

Improving mine closure and rehabilitation outcomes in South Australia: integrating evidence, stakeholder feedback and regulatory reform

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Abstract

Mining remains fundamental to Australia's economy and is increasingly critical as the global transition to net zero accelerates. Demand for critical minerals such as copper, lithium and rare earth elements continues to grow, elevating the strategic importance of Australia's resource base. South Australia plays a significant role, hosting innovative operations such as in situ recovery of uranium and holding approximately 68% of Australia's Economic Demonstrated Resources of copper, a key input to renewable energy technologies. In parallel, the quarry sector underpins major construction and infrastructure projects, including the River Torrens to Darlington project and the Osborne submarine construction yard, while contributing materially to regional employment and economic activity.

As mining and quarrying activity expands, expectations around environmental performance, rehabilitation, closure planning and post-mining land use have increased. However, only a small number of mines achieve full relinquishment, with many remaining in long-term care and maintenance. In addition, the South Australian government retains responsibility for several legacy mine sites, reinforcing the importance of effective closure planning and progressive rehabilitation to minimise long-term environmental and management obligations.

In response, the South Australian Department for Energy and Mining is developing a mine closure and rehabilitation framework comprising a new policy, a review of existing guidance and processes, and supporting technical guidelines. This work has been informed by a literature review, targeted stakeholder engagement and analysis of 100 mining and quarrying programs assessed between 2021 and 2025 across 11 commodities.

The review identified recurring gaps which align with national and international guidance, including the definition of completion criteria and closure outcomes, planning for post-mining land use, integration of closure into mine development planning and implementation of effective progressive rehabilitation. Stakeholder feedback reinforced the need for an outcomes-focused closure framework supported by practical tools and supporting guidelines.

Collectively, this evidence highlights an opportunity to transform South Australia's closure framework to better integrate closure across the mine life cycle, support progressive rehabilitation and provide clearer pathways to relinquishment, consistent with leading practice. The work proposed in South Australia is positioned to translate internationally recognised principles as articulated by global and national leading practice guidance and other jurisdictional examples into South Australia-specific practical mechanisms that support progressive rehabilitation and closure, reduce long-term public liability, and enable the timely transition of mine and quarry sites to beneficial post-mining land uses.

Keywords: *regulation, mine closure, progressive rehabilitation, closure outcomes, post-mining land use, relinquishment, governance, guidelines*

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1 Introduction

Globally and nationally, mine closure and rehabilitation have increased in importance as the resources sector responds to decarbonisation, the transition to low-emissions energy systems, and growing demand for critical minerals and materials. While these trends reaffirm the continued importance of mineral and extractive development, they also heighten scrutiny on the long-term environmental, social and land use legacy of mining activities after operations cease. Contemporary leading practice (e.g. Commonwealth Scientific and Industrial Research Organisation [CSIRO] 2023; Department of Industry, Science and Resources 2016a and 2016b; International Council on Mining and Metals [ICMM] 2025), emphasises early integration of closure planning, progressive rehabilitation, outcome-based performance frameworks and the delivery of sustainable post-mining land uses that support long-term land stewardship and community outcomes.

Mining and quarrying operations in South Australia occur across diverse environmental and land use settings and are regulated under a comprehensive legislative framework. However, rates of full tenement relinquishment, specifically for mines, remain low, with many sites transitioning into prolonged care and maintenance or in some instances requiring ongoing regulatory oversight. The South Australian government retains responsibility for several legacy mine sites, reinforcing the importance of effective closure planning to reduce long-term environmental, social and financial liabilities. The quality of closure planning and closure documentation remains variable, often resulting in multiple rounds of regulatory clarification and uncertainty for operators, regulators and communities.

In response, the South Australian Department for Energy and Mining (the department) has undertaken an evidence-based program to transform closure and rehabilitation policy, informed by a review of approved programs, targeted stakeholder consultation and consideration of contemporary leading practice.

This paper concludes that improving mine closure outcomes in South Australia requires an integrated, outcomes-focused closure framework that is proportionate, risk-based and practically implementable. To support this, the paper draws on 3 evidence bases:

- a review of national and international mine closure literature and guidance
- analysis of closure and rehabilitation-related requests for further information issued during the assessment of 100 mining and extractive programs approved between 2021 and 2025
- targeted stakeholder consultation with industry practitioners and representative bodies.

1.1 Background

1.1.1 Sector context for mine closure in South Australia

South Australia hosts a diverse mining and quarrying sector that supports the state's economy, infrastructure development and regional communities. As of 30 June 2025 (Department for Energy and Mining 2026), there are approximately 2,570 active mineral tenements in South Australia, including around 700 mining leases, 580 extractive mineral leases and more than 200 private mines, alongside exploration licences and supporting tenure types. The sector includes large, long-life metalliferous operations producing commodities such as copper, uranium and critical minerals, including innovative mining approaches such as in situ recovery of uranium, as well as a high number of quarrying operations supplying construction materials including limestone, sand, clay and hard rock. South Australia holds approximately 68% of Australia's Economic Demonstrated Resources of copper (Geoscience Australia 2024), a critical input to renewable energy and electrification technologies, while the quarrying sector underpins major infrastructure projects such as the AUD 15.4 billion River Torrens to Darlington project (<https://www.t2d.sa.gov.au/>) and the AUD 30 billion Osborne submarine construction yard (Australian Space Agency 2026), and contributes significantly to regional employment and economic activity.

