relevant)
- Further public and stakeholder consultation and engagement (see Section 8.1.4)
- Statutory planning processes, such as planning permission or Public Exhibition and confirmation (Ministerial approval), where relevant.

Local information that can not be captured at the Plan-level of assessment, such as ground investigation results, project-level environmental assessments and interactions with local urban storm water drainage systems, may give rise at that stage to some amendment of the proposed works to ensure that they are viable, fully adapted, developed and appropriate within the local context, and that they are compliant with environmental legislation. The works set out in the Plan may therefore be subject to some amendment.

There are three routes by which such works may progress to construction stage, as set out in Figure 8.1.



**Figure 8.1: Options for the Progression of Measures Involving Physical Flood Relief Works**

Note (1): Project-level assessment will take account of the potentially viable measures identified in the Plan, but will involve the consideration of alternatives at the project-level and, as appropriate, EIA and AA, including the definition of necessary mitigation measures at the project-level. Only schemes/measures confirmed to be viable following project level assessment will be brought forward for Exhibition/Planning and detailed design

Where measures require further assessment or hydrometric monitoring before progression to further development at a local, project level, such assessments or monitoring will be implemented and progressed as soon as possible.

### 8.1.3 Other Catchment and AFA-Level Measures

Measures may have been identified at the catchment or AFA-level in the Boyne River Basin that do not involve physical works. Such measures might include:

- The need for further hydrometric monitoring / data gathering
- Further study or analysis (for example, in areas of high technical uncertainty)
- The operation of existing structures to manage water levels or flows.

Measures relating to the operation of existing structures would typically be the responsibility of the ESB or Waterways Ireland, and represent ongoing practice or the enhancement of same.

For the remaining measures under this category, the OPW will advance these, subject to any licences and/or environmental assessments that may be required, as a matter of priority within available resources.

### 8.1.4 Public and Stakeholder Consultation and Engagement

The project development stage will involve a significant level of further public consultation on the preferred measures in the Plan at key points in the progress of the design work required to bring those measures to a state of readiness to submit for planning approval (in the case of projects being implemented by local authorities under the Planning and Development Acts) or for Public Exhibition (in the case of projects being implemented by the OPW under the Arterial Drainage Acts ADA). Public Information Days will be organised to inform the communities affected of the progress with the design of the proposed scheme.

In the case of schemes being implemented by the OPW under the ADA, the main public consultation event is the formal Public Exhibition stage. This involves the preparation of the scheme documentation (schedules setting out details and benefits of the scheme, including names of the proprietors, owners and occupiers of the lands with which the proposed scheme will interfere; maps, drawings, plans, sections setting out the technical detail; Environmental Impact Statement, if required; and Interference Notices sent to each affected person detailing the extent of works proposed on their respective lands or property and any proposed compulsory interference with, or acquisition of, these lands and property). All of the Scheme Documents are forwarded to the relevant Local Authority and they are also placed on formal Public Exhibition in a public building(s) in the area typically over a period of 4 weeks when interested parties and the public have the opportunity to study the proposals and make comments, observations, objections, etc. OPW staff and/or consultancy staff are available at Public Exhibition to answer queries and offer clarification. Interference Notices are also forwarded to affected parties in advance of the Exhibition period. All observations received are responded to and, if necessary, the scheme may be revised as a result of them. Following Public Exhibition, the scheme is submitted to the Minister for Finance and Public Expenditure and Reform for Confirmation (approval) of the Scheme.

The OPW is also considering suitable mechanisms at a national level to provide for consultation and engagement for the national flood risk management programme with stakeholders that have a national remit.

## **8.2 MONITORING OF PROGRESS IN IMPLEMENTATION OF THE PLAN**

The OPW will monitor progress in the implementation of measures for which the OPW has responsibility on an ongoing basis as part of its normal business management processes.

The OPW will coordinate and monitor progress in the implementation of the Plans through an Interdepartmental Co-ordination Group.

On a six-yearly cycle, the OPW will undertake a full review of the progress in the implementation of the Plan and the level of flood risk, and will report this progress publicly and to the European Commission as part of obligations of Ireland under the 'Floods' Directive.

In addition to monitoring of implementation of the measures set out in the Plan, monitoring will also be undertaken in relation to:

- Continued collection and analysis of hydro-meteorological data for improved flood flow and sea level frequency analysis and for observation of the potential impacts of climate change
- Ongoing recording of flood events through established systems, with photographs, peak water levels, duration, etc., for recording and publication on the National Flood Event Data Archive ([www.floodinfo.ie](http://www.floodinfo.ie))
- Monitoring of compliance with the Guidelines on the Planning System and Flood Risk Management through ongoing review of development plans, local area plans and other forward planning documents
- Changes that may affect the areas prone to flooding as shown on the flood maps, with the flood maps updated on an ongoing basis as necessary

## **8.3 ENVIRONMENTAL MONITORING**

The SEA Directive requires that the significant environmental effects of the implementation of a plan are monitored in order to identify at an early stage unforeseen adverse effects and in order to undertake appropriate remedial action. The proposed monitoring programme in Table 8.1, is based on the Targets and Indicators established in the SEA Objectives and will be undertaken during development of the 2nd cycle of the Plans.



**Table 8.1 Environmental Monitoring of the Flood Risk Management Plan**

SEA Topic	Objective	Sub-Objective		Indicator	Possible Data and Responsible Authority
Biodiversity, Flora and Fauna	Support the objectives of the Habitats Directive	i)	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones	Area, condition and trend of European sites and species in the UoM (European sites to review are those identified by AA Screening.)	NPWS – Conservation Action Plans NPWS reporting on Irelands Habitats and Species – Article 17 Reports. NPWS reporting on the status of Irelands Birds – Article 12 Reports.
	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	i)	Avoid damage to or loss of, and where possible enhance, nature conservation sites and protected species or other known species of conservation concern	Area, condition and trend of national, regional or local conservation sites in the UoM (National sites to review are those identified in SEA Environmental Report.)	Local Authority – Local Area Plans and County Development Plans. NPWS - Status of Protected Sites and Species in Ireland Reporting
Population and Human Health	Minimise risk to human health and life	i)	Minimise risk to human health and life of residents	Residential property flooding in the UoM	OPW, Local Authority and Emergency Services Reporting.
		ii)	Minimise risk to high vulnerability properties	High vulnerability sites impacted by flooding in the UoM	OPW, Local Authority and Emergency Services Reporting.
Geology, Soils and Landuse	Minimise risk to agriculture	i)	Minimise risk to agriculture	Area of soil resource lost due to flooding and flood risk management in the UoM.	EPA - CORINE landcover mapping. Local Area Plans and County Development Plans – myplan.ie
Water	Support the objectives of the WFD	i)	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives	Status and status trend of waterbodies, where FRM activities are within and upstream of a waterbody.	EPA / ERBD – WFD status reporting and RBMPs.
Climate	Ensure flood risk management options are adaptable to future flood risk	i)	Ensure flood risk management options are adaptable to future flood risk	Requirement for adaptation of FRM management activities for climate change in the UoM.	OPW and Local Authority reporting.
Material Assets	Minimise risk to transport & utility infrastructure	i)	Minimise risk to transport infrastructure	Number and type of transport routes that have flooded in the UoM.	OPW, Local Authority and NRA reporting.
		ii)	Minimise risk to utility infrastructure	Number and type of utilities that have flooded in the UoM.	OPW, Local Authority, ESB, Eirgrid, Eircom, BGE, Irish Water and EPA reporting.

Cultural Heritage	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	i)	Avoid damage to or loss of features, institutions and collections of architectural value and their setting.	Number of designated architectural heritage features, institutions and collections that have flooded in the UoM.	OPW, Local Authority and DAHRRGA reporting. Archaeological Survey of Ireland Sites and Monuments Records
		ii)	Avoid damage to or loss of features, institutions and collections of archaeological value and their setting.	Number of designated archaeological heritage features, institutions and collections that have flooded in the UoM.	OPW, Local Authority and DAHRRGA reporting. Archaeological Survey of Ireland Sites and Monuments Records
Landscape and Visual	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	i)	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	Length of waterway corridor qualifying as a landscape protection zone within urban areas of UoM. Change of quality in existing scenic areas and routes in the UoM. Loss of public landscape amenities in the UoM.	Local Authority – Landscape Character Assessments, County Development Plans and Local Area Plans. EPA - CORINE Landcover.
Fisheries, Aquaculture & Angling	Protect, and where possible enhance, fisheries resource within the catchment	i)	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	Improvement or decline in fish stocks and habitat quality in the UoM. Barriers to fish movement within the UoM.	IFI and WFD fish surveys and reports. Local fisheries reporting.
Amenity, Community & Socio-Economics	Minimise risk to community	i)	Minimise risk to social infrastructure and amenity	Social infrastructure and amenity assets impacted by flooding in the UoM.	OPW and Local Authority reporting.
		ii)	Minimise risk to local employment	Non-residential properties impacted by flooding in the UoM.	OPW and Local Authority reporting.

## **8.4 REVIEW OF THE PFRA, FLOOD MAPS AND THE PLANS**

In accordance with the requirements of the EU 'Floods' Directive, the PFRA, flood maps and Plans will be reviewed on a six-yearly cycle, with the first reviews of the PFRA, maps and final Plans due by the end of 2018, 2019 and 2021 respectively.

The review of the PFRA is described in Section 3.3.

The review of the flood maps, on an ongoing basis and formally by the end of 2019, will take account of additional information received and/or physical amendments such as the construction of new infrastructure, and, where appropriate, the amendment of the flood maps.

This review of the Plans shall include any changes or updates since the publication of the Plans, including:

- A summary of the review of the PFRA and the flood maps, taking into account the potential impacts of climate change, including where appropriate the addition or removal of AFAs
- An assessment of the progress made towards the achievement of the flood risk management Objectives
- A description of, and an explanation for, any measures foreseen in the final version of the Plan which were planned to be undertaken and have not been taken forward
- A description of any additional measures developed and/or progressed since the publication of the Plan

The Review of the Plan, which will include assessments under SEA and Habitats Directives as appropriate, taking into account new information available at that time (e.g., as available from the Environmental Monitoring Framework and from the [www.catchments.ie](http://www.catchments.ie) website), will be published in line with relevant legislation, following public and stakeholder engagement and consultation.

## GLOSSARY AND ACRONYMS

Annual Exceedance Probability Or AEP	The probability, typically expressed as a percentage, of a flood event of a given magnitude being equalled or exceeded in any given year. For example, a 1% AEP flood event has a 1%, or 1 in a 100, chance of occurring or being exceeded in any given year.
Appropriate Assessment	An assessment of the potential impacts of a plan or project on the integrity of a site designated as a Natura 2000 Site, as required under the Habitats Directive
Area for Further Assessment Or AFA	Areas where, based on the Preliminary Flood Risk Assessment, the risks associated with flooding are considered to be potentially significant. For these areas further, more detailed assessment was required to determine the degree of flood risk, and develop measures to manage and reduce the flood risk. The AFAs were the focus of the CFRAM Studies.
Arterial Drainage Scheme	Works undertaken under the Arterial Drainage Act (1945) to improve the drainage of land. Such works were undertaken, and are maintained on an ongoing basis, by the OPW.
Benefiting Lands	Lands benefiting from an Arterial Drainage Scheme.
Catchment	The area of land draining to a particular point on a river or drainage system, such as an Area for Further Assessment (AFA) or the outfall of a river to the sea.
Catchment Flood Risk Assessment and Management Study Or CFRAM Study	A study to assess and map the existing and potential future flood hazard and risk from fluvial and coastal waters, and to define objectives for the management of the identified risks and prepare a Plan setting out a prioritised set of measures aimed at meeting the defined objectives.
Communities	Cities, towns, villages or townlands where there are a collection of homes, businesses and other properties.
Consequences	The impacts of flooding, which may be direct (e.g., physical injury or damage to a property or monument), a disruption (e.g., loss of electricity supply or blockage of a road) or indirect (e.g., stress for affected people or loss of business for affected commerce)
Drainage	Works to remove or facilitate the removal of surface or sub-surface water, e.g., from roads and urban areas through urban storm-water drainage systems, or from land through drainage channels or watercourses that have been deepened or increased in capacity.
Drainage District	Works across a specified area undertaken under the Drainage Acts to facilitate land drainage.
Flood	The temporary covering by water of land that is not normally covered by water.
'Floods' Directive	The EU 'Floods' Directive [2007/60/EC] is the Directive that came into force in November 2007 requiring Member States to undertake a PFRA to identify Areas for Further Assessment (AFAs), and then to prepare flood maps and Plans for these areas.
Flood Extent	The extent of land that has been, or might be, flooded. Flood extent is often represented on a flood map.
Flood Hazard Map	A map indicating areas of land that may be prone to flooding, referred to as a flood extent map, or a map indicating the depth, velocity or other aspect of flooding or flood waters for a given flood event. Flood hazard maps are typically prepared for either a past event or for (a) potential future flood event(s) of a given probability.

Flood Risk Map	A map showing the potential risks associated with flooding. These maps may indicate a particular aspect of risk, taking into account the probability of flooding (e.g., annual average economic damages), but can also show the various receptors that could be affected by floods of different probabilities.
Flood Risk Management Plan (Plan)	A Plan setting out a prioritised set of measures within a long-term sustainable strategy aimed at achieving defined flood risk management objectives. The Plan is developed at a River Basin (Unit of Management) scale, but is focused on managing risk within the AFAs.
Floodplain	The area of land adjacent to a river or coastal reach that is prone to periodic flooding from that river or the sea.
Fluvial	Riverine, often used in the context of fluvial flooding, i.e., flooding from rivers, streams, etc.
Habitats Directive	The Habitats Directive [92/43/EEC] aims at securing biodiversity through the provision of protection for animal and plant species and habitat types of European importance.
Hazard	Something that can cause harm or detrimental consequences. In this context, the hazard referred to is flooding.
Hydraulics	The science of the behaviour of fluids, often used in this context in relation to estimating the conveyance of flood water in river channels or structures (such as culverts) or overland to determine flood levels or extents.
Hydrology	The science of the natural water cycle, often used in this context in relation to estimating the rate and volume of rainfall flowing off the land and of flood flows in rivers.
Hydrometric Area	Hydrological divisions of land, generally large catchments or a conglomeration of small catchments, and associated coastal areas. There are 40 Hydrometric Areas in the island of Ireland.
Indicative	This term is typically used to refer to the flood maps developed under the PFRA. The maps developed are approximate, rather than highly detailed, with some local anomalies.
Individual Risk Receptor Or IRR	A single receptor (see below) that has been determined to represent a potentially significant flood risk (as opposed to a community or other area at potentially significant flood risk, known as an Area for Further Assessment, or 'AFA').
Inundation	Another word for flooding or a flood (see 'Flood')
Measure	A measure (when used in the context of a flood risk management measure) is a set of works, structural and / or non-structural, aimed at reducing or managing flood risk.
National CFRAM Programme	The programme developed by the OPW to implement key aspects of the EU 'Floods' Directive in Ireland, which included the CFRAM Studies, and built on the findings of the PFRA.
Pluvial	Refers to rainfall, often used in the context of pluvial flooding, i.e., flooding caused directly from heavy rainfall events (rather than over-flowing rivers).
Point Receptor	Something that might suffer harm or damage as a result of a flood, that is at a particular location that does not cover a large area, such as a house, office, monument, hospital, etc.
Preliminary Flood Risk Assessment Or PFRA	An initial, high-level screening of flood risk at the national level to determine where the risks associated with flooding are potentially significant, to identify the AFAs. The PFRA is the first step required under the EU 'Floods' Directive.

Public Consultation Day Or PCD	A public and stakeholder consultation and engagement event advertised in advance, where the project team displayed and presented material (e.g., flood maps, flood risk management options) at a venue within a community, with staff available to explain and discuss the material, and where members of the community and other interested parties could provide local information and put forward their views.
Receptor	Something that might suffer harm or damage as a result of a flood, such as a house, office, monument, hospital, agricultural land or environmentally designated sites.
Return Period	A term that was used to describe the probability of a flood event, expressed as the interval in the number of years that, on average over a long period of time, a certain magnitude of flood would be expected to occur. This term has been replaced by 'Annual Exceedance Probability, as Return Period can be misleading.
Riparian	River bank. Often used to describe the area on or near a river bank that supports certain vegetation suited to that environment (Riparian Zone).
Risk	The combination of the probability of flooding, and the consequences of a flood.
River Basin	An area of land (catchment) draining to a particular estuary or reach of coastline.
River Basin District Or RBD	A regional division of land defined for the purposes of the Water Framework Directive. There are eight RBDs in the island of Ireland; each comprising a group of River Basins.
Riverine	Related to a river
Runoff	The flow of water over or through the land to a waterbody (e.g., stream, river or lake) resulting from rainfall events. This may be overland, or through the soil where water infiltrates into the ground.
Sedimentation	The accumulation of particles (of soil, sand, clay, peat, etc.) in the river channel
Significant Risk	Flood risk that is of particular concern nationally. The PFRA Main Report (see <a href="http://www.floodinfo.ie">www.floodinfo.ie</a> ) sets out how significant risk is determined for the PFRA, and hence how Areas for Further Assessment have been identified.
Strategic Environmental Assessment Or SEA	An SEA is an environmental assessment of plans and programmes to ensure a high level consideration of environmental issues in the plan preparation and adoption, and is a requirement provided for under the SEA directive [2001/42/EC]
Standard of Protection Or SoP	The magnitude of flood, often defined by the annual probability of that flood occurring being exceeded (the Annual Exceedance Probability, or 'AEP'), that a measure / works is designed to protect the area at risk against.
Surface Water	Water on the surface of the land. Often used to refer to ponding of rainfall unable to drain away or infiltrate into the soil.
Surge	The phenomenon of high sea levels due to meteorological conditions, such as low pressure or high winds, as opposed to the normal tidal cycles
Survey Management Project	A project commissioned by the OPW in advance of the CFRAM Studies to specify and manage a large proportion of the survey work.
Sustainability	The capacity to endure. Often used in an environmental context or in relation to climate change, but with reference to actions people and society may take.
Tidal	Related to the tides of the sea / oceans, often used in the context of tidal flooding, i.e., flooding caused from high sea or estuarine levels.



Topography	The shape of the land, e.g., where land rises or is flat.
Transitional Water	The estuarine or inter-tidal reach of a river, where the water is influenced by both freshwater river flow and saltwater from the sea.
Unit of Management Or UoM	A hydrological division of land defined for the purposes of the Floods Directive. One Plan has been prepared for each Unit of Management, which is referred to within the Plan as a River Basin
Vulnerability	The potential degree of damage to a receptor (see above), and/or the degree of consequences that could arise in the event of a flood.
Waterbody	A term used in the Water Framework Directive (see below) to describe discrete section of rivers, lakes, estuaries, the sea, groundwater and other bodies of water.
Water Framework Directive Or WFD	The Water Framework Directive [2000/60/EC] aims to protect surface, transitional, coastal and ground waters to protect and enhance the aquatic environment and ecosystems and promote sustainable use of water resources

## LIST OF ACRONYMS

<b>AA</b>	Appropriate Assessment
<b>AEP</b>	Annual Exceedance Probability
<b>AFA</b>	Area for Further Assessment
<b>AR5</b>	5th Assessment Report (IPCC)
<b>BCR</b>	Benefit - Cost Ratio
<b>CFRAM</b>	Catchment-Based Flood Risk Assessment and Management
<b>DHPLG</b>	Department of Housing, Planning and Local Government
<b>EIA</b>	Environmental Impact Assessment
<b>EPA</b>	Environmental Protection Agency
<b>ESB</b>	Electricity Supply Board
<b>EU</b>	European Union
<b>FD</b>	Floods Directive
<b>FRMP</b>	Flood Risk Management Plan
<b>FRR</b>	Flood Risk Review
<b>FSR</b>	Flood Studies Report
<b>FSU</b>	Flood Studies Update
<b>HEFS</b>	High-End Future Scenario
<b>HPW</b>	High Priority Watercourse
<b>ICPSS</b>	Irish Coastal Protection Strategy Study
<b>IED</b>	Industrial Emissions Directive
<b>INFF</b>	Irish National Flood Forum
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IROPI</b>	Imperative Reasons of Over-riding Public Interest
<b>MCA</b>	Multi-Criteria Analysis
<b>MPW</b>	Medium Priority Watercourse
<b>MRFS</b>	Mid-Range Future Scenario
<b>NCCAF</b>	National Climate Change Adaptation Framework
<b>OPW</b>	Office of Public Works
<b>PCD</b>	Public Consultation day
<b>PFRA</b>	Preliminary Flood Risk Assessment
<b>RBD</b>	River Basin District
<b>RBMP</b>	River Basin Management Plan
<b>SAC</b>	Special Area of Conservation
<b>SEA</b>	Strategic Environmental Assessment
<b>SFRA</b>	Strategic Flood Risk Assessment
<b>SI</b>	Statutory Instrument
<b>SPA</b>	Special Protection Area
<b>SUDS</b>	Sustainable Urban Drainage Systems
<b>UoM</b>	Unit of Management
<b>WFD</b>	Water Framework Directive

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## APPENDICES

# **APPENDIX A**

## **FLOODING AND FLOOD RISK**

### **A.1 INTRODUCTION**

A flood is defined in the 'Floods' Directive as a "temporary covering by water of land not normally covered by water", i.e., the temporary inundation of land that is normally dry. Flooding is a natural process that can happen at any time in a wide variety of locations.

Flood *hazard* is the potential threat posed by flooding to people, property, the environment and our cultural heritage. The degree of hazard is dependent on a variety of factors that can vary from location to location and from one flood event to another. These factors include the extent and depth of flooding, the speed of the flow over the floodplains, the rate of onset and the duration of the flood.

Flooding only presents a *risk* however when people, property, businesses, farms, infrastructure, the environment or our cultural heritage can be potentially impacted or damaged by floods. Flood risk is the combination of the probability of flood events of different magnitudes and the degree of the potential impact or damage that can be caused by a flood. The actual damage that can be caused depends on the vulnerability of society, infrastructure and our environment to damage or loss in the event of a flood, i.e., how sensitive something is to being damaged by a flood.

