

An aerial photograph of Brisbane, Australia, showing the Story Bridge spanning the Brisbane River. The city skyline is visible in the background with various high-rise buildings. The image has a semi-transparent dark overlay.

# Moving beyond the Q100 Quagmire: Risk based land use planning

4<sup>th</sup> Water Sensitive Cities Conference

Tuesday 26<sup>th</sup> May 2019 | Brisbane

**ETHOS  
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Shannon McGuire, Director, Ethos Urban



## We need to get our strategic planning right

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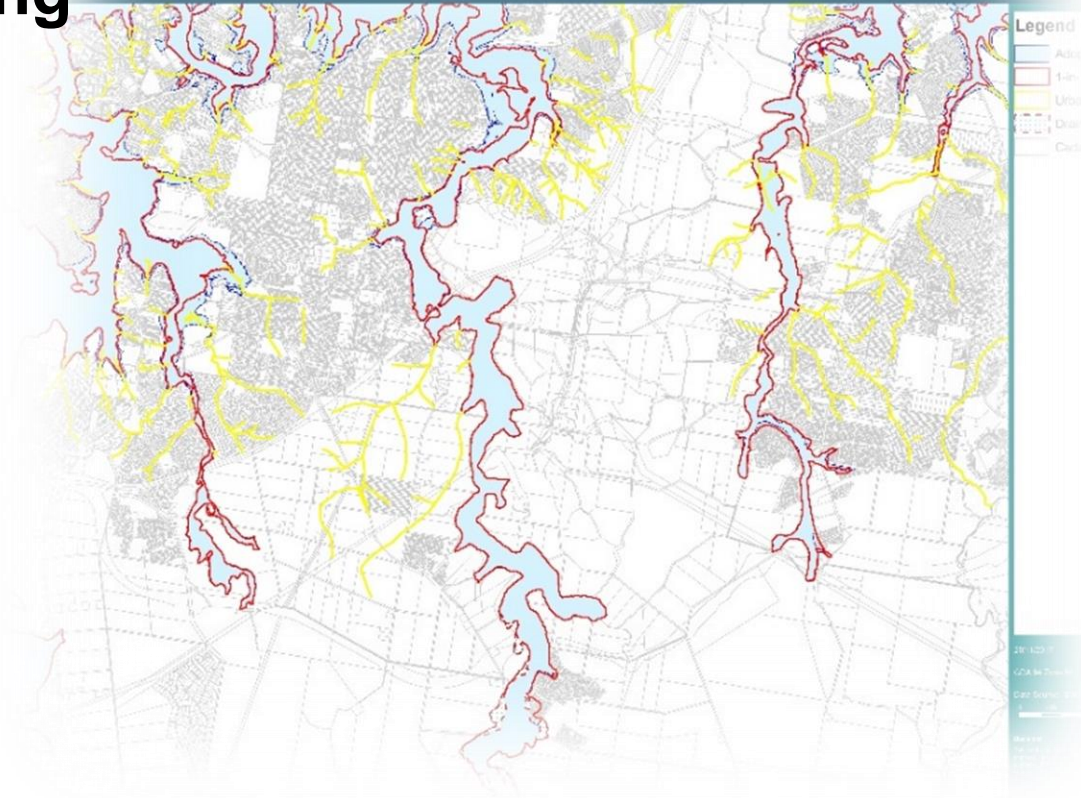
- “*City shapers*” - key role in shaping our towns and regions
- Land use policy can strengthen or detract from community resilience
- Land use planning - a very effective ‘tool’ to influence future exposure of people and property to natural hazards



# Typical approaches to planning and mapping flood hazards

## Current practice:

- Focus on the likelihood of 1 in 100 AEP with climate change factors modelled.
- Overlay maps typically identify extent of one flood event (eg: 1 in 100 AEP) and sometimes include depth and velocity
- Planning schemes *typically* have broad policy statements:
  - Mapping is 'one shade of brown or blue'
  - Uncertainty on what uses are tolerable or intolerable in the floodplain
  - Often rely heavily on site specific flood risk assessment at DA stage
  - Reliance on 'one solution' across floodplain - build above the DFE + freeboard
  - Reliance on 'designing out' impacts at DA stage.



These approaches don't identify 'full' risk.



# Key issues with our current planning approach for floodplains

- Too much attention placed on single flood event.
- Too simplistic to use the 1% DFE
- 1% AEP floodline is currently designated as having 'acceptable risk' for residential development across most of Australia
- **But**, the 1% AEP floodline does not mark the boundary between safety and flood hazard
- If land use and building design are based only on the consequences of the 1% AEP event, the flood risk is not fully understood.
- "Divorce" planning and design from the DFE





**A conundrum?**

**Or opportunity for a  
new approach?**



# Key messages for best practice risk based planning in floodplains

- Good planning needs to consider more than just the 1% AEP

## ***Best practice planning for flood risk = risk based approach to land use planning and development***

- Best practice flood risk management takes an integrated approach using a “suite of measures” and:
  - considers the full range of floods that are possible
  - considers the full floodplain extent
  - considers the consequences of flood based on an understanding of likelihood and behaviour
  - reflects a risk-based approach to land use planning responses in the floodplain
  - Maps categories or ‘bands’ of flood risk



# What is risk based land use planning?

- We need different planning responses across the floodplain
- Different people, land use, densities and forms of development have different sensitivity and vulnerability to flood risk
- ‘Hydraulic risk’ is one of the most important factors when considering risk to life and determining risk appropriate land use in a floodplain
- DFE and built form are important for managing risk to property – and should be secondary after considering hydraulic conditions and flood behaviour implications.
- **Risk-appropriate development – being clear on:**
  - areas to avoid;
  - areas where risk needs to be reduced to an acceptable or tolerable level and how this is to occur;
  - areas where no special conditions or modification of land is required.

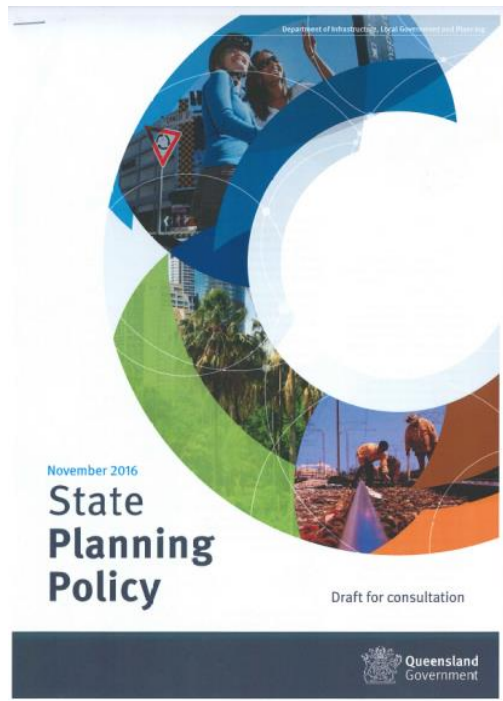
# Land use that is 'risk-appropriate' for its location in the floodplain





# Queensland is moving fast to a risk based planning approach

- State Planning Policy – mandates a risk based approach
- ShapingSEQ – SEQ Regional Plan
- Brisbane River Strategic Floodplain Management Plan and its implementation in planning schemes



# Queensland Floods Commission of Inquiry

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**THREE QUARTERS OF QLD A DISASTER ZONE**

# **CATASTROPHIC**

- \* Ten Dead
- \* Bigger than 1974 Floods
- \* Follow flood advice
- \* 78 People missing
- \* Thursday to be 'terrible'
- \* [Click here to Listen live](#)

