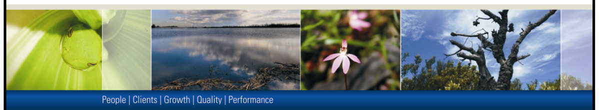

An Ocean of Inundation – Managing Coastal Floodplain Inundation Risks

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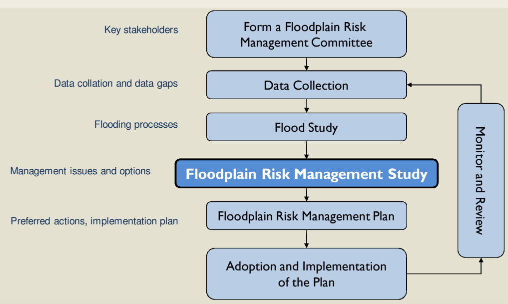
52nd Floodplain Management Association Conference
22 - 24 February 2012

Overview

- *Brisbane Water Floodplain Risk Management Study*
- Background and study area
- Flood behaviour
- Economic impact of flooding
- Floodplain risk management options
- Options assessment
- Example location within the study area
- Preliminary outcomes and conclusion.

Introduction

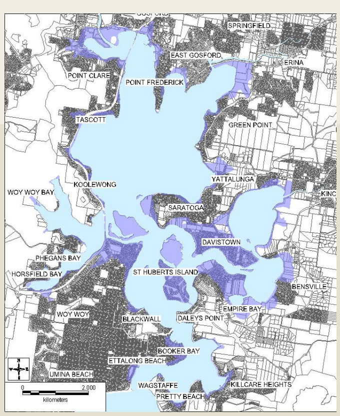


Introduction

- Coastal and estuarine locations are subject to **complex inundation processes** – catchment and tidal flows
- *NSW State Policy on Sea Level Rise* (DECCW, 2009)
- Integration of policies – consistent management and planning
- Balancing the management of:
  - Current flood risk (no sea level rise)
  - Future flood risk (with sea level rise)
  - Future tidal inundation (everyday inundation from tides)

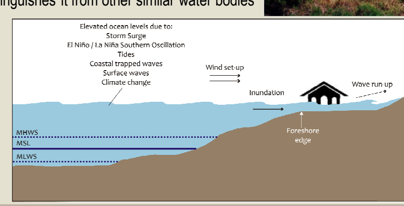
Study Area

- The Brisbane Water Estuary is located 50km north of Sydney
- City of Gosford LGA
- Wave-dominated barrier estuary (open to ocean but with narrow entrance)
- Tidal tributary of the Lower Hawkesbury River system



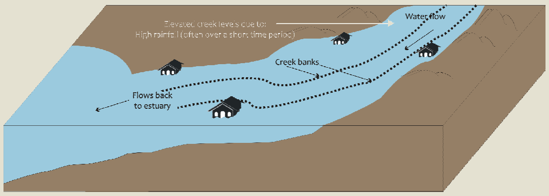
Flooding Processes

- **Coastal inundation** – elevated ocean and estuarine water levels due to significant coastal waves, large ocean storm surges
- **Dominant** type of inundation in Brisbane Water
- This distinguishes it from other similar water bodies



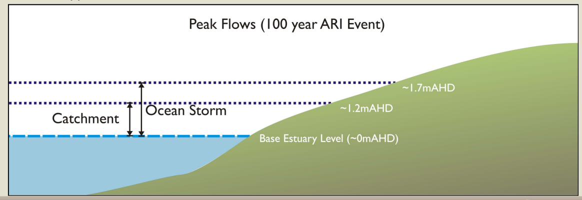
Flooding Processes

- **Catchment flooding**, where intense rainfall causes rising water levels
- Dominant **only** in individual sub-catchments and tributaries of the main estuary.



