

Integrated mine closure planning: A rapid scan of innovations in corporate practice



Author

Dr Sandy Worden, Postdoctoral Research Fellow, CSRSM

Centre for Social Responsibility in Mining (CSRSM)
Sustainable Minerals Institute (SMI)
The University of Queensland, Australia

Acknowledgements

This project report is part of a broader initiative, the Social Aspects of Mine Closure Research Consortium. Established in 2019, the consortium is a multi-party, industry-university research collaboration challenging accepted industry norms and practices around mine closure and demanding new approaches placing people at the centre of closure. Industry partners in the consortium include: Anglo American, BHP, MMG, Newcrest, Newmont, OceanaGold and Rio Tinto. The initiative falls under the SMI's Transforming Mine Lifecycles cross-cutting program.

Citation

Worden, Sandy (2020). 'Integrated mine closure planning: A rapid scan of innovative corporate practice'. Centre for Social Responsibility in Mining. University of Queensland: Brisbane.

Cover image

Carpentry students and their instructor at the Tsipi Skills and Civil Training Centre, South Africa. Photo courtesy of Anglo American.

The University of Queensland

Ranked in the world's top 50¹, The University of Queensland (UQ) is one of Australia's leading research and teaching institutions. UQ strives for excellence through the creation, preservation, transfer and application of knowledge. For more than a century, we have educated and worked with outstanding people to deliver knowledge leadership for a better world.

Sustainable Minerals Institute

The Sustainable Minerals Institute (SMI) is a world-leading research institute² committed to developing knowledge-based solutions to the sustainability challenges of the global resource industry, and to training the next generation of industry and community leaders. The Institute is transdisciplinary, and our work is impartial and rigorous. Our research integrates the expertise of production, environmental and social science specialists to deliver responsible resource development.

Centre for Social Responsibility in Mining

The Centre for Social Responsibility in Mining (CSRSM) focuses on the social, cultural, economic and political challenges that occur when change is brought about by mineral resource extraction. The Centre contributes to industry change through independent research, teaching and by convening and participating in multi-stakeholder dialogue processes. Our team consists of geographers, anthropologists, sociologists, political scientists, economists, development and natural resource specialists.

¹ QS World University Rankings and Performance Ranking of Scientific Papers for World Universities, 2018.

² The University of Queensland ranks first in the world for mining and mineral engineering, 2018 Shanghai Rankings by subject.

Executive summary

The Sustainable Minerals Institute's Centre for Social Responsibility in Mining (CSRMI) was engaged by the Social Aspects of Mine Closure Research Consortium to conduct a rapid scan of innovative corporate closure planning practice. The study aimed to identify novel approaches used by consortium member companies to integrate social dimensions into closure planning. Identifying these approaches promotes knowledge exchange between the companies, and provides direction for future research and innovation for mine closure performance.

All six consortium member companies participated in this study. The research team additionally engaged with Teck Resources. Study activities included 15-minute phone interviews with company personnel, a review of company documents relating to closure and social performance, and in-depth interviews.

We found that the seven companies are at various stages of integrating environmental, social and economic factors into planning (at all stages of the mine lifecycle). Anglo American, for example, has an integrated closure planning system that is being rolled out globally. Other companies are not yet at this stage.

Two basic approaches are being used to resource mine closure planning: (1) allocation of full-time personnel whose role is dedicated to closure planning ('dedicated'), and (2) key personnel accommodating closure planning work within their broader roles and drawing on functional expertise on an 'as needed' basis ('dispersed'). Some companies consider their resourcing to be a hybrid of these two approaches. Human resources are allocated at four different levels within businesses: at board level, within the corporate centre, in business units, and at operating sites.

Companies use a range of governance instruments for mine closure planning, including standards, strategies, plans, policies, guidance, systems, closure registers, post-closure visions and board oversight. Two companies (OceanaGold and Teck) are in the process of developing their governance instruments for closure planning. Most participating companies have adopted a risk-based approach to closure planning, with closure considered a material risk to the business. Generally, detailed planning occurs between two and five years from closure. There was general agreement among research participants that it was beneficial for companies to start preliminary closure planning at mine design (or earlier) to allow time to develop integrated knowledge and management systems for companies and their stakeholders.

There are indications that social dimensions are being integrated into mine closure planning. Innovative practices appear to be emerging, as highlighted by the three case study vignettes. The extent of integration across the seven participating companies could not be determined, however, as the study scope did not allow for a detailed investigation of the various organisational layers involved in closure planning processes. Comments from research participants raise questions about the priority some companies are giving to social dimensions compared with environmental aspects of mine closure.

Further investigation and in-depth analysis is recommended, including a series of detailed case studies prioritising mining operations that are within five years of closure. These case studies would illustrate how closure governance requirements affecting social risks and opportunities are interpreted in practice. They would provide a fuller account of innovative planning approaches, and deeper analysis of the catalysts and barriers to integrating social dimensions into mine closure planning.

Contents

1.	Introduction	1
2.	How are closure activities organised?.....	2
2.1	Corporate	2
2.2	Business unit	3
2.3	Site	3
2.4	Social aspects	4
3.	What governance instruments are used to support closure planning?.....	4
3.1	Anglo American’s integrated closure planning system	5
3.2	Closure criteria	6
4.	How are companies approaching mine closure planning?	8
4.1	Planning horizon.....	8
4.2	Closure studies.....	9
5.	What innovations are emerging around integrated closure planning?.....	10
5.1	Definitions.....	10
5.1.1	Social.....	10
5.1.2	Environmental	11
5.1.3	General.....	11
5.2	Innovation mechanisms	11
5.3	Case study vignettes	12
5.3.1	Rio Tinto: Diavik traditional knowledge panel	12
5.3.2	OceanaGold: Waihi cultural balance plan	14
5.3.3	Anglo American: Landau colliery social closure plan	15
6.	What are the catalysts and barriers to integration?	17
6.1	Catalysts.....	17
6.2	Barriers.....	18
7.	Study constraints	20
8.	Conclusions and recommendations	20
8.1	Recommendations	20
8.1.1	Recommended methodology	21
8.1.2	Further research potential	21
	References	22
	Appendix A: Research method	23

Tables

Table 1: A summary of the data collection methods for each participating company	23
--	----

Figures

Figure 1: Three-stage data generation method	1
Figure 2: Companies' approaches to closure resourcing	2
Figure 3: Key governance instruments being used for closure planning	4
Figure 4: The 39 sub-processes of Anglo American's ICPS (Grant & Lacy, 2016, p. 585)	7
Figure 5: The planning horizons companies use for mine closure, according to research participants.	8
Figure 6: Location of the Diavik, Waihi and Landau (Khwezela) mining operations.	12
Figure 7: Satellite image of Diavik mine (Google Earth, 2019).	13
Figure 8: Satellite image of Waihi mining operations in the midst of Waihi town (Google Earth, 2019).	15
Figure 9: Satellite image of the Landau colliery (Google Earth, 2019).....	16

1. Introduction

This study³ is one of four industry-funded projects commissioned under the Social Aspects of Mine Closure Research Consortium, hosted by CSRM. Integrated mine closure is an iterative process that requires environmental, social and economic factors to be considered in planning at all stages of the mine lifecycle, ideally as early as exploration (ICMM, 2019). Involvement of key stakeholders, including governments and mining-affected people, is widely accepted as critical to achieving successful closure outcomes.

The objectives of this study are to identify novel approaches used by mining companies to integrate social dimensions into closure planning and to provide insights and lessons that can assist consortium partner companies to improve their closure performance. The study is not designed to critique companies' closure planning performance nor the regulatory environment within which mine closure planning is enacted.

