

Plean um Bainistiú Priacal Tuile

Flood Risk Management Plan

Cuan Shligigh & An Drobhaois
Sligo Bay & Drowse

2018

Plean um Bainistiú Priacal Tuile

Flood Risk Management Plan

Amhantrach (35) Cuan Shligigh & An Drobhaois

River Basin (35) Sligo Bay & Drowse

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

<i>Cuill Mhuine</i>	<i>Collooney</i>
<i>Baile an Mhóta</i>	<i>Ballymote</i>
<i>Baile Easa Dara & máguaird</i>	<i>Ballysadare & Environs</i>
<i>Goirtín</i>	<i>Gorteen</i>
<i>Cúil Áine</i>	<i>Coolaney</i>
<i>Baile Shligigh (Ráth Bracháin san áireamh)</i>	<i>Sligo Town (Incl Rathbraghan)</i>
<i>Cluainín</i>	<i>Manorhamilton</i>
<i>Baile Idir dhá Abhainn</i>	<i>Riverstown</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.

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- Sligo County Council
- Leitrim County Council
- The Environmental Protection Agency
- Met Éireann
- All members of the National CFRAM Steering and Stakeholder Groups

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ACHOIMRE FHEIDHMEACH

RÉAMHRÁ

Is é seo an Plean um Bainistiú Priacal Tuile (an ‘Plean’) d’Abhantrach Cuan Shligigh & An Drobhaois. 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, 2004¹), agus freagraíonn sé oibleagáidí na hÉireann faoi Threoir ‘Tuilte’ an AE 2007 (EU, 2007²).

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 Cuan Shligigh & An Drobhaois 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.

¹ Tuarascáil an Ghrúpa um Athbhreithniú ar Pholasaí Tuile, OPW, 2004 (www.floodinfo.ie)

² 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 Cuan Shligigh & An Drobhaois

CONTAE	AINM an PHOBAIL	FOINSÍ PRIACAL TUILE
Sligeach	Baile an Mhóta	Abhann
Sligeach	Baile Easa Dara	Abhann & Taoidmhear
Sligeach	Cuil Mhuine	Abhann
Sligeach	Cúil Áine	Abhann
Sligeach	Goirtín	Abhann
Liatroim	Cluainín	Abhann
Sligeach	Baile Idir dhá Abhainn	Abhann
Sligeach	Baile Shligigh (Ráth Bracháin san áireamh)	Abhann & Taoidmhear

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 comhshaoil, 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 mapaí 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).

Thionól an OPW breis agus 200 Lá Comhairliúcháin Phoiblí maidir leis na mapaí tuile ins na pobail bhainteacha; bhí deis ag daoine tuithe staitiúla agus cruinneas na mapaí a phlé leis na hinnealtóirí ón OPW agus a gcuid comhairleoirí. Tharla comhairliúchán reachtúil phoiblí 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 phoiblí 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.

Tionsaíodh 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 mapaí tuile chun réimse, doimhneacht agus luas srutha na n-uiscí tuile a thaispeáint, chomh maith le réimse mapaí guaise (chun baol agus tionchair dhóchúla tuilte a thaispeáint) agus mapaí Creasa Tuile mar bhonn eolais ar phleanáil agus forbairt inbhuanaithe. Don chás reatha agus don chás amach anseo, ullmhaíodh mapaí 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 íoslaghdú.

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 húdarais 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 húdarais 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 húdarais 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 Údarais 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 húdarais 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 húdarais 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 dualgais úinéirí talún, maidir le cothabháil cúrsaí uisce ar a gcuid tailte nó ina gcóngar, ar fáil ag 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 chuireoidh 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 athbhreithniú 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

Ní bhfuarthas aon chéimeanna indéanta ar leibhéal abhantraí / fo-abhantraí don Abhantrach seo.

Céimeanna ar Leibhéal Pobail

Do Ráth Bracháin (Baile Shligigh), 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.

Moltar, mar chuid den fhorbairt ar Sheirbhís Náisiúnta um Réamhaisnéis Tuile, gur cóir córas réamhaisnéise tuile a fhorbairt do Bhaile Shligigh.

Do Chúil Áine 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.

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

Níl aon scéimeanna nó oibreacha eile um Fhaoiseamh Tuile tugtha chun cinn nó molta trí thionscadail nó trí phleananna eile.

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 Sligo Bay & Drowse 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, 2004³), and addresses Ireland's obligations under the 2007 EU 'Floods' Directive (EU, 2007⁴).

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 Sligo Bay & Drowse 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.

³ Report of the Flood Policy Review Group, OPW, 2004 (www.floodinfo.ie)

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

Table ES-1 **Communities at Potentially Significant Flood Risk within the Sligo Bay & Drowse River Basin**

COUNTY	COMMUNITY NAME	SOURCE(S) OF FLOOD RISK
Sligo	Ballymote	Fluvial
Sligo	Ballysadare	Fluvial & Tidal
Sligo	Collooney	Fluvial
Sligo	Coolaney	Fluvial
Sligo	Gorteen	Fluvial
Leitrim	Manorhamilton	Fluvial
Sligo	Riverstown	Fluvial
Sligo	Sligo Town (incl. Rathbraghan)	Fluvial & Tidal

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).

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.

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

No catchment / sub-catchment-level measures were found to be feasible for this River Basin.

Community-Level Measures

For Rathbraghan (Sligo Town), 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:

It is proposed that, as part of the development of the National Flood Forecasting Service, a flood forecasting system should be developed for Sligo Town.

Potentially viable structural flood relief measures have been investigated for Coolaney 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.

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

There are no other flood relief schemes or works progressed or proposed through other projects or plans.

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.

CONTENTS

1	INTRODUCTION AND BACKGROUND	4
1.1	OVERVIEW	4
1.2	FLOODING AND FLOOD RISK.....	4
1.2.1	Types and Causes of Flooding	4
1.2.2	Impacts of Flooding	5
1.2.3	Potential Impacts of Future Change	5
1.3	BACKGROUND	5
1.3.1	Flood Policy and Legislative Background	5
1.3.2	Competent and Responsible Authorities for the 'Floods' Directive.....	6
1.3.3	The 'CFRAM' Programme.....	6
1.3.4	Other Relevant Flood Risk Management Projects	6
1.3.5	Other Relevant Policies and Plans	8
1.4	FLOOD RISK MANAGEMENT OBJECTIVES	10
1.4.1	Overview	10
1.4.2	Definition of the Objectives	11
1.5	SCOPE OF THE PLAN	13
1.5.1	Spatial Scope of the Plan	13
1.5.2	Sources of Flooding Addressed in the Plan	13
1.5.3	Level of Detail of the Plan.....	13
1.6	STRUCTURE OF THE PLAN.....	14
2	OVERVIEW OF THE RIVER BASIN	15
2.1	THE SLIGO BAY - DROWES UNIT OF MANAGEMENT	15
2.2	TOPOGRAPHY, GEOLOGY, SOILS AND GROUNDWATER.....	16
2.2.1	Topography.....	16
2.2.2	Geology, Soils and Groundwater.....	16
2.3	LAND USE AND LAND MANAGEMENT	16
2.3.1	Urban Areas.....	16
2.3.2	Land cover and land use	16
2.3.3	Potential future land use changes	16
2.4	HYDROLOGY.....	17
2.4.1	Sub-catchments and river network, estuarine areas, coastlines	17
2.4.2	Rainfall distribution	17
2.4.3	Hydrometric data availability	17
2.5	FLOOD HISTORY	17
2.6	EXISTING FLOOD RISK MANAGEMENT MEASURES.....	20
2.6.1	Arterial Drainage Schemes and Drainage Districts	20
2.6.2	Minor Works.....	20
3	PRELIMINARY FLOOD RISK ASSESSMENT	21
3.1	INTRODUCTION	21
3.2	OUTCOMES OF THE PFRA	21
3.3	FURTHER INFORMATION	21

4	PUBLIC AND STAKEHOLDER CONSULTATION AND ENGAGEMENT	24
4.1	OVERVIEW	24
4.2	AVAILABILITY OF PROJECT INFORMATION	24
4.3	STAKEHOLDER ENGAGEMENT	24
4.3.1	The CFRAM Steering and Progress Groups	24
4.3.2	Stakeholder Consultation Groups.....	26
4.3.3	Coordination with the Implementation of the Water Framework Directive	26
4.4	PUBLIC CONSULTATION AND ENGAGEMENT	26
4.4.1	Consultation on Preliminary Flood Risk Assessment.....	26
4.4.2	Launch of the Western CFRAM Project	27
4.4.3	Consultation on Flood Maps	27
4.4.4	Consultation on Flood Risk Management Objectives.....	27
4.4.5	Consultation on Options	28
4.4.6	Consultation on Draft Plans	28
4.5	CROSS-BORDER COORDINATION	28
5	FLOOD HAZARD AND RISK ASSESSMENT	29
5.1	HYDROLOGICAL ANALYSIS	29
5.2	HYDRAULIC MODELLING	30
5.3	FLOOD HAZARD MAPPING	33
5.3.1	Outcomes of public consultation on flood maps.....	34
5.4	FLOOD RISK ASSESSMENT AND MAPPING	34
5.5	CONSIDERATION OF FUTURE CHANGES.....	35
5.6	COMMUNITIES (AFAS) OF LOW RISK.....	36
6	ENVIRONMENTAL CONSIDERATIONS	38
6.1	OVERVIEW	38
6.2	ENVIRONMENTAL CONSTRAINTS AND OPPORTUNITIES IN THE SLIGO BAY DROWES RIVER BASIN.....	40
6.3	STRATEGIC ENVIRONMENTAL ASSESSMENT	43
6.3.1	Screening.....	43
6.3.2	Scoping	43
6.3.3	Assessment & Evaluation	44
6.4	APPROPRIATE ASSESSMENT	47
6.4.1	Stage 1 - Screening for AA.....	47
6.4.2	Stage 2 - AA	47
6.4.3	Stage 3 - Alternative Solutions	48
6.4.4	Stage 4 - IROPI	48
6.5	COORDINATION WITH WATER FRAMEWORK DIRECTIVE	48
6.5.1	Bi-Lateral Meetings	48
6.5.2	Cross-Representation on Management Groups.....	48
6.5.3	Exchange of Information.....	49
6.5.4	Coordination on Measures.....	49
6.6	PROGRESSION OF MEASURES AND ASSESSMENT OF FUTURE WORKS	50
6.6.1	Approval of the Plan	50
6.6.2	Implementation Routes for Physical Works.....	51

6.6.3	Mitigation Measures.....	51
7	MANAGING FLOOD RISK.....	53
7.1	OVERVIEW	53
7.2	METHODS OF FLOOD RISK MANAGEMENT	53
7.2.1	Flood Risk Prevention Methods.....	53
7.2.2	Flood Protection Methods.....	54
7.2.3	Flood Preparedness (Resilience) Methods	54
7.2.4	Continue Existing Regime / Do Nothing / Minor Measures	54
7.3	DEVELOPMENT AND APPRAISAL OF FLOOD RISK MANAGEMENT OPTIONS.....	55
7.3.1	Spatial Scales of Assessment	55
7.3.2	Step 1: Screening of Flood Risk Management Methods	56
7.3.3	Step 2: Development of Options for Flood Risk Management Measures	56
7.3.4	Step 3: Appraisal by Multi-Criteria Analysis.....	57
7.3.5	Step 4: Economic Appraisal	58
7.3.6	Step 5: Public and Stakeholder Engagement.....	58
7.3.7	Step 6: Identification of Preferred Options.....	59
7.3.8	Measures Identified from Other Policies, Projects and Initiatives	59
7.4	OUTCOMES	59
7.4.1	Measures Applicable for All Areas.....	59
7.4.2	Catchment / Sub-Catchment Measures	67
7.4.3	Sligo Town AFA measures (Rathbraghan Area)	68
7.4.4	Ballymote AFA measures	70
7.4.5	Riverstown AFA measures	70
7.4.6	Ballysadare AFA measures	70
7.4.7	Collooney AFA measures	70
7.4.8	Gorteen AFA measures	71
7.4.9	Manorhamilton AFA measures	71
7.4.10	Measures with a Benefit - Cost Ratio below Unity	71
7.5	PRIORITISATION OF PROPOSED PROTECTION MEASURES.....	73
7.6	FLOOD RISK MANAGEMENT IN OTHER AREAS	74
7.7	SUMMARY OF PROPOSED MEASURES	74
8	IMPLEMENTATION, MONITORING AND REVIEW OF THE PLAN	77
8.1	IMPLEMENTATION OF THE PLAN	77
8.1.1	River Basin Level Measures	77
8.1.2	Catchment and AFA-Level Physical Measures	77
8.1.3	Other Catchment and AFA-Level Measures.....	79
8.1.4	Public and Stakeholder Consultation and Engagement	79
8.2	MONITORING OF PROGRESS IN IMPLEMENTATION OF THE PLAN	79
8.3	ENVIRONMENTAL MONITORING.....	80
8.4	REVIEW OF THE PFRA, FLOOD MAPS AND THE PLANS.....	81
	GLOSSARY AND ACRONYMS.....	82
	REFERENCES	87
	APPENDICES	88

1 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

This is the Flood Risk Management Plan (the 'Plan') for the Sligo Bay Drowse (Drowes) 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 Sligo Bay Drowse (Drowes) 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, 2004¹
- 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, 2007²). 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.

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)

¹ Report of the Flood Policy Review Group, OPW, 2004 (www.floodinfo.ie)

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

- 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

Specific recommendations of 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 2010³ and amended by SI No. 495 of 2015⁴.

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.

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

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

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 JBA Consulting Ltd for the Sligo Bay Drowes 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 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),
- Prepare a set of FRMPs, 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, focussed on the AFAs, 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 River Basins 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.

1.3.4 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, these projects are:

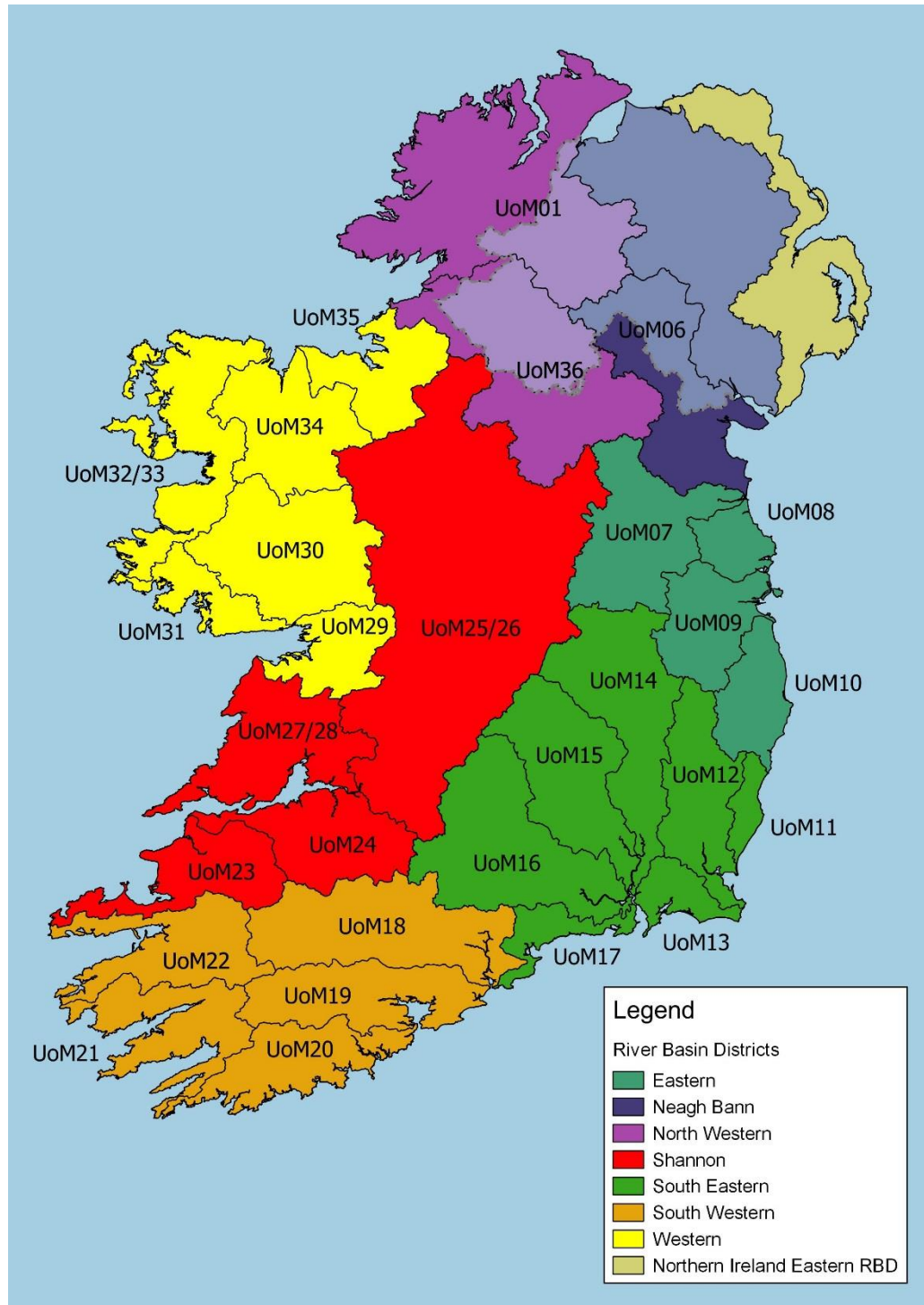
- Bonet Arterial Drainage Scheme
- Coolaney, Drunmcliff, Dunmorán and Owenmore Drainage Districts

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 relevant project website above or on the OPW website⁵:

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

Figure 1-1: River Basin Districts (RBDs) and River Basins (UoMs) in Ireland



⁵ <http://www.opw.ie/en/flood-risk-management/operations/flooddefenceschemes/#d.en.23394>
Page 7 of 88

1.3.5 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) plans are listed in Table 1-1.

Table 1-1: Legislation, Policies and Plans Relevant to the Plan

Legislation / Policy / Plan	Description
Legislation	
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.
Coastal 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.
Western River Basin Management Plan, 2010 & draft River Basin Management Plan (2 nd Cycle WFD – Feb 2017)	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. New RBMPs are to be adopted by the end of 2017.
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 NSS, while providing more detail and establishing a development and spatial framework that can be used to strengthen Local Authority development plans and other planning strategies at county, city and local level. The Border Regional Authority (2010-2011) RPG is relevant to the Sligo Bay Drowes River Basin.
Development Plans	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. Relevant development plans are: - Sligo County Development Plan 2011-2017 - Sligo and Environs Development Plan 2010-2016 - Leitrim County Development Plan 2015-2021
Local Areas Plans	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. Relevant local area plans are: - Enniscrone Local Area Plan 2014-2020 - Ballymote Local Area Plan 2012-2018 - North Fringe Local Area Plan 2010-2016 - Charlestown - Bellaghy Local Area Plan 2010-2016 - Tobercurry Draft Local Area Plan - Docklands LAP Draft Plan 2011
Other Spatial / Development Plans for River Basin	Manorhamilton Urban Framework Plan Dromahair Urban Framework Plan

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 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.

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.

Table 1-2: Flood Risk Management Objectives and Global Weightings for the National CFRAM Programme

CRITERIA	OBJECTIVE		SUB-OBJECTIVE		GLOBAL WEIGHTING
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
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
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 know 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
	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
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

1.5 SCOPE OF THE PLAN

This Plan sets out a sustainable, long-term strategy to manage the flood risk within the Sligo Bay Drowes 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 Sligo Bay Drowes River Basin addresses fluvial and tidal sources of flooding in one or more communities (AFAs), as these sources were determined through the Preliminary Flood Risk Assessment to be potentially significant in one or more communities within the area covered by the Sligo Bay - Drowes River Basin Plan. The sources of flooding addressed for each of the AFAs is 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.

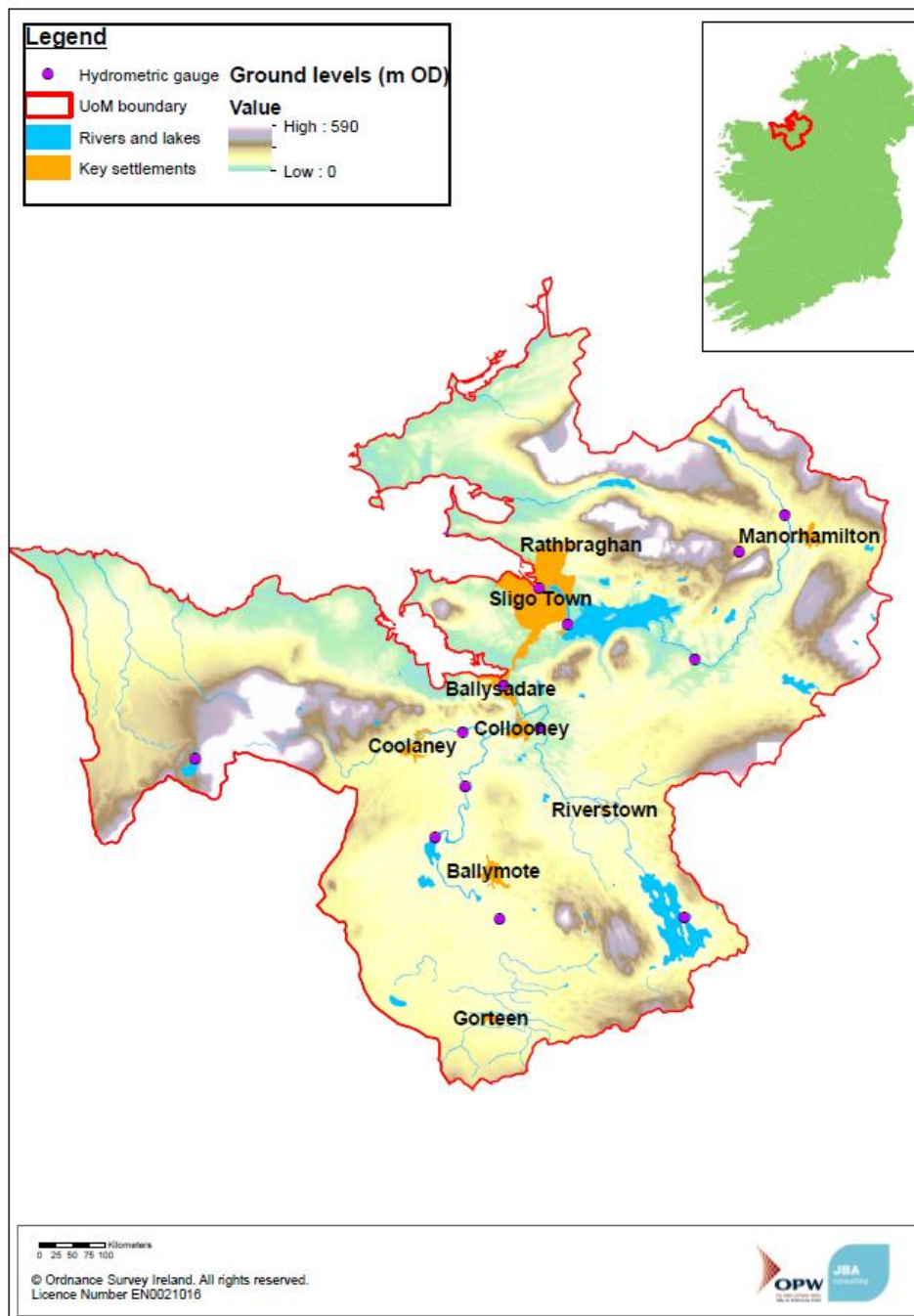
2 OVERVIEW OF THE RIVER BASIN

2.1 THE SLIGO BAY - DROWES UNIT OF MANAGEMENT

The Western RBD covers an area of 12,193 km² in the west of the Irish Republic extending north from the town of Gort to close to the border with Northern Ireland. It covers the majority of counties of Galway, Mayo and Sligo, along with some of County Leitrim and small parts of the counties of Roscommon and Clare. The Western RBD is subdivided into seven River Basins (Units of Management or UoMs).

This is the Plan for UoM35 Sligo Bay – Drowes River Basin. This covers an area of 1,603 km² of the Western RBD. The area is predominantly within County Sligo but also incorporates an area in the north of County Leitrim. The Areas for Further Assessment (AFAs) of flood risk are Ballymote, Ballysadare, Collooney, Coolaney, Gorteen, Manorhamilton, Riverstown and Sligo (Incl. Rathbraghan). The location of the AFAs and main watercourses are shown in **Figure 2-1**.

Figure 2-1. Sligo Bay Drowes River Basin



2.2 TOPOGRAPHY, GEOLOGY, SOILS AND GROUNDWATER

2.2.1 Topography

The Sligo Bay Drowes River Basin sits at the northern limit of the Western River Basin District. To the northeast, where the river basin extends into County Leitrim, the river basin is bounded by the Dartry Mountains. These are the upper hills of one of the longest rivers in this river basin, the Bonet, which drains into Lough Gill and discharges as the Garvoge River into the sea at Sligo. To the west, the Ox Mountains straddle the border with the River Moy River Basin. The centre of the river basin is dominated by two large flat watercourses, the Unshin and the Owenmore, which converge and outfall to the sea at Ballysadare. The largest lakes within the river basin are Lough Gill (14 km²) and Lough Arrow (12 km²).

2.2.2 Geology, Soils and Groundwater

The bedrock geology underlying the Sligo Bay Drowes River Basin is dominated by Carboniferous limestone, which covers over half of the area. Some of the karst limestone areas are of geological heritage and natural conservation significance. The river basin is generally used for agriculture (principally grassland) and this limestone stores large quantities of groundwater which feeds the lakes and turloughs, and provides significant amounts of drinking water to the region.

The soil in the river basin consists of a combination of acidic, brown earth, brow podzolics and surface water gleys, both derived from non-calcareous parent material (Namurian rocks). A small portion of river basin is made-up of peat bog. Peatlands are wetland ecosystems characterised by accumulation of organic matter under wet conditions, they support a wide diversity of flora and fauna, and they have carbon storage capacity.

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

2.3 LAND USE AND LAND MANAGEMENT

2.3.1 Urban Areas

The 2006 census data held by the Central Statistics Office (CSO, 2011) show a total population for the west of Ireland (defined as the counties of Galway, Mayo and Roscommon) of 341,863. Preliminary data from the 2011 census (CSO, 2011) indicate that this figure has increased to 369,577; resulting in a population change of 27,714 people, an increase of 8.1%. This trend is consistent throughout the component counties of the Western RBD, with all showing population increases of between 5% and 10% in the same period, with the exception of Galway City (4.1% growth); Galway County in contrast showed the greatest increase of 10%.

The 2006 and 2011 census data held by the Central Statistics Office (CSO, 2016) show a total population for the AFA towns in the river basin. The figures from the 2006 and 2011 census indicate that there have been large increases in the population of the selected towns across Sligo, notably in Coolaney where the increase is 300%. The exception to this is Sligo itself where the population has remained static.

2.3.2 Land cover and land use

Land use and land cover (LULC) describe the form and function of the natural land surface. Land cover is the physical description of the land and land use describes the terrestrial use from a human perspective based on socio-economic usage (EPA, 2012). In Ireland, the main source of LULC is the EPA and EEA CORINE (Co-Ordinated Information on the Environment) land cover data series, which have delivered maps in 1990, 2000, 2006, and 2014.

The land-use practices in the river basin are all a direct reflection of the soil types and underlying bedrock. According to the EPA CORINE Land Cover database for 2012, the main land-uses in the river basin were predominately pastures, some sections of -peat bogs, patches of broadleaved forests, transitional woodlands, and continuous and discontinuous urban land cover in the towns.

