

Slide 2 The purpose of this talk is to outline the role of the OPW in the Flood Relief/Drainage area. This is a list of the topics that will be mentioned and covers both areas where we have the primary responsibility and areas where our role is peripheral or minor.

Slide 3 The OPW has for more than 150 years had a role in the provision of flood relief /drainage works under a series of Acts culminating in the 1945 Arterial Drainage Act, and its amendment of 1995. Most of the flood relief works executed in the state until 1995 were agricultural in their focus. Since then the relief of urban flooding has had a higher profile. The 1945 act differs from all of its predecessors in that it obliged the Commissioners to maintain the works in proper repair and effective condition, a role that was until then handed over to the local authorities. More about this later.

Moving forward to 2004. Following a report from The Flood Policy Review Group government decided that the lead role in the flood policy area should fall to the OPW. This report also recommended amongst other things that flood risk management should be considered in a catchment wide context. The EU Floods Directive of October 2007 (transposed into Irish law by statutory instrument 122 of 2010) reiterated this requirement and also placed an onus on the member states to identify and map areas of significant flood risk and to put in place flood risk management plans for these areas. The directive also included a timetable for its implementation.

Slide 4 Some of the key dates are

Preliminary Flood Risk Assessment (commonly referred to using its acronym PFRA) by the end of 2011?

Producing flood risk maps by end of 2013

Preparation of Management plans by end of 2015

Slide 5. The PFRA, a preliminary flood risk assessment for the state was commissioned by the Office and has completed its statutory consultation period. There were just over fifty submissions. The function of this assessment is to identify areas that on the face of it are subject to significant flood risk. To do this there had to be a definition of what constituted significant risk. It was decided that a location was at significant risk where the damage equalled or exceeded the equivalent of 25 houses flooded every 10 years.

The directive states that for the preliminary assessment, which is after all a screening exercise, only readily derivable sources of information should be used. So historical records were analysed and there was widespread consultation with local authorities. These sources tended to look back so it was decided especially because of the scale of recent development that an indicative flood map should be prepared for the country using readily derivable information.

Slide 6 This slide shows the PFRA map for Youghal which shows areas at risk of fluvial flooding shown in blue, tidal flooding shown in green and pluvial shown in orange. Because this map set has been the subject of some controversy I will take some time to describe its limitations and explain the sources of error inherent in its production. To produce a map for the whole country a largely automated system had to be used.

Assumptions were made and generalised rules applied to the hydrology and the hydraulics.

On the fluvial side the channels chosen for study were those delineated on the EPA BlueLine Network with a catchment area greater than one square kilometre and flood levels were calculated at 500 m intervals. On the hydrology the design flow for the two cases to be mapped, the 100yr and the 1000 yr flood, was calculated using the catchment characteristic equation that has been developed as part of the recent and still draft Flood Studies Update in combination with the FSR national growth curve. It is a worldwide phenomenon that over a typical stretch of river, the bank full flow approximates to the median flood (that flood that will on average happen every two years). Using this “almost truism” the out of bank flood at each study location was deemed to be the difference between the design flood and the median flood again derived using the same catchment characteristic equation. On the hydraulics the roughness of the flood plain at each cross section was assumed having regard to land use data. Normal depth at each cross section was calculated for the two design floods and the levels generated were used to map the flood extents at the location. The digital terrain model used was the best available at the time for the whole country but was not to the resolution or accuracy that would be used on the design of major infrastructural projects. A five metre grid was used and levels were accurate to plus or minus 750 mm.

On the tidal side the outputs from the Irish Coastal Protection Strategy Study were used. We were fortunate that such a detailed data set was available and without major amendment it will be used again for the CFRAM. That said it is not without its limitations. Tide levels were

generated at 5 to 10 kilometre intervals around the coast for the 200 yr and 1000 yr tides including surge. To do this a Mike 21 FM (Flexible Mesh) Model was used. The flexible mesh allows the use of a coarser grid in the deeper water offshore with a finer more dense grid in the shallower and more complex coastal zone. More detailed nested models were also employed at a number of more crucial locations including Cork Harbour. The model was calibrated using extreme tide level data gathered at a relatively small number of locations around the coast. The flood levels generated were then superimposed on two different DTMs to generate the flood extents. On the west coast the DTM used for the fluvial flood extents was again used and on the south and east coasts a more accurate ground model on a 2 metre grid with a vertical accuracy of plus or minus 250 mm for more than half of the area covered was utilised. All extents show the undefended case.

