COMMUNIQUE FIVE

June 2021

The Innovative Gully Remediation Project

Photo credit Fruition Environmental Pty Ltd 2020

Best practice in large scale gully remediation

A core objective of the Innovative Gully Remediation Project has been to evaluate a number of different remediation approaches to assist in defining what constitutes ‘best practice’ gully remediation.

The metrics used to evaluate ‘best practice’ include:

- objectives of remediation
- effectiveness of the works against the objectives
- cost of the works
- practicalities of implementation
- the resilience of the approach in terms of securing long-term sediment reduction outcomes.

This communique focuses on the practical aspects of large scale gully remediation, in particular:

- data requirements for gully remediation
- design considerations and approaches
- on-ground implementation.

Key learnings in terms of treatment effectiveness, cost-effectiveness and long-term resilience will be the focus of future project updates.

About the project

The Innovative Gully Remediation Project is a collaborative project supported by the Queensland Government’s Reef Water Quality Program and Greening Australia’s Reef Aid™ Program. This project’s purpose is to identify innovative, cost-effective gully remediation techniques for the Great Barrier Reef catchments, and to communicate the outcomes of trials to ensure broad uptake of best practice gully remediation techniques.

The gully remediation trials are being conducted in collaboration with the Hughes family on Strathalbyn Station, in the East Burdekin priority sediment reduction catchment. More information about this project can be found at www.greeningaustralia.org.au/projects/rebuilding-eroding-land-2

Photo credit Annette Ruzicka

Data requirements for gully remediation

The Innovative Gully Remediation Project investigated a number of data sources for use in remediation planning, design and monitoring. These included Light Detection and Ranging (LiDAR) remote sensing, high resolution LiDAR, terrestrial LiDAR, survey-controlled drone orthophotography, real-time kinematic (satellite navigation) survey, soil survey and soil sample analyses.

The data requirements for successful remediation depend, to an extent, upon the scale of activities planned. At the most basic level, a successful remediation project can be designed off the back of a recent Digital Elevation Model (DEM), that at least covers the remediation footprint, and a composite soil sample analysis from within the works area.

Extending the DEM coverage to the site's contributing catchment allows more informed analyses of the hydrological driving factors on site, and may be particularly useful for identifying erosion pressure points and for designing diversion banks and chute structures.

The DEM need not be captured through LiDAR, although improved data accuracy will generally lead to improved confidence in any calculated earthworks and material quantities. Survey control can assist with later comparisons between DEMs, which is useful data for evaluation and monitoring.

Larger, more complex projects benefit from recent higher resolution landform data, as these projects are commonly tendered to earthworks contractors based on a schedule of quantities. As such, inaccuracies in the schedules may have significant cost implications.

At least one soil test is considered absolutely essential to understanding the physical and chemical constraints of the soils on site, as this can dramatically influence remediation design and long-term success. Seeking advice on measures required to ameliorate any soil constraints is also advised.

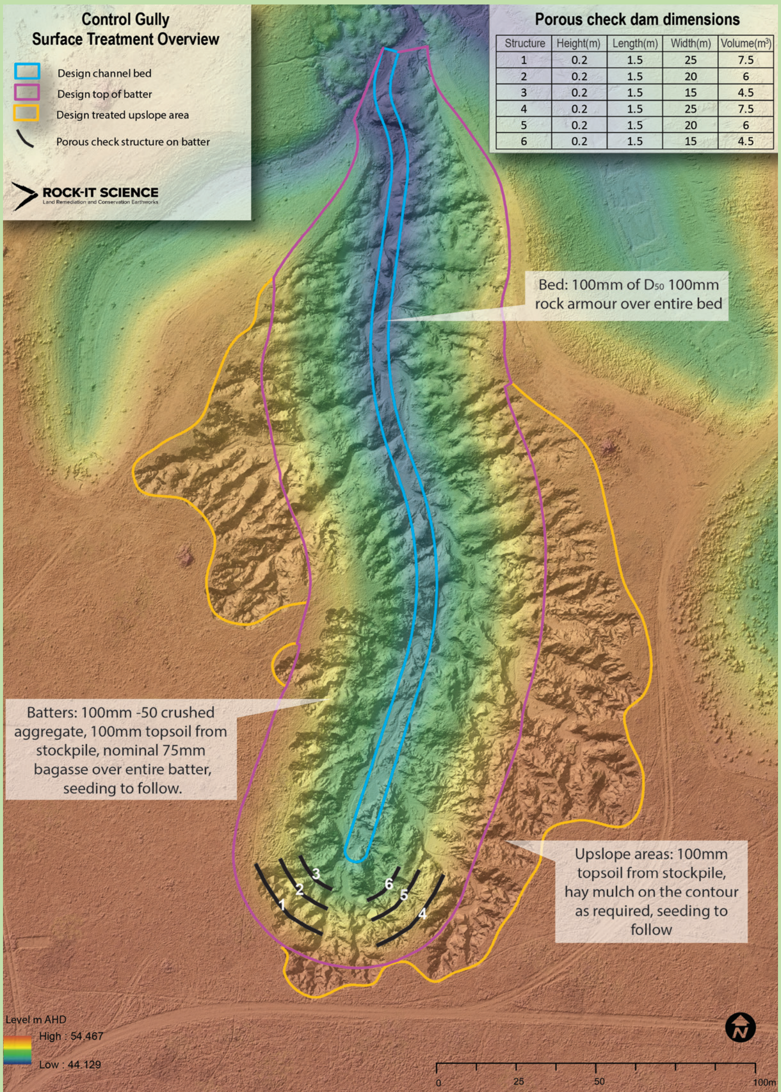
Having good data improves confidence that the project design addresses any site processes and constraints to maximise the chances of success.

