

Western Port hydrodynamic and sediment transport modelling

Dr. Kathy Cinque



Western Port Environment Study



- Seagrasses is a key habitat; support ecology and maintain water quality
- Sediment identified as the most critical risk to seagrass health in Western Port
- Sediment affects water clarity → light availability → seagrass growth/recovery

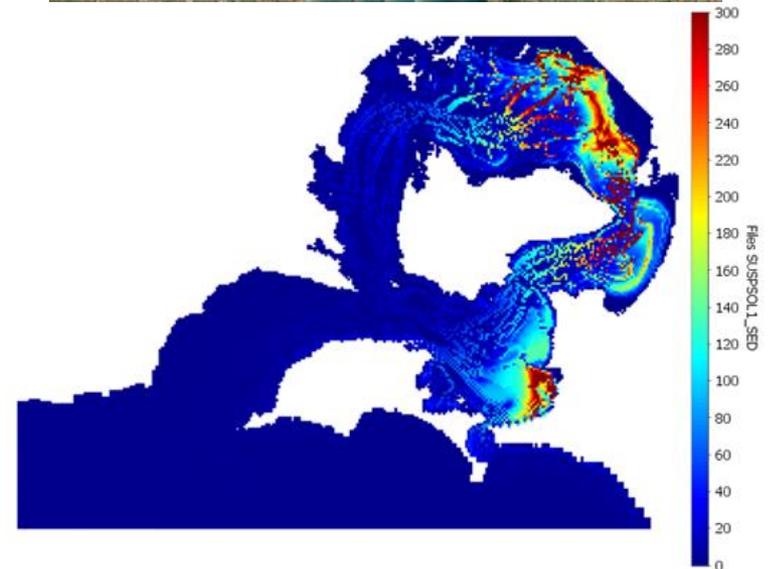
Intended model outputs

- Source, fate and transport of sediment
- Inform catchment management
- Input into the new State Environment Protection Policy (SEPP)
- **Ultimate aim - restore seagrass to pre-1970's coverage**

Modelling in Western Port

Modelling provides us with predictive capability;

- Different sources of sediments
- Help identify effective management actions
- Assist in setting realistic goals that will affect a change in water quality
- Identify where and when change will occur
- Look at impacts of climate change, including sea level rise



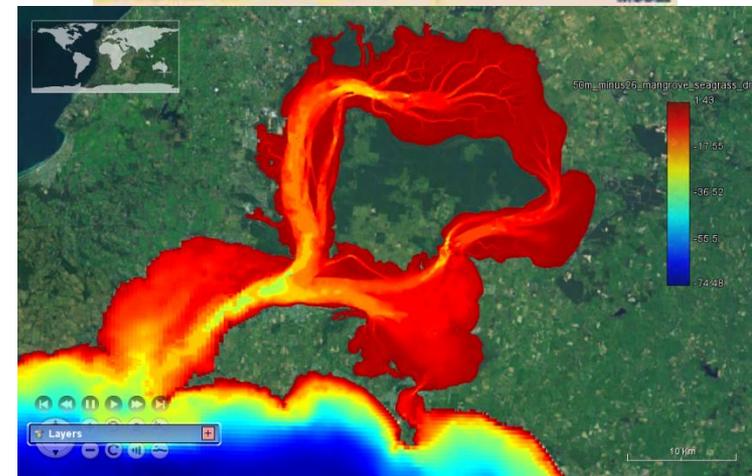
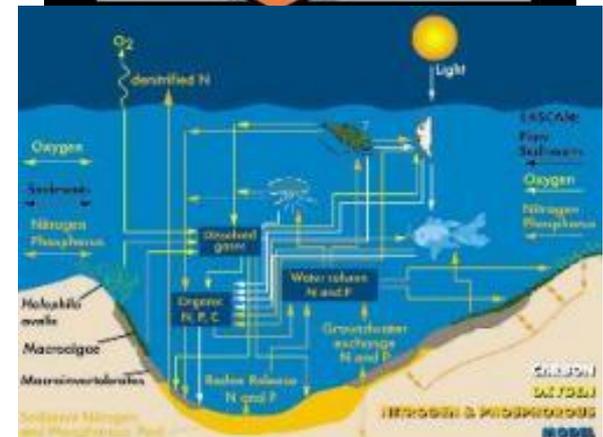
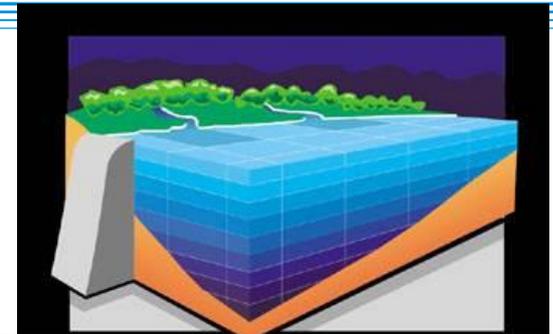
3D Hydrodynamic model

Model details

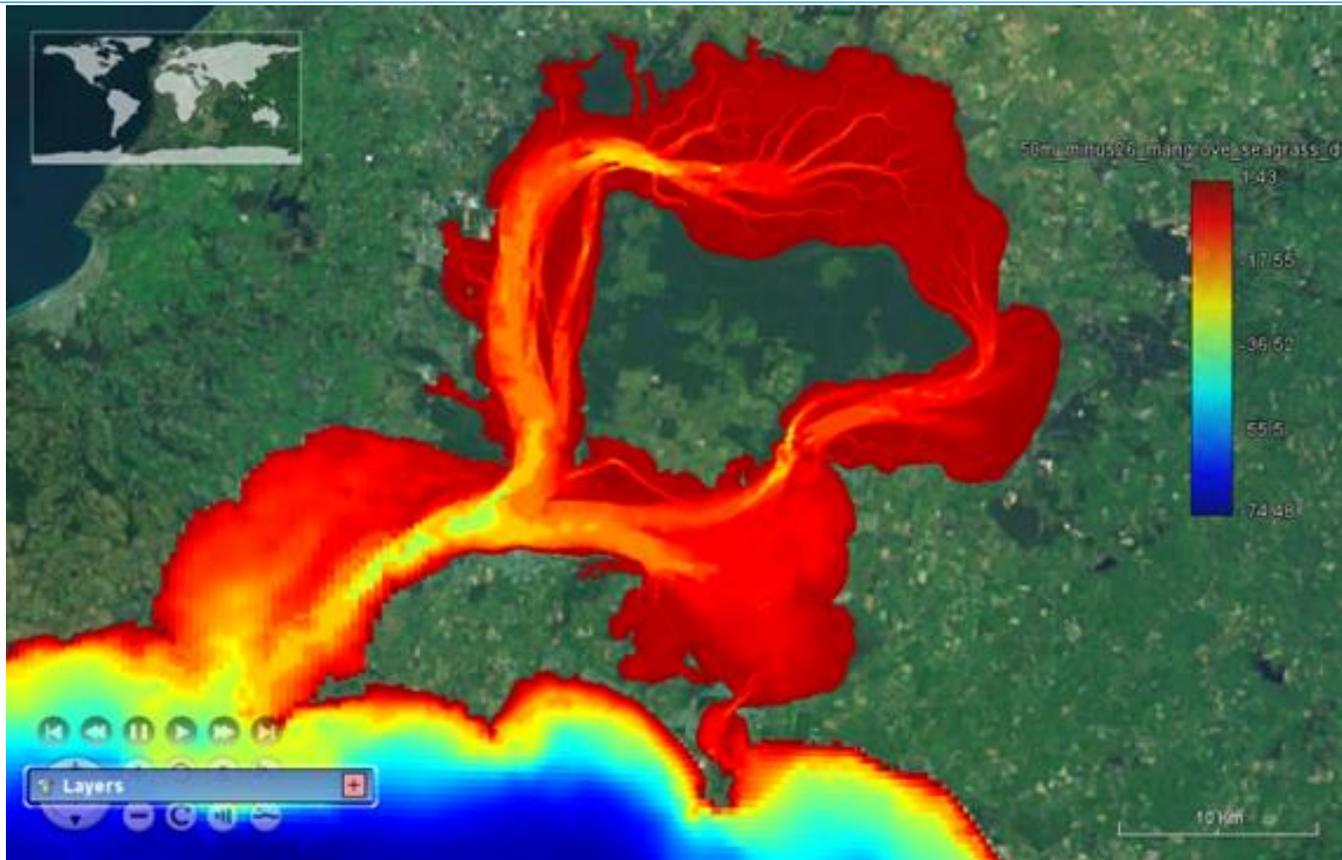
- AEM3D (previously ELCOM/CAEDYM)
- Models velocities, temperatures, salinities and densities
- Includes coupled sediment model

