Sediment sources in the Westernport catchment: findings from a collaborative research program

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Melbourne Waterway Research-Practice Partnership

mwrpp.org

A collaboration between Melbourne Water and The University of Melbourne

THE UNIVERSITY OF MELBOURNE

Waterway Ecosystem Research Group

School of Agriculture, Food and Ecosystem Sciences

Melbourne Water

Sediment pollution

Excess sediment loads affect streams, wetlands, lakes, estuaries and bays – environments that we value and need to protect

Physical (e.g. light attenuation, clogging gills, smothering habitat) and chemical (associated pollutants) impacts

Westernport catchment – sediment load

Seagrass beds sensitive to sediment load

Target has been set for sediment load to allow sediment to flush from Western Port

Extensive work on sediment budgets and hydrodynamic modelling is supporting development of a management plan to achieve target

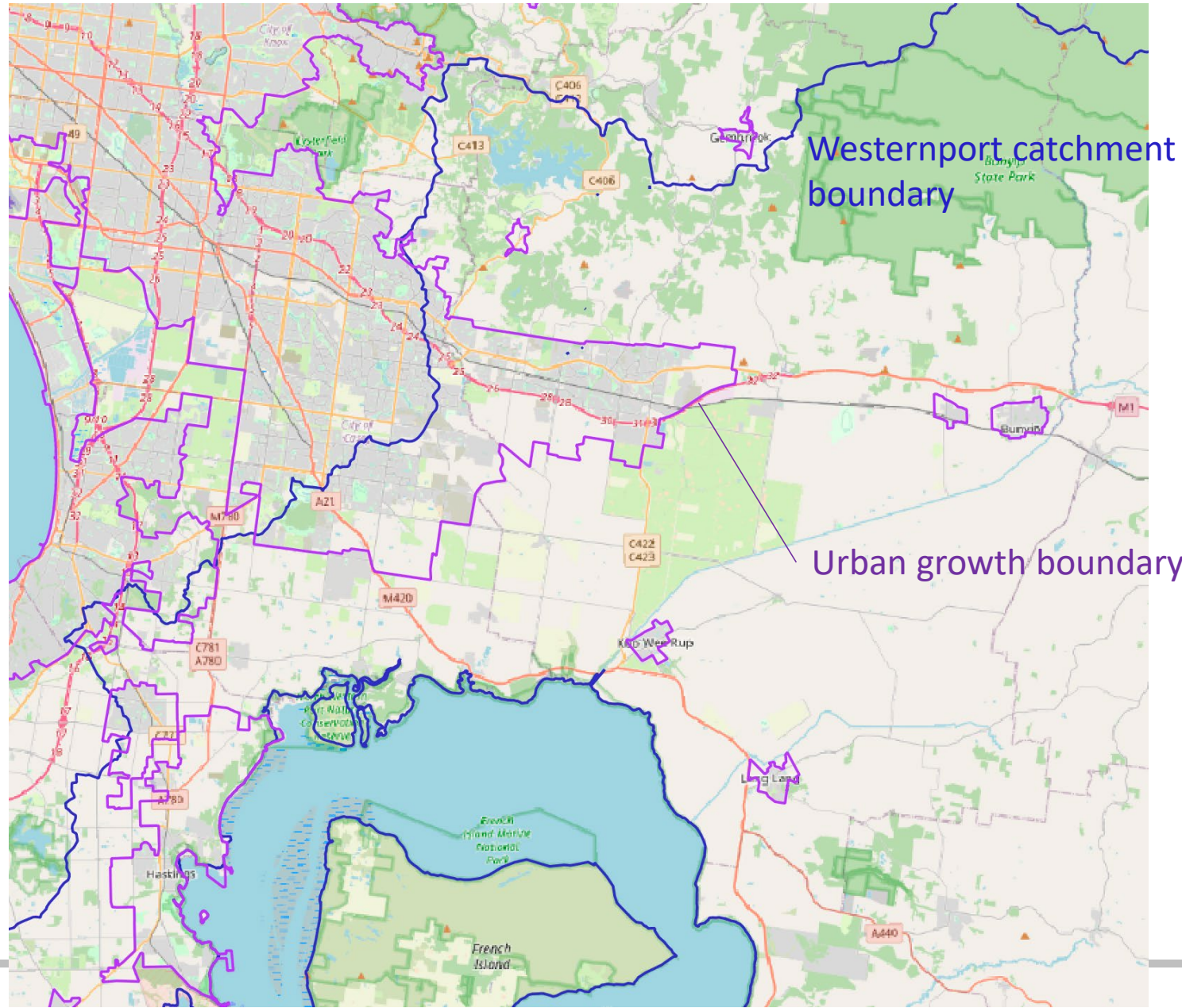
Westernport catchment – sediment load

Knowledge gaps:

- Gully activity
- Sediment deposition/resuspension
- Sediment liberated by urban development in the catchment.