For the pluvial maps the country was divided into 87 basins and the 1hr, 3hr, 6hr and 24hr duration rainfall was applied for the 100 yr and 1000 yr return period to determine the critical case. Allowances were made for initial losses, infiltration and drainage and a flood spreading model, a simpler and less data hungry version of a 2D model was used on the +/- 750 mm DTM and those areas subject to 50 mm or more of flooding were mapped. The uncertainty attaching to the hydrology, the hydraulics and DTM led to errors both of exaggeration and understatement of the flood extent.

However it must be stressed that the process being informed by the maps is a screening exercise, the maps are indicative, are tagged as such and they were fit for purpose. As they stand they are not of suitable accuracy to base decisions on planning or insurance. They do however provide a

useful heads up on flood risk at many locations where in the past there was no information. The Office has taken legal advice on whether or not it should publish such maps and the opinion received was that as long as they were suitably tagged the scales tipped strongly in favour of publication. On the legend observations were invited from the public on any instances of inaccuracy. While the date for such submissions with respect to the PFRA process is past the Office would still welcome them.

Slide 7 As already stated the floods directive obliges member states to prepare flood risk management plans by the end of December 2015. The directive also suggests that there should be coordination with the implementation of the earlier Water Framework Directive. It was therefore decided to commission the management plans now known by the acronym CFRAM in blocks that mirrored the seven river basin districts. In the past year the CFRAMs have been. Each FRAM has or will have its own website with links leading from a portal cfram.ie. This portal also has a link to the PFRA material for anyone who might want to delve deeper.

Slide 8 A logo has been designed for the whole CFRAM process with separate logos for each of its constituents in this instance the western CFRAM. We anticipate that the CFRAM will grow into a recognisable and strong brand. There have been and will be other papers on the CFRAM process and I don't propose to go into it in further detail.

Slide 9 When the flood risk management plans are completed they will recommend, among other things, certain flood relief works and will provide a consistent nationwide metric to prioritise these works. Until

then works will be commissioned using a specification that will allow them to fit seamlessly into the CFRAM. There are two categories of works, full flood relief schemes and minor works. Flood Relief Schemes are usually commissioned using the Arterial Drainage Acts. These would include the likes of Kilkenny, Clonmel and Ennis and in Cork Dunmanway, Mallow and Fermoy. In certain circumstances the powers of the local authorities and an Bord Pleanála under Parts 8 and 10 of the Planning Acts provide a more efficient process. Examples of this delivery mode one urban and one largely rural would be at Waterford and the scheme proposed for the Dunkellin in County Galway. The Arterial Drainage Act uses the wording “Whenever the Commissioners are of the opinion that the execution of works is expedient” we can proceed.

Slide 10 In reality flood relief schemes are implemented following a rigorous four stage process. These are prefeasibility, feasibility, exhibition and construction including full commissioning. As an aside we in our management systems have a further stage that of review

Prefeasibility is a preliminary appraisal usually carried out in house by our own design section generally following a flood and on foot of a letter of request to carry out a scheme usually but not necessarily from the relevant local authority. A number of criteria are considered in deciding whether or not to proceed. They include scale of damages, suffering, likely scale of costs both financial and other and preliminary stab at cost benefit. If the likely benefit and or cost of works is too low to justify the expense of carrying out a major scheme then that path is not pursued.

Slide 11 If there is a decision to proceed schemes enter the **feasibility stage**. If there is to be a scheme it is during this stage that it takes shape. At the outset of this stage a steering committee is constituted comprising

members from the OPW and the local authorities who are joined on their appointment by the engineering and environmental consultants. Briefs are prepared leading to the appointment of said consultants. The engineering consultants are also appointed as PSDP charged with ensuring that the design has due regard for safety and health.

Slide 12 The Consulting Engineer then commences work on data collection, commissions surveys and investigations, analyses both the hydrology and hydraulics, builds a hydraulic model of the study area, prepares flood risk maps, considers all possible flood risk management options, conveyance increase in all of its forms, diversion, defence possibly with pumping and storage as well as combinations of some or all of these methods. Then using a multi criteria analysis with input from the environmental team the consultant engineer distils down to an emerging preferred option for which he or she prepares an outline design. He or she then produces a report on all of the aforementioned.

