

Indigenous-led Regional Cumulative Effects Assessment and Management (I-RCEAM): why it matters in Australia

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Abstract

Sustainable mine closure increasingly requires co-led, holistic, regionally grounded approaches. In Australia, existing regulatory frameworks focus primarily on individual developments, environmental and heritage compliance, often overlooking cumulative effects of multiple operations and the knowledge and priorities of Indigenous communities. This gap limits Indigenous involvement in decision-making on lands to which they have connection and responsibility, risking long-term protection of cultural, social and ecological values, economic priorities, and the future of mining. An Indigenous-led approach to Regional Cumulative Effects Assessment and Management (I-RCEAM) is still missing in the Australian context. It offers a pathway to embed Indigenous leadership into regional mine closure processes, contributing to sustainable futures.

International examples of Indigenous-led frameworks provide valuable lessons. The Guide to Effective Indigenous Involvement in Federal Impact Assessment outlines structured roles for Indigenous parties in federal decision-making. The Indigenous-led Participatory and Cumulative Impact Assessment (IPCIA) centres community-driven identification of cumulative effects and locally defined priorities. The Framework for Assessment and Management of Cumulative Effects on the North Pacific Coast integrates ecological and social indicators within Indigenous governance structures. The Metlakatla Cumulative Effects Management Program operationalises long-term monitoring and adaptive management under Indigenous oversight. Across these cases, 3 key elements emerge: meaningful Indigenous involvement, assessment processes aligned with community priorities and cumulative impacts, and management tools that embed stewardship and shared decision-making.

This paper examines why an I-RCEAM matters to Indigenous communities and industry in Australia. For Indigenous communities, implementing an I-RCEAM can help strengthen self-determination, safeguard cultural and environmental values, and build trust in mine closure processes to heal and sustain Country. For industry, it can provide structured pathways for engagement, reduce conflict, and support sustainable mine closure practices, leading to improved legacy and responsible mining outcomes. Overall, developing I-RCEAM can address regulatory gaps in Australia, improve cumulative impact assessment, and ensure mine closure is socially, culturally, economically and environmentally sustainable, benefiting communities, industry and the environment alike.

Keywords: *Indigenous-led regional cumulative effects assessment and management, I-RCEAM, mine closure planning, self-determination, co-leadership, Indigenous governance, Australia*

1 Introduction

Mine closure in Australia is undergoing a major shift, driven by stricter regulation and growing expectations around environmental, social and cultural responsibility. Traditionally treated as a technical, compliance-focused task centred on rehabilitation and risk management, closure is now recognised as a long-term, multidimensional process involving ecological, social, cultural and economic outcomes (Measham et al. 2024).

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A central challenge is managing the cumulative effects of multiple operations. Mining activities, together with associated infrastructure, generate complex, non-linear effects across ecosystems, landscapes and communities over time (Franks et al. 2009). These effects are difficult to capture using conventional, project-based environmental impact assessment (EIA) approaches (Blakley 2021). Although cumulative effects assessment aims to evaluate the combined effects of past, present and future activities (Blakley 2021), its application in Australia remains limited.

This gap is particularly evident in mine closure, where planning must address long-term, regional transformations and legacy effects, including those affecting Indigenous cultural landscapes (Holcombe 2022; Leyton-Flor & Sangha 2024; Measham et al. 2024). Existing impact assessment frameworks lack clear mechanisms for integrated, regional approaches, creating a disconnect between policy intent and implementation, with consequences for environmental sustainability, community wellbeing and post-mining land use (Blakley 2021; Grace & Pope 2021).

A key limitation is the restricted role of Indigenous communities, whose involvement is often confined to consultation rather than leadership (O’Faircheallaigh & Macdonald 2022). While practices such as heritage surveys and monitoring contribute valuable input, they rarely enable Indigenous peoples to define priorities or lead decision-making. The literature on Indigenous impact assessment (IIA) emphasises the need for Indigenous control at all stages of assessment (Gibson et al. 2018; O’Faircheallaigh & Macdonald 2022; Nishima-Miller & Hanna 2022) and for approaches grounded in Indigenous knowledge systems and self-determination towards long-term sustainability (Atlin & Gibson 2017; Gratani et al. 2016; Jolly & Thompson-Fawcett 2021). International examples from Canada and Norway demonstrate how Indigenous-led approaches can be embedded through legislation and structured frameworks (Blom 2023; First Nations Major Project Coalition 2020; Metlakatla First Nation 2019; Wilson 2020). Such initiatives show how Indigenous leadership, community-defined indicators and co-governance can improve both processes and outcomes.

This paper positions Indigenous-led Regional Cumulative Effects Assessment and Management (I-RCEAM) as a pathway to address these challenges in mine closure plans (Tardin-Coelho et al. 2026). I-RCEAM builds on the principles of Indigenous-led approaches, enabling the assessment and management of cumulative effects across multiple projects, landscapes and time frames. It emphasises Indigenous leadership, the integration of Indigenous knowledge systems, and the co-development of assessment and management processes with industry (Tardin-Coelho et al. 2026).

