Climate positive
Nature positive
Case study

Right place, biggest return

Gully erosion repair

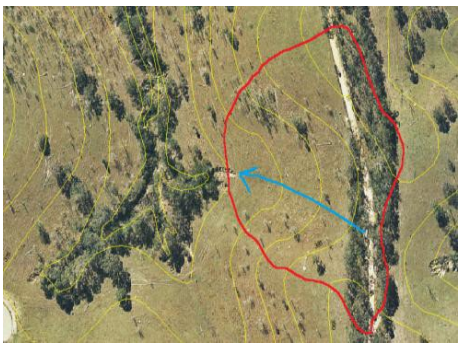
Healthy land & water

Case study: Gully erosion repair in the Ivory Creek

Gully heads are initiated where water is concentrated or the velocity of flow is increased, or where the soil is exposed or disturbed. Drains, culverts, roads and tracks, contour banks, earthworks, stock tracks, fences, fallen trees, crop row direction and low levels of ground cover can lead to concentrated flows and soil loss. Even a series of low rainfall years can result in low levels of ground cover that can increase the likelihood of erosion when rain returns.

Soil permeability and surface cover influence the time it takes before runoff starts as well as its velocity, and therefore the erosive potential, of overland flow and the estimation of peak flow. Well vegetated highly permeable soils are the most effective in reducing peak flows. Built up areas with hard surfaces, limited gardens or continually overgrazed paddocks are least effective in reducing peak flows.

Disturbance to the soil surface and exposure of the subsoil to both rainfall and overland flow can lead to gully erosion.



Aerial photographs in combination with contours from topographic information and ground checking the influence of other features including roads and culverts can help determine the catchment area and overland flow paths associated with a particular gully.

Defining the problem: Ivory Creek

A number of below average rainfall years followed by a break in the drought was enough to initiate erosion. The gully was between five and six metres deep and showed evidence of tunnel erosion and subsidence for several metres above the gully head.

Catchment area: Less than three hectares.
Soil: Shallow (15-20mm) surface of sandy loam soil over a deep erodible subsoil consisting of light to medium clay with a high sand fraction.
Subsoil: Contains a high proportion of sodium, causing it to break down into very fine particles that are easily moved by water when exposed to rainfall or overland flow.
Mitigation actions: to address the cause, for example installing whoa-boys on tracks, must be adopted in addition to treating the symptoms including the upward migration of the advancing gully head and its branches.

Further reading: The following factsheets provide further information on gully and stream bank erosion and are available for download at www.hlw.org.au.

Gully erosion repair

- ***Factsheet: Agriculture – Erosion – Gully erosion repair.*** This factsheet outlines the risks and impacts of having gully erosion on your property, actions you can take to prevent it occurring and the steps to follow when making a plan to address it.
- *Case study: Agriculture – Erosion – Gully erosion repair – Ivory Creek*
- *Case study: Agriculture – Erosion – Gully erosion repair – Using a rock chute*
- *Case study: Agriculture – Erosion – Gully erosion repair – Using concrete mats*

Stream bank erosion repair:

- ***Factsheet: Agriculture – Erosion – Streambank erosion repair***
- *Case study: Agriculture – Erosion – Streambank erosion repair – Laidley Creek case study*
- *Case study: Agriculture – Erosion – Streambank erosion repair – Case studies from the Lockyer Valley*

You will find useful tips and information from real life examples in these fact sheets.

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Designing a solution: Ivory Creek

It is important to consider the volume of water any gully being treated is expected to receive in order to design an appropriate structure to handle the flow. Topographic mapping data along with aerial photographs and site inspection of flow paths and modifications that influence flow, such as roads and culverts, is used to inform restoration design (see front page).

Restoration design features including the width, depth and shape of structures are dependent on catchment size, shape, slope and surface condition. Structures are typically designed to cope with a one in ten year storm using rainfall intensity, frequency and duration data available from the bureau of meteorology. Longer recurrence intervals for a particular intensity storm can be adopted where investment is warranted for higher value assets.

Care should be exercised to maintain ground cover above 90% all year. A forage budget for grazing stock should be developed toward the end of the pasture growing season to ensure enough residual ground cover to keep soil in place over winter, and provide protection from storms when the season breaks, typically around November in South East Queensland. In cropping situations it is important to retain mature or cover crops in high risk areas over the alluvial soils of the floodplain to minimise soil movement during the intense summer rainfall period.

A rock chute was designed for the catchment size with an erosion control blanket built into the design.

Topsoil spread over the rock chute aided the establishment of grasses that help hold the structure in place. It survived the 2011 and 2013 flood events.

Implementing the design: Ivory Creek

After careful planning and design a rock chute to safely convey hillslope flows to the gully floor was installed. Restoration activities included:

- ❒ Ripping and compacting areas of subsidence and tunnel erosion at the head of the gully.
- ❒ Battering of the entire gully area to achieve a 1:1 slope (45 degrees).
- ❒ Calculating rock chute width, shape and slope to safely conduct water to the gully floor.
- ❒ Keying in and pegging down geofabric prior to rock placement.
- ❒ Installation of the rock chute down the centre of the batter.
- ❒ Establishing wing banks to direct runoff into the chute.
- ❒ Covering the remaining battered sides with erosion matting.
- ❒ Seeding the entire area with a cover crop combined with a suitable permanent perennial pasture mix.
- ❒ Fencing the site to exclude stock until a vigorous grass cover is established.
- ❒ Managing grazing access.
- ❒ Commencing the monitoring and maintenance program.

