Consultants of the Year 2010 Winner

JBA consulting

Broad Scale Surface Water Flooding Mapping

Present Status And Future Improvements

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Halcrow

Environment Agency

Broad scale analysis of surface water flood risk

- Recognised need to better manage SW flooding following summer 2007 floods

Broad scale modelling of SW flood risk

- Based on applying rainfall directly to DEM-based 2D hydraulic models as a vertical boundary condition
- Can provide indicative information on likely flow routes and accumulation zones
- Offers a consistent basis for screening flood consequences and affected receptors across large study areas
- Scope for quantitative risk estimation as methods can incorporate different rainfall scenarios
- Value of this type of data well-established for fluvial and tidal sources (i.e. the Flood Zones from national generalised modelling)
- Lessons learned where possible

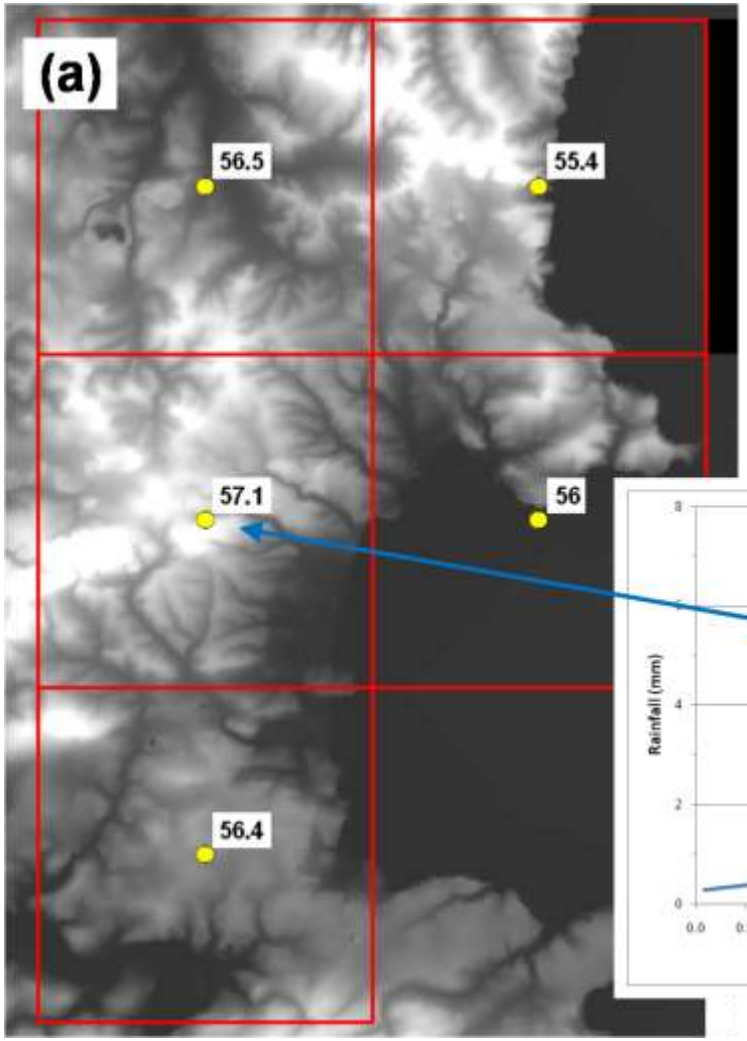
1st Generation AStSWF mapping

