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# Global pathways to relinquishment

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## Abstract

*Advances in mine closure have been driven by a global shift toward sustainable development, defined by the World Commission on Environment and Development's (WCED) Brundtland Report (WCED 1987) as "… development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The long-term impacts of mining in the absence of closure planning, resulting in a compromised ability to meet the needs of future generations, are clear, and attributable to legacy mine sites across the globe. There is increasing pressure on mine operators to leave a positive legacy for communities, the environment and future land users.*

*In line with BHP's purpose, delivering optimised closure outcomes supports BHP's commitment to social value and the aspiration to help to build a better world. This commitment is embedded in the Closure and Legacy Management Global Standard, which integrates planning, decision-making and implementation across the entire life cycle of an asset. The process considers environmental values, legal obligations, safety, costs, risks and stakeholder expectations. Optimised closure outcomes may include divestment, in-perpetuity management or relinquishment, or a combination of these. In the 2023 report Relinquishment of Closed Mine Sites: Policy Steps for Governments, the International Institute for Sustainable Development defines relinquishment as the "…legal transfer of responsibility for a closed mine site from the operator to the next landowner…" and acknowledges the lack of experience, of both industry and government, in navigating relinquishment.*

*A review of regulatory frameworks across BHP's major operating regions was completed to determine respective relinquishment pathways, including compliance requirements and potential time implications, to enable integration into BHP's decision-making frameworks. Consideration of this within mergers and acquisitions, exploration, life-of-asset planning, and decision evaluation frameworks (such as net present value modelling and risk assessments) will enable proactive evaluation of closure liabilities and opportunities.*

**Keywords:** *relinquishment, sustainable development, mine closure, legacy mine sites, closure outcomes, legal obligations, stakeholder expectation*

## 1 Introduction

### 1.1 Context

The practices and policies regarding mine closure have advanced in recent decades following the convergence of environmental, social and economic drivers, and a global paradigm shift towards sustainable development. The World Commission on Environment and Development (WCED) Brundtland Report (WCED 1987) delivered the basis for sustainability policies worldwide by defining that:

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED 1987)*

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It follows that mine operators are looking beyond life of mine to ensure future generations are not disadvantaged by the industry's activities, particularly given the enhanced understanding of the long-term impacts of mining, which are now clear and attributable to mine sites globally.

There are multiple instances of closed, inactive or suspended mining operations, but it appears it is exceptionally rare for an operation to have been relinquished. In the 2023 report *Relinquishment of Closed Mine Sites: Policy Steps for Governments,* the International Institute for Sustainable Development (IISD) defines relinquishment as the:

> *"…legal transfer of responsibility for a closed mine site from the operator to the next landowner after all closure activities have been completed…" Stevens (2023)*

BHP implements the Closure and Legacy Management Global Standard (the Closure Global Standard) across all sites (operating and non-operating). The Closure Global Standard is designed to integrate closure planning, decision-making and implementation activities throughout the life cycle of BHP assets, to refine and deliver an optimised closure outcome (i.e. closure vision). Divestment, relinquishment and in-perpetuity management all represent possible optimised closure outcomes and while repurposing can be adopted in conjunction with any one of these outcomes, most sites are targeting relinquishment and are developing closure strategies commensurate with this.

However, the challenge highlighted by the IISD (Stevens 2023) is that the details and requirements around relinquishment are 'generally absent' from industry and government mine closure policies or processes, noting that industry and government both lack experience in navigating the transition from operations to a safe and stable post-mining land use (PMLU). Jurisdictions globally are in the infancy of developing robust relinquishment requirements, and this results in a view from operators that regulators lack the experience and understanding to develop fit-for-purpose guidelines and assessment frameworks. Conversely, regulators are perceived to lack confidence in the capacity of operators to achieve relinquishment without retaining liabilities, as evidenced by the proportion of mines currently held indefinitely in care and maintenance. This uncertainty associated with relinquishment pathways lends to 'closure avoidance' by operators and perpetuates the stalemate between regulators and the mining industry.

BHP's Closure Global Standard encourages all BHP sites to adopt the closure management process across the life cycle of an asset (Figure 1). In addition to integrating closure planning activities at appropriate life cycle stages, this process also requires BHP to consider the multiple factors that may influence a site's closure outcome, including environmental values, legal obligations, safety, costs, risks (threats and opportunities) and the expectations of external stakeholders and partners.