### **A.2 Types and Causes of Flooding**

Flooding can occur from a range of sources, individually or in combination, as described below.

#### **A.2.1 Coastal Flooding**

Coastal flooding occurs when sea levels along the coast or in estuaries exceed neighbouring land levels, or overcome coastal defences where these exist, or when waves overtop the coastline or coastal defences. Mean sea levels around Ireland are rising (Dwyer and Devoy, 2012), and are expected to continue to rise due to climate change in the range of 0.52 to 0.98m (IPCC, 2014) by 2100, with an associated increase in flood risk from the sea over the coming decades.

Coastal flooding can also occur in the form of tsunami, and Ireland has suffered from tsunami flooding in the past<sup>1</sup>. It was determined during the Preliminary Flood Risk Assessment (PFRA, see Section 3) however that this cause of flooding is not, on the basis of our current understanding, a significant cause of flood risk in Ireland, although further investigation is required on this matter. As a result, tsunami risk is not addressed in this Plan.

#### **A.2.2 Fluvial Flooding**

Fluvial flooding occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas (the natural floodplains). This can arise where the runoff from heavy rain exceeds the natural capacity of the river channel, and can be exacerbated where a channel is blocked or constrained or, in estuarine areas, where high tide levels impede the flow of the river out into the sea. While there is a lot of uncertainty on the

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<sup>1</sup> The tsunami that devastated Lisbon, Portugal in 1755 also hit the south coast of Ireland according to records of that time, and there are reports of tsunami-like flood events around the South coast from 1761 and 1854 (Pers comm., GSI)

impacts of climate change on rainfall patterns, there is a clear potential that fluvial flood risk could increase into the future.

### **A.2.3 Pluvial Flooding**

Pluvial flooding occurs when the amount of rainfall exceeds the capacity of urban storm water drainage systems or the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural or man-made hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall before the flood waters eventually enter a piped or natural drainage system. This type of flooding is driven in particular by short, intense rain storms.

### **A.2.4 Groundwater Flooding**

Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall, to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding results from the interaction of site-specific factors such as local geology, rainfall infiltration routes and tidal variations. While the water level may rise slowly, it may cause flooding for extended periods of time. Hence, such flooding may often result in significant damage to property or disruption to transport. In Ireland, groundwater flooding is most commonly related to turloughs in the karstic limestone areas prevalent in particular in the west of Ireland.

### **A.2.5 Other Causes of Flooding**

The above causes of flooding are all natural; caused by either extreme sea levels or heavy or intense rainfall. Floods can also be caused by the failure or exceedance of capacity of built or man-made infrastructure, such as bridge collapses, from blocked piped sewerage networks, or the failure or over-topping of reservoirs or other water-retaining embankments (such as raised canals). While it is recognised that some of these other sources may cause local problems, it was determined during the PFRA (see Section 3) however that these causes of flooding are not, in the context of the national flood risk and on the basis of our current understanding, causes of significant flood risk, or can not always be foreseen, and hence are not addressed in the Plan.

## **A.3 IMPACTS OF FLOODING**

### **A.3.1 Impacts on people and society**

Flooding can cause physical injury, illness and loss of life. Deep, fast flowing or rapidly rising flood waters can be particularly dangerous. For example, even shallow water flowing at 2 metres per second (m/sec) can knock children and many adults off their feet, and vehicles can be moved by flowing water of only 300mm depth. The risks increase if the floodwater is carrying debris. Some of these impacts may be immediate, the most significant being drowning or physical injury due to being swept away by floods. Floodwater contaminated by sewage or other pollutants (e.g. chemicals stored in garages or commercial properties) can also cause illnesses, either directly as a result of contact with the polluted floodwater or indirectly, as a result of sediments left behind. Those most likely to be at risk are people living in a single-storey bungalow or below ground in a basement, those outdoors on foot or in a vehicle, or people staying in a tent or caravan.

As well as the immediate dangers, the impact on people and communities as a result of the stress and trauma of being flooded or having access to their property cut-off by floodwaters, or even of being under the threat of flooding, can be immense. Long-term impacts can arise due to chronic illnesses and the stress associated with being flooded and the lengthy recovery process.

The ability of people to respond and recover from a flood can vary. Vulnerable people, such as the elderly, people with mobility difficulties or those who have a long-term illness,



are potentially less able to respond to a flood emergency. Some people may have difficulty in replacing household items damaged in a flood and may lack the financial means to recover and maintain acceptable living conditions after a flood.

Floods can also cause impacts on communities as well as individuals through the temporary, but sometimes prolonged, loss of community services or infrastructure, such as schools, health services, community centres or amenity assets.

### **A.3.2 Impacts on property**

Flooding can cause severe damage to properties. Floodwater is likely to damage internal finishes, contents and electrical and other services and possibly cause structural damage. The physical effects can have severe long-term impacts, with re-occupation sometimes not being possible for over a year. The costs of flooding are increasing, partly due to increasing amounts of electrical and other equipment within developments. The degree of damage generally increases with the depth of flooding, and sea-water flooding may cause additional damage due to corrosion.

Flooding can also cause significant impacts to agriculture. A certain level of flooding is intrinsic in certain areas, and agricultural management takes this into account, however extreme or summer flooding can have detrimental impacts through loss of production, as well as damage to land and equipment.

### **A.3.3 Impacts on Infrastructure**

The damage flooding can cause to businesses and infrastructure, such as transport or utilities like electricity, gas and water supply, can have significant detrimental impacts on individuals and businesses and also local and regional economies. Flooding of primary roads or railways can deny access to large areas beyond those directly affected by the flooding for the duration of the flood event, as well as causing damage to the road or railway itself. Flooding of water distribution infrastructure such as pumping stations or of electricity sub-stations can result in loss of water or power supply over large areas. This can magnify the impact of flooding well beyond the immediate community. The long-term closure of businesses, for example, can lead to job losses and other economic impacts.

### **A.3.4 Impacts on the Environment**

Detrimental environmental effects of flooding can include soil and bank erosion, bed erosion or siltation, land slides and damage to vegetation and species that are not resilient against flooding, as well as the impacts on water quality, habitats and flora and fauna caused by pollutants carried by flood water. Flooding can however be a necessary element of natural and semi-natural habitats. Many wetland habitats are dependent on continual or periodic flooding for their sustainability and can contribute to the storage of flood waters to reduce flood risk elsewhere.

### **A.3.5 Impacts on our Cultural Heritage**

In the same way as flooding can damage properties, flood events can damage or destroy assets or sites of cultural heritage value. Particularly vulnerable are monuments, structures or assets (including building contents) made of wood or other soft materials, such as works of art and old paper-based items such as archive records, manuscripts or books. Soil erosion during flood events could also destroy buried heritage and archaeological sites.

## **A.4 Potential Impacts of Future Change**

It is likely that climate change will have a considerable impact on flood risk in Ireland, such as through rising mean sea levels, increased wave action and the potential increases in winter rainfall and intense rainfall events. Land use change, for example through new housing and other developments, can also increase potential future flood risk.

## **APPENDIX B**

### **PHYSICAL OVERVIEW OF THE RIVER BASIN**

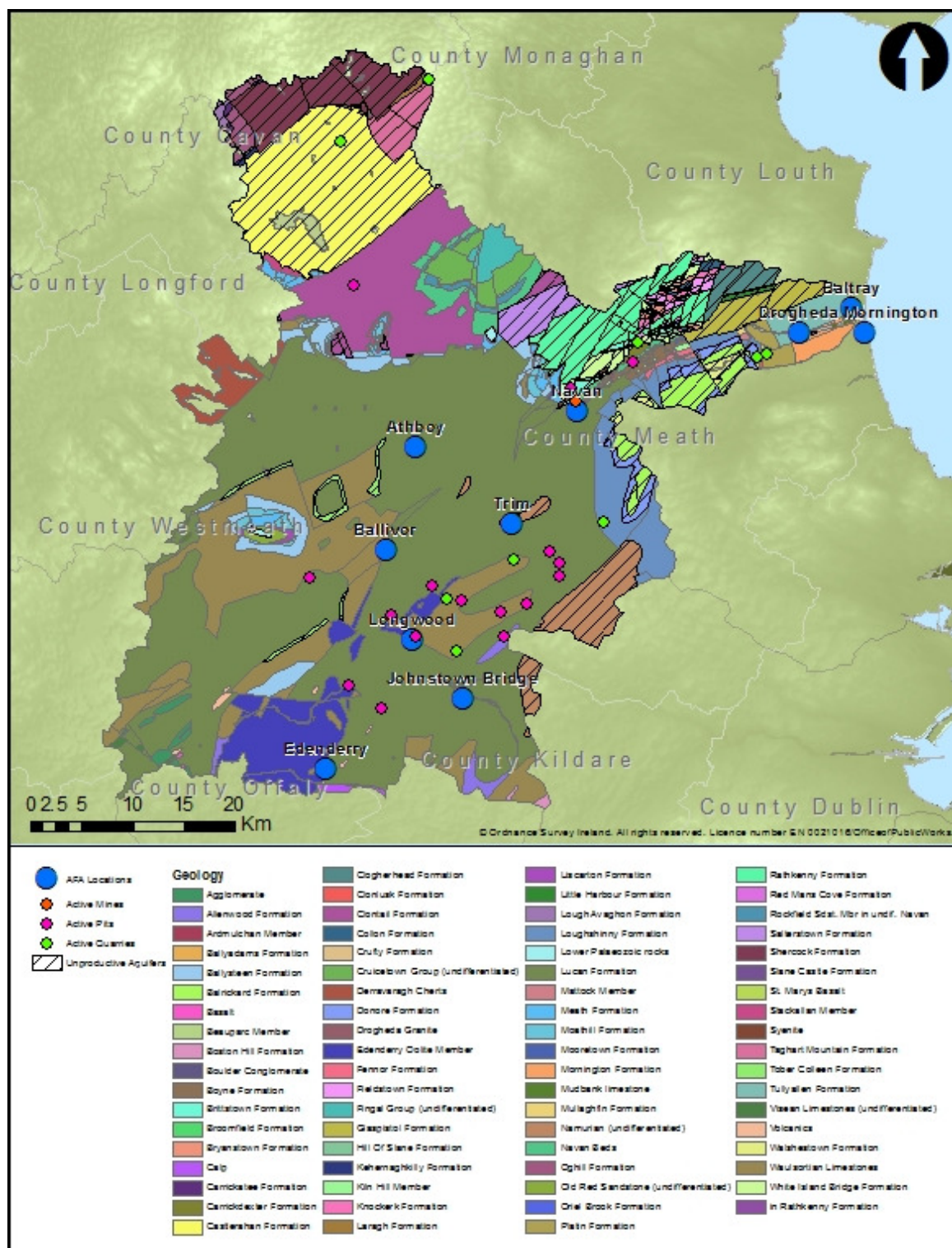
#### **B.1 TOPOGRAPHY, GEOLOGY, SOILS AND GROUNDWATER**

Section 2, Figure 2.1 demonstrates the topography of the Boyne River Basin showing a generally easterly drainage pattern of the area towards the discharge of the River Boyne, via the Boyne Estuary, to the Irish Sea eastward of Drogheda. The area is bounded to the north by the Neagh-Bann River Basin District and to the west by the Shannon River Basin District with the southerly boundary forming a watershed with the Nanny-Delvin (UoM08) and Liffey-Dublin Bay (UoM09) River Basins within the Eastern District.

The geology of the Boyne River Basin, as shown in Figure B.1, consists of a geological foundation comprised of mostly dark limestone and shale, while massive unbedded lime-mudstone has a large presence in the southern half of the River Basin. Other major formations include dark quartz greywacke and conglomerate, fine to coarse-grained tubidite, and calcareous red-mica greywacke have large formations in the north, and oolitic limestone in the south. The geological foundation is much more varied in the east of the River Basin with formations of rock including dark micrite and calcarenite and shale, coarse sandstone and shale, black mudstone and siltstone and greywacke, black mudstone and quartzose greywacke, dark limestone and calcareous shale, calcareous greywacke and banded mudstone, and pale micritic grainstone-wackestone, among other smaller formations.

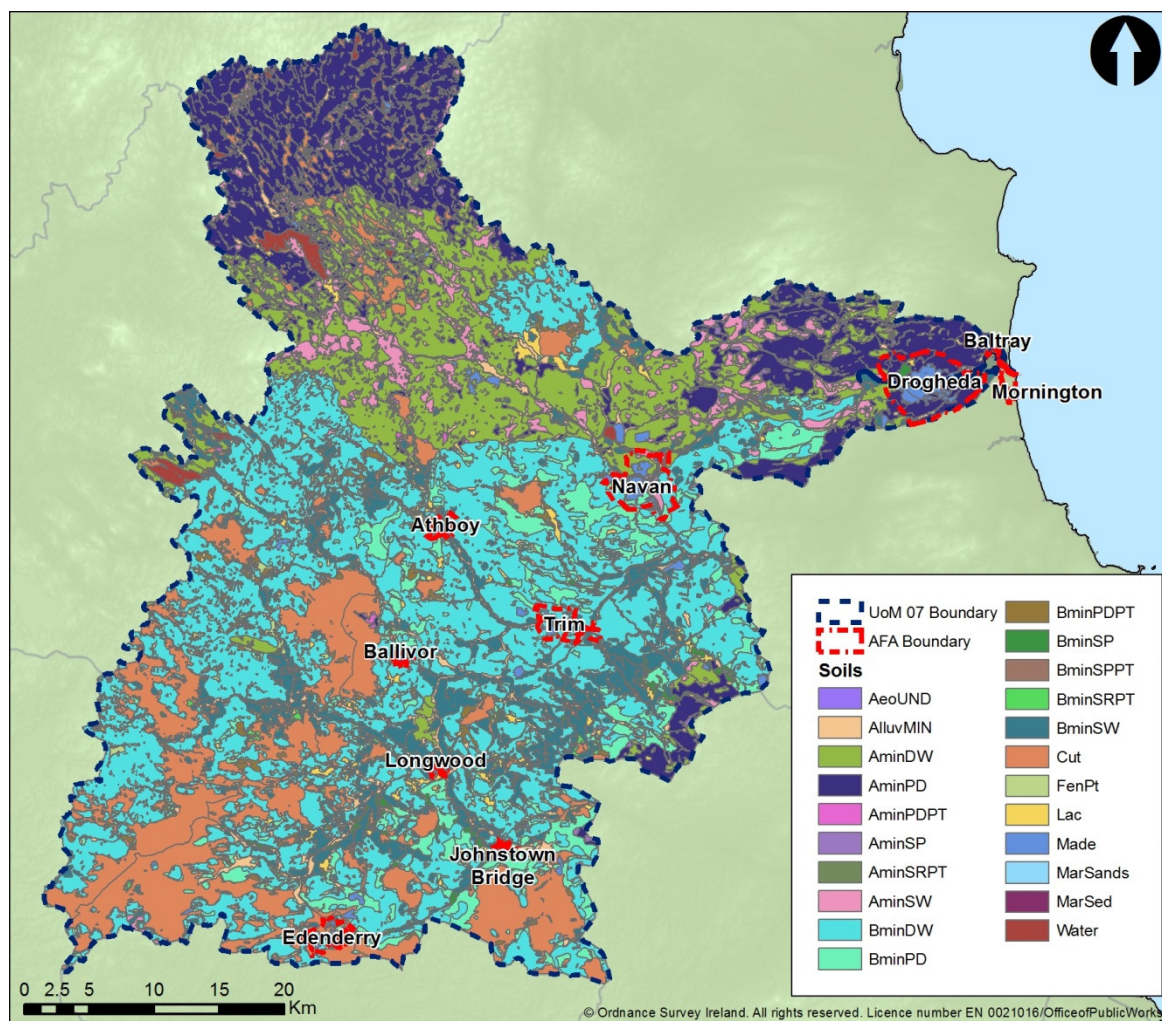
Figure B.1 also demonstrates the distribution of quarries, mines and areas of unproductive aquifers in the River Basin. These poorly productive aquifer areas can indicate areas of reduced infiltration and rejected groundwater recharge, which could contribute to flood risk. Locations where bedrock is generally unproductive are located in the east of the River Basin. Bedrock which is generally unproductive except for local zones is distributed throughout River Basin, with significant areas in the north, north east and east, while smaller unproductive aquifers are present centrally within the River Basin.

The most predominant soil types in the River Basin (Figure B.2) are deep well drained mineral soils derived from mainly calcareous parent materials including grey brown podzolics and brown earth soils are distributed over significant areas (particularly the southern two thirds of the River Basin). Deep poorly drained mineral soils including surface water and ground water Gleys derived from mainly non-calcareous parent materials, have significant presence in the north and north east, with smaller areas located along the eastern border. Cutaway/cutover basin and blanket peats have a large presence in the south, with smaller areas located in the midlands and north-west of the River Basin. The other major soil types are deep poorly drained minerals including surface water and ground water gleys derived from mainly calcareous parent materials. Large areas are located south west of Navan towards Trim, west of Athboy, north of Ballivor, south of Longwood, south east of Johnstown Bridge, and north of Edenderry.



**Figure B.1: Geology & Quarries, Mines and Unproductive Aquifers**





**Figure B.2: Soil Types**

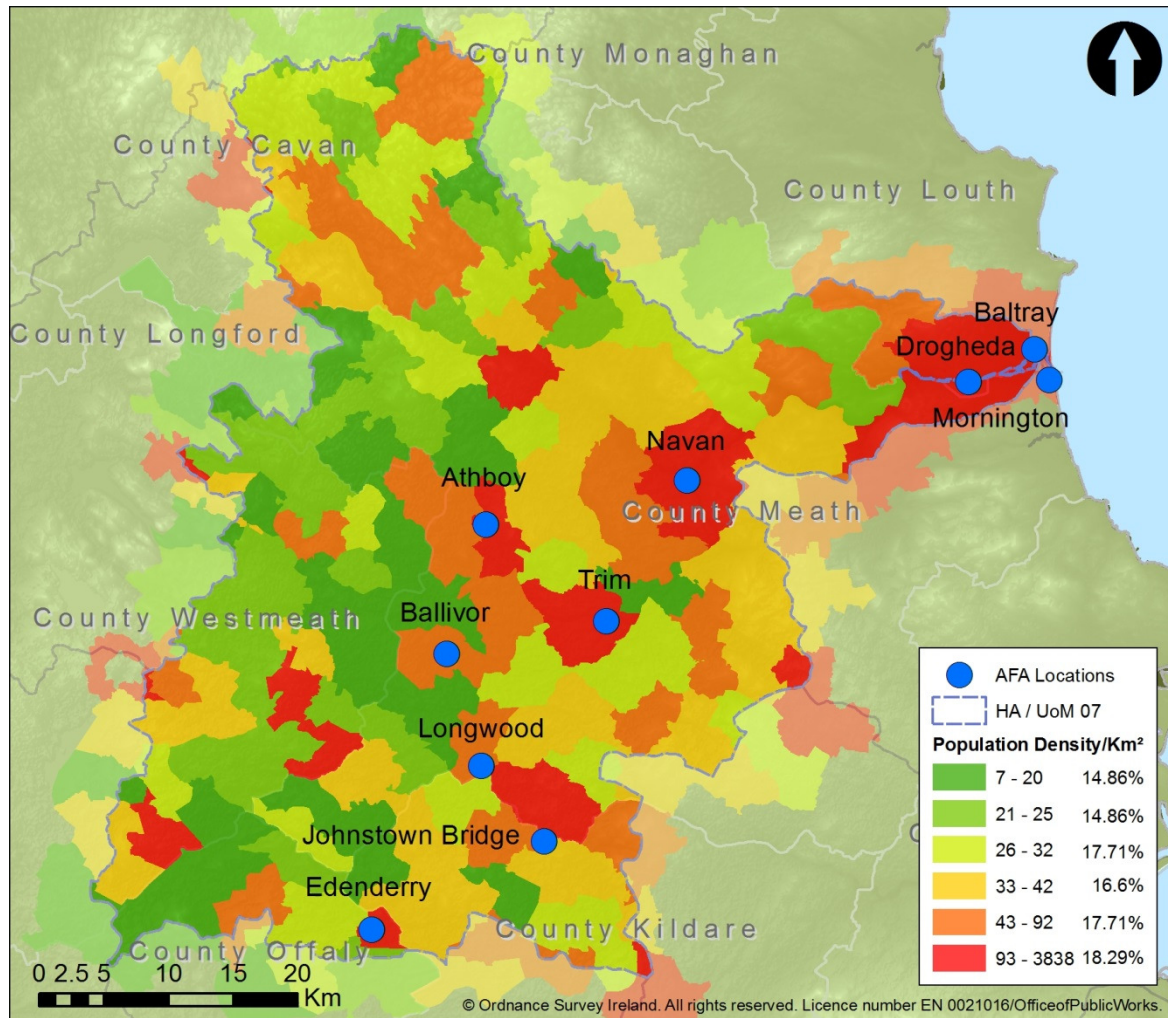
## B.2 LAND USE AND LAND MANAGEMENT

The 2011 census data held by the Central Statistics Office (CSO, 2011) show a total population for the Eastern CFRAM Study Area of approximately 1.83 million, of which 1.18 million are in County Dublin and 0.5 million in Dublin City. Population has increased in County Dublin by around 7.2% since the previous census in 2006, with counties Offaly (+8.2%), Wicklow (+8.3%), Westmeath (+8.6%), Kildare (+12.9%), Louth (+13.1%), Meath (+13.1%), and Cavan (+14.3%) also recording significant population growth over the same period.

The census also revealed the high rates of emigration, which have occurred during the economic downturn following the previous census, with a decrease of 12% since 2006 in the population of 19-24 year olds. Emigration plays a significant role in the diminishing young population, with around 30,000 young people aged between 15 and 24 leaving the country each year to seek work elsewhere. This has left behind a population with a higher proportion of aging (>65) people and particularly young people (<15) than elsewhere in Europe.