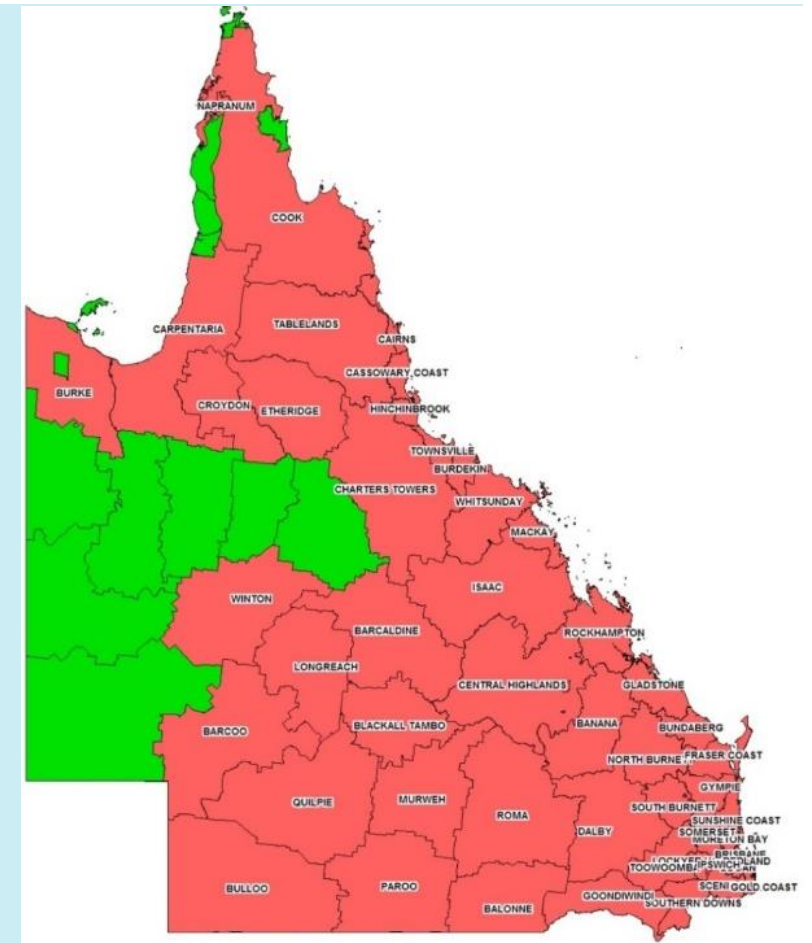


# Flooding Widespread across Queensland

Different 'types' of flooding and duration:

- **Flash flooding** (e.g. Toowoomba, Grantham)
- **Medium duration flooding** (1-2 days notice, e.g. Brisbane River. Last big flood in Brisbane was 1974)
- **Long duration flooding** (1-2 weeks notice, e.g. western rivers)

- 78% of all QLD declared a disaster zone (flooding, cyclonic effects or both)
- 2.5 million people affected
- Estimated cost > \$5 billion
- 33 died, 3 remain missing



**Toowoomba** – short duration and intense rainfall resulted in high velocities and very hazardous floodwaters, with limited warning and preparation time



*Courier Mail*



# Toowoomba



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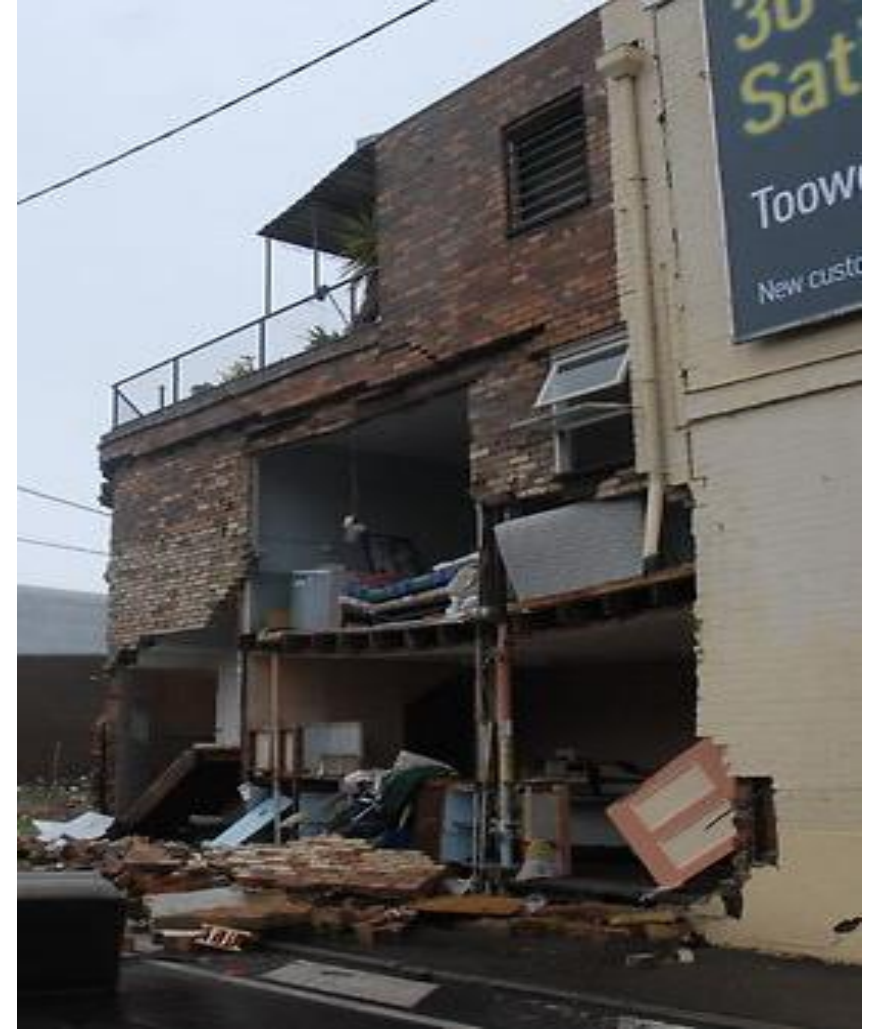
# Withcott



*The Chronicle*



**Force of Flooding** – only takes about 300mm to 500mm of water for floodwaters to start pushing cars around





# Brisbane, 2011





## Brisbane, 2011





## Brisbane, 2011





## Challenges: Disruption to Infrastructure





# Challenges: Isolation of Critical Services





# Priority Infrastructure for Queenslanders

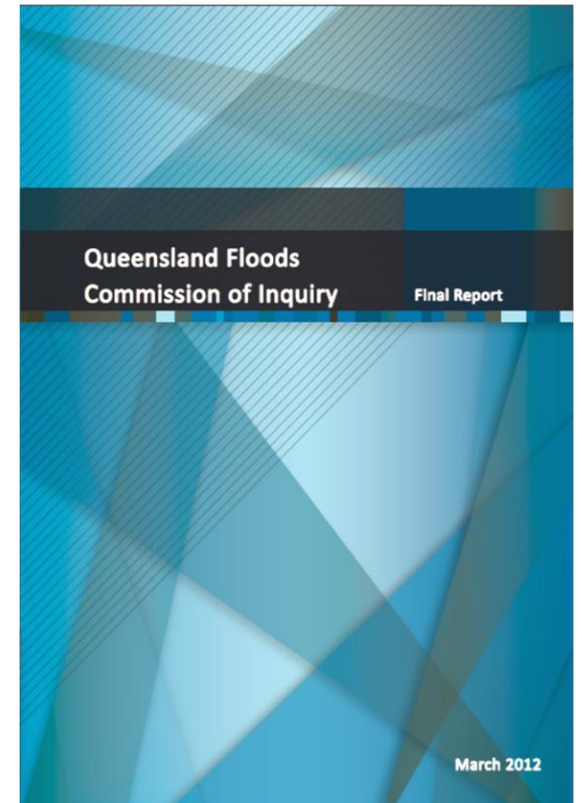


# Some of the key findings from Queensland Floods Commission of Inquiry ...

*“Focus on the Q100 and one defined flood event should not continue”*

*“The various areas to which planning controls apply should be selected having regard to the likelihood, behaviour and consequences of the full range of possible floods, up to and including the probable maximum flood”*

*“A map showing both likelihood and behaviour is best practice ... It allows the risk of flooding to be understood across the full spectrum of floods, thus enabling the appropriate flood-related planning controls to be used in development assessment”*