Westernport catchment

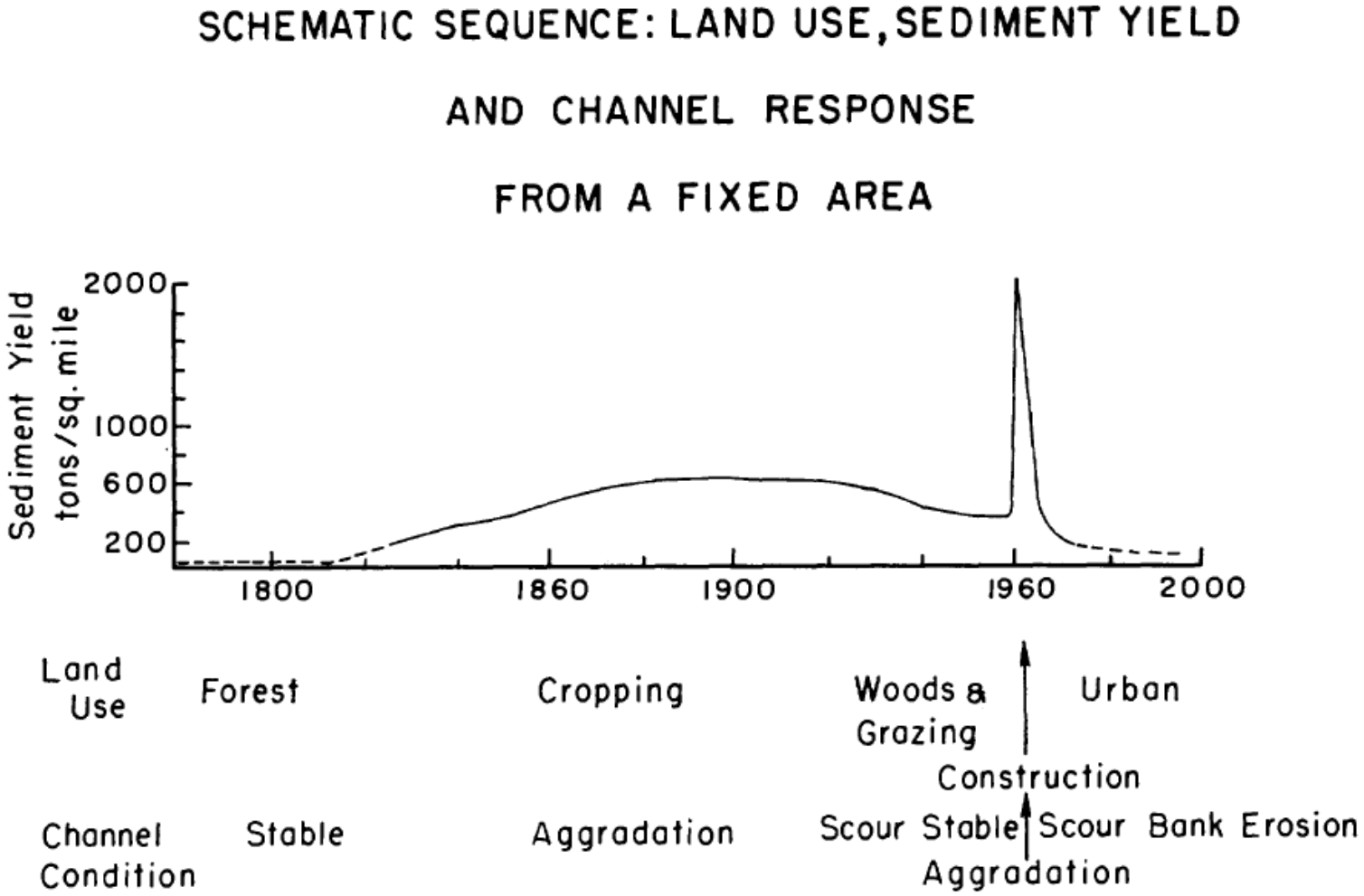
South-east growth corridor – urban development hotspot in Westernport catchment



Potential Sediment Sources during Urban Construction

Importance of construction phase

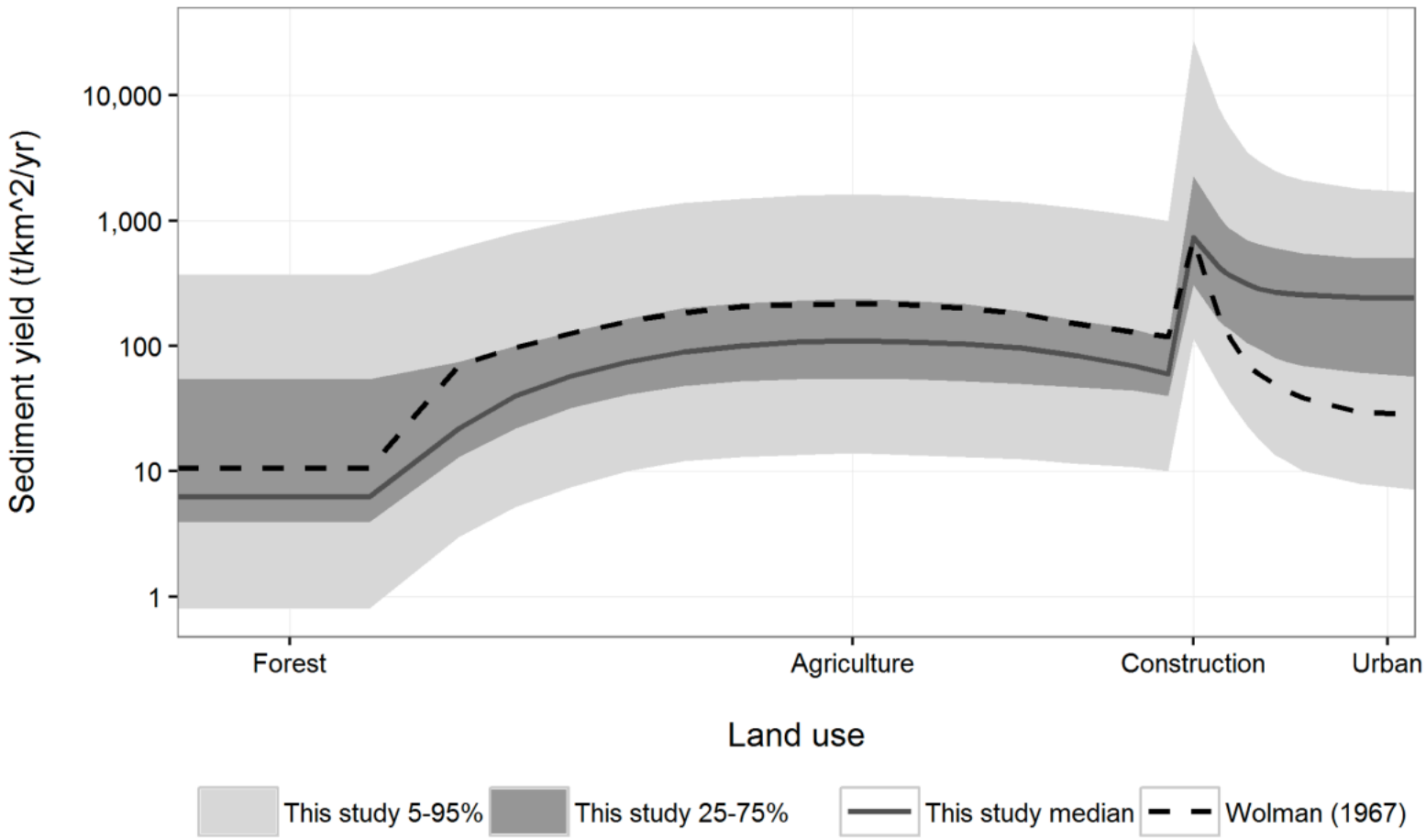
Well-recognised that urban construction produces a significant spike in sediment supply