The population trend within the Eastern CFRAM Study Area is generally one of increasing growth, broadly matching the national average growth through the last census period of around 8%, although the counties adjacent to Dublin are experiencing greater rates of up

to 14%. There will be ongoing population pressure on infrastructure and resources and the provision of adequate health care resources for the expanding population, particularly in terms of the expansion of the elderly and young populations that are not economically active. The population density by electoral division for the Boyne River Basin is shown in Figure B.3 (CSO, 2011).



**Figure B.3: Population Density (population/km<sup>2</sup>) by Small Area from 2011 Census**

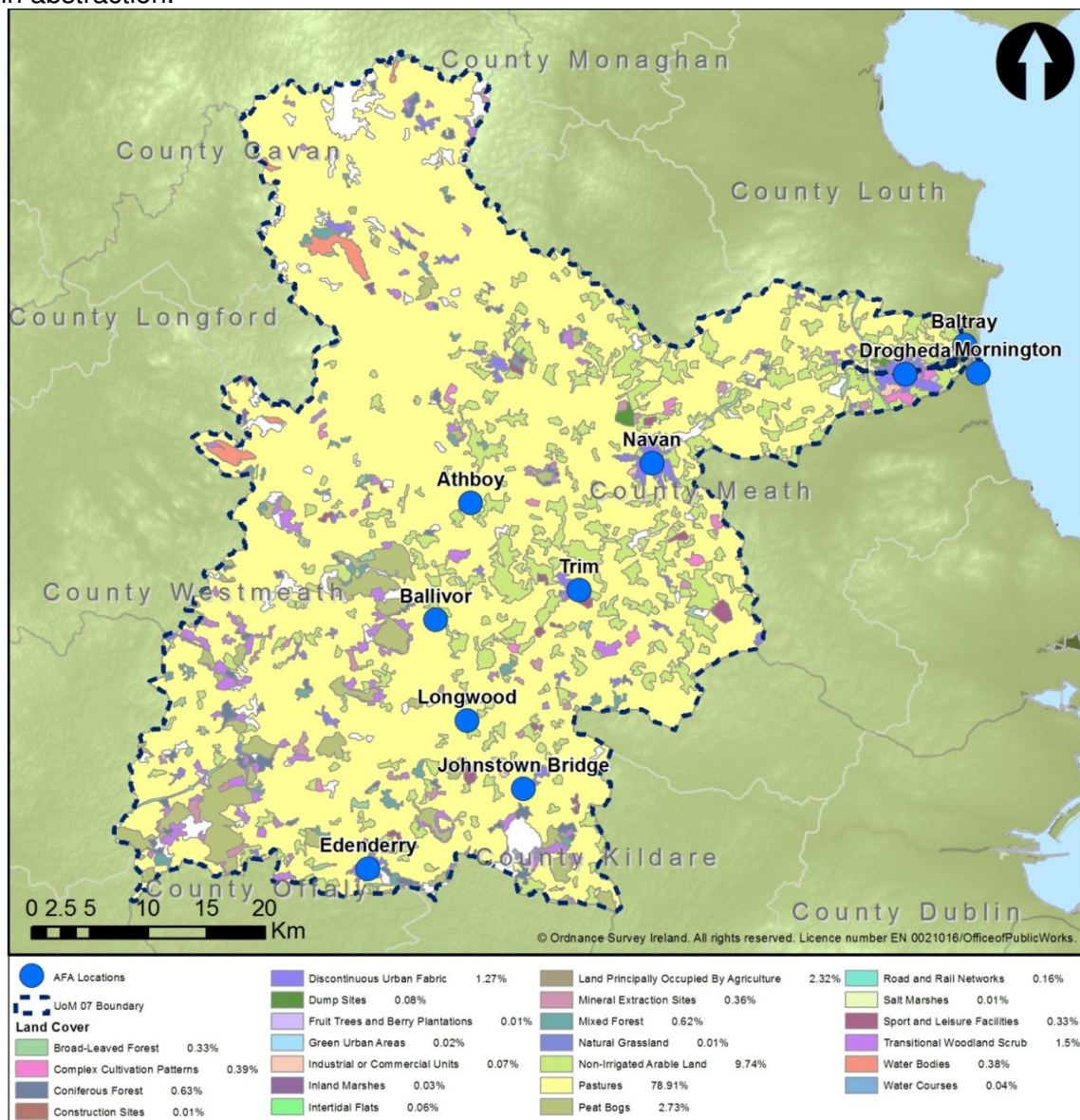
Increases in population can pose land use and land management pressures which can influence catchment response. For example, demand to increase agricultural productivity, can require associated land drainage to improve soil quality which may have effects on flood risk by increasing the speed at which water reaches the main arterial river networks.

The Eastern CFRAM Study Area is the most highly urbanised basin district in Ireland, with discontinuous urban fabric covering 6% of the area, which includes the greater Dublin area. Agricultural lands comprise over 70% of the area with the majority used for pasture (55%) to graze dairy cows, cattle, and sheep; however there are also large areas of arable land, used for the production of grains, fruit, vegetables, poultry and pigs. Peat bogs also comprise a relatively large portion of the area, covering around 7% of the land area. Two other substantial land features are the Wicklow Mountains and the extensive coast along the Irish Sea. The Wicklow Mountains located in the southern portion of the basin represent a relatively large contiguous area that remains in a natural or semi-natural state. The coastline comprising the eastern boundary is approximately 200 miles long and includes various bays, estuaries, and portions of the Irish Sea.



Land cover is dominated by agricultural pastureland; however urban areas also make a significant portion of the River Basin. While it is unlikely that the general pattern of land use will be substantially changed in the future, the increasing population will continue to drive a requirement for new housing and expansion of developed areas. The broad pattern of land cover, as shown in Figure B.4, in the River Basin has been determined from the CORINE Land Cover Database (2012) from which it can be seen that four land use types dominate the area. These are: agricultural, urban (artificial surfaces), natural areas (woodland, bogs and marshes) and coastal areas.

Increases in population also can pose development pressures resulting in changes in land use, For example increases in paved areas, which can directly affect the surface and groundwater environments through processes such as run off, infiltration and also changes in abstraction.



**Figure B.4: Land cover in the Boyne River Basin determined from the CORINE Land Cover Database**

Data from the 2000-2006 CORINE database showed an increase in urbanisation in the order of 40% with urban development increasing from 56km<sup>2</sup> to 79km<sup>2</sup>. Population increase and associated urbanisation within the River Basin is centralised around



Mornington, Drogheda and Baltray. The 2011 census recorded Drogheda (one of the most densely populated areas within the eastern region, with a population of 38,578) as having increased by 10% in population since 2006 (CSO, 2011).

### B.3 HYDROLOGY

The principal catchment characteristics for the Boyne River Basin are summarised in Table B.1.

**Table B.1** *Hydrological Catchment Characteristics in the Boyne River Basin*

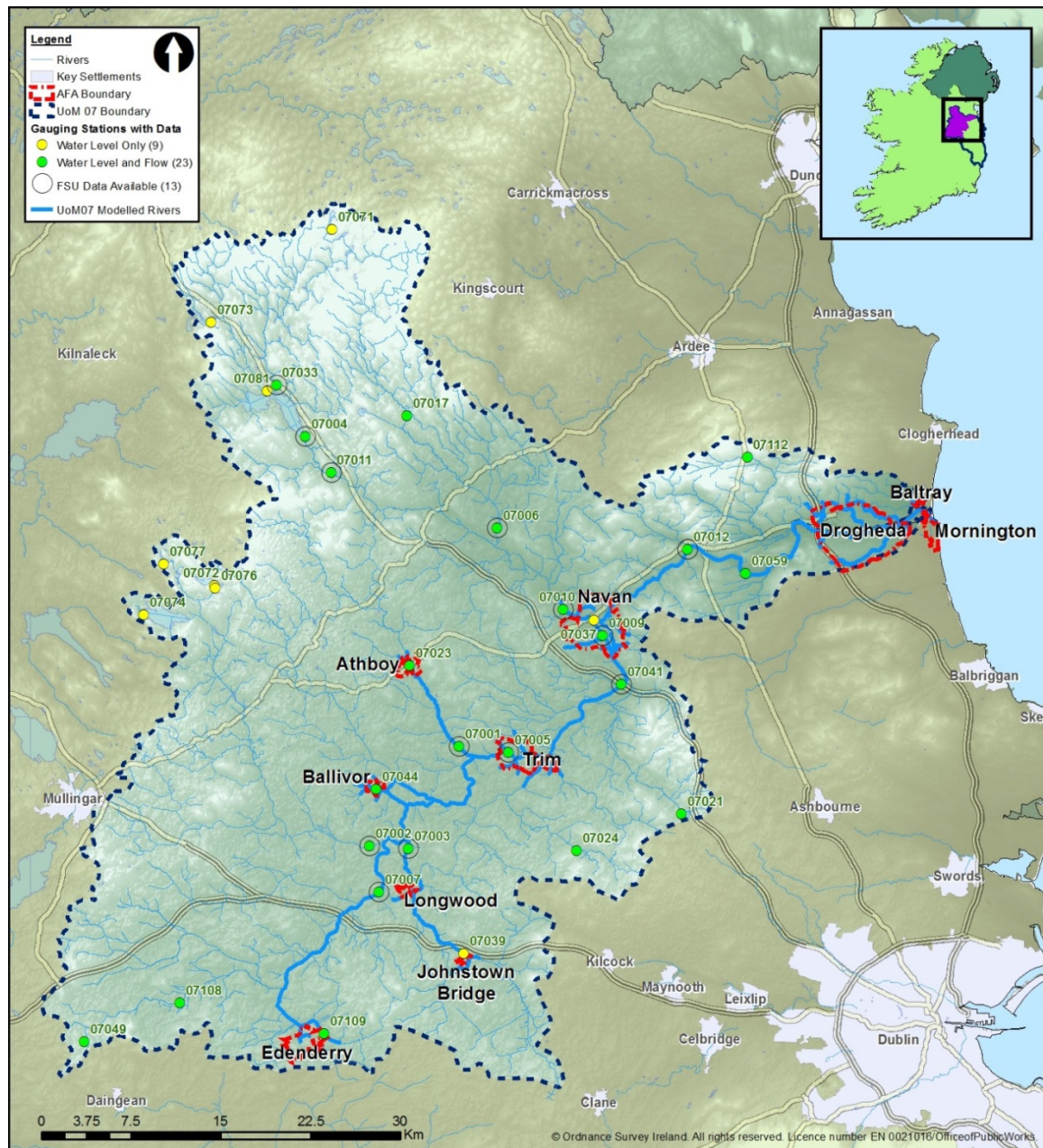
NAME	RIVER CATCHMENT	TRIBUTARIES	AREA (m <sup>2</sup> )	SLOPE (m/km)	Q <sub>MED</sub> (m <sup>3</sup> /s)
Edenderry	River Boyne	Weavers Drain	431.9	0.7	39.1
		Yellow River			
		Kilwarden River			
Ballivor	Stonyford River	Ballivor	174.6	2.0	20.4
Athboy	Tremblestown River	-	167.4	2.1	19.6
Trim	River Boyne	Knightstown Brook	1563.7	0.6	176.7
		Boycetown River			
		Stonyford River			
Johnstown Bridge, Longwood	Blackwater River	Fear English River	197.5	0.9	22.0
		Longwood Stream			
Navan	River Boyne	Blackwater (Kells)	2143.3	0.7	244.8
Drogheda, Mornington and Baltray	River Boyne	Mornington River	2690.2	0.7	277.1
		Baltray Stream			

Hydrometric data is available at 33 hydrometric gauge station locations within the Boyne River Basin as shown in Figure B.5. Fourteen stations, which are located on watercourses to be modelled have data available within the River Basin and nine of these stations were rated under FSU as having confidence in their ratings at flood flows.

In general, the River Basin can be considered to be a relatively well gauged catchment with all but the small Longwood area having at least one hydrometric gauge station with flow data available on or just upstream / downstream of the modelled watercourses.

Meteorological data is available from a number of Met Éireann daily and hourly rain gauges within the Eastern CFRAM Study Area and beyond, which was used within the hydrological analysis. In particular, within the RPS methodology the historical time series data was used as an input to catchment scale hydrological rainfall run-off models to simulate continuous flow records within a catchment. High temporal resolution data was required to achieve the required accuracy within the hydrological models. There are no hourly rain gauges within the Boyne River Basin itself. A number of Met Éireann hourly rain gauges are available with long term hourly time series data available within 50 km of the Boyne, namely at Casement, Phoenix Park and Dublin Airport to the east and south east and Mullingar, Clones and Ballyhaise to the west and north west of the River Basin. Combinations of data from these stations were used as inputs to hydrological modelling by using the area weighted thiessen polygons method to interpolate data at geographical locations between the stations. Some sub-daily historical data is also available from Local Authority rain gauges in the Dublin area also. Daily rainfall data was not considered to be of a high enough temporal resolution to be used as direct input for hydrological modelling

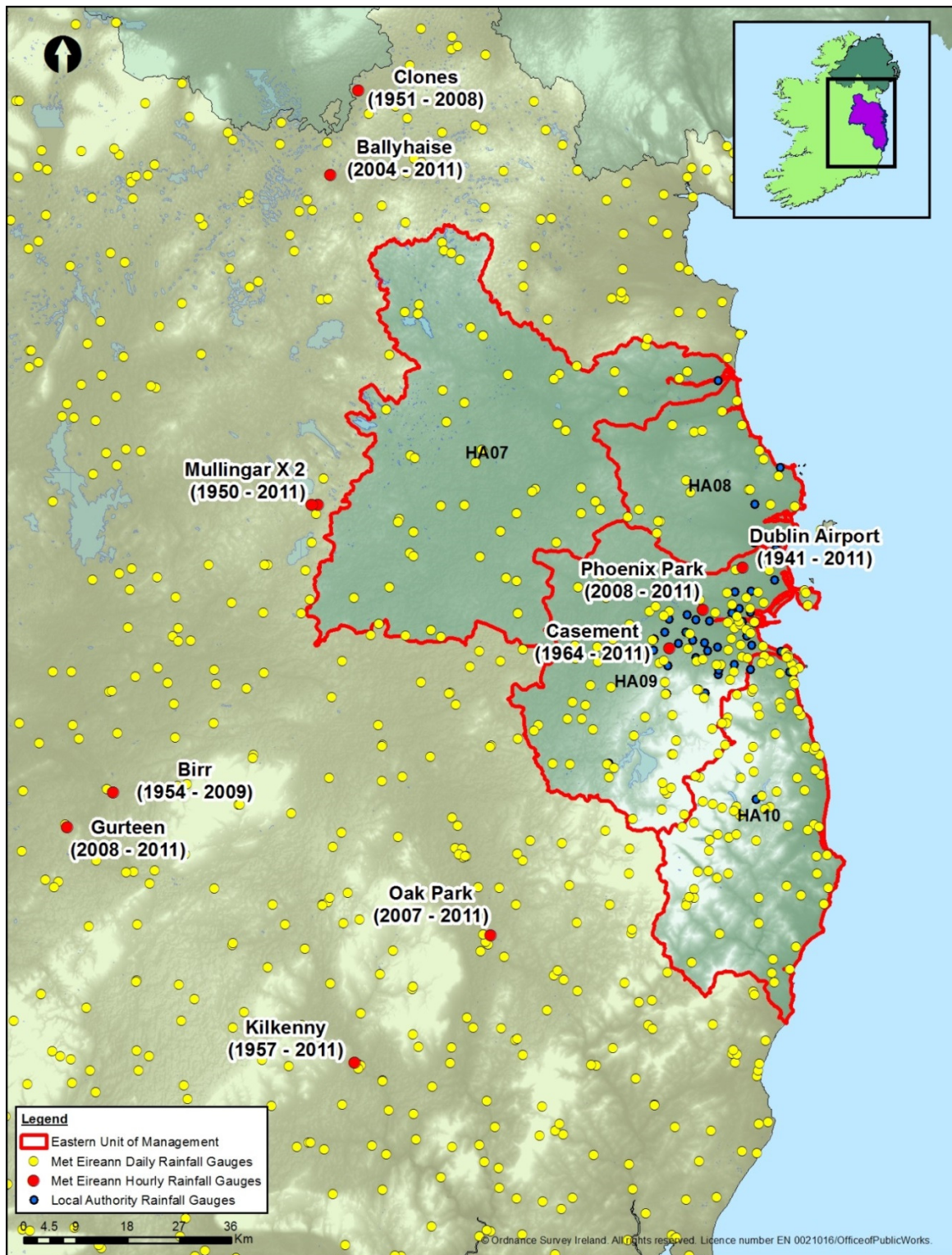
on its own but was used along with the hourly data to inform the spatial distribution of hourly rainfall data within the catchments.



**Figure B.5: Hydrometric Data Availability**

In addition to the observed historical rainfall data available at the aforementioned rain gauge locations, further meteorological information is required as input to hydrological models namely observed evaporation, soil moisture deficits and potential evapotranspiration data. Historical time series data is available for these parameters at Met Éireann synoptic weather stations. The locations for which historical data is available is generally the same as for hourly rainfall data and is available at Casement, Phoenix Park, Dublin Airport, Mullingar, Clones and Ballyhaise. This additional meteorological data was found to be of sufficient availability to be used as input to the hydrological models. Figure B.6 shows the locations of all of the rain gauges available and the availability of historic information at the hourly rainfall gauges.





**Figure B.6: Meteorological Data Availability**

Radar trials were undertaken on the Dodder catchment in the Liffey-Dublin Bay River Basin (UoM09) (IBE0600Rp0007 Eastern CFRAM Study, Dublin Radar Data Analysis for the Dodder Catchment, Stage 1, RPS / Hydrologic, 2012) and the Athboy catchment in the Boyne River Basin (UoM07) (IBE0600Rp0013 Athboy Radar Analysis). Radar derived rainfall sums were adjusted against the available rain gauge data to produce an adjusted hourly gridded time series of rainfall data. When compared to the area-weighted derived rainfall series from the gauge data alone, the use of the radar data was shown to bring significant improvements to the rainfall data for hydrological rainfall run-off modelling input

in terms of spatial distribution of the rainfall, the peak discharges and the timing of the peak discharges. Simulated hydrograph shapes and the overall water balance error margins were also shown to be significantly improved

Following approval from OPW, historical data from the Met Éireann radar located at Dublin Airport for the entire Eastern CFRAM Study Area was processed for use in the Eastern CFRAM Study. Following processing of this radar dataset rainfall sums were available for every hour at the vast majority of the 1km<sup>2</sup> grid squares within the Boyne River Basin for the calendar years 1998 - 2010. During the processing the rainfall sums have been adjusted spatially and temporally so as to match the daily and hourly sums at the rain gauges and as such RPS considers this processed dataset to be of high accuracy and high resolution.

Hydrological methodologies published in the Flood Studies Update have been used as the core methodologies upon which the hydrological analysis has been undertaken. In the case of the Boyne, these methods have been complemented with the use of hydrological techniques published in the Flood Studies Report (FSR). These dual analyses were deemed appropriate for both comparison and design flow estimation, alongside using the hydrological rainfall run-off based modelling methods described previously. Full details of the methodology, datasets used and outcomes of the hydrological analysis for the Eastern CFRAM Study Area can be found at [www.floodinfo.ie](http://www.floodinfo.ie).

## **APPENDIX C**

### **SUMMARY OF THE PRELIMINARY FLOOD RISK ASSESSMENT**

#### **C.1 INTRODUCTION**

The Preliminary Flood Risk Assessment (PFRA) is a national screening exercise, based on available and readily-derivable information, to identify areas where there may be a significant risk associated with flooding.

The PFRA in Ireland was finalised in December 2011, following public consultation.

#### **C.2 OVERVIEW OF THE PFRA**

The objective of the PFRA is to identify areas where the risks associated with flooding might be significant. These areas (referred to as Areas for Further Assessment, or 'AFAs') are where more detailed assessment will then be undertaken to more accurately assess the extent and degree of flood risk, and, where the risk is significant, to develop where possible measures to manage and reduce the risk. The more detailed assessment, that focussed on the AFAs, was undertaken through the National CFRAM Programme or parallel studies.

It is important to note that the PFRA is not a detailed assessment of flood risk. It is rather a broad-scale assessment, based on available or readily-derivable information, to identify where there is a genuine cause for concern that may require national intervention and assessment, rather than locally developed and implemented solutions.

Three key approaches have been used in undertaking the PFRA to identify the AFAs. These are:

- Historic Analysis: The use of information and records on floods that have happened in the past
- Predictive Analysis: Undertaking analysis to determine which areas might flood in the future, as determined by predictive techniques such as modelling, analysis or other calculations, and of the potential damage that could be caused by such flooding
- Consultation: The use of local and expert knowledge of the local authorities and other Government departments and agencies to identify areas prone to flooding and the potential consequences that could arise

The assessment considered all types of flooding, including natural sources, such as that which can occur from rivers, the sea and estuaries, heavy rain and groundwater, and the failure of built infrastructure. It has also considered the impacts flooding can have on people, property, businesses, the environment and cultural heritage.

Other EU Member States have used similar approaches to undertaking the PFRA as that undertaken in Ireland.

The 'Floods' Directive does not provide a definition for 'significant' flood risk. A highly prescriptive definition is not suitable given the preliminary nature of the PFRA, and so a set of guiding principles were defined. It should however be remembered that, while flooding of one home will be traumatic to the owner or residents of that home, the PFRA needs to consider what is nationally or regionally significant flood risk.

The provisional identification of the AFAs has involved interpretation of information from all three of the above approaches. The final designation of the AFAs also took into account information and views provided through the public consultation and arising from on-site inspections that were undertaken in parallel with the consultation.

### **C.3 PUBLIC CONSULTATION ON THE PFRA**

The 'Floods' Directive requires Member States to publish the PFRA once completed. However, the OPW has also publicly consulted on a draft of the PFRA before it was finalised, published and reported to the European Commission.