Quarry (extractives) operations represent a substantial proportion of regulated sites and are often (but not always) characterised by smaller footprints (and in some instances, very long mine lives), proximity to urban or peri-urban areas and differing financial assurance arrangements. Conversely, mining operations tend to

involve larger disturbance areas, remote locations and more complex geotechnical, hydrological and closure planning considerations. Examples of fully closed mines are few, with some sites entering prolonged care and maintenance periods that reflect a range of interrelated factors such as operational realities including long mine lives and staged development, changing market conditions, technical and operational challenges, and limitations in the full integration of closure planning into operational decision-making. Together these characteristics create a sector with a broad spectrum of closure pathways, challenges, risk profiles and post-mining land use opportunities.

In addition to active operations, South Australia also manages a portfolio of legacy and former mine sites, many of which pre-date contemporary regulatory frameworks and modern rehabilitation standards. Notable examples include the Brunkunga mine site, where historic pyrite and pyrrhotite mining has resulted in long-term risks associated with acid and metalliferous drainage, and the former Leigh Creek coal mine, where large-scale open-cut coal mining has left extensive voids and coal-bearing materials that present ongoing risks such as spontaneous combustion and long-term landform geotechnical stability. These legacy sites continue to present environmental, public safety and land management challenges and, in some cases, require government-led risk mitigation and management works. This legacy context reinforces the importance of effective closure planning, having robust approved closure outcomes in place, progressive rehabilitation and clear relinquishment pathways for current operations to minimise the transfer of long-term liabilities to the state, environment, community and future land users.

The scale and diversity of mining and quarrying activities in South Australia mean that closure planning must accommodate differences in mine life, disturbance type, environmental sensitivity, financial assurance and post-mining land use potential. These factors underpin the need for proportionate, outcome-focused closure regulation supported by clear guidance and adaptive frameworks rather than uniform or prescriptive approaches.

1.1.2 Regulatory framework

The department, through the Minerals Regulation Branch, is responsible for the regulation, administration and management of South Australia's mining sector, mineral resources and exploration. The *Mining Act 1971* (Government of South Australia 1971) and associated *Mining Regulations 2020* (Government of South Australia 2020) provide the legislative framework for regulating activities across the full life cycle of mining and quarrying operations, from exploration and development through to progressive rehabilitation and closure.

Tenement holders are required to conduct authorised activities in accordance with an approved program for environment protection and rehabilitation (PEPR), or a mine operations plan (MOP) for private mines. These approved programs define operational controls, environmental outcomes and completion criteria, and are the primary instruments through which closure planning and progressive rehabilitation obligations are set out. Programs are required to demonstrate how land disturbed by mining will be progressively rehabilitated and transitioned towards an agreed post-mining land use.

Closure can only be successful where a proponent is able to demonstrate, through evidence and performance, that approved closure outcomes can be achieved. This places importance on early and ongoing integration of closure planning into operational decision-making, supported by appropriate monitoring, adaptive management and financial provisioning. In this context, the department plays a central role not only in assessment and compliance, but in setting clear expectations, providing guidance and administering mechanisms designed to protect the state and community from inheriting unmanaged closure liabilities.

2 Methods

2.1 Literature review

A literature review was undertaken to establish the regulatory, policy and practice context for mine closure and post-mining transition in Australia, informed by international good practice. The review draws on

national system-level analyses, jurisdictional regulatory reviews, regulator and practitioner reflections from recent mine closure conferences, and globally recognised closure guidance aimed at both governments and industry. Together, these sources provide the foundation for identifying persistent barriers to successful closure and relinquishment, and for defining priority areas relevant to the work undertaken in this study.

The literature review considered the following documents, summarised below in Table 1.

Table 1 Documents reviewed for literature review

Title	Author
Closure planning: a review of guidance and suggestions for improving the state of practice	Nickifor et al. (2025)
Developing best-practice mine closure in South Australia (South Australian Chamber of Mines & Energy Working Group Report)	Ferguson (2019)
Enabling mine closure and transitions: Opportunities for Australian Industry	CSIRO (2023)
Guideline for preparing mine closure plans	Department of Mines, Petroleum and Exploration (2025)
Integrated Mine Closure: Good Practice Guide and Toolkit	ICMM (2025)
Mapping the regulatory framework of mine closure	CRC TiME (2022)
Mine Closure: A Toolbox for Governments	World Bank Group (2021)
Mine Closure (Leading Practice Sustainable Development Program for the Mining Industry)	Department of Industry, Science and Resources (2016a)
Mine closure guidance: review and comparative analysis	CRC TiME (2024)
Mine Rehabilitation (Leading Practice Sustainable Development Program for the Mining Industry)	Department of Industry, Science and Resources (2016b)
The regulatory journey to improving mine closure success in Western Australia	Risbey (2024)

2.2 Review of approved programs

To better understand the drivers behind repeated requests for further information (RFI) during the assessment of mine and quarry programs, a review of approved operational programs was undertaken. The review examined 100 PEPRs and MOPs approved between 2021 and 2025 in South Australia. For each program, RFIs issued by the department during the assessment process were reviewed with a focus on comments relating to progressive rehabilitation and mine closure. Each operation was also classified by commodity and operation type, including small, medium and large mines; small, medium and large quarries; heap leach operations; in situ recovery (ISR); and dimension stone operations.

