# Fit for purpose coastal hazard mapping
# Erosion prone areas

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# State Planning Policy and coastal management

2 state interests relate to coastal management:

- Coastal environment
- Natural hazards – risk and resilience

The risks associated with coastal hazards, including the projected impacts of climate change, are avoided or mitigated to protect people and property and enhance the communities resilience to natural hazards.

# Exposure to coastal hazards

- Coastal erosion
- Storm tide inundation
- Climate change - sea level rise and cyclone intensification are the key threats

# Identifying hazard areas - declared erosion prone areas

- Development assessment - trigger layer for certain development in the coastal zone under Planning Regulation 2017
- Local government planning schemes - usually incorporated into schemes to identify coastal hazard areas for land use decisions
- Coastal hazard adaptation strategies - primary data layer for identifying areas at risk from and coastal erosion including sea level rise

# Erosion Prone Area
# Fraser Coast Region Local Government Area

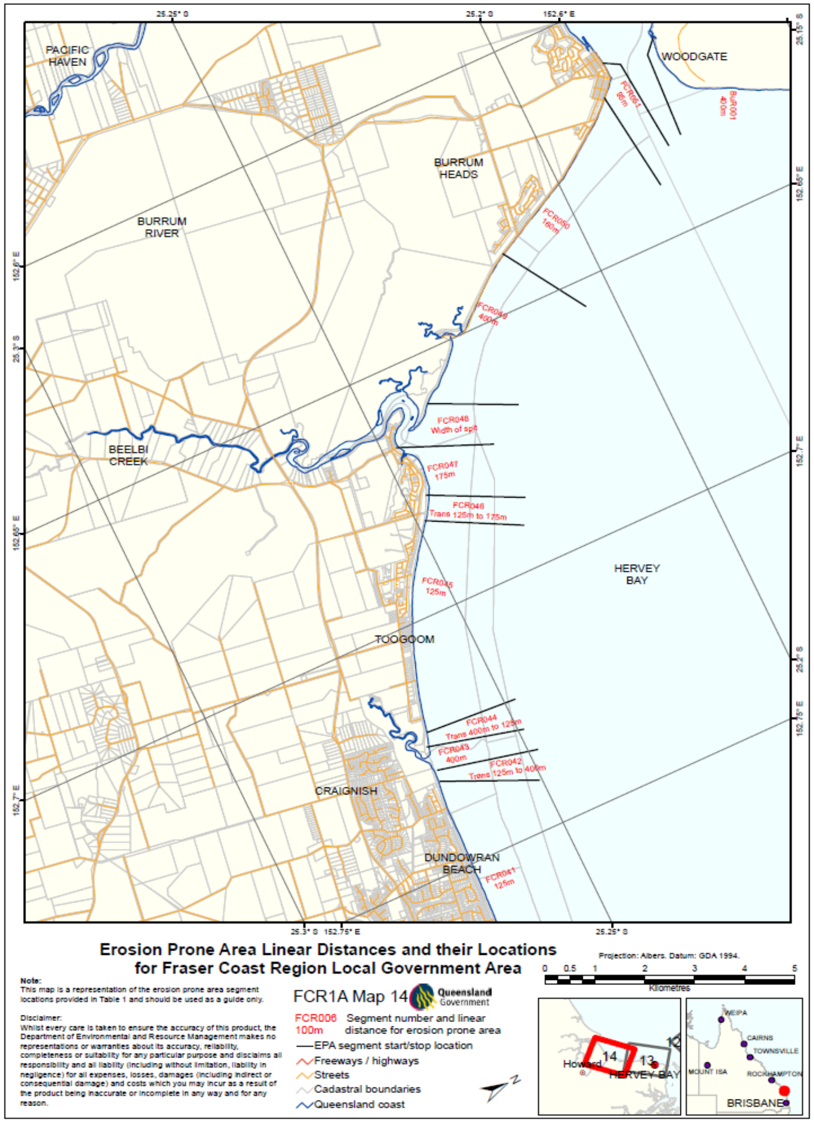
## Erosion Prone Area Definition

1. Erosion prone areas are deemed to exist over all tidal water to the extent of Queensland Coastal Waters and on all land adjacent to tidal water.
2. Erosion prone areas include areas subject to inundation by the highest astronomical tides (HAT) by the year 2100 or at risk from sea erosion.
3. On land adjacent to tidal water the landward boundary of the erosion prone area shall be defined by whichever of the following methods gives the greater erosion prone area width:
   a. a line measured 40 metres landward of the plan position of the present day HAT level except where approved revetments exist in which case the line is measured 10 metres landward of the upper seaward edge of the revetment, irrespective of the presence of outcropping bedrock;
   b. a line located by the linear distance shown on Table 1 and measured, unless specified otherwise, inland from:
      i. the seaward toe of the frontal dune (the seaward toe of the frontal dune is normally approximated by the seaward limit of terrestrial vegetation or, where this cannot be determined, the level of present day HAT); or
      ii. a straight line drawn across the mouth of a waterway between the alignment of the seaward toe of the frontal dune on either side of the mouth
   c. the plan position of the level of HAT plus 0.8 m vertical elevation.

   Except:
   i. where the linear distance specified in 3b is less than 40 metres, in which case section 3a. does not apply and the erosion prone area width will be the greater of 3b and 3c; or
   ii. where outcropping bedrock is present and no approved revetments exist, in which case the line is defined as being coincident with the most seaward bedrock outcrop at the plan position of present day HAT plus 0.8m; or