Set Up

- Bathymetry
- Drag coefficients for seagrass and mangroves
- Tides and ocean forcing
- Meteorological data, including wind
- Inflows, including water quality
- Waves
- Sediment characteristics

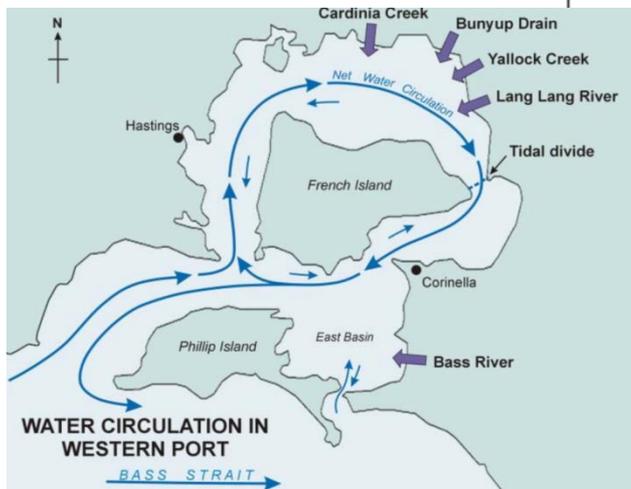


Model outputs

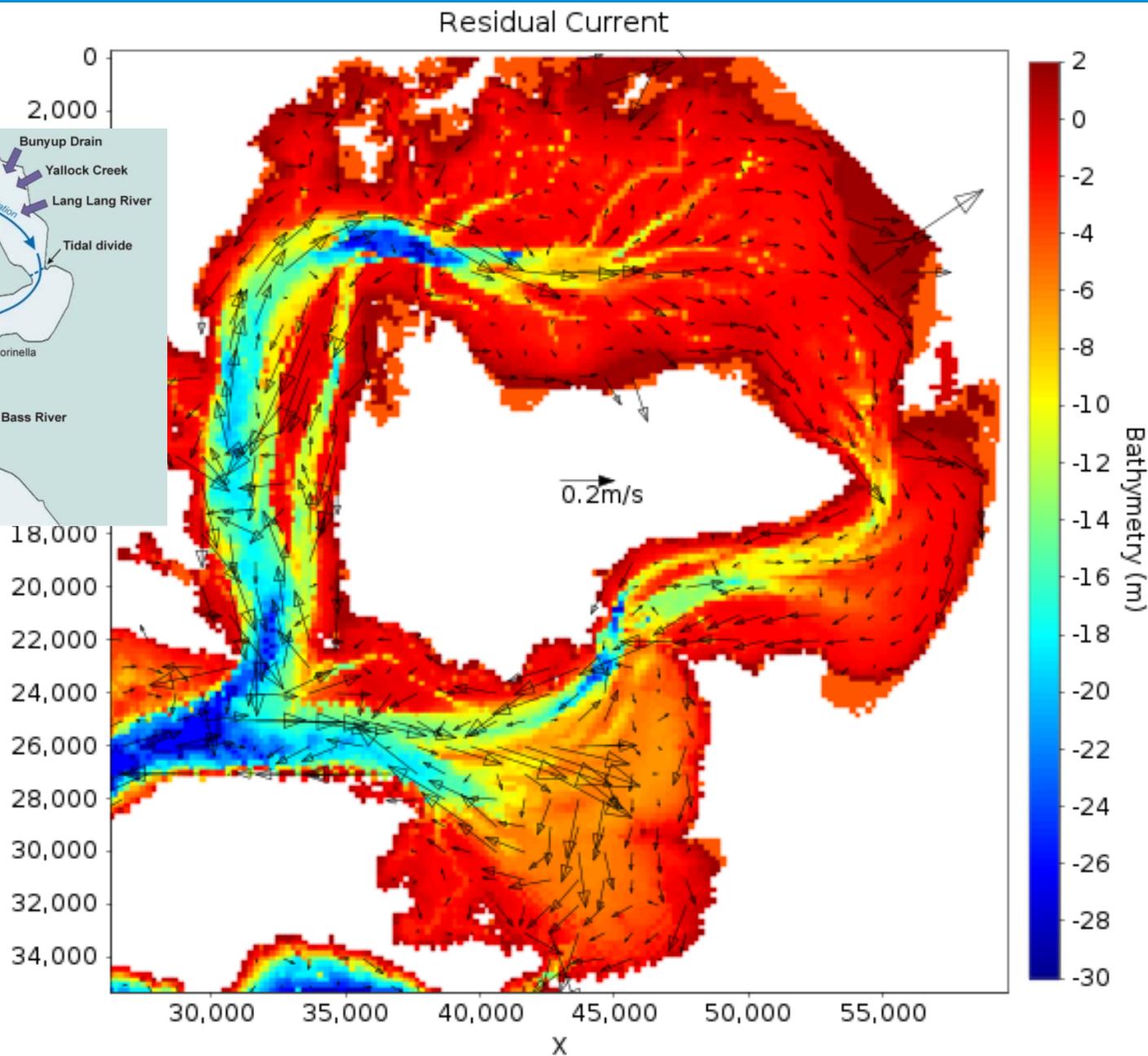


- Circulation
- Speed
- Sediment sources
- Light climate

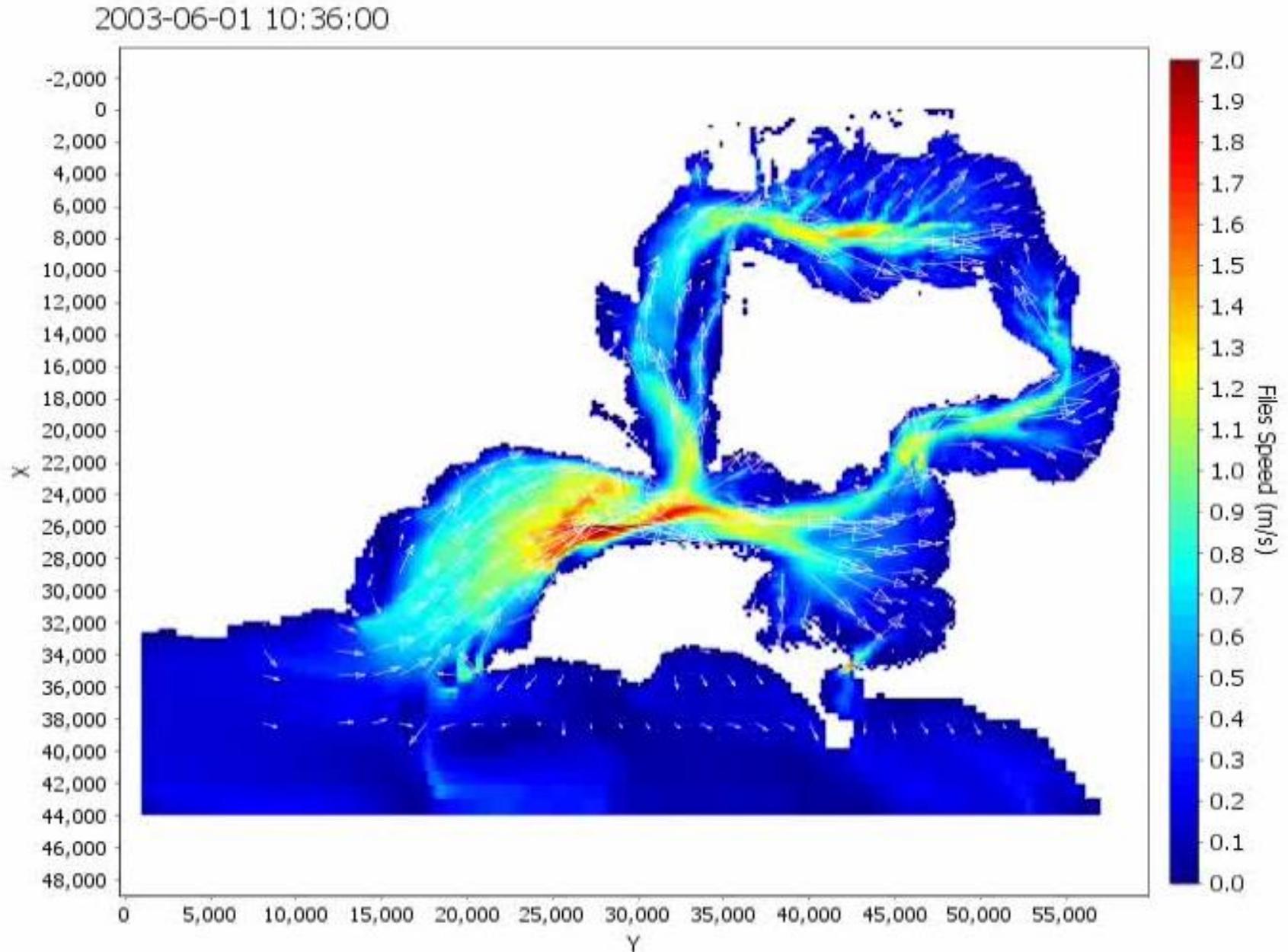
Residual circulation



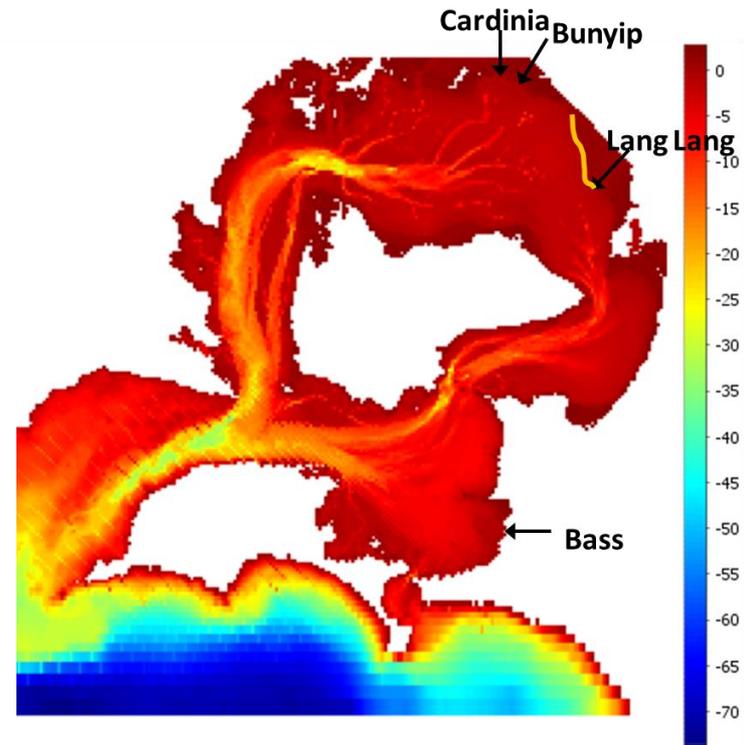
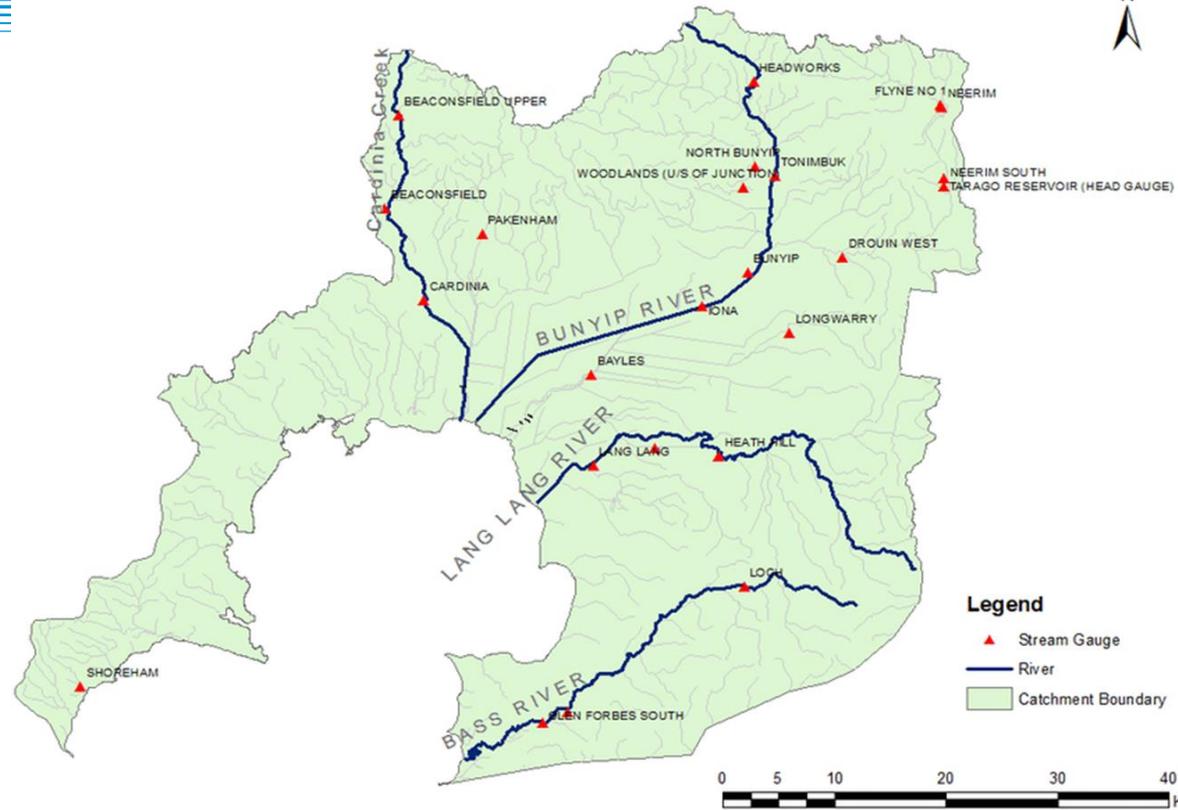
Hancock et al. 2001