Data for the project were generated using a strategic mixed methods approach, depicted in Figure 1 (see also, Appendix A). In addition to drawing participants from the six consortium partner companies, the research team engaged with Canadian mining company Teck Resources.⁴

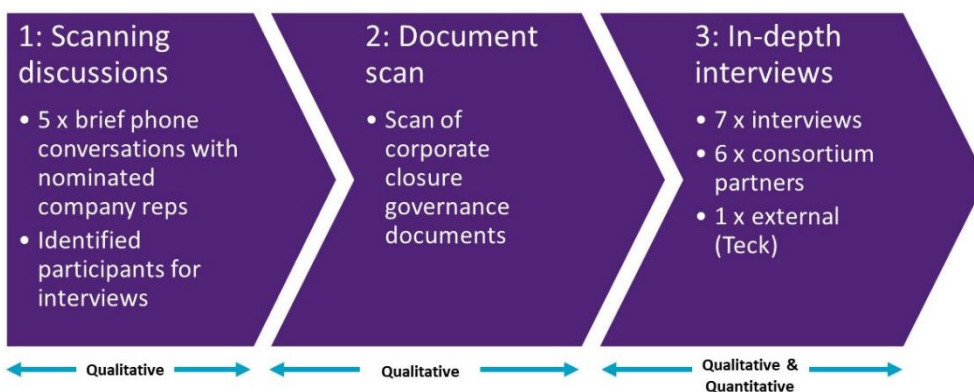


Figure 1: Three-stage data generation method

The project findings are presented under five 'guiding' questions:

- How are closure resources being organised across companies? (section 2)
- What governance instruments are being used for closure planning? (section 3)
- How are companies approaching mine closure planning? (section 4)
- What are the emerging integrated mine closure planning innovations? (section 5)
- What are the key integration catalysts and barriers? (section 6)

Although the participant sample size is small, the findings highlight a clear need for further investigation and in-depth analysis. Sections 2 to 4 focus on how companies are addressing mine closure in general. In section 3 to 6, the discussion shifts to examples of integrated mine closure planning. Study constraints, conclusions and recommendations are discussed following the findings.

³ Before any work started on data generation for this project, clearance was obtained from The University of Queensland's Human Research Ethics Sub-Committee in accordance with the National Health and Medical Research Council's guidelines. This project was not highly sensitive in nature and interviews were not conducted with indigenous nor vulnerable peoples. Informed consent was obtained from the research participants prior to the interviews and anonymity of participants was maintained.

⁴ Teck has adopted some innovative approaches to post-mining land use, including a solar farm, skiing facility and the establishment of a mine lake that supports rainbow and bull trout.

2. How are closure activities organised?

The ICMM (2019, p. 6) defines integrated mine closure as ‘a dynamic and iterative process that takes into account environmental, social and economic considerations at an early stage of mine development’. In this report we are focused on processes of integration that involve the inclusion and exchange of knowledge relating to the social aspects of mine closure planning. To action an integration process requires human and financial resources. The aim of this question is to determine how the seven companies participating in the research are resourcing mine closure planning within their businesses and the focus being given to resourcing integration processes.

Responses from the research participants demonstrate two basic approaches to resourcing (Figure 2): (1) allocation of full-time personnel whose role is dedicated to closure planning (‘dedicated’), and (2) key personnel accommodating closure planning work within their broader roles and drawing on functional expertise on an ‘as needed’ basis (‘dispersed’). Some companies consider their resourcing to be a hybrid of these two approaches. Human resources are allocated at four different levels within businesses: at board level, within the corporate centre, in business units, and on operating sites.

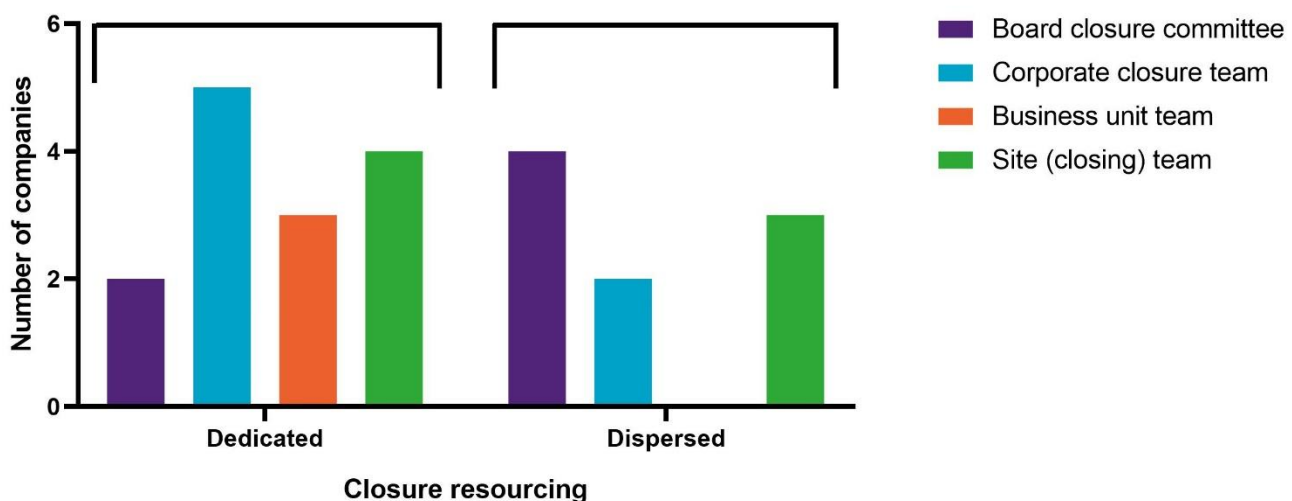


Figure 2: Companies’ approaches to closure resourcing

Figure 2 illustrates how the seven companies are allocating human resources for closure planning. Two companies have dedicated board committees for mine closure. For the remaining companies, closure is addressed through more generic working committees on sustainability or safety.

2.1 Corporate

Most companies have dedicated closure teams (or in two cases, a dedicated closure person) at the corporate level. Rio Tinto has a substantial corporate closure team with personnel in Australia, the USA and Europe. As described by one research participant:

‘The corporate team comprises 10 people in Australia, 20 in the US and four or five in Europe. Within each of the product groups for those assets that are near to closure, we are building those closure teams internally, with Rio Tinto Iron Ore being the largest standalone closure team’.

By contrast, OceanaGold and Newcrest use a dispersed resourcing model; that is, resources are located at assets rather than at the corporate level. Newmont and Teck have one person at the

corporate level who is responsible for mine closure governance. Newmont has a Director Mine Closure based in Denver, who chairs a closure working group with regional representatives that meets online (via Webex) every quarter. In addition, the closure working group and additional practitioners also meet face-to-face every two years to review and progress the strategy and share lessons learned. The director chairs a closure steering committee, which includes members of the executive leadership team. At Teck, the position of Director Regulatory Approvals and Closure provides governance and sets up minimum standards globally. The director leads the integration of mine closure planning into all stages of the mine lifecycle.

2.2 Business unit

Three companies have closure teams in their business units. No data were collected on this aspect for the remaining four companies. Within BHP's iron ore and coal business units, there are closure planning teams predominantly comprising engineers and scientists (hydrologists, geologists, environmental scientists). A former risk specialist has joined one of the teams. Employees rotate into the teams from across their respective areas of work and return to the business after gaining experience in closure planning. A BHP research participant describes the rationale for this approach:

'We have had people join the closure team from different areas of the business who learn all about closure and who then return to their day jobs as champions of mine closure considerations for life-of-asset business planning and implementing good practice measures.'

2.3 Site

Four of the seven companies have dedicated project teams for sites that are facing closure. For example, at Diavik diamond mine in the Northwest Territories of Canada (60% owned by Rio Tinto), there is a small dedicated closure planning team at the asset level. The team includes a study lead, who has operational and environmental science expertise; a closure manager, who has been in the role for the asset since the mine was approved; and a communities/social performance (CSP) specialist. Part-time support is provided from project services and key functions (legal, finance, corporate relations) from the business unit and corporate on an 'as needed' basis. The asset level team is also supported by senior management for the asset and the business unit, the corporate closure team and the central closure studies team; with governance assured at a corporate level.

