# Using 2D Modeling

## to Improve Emergency Management


FMA Conference
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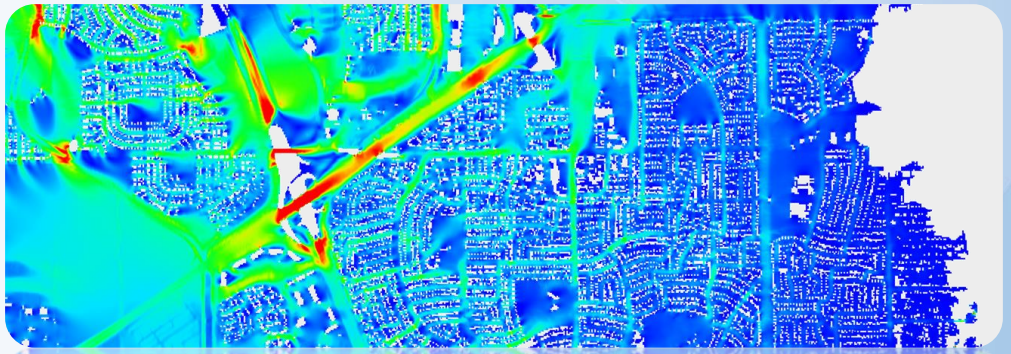
Presented by:
Chris Huxley



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# Using 2D Modelling to Improve Emergency Management
## Presentation Overview

### Overview

- Overview of emergency management phases
- 2D modelling case studies
  - Evacuation preparedness planning case studies
  - Flood forecasting research study




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# Emergency Management Overview
## 2D Modeling?

**Emergency Management Phases**

Pre-event

1. Mitigation

Theepoctimes


**Measures aiming to prevent an emergency, or reduce it's impact** (if unavoidable)

- Planning controls (flood planning levels)
- Structural measures (levees, floodways)
- Property modification (raising / purchase)
- Community education (flood awareness)

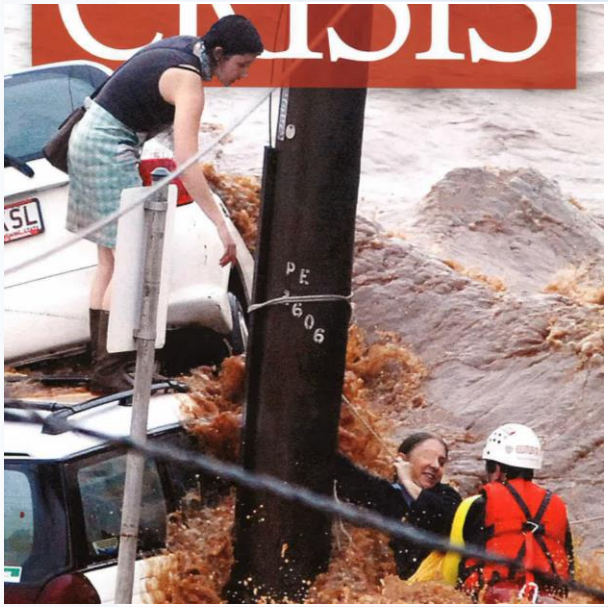
# Emergency Management Overview
## 2D Modeling?

### Emergency Management Phases

Pre-event

1. Mitigation
2. Preparedness

*The Toowoomba Chronicle*




### Preparations made to help rescue operations

- Emergency Response Plans
  - Flood intelligence information
  - Resource allocation planning
- Community education (flood awareness)

# Emergency Management Overview
## 2D Modeling?

### Emergency Management Phases

Pre-event

1. Mitigation
2. Preparedness

During Event

3. Response


### Preparedness 'Plans' in action

- Aim to prevent further damage to people or property

# Emergency Management Overview
## 2D Modeling?

### Emergency Management Phases

Pre-event

1. Mitigation
2. Preparedness

During Event

3. Response

Post-event

4. Recovery

Piles of household goods damaged in the Brisbane flood littered suburban streets after an army of volunteers turned out to clean up Australia's third-largest city. *PHOTO: Eddie Safarik AFP*

