INCLUDING INTANGIBLE VALUES IN NATURAL HAZARD DECISION MAKING
The Economics of Natural Hazards

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1) Objective of mitigation: protect the values affected by natural hazards

2) How do we determine which management options offer the best value for money?
   a) Limited budgets
   b) Prioritise investments between different locations and different hazards
1) Need better information about the environmental and social values affected

2) Need to weigh up all of the economic, environmental and social costs in an integrated economic assessment

→ Benefit-cost analyses
1) Tangible, market costs and benefits
   - Well documented

2) Intangible, non-market costs and benefits
   - Less so

Figure 2.2  The economic costs of natural disasters

Source: Adapted from BTE (2001).
HOW DO WE MEASURE THE INTANGIBLE?

1) Quantified in financial equivalent terms

2) Non-market valuation:

A set of economic methodologies able to estimate monetary figures for non-market costs and benefits

Data collected by analysing related markets, or through surveys

Identifies "willingness to pay" for a change in provision of a public good or service

→ $ values can be used in benefit-cost analyses
ORIGINAL STUDIES ARE IDEAL, BUT...

1) Natural hazards can impact a large area

2) Multiple non-market values are affected

3) To measure them all with non-market valuation
   a) requires extensive research;
   b) original studies are expensive and time consuming...
AN ALTERNATIVE: BENEFIT TRANSFER

1) Benefit transfer uses $ values estimated from original studies and applies them to similar policy contexts.

2) Can be complicated:
   a) Decision contexts are rarely the same
   b) There are not many original studies measuring willingness to pay for values affected by natural hazards
   c) Leads to uncertainty in the transferred values

3) Uncertain information is better than no information.
## Value Tool for Natural Hazards

A database of existing non-market values that can be used for benefit transfer

<table>
<thead>
<tr>
<th>Citation</th>
<th>Hazard type</th>
<th>Value type</th>
<th>Brief summary of study objectives</th>
<th>Recommendations</th>
<th>Definition of marginal change</th>
<th>Hazard type identified</th>
<th>Specific val type measure</th>
<th>Willingness to pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambrey and Pinning 2011</td>
<td>Fire, Flood, Storm, Earthquake, Tasmanian</td>
<td>Amenity</td>
<td>Examination of scenic amenity on fire satisfaction in SE Queensland</td>
<td>No 1 2 Used for BT in France; be aware of generalized context - not BT specific</td>
<td>WTP for one unit improvement in scenic amenity on a 10-point scale by non-market</td>
<td>Not specified</td>
<td>Scenic amenity</td>
<td>$14,251.46 per household per year</td>
</tr>
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<td>Ambrey and Pinning 2011</td>
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<td>Amenity</td>
<td>Examination of scenic amenity on fire satisfaction in SE Queensland</td>
<td>No 1 2 Used for BT in Australia; be aware of generalized context - not BT specific</td>
<td>WTP for one-unit improvement in scenic amenity on a 10-point scale by non-market</td>
<td>Not specified</td>
<td>Scenic amenity</td>
<td>$5,700 per person per year</td>
</tr>
<tr>
<td>Bin, et al. 2008</td>
<td>Flood, Storm</td>
<td>Amenity</td>
<td>Measurement of the rates of scenic amenity and flood risk on property value</td>
<td>Yes 2 2 Used for RTR BT, especially flood context; be aware of adjusting for population differences</td>
<td>WTP to increase view by one degree</td>
<td>Flood, Storm</td>
<td>Scenic amenity</td>
<td>$355.31 per property purchase</td>
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<td>Amenity</td>
<td>Measurement of the rates of scenic amenity and flood risk on property value</td>
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<td>WTP to increase view by one degree</td>
<td>Flood</td>
<td>Flood risk</td>
<td>-$36,081.16 per property purchase</td>
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<td>Flood, Storm</td>
<td>Amenity</td>
<td>Measurement of the rates of scenic amenity and flood risk on property value</td>
<td>Yes 2 2 Used for RTR BT, especially flood context; be aware of adjusting for population differences</td>
<td>WTP to increase view by one degree</td>
<td>Flood, Storm</td>
<td>Flood</td>
<td>$651.16 per property purchase</td>
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<td>Bin, et al. 2008</td>
<td>Flood, Storm</td>
<td>Amenity</td>
<td>Measurement of the rates of scenic amenity and flood risk on property value</td>
<td>Yes 2 2 Used for RTR BT, especially flood context; be aware of adjusting for population differences</td>
<td>WTP to increase view by one degree</td>
<td>Flood, Storm</td>
<td>Flood</td>
<td>$173,351.03 per property purchase</td>
</tr>
<tr>
<td>Res oils 2004</td>
<td>Fire, Recreation</td>
<td>Amenity</td>
<td>Examination of fire impacts on the aesthetic values with respect to user demand and values for recreation</td>
<td>Yes 3 2 Used for RTR BT, especially fire context; be aware of adjusting for population differences</td>
<td>Consumer surplus per day for booking demand associated with the impacts of fire recovery</td>
<td>Fire, Recreation</td>
<td>Recreation value</td>
<td>$17 per trip</td>
</tr>
</tbody>
</table>
NON-MARKET VALUES AFFECTED BY NATURAL HAZARDS

