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# Sustainable finance and the role of mine closure

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## Abstract

*Undertaking a robust environmental, social, governance (ESG) due diligence assessment of a mine or portfolio of mines supports informed sustainable investment decisions. While ample international guidance has been developed by reputable international lenders, and these serve as a structure to undertake a thorough ESG assessment, guidelines are largely silent on inclusion of mine closure considerations. Mine closure should be considered a cross-cutting theme which influences the majority of Performance Standards and Principles and so must be considered at all stages of project development from Pre-Feasibility onwards, as well as in the context of transaction due diligence. In the case where closure liability estimates are not comprehensively estimated, transactions may significantly increase financial provisions and portfolio-wide closure liabilities of a corporation, diminishing shareholder value and increasing risk. Undertaking a detailed review of available information, developing or challenging an existing closure base case, appreciating closure risks and opportunities, and developing conceptual liability estimates can support more sustainable transactions within proposed assets, operational assets and/or assets in closure or post-closure.*

*Over the last decade, ERM has contributed on transactional ESG projects for hundreds of operational or legacy mine sites, either individually, or as part of portfolios that can be very large. In this paper/presentation we provide a brief overview of the international guidance on mine ESG Due Diligence, with emphasis on the factors that can affect closure liability. We highlight the process by which environmental and social data, either publicly available or within a transaction data room, must be critically analysed to identify material issues that will impact the closure liability estimates. We then present examples of two of the most common issues that are uncovered - water and social performance - and how incorporating them into a revised conceptual closure base case provides a more realistic financial model to inform the valuation. Almost invariably, these revised closure cost estimates exceed the provisions made in corporate reporting, Feasibility Studies or NI43-101 documents, and we conclude with an analysis of why this is the case and why, therefore, a more comprehensive consideration of mine closure has a fundamental role in sustainable finance.*

**Keywords:** *sustainable finance, ESG, closure liability estimates, water stewardship, social performance*

## 1 Introduction

In this paper we analyse the extent to which mine closure planning and closure liability estimates is considered when it is acquired or re-financed. We present a brief overview of the recent mining transactions market, focussing on the key energy transition metals, before considering what guidance and standards there are for sustainable finance and what these say about mine closure. We then discuss the role of a wider assessment of environmental, social, governance (ESG) due diligence in these transactions, and how mine closure is a theme that cuts across both ESG and financial provisioning.

The second half of the paper presents our approach to undertaking ESG due diligence and the way in which we include mine closure in the process. This includes discussion of the typical ESG issues we encounter, based on 46 sample sites from hundreds we have assessed in the last few years, and how we calculate closure base case costings integrate them into preliminary closure liability estimates, before drawing our conclusions.

For clarity, the following section provides the definitions that we use for ESG and mining finance terminology.

# 2 Definitions

In order to avoid ambiguity, it is important to define key concepts, and a selection of these key concepts are included below. It should be noted that the understanding of these concepts is largely subjective and literature definitions are often not consistent. These represent our definitions used in this paper.

*Cross-Cutting Themes:* refers to a theme which extends across multiple aspects. In the ESG context, a cross-cutting theme is a theme which extends across multiple aspects within environmental, social and governance topics.

*Environment:* water stewardship, biodiversity, circular economy, soil quality, air quality, waste management, noise and vibration, physical climate risk, greenhouse gas emissions (scope one and scope two).

*ESG:* International Finance Corporation (IFC) simply defines ESG as a set of factors considered by companies when managing their operations, and investors when making investments, in respect of the risks, impacts, and opportunities.

*ESG Due Diligence:* is a process which is either completed internally by a mining organisation or by an external consultant, to identify and analyse ESG risks, which may have such material cost implications, or cause the loss of the social licence to operate, such that they may impact future shareholder value. It is considered that ESG due diligence projects generally include ESG Red Flags, regulatory compliance, lender standard compliance, or a combination of all three.