Wolman (1967) A cycle of sedimentation and erosion in urban river channels.

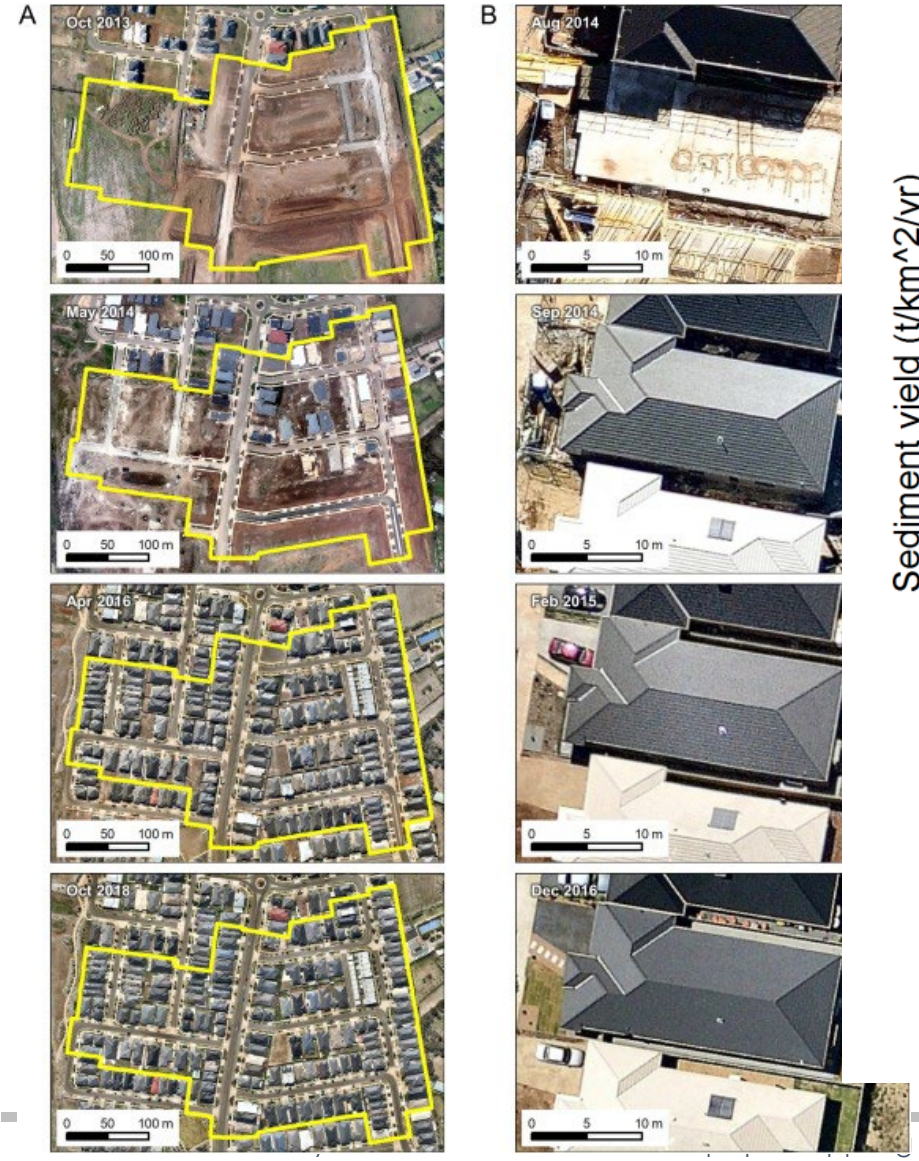
Importance of construction phase

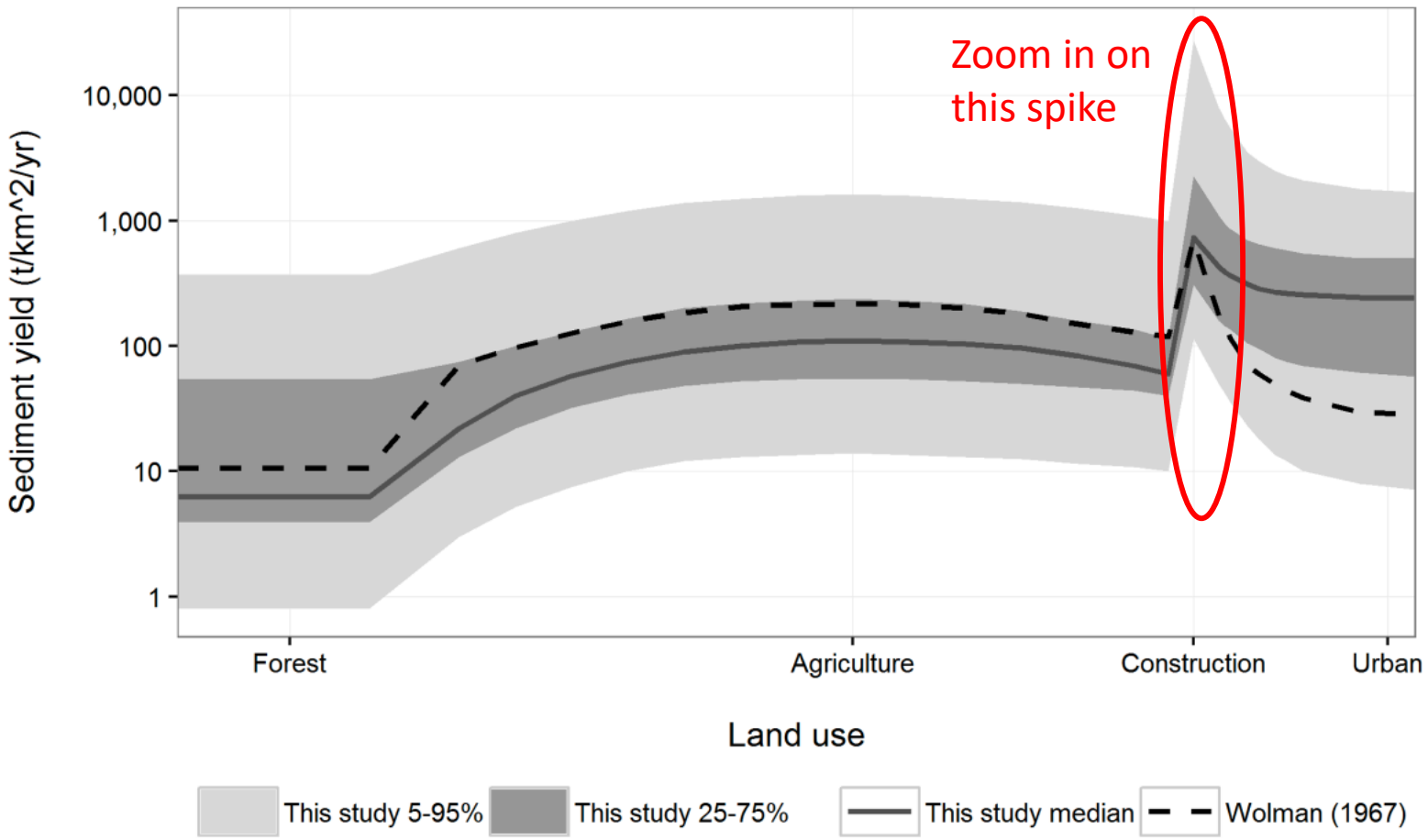
Sediment yield from active construction areas can be ~**20-12,000** times higher than background rates



