

An Empirically-based sediment budget for the Normanby Basin: Key Findings & Implications

Australian Rivers Institute, Griffith University

Andrew Brooks, John Spencer, Jon Olley, Tim Pietsch, Daniel Borombovitz,
Graeme Curwen, Leila Eslami-Endargoli, Anne Bourgeault, Jeff Shellberg,
Christina Howley

**Sediment Sinks Sources & Drivers
in the Normanby Basin**

CAPE YORK WATER QUALITY



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Summary (upper catchment sources) i.e. Excl. Coastal plain

	GU 2012 SS I/Ps (t)	%	Brodie et al 2003	%
colluvial gully	411800	13%	173000	10%
alluvial gully	736400	24%	0	0%
hillslope delivered	15900	1%	1576000	89%
Mainstem bank erosion	249900	8%	17500	1%
2ndry alluvial channel erosion	1672000	54%	0	0
total	3086000	100%	1766500	100%
storage	1697300	55%	664000	37%
Net (=18% of PCB accretion)	1,390,000		1,102,000	

Coastal plain/delta contrbt'n ~4 MT

So what are the implications of these findings?

Hillslopes like this not the major sediment source

10th Nov 2010 (before 1st storms)
C= 0.042

30.52 inHg ↑ 32°C 11/16/10 03:00 PM 0050000000

23rd Nov 2010 (after 1st storms)
C= 0.040

30.72 inHg ↓ 32°C 11/23/10 03:00 PM 0050000000

7th Dec 2010
C= 0.035

30.52 inHg ↓ 36°C 12/07/10 03:00 PM 0050000000

24th Dec 2010
