FLORAL, FAUNAL, WETLAND AND AQUATIC ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED COMMISSIEKRAAL COLLIERY, KWAZULU-NATAL PROVINCE

Prepared for

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SECTION F

Impact Assessment and Mitigation

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1.1 Principles of Decision making to mainstream biodiversity in mining projects

According to the Department of Mineral Resources (DMR) (2013) there are 6 key principles which should guide decision making with regards to any development. The six principles are defined as follows:

1. **Apply the Law:** the utilisation of the law will be viewed as the minimum requirement in ensuring biodiversity compliance attention will be given to all applicable legislation across government sectors including the Department of Water Affairs (DWA), the Department of Environmental Affairs and tourism (DEAT) and the DMR.
2. **Utilise best available biodiversity information:** a wealth of information is available on South African biodiversity with sources of information coming from digital databases, spatial (GIS based) databases as well as extensive literature and technical reports. All these sources allow improved execution of biodiversity assessment projects from inception to finalisation and practical implementation. Specific mention is made of sources of information such as the SANBI GIS databases. During the consultation of desktop information, specific attention will be given to biodiversity priority areas which include:
   - Protected areas
   - World Heritage Sites and their legally proclaimed buffers
   - Critically endangered and endangered ecosystems
   - Critical Biodiversity Areas
   - River and wetland Freshwater Ecosystem Priority Areas (FEPAs)
   - 1km buffer of river and wetland FEPAs
   - Ramsar Sites
   - Protected area buffers
   - Transfrontier Conservation Areas (remaining areas outside of formally
   - proclaimed PAs)
   - High water yield areas
   - Coastal Protection Zone
   - Estuarine functional zones
   - Ecological support areas
   - Vulnerable ecosystems

- Focus areas for land-based protected area expansion and focus areas or offshore protection.

The results of desktop assessments can then be used to categorise projects and define the significance of the development from a biodiversity conservation point of view. According to the DMR (2013) there are 4 categories of biodiversity importance into which any project could occur. The table below presents a description of each category and the implications for mining. The four categories can briefly be defined as:

- Legally protected areas
- Areas of highest biodiversity importance
- Areas of high biodiversity importance
- Areas of moderate biodiversity importance

Table 1: Description of each category and the implications for mining

Category	Biodiversity priority areas	Risk of mining	Implications for mining
A. Legally protected	• Protected areas (including National Parks, Nature Reserves, World Heritage Sites, Protected Environments, Nature Reserves) • Areas declared under Section 49 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002)	**Mining prohibited**	Mining projects cannot commence as mining is legally prohibited. Although mining is prohibited in Protected Areas, it may be allowed in Protected Environments if both the Minister of Mineral Resources and Minister of Environmental Affairs approve it. In cases where mining activities were conducted lawfully in protected areas before Section 48 of the Protected Areas Act (No. 57 of 2003) came into effect, the Minister of Environmental Affairs may, after consulting with the Minister of Mineral Resources, allow such mining activities to continue, subject to prescribed conditions that reduce environmental impacts.
B. Highest biodiversity importance	• Critically endangered and endangered ecosystems • Critical Biodiversity Areas (or equivalent areas) from provincial spatial biodiversity plans • River and wetland Freshwater Ecosystem Priority Areas (FEPAs) and a 1 km buffer around these FEPAs • Ramsar Sites	**Highest risk for mining**	Environmental screening, environmental impact assessment (EIA) and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licenses, and environmental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining project is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services. These areas are viewed as necessary to ensure protection of biodiversity, environmental sustainability, and human well-being. An EIA should include the strategic assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. This assessment should fully take into account the environmental sensitivity of the area, the overall environmental and socio-economic costs and benefits of mining, as well as the potential strategic importance of the minerals to the country. Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts, and may specify biodiversity offsets that would be written into license agreements and/or authorisations.
C. High biodiversity importance	• Protected area buffers (including buffers around National Parks, World Heritage Sites* and Nature Reserves) • Transfrontier Conservation Areas (remaining areas outside of formally proclaimed protected areas) • Other identified priorities from provincial spatial biodiversity plans • High water yield areas • Coastal Protection zone • Estuarine functional zone	**High risk for mining**	These areas are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, and for maintaining important ecosystem services for particular communities or the country as a whole. An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on

Category	Biodiversity priority areas	Risk of mining	Implications for mining
	*Note that the status of the buffer areas of World Heritage Sites is subject to a current intra-governmental process.		biodiversity. Mining options may be limited in these areas, and limitations for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into license agreements and/or authorisations.
D. Moderate biodiversity importance	• Ecological support areas • Vulnerable ecosystems • Focus areas for protected area expansion (land-based and offshore protection)	**Moderate risk for mining**	These areas are of moderate biodiversity value. EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy. Authorisations may set limits and specify biodiversity offsets that would be written into license agreements and/or authorisations.