# Emergency Management Overview
## 2D Modeling?

### Emergency Management Phases

Pre-event

1. Mitigation
2. Preparedness

During Event

3. Response

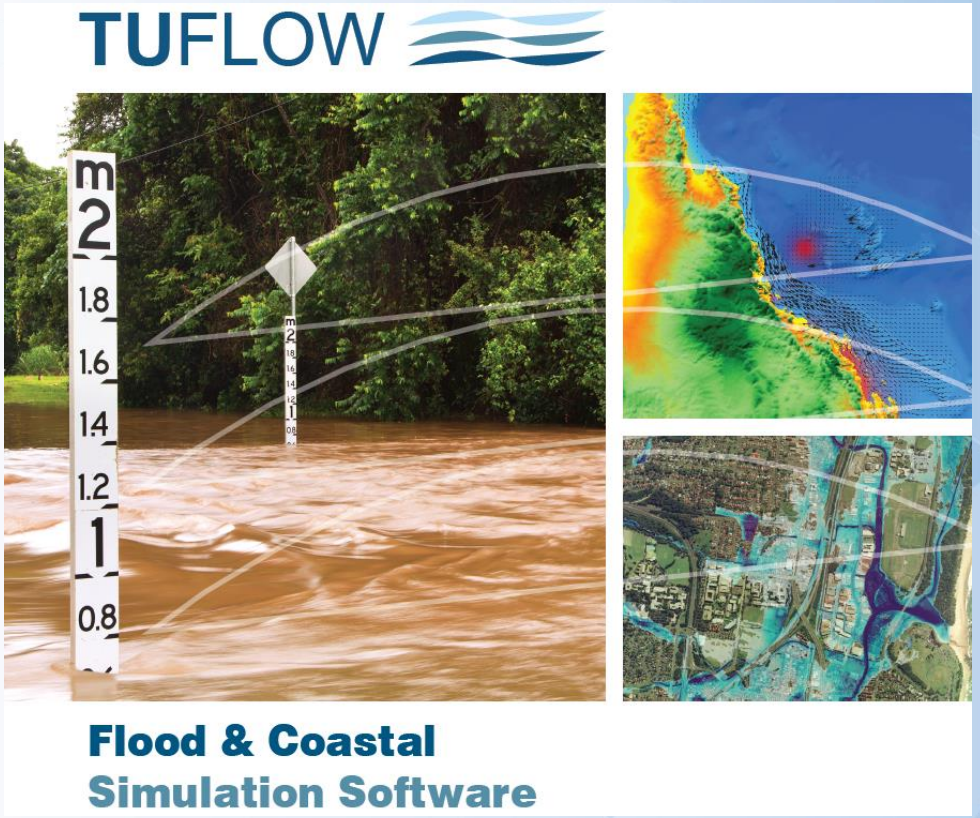
Post-event

4. Recovery

### 2D Flood Modeling?

Supplements historic flood intelligence data

Used for more than mitigation assessments

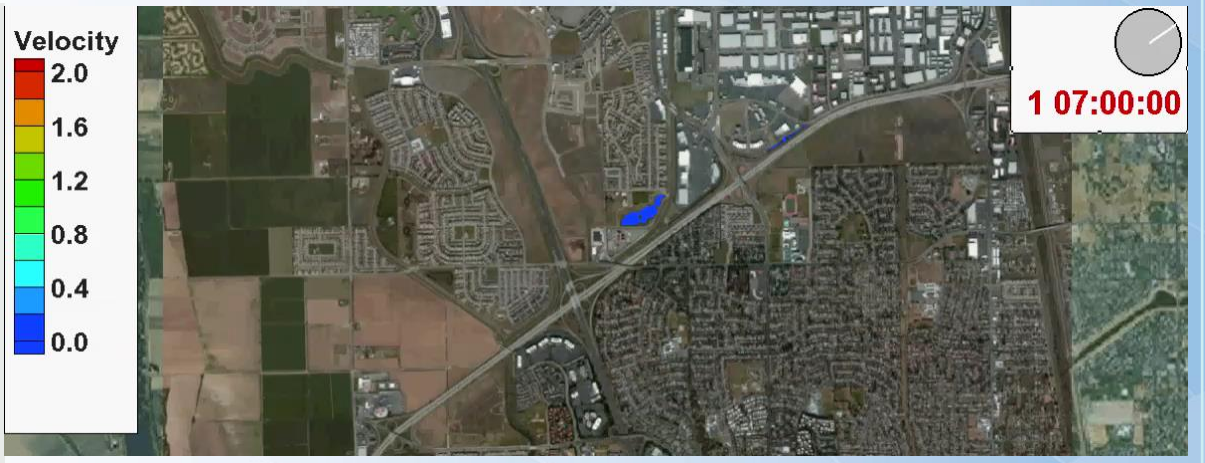


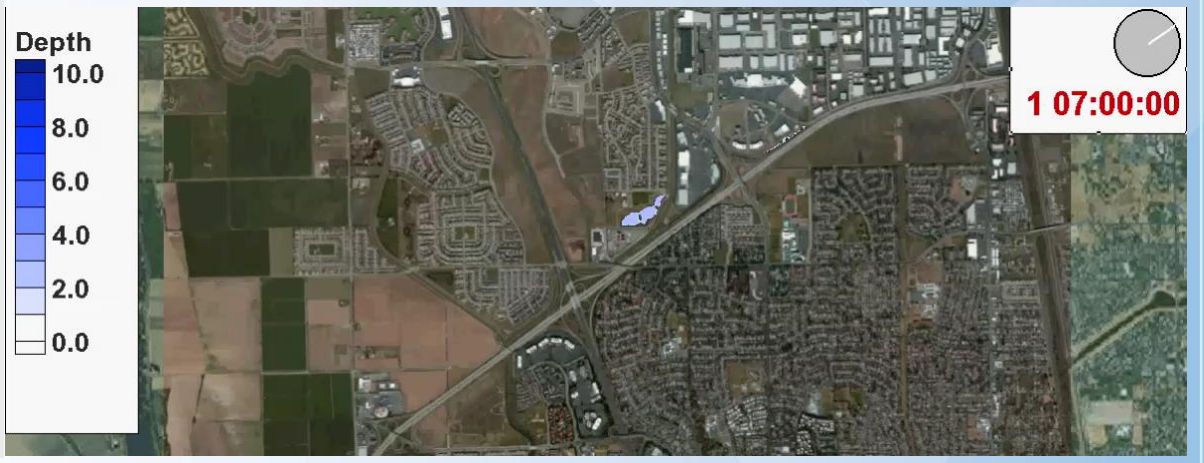

**Accurate flood information supports good emergency management decision making**

# Emergency Management Overview
## 2D Modeling?

### Benefits of 2D Modeling?

1. Easy to develop
2. High resolution results
   - Depth
   - Velocity
   - Hazard
   - Timing