C= 0.0244

30.38 inHg ↓ 30°C 12/21/10 03:00 PM 0050000000

4th Jan 2011
C= 0.020

30.52 inHg ↓ 35°C 01/04/11 03:00 PM 0050000000

18th Jan 2011
C= 0.0177

30.46 inHg ↓ 28°C 01/18/11 03:00 PM 0050000000

1st Feb 2011
C=0.015

30.58 inHg ↑ 34°C 02/01/11 03:00 PM 0050000000

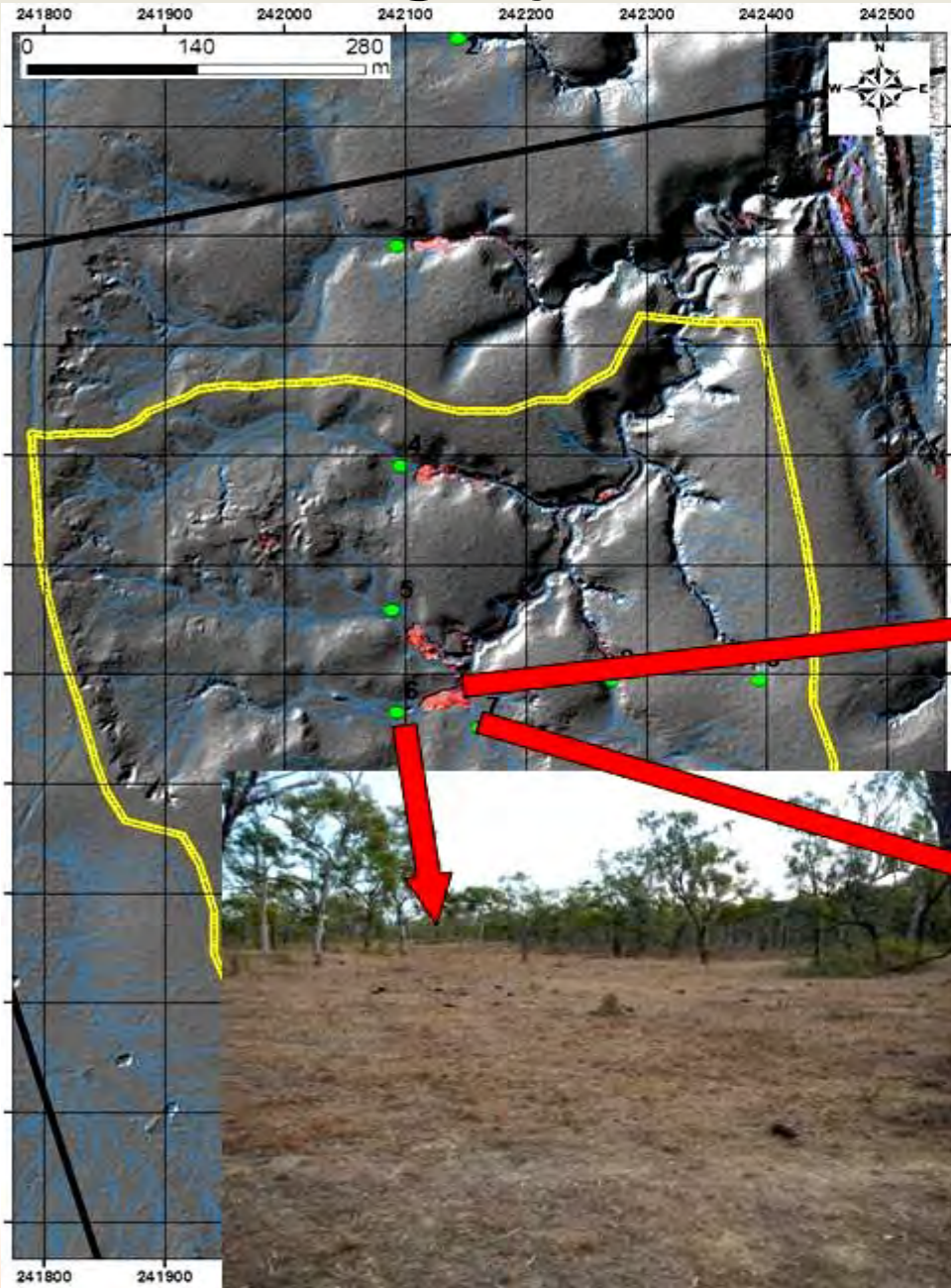
14th Feb 2011
C= 0.0083

30.72 inHg ↓ 34°C 02/14/11 03:00 PM 0050000000

13th Mar 2011
C=0.0053

30.66 inHg ↓ 34°C 03/13/11 03:00 PM 0050000000

Alluvial gully erosion like this is a major source

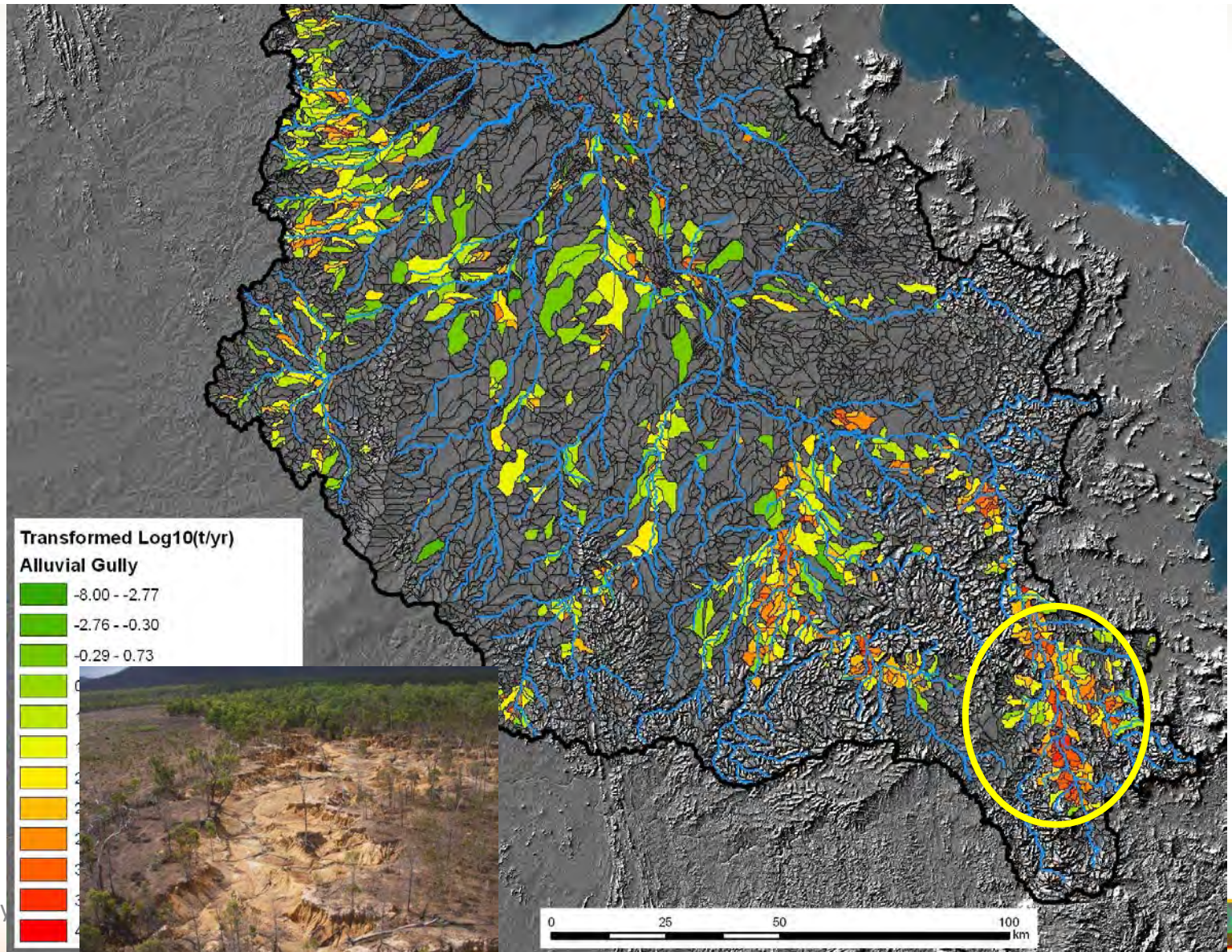


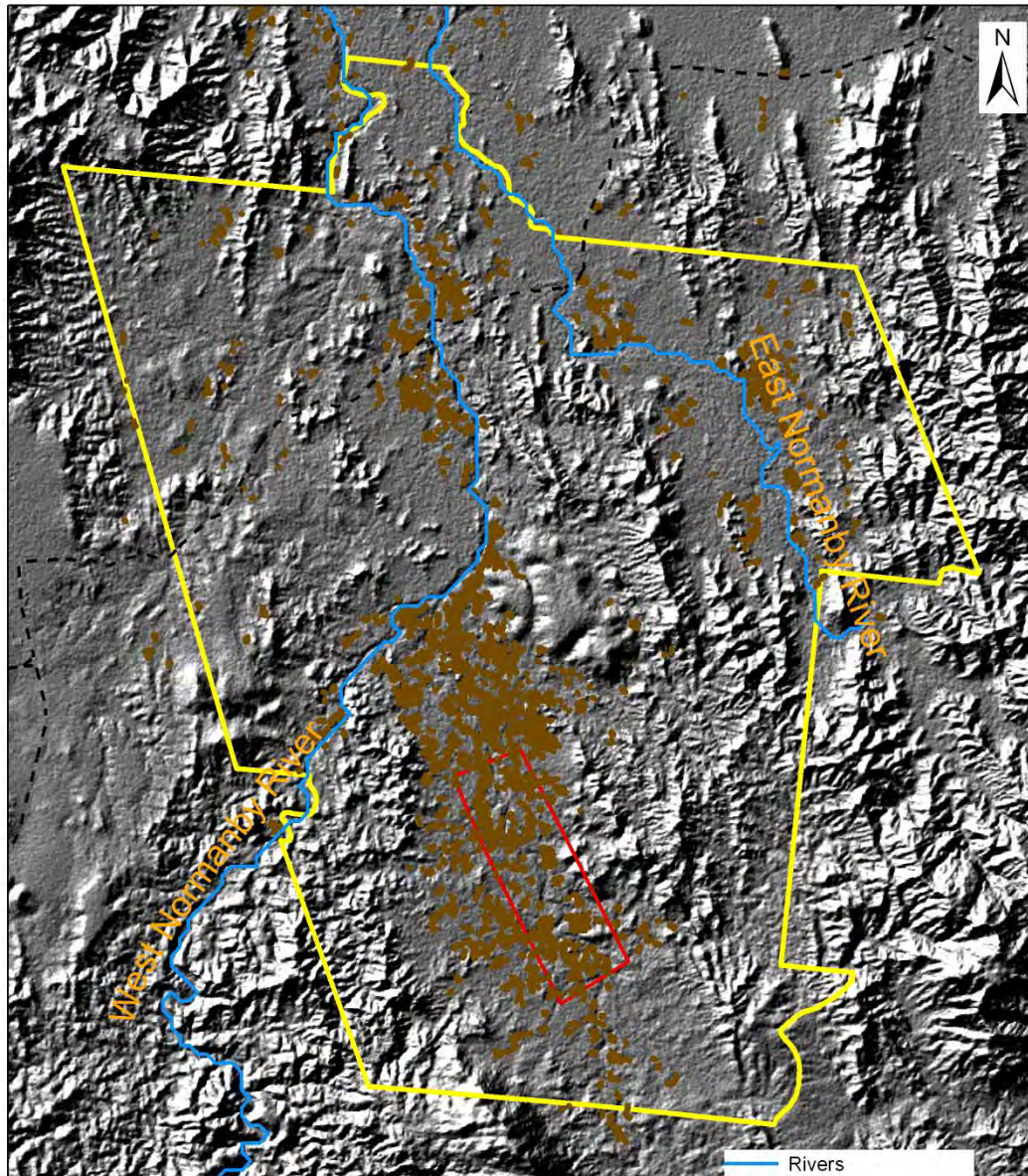
Laura River at Crocodile Gap (Norm 16)