*Governance:* can be consider in two realms, internal and external to the company. Internal governance includes disclosure, corporate governance, data management and verification, tax accountability, agreements and commitments, enterprise risk management, legal compliance, anti-corruption and bribery, auditing and assurance, supply chain management (scope three greenhouse gas emissions). External governance is where local and national regulation impinges on the company's operations, typically through the licencing and permitting process, which ultimately is politically managed and so subject to political and geo-political risk and to the social license to operate.

*International Best Practice (IBP): Sets* of standards that define planning, operational or compliance criteria set by international organisations, rather than national regulators or company's own internal standards, policies and guidance. In the mining context these take the form of overarching frameworks and more detailed performance standards, as well as topic-specific and industry-specific guidance. For mining, standards that are typically considered IBP include the IFC Standards, the Equator Principles, European Bank for Reconstruction Development (EBRD) Standards, as well as more specific process / activity guidance by the European Union Best Available Techniques (BAT) Reference Documents (BREFs).

*Red Flags:* in the ESG due diligence context, a red flag issue is defined as a material issue that has the potential to significantly impact the project valuation or result in unacceptable reputational risks, such as a continued or demonstrated lack of management around an issue, or a history or non-compliances or unacceptable ESG practices.

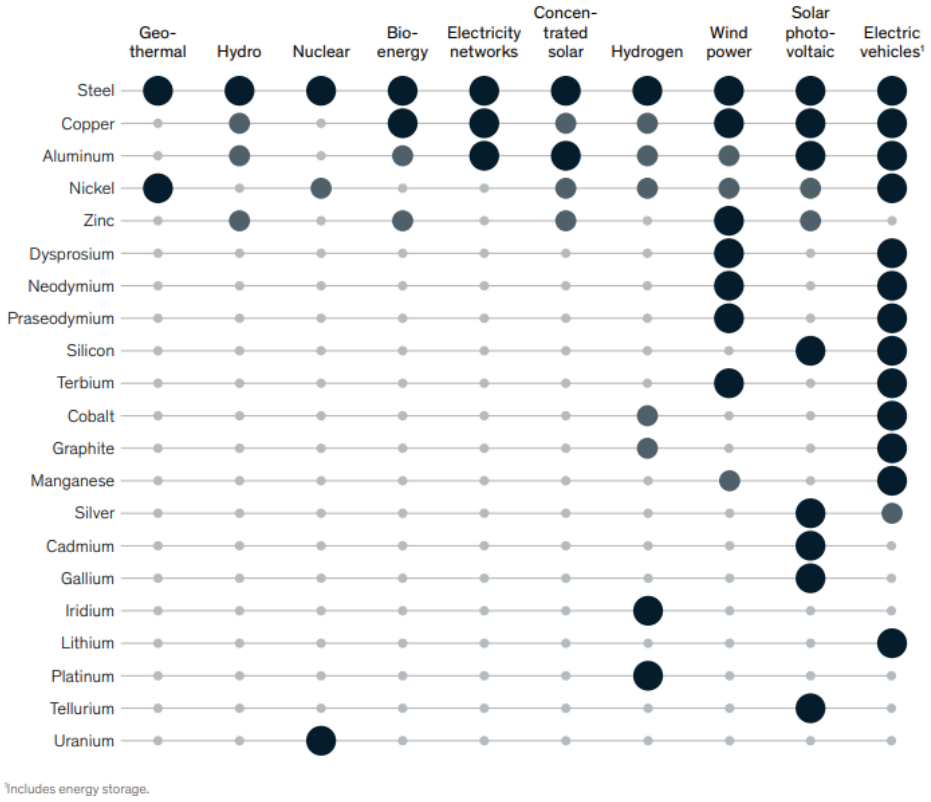
*Social:* often broadly described as social performance but often includes geo-politics, human rights, land acquisition and resettlement, workforce, community impact, indigenous peoples, diversity equity and inclusion, modern slavery, child labour, health safety and wellbeing, tangible and intangible cultural heritage, stakeholder engagement / communication, local employment and community development.