2.3.3 Potential future land use changes

The general trend in terms of population growth and distributions in the river basin continues to be a slight annual increase in population and a movement towards larger towns and cities. Coolaney's

significant increase in population is likely to be due to its proximity to Sligo Town, making it an appealing commuting town. The movement of population will create pressure in urban fringes, suburbs, and commuting towns. A rise in housing and infrastructural development will be needed to accommodate the population numbers and movement. Considering risk of flooding in future housing or recreational developments will continue to be necessary, especially in the context of climate change.

Water infrastructure and the associated demand for abstraction and discharges of waste water will require upgrading or replacement. The continued increase in population is likely to lead to a bigger demand for amenity, tourism and recreation resources, both formal and informal. The region's water resources are likely to be important features in this process offering prospects for more informal recreation and potential formal development. Securing and improving water quality will be very important.

Domestic and international tourism will continue and there will be a potential for more development of outdoor, adventure, and cultural destinations. Tourism centres in rural areas could benefit villages and towns by attracting visitors to these areas, which could result in social and economic benefits (i.e. new developments and/or improvement of infrastructure).

2.4 HYDROLOGY

The focus of the hydrological investigations has been on the AFAs identified through the PFRA, see Section 3. Full details of the hydrological investigations are provided in the Western CFRAM UoM 35 Final Hydrology Report, which can be accessed through the Western CFRAM website (www.floodinfo.ie).

2.4.1 Sub-catchments and river network, estuarine areas, coastlines

The majority of the river basin is formed of two catchments; the Ballysadare and the Garvoge (also spelt Garravogue). Upstream of Lough Gill the main channel in the Garvoge catchment is known as the River Bonet. Other smaller catchments drain into Sligo Bay. All AFAs lie within one of these two catchments. Sligo Town (Incl. Rathbraghan) and Ballysadare are also coastal AFAs. Sligo Town (incl. Rathbraghan) is situated in Sligo Bay and Ballysadare is situated in Ballysadare Bay.

2.4.2 Rainfall distribution

The distribution of annual average rainfall in the river basin is topographically driven and varies with high annual rainfall in the upland areas and much lower rainfall in the lowlands. The average annual rainfall in the AFAs is different to the annual rainfall in the upstream catchments.

2.4.3 Hydrometric data availability

In total there are 11 river level gauges that have been used in the study. At 8 of these gauges it is possible to calculate flow from the observed water levels using a rating equation for at least part of the record, the three where this is not possible are Ballygrania (35003), Templehouse Demesne (35078) and Ballynary (35087). Six of the stations (of which Big Bridge and Ballygrania did not previously have ratings) were identified for review and extension of rating equations within this study. There are six tidal gauges in the Western River Basin District. Many of these gauges have been recently installed and are part of an ongoing project to develop a centrally controlled Irish national tidal network.

Further details on the hydrology of the Sligo Bay - Drowes River Basin is provided in Appendix B.

2.5 FLOOD HISTORY

Historic flood records were collected from sources such as local newspapers, previous studies, OPW's National Flood Hazard Mapping website, publications on flood history and other relevant websites. Dates and magnitude of more recent events were obtained from hydrometric records. The information was reviewed in order to provide qualitative and, where possible, also quantitative information on the longer-term flood history in the area. Further details relating to the specific flood history of individual AFAs are provided in the relevant Flood Risk Review Reports.

The table below gives a chronology of flood events, including information on their impacts.

Table 2-1: Flood History

Date	Catchment/river	Details
27 August 1910	Collooney	Heavy rainstorm was recorded at Captain Cooper's observatory near Collooney from noon on Thursday to 9am on 26th August, and was the heaviest rainfall recorded there for 50 years; River Boyle south east of the Ballysadare catchment was out of bank, causing "the worst flooding in living memory".
28th October 1954	Riverstown	Crops damaged by flooding from River Arrow in the Riverstown area.
November 1999	Riverstown	Water treatment plant and Colbrook estate experienced flooding.
11th June 2007	Sligo	Flooding in Adelaide St, Market Yard, Knappagh Rd. Cranmore Place, Larkhill Rd and Cleveragh Rd.
November 2009	Sligo	Flooding in Sligo Strandhill area along the coastline.
	Ballysadare	Highest gauged flow on record (1945 to date) at Ballysadare and yet no reports of flood damage.
17th October 2011	Manorhamilton	Properties in Tuckmill Park flooded.
8th June 2012	Coolaney	A small embankment on the right bank downstream of Coolaney Road Bridge overtopped flooding a property and the treatment works in this location. The treatment works upstream of Coolaney had to be closed as water levels were close to the electricity assets.
January 2014	Sligo	Tidal flooding of Sligo harbour areas including Ballast Quay, Lower Quay Street/ Fish Street and Old Quay. Inundation of properties occurred in these areas. Ballytivnan Road and Ash Lane also flooded as a result of tidal water waters backing up the Sligo River.
November 2015	Manorhamilton	Gardens of properties in Tuckmill Park flooded.
5th December 2015	Rathbraghan	The culvert upstream of the Woodlands Estate surcharged resulting in flooding to the Woodlands Estate and nursing home in this area.
	Collooney	Properties adjacent to the river flooded.
	Ballysadare	Properties adjacent to the river flooded.

Information on the above 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.

Based on the outcomes of the analysis, a flood history time line was produced. The time line provides a comprehensive overview of the main flooding events by putting together key events extracted from the available hydrometric data (usually limited to the top three events indicated by rank 1-3), and the events identified in the collated information on historic flooding. The time line sheet also includes locations of the flood events and indicates spatial distribution of these locations (i.e. downstream or upstream along a watercourse).

Four levels of flood severity are used in the table, namely "Severe", "Significant", "Minor" and "Uncertain" classifications. These are indicative only and are based on the available quantitative and qualitative flood history information. The table below provides details of the classification.

Table 2-2: Flood severity classification

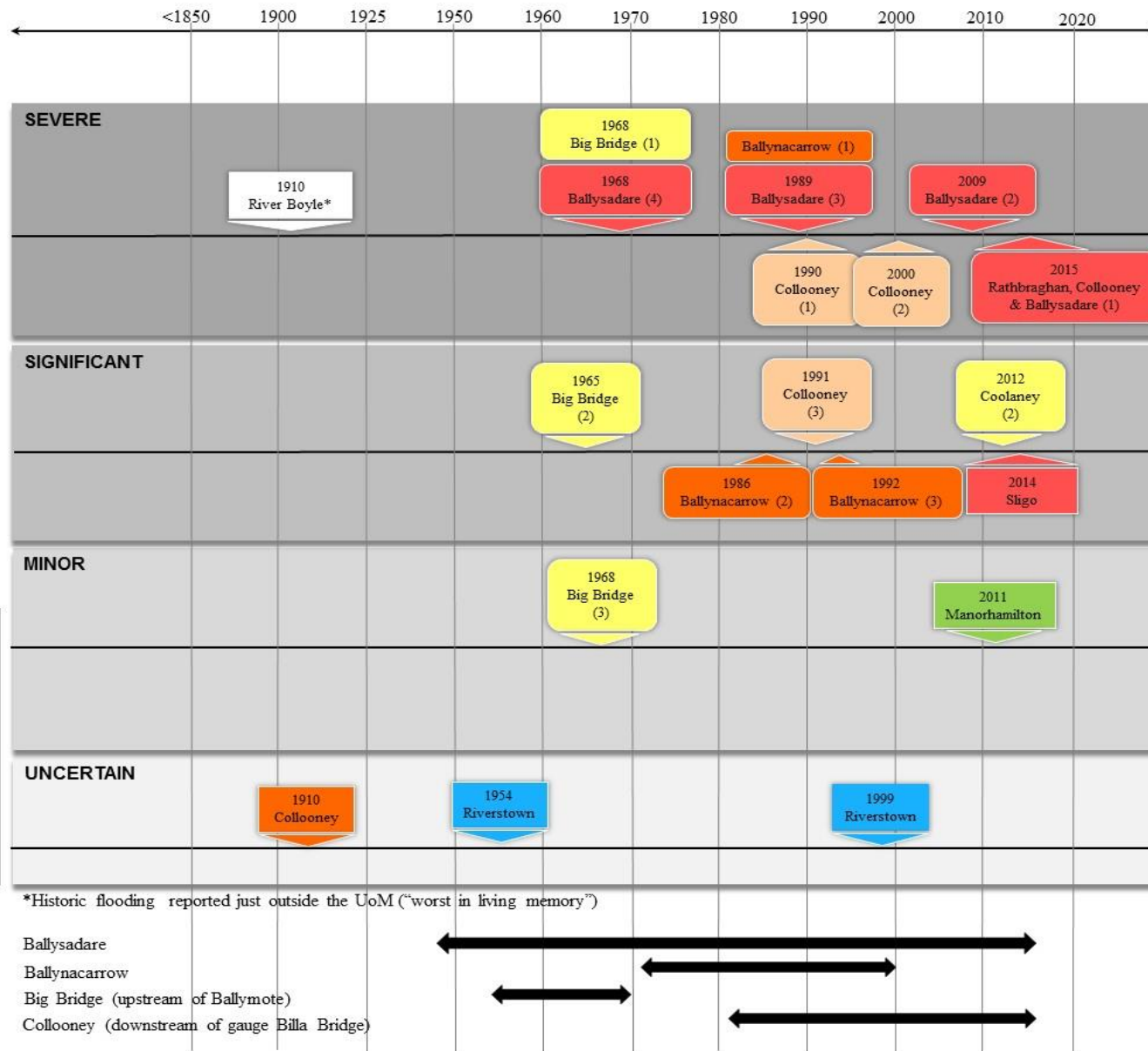
Flood severity classification	AEP (from hydrometric data)	Flood severity from historic information
Severe	< 4%	Greatest flood in more than 25 years and/or widespread flooding covering area
Significant	4% - 10%	Widespread flooding
Minor	> 10%	Other
Uncertain	N/A	Other

UoM 35

Artificial influence:

Drainage

Flood events:



2.6 EXISTING FLOOD RISK MANAGEMENT MEASURES

2.6.1 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 Sligo Bay Drowes River Basin.

- Bonet Arterial Drainage Scheme: 92km of channel, 1441km² of benefitting lands.
- Coolaney Drainage District: Sligo County
- Drumcliff Drainage District: Sligo and Leitrim County
- Dunmorán Drainage District: Sligo County
- Owenmore Drainage District: Sligo County

2.6.2 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

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) 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. 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). 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 Sligo Bay Drowes River Basin

ID No.	COUNTY	NAME	SOURCE(S) OF FLOOD RISK
IE-AFA-350547	Sligo	Ballymote	Fluvial
IE-AFA-350548	Sligo	Ballysadare	Fluvial and Tidal
IE-AFA-350549	Sligo	Collooney	Fluvial
IE-AFA-350550	Sligo	Coolaney	Fluvial
IE-AFA-350554	Sligo	Gorteen	Fluvial
IE-AFA-350557	Leitrim	Manorhamilton	Fluvial
IE-AFA-350559	Sligo	Riverstown	Fluvial
IE-AFA-350561	Sligo	Sligo Town (incl. Rathbraghan)	Fluvial and Tidal

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). 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

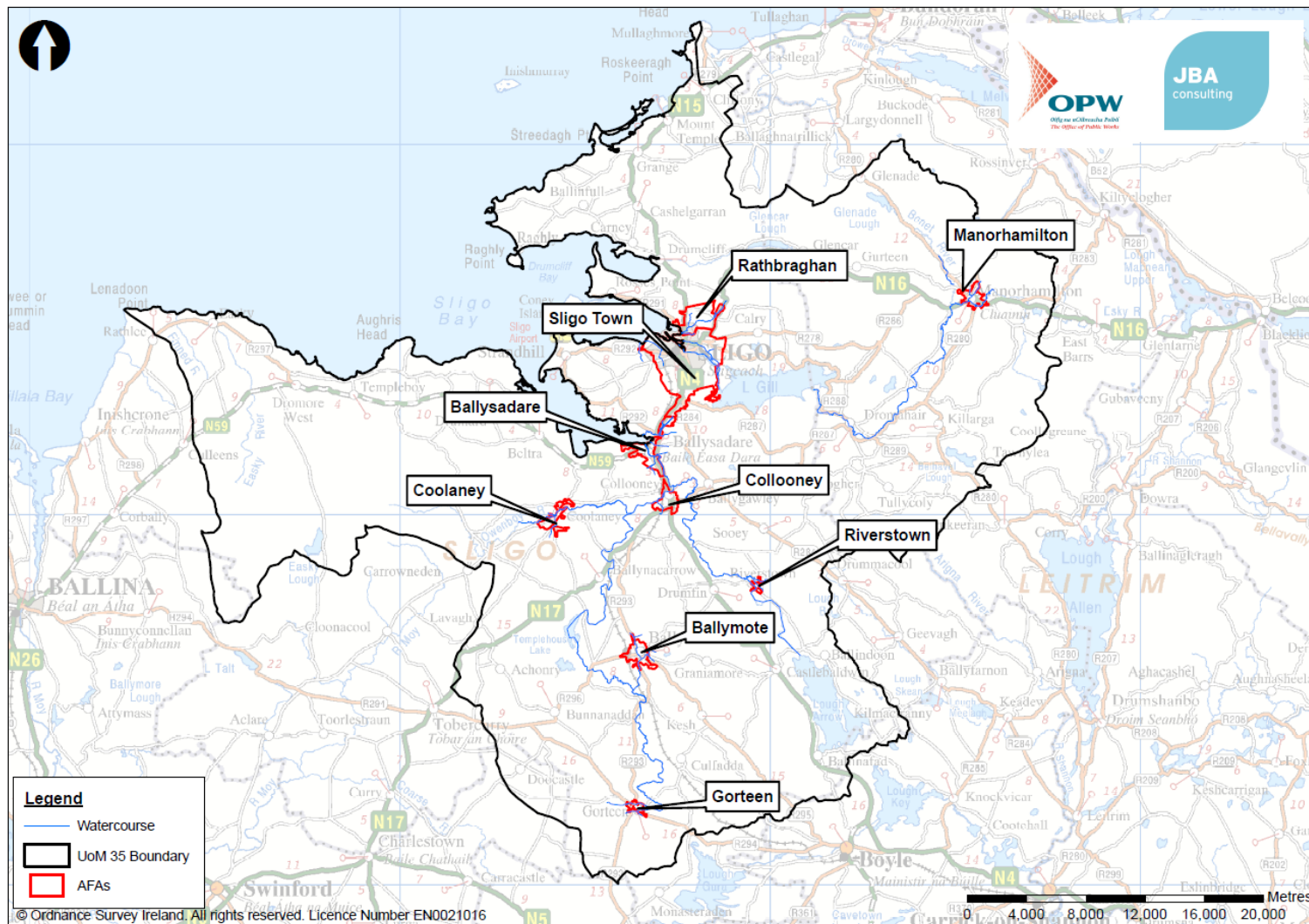
hence on flood flows. This should support future assessments of potential future changes in flood risk.

- 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.

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Figure 3-1. Map of the AFAs within the Sligo Bay Drowes 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 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 Sligo Bay Drowes 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 Western CFRAM Project. Relevant information from these websites is now available from the OPW website (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.

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

4.3 STAKEHOLDER ENGAGEMENT

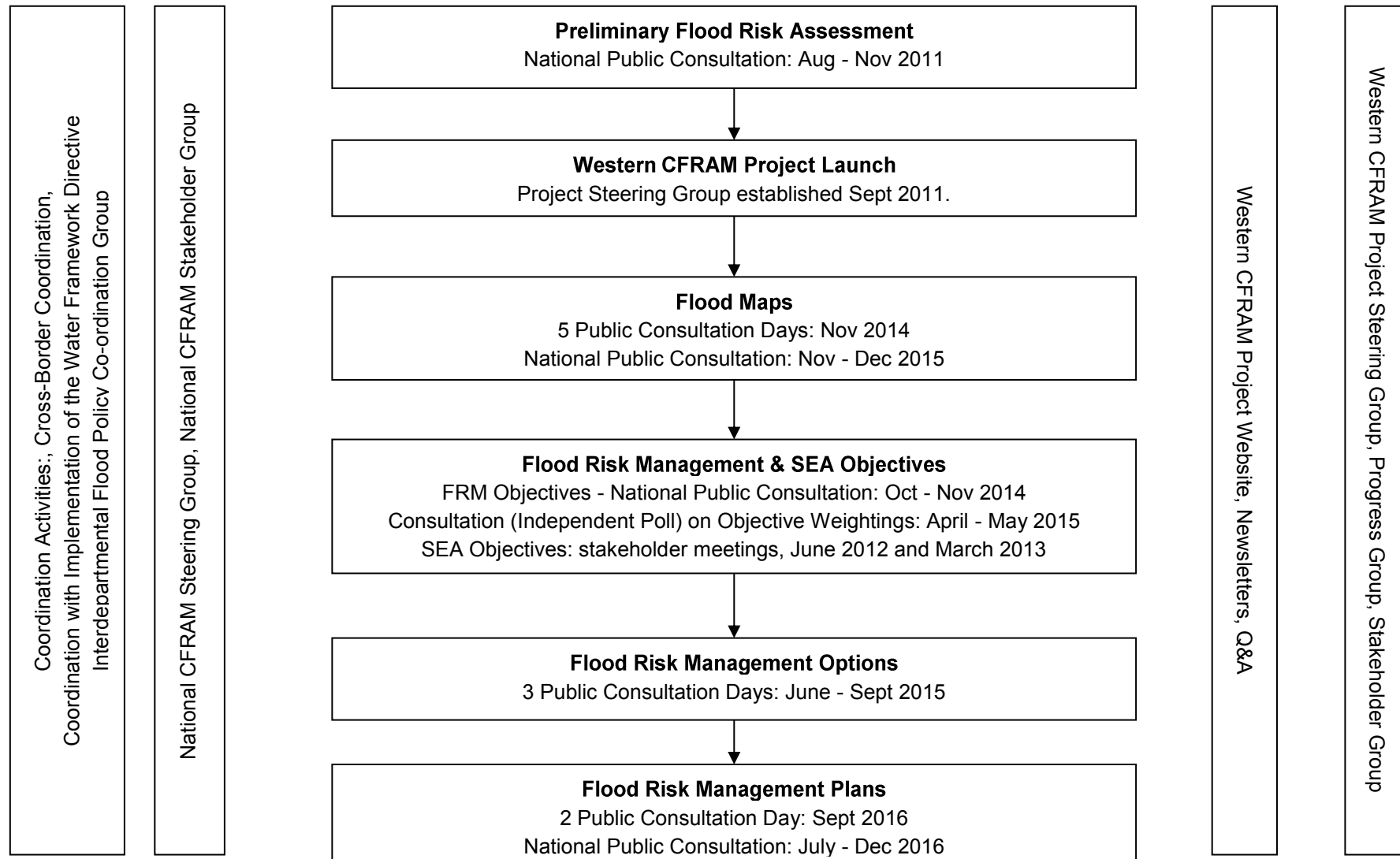
4.3.1 The CFRAM Steering and Progress Groups

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 *Western CFRAM Project Steering Group*

A Project Steering Group was established for the Western CFRAM Project, that included the Sligo Bay Drowes 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 *Western CFRAM Project Progress Group*

A Project Progress Group was established for the Western CFRAM Project in 2012. 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 is the same as for the Western CFRAM Project Steering Group.

4.3.2 Stakeholder Consultation Groups

Stakeholder Groups were formed at national and regional level to permit 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 Western CFRAM Stakeholder Group was established in 2012, and has met on three occasions up 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 Western CFRAM Project. Members of the organisations listed in Appendix D4 have 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 Western CFRAM Project

The formal project inception meeting took place on 11th August 2011 and the project was introduced to the Project Steering Group on 15th September 2011. Following that, a Project Introductory Stakeholder Workshop was held in NUIG on 21st June 2012. All project information was made available to members of the public on the project website, and through Project Newsletters (the first of which issued in January 2012).

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 Western CFRAM 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 JBA Consulting 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 Sligo Bay - Drowes River Basin were held for consultation on the flood maps at the venues listed in Appendix D.5.

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 undertaken⁶. 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.

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 UCD⁷, and the weightings for each of the Objectives then set.

⁶ Sections 12, 13 and 14, SI No. 122 of 2010

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

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 Sligo Bay Drowes 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 Sligo Bay Drowes River Basin as published for the purposes of public consultation on Tuesday 13th September 2016. Observations from the public and from relevant Councils were to be submitted to the OPW by Tuesday 22nd November 2016. 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. The PCDs in the 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).

4.5 CROSS-BORDER COORDINATION

There is no requirement for cross-border coordination in the Sligo Bay Drowes River Basin.

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 Sligo Bay Drowes 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

The objective of the hydrological study was to derive best estimates of design flood event peak flows and hydrographs at sufficient locations along High and Medium Priority Watercourses to feed into the hydraulic modelling study and the flood maps. 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 1km². 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 proposed measures would also need to be considered in detail. These watercourses within AFAs are classified as High Priority Watercourses (HPWs). Medium Priority Watercourses (MPWs) are those which flow between AFAs.

The approach taken for the Western CFRAM's estimate of design floods was to base the analysis closely on the recorded flow data, in accordance with the methods developed during the Flood Studies Update research, undertaken by OPW.

Peak flows have been estimated from statistical analysis of annual maximum flows recorded at gauging stations across Ireland. At locations without flow data, design flows have been estimated indirectly from physical properties of the catchment, combined with transfer of data from representative gauged catchments both locally and further afield throughout Ireland. For the most extreme design floods (annual probabilities below 1%), the statistical analysis has been supplemented with an extended flood growth curve from the Flood Studies Report rainfall-runoff method.

The approach for the estimation of design flood hydrographs for most watercourses was to derive the shape of design hydrographs using the rainfall-runoff method from the Flood Studies Report. For some unusual catchments, particularly those containing large loughs, design hydrograph shapes are derived more directly from averaging of observed flood hydrographs.

The approach used to develop the design flows and hydrograph shape for each AFA is summarised in **Table 5-1**.

Table 5-1: Methods used to estimate design flood hydrographs at each AFA

AFA	Watercourse	QMED method	Growth curve method	Distribution	Hydrograph shape
Ballymote	Ballymote, Rathnakelliga, Owenmore, Carrigan's Upper	Catchment Descriptors	Pooled	General Logistic	FSR rainfall-runoff
Ballysadare	Ballysadare	Data Transfer – Pivotal 35005	Single Site - 35005	Gumbel	Hydrograph Width Analysis - 35005
	Knoxspark, Belladrihid, Glennagoolagh, Kilmacowen, Carrowgobbadagh	Catchment Descriptors	Pooled	General Logistic	FSR rainfall-runoff
Collooney	Owenmore	Data Transfer –	Pooled	General Logistic	Hydrograph Width Analysis (separate

AFA	Watercourse	QMED method	Growth curve method	Distribution	Hydrograph shape
		Pivotal 35001 and 35002			hydrographs for Owenmore and Owenbeg at their confluence) – 35001 and 35002
	Unshin U/S of Owenmore	Data Transfer – Pivotal 35003	Pooled	General Logistic	FSR rainfall-runoff
	Unshin D/S of Owenmore	Data Transfer – Pivotal 35005	Pooled	General Logistic	n/a – will be routed by model
	Knockbeg East	Catchment Descriptors	Pooled	General Logistic	FSR rainfall-runoff
Coolaney	Owenbeg	Data Transfer – Pivotal 35002	Single Site – 35002	Gumbel	FSR rainfall-runoff
	Rathbarran	Catchment Descriptors	Pooled	General Logistic	FSR rainfall-runoff
Gorteen	Gurteen, Ragwood	Catchment Descriptors	Pooled	General Logistic	FSR rainfall-runoff
Manor-hamilton	Owenmore (Manorhamilton)	Data Transfer – Pivotal 35028	Pooled	General Logistic	FSR rainfall-runoff
	Brackary, Curraghfore	Catchment Descriptors	Pooled	General Logistic	FSR rainfall-runoff
Riverstown	Unshin	n/a: Design flood hydrographs downstream of Lough Arrow outlet to be estimated using the FSR rainfall-runoff method, routed through the lough			
	Ardcumber, Douglas	Catchment Descriptors	Pooled	Generalised Extreme Value	FSR rainfall-runoff
Sligo Town	Garvoge	Data Transfer – Pivotal 35012	Pooled	General Logistic	Hydrograph Width Analysis - 35012
	Knappagh	Catchment Descriptors	Pooled	General Logistic	FSR rainfall-runoff

As well as design flows for the present-day situation, the study produced a set of flows for two future scenarios, a Medium Range Future Scenario (MRFS) and a High End Future Scenario (HEFS). The objective of the future scenarios is to understand the implications of climate change and land use change on flood risk over the period to 2100. These scenarios have considered climate change impacts on both river flows and sea levels and the impact of increased urbanisation. It is considered that land use change, in the form of changes to forestry practice, will have little impact on flood risk in the Western RBD, so this has not been accounted for.

Full details of the hydrological investigations are provided in the Western CFRAM UoM 35 Final Hydrology Report, which can be accessed through the website (www.floodinfo.ie).

5.2 HYDRAULIC MODELLING

Hydraulic models were developed to prepare flood maps and so determine the flood risk within each AFA. Models have been developed to assess flood risk from fluvial and coastal (including wave overtopping) sources only.

Greater emphasis has been placed on determining flood risk within AFAs. As such hydraulic models of HPWs incorporate a greater level of detail and have been constructed as 1D-2D models

to better represent the complexity of the floodplain within the towns and cities. Hydraulic models of MPWs have been constructed as 1D models only. MPW models are less detailed than HPW models reflecting the focus of the study on AFAs, but these models have been used to determine flow interactions upstream, downstream and between AFAs.

Table 5-2 provides an overview of the modelled watercourses and the sources assessed within the river basin.

Table 5-2: Summary of hydraulic models and flood sources in Sligo Bay Drowes River Basin

AFA / MPW	Watercourses	Priority	Flood risk sources
Ballymote	Ballymote, Rathnakelliga, Carrigan's Upper, Derroon.	HPW	Fluvial
Ballysadare	Ballysadare, Knoxspark, Kilboglashy, Loughnambraher, Belladrihid.	HPW	Fluvial
	Belladrehid, Glennagoolagh, Kilmacowen, Carrowgobbadagh, Drumaskibbole.	HPW	Fluvial/Tidal
Collooney	Owenmore, Knockbeg East	HPW	Fluvial
Coolaney	Owenbeg, Rathbarren, Halfquarter.	HPW	Fluvial
Coolaney to Owenbeg / Owenmore	Owenbeg	MPW	Fluvial
Gorteen	Rathmadder (Gurteen), Gorteen South, Ragwood.	HPW	Fluvial
Gorteen to Collooney	Owenmore.	MPW	Fluvial
Manorhamilton	Owenmore (Manorhamilton), Brackary, Curraghfore.	HPW	Fluvial
Manorhamilton to Lough Gill	Bonet, Lough Gill.	MPW	Fluvial
Rathbraghan	Willsborough, Lisnalurgh, Shannon Eighter.	HPW	Fluvial
Riverstown	Unshin, Ardculmer, Douglas.	HPW	Fluvial
Riverstown to Collooney	Unshin	MPW	Fluvial
Sligo Town	Knappagh, Tobernaveen.	HPW	Fluvial
	Garvoge, Sligo.	HPW	Fluvial/Tidal
Sligo Town Coastal	Sligo Coastline	HPW	Tidal/Wave Overtopping

The hydraulic models have been constructed from topographic survey of the river channels and ground level survey of the floodplain. Topographic survey has been collected as cross sections perpendicular to the direction of flow at regular intervals along watercourses and along the faces of key structures, and a spot level survey along the bank tops between cross sections. Cross sections have been surveyed at 50-100m intervals along HPWs and 500m-1,000m intervals along MPWs. Ground level survey is available from LIDAR data for AFAs only, so covers HPWs and associated floodplains. For MPWs, floodplain data has been extracted from a coarse IfSAR Digital Terrain Model (DTM).