**Figure 1 BHP's asset life cycle**

## 1.2 Defining local standards

The Closure Global Standard stipulates that where local regulatory reporting requirements are misaligned with BHP requirements, local standards governing closure and relinquishment prevail. With most sites targeting relinquishment, BHP set out to understand these local standards by exploring relinquishment requirements in all major operating regions, with the overarching objective to embed these requirements, where possible, into life-of-asset planning, risk and opportunity assessments and future and existing project evaluations and investment decisions. This commenced by undertaking a review of legislation, regulations and guideline material relevant to the relinquishment of mining leases across states, provinces and regions in Australia, North America and South America where BHP operates. Table 1 outlines the different attributes reviewed and considered across the operating regions.

**Table 1 Key attributes influencing closure and relinquishment requirements**

| Attribute | Relevance |
|---|---|
| Federal influences | Defines federal overlays/statutes/legislation that may influence/impact the relinquishment pathway within a region. |
| Primary statutes/legislation, including year of effect and major amendment years/periods (if applicable) | Defines the primary mechanism governing relinquishment requirements.<br>Year of effect and/or major amendments important in the context of case studies, as most mine sites pre-date modern closure regulation. |
| Primary regulatory entities | Identifies the regulatory bodies which administer the statute/legislation and provides insight on whether the regulatory model is local, state or federally structured. |
| Secondary statutes/legislation and regulatory entities | Provides insight on additional legal requirements or government stakeholders that will influence relinquishment pathways. |

| Attribute | Relevance |
|---|---|
| Guidelines and standards | Guideline documents may be provided by regulators to help operators satisfy legislated requirements. These could provide insight into the maturity of closure requirements, or indicate whether closure outcomes are driven by operators or the regulatory body. |
| Key governing output/document | Identifies the output of primary statute/legislation, such as a requirement to develop a closure plan, and when (for example at time of approval, triggered following amendment or addition of legislation). |
| Financial assurance | Defines if financial assurance is required, and where information is available, detail on:<br>• where/what entity it is held by<br>• the basis for the value, and how its calculated<br>• the frequency at which the value is reviewed, and if the value is reduced through formal recognition of progressive rehabilitation. |
| Progressive rehabilitation/reclamation | Define if progressive rehabilitation is required, and if there is progressive sign-off/acceptance from regulators. This may be linked to a reduction in financial assurance, and may also indicate a pathway to partial relinquishment. |

This was followed by benchmarking of sites that have achieved or not achieved relinquishment, with particular note taken regarding the duration/timescale of the site's life cycle phases. Then, relinquishment pathways for each region were illustrated via flowcharts, highlighting the key stages, legislation, administering authorities, stakeholders and outcomes/activities. This enabled a clearer understanding of the similarities and differences between regions, that then allowed consolidation and presentation of the key themes, barriers and issues surrounding relinquishment.

# 2 Closure planning and integrating closure projects

## 2.1 BHP's closure planning framework

BHP's closure management process is structured around 4 iterative and integrated phases that occur across the entire life cycle of an asset in pursuit of the optimised closure outcome (refer Figure 2):

1. scope
2. plan
3. implement
4. review and feedback.

The scoping phase defines the strategic direction for closure through the development of a robust knowledge base, clear closure objectives, and early risk and options assessments. This informs the planning phase, during which detailed closure options and designs are developed, including closure criteria, activity schedules and cost estimates. The implementation phase executes progressive closure, supported by ongoing monitoring, investigations, trials and the staged completion of final designs. The review and feedback phase is an opportunity for lessons learned to be incorporated into the closure strategy, as well as into the 3 preceding phases, allowing for continuous improvement of closure objectives against regulatory and performance requirements. Continued feedback and ongoing stakeholder engagement loops in each phase to ensure that

activities are always aligned with regulatory and stakeholder expectations. The iterative nature of the closure management process results in a comprehensive closure management plan and closure cost estimate, commensurate to risk and time until cessation of operations.