Design considerations and approaches

Design is an important factor in gully remediation success and cost-effectiveness. The Innovative Gully Remediation Project trialled various design approaches. These included utilising:

- civil engineering services for bulk earthworks design, with input from specialist land remediation contractors.
- hydrological modelling for design of chute structures and diversion bunds.
- registered surveyors with experience in bulk earthworks design and design packages such as 12D and Trimble Business Centre.
- specialist soil conservation practitioners for post-earthworks remediation elements, including design and location of diversion bunds, check dams, and batter chutes.
- specialist advice on soil amelioration and revegetation.

The most successful and cost-effective designs involved close collaboration between experienced on-ground practitioners, soil amelioration experts and surveyors familiar with creating digital design models.



In any remediation design, there are a number of factors that can significantly affect implementation costs and effectiveness of the works. At Strathalbyn, the design factors that most influenced cost and success included:

- ***Design landform efficiency.*** Remediation designs that carefully considered the cut to fill balance of earthworks, and minimised as much as practical the movement of large quantities of material over distance, were cheaper to implement.
- ***Available resources for remediation.*** Designs that required bringing in large quantities of off-site materials were avoided, as they were shown to be significantly more expensive than those using locally sourced materials (e.g. rock, hay). This would apply to any remote site.
- ***Soil constraints.*** The sodic and dispersive soils on site required specific approaches to bulk earthworks that increased the costs of implementation (e.g. addressing tunnel erosion). It is known from other sites that failure to address these soil constraints effectively has led to ongoing maintenance costs or failure of the remediation project.
- ***Attention to batter slopes and lengths.*** The correlation between batter slope and batter length in the design is an important consideration. Steeper batters are shorter in length and may be appropriate depending upon soil characteristics and subsequent capping and revegetation. For long batters of low slope, generally some form of run-off control (e.g. hay bunds or diversions) is required to prevent rilling of the batter surface while vegetation is establishing.
- ***Avoidance of drainage depressions above batters.*** Designs should ensure that all slopes above batters are free draining in a way that reduces flow concentration down batters. Where this is unavoidable, then some form of dispersion or flow control structures are required (e.g. hay bunds, contour checks, or batter chutes).

On-ground implementation

Implementing the remediation design is the critical phase of the process. Best practices in construction management should be adopted, including workplace health and safety planning and management, erosion and sediment control, and environmental safeguards related to minimising disturbance, avoiding contamination from fuels, etc.

Other factors proving important during the construction phases at Strathalbyn included:

- ***Survey control.*** For large scale gullies, survey control is important to ensure that designs are implemented correctly and that material quantities are accurate. Machine GPS control with digital designs can assist in this regard. As an example, for imported capping materials, an error of an additional 50mm over a 2-hectare gully equates to 1,000m^3, with implications for project budgets.
- ***Access management.*** Generally, a graded track is all that is required for access for construction and materials. Access routes leading directly to gully heads should be avoided at all costs. Remediation of access tracks at the completion of works is also important.

Photo credit Rock-It Science Pty Ltd 2020

- ***Tunnel erosion.*** The most successful technique for treating tunnel erosion has been proper foundation preparation. This involves excavating the tunnel to base level, replacing material in layers with compaction at optimal moisture level, and ensuring free drainage of the repaired surface. This method minimises subsequent repairs due to subsidence. Where repairs are required, it is often only in the first year after construction, and picked up during routine maintenance. Repairs are made by filling subsidence with coarse sand, gravel or stable topsoil.
- ***Materials separation.*** Topsoil and other soils with stable chemical and physical characteristics have been very important resources at Strathalbyn. The topsoil resource is stripped carefully and winrowed or stockpiled for later use as the final layer on batters. Less reactive subsoils are similarly segregated. The least stable materials are used at depth in the batters.
- ***Incorporation of soil ameliorants.*** Many methods of incorporating ameliorants, such as gypsum and organic matter, were trialled at Strathalbyn. The most successful method involved ripping with a dozer and grader, then using a power harrow as the final stage. An air seeder was fitted to the harrow, so the remediated surfaces were seeded at the same time as incorporating organic matter into the top 20mm of soil. Avoiding over-compaction of the final surface layer assists with revegetation establishment.
- ***Final treatments.*** The final treatments at all sites revolved around identifying pressure points in the design and alleviating them using appropriate strategies (e.g. through surface application of permeable materials such as hay or cobbles on the contour). Typically, pressure points occur where there are long (>40m) low relief slopes, depressions above the batters that concentrate flow down the batters in one location, concave sections of batters that concentrate flow midway down the batter, and gully outlets, which are prone to initiating bed incision if overly steep, and may eventually undermine the batters. These pressure points should be regularly monitored as part of a maintenance program.

Prior to works in August 2017. Photo credit Damon Telfer.

The same site in August 2020. Photo credit Damon Telfer.

Donors on a tour of works at Strathalbyn. Photo credit Annette Ruzicka.

PRIVATE FUNDERS

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