Russell et al. (2017) Global sediment yields from urban and urbanizing watersheds.

Importance of construction phase

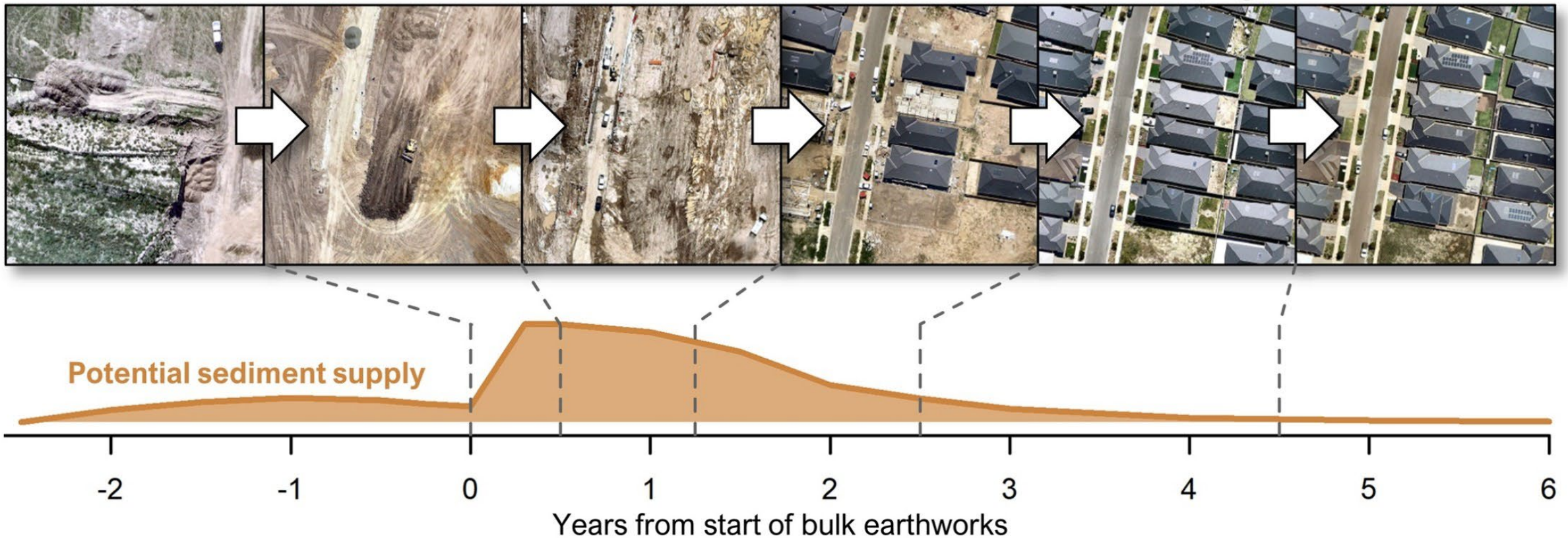




Russell et al. (2017) Global sediment yields from urban and urbanizing watersheds.