Consultation with various bodies has been undertaken during the preparation of the draft PFRA, which has included two rounds of workshops (Summer 2010 and Winter 2010-2011) involving all local authorities. During these workshops, the local authorities provided information on areas known or suspected to be at risk from flooding, and reviewed provisional Areas for Further Assessment (AFAs) identified by the OPW in relation to fluvial and coastal flood risk.

Consultation was also held with the following organisations to inform the process and draft outcomes of the PFRA:

- Dept. Agriculture, Food and the Marine
- Dept. of Culture, Heritage and the Gaeltacht
  - *National Monuments*
  - *National Parks and Wildlife Service*
- Environmental Protection Agency
- ESB
- Geological Survey of Ireland
- Health Service Executive
- Transport Infrastructure Ireland (formerly National Roads Authority)
- Waterways Ireland

Discussions were also held with utility operators in relation to the location and potential vulnerability of utility infrastructure.

The OPW published the Draft PFRA for consultation on the National CFRAM Programme website (now closed) in August 2011, and placed it on public exhibition in the principal offices of all city and county councils on the same date. While not a requirement of the Directive, SI No. 122 of 2010 set out a requirement for public consultation on the PFRA. The public consultation period began upon publication of the PFRA and extended to 1<sup>st</sup> November 2011. Submissions were invited in writing, by email, or via the website.

A total of 52 submissions were received under the public consultation process. A breakdown of the source of submissions is set out below:

County and City Councils	18
Councillors	4
Members of the Public	15
Community Groups / Associations	5
Other	10

The principal issues raised in the submissions include the following:

- Recommendations for the inclusion of locations for designation as AFAs, and / or expressions of concern related to past flooding, or the potential for flooding, of a particular location
- Comments that certain bodies, and / or their past or ongoing actions, were responsible for causing or aggravating flooding or flood problems
- Requests for inclusion in the consultation / engagement process for the CFRAM Studies
- Comments relating to past planning decisions and / or recommendations for changes to planning law
- Queries on the accuracy of, or suggested correction to, the PFRA maps
- Recommendations as to how flood risk in a location / region could be managed, or concerns as to how future flood risk management could have detrimental impacts

Only a very small number of submissions (7) included comments (positive or negative) on the PFRA process and / or the PFRA consultation process. These were carefully considered by the OPW and it was concluded that there was no basis to amend the PFRA process given nature of the exercise.

All submissions were also considered, in parallel with the findings of the Flood Risk Review (see below), in the final designation of the AFAs.

## **C.4 FLOOD RISK REVIEWS**

To assist in the final designation of AFAs, it was deemed appropriate that the probable and possible AFAs be inspected on-site, informed by the PFRA data and findings, by suitably qualified professionals.

The on-site inspections, referred to as Flood Risk Reviews (FRRs), were undertaken by the Consultants. The inspections included a prior review of available relevant information (such as the PFRA data and findings), interviews with local residents and / or local authority staff (where possible), and an on-site inspection of the AFA to confirm, through duly informed professional opinion, the likely flood extents and potential receptors.

Following the FRR, the Consultants submitted to the OPW FRR reports that set out the FRR process, described their findings and made recommendations as to whether or not a location should be designated as an AFA. The final FRR reports are available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

The CFRAM Steering and Progress Groups (comprising representatives of the local authorities, regional authorities and the EPA as well as of the OPW <sup>2</sup>) considered the FRR reports and their recommendations, and expressed their opinions on the designation of AFAs to the OPW. The OPW has taken these opinions into consideration in the final designation of AFAs.

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<sup>2</sup> Representatives of the Rivers Agency of Northern Ireland are also members of the Steering and Progress Groups for CFRAM Studies that cover cross-border catchments.



## **C.5 OUTCOMES OF THE PFRA**

The communities designated as AFAs are set out in Section 3 herein.

Full information on the PFRA, including the outcomes nationally, are set out in the Main Report of the PFRA and the Report on the Designation of the Areas for Further Assessment, which are both available from the OPW website ([www.floodinfo.ie](http://www.floodinfo.ie)).

## **APPENDIX D**

### **STAKEHOLDER AND PUBLIC ENGAGEMENT AND CONSULTATION**

#### **APPENDIX D.1 Membership of the National CFRAM Steering Group**

- Office of Public Works
- County and City Managers Association
- Dept. Housing, Planning and Local Government
- Dept. Agriculture, Food and the Marine
- Dept. of Culture, Heritage and the Gaeltacht
- Environmental Protection Agency
- Electricity Supply Board
- Geological Survey of Ireland (Dept. of Communications, Climate Action and Environment)
- Irish Water
- Met Eireann
- Office of Emergency Planning
- Rivers Agency (Northern Ireland)
- Waterways Ireland

#### **APPENDIX D.2 Membership of the Eastern CFRAM Steering Group**

- Office of Public Works
- RPS
- Environmental Protection Agency
- WFD Local Authorities Water and Communities Office LAWCO
- Cavan County Council
- Dún Laoghaire - Rathdown County Council
- Dublin City Council
- Fingal County Council
- Kildare County Council
- Louth County Council
- Meath County Council
- Offaly County Council
- South Dublin County Council
- Westmeath County Council
- Wexford County Council
- Wicklow county Council
- Mid-East Regional Authority
- Dublin and Mid-Eastern Regional Authority

## APPENDIX D.3 Organisations Invited to Meetings of the National Stakeholder Group

*Table D.3.1 Organisations Invited to Meetings of the National Stakeholder Group*

An Bord Pleanála	Iarnród Éireann	Irish Small and Medium Enterprises Association
An Taisce	Industrial Development Agency	Irish Water
Association of Consulting Engineers of Ireland (ACEI)	Inland Fisheries Ireland	Irish Water and Fish Preservation Society
Badgerwatch	Inland Waterways Association of Ireland	Irish Wildlife Trust
Bat Conservation Ireland	Institute of Professional Auctioneers and Valuers	IRLOGI
BirdWatch Ireland	Insurance Ireland	Landscape Alliance Ireland
Bord Gáis Networks	Irish Academy of Engineering	Macra na Feirme
Bord na Mona	Irish Angling Development Alliance	Marine Institute
Canoeing Ireland	Irish Business and Employers Confederation (IBEC)	National Anglers Representative Association
Chambers Ireland	Irish Co-Operative Organisation Society	Transport Infrastructure Ireland (formerly National Roads Authority)
CIWEM Ireland	Irish Countrywomen's Association	Native Woodland Trust
Coarse Angling Federation of Ireland	Irish Creamery Milk Suppliers Association (ICMSA)	Recreational Angling Ireland
Coastal and Marine Resources Centre	Irish Farmers Association (IFA)	Rivers Agency (NI)
Coastwatch Ireland	Irish Federation of Pike Angling Clubs	Rowing Ireland
Coillte	Irish Federation of Sea Anglers	Royal Town and Planning Institute (RTPI)
Construction Industry Federation (CIF)	Irish Marine Federation / Irish Boat Rental Association	Society of Chartered Surveyors of Ireland (SCSI)
Council of Cultural Institutes	Irish National Committee of Blue Shield	St. Vincent de Paul
Dublin City Council / Dublin Flood Forum	Irish National Flood Forum	Sustainable Water Network (SWAN)
Eircom	Irish Natural Forestry Foundation	Teagasc
EirGrid	Irish Peatland Conservation Council	The Heritage Council
Engineers Ireland	Irish Planning Institute (IPI)	Trout Anglers Federation of Ireland
Health Services Executive (HSE)	Irish Red Cross	

## APPENDIX D.4 Organisations Represented at Meetings of the Eastern CFRAM Stakeholder Group

*Table D.4 Organisations Represented at Meetings of the Eastern CFRAM Stakeholder Group*

Scoping Phase	26.01.2012	Bord na Mona
Scoping Phase	26.01.2012	Electricity Supply Board
Scoping Phase	26.01.2012	Sustainable Water Network
Scoping Phase	26.01.2012	Irish Farmers Association
Scoping Phase	26.01.2012	Dublin and Mid-East Regional Authority
Scoping Phase	26.01.2012	Dublin Airport Authority
Scoping Phase	26.01.2012	Wicklow County Council
Scoping Phase	26.01.2012	Electricity Supply Board
Scoping Phase	26.01.2012	Railway Procurement Authority
Scoping Phase	26.01.2012	Inland Fisheries Ireland
Scoping Phase	26.01.2012	Waterways Ireland
Scoping Phase	26.01.2012	Bat Conservation Ireland
Scoping Phase	26.01.2012	Louth County Council
Scoping Phase	26.01.2012	Dublin Bus
Scoping Phase	26.01.2012	EirGrid
Scoping Phase	26.01.2012	Dept. of Culture, Heritage and the Gaeltacht
Scoping Phase	26.01.2012	South Dublin County Council
Scoping Phase	26.01.2012	National Transport Authority
Scoping Phase	26.01.2012	The Office of Public Works
Scoping Phase	26.01.2012	Louth Local Authorities
Scoping Phase	26.01.2012	Birdwatch Ireland
Scoping Phase	26.01.2012	IBEC
Scoping Phase	26.01.2012	Canoeing Ireland
Scoping Phase	26.01.2012	Louth County Council
Scoping Phase	26.01.2012	Meath County Council
Scoping Phase	26.01.2012	Dún Laoghaire - Rathdown County Council
Scoping Phase	26.01.2012	Dublin Docklands Development Authority
Scoping Phase	26.01.2012	Irish Creamery Milk Suppliers Association
Scoping Phase	26.01.2012	Eastern River Basin District
Scoping Phase	26.01.2012	Coastwatch
Scoping Phase	26.01.2012	WCA Architects
Scoping Phase	26.01.2012	Environmental Protection Agency
Scoping Phase	26.01.2012	Dublin City Council
Scoping Phase	26.01.2012	Fearon O'Neill Rooney
Scoping Phase	26.01.2012	Fingal County Council
Camac Poddle	05.06.2013	Fingal County Council
Camac Poddle	05.06.2013	Electricity Supply Board Networks
Camac Poddle	05.06.2013	Inland Fisheries Ireland
Camac Poddle	05.06.2013	Waterways Ireland

Camac Poddle	05.06.2013	The Office of Public Works
Camac Poddle	05.06.2013	South Dublin County Council
Camac Poddle	05.06.2013	Fearon O'Neill Rooney
Camac Poddle	05.06.2013	WCA Architects
Camac Poddle	05.06.2013	Dept. of Culture, Heritage and the Gaeltacht
Camac Poddle	05.06.2013	Dublin City Council
Camac Poddle	05.06.2013	National Parks and Wildlife Service
Camac Poddle	05.06.2013	Railway Procurement Authority
Camac Poddle	05.06.2013	Eastern River Basin District
Mapping Phase	24.09.2015	The Office of Public Works
Mapping Phase	24.09.2015	Electricity Supply Board Networks
Mapping Phase	24.09.2015	PUNCH Consulting Engineers
Mapping Phase	24.09.2015	Louth County Council
Mapping Phase	24.09.2015	Environmental Protection Agency
Mapping Phase	24.09.2015	Wicklow County Council
Mapping Phase	24.09.2015	Dublin City Council
Mapping Phase	24.09.2015	IBEC
Mapping Phase	24.09.2015	Kildare County Council
Mapping Phase	24.09.2015	South Dublin County Council
Mapping Phase	24.09.2015	Dublin Trout Anglers Association
Mapping Phase	24.09.2015	Kildare County Council
Mapping Phase	24.09.2015	Dept. of Culture, Heritage and the Gaeltacht
Mapping Phase	24.09.2015	Coastwatch Europe
Mapping Phase	24.09.2015	Fingal County Council
Mapping Phase	24.09.2015	Meath County Council
Mapping Phase	24.09.2015	Dept. of Agriculture
Mapping Phase	24.09.2015	Transport Infrastructure Ireland
Mapping Phase	24.09.2015	Inland Fisheries Ireland
Mapping Phase	24.09.2015	South Dublin Chambers
Options Phase	20.04.2016	Sustainable Water Network
Options Phase	20.04.2016	Inland Fisheries Ireland
Options Phase	20.04.2016	Dún Laoghaire - Rathdown County Council
Options Phase	20.04.2016	Dublin City Council
Options Phase	20.04.2016	Electricity Supply Board
Options Phase	20.04.2016	Louth County Council
Options Phase	20.04.2016	Kildare County Council
Options Phase	20.04.2016	Fingal County Council
Options Phase	20.04.2016	Wicklow County Council
Options Phase	20.04.2016	South Dublin County Council
Options Phase	20.04.2016	The Office of Public Works
Options Phase	20.04.2016	Dept. of Culture, Heritage and the Gaeltacht
Draft FRMP Phase	18.10.2016	Inland Fisheries Ireland
Draft FRMP Phase	18.10.2016	ESB Networks

Draft FRMP Phase	18.10.2016	Sustainable Water Network
Draft FRMP Phase	18.10.2016	Kildare County Council
Draft FRMP Phase	18.10.2016	Dún Laoghaire - Rathdown County Council
Draft FRMP Phase	18.10.2016	Punch Consulting Engineers
Draft FRMP Phase	18.10.2016	Oversight Property Consultants
Draft FRMP Phase	18.10.2016	LAWCO
Draft FRMP Phase	18.10.2016	Fingal County Council
Draft FRMP Phase	18.10.2016	Dublin Bus

## **APPENDIX D.5 Public Consultation Days Held at the Flood Mapping Stage in the Boyne River Basin**

*Table D.5 Flood Mapping PCDs Held in the Boyne River Basin*

AFA	Date	Venue	No. Attendees
Athboy	24.03.2015	Athboy Library	2
Ballivor	02.03.2015	Ballivor Credit Union	7
Baltray	16.03.2015	The Gatehouse Grill	27
Drogheda	12.03.2015	Drogheda Library	10
Edenderry	19.03.2015	Edenderry Town Hall	12
Johnstown Bridge	17.02.2016	Hamlet Court Hotel	3
Longwood	23.03.2015	Longwood GAA Club	4
Mornington	16.03.2015	Colaiste na Hinse	16
Navan	24.03.2015	Navan Library	10
Trim	23.03.2015	OPW Head Office	19

## **APPENDIX D.6 Public Consultation Days Held at the Flood Risk Management Optioneering Stage in the Boyne River Basin**

*Table D.6 Flood Risk Management Optioneering PCDs Held in the Boyne River Basin*

AFA	Date	Venue	No. Attendees
Athboy			
Ballivor			
Baltray	09.03.2016	The Gatehouse Grill	17
Drogheda	10.03.2016	Drogheda Library	7
Edenderry			
Johnstown Bridge	17.02.2016	Hamlet Court Hotel	3
Longwood			
Mornington	09.03.2016	Colaiste na Hinse	15
Navan	16.02.2016	Navan Library	10
Trim	15.02.2016	OPW Head Office	7

## **APPENDIX D.7 Public Consultation Days Held at the Draft Flood Risk Management Plan Stage in the Boyne River Basin**

**Table D.7**      *Draft Flood Risk Management Plan PCDs Held in the Boyne River Basin*

AFA	Date	Venue	No. Attendees
Allenwood, Athy, Blessington, Castledermot, Celbridge, Clane, Hazelhatch, Johnstown Bridge, Leixlip, Kilcock, Maynooth, Monasterevin, Naas, Newbridge, Rathangan, Suncroft, Turnings/Kileenmore.	27.09.2016	Kildare County Council Devoy Park Naas	16
Athboy, Ballivor, Bettystown, Drogheda (south), Gormanston, Kilcock, Longwood, Maynooth, Mornington, Navan, Ratoath, Trim	04.10.2016	Navan Library Railway Street Navan	6
Trim	05.10.2016	The Office of Public Works Jonathan Swift Street Trim	6
Drogheda, Termonfeckin, Baltray	25.10.2016	Drogheda Library Stockwell Lane Drogheda	14



## **APPENDIX E**

### **DESCRIPTION OF THE FLOOD RISK IN EACH AFA**

The numbers of properties at risk and the damage values set out herein are as understood under current conditions and at this stage of assessment. The numbers and values may change when the risk is assessed in more detail at the project-level of development of measures and/or due to the potential impacts climate change, future development and inflation. The numbers presented are determined independently for each source of flooding. For AFAs which are affected by more than one source of flooding, some properties may be at risk by more than one source, and as such properties may have been included in the numbers for both sources.

#### ***E.1 Flood Risk Analysis and Mapping - Athboy AFA***

Fluvial flooding is predicted, during the 1% AEP event, affecting a local road upstream of properties within Athboy; there are no properties at flood risk during this event.

The model was calibrated to the available spot gaugings at the Athboy gauging station and the roughness values of the model adjusted accordingly, however, there is little quantitative data available to calibrate the Athboy model to the larger flood events and further observations would be necessary to reduce uncertainty in model results.

Athboy is considered to be at low risk during the present day 1%AEP fluvial event and optioneering has not been undertaken, consequently, the existing regime should continue in order to maintain the current SoP.

The event damages and numbers of assets at risk in the present day and future scenarios are summarised in the following table.

**Athboy AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	0	0	184,907
No. Residential Properties at Risk	0	0	4
No. Business Properties at Risk	0	0	1
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	1	1	1
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	6	6	7
No. Environmental Assets at Risk	3	3	3
No. Potential Pollution Sources at Risk	0	0	0

Mid-Range Future Scenario			
Event Damage (€)	2,078	31,494	365,353
No. Residential Properties at Risk	0	3	5
No. Business Properties at Risk	1	2	3
No. Utilities at Risk	1	1	1
No. Major Transport Assets at Risk	2	2	2
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	6	7	7
No. Environmental Assets at Risk	3	3	3
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	53,000	854,482	4,820,225
No. Residential Properties at Risk	4	8	30
No. Business Properties at Risk	3	4	15
No. Utilities at Risk	1	1	4
No. Major Transport Assets at Risk	2	2	4
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	7	7	11
No. Environmental Assets at Risk	3	3	3
No. Potential Pollution Sources at Risk	0	0	0

## ***E.2 Flood Risk Analysis and Mapping - Ballivor AFA***

Fluvial flooding is predicted during the 1% AEP event within the AFA from the Ballivor River with a small number of local roads in the floodplain affected. There is no risk to residential or non-residential properties during this flood event.

The Ballivor model was calibrated to the available spot gaugings at the Ballivor gauging station and the roughness values of the model adjusted accordingly. Limited verification was achieved whereby the areas shown to flood by the model are reported to have historically flooded, however, there is little or poor data to calibrate the model to and observation of more events would be necessary to reduce the uncertainty in model results.

Ballivor is considered to be at low risk during the present day 1%AEP fluvial event and optioneering has not been undertaken, consequently the existing regime should continue in order to maintain the current SoP.

The event damages and numbers of assets at risk in the present day and future scenarios are summarised in the following table.

**Ballivor AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	0	0	69,862
No. Residential Properties at Risk	0	0	3
No. Business Properties at Risk	0	0	3
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	2	3	4
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	1	2
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	0	18,429	652,622
No. Residential Properties at Risk	0	1	18
No. Business Properties at Risk	0	2	5
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	2	3	8
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	1	3
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	102,406	560,590	19,588,238
No. Residential Properties at Risk	2	10	212
No. Business Properties at Risk	5	6	10
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	3	7	22
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	2	3	7
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0

### E.3 Flood Risk Analysis and Mapping - Baltray AFA

Baltray is affected by both fluvial and coastal mechanisms. There are a number of residential properties at risk of flooding during the 1/0.5% AEP events as well as a small number of business properties. Roads including a regional road are at flood risk along with environment and social infrastructure assets.

There is good confidence in both the hydrology and hydraulics of the Baltray.

The event damages and numbers of assets at risk in the present day and future scenarios associated with the two CFRAM flooding mechanisms applicable to Baltray; fluvial and coastal (tidal inundation), are summarised in the following table.

**Baltray AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	528,849 Fluvial 1,690,655 Coastal	615,063 Fluvial 5,203,993 Coastal	884,712 Fluvial 6,340,458 Coastal
No. Residential Properties at Risk	23 Fluvial 33 Coastal	26 Fluvial 40 Coastal	30 Fluvial 44 Coastal
No. Business Properties at Risk	2 Fluvial 2 Coastal	2 Fluvial 5 Coastal	2 Fluvial 5 Coastal
No. Utilities at Risk	2 Fluvial 2 Coastal	2 Fluvial 2 Coastal	2 Fluvial 2 Coastal
No. Major Transport Assets at Risk	5 Fluvial 5 Coastal	5 Fluvial 5 Coastal	5 Fluvial 5 Coastal
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	10 Fluvial 11 Coastal	11 Fluvial 12 Coastal	11 Fluvial 13 Coastal
No. Environmental Assets at Risk	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal
No. Potential Pollution Sources at Risk	0	0	0

Mid-Range Future Scenario			
Event Damage (€)	4,448,893 Fluvial 5,832,344 Coastal	4,630,787 Fluvial 7,509,151 Coastal	5,314,789 Fluvial 8,163,136 Coastal
No. Residential Properties at Risk	40 Fluvial 42 Coastal	40 Fluvial 44 Coastal	41 Fluvial 45 Coastal
No. Business Properties at Risk	3 Fluvial 5 Coastal	4 Fluvial 5 Coastal	5 Fluvial 5 Coastal
No. Utilities at Risk	2 Fluvial 2 Coastal	2 Fluvial 2 Coastal	2 Fluvial 2 Coastal
No. Major Transport Assets at Risk	7 Fluvial 7 Coastal	8 Fluvial 7 Coastal	9 Fluvial 8 Coastal
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	13 Fluvial 13 Coastal	13 Fluvial 13 Coastal	13 Fluvial 13 Coastal
No. Environmental Assets at Risk	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	6,702,250 Fluvial 7,893,999 Coastal	6,983,015 Fluvial 9,021,685 Coastal	7,562,417 Fluvial 9,743,304 Coastal
No. Residential Properties at Risk	44 Fluvial 45 Coastal	44 Fluvial 48 Coastal	45 Fluvial 48 Coastal
No. Business Properties at Risk	5 Fluvial 5 Coastal	5 Fluvial 5 Coastal	5 Fluvial 5 Coastal
No. Utilities at Risk	2 Fluvial 2 Coastal	2 Fluvial 2 Coastal	2 Fluvial 2 Coastal
No. Major Transport Assets at Risk	8 Fluvial 7 Coastal	8 Fluvial 8 Coastal	9 Fluvial 8 Coastal
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	13 Fluvial 13 Coastal	13 Fluvial 13 Coastal	13 Fluvial 13 Coastal
No. Environmental Assets at Risk	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal
No. Potential Pollution Sources at Risk	0	0	0

#### **E.4 Flood Risk Analysis and Mapping - Drogheda AFA**

The main predicted flood risk within Drogheda is to receptors adjacent to the channel of the River Boyne due to high coastal and/or fluvial water levels. Coastal and fluvial flood mechanisms operate in tandem and the flood extents from both mechanisms overlap to some degree. The downstream portion of the Ushers Stream is affected both by culvert capacity and by tidal levels in the Boyne causing the discharge in the culvert to back up. There are two other locations of fluvially dominated flooding further upstream on this tributary watercourse. Two further discrete fluvially affected areas, each with few properties at risk are located on smaller tributaries within Drogheda. There are a significant number of both residential and business properties at flood risk during the 1% fluvial and 0.5% AEP coastal events (with a portion of these related to commercial activities associated with, and supporting, Drogheda Port and also including several social infrastructure assets Homeless Centre, Post Office, Library, and social amenity sites). Cultural heritage assets and transport infrastructure also located on the floodplain.

