Outcomes Factsheet

Project 5.9 Gully remediation effectiveness

Tropical Water Quality Hub
National Environmental Science Programme

Gully erosion contributes ~40% of the excess soil erosion to the Great Barrier Reef (GBR) from just ~0.1% of the catchment area. Previously, the methods for reducing gully erosion were not well tested in the GBR catchments. This project evaluated the most effective methods for reducing the sediment and particulate nutrients generated and delivered from this erosion source.

Vegetation, land condition, terrain and water quality data from seven gully remediation trial sites on grazing properties in the Burdekin catchment of North Queensland were measured. The sites underwent a range of rehabilitation including fencing, livestock management, small sediment trapping check dams, diversion banks upslope of gully heads, and larger engineering approaches including re-shaping and rock grade control structures were used. Several projects showed statistically significant improvements in water quality following remediation. Pre-remediation data is crucial to detecting change.

- Rehabilitation involving diversion banks, which starved the gullies of runoff, and the larger engineering approaches using re-shaping and rock structures, demonstrated the most rapid improvement in water quality (within 3 years).
- Cheaper rehabilitation options such as fencing and small check dams also showed positive results, however, the timescales associated with improvements will be considerably longer, and fine sediment trapping was lower than expected in some soil types.
- Engineering measures are important for stabilising sites in the early phases of rehabilitation to support the revegetation of gullies and adjacent hillslopes.
- Vegetation is considered the key to the long-term success of gully rehabilitation. This is because many engineering structures eventually fail, or they have a limited life span on erosion control.
- Grazing management during and following rehabilitation needs to be carefully monitored to ensure treatments are not compromised. In most cases it is important to give treated areas a spell from grazing to allow vegetation to recover from the initial disturbance associated with rehabilitation.





An example of a gully erosion feature (above, top) and initial stages of rehabilitation (above) at a property in the Bowen catchment. This site was monitored as part of this NESP TWQ Hub project. Images by Matt Curnock (above, top) and Verterra (above).

Acknowledgement for the Image by Matt Curnock. Support for the aerial footage was provided by TropWATER JCU, the Marine Monitoring Program – Inshore Water Quality through the Great Barrier Reef Marine Park Authority, the Queensland Government, the Landholders Driving Change project led by NQ Dry Tropics, CSIRO and the National Environmental Science Program Tropical Water Quality Hub.





An example of the water quality instrumentation used to collect water samples from the five paired treatment and control gully sites in the Burdekin catchment. Photos are of Aaron Hawdon (above), Leader of Instrumentation Support); and Kahlytah Ahwang (left) Water Quality Officer). Both images by CSIRO

Summary of the treatment history and monitoring results for all sites; *represents early indicator, pending further data, NA = not available. Note that NESP funding supported the first five sites listed and the Queensland Government Landholders Driving Change Projects funded Glen Bowen and Mt Pleasant.