Potential sediment generation over urban development lifecycle

Site preparation	Bulk earthworks	Road & drain construction	House construction	Landscaping	Mature urban
Some soil disturbance and stockpiling	Highest level of bare soil cover and soil disturbance	Increase in runoff, decrease in bare soil cover	Renewed soil disturbance, decrease in bare soil cover, increase in runoff	Renewed soil disturbance, decrease in bare soil cover	High runoff, low soil disturbance



Russell (2021) Potential sediment supply fluxes associated with greenfield residential construction. Anthropocene, 35, 100300 (open access)

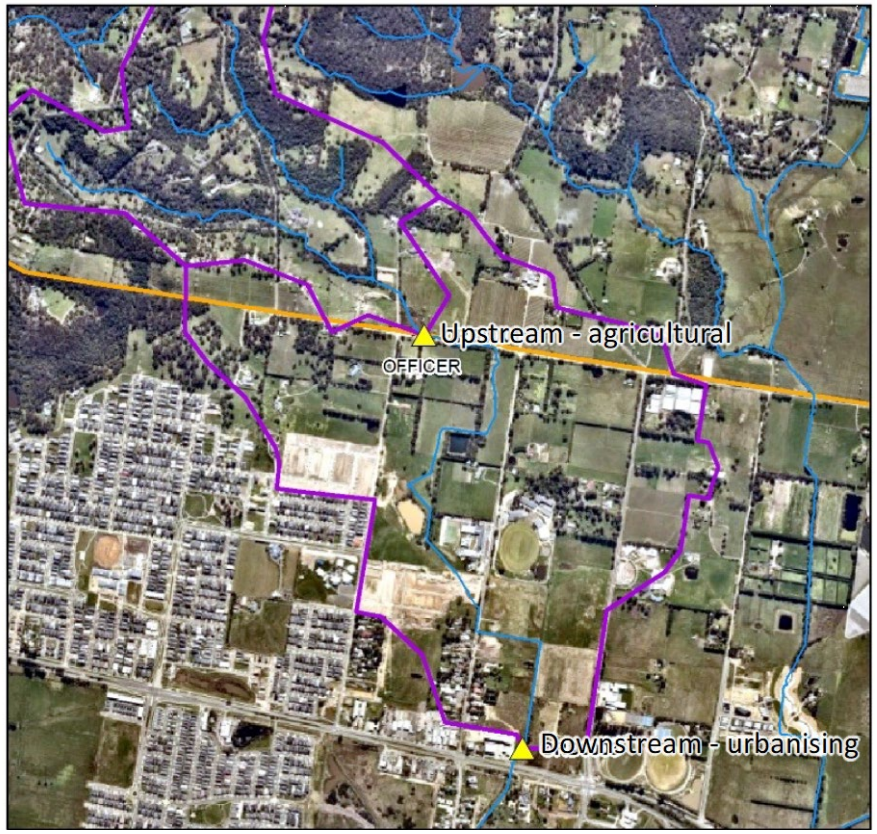
Validation – field data at different construction stages (Officer VIC)

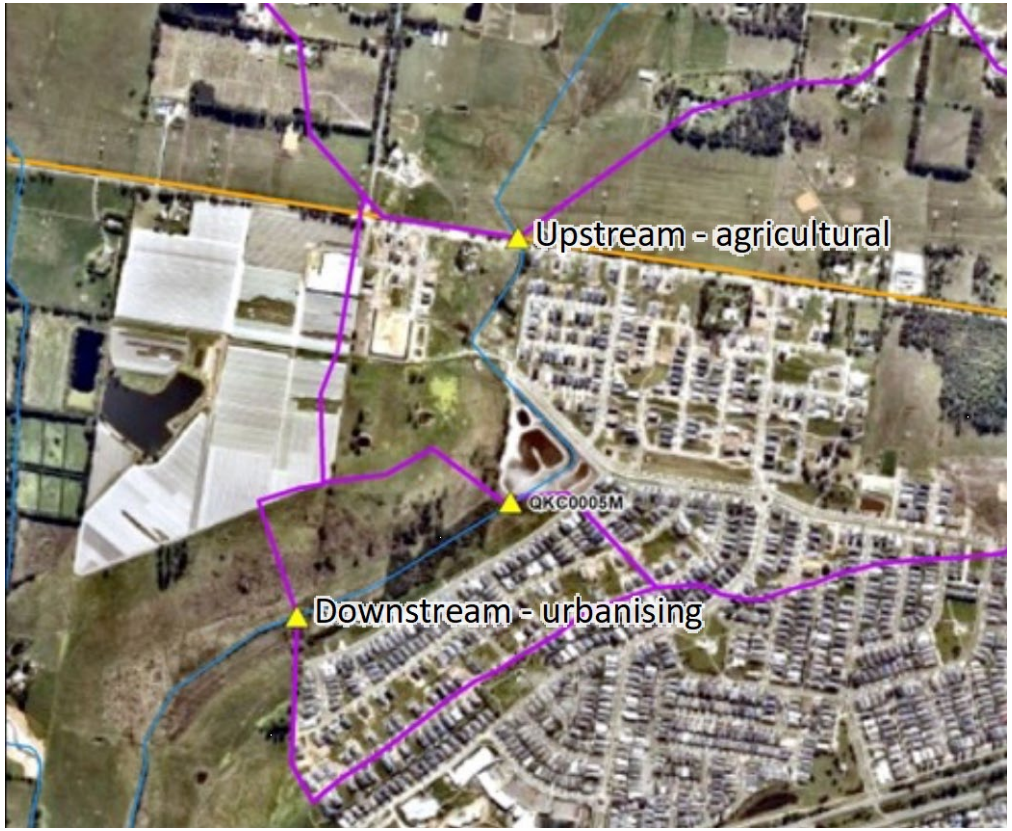
Station – Sample #	SSC – Observed (g/L)	Stage of Urbanisation
ST02 – 01	0.5	Mature urban
ST02 – 02	0.4	
ST02 – 03	0.6	
ST01 – 01	2.2	House construction / Landscaping
ST01 – 02	2.3	
ST06 – 01	9.5	House construction
ST05 – 01	11.1	Road and drain construction
ST05 – 02	23.2	

