A New National Flood Risk Assessment for Wales (FRAW)

Simon James, Lead Specialist Advisor (NRW) & Dr Neil Hunter, Head of Flood Modelling (JBA)
Background

- Existing NaFRA Dataset, significant for NRW and EA
- Used by Government, insurance industry and public
- Shown as 50m x 50m impact cells, on RoFRS map
- Not updated since 2013 (in Wales)
- Underlying modelling not always suited to Welsh catchments. Manual adjustments required.
- Previous NaFRA viewed as a ‘black box’ by end users
Scoping Study

- Replacement aligned with Welsh requirements
- Scoping study ran from November 2016 to October 2017
- Two pilot catchments
- Undefended modelling combined with Defended Areas
- Economic damage assessment at receptor level
- Recommendations made for Main Stage
Guiding principles

- Nationally consistent data
- Integration of National and Local data at the ‘right’ level
- Flexibility to update
- Development of the right “building blocks”, which can facilitate longer term aspirations
- Can be managed, maintained and improved
- Repeatable and not dependant on a single provider
- Assists NRW and LLFA’s to meet their requirements under EU Floods Directive
- Used as an annual reporting tool to Welsh Government
Core requirements

- Create new, **National Flood Hazard and Risk Mapping** information for fluvial, tidal and surface water flooding in Wales
- Provide a consistent level of data across Wales to update the **Communities at Risk Register** and allow a more faithful comparison of sources
- Provide a **toolset** for the cost benefit analysis of different scenarios enabling decision making on investment and the prioritisation of activities at National, Catchment and Community levels
- Integrate local model output data with Nationally derived output data to create new FRAW risk maps
- **Creating and collating datasets** to support FRAW and other flood risk modelling activities across Wales
New generalised hazard modelling

- Comprises new Wales-wide fluvial, tidal and pluvial modelling
  - 6 present day probabilities - 1:10, 1:30, 1:75, 1:100, 1:200, 1:1,000
  - 6 climate change scenarios - central and upper estimates for 1:30, 1:100 and 1:1,000 probabilities using latest WG/NRW guidance

- 2D Shallow Water Equation-based flood model, JFlow®

- Maximum flood extent, depth, velocity, hazard rating, flow direction and duration outputs

- Built on established methods (evolution not revolution)

- Used best available input data with complete national coverage

- Models were reviewed/improved with input from NRW, LLFAs and other invited stakeholders via a dedicated website
Hazard model development

• All modelling based on EA Integrated Height Model (IHM) 2016 and run at 2m grid resolution

• Several tasks required to prepare IHM for 2D modelling
  – Remove anomalies associated with aerial photogrammetry infill
  – Remove raised flood defences as per NRW Flood Risk Map Policy
  – Add ‘stubby’ building upstands (but not lowered roads)
  – Add flow routes through ‘flyover’ structures

• Hydraulic structures added using information from a variety of sources, including the National Asset Database

• Additional structures and/or better information added during the review phase
Fluvial hazard modelling

• Based on same 2D-only approach used to produce the original fluvial Flood Zones

• Flood flows and design hydrographs calculated at ~31,000 locations using latest NRW guidance in preceding project

• Wales Fluvial Flow Database (WFFD) further developed as part of the model set-up and will be made available for reuse

• Channel capacity represented using QMED

• Model set-up was updated where necessary during review phase
Tidal hazard mapping

- Based on projection mapping approach and schematisation used to produce the current tidal Flood Zones
- Utilises new extreme water level estimates along coastline and up key estuaries (CFBD 2018)
- New approach to identifying connected flooding using hydraulic structures
- Hazard rating and flood duration maps produced using heroic assumptions
Pluvial hazard modelling

- Direct rainfall approach as per uFMfSW
- Provides flood mapping for surface water and small watercourses
- Modelling undertaken on catchments
- Hydrology based on new FEH13 rainfall and ReFH2 runoff estimates
- Where rivers are modelled explicitly, river centrelines configured as sumps to prevent double counting of ‘fluvial’ flooding
- For each flood probability, the 1-hr, 3-hr and 6-hr storm durations were simulated
Collaborative development via review website
Local data improvements via review website

Area where previous model output was marked on map with an improvement note by LLFA

Flood relief culverts added to model

DEM modification added to model

Dialogue leading to model improvements and resolution of issues, involving LLFA, NRW and JBA
Draft flood map review
New public-facing mapping

- Final hazard mapping provides a basis for updating public-facing flood map ‘products’
- New FRAW ‘risk of’ mapping is more than just rivers and sea, now also considers **pluvial flooding** and **historic events**
- Use of Defended Areas to adjust undefended fluvial and tidal generalised modelling
- Use of defended scenarios from local models where available
- GIS infilling of estuaries and inland water bodies
- High-Medium-Low risk layers available for each flood source and as a combined product
Impacts analysis

- Large number of impacts metrics calculated for each scenario using established methods (e.g. MCM)
  - Residential properties
  - Key services
  - Agricultural areas
  - Non-residential properties
  - Road and rail networks
  - Environmentally significant sites

- Per-scenario and annual average quantities

- Property counts and economic damages are available for different combinations of water level and property threshold

- Data available on 50m x 50m regular grid

- Distilled into updated CaRR and new investment planning tools
Community Risk Register (CaRR)

- Provides an objective ranking of flood risk based on danger to life within 2,207 “community” polygons
- Previously used to prioritise FCRM activities and inform funding across Wales
- Updated CaRR incorporates a number of data and method improvements
- Used to provisionally determine and agree new Flood Risk Areas as part of PFRA process
- Comprises a summary spreadsheet and GIS datasets that describe the community reporting units and the individual properties affected by each flood source
Investment planning

- Proposed approach to economic assessment and investment planning based on the manipulation of impact curves using adaptation levers (as used in the UK Climate Change Risk Assessment)

- Output metrics available at a range of reporting units to support future investment planning

Impact curves are used to calculate annual averages and property counts in bands

Climate change, population growth and adaptation measures are applied as transformations to these curves

Fragility of defences is represented by interpolating between defended and undefended state
Investment planning toolset

- Allows users to **analyse** present and future flood risk up to 2120, taking account of climate change, population growth and changes to flood risk management infrastructure.

- Allows the **benefits of adaptation** measures (i.e. the reduction in risk delivered by them) and the **costs of adaptation** to considered.
Immediate priorities

- Replacement RoFRS maps (FRAW Maps) online by **December 2019**
- Supporting WG draft FR Strategy and TAN15 review with a new Wales Flood Map, **Spring 2020**
- New, published Risk & Hazard Maps to support the Flood Risk Regulations by **December 2019**
- Annual reporting to WG
- Testing and implementation of investment planning toolset
- Integration of tools and data into NRW ICT
Future

- Embed FRAW into the way we work and develop improvements plan
- Refresh key datasets at regular intervals for flood hazard and risk mapping and annual reporting
- Develop National Model and Mapping Strategy
- Build technical capacity and resilience within NRW
- Communicate and disseminate FRAW across Wales
Contact

- NRW exhibition stand here today

- National Flood Risk Analysis Team
  - Mark Pugh       Principal Advisor
  - Simon James    Lead Specialist Advisor (Mapping and Modelling)
  - Dave Tarrant  Lead Specialist Advisor (Mapping and Modelling)
  - Jenny Dickinson Lead Specialist Advisor (DFR)

- FRA.Wales@cyfoethnaturiolcymru.gov.uk