Given the variable length and level of detail within RFIs, individual comments relating to rehabilitation and closure were recorded and then refined to their underlying issue or intent. This allowed similar or recurring matters to be identified across different programs and operation types. These comments were then grouped into simplified thematic categories, resulting in a set of 22 categories used for comparative analysis. The approach was designed to identify common areas where additional clarification, guidance or alignment

may be required, and to inform both the development of improved guidance materials and the overarching intent and direction of the department's mine closure and rehabilitation policy.

2.3 Stakeholder consultation

Targeted stakeholder consultation was undertaken to inform both the content and direction of the mine closure and rehabilitation policy, as well as the development and refinement of supporting guidelines and tools. An online questionnaire was developed to capture input from across industry, with a combination of structured and open-ended questions. Initial questions used drop-down options to identify respondents' primary sector and professional role, followed by free-text questions seeking views on priority principles for inclusion in the policy, areas where existing departmental guidelines or processes may benefit from clarification or improvement, key challenges to achieving effective mine or quarry closure and rehabilitation, and the types of supporting documents or tools most likely to assist in planning and implementation. A final open question provided respondents with the opportunity to raise any additional matters relevant to policy or guidance development.

The questionnaire was distributed using a focused distribution approach to ensure representation across operators, industry bodies and technical professionals involved in closure and rehabilitation planning. It was issued to 5 key industry representative organisations, representatives from major mining and quarry operations, one research centre, and a selection of environmental and mining consultants, recognising the role of specialist practitioners in supporting industry planning and the development of approvals documentation.

In total, the questionnaire was sent directly to 40 individuals, with the expectation that industry organisations would further distribute it within their memberships. The questionnaire was open from December 2025 to February 2026. At the request of one industry representative organisation, a facilitated session was held with its members to provide context on the purpose of the engagement and to respond to questions. Additional discussions were also held with representatives from 2 separate companies to provide further clarification on the engagement process and to respond to specific questions.

3 Key findings

3.1 Literature review

Recent literature consistently frames mine closure as a governance and transition challenge as opposed to a purely technical task. National analysis by the CSIRO (2023) and Cooperative Research Centre for Transformations in Mining Economies (CRC TiME) estimates that approximately 240 Australian mines are expected to close by 2040, with annual expenditure on closure and rehabilitation exceeding AUD 4–8 billion, alongside substantial ongoing legacy risk. Despite the scale of anticipated activity and significant advances in closure planning and rehabilitation practice, examples of final closure, relinquishment and enduring post-mining land use remain uncommon across Australia.

This disconnect between planning effort and closure outcomes is increasingly recognised as a systemic issue rather than a site-specific failure, raising questions about how mine closure is governed, financed and integrated into broader land-use and regional development systems.

Comparative analysis of Australian regulatory frameworks highlights that the gap between planning and closure outcomes reflects institutional and governance limitations rather than simply a lack of guidance. Queensland has progressive rehabilitation and closure plans embedded within environmental authorities and supported by financial provisioning and residual risk mechanisms. Western Australia, with a mature and extensive mining industry exceeding Victoria, Queensland and South Australia in terms of sheer scale and the number of operations, production value and export volume, has a detailed mine closure framework with mandatory closure plans which must be updated regularly throughout the life of the project. Closure requirements in Victoria sit within work plans and work plan variations. The state has also taken on

a stronger role in oversight and scrutiny on performance following the experience with Hazelwood coal mine's closure in 2017.

Across all jurisdictions, regulation remains focused on closure planning and compliance rather than clearly defined pathways to relinquishment. Persistent gaps are evident in the treatment of residual risk, repurposing of mine land and infrastructure, integration with land-use planning systems, and governance of social and economic transition for mine-affected regions.

Regulator experience, particularly from Western Australia, reinforces this diagnosis (Risbey 2024). Despite more than a decade of mandatory mine closure plans, closure outcomes have not materially improved. Prolonged care and maintenance have emerged as a dominant closure-avoidance mechanism, enabling operators to defer rehabilitation indefinitely while increasing long-term residual risk. Regulators are institutionally better equipped to approve new mines than to accept land back following closure, with inter-agency uncertainty around acceptable residual risk presenting a major barrier to relinquishment.