   iii. in approved canals in which case the line of present day HAT applies, irrespective of the presence of approved revetments or outcropping bedrock.
4. Erosion prone areas defined in accordance with the above are deemed to exist throughout all the local government areas, irrespective of whether the entire local government area is depicted on erosion prone area plans for the area.

## Notes to clarify the definition

1. The specific location along the coast to which each erosion prone area linear distance applies (a segment) is shown in Table 1.
2. A map indicating the approximate location along the coast of each linear distance segment is attached.
3. Each erosion prone area segment is located on the coastline between 2 points defined by latitude and longitude. A projection of each point to the nearest actual coastline and continuing inland perpendicular to the coast defines the erosion prone area segment.
4. "Present day HAT" in the definition is always taken to be the present day level of HAT for the coastline as defined in the Queensland Tide Tables for that year or as defined by empirical methodology at the site.
5. The extent of the erosion prone area where it is defined by "HAT plus 0.8m" is the HAT coastline at the year 2100 and includes sea level rise to that time. It is determined by the area of land inundated to the level HAT of the nearest adjacent open coast or river tide gauge plus 0.8m vertical elevation. Site based HAT is not to be used as present day attenuation of inland HAT level due to flow constraints may not persist to 2100 with coastline response to sea level rise. For further explanation see the Coastal Hazard Technical Guide.
6. Where noted on Table 1 (and the map) the specified linear distance applies except where a revetment has been constructed and maintained to the approved design in which case the landward boundary of the erosion prone area is at the upper seaward edge of the revetment (A-line).
7. The approximate erosion prone area footprint is shown on Coastal Hazard Area Maps available on the Department of Environment and Heritage Protection website at www.ehp.qld.gov.au. These footprints are indicative only and the definition in this plan prevails for any inconsistency between the two.
8. This erosion prone area plan may be updated from time to time and a new revision created. Please check with the Department of Environment and Heritage Protection or the local government that this copy is the current version prior to using the contained information in any way.



# Three components to an erosion prone as per the declared plan

Erosion prone areas are deemed to exist over all tidal water and on land adjacent to all tidal water. Over land, EPA is:

- Calculated by a formula (calculated distance); and
- Where not calculated, a default EPA is applied which is 40m landward of the plan position of highest astronomical tide; and
- The plan position of highest astronomical tide plus 0.8m vertical elevation - permanent inundation by tidal water due to climate change sea level rise.

