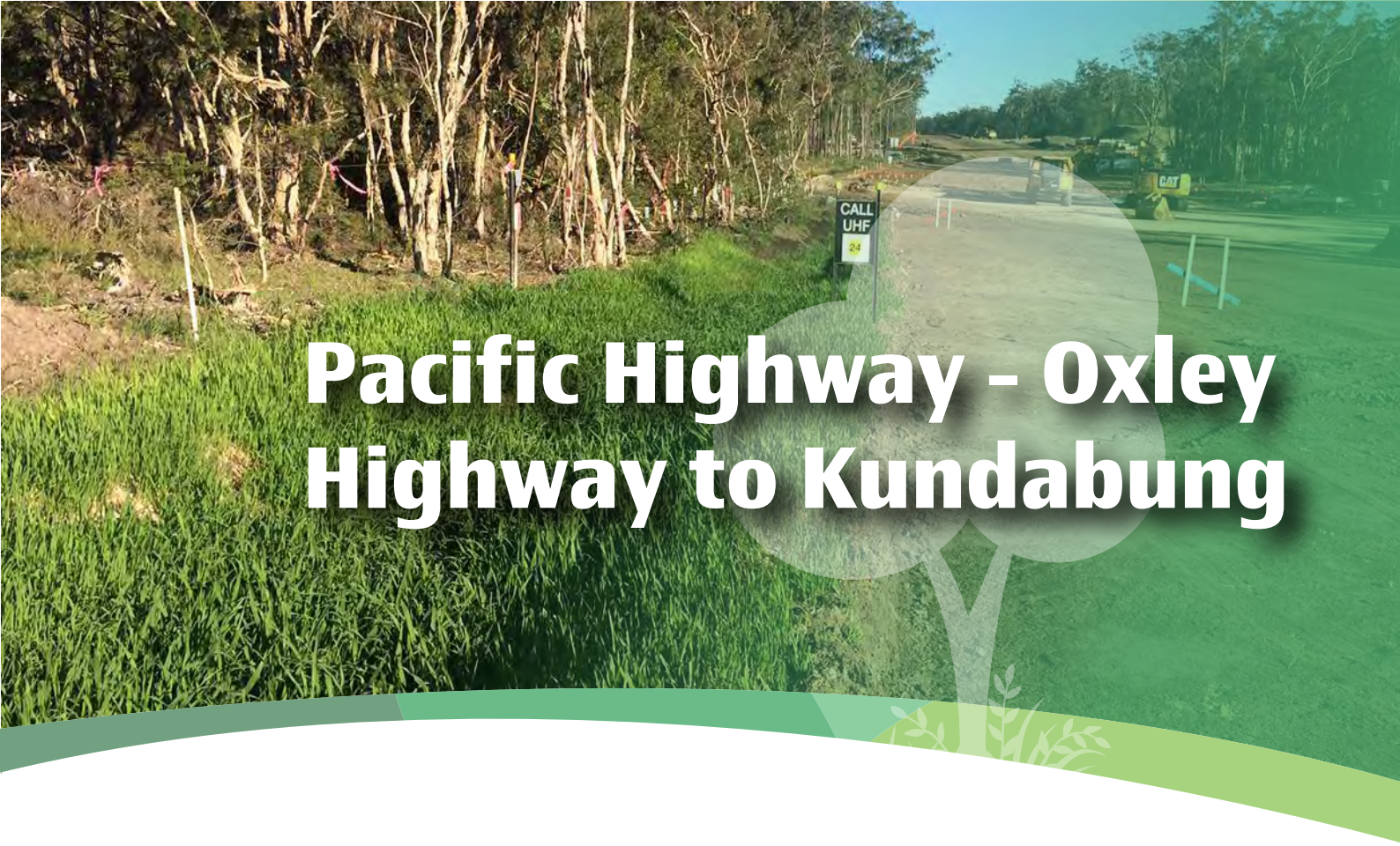


# Pacific Highway – Oxley Highway to Kundabung

**This report outlines three prominent issues with civil construction site revegetation processes and how we were able to efficiently and cost effectively overcome them.**

## Abstract

## Standard Vs Ameliorated Applications

Site works began completion on the Oxley Highway to Kundabung project (OH2KU), with a Standard RMS Hydromulch Application. However, these applications are limited to fertilisers, which offer very little in the way of providing the required nutrients that are deficient in the soil.