Health values
- Physical health
- Mental health

Environmental values
- Ecosystems
- Water quality

Social values
- Recreation
- Amenity
- Safety
- Cultural heritage
- Social disruption
- Memorabilia
- Animal welfare
USING THE VALUE TOOL DATABASE

1) Define the policy context
   a) hazard/mitigation action, values affected, who is affected

2) Define the bounds of the benefit transfer – Guidelines
   a) Critical to understand the breadth of the existing non-market value literature on the relevant value types

3) Consult the database
CASE STUDY: BROWNHILL AND KESWICK CREEKS CATCHMENT

1) High flood risk catchment in Adelaide

2) Mitigation options include creek capacity upgrades, bypasses and detention dams

3) Our other project – benefit cost analysis of the different mitigation options, including non-market values

DEFINE THE POLICY CONTEXT

1) What is the natural hazard type?
   - Flooding

2) Which non-market values are affected by the hazard type or its mitigation?
NON-MARKET VALUES AFFECTED IN THE CATCHMENT

Health values
- Physical health: mortality
- Mental health: stress, anxiety

Environmental values
- negligible

Social values
- Amenity: amenity related park recreation
- Cultural heritage: Stone Pine trees
- Social disruption:
  - Electricity outage
  - Road traffic annoyance
  - Road traffic delays
  - Inability to return home
1) What is the natural hazard type?
   - Flooding

2) Which non-market values are affected by the hazard type or its mitigation?
   - We’ll focus on social disruption – electricity outage

3) How are those values affected, in terms of the physical changes likely to occur?
   - Mitigation works will reduce # of households experiencing 12hr outage
1) What is the natural hazard type?
   - Flooding

2) Which non-market values are affected by the hazard type or its mitigation?
   - Social disruption - electricity outage

3) How are those values affected, in terms of the physical changes likely to occur?
   - Mitigation works will reduce # of households experiencing 12hr outage

4) What is the scale of the proposed change?
   - 100yr ARI flood = 1,172 households affected
   - Full mitigation works = 6 households affected
1) What is the natural hazard type?
   - Flooding

2) Which non-market values are affected by the hazard type or its mitigation?
   - Social disruption – electricity outage

3) How are those values affected, in terms of the physical changes likely to occur?
   - Mitigation works will reduce # of households experiencing 12hr outage

4) What is the scale of the proposed change?
   - 100yr flood = 1172 households with 12hr outage
   - Full mitigation works = 6 households with 12hr outage

5) What are the socio-economic characteristics of the affected population?
   - Greater Adelaide area population
1) Social disruption:

“There are very few cases where non-market valuation studies have estimated the value of avoiding social disruption. These are either not in the context of natural hazards, or are not Australian studies.”