At Anglo American's Landau (now Khwezela) colliery in South Africa, corporate, business unit and site resources were utilised in the development of a social closure plan in 2015.⁵ Anglo American considers 'social closure' to be an operational activity. According to a conference paper authored by Anglo American personnel: 'The importance of reviewing and improving current onsite operational activities and social projects, to maximise the reduction of post closure residual impacts, are critical to successful social closure and obtaining the best value from allocated resources and funds "spending the same money wisely". Empowering the onsite team and having clear accountabilities and responsibilities associated with the development of the social closure plan forms a very important success factor' (Heymann et al., 2016, pp. 13-14). In keeping with this approach, the following resources were employed to complete the social closure plan:

- **Site:** Human resources, health, social performance, safety and environment
- **Business unit:** Regional community development
- **Corporate:** The Technical and Sustainability mine closure team and the Government and Social Affairs team.

⁵ Landau has since merged with Kleinkopje to form Khwezela colliery and has, therefore, avoided mine closure in the short term.

2.4 Social aspects

The importance of stakeholder engagement in closure planning was a common topic discussed by the research participants, with the focus being on employees, communities and regulators. In addition, a rapid scan of governance documents supplied by three companies shows that stakeholder engagement is required as part of the closure planning process. The degree to which closure project teams integrate the results of stakeholder engagement into the decisions they make around mine closure will need to be tested in future research. There is also opportunity to assess how external stakeholders use the planning and consultation process and whether they could do so more effectively.

Research participants discussed the value of drawing on social performance expertise in mine closure planning to help address social aspects and section 5.3 presents two examples of social performance specialists being integrated into site-focused closure project teams (Diavik and Landau). One research participant explained that it was important to include social performance specialists into teams not only to optimise their expertise in the planning process but also to ensure ‘that CSP engagement accurately reflects genuine consultation and engagement, as well as realistic closure outcomes’ (a Rio Tinto research participant).

The point was raised by one research participant that, unlike environmental aspects, social aspects of closure are not often prescribed in regulation. The participant contended that social aspects, therefore, were not solely a company’s responsibility: ‘The communities themselves, as well as their governments, need to take accountability and play a key role.’

3. What governance instruments are used to support closure planning?

Effective governance is needed to drive integrated mine closure planning from the boards of companies throughout the organisational structure so that what happens at each level of the organisation reflects the company’s closure objectives. Governance is enacted using various instruments, such as mine closure policies. The aim of this question is to identify which instruments companies use to govern closure planning.

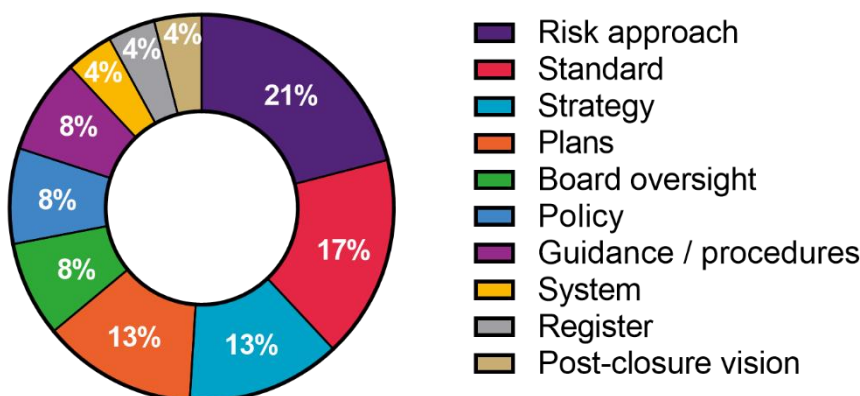


Figure 3: Key governance instruments being used for closure planning

The main instruments discussed by the research participants are illustrated in Figure 3, with instruments mentioned presented as a percentage of the total number of mentions on a company basis. Risk-based approaches were commonly mentioned (21%), followed by company closure standards (17%), business closure strategies (13%) and mine closure plans (13%). The emphasis

on risk, for example, is captured in Rio Tinto's governance documentation which expresses the objective of minimising 'the financial, social and environmental risks and liabilities associated with permanently ceasing operations' (Rio Tinto, 2019, p. 1). Each Rio Tinto closure study has its own independent study governance board. A closure steering committee, with director-level representation from all product groups, oversees all asset closure strategies. A small closure governance and assurance team, led by a chief advisor, resides within the corporate closure team.

At OceanaGold, mine closure sits under the environment function and is considered a material environmental risk. The company aims to: 'Manage closure and rehabilitation in a responsible manner that provides for robust planning, cost estimation and removes the potential for ongoing legacy issues' (OceanaGold, 2019, p. 1).

Individual governance instruments are also considered integral to companies' risk management approaches. For example, Anglo American's Mine Closure Toolbox, launched in 2008 and updated in 2013, is described by Chief Executive Mark Cutifani as a risk/opportunity instrument designed 'to support an integrated approach to risk assessment and sustainable development planning' (Anglo American, 2013, p. 1). Anglo American is expected to launch version 3 of the Mine Closure Toolbox in early 2020.

Other mine closure governance instruments include:

- **Anglo American:** Integrated mine closure planning system (discussed below), standard, guidance, plans, strategy, post-closure vision
- **BHP:** Corporate-level closure standard, asset-level closure management plans, independent audits and closure risk registers
- **Newcrest:** Closure standard
- **Newmont:** Closure strategy
- **Rio Tinto:** Strategic plan for asset closure, closure standard, guidance note, asset closure strategy.

OceanaGold and Teck are in the process of developing their governance instruments. OceanaGold is producing a closure and rehabilitation management position statement, standards and a framework. According to its draft closure and rehabilitation management framework, effective closure management has social, cultural and environmental implications in addition to operational performance. For example, one of OceanaGold's stated aims is to 'implement appropriate mechanisms to avoid, minimise, restore/rehabilitate cultural and environmental uses and values at closure' (OceanaGold, 2019, p.1). Teck expects its closure standard, which will incorporate social aspects, to be in place by mid-2020.

3.1 Anglo American's integrated closure planning system

A key instrument guiding Anglo American's approach to mine closure is its integrated closure planning system (ICPS). A team comprising mine closure, mining engineering/planning, technology and business experts from Anglo American and MWH Global⁶ was formed in 2014 to develop the ICPS. The system combines the various mine planning regimes, internal and external requirements, financial considerations, and governance systems from a 'people, process and technology' perspective. An Anglo American research participant stated that 'social aspects are fully integrated' into mine closure planning via the ICPS. According to Grant & Lacy (2016, p. 581), the aim of the ICPS is 'to provide a consistent approach over the lifecycle of projects for the reporting and

⁶ A company that provides technical engineering, construction services and consulting services.

management of long-term liabilities, to achieve their goal of ensuring that they leave a positive and sustainable legacy for their host communities after their operations have closed’.

A maturity assessment scorecard is used to assess 33 of the 39 closure sub-processes according to five levels of maturity: innocence, awareness, understanding, competence and excellence. Anglo American is targeting level four maturity (competence) for all sub-processes and level five (excellence) where there is ‘a compelling business case’ (Grant & Lacy, 2016, p. 589). Figure 4 (over page) shows the sub-process design for Anglo American’s ICPS. Note the following social components: 1.2 Establish social and economic context; 2.1 Evaluate internal and external stakeholder expectations; 2.3 Evaluate conditions and commitments; 3.5 Establish success criteria; 5.3 Implement stakeholder engagement plan; and 6.2 Compare results to success criteria.