Also, the standard R178 application assumes an ideal topsoil, which evidently, does not correlate to civil construction sites. These soils are often of poor quality, often mixed with site-won mulch and require amelioration in order to achieve a result.

After the Standard Application failed, the site works were required to be re-treated with an Ameliorated Application, which soon became the adopted choice for the remaining revegetation works of the project.

The comparisons in results showed the ameliorated application to be very successful on site, stabilising the soil, establishing effective erosion control and promoting long-term germination on site.

We confirm that the AS4454 Organic Compost is an important part of the Long-Term Revegetation Process in the addition of organic carbon and microbes, and should be included within the applications.

## Rainfall

Performance of the application relies on appropriate rainfall. The rainfall has shown to wash materials into the surface. Once the ameliorants have infiltrated into the soil, grasses begin to germinate and results seen. The works on site have shown that the ameliorated hydromulch application is able to withstand a great amount of rainfall without failure.

## Topsoil Preparation

Site works required scarification immediately prior to an application. Appropriate preparation works were completed where possible, and results easily seen. This comes with minimal cost when completing trimming works in comparison to reworks. Good preparation will provide the best results and ultimately, the most effective erosion controls and stabilisation methods.

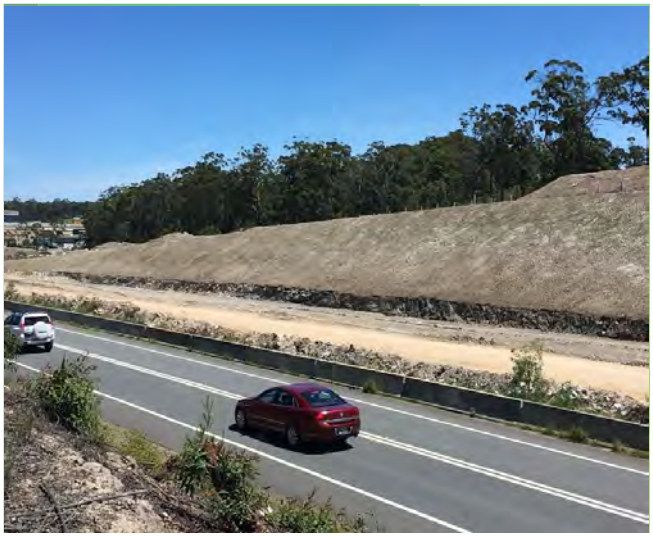

*Figure 1 - Cut 5 NB Nov 2015, Failed Standard Specification Mix*

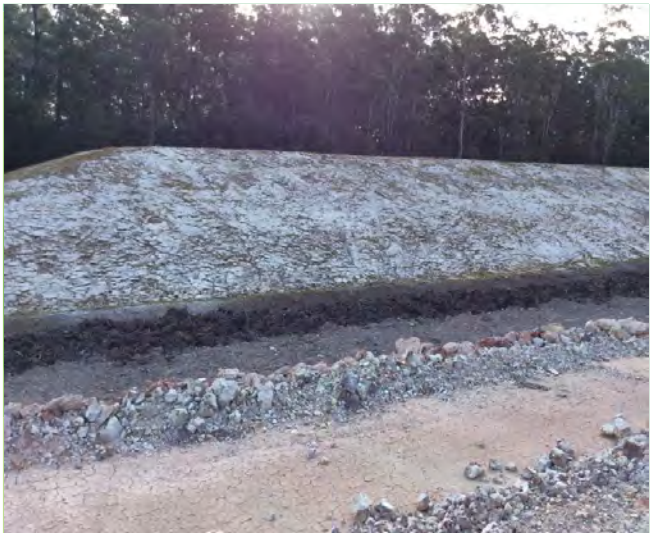

*Figure 2 - Cut 5 NB Nov 2015, Failed Standard Specification Mix*

## The Problem With Civil Site Revegetation

Australian soils, especially those on civil sites, generally have a broken-down soil system, lacking the available nutrients and subsequent efficient microbial activity, required for successful growth.

