21st International RIVER SYMPOSIUM

# CITYWIDE CREEK & OVERLAND FLOW MODEL PROJECT

## Brisbane City Council

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Environmental Planning & Flood Resilience

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MANAGED BY

INTERNATIONAL RiverFoundation

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# Why More Maps?
# Flood Commission of Inquiry

8.1 OLF Maps for Development Assessment

- Based on hydraulic modelling
- Easily updatable

8.2 OLF Maps & models available to applicants & consultants

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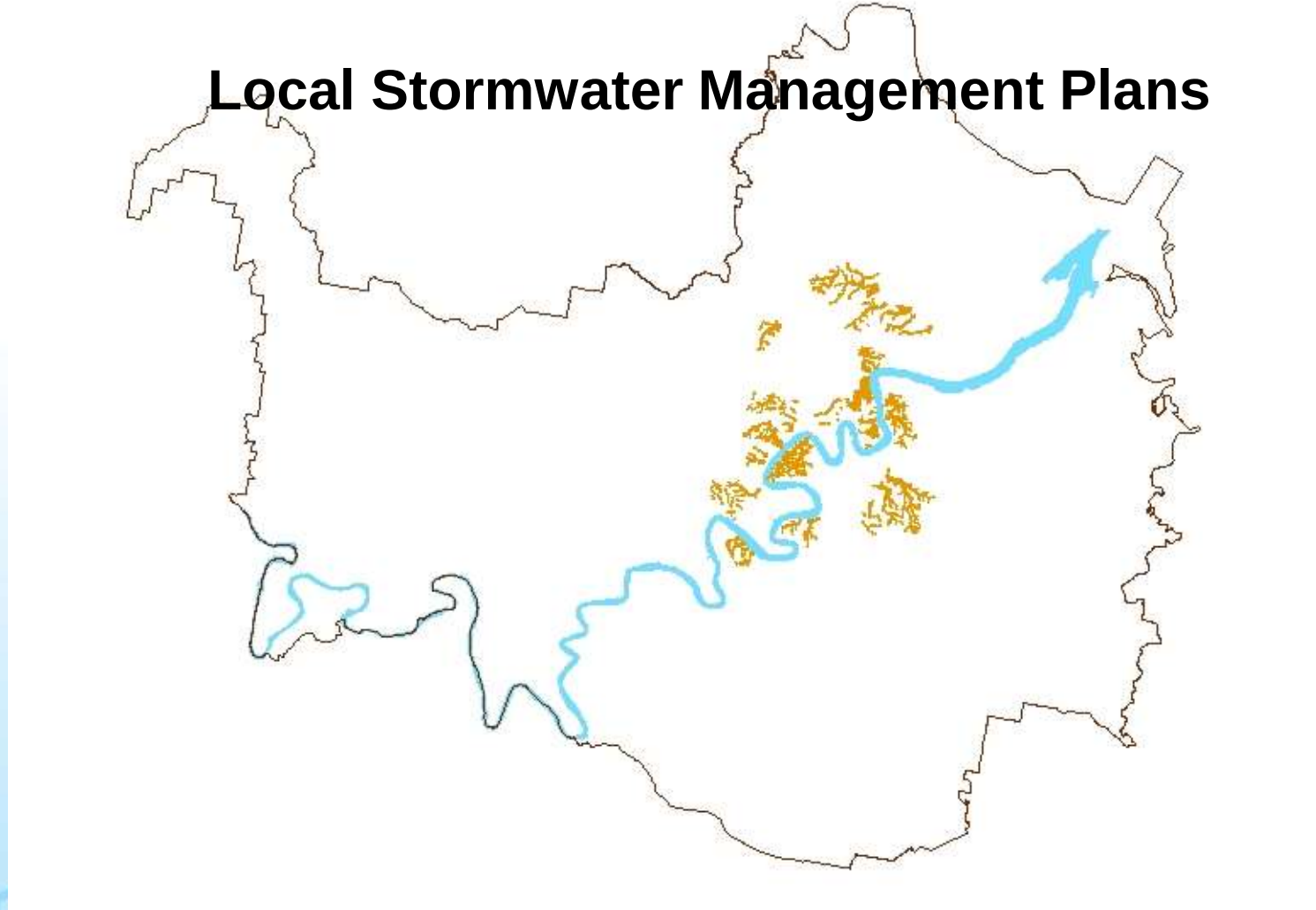
# The Overland Flow Story – to date.