3.2 Closure criteria

Research participants from three companies acknowledged that their governance documentation includes a requirement for closure success criteria to be developed. The documents provide high-level guidance, with specific criteria expected to be developed by each mine closure planning team based on the specific conditions in the local context. No research participant provided actual closure criteria developed for a site.

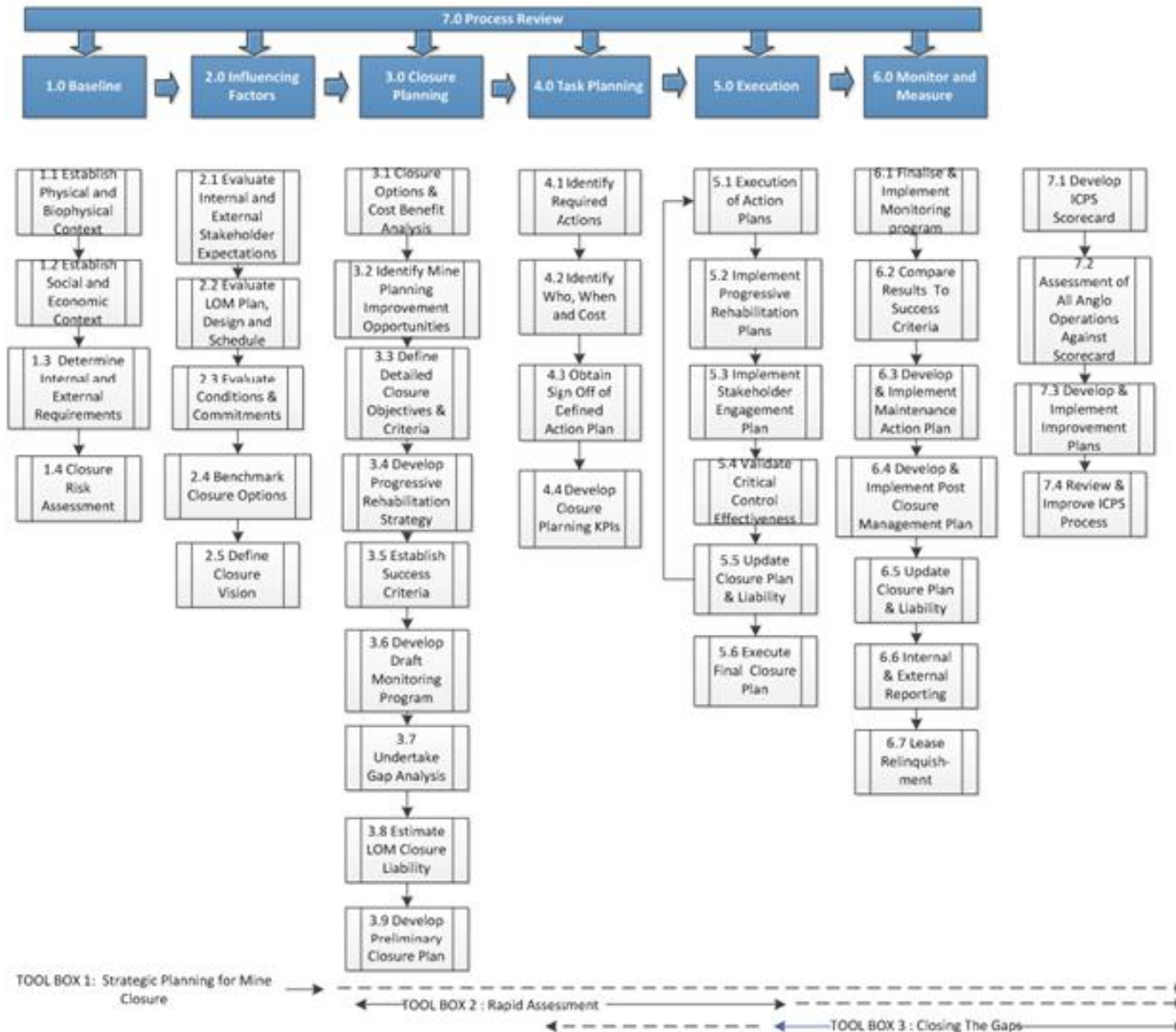


Figure 4: The 39 sub-processes of Anglo American's ICPS (Grant & Lacy, 2016, p. 585)

4. How are companies approaching mine closure planning?

This section captures key approaches not addressed in the previous two sections, namely, the planning horizon for mine closure and closure studies.

4.1 Planning horizon

Research participants agree that it is beneficial to start addressing closure at the mine design phase (Figure 5), with the level of detail required dependent on time left to closure.

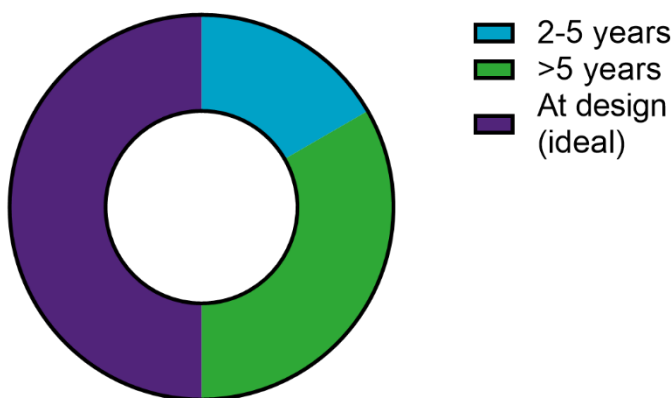


Figure 5: The planning horizons companies use for mine closure, according to research participants (n=6).

Anglo American classifies closure planning into four stages:

1. delivery of a preliminary plan (>25 years and 25-15 years out from closure)
2. a draft plan (15-10 years)
3. a detailed plan (10-5 years)
4. a final plan (5-0 years).

The company's approach to mine closure is described as 'cradle-to-cradle'. According to one research participant:

'The other innovation is cradle-to-cradle, starting closure planning in exploration or even before land acquisition and lease acquisition, taking it through to "second cradle" or the next planned use [...], making "closure" redundant'.

At Rio Tinto, an internal working group was established to develop asset closure strategies over the past year. Led by the corporate closure team, the group comprises participants from each of the operating businesses or operating product groups. As described by one research participant:

'The asset closure strategy work looks at how we design, operate and relinquish our assets right throughout the asset lifecycle. A key component of that is defining up front [...] closure outcomes, which potentially impact communities – defining things such as socio-economic baseline analysis, who the stakeholders are with our two by two matrix, stakeholder engagement and planning those stakeholder engagements throughout the operating lifecycle all the way through to closure, then through closure execution'.

Two pilot asset closure strategies were rolled out in 2018 and two in 2019. Another 62 site-specific strategies are planned to be rolled out at a rate of 8-10 assets per year.

At Newmont, conceptual mine closure plans need to be prepared ahead of commissioning. Closure aspects are addressed and matured during the operational stage of the mine lifecycle via mechanisms such as development of trials and community consultation. Five years from closure, mines enter the investment system phase. A study lead is appointed and very detailed planning takes place, particularly around the costing of closure activities. The increased focus on social aspects and interaction with stakeholders during this phase is founded on established working relationships with those stakeholders.

According to a research participant, BHP starts detailed planning five years out, defining business processes and allocating cost centres. Teck undertakes detailed planning around two years from closure.

4.2 Closure studies

Many of the research participants interviewed are not directly involved in closure projects at the site level, so their knowledge of, and experience with, closure studies was limited. The types of social closure studies mentioned by participants were:

- social impact assessments
- socio-economic studies
- infrastructure repurposing
- post-mining land use options
- community perception surveys
- community mapping
- government requirements (general comments rather than detailed discussions).