Dynamic speed demonstration



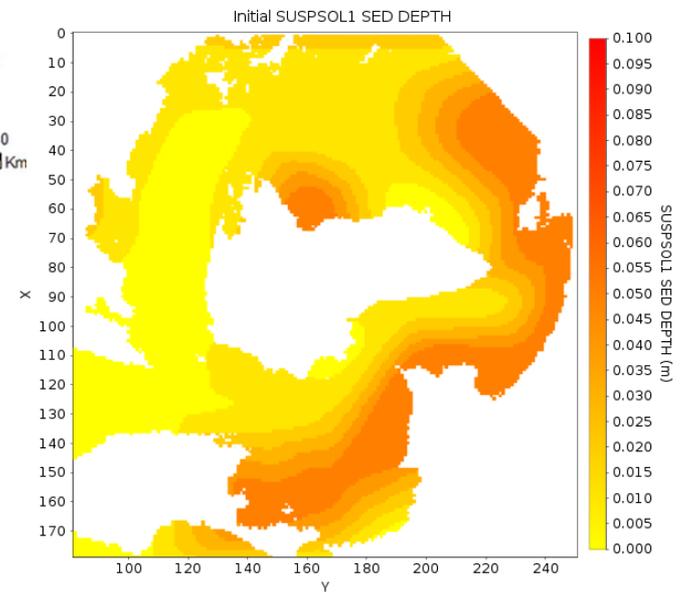
3 x Sediment sources



Legend

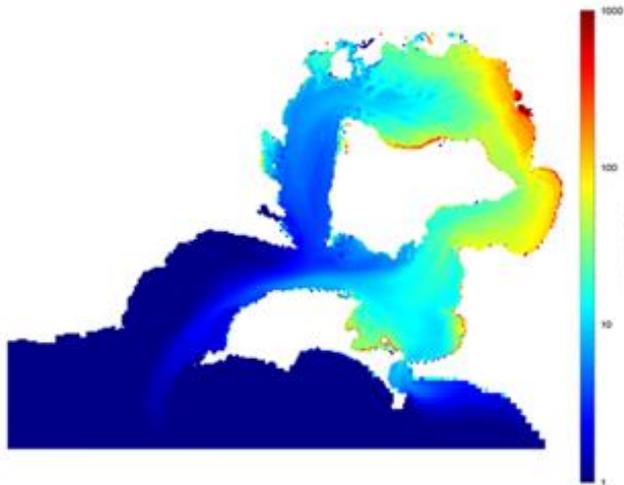
- ▲ Stream Gauge
- River
- Catchment Boundary

Class	Size	Legacy	Catchment	Cliffs
Clay	4 μ m	5cm	20%	20%
Silt	30 μ m	5cm	60%	60%
Sand	60 μ m	5cm	20%	20%
Coarse sand	<250 μ m	5cm	-	-