*Sustainability:* in 1987, the United Nations defined sustainability as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

*Sustainable Finance:* The European Commission defines sustainable finance as the process of taking environmental, social and governance considerations into account when making investment decisions in the financial sector, leading to more long-term investments in sustainable economic activities and projects.

# 3 Current state and trends in mining transactions—a summary

The global advancement towards decarbonization and the increase in demand for 'green metals' required for the energy transition, which include copper, nickel and lithium among many others, is expected to result in an unprecedented demand in the coming decades (Valckx et. al 2021). EBRD (2023) identified decarbonisation, increased consumption, underinvestment, geopolitics, sustainability, COVID-19, increasing natural disasters and resource nationalism as key drivers for demand acceleration. Metals required for the transition to a low-carbon economy by technology type are shown in Figure 1 below.




Source: The raw-materials challenge: How the metals and mining sector will be at the core of enabling the energy transition, McKinsey & Company, 2022.

**Figure 1 Materials and technology type**

Mining organizations have been attempting to increase access to these commodities through strategic acquisitions (Marjolin, 2023), with the overall aim of either diversifying their current portfolios, capitalizing on the sustained elevated commodity prices, or consolidating their operations to increase supply to address anticipated demand (or perhaps all three). It is a widely held view across industry, academia and politics, that there is uncertainty on whether the mining and metals industry will be capable of meeting demand for key decarbonization enablers such as wind turbines, solar panels, grid storage batteries and electric vehicles (KPMG International, 2023). It is also widely stated that meeting this demand should not be to the detriment of ESG objectives (KPMG International (2023), EBRD (2023) and Dolowy-Busch, (2023)).

White and Case (2023) reports that in 2022, there were 228 mining and metals transactions, worth $288.2 billion US Dollars. Despite economic pressures, market uncertainty and volatility, specifically associated with the COVID-19 pandemic and the Russia-Ukraine conflict, metals prices have been strong, which benefits mining operators (Marjolin, 2023). While the volume of transactions focussed on gold in 2022 was marginally greater than copper, the overall transaction value for gold decreased by 50%. It was also noted that base metal transactions increased by approximately 65%, nearly all of which were copper deals (97%). Junior exploration companies remain key targets for mergers and acquisition activity (Dolowy-Busch, 2023), with

10 of the 18 recent copper deals focussed on the reserves or development phase of the mining lifecycle (Marjolin, 2023).

The context of increasing demand emphasises the importance of mining transactions, particularly at earlier stages of the mining lifecycle. It is also clear that the acquisition and development of these assets must consider ESG objectives in order achieve sustainable decarbonization and to access capital funding from the sustainable finance sector. As a result, we consider that we are living in a 'golden era' of sustainable finance transactions within the mining industry, and market data trends confirm this.

# 4 Review of guidance for sustainable finance

While ample international guidance has been developed by reputable international lenders, and these serve as a structure to undertake a thorough ESG assessment, guidelines are largely silent on inclusion of mine closure considerations.

*International Finance Corporation Performance Standards (IFC PS):* provide detailed guidance on how to manage environmental and social risks and can be utilised to assess a target and associated red flags. The IFC PS also provides guidance on implementation but does not consider mergers and acquisitions and is silent on the assessment of mine closure risks, specifically mine closure liability estimation.

*Equator Principles (EP):* are proposed to be a financial industry benchmark for determining, assessing and managing environmental and social risks in projects. While they are frequently updated to adapt for changes in requirements, they too are silent on the assessment of mine closure risks and mine closure liability estimation.

*European Bank for Reconstruction Development Performance Requirement (EBRD PR):* EBRD-financed projects are expected to be designed and operated in compliance with good international practices relating to sustainable development. To support improvement and compliance, EBRD defined ten performance requirements covering the key areas of environmental and social issues and impacts. However, like IFC PS and EP, there is no mention of mine closure or liability estimation.

