

Scope of the Gamsberg Biodiversity Offset

A report prepared for Vedanta.

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1 Introduction

Vedanta Resources purchased Black Mountain Mine and the associated rights in 2011 with a view to pursuing the Gamsberg Zinc resources. ERM was appointed to undertake an Environmental and Social Impact Assessment (ESIA) for the various listed activities and to amend the existing EMPR for Gamsberg. After the initial approach, the provincial competent authority (The Department of Environment and Nature Conservation - DENC) informed Vedanta that due to the sensitivity of the site, (established in the previous EIA), it was likely that a biodiversity offset commitment would need to be investigated in parallel to the ESIA process.

Vedanta approached Dr Philip Desmet and Mark Botha to assist with developing a turn-key proposal for a biodiversity offset that would satisfy DENC.

This document outlines the approach, context, scope and preliminary considerations for the Gamsberg Mine Offset. It is designed to clarify the objectives of and opportunities for the Offset, and facilitate agreement between the parties for finalisation in a binding agreement. It does not provide a comprehensive picture of the impacts of the mine and national offset policy, nor aim to substitute any condition contained in any permit, licence or authorisation granted to the mine. This Offset Scope should be read in conjunction with the ESIA and the Sustainability plan developed for the proposed Gamsberg Mine. Once the scope of the Offset is finalised, a detailed implementation agreement will be developed.

The proposed offset plans presented here are based on literature review, extensive expert site study, the specialist reports conducted for the ESIA pertaining to faunal and floral biodiversity, as well as specific geotechnical impacts, interviews with key officials and experts, a technical committee review process, and perspectives gleaned from field trips. The field work aimed to delineate specific habitats and ecosystems affected, verify the expected species, plant community and ecological functioning impacts of different mine design options, and to clarify desired offset outcomes and potential implementation constraints.

This preliminary scoping report provides a brief context for the offset, a quantification of the residual impact of the mine, proposes appropriate metrics and multipliers for the offset, and finally outlines the proposed offset options.

2 Context

Vedanta purchased the mining rights to the Gamsberg deposit with its acquisition of Black Mountain Mine. Although it will require an amended Environmental Management Programme (under the Mineral and Petroleum Resources Development Act (MPRDA (Act 28 of 2002)) and a new Water Use licence under the National Water Act (NWA(Act 36 of 1998))), there are associated activities which will require an Authorisation under the National Environmental Management Act (NEMA (Act 101 of 1998)). After an initial approach the competent authority under NEMA (the Northern Cape Department of Environment and Nature Conservation - DENC) noted that previous studies had indicated that the Gamsberg had significant biodiversity values, and that the applicant should develop suitable biodiversity offset proposals in parallel with the EIA if they intended to pursue the listed activities.

The link between impacts, mitigation and offsets in our South African context means that biodiversity offsets have to be embedded within the EIA process to ensure the mitigation hierarchy is effectively exhausted, and that there are no unnecessary delays in the development application process. Caution must obviously be taken to ensure that Offset proposals do not unduly influence the impact assessment and decision making process for any environmental authorisation or other licence.

For more detailed information on the receiving environment of Gamsberg, Bushmanland and Khai-Ma municipality please see the Final Scoping Report for Gamsberg Zinc Mine project (ERM 2013).

2.1 Requirement for the offset

The requirement for the offset stems from the extended mitigation requirements outlined in the National Environmental Management Act 107 of 1998 (NEMA) and the associated environmental authorisation process. The principles in NEMA state that the environment is held in public trust for the people, and must be protected as the 'people's common heritage'. The principles point to the need to conserve biodiversity and ecological integrity and, where impacts on biodiversity and disturbance to ecosystems cannot be altogether avoided, they must be minimized and remedied. These principles bind the proponent and the competent authority in the authorisation process.

It was apparent from the outset, and from previous EIAs and the history of Anglo American Base Metal's involvement in the Gamsberg, that any mine on the Gamsberg would likely impact on biodiversity of high conservation value. This realisation emphasised the need to avoid and minimize impacts from the start, but also raised the likelihood of the need for biodiversity offsets. The competent authority requested the proponent to conduct a detailed offset study as part of the ESIA.

Beyond the regulatory requirement, Vedanta's Technical Standard for Biodiversity Management (version of 30 September 2011) states that net positive gains shall be designed for any "critical habitat" impacts that cannot be avoided, and that mechanisms will be used to achieve No Net Loss and improve biodiversity outcomes wherever possible. The standard notes further that offset mechanisms are to adhere to 'like for like or better' principle. The Standard also references compliance with the IFC Performance Standard 6 on Biodiversity. To satisfy IFC PS6 requirements, an offset is needed as both Natural and Critical Habitat will suffer residual impacts.

2.2 How the Offset fits into the ESIA

The biodiversity offset constitutes the final measure to mitigate residual negative impacts of the proposed mining operation, after avoidance, minimization and rehabilitation actions have been decided. As such, its influence on the final significance of negative impacts – and thus compliance with the NEMA principles - must be taken into account by the relevant competent authority in reaching a decision on the mine. In addition, the capacity implications of the offset (financial and other resources) to the proponent must be addressed by the proponent and assurance provided to the decision maker that the offset could and would be successfully implemented.

Documentation of the need for, and the design and proposed implementation of, the biodiversity offset, must be made available to stakeholders in the ESIA process, to ensure that they are given an opportunity to comment on the offset proposals before the final ESIA is revised and submitted to the decision-making authority.

2.3 Scope of the Study

The geohydrology, hydrology, vegetation, fauna and general ecology studies commissioned during the ESIA provide the basis for assessing the impact of the mine, associated infrastructure. The impacts of any additional transport, rail, port or energy activities are excluded, as they are not in the current ESIA. Due to lack of information, the impacts from extraction of the required water, road ballast and acid potential reducing substrates is excluded.

3 Offset policy framework

3.1 International guidelines for Biodiversity Offsets

A biodiversity offset is:

“the measurable conservation outcomes resulting from actions designed to compensate for significant negative residual impacts on biodiversity arising from project development after appropriate prevention and mitigation measures have been taken” (BBOP 2012)

Biodiversity offsets can encompass spatial patterns of biodiversity and the ecological processes that maintain those patterns, as well as people’s use and cultural values associated with that biodiversity (ecosystem services). Our ecosystems create landscapes of aesthetic and natural heritage value; any cultural landscape and associated heritage depends in part on conservation of these natural systems. Impacts on biodiversity and ecosystems affect water resources either in terms of quality or flow, and thus also water users. Likewise, biodiversity offsets – in particular involving riparian and freshwater ecosystems – can be designed to benefit water resources and users in addition to the ecosystem itself.

Offsetting ecosystem service impacts can, however, have undesirable outcomes if the biodiversity or ecological process responsible for the original service is lost due to a development, and the service is effectively replaced with artificial provisions. It is important to ensure that ecosystem service offsets do not

compromise or are not traded off for the original biodiversity and/or ecological processes being lost. Moreover, only ecosystem services that flow directly from the biodiversity or ecological process should be considered for offsets, and all ecosystem service offsets should aim to improve those services by enhancing the underlying biodiversity or process.

The most detailed international development of the biodiversity offset concept is outlined in the 2012 Business and Biodiversity Offset Programme (BBOP) Standard. This provides a coherent set of principles, criteria and indicators for offsets, as well range of tools and metrics for pursuing defensible offset projects. As far as possible, this study has followed the BBOP approach, except in one or two technical details which flow from the specific regulatory context and biodiversity planning and assessment tools used in South Africa.

In January 2012 the IFC released an updated set of performance standards for large projects. PS6 in the series covers *Biodiversity Conservation and Sustainable Management of Living Natural Resources*, and includes reference to the use of Offsets in the mitigation hierarchy. It requires consideration and due process to avoid and mitigate impacts, as far as possible, on critical habitat, threatened species and ecosystem services. The need to take a conservative approach is embedded in the IFC standards in instances where there is significant uncertainty.

Vedanta Resources group policy on Biodiversity Offsets is predicated fundamentally on compliance with the IFC PS6, and is provided in an appendix.

3.2 Legal and policy framework for biodiversity offsets in South Africa

3.2.1 Legislation

The Constitution of South Africa requires that development be ‘ecologically sustainable’. The principles in the National Environmental Management Act 107 of 1998 (NEMA) state that the environment is held in public trust for the people, and must be protected as the ‘people’s common heritage’. The principles point to the need to conserve biodiversity and ecological integrity and, where impacts on biodiversity and disturbance to ecosystems cannot be altogether avoided, they must be minimized and remedied. Further, the principles reflect the ‘mitigation hierarchy’, and state that the party who causes environmental damage is responsible for ‘paying’ or remedying that damage. Finally, the NEMA principles advocate a ‘risk-averse and cautious approach’ where we are uncertain about the consequences of our actions. Both NEMA and the National Water Act 36 of 1998 (NWA) provide the competent authority with the discretion to impose any condition necessary for the protection of the environment/water resource, whilst the latter specifically authorises the lodging of financial guarantees for any required mitigation actions.

In terms of the National Environmental Management Biodiversity Act 10 of 2004 (Biodiversity Act), the State has trusteeship of the country’s biodiversity and must ‘manage, conserve and sustain’ South Africa’s biodiversity and its components and genetic resources. The Biodiversity Act provides for the listing of threatened or protected species and ecosystems, and for the publishing of Bioregional Plans, thus identifying our priority biodiversity areas. In addition, this information signals the probable significance of impacts where the species or ecosystems are adversely affected by any proposed development.

The National Environmental Management Protected Areas Act 57 of 2003 (Protected Areas Act) provides for a range of options to protect an area, and point to the most secure statutory options to achieve this. Any of the four categories of protected area can be declared on privately owned land at the request, or with the consent, of the landowner(s). The Act provides for the involvement of parties other than organs of State in

the declaration and management of protected areas as the primary tool to safeguard the nation's biodiversity assets, enabling offset management arrangements.

Both the National Framework for Sustainable Development in South Africa (2008) and the National Strategy for Sustainable Development (2010) highlight the value of biodiversity to society, its importance in sustaining our life support systems and livelihoods, and the range of benefits to people of healthy, functioning ecosystems.

The National Biodiversity Framework (NBF, 2009) notes that biodiversity offsets are already being implemented to some extent in South Africa, but with little consistency.

The Department of Agriculture, Forestry and Fisheries (DAFF, undated) has produced "Principles and Guidelines for control of development affecting natural forests" which includes biodiversity offsets and set out the steps to be taken and aspects to be addressed.