All raised structures identified adjacent to watercourses and coastlines, whether OPW defences or other structures identified on site, have been reviewed and classified as effective or ineffective depending on their ability to provide a flood defence function. This classification then dictates how the structure has been represented in the hydraulic model.

To provide confidence in the outputs from the hydraulic model (either fluvial or coastal), calibration events were modelled to demonstrate that the models produce a suitable representation of past events, and are therefore more likely to predict the output of design events accurately. The process was heavily dependent on the availability of data from past events, both from gauge records and evidence of historical events. Three levels of checking were identified for use in the study:

- Calibration - where gauge data and evidence of one or more events is available

- Partial calibration - where there is gauge data but limited / no evidence of flooding, or no gauge data but evidence of flooding
- Sensibility check - where there is no gauge and no evidence of flooding.

Inflows to the hydraulic models for the design events have been informed by the hydrological analysis. Downstream boundaries have either been determined from other hydraulic models or, where they outfall to the sea, design tidal graphs have been created by combining information on extreme sea levels with design surge shapes and design astronomical tide curves. Extreme sea levels were taken from the Irish Coastal Protection Strategy Study (ICPSS) Phase IV - West Coast, Predicted Extreme Water Levels. Wave overtopping volumes have been estimated for AFAs which are vulnerable to wave overtopping flood sources.

The hydraulic models have been run for the present day, Medium Range Future Scenario and High End Future Scenario events as determined by the hydrological analysis. The full suite of design events includes the 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.1% AEP events and all these were run for the present day and MRFS. Only the 10%, 1% and 0.5% and 0.1% AEP events have been run for the HEFS.

The modelling outputs have been used to prepare flood extent maps, Flood Zone maps, flood depth maps, flood velocity maps and risk to people maps. The Flood Zone maps are primarily used for development planning and management, and represent an undefended situation.

To support the understanding of the uncertainties associated with the hydraulic modelling process, a suite of sensitivity tests has been carried out. These tests investigate in further detail the implications of the assumptions in the development of the hydraulic model and the production of the design flood extents. Not all sensitivity tests are applicable to all watercourses. The sensitivity tests and the situations in which they apply are laid out in **Table 5-3**.

Table 5-3: Sensitivity tests

Sensitivity test	HPW/ MPW applicable	Other watercourse characteristics
Peak flow	HPW and MPW	In all watercourses
Roughness	HPW and MPW	In all watercourses
Water level boundaries	HPW and MPW	Watercourses which discharge into the sea or a lake
Building representation	HPW	Where buildings are within the flood extents
Flow volume	HPW and MPW	Where the hydrograph is generated from catchment descriptors
Afflux / headloss at key structures	HPW and MPW	Where headloss has been noted in the long section, and the structure may cause flood risk
Timing of tributaries	HPW	Where tributary is in the same model as the main river
Timing of fluvial and tidal peaks	HPW and MPW	Where the river has a tidal boundary
Critical storm duration	HPW	Where tributary is in the same model as the main river
Cell size	HPW	Where cell size is greater than 2m and there are complex flow routes across the floodplain.

Full details of the hydraulic modelling investigations are provided in the Western CFRAM UoM 35 Final Hydraulic Modelling Report, which can be accessed through the website (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 are intended to inform the Spatial Planning processes and to 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 Management⁸.

Emergency Response Management:

The flood maps are intended to 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.

For each of these mapping deliverables there are different combinations of scenario and design event model runs required.

Table 5-4 details the flood mapping requirements for the Western CFRAM. Flood velocity maps and risk to people maps are not required for MPWs.

Table 5-4: Flood mapping requirements

Map type	Flood event probabilities to be mapped for each scenario		
	Present day	MRFS	HEFS
Flood extent	All probabilities	All probabilities	10%, 1% / 0.5%*, 0.1%
Flood Zone	1% / 0.5%*, 0.1%	1% / 0.5%*, 0.1%	Not required
Flood depth	All probabilities	10%, 1% / 0.5%*, 0.1%	Not required
Flood velocity	All probabilities	Not required	Not required
Risk to People	10%, 1% / 0.5%*, 0.1%	Not required	Not required
Wave overtopping	10%, 1% / 0.5%*, 0.1%	Not required	Not required

* The requirement for the 1% AEP is for fluvial maps, for coastal flood maps the 1% is replaced by the 0.5% AEP event.

The flood maps can be accessed through www.floodinfo.ie.

The print ready flood extent maps present the 10%, 1% and 0.1% AEP flood extents on a single map. These maps also detail peak modelled water levels at each channel cross section and peak modelled flows at a selection of cross sections. Flows in the hydraulic model may sometimes be lower than those calculated in the hydrological analysis as a result of the local channel conditions, such as structures retaining flows upstream or significant attenuation in the floodplain.

The print ready Flood Zone maps present the 1% (fluvial) or 0.5% (coastal) and 0.1% AEP (or Flood Zones A and B) on a single map. Print ready maps for depth have been produced for the 10%, 1% / 0.5% and 0.1% AEP events only and are presented individually.

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).

5.3.1 Outcomes of public consultation on flood maps

The flood models were reviewed following the flood map consultation process. Any changes to the flood maps have been carried forwards to the final flood maps.

5.4 FLOOD RISK ASSESSMENT AND MAPPING

Risk maps have been produced showing flood risk to a number of receptors within each of the AFAs. Three risk maps have been prepared for the Flood Risk Management Plan, each one presenting a different indicator of the type of risk within an AFA as a result of flooding. **Table 5-5** details the three risk maps in the left hand column and the receptors analysed and presented in these maps in the right hand column.

Table 5-5: Risk map receptors

Map type	Receptors mapped
Specific risk - No. inhabitants	Gridded density of inhabitants at flood risk
Specific risk - Type of activity	Presence or absence of property, infrastructure, rural activities or economic activities at flood risk within the AFA.
General Risk - Environmental	Pollution Sources
	Groundwater abstraction for Drinking water
	Recreational water including Bathing water
	Special Area of Conservation
	Special Protected Area
	S4 and S16 licences
	Shellfish waters including fresh water pearl mussel areas, surface drinking water, and nutrient sensitive areas.

A property is considered to be at flood risk when water levels exceed an assumed property threshold level, taken to be the mean LIDAR level within the building footprint. This assumed threshold has been stamped into the ground level in each model so that building footprints are flat and buildings flood in their entirety once this level has been exceeded. The An Post Geodirectory address point has been used to determine the number of properties within a building that are flooded.

Table 5-6 details the flood risk map requirements for the Western CFRAM. The specific risk - type of activity and specific risk - risk density maps are not required for MPWs.

These maps have been developed by interrogating the receptor data against the 10%, 1% fluvial or 0.5% tidal, and 0.1% flood extents for fluvial and coastal scenarios.

The flood maps can be accessed through www.floodinfo.ie- Flood Maps.

Table 5-6: Flood risk map requirements

Map type	Flood event probabilities to be mapped for each scenario		
	Present day	MRFS	HEFS
Specific risk - No. inhabitants	10%, 1%/0.5%*, 0.1%	10%, 1%/0.5%*, 0.1%	Not required
Specific risk - Type of activity	10%, 1%/0.5%*, 0.1%	10%, 1%/0.5%*, 0.1%	Not required
General risk - Environment	10%, 1%/0.5%*, 0.1%	10%, 1%/0.5%*, 0.1%	Not required

* The requirement for the 1% AEP is for fluvial maps, for coastal flood maps the 1% is replaced by the 0.5% AEP event.

Table 5-7 presents a summary of the risk within the Sligo Bay Drowes River Basin, including the number of residential and non-residential properties at risk in each AFA and in the floodplains of other rivers reaches modelled outside of the AFA.

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

Table 5-7: Summary of Flood Risk in the Sligo Bay Drowes River Basin

AFA / Area	No. of Residential Properties at Risk		No. of Non-Residential Properties at Risk		NPVd (€)
	1% / 0.5% AEP ¹	0.1% AEP	1% / 0.5% AEP ¹	0.1% AEP	1% / 0.5% AEP ¹
Ballymote	1	27	0	2	-

AFA / Area	No. of Residential Properties at Risk		No. of Non-Residential Properties at Risk		NPVd (€) 1% / 0.5% AEP ¹
	1% / 0.5% AEP1	0.1% AEP	1% / 0.5% AEP1	0.1% AEP	
Ballysadare	0	6	0	2	-
Collooney	2	2	0	0	-
Coolaney	1	2	1	2	€34,707
Gorteen	0	1	0	3	-
Manorhamilton	0	3	1	17	-
Riverstown	0	0	0	0	-
Sligo Town (Incl. Rathbraghan)	18	52	7	28	€751,879
Coolaney to Owenbeg MPW	0	0	0	0	N/A
Gorteen to Collooney MPW	1	1	1	1	N/A
Riverstown to Collooney MPW	0	1	0	0	N/A
Manorhamilton to Lough Gill	5	8	3	3	N/A

Notes

1: AEP Flood Event Probabilities: 1% (or 100-year flood) for Fluvial Flooding, 0.5% (or 200-year flood) for Coastal / Tidal Flooding

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

3: Insufficient level of detail in MPW models to provide damage estimate with reasonable level of certainty.

4: The number of properties at risk in the table are determined individually for each source (fluvial and coastal). Some properties may be at risk from both sources, and such properties have been included in the numbers for both sources.

The numbers of properties at risk and the damage values set out in Table 5.7 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.

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, particularly in the West of the country, could give rise to increased groundwater flood risk associated with turloughs.

These potential impacts could have serious consequences 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 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.

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 5-8**.

Table 5-8: 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	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year ¹	- 0.5 mm / year ¹
Urbanisation	No General Allowance – Review on Case-by-Case Basis	No General Allowance – Review on Case-by-Case Basis
Forestation	- 1/6 Tp ²	- 1/3 Tp ² + 10% SPR ³

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 impacts on flooding and flood risk under the MRFS and HEFS for the AFAs within the Sligo Bay Drowes 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 Sligo Bay – Drowes 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 existing properties 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 Sligo Bay Drowes River Basin, the level of risk has been determined as being low in the following AFAs:

- Ballymote
- Ballysadare
- Collooney
- Gorteen
- Manorhamilton
- Riverstown

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 lands around the community are not prone to flooding, only that a limited number of existing properties are prone to flooding. The potential for flooding in undeveloped areas needs to be fully considered for the AFAs where the risk to existing properties 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 Sligo Bay - Drowes 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 respectively⁹. This Section provides a description of the process used to ensure that the environmental considerations within the Sligo Bay - Drowes 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 (Vol. III), 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 (Vol. III) 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)¹⁰.

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 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 7.1). Flood relief schemes and works proposed or progressed through other projects and plans (see Table 7.2) 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.

⁹ SI No. 435 of 2004 (SEA Directive) and SI No. 477 of 2011 (Habitats Directive)

¹⁰ http://ec.europa.eu/environment/nature/natura2000/index_en.htm

Particular issues such as knowledge gaps or mitigation measures that are expected to be necessary, are set out in the addendum to the Natura Impact Statement (Volume IIa – Appendix B) and the SEA Environmental Report (Volume IIb).

Figure 6-1 shows the interactions between the stages of the optioneering, the SEA and AA processes.

Figure 6-1: Diagram showing the interaction between the CFRAM optioneering, SEA and Appropriate Assessment Processes



6.2 ENVIRONMENTAL CONSTRAINTS AND OPPORTUNITIES IN THE SLIGO BAY DROWES RIVER BASIN

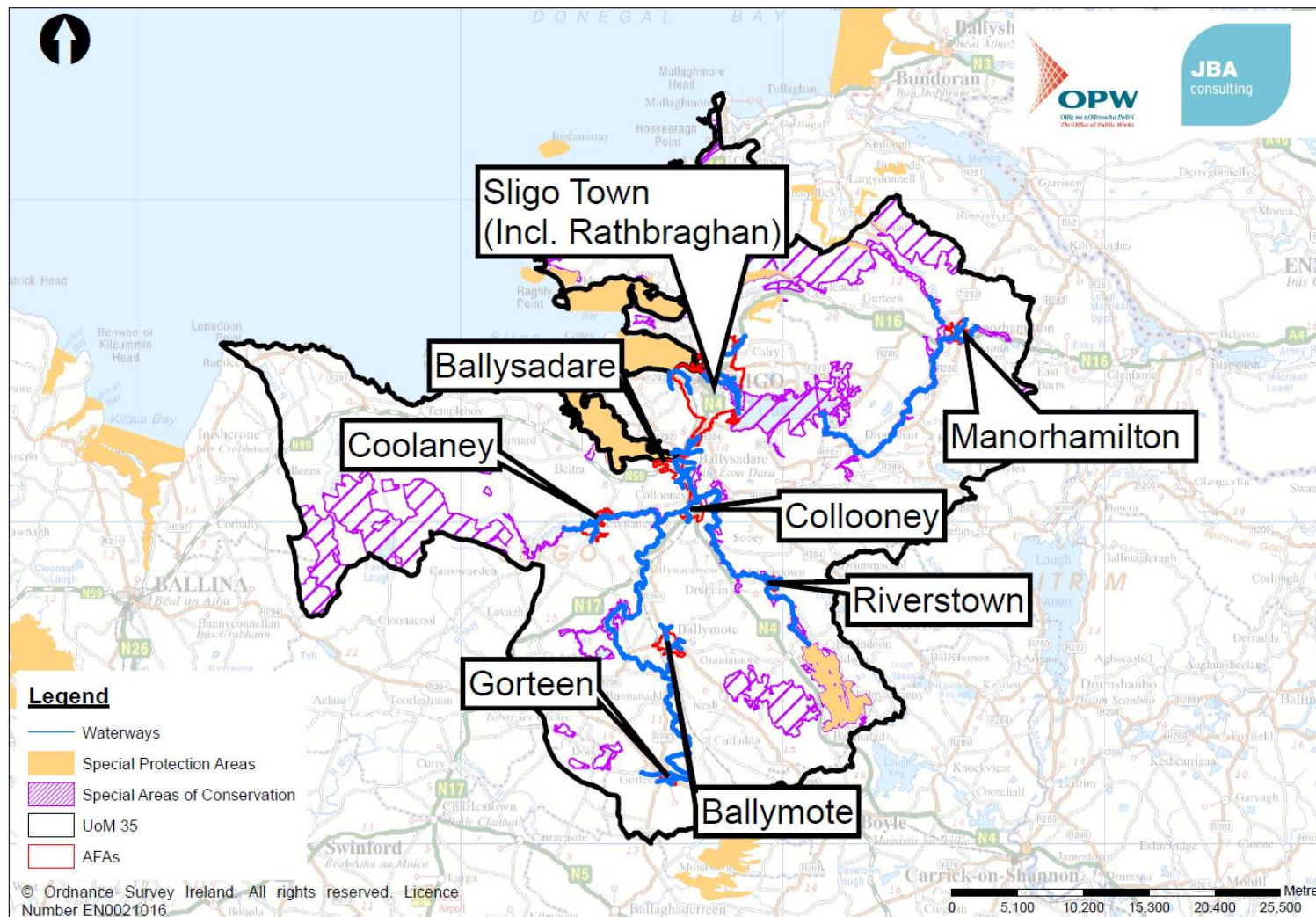
A summary of the environmental constraints, issues and opportunities is presented below in **Table 6-1**. A map of EU Habitats Directive Natura 2000 sites is shown in Figure 6-2. More details can be found in the SEA Environmental Report for the Sligo Bay Drowes, which is Volume II of the Flood Risk Management Plan and which can be accessed through the OPW website (www.floodinfo.ie).

Table 6-1: Summary of environmental constraints in the Sligo Bay - Drowes River Basin

SEA Topic	Opportunities, Issues and Constraints
Soils & Geology	<p>Extensive and intensive land drainage in both the uplands and lowlands can increase the speed at which water reaching the land surface (from precipitation) is then transported to the main arterial networks and discharged downstream to potentially threaten flood risk receptors (people and property).</p> <p>Certain inappropriate and untimely land management practices, especially on more sensitive soil types, can contribute to a reduction in the infiltration of water into the soil and an increase in rapid surface runoff.</p> <p>Appropriately managed pasture, rough semi-natural vegetation, wetlands (including peat bogs) and forestry/woodland can all assist in the attenuation and storage of rapid surface runoff and floodplain flows upstream of flood risk receptors.</p> <p>The targeted use of appropriate agri-environment scheme agreements could be used for multiple benefits, including flood management and biodiversity gains.</p> <p>Natural flood storage and attenuation areas on floodplains including wetlands, should be further protected from development pressures.</p>
Water	<p>All strategic flood risk management options being proposed should fully consider any WFD implications and, wherever possible, link to and support the programme of measures in the River Basin.</p> <p>Flooding of key water supply and water treatment facilities would present a pollution risk with associated impacts on human health, water quality and ecology, however flood risk management may provide opportunities to improve water quality.</p> <p>Licensed abstractions and discharges should not be affected by strategic flood risk management options</p> <p>Group Water Schemes and private wastewater treatment systems, where poorly installed, operated or maintained, can be a threat to water quality in the west of Ireland and flood risk management options should ensure that water quality is not compromised further.</p>
Morphology, fluvial and coastal processes	<p>Proposed flood risk management measures must be compatible with any WFD requirements to restore the natural morphology of waterbodies 'at risk' due to structural alterations.</p> <p>Diffuse pollution is considered to be the primary pressure causing siltation and degrading of spawning sites. Source mitigation measures are detailed in the WMUs linked to the implementation of Nitrate Regulations and the Agricultural Catchment Programme.</p> <p>Agricultural intensification is a key pressure here.</p> <p>Siltation and shoaling of coarser material can compromise flood capacity and is common where channel dimensions have been increased, a hydromorphic assessment is needed to ensure WFD compliance.</p> <p>Activities in the channel have the potential to disturb spawning gravels at a number of sites</p> <p>Floodplain and coastal habitats are linked to river dynamics and must be considered during flood alleviation and engineered structure design.</p>
Air & Climate	<p>Potential for increased fluvial and coastal flooding resulting from climate change.</p> <p>The carbon footprint of flood risk management options should be a consideration during their development.</p>
Biodiversity, Flora & Fauna	<p>Need to protect and, where possible, enhance the conservation status of the SACs, SPAs, NHAs, proposed NHAs and other designated nature conservation sites within the river basin and also those outside the study area that may be impacted by proposals within in.</p> <p>It will be necessary to undertake an assessment under the Habitats and Birds Directive to ensure that adverse impacts on SACs and SPAs do not arise.</p> <p>Freshwater Pearl Mussel, Atlantic Salmon, lamprey species and White-clawed Crayfish will be particularly sensitive to pollution and in-channel flood risk management measures, which may also contradict objectives of the WFD.</p> <p>A large proportion of the river basin is designated for its biodiversity interest; however, it will still be important to conserve, where possible, non-designated biodiversity (e.g. riparian vegetation, habitats adjacent to watercourses).</p> <p>Increased flooding has the potential to provide opportunities for enhancement or creation of wetland areas, with associated benefits for the species these habitats support.</p>

SEA Topic	Opportunities, Issues and Constraints
	Changes to the flooding regime can adversely impact upon biodiversity, through nutrient enrichment, detrimental impacts on water quality, siltation and community changes. The spread of non-native invasive species has the potential to threaten native flora and fauna within the river basin. Where possible, opportunities to control non-native, invasive species as part of implementation of the Plan should be taken.
Fishing & Angling	Need to maximise the opportunity for inclusion of mitigation measures to reduce the impact of barriers to longitudinal migration, especially for juvenile European Eel and ensure that no additional barriers to migration are installed. Consideration should be given to preservation, protection and enhancement of habitat utilised by all life stages of fish, both freshwater and marine. The amenity and economic value provided by the fishery resource within the river basin should be protected and enhanced where possible.
Landscape	Flood risk management activities need to be in keeping with the existing landscape character, whether protected or not, and the visual amenity of the catchment – guidance should be taken from landscape character assessments, development plans and local plans depending on the scale and nature of proposals. Flood risk management options may present opportunities to enhance the existing landscape and/or townscape – landscape character assessments, development plans and local plans often outline for example, opportunities for landscape protection and management, or opportunities for the development of the green network of an area which might allow the integration of flood risk management activities with other aspects of sustainable development such as sustainable transport routes, open space provision, green infrastructure etc. Future restrictions on development within areas at risk from flooding such as undeveloped river valleys and the coastline may help protect the landscape character of, and views within and from, these important landscapes.
Archaeology & Cultural Heritage	Potential to reduce the risk from flooding to existing archaeological and architectural resources, both in historic city centres and to individual sites dispersed throughout the river basin. Flood risk management options will be constrained by the need to protect the setting of areas of existing archaeological and architectural value e.g. Monuments, Protected Structures, ZAPs, ACAs etc. Specific impacts on known individual sites, monuments and structures, and further consideration of undiscovered archaeological resources will be addressed at the next stage of the study i.e. prior to or during the development of detailed projects requiring EIA.
Amenity & Tourism, Recreation	Maintaining and improving water quality in the region. The Sligo Bay - Drowes River Basin, its ongoing development and importance to the surrounding area's tourism. One international airport and seven domestic airstrips, with strong visitation via roads, rail and ferries including through flood risk areas. Dependence of tourism and recreation on natural, cultural and heritage resources including landscape, rivers, Loughs, coasts and associated wildlife. Population increases and associated developmental pressures.
Population and Health	Ongoing population growth for all counties and cities within the Western RBD includes the river basin. Increasing population pressure in urban fringe and rural areas. Associated increases in housing and infrastructure development. A number of vulnerable receptors (e.g. hospitals, nursing homes) located in lowland areas which are potentially at flood risk.
Infrastructure and Material Assets	Ongoing expansion and improvement of national and regional road network. Requirement to develop infrastructure to service an increasing population, particularly in rural and urban periphery areas. Expansion of ports and airports, with the majority situated in coastal locations.

Figure 6-2: Natura 2000 sites within the Sligo bay Drowes River Basin



6.3 STRATEGIC ENVIRONMENTAL ASSESSMENT

The SEA identifies significant environmental effects created as a result of implementing the Flood Risk Management Plan (FRMP) on issues such as biodiversity, water quality, humans, landscape, soils and geology, archaeology and cultural heritage and the interaction of the foregoing.

In the context of preparing a SEA for the Flood Risk Management Plan for the Sligo Bay - Drowes River Basin, the following stages are undertaken:

- **Screening:** to determine the requirement for a SEA for the Plan for the Sligo Bay - Drowes River Basin.
- **Scoping:** to liaise with the Statutory Consultees to identify key issues of concern that should be addressed in the Environmental Report
- **Assessment and Evaluation:** the identification, prediction, evaluation of the impacts of the Plan on the environment. Where significant impacts are identified suitable mitigation measures to remedy the impacts will be suggested
- **Consultations:** Consultations with the Statutory Bodies, Stakeholders and the public on the proposed Plan
- **Revisions and Amendments to the Environmental Report:** Based on the comments received, they may influence the programme and consequently the Environmental Report
- **Post Adoption:** Preparation of the SEA Statement and subsequent monitoring of the Programme during its implementation.

6.3.1 Screening

All Flood Risk Management Plans fall under Annex II of the SEA Directive and are required to be screened to determine the requirement for a SEA. This screening protocol is reflected in Schedule 2A of the SEA Regulations.

A screening process was undertaken by the OPW for the national CFRAM Programme and it was concluded that SEA's should be undertaken for all plans because the CFRAM study may influence future planning in an area, the vulnerability of the study area and natural environment.

6.3.2 Scoping

A Scoping Report was prepared in 2013 and a copy of the Scoping Report was sent to the listed Statutory Consultees as defined in the SEA Regulations. The Scoping Report is available at www.floodinfo.ie and in summary provided a description of the baseline environment for the Western CFRAM Study Area. The Scoping Report considered the following environmental aspects:

- Water
- Biodiversity, Flora and Fauna
- Soils & Geology and Land-use
- Population & Health
- Landscape
- Archaeology & Cultural Heritage
- Morphology, fluvial and coastal processes
- Fishing and angling
- Amenity, Tourism and Recreation
- Infrastructure and Material Assets.

The Scoping Report established a decision-making framework based on a number of Environmental Objectives that were used to assess the impacts of the Western CFRAM on the environment. The Environmental Objectives were refined and a number of sub-objectives, targets and indicators were developed for the objectives.

A stakeholder mapping exercise was conducted in autumn 2011, in conjunction with the Progress and Steering Group, to identify all potentially relevant stakeholders for the Western CFRAM study. This identified a number of relevant stakeholder groups including:

- County, city and town councils
- Government departments
- State agencies and bodies
- Environmental authorities
- Regional authorities
- Non-governmental organisations
- Research bodies/educational establishments
- Special interest and local interest groups
- Development boards
- Industry and representative bodies
- Service providers

The Scoping Report helped to identify key issues and key threats to the environment and helped to prepare a relevant set of Environmental Objectives and targets.

6.3.3 Assessment & Evaluation

The assessment stage of the SEA requires an evaluation of the impacts of the Flood Risk Management Plan on the environment. Schedule 2 B of the SEA Regulations requires details on the current state of the environment. A desk-top baseline assessment of all environmental aspects was conducted as part of the Scoping Report. This information has been updated and is presented in Chapter 7 of the Scoping Report. A 'do nothing' scenario was also investigated as part of this assessment. It also serves to identify suitable mitigation measures to reduce the impacts of the scheme on the environment.

Data gaps relating to site specific data on sensitive receptors in the Study Area is identified as one of the short comings of the SEA process. To combat this a 'precautionary approach' has been taken to the assessment of the potential effects of the option(s).

6.3.3.1 Strategic Environmental Objectives

An initial set of Environmental Objectives and Targets were established as part of the Scoping exercise. This list was reviewed to determine if the targets and indicators could be used as part of the options assessment process. Furthermore, the targets and indicators were assessed to determine if they would provide sufficient robust evidence in the future to determine the success or otherwise of the SEA for the Plan. The Environmental Objectives were included in the Multi Criteria Analysis (MCA) list of 15 flood risk management objectives, which defined economic, social, environmental and technical objectives for the flood management plan. Ultimately these objectives were used to assess the flood risk management options.

6.3.3.2 Options Identification and Assessment

The preparation of the Environmental Report ran in parallel with the preparation of the Preliminary Options Reports (POR) for the AFAs in the River Basin. The authors of the Environmental Report had an input into the MCA process and were involved in the assessment of the options. The SEA team used a number of databases to define the environmental receptors within the river basin and on a more local basis within the Areas for Further Assessment. The presence of environmental receptors for the predicted 1% annual exceedance probability (AEP) for fluvial areas and the 0.5% AEP for tidal areas was identified. Databases used to carry out this work included:

- The Environmental Protection Agency's Envision Portal
- The National Parks and Wildlife database
- The Geological Survey of Ireland's geology database
- County Development Plans for the area
- Strategic Environmental Assessments for the County Development Plans
- Local Area and Town Plans where applicable

- Strategic Environmental Assessments for the Town and LAPs.

The SEA team paid particular interest to water dependant habitats and the impact that flood alleviation measures might have on them. The team was cognisant of the requirements of the WFD and the River Basin Management Plans. The environmental baseline data for the River Basin is described in the Environmental Report. More localised environmental data for the AFAs was gathered and is presented in the same section of the report.