# Issues in determining the erosion prone area

# 1. Calculated erosion prone area

$$E = [(N \times R) + C + S] \times (1 + F) + D$$

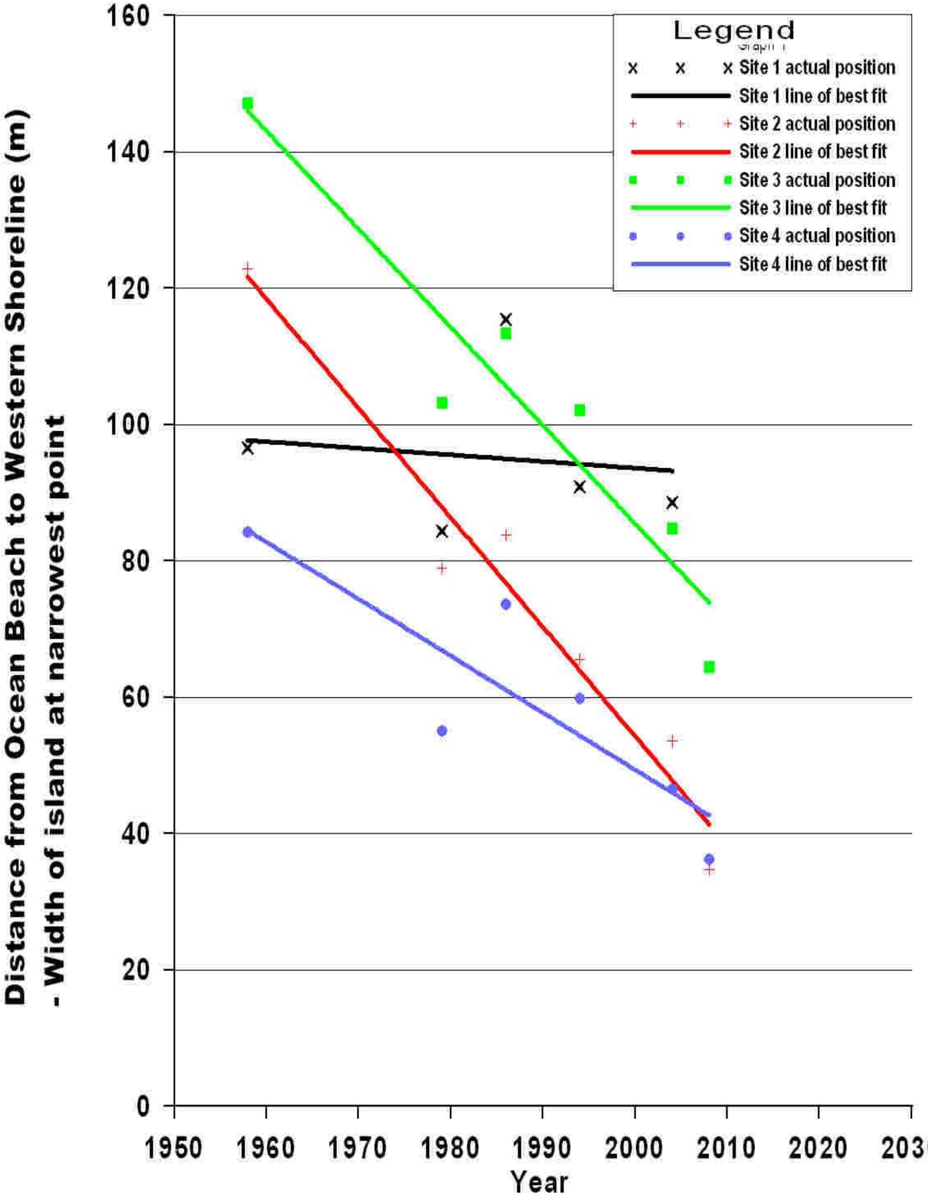
- Assessment of erosion vulnerability based on:
  - N – Long term erosion for a 50 year planning period (R)
  - C – Short term erosion
  - S – Recession due to sea level rise of 0.8m by 2100
  - D – Scarp collapse component
  - F – Safety factor

- Determined for most open coast locations
- Methodology published in DES's Coastal Hazard Technical Guide

# Long term component

- Can be derived from coastal process studies  which determine sand supply and loss for a beach compartment and therefore the long-term sand deficit – derive a horizontal beach recession.
- Can be derives from an analysis of shoreline positions in historical imagery and making an assumption about  the continuation of the erosion trend into the future.
- First look – end point analysis which compares present day with oldest reliable imagery preferably 40 – 50 years
- Detailed look  - regression analysis of multiple shoreline positions over time – gives longtern rate of change.
- DIGITAL SHORELINE ANALYSIS SYSTEM https://woodshole.er.usgs.gov/project-pages/DSAS/