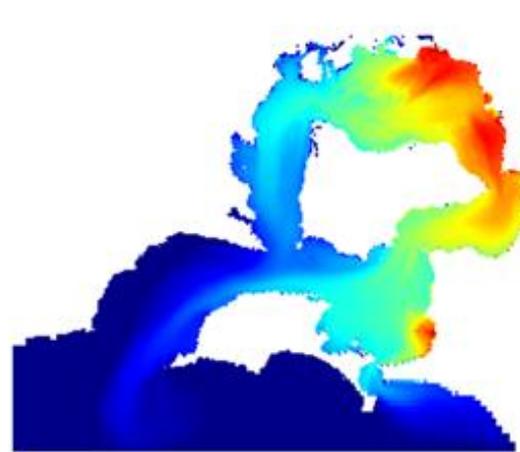


Source of sediments in the water column

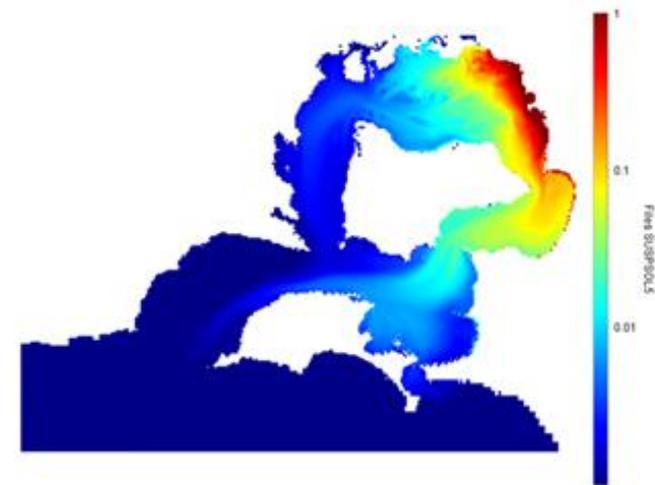
Legacy sediments



Catchment sediments



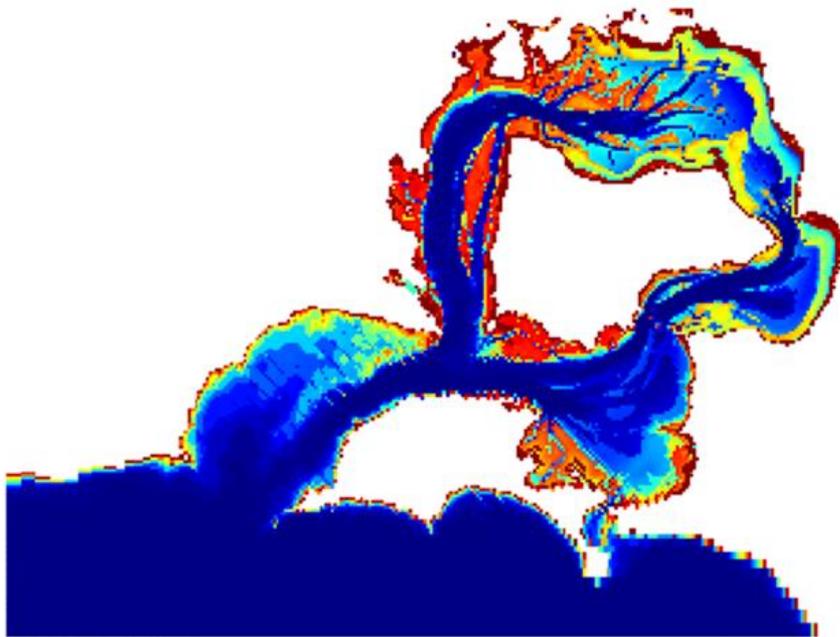
Cliff sediments



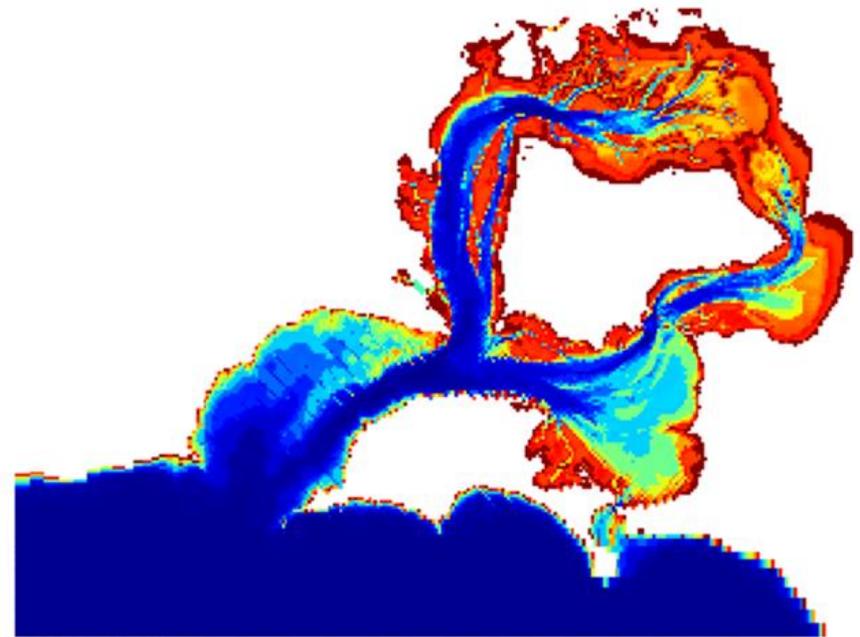
NOTE – different scales

- Redistribution of legacy sediment dominates the in-bay water column sediment loads
- Reduction of catchment/cliff sediments will not have a noticeable impact on bay-wide sediment loads BUT WILL impact at the local scale and especially in the north west section of the bay

Light climate



Inclusive of bed sediment



Exclusive of bed sediment



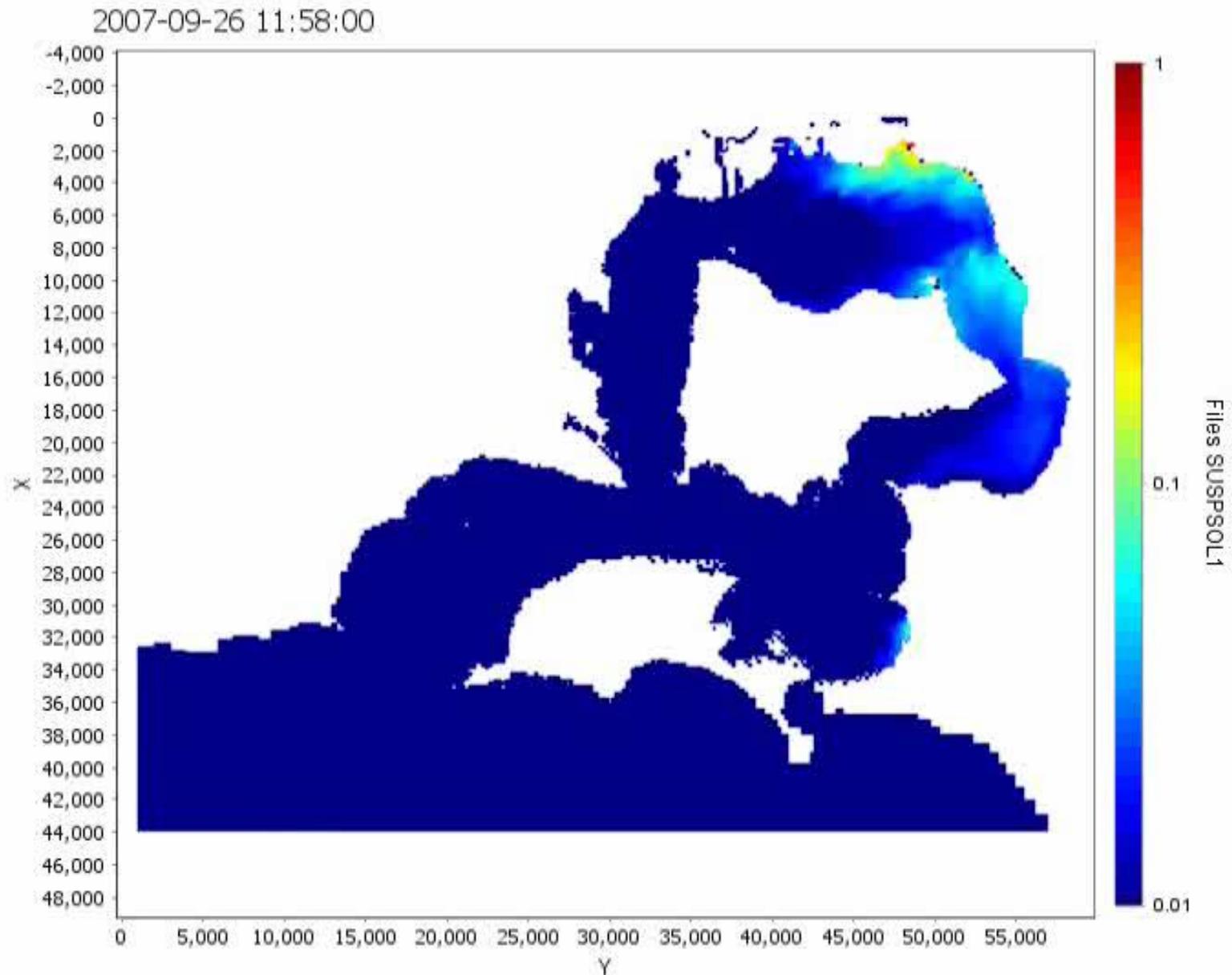
- <0.2 = decline in seagrass density
- Other factors important – depth, velocities, temperature etc