Paulo da Silva – PhD student, University of Melbourne

Sediment supply at catchment scale: Officer VIC

- Urbanising catchments – 3-5 km^2
- Sediment load monitoring stations on each creek
  - Upstream – agricultural
  - Downstream – urbanising





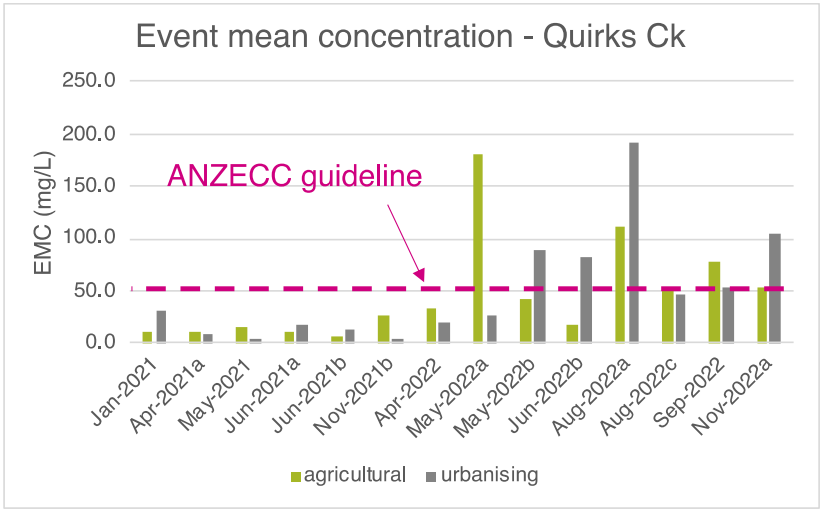
Methods: sediment load monitoring

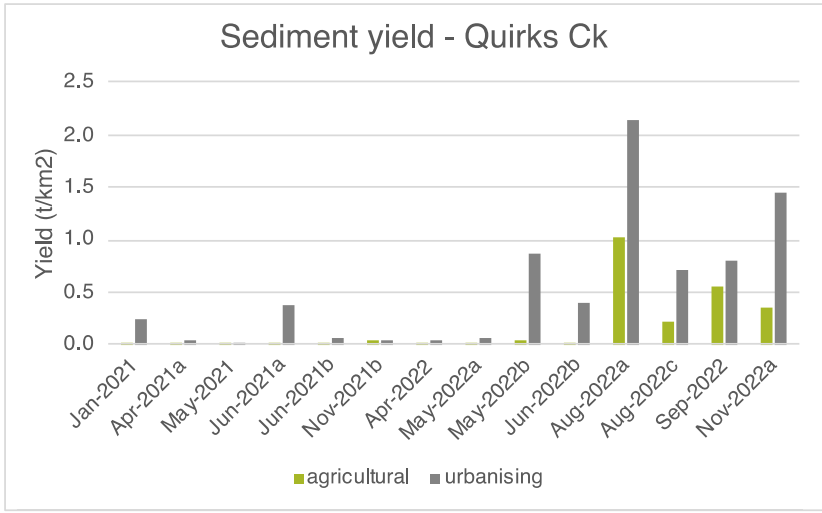
- Flow gauge and autosampler at each site
- Took multiple samples for each high-flow event
- Sampled 25 events through 2021 and 2022
- Lab analysis of total suspended solids for each sample
- Computed measures:
  - Sediment loads (from concentration and flow data)
  - Sediment yields (load per catchment area)
  - Event mean concentration (load per flow)

Results – Creek 1

- Higher sediment loads in 2022 than 2021 – full dams, saturated soils
- Concentrations high in both agricultural and urbanising areas - no consistent increase
- Sediment yield increased due to flow increases (i.e. increased runoff from impervious surfaces)

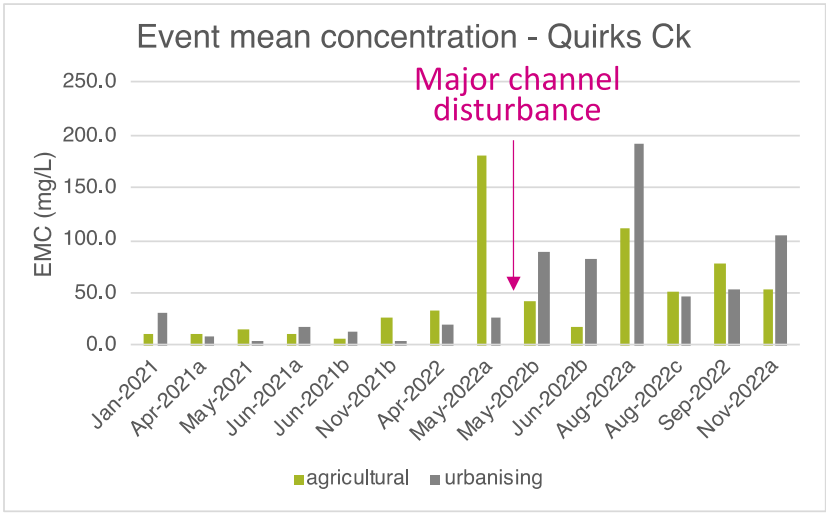
Note: sediment yield = sediment produced per catchment area