International practitioner perspectives mirror these findings. Reviews of global mine-closure guidance and corporate standards indicate that while the 'why' and 'what' of closure are widely understood, the 'how' remains unresolved. Closure plans often meet regulatory requirements yet are poorly integrated with life of mine planning, lack a clear closure design basis, underestimate costs and fail to provide sufficient confidence for long-term risk transfer.

International guidance, particularly the ICMM (2025) Integrated Mine Closure Good Practice Guide, articulates a comprehensive life of asset approach to closure. Key principles include early integration of closure into mine planning, stakeholder co-design of post-mining land use, progressive rehabilitation, alignment of objectives and success criteria, and explicit consideration of social transition and relinquishment. The World Bank's *Mine Closure: A Toolbox for Governments* (World Bank Group 2021) complements this by focusing on governance capacity, legislative clarity, financial assurance, institutional roles and the management of socio-economic transition, emphasising that legislation is insufficient to deliver closure outcomes if without aligned policy, guidance and capability.

In Australia, the Leading Practice Sustainable Development Program: *Mine Closure and Mine Rehabilitation Handbooks* (Department of Industry, Science and Resources 2016a and 2016b) reflects strong alignment with ICMM principles, promoting whole-of-life closure planning, risk-based decision-making, progressive rehabilitation and consideration of relinquishment. However, it also implicitly highlights an enduring issue: the availability of guidance has advanced more rapidly than the regulatory and institutional mechanisms required to translate plans into completed closures. Ultimately, successful closure depends not only on regulatory frameworks and guidance but on their effective implementation by capable and committed parties supported by internal governance that prioritises closure and progressive rehabilitation and enables the allocation of financial resources at appropriate stages of the mine life.

CRC TiME *Final Report Project 1.9 – Mine Closure Guidance: Review and Comparative Analysis* (CRC TiME 2024) undertook a comparison of 11 leading mine-closure and transition guidance documents, including ICMM, World Bank, Asia-Pacific Economic Cooperation (APEC), ISO Standards and Australian jurisdictional guidance. Rather than proposing new principles, the study assessed guidance using a series of consistent 'activity slices' across the mine life cycle, including regulatory interpretation, baseline data and monitoring, stakeholder engagement, setting closure outcomes and success criteria, risk and opportunity assessment, post-mining land use and repurposing, and financial assurance.

The review found strong convergence across guidance on what constitutes leading practice. Importantly, it concludes that persistent gaps remain in operationalisation, particularly in translating closure objectives into accepted outcomes, managing residual risk over time, and enabling relinquishment and post-mining transition. This finding directly aligns with regulator and practitioner experience, reinforcing that future effort is best directed towards governance arrangements and the practical application and strengthening of guidance.

Collectively, the literature highlights a clear opportunity to proactively address mine closure and post-mining transition before legacy risks become entrenched. While South Australia has a smaller mining footprint than

jurisdictions such as Western Australia or Queensland, it faces similar challenges related to ageing assets, evolving land-use expectations and increasing scrutiny of residual risk and relinquishment. The absence of a large backlog of closed or abandoned sites creates an opportunity to test approaches that move beyond solely compliance towards outcome-focused closure. The work proposed in South Australia is therefore positioned to translate internationally recognised principles as articulated by the ICMM, national leading practice guidance and other jurisdictional examples into South Australia-specific practical mechanisms that support timely closure, reduce long-term public liability and enable mine sites to contribute positively to regional futures.

3.2 Findings from the assessment of programs

Of the 100 approved programs reviewed, approximately 70% related to quarry operations, with the remaining 30% comprising mining operations. The distribution of programs by commodity is shown below in Figure 1, with limestone and sand operations dominant, representing 25% and 23%, respectively, of all programs assessed. Operation scale was similarly skewed towards smaller sites, with small quarry operations comprising approximately 50% of the programs reviewed, followed by medium-sized quarry operations at 13%. Notably, 75% of all programs reviewed had RFIs seeking clarification on closure and rehabilitation matters. Observations suggest that RFIs were more frequently associated with programs presenting greater closure complexity, uncertainty, lack of evidence of progressive rehabilitation implementation and technical gaps. In contrast, some lower-risk operations, or those with more limited closure pathways and fewer sensitive receptors, did not always trigger additional information requests, reflecting a proportionate, risk-based approach to regulatory scrutiny rather than systematic differences in submission quality across operation types. These requests had, and continue to have, implications for assessment efficiency and contributed to extended assessment time frames, an outcome that is directly relevant to the department's objective of improving assessment timeliness and streamlining approvals processes.

Analysis of the RFIs identified 22 thematic categories, with 3 themes accounting for most of the closure and rehabilitation-related comments: progressive rehabilitation (33%), post-mining land use (25%), and completion criteria and closure outcomes (25%) (Figure 2). In relation to progressive rehabilitation, common issues included limited or absent scheduling of progressive rehabilitation activities, missing milestones or reliance on rehabilitation being undertaken late in the mine life following extended operational stages. In many cases, programs did not demonstrate consideration of opportunities for smaller-scale or trial rehabilitation activities where full pit or landform rehabilitation may have been constrained by mine design or staging. This pattern was consistent across multiple commodities and operation types and was often corroborated by observations from site inspections. Programs also frequently lacked clear reporting on progressive rehabilitation undertaken to date, the performance of rehabilitation works on the ground and how learnings from completed rehabilitation had informed future rehabilitation planning through adaptive management.

