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Integrating community participation in mine rehabilitation in the West Rand, South Africa

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Abstract

South Africa has a long legacy of abandoned gold mines where operations ended without proper closure or rehabilitation. Many of these sites contain tailings or residue dams that often attract illegal mining and pose environmental and health risks. Technological advances now enable these tailings to be reclaimed or repurposed as secondary orebodies, allowing reworking of old deposits and freeing substantial land for sustainable rehabilitation, such is the case in the West Rand, Johannesburg area in Gauteng Province. The West Rand has a long and complex history of gold mining dating back to the 1880s. Over time mining activities, coupled with changes in ownership and gaps in regulatory oversight, have left a legacy of environmental challenges. These include varying degrees of land and wetland contamination, soil erosion, abandoned infrastructure and widespread infestations of invasive alien plants. One mining company has sought to transform this legacy into an opportunity by actively involving local communities in the rehabilitation and shaping the future land use.

The process began by identifying areas within the mining right for rehabilitation during operations, determining the required interventions, and assessing community skillsets to inform targeted upskilling beneficial for the mine and the community. Initiatives have included training in invasive species management (mechanical and chemical management), supporting the registration of small businesses in vegetation management, and enabling access to timber resources, thereby contributing to employment opportunities while meeting rehabilitation objectives. Annual rehabilitation targets are set and, where feasible, allocated to local community contractors. Although this approach navigates regulatory, financial, and health and safety standards, it demonstrates that meaningful community participation in concurrent rehabilitation is both achievable and valuable. This paper outlines the approach undertaken and demonstrates how community participation can be successfully integrated into concurrent mine rehabilitation efforts to support both environmental restoration and socio-economic developments.

Keywords: *rehabilitation, community, abandoned mines, training, invasive species*

1 Introduction

Mining, particularly gold and uranium extraction, has shaped South Africa's economic and spatial development for more than a century, particularly across the Witwatersrand Basin. While the sector has generated substantial economic value, historical mining practices frequently concluded without effective implementation of rehabilitation and closure activities necessary to achieve sustainable closure outcomes. Consequently, many abandoned or partially rehabilitated mine sites persist as sources of environmental risk and social concern.

The reprocessing or remining of historical mining waste facilities in South Africa began on an experimental basis in the 1930s, transitioned to operational retreatment from the 1960s to 1970s, and was firmly established as a commercial mining practice from the 1980s onward, particularly in the Witwatersrand

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goldfields (van Wyk 1989). Gold recovery technology and processes have advanced sufficiently, and continue to do so, enabling the re-extraction of residual gold (and uranium) from historical mining waste facilities as secondary profit avenues (Sutton et al. 2006). This has resulted in large areas of lands becoming available for potential redevelopment, including agricultural, residential or industrial purposes. Re-treated or re-mined tailings is subsequently deposited in newly engineered tailings storage facilities (TSFs). These TSFs incorporate modern pollution control measures such as continuous concurrent rehabilitation practices including revegetation of slope surfaces, and engineered containment solutions including high-density polyethylene (HDPE) lining systems (SLR Consulting2026).

Modern mine closure and rehabilitation practices emphasise a life of mine approach that integrates concurrent rehabilitation, defining post-mining land uses, and undertaking meaningful stakeholder engagement throughout both the operational and closure phases. Within this framework, community participation has become increasingly important for maintaining social licence to operate and a practical mechanism to enhance rehabilitation success and support the transition to closure. This paper examines how community participation was incorporated into concurrent rehabilitation at a gold mining operation in the West Rand, demonstrating alignment between environmental objectives and socio-economic development.

2 The West Rand mining landscape

The West Rand District Municipality (WRDM) represents the jurisdiction area of the Western and Far West Rand mining areas and is in the west of Gauteng Province. The area is currently covered by 4 local municipalities: Merafong City, Mogale City, Randfontein and Westonaria. The project area is characterised by extensive mining activities, with the landscape dominated by large, engineered mine residue deposits including TSFs. Formal and informal settlements exist, which include Munsieville, Kagiso, Azaadville, Tarlton Hekpoort, Emhlangeni, Lewisham, Chamdor and Millsite (https://www.wrdm.gov.za/). The land use in the area primarily comprises mining, residential areas, agricultural activities (historical and current cultivated areas) and grazing areas. Wetlands, marshes and dams occur within the project area, and together with the river network, constitute a system of sensitive surface water features.

The West Rand area has a long and complex history of gold mining dating back to the 1880s after the discovery of the Witwatersrand Basin. Early mining activity targeted outcropping and near-surface reefs, using shallow shafts, adits and surface quarrying methods typical of late 19th century mining technology. Mining activity expanded rapidly, driven by investment and the establishment of numerous small mining companies. Although ore grades were generally lower and reefs more geologically complex than those of the Central Rand, early extraction proved economically viable. Mining operations in the early phase generated the first substantial volumes of mine residue material (tailings). The TSFs, abandoned infrastructure, and waste rock dump facilities were generally situated close to workings with little consideration for long-term environmental impacts . The result is a fragmented landscape of legacy infrastructure, storage facilities and degraded lands. Mining has seen the adoption of re-treatment or reprocessing methodologies within the West Rand area, enabling the reduction of environmental impacts associated with historical mining waste facilities.