2) Benefit transfer:

Recommend an ‘adjusted unit value transfer’
**CONSULT THE DATABASE**

(1) Select the relevant value category

<table>
<thead>
<tr>
<th>Observation ID</th>
<th>Citation</th>
<th>Hazard types applicable</th>
<th>Value type applicable</th>
<th>Brief summary of study objective(s)</th>
<th>Study conducted in the context</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Hensher, et al. 2014</td>
<td>Fire, Flood, Storm, Earthquake, Tsunami</td>
<td>Social disruption</td>
<td>WTP for the disruption of electrical service in Canberra, Australia</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Landry, et al. 2007</td>
<td>Flood, Storm</td>
<td>Social disruption</td>
<td>Measurement of the WTP for a sample of relatively poor households to return home after Hurricane Katrina</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Cicia and Colantuoni 2010</td>
<td>Fire, Flood, Storm, Earthquake, Animal welfare</td>
<td></td>
<td>Measurement of the WTP for animal welfare in livestock production</td>
<td></td>
</tr>
</tbody>
</table>

(2) Select studies matching your hazard & value type
(3) Refine study selection:
- How well does the marginal change correspond to your policy context?
- How well do the sample characteristics match?
CONSULT THE DATABASE

<table>
<thead>
<tr>
<th>Observation ID</th>
<th>Citation</th>
<th>Definition of marginal change (This is what is being measured - e.g. WTP to avoid being located in a hazard risk zone)</th>
<th>Hazard types identified</th>
<th>Specific value type measured</th>
<th>WTP estimate (2016 AUS$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Hensher, et al. 2014</td>
<td>WTP for a residential customer to avoid an 12-hour electricity outage per event</td>
<td>Not specified</td>
<td>Social disruption</td>
<td>$65.57 per customer</td>
</tr>
</tbody>
</table>

(4) Find the willingness to pay estimate in 2016 AUS$
CONDUCTING THE BENEFIT TRANSFER
ADJUSTING THE UNIT VALUE TRANSFER

1) Willingness to pay to avoid 12hr electricity outage

=$90.57 per household per event, for ACT residents

2) Our decision affects Greater Adelaide residents → income adjustment

=$90.57 \times 78.48$

=$71.08$ per household per event, for Greater Adelaide
CONDUCTING THE BENEFIT TRANSFER AGGREGATION

1) Willingness to pay = $71.08/household

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Households affected</th>
<th>Willingess to pay to avoid 12hr outage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current scenario: 100yr ARI flood</td>
<td>1172</td>
<td>$83,304</td>
</tr>
<tr>
<td>Full mitigation works</td>
<td>6</td>
<td>$427</td>
</tr>
</tbody>
</table>

The non-market benefits of the mitigation works for avoiding a 12hr electricity outage are $82,877
A VALUE TOOL FOR NATURAL HAZARDS

1) Accessible database of $ estimates for non-market values

2) Guidelines on conducting simple benefit transfers

3) Easier to account for all costs and benefits that affect natural hazard decision making
**NEXT STEPS**

1) Finalising the database & guidelines

2) Online presence
   a) Website housing the Value Tool
   b) Explanatory videos on how to use it

3) Training workshops (e.g. ANHMC)

4) Updating and finding a custodian
JOIN THE UWA TEAM AT OUR BREAKOUT SESSION TOMORROW: 11.15AM ROOM 1

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Fiona Gibson
Atakelty Hailu
Veronique Florec
Jacob Hawkins

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TRADE-OFF: INCOMPLETE OR UNCERTAIN INFORMATION

1) Better to include information with uncertainty than to ignore it completely (Pannell & Gibson 2016):
   a) Investigated variables used in decision metrics for environmental project prioritisation
   b) Environmental outcomes were better with uncertain information compared to incomplete information

→ Values from benefit transfer are worth including in benefit-cost analyses

(4) Check the recommendations made about the study