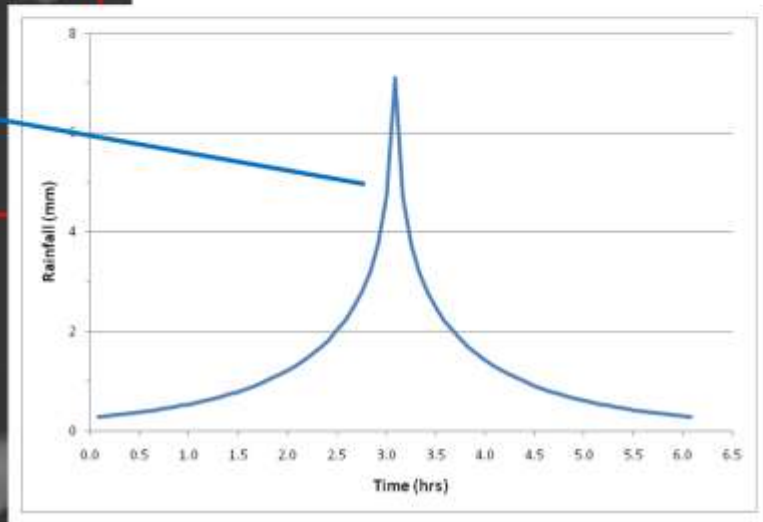
- A national map of Areas Susceptible to Surface Water Flooding (AStSWF) has been available for emergency planning purposes since September 2008
- Procured by Environment Agency under license from JBA as a response to Urgent Recommendation 2 of the Interim Pitt Report
- Also available for spatial land use planning in England since July 2009 and Wales since November 2009

1st Generation AStSWF mapping - methodology

- A three-stage process that involved:
  1. **Deriving hyetographs for design storms**
  2. Hydraulic modelling to route the resulting flood water overland
  3. Post-processing of results to produce coherent maps of surface water flood risk
- Conceptually very straightforward

Rainfall estimation





- FEH DDF model applied on 5 x 5km grid
- Single design event – 6.25 hr duration, 1 in 200 probability
- 100% runoff assumed

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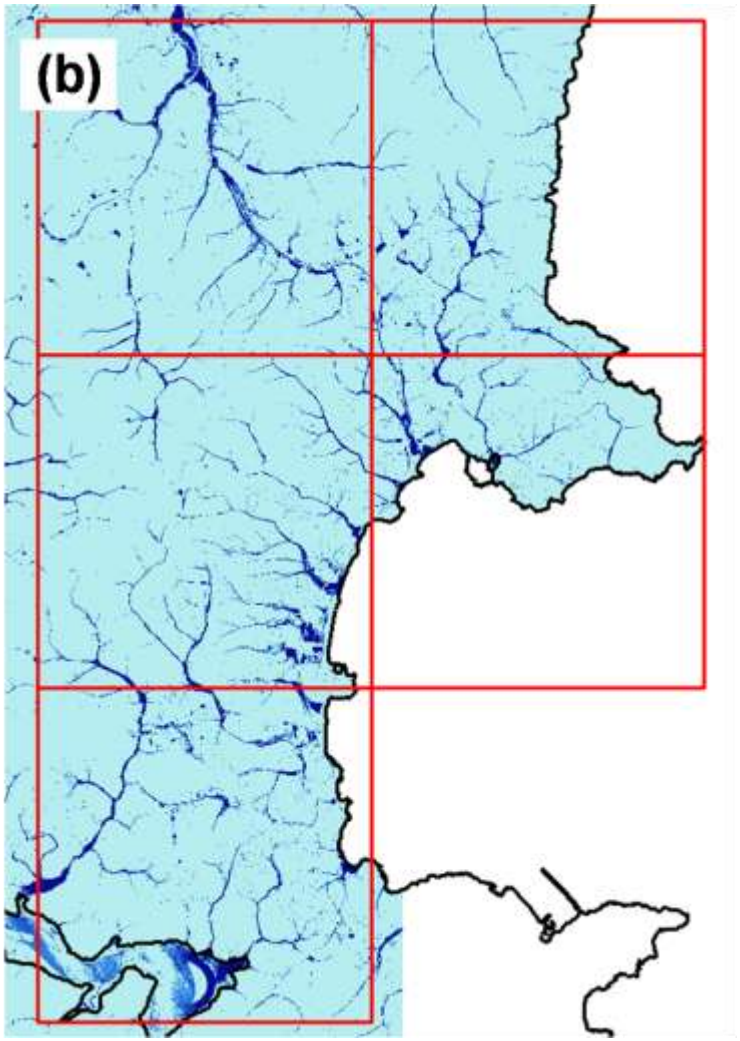
Hydraulic routing