More granularity around closure studies was obtained from an interview with a member of the Diavik closure team. Diavik (Rio Tinto 60%) is a diamond mine in Canada's Northwest Territories (see case study vignette on page 13 for more information). The research participant explained that Rio Tinto utilises a projects framework where closure studies are advanced through stage gates. This approach provides an increasing level of understanding and detail at each step: order of magnitude (10 years out), prefeasibility (5 years out), and feasibility (1 year out). Diavik commenced prefeasibility at the beginning of 2019.

'When I say prefeasibility study, we've got clear guidance and standards on what that means. For example, the required level of engineering, workforce planning and stakeholder engagement are all detailed'.

—Diavik closure team member

Work streams within the prefeasibility study include, but are not limited to, technical (including resources and reserves), communities and social performance, and legal (including participation agreements). Examples of social studies that may be undertaken at Rio Tinto operations at the prefeasibility stage of a closure study are:

- socio-economic impact assessments
- long-term closure communications plans and strategies, engagement plans and strategies
- severance, retraining and retention strategies
- financial aspects: estimating closure costs.

‘Closure studies focus on risks and opportunities in each work stream. Scopes of work are very much set based on managing/mitigating risks and realising upside opportunities’.

—Diavik closure team member

Studies include assessment of impacts on community and business partners so that plans can be developed in advance of closure to work together through the ramp down of an operation and execution of closure work. The studies cover engineering, environmental and final land use outcomes which can then be discussed with stakeholders to agree on recommended options.

5. What innovations are emerging around integrated closure planning?

An overarching objective of the rapid scan is to identify and describe emerging points of innovation within consortium partners’ companies on the topic of integrated mine closure planning so that partner companies can learn from each other and improve closure practice. This question, therefore, aims to capture those innovations.

The discussion is divided into three subsections that cover: the meaning research participants attribute to the term ‘innovation’; the mechanisms companies have implemented to foster innovation; and three case vignettes: Diavik’s traditional knowledge panel, Waihi’s cultural balance plan, and Landau colliery’s social closure plan.

5.1 Definitions

Research participants define ‘innovation’ according to three orientations: social, environment or general. This section presents a selection of participants’ definitions.

5.1.1 Social

‘Social’ was the most common orientation research participants used to define innovation:

- ‘When [company] talks about innovation, the first thing to my mind is if we start to incorporate social aspects that, in itself, is already a giant leap forward for the company.’
- ‘Innovative ways to get engagement and two-way feedback from communities, so there’s ownership of the process and we’re not making decisions for people, so [we] don’t get down [the] track and they’re not with us.’
- ‘For me, what innovation in social aspects looks like is ensuring that both social and environmental aspects of mine closure activities are given equal weighting. Be cognisant that we have fundamentally changed the landscape and the communities where we operate. But we’ve added infrastructure. We’ve added beneficial items for communities that weren’t there before, so rather than removing this infrastructure, how can we reuse this for ongoing social benefits?’
- ‘Historically closure has had an environmental bent to it, and the social aspects are tagged on at the end if companies have wanted to do something to help their reputation. To me, it’s more that integration approach. What we find in the [our] context is that the environmental approach is very closely aligned to the cultural/social approach. We’ve always had plans about how we’re going to make the site look nice etc. but we haven’t really taken the time to think how we could have added benefits of cultural closure, not just social, and how that lines up with environmental closure.’

- For another research participant, innovation was not so much about new ideas but, in a multi-disciplinary context, how to ‘get the right people to own [the closure initiatives] and the right people to get involved at the right time, at the appropriate level’. In addition, the participant spoke of innovative approaches to integration in post-mining land use.

5.1.2 Environmental

For one company, closure innovation is closely linked to environmental considerations:

- ‘It means to do a progressive closure during operations and that basically boils down to reduced footprint, as minimum as possible, and reclaim land as soon as possible. We try to use new technology as much as we can.’

5.1.3 General

Other participants considered innovation within a broader context:

- ‘When I think of using the word ‘innovative’, I would think of anything that’s unique or different or not the norm.’
- ‘Thinking beyond or outside what has been the normal driver for closure planning, which has been making the land safe and stable, so trying to go beyond that. There’s also an element of us having to be entrepreneurial in our thinking. We’re closed on the way we think about things because we’re miners. We need to open that way of thinking a bit more, to get some other people into the room to help us around that one. There needs to be more participatory planning and implementation of closure.’

These definitions indicate that there is still a strong focus among mining companies on the environmental aspects of closure given that some participants consider the integration of social aspects into mine closure planning to be innovative in itself.

5.2 Innovation mechanisms

The mechanisms companies have established to facilitate innovation in closure planning was not a topic research participants discussed in detail. They mentioned five mechanisms that enable innovation:

- using multi-disciplinary closure teams
- hosting open forums/workshops and global teleconferences
- having a closure working group
- engaging with site champions
- closure reviews.

The first three mechanisms provide an opportunity for examples of innovation to be shared across sites (‘cross-pollination’ of ideas) and for diverse disciplinary perspectives on mine closure to be utilised in solving closure challenges. One research participant said the use of site champions brought energy and attention to different activities across the closure lifecycle.

At Newmont, tri-annual closure reviews are conducted at each operating mine site. The review teams comprise the Corporate Closure Director and members of the closure working group (including a social specialist, regional representation and an external service provider), who primarily focus on cost and engineering design. A Newmont research participant said the reviews provided an opportunity to share lessons learned and innovative ways of addressing issues across the globe.

5.3 Case study vignettes

This section presents three case study vignettes: Diavik traditional knowledge panel (Rio Tinto), Waihi cultural balance plan (OceanaGold), and Landau colliery social closure plan.

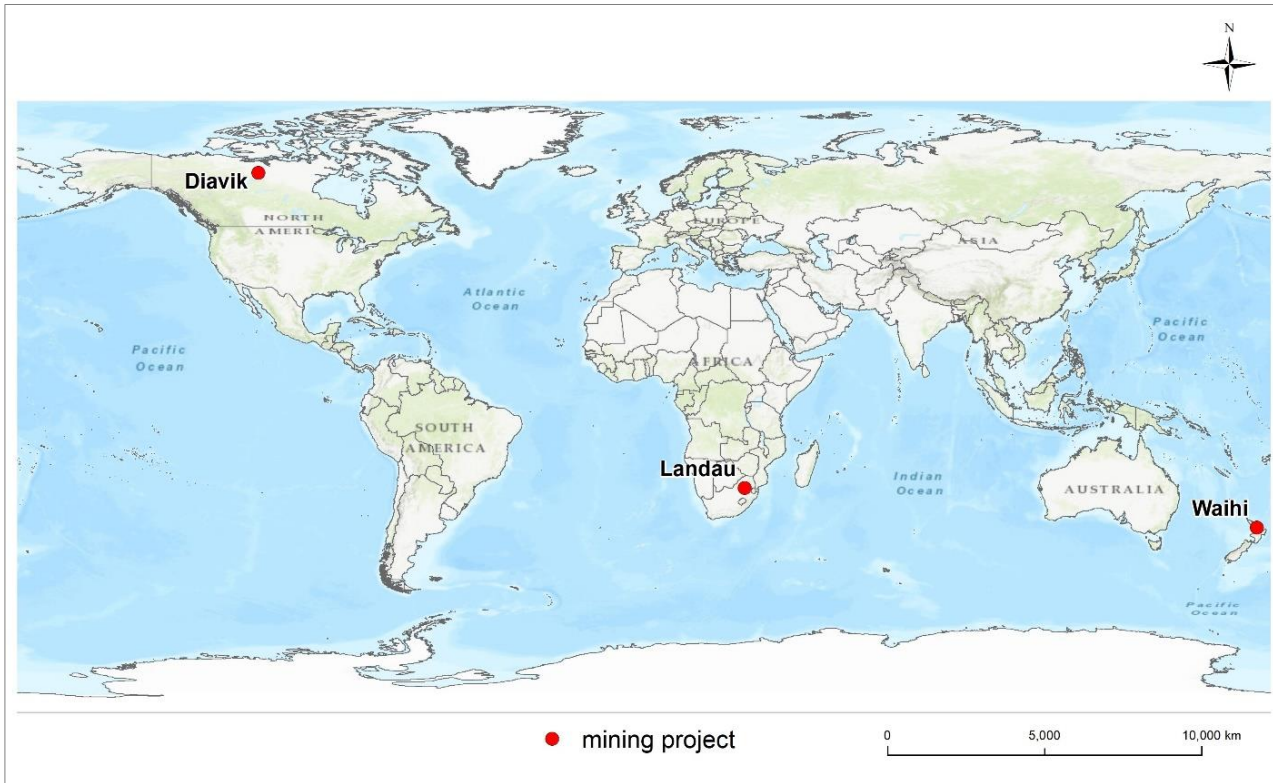


Figure 6: Location of the Diavik, Waihi and Landau (Khwezela) mining operations.