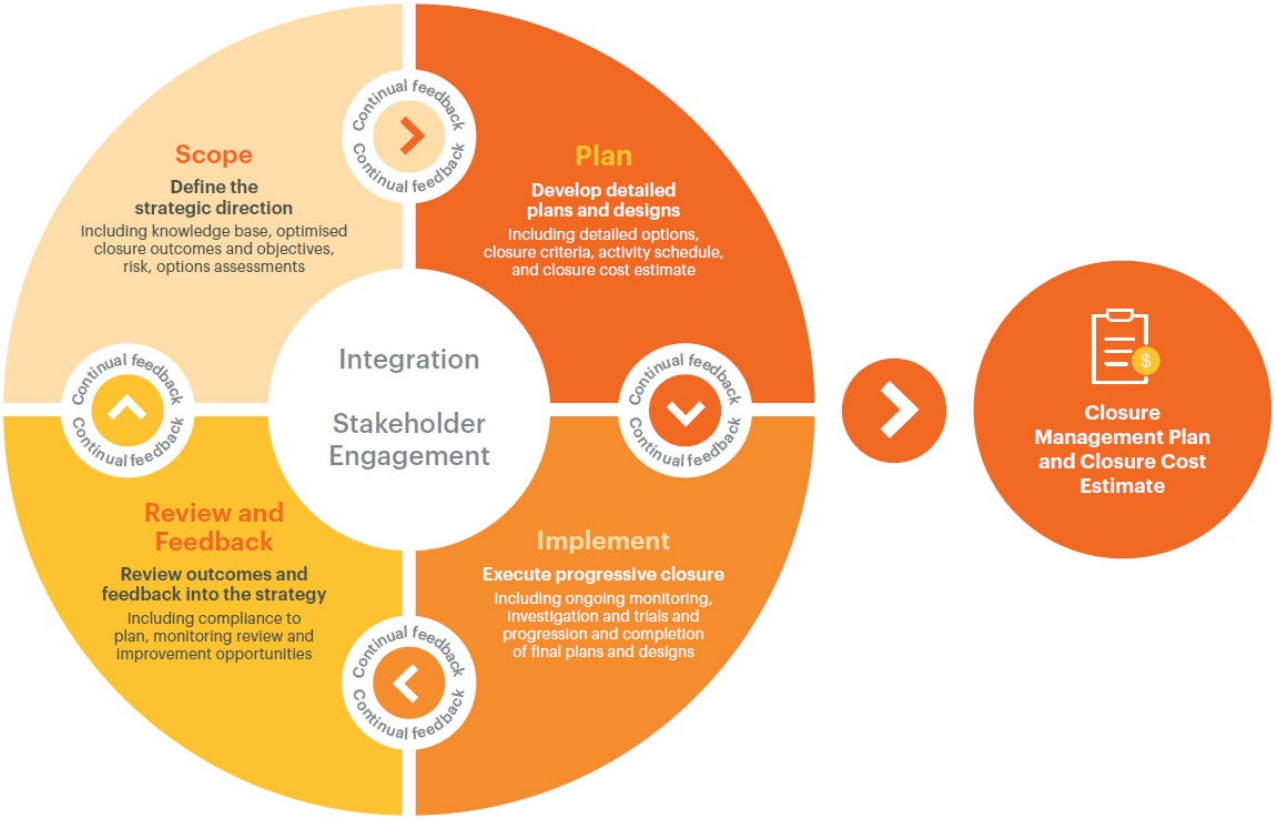


**Figure 2 BHP's closure management process**

BHP's closure culture is guided by 3 complementary goals (Figure 3): being risk-driven, prioritising early and progressive closure management, and fostering integrated contributions. This approach ensures closure risks are proactively managed throughout the asset life cycle, with clear accountability and transparent reporting. By integrating closure planning into daily decisions and encouraging cross-disciplinary collaboration, BHP embeds closure as a core value, supporting sustainable, long-term outcomes for communities, the environment, and the business. Through clear roles and responsibilities, cross-disciplinary collaboration, ownership of risk, and active advocacy for closure and legacy management, these goals foster a shared culture that delivers enduring value beyond the life of BHP's assets.


**Figure 3 BHP's closure goals**

The structured phases of the closure management process (scoping, planning, implementation and review) provide the framework for managing closure, while the closure culture shapes the behaviours, decisions and accountability that bring the process to life. A risk-driven culture ensures the process remains focused on prioritising material closure risks and long-term liabilities, early and progressive thinking embeds closure considerations into planning, and integrated contributions ensure collaboration and shared ownership across disciplines. Together, this aids the delivery of robust and value-focused closure outcomes to be achieved by closure projects.