The central question guiding this paper is: Why does Indigenous-led RCEAM matter for Indigenous communities and industry in the Australian context of mine closure? In addressing this question, the paper examines the limitations of current regulatory frameworks, draws lessons from international Indigenous-led approaches, and explores the benefits of an I-RCEAM for both Indigenous communities and industry.

2 Methods

2.1 Approach

This paper uses an exploratory qualitative literature review to examine the relevance of an I-RCEAM for mine closure in Australia. It builds on a previously completed structured literature review (Tardin-Coelho et al. 2026). However, it adopts a more targeted and interpretive approach to draw out insights to address the paper's objective stated above, rather than provide an exhaustive or systematic synthesis. Sections 3.1 and 3.2 summarise findings from Tardin-Coelho et al. (2026), while sections 3.3 and 3.4 show new Insights based on this paper’s research question. Any text was literally re-used.

2.2 Scope and sources

The review integrates peer-reviewed and grey literature, including academic studies, policy documents and Indigenous-led frameworks. The scope focuses on Indigenous leadership and participation in impact

assessment, cumulative effects assessment and regional approaches; mine closure and post-mining land use in Australia; and international Indigenous-led CEAM frameworks (notably Canada and Norway). Sources were selected based on their direct relevance and practical contribution to understanding how cumulative effects and Indigenous leadership can be incorporated into mine closure. Foundational and widely cited works were prioritised, alongside applied frameworks with demonstrated implementation. The analysis draws primarily on literature identified through the original structured review, supplemented by targeted refinement and reference mining to ensure relevance to mine closure.

2.3 Analysis

A thematic analysis using NVivo 2020 (v20) was undertaken to identify recurring themes, building on the coding framework developed in the structured review. The analysis focused on the regulatory landscape in Australia, international Indigenous-led frameworks, and the importance of an I-RCEAM for Indigenous communities and industry.

2.4 Limitations

This is an exploratory review and does not aim to be comprehensive. The findings are conceptual and interpretive, with a focus on relevance to practice rather than completeness. The transferability of international examples to Australia is approached with caution, and the review is limited to English-language, publicly available sources. Nonetheless, it provides a practical evidence base to inform discussion on embedding Indigenous-led approaches into cumulative effects assessment and management for mine closure planning.

3 Results

3.1 Regulatory landscape in Australia

Australia's regulatory framework for mine closure, assessment of environmental impact, and cumulative effects reflects a complex, multi-level system shaped by federal legislation and state-based governance. While this framework recognises the importance of environmental protection and, to some extent, social and cultural values, it remains limited in its capacity to address cumulative effects of multiple operations and impacts at a regional scale, and to embed Indigenous leadership in decision-making. This section reviews the current landscape, highlighting both emerging opportunities and persistent gaps that constrain the development of an Australian I-RCEAM.

3.1.1 Federal and state regulatory frameworks

At the federal level, the central piece of environmental legislation is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999 [Commonwealth of Australia 1999]), which was reviewed in 2020 (Samuel 2020), and amended in 2025 (*Environment Protection Reform Act 2025* [Commonwealth of Australia 2025]). The EPBC Act provides a national framework for the protection of matters of national environmental significance, including threatened species, ecosystems and heritage places. Importantly, the Act defines the 'environment' broadly, encompassing ecosystems, natural and physical resources, and the social, cultural, and economic wellbeing of people and communities. This definition acknowledges the interconnectedness of biophysical and social systems and aligns conceptually with holistic approaches to cumulative effects assessment.

The EPBC Act 1999 review explicitly refers to cumulative effects, requiring that EIAs consider the combined effects of past, present, and reasonably foreseeable actions. It further emphasises protection, restoration, and management of biodiversity and cultural values, including significant natural and cultural places such as heritage sites and water bodies. Despite the review's suggested broad scope, the Act amendment does not include or provide guidance on how to assess or manage cumulative effects in practice. Nor does it establish mechanisms for regional-scale assessment or Indigenous-led governance. A key limitation of the EPBC Act is

its trigger-based nature. Assessment is required only when a project is likely to significantly impact a matter of national environmental significance, such as a threatened species or habitat. As a result, many mining projects are assessed primarily under state and territory legislation, where regulatory approaches to cumulative effects are similarly underdeveloped.