The proximity of legacy mining waste facilities and infrastructure to expanding urban and peri-urban development has amplified both environmental and social risks. Key risks include geotechnical instability of degraded landforms, dust generation from unrehabilitated tailings surfaces, deterioration of wetland and watercourse systems, contamination of soils and widespread infestation by invasive plant species (Mpanza et al. 2020; Mabaso 2023). Addressing these cumulative impacts benefits from an integrated rehabilitation approach that incorporates environmental, social and land use considerations, supported by inclusive stakeholder engagement, rather than relying solely on technical remediation measures.

3 Regulatory context

Mine rehabilitation and closure in South Africa are primarily governed by the *Mineral and Petroleum Resources Development Act 2002* (Act No. 28 of 2002) (Republic of South Africa [RSA] 2002) and *National*

Environmental Management Act 1998 (Act No. 107 of 1998) (RSA 1998) and associated regulations administered by the Department of Mineral Resources and Energy and the Department of Forestry, Fisheries and the Environment (Mpanza et al. 2020). The legislative frameworks require mining right holders to undertake progressive or concurrent rehabilitation, make adequate financial provision for closure, and engage stakeholders throughout the mining life cycle.

In practice, these regulatory requirements are implemented during the implementation of concurrent rehabilitation activities. In this case, these included alien and invasive plant clearing, wetland rehabilitation, contaminated land remediation and revegetating most of the project area using appropriate plant seed mixes. The implementation of these rehabilitation activities is further informed by complementary legislation which includes the *National Environmental Management: Biodiversity Act 2004* (Act No. 10 of 2004) (RSA 2004) alien and invasive species lists categories as published in Alien and Invasive Species Lists (GNR 1003; GG 43726; 2020) (RSA 2020), *Conservation of Agricultural Resources Act 1983* (Act No. 43 of 1983) and the *Fertilizers, Farm Feeds, Seeds and Remedies Act 1947 (*Act No. 36 of 1947) (RSA 1947) which is the primary South African legislation governing the registration, importation, application and sale of agricultural remedies, including herbicides for weeds and invasive plants.

Within this broader regulatory context, concurrent rehabilitation is recognised as a key mechanism for reducing closure risk and associated liabilities over the life of mine. While legislation mandates public participation, it does not prescribe how communities should be involved during the operational phase. This creates opportunities for most mining companies to identify and create innovative, site-specific approaches such as those described in this case study.

4 Integrating communities into rehabilitation

During the permitting and licensing phase, several specialist studies pertinent for the authorisation process included soil, biodiversity baseline, groundwater and surface water, and wetland baseline studies. These studies informed the identification of the remediation and rehabilitation activities that would be required within the project area to reduce the extent of the environmental pollution and degradation identified within each baseline study. The initially identified potential positive impacts of the project activities included removal of historical TSFs, rehabilitation of impacted footprints (including wetlands and watercourse areas), the removal of historical infrastructural facilities, removal of contamination sources and creation of employment opportunities either by direct employment or the requirement of various service providers to support the mining activities. Final land use plans are important to guide the rehabilitation success criteria; however, in most cases these are not always determined in the early stages of mining, meaning that rehabilitation can usually be guided by baseline findings and provisional land use assumptions.

Preliminary land use activities identified within the project area included ecological conservation, managed grazing and agricultural activities, a high-density residential area, industrial development and the expansion of the existing recreational areas. The post-mining land use plan is to be finalised. While the multiple post-mining land use options did not delay the concurrent rehabilitation activities, a quantitative land use option analysis may be conducted over time to consider both the current and post-mining land use. Large portions of the mining area had historically been mined through traditional mining methods and a high level of small-scale mining and illegal mining activities were underway when the rehabilitation activities commenced.

While rehabilitation projects are typically implemented using established and experienced contractors, the mine elected to pursue an alternative delivery model that prioritised community participation. A key component of the rehabilitation activities was executed by community contractors, who focused primarily on invasive alien plant clearing and follow-up maintenance. Mechanical clearing was supplemented by controlled chemical treatment where required. However, herbicide use was avoided upstream of wetland areas in accordance with the national legislation. Clearing activities comprised the removal of gum (*Eucalyptus camaldulensis*), pampass grass (*Cortaderia selloana*) and various wattle (*Acacia* spp.) trees which are prevalent on site. Cleared biomass was made available to contractors and communities surrounding the project area (Figure 1) as timber or fuelwood, providing an additional socio-economic benefit.

A comprehensive list of the plant species recorded on site is available through the adaptive mine management plan.

Figure 1 Cleared biomass made available to contractors and surrounding communities

Prior to the implementation of the rehabilitation activities, the mine identified lack of skills and experience within the rehabilitation sector in the community. Targeted training and upskilling within the community was offered to interested members through the stakeholder engagement processes. The training was facilitated by an accredited third-party institution, and included the following certified courses:

- Alien and invasive plant species identification and mechanical management
- Accredited course in hand tools use such as chainsaw operation
- Brush cutting operation
- Herbicide application for weeds and invasive plants management (Figure 2)
- Personal protective equipment requirements for each activity.