Photos Jeff Shellberg

Can now identify erosion hotspots and better prioritise effort

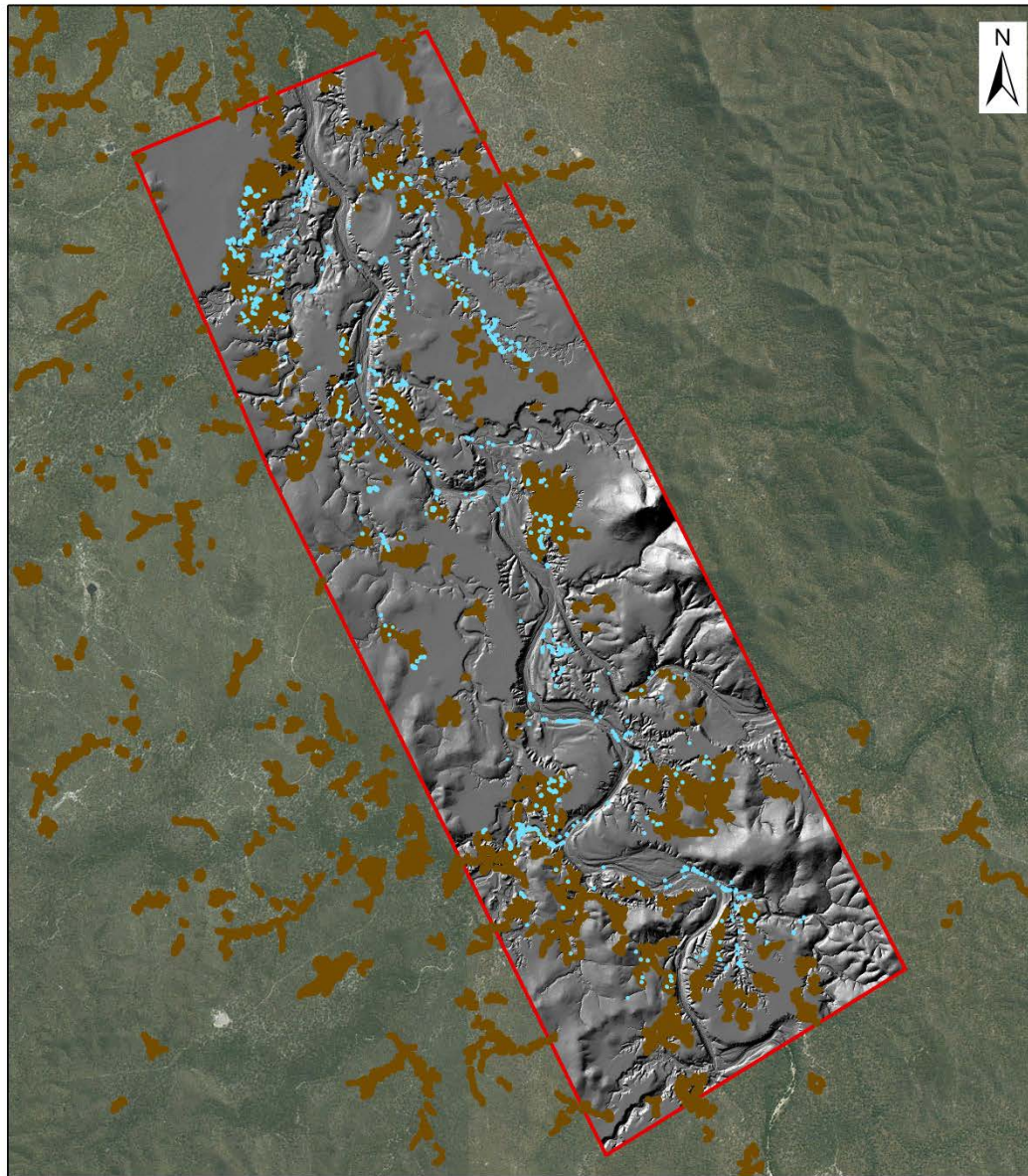




0 2.5 5 10
km

- Rivers
- Roads
- Mapped Gullies (GE)
- Lidar Block
- Springvale

Distribution of gullies as mapped on Google Earth imagery.