5.3.1 Rio Tinto: Diavik traditional knowledge panel

Site details

Diavik diamond mine is located on Lac de Gras in Canada’s Northwest Territories, 300km north-east of Yellowknife and 220km south of the Arctic Circle. Production started in 2003 and the end of the economic life of the mine is currently estimated at around 2025. Built on 4 diamond-bearing kimberlite pipes, Diavik has an annual production of 6-7 million carats of predominantly white-gem quality diamonds.

The mine is owned by Diavik Diamond Mines (2012) Inc. (60%), a wholly owned subsidiary of Rio Tinto plc, and Dominion Diamond Diavik Limited Partnership (40%), an unincorporated joint venture. Diavik Diamond Mines (2012) Inc. operates the mine, which is part of Rio Tinto’s Copper and Diamonds product group.



Figure 7: Satellite image of Diavik mine (Google Earth, 2019).

Context

Diavik has a socio-economic monitoring agreement with the Government of the Northwest Territories and local Aboriginal communities that formalises commitments to local training, employment, and business benefits for Northwest Territories and West Kitikmeot region of Nunavut communities. The agreement has been in place since 1999.

The mine also has participation (impact and benefit) agreements with each of the following groups:

- Kitikmeot Inuit Association
- Lutsel K'e Dene First Nation
- North Slave Metis Alliance
- Tlicho Government
- Yellowknives Dene First Nation

Innovation

The importance of integrating traditional knowledge (TK) into closure planning was emphasised in the research interviews:

'One thing that we've been doing for quite some time now is working with our communities and regulators to develop closure goals, objectives and criteria that include both traditional knowledge and Western science.'

—Diavik closure team member

‘Communities want to be involved in monitoring the site after closure. This will allow us to combine Western science with traditional knowledge; to have both views as to whether or not things are performing after we’re done’.

—Diavik closure team member

Diavik has engaged a TK panel of elders and youth from its Aboriginal partner groups, which is providing guidance on key areas, including rehabilitation of mining pits and revegetation of the mine site, with details as follows:

- **Rehabilitation of the mining pits:** The pits are located within a 60km-long pristine lake (Lac de Gras). Diavik built a dam in the lake, pumped out water and mined underneath. The TK panel is providing guidance on how to measure the success of re-integrating the dam (pit) with the rest of the lake. An on-site assessment in September 2019 with the panel produced recommendations for monitoring and performance criteria that could be put in place to determine when the pit dykes could be breached post-closure. The findings have been captured in a report.
- **Revegetation of the mine site:** Recommendations from the TK panel include advice on where to promote/encourage revegetation and to allow revegetation to establish naturally on its own; e.g. it is unlikely that revegetation efforts will be deployed in the processed kimberlite containment area based on community and TK panel input. Instead, the area will be capped, and fuel storage areas will be demolished and remediated if/where necessary.

5.3.2 OceanaGold: Waihi cultural balance plan

Site details

The Waihi Gold operations are situated on the east coast of New Zealand’s North Island, in the small town of Waihi. Gold mining has been a feature of the region for three centuries. Current operations comprise the Martha open cut and the Correnso underground mines. In December 2018, resource consents were granted for the Martha underground. The operations are owned and operated by Waihi Gold (OceanaGold 100%), which was acquired from Newmont Mining Corp in 2015.

Context

Māori have a close spiritual connection with the earth and waterways. The physical and spiritual survival of all things is dependent on the maintenance of the life force (Mauri), spirit, power and sacredness of Papatuanuku (the Earth Mother). Māori regard land, soil and water as taonga (treasures) and they consider themselves to be the kaitiaki (guardians) of these taonga. Pukewa is the Māori name for the hill that once stood in the centre of the Waihi town. Pukewa was mined out by the Martha open cut which began operation in 1987. Mining of Pukewa has had a significant negative impact on the spiritual connection of local Māori with the land. In previous closure discussions, many Māori who were interviewed spoke about the need to restore the balance and undergo a healing process: ‘The main concern with closure is ensuring cultural balance. We have a philosophy of replacing what is lost with something of equal value. I don’t think that creating a statue or a pou gives back the value of something that was culturally significant (Pukewa). I don’t know what will, but we should be able to discuss it,’ (quoted in Evans et al., 2009, p. 21).



Figure 8: Satellite image of Waihi mining operations in the midst of Waihi town (Google Earth, 2019).

Innovation

Waihi Gold is developing a cultural balance plan in partnership with local iwi (Māori). The aim of the plan is to identify the Mauri of the whenua (land) and to work collaboratively to ensure its life force is restored at the conclusion of mining. Development of the cultural balance plan is ongoing.

In addition, the closure team (Waihi and corporate) is engaging with an iwi liaison group on how to address the cultural significance of the area. The group comprises tribal groups with a significant interest in Waihi. To further this work, an iwi representative has been appointed to the Waihi external closure review team.

5.3.3 Anglo American: Landau colliery social closure plan⁷

Site details

Landau colliery is located 10km north-west of eMalahleni in the Mpumalanga Province of South Africa. Landau comprises two geographically separate blocks – Navigation Section and Kromdraai Section. There has been a history of underground mining on this site stretching back to 1926, although modern mining operations use open-cut methods. Commercial production was scheduled to cease in 2018 but, in 2017, the operation merged with Kleinkopje to form Khwezela colliery. Prior to the merger, production at Landau was 5-6 million tonnes of thermal coal per annum. The mine is owned by Anglo American (100%).

⁷ Source: Heymann et al. (2016).



Figure 9: Satellite image of the Landau colliery (Google Earth, 2019).

Context

At Anglo American, a detailed mine closure plan must be completed 5-10 years from closure. The plan includes a 'proven' social and health needs assessment. A final plan is required when closure is less than five years away and includes an 'agreed' social and health needs assessment. 'Proven' means:

- social closure requirements and final land use objectives via sustainable development planning are identified and re-confirmed through engagement with interested and affected parties and government officials
- impacts on community health and well-being are managed (mitigated and/or enhanced) in partnership with key stakeholders
- a comprehensive, portable skills plan (development and redeployment) is developed
- plans to address individual and community members' social needs are in place.

'Agreed' means that the authorities have agreed to, and that interested and affected parties have been consulted about, the social closure plan. The health components of the plan must be reviewed by an independent agency at stipulated intervals.

Innovation

When Landau was between three and seven years from closure, a review identified an insufficient level of confidence in the mine closure plan and that the social closure component needed the most attention. To address this gap, a social closure plan was undertaken. Four stakeholder groups were identified: employees, affected parties, interested parties and regulators. For each stakeholder group, success criteria were developed, including costs and resources to execute; risk assessments were conducted; and social closure plans developed for each group. A workshop was carried out to finalise the social mine closure criteria and risks. The separate plans were then integrated and a final plan issued. The next steps included ongoing corporate support to the site team for plan implementation over the remaining life-of-mine and improving the level of confidence in the final closure plan.