An initial screening of flood management measures was carried out for each of the AFA within the river basin. The environmental sensitivity of each the area within the floodplain was taken into consideration. Each measure was rated between +1 (a positive impact), 0 (neutral impact) and -1 (negative impact). Scores of -999 implied an unacceptable environmental impact and the proposed measure was discounted at this stage of the process.

The SEA process formed a part of the detailed MCA process that was carried out to assess the suitability of flood risk management options. The options were assessed against the SEA Environmental Objectives to determine their potential environmental impacts and to inform the final decision making process. An overall SEA score was obtained for each option which was the sum of the weighted scores for each of the SEA Environmental Objectives.

6.3.3.3 *Assessment of the Plan recommendations*

Following the identification of the preferred flood risk management options from the MCA process, the final stage of the process was the development of the preferred flood risk management option which forms the basis for the recommendations of the Plan for the Sligo Bay - Drowes River Basin.

The potential environmental impacts of the components of the Plan were characterised in terms of:

- Significance
- Duration of impact
- Extent of the impacts.

6.3.3.4 *Significance Testing*

In line with the SEA Regulations, the following criteria has been used to describe the significance of an impact. In identifying the changes to the baseline and describing the magnitude and duration of the impacts, the following criteria have been used to inform the assessment:

- The significance of the impact whether the impacts are positive or negative (i.e. does the impact support or conflict with the Environmental Objectives)
- The duration of the impact (i.e. will the impacts occur during construction only or will the impacts manifest itself during the operation of the flood defence option)
- What will be the geographical extent of the impact (i.e. will it be local, regional or national)
- Whether the impacts are direct or indirect, secondary or cumulative.

Significance

The overall significance of the impact of a method or measure on the Environmental Objectives is dependent upon two factors - the size of the disturbance caused (magnitude) and the sensitivity of the receptor. The sensitivity of the receptor may be based on a legal designation of a site, for example a Special Area of Conservation or a Natural Heritage Area. It may also be based on the proximity to sensitive receptors such as schools, hospitals, wastewater treatment plants etc. In our assessment we have assigned different ratings for positive and negative impacts. Within these two groups we have further defined the impacts as major, moderate and minor. This refined impact assessment has allowed more specific mitigation measures to be suggested.

The significance testing at this strategic level is qualitative and is based on the baseline information and technical judgement. More quantitative significance testing will arise during the project and environmental impact assessment stage.

The assessment tables in the SEA Environmental Report illustrate the impacts of the measures on each of the environmental objectives with and without mitigation measures. The following levels of significance have been used.

- Significant major negative impact - Measures that posed a significant major negative impact on a receptor would or has the potential to have a permanent, irreversible impact on the baseline conditions. In other cases, the option would or could have a negative impact on a designated European site, an area of archaeological importance, or a negative impact on humans close to the site.
- Moderate negative impact - Measures that were assessed to have a moderate negative impact on a receptor would or could have a temporary, short term reversible impact on a receptor. This level of impact is most likely to arise during the construction of the flood defence(s).
- Minor negative impact - Measures that were assessed to have a minor negative impact on a receptor would or could have a short term negative impact on a local habitat or receptor. It is anticipated that this impact would be remedied by good construction practices and would only be of short duration i.e. less than a day or two.
- Neutral impact - A neutral impact would arise where there is likely to be a change in the baseline conditions but where the level of change/impact is negligible.
- Minor positive impact - Measures with a minor positive impact will exceed the sub-objective only.
- Moderate positive impact - A moderate positive impact will have a moderate positive impact on the baseline conditions and will partially achieve the requirements and support the Environmental Objective and sub-objective.
- Major positive impact - Measures with a major positive impact will have a positive effect on the baseline conditions and will support the Environmental Objectives.

Duration of an Impact

It is anticipated that the majority of the impacts on the environment will occur during the construction of the proposed measures. However, some impacts may arise over time for example hydromorphological impacts on a riverbed due to the presence of a culvert or in-river flood defences. The duration of effects used in the SEA Environmental Report reflects the guidance given by the Environmental Protection Agency in their 2015, Draft Guidelines on information to be contained in an environmental impact statement.

Table 6-2: Duration of Impact

Effect	Duration of the Effect
Temporary effect	Lasting less than 1 year
Short-term effect	Lasting 1 to 7 years
Medium term effect	Lasting 7 to 15 years
Long-term effect	Lasting 15-60 years
Permanent effect	> 60 years

Extent of the Impacts

The extent of the impact of the proposed measures have been assessed as described in the table below. It should be noted that these impacts are only assessed at a strategic level with predicted impacts.

Table 6-3: Extent of impact

Impact	Extent of Impact
Local (L)	Impact occurs within the AFA
Regional (R)	Impact occurs within the River Basin
National (N)	Impact occurs beyond the River Basin

The impacts of the measures were assessed using the criteria. Where a significant impact was identified during the assessment, mitigation measures to remedy same were identified. Opportunities (positive impacts that could achieve the aspirational targets) were also identified.

6.3.3.5 Mitigation Measures

Where the assessment has identified significant environmental impacts, mitigation measures will be required to reduce/remedy these impacts. The mitigation measures that are considered as part of this assessment are generic and more site specific mitigation measures will be required as part of planning for the Plan measures. The need for the installation of on-site specific mitigation measures will be a requirement of the planning consent for same.

6.3.3.6 Residual Impacts

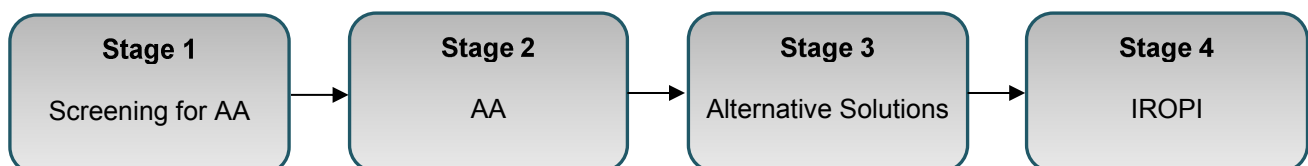
Residual impacts can be defined as impacts that remain after the installation of the mitigation measures. For the purposes of the SEA it is difficult to accurately assess potential residual impacts and it is considered that this is better addressed at the project environmental impact assessment stage.

6.4 APPROPRIATE ASSESSMENT

A number of Natura 2000 sites, designated under the EU Birds Directive (2009/147/EC) and Habitats Directive (92/43/EEC), are located within the zone of influence of the proposed Plan. Therefore, the plan needs to go through the appropriate assessment (AA) process. A stage 2 AA is required to assess the measures and objectives of the Plan for the river basin. The Stage 2 AA is presented as a Natura Impact Statement, which specifies details of the Plan, associated objectives and measures and analyse the potential negative effects on the Natura 2000 sites at a plan level in accordance with Article 6(3) of the Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora).

Guidance on the Appropriate Assessment (AA) process was produced by the European Commission in 2002, which was subsequently developed into guidance specifically for Ireland by the Department of Environment, Heritage and Local Government (DEHLG) (2009). These guidance documents identify a staged approach to conducting an AA, as shown in **Figure 6-3**.

Figure 6-3: The Appropriate Assessment Process (from: Appropriate Assessment of Plans and Projects in Ireland- Guidance for Planning Authorities, DEHLG, 2009)



6.4.1 Stage 1 - Screening for AA

The initial, screening stage of the Appropriate Assessment is to determine:

- whether the proposed plan or project is directly connected with or necessary for the management of the European designated site for nature conservation
- if it is likely to have a significant adverse effect on the European designated site, either individually or in combination with other plans or projects

For those sites where potential adverse impacts are identified, either alone or in combination with other plans or projects, further assessment is necessary to determine if the proposals will have an adverse impact on the integrity of a European designated site, in view of the sites conservation objectives (i.e. the process proceeds to Stage 2).

6.4.2 Stage 2 - AA

This stage requires a more in-depth evaluation of the plan or project, and the potential direct and indirect impacts of them on the integrity and interest features of the European designated site(s), alone and in-combination with other plans and projects, taking into account the site's structure, function and conservation objectives. Where required, mitigation or avoidance measures will be suggested.

The competent authority can only agree to the plan or project after having ascertained that it will not adversely affect the integrity of the site(s) concerned. If this cannot be determined, and where mitigation cannot be achieved, then alternative solutions will need to be considered (i.e. the process proceeds to Stage 3).

6.4.3 Stage 3 - Alternative Solutions

Where adverse impacts on the integrity of Natura 2000 sites are identified, and mitigation cannot be satisfactorily implemented, alternative ways of achieving the objectives of the plan or project that avoid adverse impacts need to be considered. If none can be found, the process proceeds to Stage 4.

6.4.4 Stage 4 - IROPI

Where adverse impacts of a plan or project on the integrity of Natura 2000 sites are identified and no alternative solutions exist, the plan will only be allowed to progress if imperative reasons of overriding public interest (IROPI) can be demonstrated. In this case compensatory measures will be required.

The process only proceeds through each of the four stages for certain plans or projects. For example, for a plan or project, not connected with management of a site, but where no likely significant impacts are identified, the process stops at stage 1. Throughout the process, the precautionary principle must be applied, so that any uncertainties do not result in adverse impacts on a site.

The assessment of this plan has not proceeded to stage 3 or 4.

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, Community 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 cannot 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 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 cannot 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 (FRMP) 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
- 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 contain a WFD assessment, which will include a hydro-morphological assessment, to more clearly consider and support the Water Framework Directive (WFD) objectives (see Section 6.5.4). This WFD assessment will inform the project level AA regarding likely significant effects and adverse impacts on the site integrity of Natura 2000 sites in respect of their conservation objectives and if necessary, appropriate mitigation measures will be implemented at project level to ensure adverse effects will not occur.

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 applicable¹¹.

¹¹ 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.

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.

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 Sligo Bay - Drowes 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 Sligo Bay - Drowes River Basin is set out in the Preliminary Options Report for the Western CFRAM Project, and in similar reports for parallel studies. These reports are available from the OPW website; 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.

In other areas, the level of risk may be relatively low and the cost of implementing any substantial additional measures may be significant. Where the costs of implementing new measures are higher than the benefits of such measures, in terms of risk reduction, then it will not be possible to justify such works. In this case, it may not be possible to undertake any new measures, or only implement low-cost actions such as local maintenance of a channel or minor repairs / alterations to existing structures to reduce the risk and/or avoid a future increase in risk.

7.2.4.1 *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.

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.

7.3.1.1 *Unit of Management level*

At this scale, methods that could provide benefits to multiple AFAs within the Sligo Bay - Drowes River Basin as a whole were considered. Flood risk management methods applicable at this spatial scale included:

- Planning Policy Requirements
- Flood Forecasting and Warning Systems
- Sustainable Urban Drainage systems (SUDs)
- Land Use Management
- Measures implemented under other legislation
- Requirements for additional monitoring (rain and river level / flow gauges)
- Provision of channel maintenance

The implementation of planning policies, potential for SUDs and the possibility for flood forecasting and warning systems respectively are all discussed at a catchment scale

Flood risk management measures applicable at the River Basin level are generally non-structural measures already required under existing legislation or policy, and are set out in the Plan for clarity, although further work may be required under some such measures to further enhance the management of flood risk.

7.3.1.2 *Sub catchment level*

The sub-catchment Spatial Scale of Assessment (SSA) refers to the catchment of the principal river on which an AFA sits, and as such includes AFAs upstream or downstream which may benefit from a catchment level solution. Methods that could provide benefits to multiple AFAs include upstream storage or flood forecasting systems. Methods proposed for an individual AFA have also been reviewed for their positive and negative impacts on the rest of the catchment.

This SSA would generally not be applicable to AFAs that are only at risk from coastal flooding, except where multiple AFAs are at risk around an estuarine area, in which case the estuary area

may be treated as a Sub-Catchment SSA. This is the case in Ballysadare and Sligo and in response, the potential for a tidal flood forecasting system for Sligo Bay was explored.

7.3.1.3 *AFA level*

At this scale, methods benefitting only the AFA in question were considered, even if the implementation of a given method includes works or activities outside of the AFA, i.e., elsewhere in the sub-catchment or river basin. Examples include storage upstream of the AFA, or flood forecasting and warning systems that provide no benefits to other AFAs, as well as all other FRM measures and options, such as protection measures, conveyance improvement, etc.

In most cases a single method to address all risk within an AFA will not be sufficient, and proposals will comprise a combination of measures and methods to address the risk in different areas within the AFA.

7.3.1.4 *Flood cell level*

Within an AFA there may be discreet areas of flood risk, called 'Flood Cells', that are hydraulically independent from other areas at risk within the AFA. The viability of methods has been assessed at a flood cell level only if an AFA wide solution is not viable.

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 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 are screened, based on an initial assessment, against the following criteria:

- **Applicability:** Effectiveness of the measure in managing or reducing flood risk
- **Economic:** Potential 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 is 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 proposed 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).

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, CFRAM Technical Methodology Note - Option Appraisal and the Multi-Criteria Analysis (MCA) Framework).

The Local Weightings for the AFAs for the Sligo Bay - Drowes River Basin are set out in the Preliminary Options Report available from the OPW website (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.

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 proposed measures are effective. Community participation is also essential to make sure that any proposed 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 preferred measures set in this Plan have been determined based on range on 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 JBA Consulting
- 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 Sligo Bay - Drowes 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 Sligo Bay Drowes 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.

Measure Name:	Application of the Guidelines on the Planning System and Flood Risk Management (DHPLG/OPW, 2009)
Code:	IE35-UoM-9011-M21
Measure:	The Planning Authorities will ensure proper application of the Guidelines on the Planning System and Flood Risk Management

	(DHPLG/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.
Implementation:	Sligo County Council and Leitrim County Council Planning Authorities
Funding:	Existing duties (Planning Authorities)

A review of the Development Plans, Local Area Plans and other spatial planning documents has been carried out for each AFA and the river basin as a whole.

The assessment has focused on two main areas:

- A review of current policy and guidance with recommendations for future development plan cycles;
- A review of current land use zoning against the CFRAM Flood Zones. This recognises that most development plans were completed prior to the CFRAM Study and were based on indicative flood risk information;

Table 7-1 summarises the findings for each of the AFAs. Outside the AFAs, the Medium Priority Watercourse (MPW) models should be considered as updates to the PFRA flood maps which are currently used to inform planning applications in rural areas.

Table 7-1: Summary of spatial planning considerations taking into account current flood risk

AFA	Current flood risk
Ballymote	Two areas in the town shows conflict between flood risk and land zoning. Generally, all other land at flood risk has been zoned for water compatible uses.
Ballysadare	Generally, all land at flood risk is zoned for water compatible uses.
Collooney	Two areas to the North of the town are zoned for residential inside Flood Zone A and should be reconsidered. Locations for development are generally outside Flood Zone A and Flood Zone B, however, redevelopment proposals for the town centre should consider the resilience of flooding and public safety.
Coolaney	Generally, all land at flood risk is zoned for water compatible uses.
Gorteen	Generally, all land at flood risk is zoned for water compatible uses.
Manorhamilton	An area to the north of the town has been zoned for Enterprise and Employment and is within Flood Zone A. Given the fact it is currently within Flood Zone A and there are other surrounding lands outside of Flood Zone A viable for development it should be rezoned as open space
Riverstown	Generally, all land at flood risk is zoned for water compatible uses. Consideration of zoning should be completed in a parcel of land zoned currently for business and development to the south of the town.
Sligo Town (Incl. Rathbraghan)	On the Sligo River, flood mapping depicts areas zoned for "Community Uses" adjacent to Sligo Institute of Technology inside Flood Zone A and B. Any development in this area would be subject to a justification test and a site specific flood risk assessment. In Rathbraghan, an area adjacent to the Shannon Eighter zoned for Business, Industry and Technology Park and industrial land is within Flood Zone A. Early consideration of the drainage infrastructure requirements across the site will provide opportunities to combine the surface water drainage strategy with a flood mitigation scheme for the wider catchment.

The CFRAM Flood Zones provide an improved understanding of flood risk within the AFAs highlighted and along watercourses between the AFAs and the sea. Strategic Flood Risk Assessments should be updated to incorporate the latest understanding of flood risk.

Building regulations / planning conditions

It may be possible to mitigate risk of damage from flood inundation using appropriate construction techniques and materials. A timber stud partition covered with plasterboard with low level electric wiring would require complete replacement if the property flooded, however solid concrete walls covered with tiles and high level electrical wiring makes a property more resilient to flooding, with quick and lower cost clean up required. In the absence of funding for a full scheme such methods can be utilised to reduce the damage.

The Guidelines for Planning Authorities should prevent inappropriate development in areas at risk of flooding, but some development may still be acceptable. Redevelopment of existing properties of the same use is often an acceptable planning approach, however in areas of significant flood risk, such redevelopment should avoid exposure, or be resistant and resilient to flood hazards.

Certain building regulations and planning conditions could be adopted to ensure structures are flood resilient through specified construction methods and the types of building fabrics used. Similarly, construction outside but close to the Flood Zone B extent may be susceptible to

increases in flood risk as a result of climate change, and applying such building regulations would reduce the potential impact in the future.

7.4.1.2 *Prevention: Sustainable Drainage Systems (SUDS)*

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.

Measure Name:	Implementation of Sustainable Urban Drainage Systems (SUDS)
Code:	IE35-UoM-9012-M34
Measure:	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.
Implementation:	Planning Authorities
Funding:	Existing duties (Planning Authorities)

7.4.1.3 *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.

Measure Name:	Voluntary Home Relocation Scheme
Code:	IE35-UoM-9052-M22
Measure:	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.
Implementation:	Home-Owners with humanitarian assistance to those qualifying under the Voluntary Homeowners Relocation Scheme, 2017
Funding:	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).

Measure Name:	Consideration of Flood Risk in local adaptation planning
Code:	IE35-UoM-9013-M21
Measure:	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.
Implementation:	Local Authorities
Funding:	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.

Measure Name:	Assessment of Land Use and Natural Flood Management Measures
Code:	IE35-UoM-9021-M31
Measure:	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.
Implementation:	Local Authority WFD Offices, OPW, EPA, Others
Funding:	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.

Measure Name:	Minor Works Scheme
Code:	IE35-UoM-9051-M61
Measure:	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.
Implementation:	OPW, Sligo County Council, Leitrim County Council
Funding:	OPW, Sligo County Council, Leitrim County Council

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

There is one Arterial Drainage Scheme within the Sligo Bay - Drowes River Basin, namely the Bonet Arterial Drainage Schemes, as 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, and 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 four Drainage Districts within the Sligo Bay Drowes River Basin, namely the Coolaney, Drumcliff, Dunmoran and Owenmore. 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.

7.4.1.10 *Preparedness: Flood Forecasting*

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, Community 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.

Measure Name:	Establishment of a National Flood Forecasting and Warning Service
Code:	IE35-UoM-9031-M41
Measure:	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.

Implementation:	OPW, DHPLG, Met Éireann and Local Authorities
Funding:	OPW, DHPLG

7.4.1.11 *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.

Measure Name:	Review of Emergency Response Plans for Severe Weather
Code:	IE35-UoM-9032-M42
Measure:	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.
Implementation:	Principal Response Agencies, Regional Steering Groups, National Steering Group
Funding:	Existing duties (Implementation Bodies)

Until such time as flood prevention schemes are built, the existing level of risk will remain unless a flood response plan can ensure necessary actions are taken and all vulnerable residents can be safely evacuated and accommodated. Well prepared and executed emergency plans can significantly reduce the impact of flood events. Sligo County Council has set up a Framework for a Major Emergency and has produced a guidance document "A guide to Flood Emergencies" and a protocol "A protocol for multi-agency response to Flood Emergencies".

7.4.1.12 *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 DHPLG 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/>).

Measure Name:	Individual and Community Action to Build Resilience
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Code:	IE35-UoM-9033-M43
Measure:	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.
Implementation:	Public, business owners, farmers and other stakeholders
Funding:	N/A

7.4.1.13 *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 home owners 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.

Measure Name:	Individual Property Protection
Code:	IE35-UoM-9053-M43
Measure:	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.
Implementation:	Home owners, Interdepartmental Flood Policy Co-ordination Group
Funding:	Home owners, N/A

7.4.1.14 *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.

Measure Name:	Flood-Related Data Collection
Code:	IE35-UoM-9041-M61
Measure:	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.
Implementation:	OPW, Sligo County Council and Leitrim County Council, EPA and other hydro-meteorological agencies
Funding:	Existing duties (Implementation Bodies)

The hydrometric data across the west of Ireland consists of flow gauges on the larger watercourses. There is a scarcity of sub-daily rainfall gauges across the west of Ireland meaning there is insufficient data with which to determine the response of individual catchments during flood events. As part of the ongoing national review into hydrometric data collection a network of sub-daily rainfall gauges should be established, cognisant of the requirements of other stakeholders, to support future analysis of flood events.

Consistent standards for post flood reporting should be implemented and include reviews of flood models and damage estimates. Such as OPW guidance - Flood Data Collector's Handbook, <http://www.opw.ie/media/Guide%20to%20Flood%20Data%20Collection.pdf>.

Further data collection will allow for model uncertainty to be reduced over time and the impacts of climate change to be monitored. In Sligo Bay - Drowes River Basin the key areas of model uncertainty linked to data uncertainty are shown below. Priority for additional data collection should be given to those AFAs where structural schemes are to be progressed.

- There are no gauges within the Ballymote drainage catchment to its confluence with the Owenmore River. Given the extent of flooding predicted within the Ballymote AFA it is strongly recommended that a recording flow gauge be installed on this catchment to improve confidence in flood risks modelled and to inform option development.
- The greatest uncertainty within the hydraulic modelling for the Riverstown AFA arises from the development of the hydrology for the River Unshin. The short record of data available (five years) from the Ballynary gauge on Lough Arrow provides an insight into the response of the lough, but not a full picture. In order to calibrate the model of Lough Arrow a longer record of levels is required, and it is recommended a gauge is installed for this purpose.
- There was previously a tidal gauge installed in Sligo Bay but has since been removed. The lack of a tide level gauge in Sligo Bay to understand the influence of Sligo Bay and the Garvoge on tidal propagation and flood risk should be addressed to reduce the uncertainty in flood mapping for Sligo. This data would also be of use to refine any flood alleviation scheme design if necessary and also improve the accuracy and reliability of flood forecasting and warning systems.
- New, either permanent or temporary, recording flow gauging stations on some smaller ungauged watercourses would allow models to be calibrated. This includes the Shannon Eighter catchment in Rathbraghan as part of Sligo Town AFA, where a potential scheme is being proposed.
- In Manorhamilton, there are a number of properties where flooding has been reported, however the hydraulics suggest flood risk of these properties occurs only in extreme events. There is no gauge data within this catchment. Installation of a recording flow gauge would lead to a reduction of uncertainty in the hydrological analysis and help to confirm the current flood extents.

7.4.2 Catchment / Sub-Catchment Measures

All three of the AFAs within Sligo Bay - Drowes River Basin where flood risk has been identified in the 1% AEP fluvial or 0.5% AEP tidal events are hydraulically independent. As such there are no catchment or sub-catchment structural measures that will provide benefit to more than one of these AFAs and no further screening of structural measures at the sub-catchment level has been undertaken.

7.4.2.1 *Flood forecasting and warning systems*

Flood forecasting and warning systems are important measures to manage the residual risks of flooding in locations protected by structural flood defences. They provide the ability to inform managing authorities and the public of the potential for failure or overtopping of flood defence structures and to trigger emergency response plans. Flood forecasting and warning systems are low-regret methods for managing flood risk.

There are minimal environmental impacts from flood forecasting and warning systems, assuming all gauges are installed to have no disruption to flow and are installed sensitively to avoid damage and disruption to habitats and species. The avoidance of barriers to flow and movement of aquatic species is consistent with the objectives of the Water Framework Directive. Any new gauges or telemetry systems will be subject to project level assessments as appropriate.

Full details of all methods investigated are detailed in Appendix G of this Plan and the Overarching Preliminary Options Report for the Sligo Bay - Drowes River Basin. These measures supplement the Flood Forecasting measure proposed for all areas

Flood forecasting and warning systems have been investigated for Coolaney and Sligo Town (Incl. Rathbraghan). Systems for the remaining AFAs have not been assessed at this time as there is no flood risk in the 1% AEP fluvial or 0.5% AEP tidal events. The only viable system identified is a coastal forecasting system for Sligo.

Measure Name:	National tidal flood forecasting and warning system to include high resolution forecasts for Sligo City
Code:	IE35-Cat-0001-M41
Measure:	High resolution forecasts are available at Galway Bay and could be used to provide warning to Sligo City.
Implementation:	OPW, Local Authorities (TBC)
Funding:	OPW, DHPLG

The OPW, as part of the Irish Coastal Protection Strategy Study (ICPSS), has developed a storm surge model for the coast of Ireland. This model is currently being trialled with a view to evaluating and improving its capability.

The tide and storm surge forecasts are provided twice daily to a project website during the autumn and winter period which is accessible to Local Authorities. The service provides surge, astronomical tide and total water level time series predictions approximately 65 hours in advance. Low resolution forecasts are available at Sligo and could be used to provide warning to the residents of Sligo. The model is currently only in operation in the autumn / winter months and its operation may need to be extended. As this is a national system its costs would be low when broken down by AFA. The system cost €87,000 to put in place with annual running costs of €68,100, which is the cost that is currently incurred by the OPW.

As this is a national forecasting system, a multi-criteria analysis has not been completed to determine a ranking score for this measure at an AFA level. This measure will fall under the requirements set out for the development of a national forecasting system.

No submissions or comments on this measure have been received during the draft FRMP consultation process.

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

7.4.3 Sligo Town AFA measures (Rathbraghan Area)

Potentially viable flood relief works have been investigated for Rathbraghan Area. Full details of all methods investigated are detailed in the Preliminary Options Report for Rathbraghan Area (Volume 2g).

The aim of the screening assessment was to identify potentially viable flood relief methods, from which a potentially viable flood risk management measure for the AFA as a whole can be developed.

Table 7-2: Summary of potentially viable flood relief works in Rathbraghan Area

AFA Name	Options for screening	Conclusion
Rathbraghan Area	Storage embankment This involves the construction of an embankment measuring 415m long and 1.2m average height to store / attenuate flood water in larger events and an associated controlled outfall to prevent overland flooding of properties downstream (including the Woodlands Estate and the nursing home) when flow exceeds the existing culvert capacity.	Economically viable - Screening BCR 2.98

Further details of the potentially viable flood relief works, including a full description, environmental considerations and impacts, climate change adaptation and public consultation feedback are in Appendix G of this Plan.

The potentially viable flood relief works consist of an embankment approximately 415m in length with a maximum height of 1.7m at the lowest point in the floodplain (average height 1.2m). The design crest level is 9.77mOD, which includes a 0.5m freeboard allowance.

It is noted that this design level provides protection in the MRFS 1% AEP event, although with a reduced freeboard of 0.34m. An additional 160mm on the embankment crest level would be required to ensure adequate (i.e., 0.5m) freeboard.

The volume of fill required for the construction of the embankment is 2,500m³ based on a typical cross section of 2m top width and 1 in 3 side slopes. As space is not a constraint here, a shallower side slope can be accommodated and it is possible, depending on site investigation and soil type, that fill material can be sourced locally by re-grading the proposed storage area. This would improve the economic viability of the option. Re-grading the storage area will also allow a refinement of the basin topography and could incorporate the restoration of the former open channel upstream of the embankment. Such development of the potentially viable flood relief works could introduce additional environmental benefits to enhance the existing environment, for example a wetland habitat. It is noted that the long culvert remaining downstream will limit the environmental benefits of reinstating the channel and an operating storage capacity will need to be maintained above any natural wetland.