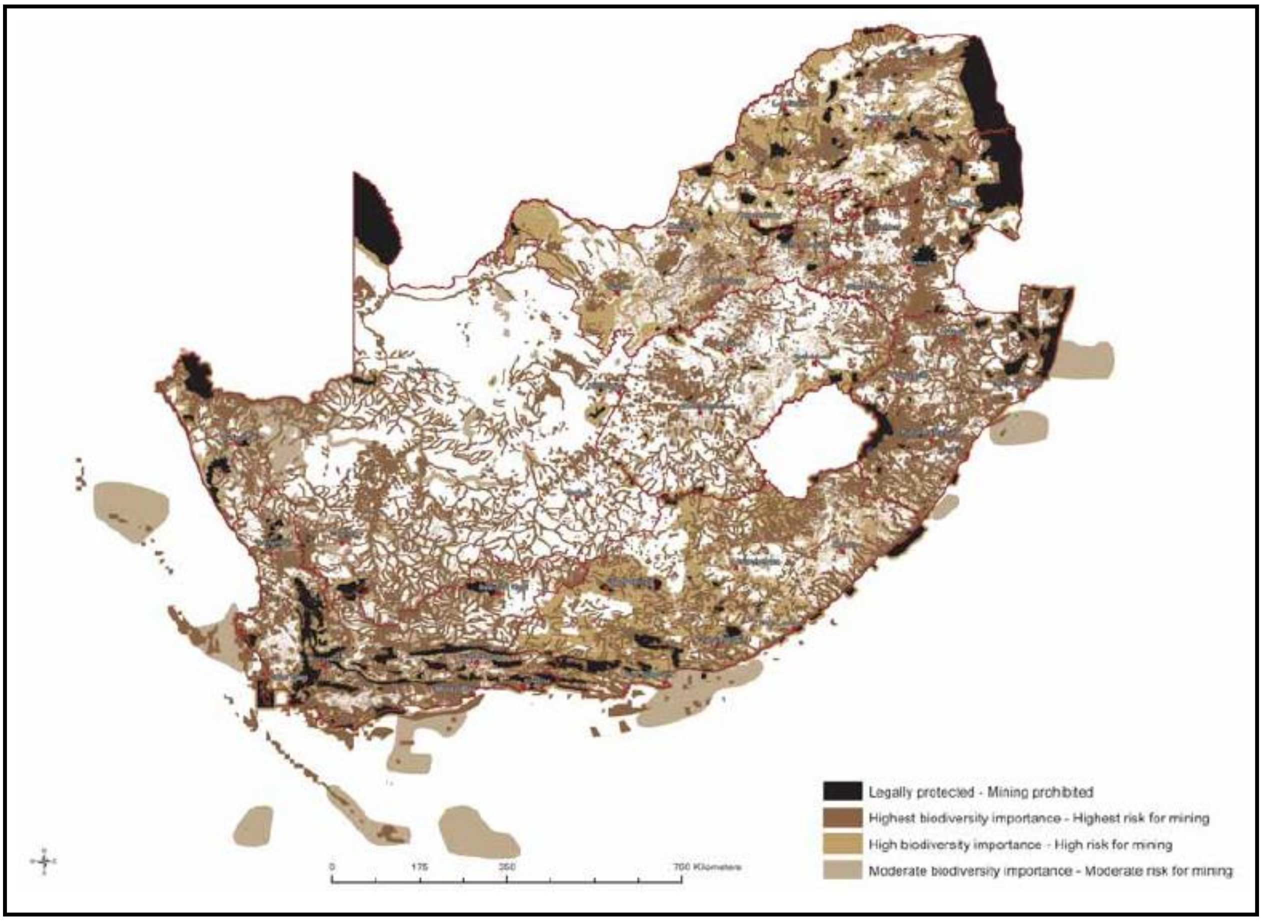

Figure 1: Levels of biodiversity importance in South Africa.

3. **Relevant stakeholder engagement in the assessment and decision making process:** biodiversity studies and plans should address the need for stakeholder engagement through consultation with local and provincial authorities, databases, reference material and where possible local and provincial experts.
4. **Environmental Impact Assessment:** the ecological baseline assessment should include assessments of:
   - The presence of and category of biodiversity priority areas.
   - The condition of ecosystems or habitat.
   - Vegetation type and ecosystem status.
   - The presence of any species of special concern.
   - The presence of any unique or special features.
   - Important spatial components of ecological processes (e.g. ecological corridors).
   - Any known or projected trends in both biodiversity and/or ecosystem services.
   - Contextual analysis of the site/surrounding environment.

Ground-truthing (i.e. a baseline survey) of the biodiversity features in the affected area (receiving environment) is the preliminary requirement to identify environmental constraints.