Key learnings from the social closure planning process include:

- development of a detailed project plan (actions, clear accountabilities, resources and timelines) is critical to ensure that the social closure plan is incorporated into the overall mine closure plan at the appropriate level of confidence
- proper project management principles and tools should be used, including project schedules (i.e. Gantt charts and critical path views) with a project ‘action log’, ‘decision log’ and ‘lessons learned log’
- the mine closure development team should cover all disciplines across the functional levels to ensure the social mine closure plan is acceptable from a financial and residual post-closure risk point of view
- ‘increasing the level of stakeholder engagement and transferring the acceptability/ownership of the overall closure plan, from the mine to the people that will remain in the area post mining, based on a well-defined closure vision and land use plan, is the key to leaving behind a positive legacy’ (Heymann et al., 2016, p. 14).

6. What are the catalysts and barriers to integration?

As this study aims to identify novel approaches, it is helpful to understand the factors that enable integration of social aspects into closure planning to occur (the catalysts) and those that make integration challenging (the barriers). This section presents research participants’ perspectives on those factors.

6.1 Catalysts

Having closure governance instruments in place, and communicating and engaging with stakeholders, were the key catalysts discussed by research participants. Governance instruments provide guidance around a company’s approach to mine closure, such as closure performance specifications (including minimum performance), accountabilities, options and strategies, approvals and peer review requirements, timeframes and scheduling, closure cost estimates and accounting provisions, and integration practices. In its Mine Closure Toolbox, Anglo American calls for a holistic approach to closure planning: ‘The aim is to follow a holistic approach by understanding the broader environment and then to fit the closure of a mine into it. The earlier this approach is followed in the life of a mine, the greater the opportunity for proactive planning’ (Anglo American, 2013, p. 7).

Ensuring that companies’ various closure governance instruments are aligned was considered important. One research participant said that as a result of the alignment of three instruments at his company, employees working in different disciplinary contexts started to talk ‘one closure language’.

Dispensing with discipline-specific terminology helped to address internal confusion around closure planning.

Research participants considered communication and engagement with internal and external stakeholders to be a key enabler of integrated mine closure planning. There are three main types of integration: horizontal and vertical integration within companies; consideration of external mine closure perspectives into the planning process; and the incorporation of social, physical, biophysical and financial aspects into the planning process. Horizontal and vertical integration focuses on internal stakeholders, such as boards and the executive, senior leaders, closure team members, closure site employees and their dependents, and employees more generally. External mine closure perspectives are gathered via engagement with interested and affected parties (i.e. host communities) and regulators. Engagement with internal stakeholders was specified in governance documents provided to the research team but it did not feature regularly in discussions with research participants.

Engagement with external stakeholders was a more common topic of discussion. In presenting their perspectives, OceanaGold research participants drew heavily on their experience of closure practices at Waihi. One participant said that over the course of a decade, social performance specialists had met with community representatives at least once a fortnight, and often several times a week, to understand the ramifications of closure and to enable the community to have input into the closure planning process. The focus was on the social dimensions of closure rather than the ‘comparatively simple’ physical aspects. The closure team, comprising representatives from Waihi Gold and the community, used a range of transparent mechanisms to articulate and rank the proposals put forward by the community.

Other research participants have found that non-closure-specific mechanisms, such as Indigenous land-use agreements (ILUAs), provide a framework through which mines can discuss closure with Traditional Owners. At the Telfer gold-copper mine in Western Australia, for example, the Newcrest team has had regular meetings with the Martu to talk about closure. The ILUA requires a relationship committee, which includes the Telfer General Manager, Planning Manager, representatives from the Environment team, the Manager External Affairs and Social Performance – WA, and Martu representatives. Acknowledging that the committee may not have had ‘the right people in the room’, a larger group of 30 people was established to discuss closure, ‘generate ideas and talk about the future,’ a research participant said. As part of this process, Traditional Owners have toured the Telfer facility and have had the opportunity to more closely engage with mining personnel on closure, as described by a Newcrest research participant:

‘This has been on the back of the ILUA and the company acknowledging that this is important. [...] The ILUA instructs the appropriate level of commitment from the company around social closure, so that it is [...] something that has to be taken seriously by the various groups and the GM on site.’

The research participant said having a social performance specialist on the site leadership team enabled consideration of the social and cultural aspects of mine closure in the planning process.

6.2 Barriers

The integration barriers commonly discussed by research participants were the planning horizon (long lead times and uncertainty of the closure date), internal social transition buy-in and a lack of social closure specialists. Other barriers included differing priorities between companies and affected parties, inadequate social data, a focus on legal risks, the difficulty of being innovative about post-mining land use due to existing consent conditions/legal requirements, managing expectations, and the complexity of social aspects of mine closure. This section focuses on the complexity of engaging

with affected parties throughout the mining lifecycle and business strategies as barriers to integrating social dimensions into closure planning.

Research participants noted that asset leaders were reluctant to engage with communities on closure at the operational stage of the mining lifecycle because the leaders indicated engagement at that time should focus on sustaining local communities rather than winding down production. One research participant, a social performance specialist, said that it was not clear how companies should be supporting external stakeholders to have those discussions 20 years out from closure, particularly in circumstances where there were differences between the priorities of companies and host communities. An OceanaGold participant explained another challenge of discussing closure early in the mining lifecycle:

'We started [engaging on closure] ridiculously early. In fact, we started so early that some members of the community said, 'well this is actually just a ploy, obviously. You're not planning on closing the door, otherwise why would you be talking about this now? We know you've got several years left. Surely we shouldn't be talking about this until you've reached the bottom of the pit or until you've finished.' And it actually worked to our disadvantage for a little while. It didn't take long for people to realise that we were serious and that there were substantive matters that we could discuss. That's one of the good things about it'.

The concept of intergenerational discussions, particularly with Traditional Owners, was also raised, with the point being made that the people companies engage with during the establishment of an ILUA may not be the same people they engage with on closure, due to the duration of the mining lifecycle.

Research participants commented that having sites facing imminent closure influenced the focus placed on this stage of the mine lifecycle. For example, BHP's business strategy is to have a portfolio of long-life assets. As described by a BHP research participant:

'Our assets have long lives, generally over 50 years, so social transitions are not something that we are developing detailed plans for in the short to medium term'.

At OceanaGold's new operations, such as Haile in the USA (mine life of 25+ years), innovative approaches to mine closure are not a current priority; however, closure has been a focus at the company's New Zealand assets. In the South Island, the former Globe Progress mine transitioned to closure and rehabilitation in 2010 and is now known as the Reefton Restoration Project. Technical closure studies are ongoing, including a research project investigating the passive treatment of water in the Globe pit lake.

Substantial closure planning work has been undertaken at Waihi in the North Island across operational life, with a significant focus on social dimensions. This mine has faced closure multiple times, but approval to further develop resources has continued to extend mine life, the latest being approval for the Martha underground mine, granted in December 2018. Research participants noted that this cycle of immanent closure followed by short-term extensions of mining created a number of challenges for local residents, including issues of trust. There are concerns that when the mine finally closes, residents will not believe the announcement and will not, therefore, be prepared. Confusion about whether the mine is closing has already affected new residents who, based on closure announcements, moved to Waihi for the lifestyle and affordable housing. Having made a significant financial investment in the town, they are now facing a future in an environment that they did not anticipate (i.e. in a town with an operating mine).