Post-mining land use was another recurring area requiring clarification, with many programs presenting broadly defined or aspirational post-mining land uses (which is not an issue in and of itself in the early stages of a mine life) but limited detail on how these outcomes would be assessed, progressed or demonstrated over the life of the operation. RFIs commonly sought further information on how post-mining land use options would be refined, tested or validated prior to closure, and the extent to which these options were integrated into mine planning and rehabilitation design, and discussed with relevant stakeholders, the community and planning agencies which may be involved in future zoning and land use decision-making. Similarly, comments relating to completion criteria and closure outcomes highlighted a widespread lack of quantitative, performance-based criteria aligned with SMART (specific, measurable, achievable, realistic and time-bound) principles. RFIs for this theme typically sought clarification on how completion criteria would be developed, refined and validated over the life of the operation, including their linkage to baseline data, monitoring programs and the intended post-mining land use. In many cases, criteria were expressed as management actions rather than measurable outcomes or used qualitative and non-specific statements such as 'no major erosion' or 'rehabilitation will support a post-mining land use' without supporting metrics to define actual performance. This limited the usefulness of completion criteria for compliance assessment during operations and prior to tenement surrender or relinquishment.

Consistent with comments on post-mining land use, RFIs also reflected the staged nature of closure planning, recognising that detailed, site-specific and fully quantitative criteria may not be feasible in early phases of mine planning. However, in these instances, further information was often sought on the proposed pathway to developing more robust, measurable criteria over time, including interim criteria, triggers for refinement, and how the increasing site knowledge (e.g. from progressive rehabilitation trials, monitoring results or refinement of post-mining land use options) would be incorporated through adaptive management.