- Rainfall inputs applied uniformly across DEM & resultant runoff routed dynamically using JFLOW-GPU
- Results dependent on quality, representativeness and resolution of topographic inputs
  - Based on Infoterra's LIDAR and aerial photogrammetry products
  - Provided a 'bare earth' 5m DTM that required further manual editing to remove 'flyover' features



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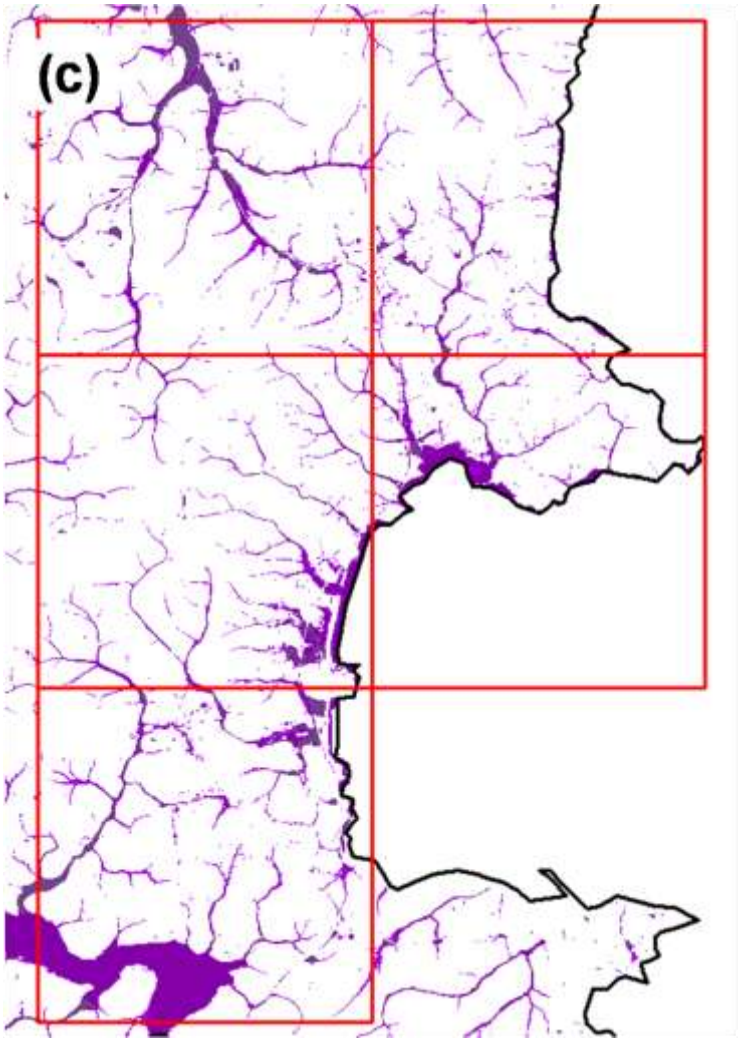
Post-processing of model output

- Initial product is a national map of maximum water depth
- Thresholding required to extract significant flood signal from background shallow depth noise
- Depths less than 0.1m set to null and excluded from further analysis
- Remaining map data categorised into 3 susceptibility bands. Intention was to prevent over-interpretation of uncertain model results
- Map data finally ‘cleaned’ to remove isolated wet and dry areas



1st Generation AStSWF mapping - limitations

- The 1st Generation map, while a significant step forward, has a number of recognised limitations:
  - No allowance for subsurface drainage, infiltration capacity or antecedent conditions
  - Developed independently of Environment Agency and thus did not use Environment Agency's catalogue of high-quality LIDAR data
  - Buildings not explicitly resolved
  - Some confusion over susceptibility categories
- Subsequently, '2nd Generation' mapping was commissioned by Environment Agency to address these issues