0 0.5 1 2
km

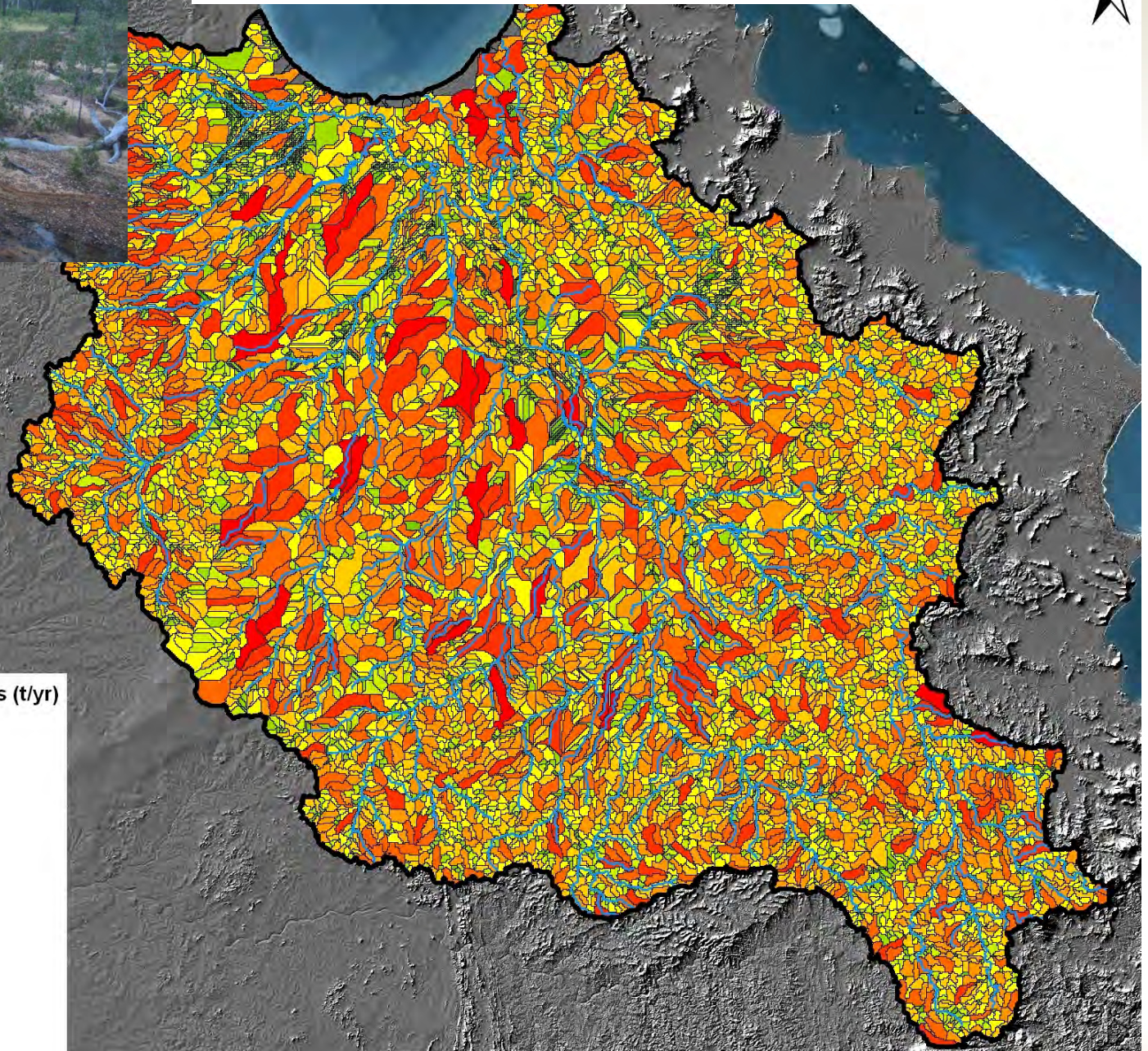
This map shows polygons of material eroded between lidar acquisition in 2009 and 2011 overlain on distribution of gullies as mapped on Google Earth imagery.