The purpose of a hydromulch is to establish a root system in order to minimize erosion, and to 'start' the natural regeneration process up faster. This means that an effective application will require fertilisers to be used in the extended short-term, to establish cover quickly, as well as an effective soil amelioration in order to actively sustain long-term regeneration with desired species. This can be achieved by incorporating common materials that have been used on Australian soils for more than 50 years (lime, gypsum, fertilisers, etc.).

There exists a misconception that the materials and associated costs of this process can be minimized, with the desired appropriate results still achieved. Initial cost savings in 'skipping' required steps often result in large losses toward the end of the project.

The prominent factors contributing to the success of revegetation are:

- Appropriate applications
- Appropriate surface preparation
- Appropriate seed blends
- Rainfall

The OH2Ku Project was a great opportunity to monitor results and test these parameters.

## Project Background

Initial Seeding Works up to 21st Aug 2015 were carried out in accordance with Specification requirements and results were poor in that germination after rainfall was patchy, and the grasses after initial strike exhibited signs of severe stress after initial germination and growth to about 50 mm height.

Grasses generally turned yellow before dying back leaving extensive bare areas after about two months. Surviving cover crop grasses became colourless and spindly before eventually haying off.

On our own initiative in early July 2015, we took soil samples for testing and experimented with various combinations of ameliorants and monitored results.

Our recommendations were as follows:

Hydromulch to Specification, plus

- Microfine Lime
- Microfine Gypsum
- Organic Compost
- Nitrophoska Special Inorganic Fertiliser Sulphate of Potash
- Urea

Figure 1 and 2 above illustrates the difficulty in achieving a result with standard applications. These applications are still visible on the soil surface, yet following sufficient rain, have not germinated.

The site topsoil was deficient in calcium, nitrogen, phosphorus and potassium, with little organic content, resulting in poor microbe activity and nutrient cycling. Site-won mulch was also mixed in with the topsoil, which would result in a nutrient draw-down, again not compensated for in a standard application.

Inorganic fertilisers and ameliorants were a necessity for these soils in order to stabilize the soil surface and promote healthy germination.

In areas where the annual crop did germinate, the annual grasses 'yellowed' and died off very quickly, due to the inefficient additives applied to the topsoil in the standard R178 application. Please see Figure 3.

This premature 'yellowing' of grasses can easily be noted on many highways and freeway revegetation projects. It is easily recognizable and relates to the lack of appropriate materials and ameliorants in the application. It is not suited to the site soil.

## Site Soil Testing

A full soil analysis should be conducted on site top-soils in order to determine the appropriate application, specific to the site. A soil analysis removes the 'guess-work' in that it illuminates the soil requirements for effective germination.

Soil tests were taken from site, and a tailored mix derived using these results. The site-specific application included hydromulch to R178 specifications, plus additional ~7t per hectare of fertilisers and ameliorants.

Micro-fine ameliorants were used in order to improve the solubility, increasing the rate they were absorbed into the topsoil.

The intention of this ameliorated application is to stabilize the soil by improving soil structure, increasing the macro and micro nutrients to stimulate plant growth, while also boosting microbe activity.

This will lead to improved nutrient cycling and further, the eventual sustainable long-term germination of the grasses and natives.

See the figures 6, 7, 8, 9 & 10, showing annual, perennial and native germination.