2nd Generation Flood Map for Surface Water

- The project, *Refining the Data Quality and the Methodology for Mapping Surface Water Flood Risk* (SC080029), is ongoing but the new national product will incorporate major improvements in four key areas:

1. **Identification of more representative critical rainfall durations for all rainfall probabilities modelled**
2. Representation of spatially variable infiltration and drainage system capacity using percentage runoff coefficients and Monte Carlo analysis of sewer capacity proxies respectively
3. DEM quality and composition. New mapping will incorporate Environment Agency LIDAR data where available and include buildings as solid, unfloodable objects in the model grids
4. Post-processing and formatting of final flood map deliverables

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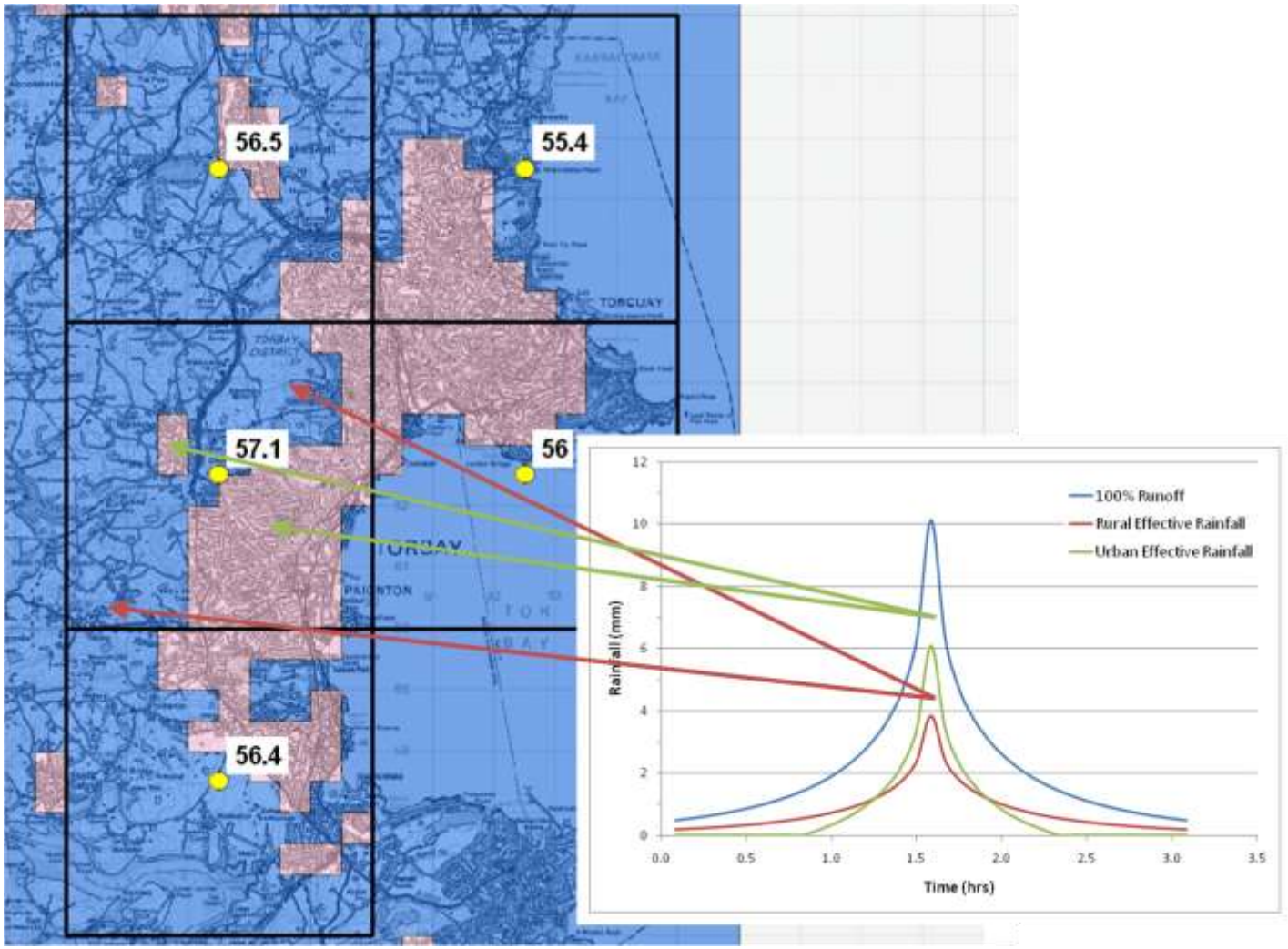
Effective rainfall modelling