North Bribie Island - Site 2

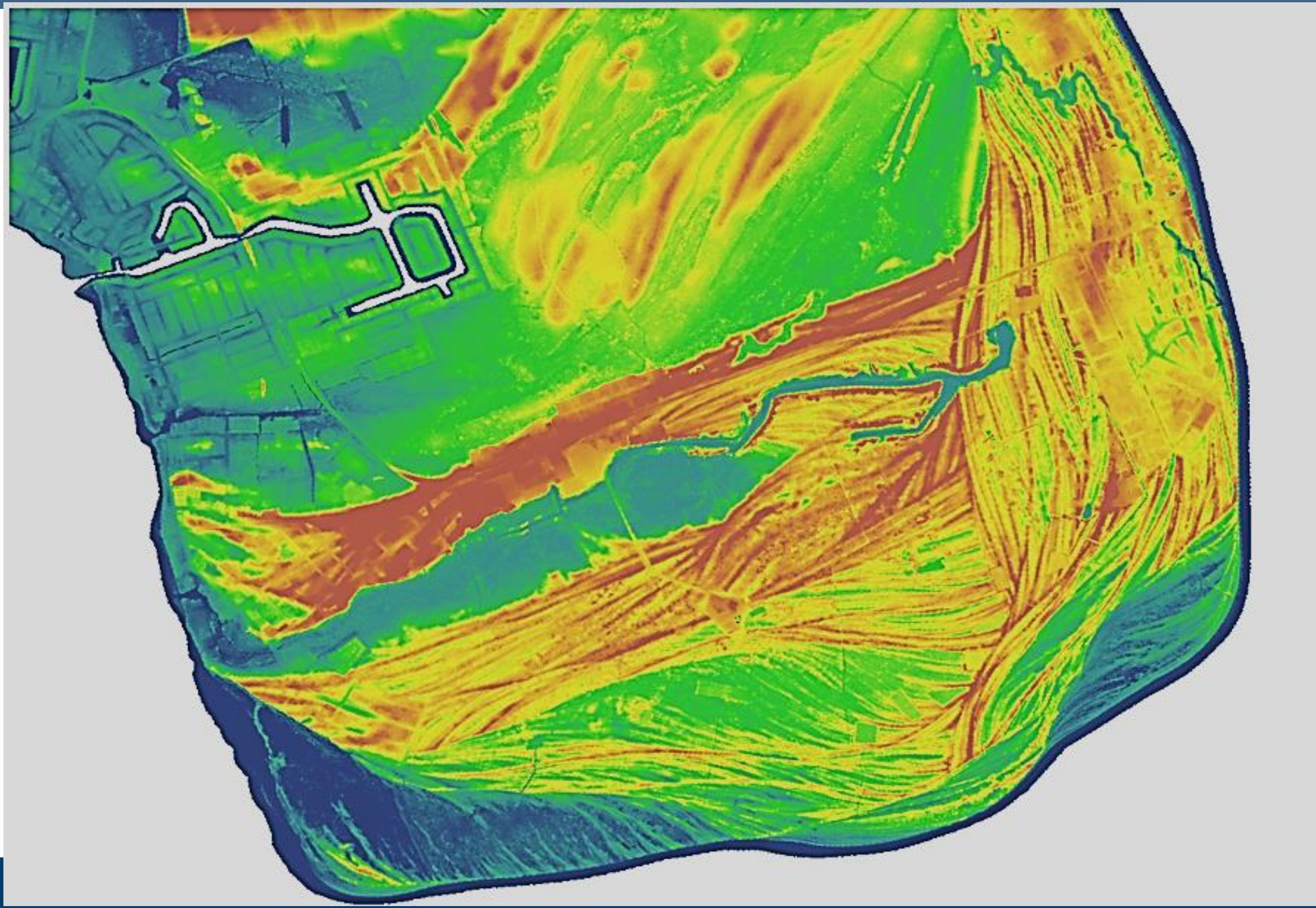



# Duration of long term trend

Identify long term trend from a assessment of erosion driver/geomorphic processes.

Guideline recommends:

- 50 year planning period for cyclical processes – channel migration, sediment pulsing from delta, creek mouth migration
- 100 year planning period for long term processes – river mouth migration, big picture geomorphic processes.