7. Study constraints

This project report provides a snapshot of the way seven mining companies – Anglo American, BHP, Newcrest, Newmont, OceanaGold, Rio Tinto and Teck – are approaching integrated mine closure planning from their own perspectives. In line with the project scope, the study was rapid and partial. Three main constraints are inherent in a study of this type:

- **Sample size:** The study results were formulated drawing on five scanning discussions, seven in-depth interviews and a quick review of closure planning governance documents provided by three of the companies. To understand the site, project and jurisdictional complexities, a larger sample of informants with greater access to site planning processes and documentation is required.
- **Coverage of jurisdictions:** The study is confined to a small number of mining jurisdictions. It only considers operations in developed countries – Australia, New Zealand, Canada and South Africa. All participating companies have a significant number of assets in non-OECD countries, where planning processes will necessarily be affected by different factors.
- **Skewed towards social performance and environmental generalists:** The sample size and the selection process meant that the research team most often engaged with social performance and environmental generalists and not mine closure specialists. Much of the data is framed around mine closure planning governance, rather than the specific challenges that closure planners are facing on the ground.

These constraints should be kept in mind when interpreting the findings as reported herein.

8. Conclusions and recommendations

The research found that the seven participating companies are at various stages of integrating environmental, social and economic factors into planning at all stages of the mine lifecycle. Anglo American, for example, has an integrated closure planning system that is being rolled out globally. Other companies are not yet at this stage.

In reviewing the data from across the seven companies, there are indications that social dimensions are being integrated into mine closure planning. Innovative practices appear to be emerging, as highlighted by the three case study vignettes. The extent of integration across the seven participating companies could not be determined because the study scope did not allow for a detailed investigation of the various organisational layers involved in closure planning processes. Comments from research participants raise questions about the priority some companies are giving to social dimensions compared with environmental aspects of mine closure, notwithstanding that social dimensions are not often prescribed in regulation.

8.1 Recommendations

Further investigation and in-depth analysis are required to extend this study. We recommend that a series of comprehensive case studies be undertaken to highlight practices companies have found to work and those that have not worked when integrating social aspects into mine closure planning. We recommend that mining operations be targeted that are within five years of closure as this timeframe represents the start of detailed closure planning for most companies participating in the current research project, and would be the optimal time for data generation.

The aims of these case studies would be to:

- better understand how closure governance requirements are interpreted in practice

- obtain a fuller account of innovative planning approaches
- conduct a deeper analysis of the catalysts and barriers to the effective integration of social dimensions into mine closure planning.

8.1.1 Recommended methodology

A mixed methods approach comprising in-depth interviews and content analysis of key mine closure planning governance documentation is recommended for this research. Interviews could be conducted with:

- all members of the site-focused closure planning team
- corporate closure planning team members
- where appropriate, business unit closure team members
- executive and/or board committee members.

Research outputs would be detailed case study reports (approximately 10,000 words each).

8.1.2 Further research potential

There would be scope to use the completed case studies as the basis for further research, for example:

- a comparative analysis of factors, such as catalysts and barriers for integrating social dimensions into mine closure planning, in developing and developed countries⁸
- the cumulative regional impacts of multiple mine closures in mining regions compared with single closures in regions with diverse economies⁹
- A deeper dive comparative analysis of the specific details within company standards, guidance and assurance processes, and the level of integration of social aspects into closure planning and execution.

⁸ No additional data generation would be required for this project; data from the proposed case studies would be sufficient.

⁹ This project would require additional data-gathering. Interviews would need to be conducted with participants from local government administration areas, regional economic development organisations, state/provincial governments, chambers of commerce, and industry associations. In addition, there is potential to undertake a quantitative study.

References

- Anglo American. (2013). *Mine closure toolbox* (Version 2). Johannesburg, South Africa: Author.
- ArcGIS. (2019). World roads (dataset). Retrieved from <https://www.arcgis.com/home/item.html?id=83535020ce154bd5a498957c159e3a99>
- Bainton, N. & Holcombe, S. (2018). A critical review of the social aspects of mine closure. *Resources Policy*, 59, 468-478. doi: 10.1016/j.resourpol.2018.08.020
- Esri. (2019). World roads (dataset). Retrieved from <https://www.arcgis.com/home/item.html?id=83535020ce154bd5a498957c159e3a99>
- European Commission. (2015). Global human settlement (dataset). Retrieved from <https://datacatalog.worldbank.org/dataset/world-external-geospatial-platforms-population/resource/2912a92b-9334-4d75-ac39-29bc57109c79>
- Evans, R., Clark, P., Hill, T., Sarker, T., & Zhang, T. (2009). *Social impacts of closure of Newmont Waihi Gold operations: A report for Newmont Waihi Gold*. Brisbane: CSRM.
- Garnett, S. T., Burgess, N. D., Fa, J. E., Fernández-Llamazares, Á., Molnár, Z., Robinson, C. J., ... Leiper, I. (2018). A spatial overview of the global importance of Indigenous lands for conservation. *Nature Sustainability*, 1, 369–374.
- Grant, C. D. & Lacy, H. W. B. (2016). Developing Anglo American's integrated closure planning system requires people, process and technology working together. In A. B. Fourie & M. Tibbett (Eds.), *Proceedings of the 11th International Conference on Mine Closure*. Australian Centre for Geomechanics, Perth (pp. 581-594).
- Heymann, E. F., Botha, P. R., Grant, C. D. & January, M. (2016). Social closure planning: scoping, developing and implementing – a case study. In A. B. Fourie & M. Tibbett (Eds.), *Proceedings of the 11th International Conference on Mine Closure*, Australian Centre for Geomechanics, Perth (pp. 213-227).
- ICMM. (2019). *Integrated mine closure: Good practice guide* (2nd edition). London: Author.
- OceanaGold. (2019). *Draft closure and rehabilitation management framework*. Brisbane: Author.
- O'Faircheallaigh, C. (2017). Shaping projects, shaping impacts: community-controlled impact assessments and negotiated agreements, *Third World Quarterly*, 38(5), 1181–1197.
- Rio Tinto. (2019). *Strategic plan for asset closure* (unpublished document). Melbourne: Author.
- World Resources Institute. (2019). Aquaduct global maps 3.0 data (dataset). Retrieved from <https://www.wri.org/resources/data-sets/aqueduct-global-maps-30-data>

Appendices

Appendix A: Research method

The project adopted a strategic mixed method approach using three data generation methods: scanning discussions, a document scan and in-depth interviews (see Table 1). Five scanning discussions (short phone conversations of around 15 minutes each) were conducted with company personnel nominated by consortium partners. The purpose of these discussions was to identify innovative approaches to integrated mine closure planning and the company personnel who could provide detailed information about those innovations. This data was used to select participants for in-depth interviews.

As only one research participant was nominated for Anglo American, Newmont and Teck, no scanning discussions were conducted with these companies; the research team moved straight to in-depth interviews. Of the five scanning discussions, three were conducted with individual participants; one discussion was held with two participants, and the remaining discussion was with four participants.

One face-to-face interview was conducted with a research participant based in Brisbane; the remaining six interviews were conducted by phone or using Zoom video-conferencing software. One interview was conducted with three research participants; the remaining interviews were with individual participants. Apart from one participant in Canada and one in New Zealand; all other research participants were based in Australia. The interviews ranged from 30 to 60 minutes in duration.

Detailed notes were taken during the in-depth interviews and a request made for the interviews to be recorded electronically to enable details to be checked if necessary. As specified in the project plan, the interviews were not transcribed. All but one of the in-depth interviews were recorded (one participant did not consent to being recorded).

During the scanning discussions and interviews, research participants were asked to provide the research team with examples of their companies' mine closure governance documentation. Documents were received from three companies.

Table 1: A summary of the data collection methods for each participating company

	Scanning discussions	Document scan	In-depth interviews
Anglo American	x	✓	✓
BHP	✓	x	✓
Newcrest	✓	x	✓
Newmont	x	x	✓
OceanaGold	✓✓	✓	✓
Rio Tinto	✓	✓	✓
Teck	x	x	✓

Contact details

Dr Sandy Worden

T +61 7 3346 4070

M +61 466 965 403

E s.worden@uq.edu.au

W smi.uq.edu.au

CRICOS Provider Number 00025B