Slide 13 The Environmental Consultant also carries out a data search, leads a thorough consultative process and prepares in a timely fashion a constraints report. The constraints report lists the green orange and red lights across a range of issues in the environmental, cultural, economic and social areas. The environmental consultant assesses the impacts of the various options as they are developed and is in regular near constant communication with the engineering consultant. He or she is also charged with producing a statement of appropriate assessment to comply with the provisions of the Habitats Directive and an Environmental Impact Statement for the project as a whole.

Slide 14 This photomontage shows some of our proposal for Bandon where this stage is almost complete.

Slide 15 If a feasible scheme of structural measures is identified that is cost beneficial the proposal advances to the **exhibition stage**. All county councils in whose jurisdiction works are proposed are notified. A notice is entered in the Iris Oifigiul, placed in the papers and all the owners and occupiers of properties affected by the scheme are issued with interference notices. Copies of the scheme are exhibited in at least one location for each council. Though there are a number of public consultations during feasibility it is at this stage affected parties and councils get their statutory opportunity to make observations. When the Commissioners are satisfied that all observations have been properly considered they may seek ministerial sanction to proceed. Though not a requirement the OPW, as it does not wish to impose a scheme on any location, asks the local town, city or county council to pass a motion welcoming the scheme.

It is at the exhibition stage that the paths diverge somewhat with Part 8 where the outline design is submitted to the county councillors for their approval and with Part 10 where following the agreement of the councillors the Environmental Impact Statement is submitted to An Bord Pleanala for their approval.

SLIDE 15 In all three if there is a green light a detailed design is completed, and if scheme delivery is to be via a contractor a tender competition is held, ministerial confirmation of the scheme is sought in the case of an OPW scheme or Dept of Finance sanction in the other cases, the successful contractor is appointed, works are carried out and

commissioned, maintenance protocols are identified and put in place and following a defects period without incident the scheme is certified as complete. The OPW has a long and continuing proud tradition of carrying out the works themselves and in this event the procurement step is omitted.

Slide 16 This slide shows some of the flood relief works along the Tolka which along with those on the Dodder are an unusual hybrid of the OPW funding and carrying out works as agents of both Dublin City and Dun Laoighaire and Rathdown Councils. Though empathising with the plight of those flooded it was with some satisfaction that colleagues in the East Region noted that those areas where protection work was complete escaped largely unscathed in the Dublin floods last autumn.

Slide 17 This photograph shows the extension to the bridge at Claregalway that was built by the Office also by direct labour. The new bit is the eye on the left.

Slide 18 However most of our work is delivered by the consultant/contractor model using the Dept. of Finance suite of fixed price contracts. This shows an access through an embankment in Fermoy with provision for the installation of demountable barriers.

Slide 19 This is an aerial view of a flood relief culvert in the Spa area of Mallow

Slide 20 This is an atmospheric shot showing the defences in Mallow doing their job.

Slide 21 This photograph shows the trash screen and control structure at the upstream end of the flood relief culvert shown on Slide 19. This was included to highlight the potential for flooding that there is in underdesigning trash screens and to show that properly designed screens are structures of some presence. Ciria have produced worthwhile guidance in this area that might be profitably followed.

There is understandable frustration out there at the perceived delay between the decision to proceed and completion of works. I hope this description of the process shows its complexity and goes some way to explaining the time taken. We do however acknowledge that there is always room for improvement.

Slide 19 As can be seen it takes some time and is quite a costly exercise to prepare a statutory scheme and this lead in cost would rule out many otherwise worthwhile smaller projects. For this reason the Office a few years ago introduced a Minor Works scheme. On receipt of an application from a local authority where works cost less than five hundred thousand euros, the Office agrees to provide funding of 90% subject to the proposal passing a rudimentary cost benefit analysis. Benefits are calculated using flat rate allowances for a number of categories of damage, 25000 euros in the case of a house flooded, 10000 for a house at risk, 30000 for a commercial premises, 20 euros for journeys disrupted by more than 30 minutes and 400 euros/hectare of land flooded for more than a month. Using this metric the benefit must be 1.5 times the cost. The council also undertakes to deal with all of the planning, property and environmental issues. This scheme is of course subject to budgetary constraint but the Office has remained open for business since its inception. Since its inception in 2009 (over 300 locations have received

sanction for funding of some 24 million euros. Details of these locations are available at www.engineeringservicesopw.ie.

