GREEN MINING: BEYOND THE MYTH

PERSPECTIVES ON THE FUTURE OF MINING

Editors: Caroline Digby, Dee Bradshaw, Hanri Mostert and Brian Chicksen

erals to metals

MINERAL LAW
IN AFRICA

The paradox of 'Green Mining' captures the contradiction of the invasive mining process and the colour green, which symbolises life, renewal, and sustainability. Green Mining depicts the provision of minerals and metals in a way that is not only techno-economically viable but also environmentally responsible, and that contributes to social inclusion and benefitting communities. While it does not necessarily describe the mining industry as we currently know it, it is one we can imagine, aspire to and seek to create.

The Green Mining symposium, held on the 11th August 2017, brought together a range of different voices from across the mining sector, each talking about elements of the mining and sustainable development space, with the purpose of exploring new frontiers and opportunities to shift the mining sector into a more sustainable paradigm. This publication presents a summary of the presentations and discussions of the day, highlighting where the gaps are and proposing an agenda for future investigation, research, training and collaboration.

The cover image entitled 'Measuring Modernity' is by South African Earth artist Jeannette Unite. Her interest in mining began during her time spent on the West Coast diamond fields in the 1990s witnessing the scarring impact of mining on the landscape. She continues to explore humankind's engagement with minerals and metals and how colonialism and globalisation affect how we occupy land. Her artwork series, including 'Earthscars', 'Headgears', 'The Paradox of Plenty', 'Above Below', 'Terra' and 'Complicit Geographies', have been exhibited in mining regions across the globe.

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SUSTAINABLE OPERATION THROUGH DESIGN

By Wynand van Dyk

Context

The world today has an almost insatiable demand for the minerals and metals produced by the mining industry. In essence, if it has not been grown, it had to be mined at some point in time. By its very nature, the mining industry has an impact on the environment within which it operates, and consumes a finite resource. This raises an interesting dilemma from a sustainability perspective: the Brundtland Commission defined sustainable development as development that meets the needs of the present, without compromising the ability of future generations to meet their own needs (United Nations World Commission on Environment and Development, 1987). This process of balancing the needs of the present (demand for minerals and metals) with the ability of future generations to meet their own needs has to be embedded in the design phase of any new venture.

In designing a sustainable operation, there are two key questions to consider (Econation, 2017):

1. Am I doing the right thing?
2. Am I doing things right?

The question whether mining is the right thing (or not) is a debate outside the scope of this article – my assertion is that the world needs mining. However, given the proclivity of the mining industry to major environmental disasters, for example acid mine drainage and the collapse of tailings dams, the industry needs to seriously consider how to 'do things right'.

Design for sustainability

ABET defines the process of design as 'a decision-making process (often iterative), in which basic science, mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective' subject to a 'variety of realistic constraints' (Department of Mechanical Engineering, University of Nevada, 2017). The question therefore arises, whether sustainability should be a constraint, or an objective, within the design phase of a project.

If sustainability is viewed as a project constraint, then, by implication, sustainability trade-offs and/or compromises have to be made in the project, similarly to how the usual project dimensions of cost, time and quality are traded off. However, if sustainability is viewed as the overall objective of the project, then the cost/time/quality dimensions cannot overshadow the sustainability objective, and sustainability can be embedded within the project risk management framework.

Sustainable project risk management

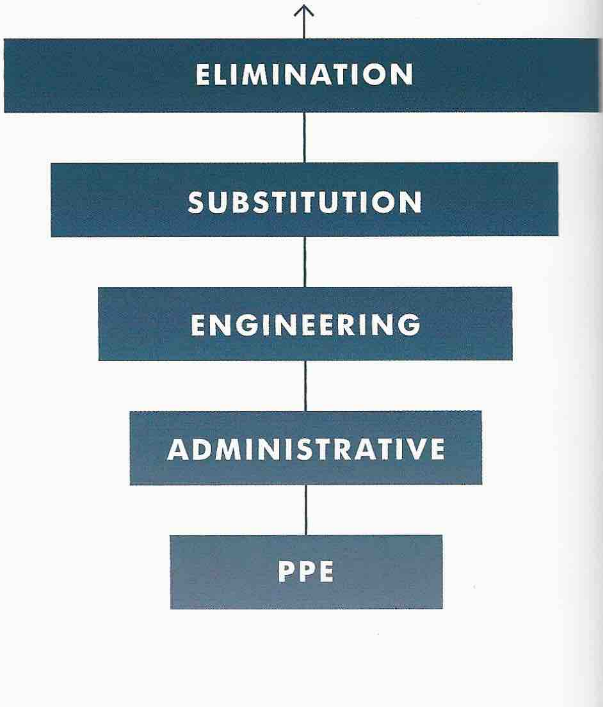
Managing project risk is managing the possibility that the project will not turn out as planned, i.e. managing negative impacts on the project objectives. As the project objective is to develop a sustainable operation, managing the project risk will include managing the sustainability of the operation. In order to manage risk, it is imperative to understand what risk is: a joint function of the likelihood that an event will occur, and the consequence of the event if it does occur.