## 2.2 Implementation of closure frameworks

The management and implementation of closure activities as projects is progressively evolving across the industry from a compliance activity at the end of asset life, to an embedded process within the life-of-asset planning process. While some organisations have restructured their approach and now view closure as a phased project requiring early investment, others remain reactive, addressing closure requirements in the final years of operation or even following the cessation of mining. It is acknowledged that site closures can often be unplanned, with estimates that up to 75% of closures occur unexpectedly and outside planning processes (Owen & Kemp 2018) and in this case delaying closure projects often means little detailed planning has been done when the closure occurs.

Despite this step in the right direction, traditional capital project frameworks are biased towards identifying and implementing the highest value alternative, which in some cases include 'do nothing' alternatives. This is ultimately not an option for closure projects and often leads to closure projects being delayed until as late as possible in the mine life cycle.

Progressive rehabilitation is a central component of more mature closure strategies, as demonstrated by the *Integrated Mine Closure Good Practice Guide* (ICMM 2025). Organisations that have embedded final landform requirements into mine planning process have seen improved alignment between operational activities and closure outcomes, which could ultimately reduce the final closure liability and cost. This benefit is only realised where final landforms are optimally defined through appropriate closure, rehabilitation, and geochemical expertise, ensuring they are stable and sustainable without the need for future rework.

This type of integration is rarely consistent though, and a lack of compliance to plan can impact implementation within the operation. In many cases the short-, medium- and long-term planning horizons are not well aligned to progressive rehabilitation requirements or opportunities to optimise costs (i.e. minimise rehandling).

Across the industry, relinquishment is a key emerging issue. Closure strategies are increasingly being framed not just in terms of physical and environmental performance, but ultimately relinquishment. Yet clear pathways and precedents rarely exist from regulatory bodies across all geographies and jurisdictions. Most jurisdictions lack established criteria, time frames, or regulator-endorsed success measures, making it difficult to forecast end-of-closure conditions with confidence, adding an additional layer of complexity in framing and defining success for closure projects.

# 3 Relinquishment findings across BHP operating regions

## 3.1 Australia

BHP operates assets across Queensland, New South Wales, South Australia and Western Australia, where mine closure and relinquishment are governed by state legislation, with some overarching federal requirements. Despite variation across states, consistent themes include integration of closure planning during approvals, requiring progressive rehabilitation with ongoing reporting and adaptive management, demonstration of approved PMLU prior to relinquishment, and the need to engage stakeholders early. Key barriers and risks to relinquishment include the evolving nature of closure regulation, often requiring legacy operations to retrospectively apply modern standards, limited precedence for relinquishment, the need for long-term records to demonstrate compliance, and uncertainty regarding residual liability and monitoring responsibilities.

Case studies of note for Australia include Jarrahdale Bauxite in Western Australia, where a portion of the site (Jarrahdale Area One) has been relinquished; Leigh Creek in South Australia, now managed by the South Australian Department for Energy and Mining, and the Northern Rhondda Colliery legacy site in New South Wales, where a developer has taken on responsibility for 'ongoing rehabilitation matters' (NSW Resources 2024) for a portion of the site that has been relinquished. These examples are dissimilar and individually unique, and the only similarity is the complexity of the type and number of stakeholders invested in the closure and relinquishment outcome. Despite not administering the legislation for which the mining approval was granted, in 2005 the relinquished portion of Jarrahdale Bauxite was certified by the Department of Conservation and Land Management (now the Department of Biodiversity, Conservation and Attractions (DBCA)) (Grant 2006) pursuant to Part IV of the *Environmental Protection Act 1986* (Government of Western Australia 1986). Leigh Creek comprises 4 perpetual Crown Leases granted under the *Electricity Trust of South Australia Act 1946* (Government of South Australia 1946). The site was operated by the Electricity Trust of South Australia until the leases were transferred to Flinders Power Partnership (FPP) in September 2000 (Government of South Australia 2017). The coal was used exclusively to supply the Augusta Power Stations, until operations ceased in November 2015. The FPP prepared a Development Program, which was endorsed by the South Australian Government in 2017 as providing adequate controls and strategies to manage risk. The site commenced a 5-year monitoring program in 2019, and in 2024, the Government of South Australia took over the ongoing management of the site. It appears that the site is still not 'relinquished', and rather defined and managed as a 'former mine'.