There is good confidence in both the hydrology and hydraulics of the Drogheda, particularly along the Boyne channel where there are high quality long term gauging station records and good flood extent verification events. Maintenance carried out by Drogheda Port Company on the main channel of the Boyne (largely dredging works) forms a significant part of the ongoing regime.

The event damages and numbers of assets at risk in the present day and future scenarios associated with the two CFRAM flooding mechanisms applicable to Drogheda; fluvial and coastal (tidal inundation), are summarised in the following table.

**Drogheda AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	5,840,474 Fluvial 10,542,153 Coastal	26,321,807 Fluvial 40,321,683 Coastal	91,803,517 Fluvial 69,683,603 Coastal
No. Residential Properties at Risk	8 Fluvial 56 Coastal	79 Fluvial 104 Coastal	143 Fluvial 116 Coastal
No. Business Properties at Risk	30 Fluvial 52 Coastal	78 Fluvial 120 Coastal	192 Fluvial 168 Coastal
No. Utilities at Risk	0	0	1 Fluvial
No. Major Transport Assets at Risk	21 Fluvial 21 Coastal	32 Fluvial 29 Coastal	72 Fluvial 310 Coastal
No. Highly Vulnerable Properties at Risk	1 Coastal	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal
No. of Social Infrastructure Assets at Risk	3 Fluvial 3 Coastal	15 Fluvial 20 Coastal	28 Fluvial 27 Coastal
No. Environmental Assets at Risk	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal
No. Potential Pollution Sources at Risk	0	0	0

Mid-Range Future Scenario			
Event Damage (€)	73,102,469 Fluvial 71,933,320 Coastal	120,160,802 Fluvial 121,143,248 Coastal	200,579,536 Fluvial 157,034,732 Coastal
No. Residential Properties at Risk	132 Fluvial 119 Coastal	205 Fluvial 165 Coastal	344 Fluvial 173 Coastal
No. Business Properties at Risk	182 Fluvial 161 Coastal	234 Fluvial 262 Coastal	317 Fluvial 291 Coastal
No. Utilities at Risk	0	3 Fluvial 1 Coastal	3 Fluvial 2 Coastal
No. Major Transport Assets at Risk	45 Fluvial 34 Coastal	82 Fluvial 39 Coastal	99 Fluvial 42 Coastal
No. Highly Vulnerable Properties at Risk	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal
No. of Social Infrastructure Assets at Risk	5 Fluvial 5 Coastal	7 Fluvial 6 Coastal	10 Fluvial 8 Coastal
No. Environmental Assets at Risk	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	183,201,972 Fluvial 136,666,138 Coastal	285,880,868 Fluvial 224,224,414 Coastal	406,241,974 Fluvial 269,323,466 Coastal
No. Residential Properties at Risk	196 Fluvial 170 Coastal	268 Fluvial 180 Coastal	407 Fluvial 185 Coastal
No. Business Properties at Risk	310 Fluvial 280 Coastal	351 Fluvial 307 Coastal	403 Fluvial 312 Coastal
No. Utilities at Risk	3 Fluvial 0 Coastal	3 Fluvial 3 Coastal	4 Fluvial 3 Coastal
No. Major Transport Assets at Risk	73 Fluvial 42 Coastal	97 Fluvial 44 Coastal	119 Fluvial 47 Coastal
No. Highly Vulnerable Properties at Risk	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal
No. of Social Infrastructure Assets at Risk	9 Fluvial 7 Coastal	11 Fluvial 8 Coastal	14 Fluvial 8 Coastal
No. Environmental Assets at Risk	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal	3 Fluvial 3 Coastal
No. Potential Pollution Sources at Risk	0	0	0



### **E.5 Flood Risk Analysis and Mapping – Edenderry AFA**

Fluvial flooding is predicted during the 1% AEP event and a local road, which crosses Weavers Drain is within the floodplain. There are no properties at risk during this event.

The gauging station data was found to be of limited use in verification of the Edenderry model due to the uncertainty in the flood flow data. Therefore, despite available information, including feedback from the Local Authority review confirming that the model represents the historical information well, a low confidence was assigned.

Edenderry is considered to be at low risk during the present day 1% AEP fluvial event and optioneering has not been undertaken, consequently the existing regime should continue in order to maintain the current SoP.

The event damages and numbers of assets at risk in the present day and future scenarios are summarised in the following table.

**Edenderry AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	0	0	548,373
No. Residential Properties at Risk	0	0	6
No. Business Properties at Risk	0	0	2
No. Utilities at Risk	0	0	1
No. Major Transport Assets at Risk	1	1	6
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	3	4	6
No. Environmental Assets at Risk	4	4	4
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	35,634	369,458	834,571
No. Residential Properties at Risk	1	3	9
No. Business Properties at Risk	0	3	3
No. Utilities at Risk	1	1	1
No. Major Transport Assets at Risk	1	5	9
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	4	6	7
No. Environmental Assets at Risk	4	4	4
No. Potential Pollution Sources at Risk	0	0	0

High-End Future Scenario			
Event Damage (€)	340,670	640,549	1,715,595
No. Residential Properties at Risk	2	4	26
No. Business Properties at Risk	3	3	4
No. Utilities at Risk	1	1	1
No. Major Transport Assets at Risk	2	9	11
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	6	7	9
No. Environmental Assets at Risk	4	4	4
No. Potential Pollution Sources at Risk	0	0	0

### ***E.6 Flood Risk Analysis and Mapping - Johnstown Bridge AFA***

Fluvial flooding is predicted during the 1% AEP event at two discrete locations within the AFA. At each location there are a couple of properties within the floodplain affected due to the insufficient channel capacity of a tributary of the River Blackwater, the Fear English Stream. There are also a few local roads affected within these local areas in Johnstown Bridge.

The model was calibrated to the spot gaugings at the Castlerickard gauging station. However, it is recommended that larger flood events should be recorded at the gauging station in order to improve model confidence.

Johnstown Bridge is considered to be at low risk during the present day 1%AEP fluvial event and optioneering has not been undertaken, consequently the existing regime should continue in order to maintain the current SoP.

The event damages and numbers of assets at risk in the present day and future scenarios are summarised in the following table.

**Johnstown Bridge AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	20,311	146,669	1,673,803
No. Residential Properties at Risk	0	2	39
No. Business Properties at Risk	1	1	1
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	5	6	10
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	1	1
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0

<b>Mid-Range Future Scenario</b>			
Event Damage (€)	45,615	715,352	3,834,903
No. Residential Properties at Risk	1	24	61
No. Business Properties at Risk	1	1	1
No. Utilities at Risk (Only check Dam Assess)	0	0	0
No. Major Transport Assets at Risk	9	10	13
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	1	1
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	1,257,551	6,390,645	10,267,450
No. Residential Properties at Risk	31	67	93
No. Business Properties at Risk	1	1	4
No. Utilities at Risk (Only check Dam Assess)	0	0	0
No. Major Transport Assets at Risk	10	10	15
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	1	1
No. Environmental Assets at Risk	1	1	1
No. Potential Pollution Sources at Risk	0	0	0

### ***E.7 Flood Risk Analysis and Mapping - Longwood AFA***

Flooding is predicted at a discrete location in Longwood from the River Blackwater during a 1% AEP event due to insufficient channel capacity inundating the floodplain. During the same 1% AEP flood event this out of bank flood water would be met by flood water coming from the Longwood River caused by an undersized culvert. A non-residential property is affected during this event along with social infrastructure assets.

The model was calibrated to the spot gaugings at the Castlerickard gauging station and the roughness values of the model adjusted accordingly. However, there is little quantitative data available to calibrate Longwood and further observations would be necessary to reduce uncertainty in model results.

Longwood is considered to be at low risk during the present day 1%AEP fluvial event and optioneering has not been undertaken, consequently the existing regime should continue in order to maintain the current SoP.

The event damages and numbers of assets at risk in the present day and future scenarios are summarised in the following table.

### Longwood AFA Flood Risk Table

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	0	130,373	8,850,749
No. Residential Properties at Risk	0	0	79
No. Business Properties at Risk	0	1	2
No. Utilities at Risk	0	0	1
No. Major Transport Assets at Risk	0	2	4
No. Highly Vulnerable Properties at Risk	0	1	2
No. of Social Infrastructure Assets at Risk	3	4	7
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	0	9,081,969	12,099,965
No. Residential Properties at Risk	6	80	88
No. Business Properties at Risk	0	2	2
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	4	4
No. Highly Vulnerable Properties at Risk	0	2	2
No. of Social Infrastructure Assets at Risk	5	6	6
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0
<b>High-End Future Scenario</b>			
Event Damage (€)	9,791,027	13,078,248	13,791,961
No. Residential Properties at Risk	81	92	93
No. Business Properties at Risk	2	2	2
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	4	4	6
No. Highly Vulnerable Properties at Risk	2	2	2
No. of Social Infrastructure Assets at Risk	6	6	6
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0

## E.8 Flood Risk Analysis and Mapping - Mornington AFA

Mornington is affected by both 1% AEP fluvial and 0.5% AEP coastal events. Mornington has a scheme that has significantly addressed the historic risk in the area. There are two separate locations of flood risk, which were not examined under the scheme; one of which experiences out of bank flooding emanating from the Boyne Estuary. This is predicted in both the fluvially and tidally dominant flood mechanisms and affects residential properties on the edge of Mornington. The tidally dominant scenario affects most properties. In the other location, fluvial flooding is predicted at the 1% AEP event, emanating on the right bank of a small drain, which eventually reaches both residential and commercial properties downstream. There are a number of local roads affected by the 1% AEP fluvial and 0.5% AEP coastal events, including one regional road. A waste water treatment works is also affected along with a number of social infrastructure assets.

There is moderate confidence in the hydrology and hydraulics of the AFA. The Mornington River is not gauged; however the Boyne River is and there is good calibration / validation data available in relation recent flood events.

The event damages and numbers of assets at risk in the present day and future scenarios associated with the two CFRAM flooding mechanisms applicable to Mornington; fluvial and coastal (tidal inundation), are summarised in the following table.

**Mornington AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP 0.5% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	7,200 Fluvial 76,972 Coastal	1,552,240 Fluvial 458,099 Coastal	9,059,819 Fluvial 11,112,767 Coastal
No. Residential Properties at Risk	1 Fluvial 1 Coastal	40 Fluvial 10 Coastal	202 Fluvial 162 Coastal
No. Business Properties at Risk	0 Fluvial 1 Coastal	1 Fluvial 0 Coastal	8 Fluvial 8 Coastal
No. Utilities at Risk	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal
No. Major Transport Assets at Risk	6 Fluvial 4 Coastal	7 Fluvial 5 Coastal	21 Fluvial 21 Coastal
No. Highly Vulnerable Properties at Risk	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal	1 Fluvial 1 Coastal
No. of Social Infrastructure Assets at Risk	5 Fluvial 5 Coastal	6 Fluvial 6 Coastal	7 Fluvial 8 Coastal
No. Environmental Assets at Risk	4 Fluvial 4 Coastal	4 Fluvial 4 Coastal	4 Fluvial 4 Coastal
No. Potential Pollution Sources at Risk	0	0	0

Mid-Range Future Scenario			
Event Damage (€)	3,268,010 Fluvial 7,132,086 Coastal	21,452,104 Fluvial 42,750,352 Coastal	51,552,010 Fluvial 61,060,246 Coastal
No. Residential Properties at Risk	80 Fluvial 140 Coastal	384 Fluvial 420 Coastal	580 Fluvial 563 Coastal
No. Business Properties at Risk	5 Fluvial 7 Coastal	8 Fluvial 10 Coastal	16 Fluvial 14 Coastal
No. Utilities at Risk	4 Fluvial 1 Coastal	4 Fluvial 1 Coastal	4 Fluvial 4 Coastal
No. Major Transport Assets at Risk	13 Fluvial 17 Coastal	30 Fluvial 27 Coastal	39 Fluvial 31 Coastal
No. Highly Vulnerable Properties at Risk	2 Fluvial 1 Coastal	3 Fluvial 2 Coastal	3 Fluvial 2 Coastal
No. of Social Infrastructure Assets at Risk	9 Fluvial 7 Coastal	10 Fluvial 9 Coastal	11 Fluvial 11 Coastal
No. Environmental Assets at Risk	4 Fluvial 4 Coastal	4 Fluvial 4 Coastal	4 Fluvial 4 Coastal
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	42,901,545 Fluvial 52,238,857 Coastal	67,311,373 Fluvial 140,367,478 Coastal	115,759,409 Fluvial 161,405,829 Coastal
No. Residential Properties at Risk	439 Fluvial 495 Coastal	698 Fluvial 1053 Coastal	1,004 Fluvial 1071 Coastal
No. Business Properties at Risk	13 Fluvial 10 Coastal	13 Fluvial 16 Coastal	18 Fluvial 20 Coastal
No. Utilities at Risk	4 Fluvial 1 Coastal	4 Fluvial 4 Coastal	4 Fluvial 4 Coastal
No. Major Transport Assets at Risk	37 Fluvial 28 Coastal	46 Fluvial 49 Coastal	56 Fluvial 54 Coastal
No. Highly Vulnerable Properties at Risk	3 Fluvial 3 Coastal	4 Fluvial 4 Coastal	4 Fluvial 4 Fluvial
No. of Social Infrastructure Assets at Risk	9 Fluvial 10 Coastal	12 Fluvial 13 Coastal	13 Fluvial 13 Coastal
No. Environmental Assets at Risk	4 Fluvial 4 Coastal	4 Fluvial 4 Coastal	4 Fluvial 4 Coastal
No. Potential Pollution Sources at Risk	0	0	0

## E.9 Flood Risk Analysis and Mapping - Navan AFA

The main flood risk within Navan is to receptors adjacent to the River Boyne. There are three areas of predicted flooding which are affected by out of bank flooding due to insufficient channel capacity. A significant number of properties are at flood risk during the 1% AEP event along with a small number of roads, one of which is the R147 - Dublin Road. A utility (Kilcarn Treatment Works) is also situated in this floodplain. There are two further discrete areas of predicted flooding upstream of the River Boyne, along the River Blackwater and its tributary, Abbeylands, which are each affected by single flood mechanisms. In these local areas there are a small number of properties and a road at risk.

There is a long history of flooding events at Navan with relatively good quality recorded water level and flow data at three gauging station locations, with water level data available at a fourth location.

The event damages and numbers of assets at risk in the present day and future scenarios are summarised in the following table.

**Navan AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	891,316	11,305,871	45,589,762
No. Residential Properties at Risk	13	104	219
No. Business Properties at Risk	3	21	54
No. Utilities at Risk	1	1	1
No. Major Transport Assets at Risk	7	13	27
No. Highly Vulnerable Properties at Risk	1	2	2
No. of Social Infrastructure Assets at Risk	41	57	82
No. Environmental Assets at Risk	7	7	7
No. Potential Pollution Sources at Risk	0	0	0
<b>Mid-Range Future Scenario</b>			
Event Damage (€)	28,620,853	59,027,910	146,348,283
No. Residential Properties at Risk	82	242	543
No. Business Properties at Risk	24	42	80
No. Utilities at Risk	1	1	2
No. Major Transport Assets at Risk	30	51	60
No. Highly Vulnerable Properties at Risk	1	2	2
No. of Social Infrastructure Assets at Risk	64	79	112
No. Environmental Assets at Risk	9	9	9
No. Potential Pollution Sources at Risk	0	0	0



High-End Future Scenario			
Event Damage (€)	52,748,241	94,183,322	520,954,000
No. Residential Properties at Risk	156	448	828
No. Business Properties at Risk	42	68	197
No. Utilities at Risk	2	3	3
No. Major Transport Assets at Risk	46	60	62
No. Highly Vulnerable Properties at Risk	2	2	6
No. of Social Infrastructure Assets at Risk	76	101	130
No. Environmental Assets at Risk	9	9	9
No. Potential Pollution Sources at Risk	0	0	0

### ***E.10 Flood Risk Analysis and Mapping - Trim AFA***

The main flood risk in Trim originates from the River Boyne. There are three areas, interacting along the river, which are predicted to flood during a 1% AEP event due to insufficient channel capacity. There are a small number of properties in each location, both residential and non-residential, at risk of flooding. There is one other discrete area of flooding along the Boycetown River, which floods during a 1% AEP flood event. There is one residential property located in this floodplain. Within these floodplains, local roads and a regional road are also affected, along with Trim Waste Water Treatment works and environmental assets.

Despite limited data, the model is considered to be performing satisfactorily for design event simulation. The model was calibrated to rating curves at three hydrometric gauges and good agreement was achieved. Good qualitative support for results was also achieved from limited historical flooding information available.

The event damages and numbers of assets at risk in the present day and future scenarios are summarised in the following table.

**Trim AFA Flood Risk Table**

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
<b>Current Scenario (Present Day)</b>			
Event Damage (€)	110,227	1,340,919	8,080,611
No. Residential Properties at Risk	0	6	24
No. Business Properties at Risk	2	6	23
No. Utilities at Risk	0	1	3
No. Major Transport Assets at Risk	6	12	15
No. Highly Vulnerable Properties at Risk	1	1	1
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0

Mid-Range Future Scenario			
Event Damage (€)	1,755,518	9,375,799	41,376,639
No. Residential Properties at Risk	9	30	60
No. Business Properties at Risk	10	31	77
No. Utilities at Risk	3	3	4
No. Major Transport Assets at Risk	12	15	18
No. Highly Vulnerable Properties at Risk	1	1	1
No. of Social Infrastructure Assets at Risk	0	0	2
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	18,201,345	47,993,844	64,752,827
No. Residential Properties at Risk	45	66	111
No. Business Properties at Risk	60	83	108
No. Utilities at Risk	3	4	7
No. Major Transport Assets at Risk	15	21	30
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	1	8	9
No. Environmental Assets at Risk	2	2	2
No. Potential Pollution Sources at Risk	0	0	0

## **APPENDIX F**

### **METHODS OF FLOOD RISK MANAGEMENT**

There are a wide range of different approaches, or methods, that can be taken to reduce or manage flood risk. These can range from non-structural methods, that do not involve any physical works to prevent flooding but rather comprise actions typically aimed at reducing the impacts of flooding, to structural works that reduce flood flows or levels in the area at risk or that protect the area against flooding.

The range of methods for managing flood risk that are considered include those outlined below.

#### **F.1 FLOOD RISK PREVENTION METHODS**

Flood risk prevention measures are aimed at avoiding or eliminating a flood risk. This can be done by not creating new assets that could be vulnerable to flood damage in areas prone to flooding, or removing such assets that already exist. Alternatively, prevention can be achieved by completely removing the potential for flooding in a given area, although in practice this is rarely possible (the frequency or magnitude of flooding can be reduced by flood protection measures, but it is generally not possible to remove the risk of flooding entirely).

Flood prevention is hence generally focussed on sustainable planning and / or the re-location of existing assets, such as properties or infrastructure.

##### **F.1.1 Sustainable Planning and Development Management**

In November 2009, the Consultation document on the NCCAF (DCCAE, March 2016), were published under Section 28 of the Planning Acts. These Guidelines provide a systematic and transparent framework for the consideration of flood risk in the planning and development management processes, whereby:

- A sequential approach should be adopted to planning and development based on avoidance, reduction and mitigation of flood risk.
- A flood risk assessment should be undertaken that should inform the process of decision-making within the planning and development management processes at an early stage.
- Development should be avoided in floodplains unless there are demonstrable, wider sustainability and proper planning objectives that justify appropriate development and where the flood risk to such development can be reduced and managed to an acceptable level without increasing flood risk elsewhere (as set out through the Justification test).

The proper application of the Guidelines by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future, and to take a precautionary approach in regards to the potential impacts of climate change on flood risk that should be addressed in spatial plans, planning decisions and through Local Adaptation Plans. The flood mapping produced through the CFRAM Programme and parallel projects provided as part of the Plan will facilitate the application of the Guidelines.

In flood-prone areas where development can be justified (i.e., re-development, infill development or new development that has passed the Justification Test), the planning

authorities can manage the risk by setting suitable objectives or conditions, such as minimum floor levels or flood resistant or resilient building methods.

### **F.1.2 Sustainable Urban Drainage Systems (SUDS)**

Development of previously 'green', or permeable, land within an urban area increases the impermeable area, reducing infiltration and increasing runoff rates and volumes. Traditional urban storm water drainage systems are effective at transferring surface water quickly, but they provide only limited attenuation causing the volume of water in the receiving watercourse to increase more rapidly and increasing flood risk. Sustainable Drainage Systems (SUDS) can play a role in reducing and managing run-off to surface water drainage systems as well as improving water quality and contributing to local amenity. SUDS comprise a wide range of techniques, including swales, basins, ponds and infiltration systems.

