

Addressing topsoil deficits at Queensland mines

Implications for Leading Practice

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- A priority for mine sites is to develop an inventory of topsoil and assess whether there is sufficient topsoil available to meet rehabilitation requirements.
- Where a topsoil deficit is identified, early planning is required to identify alternate materials and develop a strategy to convert them into suitable growth media.
- Strategies should be promptly trialled to evaluate if alternate growth media can achieve PMLU requirements.
- Topsoil resources should be conserved and managed to maintain viability and ameliorated to overcome constraints where needed.
- Regardless of the source (i.e. topsoil or an alternative), a growth medium must support establishment of the target vegetation species.

Background

A topsoil deficit presents a significant constraint to rehabilitation activities, as topsoil is a critical growth medium that supports vegetation establishment, growth, and long-term ecosystem development.

The Office of the Queensland Mine Rehabilitation Commissioner (OQMRC) has published two documents on topsoil deficits. The first is a review conducted during a higher degree industry placement program, presented as a Student Report (da Silva et al. 2024). OQMRC also engaged Verterra Ecological Engineering to develop advice to create an alternate growth medium where there is a topsoil deficit, published as a Technical Paper (Wehr et al. 2026).

The role of a growth medium

For mine rehabilitation, a growth medium is the layer of material that supports plant establishment and growth, enabling the land to achieve its intended post-mining land use. Growth media should provide substrates that are stable, not dispersive or hostile to root growth or penetration, have adequate water holding capacity, and supply adequate nutrients and microbial associations to support plant growth (Australian Government 2016).

Topsoil – a valuable resource

As the uppermost portion of a soil profile, topsoil is characterised by accumulated organic matter and biological activity, and a concentrated seedbank. These characteristics decline with depth, making topsoil a valuable resource for revegetation activities at mine sites.

Poor topsoil harvesting and handling practices lead to structural and/or organic decline in topsoil quality. Disturbance or mixing of stockpiled topsoil with other materials can degrade or cause the material to be unavailable for revegetation activities.

da Silva et al. (2024) describes the implications arising from a deficit of topsoil and the use of a poor or inadequate growth medium as a substitute. Particularly, the risk that deficiencies or limitations in the alternate growth medium may adversely impact plant growth and establishment, thereby compromising achievement of the intended post-mining land use (PMLU). da Silva et al. (2024) reviewed 27 Progressive Rehabilitation and Closure plans (PRC plans) and found that, regardless of whether sufficient topsoil was



available, all 27 sites would need to ameliorate harvested topsoils to overcome constraints and improve their performance as a growth medium. From the group of reviewed plans, there were 6 sites projected to have topsoil deficits, with 5 of these planning to amend spoil material to make a growth medium (da Silva et al. 2024).

Alternate growth media

At a mine site, there are often a variety of materials available (e.g. subsoil or excavated overburden) that may be suitable to act as a growth medium. As noted by Wehr et al. (2026) 'material sourced for use as a manufactured growth medium should have mineral, biological and physical properties which can be manipulated to support the intended PMLU.' Subsoils or overburden used as a topsoil substitute should be demonstrated to be suitable as a plant-growth medium before use.

Leading practices for managing growth media resources

Leading practice is to remove topsoil resources prior to mining and preserve these for use in rehabilitation to support vegetation, to identify shortfalls early and develop strategies to overcome any deficit ahead of progressive rehabilitation. Topsoil is to be protected from wind and water erosion while stored before its use.

Soils need to be properly characterised ahead of mining (including mapping soil units and depths, characterisation of baseline soil physical, chemical and microbial conditions). Any new and ongoing topsoil salvage activities should conserve topsoils and subsoils and avoid a deficit for rehabilitation.

Prompt identification of topsoil shortfalls and sources of alternate growth media provide opportunities to efficiently handle and appropriately store materials during mine operations.

Improper handling and storage practices for topsoils will result in the loss of seed bank and sterilisation of microbial activity. It is important to ensure topsoil is kept in a usable condition for sustaining vegetation in rehabilitation areas. Old topsoil stockpiles can be used as a growth medium, provided limitations are overcome via amelioration.

Following the approach presented by Wehr et al. (2026), the constraints and limitations of alternate growth media and old topsoil stockpiles should be addressed in a timely manner through the addition of nutrients and or ameliorants where required to make the soil fertile and limit dispersion. Such interventions will support the evolution of a functional soil as pedogenetic processes commence. Organic matter plays a critical role in the development of stable soil structure and the establishment of an active soil microbiome. This microbiome is a key driver of pedogenic processes, nutrient cycling, and carbon storage which highlights the importance of sourcing organic material to increase organic carbon levels.

The lack of large scale, in situ trials was identified as a gap hindering successful rehabilitation by da Silva et al. (2024). Site-specific characteristics associated with soils, vegetation and climate can influence the success of growth media. Trialling amelioration strategies is key to test their practical application and to provide long-term insights and opportunities for refinement ahead of full-scale implementation. For this reason, trials were included as a part of the approach developed by Wehr et al. (2026) and are considered to be leading practice.

Despite best endeavours to develop and trial site-specific amelioration strategies, there remains the risk that revegetated areas can fail after several years. Additional treatment with a soil ameliorant such as gypsum or a fertiliser may also be required to improve soil properties. To identify any necessary interventions and to demonstrate vegetation is on a trajectory to be self-sustaining, characteristics of a healthy, functioning soil such as nutrient cycling, erosional stability and plant available water capacity must be monitored after vegetation has established. The requirement for monitoring has also been included in the approach developed by Wehr et al. (2026).

References

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