Slide 20 When a scheme carried out under the 1945 Act and its amendment is certified as complete the Commissioners have a duty to maintain the works in proper repair and effective condition. The Office at the moment maintains more than 11000 kms of channel shown in blue on the slide, almost 800 km of embankment most of which is tidal, and almost 20000 structures. A present workforce of about 260 down from 290 carries out most of this maintenance. These operatives are specialists within their realm. As well as having the primary skills needed to carry out the work be that excavator driver or structures ganger they carry a vast store of local knowledge, have built a rapport with the landowners our primary clients and are trained to deal appropriately with the wide range of issues that arise under environmental and safety legislation. We have in collaboration with the Fishery authorities been carrying out an Environmental River Enhancement Programme for several years.

For all of the schemes carried out under the earlier drainage acts responsibility for maintenance was handed over to the local authorities. These schemes are known as Drainage Districts or DDs and there are 170 of them in all remaining in the state of the original 293. When a 1945 scheme covered the same ground as one of the earlier schemes the DD was abolished. The extant districts are shown in red on the slide. As stated the primary responsibility for the maintenance of DDs rests with the relevant local authority but the Office has a duty to inspect every five years 41 of them, those that were carried out under a 1925 Act. The councils have an obligation on all of the Districts to make annual returns to the OPW stating the expenditure and summarising the work completed.

Slide 21 Moving back to deal with non structural measures we'll start with the most important planning. The local authorities and their parent department Environment and Local government have the primary role with respect to planning. The Office in discharging its lead role in flood policy makes or has made an input in a number of areas. We were centrally involved in the preparation of the guidelines on flooding shown which advise that development should ideally be avoided on the floodplain. It is however recognised that there are circumstances where this is not feasible and the guidelines includes a justification test. Where development is justified obey two rules, make sure that the development itself has an appropriate immunity to flooding and secondly that it does not cause problems for anyone else. The flood maps now being prepared under the CFRAM process will help inform the planning authorities as to the extent of the floodplain. Where development plans are being prepared the Office is a statutory consultee. Unless they affect our schemes the Office does not have a role in the vetting of individual planning applications. Where there is interference with one of our schemes a separate application for consent should be made to The OPW under Section 9 of the 1995 Amendment.

Slide 22 There is one area where the OPW discharges a primary planning role that is in the construction of bridges. Section 50 of the 1945 Act prohibits the construction, alteration, reconstruction or restoration of any bridge without the prior approval of the Commissioners. While the Act covered local authorities, rail and canal companies and industrial concerns it did not because of a quirk of parliamentary drafting include private individuals. This shortcoming has been amended in SI 122 also under Section 50. The explanatory brochure shown is available for download on our main website www.opw.ie.

Slide 23 Acting on a recommendation in the flood policy review the Office in June of 2010 commissioned a Strategic Review of Options for Flood Forecasting and Flood Warning in Ireland. While fully funded by OPW the Office was joined on the Steering Group by representatives from Met Eireann and the City and County Managers Association. This review has now been completed and it is anticipated that a proposal will be brought to government in the near future.

As well as this strategic approach the CFRAM process as part of option selection described earlier will identify in the flood risk management plan the need for forecasting at specific locations. This location specific approach has already been implemented at Clonmel Mallow and Fermoy sites where demountable defences are mobilised and so rely heavily on their forecasting systems. Here the OPW with its consultants developed the system which is then operated by local authority staff. Where it forecasted that certain thresholds are to be exceeded a protocol is triggered that informs the public and a range of operations are initiated most notably the erection of demountables and the management of traffic. Bespoke flood forecasting systems for a given location are quite complex and so are quite expensive. On the Blackwater serving both Fermoy and Mallow there are 32 data loggers recording river levels and 25 rain gauges. These all feed via telemetry to a central control that depending on the severity of the weather can generate forecasts of flood levels every fifteen minutes. It needs to be stated that there are locations around the country where meaningful flood forecasts will always be problematic. Where a location is too close to the watershed the time to flood peak after the commencement of the rainstorm is just too short for meaningful forecasts. Newcastlewest and Clonakilty would be two such locations. In

Newcastlewest where there is a significant risk to life we have installed a flood alarm that goes off when the river rises to a threatening level.

Tidal Surge is that effect on the predictable astronomical tide levels caused by barometric pressure and wind. It does not include wave action. The Office has commissioned a model that forecasts this surge at 15 locations 4 of which are at high resolution around the coast. There is a short term forecast for the next 65 hours generated twice a day and a medium term forecast that is generated once a day for the period from 65 hours out to five days. These forecasts are made available to the local authorities via a password protected website.