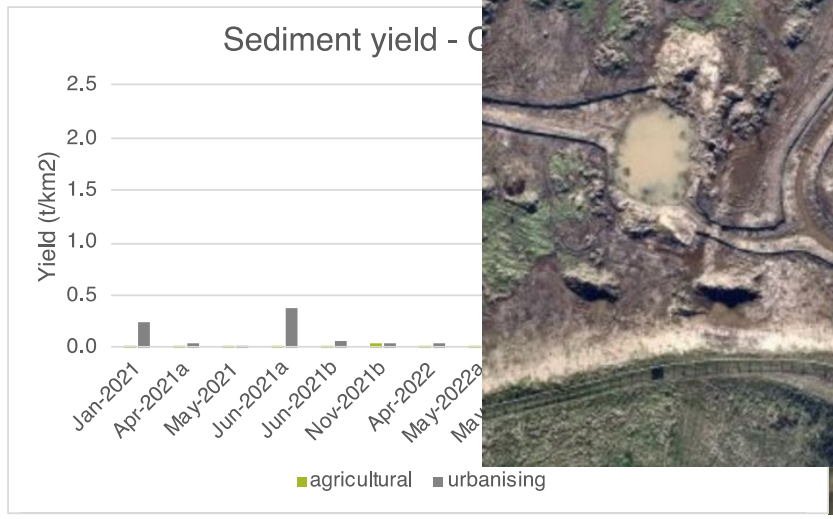




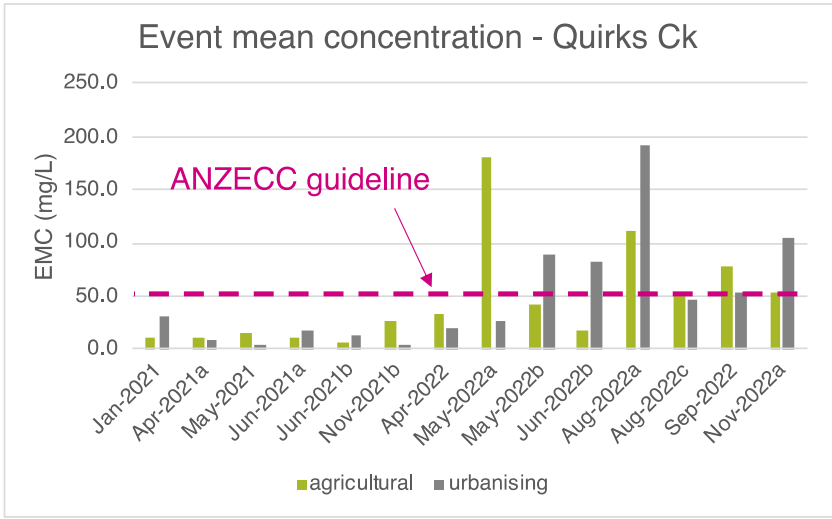
Results – Creek 1

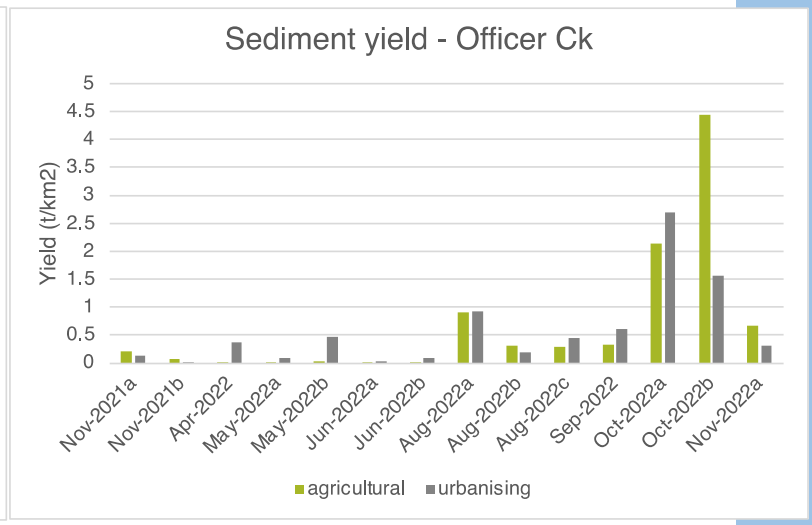
Major channel disturbance can have a big impact