The environmental assessment of the potentially viable flood relief works has identified the following key points:

- There are permanent positive economic and social impacts as a result of the flood protection provided.
- During construction there are temporary environmental impacts beyond the AFA boundary. These impacts include the potential release and transportation of sediments during the culvert inlet works. These can be mitigated through the development and implementation of a Construction Environment Management Plan (CEMP).
- In operation the water impounded within the flood storage area may increase the potential for suspended sediment mobilisation and transport. Appropriate design of the culvert inlet structure can mitigate the environmental impacts of this.
- Protecting the industrial land from flooding will reduce flood risk to a potential pollution source.

The environmental assessment indicates the mitigation methods and best practice available is considered likely to succeed in preventing significant impacts on the habitats and species in the area, given the location, nature and scale of the works is deemed environmentally viable.

The potentially viable flood relief works have been presented to the public at the Preliminary Options Public Consultation Day in June 2015. No one attended the PCD despite a letter drop being carried out for all affected residents.

The results of the MCA are shown in **Table 7-3**.

Table 7-3: Appraisal of potentially viable flood relief works in Sligo Town (Incl. Rathbraghan)

Potentially Viable Flood Relief Works	MCA Appraisal Score							
	Technical	Social	Economic	Environmental / Cultural	TOTAL – MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
Flood embankment to 1% AEP design standard	1100	387	126	-184	329	0.25	1316	2.98

Further details of the potentially viable flood relief works are included in Appendix G, including the Multi-Criteria Analysis.

This measure has been developed with a focus on managing flood risk and scores well in OPW's national prioritisation of future management works. The progression of a flood risk management scheme in the Rathbraghan Area will need to open discussion with industrial land owner so that a more appropriate scheme can be developed in partnership with industrial land owners that meets the requirements of the Flood Risk Management Plan and the Development Management Justification Test.

Measure Name:	Progress the development of a Flood Relief Scheme for Rathbraghan Area
Code:	IE35-IE-AFA-350561-0001-M33
Measure:	Progress the project-level development and assessment of a Flood Relief Scheme for the Rathbraghan Area, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if as appropriate, implementation.
Implementation:	Typically, the Local Authority under the OPW Minor Works Scheme
Funding:	Typically, OPW Minor Works Scheme

The potentially viable Flood Relief Scheme for the Rathbraghan Area will be subject to project-level development and assessment.

Potentially viable flood relief works have been identified for the Rathbraghan Area using the current flood risk maps. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

For the ongoing management of flood risk within the Rathbraghan Area it would be beneficial for the responsibility of maintenance of flood sensitive channels, streams and culverts and associated structures providing a flood defence function to be formalised to maximise their flood risk benefits in line with environmental and economic considerations.

7.4.4 Ballymote AFA measures

The flood risk maps for the Ballymote AFA have not highlighted significant risk within the 1% AEP flood event. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

7.4.5 Riverstown AFA measures

The flood risk maps for the Riverstown AFA have not highlighted significant risk within the 1% AEP flood event. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally, this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

7.4.6 Ballysadare AFA measures

The flood risk maps for the Ballysadare AFA have not highlighted significant risk within the 1% AEP flood event. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally, this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

7.4.7 Collooney AFA measures

The flood risk maps for the Collooney AFA have not highlighted significant risk within the 1% AEP flood event. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally, this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

7.4.8 Gorteen AFA measures

The flood risk maps for the Gorteen AFA have not highlighted significant risk within the 1% AEP flood event. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally, this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

7.4.9 Manorhamilton AFA measures

The flood risk maps for the Manorhamilton AFA have not highlighted significant risk within the 1% AEP flood event. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally, this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

7.4.10 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.

7.4.10.1 Coolaney AFA measures

Potentially viable flood relief works have been investigated for Coolaney. Full details of all methods investigated are detailed in the Preliminary Options Report for Coolaney (Volume 2d).

The aim of the screening assessment was to identify potentially viable flood relief methods, from which a potentially viable flood risk management measure for the AFA as a whole can be developed.

Table 7-4: Potentially viable flood relief works in Coolaney

AFA Name	Potentially viable flood relief works	Conclusion
Coolaney	Flood embankment to the 1% AEP design standard A 70m embankment 1m in height on the right bank to cut off the flow route.	Economically unviable - BCR 0.98

Further details of the potentially viable flood relief works, including a full description, environmental considerations and impacts, climate change adaptation and public consultation feedback are in Appendix G of this Plan.

The embankment would be 70m in length and 1.0m in height including freeboard. It is likely that the embankment will be located on private land and so space and access for maintenance will need to be negotiated with the landowner. The bank in this location is lined with large conifers which will either need to be cleared for construction or the embankment situated on the landward side. It will tie into the Coolaney Road Bridge at its upstream end and high ground at its downstream. Due to the trees, there is currently no access in this location so constructing the embankment will not negatively impact on access. The local topography drains away from the embankment so if overtopped, the existing bypass route will be re-established and flood waters would cut off the meander and return to the channel downstream.

There is scope to increase the height of the embankment to accommodate climate change although its length would need to be increased as well. The embankment would need to be

designed with this adaptation in mind. Increased flows within the Owenbeg will start to flood the Waste Water Treatment Plant (WWTP) from the downstream side of the meander, effectively bypassing the proposed embankment. Further measures would need to be considered at that stage to continue to protect the WWTP.

The environmental assessment of the potentially viable flood relief works has identified the following key points:

- There are permanent positive economic and social impacts as a result of the flood protection provided.
- The non-native conifer trees along the river bank may provide shelter or nesting habitat for a range of species. The removal of these may have temporary environmental impacts.
- Protecting the Waste Water Treatment Works from flooding should reduce the potential for pollution during flood events.

The environmental assessment indicates the mitigation methods and best practice available is considered likely to succeed in preventing significant impacts on the habitats and species in the area, given the location, nature and scale of the works and is deemed environmentally viable.

In June 2016 the potentially viable flood relief works were presented to the property owner on whose land the option would be constructed.

The results of the MCA are shown in **Table 7-5**.

Table 7-5: Appraisal of potentially viable flood relief works in Coolaney AFA

Potentially Viable Flood Relief Works	MCA Appraisal Score							
	Technical	Social	Economic	Environmental / Cultural	TOTAL – MCA Benefit Score	Cost (€millions)	MCA Score / Cost	BCR
Flood embankment to 1% AEP design standard	1200	1	175	346	522	0.04	14,77	0.98

Further details of the potentially viable flood relief works are included in Appendix G, including the Multi-Criteria Analysis.

Measure Name:	Progress the development of a Flood Relief Scheme for Coolaney
Code:	IE35-IE-AFA-350550-0001-M33
Measure:	Undertake a detailed assessment of the costs of potential measure for the community
Implementation:	Typically the Local Authority under the OPW Minor Works Scheme
Funding:	Typically OPW Minor Works Scheme

The potentially viable Flood Relief Scheme for Coolaney will be subject to further project-level development and assessment.

Potentially viable flood relief works have been identified for Coolaney using the current flood risk maps. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

For the ongoing management of flood risk within Coolaney it would be beneficial for the responsibility of maintenance of flood sensitive channels, streams and culverts and associated structures providing a flood defence function to be formalised to maximise their flood risk benefits in line with environmental and economic considerations.

7.4.10.2 Sligo Town AFA measures (excl. Rathbraghan)

Potentially viable flood relief works have been investigated for Sligo Town. Full details of all methods investigated are detailed in the Preliminary Options Report for Sligo Town (Volume 2i). A summary of the findings of the screening assessment is presented in **Table 7-6**.

The aim of the screening assessment was to identify potentially viable flood relief methods, from which a potentially viable flood risk management measure for the AFA as a whole can be developed.

None of these methods were found to be economically viable with respect to current levels of flood risk. There is therefore no potentially viable flood relief works for Sligo Town and no further analysis has been undertaken.

Table 7-6: Summary of viable structural flood risk management methods in Sligo AFA

AFA Name	Options for screening	Conclusion
Sligo Town	Construction of flood containment methods. This option would include the construction of two walls on Lower Quay Street to prevent tidal inundation at the existing low points along the Quay.	Not economically viable - BCR 0.01

The potential for viable flood relief works has been assessed for Sligo Town using the current flood risk maps. For the level of risk identified to continue to be representative it is implicit in the flood maps that the form and capacity of the existing river channels remains broadly the same. Generally, this form and capacity would be preserved by preventing a reduction in the conveyance capacity of the channel and ensuring structures currently containing or diverting flows continue to do so.

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 2.6.3 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 PROPOSED MEASURES

Table 7-6 provides a summary of the measures that are to be progressed through the implementation of the Plan for the Sligo Bay - Drowes River Basin. 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		
National tidal flood forecasting and warning system to include high resolution forecasts for Sligo.	OPW, Sligo County Council	OPW, DHPLG, Sligo County Council
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 as appropriate, implementation, for the Communities set out below.		
Sligo Town (Rathbraghan Area)	OPW and/or Sligo County Council,	Typically OPW
Undertake a Detailed Assessment of the Costs of the Potential Measure for the Communities set out below		
Coolaney	OPW and/or Sligo County Council,	Typically 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 of Works	Status
None		

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 pro-actively 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 8.1).

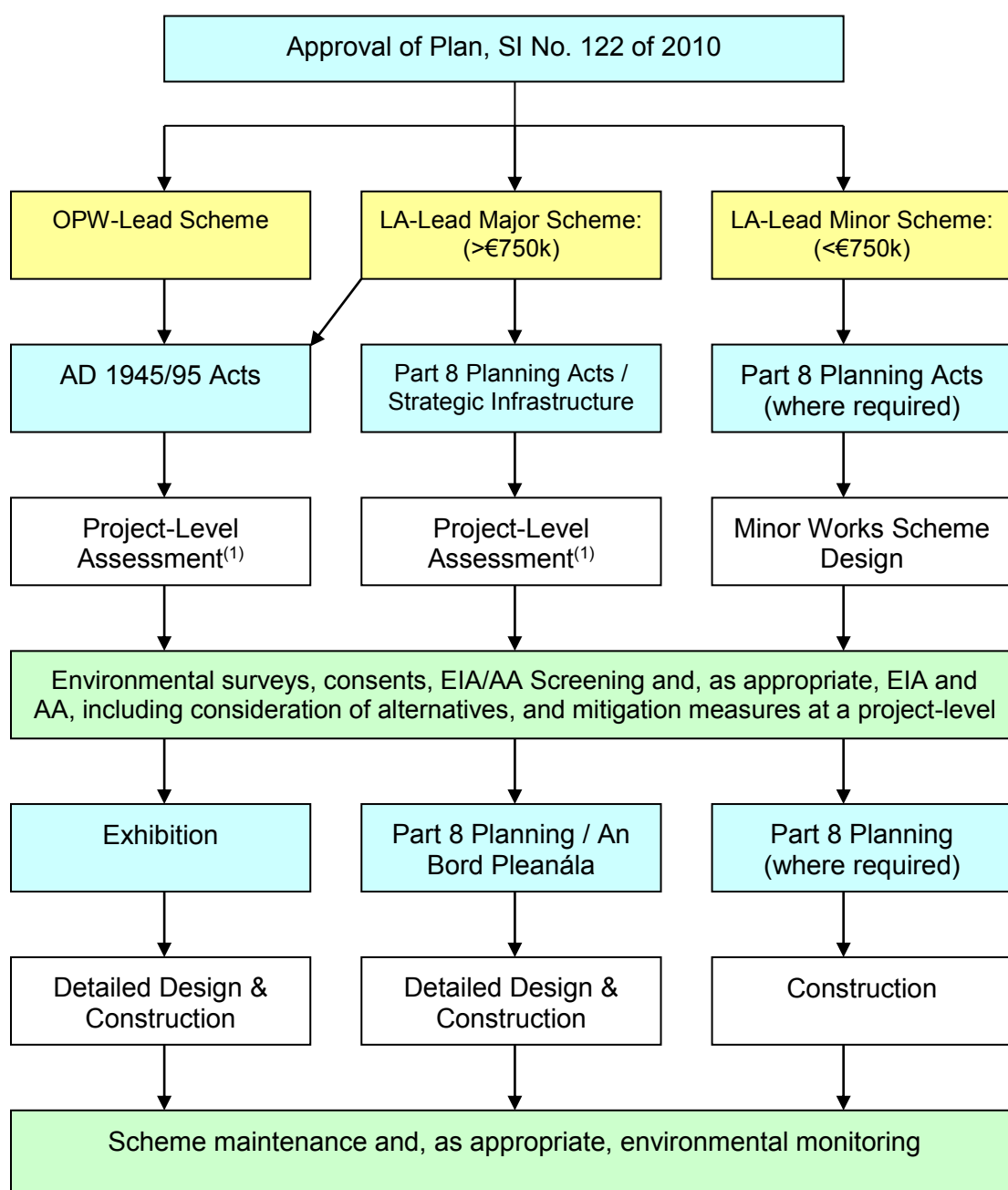
The potential physical flood relief works or 'Schemes' set out in the Plans that have been developed through the CFRAM Programme are to an outline design, and are not at this point ready for construction. Further detailed design through a project-level of assessment will be required for such works before 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 cannot 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 Sligo Bay - Drowes 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 proposed 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)
- 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

A monitoring programme allows the actual impacts of the Programme to be tested against those that were predicted. It allows major problems to be identified and dealt with in a timely manner, and environmental baseline information to be gathered for future Programme reviews. Monitoring is carried out by reporting on the set of indicators and targets drawn up previously and used to describe the future trends in the baseline, which will enable future positive and negative impacts on the environment to be measured.

The OPW will be responsible for implementing the monitoring programme.

This monitoring programme will encompass the Plan for the Sligo Bay - Drowes River Basin. The impact of the local flood risk management schemes particularly during construction will need to be assessed and sufficient mitigation measures put in place to reduce these impacts. The mitigation measures will form part of the Contractor's Construction Environmental Management Plan for the individual schemes.

The EPA's Catchment Portal (www.catchments.ie) can be used as a baseline for the environmental status of a habitat or waterbody prior to the commencement of any projects arising from the Plan. The data and maps that are available on this website can be incorporated into the SEA monitoring programme. Monitoring requirements will also be conditioned on any consents/planning permissions required for the Plan.

This Plan sets out a framework for flood risk management in the Sligo Bay - Drowes River Basin. A full monitoring programme for the Plan is difficult to present at this stage because some elements of the Plan are dependent upon changes to current strategic documents such as the County and City Development Plans. The monitoring programme should be aligned with the monitoring programme for other Plans and Programmes such as the WFD, and the EPA's fluvial geomorphological assessment programme.

However, when implementation of the plan is initiated a monitoring programme can be put in place using the baseline data presented in this Environmental Report. This monitoring will inform the six yearly update as is a requirement of the EU Floods Directive.

It is recommended that all the monitoring data generated from the implementation of the Plan is stored in a centralised database that can be accessed nationally. This information should be used to inform the 6-yearly update to the Plan. The review should focus on:

- The level of progress of the Plan that has occurred in Sligo Bay - Drowes River Basin over the previous 6 years
- Have any significant impacts occurred during this period?
- What new data has been accumulated from other programmes during this timeframe and how has it being made available to the OPW
- What Plans/Programmes have been initiated during this period that could influence/impact on the Plan for the Sligo Bay - Drowes River Basin
- How have these new Plans/Programmes been integrated into the Plan?
- Does the review of the monitoring data for this period highlight any changes/amendments that should be made to the Plan or the National CFRAM programme?
- Has the review identified more areas at risk of flooding and will the revised Plan require a revised SEA and AA
- Have any new approaches to flood management been identified within this period?
- What progress has been made with integrating Flood Risk Management Plans with other Plans and Programmes such as the WFD, National Biodiversity Plan, Peatland Conservation Plans, Freshwater Pearl Mussel Conservation Plans etc.

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.

It is anticipated that this review of the Plans will 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 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 FRMPs 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 (FRMP)	A Plan setting out a prioritised set of measures within a long-term sustainable strategy aimed at achieving defined flood risk management objectives. The FRMP is developed at a catchment or 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, and hence 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 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 www.floodinfo.ie) sets out how significant risk is determined for the PFRA, and hence how Areas for Further Assessment have been identified
Standard of Protection	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.
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]
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	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

AA	Appropriate Assessment
ACA	Architectural Conservation Area
AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
AMAX	Annual Maximum Flow Record
AR5	5th Assessment Report (IPCC)
BCR	Benefit - Cost Ratio
CEMP	Construction Environment Management Plan
CFRAM	Catchment-Based Flood Risk Assessment and Management
DHPLG	Department of Housing, Planning and Local Government
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESB	Electricity Supply Board
EU	European Union
FSR	Flood Studies Report
FRMP	Flood Risk Management Plan
FRR	Flood Risk Review
FSU	Flood Studies Update
GSI	Geological Survey Ireland
HEFS	High-End Future Scenario
HPW	High Priority Watercourse
ICPSS	Irish Coastal Protection Strategy Study
IFA	Irish Farmers Association
IPCC	Intergovernmental Panel on Climate Change
IRR	Individual Risk Receptor
LAP	Local Area Plan
LULC	Land Use and Land Cover
MCA	Multi-Criteria Analysis
MPW	Medium Priority Watercourse
MRFS	Mid-Range Future Scenario
NCCAF	National Climate Change Adaptation Framework
NHA	Natural Heritage Area
NI	Northern Ireland

NIG	National Implementation Group
NPWS	National Parks and Wildlife Service
OPW	Office of Public Works
PCD	Public Consultation day
PFRA	Preliminary Flood Risk Assessment
RBD	River Basin District
RBMP	River Basin Management Plan
RPG	Regional Planning Group
SAAR	Standard Average Annual Rainfall
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SI	Statutory Instrument
SPA	Special Protection Area
SUDS	Sustainable Urban Drainage System
UoM	Unit of Management
WFD	Water Framework Directive
WMU	Water Management Unit
ZAP	Zones of Archaeological Potential

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APPENDICES

APPENDIX A

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 past¹. 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 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

¹ 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)

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 cannot 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, landslides 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

B PHYSICAL OVERVIEW OF THE RIVER BASIN

B.1 Topography, Geology, Soils and Groundwater

B.1.1 Topography

The Sligo Bay Drowes River Basin sits at the northern limit of the Western River Basin District (Figure B-1). To the northeast where the river basin extends into County Leitrim, the river basin is bounded by the Dartry Mountains. These are the upper hills of one of the longest rivers in this river basin, the Bonet, which drains into Lough Gill and discharges as the Garvoge River into the sea at Sligo. To the west the Ox Mountains straddle the border with the River Moy River Basin. The centre of the river basin is dominated by two large flat watercourses, the Unshin and the Owenmore, which converge and outfall to the sea at Ballysadare. The largest lakes within the river basin are Lough Gill (14 km²) and Lough Arrow (12 km²).

B.1.2 Geology, Soils and Groundwater

The bedrock geology underlying the Sligo Bay - Drowes River Basin is dominated by Carboniferous limestone, which covers over half of the area. Some of the karst limestone areas are of geological heritage and natural conservation significance. The land in the river basin is generally used for agriculture (principally grassland) and this limestone stores large quantities of groundwater which feeds the lakes and turloughs, and provides significant amounts of drinking water to the region.

The soil in the river basin consists of a combination of acidic, brown earth, brow podzolics and surface water gleys, both derived from non-calcareous parent material (Namurian rocks). A small portion of the river basin is made-up of peat bog. Peatlands are wetland ecosystems characterised by accumulation of organic matter under wet conditions, they support a wide diversity of flora and fauna, and they have carbon storage capacity.

B.2 Land Use and Land Management

B.2.1 Urban Areas

Preliminary data from the 2011 census (CSO, 2011) indicate that the population of Western Ireland has increased.. This trend is consistent throughout the component counties of the Western RBD, with all showing population increases of between 5% and 10% in the same period, with the exception of Galway City (4.1% growth); Galway County in contrast showed the greatest increase of 10%.

Table B-1: Population Changes by Area in Western RBD

Area	2006	2011	Increase	% Increase
Clare	110950	116885	5935	5.3
Galway City	72414	75414	3000	4.1
Galway County	159256	175127	15871	10.0
Leitrim	28950	31778	2828	9.8
Mayo	123839	130552	6713	5.4
Roscommon	58768	63898	5130	8.7
Sligo	60894	65270	4376	7.2

The 2006 and 2011 census data held by the Central Statistics Office (CSO, 2016) show a total population for the AFA towns in the river basin. The figures from the 2006 and 2011 census indicate that there have been large increases in the population of the selected towns across Sligo, notably in Coolaney where the increase is 300%. The exception to this is Sligo itself where the population has remained static (refer to Table B-2).

Table B-2. Census population and percentage change (2006 and 2011)

Town	2006	2011	% Change
Sligo (Incl. Rathbraghan)	19,402	19,452	3%
Coolaney	208	866	300%
Ballysadare	/	/	/
Manorhamilton	1,158	1,336	15%
Collooney	892	1,369	53%
Riverstown	310	374	20%
Ballymote	1,229	1,539	25%
Gorteen	269	349	29%

In comparison with the rest of Europe, the population of Ireland continues to be relatively sparse, with approximately 60 persons per square kilometre as opposed to the EU's average of 116 persons per square kilometre (Eurostat, 2011). In more recent years, the Irish population has become more urbanised, especially around major towns.

B.2.2 Land cover and land use

Land use and land cover (LULC) describe the form and function of the natural land surface. Land cover is the physical description of the land and land use describes the terrestrial use from a human perspective based on socio-economic usage (EPA, 2012). In Ireland, the main source of LULC is the EPA and EEA CORINE (Co-Ordinated Information on the Environment) land cover data series, which have delivered maps in 1990, 2000, 2006, and 2014.

The land-use practices in the river basin are all a direct reflection of the soil types and underlying bedrock. Refer to Figure B-2. According to the EPA CORINE Land Cover database for 2012, the main land-uses in the river basin were predominately pastures, some sections of -peat bogs, patches of broadleaved forests, transitional woodlands, and continuous and discontinuous urban land cover in the towns. (See Figure B-3).

B.2.3 Potential future land use changes

The general trend in terms of population growth and distributions in the Sligo Bay - Drowes River Basin continues to be a slight annual increase in population and a movement towards larger towns and cities. Coolaney's significant increase in population is likely to be due to its proximity to Sligo Town, making it an appealing commuting town. The movement of population will create a pressure in urban fringes, suburbs, and commuting towns. A rise in housing and infrastructural development will be needed to accommodate the population numbers and movement. Considering risk of flooding in future housing or recreational developments will continue to be necessary, especially in the context of climate change.

Water infrastructure and the associated demand for abstraction and discharges of waste water will require upgrading or replacement. The continued increase in population is likely to lead to a bigger demand for amenity, tourism and recreation resources, both formal and informal. The region's water resources are likely to be important features in this process offering prospects for more informal recreation and potential formal development. Securing and improving water quality will be very important.

Domestic and international tourism will continue and there will be a potential for more development of outdoor, adventure, and cultural destinations. Tourism centres in rural areas could benefit villages and towns by attracting visitors to these areas, which could result in social and economic benefits (i.e. new developments and/or improvement of infrastructure).