Both the Western Cape and KwaZulu-Natal have issued guidelines for Biodiversity Offsets, and other provinces are developing their own. Biodiversity Offsets are being called for by regulators in all provinces in South Africa.

3.2.2 National Offsets framework

A draft National Biodiversity Offsets Policy Framework is currently under development by the Department of Environmental Affairs (DEA), the nine provinces and SANBI and as yet is only available in preliminary form. Fortunately, several international frameworks, and regional and municipal policies provide cogent guidance. Further, national good practice on biodiversity offsets is emerging from several projects around SA.

A more detailed Draft Guideline on Wetland Offsets (SANBI 2012) is available for beta-testing. The various protocols for defining wetland impacts and developing appropriate offset metrics were considered in the approach to the Gamsberg Offset.

The following principles (not exhaustive) are recommended as a departure point for biodiversity offset development (adapted from the draft National Biodiversity Offsets Policy – DEA/SANBI May 2012):

Biodiversity Offset principles

1. The Ecosystem Approach

The implementation of biodiversity offsets recognises the ecosystem approach (as opposed to a species approach) to biodiversity management, which promotes the integrated management of land, water and natural capital to effect the conservation and sustainable use of biodiversity, especially the need to safeguard and maintain critical biodiversity areas.

2. Habitat Contribution on the ground

Biodiversity offsets should directly improve the security of priority habitats against future land-use change or incompatible land-uses, including the management requirements of such habitat, and yield measurable outcomes on the ground. The offset could also improve management of ecological infrastructure underpinning the persistence of that habitat, in order to improve ecosystem health, use value and ecological connectivity.

3. No Net Loss up to specified limits of acceptable change

Biodiversity offsets should result in no net loss of biodiversity beyond the scientific targets established for a particular biodiversity feature or ecosystem. No biodiversity feature or ecosystem should be pushed beyond an Endangered threat status by any development.

4. Avoid incremental loss and regional impacts endangering an ecosystem

Biodiversity offsets calculation and design should be undertaken in a manner that ensures that incremental loss and fragmentation is avoided.

5. Equivalence - “like for like or better”

Biodiversity offsets should comprise the same habitat structure, species composition and ecological function(s) as would be lost on the development site, or could constitute a habitat with a more threatened status or higher conservation priority than that affected (so-called ‘trading up’).

6. Additionality – new action required

Offsets should achieve gains above and beyond that which is already required by law or would have occurred had the offset not taken place.

7. Proportionality

Biodiversity offsets are to be used in cases where the environmental assessment process identifies **negative residual impacts of medium or high significance** on the intrinsic, use and/ or cultural values of biodiversity. Low impact activities may not require an offset. Highly Significant, unacceptable negative impacts should not be authorised, and hence no offset would be possible. Offsets must thus be commensurate with the residual impacts.

8. Offsets are a last resort

Only once the mitigation hierarchy has been exhausted and all feasible actions to avoid, prevent, minimize and/ or repair damage caused by development have been taken into account is consideration of an offset appropriate. Some impacts, however, are not “offset-able” and for which authorisation should therefore not be granted.

9. Permanence/ duration

The biodiversity offset should endure at least for the duration of the environmental impact, but preferably in perpetuity, in order to yield a long term contribution.

10. Defensibility

Biodiversity offset design should be based on sound science, as well as incorporate traditional and expert knowledge, as appropriate.

11. Fairness and equity

The exploration and determination of biodiversity offsets should be undertaken in a timeous and transparent manner, allowing and supporting informed public participation and stakeholder engagement, and respecting recognised rights.

3.2.3 Northern Cape Offset policy

Although no dedicated offset policy has been approved for the Northern Cape, several examples of existing Offsets have been promoted in the province. It is the intention of the competent authority to adopt the national policy framework once completed (J Koen, *pers comm.* November 2012).

3.2.4 Consistency with the current draft biodiversity guidelines and policies

The objective of biodiversity offsets in South Africa is to ensure that residual impacts on biodiversity and ecosystem services that are of medium to high significance (i.e. that do not represent a ‘fatal flaw’ from a biodiversity perspective) are duly compensated by developers in such a way that a material contribution is made to implementing national, provincial (or sometimes municipal level) conservation plans to reach associated targets, and to safeguard valued ecosystem services.

The offset development process for the Gamsberg mine has followed the Principles and guidance contained in the Draft National Offsets Policy Framework. Where the framework is silent, (e.g. on specific ratios and multipliers) guidance is taken from the Western Cape and KwaZulu-Natal guidelines, and explicitly justified particular metrics are used where we have gone beyond the guidance available. We have developed an approach to quantifying the applicable offset metrics. It is outlined in Section 6.

4 The nature of Compensation and Offsets

4.1 The form and nature of acceptable biodiversity offsets

It is useful to clarify the important conceptual differences between **trade-offs**, **compensation** and **offsets**. These mean different things, and have rather different outcomes.

A measure must satisfy the principles above to call itself an ‘**offset**’. In particular, an offset would not undermine conservation targets or lead to irreplaceable loss of biodiversity, and would be commensurate with the residual impacts of the proposed activity¹.

If a measure does not satisfy these principles, and instead offers some form of remedy that is not commensurate with, equivalent in type, or is insufficient to qualify as an offset (although it could contribute to meeting the target of the affected component biodiversity), then it would be termed ‘**compensation**’.

A ‘**trade-off**’ is typically made between, rather than within, different categories or ‘pillars’ of capital (e.g. between socioeconomic benefits and biodiversity loss). A trade-off is not to be confused with ‘trading-up’ which can be accommodated in the offsets framework, and allows impacts on one biodiversity feature to be offset by safeguarding another biodiversity feature of greater value and/or under greater threat.

Ultimately, even if an offset is deemed unacceptable due to, for example, the irreplaceability of the impacted biodiversity, ecological process or the ecosystem service being lost, this would not impede a regulator’s ability to require compensation, or even to make a trade-off, provided that such compensation or trade-off is

¹ In the international context of the IFC PS6 and the BBOP Standard, an offset must achieve NNL or net gain; any measure that does not achieve that outcome would be termed ‘compensation’.

made within our legal framework and is defensible. In this situation, however, compliance with either Vedanta's policies and/ or the IFC PS6 would not be achieved.

Biodiversity offsets can be achieved by:

- Increasing a target site's security against land use change, in the long term
- Restoring or repairing degraded areas
- Improved management, and/ or
- Preventing likely transformation or degradation of areas through formal/ legal protection.

For protection and restoration to be effective in the offset context, they should endure in perpetuity, and be accompanied by significant land use and allied protection mechanisms to safeguard the biodiversity features for which they initially set aside.

While it may be possible to achieve net gain in some critical habitat through successful restoration (of structure, function or condition), it is almost always preferable, in the South African context, to conserve a more pristine expression of the type, habitat of feature first.

Research work, education and/ or capacity building are not acceptable forms of offset, since their 'on the ground' outcomes cannot be measured, and would be better conceived of as trade-offs.

4.2 Offset quantum and design

The quantum of biodiversity offsets in South Africa uses a basic ratio derived from a target which is in turn linked to the status² of residually affected ecosystems. Multipliers are often applied to this basic ratio where:

- the area comprises a component of a wider landscape recognized as having high conservation importance;
- the area supports several threatened species or species of special conservation significance;
- the area plays an important role at a landscape level with regard to ecological and/or evolutionary processes that, amongst others, help adapt to climate change;
- the natural systems of the affected area deliver ecosystem services on which there is a high dependency by local or downstream communities, or society as a whole;
- there is either a lack of confidence in impact predictions and/ or a risk of failure of proposed measures to avoid, minimize or rehabilitate/ restore negative impacts within stated time frames, implying that residual impacts would be greater (in extent and severity) than initially estimated; and/ or
- the delay between the impact and the return to pre-mining condition is greater than 10 years, or a lifespan of a key component of the rehabilitation system, whichever is longer.

There is little experience in South Africa with quantifying the metrics associated with these multipliers and applying these to specific situations. We take our cue from the existing provincial guidelines for the W Cape, KZN and the specific guideline on Wetlands (SANBI 2013) on using ratios and multipliers. The approach developed for this study is summarised in Tables 6 and 7.

² The NEM: Biodiversity Act (Act 10 of 2004) provides for gazetting the threat status of different ecosystems. Notation used is the same as for Threatened species. Endangered = EN, Least Threatened = LT etc. The most recent list was published in 2011.

The design of the final offset area is dependent on several factors:

- The location and proximity of existing protected areas which may be expanded or consolidated
- The distribution of those biodiversity features and components of the offset across properties in the region
- The availability of specific properties on the market and/or the willingness of the owners to sell them or have them encumbered with offset restrictions
- Consideration of the objectives of the offset area, and its specific management requirements or efficiencies (e.g. having a sensible boundary to secure and avoiding disjointed management units that cross communication and transport lines)
- Capitalising on existing or proposed land use developments that could augment the offset and increase establishment success, and avoidance of current and future land use conflicts.

4.3 Exhausting the mitigation hierarchy

Offsets studies should satisfy the requirement that the mitigation hierarchy has been exhausted. A highly summarised account of the iterative mitigation process followed and the decisions taken to effectively exhaust all other mitigation options is given below in section 6. A fuller treatment of alternative and option choice is provided elsewhere in the ESIA

5 Biodiversity Context of the Gamsberg

5.1 Description of the Biodiversity

Please refer to the specialist studies conducted for the ESIA: Vegetation Baseline and Impact Assessment (Desmet 2013), Faunal and Aquatic Biodiversity Report (GroundTruth 2013), and the General Fauna and Flora Ecology Report (Todd 2013). **Error! Reference source not found.** contains a summary of biodiversity pattern and process features encountered by the mine.