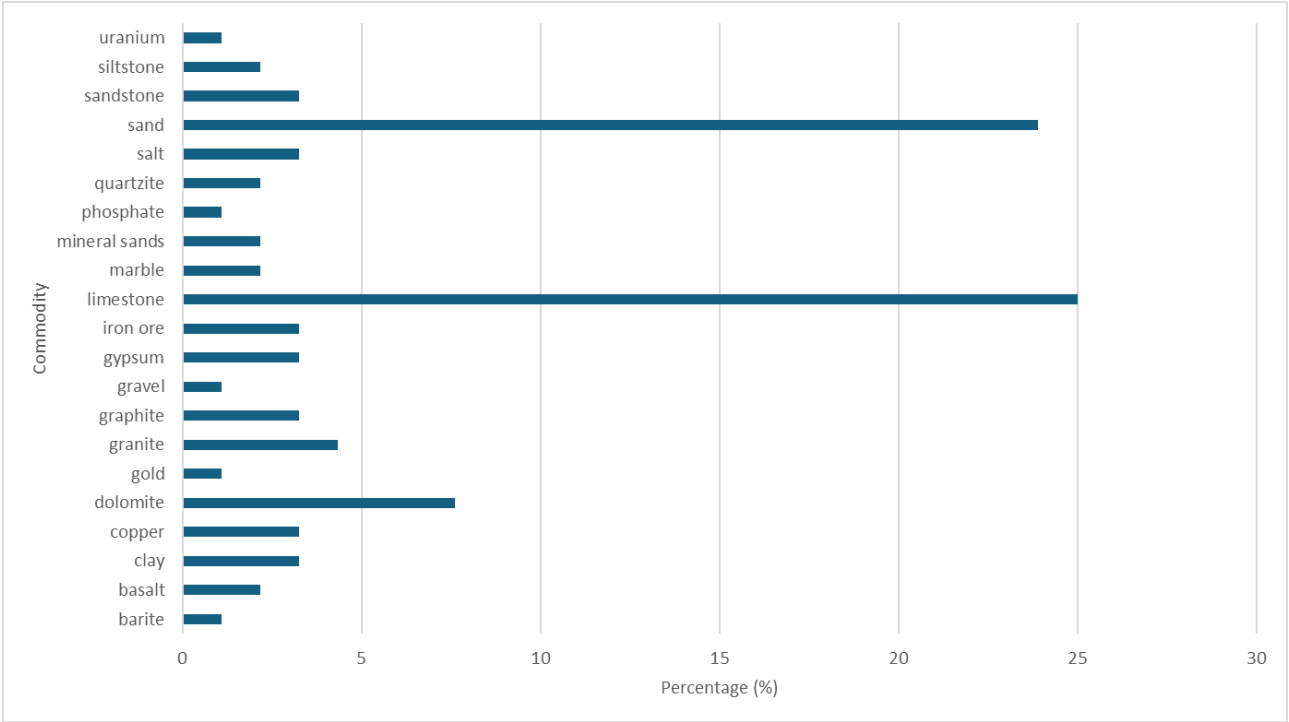


Figure 1 Distribution of approved programs reviewed by commodity

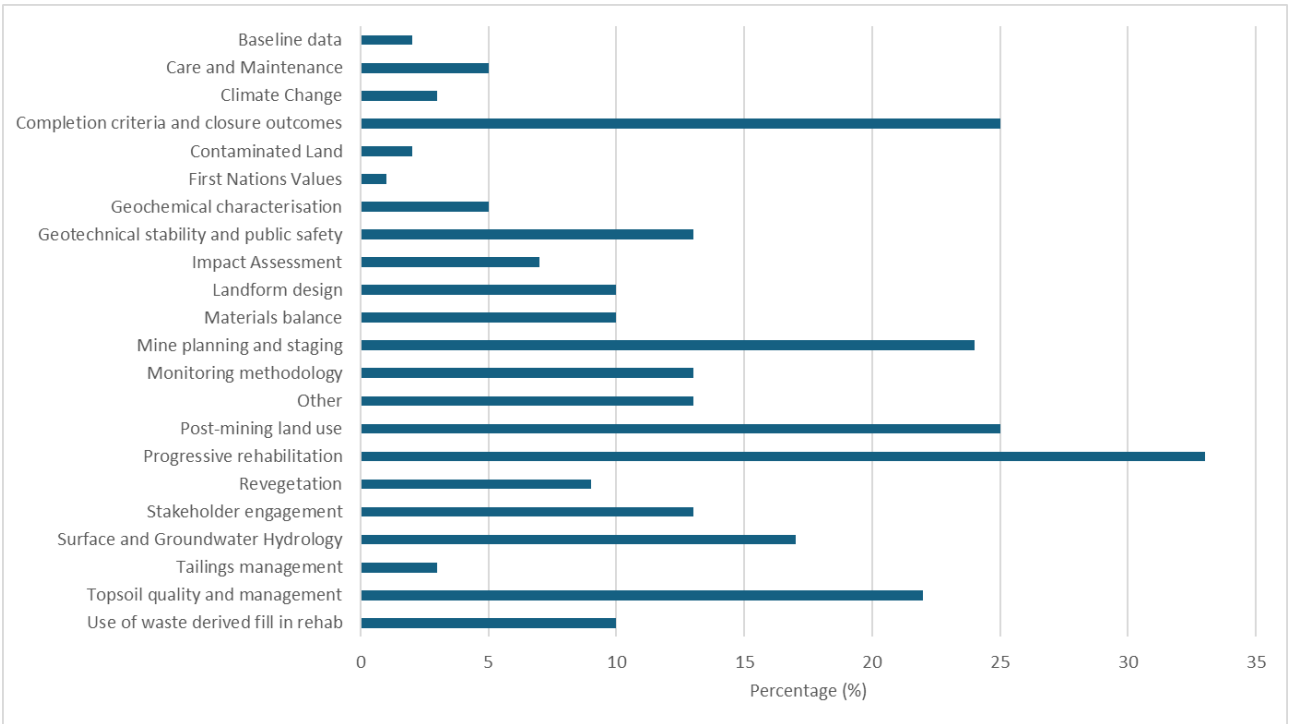


Figure 2 Distribution of closure/rehabilitation-related requests for further information comments across thematic categories

3.3 Stakeholder consultation findings

Stakeholder consultation generated 12 responses to the structured online questionnaire, supplemented by 3 detailed written submissions from industry representative bodies. Respondents represented a variety of sectors, including approximately 40% from mining operations, 25% from quarry operations and 20% from environmental consultancies, with the remainder from industry associations and research organisations. Professional roles spanned environmental and sustainability practitioners, closure and rehabilitation specialists, technical experts, senior management and industry representatives. While the number of responses was limited, the feedback was detailed and, in some instances, technically informed; reflecting direct experience with closure planning, implementation and regulatory engagement across a range of operation types and mine life stages.

A dominant theme emerging from the consultation was strong support for early integration of closure planning across the mine life, coupled with a clear expectation that regulatory requirements remain proportionate and adaptive. Respondents widely endorsed the principle of ‘beginning with the end in mind’, while emphasising that closure planning effort must be explicitly staged and aligned with the level of knowledge and certainty available at each phase of an operation. Long-life mines and quarries were highlighted as operating within planning, climatic, social and economic contexts that evolve substantially over time, with mine lives commonly extending several decades. As a result, closure planning during exploration or early operations was viewed as necessarily conceptual, with progressively greater definition expected as operational footprints, material inventories and post-mining land use contexts become better understood. Respondents consistently noted that attempting to mandate detailed closure designs too early risks inefficiencies, repeated plan revisions and regulatory effort that may not deliver commensurate environmental benefit.