**Local Stormwater Management Plans**



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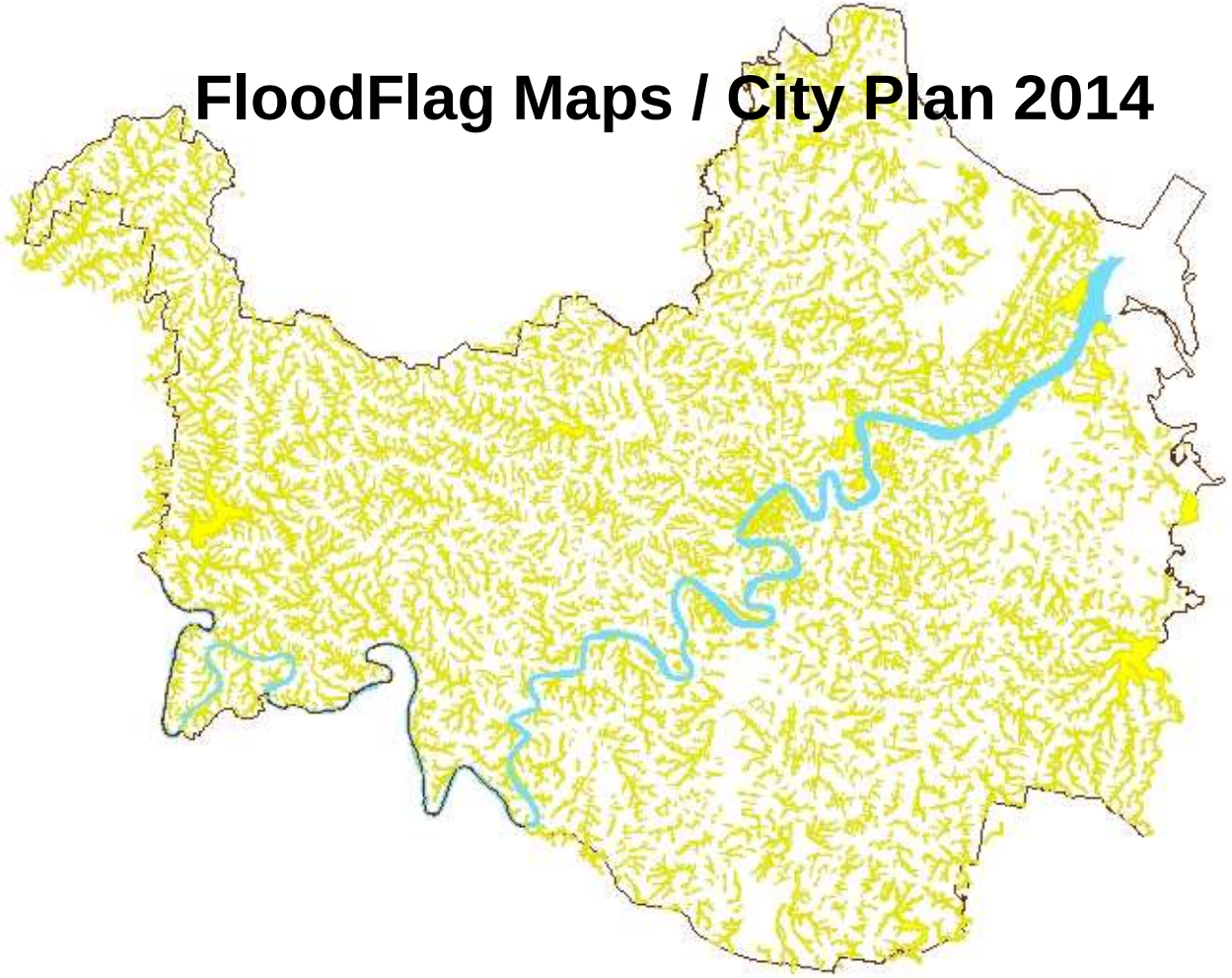
# The Overland Flow Story – to date.

**FloodFlag Maps / City Plan 2014**



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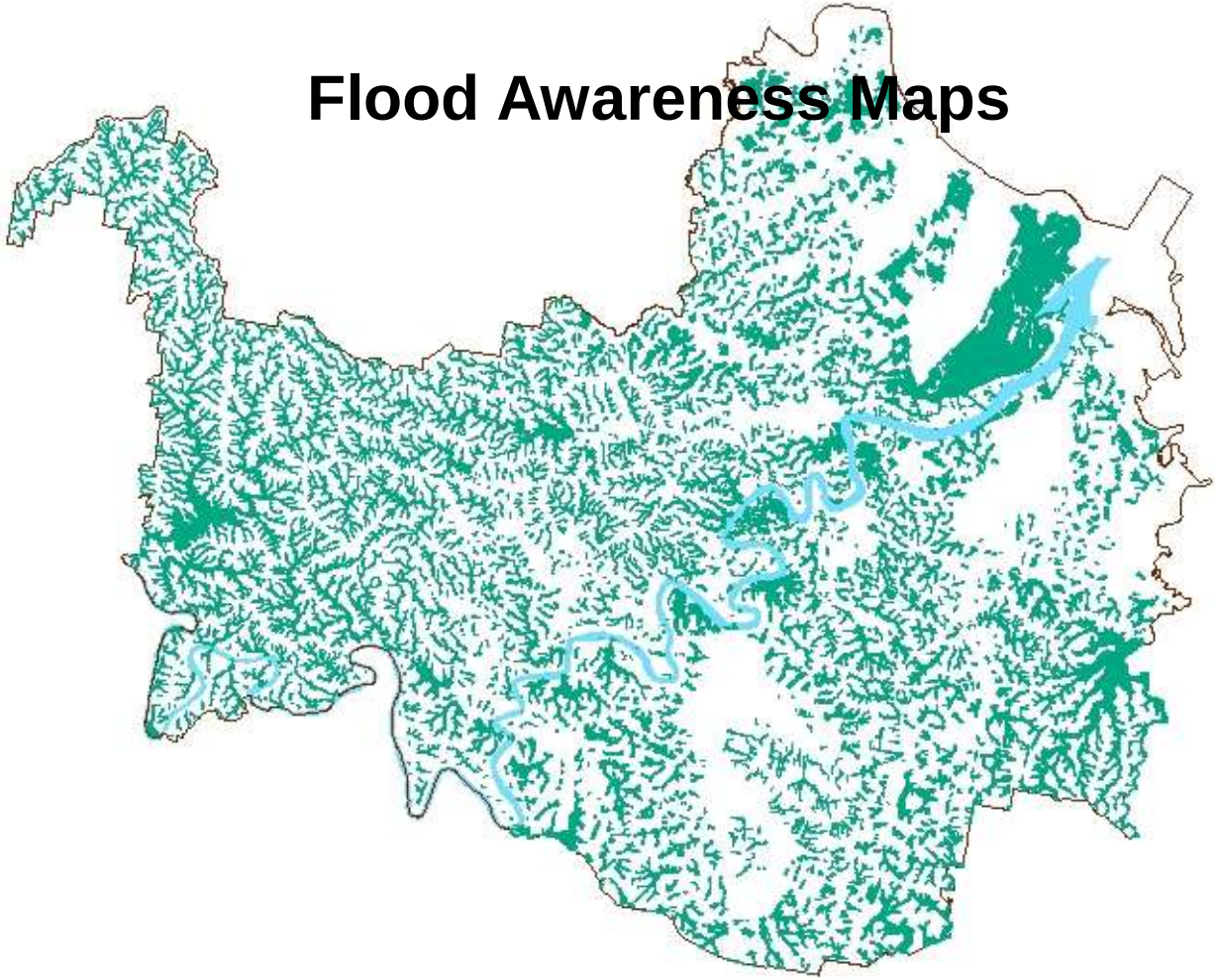
# The Overland Flow Story – to date.

