USING REALISTIC DISASTER SCENARIO ANALYSIS
To understand natural hazard impacts and emergency management requirements

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WHY DISASTER SCENARIOS

Risk = Hazard × Elements at-risk × Vulnerability

Scenarios enable the combination of these risk attributes to be analysed and ultimately achieve a fuller understanding of the risk.

Enables what if questions to be realistically answered?
HOW CAN THEY BE USED

• Enhance planning:
  • Basing planning assumptions upon realistic consequences of a disaster.
  • Moving beyond planning based upon administrative boundaries.
  • Improving our understanding of the indirect consequences of a disaster, economic losses, possible fatalities and recovery priorities.

• Assist to identify gaps in our understanding
• Enhance resource allocation modelling
• Provide realistic tools for engaging with communities
ULTIMATE BENEFITS IF UTILISED

• Improved knowledge of the risk
• Establishment of priorities for mitigation
• Enhanced planning to manage consequences and apply resources effectively
• Overcome cross boundary issues
• Enhanced engagement with community and political leaders
Historical earthquake epicentres
**DAMAGES**

Number of equivalent addresses destroyed

<table>
<thead>
<tr>
<th>Event</th>
<th>Number of Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63,452</td>
</tr>
<tr>
<td>2</td>
<td>126,955</td>
</tr>
<tr>
<td>3</td>
<td>609,138</td>
</tr>
</tbody>
</table>
Building damage distribution - % of replacement value

(a) Mw 5.5

(b) Mw 6

(c) Mw 7
Median fatalities, by severity night and day

- **Severity 1**: Injuries requiring basic medical aid that could be administered by paramedics.
- **Severity 2**: Injuries requiring a greater medical care and medical technology or surgery, but not expected to be life threatening.
- **Severity 3**: Injuries that pose an immediate life threatening condition if not treated expeditiously.
- **Severity 4**: killed or mortally injured.
# DAMAGES

<table>
<thead>
<tr>
<th>Facility</th>
<th>Event 1</th>
<th>Event 2</th>
<th>Event 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitals</td>
<td>0</td>
<td>2</td>
<td>110</td>
</tr>
<tr>
<td>Schools</td>
<td>4</td>
<td>24</td>
<td>941</td>
</tr>
<tr>
<td>Fire Stations</td>
<td>1</td>
<td>2</td>
<td>119</td>
</tr>
<tr>
<td>Police Stations</td>
<td>0</td>
<td>4</td>
<td>79</td>
</tr>
<tr>
<td>SES Stations</td>
<td>0</td>
<td>3</td>
<td>31</td>
</tr>
<tr>
<td>Ambulance Stations</td>
<td>0</td>
<td>2</td>
<td>74</td>
</tr>
</tbody>
</table>

Damage to essential services to experience > 10%
DAMAGES

(c) Mw 7

Distribution of fatalities and injuries

Distribution of essential services damage
The Newcastle Workers Club. The Club was the scene of the greatest damage to any building in Newcastle. 9 deaths occurred there and many others were injured.

Localised liquefaction of soft soil near rivers

**Local and foreign events**

- Casualties
- Building damage
- Services disruption (Hospitals, Schools...)
- Utilities disruption (Power, Sewage, Fresh Water...)
- Transport disruption (Airports, Roads, Rail...)
INFRASTRUCTURE DAMAGE

- Transport
- Electricity
- Water Supply
- Waste Water
- Communications
YEAR 3 - MODELLING SCENARIOS

1) **Tropical Cyclone, QLD** Rockhampton/Yeppoon
   - University of Queensland in association with Queensland Fire and Emergency Services (QFES) and Livingstone Shire Council
   - Hazards: storm surge, rain and wind

2) **East Coast Low, NSW** Greater Sydney region
   - Risk Frontiers in association with State Emergency Services (SES) New South Wales
   - Hazards: river and surface water flooding and storm surge
1. TROPICAL CYCLONE - QLD

- Modified Tropical Cyclone Marcia (2015)

- Scenario based on a modification of actual track for ‘worst-case’ planning

- Scenario makes landfall east of Shoalwater Bay as a very strong Category 5 cyclone with slow forward speed and at high tide

- Impacts Rockhampton and Yeppoon region
1. TROPICAL CYCLONE - QLD

- Three components: 1) **wind model**, 2) rainfall model and 3) storm surge model

- **Wind model**: a wind field for the modified Martia track has now been completed
- 1 x 1 km grid resolution
- Geoscience Australia Dynamic Land Cover Data (DLCD) has been used to simulate over land mean and gust wind speeds.
- Geoscience Australia wind speed multipliers used to compute maximum three-second gust wind speeds to assess **building damage**
1. TROPICAL CYCLONE - QLD

- Three components: 1) wind model, 2) rainfall model and 3) storm surge model

- **Rainfall model**: uses wind field and storm radius to derive rainfall totals by empirical relations based on US cyclone data

- Rainfall rates are adjusted based on near-surface terrain conditions

- 1 x 1 km grid resolution like wind model
1. TROPICAL CYCLONE - QLD

- Three components: 1) wind model, 2) rainfall model and 3) storm surge model

  - **Storm surge model**: uses BMT WBM’s TUFLOW surge model

  - Model is driven using background tides and cyclone wind field from wind model over wider region

  - Storm tide heights will be converted to **inundation hazard maps** using high-res land elevation data within the focus area (white box)
2. EAST COAST LOW - NSW

- Focus on **river flooding**, but also includes **surface water** and **storm surge flooding** where applicable.

- After consultation, flood modelling is of most use to end user if it is **regional** and **time-variant** (i.e. cross-catchment and 3-hrly flood surfaces throughout the storm).

- Covers five rivers across Sydney West, Sydney CBD and Central Coast NSW.

- Modelling underpinned by high-resolution (1 m²) **coastal lidar data** and **river and rainfall gauge network**.
2. EAST COAST LOW - NSW

• **17 - 21 Mar 1978** – severe flooding of the Hawksbury, Georges rivers
  Not really an East Coast Low, but an extra-tropical transition of a Tropical Low, with a slightly more inland flood footprint

• **5 - 8 Aug 1986** – severe flooding of the Nepean, Hawksbury, Georges rivers
  A fairly stationary East Coast Low on the Central NSW coast
2. EAST COAST LOW - NSW

STEP 1: Develop relationship between rainfall and river heights on a reach-by-reach basis.

Accumulated rainfall maps

Rainfall to streamflow

Streamflow to river height
2. EAST COAST LOW - NSW

STEP 2: Convert river heights to flood extents on a reach-by-reach basis.

Convert river heights to a sloped flood surface over the floodplain.

Extract all terrain underneath flood surface.

OVERALL: Rainfall maps converted to river flood maps.
2. EAST COAST LOW - NSW

- Forecast or historical rainfall maps
- Pre-processed database of flood extents
- Rapid viewing of first-pass inundation extents at 3-hr intervals through the storm
- Flood layers intersected with geo-located assets and infrastructure data
SUMMARY YEAR 3 MODELLING

- **Tropical Cyclone** scenario for Rockhampton/Yeppoon that includes wind, rain and storm surge

- Development and calibration of the storm surge model has delayed the final outcomes and report. The final scenario results will be delivered in report form by the **end of April 2017**.

- **East Coast Low** scenario for Sydney region that includes river and surface water flooding and storm surge

- Delayed consultation with key end-user means extension has been requested. The final scenario results will be delivered in report form by the **mid-May 2017**.

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