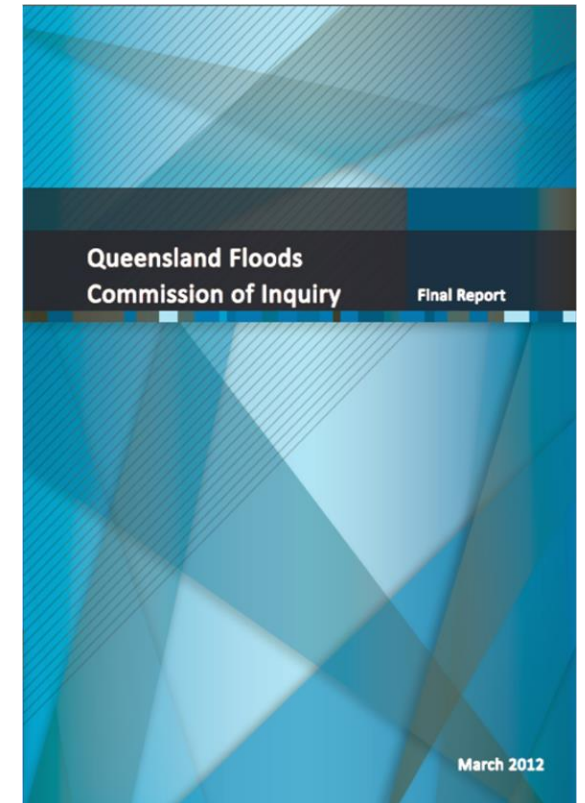


# Recommendations: Floodplain Management and land use planning

# 8.7 - Councils should not rely on a condition requiring an evacuation plan as the sole basis for approving a development susceptible to flooding

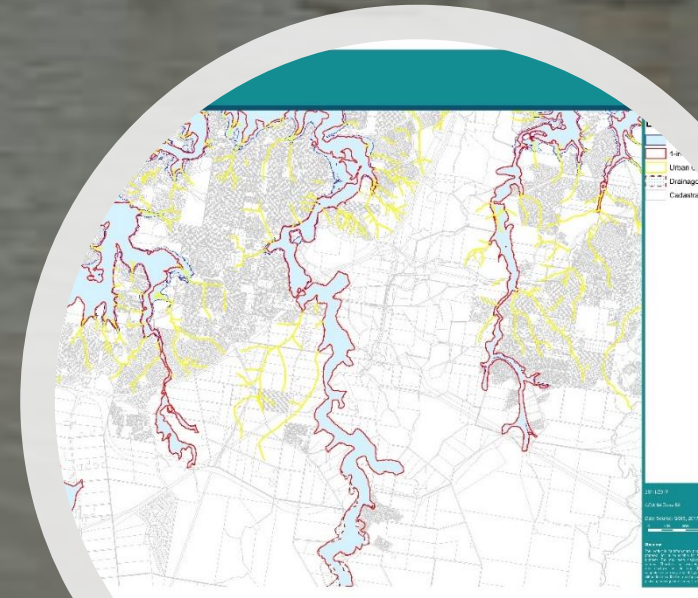
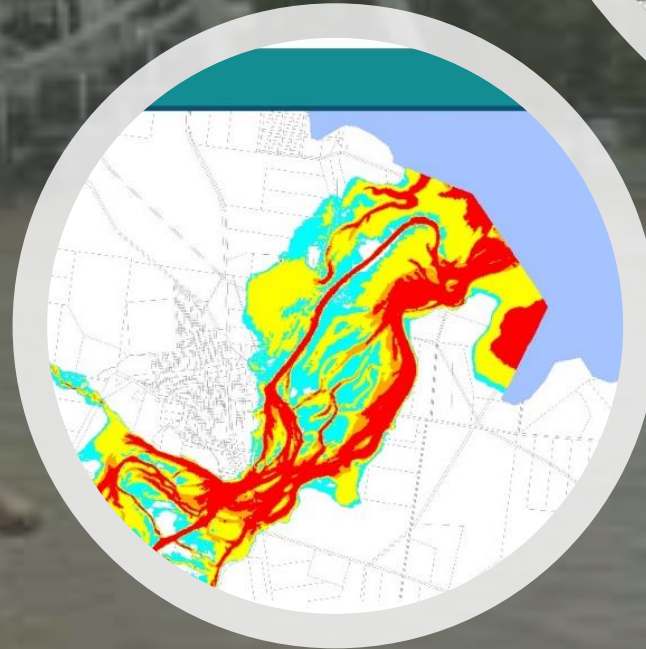
# 2.13 Using flood maps that show at least 3 'zones of risk' based on likelihood and behaviour of floods

# 5.2 Use flood overlay maps in planning schemes (5.2)



# How do we define, map and prioritise flood risk?

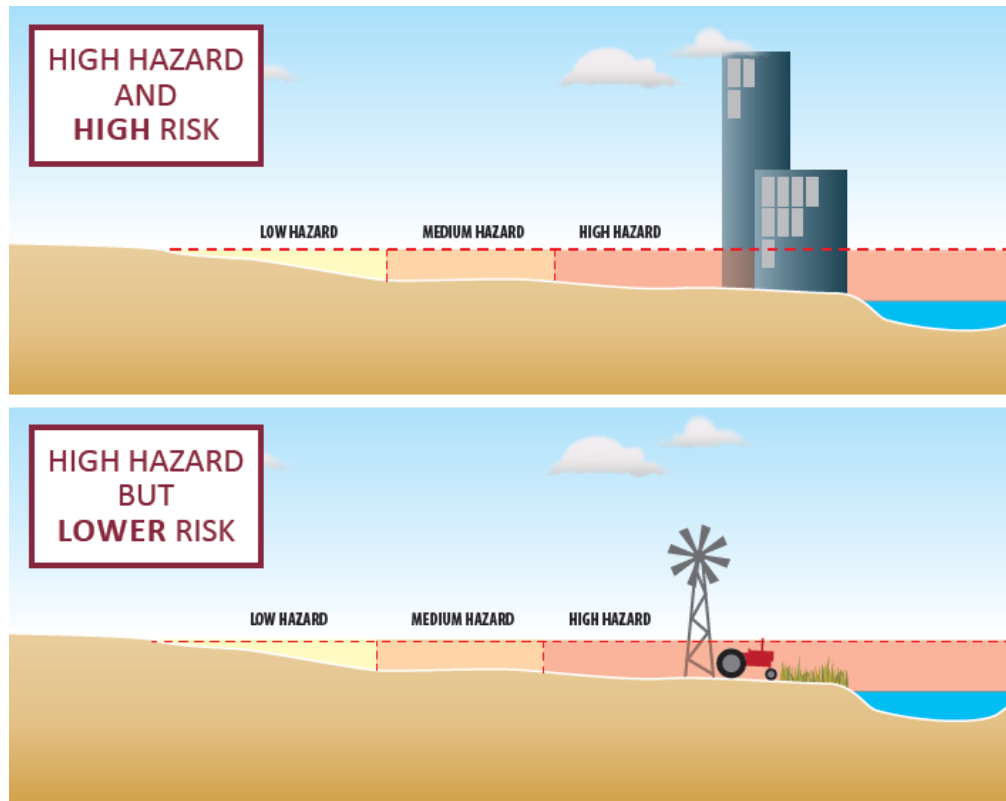
- What is flood hazard?
- What is flood risk?
- Types of flood risk?
- How do we establish and map flood risk?
- How do we use flood risk maps to inform land use policy and development responses?