Figure B-1: Topography map for the Sligo Bay - Drowes River Basin

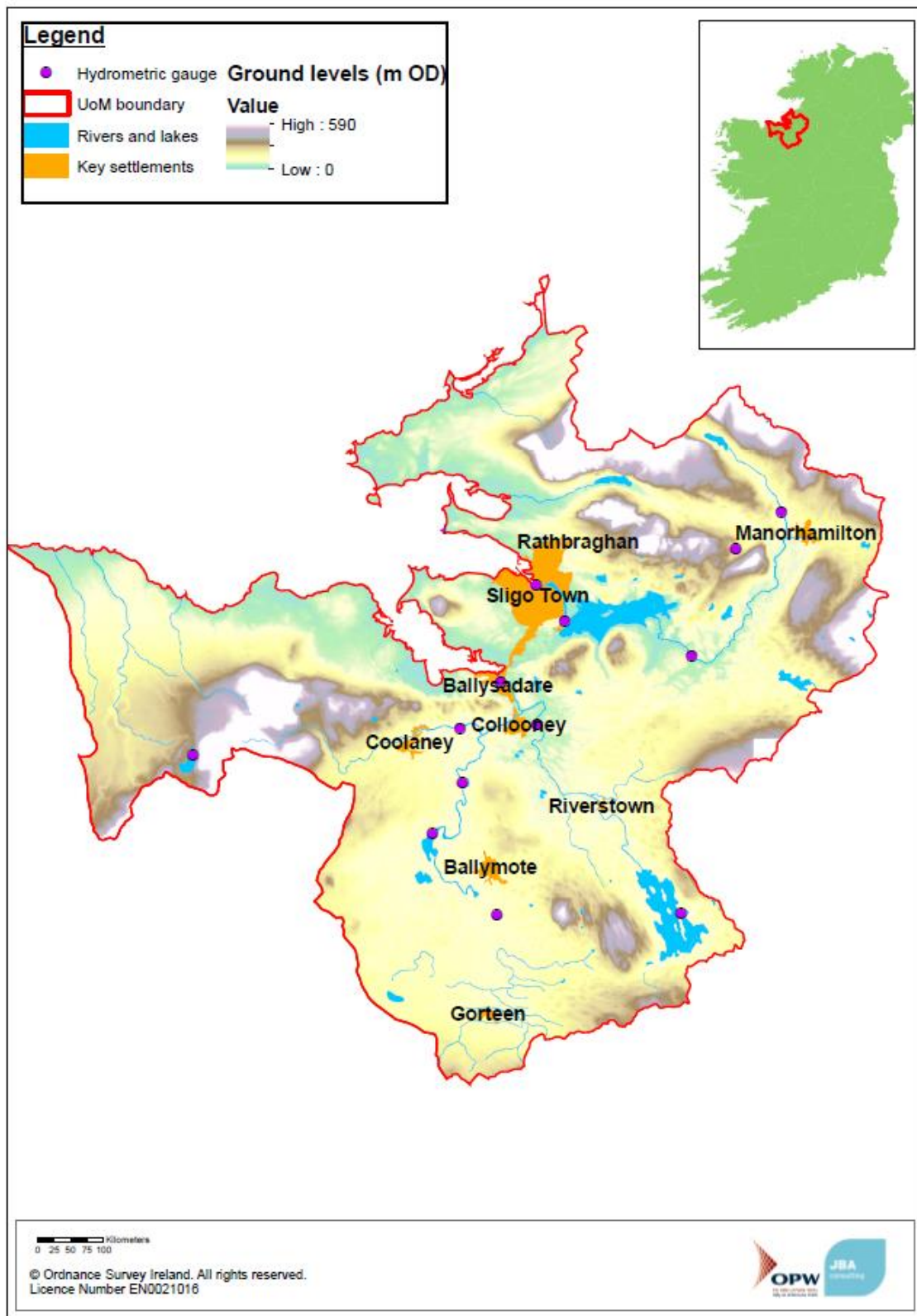


Figure B-2: EPA CORINE Land-use database for Sligo Bay - Drowes River Basin

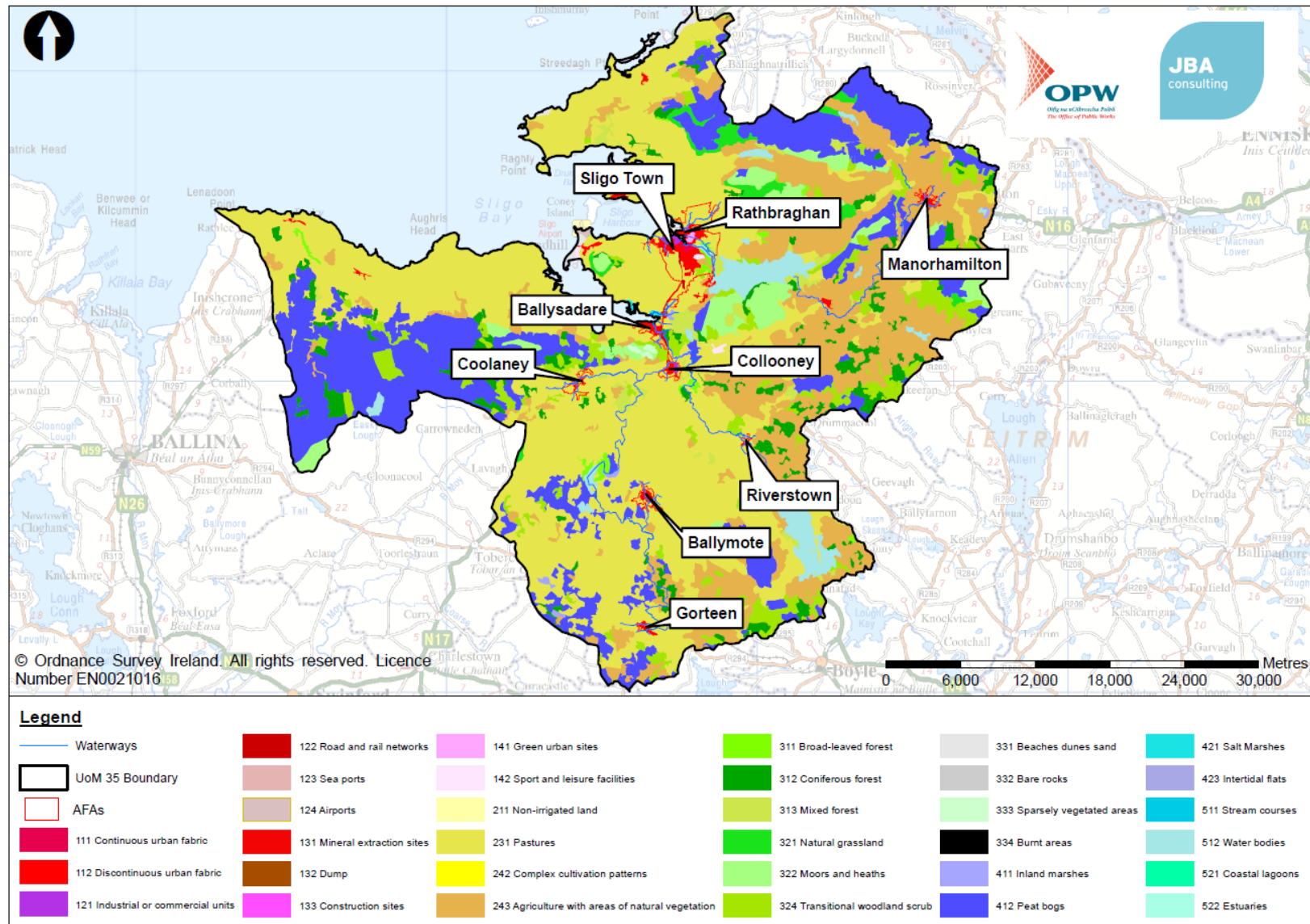
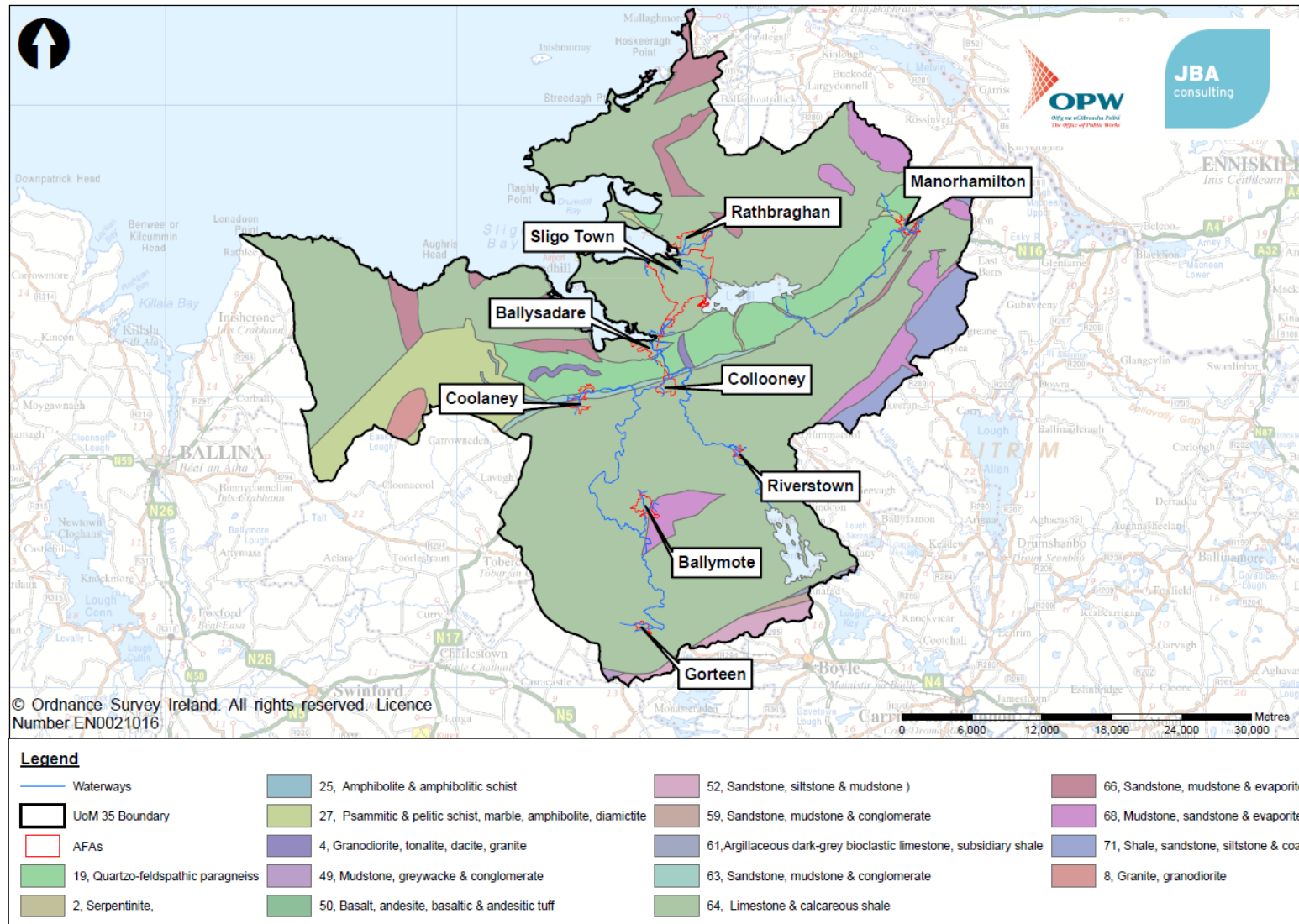


Figure B-3: Bedrock Geology (GSI €750k mapping) Sligo Bay - Drowes River Basin



B.3 Hydrology

The focus of the hydrological investigations has been on the AFAs identified through the PFRA, see Section **Error! Reference source not found.**. As such discussion in this section leans towards the data required to support the hydrological investigations for these AFAs.

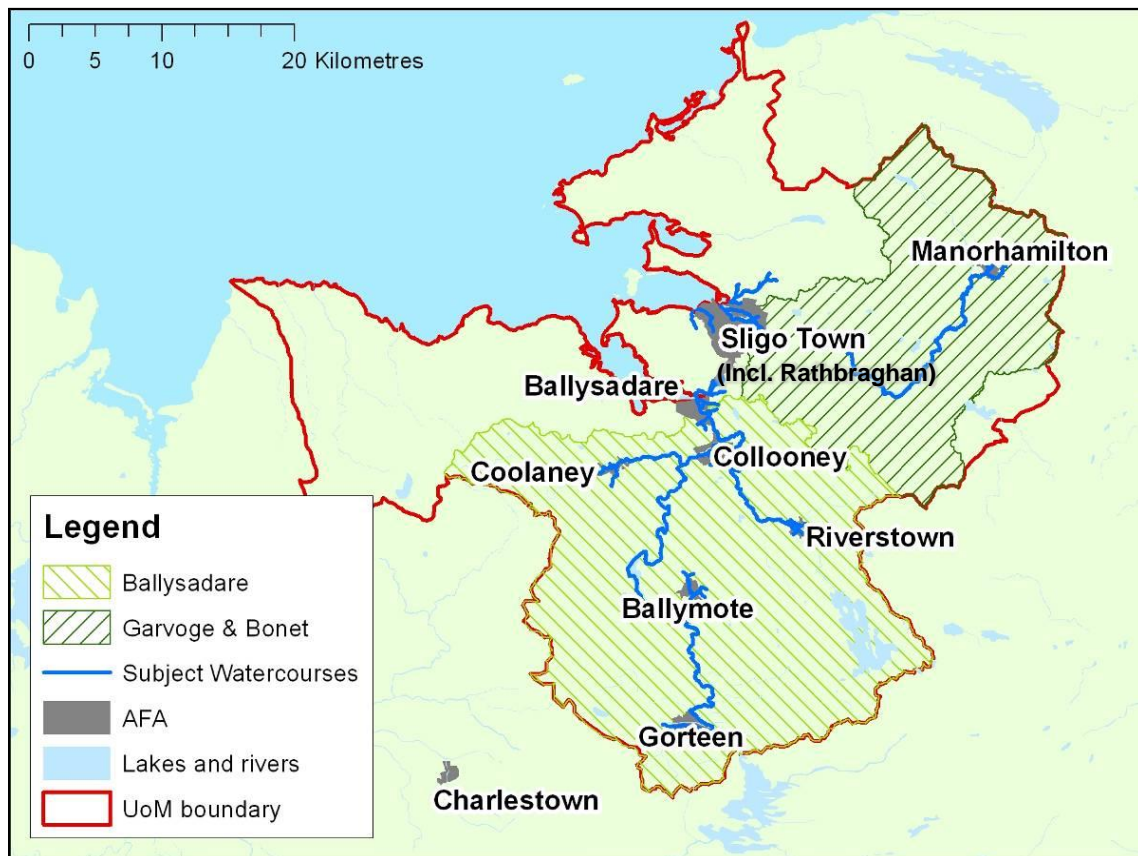
Full details of the hydrological investigations are provided in the Western CFRAM UoM 35 Final Hydrology Report, which can be accessed through the CFRAM website (www.floodinfo.ie).

B.3.1 Sub-catchments and river network, estuarine areas, coastlines

The majority of the river basin is formed of two catchments; the Ballysadare and the Garvoge (also spelt Garravogue). Upstream of Lough Gill the main channel in the Garvoge catchment is known as the River Bonet. Other smaller catchments drain into Sligo Bay. All AFAs lie within one of these two catchments. The map in Figure B-4 illustrates these catchments.

Sligo Town (incl. Rathbraghan) and Ballysadare are also coastal AFAs. Sligo Town (incl. Rathbraghan) is situated in Sligo Bay and Ballysadare is situated in Ballysadare Bay.

Figure B-4: Subject catchments in Sligo Bay - Drowes River Basin

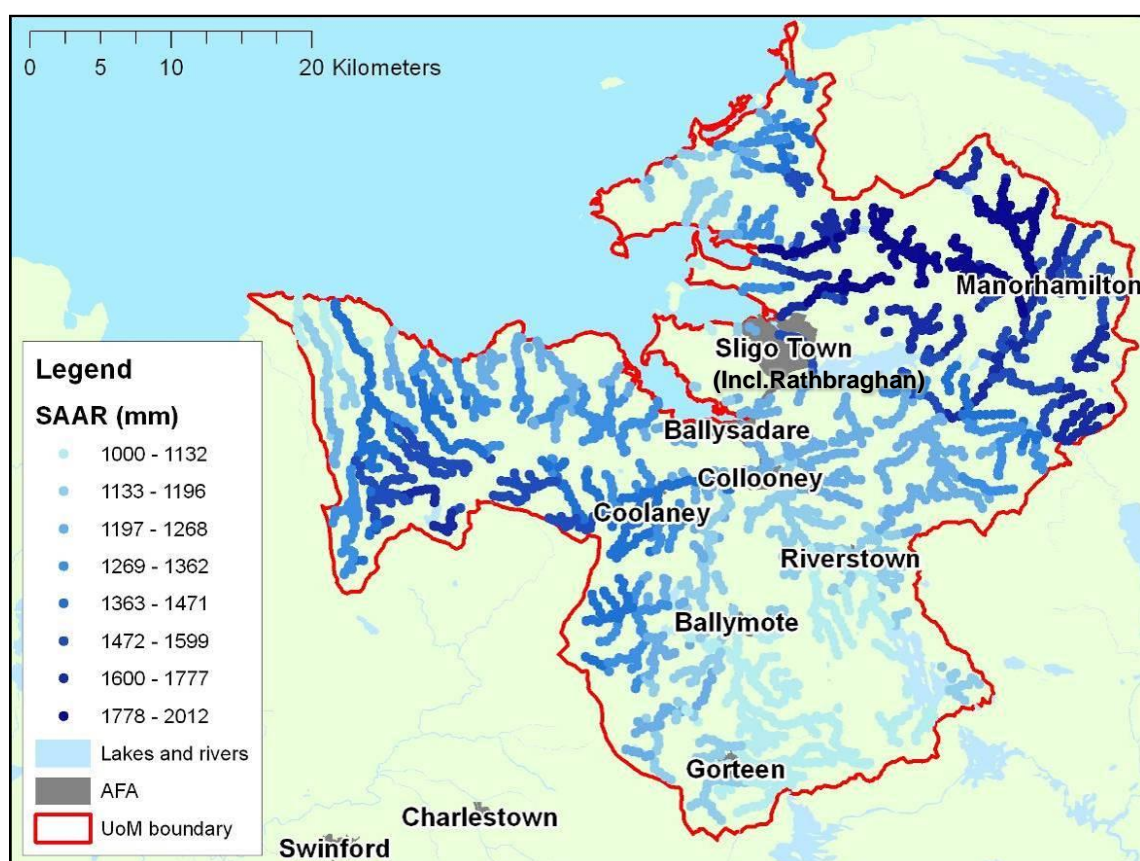


B.3.2 Land Drainage

Rivers can be divided into three main categories when it comes to maintenance:

- **Arterial Drainage Rivers** - Where the Office of Public Works have completed a drainage scheme under the Arterial Drainage Acts, 1945 and 1995, there is a statutory requirement to maintain the drainage works forming part of the scheme. These drainage works includes watercourses, embankments and other structures. Watercourses are subject to siltation and erosion, among other processes, and embankments are subject to settlement and erosion. Ongoing maintenance activities are of a cyclical nature. Annual maintenance works schedules are compiled to prioritise drainage works based on a rate of deterioration and the risk arising. As shown in Figure B-5 the only arterial drainage scheme, within an AFA is a short reach in Manorhamilton of the Bonet River. This is the Bonet Arterial Drainage Scheme which consists of 92km of channel and 1441km² of benefitting lands.
- **Drainage Districts** - Many local authorities have a statutory responsibility for the maintenance of Drainage Districts under the Arterial Drainage Act, 1925. However, the

Figure B-6: Standard-period annual average rainfall, SAAR

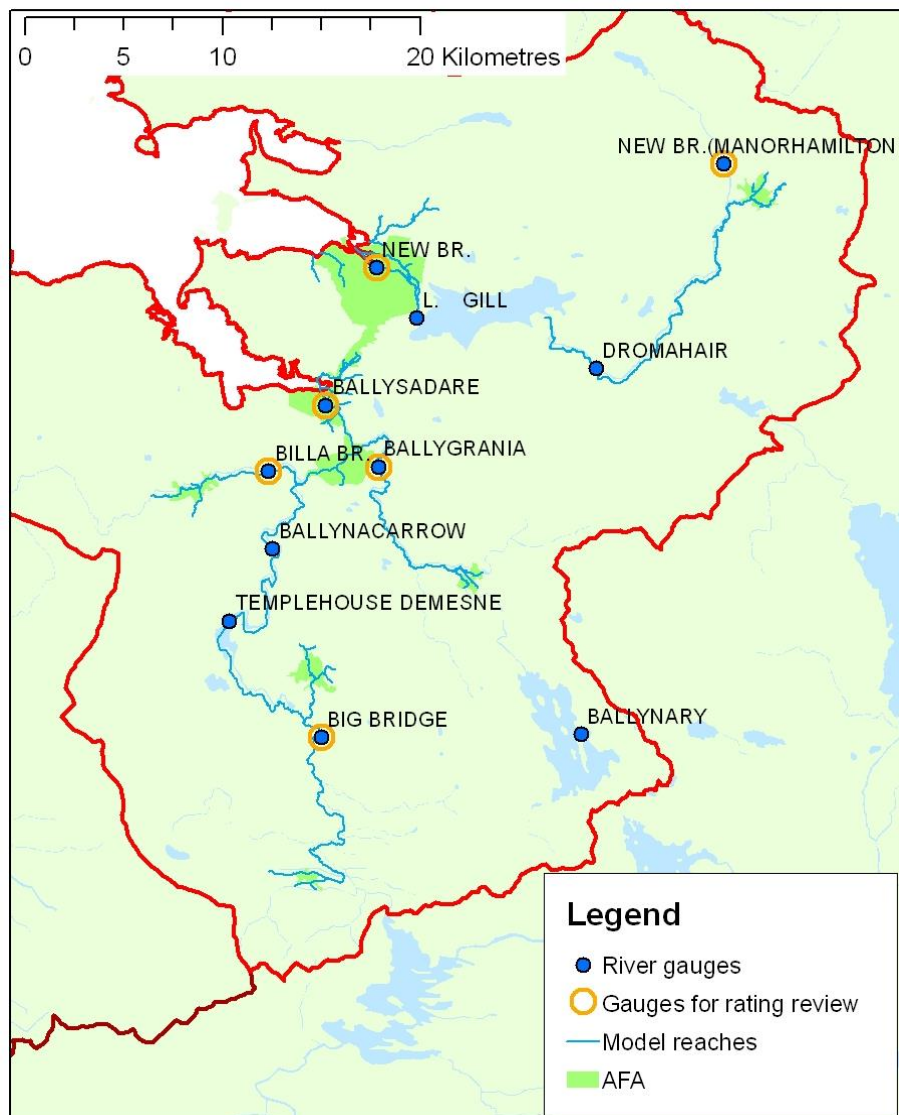


B.3.4 Hydrometric data availability

Figure B-7 shows the river gauging stations in the catchments where AFAs have been identified within this unit of management. It shows only those stations at which a continuous record of river level is available, which excludes staff gauges where occasional readings are taken. It includes any closed gauges as well as current ones.

In total there are 11 river level gauges that have been used in the study. At 8 of these gauges it is possible to calculate flow from the observed water levels using a rating equation for at least part of the record, the three where this is not possible are Ballygrania (35003), Templehouse Demesne (35078) and Ballynary (35087). Six of the stations (of which Big Bridge and Ballygrania did not previously have ratings) were identified for review and extension of rating equations within this study.

Figure B-7: River gauge locations



Summary information on the gauges and their relevance to this study is given in Table B-3. River level and flow data, where available, has been provided for all these gauges by the OPW and EPA.

Table B-3: Summary of river level and flow gauges

Ref. No.	Name	Catchment Area (km ²)	Start of record	End of record	Flow available?	FSU class	Comments
35001	BALLY-NACARROW	300	1970	-	Yes	A2	Gauge moved in 2001 and no rating developed yet for new location.
35002	BILLA BR.	89	1972	-	Yes	A2	Rating review gauge. Earlier data on charts from 1955
35003	BALLYGRANIA	202	1973	-	No	n/a	Rating review gauge (no current rating).
35004	BIG BRIDGE	117	1956	-	Only to 1970	A1 (pre-1970)	Rating review gauge. No rating since 1970. AMAX flows to 1970; AMAX stage from 1977. Gauge moved 25m upstream in 1998.
35005	BALLYSADARE	640	1945	-	Yes	A2	Rating review gauge.
35011	DROMAHAIR	293	1957	-	Yes	B	
35012	NEW BR. (SLIGO)	369	2001	-	Yes	n/a	Rating review gauge.
35028	NEW BR. (MANOR-HAMILTON)	47	1990	-	Yes	n/a	Rating review gauge.
35073	L. GILL	363	1975	-	Yes to 1997 or 2005	A2	Level-only station from 1997 although FSU AMAX flow available to 2005. Flow now available shortly downstream at 35012.
35078	TEMPLEHOUSE DEMESNE	274	2007	-	No	n/a	
35087	BALLYNARY	66	2008	-	No	n/a	
<p>Notes:</p> <ol style="list-style-type: none"> 1. The start of record is given as the earlier of the year from which continuous digital data is available or the year from which flood peak data are available. Some gauges have earlier records available on paper charts. 2. FSU quality classes indicate the extent to which high flow data can be relied on as judged by the Flood Studies Update research programme. Class A gauges are thought to provide reasonable measurement of extreme floods, and thus are suitable for flood frequency analysis (the best gauges being classed as A1); class B are suitable for calculation of moderate floods around QMED and class C have potential for extrapolation up to QMED. Class U indicates gauges thought to be unsuitable at the time of the FSU research. These quality classes were developed around 2005-2006 and some may no longer be applicable following recent high flow gaugings. 4. All gauges with flow available have rating equations and check gaugings. All gauges listed have annual maximum series. 5. All gauges are operated by OPW apart from 35012 and 35073 which are operated by Sligo County Council. 							

Figure B-8 and Table B-4 detail the location and available data associated with tidal gauges around the west coast of Ireland. Many of these gauges have been recently installed and are part of an ongoing project to develop a centrally controlled Irish national tidal network.

Figure B-8: Tidal gauge locations

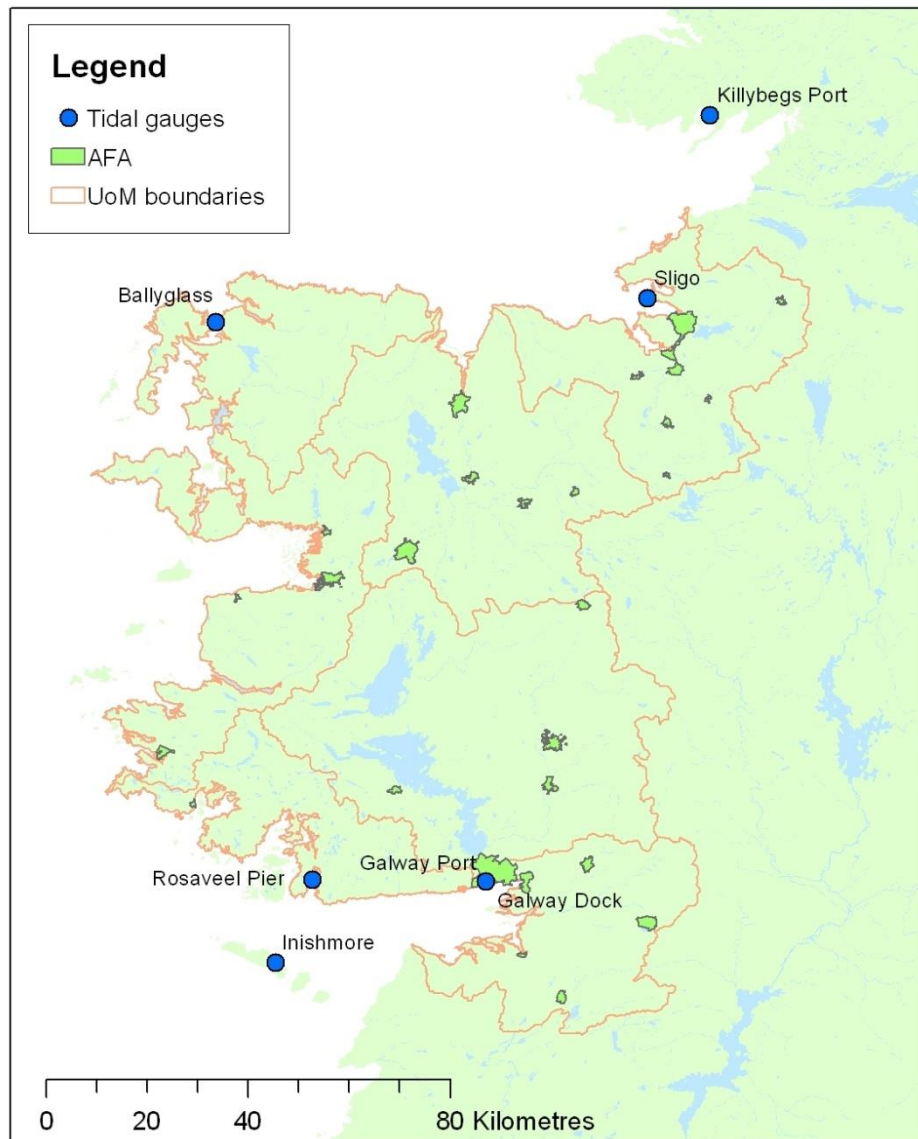


Table B-4: Summary of tidal gauges

Name	Operating Authority	Start of record	End of record	Comments
Killybegs	Marine Institute	Mar 2007	-	
Sligo, Rosses Point	Marine Institute	Jul 2008	Aug 2013	
Ballyglass	Marine Institute	Apr 2008	-	
Inishmore	Galway Co. Co.	Apr 2007	-	Currently inactive due to harbour works
Rosaveel Pier	OPW	Jul 1986	-	
Galway Port	Marine Institute/Galway Port Company	Mar 2007	-	
Galway Dock	OPW	Sep 1985	Nov 1989	

APPENDIX C

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 Eurther 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 PFRA on the National CFRAM Programme website 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 1st November 2011. Submissions were invited in writing, by email, or via the National CFRAM 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).

The CFRAM Steering and Progress Groups (comprising representatives of the Local Authorities, regional authorities and the EPA as well as of the OPW ¹) 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.

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).

¹ 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.