3. Well suited to complex flood scenarios
4. Flood information for large spatial extent
5. Inbuilt functions: workflow efficiency
6. Fast simulation runtime: Real-time forecasting

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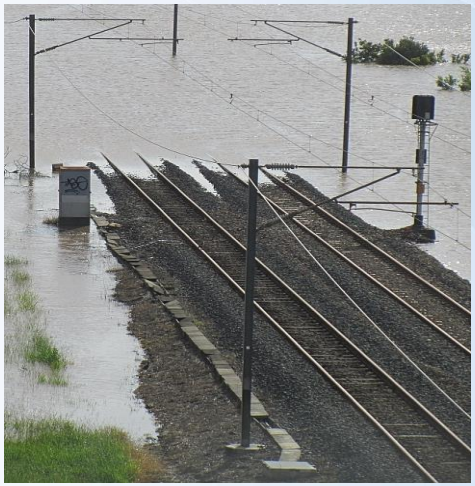
# Tweed Valley Flood Risk Management Study, Australia

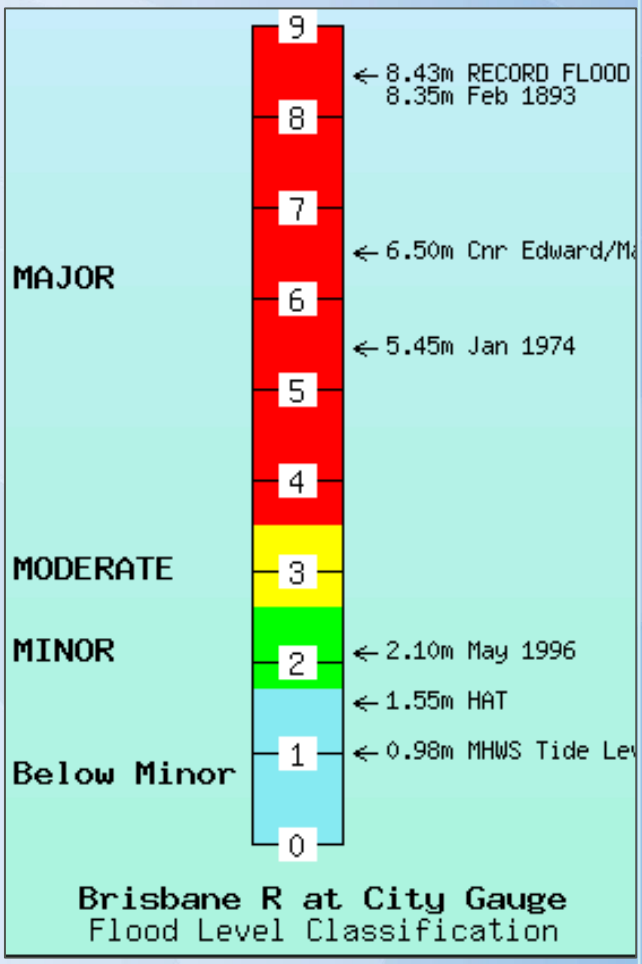
## Preparedness Planning

**Example: Inbuilt TUFLOW 'Evacuation' function**

Inputs

- GIS data
  - properties, routes infrastructure, gauge
- Trigger value
  - depth, velocity or hazard



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# Tweed Valley Flood Risk Management Study, Australia