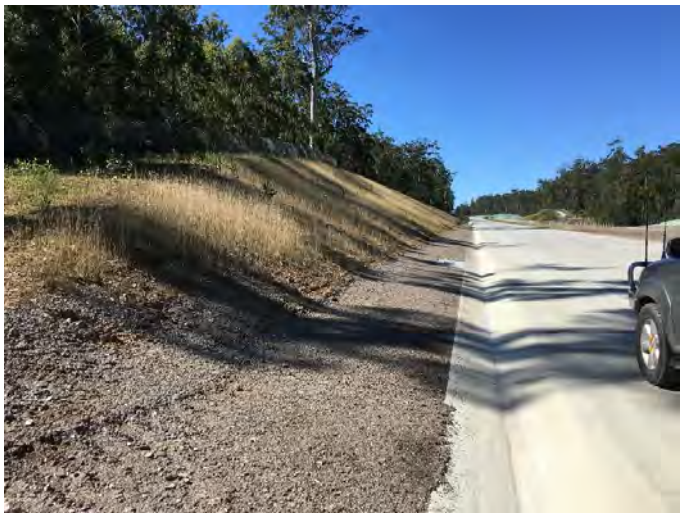

*Figure 3 - Standard Hydromulch typical batter where initial cover crop germination has hayed off due to lack of long term nutrition.*

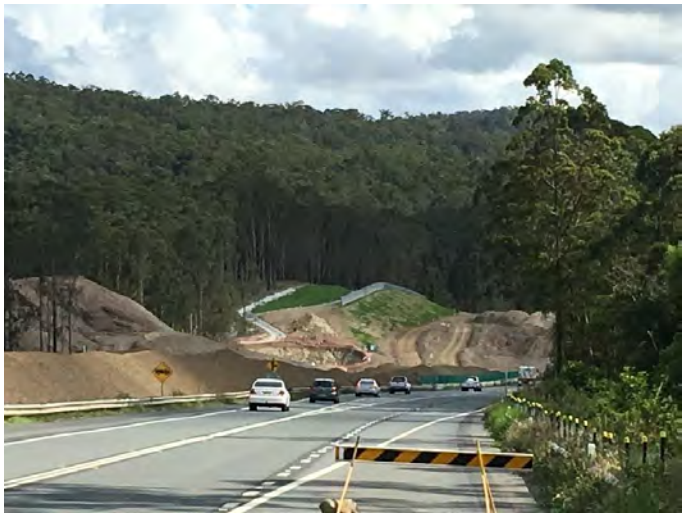

*Figure 4 - Cut 19 NB Ameliorated Mix Application, Upper Batter 10th Oct 2015, Lower Batter 29th Oct 2015*