# How is risk defined?

$$\text{RISK} = \frac{\text{LIKELIHOOD}}{\text{(of a hazard occurring)}} \times \frac{\text{CONSEQUENCE}}{\text{(of impact if it does occur)}}$$



← Same 'high' flood hazard, but different consequences because of assets

←

Source: BMT

Same 'potential' risk: Different 'actual' risk

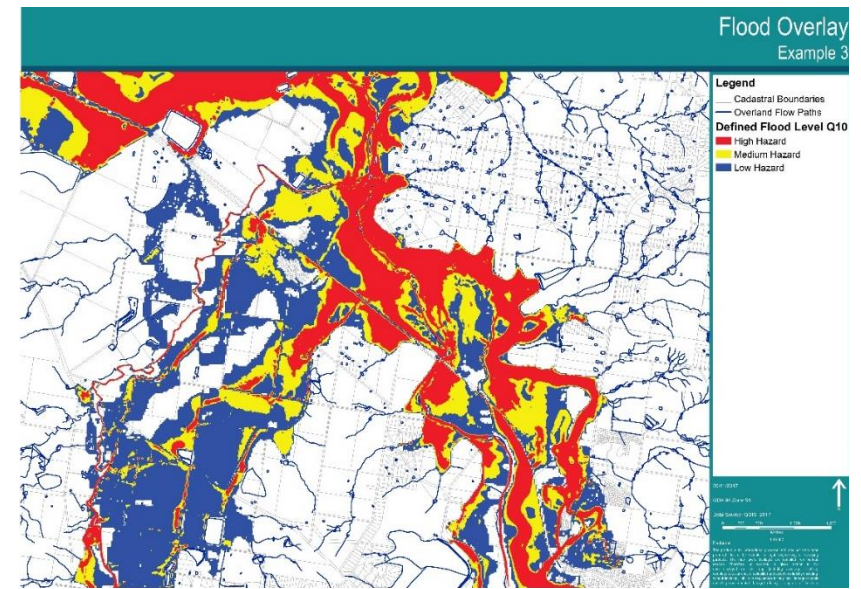
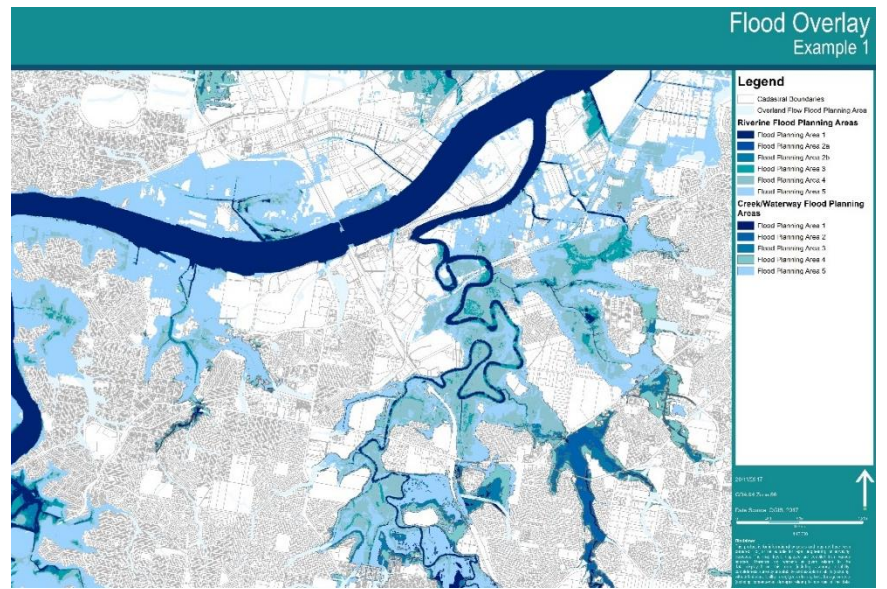
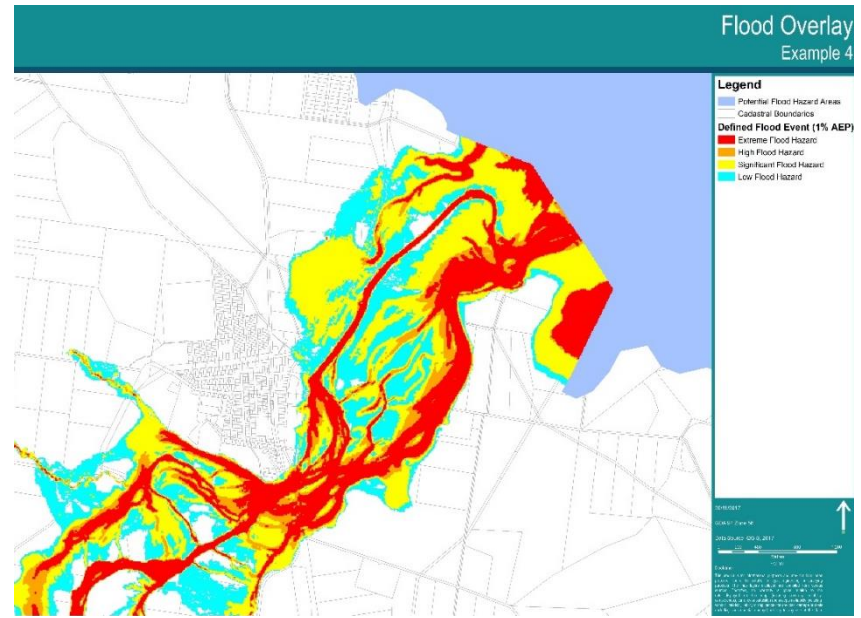
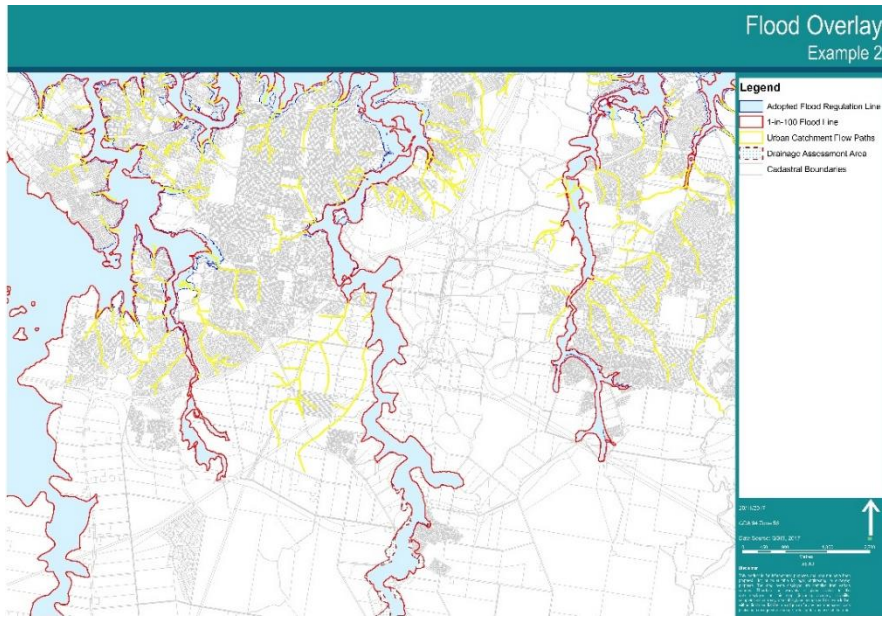
# Types of Flood Risk

- Only one of these risks involves actually getting wet!
- All of these factors contribute to flood risk and are useful to informing land use planning responses
- Need to consider all types of flood risk in informing land use planning responses



Risk factors	Assessment method
Inundation	Hydraulic modelling of flood behaviour
Isolation risk (especially 'shrinking islands')	Identification of High Islands and Low Islands
Loss of access	Identification of Evacuation Routes
Loss of services and amenity	Identification of Critical Infrastructure