## Preparedness Planning

**Example: Inbuilt TUFLOW 'Evacuation' function**

Inputs

- GIS data
  - properties, routes infrastructure, gauge
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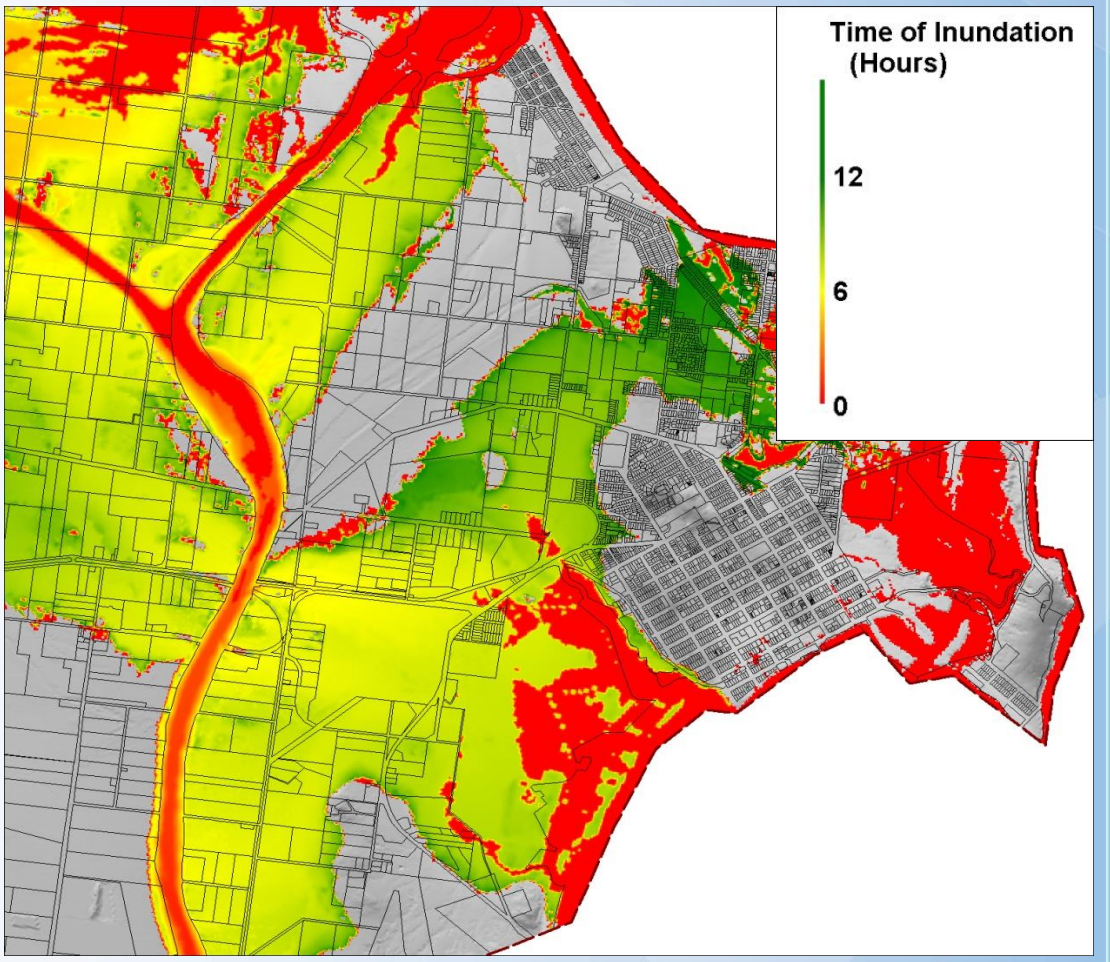
Output (grid and point)

- Time of inundation
- Inundation duration

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# Tweed Valley Flood Risk Management Study, Australia
## Preparedness Planning