In addition to the performance requirements, EBRD have recently produced a Mining Sector Strategy (2024-2028), which, in combination with the organization-wide Strategic and Capital Framework, dictates how, where and in what the EBRD invests. EBRD (2023) makes the commitment to align all its activities, including mining projects, with the Paris Agreement. The Strategy recognises that demand for certain metals is accelerating and that extraction and processing of these must be undertaken in an environmentally-sound, sustainable, resilient, circular manner, which is respectful of human rights, including labour rights. It also notes that investors and end-users are expecting high ESG standards and performance and are seeking increased access to information, and the EBRD Strategy aims to accommodate this. However, in relation to this paper, the Strategy remains largely silent on mine closure, especially mine closure liability estimation.

*Global Industry Standards on Tailings Management (GISTM):* The GISTM is directed at operators of mines with tailings storage facilities (TSFs) and applies to both existing and to-be-built facilities. However, compliance with the GISTM is often used to assess due diligence red flags. While it includes numerous criteria regarding closure of TSFs, both operational and non-operational, it does not include details regarding mergers and acquisitions or estimation of asset-wide closure liabilities.

*International Council on Mining and Metals (ICMM):* is a mining industry body with the stated aim to be a global leadership organisation for sustainable development. To achieve this, it has a requirement for a high standard of member compliance with ICMM's Mining Principles. These principles define the good practice environmental, social and governance requirements of company members through a comprehensive set of 39 Performance Expectations and eight related position statements on critical industry challenges. Whilst ICMM's general mining guidance and expectations are largely silent on mine closure and liability estimation, they have produced multiple guidance documents which, if applied together, provide useful guidance regarding mine closure and liability estimation. These include Integrated Mine Closure: Good Practice Guide

(2nd Edition, 2019) and associated training materials, Financial Concepts for Mine Closure (2019) and Human Rights Due Diligence Guidance (2023).

# 5 Importance of robust ESG due diligence

Leading companies integrate ESG strategies and transition thinking across every stage of the mining lifecycle to deliver successful business outcomes, value creation opportunities and a positive legacy. Acquisition and re-finance can occur at any stage of the mining lifecycle, from mature exploration phases, through feasibility studies, construction and permitting into operation and even as closure nears. Indeed, many of the portfolios assessed include multiple legacy assets, where the mine has already closed, and represent an ongoing financial and organizational commitment post-closure.

With consideration of an increased ESG awareness and an overall focus on ESG strategy and integration, it is important to assess the ESG non-technical risks that may be introduced to a portfolio via acquisition. In additional to ESG non-technical risks, a robust ESG due diligence should also assess the potential closure liabilities that are introduced into the portfolio.

In cases where closure liability estimates are not comprehensively estimated, transactions may unexpectedly and significantly increase financial provisions and portfolio-wide closure liabilities of a corporation, diminishing shareholder value and increasing risk. Undertaking a detailed review of available information, developing or challenging an existing closure base case, appreciating closure risks and opportunities, and developing conceptual liability estimates can support more sustainable transactions within proposed assets, operational assets and/or assets in closure or post-closure. Creating shared value and leaving a positive legacy can only be delivered through sustainable mine closure planning, considered closure execution and where possible, regeneration initiatives such as repurposing.

# 6 Closure as a cross-cutting ESG theme

We have shown above that mine closure is not specifically detailed within most ESG methodologies or the key sustainable finance guidance documents. The relative success (or otherwise) of integrated closure planning and execution will significantly impact the closure liability estimate, which will also impact the overall profitability of the asset. In addition to the direct impacts on profitability, the attractiveness of the asset may be further increased (or decreased) by other indirect aspects such as social performance and water stewardship, among many others.

Due to this ability of mine closure to impact across environmental, social and governance themes and in multiple individual topics, we consider it as a cross-cutting ESG theme.