Table 5 Overview of habitats, the conservation status and extent (ha) of impact through the mining footprint, dust deposition and groundwater drawdown

Vegetation Types; Habitat units and Conservation status	Mine footprint (a)	Dust Deposition (b)		Groundwater Drawdown (c)	Extent of Impact (d)
		50 mg/m²/day	20 mg/m²/day		
Aggeneys Gravel Vygieveld					
Mountain plateau; Constrained (VU)	123.2	58.5	117.1	280.8	181.7
Plateau quartz gravel; Irreplaceable (VU)	10.2	39.5	1.8	98.5	51.5
Plateau quartz gravel (fine grain); Irreplaceable (VU)			49.1		49.1
Plains quartz gravel; Irreplaceable (VU)	115.9	179.9	110.9	325.5	406.7
Plains quartz gravel intermediate; Constr. LC		56.5	231.0	240.4	56.5
Plains feldspar gravel; Constrained LC		17.4	73.8		91.2
Plains rocky; Constrained LC	71.8	160.6	559.0	237.6	232.5
Bushmanland Inselberg Shrubland					
Mountains; Flexible LC	535.4	335.5	751.3	1 314.5	871.0
Bushmanland Arid Grassland					
Flat sandy plains; Flexible LC	447.5	1 947.0	2 083.6	3 038.3	2 394.5
Hummocky sandy plains; Flexible LC	17.2	316.8	447.4	0.0	334.0

Calcrete gravel plains; Irreplaceable	EN	20.3	154.1	229.4	44.6	403.7
Bushmanland Sandy Grassland						
Mobile sandy dunes; Flexible	LC		5.3	29.6	18.1	5.3
Easten Gariep Plains Desert						
Plains Rocky; Flexible	LC			252.1	120.7	
Bushmanland Inselberg Succulent Shrubland						
Southern Slopes; Irreplaceable	(VU)	58.1	40.3	133.4	246.0	98.4
Azonal Habitats						
Kloof; (Irreplaceable)		27.8			148.9	176.7
Freshwater springs & Head-water Seep; (Irreplaceable)		-			-	-
River (Wash with sub-surface flow); Flexible		11.9			1 010.2	1 022.1
LC						
Wash; (Constrained)		39.9	442.4	928.9	276.5	482.3
TOTAL IMPACTED AREA (ha)						6 857.1
(a) Mine footprint includes pit, waste rock dumps, tailings, explosives magazine, plant, dams, administrative buildings, buffers on previous, roads and road buffers.						
(b) Dust deposition is modelled extent of 50 mg/m ² /day and 20 mg/m ² /day. Habitats where dust exceeds 25% (50 mg/m ² /day) of normal baseline are considered significantly impacted, similarly habitats where a high proportion of available habitat is affected by the 20 mg/m ² /day dust zone.						
(c) Groundwater drawdown based on the extent of the 10m drawdown after 100 years.						
(d) Extent of Impact = sum of areas of affected habitats. (Note: Above areas exclude overlap and can be added)						
LC – Least Concern; VU – Vulnerable; (VU) – VU implied by level of threat; EN – Endangered habitat.						
Key to shading:	Habitat affected by respective impact	High proportion of available habitat affected		Very high proportion of available habitat impacted		

5.2 Regional biodiversity significance

Knowledge of the regional occurrence of biodiversity features impacted by the mining process is used in the offset calculation to determine the ecosystem status of habitats (Criterion C) and the ability to design an offset for each impacted habitat type.

From the regional context vegetation study the following conclusions about the regional biodiversity importance of the Gamsberg can be made.

- The Gamsberg has the highest number of species of all sites surveyed in the inselberg region. These plants are representative of the entire regional flora. No other site surveyed has comparable diversity of plant species.
- Although the Gamsberg inselberg is effectively an island for the majority of plant species that occur there, the plant diversity is exceptional by local, regional and global standards. Given the diversity of species, habitats, number of regionally rare species and size of specific plant populations, the Gamsberg is regarded as a “mainland” area of plant biodiversity in the region.
- The Gamsberg has the largest number of range-restricted plants represented (six species) with two additional species presently known only to occur on this inselberg.
- From an ecological process perspective the Gamsberg can be regarded as a keystone ecological process area because:
 - It is the largest inselberg in the region and located in the middle of the main belt of inselbergs (Namies and Achab to the east; Aggeneys, Witberg and Haramoep to the west) thus it is an important stepping-stone facilitating species migration between the eastern and western inselbergs.
 - The Gamsberg has the largest patches of habitats of conservation concern namely mountain plateau, mountain plateau quartz gravel plains, mountain plateau fine-grained quartz patches, Bushmanland Inselberg Succulent Shrubland, calcrete patches, freshwater springs and the Kloof. Any impact on these patches will have important ecological process impacts at the whole species-

level (rather than population-level) with implications for the persistence of populations and more importantly species in the region. There is the potential for species extinctions to occur. Therefore, offset ratios for these habitats could be significantly greater than baseline ratios given the anticipated ecological process impacts.

- Many habitats and associated species that occur at the Gamsberg are rare and range-restricted features. The kloof at the Gamsberg is one of only two in the inselberg region. The headwater seeps are only known to occur here. The regional context study was unable to find examples of a similar habitat elsewhere in the region. The two permanent freshwater springs are also regionally very rare features. There are only two other similar springs elsewhere in the region. The majority (85%) of the known distribution of plateau fine-grained quartz gravel patches occurs on the Gamsberg. For these features the potential for full like-for-like offset is low.

6 Determining the Offset

6.1 Assumptions, limitations, uncertainties and risks

6.1.1 Assumptions

The following assumptions have been made for the quantification of the Gamsberg mine offset.

- The offset study must assume that all possible and required mitigation has been undertaken by the mine, and these requirements have been assessed and/or approved by the relevant regulatory authorities.
- That underground mining is not a reasonable and feasible option, and that the comparative evaluation is robust and defensible
- Offset design must cater for worst case scenarios, applying a risk-averse and cautious approach in accordance with the requirements of NEMA's environmental management principles.
- The condition of impacted terrestrial and freshwater ecosystems is 'good to very good' and not 'degraded'³.
- With the exception of the sandy plain habitats no impacted area has the potential to be restored to or near their original condition within the life of the mine and its closure phase. The physical environmental qualities that determine habitats cannot be recreated. Dewatering as a result of the pit is a permanent and irreversible change.
- The off-site impacts not included in the current offset calculations include: concentrate transport to Loop 10 and via N7/14 to port⁴; port stockpile facilities; water pipeline from the Orange River; additional power transmission lines; and, additional housing development at Aggeneys. With the exception of the port they are presumed by Todd (2103) to be of low significance, in extensive vegetation types, and would almost certainly be catered for in the current offset design.
- Impacts from any additional power generation required for the mine have not been included.
- Impacts on those water resources being exploited to supply the mining operation are being addressed in a separate EIA.

³ Where the condition of the affected ecosystem is either 'good' or 'moderate' (*definition in W Cape & KZN offset guideline: not less than 25% of expected species supported by the affected habitat, compared with an undisturbed site in a comparable vegetation type*), the significance rating should be dictated by the ecosystem status (e.g. critically endangered, endangered, vulnerable or least threatened). Condition of that ecosystem should not influence that rating. We have also catered for condition as a modifier of the requisite offset ratio.

⁴ Development at the port of Saldanha is excluded from this ESIA.

- Impacts on ecosystem services highlighted in the ESIA comprise potential negative effects on i) the sense of place and landscape character of the Bushmanland Inselberg Region, ii) on future tourism, and (iii) Genetic pathways & biodiversity. No provisioning services are considered to be significantly affected. Only the iii) is adequately addressed by an offset, and we don't consider that the former two services should be expected to be addressed by offsets.

6.1.2 Limitations and uncertainties encountered in the calculation of residual impacts and the design of the offset include:

- The mine footprint represents the residual impact after incorporation of initial mitigation measures adopted up to March 2013. Changes in the residual impact from additional mitigation are unlikely to significantly change the spatial scope of the offset.
- The dust fallout zone is based on the model developed by DDA provided in March 2013. It is anticipated that the black colour of the dust; its acid generating properties; and, nitrogen content (from explosives) will significantly alter and reduce ecosystem functioning particularly in freshwater and quartz gravel patch ecosystems. The impact of the dark, sulphide- and nutrient-rich ore dust on the unique micro-flora and habitats on the Gamsberg is unclear, but is assumed to be detrimental, even at relatively low concentrations or 20mg/m²/day (10% above background rates). The quartz patches appear to derive their unique characteristics from the reflective nature of the white quartz. Any acidification or nutrient input is likely to be detrimental owing to the minimal buffering capacity in these systems. The effectiveness of proposed mitigation actions is also unclear.
- The ground-water dewatering zone is based on the model constructed by ERM. The impacts of the water table depression of 5-10m along the wash and riparian areas, on the trees within the Kloof and on the succulent vegetation types, are not clear.
- The extent to which the dewatering of the pit will impact on the water supply to the permanent springs, seeps in the kloof and the downstream riparian area is unclear. There may still be some local, structural control of groundwater movement which allows rainfall on the Eastern rim of the inselberg to appear at the springs. As this impact will manifest both during mining and in the long term, after the closure of the pit, we are forced to take a precautionary approach to offsetting the expected loss of ecological functioning of the springs and kloof.
- The set back line for the eastern edge of the pit will maintain the physical structural integrity of the main kloof and its associated micro-climate properties. Dust emissions in the kloof during life of mine will negatively impact ecological functioning; however, there is potential post-closure for the impacts of dust to reverse. Whilst the physical attributes of the main kloof can be maintained the hydrological impacts will be permanent and irreversible.

6.1.3 Risks

- There is no provision in this offset for addressing the impacts of ARD, as the scope of the impact is as yet unclear, and the appropriate remedy is unlikely to be an offset.
- The risk of failure in offset establishment, protection and management is being addressed by pursuing a statutory authority with the mandate for biodiversity conservation in the Region to be the implementing agent and management authority for the offset area.
- There is a risk that requiring sufficient upfront guarantees from the proponent to cover the costs of establishment or to cover the costs of management becomes unaffordable for BMM.
- There is a lack of clarity on management of surface water flow, surface water quality impacts and effects on biodiversity.

- Impacts of any heavy metal fallout on vegetation are unclear, even though the sample points downstream from Gamsberg show natural high levels of lead and zinc.
- There is a risk that the protected area vision for the region to which the offset would contribute will be compromised by competing development, specifically power generation. Some areas earmarked for offset may be subject to alternative mining or power generation applications. Certain areas required to create a single continuous and manageable protected area may be subject to non-compatible development applications.

6.1.4 Exhausting the mitigation hierarchy

A suite of alternative activity options was explored in the ESIA process. These are not commented on further here (refer to chapter 4 in the ESIA).