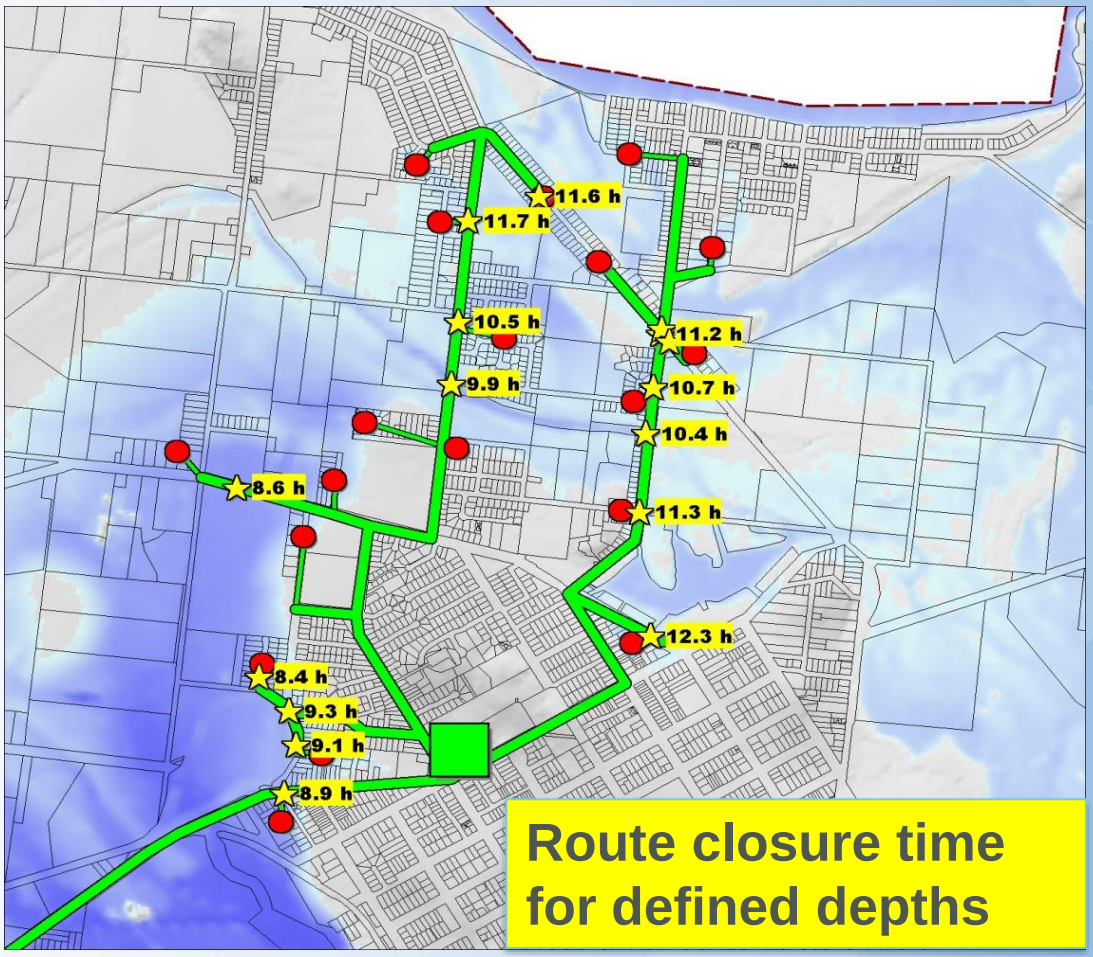
**Example: Inbuilt TUFLOW 'Evacuation' function**

Inputs

- GIS data
  - properties, routes infrastructure, gauge
- Trigger value
  - depth, velocity or hazard

Output (grid and point)

- Time of inundation
- Inundation duration
- Cut off location
- Gauge water level when these things occur