# 7 Our approach to mine closure in esg due diligence

Over the last few years, ERM has contributed on transactional ESG projects for hundreds of operational, developing or legacy mine sites. The acquisition targets have been either individual assets, or part of a company portfolio that can be very large (often ranging up to 20 individual assets, sometimes more). Given our assessment above that sustainable finance guidance documents are largely silent on mine closure, and the fact that mine closure is a key cross-cutting ESG theme, it has been necessary to develop a bespoke methodology to include closure costing. We appreciate that ESG red flags or materiality varies substantially between potential purchasers, and much of this is subjective, dictated by organizational risk tolerance, or occasionally even driven by the individual preferences of client deal managers. Given this variability, we present our general methodology for a typical mine ESG due diligence and how we incorporate mine closure into it.

As well as variations in materiality, risk tolerance and preferences, there is also substantial variation between projects on the amount of ESG and closure planning data available. This often relates to the stage of corporate interest that a client is at, e.g., strategic advice for a client prior to, or outside of, a formally declared due diligence process – where only public information can be obtained. In contrast, in a formal offer

process, typically mediated by legal firms, there may be a virtual data room with thousands of files opened to multiple interested bidders on a confidential basis.

Given all these variations, it is critical to work closely with the client deal managers to clearly define the scope of what can be achieved on mine closure for given site. Often this is carried out in collaboration with our client's ESG or sustainability managers, and their internal closure specialists.

As a general approach to mine closure within these portfolios, and subject to the variables stated above, we are guided by four key questions:

1. **Do we really understand the true cost of closure?** What are the unforeseen elements and the foreseen elements of closure that can escalate costs?
2. **Are the closure plans we have robust and implementable?** As closure comes ever closer can these plans be optimised to develop value?
3. **Where do they need to focus attention across our portfolio?** given the limited resources and broad range of issues that are faced by the target?
4. **How can we maximize value in our closure operations** and reduce our long-term liability?

In the rest of this section, we describe how we gather and analyse the information to attempt to answer these questions.

## 7.1 Public data review

Public data is present and useful to some extent in most ESG due diligence projects. We undertake a desk-based search of public documentation for mine operation and closure plan details, with emphasis on closure liabilities and stated life of mine (LOM) closure liabilities, as well as environmental and social risk factors. Data sources examined will typically include published reports, often to be found on the target company website and annual reporting (Financial, Environmental & Social, Sustainability), technical reports (such as NI43-101), environmental social impact assessments, feasibility studies, closure plans and permit compliance reporting. Depending on jurisdiction, regional and national regulators, such as Ministry of Mines or Environment, may also hold public records that can be accessed, such as permit compliance monitoring reports, permit status, land holding records, even closure plans and their financial bond or provision. Often there is a general internet footprint for a given site or company, such as conference and journal papers, news articles (industry and media) and social media. A great deal of social and community information on a mine site can often be found on social media, particularly if there are disputes (such as over land, water or access), non-governmental organisation activity or a history of incidents that have impacted the communities. In addition, publicly accessible mapping tools, such as Google Earth also provide valuable topographic context and information on local communities, environments and land uses, and the historically imagery available allows for changes over time at a mine site to be analysed.

## 7.2 Data room review

In a formalised transaction process the target company typically will prepare a confidential virtual data room (VDR) to present company due diligence information to prospective buyers or investors. These may amount to thousands or even tens of thousands of documents, on a wide range of topics, many not relevant to ESG due diligence or closure. The VDR review must be tailored to fit the scope and time constraints of the transaction timeline, and care must be taken to focus on the key documents that relate to ESG and mine closure.

We undertake a screening review of the documents in the VDR to identify those related to the mine operation and closure plan details, with emphasis on closure liabilities and LOM estimates, and environmental and social risk factors. Often these may include, for example, the full closure plan, detailed design reports for the TSFs and waste rock dumps, acid-rock characterisation, water, air and soil management and monitoring data,

progressive rehabilitation reporting, biodiversity monitoring and projects, emergency response plans, human resources data, stakeholder mapping, legal dispute records and community projects.

## 7.3 Multi-disciplinary teams

All publicly accessible and VDR environmental and social closure data gathered for a site must be critically analysed, synthesised and interpreted to identify material issues that could impact the closure liability estimates. In addition to these, information is gathered on the local regulatory framework and the relevant legislative requirements in each jurisdiction and whether each site has complied generally with these requirements.