# Beachridge plains



# Short term erosion component

Relatively straight forward use of the Vellinga equation but dependent on  quality underlying data including:

- Accurate profile survey data
- Sediment grain size
- Wave and water level conditions

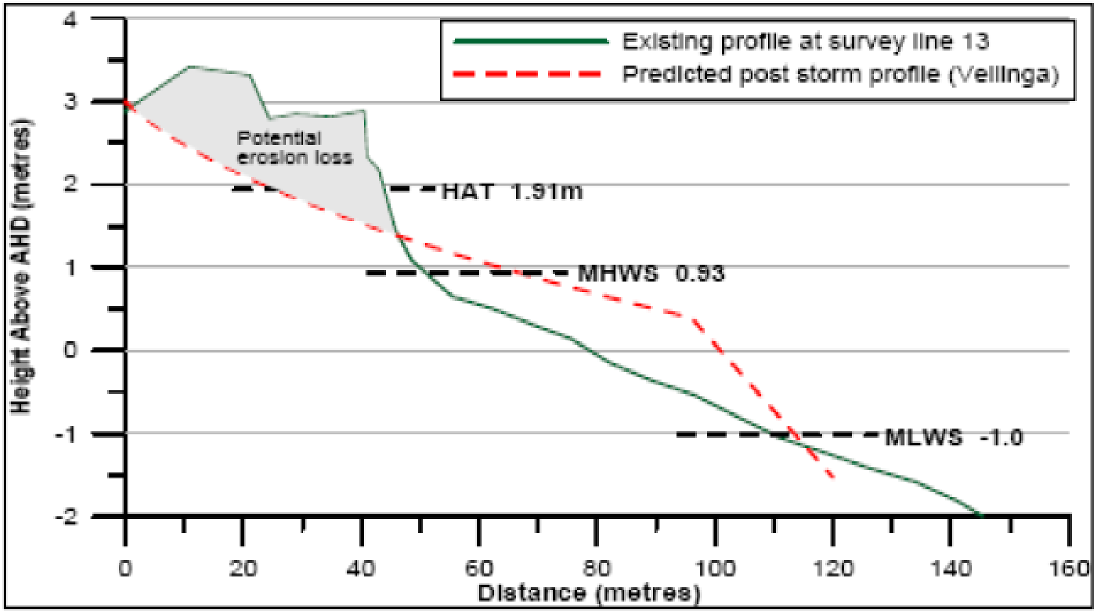


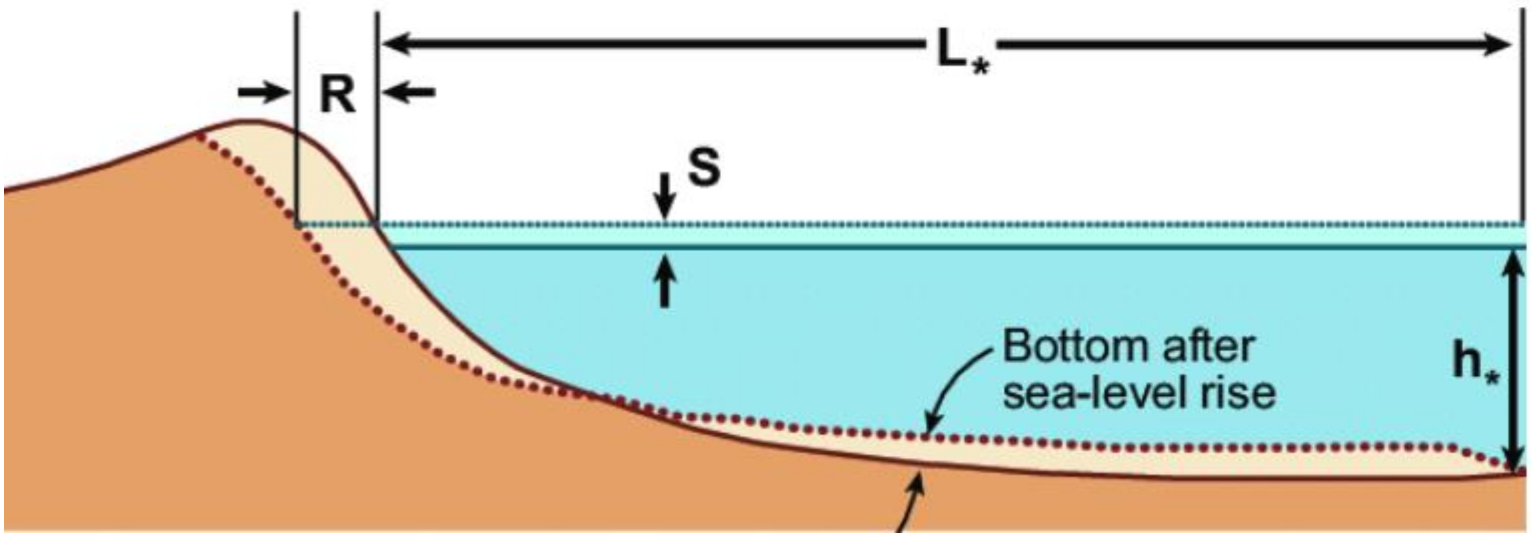

**Figure 2: Estimated short-term beach profile response to a 1-in-100-year average recurrence interval storm event based on Vellinga (1983)—South Mission Beach**

# Issues with short term component

- Present day beach dune profile is ideal – but acquiring survey data especially in the nearshore is problematic
- Erosion of soft rock - cliff retreat
- Assumption that sediment transfer is cyclical