In accordance with the Guidelines (see Section 7.2.1.1), planning authorities should seek to reduce the extent of hard surfacing and paving and require the use of sustainable drainage techniques to reduce the potential impact of development on flood risk downstream.

### **F.1.3 Voluntary Home Relocation**

In extreme circumstances, the flood risk to a home may be such that the home owner may consider that continuing to live in the property is not sustainable and would choose to relocate.

### **F.1.4 Preparation of Local Adaptation Planning**

It is likely that climate change will have a considerable impact on flood risk in Ireland, such as through rising mean sea levels and the potential increases in winter rainfall and intense rainfall events. For example, it is known that sea levels are rising at a rate of more than 3mm/yr at present, and the Fifth Assessment Report (AR5) of the Inter-Governmental Panel on Climate Change (IPCC) projects that mean sea level is likely to rise between 0.52m and 0.98m by the end of the century. The flood risk assessment for the future scenarios, described in Section 5 herein, highlight the potential impacts of such changes. More recent research (Jevrejeva et al. 2014) indicates that it is plausible that mean sea level may rise by up to approximately 2m by the end of the century.

The Climate Action and Low Carbon Development Act, 2015, required that the Minister for Communications, Climate Action and Environment prepare a National Climate Change Adaptation Framework (NCCAF) that shall specify the national strategy for the application of adaptation measures in different sectors and by a local authority in its administrative area in order to reduce the vulnerability of the State to the negative effects of climate change. The consultation document on the NCCAF (DCCAE, March 2016) noted that as the impacts of climate change vary by region, adaptation requires locally specific, place-based responses, and that Building resilience to the impacts of the climate change at local level for communities and businesses can be achieved in an effective manner if it is integrated into existing planning frameworks and policies under the remit of the local government sector. The NCCAF was published in January 2018 and sets out that local level adaptation measures will be identified in Local Adaptation Strategies prepared by the relevant local authority and implemented through inclusion in relevant plans and policies under the local authority's remit. To this end, local authorities should take into account the potential impacts of climate change on flooding and flood risk in their planning for local adaptation, in particular in the areas of spatial planning and the planning and design of infrastructure.

### **F.1.5 Land Use Management and Natural Flood Risk Management Measures**

Flood flows depend on how much rain falls in the catchment and the pattern of rainfall, and also on how much and how rapidly the rain runs off the land into the river. The volume and rate of runoff can be reduced by changing land use practices, such as by reducing stocking rates, changing the way ploughing is undertaken (e.g., along contours rather than perpendicular to contours), the retention, protection and/or rewetting of peatlands and bogs and by planting hedgerows across hillsides.

Similarly, excess runoff can be stored in wetlands, micro-detention basins, or be attenuated in small streams and channels through the use of obstructions to flow, such as large woody-debris dams. While such measures have been shown to reduce flood peaks in small catchments and frequent, less severe flood events, they may be less effective for more severe floods and in larger catchments and often require very significant land owner engagement for implementation (EU, 2014).

These types of measures will often not be able to solve severe flood problems on their own, but they have the potential to form part of the solution and can also help to achieve the goals in a range of areas, including water quality, nature conservation / biodiversity, agriculture and forestry, green growth and climate change mitigation and adaptation (EU, 2014), and as such would be best addressed on a multi-sectoral level in partnership with all relevant agencies, to promote integrated catchment management.

## **F.2 FLOOD PROTECTION METHODS**

Flood protection measures are aimed at reducing the likelihood and/or the severity of flood events. These measures, typically requiring physical works, can reduce risk in a range of ways, such as by reducing or diverting the peak flood flows, reducing flood levels or holding back flood waters. The preferred Standard of Protection offered by such measures in Ireland is the current scenario 1% Annual Exceedance Probability (AEP) flood for fluvial flooding and 0.5 % AEP flood for tidal flooding (also referred to as the 100-year and 200-year floods respectively), although these standards can increase or decrease depending on local circumstances.

A description of the protection measures typically considered is provided below.

### **F.2.1 Enhance Existing Protection Works**

Flood protection works will provide flood protection up to a certain 'Standard of Protection' and, depending on the type of protection measure, may reduce the severity of flooding above this Standard. The Standard of Protection is the magnitude of flood, often defined by the annual probability of that flood occurring being exceeded (the Annual Exceedance Probability, or 'AEP'), that the measure is designed to protect the area at risk against.

In some locations where existing flood protection works exist, measures can be taken, in addition to the necessary ongoing maintenance, to improve the condition of the works to reduce the likelihood of failure, and/or increase the Standard of Protection to further reduce the risk in, and extend, the protected area. This can apply to both structures that were deliberately built as flood protection works, and also other structures (e.g., quay walls, road embankments) that provide some flood protection as a secondary function.

Some natural features can provide defences against floods, or form part of a defence in depth. For example sand dunes and flood marshes often form effective barriers against flooding in coastal areas. These features may be vulnerable to rapid erosion and some enhancement may be useful to retain the feature and their effectiveness in providing a defence function.

### F.2.2. Flood Defences

Solid structures built between the source of flood waters (rivers, estuaries or the sea) and an area vulnerable to flooding (people, properties, land and other assets) can prevent flooding up to the Standard of Protection of the structure, hence reducing the flood risk in the area being protected by the structure. Such structures typically include walls (generally in urban areas with limited space) or embankments (generally in rural areas and in urban areas where space is available, such as parks), but can also include other built or natural structures, such as sand dunes. However, the residual risk of flooding which remains after a defence is constructed, which arises as a flood in excess of the design standard of the defence may occur, also needs to be carefully considered during design.



*Figure F.1: Flood Defence Wall*



*Figure F.2: Flood Defence Embankment (During Construction / Maintenance)*



### **F.2.3 Increasing Channel Conveyance**

The water level of a river is determined by the flow and the hydraulic characteristics of the river, any structures (e.g., bridges, weirs, walls) in, alongside and over the river and, when in flood, of the floodplain. The hydraulic characteristics determine the conveyance of the river, and changing these characteristics can reduce the water level for a given flow. This can be achieved by works such as dredging to deepen and/or widen the river, reducing the roughness of the rivers, its banks and floodplain to allow more flow to pass, or removing or altering structures to reduce the build up of water upstream of the structure.



*Figure F.3: River Widening (During Construction)*



*Figure F.4: River Widening (After Construction)*



By increasing channel (and floodplain) conveyance, river levels during a flood can be lowered, hence reducing the likelihood and severity of flooding. This can be to the point that flooding during events up to the design Standard of Protection is avoided, but this type of measure has the advantage that it also reduces the risk for floods greater than the design Standard of Protection.

This type of measure is typically only applicable for river flooding,

#### **F.2.4 Diverting Flood Flows**

Flooding of an area from a river occurs because the quantity of flow flowing through an area exceeds the conveyance capacity of the channel and so the river spills out on to its floodplain. Reducing the flow through an area in the event of a flood can reduce the likelihood of flooding for that area, and this can be achieved by diverting some of the flows around the area of risk through a flood diversion channel or across a designated area of land.

#### **F.2.5 Storing Flood Waters**

Instead of diverting excess flood waters to reduce the flow through an area at risk, the flow can also be reduced by storing flood waters upstream of the area.

This can be in large, single flood attenuation structures, in wash-lands on the floodplain or in multiple, smaller storage areas dispersed around the catchment. Storage using soft measures, such as wetlands or micro-detention basins, or through attenuation in small channels, is generally considered to be part of land use management, or natural flood risk management (see Section 7.2.2.7).

Floods can also be attenuated (i.e., the flood slowed down, the peak flow reduced and the flood volume spread over a longer period of time) by measures along the river and floodplain, e.g., increasing channel and floodplain roughness (introducing impediments to flow in the river, or on floodplains, such as by increasing riparian vegetation or planting hedgerows) or by restoring meanders.

Such measures are often referred to as natural water retention measures or natural flood management. While these have been shown to reduce flood flows in smaller, more common floods, it is understood that their impact in larger, more extreme or rare floods, is reduced. Further research is required on this matter. However, such measures can have significant benefits for environmental enhancement, such as contributing to the objectives of the Water Framework Directive or increasing biodiversity.

#### **F.2.6 Implementing Channel Maintenance Programmes**

Excess silt and gravels deposited in watercourses and vegetation in and on the banks of river channels, or the blockage of channels by discarded rubbish or bulky objects in urban areas, can reduce the conveyance of a channel, increasing flood levels in the event of a flood and hence increasing the flood risk in the surrounding area. The blockage of culvert screens by debris and rubbish can also increase flood risk.

A regular maintenance programme to remove excess inorganic material, vegetation and/or remove debris and rubbish from river channels, and ensure that culvert screens are kept clear, can help reduce flood levels during flood events.

#### **F.2.7 Maintenance of Drainage Schemes**

Following the passing of the Arterial Drainage Act, 1945, the OPW began investigations to determine where Arterial Drainage Schemes would be suitable and economically viable. The implementation of the Schemes began in the late-1940s and continued into the early-

1990s, and a total of 11,750kms of river channel now form part of the Arterial Drainage Schemes, that also include 800km of embankments.

The purpose of the Arterial Drainage Schemes was primarily to improve the drainage of agricultural lands to enhance production. This typically involved lowering or widening river beds and removal of weirs to facilitate the drainage and discharge of neighbouring lands and drainage channels. While not the primary focus of the Schemes, they did also provide enhanced conveyance capacity where they passed through towns, villages and dispersed rural communities that in turn has reduced the flood risk to properties in these areas.

While new Arterial Drainage Schemes are no longer being undertaken, the OPW has a statutory duty to maintain the completed schemes in proper repair and in an effective condition. The annual maintenance programme is published by the OPW on the OPW website, and typically involves some clearance of vegetation and removal of silt build-up on a five-yearly cycle.

Drainage Districts are areas where drainage schemes to improve land for agricultural purposes were constructed under a number of Acts of Parliament and Acts of the Oireachtas prior to 1945. 170 Drainage District Schemes were established, covering 4,600km of channel. The statutory duty of maintenance for these schemes lies with the local authorities concerned. The standard of this maintenance varies widely from county to county.

### **F.2.8 Land Commission Embankments**

The Land Commission was created in 1881 as a rent fixing commission by the Land Law (Ireland) Act 1881, and was reconstituted in the Irish Free State by section 2 of the Land Law (Commission) Act, 1923, backdated to the state's creation. With very few exceptions, lands acquired through the Land Commission are now in private ownership. Trusts were established in some cases for the maintenance of flood defences on acquired lands. The Commission was dissolved on 31 March 1999 by the Irish Land Commission (Dissolution) Act, 1992 and the trusts held by the Land Commission were transferred to the Dept. Agriculture, Food and the Marine (DAFM), with retained funds entrusted to the Public Trustee, who is an officer of the DAFM.

While the Public Trustee administers these funds that may be used for repairs of the embankments, this is applied only in very exceptional circumstances, as the amount of such funds is generally small and wholly inadequate to maintain the various embankments. The DAFM does not however have a general responsibility for the maintenance, repair or restoration of the embankments, which rests with the land owner in most cases (Section 10 of the Land Act, 1965).

## **F.3 FLOOD PREPAREDNESS (RESILIENCE) METHODS**

In some instances, it may not be possible to reduce the likelihood or severity of flooding to an area at risk. However, actions and measures can be taken to reduce the consequences of flooding, i.e., reduce the risk to people and of damage to properties and other assets, and make sure that people and communities are resilient to flood events. This can be achieved by being aware of and preparing for the risk of flooding, knowing when floods are going to occur, taking actions immediately before, during and after a flood. The actions and measures of this type are described below.

### **F.3.1 Flood Forecasting and Warning**

Knowing that a flood event is imminent allows people, communities and local authorities to prepare for the flood by, for example, erecting temporary defences or moving people and assets out of harm's way.

It is possible to forecast floods under certain conditions using weather predictions, observed rainfall and river levels and flows, and with the aid of computer models. Flood forecasts based on predicted weather are generally less certain than those based on observed rainfall or river levels or flows. The forecast period achievable generally depends on the catchment size and characteristics, and, while in larger catchments it may be possible to provide a number of hours or even days of advance warning of a flood event, in small, flashy catchments this period can be extremely short and therefore of less or potentially no real benefit. Flood forecasting also involves significant uncertainty, as it entails trying to simulate very complex systems in real time with limited data.

The OPW, on behalf of Ireland, signed a partner agreement in 2010 with the European Flood Awareness System (EFAS), which was developed by the EU Joint Research Centre for use by partner organisations. EFAS was developed to help improve and increase preparedness for fluvial floods and is intended to provide early warning or notification of potential flood events under specified criteria. These EFAS flood notifications are disseminated by the OPW to local authorities and other relevant stakeholders. During the floods of winter 2015/16, EFAS provided a number of valuable flood notifications and forecasts which informed and supported the management of these floods. The OPW also provides national tidal and storm surge forecasts for local authorities and other relevant stakeholders and disseminates high tide advisory notices to local authorities when tide, weather and atmospheric conditions are such that coastal flooding may arise.

A number of other project specific flood forecasting systems are in place as part of OPW funded flood relief schemes that include demountable flood defence systems.

Appendix F6 of the Major Emergency Management (MEM) Framework (2006) sets out the arrangements put in place by Met Éireann to issue public service weather warnings to the local authorities. Met Éireann operates a weather warning system that aligns with the EU Meteoalarm system ([www.meteoalarm.eu](http://www.meteoalarm.eu)). Met Éireann also issues weather warnings to the public. Warnings for very heavy rainfall may indicate a threat of widespread flooding or flooding for a specific area.

Local warnings are also issued by the local authority. Warnings may be circulated to national and/or local broadcast media, as appropriate, which can be supplemented, in the case of specific local areas identified as being at risk, with emergency vehicles and personnel to deliver the warnings in very exceptional cases.

A Government decision was taken on the 5th January 2016 to establish a National Flood Forecasting and Warning Service (refer Section 7.4.1.10 for further details).

### **F.3.2 Emergency Response Planning**

Well prepared and executed emergency response plans can significantly reduce the impact of flood events, particularly for human health and welfare. The MEM Framework designates the local authority as the lead agency for co-ordinating a response to a flooding emergency. “A Guide to Flood Emergencies (2013)” sets out the sequence of steps required to prepare for and respond to flood emergencies. The Department of Housing, Planning and Local Government is designated as the Lead Government Department for co-ordinating a national response to large scale flood emergencies.

Local authorities develop and review flood plans. Flood plans detail how local authorities receive, assess and respond to weather and flood warnings that can be received from the OPW, Met Éireann, EFAS or other sources, taking into account other relevant information

available to them, such as real-time gauge information (e.g., [www.waterlevel.ie](http://www.waterlevel.ie)) and local knowledge of river systems, roads, infrastructure and vulnerable communities.

Local authorities, as part of their planning for flood emergencies, appoint a Severe Weather Assessment Team. This team monitors weather alerts and provides an analysis of the flood risk before and during an event, as well as providing specialist advice to the operational services deployed to a flood event.

It is the responsibility of the Severe Weather Assessment Team to determine the scale of response that is required, i.e. further action required, the activation of an internal operational response, or the requirement for increased levels of inter-agency co-ordination, up to the declaration of a major emergency and activation of the Major Emergency Plan.

During a flood emergency, where a national response is required to support the local response, the Lead Government Department activate and chair the National Co-ordination Group. Once the National Co-ordination Group is activated, the Lead Government Department establishes links with all Regional / Local Co-ordination Groups. The National Co-ordination Group sets key response objectives, prioritising life safety and protection of property/ critical infrastructure. The National Co-ordination Group works with the Principal Response Agencies to ensure that resources are allocated where needed and can provide optimum benefits. The National Co-ordination Group also develops key public safety messages and provides a single point for information to media and public sector organisations.

### **F.3.3 Promotion of Individual and Community Resilience**

Individuals and communities that are aware of any prevalent flood risk are able to prepare for flood events such that if and when such events occur, people are able to take appropriate actions in advance of, during and after a flood to reduce the harm and damages a flood can cause. This could include short-term preparation and action such as elevating valuables to above likely flood levels, helping neighbours who may have mobility difficulties to prepare and if necessary evacuate, moving vehicles to high ground and evacuating themselves if necessary. Longer-term preparations can involve making homes and properties flood resilient or flood resistant, such as through new floor and wall coverings chosen to be durable in a flood or moving electrical sockets above likely flood levels.

In 2005, the OPW launched the Plan, Prepare, Protect campaign that provides general, practical advice to homeowners, businesses and farmers on what they can do to prepare for flood events and make themselves resilient. This advice has recently been updated and is available to view and download from: [www.flooding.ie](http://www.flooding.ie).

While the Plan, Prepare, Protect campaign provides useful information, as a national campaign it is generic. Resilience also has a strong local dimension involving consultation with the local community, the dissemination of site-specific advice, and the provision of assistance with preparedness at a local level for individuals and businesses known to be at risk. The Report of the Flood Policy Review Group (OPW, 2004) recommends that local authorities should assume responsibility for the local dimension of the flood risk education programme, including raising awareness of individuals and business interests considered to be at risk, and to assist individuals and business interests considered to be at risk with preparations for minimising damages in the event of a flood event

While the State, through the OPW, local authorities and other public bodies can take certain actions to reduce and manage the risk of flooding, individual home-owners, businesses and farmers also have a responsibility to manage the flood risk to themselves,

their property and other assets to reduce damages and the risk to personal health in the event of a flood.

All people at flood risk within the Boyne River Basin should:

- Make themselves aware of the potential for flooding in their area, including the likely extents, depths and risk-to-people
- Consider what long-term preparatory actions they might take to reduce the potential damage, such as implementing property resilience or resistance measures
- Prepare a flood event plan to set out the actions they should take before, during and after a flood event
- Discuss the issue of flooding and flood risk with other people in their communities, and consider forming a local Flood Action Group

Advice on what steps can be taken is provided in the Plan, Prepare, Protect booklet available through [www.flooding.ie](http://www.flooding.ie).

### **F.3.4 Individual Property Protection**

Individual Property Protection includes generally low-cost and small-scale measures that can be applied to individual properties to help make them more resistant to flood waters. Examples might include flood-gates to go across doorways, water-proof doors, air-vent covers, non-return valves for pipe-work and sewerage, etc. These measures can be effective in reducing the damage to the contents, furniture and fittings in a house or business, but are not applicable in all situations (for example, they may not be suitable in areas of deep or prolonged flooding, or for some types of property with pervious foundations and flooring).

### **F.3.5 Flood-Related Data Collection**

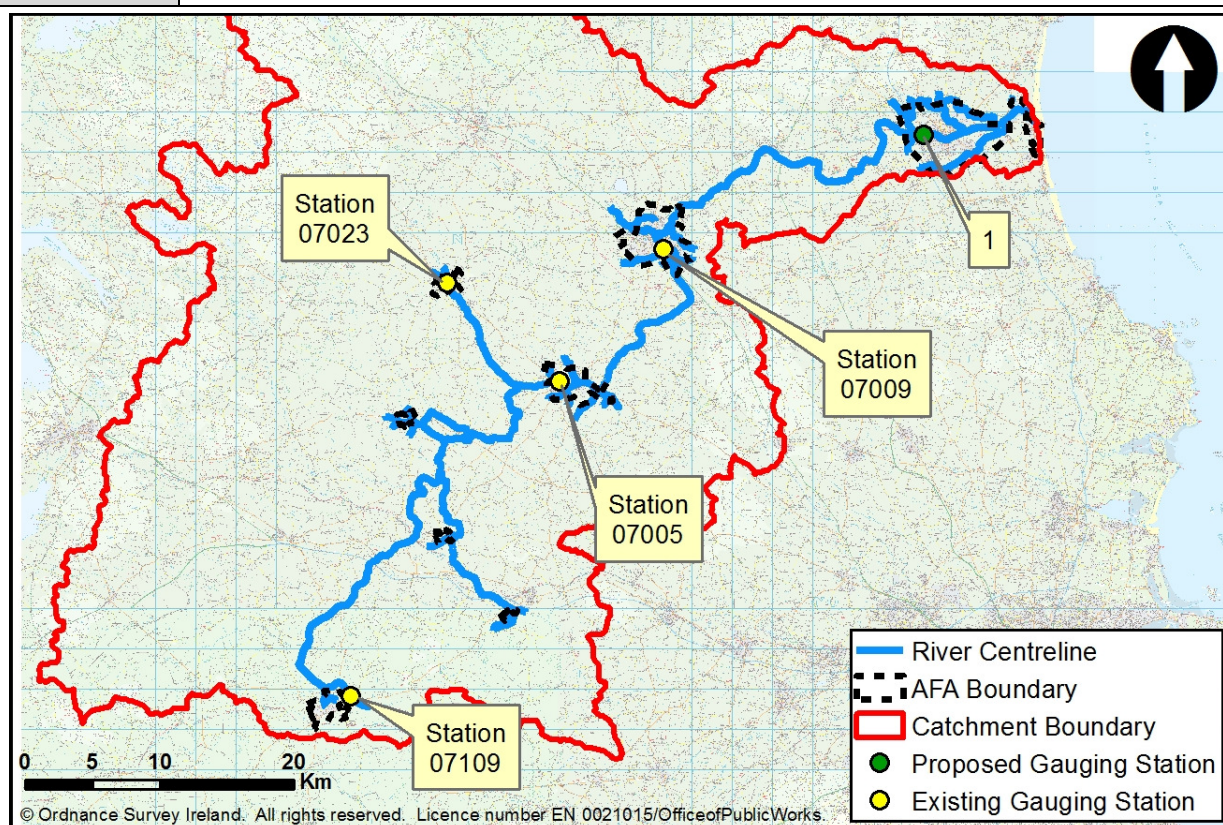
Data on flood flows and levels, as collected through the hydrometric networks of the OPW, EPA / local authorities, the Marine Institute and other organisations, are essential to understand what extreme river flows and levels and sea levels might occur, and hence to enable the appropriate design of structural and non-structural flood risk management measures. Similarly, recording details on flood events that happen are extremely useful to build up our knowledge of flood risk throughout the country and also to understand how the flooding occurs in the affected area to calibrate the computer models used to predict potential future flooding. The ongoing collection and, where appropriate, publication of such data is a measure that will help us to continually improve our preparation for, and response, to flooding.