## 3.2 South America

South American mine closure frameworks have national and provincial variations, but clear, single relinquishment pathways are absent from statutory requirements. In the case of Chile, Brazil, Peru and Argentina where BHP has assets, it appears that BHP's Closure Global Standard and management process exceed the minimum regulatory requirements. This also appears to be the case for AngloGold Ashanti's Mineração mine in Brazil, where care and maintenance activities are being undertaken in accordance with AngloGold Ashanti's closure planning standard (AngloGold Ashanti 2022). In Chile, closure is governed at the federal level, mainly through an Environmental Permit (RCA) and Law 20.551. Law 20.551 came into force in 2012, and requires closure plans, including risk evaluation and environmental commitments, to be approved prior to commencement of operations. The focus for closure from this statute, is physical and chemical stability. But other influencing statutes [Supreme Decree 41, Mining Code (Republic of Chile 1958), the

*General Environmental Framework Act 1994* and the Environmental Impact Assessment System (SEIA)] govern requirements related to other operational obligations such as approvals, tenure and water management, and are administered by other regulatory bodies. In this sense, Chile is not unlike the states in Australia whereby there are multiple regulatory stakeholders interested in the environmental performance and impact of operations.

The closure planning and relinquishment landscape in South America is both underdeveloped comparative to Australian and Canadian jurisdictions, and rapidly evolving. In Peru, government decrees mandating mine closure plans are relatively recent, with Supreme Decree No. 033-2005-EM amended in March 2025 to include post-closure inspection and monitoring. Under this Supreme Decree, the asset operator is responsible for the care and maintenance of closed mine sites for a minimum of 5 years, though what happens beyond this typical 5-year post-closure monitoring period remains untested. This also presents a challenge for most sites where operations pre-date emerging regulatory requirements. Legacy issues persist, such as at Aladino VI in Peru, which was abandoned by the original operator in 1986, prior to the implementation of robust legislative and regulatory controls on mining operation and closure.

## 3.3 North America

Asset closure responsibility within Canada generally resides with the provincial and territorial governments, with BHP operating assets across British Columbia, New Brunswick, Nova Scotia, Ontario, Quebec and Saskatchewan. Historical incidence of ‘orphaned’ sites and growing public liabilities have influenced growing changes to closure requirements under regulation, including securities calculation and review, auditing and reporting and abandoned mine remediation funding. A challenge that persists in Canadian case studies is the framing and potential transfer of residual risk and/or closure liability. In New Brunswick, there are no well-documented or publicly reported examples of whole or partial lease relinquishment, with most well-known sites in this province pre-dating modern regulation. There are some more recent examples where operators have entered sites into care and maintenance, transferred the lease, or entered receivership and been unable to continue meeting environmental and closure obligations.

The Caribou zinc mine appears to have undergone multiple periods of care and maintenance before its former operators entered receivership in 2023. The New Brunswick government stepped in to pump and treat water from the underground, with the intent to maintain the site and allow another operator to buy the site (Magee 2024). Following recent signing of a Term Sheet and Exclusivity Agreement, Canadian Copper is set to acquire the Caribou Processing Plant. Acquisition of the processing facilities would support development of Canadian Copper’s nearby Murray Brook Cu-Zn-Pb-Ag deposit (Canadian Copper 2024). However, it is not clear how/ if the closure liability will be transferred or proportioned to processing facilities only. In Nova Scotia, the government designated gold as a ‘provincial strategic mineral’ in September of 2025, prompting St Barbara to consider re-opening its Touquoy gold site for 15 months to allow processing of low-grade stockpiles. St Barbara noted that this would not impact reclamation (Webb 2025). Some of the most unique case studies in Canada include former uranium mines in the Elliot Lake area of Ontario and Cuff Lake in Saskatchewan, where former operators are licensed by the Canadian Nuclear Safety Commission to ‘operate’ the historical mines. In 2023, the Canadian Nuclear Safety Commission revoked the uranium mine licence held by Orano for Cuff Lake, allowing transfer of the site to Saskachewan’s Institutional Control Program. The Commission concluded that the decommissioning objectives and criteria established for the Cluff Lake Project had been met, that the site is passively safe, and that the site will remain passively safe for the long term.

Similar to Canada and Australia, closure requirements in the United States are state driven, though there are some federal overlays, depending on the commodity and underlying land tenure. Of note for the U.S states relevant to BHP operations (Arizona, California, New Mexico and Utah) is the financial assurance requirements. The financial assurance mechanism is third-party bonding but is estimated assuming reclamation activities are completed by a third party. This value is reviewed ‘periodically’ in Arizona, New Mexico and Utah, and annually in California.