1. The No-Go option is not considered viable due to the attractive size of the ore reserves in the region, and the dependence on mineral resources for continued economic activity and employment.
2. Underground vs Open Pit mining option
 - a. Vedanta contracted a service provider (AMEC) to undertake a comparison between different mining methodologies.
 - b. The offset team is not qualified to interrogate the study fully or establish the veracity of its methodologies or conclusions, especially with regard to the mining, economics and financial aspects. It is admittedly a very high level conceptual comparison study, which should ideally be revisited once more detail has been obtained. The regulators and other independent experts need to interrogate this study appropriately.
 - c. Note that several key costs were omitted from trade-off study – diesel use, remediation of acid potential, rehabilitation (especially waste rock dumps and tailings) and especially the costs of the biodiversity offset (which would be significantly higher for Open Pit versus Underground methods). However, it appears unlikely that these costs would affect the outcome of the feasibility study.
3. Accommodating biodiversity constraints in the mine design and layout.
 - a. A more detailed treatment is given elsewhere in the ESIA.
 - b. We are not qualified to comment in detail on any engineering issues or constraints which may determine final mine design or layout. The veracity of engineering choices needs to be interrogated by independent experts.
 - c. The various specialists provided detailed input and an iterative process of incorporating these constraints in the layout was followed by AMEC. All engineering drawings have used the underlying biodiversity constraints map as a key informant.
 - d. Mine layout design (Design version January 2013) was extensively revisited, in particular to accommodate the constraints imposed by the biodiversity. Changes include:
 - i. Access roads were redesigned, to minimise further disturbance of the southern slopes of the inselberg. A Northern access road has been incorporated for the heavy vehicle access and haulage.
 - ii. Waste Rock Dumps – 5 options were explored for the dumps. It appears that the best compromise location is on the northern rim of the inselberg to avoid threatened biodiversity features, minimise handling distances, reduce long distance visual impact (essentially maintaining the inselberg outline against the skyline).

- iii. Tailings dam – 2 options were explored. The northern option significantly reduces downstream damage in case of failure by locating the dam in the endorheic Koa valley system.
 - iv. Crusher Plant and concentrator infrastructure are located away from all biodiversity features of importance.
 - v. The Contractor camp has been shifted to accommodate sensitive feldspar and quartz habitats on the plains.
 - vi. Sewage treatment plant – 2 options were explored. Upgrading the current Aggeneys plant is not considered feasible or suitable.
 - e. There is less clarity on the requirements for extended housing in Aggeneys and the need for a licensed waste disposal facility during mine operation. It appears that the likely residual impacts would be of low significance in any event, given the receiving environment.
4. Mitigation of surface water, groundwater and hydrological impacts has been proposed. However, the following are noted:
- a. Pit safety and clean water management licence conditions may require some substantial earthworks on its rim which will impact on critical habitat. Avoidance and minimisation actions are not yet specified by the regulator.
 - b. The drawdown of the water table resulting from pit dewatering (for operational and post closure ARD mitigation purposes) will have a significant effect on the springs and riparian system of the inselberg. We assume that impacts on water for human and livestock will be dealt with effectively through compensation, although these are likely to be minor and only emerge after pit closure.

6.2 Quantifying the Offset required

Information used in the calculation of the required offset comprises:

1. Determining the residual impacts on biodiversity. The area of individual biodiversity features (both biodiversity pattern and ecological process) predicted to be impacted by the development after prior mitigation (avoidance, minimization, rehabilitation);
2. Determining the size of offset required by:
 - Using the conservation targets for these features as used in national and regional conservation planning exercises, as modified based on expert investigation of the specific case and context (regional extent or biodiversity context, the condition, occurrence of species of conservation concern, and important ecological processes as described in the biodiversity baseline report);
 - Deciding on the Basic Offset Ratio for each feature drawing on the modified conservation targets; and
 - Determining a Final Offset Ratio by applying multipliers for Risk and Uncertainty, Condition and Biodiversity Priority to the Basic Offset Ratio.

Each of these key steps is described in a separate section below.

6.2.1 Determining the residual impact

Each specialist biodiversity study conducted for the project was asked to include specific information pertinent to the offset in their reports: This included:

- Outline what habitat will be impacted, its conservation status/ use/ heritage value, any important role in landscape-scale processes/ function, the area and condition of habitat to be lost that must be offset.
- Identify of any species of conservation concern that may - or may not - rely on the impacted habitats.
- Highlight areas of uncertainty, risks and gaps in information (e.g. where siting of some infrastructure may not yet be known, where sampling is insufficient, etc.).
- Provide input on which indirect impacts from the air quality (dust), groundwater (drawdown) and geochemistry (pollutant plume) specialist studies that will need to be taken into account in the offsets.

In addition, the faunal specialist was asked to:

- provide information on the species affected, their conservation status/ use/ heritage value (as relevant), their level of dependence on particular habitat type(s) that will be impacted by the mine (including the freshwater features), the proportion of the species/ populations/ range that would be impacted and to what degree (i.e. intensity of impacts), the consequent significance of that impact, whether or not it can be offset, what residual impacts should be offset and how best to do that. (e.g. will setting aside of 'like' habitat for protection be sufficient, or are there additional measures that'd be needed?)

A number of fauna species within the Gamsberg are considered to be at risk due to the proposed mining activities, although none is more threatened than Vulnerable and none is restricted to 'irreplaceable' habitat. Newly-discovered ant species were detected but insufficient information is available to demonstrate their habitat requirements and regional distribution. Both the general ecologist and the faunal specialist have not recommended any additional offset requirements beyond what was proposed by the flora specialist; i.e. the offsets proposed to address residual impacts on critical and natural habitats are expected to simultaneously provide for affected faunal species. Demonstrating the presence of specific faunal species during short surveys is notoriously difficult, and a common approach is to predict their likelihood of occurrence based on available habitat within their normal distribution range. This approach is adopted towards the applicability of the offset for the current project.

The residual impact of the mine on the various biodiversity features and important ecological processes was calculated by the flora specialist. Please see ESIA Chapter 9 and Desmet (2013) for a fuller treatment of the significance rating. Mine impacts on biodiversity can be grouped into:

1. Direct impacts of mine infrastructure and processes resulting in immediate and permanent loss of habitat; and,
2. Indirect impacts resulting in permanent loss of habitat or reduced (temporary or permanent) ecosystem function primarily from:
 - a. modified surface drainage/run-off patterns
 - b. dust fall-out
 - c. acid rock drainage
 - d. lowered groundwater table.

Based on the mine layout proposal as at January 2013 a mine footprint was developed to spatially quantify the impacts listed above (Figure 1). The mine layout plan presented in the Scoping Report represents a mine-site concept that needs to be interpreted into a working mine-site plan before a likely footprint can be determined. The Scoping Report layout plan does not take into account the topography of the landscape and

boundary effects that are associated with any development. In developing a likely mine footprint the following modifications and assumptions were made in interpreting the mine-site layout plan:

- Processing plant stockpile was increased by 3ha.
- An 8ha concentrate stockpile and loading facility was added.
- Mine plan explosives magazine area replaced with 5ha footprint on Barite/AA Exploration office site in crater.
- Northern and Southern haul-road footprints calculated based on 25° slope of repose and a cut-fill construction.
- Impact buffers were defined for all site and road features based on anticipated boundary effects (e.g. material run-off, additional roads, development overflow, diversion walls/trenches, etc.).

Assumptions and limitations in determining the likely mine footprint include:

- The mine footprint represents the residual impact after incorporation of initial mitigation measures adopted up to January 2013.
- The dust fallout zone is based on the model developed by DDA provided in March 2013.
- The ground-water dewatering zone is based on the model constructed by ERM (March 2013)
- There is constant iterative shifting of mine layouts to accommodate mitigation requirements proposed during the ESIA process. While we have endeavoured to be as accurate as possible, uncertainties remain, and these have been catered for in the offset calculation multipliers.

See figure 2 below.

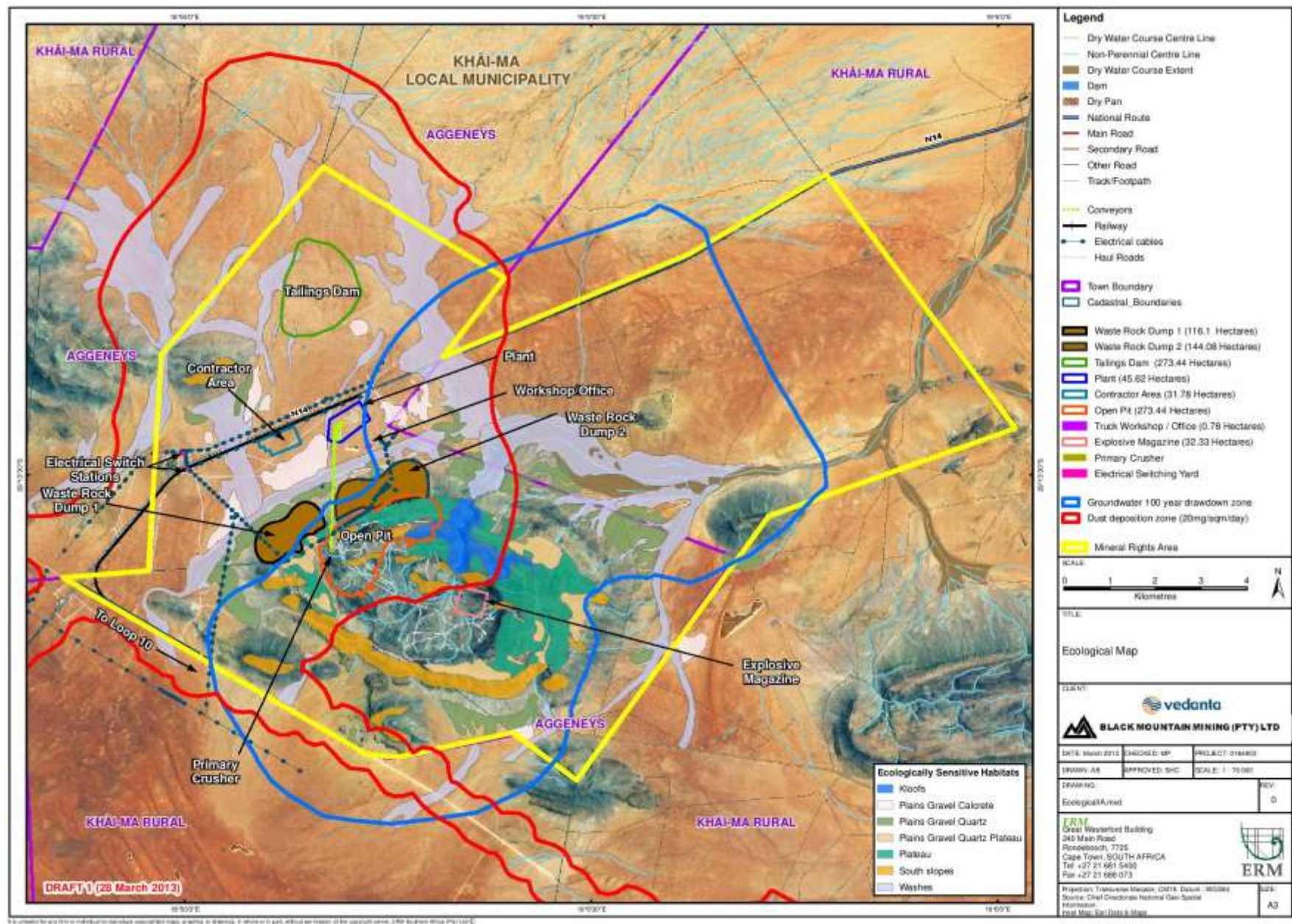


Figure 1 Spatial extent of different mine impact components.