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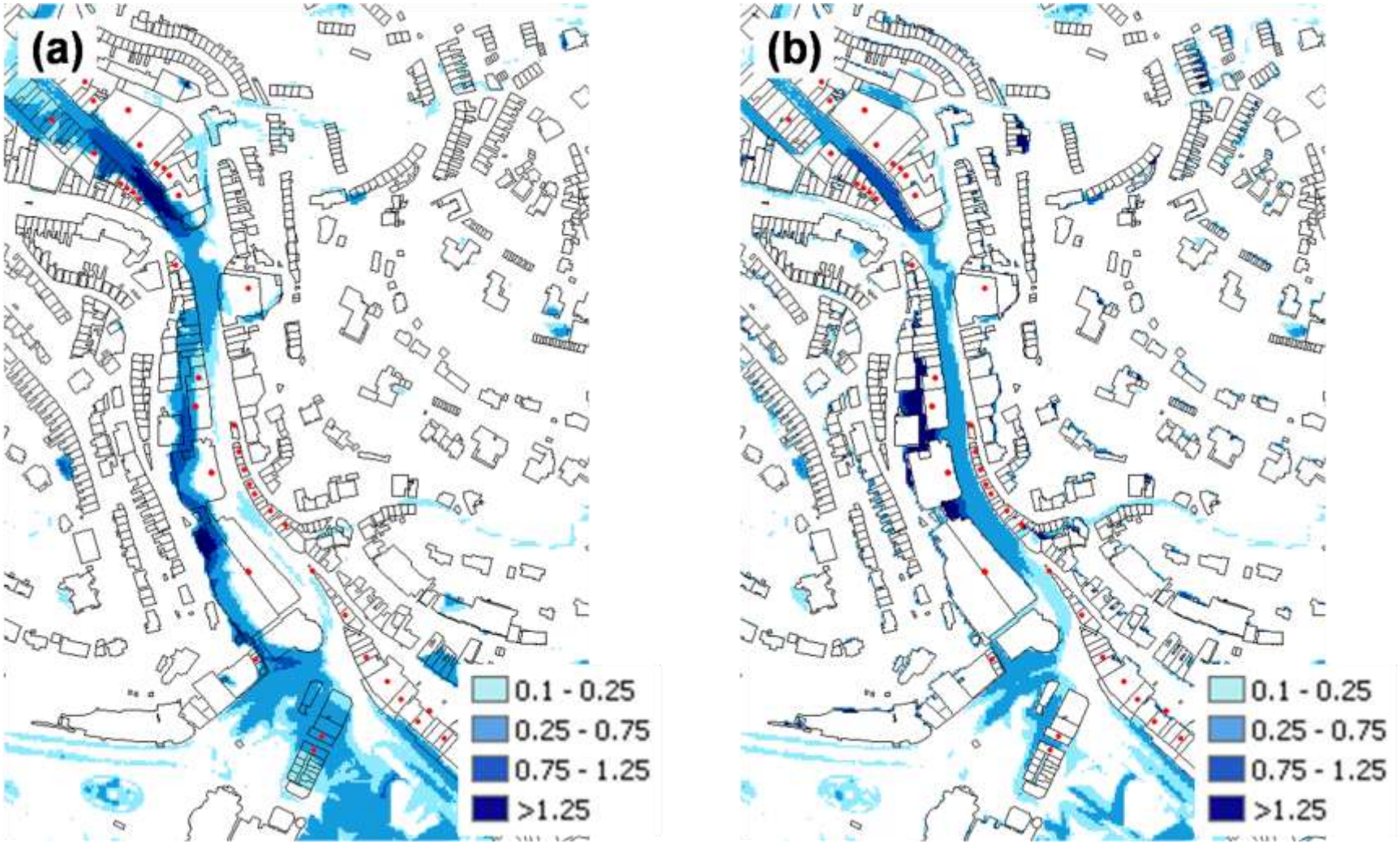
Topographic representation of the built environment