# 4 Relinquishment challenges

Relinquishment is now being framed as the next challenge in mine closure, with many recently exploring the role that regulatory ambiguity, technical uncertainty and financial risk play in delaying closure and relinquishment.

## 4.1 Regulatory uncertainty and residual risk

The scale and urgency of the mine closure and broader relinquishment challenge is growing rapidly, given that in 2024, it was estimated that at least 400 mines are expected to close in the next decade (Measham et al. 2024). Despite closure of sites, formal relinquishment remains rare, with an examination of 1,800 'closed' sites indicating that only one site had achieved formal relinquishment, while the remainder were classified as 'inactive' (neither operating/active or relinquished) (Keenan & Holcombe 2021). In recognition of growing instances of mine closure, regulators are placing increasing requirements on operators to demonstrate and achieve sustainable closure and relinquishment outcomes. However, in most instances, regulators lack the capability and diversity of technical expertise to then adequately assess and verify if the outcomes have been achieved. When there is a lack of confidence in accepting or approving closure objectives, operators are erring on the side of caution and may seek to enter care and maintenance until regulators provide more certainty regarding successful relinquishment.

Most jurisdictions lack established criteria, time frames or regulator-endorsed success measures, making it difficult to forecast end-of-closure conditions with confidence, adding an additional layer of complexity in framing and defining success for closure projects.

Residual risk, defined as risk or liability which remains after all closure activities have been completed, is the most consequential and recurrent barrier to relinquishment across regions. Residual risks commonly cited as barriers to relinquishment include water quality monitoring, geotechnical stability, and unforeseen and unplanned risks identified through post-closure monitoring or arising from unexpected events (Tiemann et al. 2019). As stated above, inadequacy of closure activities on site has the potential to contribute to residual risks to the environment.

The implications of residual risk on relinquishment are particularly difficult for operations which pre-date what is now considered 'best practice' closure planning, or for operations that have undergone multiple changes in ownership. The recent and rapid evolution of closure principles is likely to act as a significant barrier for operations, with legacy environmental management issues resulting in costly and unrealistic management time frames to achieve a safe and stable landform. Across many jurisdictions (including Australia and Canada), the Environmental Impact Statement–driven approach to mine closure planning, in which closure conditions are established at project approval typically decades prior to closure, has the potential to create conditions where closure objectives, regulator expectations, technologies and operator capacity are misaligned due to the time between initial approval and closure. Across many regions, regulatory agencies are unwilling to accept residual risk, while operators may struggle to accurately quantify risk with sufficient certainty. Consequently, operators are increasingly seeking alternative management strategies, which is reflected in the global stock of inactive, unrehabilitated sites.

Across the industry, stakeholder expectations are increasingly influencing closure planning and criteria for success, with influence from regulators, community and indigenous peoples. In some jurisdictions, regulators have implemented annual peer reviews, cultural overlays, or independent audits to assess closure readiness, which is seen as a positive influence. This external interaction is generally seen as constructive, providing clarity on expectations, helping to drive internal alignment, and reducing ambiguity in relation to closure outcomes and PMLUs.

However, in many jurisdictions, closure regulation lags significantly behind operational or environmental legislation, although there does appear to be progress in closing this gap. The absence of detailed guidance, inconsistent approval and/or relinquishment pathways, and limited regulator capability makes it difficult for operators to define and forecast closure outcomes and key success drivers. Many organisations appear

discontent with shifting expectations, non-defined relinquishment criteria, and a lack of clarity on how to transition to relinquishment where that was the defined closure strategy. General discussion among closure professionals also suggests that while current regulation does not prescribe clear closure requirements for PMLUs, alternative and potentially more sustainable and beneficial PMLUs are unlikely to be prioritised until the pathway is defined and clear benefits (e.g. economic benefits) are demonstrable to key stakeholders, including the mining companies themselves.

## 4.2 Completion criteria and technical barriers

Completion criteria (also known as success or closure criteria) can be set by regulators and/or licensing at the start of, or during mining. However, those criteria do not always consider variations to the mining operations over the life of the asset. Achieving relinquishment is often constrained by several interrelated technical barriers that create uncertainty over long-term outcomes and regulatory acceptance, with completion criteria – and demonstrating success – key among them.