Practical application of model

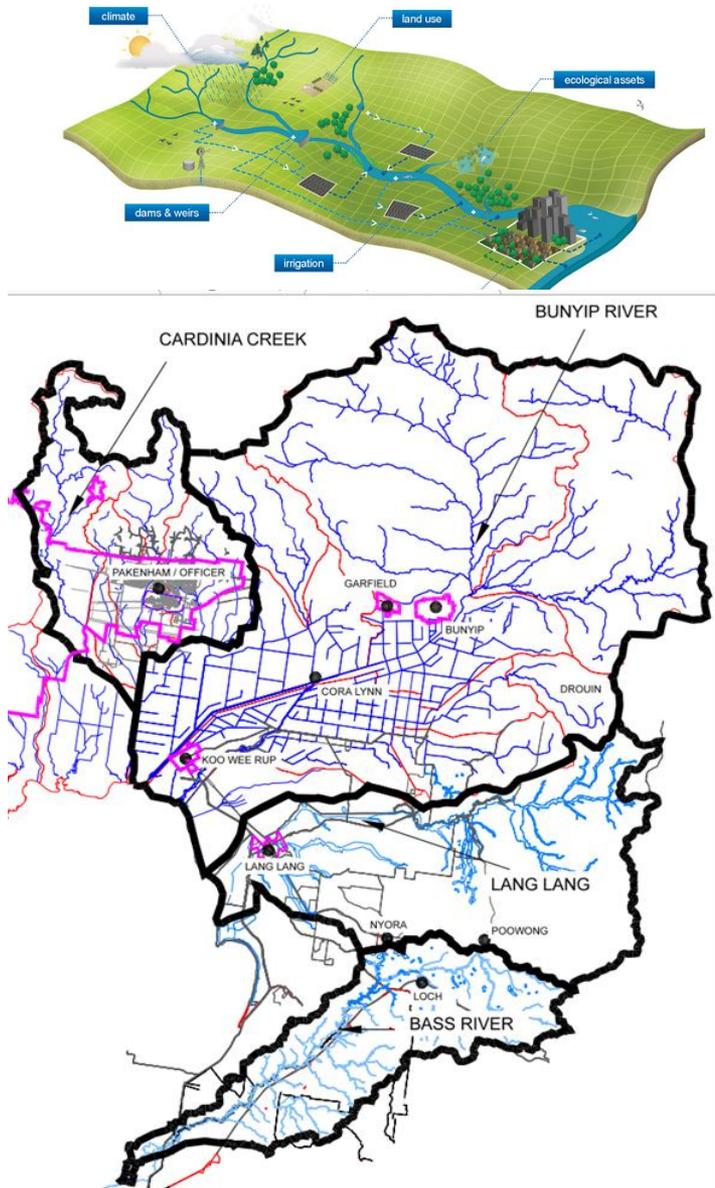


- **Catchment management**
- **Construction loads**
- **Inform SEPP guidelines**
- **Future applications**

Catchment derived fine SS



Catchment modelling

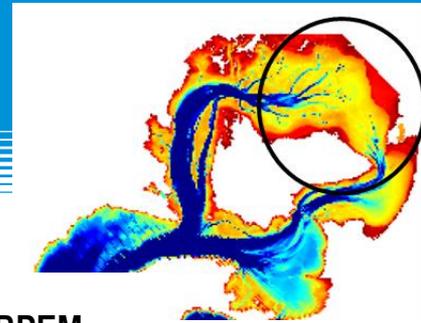


Comparison of current catchment runoff with 2050 runoff including urban development to the limit of the current UGB and climate change impacts (rainfall and evap)

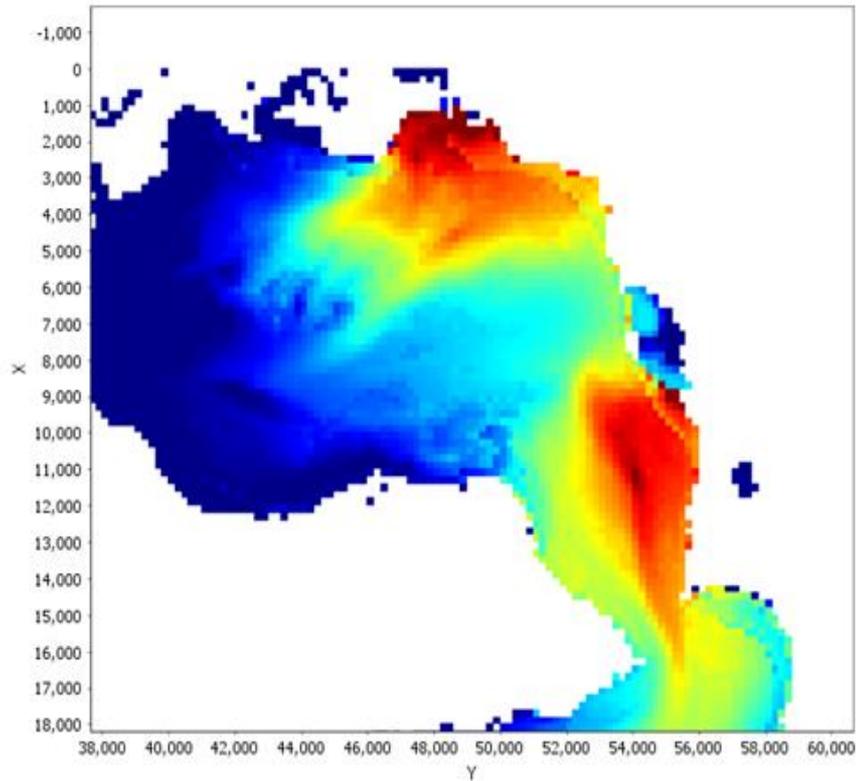
3 scenarios

- No stormwater treatment for future development
- Application of current BEPM on all new development (80%TSS, 45%TP, 45%TN)
- Application of tightened BEPM on all new development (93%TSS, 66%TP, 63%TN)