Clearly, for a wider ESG due diligence, reviewers need to include people not just with experience of mining and mine closure, but also experience in a wide range of technical disciplines, covering water, geochemistry, air, land quality, biodiversity, TSF failure risk and consequence, as well as social and community issues, and colleagues who understand the regional and national political and mine regulation context, who are probably located in the same country as the target site. For the mine closure element of an ESG due diligence, the closure specialist needs to interact with and understand the findings from all these other ESG specialist reviewers.

## 7.4 Typical ESG red flags

For this paper we have collected the summary ESG red flags for a representative sample of 46 mine and processing sites from a range of due diligence projects ERM have undertaken in the last three years, spread across the continents and across commodities (most are mines for the 'green metals' required for the energy transition, along with three gold mines). These projects were a mixture public data only, and VDR with public data, analysed in the way described in the sub-sections above. Half the projects were operational mines or processing facilities, 14 were closed or legacy assets, and nine were projects close to beginning operations.

**Table 1 Typical ESG findings – most common red flags in the 46-site sample**

| Environmental Red Flags | Social and Governance Red Flags |
|---|---|
| 11 (24%) had insufficient provision for post closure water monitoring and / or treatment | 7 (15%) had damaged (non-indigenous) community relationships |
| 10 (22%) had uncontained groundwater plumes | 7 (15%) had residents immediately downgradient of TSF dams with higher risk categories |
| 7 (15%) required water treatment in perpetuity | 5 (11%) had disputes or damaged relationships with indigenous communities |
| 6 (13%) had biodiversity impact issues | 5 (11%) had serious labour disputes |
| 6 (13%) had TSF closure or long-term stability issues | 4 (9%) had unresolved resettlement issues |
| 5 (11%) had surface water quality issues | 3 (7%) had cultural heritage issues or constraints |

Some other issues were cross-cutting, for example, water supply for the mine in competition with water needs in the wider society was an issue at three (7%) sites. The same number of sites had issues with air quality permit compliance linked to community health impact. In fact, regular permit limit breaches of environmental monitoring were found to be occurring at four (9%) of the sites. None of the sites assessed had no red flags reported for them, although many (about a third) had just one or two, often of lower significance or magnitude than at other sites.

Several issues were only identified once each in the sample of 46 sites, and these included poor surface water management, untreated process water disposal, subsidence issues in the community, access to mine infrastructure shared with the public, lack of skilled workforce in the area, a high health and safety incident

rate, political and regulatory risk to operations and royalties, and intense opposition from non-governmental organisations.

Of the most common red flags, issues around water were in the top four environmental themes, whilst for social and governance, local and indigenous community relationship issues were most common.

It was found that there was no, or almost no, information on closure planning available in 16 (35%) of the sites assessed, which is concerning because many of the environmental and social issues most identified were directly or indirectly related to closure. This emphasises that closure is a cross-cutting theme and provides ample justification for establishing a costed closure base case as a matter of course in ESG due diligence if time allows.

## 7.5 Closure base case

Many target assets either do not have a closure plan, it is not of sufficient detail, or it was not available as a component of the due diligence process. As a result, the development or verification of a viable closure base case, including key assumptions, is required. In the due diligence assignments that have been completed, we considered the development of a viable closure base as an essential initial step to estimating closure liabilities.

The closure base case should support the development of a high-level work breakdown structure (WBS), which should be compiled based on domain or aspect. We have applied the term ‘aspect’ as not all key components of the WBS are strictly infrastructural domains. When developing the base case, we consider whether our approach would be acceptable in accordance with the client’s expectations, risk tolerance and that the base case will comply with client closure guidance. An example of a due diligence closure base case is included below as Table 2.