APPENDIX D

D STAKEHOLDER AND PUBLIC ENGAGEMENT AND CONSULTATION

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 Éireann
- Office of Emergency Planning
- Rivers Agency (Northern Ireland)
- Waterways Ireland

D.2 Membership of the Western CFRAM Steering Group

- Office of Public Works
- JBA Consulting Ltd
- Environmental Protection Agency
- Mayo County Council
- Sligo County Council
- Galway County Council
- Galway City Council
- Leitrim County Council
- RBD WFD Coordinator
- Clare County Council
- North and Western Regional Assembly
- Roscommon County Council

D.3 Organisations Invited to Meetings of the National Stakeholder Group

Table D-3: 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	

D.4 Organisations Represented at Meetings of the Western CFRAM Stakeholder Group

Table D-4: Organisations Represented at Meetings of the Western CFRAM Stakeholder Group

OPW	Geological Survey Ireland (GSI) - Groundwater Section
Galway City Council	Irish Farmers Association (IFA) - Chairman Galway IFA Environment Committee
Inland Fisheries Ireland (IFI)	Galway County Council - Road Design
Mayo County Council	Carra Mask Corrib Water Protection Group
Clare County Council	Western RBD WFD Coordinator
West Regional Authority	Sligo County Council
National Parks and Wildlife Service (NPWS)	National Monuments Section, OPW
Leitrim County Council	

D.5 Public Consultation Days Held at the Flood Mapping Stage in the Sligo Bay Drowes River Basin

Table D-5: Flood Mapping PCDs Held in the Sligo Bay Drowes River Basin

AFA	Date	Venue	No. Attendees
Gorteen	12/11/2014	Coleman Irish Music Centre	11
Riverstown	24/11/2014	Cooper Memorial Hall	14
Ballymote	24/11/2014	Family Resource Centre	5
Sligo Town (Incl. Rathbraghan)	25/11/2014	Sligo City Hall Chamber	11
Collooney	26/11/2014	Teeling Centre	6
Ballysadare	27/11/2014	Ballysadare Community Centre	6
Coolaney	27/11/2014	Coolaney Community Centre	16
Manorhamilton	26/11/2014	Bee Park Resource Centre	12

D.6 Public Consultation Days Held at the Flood Risk Management Optioneering Stage in the Sligo Bay Drowes River Basin

Table D-6: Flood Risk Management Optioneering PCDs Held in the Sligo Bay Drowes River Basin

AFA	Date	Venue	No. Attendees
Coolaney	03/06/2016	Visit to resident's home	1
Sligo Town (Incl. Rathbraghan)	23/06/2016	Sligo City Hall Chamber	0

D.7 Public Consultation Days Held at the Flood Risk Management Plan Stage in the Sligo Bay - Drowes River Basin

Table D.7: Draft Flood Risk Management Plan PCDs Held in the Sligo Bay - Drowes River Basin

AFA	Date	Venue	No. Attendees
Ballymote	09/09/2016	Family Resource Centre	12
Sligo Town (Incl. Rathbraghan)	05/09/2016	Sligo City Hall	22
	06/09/2016	Clarion Hotel	12
Coolaney	08/09/2016	Coolaney Community Centre	31
Manorhamilton	07/09/2016	Bee Park Resource Centre	6

APPENDIX E

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.

E.1 Flood Risk Analysis and Mapping - Ballymote

A brief description of the key flood risk sites and flooding mechanisms is provided below. Overall, the flood risk to property within Ballymote remains low and is largely driven by a number of key structures which act as flow constrictions. Once surcharged, these structures lead to localised flooding to property along flow routes through Ballymote.

E.1.1 Flooding at Grattan Street on the Ballymote

Flooding is predicted from the 50% AEP event upwards immediately upstream from Grattan Street. One of the two culvert arches is surcharged in events equal to or greater than the 50% AEP event, both arches are surcharged in events equal to or greater than the 2% AEP event. Once surcharged, flows are observed to spill across both of the banks ponding within the open land and crossing Grattan Street. A single property is predicted at flood risk during the 0.1% AEP event in this vicinity.

E.1.2 Flooding upstream of Keash Road on the Ballymote

Immediately upstream from the Keash Road culvert, flooding is predicted within the open land adjacent to the channel during modelled design events. The culvert is not predicted to surcharge during any of the modelled design events with flooding initiated from the low lying land and the bank tops along this reach. During the 0.1% AEP event, water levels rise sufficiently to take a preferential flow route on the right bank through a property and its garden rather than spill over the Keash Road culvert which is significantly higher. The flood route continues along Keash Road before flowing south along Wolfe Tone Street inundating a total of nine properties during the 0.1% AEP event.

E.1.3 Flooding adjacent to R293 Road/Creamery Road on the Ballymote

The model predicts flooding to several areas of open land on both of the banks adjacent to the R293 Road/Creamery Road during the 10% AEP event upwards although no properties are predicted at risk. The Access Road Bridge downstream from Wolfe Tone Street is predicted to surcharge during events equal to or greater than the 1% AEP event leading to localised flooding within the open land immediately upstream. During the 0.1% AEP event water levels in this area are sufficient to spill onto and along the R293 Road/Creamery Road for approximately 200m as well as flow towards Corn Mill Park and Carrigan's Upper. Further flooding is predicted on the left bank downstream from both access road bridges, on the opposite bank to the retail buildings, during the 0.1% AEP event although it is not predicted to pose any flood risk to property.

E.1.4 Flooding at playing fields, Castle Burn and adjacent to R293 Road/Sligo Road along Carrigan's Upper

Significant flooding is predicted for an approximate 800m reach of Carrigan's Upper alongside the R293 Road/Sligo Road. Flooding is initiated for all modelled design events upstream from the playing fields as a result of the 700mm diameter culvert surcharging during all modelled design events. Whilst the 10% AEP event remains contained within the open land upstream from the culvert, events equal to or greater than the 5% AEP event spill onto the R293 Road/Sligo Road and flow south towards Castle Burn for a distance of approximately 500m down to the junction between the R293 Road and Camross Road.

Immediately downstream from the 700mm diameter culvert and playing fields, flood water on the R293 Road/Sligo Road is predicted to flow into the commercial yard and residential estate at Castle Burn. This flow route, together with surcharging of the Castle Burn culvert during modelled design events greater than the 50% AEP event, leads to flooding within Castle Burn to a single property and several gardens in the 1% AEP event and up to seven properties during the 0.1% AEP event.

Further downstream, the culvert passing Carrigan's Upper beneath the R293 Road is also predicted to surcharge during all modelled design events. This leads to localised flooding on the left bank during the 2% AEP event although only inundates property during extreme events with five properties affected during the 0.1% AEP event. During the 1% AEP event, the flow along the R293 Road/Sligo Road from upstream is predicted to re-enter Carrigan's Upper immediately upstream from this culvert. However, in the 0.1% AEP event, water levels within Carrigan's Upper are sufficient to bypass this culvert via a flow route on the left bank across the junction of the R293 Road and Camross Road and into the recreation ground downstream. An additional flow route is predicted across the R293 Road/Sligo Road and onto the incised railway flowing south for a distance of approximately 500m before leaving the railway and entering the grounds of the castle downstream; no properties are predicted at flood risk as a result of this railway flow route.

E.1.5 Flooding to recreation park along Carrigan's Upper

Downstream from the R293 Road culvert, flooding is predicted within the recreation park for modelled design events greater than the 20% AEP event. The flooding is as a result of the low left bank top and low lying hinterland within the park although it does not pose any flood risk to property. A significantly larger flood extent is predicted for the 0.1% AEP event as a result of the upstream flow route across the junction of the R293 Road and Camross Road although it still does not pose flood risk to property.

E.1.6 Flooding at Corn Mill Park on Carrigan's Upper

The Corn Mill Park culvert within the lower reaches of Carrigan's Upper which runs parallel with the R293 Road/Creamery Road is predicted to surcharge within the lower barrel section of the culvert during all modelled design events. The resulting higher water level at the upstream face during the 0.1% AEP event is sufficient to flood the nursing home, castle grounds and Corn Mill Park and inundate a total of 13 properties in this area. The flow route within the castle grounds meets the flow passing along the railway from upstream and ponds within the castle grounds. The flow route passing through Corn Mill Park is predicted to pass along the R293 Road/Creamery Road and return to the Carrigan's Upper drainage ditch and Ballymote River on either side of the road.

E.1.7 Model Uncertainty

There are a number of limitations associated with the model. In summary these are:

- Hydrology - No gauges within the Ballymote drainage catchment
- Culvert blockage - No investigation carried out for impact of blockage and resulting potential overland routes.
- Sprung arch culvert inlets - No facility available in ISIS to incorporate these. These have been considered in the sensitivity analysis.
- Carrigan's Upper - Footbridge within recreation park - Not surveyed so not included in the hydraulic model.
- Corn Mill Park culvert - Lack of CCTV information for culvert introduces uncertainty about culvert geometry and bends along its entire length.

E.1.8 AFA-Level Flood Risk Table-Ballymote

Table E-1: AFA Level Flood Risk Table - Ballymote

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	-	9,146	493,743
No. Residential Properties at Risk	0	1	27
No. Business Properties at Risk	0	0	2
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	-	121,173	820,533
No. Residential Properties at Risk	0	7	49
No. Business Properties at Risk	0	2	5
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	-	236,060	1,075,737
No. Residential Properties at Risk	0	9	54
No. Business Properties at Risk	0	2	5
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0

Notes.

- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood. It does not consider property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

E.2 Flood Risk Analysis and Mapping - Ballysadare

E.2.9 Owenmore River left bank

High water levels immediately downstream of the R290 Road Bridge exceed local ground levels on the left bank. The single skin breeze block walls in this location are not considered to be flood defences and as such have been removed from the model; this allows flows to bypass the constructed embankment located a short distance downstream to enable flooding a number of farm properties in this location. Low ground further north is connected to the Ballysadare River floodplain via drains beneath the N4, however levels on the Ballysadare River are not sufficiently high enough to flood this area directly. In the 0.1% AEP event water levels are sufficiently high on the western side of the N4 for flows to continue northwards and pass beneath the railway line via the R290 and flood properties towards Knoxpark.

E.2.10 Ballysadare River left bank

High water levels on the Ballysadare River back up the Knoxpark tributaries and are predicted to flood the R290 in this location. There are no properties at risk from this flow route in the 1% AEP event. In larger events it is difficult to determine the extent of flood risk from this location given flows entering the site from the Owenmore as described above.

E.2.11 Knoxpark tributaries

The small capacity of the culvert passing beneath the Carricknagat Road on the Kilboglashy watercourse results in flooding of the land upstream. Whilst there are a number of properties on the right bank of this watercourse the local topography in this location drains away from these towards the Knoxpark tributary. Here the capacity of the culvert beneath the Carricknagat Road is greater and flows discharge downstream. The crest level of the Carricknagat Road appears to be higher than the nearest property and in the event of a blockage occurring in the Knoxpark culvert during an extreme event it is possible that this property may be affected.

E.2.12 Belladrihid at the N59

In extreme events the capacity of the culvert beneath the N59 at the downstream limit is insufficient to convey flows. Water overtops at the culverts entrance, flowing directly over the N59 before falling into Ballysadare Bay. Nearby properties are not shown to be affected by this flooding.

E.2.13 Flooding of the Drumaskibbole/Carrowgobbadagh Road

The Drumaskibbole/Carrowgobbadagh Road is flooded towards the upstream limit of the model. This occurs in both tidal and fluvial events with a 10% AEP, although the fluvial flood extent in the 1% AEP event is much larger than the corresponding tidal event. Flooding is a result of a tide locked downstream boundary and the flat nature of the site. Inflows discharging into the Carrowgobbadagh Highway Drains steadily back up and eventually exceed the top of the channel banks. Whilst peak velocities are generally low, approximately 0.1m/s in the 1% AEP fluvial event, flood risk is exacerbated by high levels of weed growth in the channel.

E.2.14 Flooding on the Glennagoolagh watercourse

The natural floodplain on both the left and right banks of the lower Glennagoolagh River, immediately upstream of the confluence with the two highway drains. The fluvial flood extent is marginally larger than the corresponding tidal event, for the 10%, 1% and 0.1% AEP events although more comparable than along the two drains. This flooding is a result of the tidal inflow through the open section of the flapped gates in all scenarios as all large tidal events exceed the local ground levels.

E.2.15 Model Uncertainty

There are a number of limitations associated with the model. In summary these are:

- Culverts in the floodplain below the N4- Not surveyed so dimensions are based on the size of the local drainage channel.
- Operation of the Hydropower station - Operating rules for the Ballysadare hydropower station have been obtained from the Irish Hydropower Association. The station does not appear to be operated automatically, rather a series of rules are in place dictating what flows can be extracted at any given time of year. These rules have been incorporated into the model and linked to the flows in the channel upstream but in reality the operation of the station may vary from the approach included within the model.

- Tidal flap opening - Not surveyed as water levels were too high so dimensions and condition are estimated from photographs taken at low tide.

E.2.16 AFA-Level Flood Risk Table- - Ballysadare

Table E-2: AFA Level Flood Risk Table - Ballysadare

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	-	-	403,917
No. Residential Properties at Risk	0	0	6
No. Business Properties at Risk	0	0	2
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	-	196,524	563,392
No. Residential Properties at Risk	0	3	7
No. Business Properties at Risk	0	0	5
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	-	294,956	624,490
No. Residential Properties at Risk	0	4	9
No. Business Properties at Risk	0	0	5
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0

Notes.

- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood. It does not consider property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

E.3 Flood Risk Analysis and Mapping - Collooney

E.3.17 Flooding on left bank of the Collooney Mill Run

The capacity of the hydropower station situated in the mill building is 5m³/s. During flood events, peak water levels on the Owenmore at the inlet to the mill race are predicted to rise to a level where flows along the mill race are in excess of the capacity of the hydropower station. Bypassing of the station occurs on both the left and right banks, with the majority of flows returning to the Owenmore. However, some flows are predicted to overtop the right bank and flood behind the mill building, returning to the Owenmore further downstream. No confirmation of this flow route was provided by Sligo County Council.

The flood risk is contained within this localised area affecting only the mill buildings; however, feedback from Sligo County Council noted that there is a proposal to construct a sub-station to the north of the mill buildings. This is likely to be situated within this flood extent and further investigations are recommended before this proposal is progressed.

E.3.18 Flooding on Knockbeg East

Flood risk on the Knockbeg East watercourse is controlled by the presence of the railway line and the floodplain in the upstream reaches of the model. These combined attenuate water levels to such an extent that there is no significant risk to receptors further downstream.

E.3.19 Model Uncertainty

There are a number of main uncertainties associated with the model. In summary these are:

- N17 culvert - Culvert was submerged when surveyed initially. The sizing of the culvert has been based on a visual inspection only at a later date when water levels were lower.
- Mill Race Bridge - Sluice gates present are assumed to remain in an open state as they were in a state of disrepair when surveyed.
- Hydropower station - No detailed modelling of this structure completed.
- Potential build-up of debris along the main channel - Model calibration could not reach peak water levels reported as being observed. Build-up of debris or other sources of flooding are likely cause.

E.3.20 AFA-Level Flood Risk Table- Collooney

Table E-3: AFA Level Flood Risk Table - Collooney

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	4,178	70,991	143,327
No. Residential Properties at Risk	2	2	2
No. Business Properties at Risk	0	0	0
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	19,964	102,236	182,683
No. Residential Properties at Risk	2	2	2
No. Business Properties at Risk	0	0	0
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	43,506	117,674	197,418
No. Residential Properties at Risk	2	2	2
No. Business Properties at Risk	0	0	0
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0

Notes.

- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood. It does not consider property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

E.4 Flood Risk Analysis and Mapping - Coolaney

E.4.21 Owenbeg and Rathbarran HPWs

Flooding on right bank of the Owenbeg downstream of Coolaney Road Bridge

The capacity of the channel is exceeded in this area and floodwaters overtop the lower right bank and follow the natural topography of the floodplain, cutting off the meander and flooding the local residential property and the treatment works in this location. Historical reports suggest the property had not been flooded for over 30 years prior to the June 2012 event indicating that this is a relatively rare occurrence. The predicted flood extents agree reasonably well with the expected frequency showing no flooding in the 10% AEP event but flooding in the June 2012 calibration event, which is equivalent to a 2% AEP event.

The calibration work completed for the June 2012 event suggests this flood risk could be exacerbated further as a result of blockage at the downstream abandoned railway bridge.

Flooding on the right bank of the Rathbarran upstream of the upstream L2801 Road Bridge

The L2801 Road Bridge is not a key hydraulic structure, with limited impact on upstream water levels, however the low lying right bank upstream of the road bridge becomes inundated at relatively low flows and overtops the road on the right bank flooding fields on the downstream bank. The effect of this in conjunction with the upstream floodplain is to manage flows passing down the Rathbarran watercourse and to limit flood risk in more critical urban areas.

E.4.22 Halfquarter HPW

There is no flooding predicted from this watercourse.

E.4.23 Owenbeg MPW

Bypassing of Billa Bridge

Billa Bridge represents a constriction in the channel and results show a reduction in water levels across the structure of up to 0.5m in the 10% AEP event. The road level on the left and right bank is comparable to the floodplain and floodwaters, having exceeded bank top, bypass the bridge on both banks.

E.4.24 Model Uncertainty

There are a number of main uncertainties associated with the model. In summary these are:

- Debris build-up at the abandoned railway bridge - Detailed investigations of blockage and debris build up have not been undertaken within the scope of the CFRAM.
- Potential build-up of debris along the main channel - Model calibration could not achieve the peak water levels reported to have been observed at the waste water treatment works upstream of Coolaney.
- Downstream boundary of MPW - Flood risk through the downstream reaches of the Owenbeg MPW will be affected to a significant degree by levels on the Owenmore. The flood plain at its confluence with Owenbeg is wide also.

E.4.25 AFA-Level Flood Risk Table- Coolaney

Table E-4: AFA Level Flood Risk Table – Coolaney

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	-	84,644	230,765
No. Residential Properties at Risk	0	1	2
No. Business Properties at Risk	0	1	2
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	-	105,786	330,370
No. Residential Properties at Risk	0	1	2
No. Business Properties at Risk	0	3	3
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	10,405	137,543	314,962
No. Residential Properties at Risk	1	1	2
No. Business Properties at Risk	0	1	1
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0

Notes.

- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood as refined in the preliminary options appraisal and so does consider property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

E.5 Flood Risk Analysis and Mapping - Gorteen

E.5.26 on left bank of the Gorteen South Stream

Floodwaters are constrained by the capacity of the 300mm diameter pipe culvert beneath the R293 at the upstream limit of the Gorteen South Stream. Levels back up behind this structure and exceed the left bank levels. The flow comes out of bank on the Gorteen South Stream during the 1% AEP fluvial event. The natural topography results in a flow path away from the Gorteen South stream, in a northerly direction to the Rathmadder Estate Road. From here it follows the road in a north westerly direction, joining a local drainage ditch which passes behind the Gorteen View residential housing estate before joining the Rathmadder River at 35RMAD00286. No properties are affected by this flow path.

E.5.27 Model Uncertainty

The main limitation associated with this model is the risk associated with blockage of culverts and small span bridges. In Gorteen, the majority of structures on the Rathmadder, Gorteen South and Ragwood watercourses have the potential to block due to the small size of each of the openings. Blockage has not been modelled as part of the CFRAM.

E.5.28 AFA-Level Flood Risk Table- Gorteen

Table E-5: AFA Level Flood Risk Table - Gorteen

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	-	-	6,918
No. Residential Properties at Risk	0	0	1
No. Business Properties at Risk	0	0	3
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	-	-	18,057
No. Residential Properties at Risk	0	0	1
No. Business Properties at Risk	0	0	3
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	-	-	21,123
No. Residential Properties at Risk	0	0	1
No. Business Properties at Risk	0	0	3
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0

Notes.

- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood. It does not consider property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

E.6 Flood Risk Analysis and Mapping - Manorhamilton

E.6.29 Flooding upstream of Curley Bridge on the Owenmore Watercourse

The farmland upstream of Curley Bridge is flooded from the 10% AEP event upwards. When flood waters exceed the channel capacity water fills in the natural floodplain. In addition, the structure of Curley Bridge exacerbates the flooding by increasing water levels upstream. There are no defences on this section of the watercourse but the flood extent on the left bank is restricted by the high ground levels of the railway embankment.

E.6.30 Flooding on the left bank of the Owenmore Watercourse at Tuckmill Park

Tuckmill Park is flooded in the 0.1% AEP event. Low points in the bank allows the water to spill out of the channel where it follows the natural topography and runs along the road before rejoining the main watercourse downstream. In 2011 flow was observed coming out of the left bank in this location before returning to the channel by bypassing the meander. Most of the houses in the area are on higher ground which exceed predicted flood levels.

E.6.31 Flooding on the left bank of the Curraghfore near the Park Road culvert

Water leaves the channel causing localised flooding at all return periods modelled from the 10% AEP event upwards. This is due to low ground on the left bank and elevated water levels caused by the Park Road culvert immediately downstream. In the 0.1% event the flooding is more widespread, flood waters exceed wall levels on the left bank of the watercourse flooding Park Road and the buildings near the confluence with the Brackary.

E.6.32 Model Uncertainty

The culvert beneath the N16 in the 2D domain was not surveyed and therefore it has been necessary to estimate its capacity. An understanding of the capacity is possible from available data and has been estimated to be 2.5m wide and 2m high. Given the size of this structure it is unlikely that there will be significant head loss across it but there remains uncertainty associated with the flood extent to the south of the N16 in this location.

E.6.33 AFA-Level Flood Risk Table- Manorhamilton

Table E-6: AFA Level Flood Risk Table - Manorhamilton

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	-	-	243,421
No. Residential Properties at Risk	0	0	3
No. Business Properties at Risk	1	1	17
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	-	-	590,685
No. Residential Properties at Risk	0	0	8
No. Business Properties at Risk	1	1	22
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	-	11,779	731,425
No. Residential Properties at Risk	0	1	9
No. Business Properties at Risk	1	17	25
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0

Notes.

- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood. It does not consider property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

E.7 Flood Risk Analysis and Mapping - Riverstown

E.7.34 Flooding of Emlagh Road

At the upstream limit of the HPW model extent, Emlagh Road passes from higher ground to lower ground directly adjacent to the River Unshin. It is in this location that the road is shown to infrequently flood; it is predicted in the 0.1% AEP event.

E.7.35 Flooding upstream of Cooperhill Road bridge

As a result of the headloss through Cooperhill Road Bridge, river levels are elevated upstream. Out of bank flow occurs on the left bank of the River Unshin immediately upstream of the bridge in the 0.1% AEP event, where there is a low spot in the bank.

As a result of elevated levels upstream of Cooperhill Road bridge due to a narrowing of the channel upstream, Sligo Folk Park is shown to flood from the southern end of the site from the 10% AEP event onwards. No buildings on site are however predicted to flood, even in the 0.1% AEP event.

E.7.36 Flooding downstream of Cooperhill Road bridge

From the 1% AEP event onwards, the River Unshin is shown to spill on to Cooperhill Road where a gate is found in the wall on the downstream face of the bridge.

E.7.37 Flooding upstream of Ardculmer Road bridge

Out of bank flow is predicted on the River Douglas upstream of Ardculmer Road Bridge from the 10% AEP event onward. The flood water does not spread due to the confined nature of the floodplain along this reach. A large extent of flooding is predicted adjacent to Rockfield House; however, Rockfield House itself is not predicted to flood, even in the extreme 0.1% AEP event.

E.7.38 Flooding downstream of Riverstown

The greatest extent of flooding within the Riverstown AFA occurs in the fields downstream of the town. The floodplain downstream of Riverstown is wide and flat. The River Douglas provides the greatest contribution to the predicted flooding, and it is unable to convey the 10% AEP event within bank along this reach.

E.7.39 Model Uncertainty

There are a number of main uncertainties associated with the model. In summary these are:

- Lough Arrow - The greatest uncertainty within the hydraulic modelling for the Riverstown AFA arises from the development of the hydrology for the River Unshin. The river routing model developed to provide a more representative flow hydrograph at the upstream extent of the River Unshin HPW had limitations and was not pursued. The short record of data available (five years) from the Ballynary gauge on Lough Arrow provides an insight into the response of the lough, but not a full picture. In order to calibrate the model of Lough Arrow a longer record of levels is required, and it is recommended a gauge is installed for this purpose. This would allow a better assessment of the typical duration of an event on the lough, typical median levels on the lough and even to develop more appropriate return periods for lower levels than the 2009 event. Ardculmer watercourse - groundwater spring - Groundwater modelling is beyond the scope of the Western CFRAM study.
- The Ardculmer watercourse is a tributary of the River Douglas, and discharges into the groundwater beneath Riverstown. It re-emerges as a groundwater spring in a field to the north west of the town, and meets the River Douglas 500 m downstream of Ardculmer Road Bridge. Groundwater modelling is beyond the scope of the Western CFRAM study, however, the approach taken to model this watercourse is considered to be conservative. It is assumed that the peak flows predicted on the watercourse are able to pass through the groundwater stream and reach the River Douglas unhindered.

E.7.40 AFA-Level Flood Risk Table- Riverstown

Table E-7: AFA Level Flood Risk Table - Riverstown

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	-	-	-
No. Residential Properties at Risk	0	0	0
No. Business Properties at Risk	0	0	0
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	-	-	9,661
No. Residential Properties at Risk	0	0	1
No. Business Properties at Risk	0	0	0
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario			
Event Damage (€)	-	-	11,464
No. Residential Properties at Risk	0	0	1
No. Business Properties at Risk	0	0	0
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0

Notes.

- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood. It does not consider property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

E.8 Flood Risk Analysis and Mapping – Sligo Town (Incl. Rathbraghan)

E.8.41 Garvoge and Sligo Rivers

Flooding on right bank of Garvoge River upstream of town

Extensive flooding of the marshland on the right bank of the Garvoge River is predicted to occur frequently. The modelling shows that this area will flood at least as often as the present day fluvial 50% AEP event; more frequent flooding may occur, but model runs of higher probability events has not been carried out. No properties are predicted to be at risk up to the present day fluvial 0.1% AEP event as a result of this flooding.

Water levels in this area are controlled by the John Fallon Weir; in addition, the size of the upstream floodplain and the presence of Lough Gill will significantly moderate changes in water levels through this reach. It is these three elements combined that will dictate the water levels upstream of the N16 road culvert and hence the flows into the Sligo River.

Flood risk from the Garvoge in the centre of Sligo

The gradient of the Garvoge increases significantly through the town centre. Flow velocities through this reach are high and site visits confirmed the river bed to be clear of silts. The attenuating effects of Lough Gill and the upstream floodplain will restrict increases in water levels upstream and hence the flows passing over the John Fallon Weir. As a result, although the capacity of the channel appears limited, the models show it has sufficient capacity to accommodate the discharges over the weir up until the 0.1% AEP event.

In the 0.1% AEP event, a low spot along the left bank of the Garvoge River on John F Kennedy Parade, upstream of New Bridge, allows flow out bank. The constriction of flow at New Bridge causes elevated levels upstream which are significant in this event. This reflects the understanding of the hydraulics described at meetings with Sligo County Council that the structure starts to become significant around the 1% AEP event. Several properties are predicted to be at risk in the 0.1% AEP event.

Tidal flood risk on left bank of Garvoge River downstream of Hyde Bridge

Flood risk to the Lower Quay Street car park and surrounding area is a direct result of tidal levels exceeding bank levels along the front. Flood risk here is expected to be greater than currently shown based on known historical flooding and this discrepancy is attributed to the assumption that the ICPSS extreme sea levels are not directly applicable at the near shore.

It should also be noted that the quayside wall (retaining wall) downstream of Hughes Bridge (N15 road Bridge) is predicted by the hydraulic model to be overtopped by the present day tidal 0.1% AEP event. This area was not reported to flood in the January 2014 event. Once the wall is overtopped in the model, flood water spreads over the disused railway line towards Finisklin Road.

Flooding of Sligo River

Modelling shows there is frequent flooding of the low lying areas off both banks of the Sligo River. "Liable to Flooding" is noted in some of these locations on the 5k mapping, which supports the predicted flood risk. Flooding impacts Ash Lane (N16 road) and the car park of the Sligo Institute of Technology but no properties are shown to be at risk.

As flood risk along this watercourse is predominantly tidal, water levels simply exceed local ground levels during an event. However, the culverts at the N4 road Bridge control water levels, restricting the rate at which the Sligo River can discharge into the Garvoge River as the tide recedes, and hence prolonging the duration of flooding.

E.8.42 Tidal inundation

Flood risk at Sligo Harbour

There is a risk in the 0.1% AEP event to commercial properties from tidal flooding due to local depressions in the ground-elevation along Ballast Quay. Approximately 11 separate properties are seen to be within the aforementioned outline as derived from the specialist coastal model.

Flood risk at Ballincar and Shannon Eighter

There is also an appreciable risk to the townlands of Ballincar and Shannon Eighter in the north of the AFA from tidal inundation. Fortunately, there does not seem to be any properties within the modelled outlines, but flooding does encroach quite closely on a couple for all of the AEP events tested.