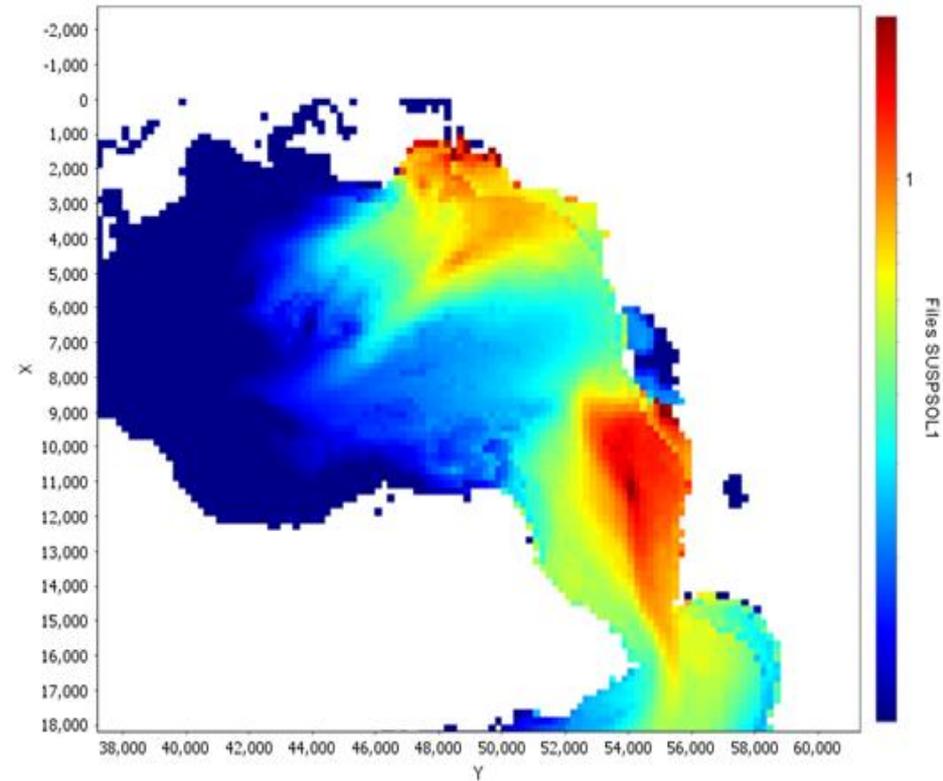
95th percentile fine SS from catchments (10-years)



No BPEM

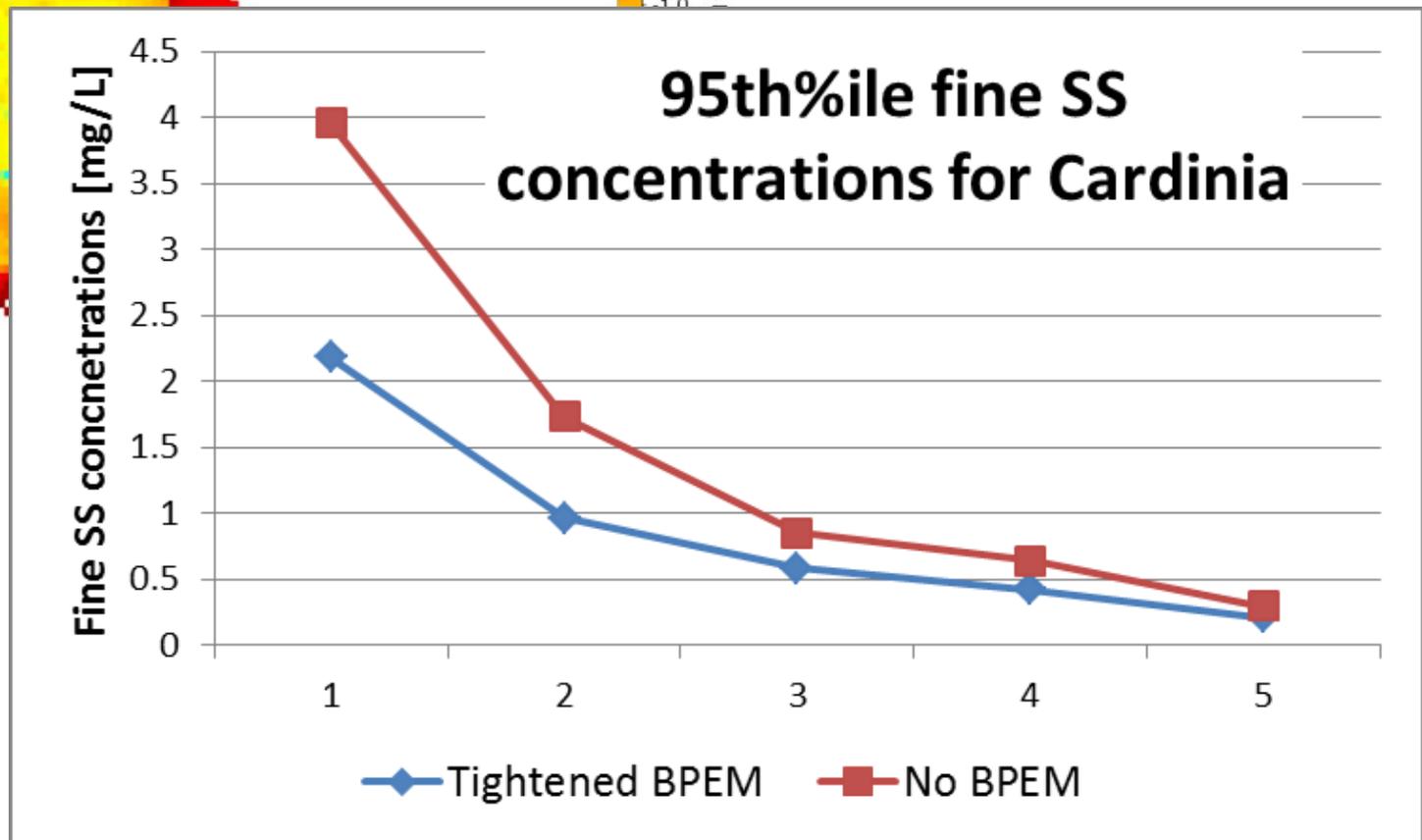
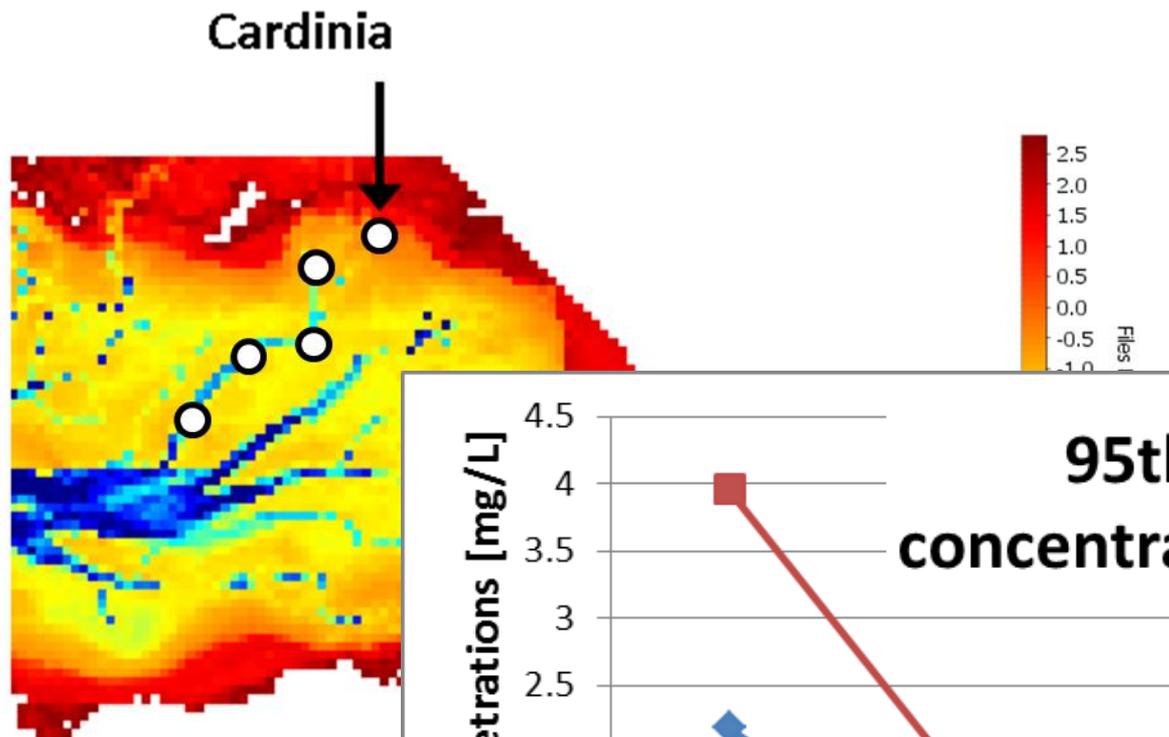