## APPENDIX G

### DESCRIPTION OF POTENTIALLY VIABLE FLOOD RELIEF WORKS

#### G.1 Boyne River Basin (UoM07)

<b>River Basin</b>	Boyne (UoM07)	<b>AFA</b>	(Trim, Navan and Drogheda AFAs)
<b>Measure</b>	Flood Forecasting and Warning		
<b>Code</b>	IE07-UoM-0799-M41		
<b>Description</b>	Progression of a Flood Forecasting and Warning System for the Boyne (UoM07) River Basin, comprising of gauging stations (existing and new) and a forecasting model system, to project-level development and assessment for refinement and preparation for planning / Exhibition and, as appropriate, implementation.		



The works presented herein are not the final and definitive works. The development of a Flood Forecasting and Warning System for the Boyne (UoM07) River Basin will progress as part of the development of the National Forecasting Service (See Section 7.4.1.10).

#### MCA Appraisal Outcomes

Objective	Un-Weighted Score	Local Weighting	Comment
1.a.i	0.0	1.0	<i>There are no additional ground floor properties and there are no additional upper floor properties benefiting with this option in place.</i>
1.a.ii	0.0	1.0	<i>There are no additional highly vulnerable properties benefiting with this option in place.</i>



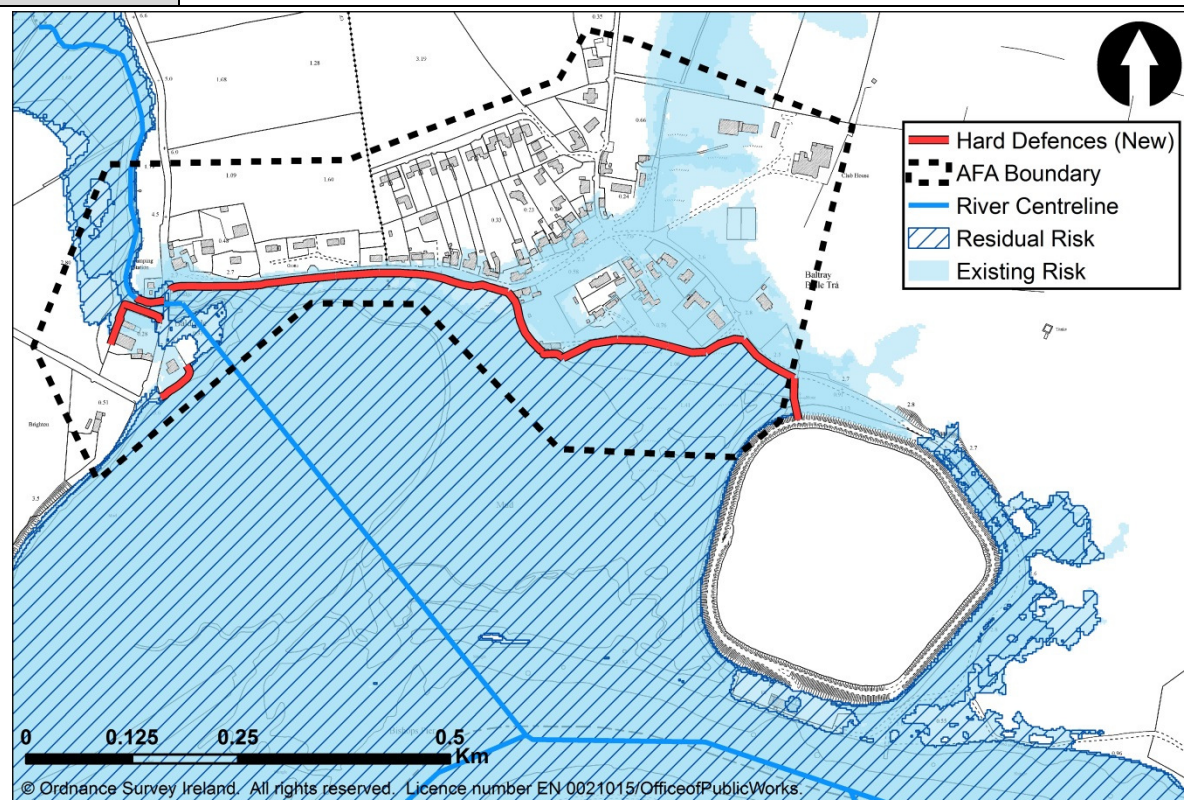
1.b.i	0.0	1.0	<i>There are no additional social infrastructure/amenity sites benefiting with this option in place.</i>
1.b.ii	0.0	1.0	<i>There are no additional commercial properties benefiting with this option in place.</i>
2.a	0.46	5.0	<i>With this option in place the annual average damages have been reduced from €3,137,199 to €2,848,954.</i>
2.b	0.0	1.0	<i>There are no additional transport links benefiting with this option in place.</i>
2.c	0.0	1.0	<i>There are no additional utilities benefiting with this option in place.</i>
2.d	0.0	4.0	<i>As flood extents will remain the same before and after the option is in place the agricultural land will remain at risk giving a final score of zero.</i>
3.a	0.0	5.0	<i>No anticipated environmental impact at this strategic stage.</i>
3.b	0.0	5.0	<i>No anticipated environmental impact at this strategic stage.</i>
3.c	0.0	4.0	<i>No anticipated environmental impact at this strategic stage.</i>
3.d	0.0	5.0	<i>No anticipated environmental impact at this strategic stage.</i>
3.e	0.0	5.0	<i>No anticipated environmental impact at this strategic stage.</i>
3.f.i	0.0	5.0	<i>No anticipated environmental impact at this strategic stage.</i>
3.f.ii	0.0	5.0	<i>No anticipated environmental impact at this strategic stage.</i>
4.a	3.00	5.0	<i>Regular monitoring and maintenance required</i>
4.b	4.00	5.0	<i>The following hazard has been identified: Working near water</i>
4.c	5.00	5.0	<i>Option is inherently adaptable at no/negligible cost</i>
<b>Total MCA-Benefit Score</b>		<b>Option Cost (€millions)</b>	<b>MCA-Benefit Score / Cost Ratio</b>
55		1.06	51.9
<b>Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions</b>			
<b>Area NPVd (uncapped)</b>	<b>Option Cost</b>	<b>Option NPVb (capped)</b>	<b>Benefit - Cost Ratio</b>
62.27	1.06	1.98	1.87
<b>Environmental Assessments</b>			
The preferred measure is considered to be environmentally neutral providing that the installation of the new gauge follows best practice however the majority of the measure would relate to analysis of data from existing gauges.			
<b>Adaptability to Potential Future Changes</b>			
Flood Forecasting and Warning is considered to be readily adaptable at negligible cost as the method's effectiveness is not impeded by increased flows or levels.  It may be noted that the assessment of the hazard/risk as carried out under the 6-year cyclical review process of the Flood Risk Management Plans can be used as the trigger to activate potential future works or action to mitigate against any such change.			
<b>Public Consultation Outcomes</b>			
No comments on this measure were received during public consultation.			

## Other Issues / Conclusions

Flood Forecasting and Warning has been identified as a suitable measure for Trim, Navan and Drogheda AFAs. Navan and Drogheda AFAs, which have structural preferred measures identified at AFA level, would derive benefit from the Flood Forecasting and Warning in the interim period between installation of the Flood Forecasting and Warning system and the completion of AFA level structural measures.

## G.2 Baltray AFA

<b>River Basin</b>	Boyne (UoM07)	<b>AFA</b>	Baltray
<b>Measure</b>	Progress the development of a Flood Relief Scheme for Baltray AFA		
<b>Code</b>	IE07-IE-AFA-070030-0107-M33		
<b>Description</b>	Progress the project-level development and assessment of a Flood Relief Scheme for Baltray, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation.		



The works presented herein are not the final and definitive works. Potential flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval (see Section 6.1 and 8.1).

## MCA Appraisal Outcomes

Objective	Un-Weighted Score	Local Weighting	Comment
1.a.i	4.96	5.0	<i>There is a combined number of 106 ground floor properties and no additional upper floor properties benefiting from the option's SoP from fluvial and coastal flood sources.</i>

1.a.ii	0.0	1.0	<i>There are no additional highly vulnerable properties benefiting from the option's SoP from fluvial and coastal flood sources.</i>
1.b.i	4.58	5.0	<i>There is a combined number of 17 social infrastructure/amenity sites benefiting from the option's SoP from fluvial and coastal flood sources.</i>
1.b.ii	4.97	5.0	<i>There is a combined number of 5 commercial properties benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.a	4.89	5.0	<i>With this option in place the annual average damages have been reduced from €392095.7 to €8334.18.</i>
2.b	4.97	5.0	<i>There is a combined number of 15 transport links benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.c	4.97	5.0	<i>There is a combined number of 3 utilities benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.d	1.00	2.0	<i>Some low value agricultural land to the south and west of the golf club protected by the option. Particularly protected against salt water inundation.</i>
3.a	-2.00	5.0	<i>Potential for construction phase impacts, including excavation and restoration of banks, from flood walls and embankments, mostly set back from sensitive waterbody.</i>
3.b	1.00	5.0	<i>Potential for temporary, indirect negative impacts on the Boyne Coast and Estuary SAC and Boyne Estuary SPA during construction of flood walls and embankments, set back from the designated areas. Potential for temporary negative impacts downstream from sedimentation during construction. Should be possible to mitigate for the significance of impacts with good construction works and good timing of works. Potential for increased area of wetland and estuarine habitat. Reconnection with more land to the natural floodplain.</i>
3.c	1.00	4.0	<i>Potential for negative impacts downstream on the Boyne Coast and Estuary pNHA from sedimentation during construction. Direct local loss of flora and displacement of fauna in footprint of defences, in undesignated areas. Potential for increased area of wetland and estuarine habitat. Reconnection with more land to the natural floodplain.</i>
3.d	-1.00	5.0	<i>Potential for excavation and restoration of banks and construction of walls, mostly set well back from sensitive waterbody. Short term construction impacts. Seasonality of works important.</i>
3.e	-1.00	5.0	<i>Short term negative impacts during the construction / extension of flood walls at Baltray. Localised negative impacts on views of the estuary to properties to be protected. Unlikely to be any impacts on the landscape of the Boyne Valley.</i>
3.f.i	1.00	3.0	<i>Potential for slight negative impacts on the setting of several NIAH buildings within Baltray. Potential for the increased protection of these NIAH buildings. Score marked down by 1 to reflect proximity to buildings.</i>
3.f.ii	0.00	1.0	<i>No effects on archaeological heritage</i>
4.a	5.00	5.0	<i>No operational risk</i>
4.b	4.00	5.0	<i>The following hazard has been identified: Working near water</i>

4.c	1.00	5.0	Option is adaptable only at significant cost	
Total MCA-Benefit Score		Option Cost (€millions)		MCA-Benefit Score / Cost Ratio
2074		1.93		1072.5
No Properties Benefitting		10% AEP Event	1%/0.5% AEP Event	0.1% AEP Event
Residential		23 (Fluvial) 33 (Coastal 1)	26 (Fluvial) 40 (Coastal 1)	N/A
Commercial		2 (Fluvial) 2 (Coastal 1)	2 (Fluvial) 5 (Coastal 1)	N/A
Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions				
Area NPVd (uncapped)	Option Cost		Option NPVb (capped)	Benefit - Cost Ratio
17.76	1.93		12.07	6.25
Environmental Assessments				
<p>The preferred measure will deliver several key flood protection benefits; reducing risk to numerous local properties and commercial properties, NIAH buildings, transport links and social infrastructure/amenity sites in the medium and long term. There is potential for an increase in the extent of estuarine and wetland habitat, due to the setting back of defences from the estuary.</p> <p>The Strategic Environmental Assessment identified a number of potential negative impacts associated with the preferred measures, but these are predominantly short term in nature. They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for minor visual impacts from flood defences in the medium to long term. As the measure involves a new line of flood defences set further back from the estuary than the existing defences, there is potential for loss of an amenity area; however, should this occur, it will be replaced with a more natural amenity area.</p> <p>As Boyne Coast and Estuary SAC and Boyne Estuary SPA are adjacent to and downstream of Baltray and several other European sites are located in the vicinity, with the potential for indirect impacts on the qualifying habitats and/or species, Appropriate Assessment was required. This assessed the proposed new line of hard defences at Baltray in addition to a second option encompassing a series of flood walls constructed along the existing line of defences. The new route avoids impinging on qualifying wetland and estuarine habitats for which the Boyne Coast and Estuary SAC was designated, and creates potential for their expansion. The direct impacts relate to the disturbance of protected birds, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.</p> <p>The specific mitigation measures will be identified in detail at project-level development stage of the preferred measure (ie. the stage at which the final measure to be progressed will be determined), through the project-level EIA/AA, as necessary. However, at this stage of assessment, it is foreseen that the mitigation measures that are likely to be required will include the following:</p> <ul style="list-style-type: none"><li>• the appropriate timing of construction work to minimise disturbance of species,</li><li>• effective sediment control measures to protect water quality,</li><li>• and appropriate surveys of habitats, species and hydrological processes</li></ul> <p>(see Section 6.6.3: timing to avoid overwintering of designated bird species, specific sediment control measures for sensitive areas, surveys).</p>				

### **Adaptability to Potential Future Changes**

An assessment of climate and catchment changes shows Baltray to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the preferred measure would require additional lengths and heights (circa 1m) of hard defences to maintain the existing proposed SoPs. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

It may be noted that the assessment of the hazard/risk as carried out under the 6-year cyclical review process of the Flood Risk Management Plans can be used as the trigger to activate potential future works or action to mitigate against any such change.

### **Public Consultation Outcomes**

A public consultation day on the potential options for Baltray was held on 09/03/16 (combined with Termonfeckin), and 17 members of the public attended.

Baltray was included in the consultation on the Eastern Draft Flood Risk Management Plans. A series of public consultation days for the Eastern Draft Flood Risk Management Plans were held between 27/09/16 and 02/11/16, which a total of 143 elected representatives and members of the public attended. A period of formal consultation on the draft Plans was also held between 22/09/16 and 02/12/16, which received 63 formal submissions.

Local details of drainage issues and ground conditions were provided however there was no overall consensus regarding a preferred line for the defences nor were any alternative options suggested.

The consultation process provided information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the preferred measure at this stage.

### **Other Issues / Conclusions**

Of the two potentially viable measures presented in the Preliminary Options Report, the preferred measure, as described above, scored better environmentally and economically and therefore has a significantly higher benefit cost ratio than the other potential measure.

Overall the preferred measure has a positive technical, social and economic score with a negative environmental/cultural score but the benefit – cost ratio is above unity.

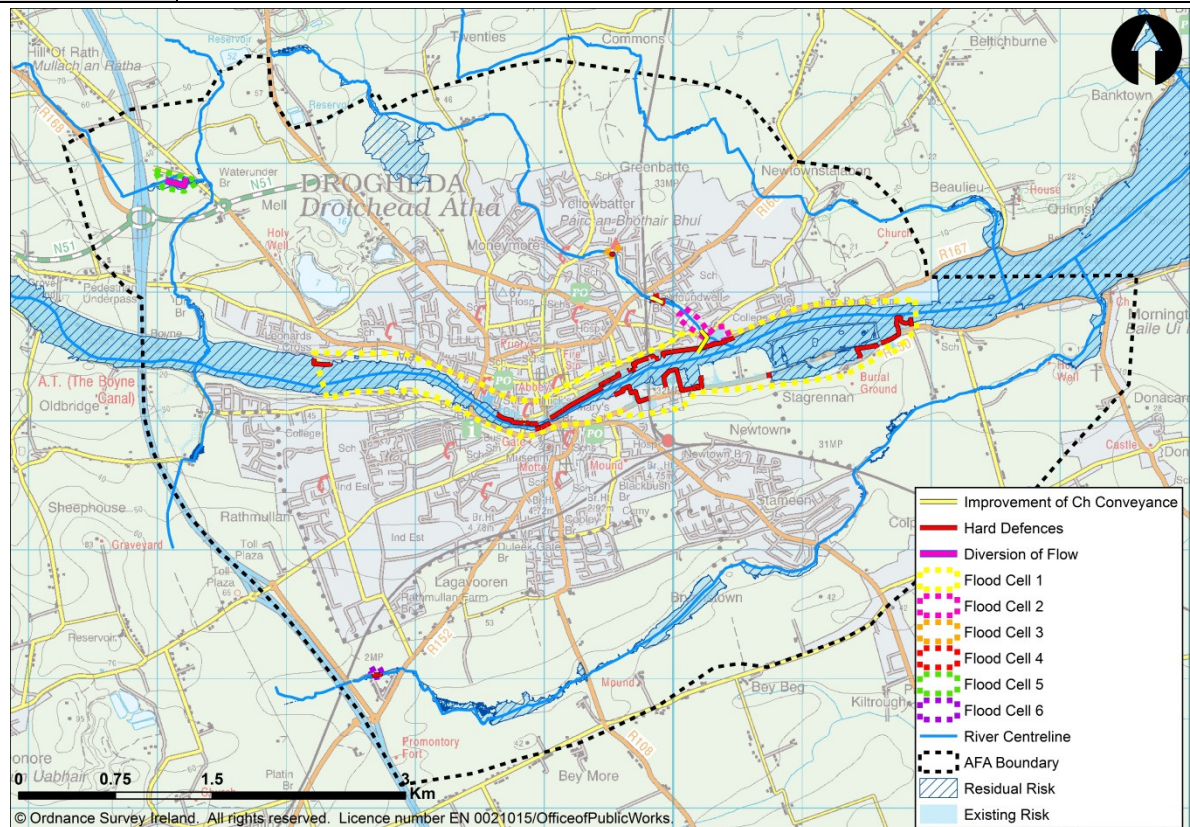
Issues for note during project-level assessment:

- The polder/channel maintenance regime and its interaction of the Baltray / Drogheda / Mornington schemes warrants further investigation at project-level assessment stage in order to establish an operational programme, in particular with regard to the fluvial risk within Drogheda AFA.



### G.3 Drogheda AFA

<b>River Basin</b>	Boyne (UoM07)	<b>AFA</b>	Drogheda
<b>Measure</b>	Progress the development of a Flood Relief Scheme for Drogheda AFA		
<b>Code</b>	IE07-IE-AFA-070033-0207-M61		
<b>Description</b>	Progress the project-level development and assessment of a Flood Relief Scheme for Drogheda, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation.		



The works presented herein are not the final and definitive works. Potential flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval (see Section 6.1 and 8.1).

#### MCA Appraisal Outcomes

Objective	Un-Weighted Score	Local Weighting	Comment
1.a.i	4.62	5.0	There is a combined number of 267 ground floor properties and there are 369 upper floor properties benefiting from the option's SoP from fluvial and coastal flood sources.
1.a.ii	0.0	1.0	There are no additional highly vulnerable properties benefiting from the option's SoP from fluvial and coastal flood sources.
1.b.i	4.87	5.0	There is a combined number of 51 social infrastructure/amenity sites benefiting from the option's SoP from fluvial and coastal flood sources.



1.b.ii	4.82	5.0	<i>There is a combined number of 272 commercial properties benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.a	4.43	5.0	<i>With this option in place the annual average damages have been reduced from €2619354.14 to €300508.05.</i>
2.b	1.67	5.0	<i>There is a combined number of 43 transport links benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.c	0.00	1.3	<i>There are no additional utilities benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.d	1.00	4.0	<i>No agricultural activity in the urban centre of the AFA FC1 - 4. Reduced flooding in FC5 due to flow diversion. No change in FC6.</i>
3.a	-4.00	5.0	<i>Potential for in-stream and on-bank construction phase impacts, including excavation and restoration of banks, from flood walls and embankments in sensitive waterbody. Flow diversion within the same river, in non-sensitive waterbody. Improvement of channel conveyance by minimal dredging and new constructed offline, overflow culvert section in non-sensitive, urbanised, trib stream which discharges to the River Boyne. Reduced flood risk for the 1% AEP fluvial and 0.5% AEP coastal flood events.</i>
3.b	-4.00	5.0	<i>Potential for temporary, direct negative impacts on the River Boyne and River Blackwater SAC and SPA during construction of flood walls and embankments, which will border the designated areas. Potential for negative impacts downstream from sedimentation during construction. Should be possible to mitigate for the significance of impacts with good construction works and good timing of works.</i>
3.c	-4.00	4.0	<i>Potential for negative impacts downstream on the Boyne Coast and Estuary pNHA from sedimentation during construction. Direct local loss of flora and displacement of fauna in footprint of defences and flow diversion, in areas not already impacted by development.</i>
3.d	-4.00	5.0	<i>Potential for excavation and restoration of banks and construction of walls in and adjacent to sensitive waterbody. Short term construction impacts. Flow diversion in the same river, in non-sensitive waterbody. Seasonality of works important.</i>
3.e	-3.00	5.0	<i>Mainly short term negative impacts during the construction of flood walls in Drogheda, otherwise localised negative impacts on views in the town of the River Boyne. Unlikely to be any impacts on the upstream UNESCO designation or the landscape of the Boyne Valley. Potential for permanent negative localised impacts in the vicinity of any proposed high walls.</i>
3.f.i	-1.00	5.0	<i>Potential for direct physical impacts and impacts on the setting of many NIAH buildings and other architectural heritage within Drogheda. Unlikely that any feature will require removal. Potential for the increased protection of these NIAH buildings and other architectural heritage within the AFA from flooding.</i>

3.f.ii	-1.00	5.0	Potential for direct physical impacts and impacts on the setting of many recorded monuments within Drogheda. Unlikely that any feature will require removal. Potential for the increased protection of these monuments within the AFA from flooding.	
4.a	4.00	5.0	Negligible operational risk	
4.b	2.00	5.0	The following hazards have been identified: Working near water, Maintenance near water, Heavy plant and machinery	
4.c	0.00	5.0	Option is not adaptable	
Total MCA-Benefit Score		Option Cost (€millions)	MCA-Benefit Score / Cost Ratio	
654		16.83	38.9	
No Properties Benefitting		10% AEP Event	1%/0.5% AEP Event	0.1% AEP Event
Residential		8 (Fluvial) 56 (Coastal 1)	79 (Fluvial) 104 (Coastal 1)	N/A
Commercial		30 (Fluvial) 52 (Coastal 1)	78 (Fluvial) 120 (Coastal 1)	N/A
Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions				
Area NPVd (uncapped)		Option Cost	Option NPVb (capped)	Benefit - Cost Ratio
111.48		16.83	50.12	2.98
Environmental Assessments				
<p>The preferred measure will deliver several key flood protection benefits; reducing risk to numerous local properties and commercial properties, NIAH buildings, monuments and other architectural heritage, transport links and social infrastructure/amenity sites in the medium and long term.</p> <p>The Strategic Environmental Assessment identified a number of potential negative impacts associated with the preferred measures, but these are predominantly short term in nature. They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for disturbance or loss of habitats and/or species in the direct footprint of the hard defences, and minor visual impacts in the medium to long term.</p> <p>As the proposed works will be located immediately adjacent to the River Boyne and River Blackwater SAC and SPA, and upstream of the Boyne Coast and Estuary SAC and SPA, with the potential for direct and indirect impacts on the relevant qualifying habitats and/or species, Appropriate Assessment was required. The direct impacts relate to the footprint of hard defences, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.</p> <p>The specific mitigation measures will be identified in detail at project-level development stage of the preferred measure (ie. the stage at which the final measure to be progressed will be determined), through the project-level EIA/AA, as necessary. However, at this stage of assessment, it is foreseen that the mitigation measures that are likely to be required will include the following:</p> <ul style="list-style-type: none"><li>the appropriate timing of construction work to minimise disturbance of species,</li><li>effective sediment control measures to protect water quality,</li><li>and appropriate surveys of habitats, species and hydrological processes</li></ul> <p>(see Section 6.6.3: timing to avoid overwintering of designated bird species, specific sediment control measures for sensitive areas, surveys).</p>				

### **Adaptability to Potential Future Changes**

An assessment of climate and catchment changes shows Drogheda AFA to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the preferred measure would require significant additional lengths and heights (over 1m) of hard defences along the Boyne to maintain the existing proposed SoPs. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

It may be noted that the assessment of the hazard/risk as carried out under the 6-year cyclical review process of the Flood Risk Management Plans can be used as the trigger to activate potential future works or action to mitigate against any such change.