**Flood Awareness Maps**



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# Council's Flood Action Plan

1. Review of high risk area
2. Determine areas in need of update
3. Update existing OLF mapping

**Using traditional modelling methods $$$**

**An innovative approach required**

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# The Brief

1. Citywide 2D Hydrodynamic Model
2. Overland Flow & Creek
3. Account for underground drainage
4. Updateable and expandable
5. Sufficient for Development Assessment

# The Challenge

- A need to map and understand overland flow & stormwater flooding in major cities
- Very large areas, with very complicated overland flow paths and stormwater networks
- Modelling the entire system using traditional methods would require a lot of time, money and data

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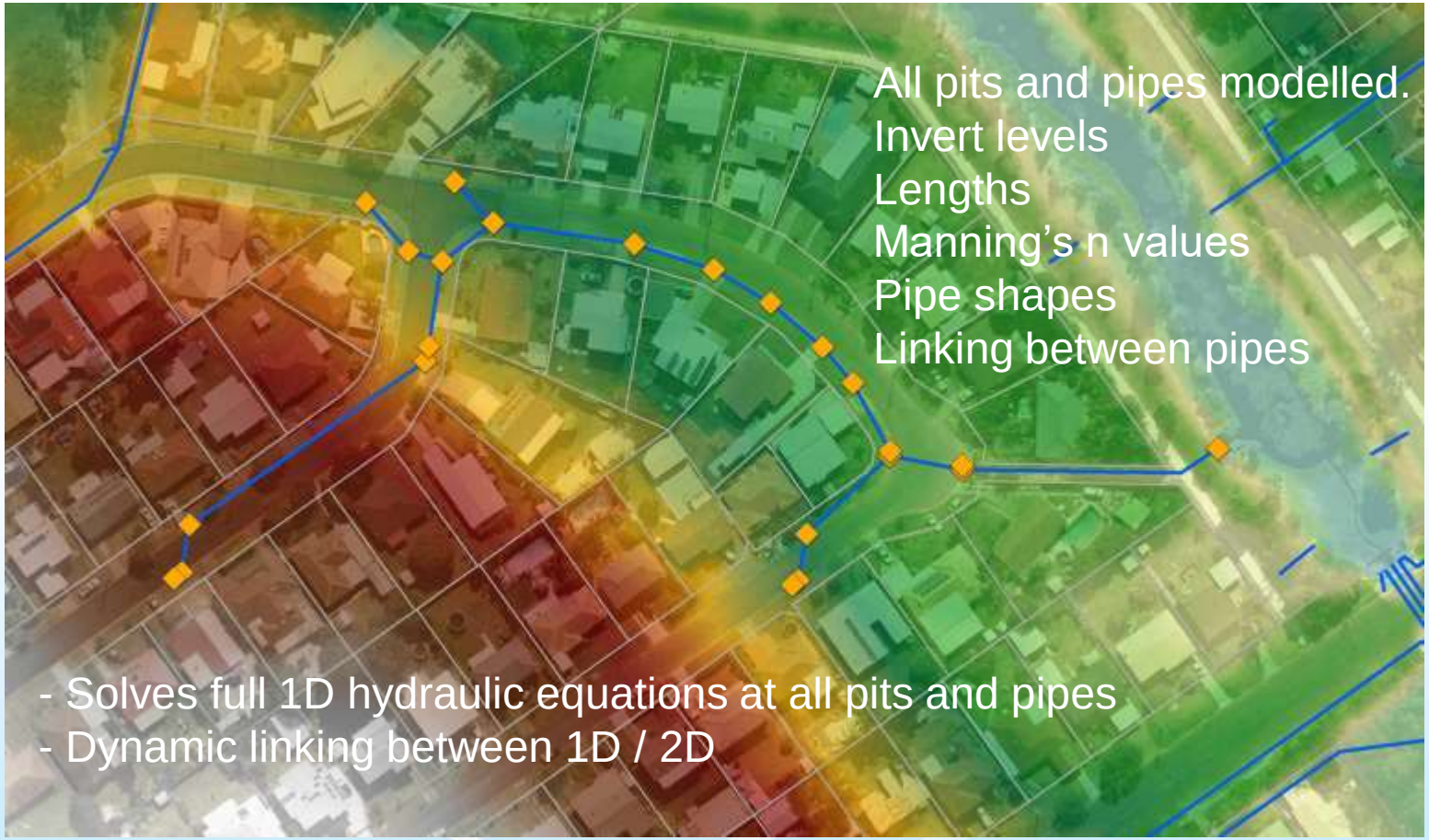
# The “Virtual Pipes” Method

- A new methodology developed by GHD in conjunction with BCC and the software vendor
- Allows simulation of stormwater systems in TUFLOW GPU using a simplified approach
- Aims to provide a reasonable approximation of the underground stormwater flows
- Greatly reduced data & time requirements, and greatly increased modelling speed compared to traditional full 1D/2D coupled models.