Tightened BPEM



- Localised improvement in sediment concentrations

Fine SS from catchments



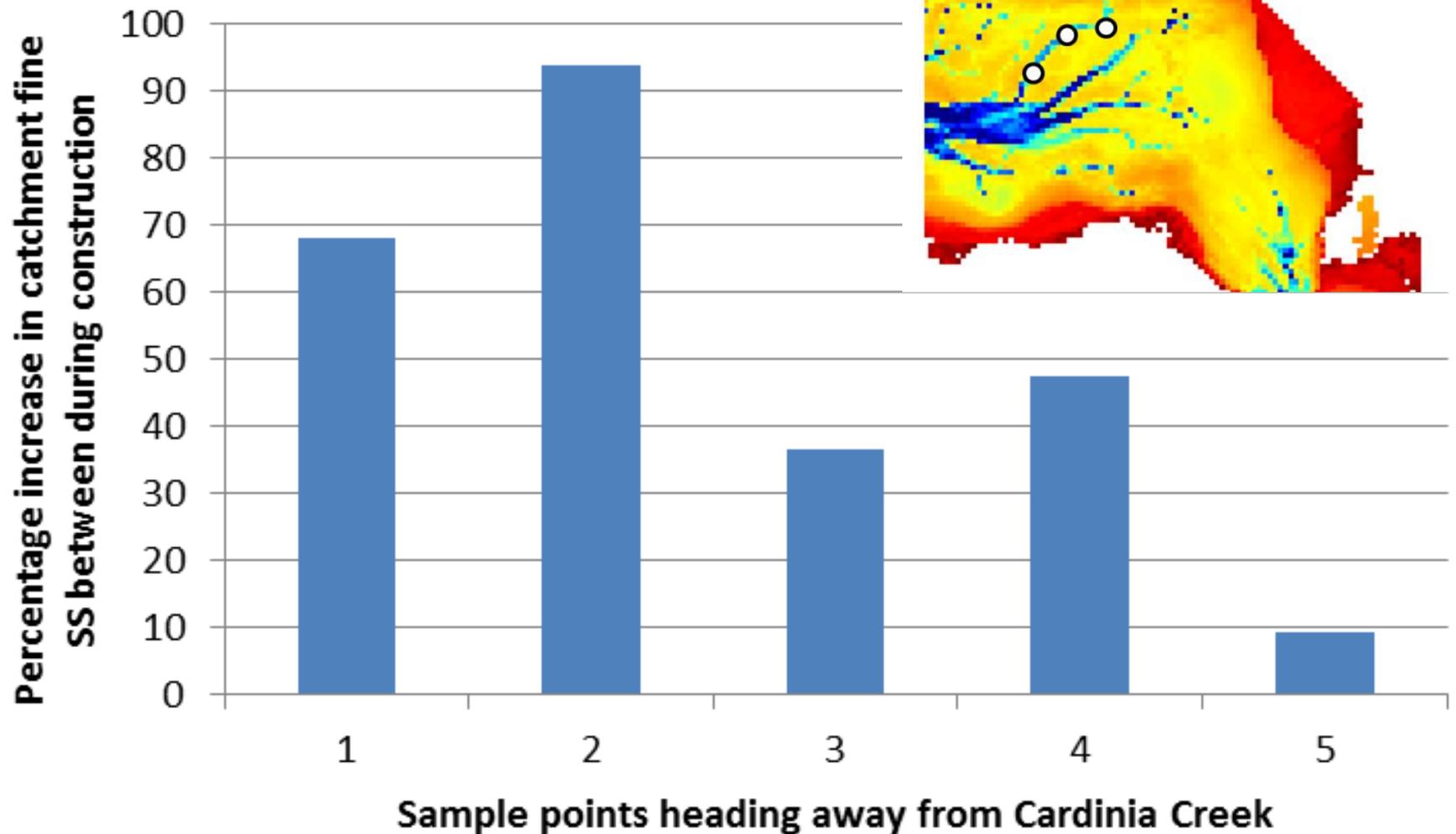
Construction loads modelling

Based on literature areas of active construction contribute between 120-27,000 t/km²/year of fine sediment (median of **740 t/km²/year**)

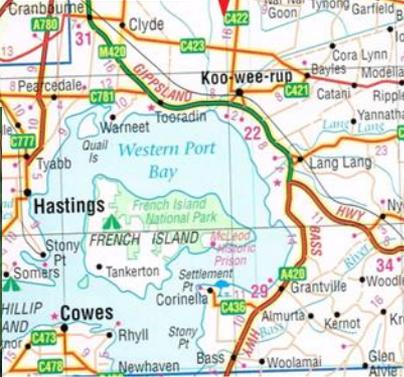
- as a comparison the current contribution of the 3 major catchments in Western Port Bay combined is approximately **10 t/km²/year**



Effect of construction



Targeted catchment management is the key



- Focus on construction phase of development
- Potential to look at offsets for developers who struggle with achieving BEPM – move to more influential part of catchment

SEPP (WoV) Guidelines - DELWP

- Aims to drive investment in land-based management by setting quantitative targets that will reduce pollutant loads
- Ultimate aim is to protect and improve Victoria's water environments
- Model outputs were used to help set targets ensuring;
 - Most recent science
 - Relevant
 - Outcome focussed

/ DEPARTMENT OF ENVIRONMENT, LAND, WATER AND PLANNING

Draft State Environment Protection Policy (Waters)

Make a submission on the Draft SEPP (Waters) until 19 June 2018.

+ Follow



Future applications

- **Determining where management actions should be focussed**
- **Suitability mapping for seagrass revegetation**
- **Hindcasting – what caused original deposition of the legacy sediment**
- **Incorporation of dynamic seagrass module**



Thanks!!

Dr Kathy Cinque
Melbourne Water