The likelihood of an unwanted event occurring is a function of the effectiveness of the controls put in place to prevent the event from occurring, whereas the consequence of an event (if it occurs) is determined by the magnitude of the uncontrolled energy released during the event. The control effectiveness is linked to the hierarchy of control, as shown in the figure below.

In order to manage the sustainability risk of a project, it is therefore necessary to understand the energy (or driving force) behind certain identified events, as well as to consider the hierarchy of control within the design process.

Application examples

The sustainable project risk management approach is best described using a selection of examples as implemented at the recently developed Elandsfontein Mine, owned by Kropz. The mine is located in the Saldanha Bay Municipal area, which has more than 25% youth unemployment. The mining area is within an environmentally sensitive area adjacent to the West Coast National Park, and the ore body is located within the Elandsfontein aquifer, which is linked to the Langebaan Lagoon, a RAMSAR site.



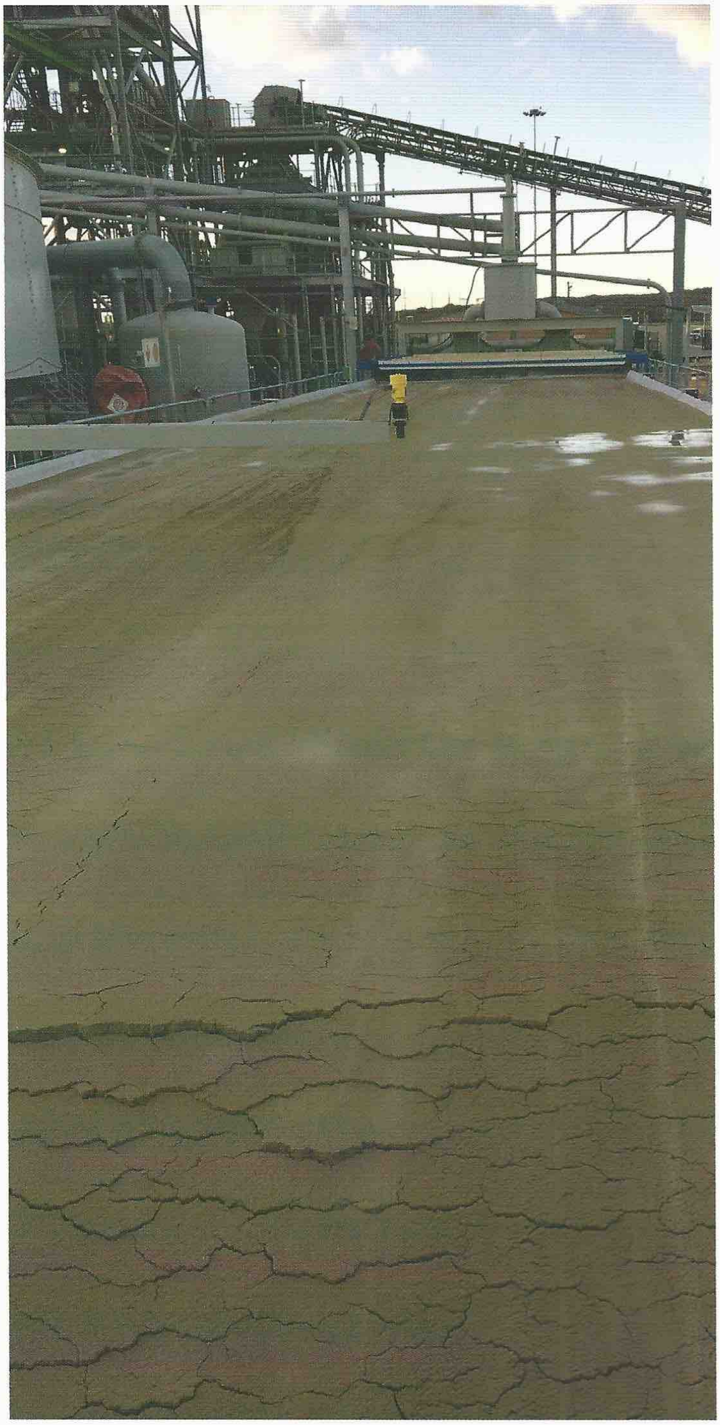
Hierarchy of control

Example 1: Raw water consumption
Most minerals processing plants need raw water to operate, and therefore the use of raw water cannot be eliminated. Given that the aquifer is part of a strategic water resource, the municipal raw water could not be replaced by aquifer water. Following the logic of the hierarchy of control, the project therefore looked at engineering controls as part of the process design associated with water. In order to minimise raw water consumption, a belt filter was installed on the tailings stream and dry tailings deposition (compared to the conventional slimes dams) was used. With the elimination of conventional tailings dams, the 'energy' associated with conventional slimes dams and slimes dam failures is also eliminated. All raw water take-offs are measured and reported on a daily basis, including a detailed water balance for the entire site.