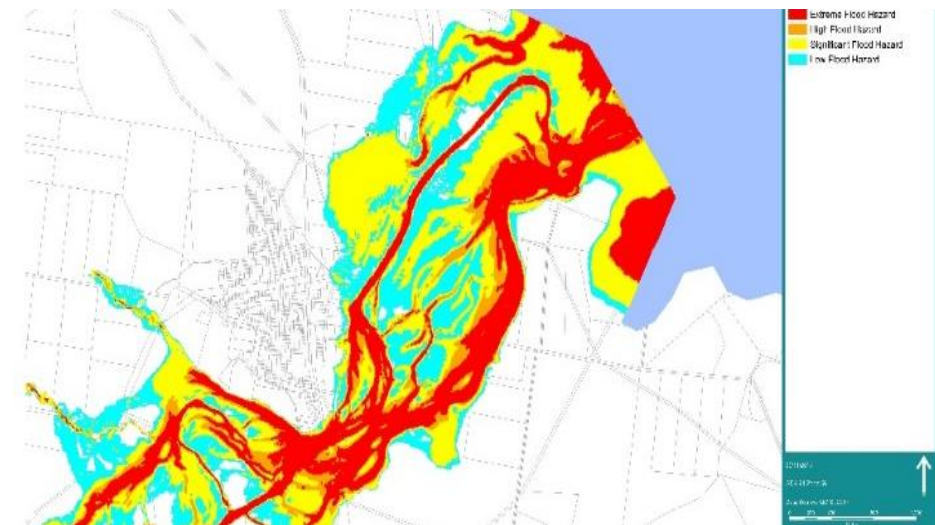
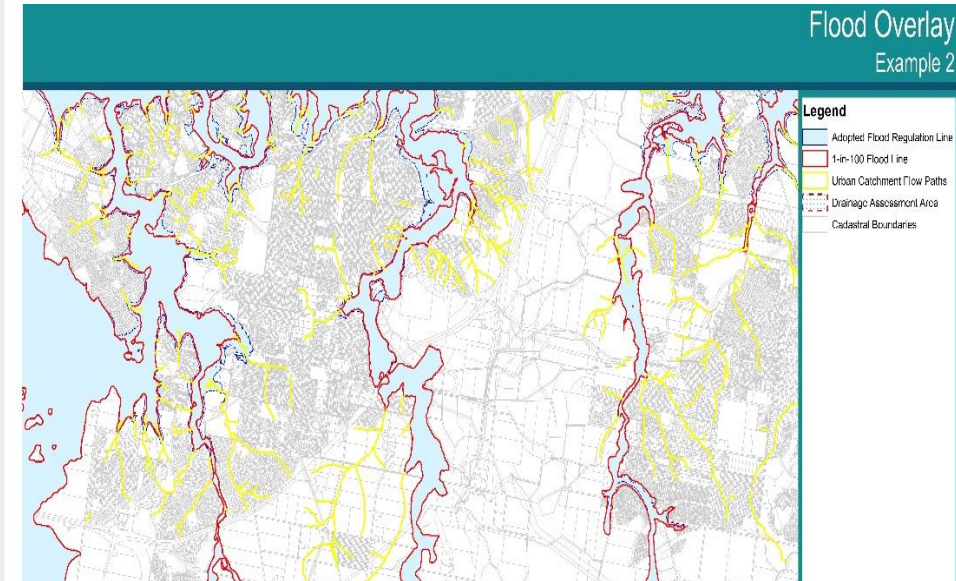




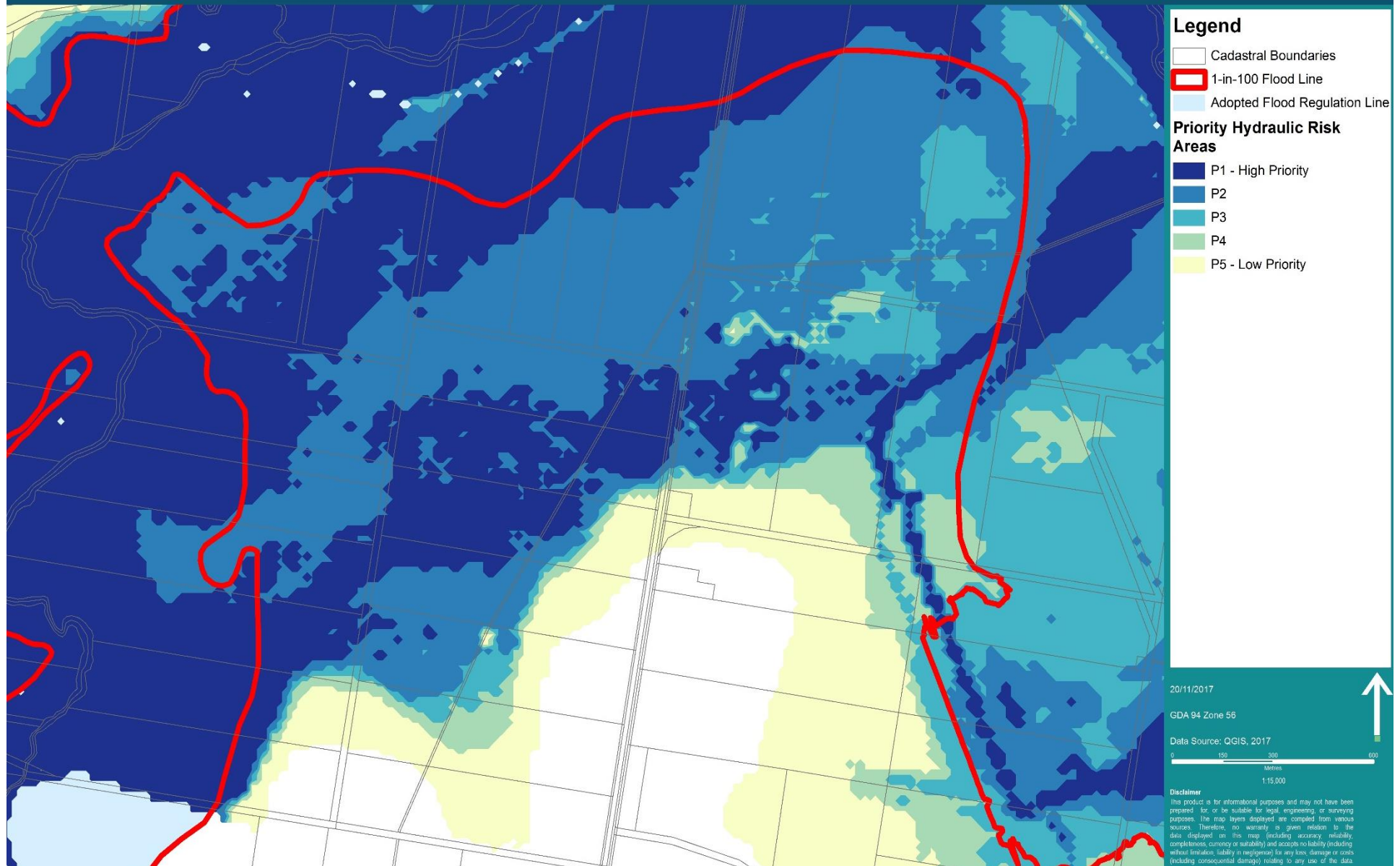


# Some key issues for land use planning...

- Do we understand what our flood overlay mapping shows?
- Do our planning schemes clearly identify which areas of the floodplain are potentially:
  - more hazardous because of deep or fast flowing flood waters?
  - lower risk areas because flood hazard is low or likelihood is extremely rare?
- Is the planning scheme unnecessarily restricting development or, not being strict enough?
- Can we 'tailor' our land use planning responses based on our understanding of flood behavior and flood risk?