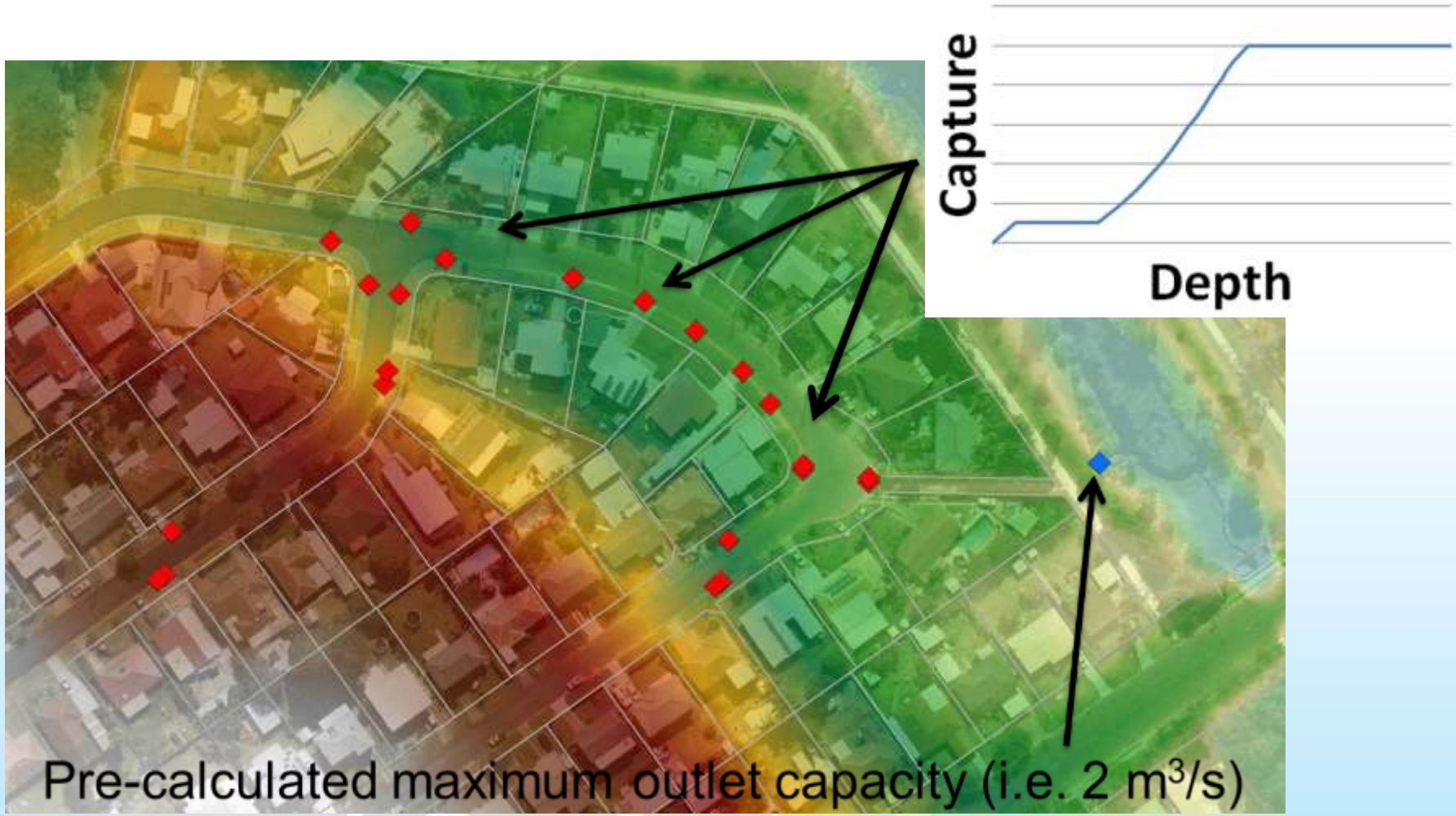
# “Virtual Pipes Method”

- Stormwater inlets and outlets represented as points in TUFLOW GIS layer (no pipes)
- Inlets are represented by depth vs discharge capture curves
- Outlets are represented by point sources with a specified maximum discharge capacity
- Within a pipe “group”, flows capture at inlets are dynamically transferred to the outlets.

# Traditional 1D Model Setup



# “Virtual Pipes” Representation

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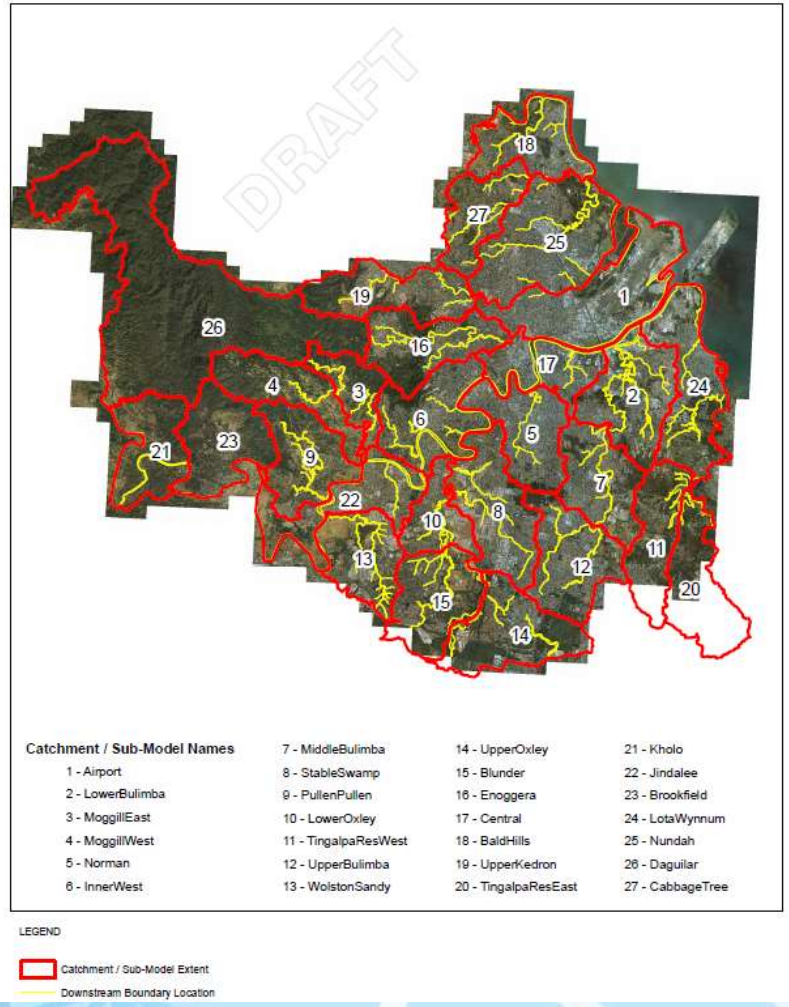
# Study Area & Sub-Model Extents