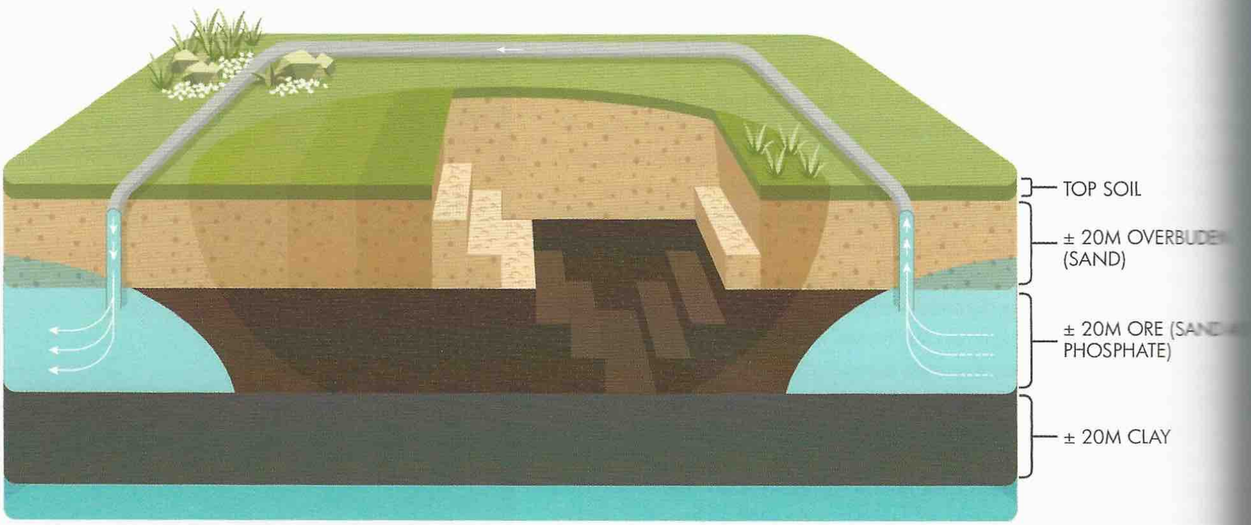
Example 2: Rehabilitation of sensitive vegetation
In order to achieve the successful rehabilitation of sensitive vegetation, it is vital to understand the energy/driving force behind it. As this is outside the field of experience of the typical project engineer, a botanist was recruited onto the project team. The rehabilitation expert advised the team on the strategy for topsoil handling, as well as how the impact could be minimised. As such, prior to any vegetation being cleared, the area was walked by a team of people (trained from the local community) to search and rescue species of conservation concern. Cuttings were grown in an off-site nursery, while seeds and bulbs were stored, creating a plant-stock for rehabilitation. Furthermore, topsoil handling was restricted to specific growth seasons, and was therefore embedded into the project schedule and the detailed mine planning.

Example 3: Selection of mining method
As mentioned above, the orebody is located within the Elandsfontein aquifer, which is linked to the Langebaan Lagoon. From a purely economic perspective, the best mining method would have been to dredge the orebody using aquifer water as a transport medium and to pump the slurry to the plant. However, this method could not guarantee a zero impact on the aquifer water quality. It was therefore decided to dewater the pit by drilling multiple dewatering boreholes around the pit, and to recharge the aquifer, under gravity, downstream from the mining operation. By eliminating the exposure of the water to the energy source, the impact on the water quality is minimised.

Furthermore, a roll-over mining method was selected, whereby multiple small-mining fleets mine strips of the orebody on several benches. This method allows the flexibility of in-pit blending of ore to the plant and, more importantly, the early rehabilitation of the pit. For the first two years, overburden is transported to the soft stockpile. Once sufficient space has been created, the soft stockpile is rehabilitated, and the overburden (together with the plant tailings) is backfilled into the pit void. Through the careful planning of topsoil stripping, and by using the plant cuttings and bulbs discussed in Example 2, rehabilitation of the pit area can become part of the ongoing operation from year two onwards.