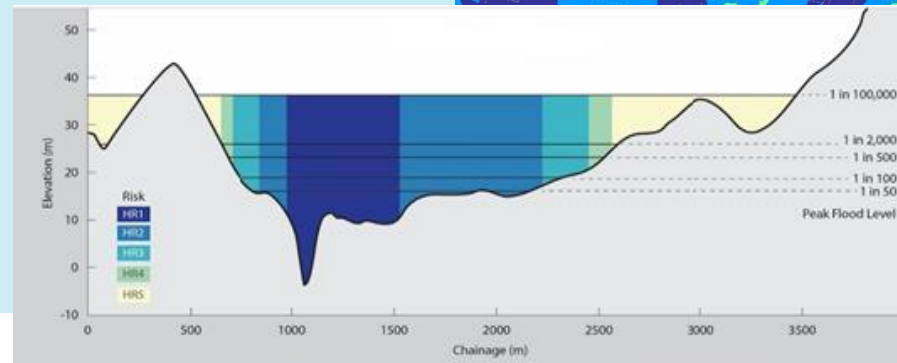
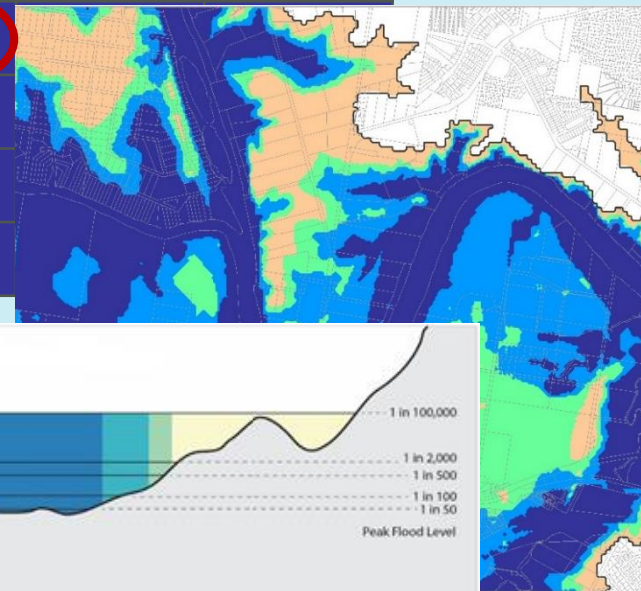




# Advancing planning practice to respond to the floodplain mapping 'maturity' model

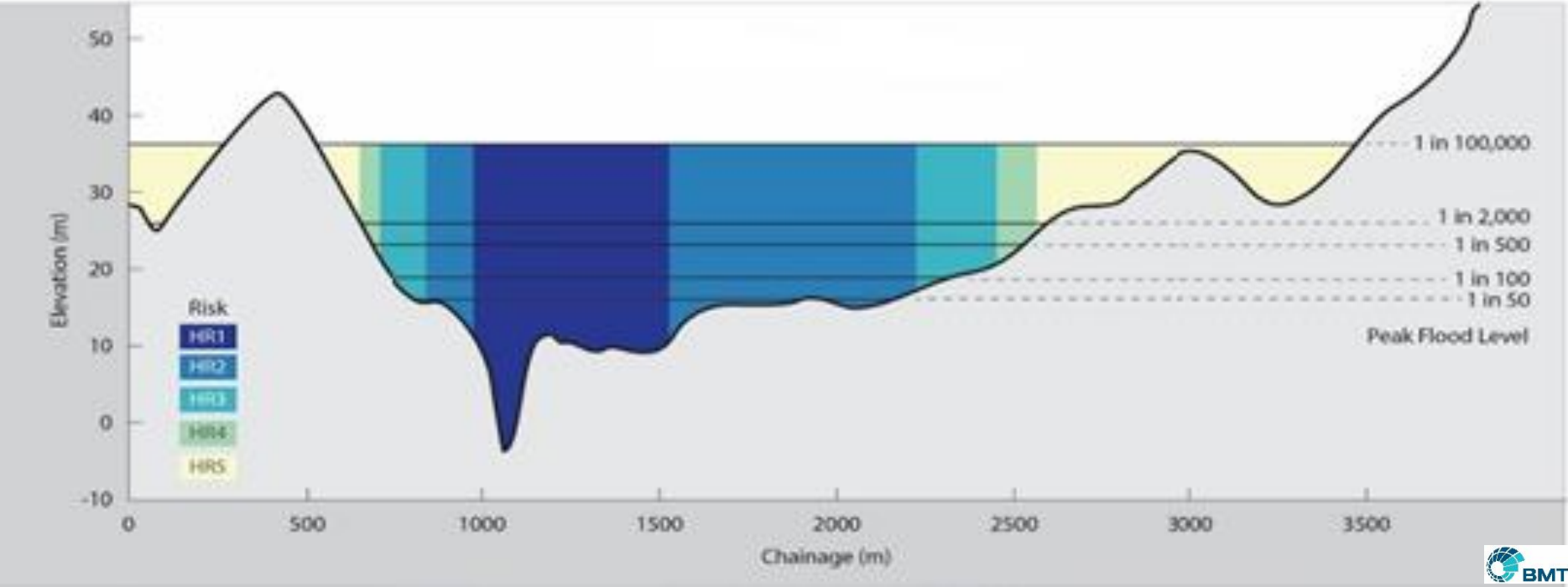
## Hydraulic risk matrix and mapping (for demonstration purposes)

AEP	H1	H2	H3	H4	H5	H6
PMF	HR4	HR4	HR4	HR4	HR4	HR4
1 in 2000	HR4	HR4	HR3	HR3	HR3	HR3
1 in 500	HR4	HR3	HR3	HR2	HR2	HR2
1 in 100	HR3	HR3	HR2	HR1		
1 in 50	HR3	HR2	HR1	HR1		
1 in 20	HR2	HR1	HR1	HR1		
1 in 10	HR1	HR1	HR1	HR1		

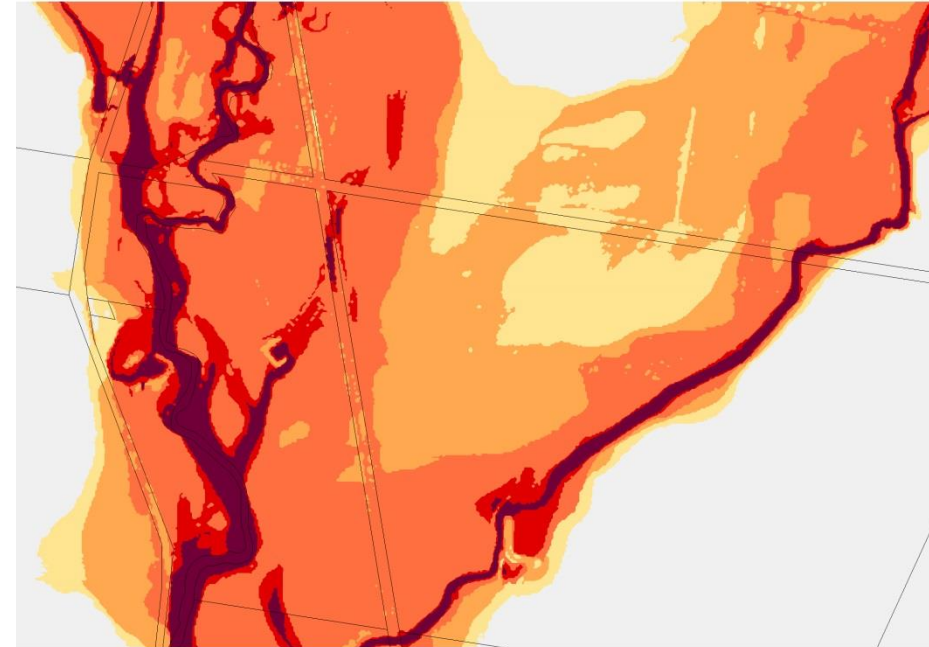
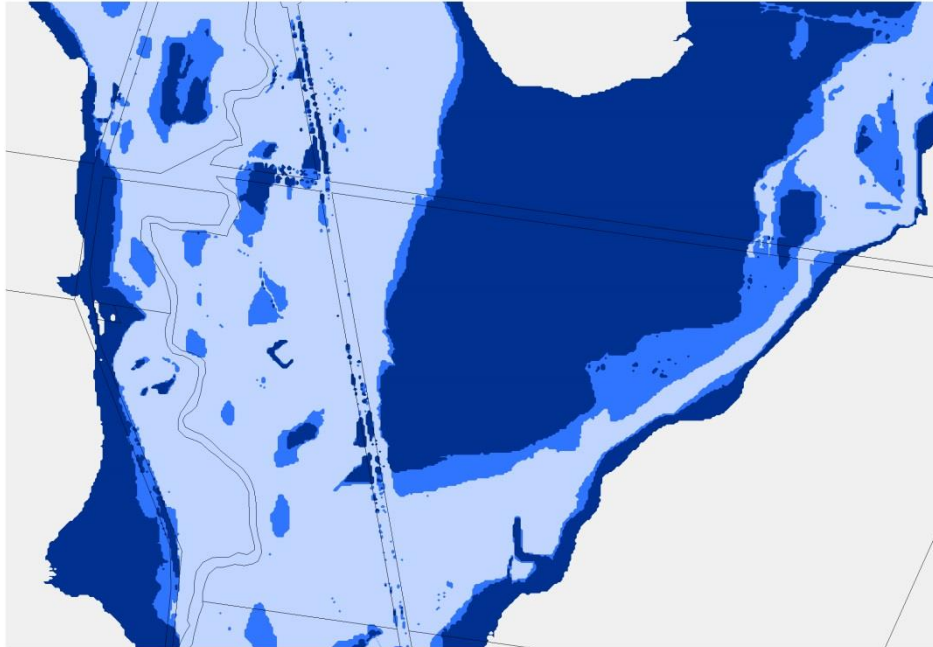