6.2.2 Calculating the required offset

This section assumes that the quantification of residual negative impacts of the mine (as described in the section above) is reliable. Should monitoring highlight significant changes in impact predictions, it would be necessary to revisit the offset requirements accordingly. Particular attention must be paid to the impacts of dust fallout in this respect, specifically in the Calcrete Gravel and Fine-grained Plateau Quartz Gravels patches.

6.2.2.1 Ecosystem Status

Each biodiversity feature or habitat unit⁵ was allocated an initial target based on ecosystem status derived from the National Biodiversity Assessment (2011) and the Namakwa District (Bioregional Plan) Critical Biodiversity Areas map. This ranged from 18% to 34% of original extent.

Each habitat unit was then evaluated using the criteria for listing threatened terrestrial ecosystems (see Table 1) and by an assessment of the presence of species of special concern, the ecological process value of that habitat or feature, and by the imminent threat faced by that habitat or feature in the region. This process assigned an ecosystem status to each habitat unit based on the current status of the habitat (this is slightly different to the approach used to calculate significance and “conservation status”⁶ in the impact assessment). We feel that this is legitimate based on the approach adopted in other provinces during the listing process and the nature of many current listed ecosystems under the Biodiversity Act⁷.

Ecosystem status is used to determine the basic offset ratio for each habitat unit. This is calculated using the criteria described in the Listing of Threatened Ecosystems (DEA 2011). Three of the criteria (A1, A2 and C) are applied here to the ‘status quo’ scenario. The resulting ecosystem status is used to determine the basic offset ratio as described in the Western Cape and KZN offset guidelines.

Table 1 Criteria used to determine ecosystem status (DEA 2011)

Criterion	Critically Endangered - CR	Endangered – EN	Vulnerable - VU
A1: Irreversible loss of natural habitat	Remaining natural habitat ≤ biodiversity target	Remaining natural habitat ≤ (biodiversity target +15%)	Remaining natural habitat ≤ 60% of original area of ecosystem
A2: Ecosystem degradation and loss of integrity	≥ 60% of ecosystem significantly degraded	≥ 40% of ecosystem significantly degraded	≥ 20% of ecosystem significantly degraded
C: Limited extent and imminent threat	--	Ecosystem extent ≤ 3000ha, and imminent threat	Ecosystem extent ≤ 6000ha, and imminent threat
D1: Threatened plant species associations	≥ 80 threatened Red Data list plant species	≥ 60 threatened Red Data list plant species	≥ 40 threatened Red Data list plant species
E: Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan	Very high irreplaceability and high threat	Very high irreplaceability and medium threat	Very high irreplaceability and low threat

⁵ Note that “biodiversity feature” and “habitat unit” are used interchangeably but are not equivalent. See **Error! Reference source not found.**

⁶ “Conservation status” is either ‘Irreplaceable’, ‘Constrained’, or ‘Flexible’ and accords with ‘Critical (Irreplaceable)’ and ‘Natural Habitat (Constrained and Flexible)’ designations required by the Vedanta Standard.

⁷ Jeffery Manuel, SANBI, *Pers Comm* March 2013

It should be noted that Criterion E, although not used to determine ecosystem status in this context, is relevant since the Gamsberg lies at the core of the Critical Biodiversity Area determined in the Namakwa District Bioregional Plan; although options do exist in the landscape to meet conservation targets, this Plan depicts the optimum and most efficient configuration for so doing. We have catered for Criterion E in the ratio multipliers below as this is a more appropriate way to deal with the priority area imperative.

6.2.2.2 Conservation Target Modifiers for presence of species of special concern, ecological process value and imminent threat

A revised conservation target was then assigned to each habitat unit, being:

- a- 80% of remaining habitat before the impact needs to be conserved where the habitat is already regarded as Endangered, is unique in the region, is of extremely limited extent (<3000ha in extent), has species of special concern, and has a high ecological process value (this is an extraordinarily high target accorded to a very small number of habitats);
- b- 60% of remaining habitat before the impact is required where the ecosystem status is already Vulnerable, and the ecological process value or the presence of species of special concern warrant it; and
- c- when it was assessed to be of least concern, the initial national target (for widespread habitats) or the initial target plus 15% (for vulnerable, regionally restricted habitats) as a buffer to ensure that no habitat becomes endangered.

6.2.2.3 Assigning Basic and Final Offset Ratio, using multipliers

A Basic Offset Ratio was then assigned to each habitat unit by reading it off against its corresponding target on the “No-Net-Loss up to a Target” graph (see Figure 2). Thus a vegetation type or habitat unit requiring an adjusted target of 80% requires a ratio of 4X (i.e. for every hectare lost, an area of 4 ha should be set aside as an offset to ensure that the adjusted target would ultimately be met), 60% would indicate a basic offset ratio of 1.5X, and a 50% target would require a ratio of 1X.

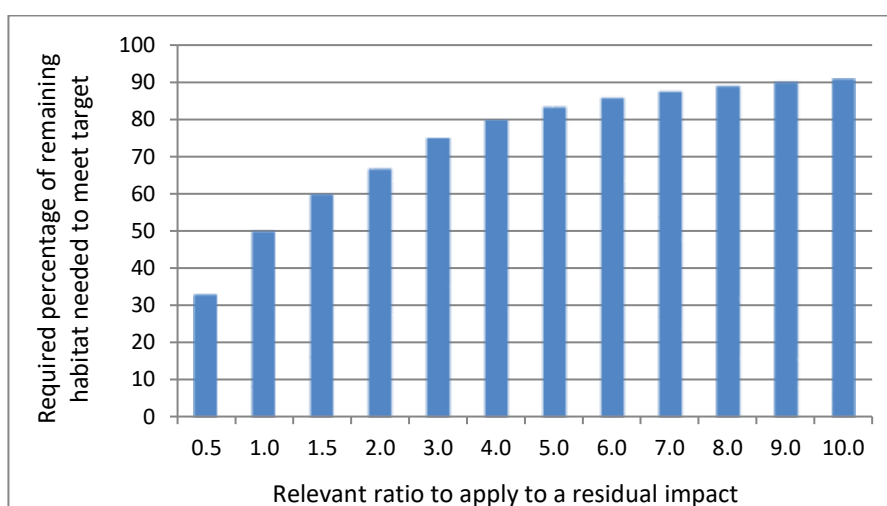


Figure 2 The No Net Loss up to a Target graph for determining Basic Offset Ratio.

This Basic Offset Ratio was then subjected to three different multipliers:

1. The first multiplier caters for acknowledged **risk and uncertainties** in the determination of the impact areas. This can range from 1 to 2X. Given the uncertainty regarding impacts from dust, groundwater lowering, and potential acid rock drainage, a multiplier of 2X was chosen. For some habitats, where we have assumed a complete loss of relevant species due to dust impacts, this has been lowered to 1X (as uncertainty is not relevant in these cases).
2. The second multiplier caters for differences in **condition of the habitat** impacted versus that in the offset area. We propose that the value can range from 0.5X to 2X. Given that the plains habitats around Gamsberg, by virtue of a long period of rest from grazing, have baseline conditions of near pristine, and that the receiving areas are rather heavily impacted by grazing, with demonstrably lower levels of diversity in key habitat units (especially calcrete patches) a multiplier of 2X was selected for these. Multipliers of 1X was used for all Mountain habitats that are in substantially similar condition in the offset area, and multipliers of 1.5X was selected for four habitats where the impacted areas were in medium condition and the offset area in poor condition.
3. The final multiplier recognises the **biodiversity priority** of certain areas in recognised, published bioregional or systematic biodiversity plans. The value can range from 1 to 2X. As the Gamsberg development would compromise 65% of the core of a Critical Biodiversity Area (1) corridor in the Namakwa Bioregional Plan, which compromises the attainment of regional biodiversity objectives and the efficiency with which biodiversity and ecological functioning targets could be met, a multiplier of 2X was chosen for all habitats comprising the CBA corridor, and 1X for those outside.

Multiplying the Basic Offset Ratio by the Risk and Uncertainty, Condition of the Habitat and Biodiversity Priority multipliers yields the Final Offset Ratio. **The Final Offset Ratio is multiplied by the size of the impacted area to give the required offset area in hectares.** The highest offset ratio for the features of the Gamsberg is 16X in the case of the Calcrete Gravel Plains which is line with existing guidance in the W Cape for 'Endangered' habitats that are offsetable. See **Error! Reference source not found.**

Some impacted features have limited regional extent within the Core Inselberg Region. Where the impacts of the mine on a particular habitat type result in the remaining area of that habitat being less than the area required to meet conservation targets, the residual impacts cannot be offset. In this situation, it would not be possible to satisfy either No Net Loss or Net Gain outcomes for affected component of biodiversity.

Where remaining areas are sufficient to meet conservation targets, the principal focus area for offsets would be within the defined core of the region; an area that could be managed as a semi-contiguous unit.

If offset requirements cannot be met within this target area due to the constraint to meet the offset target in the core, and where the risk of undermining achieving conservation targets for particular impacted feature(s) was low, they could be traded-up to achieve conservation targets within the offset protected area for other impacted features or features occurring locally but not impacted by the mine. Alternatively, offset targets could be sought in the wider region through piecemeal agreements with landowners, but would not in all likelihood be optimally protected or managed.