- Measured Erosion
- Mapped Gullies (GE)
- Lidar Block
- Springvale

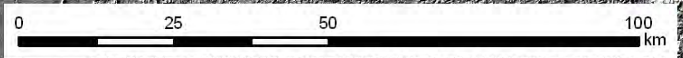
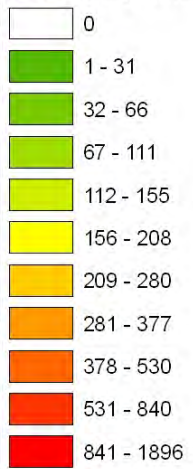
Channel erosion from ubiquitous small channels also a major source



Minor alluvial channel bank erosion



Secondary Channels (t/yr)



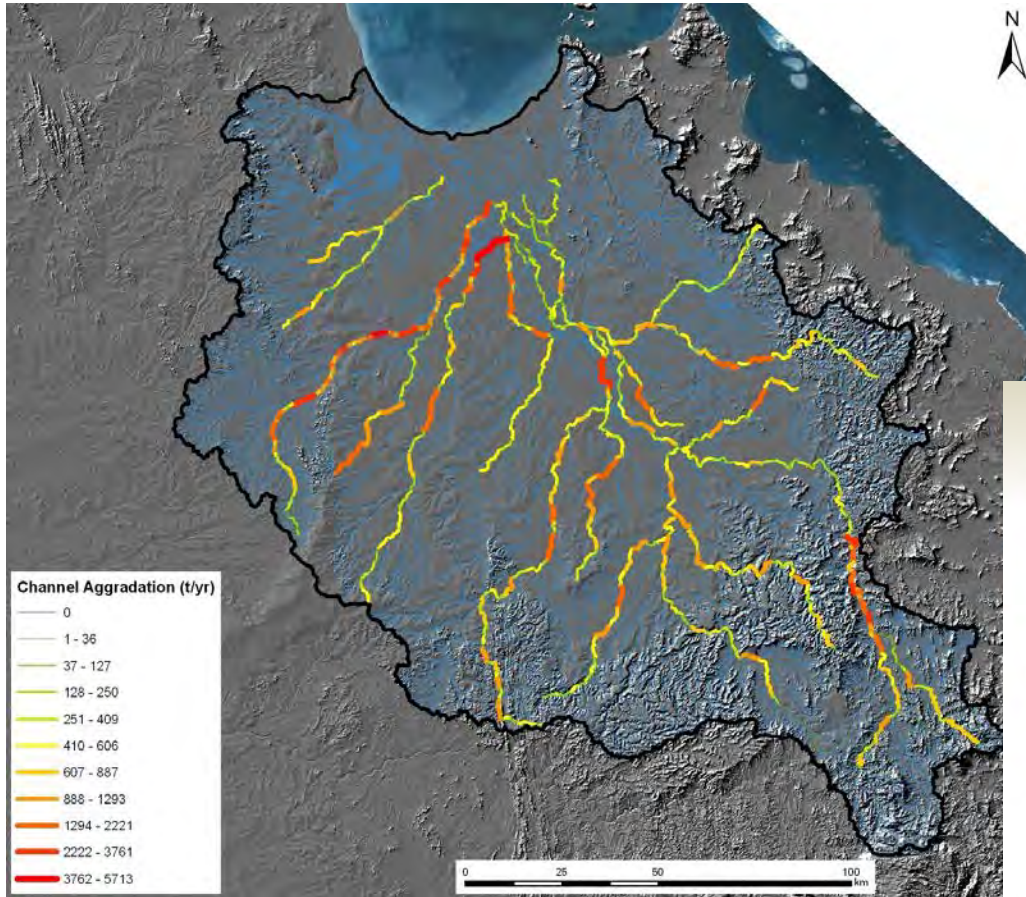
Where ever we look - we find a similar story of the dominance of bank & gully erosion!