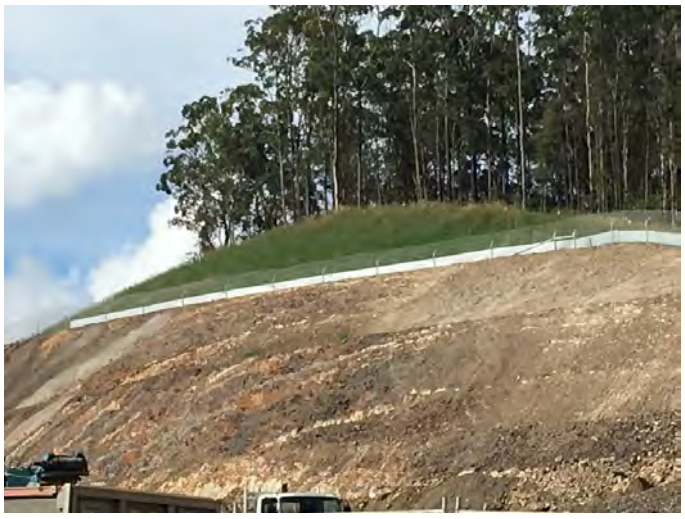

*Figure 5 - Cut 19 NB Ameliorated Mix Application, Upper Batter 10th Oct 2015*

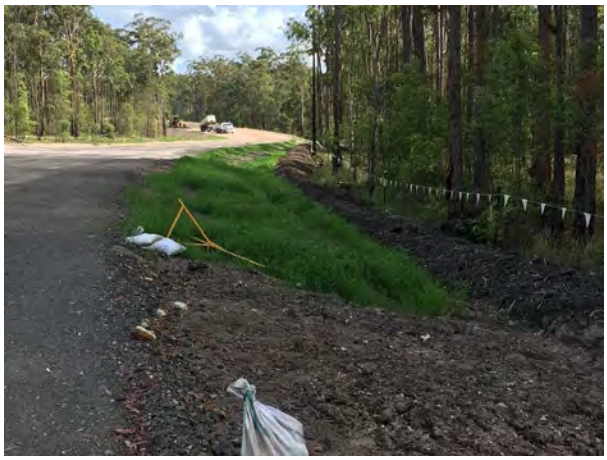

*Figure 6 - Blackmans Point Rd Interchange SB - 10th Nov 2015, Dense healthy grass on loose topsoil surface*

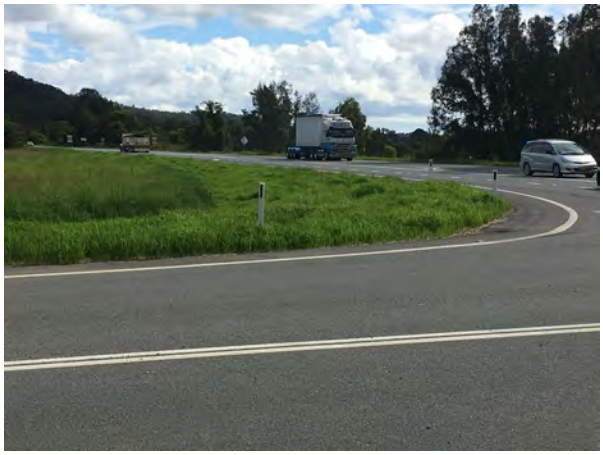

*Figure 7- Pub Intersection - 10th Nov 2015, Dense healthy grass on loose topsoil surface.*

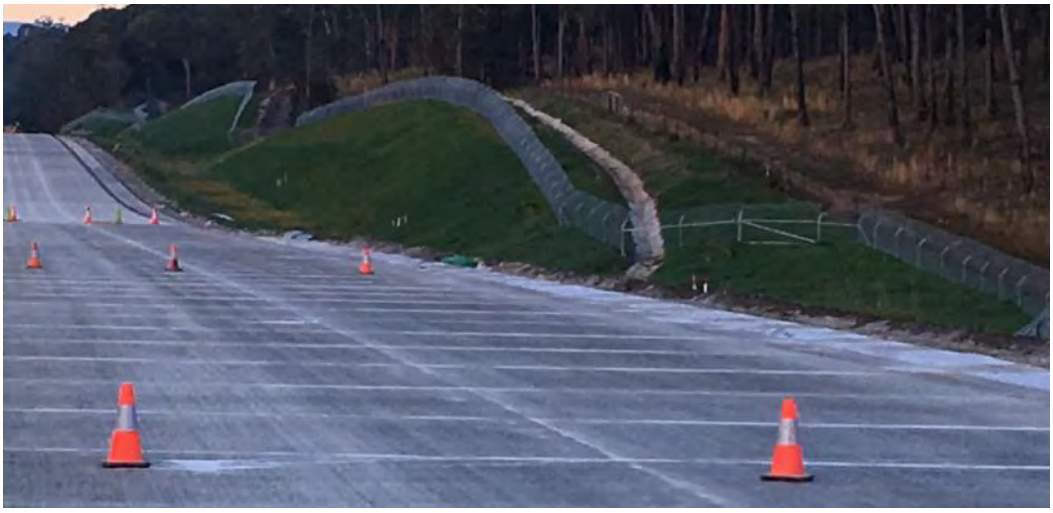

*Figure 8 - Cut 2, 27th July 2016, Ameliorated Application Annual Grass Germination*