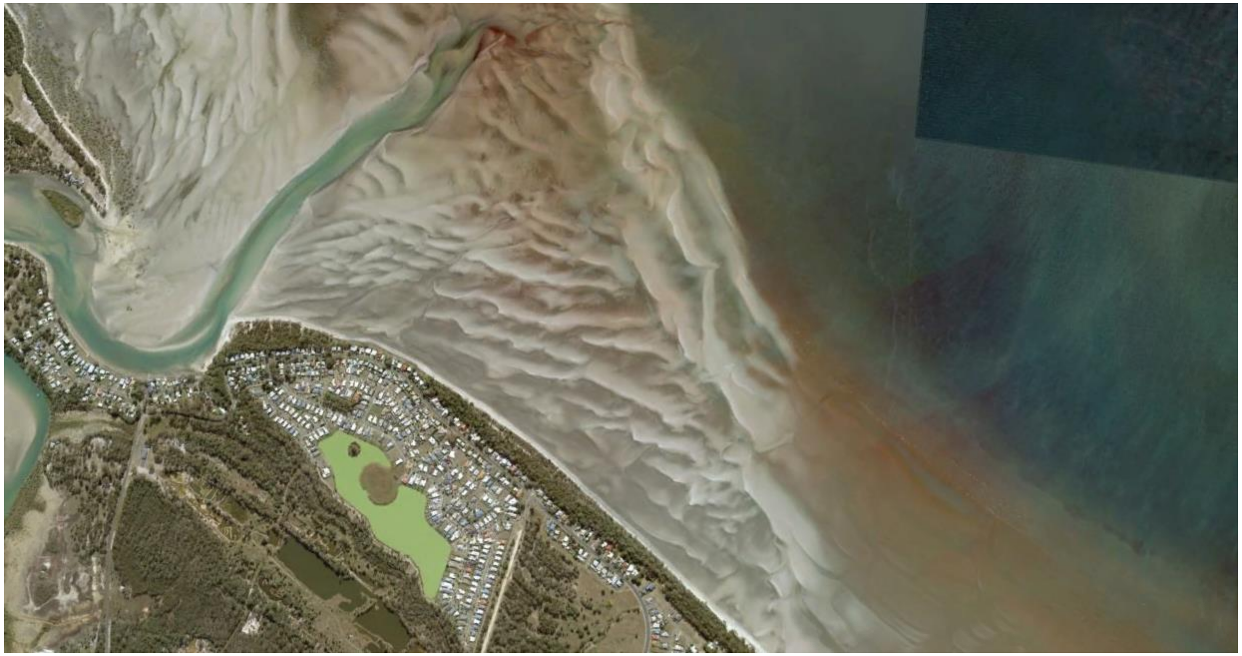
# Recession due to sea level rise

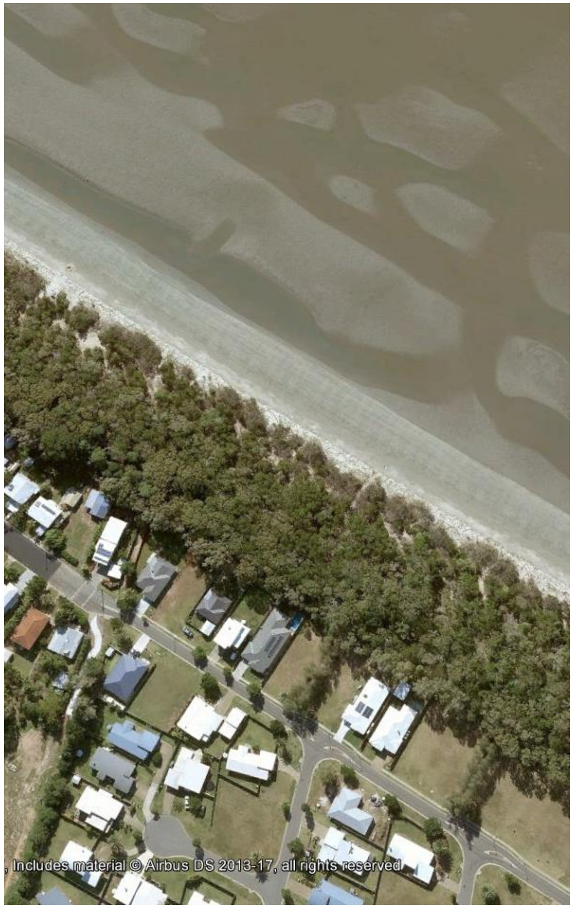
- Use of the Bruun Rule is recommended to estimate erosion due to sea level rise but doesn't work in all situations



# Recession due to sea level rise

- Beaches perched on river delta platforms need to be carefully examined to prevent over-estimation
- No guidance provided on muddy/silty landforms especially riverbank and estuary shores.





# So we're stuck on 0.8m for sea level rise?

# Factor of safety

- Calculated erosion distance increased by 40% to account for errors and uncertainty.
- Sound engineering practice.
- Can it be reduced?

# 2. Default distance - 40m on highest astronomical tide

- Used to estimate erosion where a calculation has not been carried out
- Mainly used in riverine and estuarine tidal areas
- Erosion calculation more difficult in these areas – no specific methodology prescribed

# Can the default distance be changed?

- Bedrock exclusion
- Set at 10m where approved revetment exists
- Will consider a reduced distance (not less than 10m) where erosion drivers are insignificant or non-existent
- But must consider bank stability. Sea level rise morphological response and elevated water level events.
- Typical case would be behind extensive mangrove systems

# 3. Inundation due to sea level rise

- Biggest issue is correctly determining highest astronomical tide level over a region

# Mapping issues

- EPA measured inland from the toe of dune
- Present day mapping preferred or use surrogate eg HAT plus 30cm
- Alternative to toe of dune must be evidence based