# Typical cross sections showing variable risk profile across a floodplain



# Flood Extents (likelihood only) vs Hydraulic Risk (likelihood + hazard)



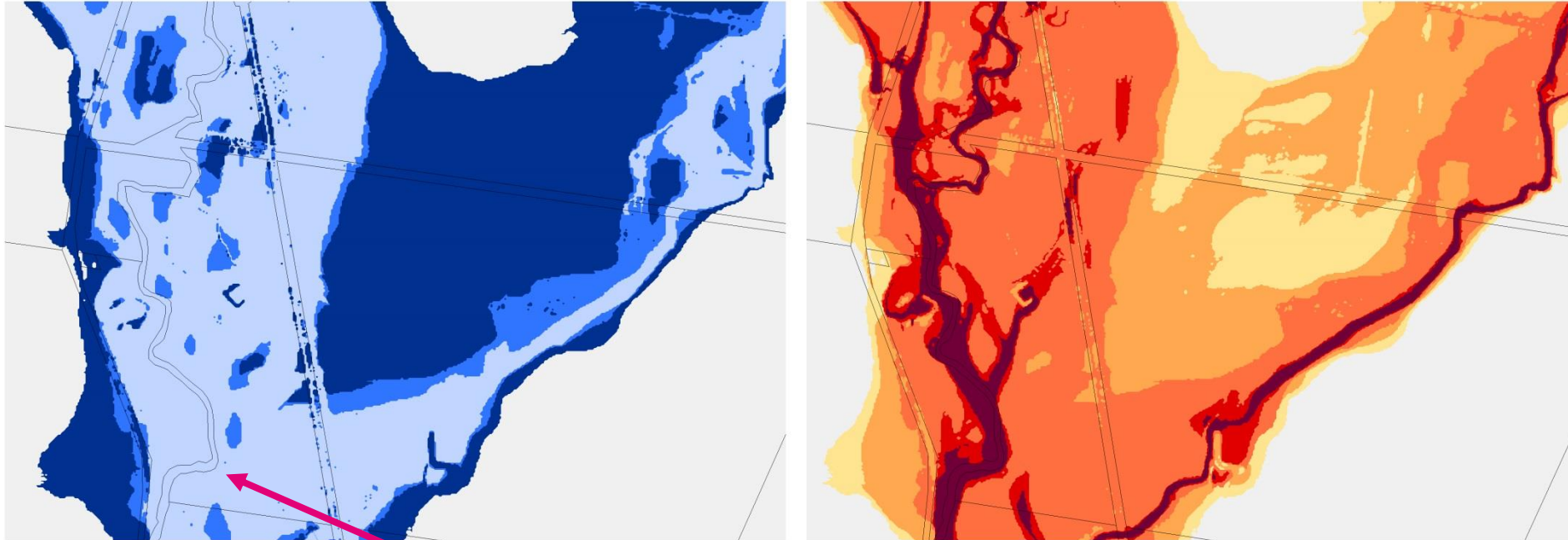
Source: BMT

Frequent event  
+  
DFE  
+  
PMF

Hydraulic risk



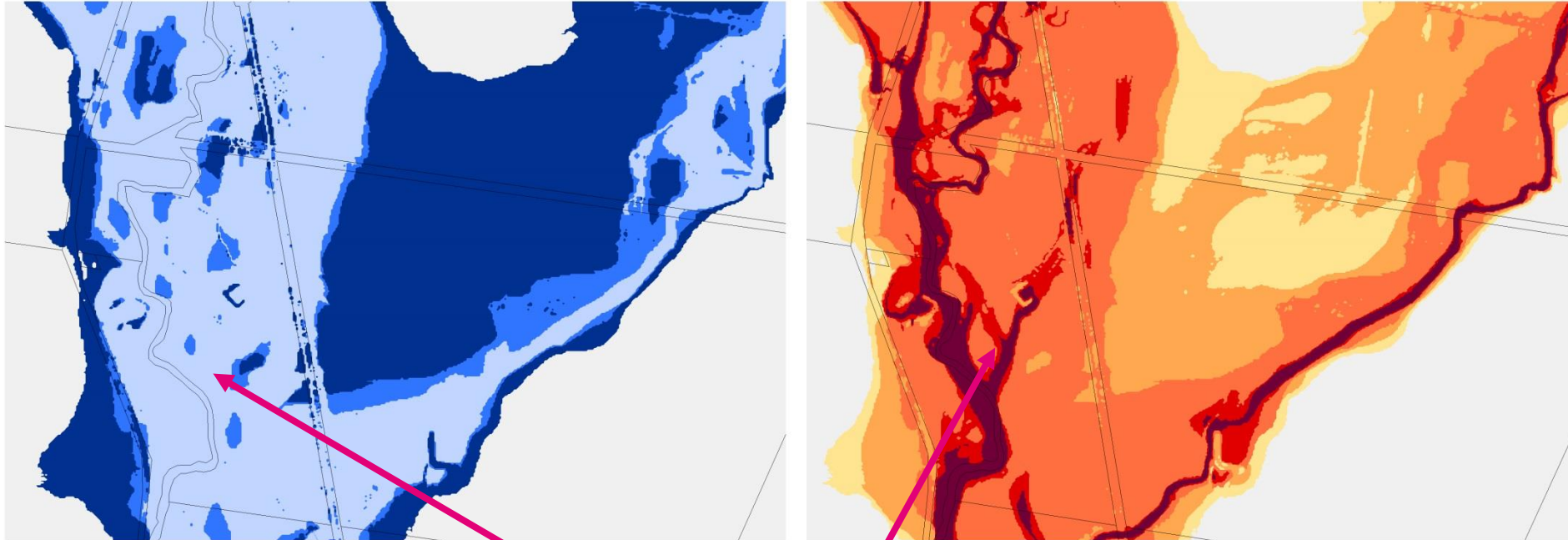
## Flood Extents (likelihood only) vs Hydraulic Risk (likelihood + hazard)