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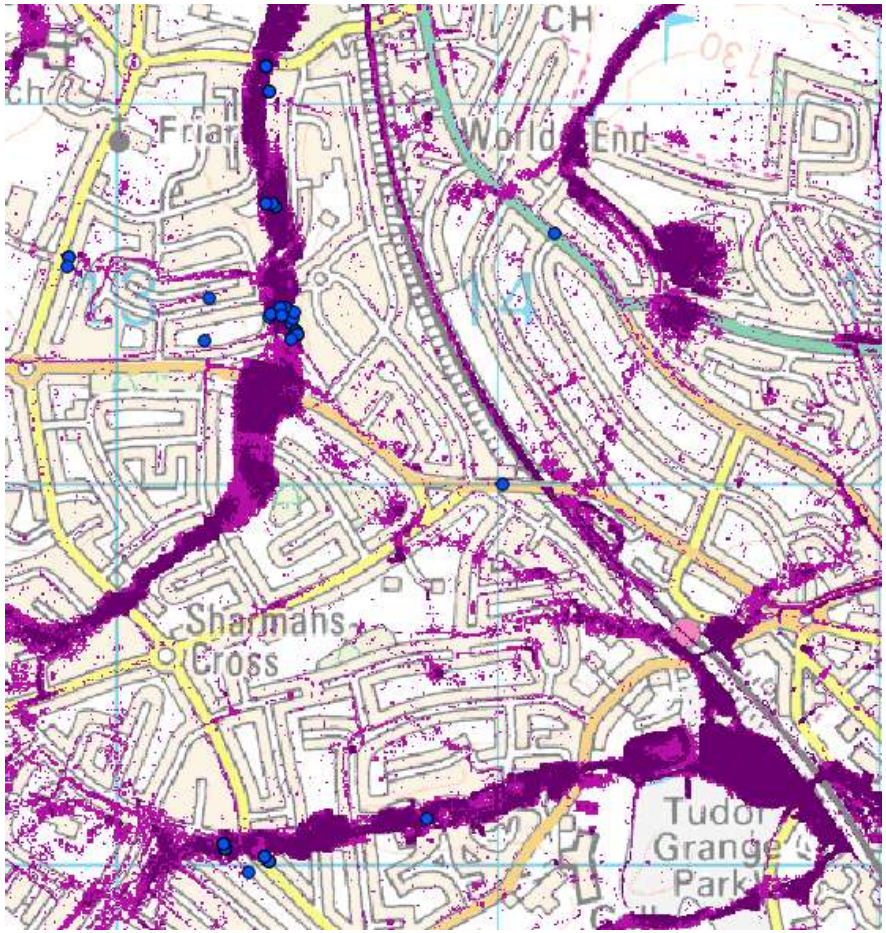
Differences in the 1st and 2nd Generation mapping