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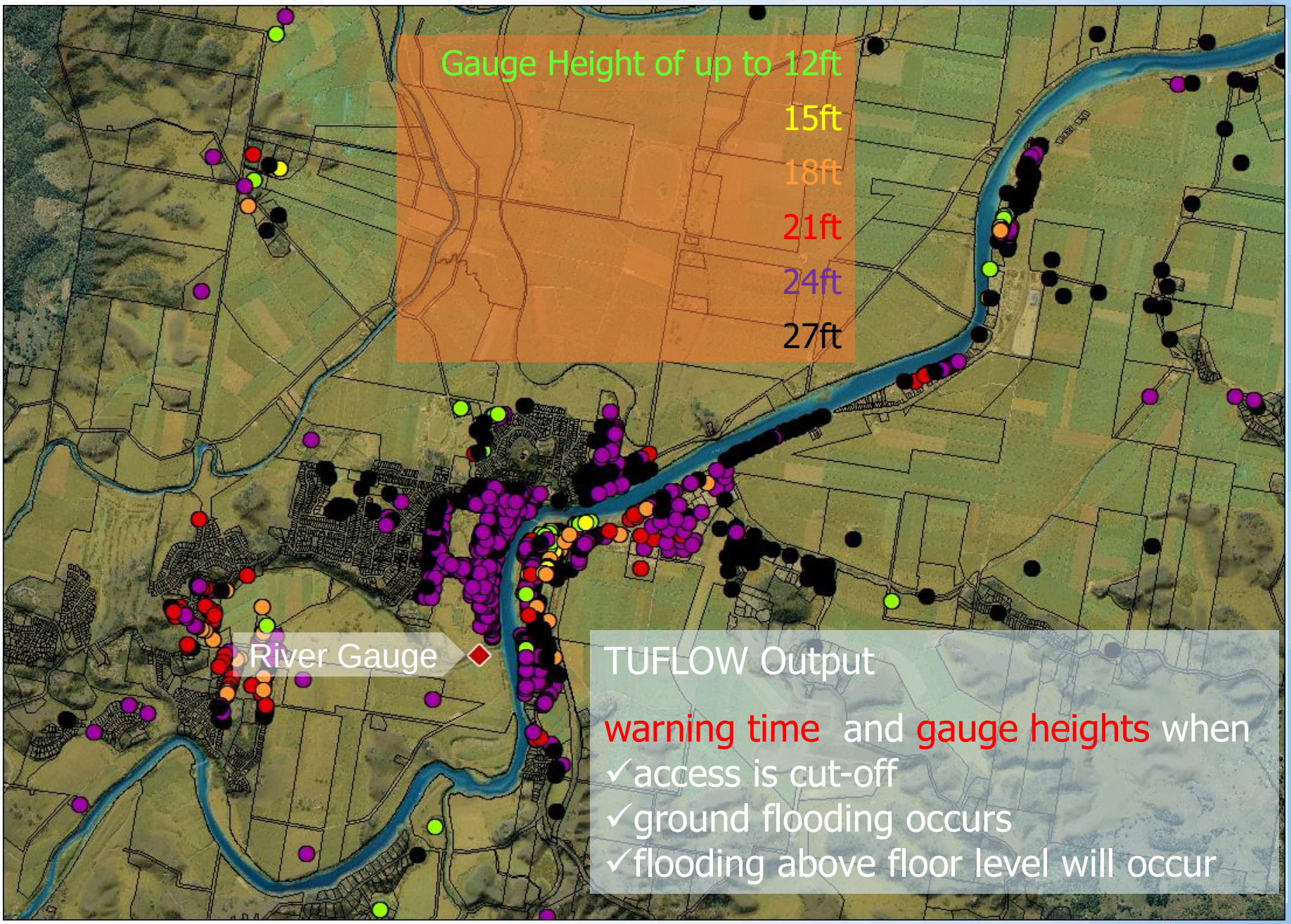


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# Northern New South Wales, Australia
## Preparedness Planning

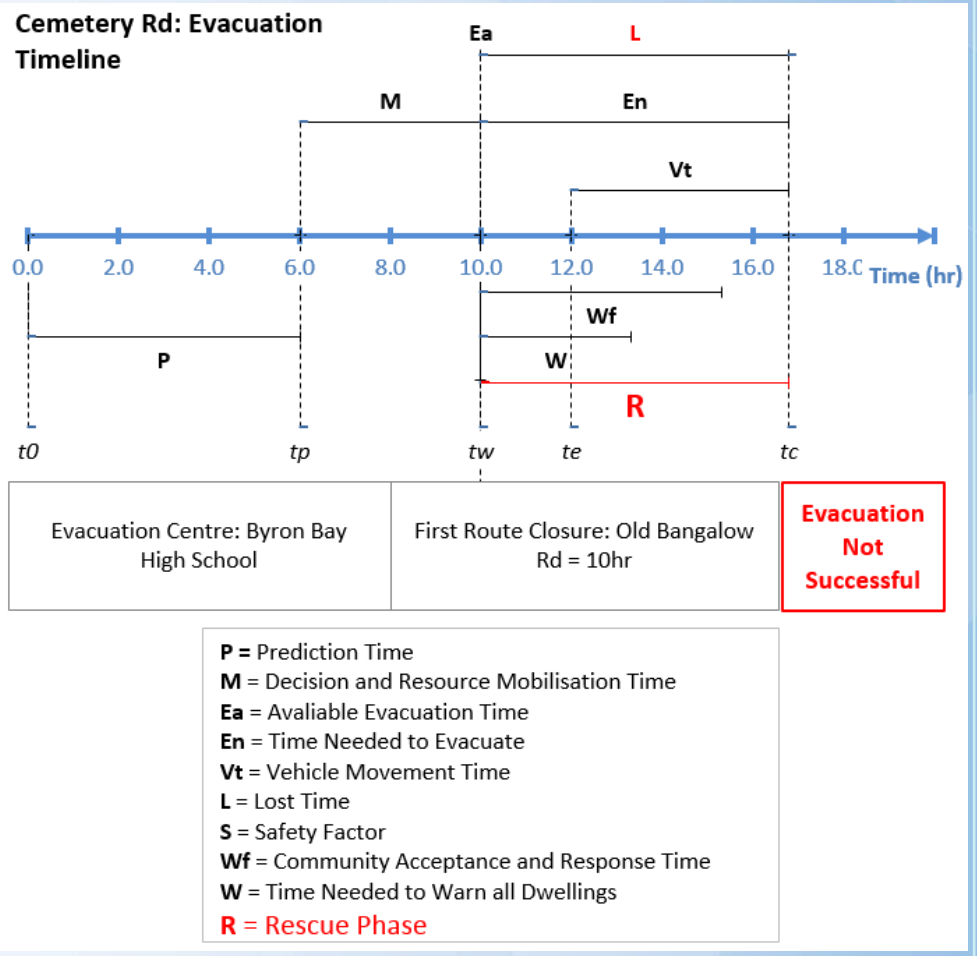
### Example: Flood intelligence information for the flood evacuation plan