Industry feedback also reinforced support for an outcome-based regulatory approach to closure and rehabilitation. Respondents favoured guidance that prioritises the achievement of safe, stable, non-polluting and erosion-resistant landforms capable of supporting an agreed post-mining land use rather than prescriptive engineering designs or rehabilitation methodologies. South Australia’s diverse climatic, geomorphological and ecological settings were frequently cited as making ‘one-size-fits-all’ requirements inappropriate. From a technical perspective, respondents described closure planning as an optimisation process in which landform design, drainage, soil reconstruction and revegetation can be tailored to site-specific conditions, provided performance outcomes are demonstrable. However, consultation responses also consistently emphasised that outcome-based regulation must be supported by clear completion criteria frameworks and agreed metrics to maintain consistency, regulatory confidence and auditability.

A further technically significant finding related to completion, residual risk and relinquishment was identified as one of the least well-defined aspects of the current closure framework. Respondents highlighted a lack of clarity around what constitutes ‘completion’, how residual risks are assessed and accepted, and how responsibilities transition at surrender, particularly where low-probability or long-term risks remain. This uncertainty was raised across both mining and extractives sectors and was considered especially problematic for legacy sites and care and maintenance operations. Some respondents noted that when clear limits on acceptable residual risk are not set, closure designs tend to become overly cautious. This can make it harder to define completion criteria and often results in conservative cost estimates based on the assumption of ongoing, long-term liability.

Finally, there was consensus that practical, implementation-focused tools are essential to translate policy intent into improved closure outcomes. Respondents consistently identified the value of templates, worked examples, checklists and case studies to support closure planning and rehabilitation delivery, particularly for smaller operators, consultants and long-life extractive operations. Practical guidance linking progressive rehabilitation performance to financial assurance, supporting proportional approaches for low-risk and legacy sites, and enabling self-assessment of closure readiness was viewed as particularly important. Collectively, consultation findings indicate that industry is seeking clearer pathways, proportionate expectations and technically defensible criteria that enable closure and rehabilitation to be planned, implemented and completed efficiently over long time frames.

4 South Australia's emerging closure and rehabilitation framework

The findings from the review of approved programs, stakeholder consultation and literature have highlighted a consistent set of gaps in closure planning practice, the clarity of expectations and supporting guidance. In response, the department is developing an integrated closure and rehabilitation framework intended to provide clearer policy intent, improve regulatory efficiency, and support more consistent and effective closure outcomes across the mining and extractives sectors. The framework is designed to address both systemic issues observed through program assessments and practical challenges raised by industry, while aligning with recognised leading practice for risk-based, outcome-focused mine closure.

4.1 Closure and rehabilitation policy

At the centre of the framework is the development of a standalone policy, which sets out the department's position, expectations and principles for effective closure planning and implementation across the life of an operation. The policy is intentionally high level and principles-based, providing a clear statement of intent while allowing flexibility for site-specific application. Key principles include early and integrated closure planning, proportionate and risk-based expectations, the incorporation of progressive rehabilitation into operations, development of a robust closure knowledge base, and the setting of measurable closure outcomes and criteria. The policy also emphasises early consideration of post-mining land use and the need to integrate *Mining Act 1971* requirements with other relevant statutory frameworks.

4.2 Technical guidelines to support the policy

The department proposes a suite of technical guidelines to sit beneath the policy and translate high-level principles into clear, practical guidance for proponents and practitioners. Two primary closure and rehabilitation guidelines are proposed: one for mining and exploration activities, and a second for the quarry sector. This distinction recognises differences in operational scale, risk profiles, mine life and rehabilitation processes, in some cases, between the sectors. These guidelines are intended to function as practical 'how-to' documents, expanding on policy principles and providing clarity on expectations for closure planning, progressive rehabilitation, staging, documentation and performance demonstration, and explaining a clear pathway to relinquishment.

A dedicated rehabilitation monitoring guideline is also being developed to address recurring gaps identified in approved programs. Effective monitoring is critical for demonstrating progress towards closure outcomes, verifying achievement of completion measurement criteria and supporting sign-off at closure. While existing South Australian guidelines for landscape function analysis have informed monitoring approaches to date, they no longer reflect the breadth of monitoring tools and methodologies now available. The proposed guideline will provide contemporary guidance on rehabilitation monitoring approaches, including how to design fit-for-purpose monitoring programs that are aligned with site-specific risks, environmental settings and intended post-mining land uses. Importantly, the department does not prescribe a single monitoring methodology; rather, proponents are expected to select and justify suitable tools capable of generating robust, repeatable and auditable evidence against completion criteria.

Further technical guidance is proposed to support planning for post-mining land use, recognising this as a recurring area of uncertainty and misalignment. This guideline will address the intersection between the *Mining Act* and other statutory frameworks such as the *Planning, Development and Infrastructure Act* (2016) (Government of South Australia 2016), and the challenges associated with long-life operations, multiple zoning contexts and evolving land use expectations. Emphasis is placed on early and progressive planning, transparent option assessment, engagement with relevant agencies and stakeholders including First Nations traditional owners, and ensuring that rehabilitation designs are engineered for the intended end use rather than a generic safe and stable outcome. For complex or long-life sites, the framework recognises that a standalone post-mining land use plan is required to further demonstrate feasibility and an intended pathway for investigating potential options.