- 1,200 km2 study area
- 2m x 2m grid resolution
- ~300 million active grid cells
- ~200,000 stormwater inlets and outlets
- 30 individual sub-models

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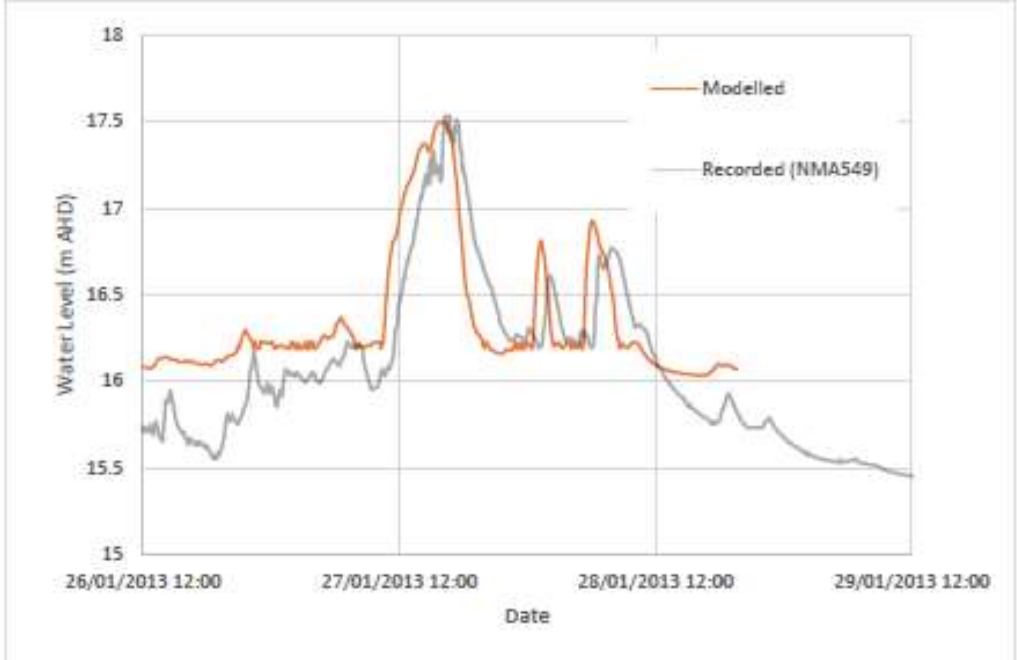
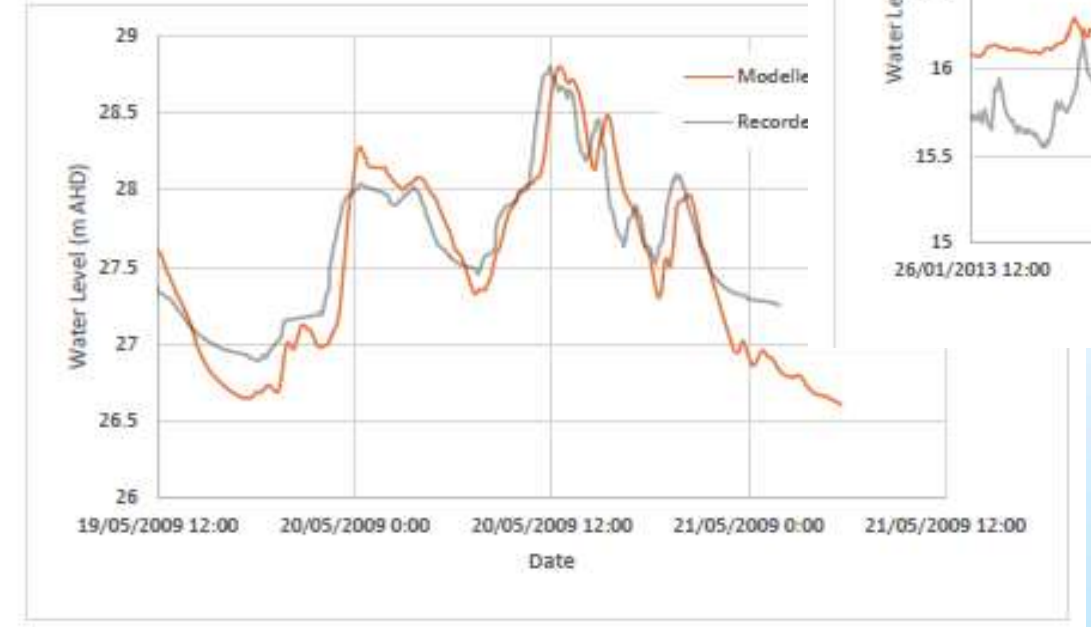
# Pre-Processing of Stormwater Data

- Multiple steps:
  - Fix connectivity issues
  - Identify pipe groups
  - Identify inlets and outlets
  - Assign inlet curves
  - Estimate outlet discharge capacities (i.e. Manning's equation)

# Calibration to Gauged Levels

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# “Virtual Pipes” Validation – Area 1



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# “Virtual Pipes” Validation – Area 2