At the state level, each jurisdiction has its own legislation governing mining operations, environmental approvals and mine closure (Hamblin et al. 2022). For example, in Western Australia, regulatory guidance from the Department of Mines, Industry Regulation and Safety (DMIRS 2025) requires mine closure planning to consider a broad range of regional factors. These include climatic conditions, geomorphology, land use, affected communities and heritage values, both natural and cultural. Closure plans must also address impacts identified through agreements with Traditional Custodians and consider elements such as Native Title areas, Indigenous Protected Areas and Aboriginal heritage sites. Similarly, guidance from the Western Australian Environmental Protection Authority recognises ‘social surroundings’ (*Environmental Protection Amendment Act 2024* [Government of Western Australia 2024]) as an important factor, defined as the effects of environmental change on a person’s cultural, aesthetic and economic context. This reflects an emerging understanding that environmental impacts cannot be separated from social and cultural dimensions. Despite these advances, state frameworks generally lack clear definitions and methodologies for cumulative effects assessment. While cumulative effects are referenced in policy and guidance documents (Environmental Protection Authority 2026), there is little consistency in how they are interpreted or applied. This results in fragmented and project-specific approaches that do not adequately capture the broader, long-term effects of mining activities across regions.

This fragmented approach contrasts sharply with international practices in jurisdictions such as Canada (*Impact Assessment Act* [Department of Justice 2019]) and Norway (*Planning and Building Act 2008* [Norwegian Ministry of the Environment 2008]), where cumulative effects assessment is embedded in legislation and requires Indigenous involvement in its governance. In Australia, the absence of a coordinated regional approach means that cumulative impacts on landscapes, particularly those of cultural significance, are often underestimated or overlooked.

3.1.2 Indigenous involvement: opportunities and barriers

Indigenous involvement in environmental assessment processes in Australia is typically framed as ‘engagement’ rather than governance or leadership. This engagement often takes the form of consultation during environmental and heritage surveys, participation in monitoring programs (such as ranger initiatives), and input into rehabilitation or restoration activities. While these processes are important, they do not equate to meaningful participation in decision-making and increase the burden on communities, particularly where there are multiple proponents.

Current regulatory frameworks do not mandate Indigenous-led governance in cumulative effects assessment or mine closure planning. Voluntary industry assessments have proven ineffective (Larsen et al. 2018). This limits Indigenous communities’ ability to shape assessment criteria, define valued components or influence long-term management strategies. At the same time, there are emerging opportunities. The broad definition of ‘environment’ in the EPBC Act 1999 provides a conceptual foundation for integrating cultural and social values into assessment processes. State-level guidance, such as that in Western Australia, increasingly acknowledges the importance of heritage, land use and community context in mine closure planning, mainly after the Juukan Gorge incident, which refers to the destruction of a 46,000-year-old Aboriginal heritage site in Western Australia in May 2020 (Holcombe 2022). These elements create potential entry points for more holistic and inclusive approaches. The recent EPBC reform also highlighted the need for greater involvement of Indigenous peoples in environmental governance. While these initiatives have not yet resulted in fully developed mechanisms for I-RCEAM, they signal a growing recognition of the limitations of current approaches.

An I-RCEAM framework offers a pathway to address these shortcomings by shifting from fragmented, project-based assessments to integrated, regional processes grounded in Indigenous leadership and knowledge (Tardin-Coelho et al. 2026). Such an approach would enable the understanding of cumulative

effects in their full ecological and cultural context, while also supporting shared decision-making and long-term stewardship. In this context, the Australian regulatory landscape can be seen as both a constraint and an opportunity. While existing legislation does not yet fully enable an I-RCEAM, it provides a foundation upon which more inclusive and effective frameworks can be built. The challenge and opportunity lie in moving beyond consultation toward genuine co-leadership, ensuring that cumulative effects assessment supports sustainable mine closure outcomes for communities, industry and the environment alike.

3.2 Learning from international Indigenous-led frameworks

International experience demonstrates that Indigenous-led approaches to cumulative effects assessment and management are not only feasible but essential for achieving sustainable and equitable outcomes in resource development. In contrast to the fragmented, project-focused practices observed in Australia, jurisdictions such as Canada and Norway have developed structured frameworks that embed Indigenous leadership and knowledge systems into impact assessment processes.

This section examines four key Indigenous-led frameworks to identify transferable lessons for Australia:

- Guide to Effective Indigenous Involvement in Federal Impact Assessment (Canada) (First Nations Major Project Coalition 2020)
- Indigenous-led Participatory and Cumulative Impact Assessment (IPCIA) (Norway) (Blom 2023)
- Framework for Assessment and Management of Cumulative Effects on the North Pacific Coast (Canada) (Wilson 2020)
- Metlakatla Cumulative Effects Management Program (Canada) (Metlakatla First Nation 2019).

Together, these frameworks provide a comprehensive foundation for understanding how I-RCEAM can be operationalised in practice. The selected frameworks represent diverse but complementary approaches to Indigenous-led cumulative effects assessment and management. Each offers insights into governance structures, assessment methodologies and management strategies grounded in Indigenous knowledge and values.

3.2.1 Guide to Effective Indigenous Involvement in Federal Impact Assessment (Canada)

The Guide to Effective Indigenous Involvement in Federal Impact Assessment (First Nations Major Project Coalition 2020) was developed to support meaningful Indigenous involvement under the *Canadian Impact Assessment Act 2019* (Department of Justice 2019). The Act itself is guided by 3 central mandates: promoting sustainability, respecting Indigenous rights, and applying the precautionary principle.