A tailings belt filter minimises raw water consumption and allows dry stacking of plant tailings



Graphical representation of pit dewatering and aquifer recharge

Example 4: Routing of access road

By the very nature of a mining operation, the construction of an access road to the mine site cannot be eliminated. In addition, by law, owners of agricultural land are required to construct fire breaks in order to prevent the spread of uncontrolled veld-fires. Routing the access road along the farm boundaries provides access to the mine site and also serves as a fire break, thereby minimising the impact on the natural vegetation, albeit at a higher capital cost.

Conclusions

Sustainability should be the overarching aim of a design, not a design constraint or a competing objective. It is well known that the window of opportunity for impacting the design of any project is during the concept and design stages of the project. During these stages, the design flexibility is at its highest, while the cost to change the design is at its lowest. The sustainable project risk management approach is an easy framework to use for ensuring sustainable operations through design. For the mining industry, failure is simply not an option – we have to do 'things right'. The more we do 'things right', the more mining will become the 'right thing' to do.

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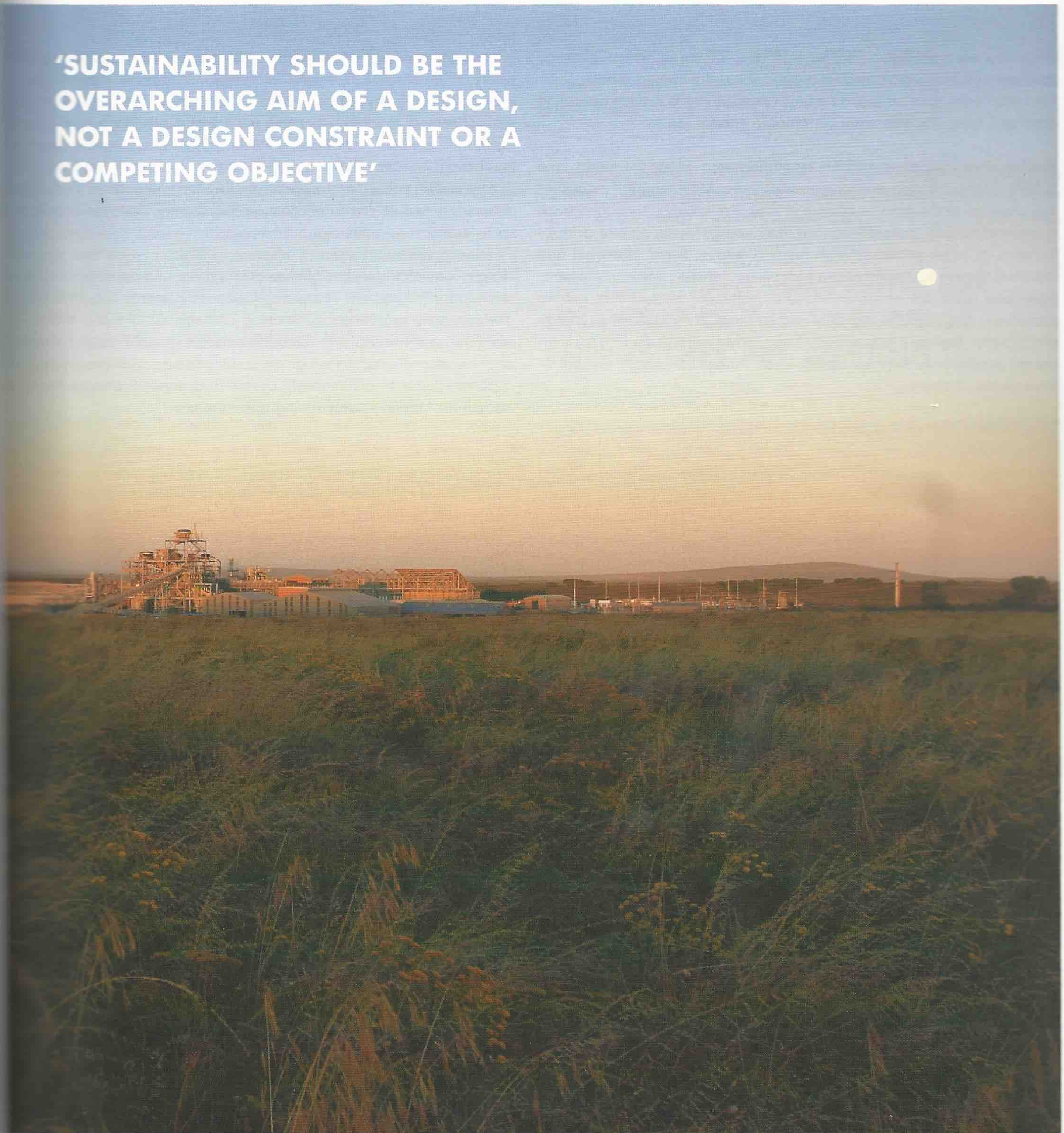

Successful early rehabilitation of topsoil stockpile, looking back towards the plant