Table 2: Tropical Australian studies that have used radionuclide tracers to estimate relative surface soil contributions to the lower catchment (after Caitcheon et al., 2012)

Catchment	Mean Surface Soil Contribution %	Tracer	Reference
Daly	11	^{137}Cs	Wasson et al., (2010)
Ord	10	^{137}Cs	Wasson et al., (2002)
Upper Fitzroy	20	^{137}Cs and $^{210}\text{Pb}_{\text{ex}}$	Hughes et al., (2009)
Herbert	50	^{137}Cs	Bartley et al., (2004)*
Herbert	20	^{239}Pu	Tims et al., (2010)*
Burdekin	17	^{137}Cs , $^{210}\text{Pb}_{\text{ex,C}}$	Wilkinson et al., (2012)
Mitchell	3	^{137}Cs	Caitcheon et al., (2012)
Daly	1	^{137}Cs	Caitcheon et al., (2012)
Cloncurry	0	^{137}Cs	Caitcheon et al., (2012)
Laura-Normanby	13 ± 3	^{137}Cs and $^{210}\text{Pb}_{\text{ex}}$	This study
Stewart	11 ± 1	^{137}Cs and $^{210}\text{Pb}_{\text{ex}}$	This study

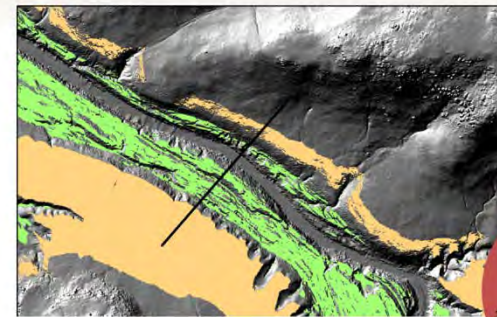
*Note these two studies were carried out pre and post cyclone Larry

Need to factor in-channel storage into modelling and management strategies

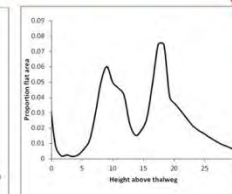
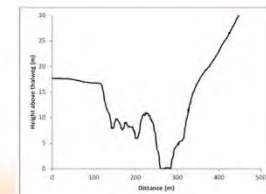
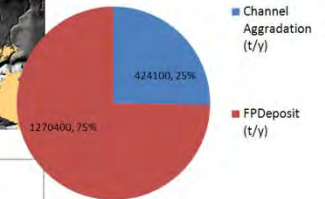


How important is bench storage in other GBR catchments?

Sediment Storage – benches & floodplains



Normanby Suspended Sediment Storage



Management approach quite different under the two scenarios (i.e. Old & New model)

- Catchment cover management (e.g. GLM) only part of the solution..(hydrologic link to channel/gully erosion)
- Need a range of other measures
 - Riparian zone management is key
 - Reducing the potential for initiating new alluvial gullies
 - Reducing bank erosion due to direct disturbance by cattle (particularly)
 - Increasing vegetation in gullies & on banks
 - Maximising storage within channels
 - Reducing potential for remobilising sediment deposited within the channel zone (benches)


Need to focus management efforts & R&D on gullies & river banks

Rehabilitation of alluvial gully erosion along river frontages

Preventing and Reducing 'Breakaways'

www.capeyorkwaterquality.info

Fence river frontage away from high banks
- Full cattle exclusion or wet season spelling




Stop erosion drivers

1. Reduce Water Runoff Into Gullies

Build erosion resistance

2. Increase Vegetation in Gullies
3. Reduce Slope (Grade) of Gully Channels

Install water diversion/retention banks above gully heads
- Divert excess water to safe disposal areas



Install grade control structures
- Only at narrow gully outlets or finger headcuts



Reduce cattle pads over steep banks
- Reduce water concentration




Increase perennial grass cover on river flats
- Cover Target: >75% at BOS
- >1000 kg/ha
- Reduce water runoff



Active rehabilitation of gully slopes
- Re-grade gully slopes with machinery
- Apply gypsum to soils with high sodium content
- Add compost or mulch for soil protection
- Add fertilizer or compost for plant nutrients
- Sow gully with perennial grass (native or exotic)



Fire management in river frontage
- Cool winter fires (3-5 yrs), infrequent hot fires



Weed management and control



Increase grass cover in gullies
- Fence out cattle
- Aerial, hand or spray grass seed in the wet season