### **Public Consultation Outcomes**

A public consultation day on the potential options for Drogheda was held on 10/03/16, and seven members of the public attended.

Drogheda was included in the consultation on the Eastern Draft Flood Risk Management Plans. A series of public consultation days for the Eastern Draft Flood Risk Management Plans were held between 27/09/16 and 02/11/16 which a total of 143 elected representatives and members of the public attended. A period of formal consultation on the draft Plans was also held between 22/09/16 and 02/12/16, which received 63 formal submissions.

The consultation process indicated a particular concern regarding flooding to the port area over the existing ineffective hard defences and through the drainage network.

The continued operations and role of the port company in terms of supporting flood risk management was also raised. As a result the indicative line of the hard defences has been reviewed and automated barriers incorporated to accommodate port activities; the specifics of these are to be identified during subsequent project-level assessment.

The consultation process provided further information, which has been noted for detailed design; however, none resulted in a change of the preferred measure at this stage.

### **Other Issues / Conclusions**

Of the three potentially viable measures presented in the Preliminary Options Report, the preferred measure, as described above, has the best combination of the MCA appraisal scores and has the highest MCA Score/Cost compared to other potential measures.

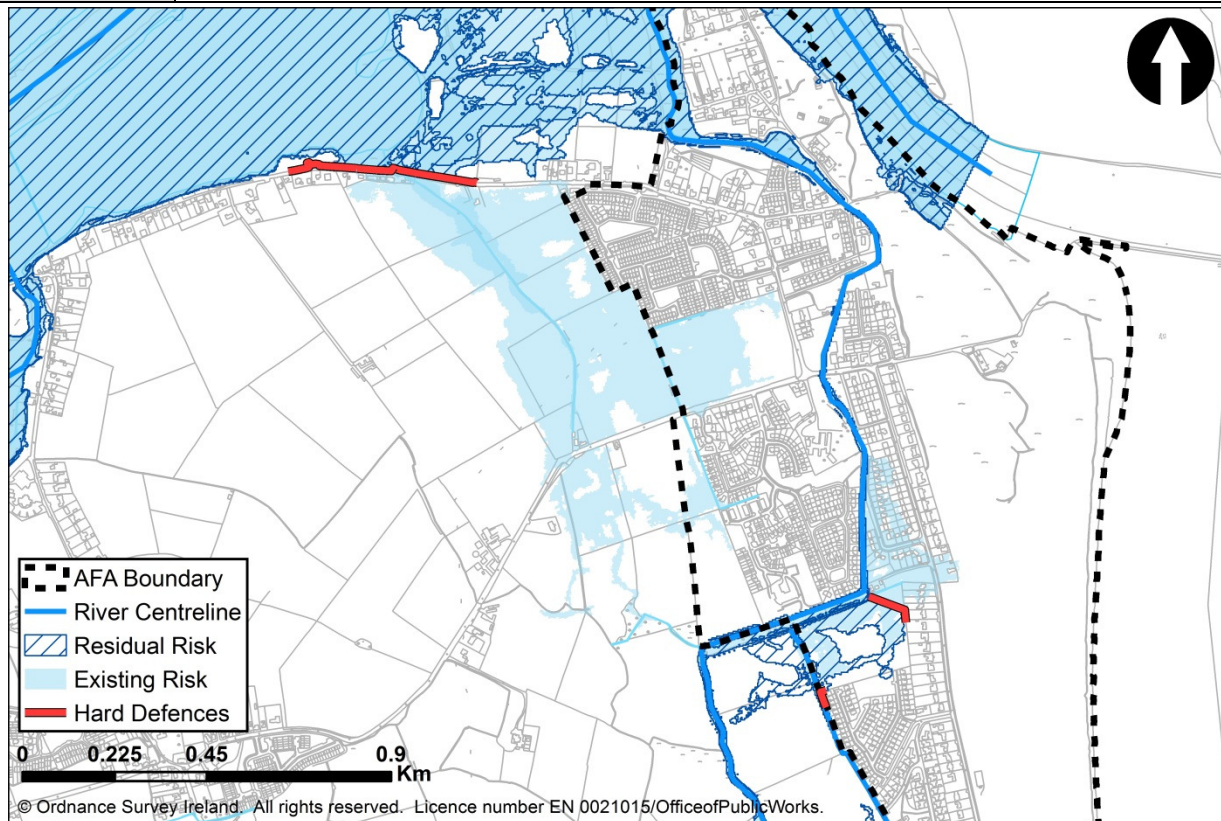
Overall the preferred measure has a positive technical, social and economic score with a negative environmental/cultural score but the benefit – cost ratio is above unity.

Issues for note during project-level assessment:

- Location of hard defences and automated barriers in relation to the Port and its activities
- The operation and maintenance regime of tidal polders and navigation channel by Drogheda Port Company
- The polder/channel maintenance regime and its interaction with the Baltray / Drogheda / Mornington schemes warrants further investigation at project-level assessment stage in order to establish an operational programme, in particular with regard to the fluvial risk within Drogheda AFA.

#### G.4 Mornington AFA

<b>River Basin</b>	Boyne (UoM07)	<b>AFA</b>	Mornington
<b>Measure</b>	Progress the development of a Flood Relief Scheme for Mornington AFA		
<b>Code</b>	IE07-IE-AFA-070880-0307-M61		
<b>Description</b>	Progress the project-level development and assessment of a Flood Relief Scheme for Mornington, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation.		



The works presented herein are not the final and definitive works. Potential flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval (see Section 6.1 and 8.1).

#### MCA Appraisal Outcomes

Objective	Un-Weighted Score	Local Weighting	Comment
1.a.i	4.09	5.0	<i>There is a combined number of 57 ground floor properties and no additional upper floor properties benefiting from the option's SoP from fluvial and coastal flood sources.</i>
1.a.ii	0.00	1.0	<i>There are no additional highly vulnerable properties benefiting from the option's SoP from fluvial and coastal flood sources.</i>
1.b.i	4.85	5.0	<i>There is a combined number of 6 social infrastructure/amenity sites benefiting from the option's SoP from fluvial and coastal flood sources.</i>
1.b.ii	0.00	1.0	<i>There are no additional commercial properties benefiting from the option's SoP from fluvial and coastal flood sources.</i>

2.a	3.11	1.0	<i>With this option in place the annual average damages have been reduced from €65852.9 to €24936.28.</i>
2.b	4.79	5.0	<i>There is a combined number of 15 transport links benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.c	4.75	5.0	<i>There is a combined number of 1 utility benefiting from the option's SoP from fluvial and coastal flood sources.</i>
2.d	3.00	2.0	<i>Significant area of agricultural land to the west of Mornington now protected up to 0.5% AEP SoP from coastal flooding and fluvial flooding from Boyne Estuary.</i>
3.a	-2.00	5.0	<i>Potential for construction phase impacts, including excavation and restoration of banks, from flood walls and embankments, mostly set back from sensitive waterbody.</i>
3.b	-3.00	5.0	<i>Potential for temporary, indirect negative impacts on the Boyne Coast and Estuary SAC and Boyne Estuary SPA during construction of flood walls and embankments, set back from the designated areas. Potential for temporary negative impacts downstream from sedimentation during construction. Should be possible to mitigate for the significance of impacts with good construction works and good timing of works.</i>
3.c	-2.00	4.0	<i>Potential for negative impacts downstream on the Boyne Coast and Estuary pNHA from sedimentation during construction of flood walls and embankments, set back from the designated areas. Direct local loss of flora and displacement of fauna in footprint of defences, in undesignated areas.</i>
3.d	-1.00	5.0	<i>Potential for excavation and restoration of banks and construction of walls, mostly set well back from sensitive waterbody. Short term construction impacts. Seasonality of works important.</i>
3.e	-1.00	4.0	<i>Short term negative impacts during the construction of flood walls and embankments at Mornington. Localised negative impacts on views of the estuary and countryside to properties to be protected. Unlikely to be any impacts on the landscape of the Boyne Valley or coastal plain.</i>
3.f.i	0.00	3.0	<i>No effects on architectural heritage</i>
3.f.ii	0.00	1.0	<i>No effects on architectural heritage</i>
4.a	4.00	5.0	<i>Negligible operational risk</i>
4.b	4.00	5.0	<i>The following hazard has been identified: Working near water</i>
4.c	0.00	5.0	<i>Option is not adaptable</i>
<b>Total MCA-Benefit Score</b>		<b>Option Cost (€millions)</b>	<b>MCA-Benefit Score / Cost Ratio</b>
1042		0.53	1977.3
<b>No Properties Benefitting</b>		<b>10% AEP Event</b>	<b>1%/0.5% AEP Event</b>
Residential		1 (Fluvial) 1 (Coastal 1)	41 (Fluvial) 10 (Coastal 1) N/A
Commercial		0 (Fluvial) 1 (Coastal 1)	1 (Fluvial) 0 (Coastal 1) N/A
<b>Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions</b>			
<b>Area NPVd (uncapped)</b>		<b>Option Cost</b>	<b>Option NPVb (capped)</b>
2.9		0.53	1.85
			<b>Benefit - Cost Ratio</b>
			3.52

### **Environmental Assessments**

The preferred measure will deliver several key flood protection benefits; reducing risk to numerous local properties, transport links, utilities, agricultural land and social infrastructure/amenity sites in the medium and long term.

The Strategic Environmental Assessment identified a number of potential negative impacts associated with the preferred measures, but these are predominantly short term in nature. They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for disturbance or loss of habitats and/or species in the direct footprint of the hard defences, and minor visual impacts in the medium to long term.

As the proposed works will be located adjacent to and upstream of the Boyne Coast and Estuary SAC and Boyne Estuary SPA, with the potential for direct and indirect impacts on the qualifying habitats and/or species, Appropriate Assessment was required. The direct impacts relate to the disturbance of protected bird species of Boyne Estuary SPA, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.

The specific mitigation measures will be identified in detail at project-level development stage of the preferred measure (ie. the stage at which the final measure to be progressed will be determined), through the project-level EIA/AA, as necessary. However, at this stage of assessment, it is foreseen that the mitigation measures that are likely to be required will include the following:

- the appropriate timing of construction work to minimise disturbance of species,
- effective sediment control measures to protect water quality,
- and appropriate surveys of habitats, species and hydrological processes

(see Section 6.6.3: timing to avoid overwintering of designated bird species, specific sediment control measures for sensitive areas, surveys).

### **Adaptability to Potential Future Changes**

An assessment of climate and catchment changes shows Mornington to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the preferred measure would require significant additional lengths of hard defences and raising of the existing Mornington defences (circa 1m) to maintain the existing proposed SoPs. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

It may be noted that the assessment of the hazard/risk as carried out under the 6-year cyclical review process of the Flood Risk Management Plans can be used as the trigger to activate potential future works or action to mitigate against any such change.

### **Public Consultation Outcomes**

A public consultation day on the potential options for Mornington was held on 09/03/16, and 15 members of the public attended.

Mornington was included in the consultation on the Eastern Draft Flood Risk Management Plans. A series of public consultation days for the Eastern Draft Flood Risk Management Plans were held between 27/09/16 and 02/11/16 which a total of 143 elected representatives and members of the public attended. A period of formal consultation on the draft Plans was also held between 22/09/16 and 02/12/16, which received 63 formal submissions.

The consultation process provided further information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the preferred measure at this stage.

### **Other Issues / Conclusions**



Only one measure was identified for Mornington as presented in the Preliminary Options Report as being viable, and consequently this is the preferred measure.

Overall the preferred measure has a positive technical, social and economic score with a negative environmental/cultural score but the benefit – cost ratio is above unity.

Issues for note during project-level assessment:

- The polder/channel maintenance regime and its interaction with the Baltray / Drogheda / Mornington schemes warrants further investigation at project-level assessment stage in order to establish an operational programme, although this is most likely to be relevant in the case of the fluvial risk within Drogheda AFA.

## G.5 Navan AFA

River Basin	Boyne (UoM07)	AFA	Navan
Measure	Undertake a Detailed Assessment of the Costs of the Potential Measure for Navan AFA		
Code	IE07-IE-AFA-070039-0407-M25		
Description	Undertake a detailed assessment of the costs to determine if an economically viable measure may exist that could justify the progression to full project-level assessment.		



The works presented herein are not the final and definitive works. Potential flood relief works set out herein will need to be further developed at a local, project level before Exhibition or submission for planning approval (see Section 6.1 and 8.1).

MCA Appraisal Outcomes			
Objective	Un-Weighted Score	Local Weighting	Comment
1.a.i	4.22	5.0	<i>There are 104 ground floor properties and there are 188 upper floor properties benefiting with this option in place.</i>
1.a.ii	2.50	5.0	<i>There are 2 highly vulnerable properties benefiting with this option in place.</i>
1.b.i	4.88	5.0	<i>There are 32 social infrastructure/amenity sites benefiting with this option in place.</i>
1.b.ii	4.12	5.0	<i>There are 15 commercial properties benefiting with this option in place.</i>
2.a	4.17	5.0	<i>With this option in place the annual average damages have been reduced from €818883.04 to €136366.17.</i>
2.b	5.00	5.0	<i>There are 15 transport links benefiting with this option in place.</i>
2.c	4.95	5.0	<i>There is 1 utility benefiting with this option in place.</i>
2.d	0.00	3.0	<i>There is no increase of flood risk within the AFA to agricultural land.</i>
3.a	-4.00	5.0	<i>Potential for direct construction phase impacts from in-stream and on-bank works creating/upgrading embankments and walls. Excavation and restoration of banks in sensitive waterbody. Potential for indirect sedimentation impacts downstream during works. Unlikely to be permanent or recurring impacts to waterbody.</i>
3.b	-4.00	5.0	<i>Potential for direct construction phase impacts to River Boyne and River Blackwater SAC and SPA, from in-stream and on-bank works creating/upgrading embankments and walls. Most works adjacent to and not within designated area. Potential for indirect sedimentation impacts downstream during works. Unlikely to be permanent or recurring impacts to designated sites following construction.</i>
3.c	-1.00	2.0	<i>Potential for direct construction phase impacts to local flora and fauna in footprint of works and clearance in the Abbeylands Tributary. Localised loss and disturbance to flora/fauna limited by the modified nature of the channel and banks. Slight potential for indirect sedimentation impacts downstream to Boyne Woods pNHA. Unlikely to be permanent or recurring impacts following construction.</i>
3.d	-4.00	5.0	<i>Potential for direct construction phase impacts from in-stream and on-bank works creating/upgrading embankments and walls. Excavation and restoration of banks in sensitive waterbody. Potential for indirect sedimentation impacts downstream during works. Unlikely to be permanent or recurring impacts to fisheries potential.</i>
3.e	-3.00	5.0	<i>Temporary impacts from construction of extension to local flood embankment prior to establishment of screening. Localised impacts on views of the river, which are already impacted. River corridor is however considered a high value landscape and is highly sensitive.</i>
3.f.i	2.00	5.0	<i>Potential for negative impacts on the setting of NIAH bridges, weirs and mill on the Boyne and Blackwater from embankments and walls. Potential for direct physical impacts to NIAH bridges and weirs during construction. Potential for increased protection from flooding for several NIAH buildings.</i>
3.f.ii	0.00	5.0	<i>No effects on archaeological features.</i>

4.a	4.00	5.0	<i>Option includes fixed flood defence walls and embankments. Negligible operational risk, i.e., no reliance on systems or intervention, with more regular monitoring and intermittent, but potentially substantial, maintenance requirements</i>	
4.b	2.00	5.0	<i>The following hazards have been identified: Working near water, Maintenance near water, Heavy plant and machinery</i>	
4.c	4.00	5.0	<i>Option is readily adaptable at limited cost</i>	
<b>Total MCA-Benefit Score</b>		<b>Option Cost (€millions)</b>		<b>MCA-Benefit Score / Cost Ratio</b>
1373		6.32		217.1
<b>No Properties Benefitting</b>		<b>10% AEP Event</b>	<b>1%/0.5% AEP Event</b>	<b>0.1% AEP Event</b>
Residential		13	104	N/A
Commercial		3	21	N/A
<b>Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions</b>				
<b>Area NPVd (uncapped)</b>		<b>Option Cost</b>	<b>Option NPVb (capped)</b>	<b>Benefit - Cost Ratio</b>
14.4		6.32	4.50	0.71
<b>Environmental Assessments</b>				
<p>The preferred measure will deliver several key flood protection benefits; reducing risk to numerous local properties, NIAH buildings, transport links, utilities and social infrastructure/amenity sites in the medium and long term.</p> <p>The Strategic Environmental Assessment identified a number of potential negative impacts associated with the preferred measures, but these are predominantly short term in nature. They include the potential for disturbance of the local community during construction of the hard defences, and short term sedimentation and water quality impacts. There is also potential for disturbance or loss of habitats and/or species in the direct footprint of the hard defences.</p> <p>As the proposed works will be located within, upstream of and downstream of the River Boyne and River Blackwater SAC and SPA, with the potential for direct and indirect impacts on the qualifying habitats and/or species, Appropriate Assessment was required. The direct impacts relate to the footprint of hard defences and disturbance of protected birds, while the indirect impacts relate to the risk of increased sediment loads and associated nutrients to the water during the construction phase.</p> <p>The specific mitigation measures will be identified in detail at project-level development stage of the preferred measure (ie. the stage at which the final measure to be progressed will be determined), through the project-level EIA/AA, as necessary. However, at this stage of assessment, it is foreseen that the mitigation measures that are likely to be required will include the following:</p> <ul style="list-style-type: none"> <li>• the appropriate timing of construction work to minimise disturbance of species,</li> <li>• effective sediment control measures to protect water quality,</li> <li>• and appropriate surveys of habitats, species and hydrological processes</li> </ul> <p>(see Section 6.6.3: timing to avoid overwintering of designated bird species, disturbance of salmon and lamprey spawning seasons and kingfisher breeding season, specific sediment control measures for sensitive areas, surveys).</p>				

### **Adaptability to Potential Future Changes**

An assessment of climate and catchment changes shows Navan to be highly vulnerable to the increases as modelled in the mid-range and high end future scenarios. Adaptation of the preferred measure would require significant additional lengths and heights (circa 1m) of hard defences to maintain the level of protection as provided by the preferred measure. Future monitoring, and subsequent implementation of other measures such as Natural Flood Risk Management Measures, may be adopted to assist in identifying and off-setting the impacts of climate change.

It may be noted that the assessment of the hazard/risk as carried out under the 6-year cyclical review process of the Flood Risk Management Plans can be used as the trigger to activate potential future works or action to mitigate against any such change.

### **Public Consultation Outcomes**

A public consultation day on the potential options for Navan was held on 16/02/16 and seven members of the public attended.

Navan was included in the consultation on the Eastern Draft Flood Risk Management Plans. A series of public consultation days for the Eastern Draft Flood Risk Management Plans were held between 27/09/16 and 02/11/16 which a total of 143 elected representatives and members of the public attended. A period of formal consultation on the draft Plans was also held between 22/09/16 and 02/12/16, which received 63 formal submissions.

The consultation process provided further information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the preferred measure at this stage.

### **Other Issues / Conclusions**

Only one measure was identified for Navan as presented in the Preliminary Options Report as being technically viable and consequently this is the preferred measure, while noting it was not found to be economically viable.

Overall the preferred measure has a positive technical, social and economic score with a negative environmental/cultural score and the benefit – cost ratio is below unity. Therefore it is recommended that a detailed assessment of the costs of the potential measure for Navan should be undertaken.

The consultation process provided further information, which has been noted for consideration during the project-level assessment stage; however, none resulted in further changes to the preferred measure at this stage.



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