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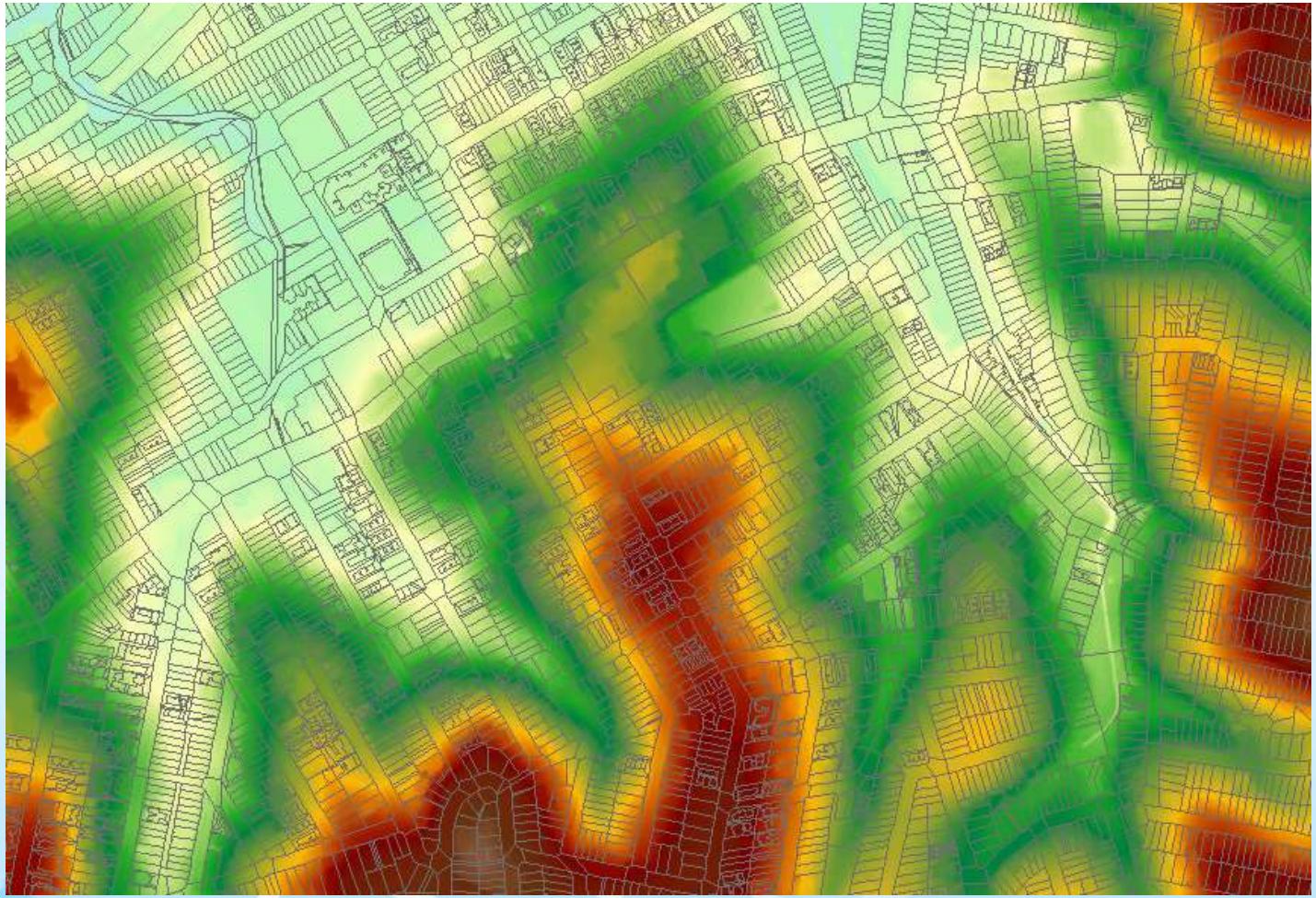
# 2014 DEM



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# Roughness

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# Inlets & Outlets

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# “Virtual Pipes” – Example Depth Results

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# “Virtual Pipes” – Example Velocity Results

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# Strengths

1. Very quick model set up times.

2. Relatively low data requirements:
   - Can work with messy or incomplete GIS data
   - Does not require invert level data
   - Only needs pipe diameter information for the outlets

3. Leverages the advantages of TUFLOW GPU (large, fast and detailed models).

4. Cost – can model an entire city for the cost of a single catchment using traditional methods

# Weaknesses & Limitations

- Simplified approach – treats stormwater systems as a black box of inlets and outlets, and doesn't solve full hydraulic equations.
- Does not account for tail-water effects or backflow.
- Does not account for pipe flow lag times.
- If weaknesses are known and understood, they can be accounted for and their effects can be minimised.

# Potential Applications

- Broad scale urban overland flow path mapping.
- Identification of urban flooding hot spots & problem areas.
- Better development that addresses urban flood risks.
- Rapid testing of stormwater infrastructure upgrades.
- Informing the public of potential urban flood risks.

# Where to from here

- FAM
- City Plan
- FWPR
- Planning
- LGIP

- “Like for Like” or “New look & Feel”
- Filter Options – fine, coarse...
- Policy Change – 1%, hazard categories, freeboard?
- Data – extent, depth, velocity, hazard?