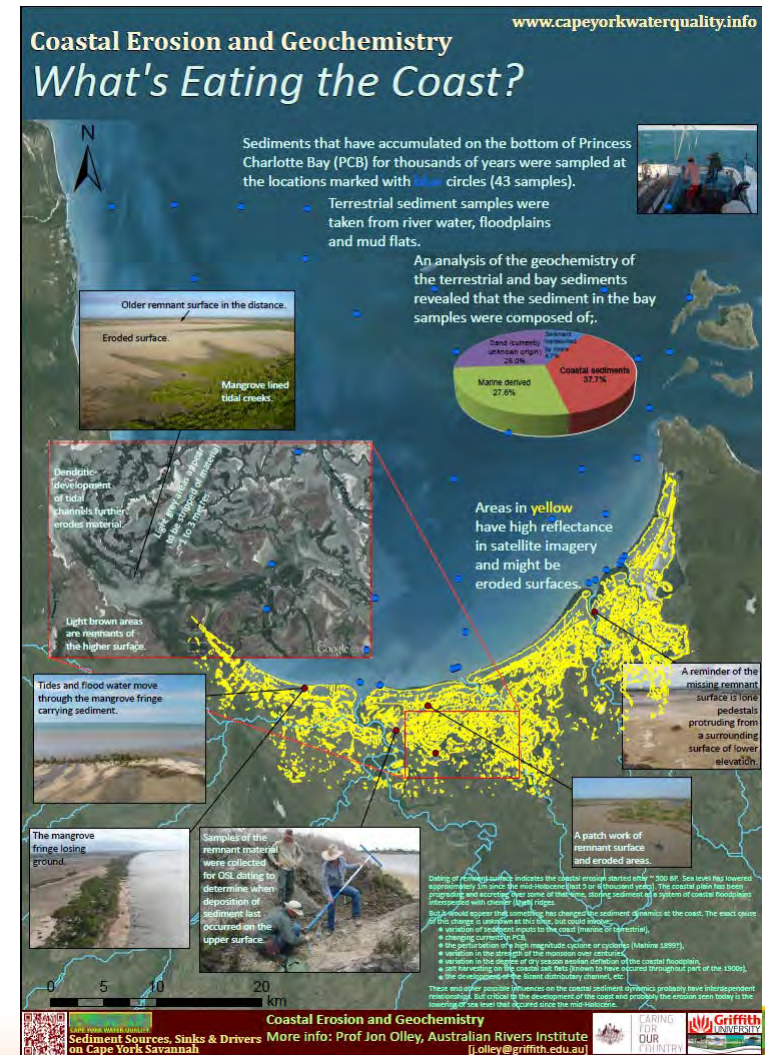

To what extent has RUSLE-based modelling over-predicted hillslope erosion in other GBR catchments?

- Are rivers like the O'Connell really dominated by hillslope erosion?
- Or are other processes like bank erosion more significant?



What is driving coastal erosion in PCB?

- What threat – if any does this pose to the reef?
- How will climate change affect this process?
- Do any other catchments have coastal erosion sources such as this?



How significant are roads as *human induced* sediment sources in other GBR catchments?

www.capeyorkwaterquality.info

Roads send sediment straight into the streams



Bare, unsealed road surface in the Normanby Basin is at least 5676 ha.

This makes roads the largest intensive landuse in the Basin (around 2000 ha more than the horticulture area around Lakeland).

The road network crosses the stream network at least 1,200 times, creating direct pathways for the input of sediment to streams.

Roads may be responsible for as much sediment as horticulture.

Sediment runoff from roads at stream crossings is a significant problem. Better road design and improved maintenance are urgently needed.

A researcher collects and measures fine sediment deposited in a small channel downstream of a road crossing.

Direct road runoff is bad enough, but there's another problem. A study on secondary unsealed roads showed that 42% of drains had initiated gullies such as these.

How many crossings are there?
No one actually knows: water crossings have never been surveyed.
We did a preliminary mapping using Google Earth and 1:100K stream network data (Gleeson, 2012). Roughly, we can estimate there are over 1,200 places where unsealed roads cross a stream line. The map shows different road classes and the stream intersection points (black dots).
Many older farm tracks are not visible through GoogleEarth and the real stream network is more extensive than the 1:100K network resolution. So we're certain that the estimated number here is far lower than the actual figure.

Still a number of unquantified sources



Hort – rill erosion



Roads



Pigs



Fences

- Need greater emphasis on empirical data to both:
 - Drive models
 - Measure response to management action
- This includes – basic data like hydrographic data – routine Sed data monitoring at gauges
- + range of different data sources on erosion processes

There are a range of more specific implications for how we measure and/or model these large savannah catchments... this is just a start.

Thankyou



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