**Table 2 Example of due diligence closure base case**

| Domain/Aspect | Suggested Base Case | Key Assumptions |
|---|---|---|
| Tailings Storage Facility (TSF) | Tailings are non-acid generating (NAG), and standard cap will be sufficient. Only the TSF1 will be active at closure, all other TSFs fully reclaimed. TSF2 has been buttressed by adjacent WRD | 500 mm cap with 300 mm growth media, both sites won |
| Waste Rock Dump (WRD) | Waste Rock Dumps are NAG and standard cover will be sufficient | 300 mm growth media, site won |
| Open Pits and Quarries | Pit 1 and Pit 2 left as voids, cease dewatering, render physically and geochemically stable, installation of safety measures | All other pits backfilled |
| Mill, Concentrator and Associated Infrastructure | Decontamination, demolition and disposal (DDD) break slabs, crush slabs, use crushed concrete in TSF1, cap, revegetate | 1,000 mm slabs in concentrator and mill, crush and leave in place. Thinner platforms excavate and backfill with 700 mm cap, 300 mm growth media, both sites won |
| Water Treatment (Including Groundwater) | Treat with existing water treatment plants | Total volume 4,800,000 $m^3$/yr. for 1 year during closure at $5 USD/$m^3$. Treat for 15 years post-closure at $0.5 M/yr. |
| Soil Remediation | Excavate and dispose in TSF1. Replace with site won material and rehabilitate | Excavate 300 mm and replace with topsoil (site won). Estimated area of 100 ha, dispose in TSF1. |
| Post-Closure Maintenance and Monitoring | 15 years post-closure maintenance and monitoring | Includes surface water, groundwater, rehabilitation and reporting. 15 years post-closure earthworks and rehabilitation maintenance |

## 7.6 Preliminary closure liability estimates

With consideration of the closure base case, as described in Table 2 above, a preliminary closure cost model is developed. In the development of many of the conceptual closure liability estimates, the Standardized Reclamation Cost Estimator (SRCE, 2022) was used. LOM liabilities were developed using either project specific or country-specific labour, equipment and materials rates with overall productivity calculated by SRCE (where applicable). Where project-specific or country-specific rates were not available, rates for neighbouring countries were used and noted in the report.

Due to the available information and the overall conceptual nature of the estimate, the preliminary closure cost model incorporated conservative estimates on domain physical attributes as calculated in available reports or as estimated via Google Earth. Following the calculation of social/community, studies and indirect costs and contingency, the medium estimate was tabulated.

To emphasize the preliminary and conceptual nature of the estimate, and to allow for residual uncertainty, an upper end (high estimate) and lower end (low estimate) were the estimated. The upper end (high estimate) was proposed to infer a maximum reasonable worst case while the lower end (low estimate) was

proposed to report a reasonable best-case scenario. An example of a conceptual due diligence closure liability estimate is included below as Table 3.

**Table 3 Conceptual due diligence closure liability estimate**

| Domain/Aspect | Low Estimate | Medium Estimate | High Estimate |
|---|---|---|---|
| Tailings Storage Facilities | $70,000,000 | $100,000,000 | $150,000,000 |
| Waste Rock Dumps | $26,000,000 | $30,000,000 | $40,000,000 |
| Open Pits and Quarries | $1,000,000 | $3,000,000 | $5,000,000 |
| Decontamination, Demolition, Disposal | $9,000,000 | $15,000,000 | $25,000,000 |
| Water Treatment | $33,000,000 | $40,000,000 | $50,000,000 |
| Soil Remediation | $3,000,000 | $4,000,000 | $6,000,000 |
| Post-Closure Maintenance and Monitoring | $9,000,000 | $13,000,000 | $25,000,000 |
| Social/Communities | $5,000,000 | $6,000,000 | $9,000,000 |
| Studies and Indirect | $75,000,000 | $80,000,000 | $100,000,000 |
| Contingency (40%) | $63,000,000 | $85,000,000 | $124,000,000 |
| **Total estimated costs** | **$294,000,000** | **$376,000,000** | **$534,000,000** |

In this example the Pre-feasibility Study included an estimated $88,700,000 LOM liability, substantially below even the low-range estimate.