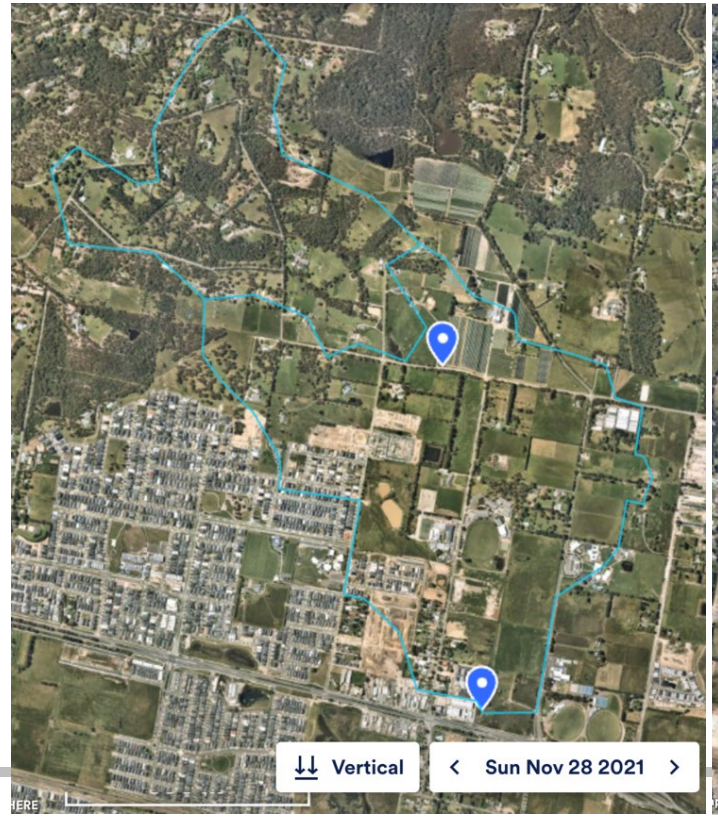


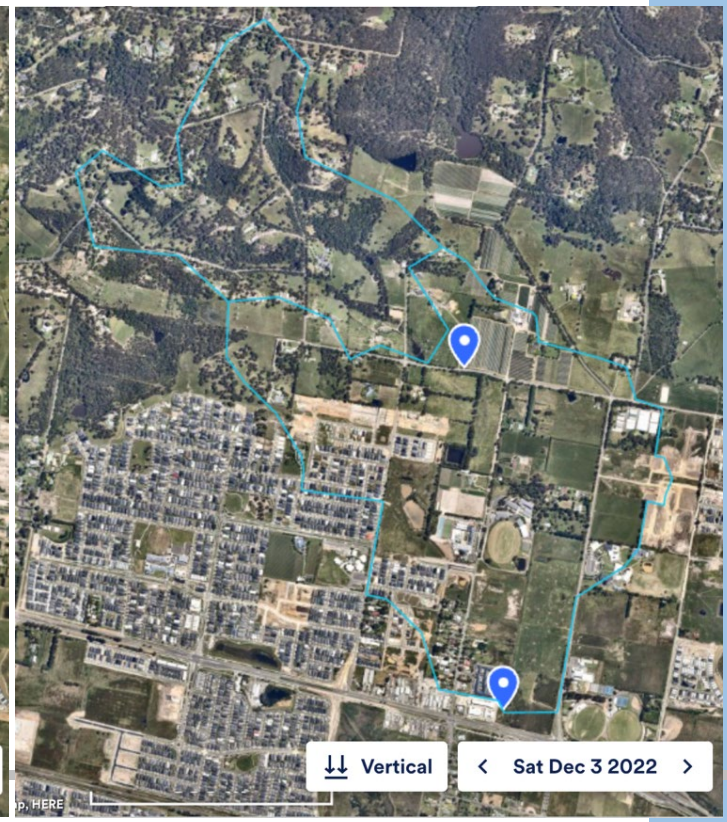
Results – Creek 2



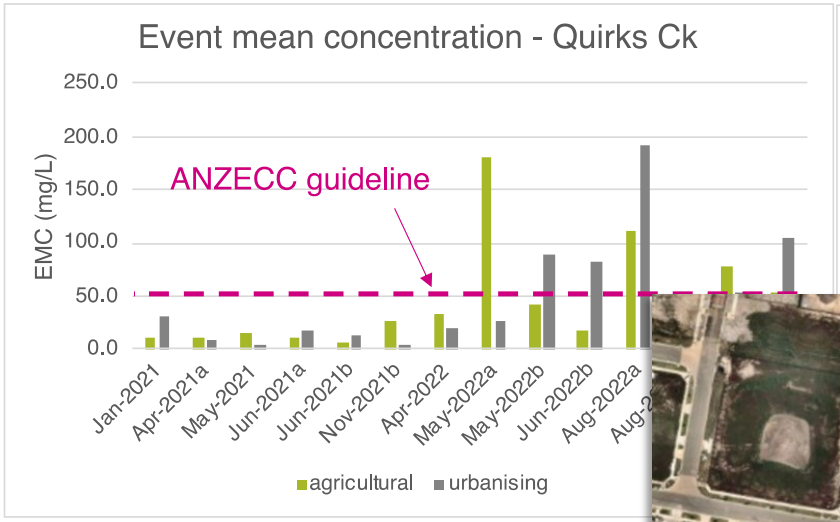


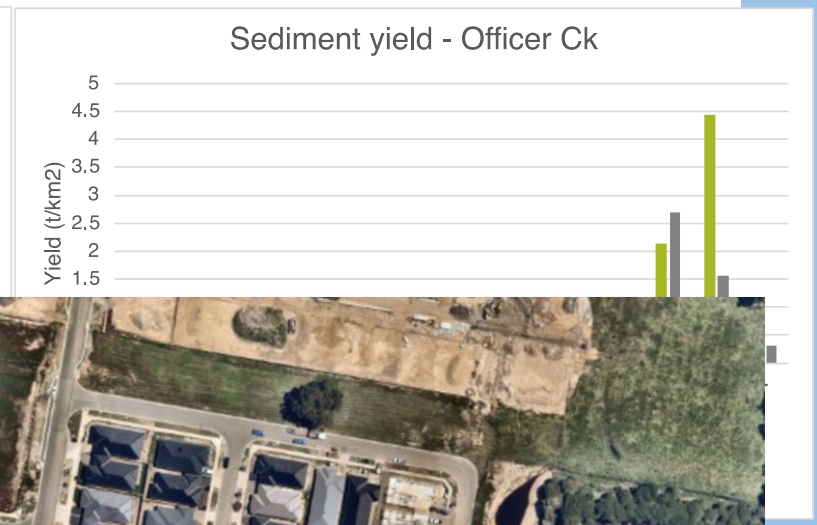
- Higher sediment loads in 2022 than 2021
- Concentrations high in both agricultural and urbanising areas - no consistent increase
- Flow and sediment yield not yet substantially increased





Results – Creek 2





- Sediment ponds, hydraulic inefficiency
- Sediment produced in construction areas being captured?

Summary – sediment loads

- Street scale: Increased sediment production at early stages of construction
- Catchment scale: increased sediment load in Creek 1, but not (yet) in Creek 2
- Increased sediment load driven by increased flow, not concentration
- Highly variable effect of urbanization on sediment load over different events.
- High background agricultural sediment loads during wet periods
- Event mean concentrations commonly above guideline values – room to improve sediment control practices across agricultural, construction and urban areas.
- Lots of complexity in catchments – natural wetlands, vegetation changes, channel disturbance, sediment capture in sediment ponds/dams

Towards better sediment control

Most sediment is mobilised in the few biggest storms - minimising area disturbed at any time is key.

- Staging
- Soil stabilisation (e.g. seeding with grass)

Qualitative observations - sediment control commonly not being designed, implemented or maintained appropriately.

- Improving industry knowledge, surveillance, enforcement
- Better design of sediment control measures

Urban runoff reduction is key and needs to start early in development process

- Prioritising stormwater reuse, retaining/re-establishing vegetation
- e.g. reusing water from sediment ponds on site

Better protection of vegetation and existing waterways

Thank you

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A collaboration between Melbourne Water and The University of Melbourne to conduct and apply research to improve Melbourne's waterways

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