Demonstrating long-term landform stability is a challenge. Post-mining landforms need to remain physically and geochemically stable over long time frames – often with no key timeline defined. While the period of active monitoring may not be prescribed, any criteria developed often require forecast modelling to demonstrate feasible future success or performance. Failure of those landforms in the future can then be linked to residual risk and financial impacts.

Inconsistent expectations around ecological performance can add complexity to the relinquishment discussion, with varying views on vegetation and ecosystem requirements, and challenges associated with determining or measuring whether something man-made is or can be ‘self-sustaining’. Climatic impacts are modelled but still invariably uncertain, with impacts not yet understood for longer-term closure time periods. This can have a flow-on effect in demonstrating success criteria for surface water and groundwater characteristics, with potential changes in catchment conditions.

Unclear and evolving data requirements, where the scope and duration as well as type of monitoring data, let alone acceptable formats over the change in technological advancements, continue to create a challenge to demonstrating closure success and supporting relinquishment. IISD states ‘Completion criteria should have a temporal component that can only be achieved through a reasonable period of post-closure monitoring’ (Stevens 2023); however, until uncertainty with respect to changes in standards and prolonged post-closure obligations can be further understood, the achievement of relinquishment continues to be a challenge, which may lead to operators delaying closure projects in favour of certainty of care and maintenance.

## 4.3 Financial risk

Achieving mine relinquishment is further constrained by several financial barriers that affect both the credibility and timing of closure decisions. There are consistent gaps between provisioned costs used for financial reporting, and actual closure costs or real execution costs. A provisioned closure cost is the amount that a company would pay to settle the obligation (liability) (ICMM 2019), while actual costs represent the real, execution cost. This difference has been observed to be in the order of 300–900% (ERM 2023), with operators citing poor planning, unanticipated regulatory changes, or legacy site complexities, among social, workforce and unknown costs, as contributing factors. Furthermore, this underestimation is also attributable to optimism bias, evolving technical standards, only estimating on the basis of meeting assumed minimum regulatory requirements, or incomplete consideration of long-term management and monitoring requirements. Another contributor is variations from a financial accounting perspective for provisioned costs.

This creates a gap between funding set aside and the true financial exposure, eroding confidence of both internal and external stakeholders in the ability to achieve the final detailed closure design. A growing number of organisations are adopting multiple closure cost models covering bonding, financial provisioning, and additional models for internal planning and investment decisions, all of which inherently have different base assumptions, but are all setting out to estimate the same thing (closure). Internal models are often based on bottom-up engineering, with a higher level of detail incorporated 5–10 years from cessation of

operations, so are tied to maturity levels. Uncertainty remains a challenge though, and there does not appear to be consistent approach to dealing with this. Traditionally, these cost estimates are single-point estimates, which fail to account for scope, environmental or stakeholder variability. There is growing recognition that cost ranges, tied to risk scenarios, are more appropriate for closure. Some organisations are integrating these into life-of-asset planning and using them to guide operations to achieve improved closure outcomes.

Despite this, there remains a disconnect between closure estimates and operational planning. In many cases, mine planning and operational teams are not held accountable for short-term decisions that result in increases to closure costs, and there is limited visibility of how today's decisions affect long-term liability. Closing this loop is critical to improving cost outcomes and making more informed trade-offs during the operational phase.

There remains a gap in accepted models for post-relinquishment financial calculations, which can leave uncertainty regarding how residual risks and future monitoring, maintenance and management should be costed and funded – if and when liabilities are released. This issue can discourage relinquishment, despite progress toward agreed closure outcomes and achievable technical stakeholder expectations. Continued trade-off between potential future reprocessing or life extension options, while remaining in care and maintenance, also weigh into the equation where upfront costs and residual uncertainty negatively influence the successful pursuit of closure and relinquishment.

## 4.4 Planning to practice

Recent literature indicates a discontinuity between approved closure objectives (that may be stated in a closure plan), and actual on-ground closure activities and outcomes. Santos et al. (2025) developed the Integrated Mine Closure Planning Adherence Index (IMCPAI) as a means of assessing mine closure plan adequacy and alignment with international best practice (such as ICMM frameworks), highlighting that a critical gap exists between theoretical closure goals and practical application on site. Execution of closure activities or actions, along with stakeholder and socio-economic integration were shown to be lacking the most. Furthermore, despite instances of closure plan guidelines that define how operators can meet regulatory requirements, evolving regulator expectations and limited engagement with external stakeholders mean the goalposts are constantly changing.