A defining feature of the Guide is its emphasis on early, continuous and respectful partnerships between proponents, governments and Indigenous communities. Rather than treating Indigenous input as a procedural requirement, it advocates co-developing assessment processes grounded in Indigenous values and governance systems. This includes ensuring that Indigenous Knowledge is integrated alongside scientific data in ways that reflect holistic worldviews, in which environmental, cultural, social, economic and spiritual dimensions are interconnected. The Guide also highlights the importance of capacity building, funding and technical support to enable Indigenous communities to lead or meaningfully participate in assessments. Community-led data collection and analysis are strongly encouraged to ensure that assessments reflect local priorities and lived realities. Importantly, the Guide recognises the need for regional cumulative effects assessment, while also respecting the distinct contexts of individual Nations. It recommends that communities consider undertaking Nation-led cumulative effects assessments where project-level assessments fail to address key concerns. Management tools include Indigenous-led studies, co-developed terms of reference, monitoring frameworks, and agreements such as impact benefit agreements, all designed to support shared decision-making.

3.2.2 Indigenous-led Participatory and Cumulative Impact Assessment (Norway)

The Indigenous-led Participatory and Cumulative Impact Assessment (IPCIA) (Blom 2023) represents a Sámi-led approach to assessing cumulative impacts on cultural landscapes and traditional livelihoods. Developed within the Norwegian planning context, IPCIA centres Indigenous self-determination by placing control of the assessment process firmly in the hands of Indigenous communities. A core strength of IPCIA is its grounding in Indigenous knowledge systems and culturally specific indicators. These indicators extend beyond biophysical measures to include social, cultural and spiritual dimensions. For example, community wellbeing may be assessed through factors such as language vitality or the health of reindeer populations, reflecting the deep interconnections between land, culture and identity.

The IPCIA process is inherently participatory, involving Elders, youth and local organisations in data collection, analysis and decision-making. Methods such as community mapping, storytelling and workshops are used to capture knowledge that would otherwise be excluded from conventional assessments. Another critical feature is its temporal dimension. IPCIA explicitly accounts for long-term and non-linear changes, recognising that cumulative impacts often unfold gradually and may only become apparent over extended periods. Continuous monitoring and adaptive management are therefore integral components, supported by community-led data systems.

3.2.3 Framework for Assessment and Management of Cumulative Effects on the North Pacific Coast (Canada)

The Framework for Assessment and Management of Cumulative Effects on the North Pacific Coast (Wilson 2020) was developed through a collaboration between the Canadian government and coastal First Nations under the Marine Plan Partnership. It provides a regionally coordinated approach to cumulative effects assessment and management across land and marine environments. This framework is distinguished by its co-governance model, which ensures shared leadership between Indigenous communities and government authorities. It is grounded in principles of stewardship, ecosystem integrity and community wellbeing, with a strong emphasis on aligning assessment processes with Indigenous values and priorities. Assessment methods integrate Indigenous and Western scientific knowledge systems to evaluate cumulative effects across spatial and temporal scales. The framework employs co-developed indicators, thresholds and monitoring protocols, which are directly linked to management actions and policy decisions.

A key implementation strategy is the development of integrated land and marine use plans, supported by scenario modelling and ongoing monitoring. This enables decision-makers to anticipate future impacts and evaluate trade-offs between different development pathways. The framework also facilitates cross-scale integration, connecting local, regional and national planning processes.

3.2.4 Metlakatla Cumulative Effects Management Program (Canada)

The Metlakatla Cumulative Effects Management Program (Metlakatla First Nation 2019) represents a pioneering Indigenous-led model for long-term cumulative effects management. Initiated in 2014 by the Metlakatla First Nation, the program was developed independently of federal legislation and is grounded entirely in community values and governance.

At the heart of the program is a values-based approach in which ‘what matters’ to the community defines the scope and direction of assessment and management. The program identifies priority values across environmental, social, economic and cultural domains, such as food security, ceremonial practices, housing and employment. These values are monitored through community-based research, with indicators designed to reflect changes over time. Importantly, the program incorporates the concept of trade-offs, recognising that changes in one value may be acceptable if they lead to improvements in another. This reflects a pragmatic and context-sensitive approach to decision-making.

Management is guided by triggers, thresholds that signal when action is needed to protect or restore a value. Decision-making is conducted through structured processes involving community members, ensuring transparency and collective ownership. The program has delivered tangible benefits, including improved decision-making capacity, increased employment opportunities, and sustained funding for stewardship

initiatives. However, challenges remain, particularly regarding data management capacity and concerns about data sharing and confidentiality.