Additional guidance is proposed on residual risk, acknowledging that some risks may remain following rehabilitation despite the achievement of closure outcomes. This guideline will clarify expectations for identifying, assessing, minimising and allocating residual risks, including the use of institutional controls where required, and the evidence needed to demonstrate that risks have been reduced to an acceptable level prior to relinquishment. A further guideline is proposed on the use of waste-derived fill in rehabilitation, an issue of particular relevance to the extractives sector. This guidance will provide clarity on acceptable use pathways, risk assessment considerations, material characterisation and documentation requirements; supporting safe and beneficial re-use while managing environmental and liability risks.

4.3 Review of existing guidelines and processes

In parallel with the development of new guidance, the framework includes a systematic review of existing documents and processes, including PEPR and MOP guidelines, terms of reference, guidance on environmental outcomes and measurement criteria, and annual compliance reporting requirements. The intent is to strengthen definitions, improve internal and external consistency, clarify information expectations, and provide practical examples that better support proponents during program development and assessment. This work responds directly to findings that multiple RFIs can often arise from ambiguity or inconsistent interpretation, as well as from technical deficiencies.

4.4 Broader framework elements and ongoing engagement

The framework also recognises the need to review related policies, such as financial assurance and the Extractive Areas Rehabilitation Fund (EARF), where future developments occur, noting that these elements sit outside the scope of this paper. Finally, continued industry engagement is a core component of the framework. To support accessibility and transparency, the department has developed a centralised online ‘one-stop shop’ for closure and rehabilitation information, consolidating current and future guidelines, links to external leading-practice resources and departmental updates. Over time, this platform may also showcase South Australian examples of successful rehabilitation, outcomes from government-delivered rehabilitation works funded through the EARF, links to informative webinars, and future opportunities for engagement and consultation as additional guidance is developed.

5 Next steps and challenges ahead

The development of South Australia’s emerging closure and rehabilitation framework reflects a deliberate shift towards evidence-based policy reform informed by both regulatory experience and stakeholder input. Together, the review of approved programs, targeted industry consultation and alignment with contemporary leading practice have provided a strong foundation for improving closure outcomes. Importantly, this work benefits from South Australia’s evolved regulatory framework and the department’s role as the primary, standalone authority for mine closure and rehabilitation; providing clear leadership while coordinating with co-regulators such as the Environment Protection Authority and the Department for Environment and Water. This integrated, whole-of-government approach is intended to improve environmental performance while also supporting more predictable, transparent and efficient regulatory processes for industry, communities and long-term land users.

The immediate next steps focus on finalising and progressively implementing the closure and rehabilitation policy and supporting technical guidance. In practical terms, this is expected to provide operators with clearer expectations at each stage of the mine life, greater consistency in assessment and compliance, and improved accountability through measurable, outcome-focused criteria. For proponents, clearer staging, proportionate requirements and better-defined completion pathways are anticipated to reduce uncertainty, minimise repeated requests for further information, and enable closure planning to be more effectively integrated into operational and financial decision-making. At the same time, clearer closure outcomes and post-mining land use pathways have implications beyond regulatory efficiency, supporting more confident long-term planning for communities, landholders and future land users.

Despite this progress, a number of challenges remain. Defining and managing residual risk continues to be one of the most complex aspects of mine closure, particularly where low-probability or long-term risks persist despite the achievement of rehabilitation outcomes. Establishing transparent, technically defensible thresholds for acceptable residual risk, i.e. defining acceptability, alongside clear pathways for relinquishment requires careful consideration of uncertainty, inter-agency responsibilities and community expectations. Similarly, post-mining land use planning remains inherently complex, particularly for long-life operations working across multiple planning regimes and land use contexts. The need to navigate the interface between mining and planning legislation, engage multiple agencies and accommodate evolving land use priorities presents ongoing challenges for both industry and regulators.

Additional complexity arises from broader external drivers, including climate change, which introduce uncertainty around long-term landform stability, hydrological performance and ecological resilience, particularly over multi-decadal time frames. Long-life mines and quarries, and operations with complex hydrological or geotechnical settings, will continue to require adaptive approaches supported by robust monitoring, modelling and progressive refinement of closure strategies. Ensuring the framework remains flexible enough to respond to these challenges while maintaining regulatory confidence is a key consideration moving forward.

Ultimately, the success of any developments in this space will be reflected not only in improved rehabilitation performance and regulatory efficiency, but in an ability to support sustainable and, where possible, beneficial transitions of land following mining and quarrying activities. This includes enabling post-mining land uses that are feasible, in line with statutory jurisdictions across various legislation and aligned with community expectations, while delivering enduring environmental, social and economic value. By reducing uncertainty, clarifying pathways to completion, and encouraging early and progressive integration of land-use considerations, the framework aims to position closure as a proactive land-use transition process rather than a discrete regulatory end point. In doing so, it seeks to support outcomes that extend beyond risk management alone; contributing to long-term land stewardship and improved confidence for the state, environment, industry, communities and future land users.

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Use of artificial intelligence disclosure statement

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