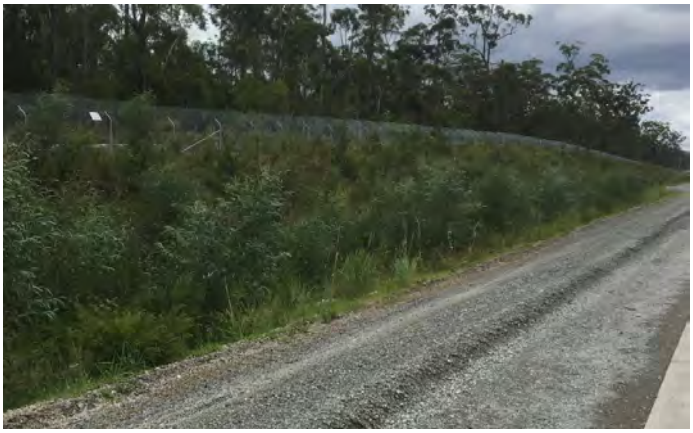

*Figure 9 - Cut 2 Ameliorated Application Native Grasses and Shrub Germination*

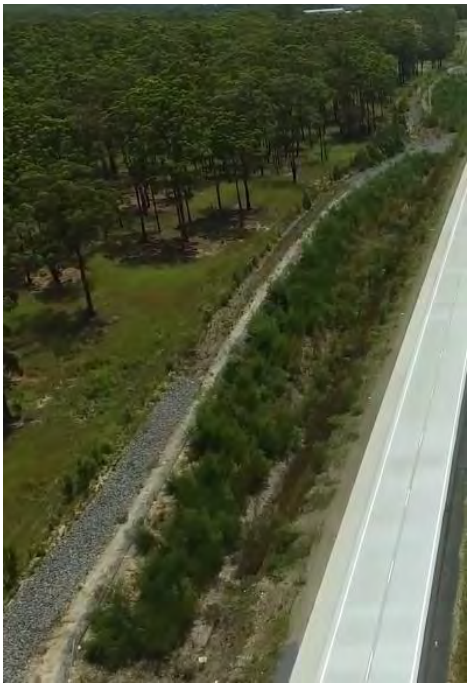

*Figure 10 - Aerial Cut 2 Ameliorated Application Native Grasses and Shrub Germination*

## Rainfall

Our ameliorated applications are applied hydraulically to the soil surface. The application itself does not contain enough water for germination. The application itself will remain dormant on the surface until adequate rainfall arrives.

The nature of utilizing fine and micro-fine materials in our applications results in the faster absorption into the topsoil surface. Our applications have a tendency to wash in rather than wash off batters following rain events.

Due to the increased absorption rate of these materials in comparison to standard conventional hydromulch, our applications tend to successfully establish at a faster rate. Please see Figure 11 below.

A polyacrylamide binder is also used to bind the wood-fibre together to the soil surface, aiding in the erosion capabilities of the topsoil until adequate rainfall for successful germination begins.

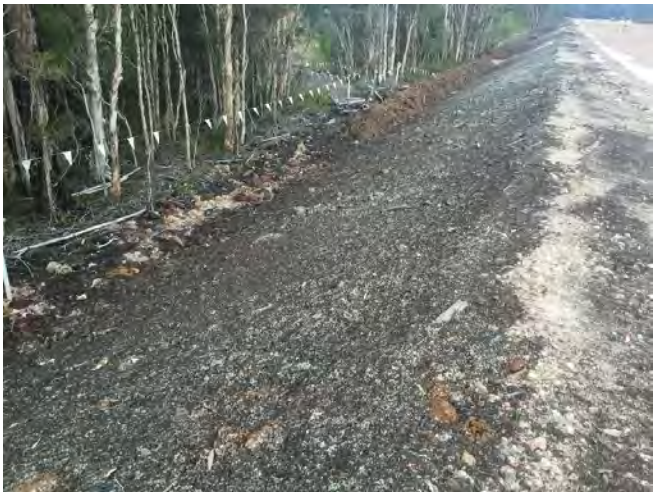

*Figure 11 - Fill 13 NB 16th Sept 2015 after Initial Rainfall - Application no longer visible on surface, allegedly washed down batter into wood chip berm*

Within two weeks of the initial rainfall event, preliminary erosion control is being established via emerging grasses. It was clear that the fine particles had been absorbed into the soil surface in the rain events, propagating grass growth shortly thereafter. See figure 12 and 13 below.