3.2.5 Lessons for Australia

International frameworks provide clear, practical lessons for advancing I-RCEAM in the context of mine closure in Australia (Table 1). These frameworks demonstrate that Indigenous knowledge systems must be central, not supplementary, ensuring assessments reflect cultural, social, economic and environmental interconnectedness. Effective implementation further requires management tools that enable long-term stewardship and adaptive decision-making, including co-developed indicators, monitoring and clear response mechanisms. In addition, co-governance and shared decision-making must be formalised through structured agreements and governance arrangements. Collectively, these lessons highlight a key gap in Australia: the absence of a coordinated, I-RCEAM framework. Addressing this gap presents an opportunity to improve mine closure outcomes by aligning effects assessment and management with Indigenous values and aspirations. Ultimately, these examples show that cumulative effects assessment is not only a technical task but a governance challenge, requiring a shift in regulation, leadership, decision-making and underlying values, and that further research is needed in this regard.

Table 1 International Indigenous-led frameworks for Regional Cumulative Effects Assessment and Management and lessons for Australia

Framework	Location	Main purpose	Key Indigenous-led features	Assessment and management approaches
Guide to Effective Indigenous Involvement in Federal Impact Assessment (First Nations Major Project Coalition 2020)	Canada	Support meaningful Indigenous participation under the <i>Impact Assessment Act 2019</i> (Department of Justice 2019).	Early, continuous, and respectful partnerships; Indigenous rights and governance recognised; Indigenous Knowledge integrated alongside Western science; strong focus on capacity building and funding.	Community-led data collection and analysis; co-developed assessment processes and terms of reference; Indigenous-led studies; monitoring frameworks; impact benefit agreements; Nation-led cumulative effects assessments where needed.
Indigenous-led Participatory and Cumulative Impact Assessment (IPCIA) (Blom 2023)	Norway	Assess cumulative impacts on cultural landscapes and traditional livelihoods.	Indigenous communities control the assessment process; Indigenous self-determination is central; indicators reflect cultural, social, spiritual and environmental values; strong participation of Elders, youth and local organisations.	Community mapping; storytelling and workshops; Indigenous-defined indicators (e.g. language vitality, reindeer health); long-term monitoring; adaptive management; community-led data systems.
Framework for Assessment and Management of Cumulative Effects on the North Pacific Coast (Wilson 2020)	Canada	Provide a regional approach to cumulative effects assessment and management across land and marine environments.	Shared leadership between Indigenous Nations and government; co-governance model; Indigenous stewardship principles guide decision-making; integration of Indigenous and Western knowledge systems.	Co-developed indicators and thresholds; integrated land and marine planning; scenario modelling; monitoring linked directly to management actions; cross-scale planning.
Metlakatla Cumulative Effects Management Program	Canada	Indigenous-led long-term cumulative effects management based on community priorities.	Fully Indigenous-led and community-driven; values-based approach centred on 'what matters' to the community; community	Priority values identified across cultural, environmental, social, and economic domains; community-based monitoring;

Framework	Location	Main purpose	Key Indigenous-led features	Assessment and management approaches
(Metlakatla First Nation 2019)			governance and decision-making; focus on stewardship and long-term wellbeing.	Indicators linked to values; trade-off analysis; triggers and thresholds that prompt management action.

3.3 Why Indigenous-led Regional Cumulative Effects Assessment and Management matters for Indigenous communities

I-RCEAM represents more than a methodological shift in how effects are assessed. It is a fundamental reorientation of governance, values and decision-making authority (Tardin-Coelho et al. 2026). For Indigenous communities, whose relationships with land are deeply embedded in cultural, spiritual, ecological and kinship systems through intergenerational knowledge (Gee et al. 2014; Goolmeer et al. 2024; Poelina et al. 2023; Woodward et al. 2020), I-RCEAM offers a pathway to restore agency, protect Country and shape sustainable futures in the context of mining and mine closure.

3.3.1 Strengthening self-determination and governance

A central benefit of I-RCEAM is its capacity to strengthen self-determination by positioning Indigenous communities as leaders and rightsholders, rather than stakeholders, in assessment and management processes. Existing literature on IIA consistently emphasises the importance of Indigenous leadership in determining what is assessed, how it is assessed and how decisions are made (Gibson et al. 2018; O'Faircheallaigh & Macdonald 2022).

In this context, Indigenous leadership involves meaningful control across all stages of assessment: scoping, data collection, analysis, management planning and decision-making. It also involves free, prior and informed consent (FPIC), Indigenous cultural and intellectual property (ICIP) and data sovereignty (AIATSIS 2020; 2020a). As defined by Gibson et al. (2018), Indigenous-led processes must be conducted on their own terms and with their approval, ensuring that communities are not merely consulted but actively shape outcomes. Extending this approach to a regional cumulative effects context is particularly significant. Rather than focusing on individual projects, I-RCEAM can enable Indigenous communities to assess the combined effects of multiple developments across their traditional lands before approvals are granted. This creates an opportunity to influence not only project design but also broader regional planning, post-mining land use plans, and overall mine closure outcomes.