Methodology

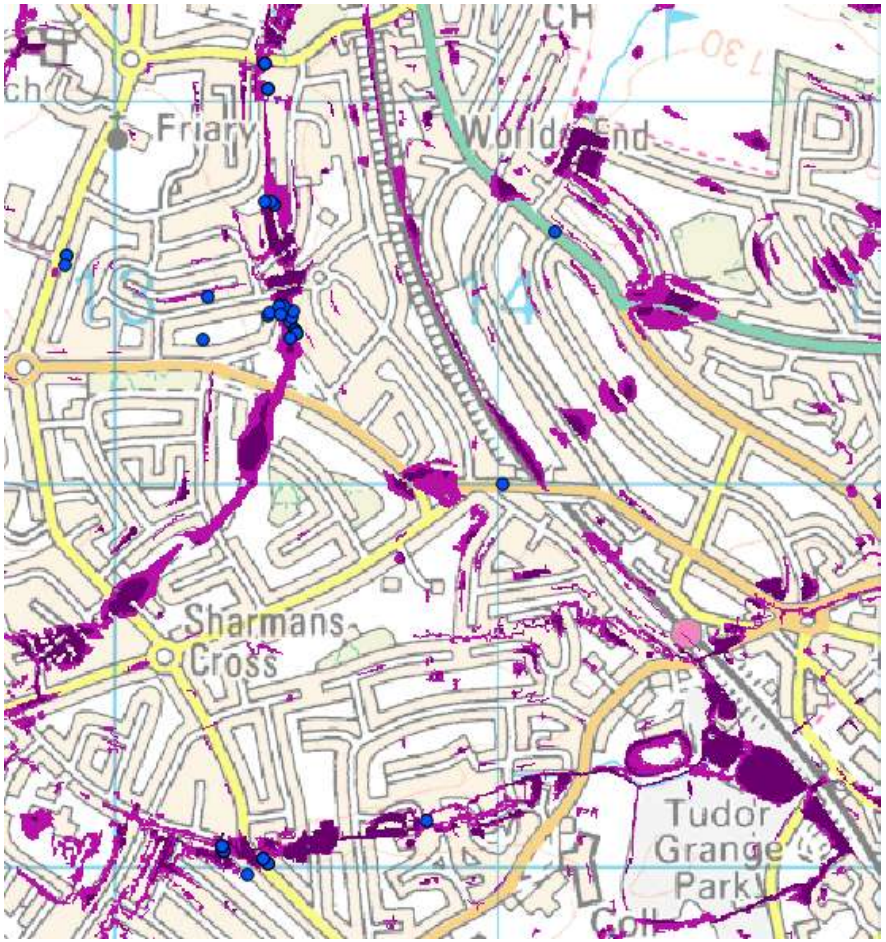
Properties	1st Generation	2nd Generation
Rainfall probability	1 in 200 (0.5% probability)	1 in 30 & 1 in 200 (3.33% & 0.5% probabilities respectively)
Storm duration	6.25 hrs	1.1 hrs
Rainfall profile	50% summer	50% summer
Percentage runoff factor	100%	39% rural, 70% urban
Sewer network proxy	0	Uniform reduction of 0mm/hr and 12mm/hr in rural and urban areas respectively
Digital terrain model	Infoterra bare earth LIDAR and GeoPerspectives	EA 2010 Composite (InSAR, EA LIDAR & PGA2 LIDAR)
Building representation	Not represented	Represented explicitly as unfloodable objects in the DTM. Building footprints, as defined in OS 2009 MM data, raised by 5m.
Manning's *n*	0.1	0.1 rural, 0.03 urban
Model grid resolution	5m	5m
Model tile size	5 x 5km	5 x 5km

Differences in the 1st and 2nd Generation mapping

1st Generation



2nd Generation



Summary

- Direct rainfall modelling has shown to be a very effective approach that can provide a preliminary indication of SW flood risk over wide areas
- Enables resources to be effectively targeted in areas that require more detailed assessment methods to understand / alleviate the risk posed
- Supports Local Authorities in their flood risk roles
- However, there are some basic limitations to broad scale SW modelling
  - Crude loss models are likely to be inappropriate for low magnitude, high probability storms where the role of underground drainage is important
  - Small scale topographic detail (such as roads, kerbs, walls) that may be significant for accurate local flood routing cannot be resolved in regional / national scale applications

Options and opportunities for improved accuracy

- A number of options and opportunities exist for improving map accuracy:
  - Higher quality DTMs
  - Additional rainfall scenarios
  - More representative hydrological loss models and drainage system proxies

For more information, contact

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