2D Modeling Informs Evacuation Strategy

- Definition of evacuation sectors
- Review of evacuation route suitability
- Evacuation trigger levels
- Warning time (relative to gauge)

Timeline Assessment Defines: Evacuation Sector Information

- Required resource allocation for successful evacuation

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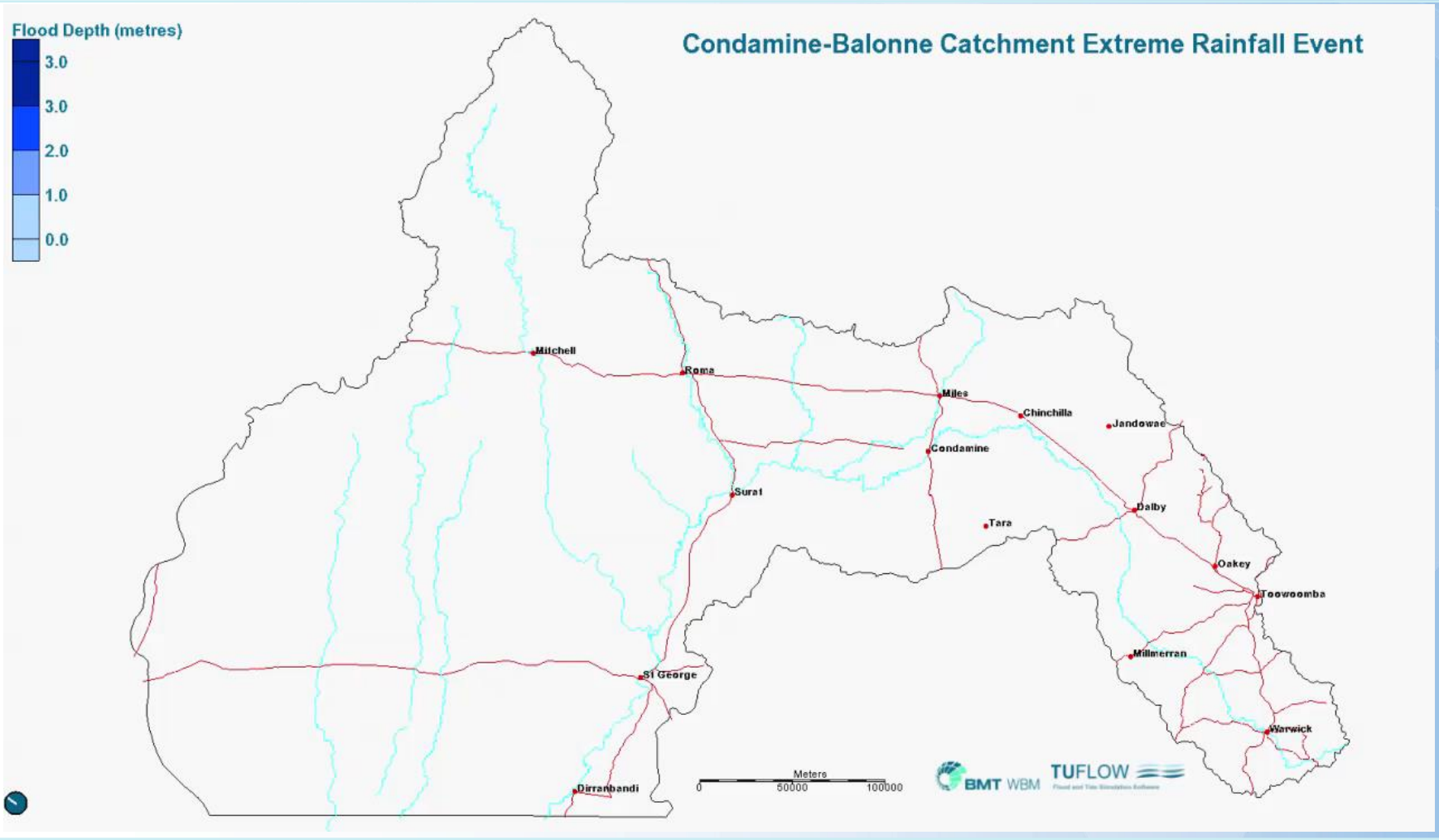
# TUFLOW GPU
## Response Planning