Importantly, such approaches align with Indigenous planning theories that prioritise future-oriented governance, where decisions are guided by long-term cultural continuity and intergenerational wellbeing (Jolly & Thompson-Fawcett 2021). By embedding Indigenous governance structures into RCEAM, communities can assert authority over land and resource management in ways that reflect their own laws, values and priorities.

3.3.2 Protecting cultural and ecological values

I-RCEAM can enable a more holistic and meaningful protection of cultural and ecological values. Those values are often inadequately captured in conventional environmental assessments (Measham et al. 2021; Muir 2022). Indigenous-led approaches emphasise cumulative and relational effects, considering how ecosystem changes affect cultural practices, social cohesion and spiritual connections to place (Arnold et al. 2024; Gibson et al. 2018; Jolly & Thompson-Fawcett 2021; Kwon et al. 2024; O'Faircheallaigh & Macdonald 2022). These approaches ensure that assessment criteria are not externally imposed but derived from community-defined values. For mine closure, this is particularly critical. Closure processes should address not only the physical rehabilitation of landscapes but also the restoration of cultural and ecological relationships disrupted by mining activities. An I-RCEAM would allow communities to define what 'successful closure' looks like, including criteria related to cultural use, ecological integrity and long-term stewardship. By incorporating both past and present effects into assessment processes, an I-RCEAM also acknowledges the legacy of

historical developments. This enables more comprehensive restoration strategies that address cumulative degradation over time, rather than focusing solely on the impacts of individual projects.

3.3.3 Enhancing trust, healing, and sustainable futures

Trust between Indigenous communities, industry and government has often been undermined by historical exclusion from decision-making processes and the cumulative effects of resource development (O'Faircheallaigh & Macdonald 2022). An I-RCEAM has the potential to provide mechanisms to rebuild this trust by creating transparent, inclusive and accountable governance structures. When communities have genuine authority over assessment and management processes, they are more likely to view outcomes as legitimate and aligned with their interests. This can reduce conflict and foster more constructive relationships with proponents and regulators. Beyond governance, an I-RCEAM can also create opportunities for community healing. Mining activities frequently disrupt not only ecosystems but also cultural practices, social structures and connections to Country. By enabling communities to define priorities for restoration and management, RCEAM can support processes of cultural renewal and reconciliation.

The concept of a 'third space', as described by Jolly & Thompson-Fawcett (2023), is particularly relevant here. This space allows Indigenous and non-Indigenous knowledge systems to coexist equitably, creating new forms of collaboration that respect both perspectives, without hierarchy. As noted by Blom (2023), scientific knowledge can contribute valuable insights, but it should be integrated into Indigenous knowledge systems, not the other way around. Such collaborative approaches can support the development of sustainable futures where resource development and Indigenous ways of life coexist respectfully. This is especially important in regions where mining will continue to play a significant economic role, requiring long-term strategies that balance development with cultural and environmental protection.

3.3.4 Empowering communities to define assessment priorities

A defining feature of an I-RCEAM is its emphasis on community-defined priorities and indicators. Unlike conventional assessments, which often rely on standardised metrics, Indigenous-led approaches allow communities to identify what matters most to them and how to measure it (Adams et al. 2023; Gibson et al. 2018; Gratani et al. 2016; Joseph et al. 2017; Kwon et al. 2024a). This empowerment is critical for ensuring that cumulative effects assessments are relevant and meaningful. For example, communities may prioritise values such as access to traditional foods, the continuity of cultural practices, community wellbeing, or the health of specific landscapes. These priorities may not align with conventional environmental indicators or other indicators, such as conventional job creation, but are essential for understanding the full effects of development.

Research on Indigenous-led impact assessment highlights the importance of tools and mechanisms to support this process, including framework agreements, customised review panels, land use planning and impact benefit agreements (Gibson et al. 2018; O'Faircheallaigh & Corbett 2005). These tools enable communities to formalise their role in assessment and decision-making, ensuring that their priorities are embedded in regulatory and planning processes. Enhancing and developing Indigenous capacity is therefore essential (First Nations Major Project Coalition 2020; Gibson et al. 2018).

3.3.5 Building collaborative relationships with industry

While an I-RCEAM centres Indigenous leadership, it can also provide a structured foundation for industry collaboration and co-management agreements that highlight Indigenous priorities (Tardin-Coelho et al. 2026). Establishing clear processes, roles, and expectations enables more effective and respectful engagement between communities and proponents. Gibson et al. (2018) suggest that Indigenous-led assessments can 'shadow' state processes, using existing data and regulatory frameworks while maintaining Indigenous control. This approach reduces duplication and creates opportunities for alignment between Indigenous and non-Indigenous systems. Parallel and collaborative assessments, in which Indigenous knowledge and scientific data are treated as equal partners, offer a practical pathway for implementation

(Gibson et al. 2018). These approaches can enhance the quality of assessments by integrating multiple knowledge systems, while also building mutual understanding and trust.