## 7.7 Integrating water management into closure liability estimates

Water issues were, by far, the most common red flags in the 46-site sample, and whilst some may have required urgent action in the operational context, most would also represent an issue to be addressed in closure. In the ESG due diligence context, water issues can be incorporated into a revised conceptual closure base case to provide a more realistic financial model to inform the valuation. This takes the form of including costs in the Studies and Indirects, Water Treatment and Monitoring line for those activities required or anticipated, for example: design and build of improved water management infrastructure, site investigation and risk assessment of soil and groundwater contamination, remediation works that may be required, establishment of additional water quality monitoring networks – costed for a sufficient duration that will realistically be required. Costings are based on internal knowledge of site investigation and remediation subject matter experts, and whilst not representing a commercial offer, provide better than order-of-magnitude costs for the types of activities required.

## 7.8 Integrating social performance into closure liability estimates

Local and Indigenous community relationship issues were the most identified social red flags in our 46-site sample. These were for a range of factors such as land ownership disputes, alleged transgression of established indigenous rights or access, perceived lack of infrastructure development in the community – especially if degraded by mine activities, favouritism or lack of employment access in the community, or direct community health impacts from environmental issues such as degraded water or air quality.

Closure planning can allow many of these issues to be addressed in a collaborative way with the communities and offers the opportunity to re-engage and re-establish disenfranchised communities through the process of setting closure vision and goals.

In the ESG due diligence context, these issues can be incorporated into a revised conceptual closure base case to provide a more realistic financial model to inform the valuation. This takes the form of including costs in the Social / Communities line for those activities required or anticipated: social engagement programmes, involvement in closure planning, beneficial infrastructure or services, or in other lines for additional allowance for soil or groundwater remediation to include community resources affected by the mine, restoration of biodiversity.

In order to cross-check social and community liability estimates as provided in Table 3, in more recent due diligence projects we applied a specific social performance (including communities) interactive cost estimating tool. In our experience, social performance costs associated with closure are rarely estimated and as a result, an intuitive tool would allow for a preliminary estimate with minimal effort. The tool considered a range of factors such as stability of operating environment, regulatory maturity, community dependence, influence of socio-cultural aspects and operational stakeholder engagement. The tool then allowed for the factors to be assessed against a simple risk matrix, which provided an indicative percentage value to the total estimated direct costs ranging from 1% to 6%.

### 7.9 Comparison to available liability estimates

Where such information is available, almost invariably these revised closure cost estimates made during the ESG due diligence process exceed the provisions made in corporate reporting, feasibility studies or regulatory documents, as was shown in Table 3 above. In a recent example portfolio of 22 sites, the stated closure provision in the corporate reporting was only about half the sum of our estimated mid-range costs, and less even than our low-range closure liability estimates. This is likely to be due to the industry approach of reporting the lowest possible liabilities as this results in lower provisions, within the reporting obligations that apply in the jurisdiction in which they are based. This is seen in corporate reporting which varies between organisations in what costs are included, and often excludes the costs of studies, social performance, contingency and other indirect costs from the stated liabilities. Whilst this can clearly be justified from a corporate reporting perspective, the closure cost estimation as part of ESG due diligence, using the approach described in this Section, provides a more realistic financial model to inform the valuations of the acquisition client.

## 8 Conclusions

Considering the current mergers and acquisitions market for minerals, and green metals required for the energy transition especially, ESG issues are now routinely assessed when making investment decisions. The main ESG red flags from a sample of 46 mine and processing sites were evaluated and the most frequent issues were related to water and community relations. Many of these can also be directly or indirectly related to mine closure, and therefore a more comprehensive consideration of mine closure has a fundamental role in sustainable finance.

A methodology for developing preliminary conceptual closure cost estimates, that specifically include provision for the actual ESG red flags identified, has been described and it was found that the revised closure cost estimates made during the ESG due diligence process nearly always exceeded the provisions stated in corporate reporting. There are clear reasons why this is justified from a corporate reporting perspective but the closure cost estimation as part of ESG due diligence provides a more realistic financial model to inform the valuations of the acquisition client.

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