The most mature examples of closure project management and implementation involve the formal establishment of closure projects with pre-defined periods and knowledge maturity levels prior to operational completion (i.e. 5–10 years before the planned closure). Most companies are using modified versions of traditional capital project frameworks and study definition guidelines. Such capital frameworks have a natural bias towards value creation within a defined period (i.e. financial year). This drives the need for rapid assessment, selection and implementation which is generally not aligned to delivery of closure projects where knowledge base development and assessment requires significant time.

There is difficulty in using existing frameworks to manage closure projects, with stage-gates creating excessive rework when closure options were not sufficiently developed, partly due to uncertainty presented by relinquishment options. The lack of clear pathway has led to poorly defined scopes, repeated delays, and a loss of credibility of closure planners with internal decision-makers. Separating a closure project into multiple smaller projects can circumvent complicated governance processes or simplify project gating or endorsement. In comparison to traditional capital projects, where a holistic, site-wide view is the standard approach, closure projects often become domain or discipline specific, leading to inconsistencies in design, closure completion criteria, target PMLU, sequencing, interactions between domains and functions, and stakeholder engagement. Where closure projects are separated, the need for a robust holistic closure strategy and one project manager/director overseeing all the smaller, separate projects to manage these risks is paramount.

Under these traditional capital project frameworks, in most cases a dedicated project manager is appointed to drive integration of planning, stakeholder engagement, and execution. However, these project managers do not typically have a closure background, which is generally a function of overall company experience in

delivery of closure projects (i.e. generally, company experience in closure is limited) or is a result of functional accountability driven by these frameworks.

# 5 Looking forward

Looking ahead, progress toward clear, objective and consistent relinquishment pathways will depend on continued collaborative and adaptive approaches between industry operators and regulators as well as final landholders and other external stakeholders. There is an opportunity to develop constructive partnerships that focus on shared objectives, risk tolerance, and pragmatic decision-making, rather than black-and-white compliance.

Pilot or pathfinder relinquishment processes can play a critical role in testing new approaches, building regulatory confidence, and establishing precedents that clarify expectations for both technical evidence and long-term outcomes. There is an opportunity to draw on existing partial relinquishment pathways, which may allow incremental transfer as defined closure criteria are met, rather than requiring all technical, stakeholder and financial challenges to be resolved simultaneously. The Northern Rhondda Colliery in New South Wales is an example of this in play, whereby a motorsport park is proposed (and approved via development application) on the relinquished portion of the site.

Increasing regulator technical capability, or instances of independent statutory bodies, would ensure regulators are adequately resourced, informed and skilled to assess long-term risks and innovative closure solutions. The Office of the Rehabilitation Commissioner in Queensland, Australia, is a statutory body that provides advice on best-practice rehabilitation of land impacted by mining, reports on trends, and engages with stakeholders to improve rehabilitation outcomes. This initiative looks to be building regulator confidence by providing assurance that mine closure and rehabilitation is being managed transparently, consistently, and to a high standard. In Canada, the Canadian Nuclear Safety Commission operates independently from industry and government, ensuring unbiased regulation. Again, this commission appears to be having a positive outcome in the case of closed uranium mines, where regulatory decisions are supported by scientific evidence, risk assessments, and technical reviews.

Stronger alignment with planning act provisions, including mechanisms that allow restricted land uses or defined ongoing management arrangements, could be a means of acknowledging that post-mining land may not return to its pre-disturbance state.

Consistent regulatory and operational frameworks across regions and countries can significantly assist companies in achieving relinquishment by reducing complexity, uncertainty, and administrative burden. When requirements for closure, decommissioning, environmental remediation and stakeholder engagement are aligned, organisations can design standardised processes, timelines and assurance mechanisms that apply across their portfolios, rather than reinventing approaches for each jurisdiction. This consistency improves predictability of costs and outcomes, supports earlier and more effective planning for end-of-life obligations, and reduces the risk of delays caused by conflicting or unclear regulatory expectations. Ultimately, harmonised frameworks enable companies to allocate resources more efficiently, strengthen compliance confidence with regulators and communities, and progress relinquishment in a timely, responsible, and orderly manner.

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