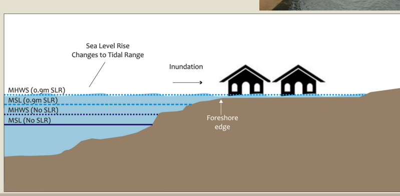
Flooding Processes

- Comparison of peak flow volumes:
  - Catchment flows (total runoff volume from 100 year ARI event of 6-hours duration) = approx. **24,000,000 m^3**
  - Ocean storm event (coastal inundation volume at the peak of the 100 year ARI) = approx. **128,000,000 m^3**



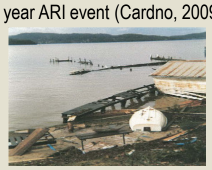
Flooding Processes

- **Tidal inundation** – "everyday" ocean and estuarine water levels affect foreshores
- Projected to worsen/become more frequent in the future (with SLR)



Major Historical Events

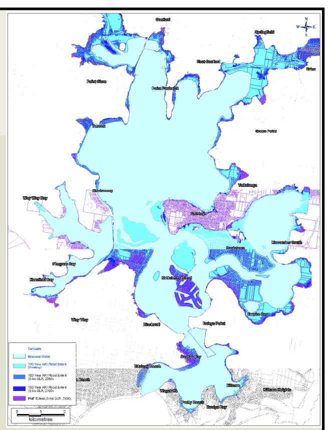
- 1974 severe ocean storm - highest recorded water levels, estimated as a 200 year ARI event (Cardno, 2009)



- More recent but less severe event in 2007 (when the oil tanker "Pasha Bulka" ran aground off Newcastle)

Existing and Future Flood Risk

- Number of private properties affected:
  - **100 year ARI (existing case)** = 1,910 properties
  - **100 year ARI (with 0.9m SLR case)** = 4,343 properties
  - Properties affected are mostly residential (~95%)
- Other assets also affected e.g. electricity and telecommunications infrastructure



Economic Damages

- Assessed for the existing scenario (no SLR) and the future scenario (0.9m SLR)
- Limitations were found when comparing the results
- Lower ARI events in existing scenario – no damages
- Damages for **future scenario (0.9m SLR)** – highly influenced by **2 year ARI event**
- Unlikely – avoid regular damage in the future
- Future scenario damages still useful in identifying the scale of modification/adaptation required.

Flooding Issues

- Flooding issues are interrelated – difficult to separate
- Areas may be affected by more than one type of flooding
  - An option that manages **existing coastal inundation** (no SLR) may also manage **future tidal inundation** (with SLR)
  - Another option may assist with managing coastal inundation but may exacerbate catchment flooding
- **Existing coastal inundation** risk is of highest priority – **current risk** to life and property
- **Future inundation risks** (coastal inundation and tidal inundation) are important, but of lower priority – do not present a current risk

Flooding Issues

Existing Scenario (Without Sea Level Rise)		Future Scenario (With Sea Level Rise)	
Issue	Description	Issue	Description
Coastal inundation	Dominant. Infrequent occurrence, high water levels, moderate consequences	**Coastal inundation**	Dominant. Infrequent occurrence, higher water levels, high consequences. Projected to increase by 0.4m by 2050 and 0.9m by 2100
Catchment flooding	Not dominant in estuary. Dealt with in sub-catchment or tributary FRMS&Ps (e.g. Erina Creek, Empire Bay/Davistown etc.)	**Catchment flooding**	Not dominant in estuary. Dealt with in sub-catchment or tributary FRMS&Ps (e.g. Erina Creek, Empire Bay/Davistown etc.)
		Tidal inundation	More frequent likelihood, lower water levels, moderate consequences. Projected to start occurring with SLR as a shift in the tidal prism occurs

Management Options Assessment

- Many options were identified to manage the flooding issues
- Multi-criteria matrix assessment – lengthy cost/benefit analysis (economic, social, environmental and planning/governance aspects)
- Separate criteria prepared for with and without SLR
- Criteria weightings were used to facilitate the integration of sea level rise:
  - Criteria **without** SLR had weightings of 1 or 0.5
  - Criteria **with** SLR had weightings of 0.1

Management Options – Coastal Inundation

- Examples of coastal inundation management options:
  - VPP, VHR (Voluntary Property Purchase, Voluntary House Raising)
  - Investigation into land swaps (this approach has been recently adopted in Grantham, Queensland)
  - Community education
  - Planning instrument and development control review to ensure consistency with coastal inundation
  - Flood Plan review (SES) to ensure consistency with coastal inundation
  - Flood warning system review
  - Evacuation centre location review – ensuring none within floodplain
  - Development of alternative road transport route plan