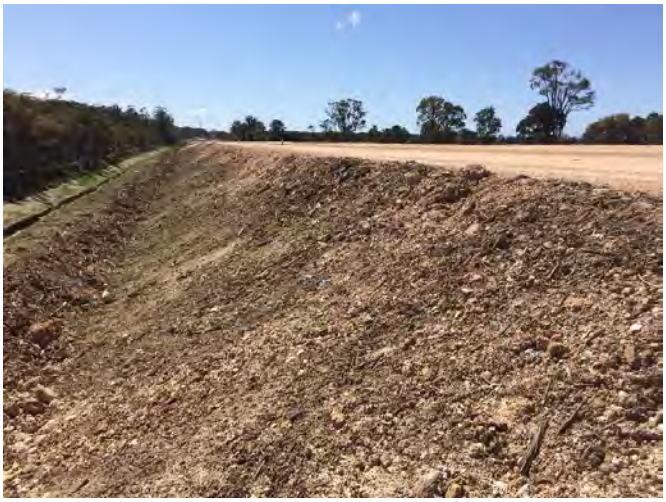

*Figure 12 - Fill 13 NB 29th Sept 2015 after 97.2 mm Rainfall since 16th Sept 2015 - Germination evident on face, more pronounced on topsoil areas.*

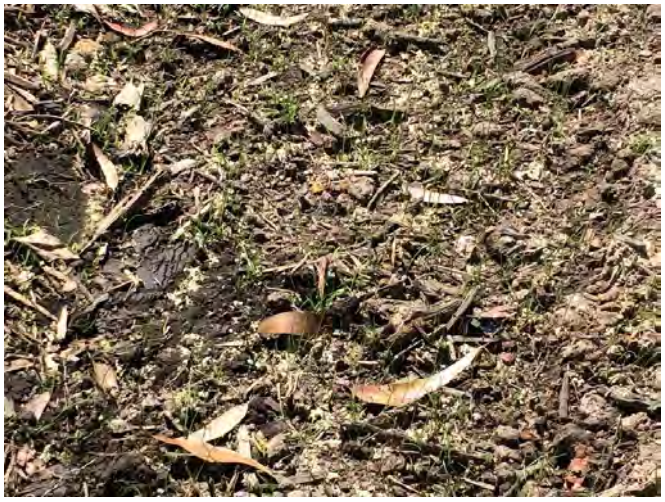

*Figure 13 - Fill 13 NB 29th Sept 2015 after 97.2 mm Rainfall since 16th Sept 2015 - Germination on Flats*

As can be noted in the figures above, grasses are beginning to emerge, working towards an established root system and subsequent effective erosion control.

Inundated areas also saw the success of the ameliorated application in the Fill 13 SB drain. The capabilities of our organic fibre medium and binder were tested here in not only the initial erosion control, but also the ability of our materials to stay intact, holding onto the soil surface. Figure 14 below illustrates our ameliorated applications success.

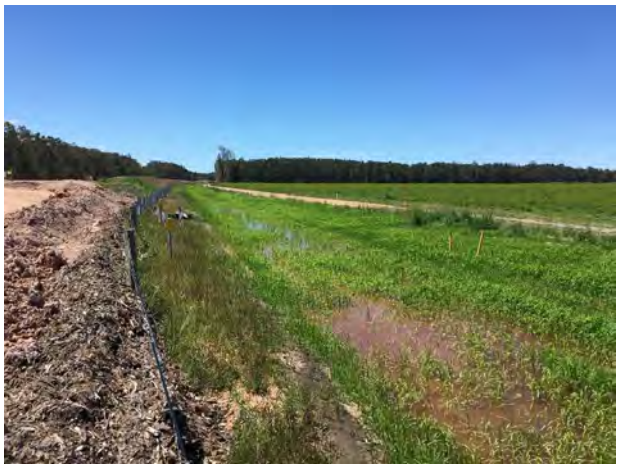

*Figure 14 - Fill 13 SB Drain 10th Nov 2015 after 173.3 mm Rainfall since 29th Sept 2015 - Dense healthy grass on loose topsoil surface*

## Topsoil Preparation

Appropriate topsoil preparation is essential in achieving successful results. A loose, roughened surface (ideally with horizontal contours) allows for easier seed and ameliorant penetration, as well as water retaining capabilities. A correctly prepared application area will always exceed the performance of a poorly prepared area.