Table 2 Offset summary table, Habitats, Offset required, Offset-ability, Optimal design configuration contribution, and No-Net-Loss and Net Gain tests.

Vegetation Types; Habitat units and Conservation status	Residual loss (ha)	Final Ratio	Regional extent	Offset required ⁸	Using Std "Averted Loss"	Technically not offset-able ⁹	Optimal portfolio contribution	Mine property contribution	No Net Loss test	Net Gain test	Total area ¹⁰ secured over target
Aggeneys Gravel Vygieveld											
Mountain plateau; Constrained (VU)	181.7	6	1 763	1 090	363		812	420	Yes		142
Plateau quartz gravel; Irreplaceable (VU)	51.5	6	449	309	103		174	137	Yes		2
Plateau quartz gravel (fine grain); Irreplaceable (VU)	49.1	8	58	58	98	49	0	9	No	No	
Plains quartz gravel; Irreplaceable (VU)	406.7	5	5 974	1 830	813		2 158		Yes		328
Plains quartz gravel intermediate; Constr. LC	56.5	1	1 201	56	113		257		Yes		201
Plains feldspar gravel; Constrained LC	91.2	1	1 237	91	182		1 102		Yes		1 011
Plains rocky; Constrained LC	232.5	2	11 723	349	465		3 636				3 287
Bushmanland Inselberg Shrubland											
Mountains; Flexible LC	871.0	2	42 037	1 306	1742		14 523		Yes		13 217
Bushmanland Arid Grassland											
Flat sandy plains; Flexible LC	2 394.5	1	148 057	2 394	4789		12 724		Yes		10 330
Hummocky sandy plains; Flexible LC	334.0	1	105 803	334	668		8 706		Yes		8 372
Calcrete gravel plains; Irreplaceable EN	403.7	16	1 732	1 732	807	404	256		No	No	
Bushmanland Sandy Grassland											
Mobile sandy dunes; Flexible LC	5.3	1	104 571	5	11		>1 000		Yes		> 1 000
Easten Gariep Plains Desert											
Plains Rocky; Flexible LC	0	1	24 376	0	0						
Bushmanland Inselberg Succulent Shrubland											
Southern Slopes; Irreplaceable (VU)	98.4	9	4 597	886	197		1 736		Yes		850
Azonal Habitats & Features											
Kloof; (Irreplaceable)	176.7		847	2 Kloofs	353		1 Kloof		No		
Freshwater springs & Head-water Seep; (Irreplaceable)	-			4 Springs			1 Spring	1 Spring	No		
River (Wash with sub-surface flow); Flexible	1 022.1	2	±7000	1 533	2044		2 040		Yes		507
Wash; (Constrained)	482.3	2	32 293	723	965		4 293		Yes		3 570
TOTAL IMPACTED AREA (ha)	6 857.1										
Key to shading: Net Gain achieved by optimal offset portfolio And Mine properties No Net Loss test failed Technically not offset-able due to impact											

⁸ This is the lesser of the Target or the regional extent of the habitat

⁹ Due to the impact of the mine on target habitats

¹⁰ This assumes that relevant portions of Mine property are set aside for conservation in perpetuity

6.3 Designing the offset

6.3.1 Defining the optimum set of areas for the offset

The boundary in which to locate the offset area was set to that of the Core Bushmanland Inselberg Region (see Vegetation Baseline and Impact Assessment report), henceforth referred to as 'the region'. This is to ensure the 'like for like' principle is met (i.e. offset target is not traded for achieving biodiversity conservation targets outside of the region) and to facilitate the creation of contiguous protected area in line with the conservation vision for the landscape and offset management objective.

All regional farms were assessed based on their potential contribution to the various offset targets for habitat features and ecological processes.

An optimal set of properties was identified, based on best achievement of the offset targets, least conflict with alternative land uses and existing rights, optimal arrangement for subsequent management and least cost (in area). The identity of the optimal set has to be treated with circumspection.

6.3.2 Defining important design components of the offset

In addition to the hectare targets for each habitat unit, the final offset design must ensure that the following features are conserved to meet the required targets (See Table 3). These are based on Desmet (2010).

Table 3. Important design requirements of the offset

<i>Feature/ habitat unit</i>	<i>Area required</i>	<i>Scheduling</i>	<i>Criteria or explanation</i>
Island biogeographic corridor	14% of Core region	2	Identified in Desmet 2010 as the approximate requirement
South slopes	2900ha	2	75% of remaining habitat in region as key climatic refuge
Plateaux	1900ha	3	100% of remaining plateaux habitats conserved as key climatic refuge and unique microclimate for evolutionary processes.
Analogous features to the kloof	n/a	1	Need to locate and conserve any other feature analogous to the Gamsberg kloof
Springs	n/a	1	Springs in this dry desert landscape are likely to be key. Locate and conserve all other freshwater springs (2 others known).

6.4 Verifying Offset sufficiency and identifying shortfalls

We define 'No Net Loss' (NNL) as being the outcome of an offset where there would be no loss of a vegetation type, habitat or feature beyond the scientifically established conservation target for that feature. This is in keeping with the draft National Framework on Offsets.

We define 'Net Gain' as a situation where a particular offset's contribution to biodiversity conservation would surpass the quantum required simply to meet the scientifically established target for the affected vegetation type, habitat or feature.

For both NNL and Net Gain, we assume that provision is made for a budget (to reduce or remove threats, improve condition) to ensure that the biodiversity values of that type, habitat or feature is maintained in the long term (i.e. at least as long as the impact endures – in this case we propose 50 years)

The approach adopted in SA to NNL is different from that intended in the IFC PS6 and Vedanta's policies, and is not aimed at a strict NNL. The methodologies for offset design used here are different from those typically used elsewhere in the world, as we have a handy legal classification of ecosystem status and defensible and widely used targets for conserving these components of biodiversity. So, while we can evaluate whether or not the proposed offsets would meet SA's NNL requirements, we have not undertaken a detailed evaluation of the outcome in terms of satisfying Vedanta's / IFC PS6 policies. For comparison, an alternative approach to calculating the required offset is given in Table 2 using the standard "averted loss" calculation (BBOP Offset Design Handbook's Appendices 2009). We have chosen a discount rate of 1%¹¹ and an anticipated background loss rate of affected habitat of 0.5% per annum¹² for this formula. This approach points to a final offset ratio of 2X and is not capped at the regional extent of the Habitat type. Of particular note is the fact that it yields results no different from our approach in terms of achieving NNL or Net Gain; i.e. the outcome is comparable.

Many habitat/ feature targets can be met through purchasing or otherwise securing biodiversity on farms in the region. Securing the optimal portfolio of properties would achieve the targets set (and the No Net Loss test) for most features **except** Fine Plateau Gravel Quartz and the Calcrete Gravel. Targets for the 'Critical habitats' Aggeneys Gravel Vygieveld Mountain Plateaux and Plateau Quartz Patches would meet Net Gain criteria if and only if the Mine properties Aggeneys 3941, Aggeneys 3940 and Gams 60/1 and Gams 60/4 were also protected from further biodiversity loss. This requirement has significant implications for the permissible mining methods that could be pursued on these properties to exploit the Big Syncline and Gamsberg South and East ore bodies.

The following residual impacts could not be offset in the core area or the broader region, and would constitute a loss of biodiversity in 'critical habitat' or the loss of a valued feature of 'natural habitat'. This is due to the impact:

- preventing conservation targets from being achieved in the region;
- leading to the likely extinction of species or the total loss of a particular habitat type;
- leading to a likely change in ecological processes on which persistence of threatened species / critical habitat is dependent.

Mitigation of unavoidable and non-offsetable residual negative impacts on these habitats/ features requires compensation only if the offset could not be secured in the core BUT could be found elsewhere AND was Natural Habitat and not Critical Habitat. See 6.4.1.

Table 4. 'Critical Habitats', Features, and dependent species that are not offsetable

¹¹ Advocated by Denne and Bond-Smith (2012) in "Discounting for Biodiversity Offsets".

¹² We feel that this rate of loss is realistic, given the anticipated increase in pressure on this area for renewable energy developments, mining and ongoing degradation from livestock.

Habitat unit	status	significance	Criteria or explanation
Plateau Fine grain Quartz Gravel patches	EN	Very High. However, it may not represent a fatal flaw as the impact is indirect through dust deposition. Monitoring is required.	This is a rather localised habitat type, restricted to Gamsberg. The unique characteristics created by the habitat structure have allowed evolution of unique species forms. Not meeting this offset is significant for its impact on at least two species.
<i>Conophytum ratum</i>	VU (endemic)	It may go extinct in the long term	Estimated that 80% of population restricted to the Plateau Fine-Grain Quartz Gravel patches of the Gamsberg. Although there are some small populations that will not be directly impacted, the major one will be impacted by dust and additional activity around Gamsberg.
<i>Conophytum angelicae</i> (Dwarf form)	Rare	It may go extinct in the long term	Although a form of a sub-species, its form on Gamsberg is unique.
Bushmanland Arid Grassland Calcrete Gravel Patches	EN	High. Significant for its impact on a unique and impacted species assemblage. However, areas will persist outside of the Offset area, and nearly 20 % of its target will be secured	This is a rather localised habitat type, restricted to Bushmanland. It is heavily utilised by stock. The extreme target set for this type and the pragmatic constraints on offset location prevents effecting offsetting of even a moderate impact. Although areas do exist outside of the core region that would allow approaching>NNL, securing these would be extremely difficult and impractical. However, the habitat is likely to persist in Offset area in the long term.
Feature			
Kloof		High. Although one other kloof could possibly be secured, the loss of the largest is significant	There are only two kloofs in Bushmanland. Both host a unique assemblage of species and provide a remarkable microclimate in this near-desert, allowing for persistence of relic species.
Head water seeps		High. This habitat and its associated species may occur outside the region in Namibia.	Although a unique local feature with an interesting assemblage, located almost entirely over the proposed pit, it holds no endemic species.
Springs (and seasonal pools)		High.	Although one other spring is located on mine land (currently dry) and one on an adjacent property, the loss of these two springs may be significant for dependent species.
<i>Hydrodictyon</i> sp nov.	Data Deficient	Undescribed species. Impact not classifiable.	The species may be found in other parts of the region, or may be new.

Table 2, Table 3 and Table 4 above form the basis for any Monitoring and Evaluation framework that should be used to check the impact of the dust, and verify the sufficiency of the offset in terms of quantum and ecological process and persistence targets.