The Office of Public Works is the Irish partner in the European Flood Alert System, an early flood warning system being developed by the Joint Research Centre of the European Commission.

Slide 24 During an emergency it is the local authority that runs the show and the Office's role is relatively minor unless the emergency is caused by the failure of an asset under our care. We do however place our resources at the disposal of the local authorities and in the 2009 flood provided and manned pumps at a significant number of locations most notably in Ennis where we had people working round the clock for a few days. We also erected an emergency flood defence in Shannon Banks on the outskirts of Limerick. We have provided lists of our resources to the local authorities for inclusion in their flood emergency plans.

The office had a central role in the design of the template for these plans. Driven by the Flood Policy Review the Office in 2006/2007 piloted in cooperation with the local authorities in Mallow, Fermoy and Clonmel

the preparation of flood emergency plans. Using the knowledge gained in this exercise the OPW in 2008 collaborated with the Department of Environment to prepare a guidance document that includes the template and a protocol document that outlines the roles and responsibilities of the various bodies contributing to the emergency response effort.

Slide 25 A lot of useful advice is provided by the Office on this topic on our website www.flooding.ie.

Slide 26 These two areas are administered by the Department of Social Protection and the Office's only role is to report on the severity of flooding at houses that are the subject of relocation grant applications, the likely frequency of this flooding and the likelihood that it can be alleviated by measures other than relocation that are not prohibitively expensive.

Slide 27 Flood Studies Update.

The flood policy review charged the Office with carrying out an update of the Flood Studies Report which was published in 1975. This course of action was recommended because a further 35 to 40 years of hydrometric records had been gathered since the original report and considerable advances had been made in technology and computing in the intervening period which in turn drove changes in the methods employed in the Hydrological sphere. In 1975 Fortran programmes were written for processing on main frame computers that in the OPW case were not on site. PCs and even spreadsheets were several years in the future and the web as we now know it was a pipedream. Now GIS provides a tool that allows the ready dissemination of quite complex information on the web which as already mentioned has itself revolutionised communications.. It

is planned that the system will be launched early next year. The delay has arisen because it has been decided to include in the analyses the 2009 flood data, the highest on record in much of the country. So what will be different or better? I will just touch on some of the more notable advances and changes. The information will be disseminated on the web via a user friendly GIS system. Rainfall information will be available across the whole country on a 2km grid for durations ranging from 15 minutes to 25 days and for return periods from 2 yrs to 200 yrs. A set of catchment characteristics now called Physical Catchment Descriptors or PCDs will be available at nodes 500 metres apart along the aforementioned EPA network for all catchments greater than 1 square kilometre. A new equation for estimating the index flood at an ungauged site using these PCDs has been developed which has a factorial standard error of 1.37 as opposed to 1.47 for the preferred 6 variable equation of the original FSR. Growth curves will be generated using pooling groups as in the FEH the British Flood Estimation Handbook. Both for the generation of index flood estimates and growth curves reference gauged sites based on hydrological similarity and geography will be prompted. There will also be a tool to generate hydrograph shapes. I must stress that though very helpful to the user this is not an automated system and it requires professional input. When it is launched colleagues will do a roadshow at forums such as this where they will go into greater detail.

Slide 27 This covers two very important sections in the Office. To provide Hydrometric data to inform the hydrological and hydraulic analyses for flood risk management The Office operates 373 surface water gauges and 62 rain gauges across the state. At present archived information gathered at many of the surface water sites is available on www.hydro.ie. and it is planned to have near real time information

available presently to all on the web for about 95% of the surface water gauges.

We have a small Environmental Section. They ensure that we act in a legally compliant fashion across the range of our activities. They represent the Office in its dealings with other Environmental Stakeholders such as the NPWS, Inland Fisheries Ireland and environmental NGOS like Birdwatch Ireland. They write many of the briefs used to engage Environmental Consultants. They train and monitor our staff and most importantly they are continuously improving the way we carry out our work from an environmental perspective. As a mark of their success the maintenance protocols developed by the section are now recognised as being the national standard.

I have not prepared a slide on research. As well as that already mentioned The Office does commission quite an amount of research both on the Hydrology and Environmental sides and supports an international effort to publish a levee handbook .

I hope that this talk has given you an understanding of how the Office does business and that it has demonstrated how we assiduously discharge our leadership for the state across the broad canvas of flood risk management. Go raibh maith agaibh