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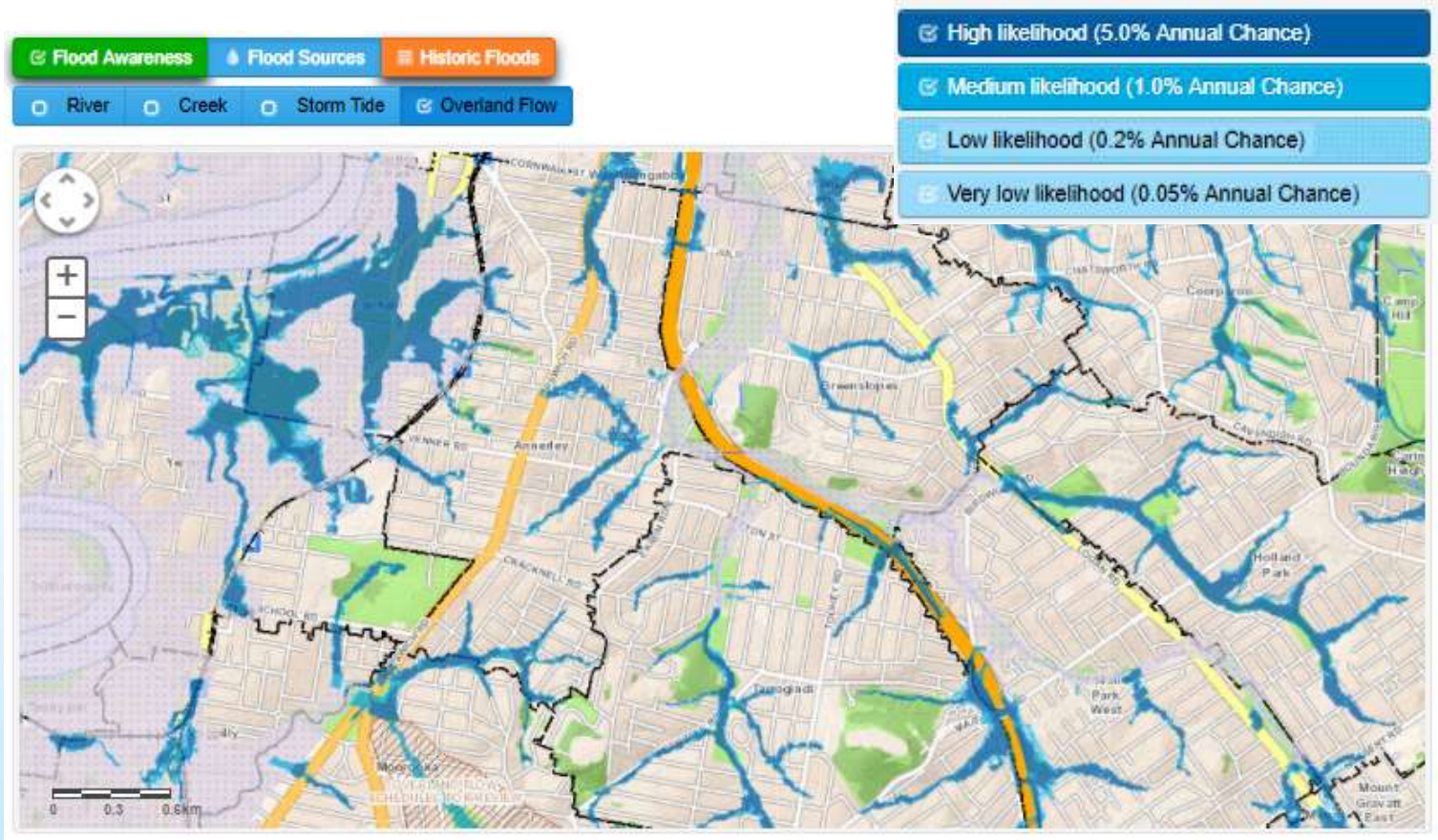
# Avoiding a flood of flood info……

- "My property has never been flooded and I've been living since the beginning of the time….." – so your maps are wrong……..




What did we learn

- Are likelihoods the most palatable means of communication…..?

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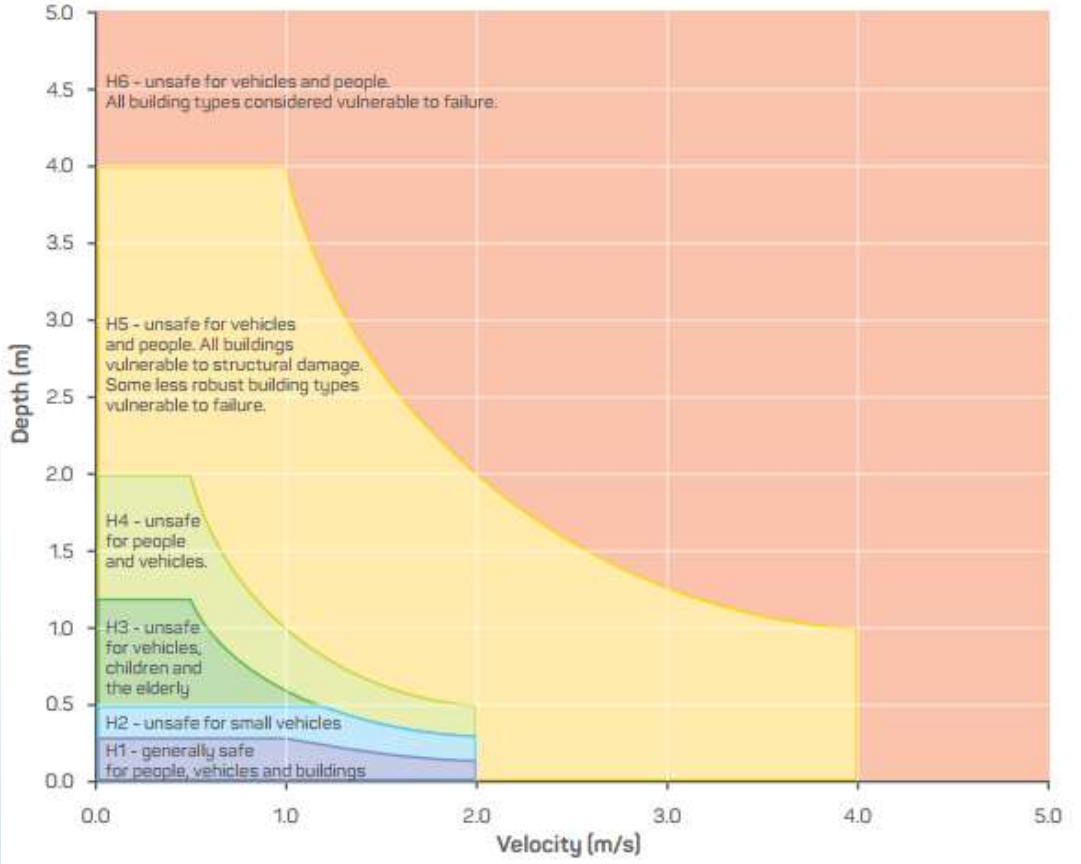
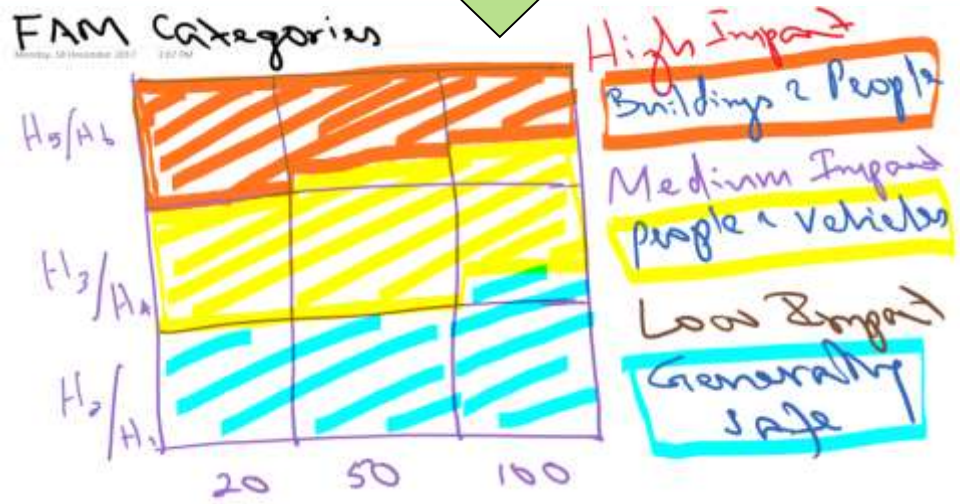
# Flood behaviour…yet Keeping it Simple