Source: BMT

High flow areas

## Flood Extents (likelihood only) vs Hydraulic Risk (likelihood + hazard)

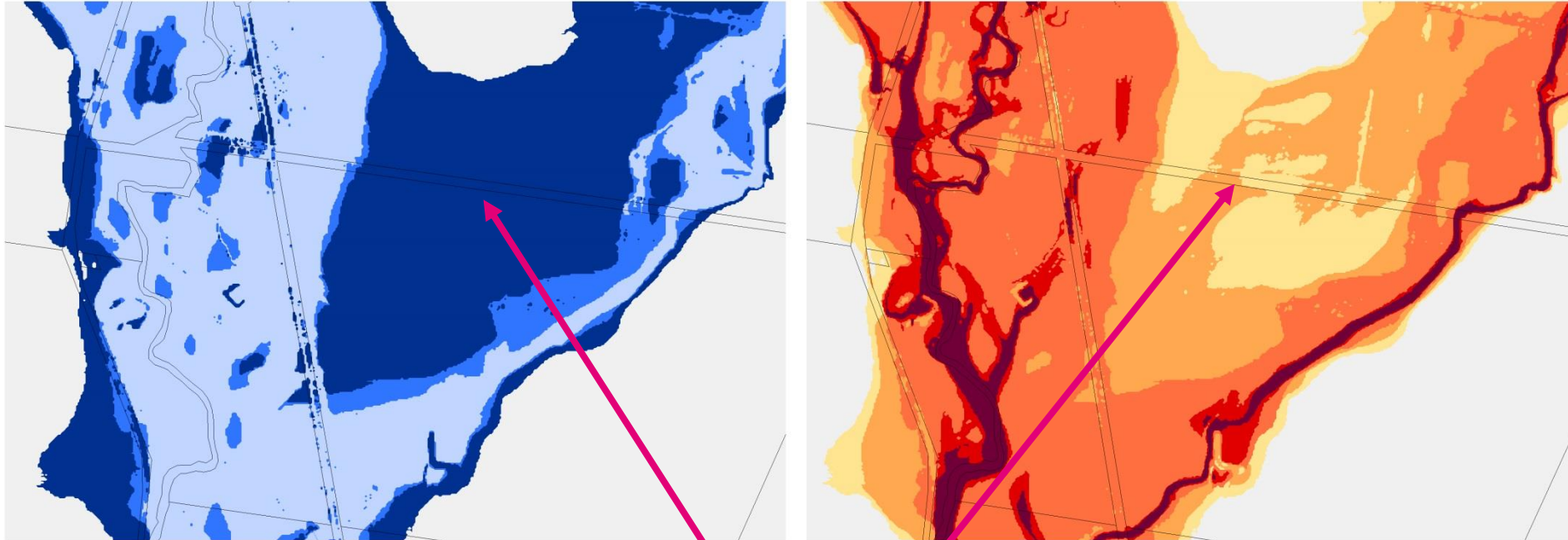


Source: BMT

**Breakout flowpaths**



# Flood Extents (likelihood only) vs Hydraulic Risk (likelihood + hazard)



Source: BMT

**Rare, higher hazard**

# Benefits of a risk-based approach to land use planning policy and overlay mapping

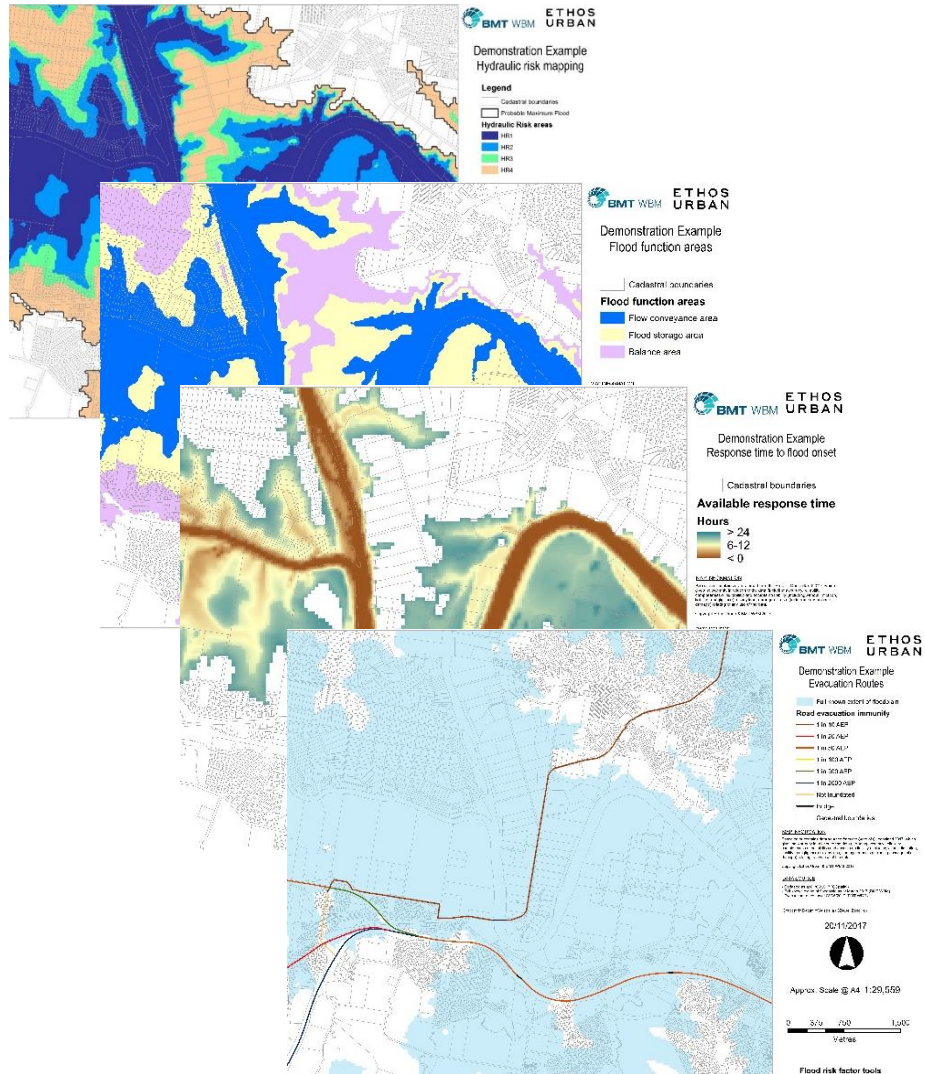
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- Understand multiple likelihoods + flood behaviour + consequences of impact (not just a single DFE)
- Evidence based and easier to defend - risk assessment informs policy and scheme provisions
- Identify 'categories' of risk in flood overlay area Eg: Extreme Risk, High Risk, Medium Risk and Low Risk.
- Tailor land use planning policy responses to be risk-appropriate for location in floodplain.
- Development expectations are clear for each level of risk - greater certainty for community and development industry
- Less reliance on site-by- site risk assessment at DA stage to determine appropriateness of development.






# Suite of flood risk factors can inform planning responses and flood overlays



- Hydraulic risk
- Response time to flood onset (available response time)
- Flood conveyance and storage areas
- Road evacuation immunity

Flood Risk Level or Category	Conceptual demonstration of possible planning responses	Tolerance
FR1 (Low)	<ul style="list-style-type: none"> <li>No planning response may be required, although critical infrastructure located outside the floodplain or designed for no flood impact.</li> </ul>	Acceptable
FR2 (Medium)	<ul style="list-style-type: none"> <li>Controlling land uses depending on flood risk vulnerability.</li> <li>Critical infrastructure not located in this area</li> <li>Eliminating risk through location, building design and development layout</li> <li>Controlling risk by using elevation to reduce exposure e.g. built above the defined flood event level + freeboard</li> <li>Using flood compatible building materials and construction methods</li> <li>Ensuring provision for evacuation and other emergency management where flood hazard is a threat to people.</li> </ul>	Tolerable / Conditional
FR3 (High)	<ul style="list-style-type: none"> <li>No new buildings</li> <li>Preventing development or limiting development to uses that are not sensitive to flood impacts, e.g. rural uses, open space etc</li> <li>No filling unless where a local floodplain management plan identifies it is acceptable</li> </ul>	Tolerable (conditional) for certain uses and unacceptable for others
FR4 (Extreme)	<ul style="list-style-type: none"> <li>No new buildings in this area, no filling.</li> </ul>	Unacceptable or intolerable





## Key take home messages for risk-based planning in floodplains

- Risk-based planning accords with the QFCoI, State Planning Policy (SPP) and best practice
- Best practice requires understanding the behaviour and consequences of flooding across the full range of likelihoods and full floodplain extent.
- Consider all flood risk factors – hydraulic risk very important
- Mapping categories or ‘bands’ of flood risk in planning schemes
- Reflecting tailored planning responses into all levels of the planning scheme:
  - land uses to be ‘risk appropriate’ for their location in the floodplain
  - set clear upfront policy direction on acceptable, tolerable and intolerable risks
  - understanding vulnerability of development and people to flood risk
  - avoiding vulnerable uses and limiting sensitive uses
  - resilient building design & development layout and using DFE to minimise property damage
  - evacuation and isolations considerations



Thank you

**ETHOS  
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[smcguire@ethosurban.com](mailto:smcguire@ethosurban.com)