Additionality of the offset action is an important consideration for Gamsberg. The Black Mountain Mining properties originally encompassed over 24000 ha, some of which may be considered appropriate for contributing to the offset. However, since at least 2006 these areas have been subject to a Biodiversity Action Plan and managed as a *de facto* conservation area under the previous owners, it would appear that their contribution to the offset would have difficulty passing the “Additionality” principle or the Vedanta Technical Standard clauses 4.2.2 and 4.2.4 (a). However, were Vedanta to commit to setting aside these

managed areas in an area with formal protection status in perpetuity (e.g. add it to a nature reserve or national park and provide for its management in the long term post closure), it could be argued that this action would be 'additional' to some extent and could thus be taken into account in the offset. This issue is of particular importance given the shortfall in achieving No Net Loss and Net Gain in certain habitats if this action were not taken (as noted above).

6.4.1 Proposals for compensating for non-offsetable residual impacts

The residual impacts on the freshwater features of the Kloof, Headwater seeps, and Springs can technically not be offset as their targets are based on numeric representation and not per cent of original extent. These impacts can perhaps best be compensated by securing similar systems (headwater seeps, springs and riparian zones) in neighbouring areas of the Eastern Gariep centre of Endemism. This could be achieved by:

- a- Identifying and protecting endangered wetlands in the adjacent Gariep Desert wetland systems to the North of the offset area. These systems are listed a FEPA priorities (Nel *et al.* 2012). This might be achievable in the long term by contracting adjacent private land into the Offset area once declared.
- b- Identifying and protecting similar systems around the nearest two statutory protected areas in the Succulent Karoo, being Goegap Nature Reserve and Namaqua National Park. This approach would obviate the need to initiate a new protected area elsewhere in Bushmanland and the necessity of establishing and funding a management authority.
- c- Alternatively, rehabilitation of the larger pans which have been drained in the Koa river system in Bushmanland might provide significant net positive impacts for avifauna. This might also be possible to include in the Offset target area in the long term.

The residual impacts on the terrestrial habitat units (Calcrete Gravel Patches and Fine-grain Plateau Quartz Patches of the Aggeneys Gravel Vygieveld) that cannot be technically offset could be compensated for by:

- 1- Securing the largest known population of Halfmens (*Pachypodium namaquanum*), an iconic, large, showy succulent, and the emblem of the Northern Cape, which is found in the region (unless already conserved through the offset).
- 2- Securing another regional vegetation type or habitat unit that is of limited extent, has unique or listed species communities, and is in imminent threat of extirpation.
- 3- Securing the only remaining habitat and populations of *Titanopsis calcaria* on the calcrete gravel patches.

The appropriate compensation and financial implications in both cases need to be finalised by the regulator.

7 Scope of the Gamsberg Offset

7.1 Offset options and implementation success factors

The choice of offset mechanisms (or combination thereof) depends on the features being impacted, the receiving environment, likelihood of restoration success or ecosystem response, compliance monitoring and enforcement, and socio-economic factors. There is a growing demand for localities for large scale renewable energy projects and for small scale stock farming in Bushmanland, which makes it difficult to prevent future transformation of the potential biodiversity offset areas.

To be effective as offsets, offset sites need to make an 'in perpetuity' contribution to the conservation estate. To this end, they need formal protection as areas devoted to biodiversity conservation, and the use of adjacent land needs to be managed to ensure that it is compatible with – and supports – conservation of the biodiversity features for which the offset was secured.

Options for securing offsets include the purchase and formal protection of areas, stewardship arrangements where the landowner consents to setting aside and managing land as a formal nature reserve, conservation servitudes across land, as well as other management agreements with landowners. In Bushmanland, the extensive size and large distances between properties are likely to present high risks for monitoring and enforcing the management of offset sites. For this reason, the optimum mechanism is deemed to be purchase of properties (direct ownership) and management by a sole conservation agency.

7.2 Scope of Offset actions

The following objectives comprise the scope of the Offset. Their various and specific parameters for assessing sufficiency of offset outcomes are provided in Table 4 and 6.

1. Establish a core Protected Area through purchase and consolidation of the top 9 identified properties and those Black Mountain Mine properties where no mining is or is likely to take place, or the purchase of development rights or other rights to the land to:
 - a. afford protection for ecosystems and/or habitats of affected species,
 - b. increase ecological connectivity,
 - c. restore ecological function, and
 - d. facilitate management of the protected area.
2. If there is a requirement to approach No Net Loss as far as possible for the Calcrete Gravel Patches habitat unit, then two additional properties may need to be secured depending on the final portfolio chosen in 1 above.
3. Declare and manage of the remaining Black Mountain Mine properties where active mining is happening as a Protected Environment buffer area to the Protected Area, with permanent land use restrictions on the surface biodiversity.
4. Securing an appropriate conservation agency / organisation to manage the proposed Protected Area.
5. Establishing a funding mechanism for the long-term management of the Protected Area.

The biodiversity features that must be represented in the offset area are likely to be found on portions of particular properties (to a greater or lesser extent). As such, it is unlikely that the exact area required by the offset to be set aside, or the exact mix of different ecosystems will be present on particular target properties.

The particular components and quanta required to be offset are presented together in Table 2. The final portfolio of properties targeted for offset action must yield an equivalent or greater area of the various components to satisfy the offset requirements; an exception to this requirement could be made for Calcrete Gravel Patches, where remnant patches of this habitat are found in discrete areas outside the core area targeted for offsets, likely making them impracticable to secure.

7.3 Aligning the Offset vision with local and regional plans

An explicit objective of this offset design is that it must contribute to the creation of a protected area in the region that is aligned with the local, regional and national planning frameworks. A key task is therefore to identify suitable target sites for the offsets that are aligned with:

- Identified Critical Biodiversity Areas and biodiversity corridors in the Namakwa District Bioregional Plan;
- The vision of the Bushmanland Conservation Initiative which had informed previous Spatial Development Frameworks of the Khai-Ma Municipality;
- SAN Parks protected area vision and preliminary design for a Bushmanland Park node; and,
- The priority areas identified in the National Protected Area Expansion Strategy 2010.

8 Establishment and Management of the Offset area

The offset area would need to be established and managed for at least as long as the impacts of the development persist. In the case of such a large open pit, it is assumed that the impact will be in perpetuity. Thus, outright protection of the land in perpetuity is suggested as the only viable offset mechanism in Bushmanland. This option is considered feasible as the opportunity costs of setting aside a few farms are low, the region has long been identified for protected area creation, and the on-going operating costs are likely to be available from the development proponents.

8.1 Management authority

It is a prerequisite for the establishment of a Protected Area (under section 20 or 23 of the NEM: Protected Areas Act (Act 57 of 2003) that a management authority be appointed to establish and/or manage the Offset Protected Area. The client, two statutory bodies and one private potential candidate with the capacity to secure and manage the offset area have potential to act as the implementing agent/management authority. Black Mountain Mining has indicated that they would prefer to outsource this function, as opposed to developing the required in-house capacity.

Two options thus seem to present themselves to establish and manage the protected area:

- 1- SAN Parks or DENC, as existing management authorities in the region, could be approached to take this on.

- 2- A private service provider, with the necessary expertise and experience, could be approached to undertake this task for a defined period (preferably the life time of the offset), with budget. At the end of this period, a subsequent decision could be taken on which authority is better placed to take over the responsibility for the offset area.

The Act further requires that a Management Plan be developed and submitted to the Minister or MEC as appropriate for consent, within a year of the declaration of the land as a Protected Area. However, DENC has required that at least the objectives of the Management Plan be submitted, along with an agreement that binds the Mine to establish the offset area, to them as part of the final ESIA and authorisation process. The management objectives and agreement could be included as conditions of authorisation for the associated activities of Gamsberg Mine.

The offset/ Protected Area management plan would need to cover a suite of relevant management actions, monitoring requirements and adaptive management measures. The extent to which the Offset commitments (in terms of own properties declared and financial liabilities for acquisition and management funding) should also become part of the EMP or the environmental management system for the mine is unclear.

It would seem appropriate that the requirements of the Offset area effectively inform the long term closure plans for all BMM mines and current land holdings as well as the desired final land uses. To this end, alignment will be required between the Offset area management plan, any sustainability planning for the mine(s) and the Social and Labour Plan.

Clearing the invasive species *Prosopis* from properties secured for the offset is one of the few direct management actions required. This has not been costed as it is a legal requirement under legislation, and thus should not form part of an offset programme. In the near term, a strategy to control fountain grass (*Pennisetum purpureum*) in Aggeneys and along road verges leading to Gamsberg and the offset areas will be an important management action.

8.2 Duration of Offset commitment

International good practice recommends that offset commitments should last for at least the duration of the residual impacts of the proposed development. The EMP notes the anticipated life of this mine to be 20 years, with potential for additional mining underground for a further 30 years. As this is an open pit, there is little chance of concurrent rehabilitation. In any event, rehabilitation in this dry and brittle environment is likely to take a substantial time. There is a paucity of experience in this arid region, indicating that a multiplier would be appropriate for determining the area to be offset. We therefore suggest 50 years to be a suitable starting point for the lifespan of the biodiversity offset commitments.

8.3 Offset Recommendations

1. Secure a statutory management authority for the offset area
2. Acquire the land (or the rights to the land) as quickly as possible

3. Pursue complementary approaches in the environmental mitigation, monitoring and adaptive management, and offset arenas, with the social and labour plan and sustainable development objectives or opportunities, as well as other large scale developments in the region
4. Seek to involve local parties as partners in implementation, especially to optimise any local socioeconomic benefits.

8.4 What are the implications for Black Mountain Mine?

The parameters and implementation arrangements for the final Offset must be captured in a binding agreement between Black Mountain Mining, DENC and the implementing agent/ management authority as determined by the process. This agreement will spell out clearly the required outcomes to satisfy the offset, provide particular geographic guidance for where to achieve these outcomes, a likely timeline to secure and establish the offset area, and a range of financial transfers to the implementing agent for on-going offset management. The agreement should spell out the apportionment of responsibility for certain actions and liability in the event of failure. Many of these actions will also be covered in an EMP for the offset area, which is likely to be referenced by the Record of Decision for the authorisation. The EMP and agreement will be specifically enforceable by DENC, Black Mountain Mining or the implementing agent.