Evaluate and improve: Ivory Creek

Evidence of gully head migration, tunnel erosion and subsidence should be assessed and recorded after significant rainfall events as well as annually at the end of the wet season. Percentage ground cover, plant health and forage quantity should be documented at the same time as the annual end of wet season inspection and a forage budget developed in grazing situations.

Comparisons with previously documented restoration progress, including photographs, should be made and management fine-tuned accordingly through actions such as fertiliser additions, reseeding, supplementary irrigation and stock number adjustments.

Defining the problem: Cooyar

A significant and actively eroding gully was identified through a combination of sediment modelling, local knowledge and ground confirmation by a qualified Soil Conservation Officer.

Gully erosion was initiated more than one kilometre downstream and became progressively deeper as it migrated up the valley floor. At the upper extent there were a series of actively eroding gully heads up to six metres deep.

Left untreated the actively migrating gully was likely to have an impact on nearby infrastructure including a powerline easement and road as well as the surrounding remnant vegetation. The migrating erosion gully was delivering large quantities sediment and associated nutrients downstream affecting water quality and aquatic health.

Your local Natural Resource Management group is often able to assist with aerial imagery and other information to assist in planning. Other tools such as Google Earth (above) and local knowledge can be used to help set design parameters.

Designing a solution: Cooyar

A number of options may need to be explored before you arrive at a suitable solution based on the capacity, experience and resources available to address the issue.

Option 1:

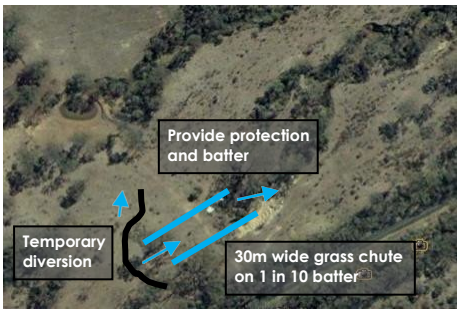
Design a gully head control dam to "drown out" the dual gully heads of the southern gully system and provide a temporary stilling pond to dissipate the energy associated with the overland flow entering the gully from the large, 100 hectare, catchment above. The dam spillway would discharge to the northwest where water could spread out over a grassed area before entering a relatively stable gully a short distance away. A bank adjacent to the gully would prevent overland flow re-entering the gully whilst it stabilises and vegetation establishes. The head of the nearby gully would be reshaped and stabilised using a rock chute.

A dam to drown out the gully head was considered in combination with a diversion bank to prevent re-entry of water into the gully; making use of the stable grassed area between the gullies to conduct water downstream.

Option 2:

A second option to construct a grass chute constructed at a 1 in 10 batter to take the runoff from the current ground level to the bed level of the gully. This chute would need to be 30m wide to accommodate all runoff from the catchment and around 70m in length to achieve the desired slope. A temporary diversion bank across the head of the cute would be required to allow grass establishment. This diversion would need to be in place for a minimum of a full wet (summer) season to ensure the development of a dense and vigorous grass sward.

Creeping grass like Couch, Pangola, African star grass or Kikuyu is recommended for the chute. The grass needs to be planted into spread top soil, fertilized and possibly irrigated. The northern gully needs to be treated also to prevent continued migration up the slope and as an alternative option in the event of failure.



An alternative involved a grassed waterway after temporarily diverting flow away from the chute during grass establishment.

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Implementing the design: Cooyar

A number of options may need to be explored before you arrive at a suitable solution based on the capacity, experience and resources available to address the issue.

It was agreed with the landholder, earthworks contractor, local natural resource management officer, local Landcare group chairperson and two ex Soil Conservation Service personnel that the gully head control dam (Option 1) would best suit the needs and resources available.

Battering the banks of the gully reduces mass failure and provides a platform for vegetation to establish to protect the soil.

Corporate support helped fund the project with the landholder contributing toward contractor payment, erecting fencing, managing stock access, weed control, supplying rock and establishing ground cover at the site.

A program of works was developed that consisted of:

- ❒ Battering the branches of the gully to a 1:1 slope.
- ❒ Shaping and compacting the dam wall across the advancing gully heads of the southern system.
- ❒ Reshaping the gully head of the northern system.
- ❒ Installing a rock chute to safely conduct water to the bed of the northern gully system.
- ❒ Fencing out stock.
- ❒ Establishing a dense groundcover of grasses.

Evaluate and improve: Cooyar

Once initial works were completed an assessment was made on the success of the restoration design and the maintenance regime commenced. Ongoing regular inspections have included photographic and written records focussing on evidence of further soil loss and condition of ground cover around the control dam, spillway, and second gully system. Checks for lateral branch development downstream are also conducted.

The Ivory Creek works was part of a demonstration project that included various gully restoration techniques including: leaky dam head control structures; paired sites to compare battering and diversion bank installation with "fence and forget"; three different erosion control matting products; and rock chute performance. Downstream water quality testing was conducted as part of the project evaluation.

The Cooyar project was supported through the GreenWorks program and has resulted in reduced soil loss and a positive impact on water quality in Cooyar Creek which flows into Wivenhoe Dam and ultimately, Moreton Bay.

Constructing the control dam across the dual gully heads included compacting the soil to improve the structural integrity of the dam.

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