Additional detailed specialist investigations should be carried out on site and in the wider area as appropriate and proportional to the levels of risk and significance of potentially impacted biodiversity and ecosystem services. The assessment and evaluation must (DMR 2013):

- Take into account any Spatial Development Frameworks approved by the provincial environmental authorities, any Environmental Management Frameworks, bioregional plans and/or other biodiversity plans prepared for the affected area.
- Enable differentiation between biodiversity priority areas and other natural areas, and areas where little to no natural habitat remains at a site scale. The type of biodiversity priority area and natural habitat remaining is important to informed application of the mitigation hierarchy during later phases of the project.
- Demonstrate that it has considered all potential impacts on biodiversity - direct impacts (occurring at the same time and in the same place as the prospecting or mining itself) as well as indirect impacts (occurring beyond or downstream of the prospecting or mining area within the 'area of influence' of the activity, and/ or may be manifest sometime after the activity e.g., groundwater pollution, acid mine drainage).
- Show that the potential impacts of this activity on biodiversity, particularly in biodiversity priority areas and on threatened species, have been evaluated in light of other similar activities that have been authorised and/ or are reasonably foreseeable in the area (i.e. cumulative impacts).
- Identify the current beneficiaries of ecosystem services, identify the biodiversity and ecosystems that underpin those services and any trends affecting them, and show that impacts on both the services and the beneficiaries have been addressed. Capturing the contribution of ecosystem services is important in the comparative evaluation of the significance of impacts (including cumulative impacts) of alternative development/land use activities. This requires understanding how development impacts on ecosystem services, who and where are the beneficiaries of those services who are likely to suffer a cost as a result of the activity (local communities and society), and evaluate the socioeconomic implications. Costs associated with the loss of ecosystem services should be added onto the project costs. Measures to mitigate impacts on ecosystem services must cover all steps of the mitigation hierarchy, giving particular attention to what may be irreplaceable or 'non offsetable' ecosystem services. It is essential also to take into account the mining activity's dependence on ecosystem services, and the risks associated with a change in the quality or availability of these services during the life of the project.

- Consider both the normal operating conditions of the mine and ancillary facilities/activities, as well as emergency or unplanned events (e.g. involving hazardous wastes, fire, toxic materials, accidental spillage of biocides, etc.); the latter require particular mitigation and management responses that should be incorporated into the EMP.

5. **Provide guidelines for the implementation of robust environmental management in line with the mitigation hierarchy:** The biodiversity assessment will aim to provide suitable mitigation measures in line with best practice while not exceeding costs in order to minimise impacts. In the contemplation of mitigation attention will be given to the mitigation hierarchy in order to provide mitigatory solutions in order of preference according to the mitigation hierarchy;
6. **Ensure and support for effective implementation:** The biodiversity assessment will aim to provide sufficient information to allow for successful, robust biodiversity management in line with the mitigation hierarchy. As far as possible consultants will remain available for post submission consultation in an advisory capacity.

1.2 Legislative, Policy and Best Practice Framework For biodiversity Management

According to the DMR (2013) “Rich biodiversity underpins the diverse ecosystems that deliver ecosystem services that are of benefit to people, including the provision of basic services and goods such as clean air, water, food, medicine and fibre; as well as more complex services that regulate and mitigate our climate, protect people and other life forms from natural disaster and provide people with a rich heritage of nature-based cultural traditions. Intact ecological infrastructure contributes significant savings through, for example, the regulation of natural hazards such as storm surges and flooding by which is attenuated by wetlands”.

According to the DMR, (2013) Ecosystem services can be divided into 4 main categories:

- Provisioning services are the harvestable goods or products obtained from ecosystems such as food, timber, fibre, medicine, and fresh water.
- Cultural services are the non-material benefits such as heritage landscapes and seascapes, recreation, ecotourism, spiritual values and aesthetic enjoyment.

- Regulating services are the benefits obtained from an ecosystem's control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards.
- Supporting services are the natural processes such as nutrient cycling, soil formation and primary production that maintain the other services.

Loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces socio-economic options for future generations. This is of particular concern for the poor in rural areas who have limited assets and are more dependent on common property resources for their livelihoods. The importance of maintaining biodiversity and intact ecosystems for ensuring on-going provision of ecosystem services, and the consequences of ecosystem change for human well-being, were detailed in a global assessment entitled the Millennium Ecosystem Assessment (MEA 2005), which established a scientific basis for the need for action to enhance management and conservation of biodiversity.

Sustainable development is enshrined in South Africa's Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (No. 10 of 2004) (hereafter referred to as the Biodiversity Act), and is fundamental to the notion of sustainable development. In addition International guidelines and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa (DMR; 2013).

The primary environmental objective of the Minerals and Petroleum Resource Development Act (MPRDA) is to give effect to the environmental right contained in the South African Constitution. Furthermore, Section 37(2) of the MPRDA states that "any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations".