Figure 15 below, provides a great comparison in the results of annual grass germination in both appropriate and inappropriate topsoil preparation.

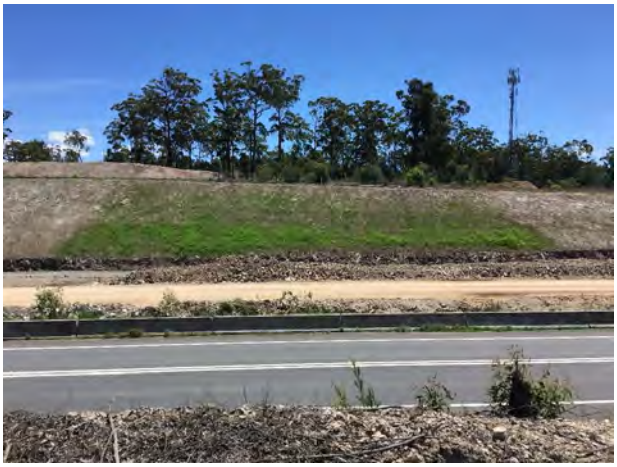

*Figure 15- Cut 5 NB 10th Nov 2015 - Ameliorated Mix over failed Specification Mix - Topsoil scarified on lower section of batter only with improved germination.*

Figure 15 demonstrates a number of comparisons. To the left and right of the grassed area is a standard specification mix failure. The standard application offers very little in terms of conditioning poor quality soils. This is because there are minimal additives in the application, as explained in the earlier sections of this report. A site specific application was then completed in the middle of the two standard applications.

Similar to the earlier figures of Fill 13, the top half of the batter in Figure 15 has limited topsoil preparation. The lower few metres of the batter have been scarified, providing the essential loose and roughened surface for seed and ameliorant penetration.

The full reward of a site-specific application is seen when topsoil preparation is completed. Rainfall, seeds and ameliorants can penetrate the soil surface and establish effective cover. Grass root systems can establish, providing effective erosion control. Ameliorants are efficiently improving the soil structure, microbial activity, nutrient cycling, and working toward restarting the natural regeneration process.

*Figure 16 - Fill 13 NB Drain 10th Nov 2015 after 173.3 mm Rainfall since 29th Sept 2015 - Dense healthy grass on loose topsoil surface*

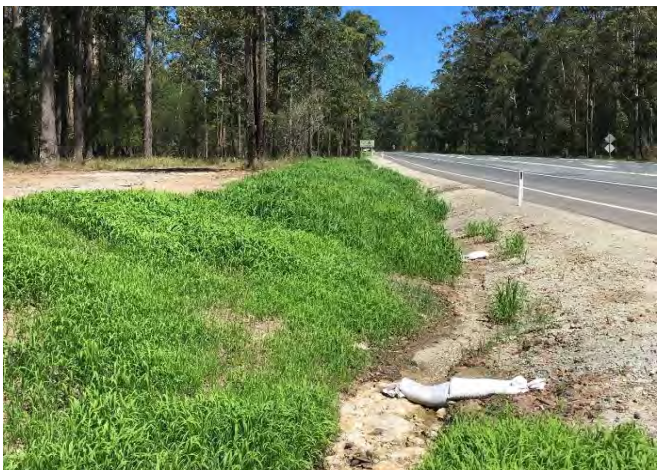

*Figure 17 - Bill Hill Road Intersection 10th Nov 2015 after 173.3 mm Rainfall since 29th Sept 2015 - Dense healthy grass on loose topsoil surface*