Importantly, I-RCEAM shifts the focus from transactional engagement to long-term partnership through co-management agreements with multiple Indigenous communities and proponents (Tardin-Coelho et al. 2026). Rather than engaging communities on a project by project basis, it supports ongoing relationships grounded in shared stewardship of land and resources. This shift is particularly relevant for mine closure, which requires coordination across multiple projects, companies and regulatory frameworks. A regional, Indigenous-led approach can facilitate this coordination, ensuring that closure strategies are aligned with community priorities and broader landscape-level objectives.

3.4 Why Indigenous-led Regional Cumulative Effects Assessment and Management matters for industry

For mining companies operating in increasingly complex social, environmental and regulatory environments, an I-RCEAM can offer a practical and strategic pathway to improve project outcomes, reduce risk, manage costs and strengthen long-term operational legitimacy. Rather than adding another layer of compliance, I-RCEAM reframes engagement, planning, and closure as integrated, regionally grounded processes co-led with Indigenous communities (Tardin-Coelho et al. 2026). This shift aligns with international expectations, including the principles set out in the United Nations Declaration on the Rights of Indigenous Peoples (United Nations 2007), and with industry guidance such as that of the International Council on Mining and Metals (ICMM 2024; 2025).

3.4.1 Structured pathways for engagement and decision-making

One of the most immediate benefits of I-RCEAM for industry is the provision of structured, transparent pathways for engaging with Indigenous communities. Current engagement practices in Australia are often project-specific, transactional, and limited to consultation requirements. In contrast, I-RCEAM can establish a consistent framework for ongoing collaboration throughout the mining operations life cycle, including closure. International guidance emphasises that effective engagement requires early, continuous and meaningful participation (ICMM 2024; Spiller et al. 2025). I-RCEAM can operationalise this by embedding Indigenous communities in governance structures, enabling co-leadership of assessment processes, and supporting shared decision-making. This aligns with Australian ethical frameworks, including the Australian Institute for Aboriginal and Torres Strait Islander Studies Code of Ethics (AIATSIS 2020) and the National Health and Medical Research Council guidelines (NHMRC 2018), which emphasise respect, reciprocity and Indigenous control in research and decision-making processes.

From an operational perspective, this structured engagement reduces ambiguity. Companies might gain a clearer understanding of community priorities, acceptable thresholds of effects and preferred outcomes for land use and closure. This clarity can support more efficient planning, reduce delays and improve alignment between project objectives and community expectations.

3.4.2 Reducing conflict, risk, and litigation

I-RCEAM can provide a proactive mechanism to identify and address potential conflicts before they escalate. By assessing cumulative effects at a regional scale and incorporating Indigenous knowledge and values, companies can better anticipate areas of concern and co-develop mitigation strategies with Indigenous communities early in the project life cycle. This approach can directly support risk mitigation and cost management. As highlighted in the literature, inadequate engagement and failure to address cumulative effects are key drivers of project delays, legal challenges and reputational damage (ICMM 2025; Spiller et al. 2025). In contrast, collaborative governance models can reduce the likelihood of disputes by ensuring that decisions are transparent, inclusive and grounded in shared understanding (Che & Hickey 2021; Gibson et al. 2018). Importantly, I-RCEAM, if well implemented, can offer the opportunity to move beyond reactive consultation to co-management. This shift enables companies and communities to jointly navigate trade-offs, balancing economic objectives with cultural and environmental priorities. Co-management agreements

are crucial in this regard. International examples, such as co-governance frameworks in Canada, demonstrate that shared decision-making can lead to more stable and predictable project outcomes.

3.4.3 Strengthening social licence to operate

Social licence to operate is increasingly recognised as a critical factor in the success of mining projects (Moffat & Zhang 2014), while the need to address Indigenous priorities persists (Poelina et al. 2021). I-RCEAM provides a robust foundation for building and maintaining social licence to operate by aligning operations with community-defined values and priorities. Unlike traditional engagement models, which often focus on compliance and risk avoidance, I-RCEAM can foster genuine partnerships in line with existing good-practice proposals (Maclean & Woodward 2021; Miller-Sabbioni et al. 2023). This aligns with the expectations set out in the United Nations Declaration on the Rights of Indigenous Peoples (United Nations 2007), particularly the principle of FPIC. By embedding this principle into assessment and management processes, companies can demonstrate a commitment to respecting Indigenous rights and supporting self-determination. The result might not only be reduced conflict but also enhanced trust and credibility, and the clear definition and equitable distribution of Indigenous meaningful influence over outcomes and benefits. This, in turn, can contribute to long-term operational stability and reputational strength.