The community contractors further contributed to early-stage monitoring and maintenance, continuing to support vegetation establishment and the long-term site stability of the project areas. Oversight by the mine ensured compliance with environmental standards and health and safety requirements.

The targeted training initiatives equipped community members with transferable skills that extend beyond the project timeframe. The initiative created employment, transferred practical environmental management skills, and enabled the establishment of small, locally based contractors. These outcomes contribute directly to closure readiness while enhancing the potential for sustained community-led land management beyond mine closure within the project areas. Overall, this approach integrating community participation into rehabilitation not only delivers on the environmental outcomes but also supports the development of self-sustaining communities during the long-life mining operations by promoting supplier development, enhancing local capacity, and reinforcing the adoption of environmental best practices.

Rehabilitated areas demonstrate improved surface stability, reduced invasive plant species density (Figure 3), and increased ground cover of indigenous vegetation. The concurrent rehabilitation of the project areas has reduced the extent of disturbed land. Furthermore, concurrent rehabilitation continuously contributes to manageable final landforms, enhancing both environmental recovery and community-driven rehabilitation outcomes.

Figure 2 Site conditions in parts of the project area during the initial alien plant clearing and herbicide application

Figure 3 Site conditions in parts of the project area during the initial alien plant clearing by various contracting teams

The rehabilitation of wetlands within the project area was primarily undertaken by experienced rehabilitation practitioners during the initial implementation phases. This approach reflects the high sensitivity of wetland habitats, where there is low tolerance for error during rehabilitation activities. The activities included removal of historical contamination and sedimentation material, landscaping and reinstating previous drainage systems, clearing of alien and invasive species, and revegetation with indigenous wetland species. After the implementation, relationships with mine and community contractors were maintained, with contractors continuing to undertake ad hoc invasive species control and maintenance within the rehabilitated wetland project areas. This demonstrates the sustained value of community integration beyond the initial rehabilitation activities.

5 Challenges and lessons learned

Key challenges encountered during implementation included limited plant identification capacity by individuals without long-term experience or regular exposure to local vegetation, particularly where species were not flowering or had no visible seed structures. During the initial phases of implementation, variability in work quality and productivity occurred. Clearing rates and ranged between 4 and 8 weeks as contractors developed practical experience and familiarity with rehabilitation standards. Other teams had to return to completed areas to address unresolved issues before sign-off. While training was provided, achieving consistent outputs often requires time, repeat exposure, and on-site supervision. To mitigate this, a management plan incorporating plant identification guides was distributed, and on-site technical support by external consultants was provided, which improved the contractors' work consistency during execution.

An additional challenge related to cost was the increased level of supervision, training and follow-up required when working with less-experienced contractors. Compared to established rehabilitation contractors, who would typically be able to achieve required outcomes efficiently, the community-based approach required additional input to achieve consistent quality and compliance with technical standards. This included extended induction processes, closer on-site supervision, and occasional corrective work, resulting in higher short-term implementation costs by requiring external consultants to attend site weekly compared to the initial plan of monthly visits. However, these cost implications were considered acceptable where possible in support of longer-term skills development, local capacity building and broader socio-economic objectives.

Additional challenges include adherence to health and safety requirements, as infrequent presence on active mine sites can reduce familiarity with site and mine-specific requirements. This risk was addressed through the continuous presence of a designated health and safety officer working alongside the various contracting teams.

Ongoing artisanal and small-scale mining activities within the mining area also present residual challenges, particularly near excavations, stockpiles, mine pits and infrastructure in areas earmarked for future rehabilitation. However, these activities have been significantly reduced (by approximately 70%) in the project areas as rehabilitation works and invasive vegetation clearance reduced concealed areas that previously provided cover for such activities.

Secondary invasion by alien plant species remains an ongoing challenge, requiring consistent follow-up maintenance, particularly for species such as wattles (*Acacia* spp.) and pampas grass (*Cortaderia selloana*) that form persistent soil seedbanks and necessitate medium- to long-term management. Additionally, some plant species that were not recorded on site during the initial site assessments are occasionally observed during monitoring and maintenance site visits, highlighting the need for adaptive management and continuous site monitoring.

6 Conclusion

Communities adjacent to mining operations often experience the direct consequences of historical environmental degradation. Their involvement in rehabilitation provides a mechanism to address legacy issues while supporting local employment and skills development. This case study demonstrates that community participation can be effectively integrated into concurrent mine rehabilitation in the West Rand. When structured, supported and aligned with regulatory and operational requirements, community involvement enhances environmental outcomes while delivering tangible socio-economic benefits.

As mine closure and rehabilitation expectations continue to evolve, community-centred rehabilitation approaches offer a practical pathway to reducing long-term closure liabilities, strengthening social licence to operate, and enabling sustainable post-mining outcomes to be achieved. This approach supports the delivery of shared environmental and socio-economic value, with this experience providing transferable lessons for similar legacy mining contexts across South Africa and beyond.

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