# Use of EPA mapping - Coastal Hazard Adaptation Plans and planning schemes

## Test 1: Is the EPA ‘Fit for purpose’?

- State EPA ‘quality’ varies from location to location
  - – based on assessment methodology
  - – ‘beach type’ assessments tend to be conservative

- Issues associated with the assessment age – older assessments may need a ‘refresh’ to consider recent changes and newer data sources

- default value (40m) based on a ‘reasonable’ buffer concept, not processes, in complex estuarine /riverine environments

# Use of EPA mapping - Coastal Hazard Adaptation Plans and planning schemes

**Test 2: how good is the mapping?**

- Base data is LiDAR from 2011 – 2014
  - More recent accretion/erosion not dentified
  - ±15cm vertical resolution error may be an issue for sea level rise inundation
- The extent and condition of coastal erosion structures not considered in the mapping
- Ground truthing has not been possible at this stage

# Decision to reassess erosion prone area or repeat mapping?

- To support planning schemes or adaptation planning
  - Land use planning (e.g. urban footprint)
  - Community vulnerability to coastal hazards

- Cost of the reassessment
  - Geographic extents
  - Complexity of the coastal processes
  - Data availability

# Summary

- EPA's have been a useful planning tool for coastal management in Queensland
- Reassessment generally been based on a coastal processes study
  - Regional, SEMP and site based
  - Can be costly due to modelling and data analysis
- Reassessment of the EPA for beach types is another option
  - May provide a more cost effective option to reassess EPA
  - Can use regional data set (e.g. LiDAR)