3.4.4 Supporting sustainable mine closure and long-term planning

Mine closure is a critical phase in which environmental, social, and economic outcomes converge (Measham et al. 2024). I-RCEAM supports more effective closure planning by integrating cumulative effects assessment into regional, long-term strategies. Rather than addressing closure on a site-by-site basis, I-RCEAM enables companies to consider the combined effects of multiple operations and infrastructure over time. This is particularly relevant in regions with overlapping mining activities, where cumulative effects can significantly influence post-closure land use and ecosystem recovery. By incorporating Indigenous knowledge and priorities, companies can define closure criteria that go beyond regulatory compliance to include cultural, social and economic outcomes. This aligns with Australian guidance on Indigenous-led land and sea management, which emphasises the importance of place-based knowledge and long-term stewardship (Woodward et al. 2020).

3.4.5 Improving cumulative effect management and post-closure outcomes

A key advantage of an I-RCEAM is its potential to improve the management of cumulative effects across the full life cycle of mining operations. By adopting a regional perspective, companies can better understand how their activities interact with other developments and landscape changes (Halseth et al. 2016). This has direct implications for post-closure outcomes. Poorly managed cumulative effects can lead to long-term liabilities, including environmental degradation, loss of ecosystem services and ongoing community dissatisfaction (Leyton-Flor & Sangha 2024), and can also negatively affect approval processes. In contrast, a coordinated, Indigenous-led approach can enable more effective avoidance, mitigation or restoration strategies, reducing the risk of negative legacy effects. Additionally, community-based monitoring programs can develop ongoing data to inform adaptive management, ensuring that closure outcomes remain aligned with agreed objectives (Metlakatla First Nation, 2019). I-RCEAM can also create opportunities for innovation in environmental and social management. For example, integrating Indigenous stewardship practices can enhance biodiversity outcomes and support participation in emerging carbon and biodiversity markets.

3.4.6 Enabling economic and strategic value creation

Beyond risk reduction, an I-RCEAM can offer pathways to create shared economic value and responsible mining outcomes as part of a project's legacy. At a regional scale, Indigenous-led approaches can support the development of new economic opportunities, including employment in monitoring, rehabilitation, and land management, as well as the growth of Indigenous-owned businesses (Metlakatla First Nation 2019). These outcomes align with broader industry commitments to environmental, social and governance performance and overall regional sustainability. As noted by ICMM (2024; 2025), companies are increasingly expected to

demonstrate that their operations contribute to sustainable development and community wellbeing. I-RCEAM provides a credible, place-based framework for achieving these objectives.

4 Conclusion

Sustainable mine closure in Australia is a complex, long-term challenge that must address not only environmental rehabilitation but also sustainable social, cultural and economic outcomes, while ensuring that replacement activities responsibly sustain the regions. This text argues that an I-RCEAM is a key approach to meeting these challenges by embedding Indigenous leadership, knowledge and priorities into decision-making. Current Australian regulatory frameworks recognise cumulative effects but remain project-focused, fragmented, and insufficient to implement regional, Indigenous-led approaches or to ensure meaningful Indigenous leadership. In contrast, international examples, particularly from Canada and Norway, demonstrate that Indigenous-led frameworks can succeed when supported by legislation, community capacity and co-governance structures, resulting in more holistic and adaptive outcomes. This highlights the need for future research on the Australian regulatory framework and why I-RCEAM matters for state and federal governments.

I-RCEAM has the potential to provide significant benefits: strengthen Indigenous self-determination and priorities; protect cultural, social and ecological values; support long-term stewardship and collaboration with industry, based on co-leadership and trustworthy relationships; and offer industry clearer pathways for engagement and decision-making. This way, an I-RCEAM has the potential to reduce conflicts, strengthen possible social licence to operate, create economic opportunities for industry and communities, and improve the management of cumulative effects. More broadly, it can improve mine closure and post-mine land use plans and their outcomes and contribute to regional planning. Importantly, it reframes cumulative effects assessment and management as both a technical and governance process requiring shared decision-making and respect for Indigenous rights. If legislated, it can also help build capacity within communities to participate more actively.

Advancing an I-RCEAM in Australia requires early integration of Indigenous governance and co-developed assessment processes to local contexts. Policy reform, capacity building, and further research are needed to support the development and implementation of an I-RCEAM framework. Overall, an I-RCEAM presents a transformative opportunity to improve mine closure practices by aligning environmental management with Indigenous knowledge systems, enabling more sustainable, culturally respectful and collaborative outcomes towards a responsible mine closure environment. To realise this opportunity, coordinated action is required from Indigenous communities, industry and governments. Indigenous communities should be supported in defining priority values, strengthening governance structures, and leading the development and implementation of I-RCEAM processes grounded in Indigenous Knowledge and aspirations. Industry should move beyond consultation towards genuine co-leadership by investing in long-term partnerships, supporting capacity building, sharing data transparently, and integrating Indigenous priorities into mine planning, closure and post-mining land use decisions. State and federal governments should establish enabling legislative and policy frameworks, formalise co-governance arrangements, provide sustained funding and technical support, and ensure cumulative effects are assessed and managed at regional scales. Together, these actions can create the institutional, financial and governance conditions necessary to advance Indigenous-led cumulative effects assessment and management in Australia and improve mine closure outcomes for current and future generations.

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