**Aim: Develop a 2D flood model suitable for real-time flood forecasting**

- Advances in computer and software technology are now making this possible
- Super computing power on a desktop computer

- **TUFLOW GPU**
  Condamine Example
  - Extent: ½ size of Texas!
  - Resolution: 90ft resolution
  - 450 million cells
  - Distributed hydrology
  - 100 times faster than CPU model

# TUFLOW GPU
## Response Planning

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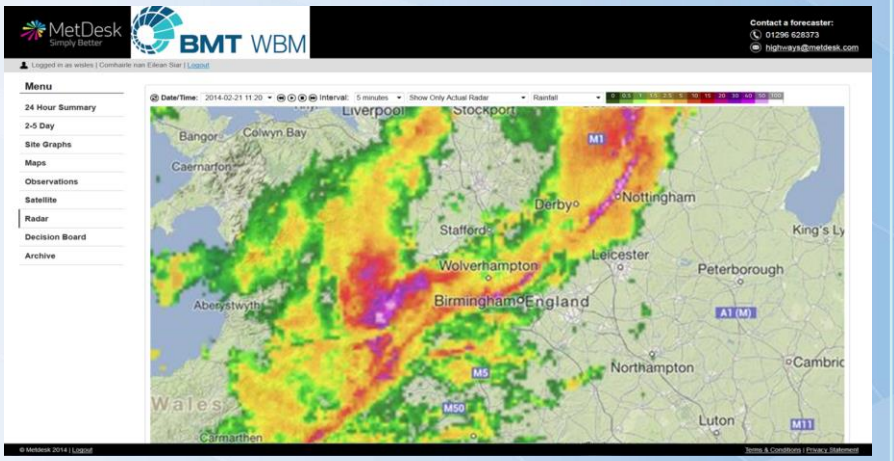
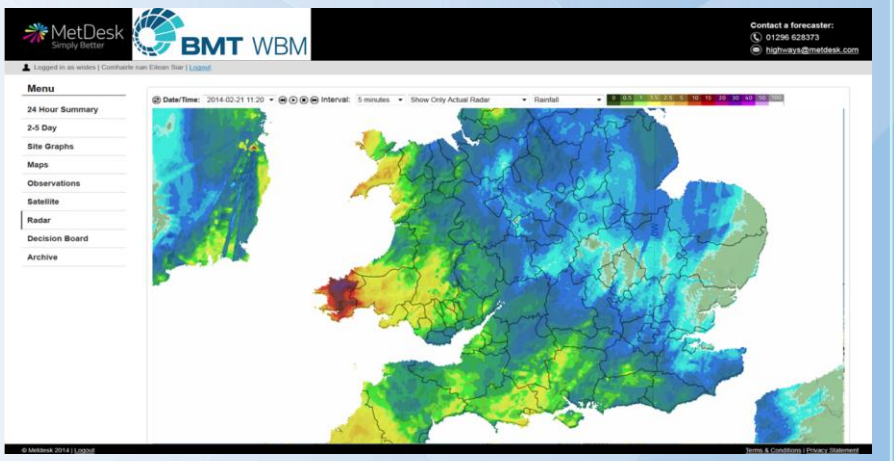
# Essex (UK) Research Pilot Study
## Response Planning

### Real-time flood forecasting potential

**Research Study**

- Results used to warm up the response unit decision making process
- Possible benefits Include:
  - Flood information for entire catchment
  - Approach accounts for event unique spatial variability in rainfall (real-time or forecast)

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# Essex (UK) Research Pilot Study
## Response Planning

### Automated Model Configuration

- TUFLOW GPU distributed rainfall model – 24/7 standby
- Monitor forecast rainfall vs average and maximum threshold triggers
- Model is triggered to simulate when threshold is exceeded
  1. Initialized ‘Cold Start’ with observed gridded radar data ($0.4mile^2$ resolution, 5 minute interval)
  2. ‘Hot start’ written when model time matches real-time.
  3. Forecast radar data modelled from the ‘hot start’
  4. ‘Hot start’ rewrite when new observed radar data available
  5. Repeat steps from previous ‘hot start’
- Output: Real-time surface water flood hazards and alerts

# Research Pilot Study
## Response Planning

### Ongoing testing to rationalise uncertainty

- Model calibration
- Antecedent conditions?
- Rainfall forecast uncertainty?
- Ensemble forecasts?

# Conclusions
## 2D Modeling and Emergency Management

- Cost and time effective way to accurately assess flood behaviour.
- Particularly well suited to complex flood behaviours
- Useful for informing emergency management decision making
  - ✓ Mitigation phases
  - ✓ Preparedness phases
  - ✓ Response phases
- Note: Modelling results don't provide 100% certainty!
- Combined with historic data, the additional level of flood information available through 2D flood modelling is proving to be a valuable tool for decision makers

# Thankyou

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