8.5 Offset Summary statement

From the offset investigation¹³, it appears that:

1. Residual impacts could be offset for most of the affected areas.
2. For 'natural habitat', 'no-net-loss'¹⁴ could be achieved for all impacted habitats if and only if the un-mined portions of the current Mine properties were included in the Offset Area.
3. For 'critical habitat':
 - a) 'net gain' (and 'no net loss') could not be achieved for Fine Grain Plateau Quartz Gravels (84% lost) if the assumption regarding the severity of dust impacts proves valid, and for the Calcrete Gravel Patches if dust impact were realised.
 - b) If the groundwater impact predictions are accurate and there is no local structural control of water infiltration which maintains key aspects of the functioning of the Kloof, Seeps and Springs, then 'no net loss /net gain would not be possible.
 - c) 'net gain' would be possible for all other 'Critical Habitats' if their remaining extent within the core region were statutorily protected and managed, **including** on the BMM properties in perpetuity.
4. 'Net gain' will be achieved for all other habitats, if the existing Mine properties are secured in perpetuity, and these habitats are secured and managed on two additional properties.
5. Where residual impacts are 'non offsetable', the following compensation measures are proposed:
 - a. Fine grain quartz gravels and Calcrete gravels: Locate and secure regional representations of remarkable species and/or other unique assemblages.
 - b. Kloof, temporal pools and freshwater springs: Secure similar systems in neighbouring regions of the Gariep Desert or Namaqualand Highlands, or rehabilitate the Seasonal pans on the Koa River, and protect in the long term.

¹³ These are preliminary findings, depending on final outcomes of the mine design, impact area re-calculations, significance ratings, and any subsequent redesign of the optimal property portfolio due to inability to secure a property.

¹⁴ Please refer to the definitions above of "no-net-loss", and "net gain"

Although it would not be possible to achieve 'net gain' for certain habitats and features, it is important to note that our analysis is relatively fine-grained and looks at habitat types within broader vegetation or ecosystem descriptions. That is, although there would be a net loss of biodiversity at the level of habitat, no net loss or net gain would be achieved at the broader ecosystem level. Moreover, it is arguable that particular features such as the kloof, springs and seeps, although rare or unique in this particular region, would indeed constitute 'critical habitat' as envisaged in IFC PS6. Although unable to achieve 'no net loss' or 'net gain' for the features and two habitats, the proposed scope of offset would safeguard ecological processes and a significant portion of the vegetation type targets that to a large degree sustain the Bushmanland Inselberg Region and its biodiversity. It could also catalyse the establishment of a regional protected area in a centre of endemism.

9 Financial implications and arrangements

Calculating the financial implications of the offset would recognise the following discrete costs:

- a. Costs of land acquisition or to secure biodiversity values on the land (e.g. the rights to conserve)
- b. Cost of incorporation, establishment and restoration (including earthworks, hydrological restoration, ecosystem restoration, dust suppression and fencing or protection) of the offset area (and not the mine site)
- c. On-going maintenance and management costs for the offset area over a predetermined time-period that may include the expected lifespan of the mine and the time period afterwards defined in 8.2 above (allowing full establishment of any restoration measures)
- d. The cost of transaction (such as legal and consulting costs) and administration if the funds are housed in an independent Trust that must disburse them annually.

A standard financial evaluation methodology will be used to ensure that results can be used in generally accepted accounting frameworks. To calculate financial implications of the proposed offsets the following information is used:

- Agreement on specific interventions, e.g. land acquisition and active rehabilitation or management interventions on the land.
- Clarity on the scope, duration and requirements of the biodiversity offset interventions.
- Historical land acquisition costs in the area.

Some of these data are on hand, but a more thorough gathering exercise will be needed to begin detailed financial provision calculations. This could include compiling an activity based budget and comparison with existing protected area management budgets in similar habitats.

We propose that a dual approach to financing the offset is adopted.

- 1- An amount should be held in trust by a suitable authority – sufficient to cover the capital costs of Offset establishment for the first 10 years, and including an endowment covering a significant component of the on-going management costs. Usually this is required up-front, but in this instance could be phased in over a 3-5 year period as the mine ramps up.
- 2- Annual contributions to the management endowment, not less than the projected costs, and possibly augmented by a percentage of mine turnover or the sale of concentrate.

The optimal structure of the funds from an administrative efficiency and taxation point-of-view depends on whether Vedanta chooses to retain ownership of the offset properties for 10 years, the final choice of management authority, whether an existing vehicle is able or willing to receive and administer the funds, and the complexity of the disbursements that will be required. There may be an opportunity to reduce some of the financial costs of interventions by ring-fencing allowable protected area tax deductions and using these to augment the endowment for the properties secured. It is premature to consider the appropriate institutional arrangements for the financial provision for the offset until the implementation parameters are better identified. However, certain projects may lend themselves to execution directly by Black Mountain

Mine, others to execution by a private service provider or the management authority using funds from Vedanta.

10 Uncertainties, data gaps, monitoring and pending information

The recommended measures in this offset in no way absolve the mine from compliance with any current or future mitigation requirements, and cannot preclude any regulatory requirement for additional mitigation or offset action should a regulatory authority require this, or actual monitored mine impact and environmental outcomes suggest this.

The final impacts of the infrastructure footprints, dust fall out, and dewatering of the pit are not yet clear. The on-going monitoring should inform additional offset requirements and/or mitigation activities should the footprints turn out to be larger, dust fallout more significant and harmful and loss of groundwater be more extensive. The legal agreement securing commitment, liability and responsibility for the offset would need to cater for an extension of the required offset areas and/or management funds to cater for this eventuality.

There is a risk that the optimal portfolio of sites cannot be secured. We propose that this is tackled by phasing in the offset imperatives to secure the properties of 2 or 3 two-year phases, and that flexibility is allowed in the mechanisms by which the properties are subdivided and/or declared as protected areas.

11 References

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12 Appendix 1: Consultation and Development Process followed to develop Biodiversity Offset

- 1- Establishment of Technical committee (including DENC, Vedanta, and invited representatives from SANBI and SAN Parks).
 - a. Technical Meetings held on:
 - i. 26 September (Cape Town), 2012
 - ii. 19 November (Kirstenbosch), 2012, and
 - iii. 21 February (ERM) 2013.
- 2- Integration meetings with ESIA team and Specialists.
 - a. Meetings Held on:
 - i. 15 November (Vedanta – JHB), 2012
 - ii. 14 December (AMEC - JHB) 2012 , and
 - iii. 31 January 2013 (ERM).
 - iv. Repeated telephone conferences between ERM, the Specialist and the Offset team
- 3- SKEP consultation workshop held in Springbok on 30 November 2012, with SANBI, WWF-SA, CSA, DENC.
- 4- Leslie Hill Succulent Karoo Trust meeting, held at WWF-SA offices, Newlands, on 23 August 2012.
- 5- WWF Land Reference Group, held at WWF-SA offices, Newlands, on 13 November 2012, and follow up meeting regarding WWF Associated Trusts on 5 March 2013.
- 6- DENC. 12 February 2013. Meeting with HOD, Director and Deputy Director. Kimberley, DENC Offices.
- 7- DMR. 12 February 2013. Meeting with Regional Manager, Mine Environmental Management. Kimberley, DMR offices.
- 8- NGO consultation forum – held at WWF-SA, Newlands, 15 March 2013.

SA Vegetation Type & Habitat Unit	Impacted area	CORE EXTENT (ha)	Ecological Process Value	Species of Concern	Special habitats under imminent threat	Revised Ecosystem Threat Status by this study	Adjusted target: Baseline Important (60%) or All remaining (80%)	Regional Target required for each Habitat (ha)	Basic offset ratio to meet target	Uncertainty, risk multiplier (residual impacts)	Habitat condition multiplier	Biodiversity priority area impact multiplier	FINAL ADJUSTED OFFSET RATIO
Aggeneys Gravel Vygieveld													
Mountains Plateau	181.7	1514	High	High	No	VU	60	1058	1.5	2.0	1.0	2.0	6
Plains Gravel quartz plateau	51.5	414	Very High	Very High	No	VU	60	269	1.5	2.0	1.0	2.0	6
Fine grain gravel quartz patch	49.1	58	Very High	Very High	No	EN(A2)	80	46	4.0	1.0	1.0	2.0	8
Plains Gravel quartz	406.7	5143	Medium	High	No	VU	60	3584	1.5	1.0	1.5	2.0	5
Plains Gravel quartz intermediate	56.5	617	Low	Low	No	VU	33	396	0.5	1.0	1.0	2.0	1
Plains Gravel feldspar	91.2	1237	Medium	Medium	Yes	VU	33	408	0.5	1.0	1.0	2.0	1
Plains Rocky	232.5	8624	Low	Medium	No	LC	18	2110	0.5	2.0	1.5	1.0	2
Bushmanland Inselberg Shrubland		28266	Medium	Medium	No								0
Mountains	871.0	3869	Very High	Medium	No	LC	34	14293	0.5	2.0	1.5	1.0	2
Bushm inselberg succulent shrub		41875	Low	Low	No								0
Bushm inselberg succ shrub	98.4	20070	Low	Low	No	VU	60	2758	1.5	2.0	1.5	2.0	9
Bushmanland Arid Grassland		1486	Medium	Very High	Yes								0
Plains Sandy flat	2394.5	20000	Low	Low	No	LC	21	31092	0.5	2.0	1.0	1.0	1
Plains Sandy hummocky	334.0	10000	Low	Low	No	LC	21	22219	0.5	2.0	1.0	1.0	1
Plains Gravel calcrete	403.7	13868	High	Low	No	EN(A2)	80	1386	4.0	1.0	2.0	2.0	16
Bushmanland Sandy Grassland		3489	Very High	Low	No								0
Plains Sandy mobile dunes	5.3	847	Very High	Very High	No	LC	21	21960	0.5	2.0	1.0	1.0	1
Easten Gariep Plains Desert		38	Very High	High	Yes								0
Plains Rocky East Gariep		3	Very High	Very High	maybe	LC	34	8288	0.5	2.0	1.0	1.0	1
Azonal													0
Kloof	176.7								4.0	1.0	2.0	2.0	16
Freshwater springs	X 2								4.0	1.0	2.0	2.0	16
River	1022.1					LC	30	2100	0.5	2.0	1.0	1.5	2
Wash	482.3					LC	30	9688	0.5	2.0	1.0	1.5	2

Table 5. The impacted vegetation types, habitat units and features, updated ecosystem status, the target required, and assigned multiplier ratio