E.8.43 Model Uncertainty

There are a number of main uncertainties associated with the model. In summary these are:

- Representation of Hyde Bridge - The Hyde Bridge structure is comprised of several hydraulic features, including the bridge itself and several weir elements. It was necessary to break down the structure into its component parts in order to represent it in the 1D ISIS model. This included modelling the Garvoge River as two separate channels at the structure, to model the divide in the river as a result of the weir that passes through the bridge. Although this is the most appropriate means of modelling the bridge, there will always be uncertainty associated with the representation of such structures in hydraulic models and without detailed calibration data it will not be possible to accurately determine head losses across this structure.
- Knappagh watercourse culvert - The urban area of the Knappagh catchment does not drain into the watercourse for events smaller than around a 4% AEP event, with runoff in these instances entering the storm water system and draining towards the Garvoge. No changes have been made to the model to reflect this though as events in excess of the 4% AEP event would be expected to exceed the capacity of the storm water system and follow the local topography, discharging into the Knappagh watercourse downstream of the culvert.

E.8.44 AFA-Level Flood Risk Table- Sligo Town (Incl. Rathbraghan)

Table E-8: AFA Level Flood Risk Table – Sligo Town (Incl. Rathbraghan)

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1%/0.5% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage (€)	52,277	218,441	327,419
No. Residential Properties at Risk	15	15	52
No. Business Properties at Risk	0	6	28
No. Utilities at Risk	0	0	0
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
Mid-Range Future Scenario			
Event Damage (€)	966,322	15,100,982	33,446,615
No. Residential Properties at Risk	23	75	133
No. Business Properties at Risk	8	58	132
No. Utilities at Risk	2	2	2
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	1
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	0	0	0
High-End Future Scenario (Fluvial)			
Event Damage (€)	6,733,482	9,442,419	16,807,498
No. Residential Properties at Risk	67	90	130
No. Business Properties at Risk	107	199	323
No. Utilities at Risk	2	2	3
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	1
No. of Social Infrastructure Assets at Risk	0	0	1
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	1	1	1
High-End Future Scenario (Coastal)			
Event Damage (€)	11,258,127	32,057,702	44,110,383
No. Residential Properties at Risk	62	91	110
No. Business Properties at Risk	112	244	275
No. Utilities at Risk	2	2	2
No. Major Transport Assets at Risk	0	0	0
No. Highly Vulnerable Properties at Risk	0	0	0
No. of Social Infrastructure Assets at Risk	0	0	0
No. Environmental Assets at Risk	At Risk	At Risk	At Risk
No. Potential Pollution Sources at Risk	2	2	2

Notes.

- This table is comprised of data extracted from the flood risk mapping and the preliminary options report. The flood risk mapping data combined the Rathbraghan flood risk statistics with the Sligo data and so this table is a combination of both.
- A separate set of rows has been provided for each source of flooding (tidal, fluvial) in the AFA for the High End Future Scenario as these statistics were not refined during the Preliminary Options Appraisal. Many properties and receptors will be at risk from more than one source of flooding and so adding the property, receptor or damage estimates for all sources of flooding within an AFA will over-estimate the risk.
- The count of properties and receptors is based upon the number within the flood extent map for the flood source and flood likelihood. Only the Current and Medium Range Future Scenarios account for property thresholds.
- The event damages reflect an estimate of the economic damages that would be incurred should a flood of that magnitude occur. They are uncapped and not discounted annual average damages over the appraisal period. This differs from the net present day damage estimates in the Preliminary Options Reports.
- Future scenario event damages, property and receptor risk statistics assume the current location, type and value of properties (i.e. no development, changes in use of properties or increase in land or property values).

APPENDIX F

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 Guidelines on the Planning System and Flood Risk Management, jointly developed by DHPLG and the OPW, 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 11,675km 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). 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) 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.

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 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.

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

G DESCRIPTION OF POTENTIALLY VIABLE FLOOD RELIEF WORKS

G.1 Sligo Bay Sub-Catchment

River Basin	35 - Sligo Bay Drowes		
Measure	National tidal flood forecasting and warning system to include high resolution forecasts for Sligo Town (Incl. Rathbraghan)		
Code	IE35-Cat-0001-M41		
Description	High resolution forecasts are available at Galway Bay and could be used to provide warning to Sligo Town (Incl. Rathbraghan)		
<p>Sligo is affected by tidal flooding and would benefit from an improved tidal warning system. The OPW, as part of the Irish Coastal Protection Strategy Study (ICPSS), has developed a storm surge model for the coast of Ireland. This model is currently being trialled with a view to evaluating and improving its capability.</p> <p>The tide and storm surge forecasts are provided twice daily to a project website during the autumn and winter period which is accessible to Local Authorities. The service provides surge, astronomical tide and total water level time series predictions approximately 65 hours in advance. Low resolution forecasts are available at Sligo Bay and could be used to provide warning to the residents of Sligo. The model is currently only in operation in the autumn / winter months and its operation may need to be extended. As this is a national system its costs would be negligible when broken down by AFA. The system cost €87,000 to put in place with annual running costs of €68,100, which is the cost that is currently incurred by the OPW.</p>			
MCA Appraisal Outcomes			
As this is a national forecasting system with local elements, a multi-criteria analysis has not been completed to determine a ranking score for this measure at an AFA level.			
No. Properties Benefitting	10% AEP Event	1%/0.5% AEP Event	0.1% AEP Event
Residential	0	3	22
Commercial	0	6	27
Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions			
Area NPVd (uncapped)	Option Cost	Option NPVb (capped)	Benefit - Cost Ratio
€ 0.137m	N/A as an element of the national scheme	€ 0.006m (damages avoided)	N/A as an element of the national scheme
Environmental Assessments			
Key Conclusions:			
Unlikely to be significant positive impacts at a strategic level, however will reduce flood risk to human health.			
Unlikely to be significant negative impacts at a strategic level.			
Any new gauging stations or telemetry would be subject to project level assessments as appropriate.			
Adaptability to Potential Future Changes			
N/A			
Public Consultation Outcomes			
N/A			
Other Issues / Conclusions			

None.

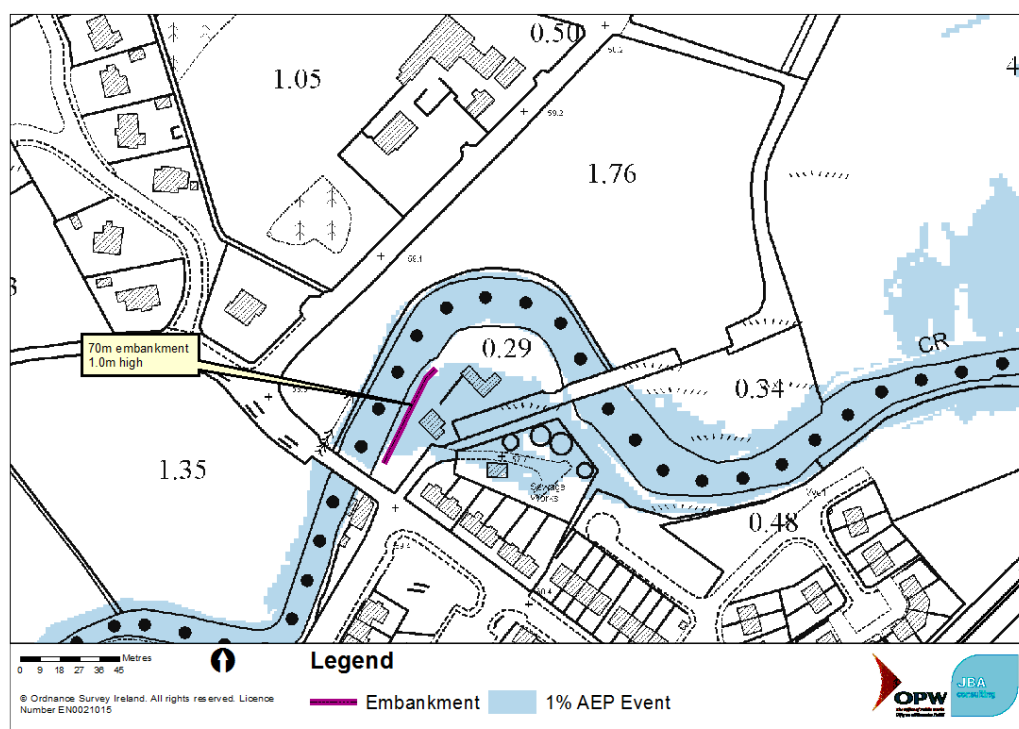
G.2 Coolaney AFA (IE-AFA-350550)

River Basin	35 - Sligo Bay Drowes
Measure	Undertake a detailed assessment of the costs of potential measure for the community
Code	IE35-IE-AFA-350550-0001-M33
Description	Further investigation into the feasibility of a Flood Relief Scheme for Coolaney is required, including environmental assessment as necessary and further public consultation.

Important Note: The works presented herein are not the final and definitive works. Potential flood relief works set out herein will need further assessment.

The potentially viable flood relief works are a containment solution and consist of a 70m embankment to ensure flows remain in bank and protect to the 1% AEP event. The embankment would need to be 1.0m high including freeboard.

The embankment will be located on private land and so space and access for maintenance will need to be negotiated with the landowner. The bank in this location is lined with large conifers which will either need to be cleared prior to construction, or the embankment situated on the landward side. It will tie into the Coolaney Road bridge at its upstream end and high ground at its downstream. As the trees currently prevent access to the river in this location, the presence of the embankment will not negatively impact on access. The local topography falls away from the embankment so, if overtopped, the existing bypass route will be re-established and flood waters would cut off the meander and return to the channel downstream.



MCA Appraisal Outcomes			
Objective	Un-weighted Score	Local Weighting	Comment
4.a	5	5	Operationally robust embankment, with no need for manual operation.
4.b	3	5	Working near water during construction, and then working near water during maintenance.
4.c	4	5	Embankment can be adapted to increased flood levels.
2.a	0.5	0.021	Only one residential property at risk.
2.b	0	0	No transport infrastructure at risk.
2.c	2	5	Wastewater Treatment Plan currently within 2% AEP flood extent protected.
2.d	0	2	No protection of agricultural land within AFA boundary at risk of flooding.
1.a.i	0.1	0.01	One residential property protected.
1.a.ii	0	0	None at risk.
1.b.i	0	0	None at risk.
1.b.ii	0	0	None at risk.
3.a	3	5	Protection of water treatment plant, which is a potential source of pollution.
3.b	1	5	Reduction in flood risk to potential source of pollution which could impact upon conservation objectives of the Unshin River SAC. No in-channel works proposed. Construction Environment Management plan can mitigate potential impacts during construction of embankment.
3.c	1	5	Reduction in flood risk to potential source of pollution which could impact local habitats and species of interest. No in-channel works proposed. Construction Environment Management plan can mitigate potential impacts during construction of embankment.
3.d	1	3	Reduction in flood risk to potential source of pollution which could impact fisheries habitat of regional importance. No in-channel works proposed. Construction Environment Management plan can mitigate potential impacts during construction of embankment.
3.e	-1	1	Construction of extension to local flood embankment prior to establishment of vegetative mitigation (i.e. screening).
3.f.i	0	0	No features present or at risk.
3.f.ii	0	0	No features present or at risk.

Total MCA-Benefit Score		Option Cost (€millions)		MCA-Benefit Score / Cost Ratio
522		€ 0.035m		14,766
No. Properties Benefitting	10% AEP Event	1%/0.5% AEP Event		0.1% AEP Event
Residential	0	1		1
Commercial	0	2		2
Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions				
Area NPVd (uncapped)	Option Cost	Option NPVb (capped)		Benefit - Cost Ratio
€ 0.034m	€ 0.035m	€ 0.034m		0.98

Environmental Assessments
<p>There are permanent positive economic and social impacts as a result of the potentially viable flood relief works.</p> <p>The non-native conifer trees along the river bank may provide shelter or nesting habitat for a range of species. The removal of these will have temporary environmental impacts. The localised visual impact on the private property through removal of the existing tree line, can be managed through careful design of a landscape plan in conjunction with the landowner.</p>

Protecting the Waste Water Treatment Works from flooding will reduce the potential for pollution during flood events.

Maintenance of the structures and embankments is required to ensure continued flood protection, however mitigation measures are required to ensure the maintenance is carried out in an environmentally sensitive manner.

The environmental assessment of the potentially viable flood relief works indicates the mitigation methods and best practice available is considered likely to succeed in preventing significant impacts on the habitats and species in the area, given the location, nature and scale of the works and the option is deemed environmentally viable.

Adaptability to Potential Future Changes

There is scope to increase the height of the embankment to accommodate climate change although its length would need to be increased as well. The embankment would need to be designed with this adaptation in mind. Increased flows within the Owenbeg will start to flood the WWTP from the downstream side of the meander effectively bypassing the proposed embankment. Further measures would need to be considered at that stage to continue to protect the WWTP.

Public Consultation Outcomes

In June 2016 the flood risk management methods within the potentially viable flood relief works have been presented to the property owner on whose land the option would be constructed. The property owner's response was positive.

Other Issues / Conclusions

Social Considerations

The wastewater treatment plant downstream of Owenbeg is at risk to flooding and was closed for a time during an event in June 2012 as water levels were close to electricity assets.

Currently in the town there is an existing river walk as a public amenity and the town has won several tidiest town of Sligo awards. This river walk transverses through the Owenbeg area that is shown to flood.

Operational Requirements

Operational requirements of the proposed option include an inspection regime to ensure that there is no deterioration in the structural integrity of the embankment. This will need to ensure that future tree growth along the bank is prevented.

The collapsing bridge downstream has the potential to load debris into the channel and thereby reduce the design standard of the embankment. Monitoring of this structure to be incorporated into the maintenance regime for the embankment.

Health & Safety - Construction stage

It is imperative that robust site investigations are carried out in advance to mitigate risks associated with the works and risk levels can be kept to a manageable level through the completion of a risk assessment and implementation of mitigation methods.

Construction works for the potentially viable flood relief works would be on undeveloped private land and will largely consist of ground and earthworks to construct a flood embankment. The embankment is to be constructed close to the riverside, temporary site / warning hoarding to be erected as segregation between the river and construction works. The Contractor should employ safe systems of work in line with Health and Safety Requirements. With the removal of the existing tree line, there is a risk of young children accessing the exposed area out of curiosity, especially if young children present in adjacent house. Exposed works to be made secure at all times. Health and Safety risks can be kept at a manageable level provided standard mitigation methods are put in place.

Health & Safety - Operation stage

The potentially viable flood relief works will reduce risk to properties by retaining water within the channel. The scheme will require regular inspection and maintenance to ensure that the embankment remain in good condition and fit for purpose. Should the scheme breach residual risk is low as existing topographic leads to water draining away rather than ponding behind the structure.

G.3 Sligo Town AFA (Rathbraghan Area) (IE-AFA-350561)

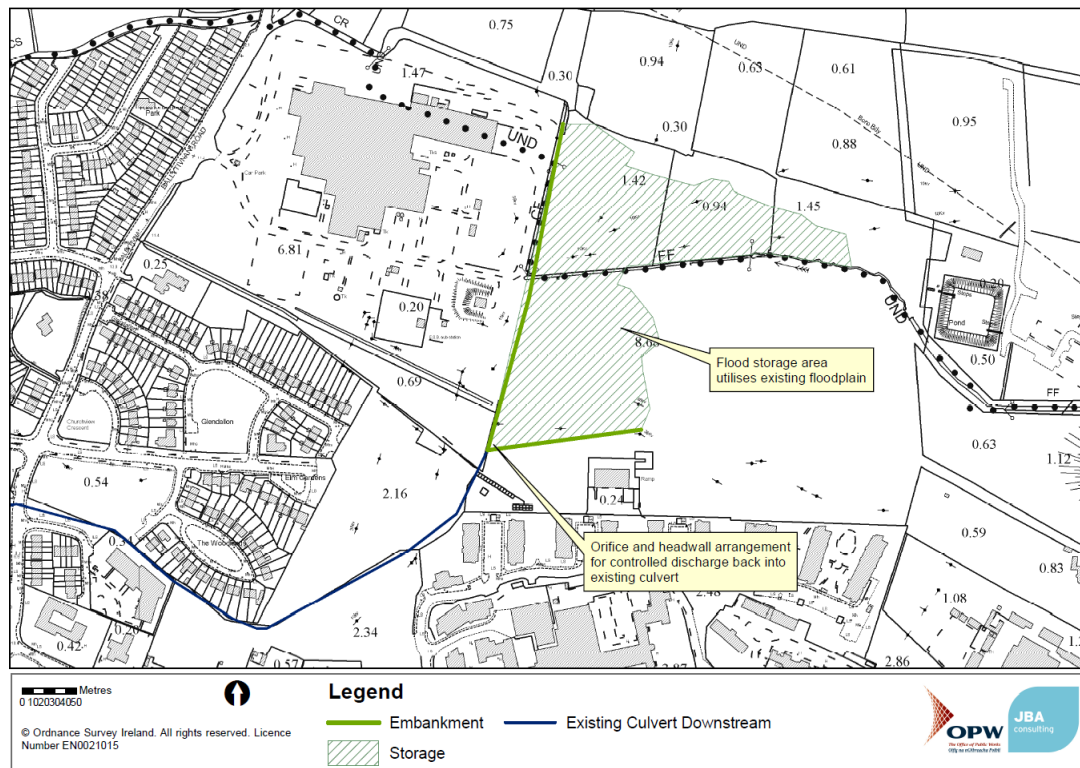
River Basin	35 - Sligo Bay Drowes
Measure	Progress the development of a Flood Relief Scheme for the Rathbraghan Area
Code	IE35-IE-AFA-350561-0001-M33
Description	Progress the project-level development and assessment of a Flood Relief Scheme for the Rathbraghan Area, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if as appropriate, implementation.

Important Note: 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 local, project level before Exhibition or submission for planning approval (see Section 7.1 and 10.1).

The potentially viable flood relief works take the form of a flood storage area. A storage area is recommended to be include an embankment approximately 415m in length with a maximum height of 1.7m, where the embankment needs to be highest.. The design crest level is 9.77mOD, which includes a 0.5m freeboard allowance.

The development of a viable flood relief scheme will involve further consultation with local landowners.

The volume of fill required for this embankment is 2,500m³ based on a typical cross section of 2m top width and 1 in 3 side slopes. As space is not a constraint here, a shallower side slope can be accommodated and it is possible, depending on site investigation and soil type, that fill material can be sourced locally by re-grading the proposed storage area. This would improve the economic viability of the option.



MCA Appraisal Outcomes			
Objective	Un-weighted Score	Local Weighting	Comment
4.a	3	5	Storage area with controlled outfall, requiring regular inspection and maintenance to ensure no build-up of debris or siltation.
4.b	4	5	Working near standing water during inspection and maintenance; safe methods of working to be adopted during O&M
4.c	4	5	Scheme is readily adaptable - relatively small increase in height required for future scenarios (+160mm in 1% MRFS to maintain 0.5m freeboard)
2.a	5.54	0.461	Damages incurred in 1% fluvial and below removed. No Annual Average Damages (AAD) for events above design standard included. Pre-scheme AAD is €34,627
2.b	4.8	2.5	These works reduce risk of flooding to local street.
2.c	0	0	No utility infrastructure at risk within AFA.
2.d	0	0	No agriculture at risk within AFA.
1.a.i	4.9	1.32	15 residential properties protected.
1.a.ii	4.54	2.75	Nursing home does not flood internally, however is surrounded as frequently as the 50% AEP event.
1.b.i	0	0	No social infrastructure.
1.b.ii	4.9	0.693	Minimal employment at risk of flooding. Two vacant warehouse/small workshops/retail units within flood extent will be protected.
3.a	-1	5	<p>Impacts During Construction</p> <p>Short term temporary localised impact from flood defence embankment and culvert works.</p> <p>Water quality monitoring shows that the nearby watercourse status is good status (Q4) and the Sligo Harbour transitional waterbody is unpolluted. All local waterbodies have good WFD status.</p> <p>In-channel works to the culvert inlet structure have the potential to release sediment downstream.</p> <p>Risk to water quality during the construction of the scheme will be minimised by a Construction Environment Management Plan (CEMP) and following IFI guidelines for works in river channels.</p> <p>Impacts During Operation</p> <p>Impoundment and storage of water may increase suspended sediment load of water discharged through the culvert.</p> <p>Embankments will protect industrial land from flooding, reducing the risk of flooding to potential pollution sources.</p> <p>Maintenance of in-channel structures and flood storage area will need to consider potential impacts of maintenance activity, including the timing of works.</p> <p>Receptors</p> <p>Willsborough Stream river waterbody.</p> <p>Garavogue Estuary transitional waterbody.</p> <p>Drumcliff-Strandhill groundwaterbody.</p> <p>Sligo Bay coastal waterbody.</p> <p>Users of the river including the public and freshwater flora and fauna that is supported by the river.</p>
3.b	-1	5	<p>Impacts During Construction</p> <p>Short term temporary localised impact from flood defence embankment and culvert works.</p> <p>In-channel works to the culvert inlet structure have the potential to release sediment downstream.</p> <p>Risk to Natura 2000 sites during the construction of the scheme will be minimised by a Construction Environment Management Plan (CEMP) and following IFI guidelines for works in river channels.</p> <p>Spread of Invasive Species during maintenance work.</p>

			<p>Impacts During Operation Spread of Invasive Species during maintenance work. Maintenance of in-channel structures and flood storage area will need to consider potential impacts of maintenance activity, including the timing of works.</p> <p>Receptors Natura 2000 sites (* denotes a priority habitat): Crummeen Strand SPA (004035), designated features: Light-bellied Brent Goose (<i>Branta bernicla hrota</i>) [A046] Oystercatcher (<i>Haematopus ostralegus</i>) [A130] Redshank (<i>Tringa totanus</i>) [A162] Wetland and Waterbirds [A999]</p> <p>Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627), designated features: Estuaries [1130] Mudflats and sandflats not covered by seawater at low tide [1140] Embryonic shifting dunes [2110] Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130] <i>Juniperus communis</i> formations on heaths or calcareous grasslands [5130] Petrifying springs with tufa formation (<i>Cratoneurion</i>) [7220] <i>Vertigo angustior</i> (Narrow-mouthed Whorl Snail) [1014] <i>Petromyzon marinus</i> (Sea Lamprey) [1095] <i>Lampetra fluviatilis</i> (River Lamprey) [1099] <i>Phoca vitulina</i> (Common Seal) [1365]</p>
3.c	-2	2	<p>Impacts During Construction Same as objective b.</p> <p>Impacts During Operation Same as objective b.</p> <p>Receptors Cummeen Strand/Drumcliff Bay (Sligo Bay) pNHA Cummeen Strand RAMSAR site Protected species e.g. bats, Kingfisher and riparian species. Mitigation possible to avoid permanent damage to river environment.</p>
3.d	-1	2	<p>Impacts During Construction Spread of Invasive Species during construction work. Pollution (instream works or bank work). CEMP will be required at design stage and should follow IFI guidelines for works in river channels.</p> <p>Impacts During Operation Spread of Invasive Species during maintenance work.</p> <p>Receptors Minimal receptors, however invasive species could be introduced without sufficient mitigation.</p>
3.e	-1	1	<p>Impacts During Construction Short term, temporary impact on low value landscape with no amenity value.</p> <p>Impacts During Operation</p>

			None.
			Receptors Public (local residents only)
3.f.i	0	0	No features present or at risk.
3.f.ii	0	0	No features present or at risk.

Total MCA-Benefit Score	Option Cost (€millions)		MCA-Benefit Score / Cost Ratio
387	€ 0.25m		1.57
No. Properties Benefitting	10% AEP Event	1%/0.5% AEP Event	0.1% AEP Event
Residential	15	15	30
Commercial	0	1	1
Economic Appraisal (Cost-Benefit Analysis) Outcomes - All figures €millions			
Area NPVd (uncapped)	Option Cost	Option NPVb (capped)	Benefit - Cost Ratio
€ 0.74m	€ 0.25m	€ 0.74m	2.98

Environmental Assessments
<p>There are permanent positive economic and social impacts as a result of the potentially viable flood relief works.</p> <p>Re-grading the storage area, would allow a refinement of the flood storage area and could incorporate the reinstatement of the former open channel upstream of the embankment. This could introduce additional environmental benefits to enhance the existing environment, for example a wetland habitat. It is noted that the long culvert remaining downstream will limit the environmental benefits of reinstating the channel and an operating storage capacity will need to be maintained above any natural wetland.</p> <p>During construction there are temporary environmental impacts beyond the AFA boundary. These impacts include the potential release and transportation of sediments during the culvert inlet works. These can be mitigated through the development and implementation of a Construction Environment Management Plan (CEMP).</p> <p>During operation the water impounded within the flood storage area may increase the potential for suspended sediment mobilisation and transport. Appropriate design of the culvert inlet structure can mitigate against the environmental impacts of this.</p> <p>Protecting the industrial land from flooding will reduce flood risk to a potential pollution source. The environmental assessment of the potentially viable flood relief works indicates that mitigation methods and best practice available is considered likely to succeed in preventing significant impacts on the habitats and species in the area, given the location, nature and scale of the works and the option is deemed environmentally viable.</p>
Adaptability to Potential Future Changes
<p>The 1% AEP design level provides protection in the MRFS 1% AEP event, although with a reduced freeboard of 0.34m. An additional 160mm on the embankment crest level would be required to ensure adequate (i.e., 0.5m) freeboard. A final decision on the design height of the defences when considered against all other objectives will need to be undertaken at design stage.</p>
Public Consultation Outcomes
<p>The flood risk management methods within the potentially viable flood relief works have been presented to the public at the Preliminary Options Public Consultation Day in June 2015. Although well publicised no-one attended the event and therefore no feedback was received from the public on the methods presented for the Rathbraghan Area.</p>
Other Issues / Conclusions
<p><i>Operational Requirements</i></p>

Operational requirements of the potentially viable flood relief works include an inspection regime to ensure that there is no deterioration in the structural integrity of the embankment. Regular inspection of the outfall structure to ensure there is no build-up of debris or siltation would also be required. A maintenance plan that considers the management of blockage and siltation should form part of the detailed design.

Health & Safety - Construction stage

It is imperative that robust site investigations are carried out in advance to mitigate risks associated with the works and risk levels can be kept to a manageable level through the completion of a risk assessment and implementation of mitigation methods.

Construction works for the potentially viable flood relief works would be on undeveloped private land and will largely consist of ground and earthworks to construct a flood embankment. The works may also include some re-grading of the ground adjacent to the embankment. The watercourse is culverted through the site; works will require a new connection to the existing culvert.

Health and Safety risks can be kept at a manageable level provided standard mitigation methods are put in place.

Health & Safety - Operation stage

The potentially viable flood relief works will reduce risk to properties by storing floodwater upstream and controlling its discharge into an existing culvert that conveys water downstream. Flood defences will require regular inspection and maintenance to ensure that the embankment remain in good condition and fit for purpose and there is no build-up of debris or siltation, in particular at the outfall structure. The storage area itself will also need to be maintained and free of significant vegetation and debris to ensure the capacity is maintained. There are potential risks if standing water remains for any period of time.



Oifig na nOibreacha Poiblí, Ceannoifig, Sráid Jonathan Swift,
Baile Átha Troim, Co. na Mí, C15 NX36

The Office of Public Works, Head Office, Jonathan Swift Street,
Trim, Co. Meath, C15 NX36

Teileafón / Telephone: (0761) 106000, (046) 942 6000
Ríomhphost / Email: floodinfo@opw.ie
Suíomh Gréasáin / Website: www.floodinfo.ie