Management Options – Tidal Inundation

- Several identified options address SLR:
  - LEP and DCP review to incorporate impacts of predicted SLR
  - Continuation of SLR monitoring and analysis programs
  - Development of management strategies to adapt to tidal inundation
  - Utilities infrastructure review to better understand potential SLR impacts on these assets
  - Exploration of options for the construction of a large storm surge barrier at the estuary entrance
  - Raising of railway infrastructure to accommodate SLR
  - Implementing managed retreat in critical areas

Management Options – Tidal Inundation

- These options do not generally manage existing 'flood' risk
- As such, these options scored lower in the MCA matrix and are unlikely to be implemented as part of the FRM process
- Alternative approach to addressing these issues sought
  - *Climate Change Adaptation Plan*

Climate Change – Strategic Overview

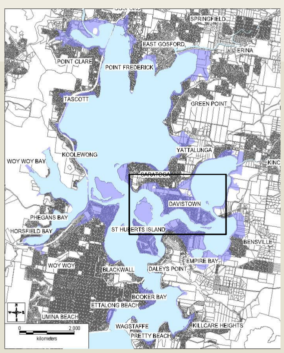
- The *Climate Change Adaptation Plan* is likely to*:*
  - Be undertaken as a separate document
  - Be undertaken at a subsequent stage
  - Assist in the investigation of "trigger levels" and trigger events
  - Assist in the identification of management options that rely on a particular trigger for implementation
  - Include management options relating to future tidal inundation
  - Flow into the next review of the FRMS&P

Management Options – Implementation

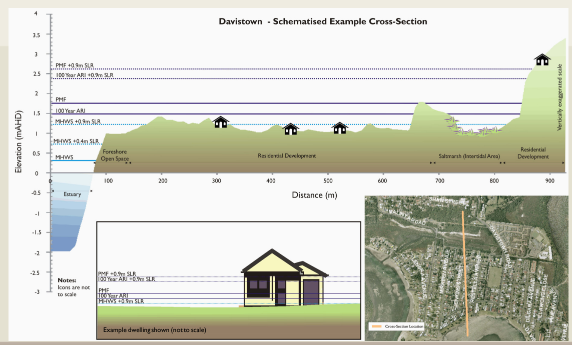
Implementation	Description
Immediate	Likely to: - Address existing risk - Have high feasibility - Be implemented in the short term - Require minimal investigations
Staged	Likely to: - Address existing or future risk - Be implemented in the short to medium term - Require additional investigations - Necessitate interim policy/planning measures
Trigger	Likely to: - Address future risk - Be implemented over the long term - Require additional investigations - Be based on sea level rise "trigger levels" or other trigger events - Necessitate interim policy/planning measures

Example Management Area - Davistown

- Can be affected by existing high tides, especially "king tides"
- Small seawall
- Large number of residential properties
- Flat terrain
- Tidal inundation (with sea level rise) is likely to have significant impacts on the area



Example Management Area - Davistown



Example Management Area - Davistown

- Potential management options include VPP, VHR, specific development/ planning controls, road-raising, land-raising, levees and seawall maintenance.
- These options have varying levels of appropriateness given the flooding issues in this location.

Preliminary Outcomes

- Suggested renaming of the study – "*Coastal Floodplain Inundation Risk Management Study*":
  - Better reflects the dominant flooding process
  - Relevance of options to coastal inundation
  - More transparent , assists community awareness
- Management options that reduce **risk to life** generally ranked highly
- Large reductions in economic damages generally not achievable

Existing coastal inundation (no SLR)	Options most likely to be recommended
Future coastal inundation (with SLR)	Options may be recommended
Future tidal inundation (with SLR)	Options unlikely to be recommended

Conclusion

- Coastal locations – coastal inundation, catchment flooding, tidal
- Brisbane Water case fairly uncommon – **coastal inundation** dominant
- **Existing** flood risk is of primary importance, SLR risks still important
- Challenges exist in integrating SLR into floodplain risk management
- Can be managed through:
  - Careful consideration of the issues and local environment
  - Integrating planning frameworks
  - Looking beyond planning and management frameworks.