		Virginia Park	Meadowvale	Strathbogie	Minnievale	Mt Wickham	Glen Bowen	Mt Pleasant
	Burdekin basin	Upper Burdekin	Upper Burdekin	Bogie	Don	Bowen	Bowen	Bogie
	Managing organisation	CSIRO	CSIRO	NQDT	Greening Aust.	NQDT (Verterra)	NQDT (Neilly Group)	NQDT (Mulloon Institute)
	Gully type	Linear hillslope gullies and scalds	Linear hillslope gullies and scalds	Linear hillslope gullies	Linear hillslope gullies and scalds	Scalds and major alluvial gullies	Scalds and major alluvial gullies	Linear hillslope gullies and scalds
	Average annual long-term rainfall (mm) from nearest BOM site	~ 660 mm	~ 680 mm	~ 750 mm	~ 880 mm	~600 mm	~ 725 mm	~ 690 mm
	Soil type	Red **Chromosol**	Red **Chromosol**	Black **Vertosol**	Sodic Hypocalcic Red **Dermosol**	Hypernatric Brown **Sodosol**	Brown or Yellow **Sodosols**	Black and Brown **Chromosols** and Brown **Sodosols**.
	Catchment area (ha) above monitoring station at treatment site	1.3 ha	5.0 ha	41 ha	25 ha	14 ha	2.7 ha	259 ha
	Primary treatment	- Disc plough above the treatment gully - Fenced off gully (electric fence) - Porous check dams installed in the gully (n=6)	- Four strand cattle exclusion fence around the gully - ~30% of the gully catchment has long term cattle exclusion	- Five hillslope flow diversion banks with two drains - Fencing - Small rock revetment near headcut	- Hillslope ripped, and seeded (creeping blue grass, V8 stylo, R.Rhodes etc) - Fencing - Total of 200 timber porous check dams installed	- Major earth works, soil treatment, rock chute structures - Fencing - Significant re-veg using mixed exotic species	- Major earth works, soil treatment, rock chute structures + earth bund, water points - Fencing - Significant re-veg using mixed exotic species	- Landscape rehydration - Four v-notch log rock sill structures and an earth bank to divert flows - Fencing and trough
	Grazing management in treatment paddock	Historically this site has undertaken wet season spelling and forage budgeting.	No grazing management outside of exclosure areas.	No grazing management.	Grazing Mgt Plan. Reduced stock numbers in treatment paddock.	Cattle have been excluded since works began, but future grazing proposed.	Cattle excluded during rehab. Low stock numbers and short duration graze proposed.	Exclusion for limited periods and then rotational grazing.
	No. years treatment in place	10	3	1	4	2.5	1	1
	No. years of control/treatment monitoring	3-4	3-4	4	4	3	1	1
	Total cost ($) of on-ground works	$3.5k	$3.8k	~$44k	~$27k	$595k	~$840k	$95k
Measured improvement at treatment site compared to control.	Land condition	Improved	Improved	Declined	Improved	Improved	No significant effect	No significant effect
	Vegetation (hillslope + gully)	Improved	Improved	No significant effect	Improved	Improved	Improved	Improved
	Erosion rate (headcut)	Improved	Improved	Improved*	Improved	NA	NA	NA
	Sediment concentrations	Improved	No significant effect	Improved	Improved	Improved	Improved*	No significant effect
	Sediment loads	No significant effect	No significant effect	Improved	No significant effect	Improved	NA	No significant effect
	Treatment effectiveness value			0.95		0.85		

Project outcomes

- This project has provided new knowledge quantifying the links between gully remediation, vegetation cover, erosion rates and water quality response. This will allow better targeting and selection of sites for on-ground rehabilitation programs.
- This research has provided important links between water quality data measured in the catchments with data from the marine system. These linkages will continue to be investigated beyond 2020.

Key project outputs

- A total of ~10 peer reviewed journal papers were published as part of this project (see https://nesptropical.edu.au/index.php/round-2-projects/project-2-1-4/ and https://nesptropical.edu.au/index.php/round-5-projects/project-5-9/). Scientific papers focused on various aspects of gully remediation; the influence of land use management on gully erosion rates; and end of catchment sediment and nutrient loads.
- This project leaves a legacy of core data that can be used for other research such as gully erosion modelling (see https://eatlas.org.au/nesp-twq-5/gully-remediation-effectiveness-5.9). The Paddock to Reef (P2R) program has been modelling potential water quality improvement following land management rehabilitation for more than a decade; however, there has been very little measured data to constrain model predictions. This study presents some of the first control/treatment field experiments that have measured statistically significant changes in water quality following gully rehabilitation. The data from these projects will be invaluable for scenario analysis as part of the P2R modelling program.



Example of a gully remediation site before, during and after rehabilitation. This site achieved a statistically significant improvement in water quality after 3 years. Images by Rebecca Bartley (top) and Verterra (centre and bottom).

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