- Use of Handbook 7 guidelines - 6 Flood Hazard categories




Impact coms simplified by likelihoods




Severity of 'impact' communicated: people → buildings → vehicle → general safety

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# From likelihood to impact….

- High likelihood (5.0% Annual Chance)
- Medium likelihood (1.0% Annual Chance)
- Low likelihood (0.2% Annual Chance)
- Very low likelihood (0.05% Annual Chance)

- ☑ High impact
- ☑ Medium impact
- ☑ Low impact

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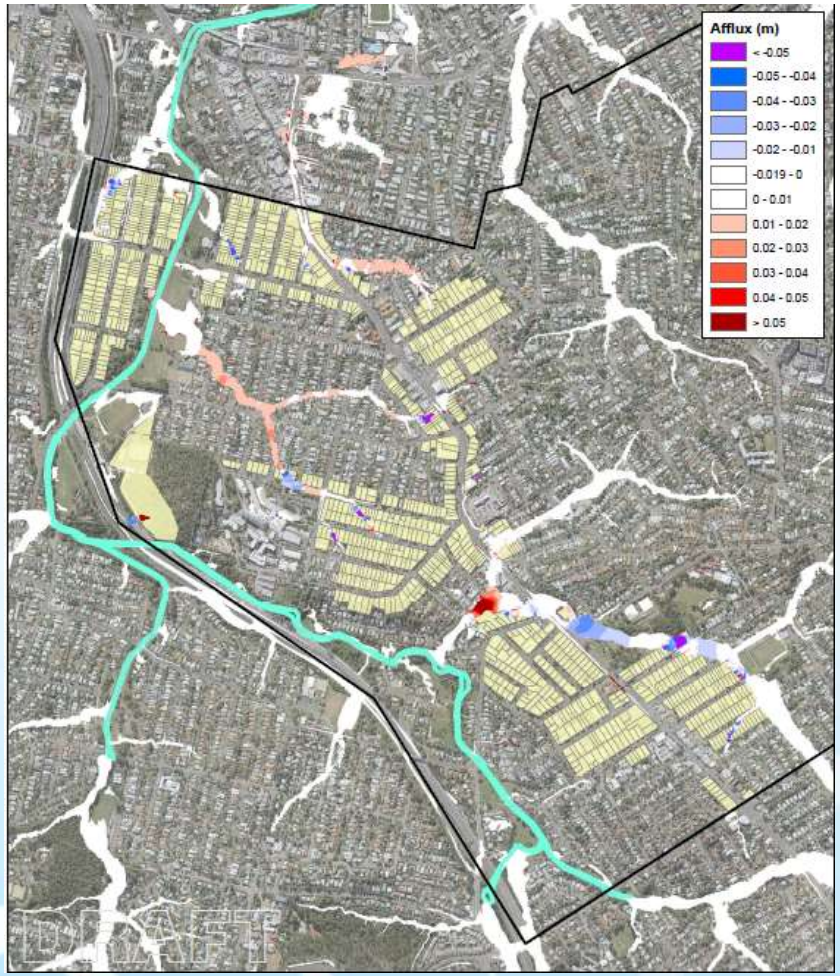
# Trunk Infrastructure Planning

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# Conclusion

- Rapid, cost-effective alternative approach to full scale 1D / 2D modelling in certain situations.
- Can simultaneously achieve large scales, high detail and low costs.
- Produces high-quality results if limitations are understood and accounted for.
- Easy to understand coms approach to convey a complex flood behaviour

# Questions?

Acknowledgements:
Dan Copelin & Ben Regan - GHD
Paul Ollett & Brany Iezzy - BCC

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