Pressures on biodiversity are numerous and increasing. According to the DMR; (2013) Loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[1]:

- Cultivation and grazing activities;

[1] North West Province Environment Outlook. A Report on the State of the Environment, 2008. Chapter 4.

- Rural and urban development;
- Industrial and mining activities, and
- Infrastructure development.

Impacts on biodiversity can largely take place in four ways (DMR 2013):

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from and to riverine resources respectively;
- **Indirect impacts:** are impacts are impacts associated with a project that may occur within the zone of influence in a project such as surrounding terrestrial areas and downstream areas on water courses;
- **Induced impacts:** are impacts directly attributable to the project but are expected to occur due to the activities of the project. Factors included here are urban sprawl and the development of associated industries.
- **Cumulative impacts:** can be defined as the sum of the impact of a project as well as the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity resources. Examples include numerous mining operations within the same drainage catchment or numerous residential developments within the same habitat for faunal or floral species.

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted in the identification of spatial biodiversity priorities, or biodiversity priority areas.

1.3 Legislative, Policy and Best Practice Framework For biodiversity Management

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other landuse. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DMR 2013):

1. **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
2. **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
3. **Rehabilitate impact** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation toll as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
   a. **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
   b. **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the subject property supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase.
   c. Biodiversity reinstatement which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use.
   d. Species reinstatement which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem

functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.

4. **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

According to the DMR (2013) 'Closure' refers to the process for ensuring that mining operations are closed in an environmentally responsible manner, usually with the dual objectives of ensuring sustainable post-mining land uses and remedying negative impacts on biodiversity and ecosystem services.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have *medium to high significance*, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[2]

2. ECOLOGICAL IMPACT ASSESSMENT METHODOLOGY

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources,

[2] Provincial Guideline on Biodiversity Offsets, Western Cape, 2007.

which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that are possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[3]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or well-being, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the table below. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the

[3] The definition has been aligned with that used in the ISO 14001 Standard.

activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[4].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

[4] Some risks/impacts that have low significance will however still require mitigation

Table 2: Criteria for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

Probability of impact	**RATING**
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function Largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear features affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear features affected < 1000m	2
Local area/ within 1 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	3
Regional within 5 km of the site boundary / < 5000ha impacted / Linear features affected < 10 000m	4
Entire habitat unit / Entire system/ > 5000ha impacted / Linear features affected > 10 000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table 3: Significance rating matrix

	CONSEQUENCE (Severity + Spatial Scope + Duration)														
LIKELIHOOD (Frequency of activity + Frequency of impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 4: Positive/Negative Mitigation Ratings

Significance Rating	Value	Negative Impact management recommendation	Positive Impact management recommendation
Very High	126 - 150	Consider the viability of the project. Very strict measures to be implemented to mitigate impacts according to the impact mitigation hierarchy	Actively promote the project
High	101 - 125	Consider alternatives in terms of project execution and location. Ensure designs take environmental sensitivities into account and Ensure management and housekeeping is maintained and attention to impact minimisation is paid according to the impact mitigation hierarchy	Promote the project and monitor ecological performance
Medium High	76 – 100	Consider alternatives in terms of project execution and Ensure management and housekeeping is maintained and attention to impact minimisation is paid according to the impact mitigation hierarchy	Implement measures to enhance the ecologically positive aspects of the project while managing any negative impacts
Medium Low	51 - 75	Ensure management and housekeeping is maintained and attention to impact minimisation is paid	Implement measures to enhance the ecologically positive aspects of the project while actively managing any negative impacts
Low	26 - 50	Promote the project and ensure management and housekeeping is maintained	Monitor ecological performance and pay extensive attention to minimising potential negative environmental impacts
Low Very	1 - 25	Promote the project	Actively seek measures to implement impact minimisation according to the impact mitigation hierarchy and identify positive ecological aspects to be promoted

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Construction;
  - Operation; and
  - Rehabilitation.
- If applicable, transboundary or global effects were assessed;
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

2.1 Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed development.

- *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[5] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favor avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation*.

[5] Mitigation measures should address both positive and negative impacts

3. ECOLOGICAL IMPACT ASSESSMENT

The ecological impact assessments undertaken for each sphere of ecology are presented in the sections below as follows:

1. Floral impact assessment;
2. Faunal impact assessment;
3. Wetland impact assessment; and Aquatic impact assessment

In all the impact assessments cross cutting impacts are considered and cumulative and residual/latent impacts are considered.

3.1 Floral Impact Assessment

The impact assessment was undertaken on all aspects of floral ecology deemed likely to be affected by the proposed Commissiekraal coal project development. The sections below present the results of the findings per identified risk/impact for the floral ecology of the focus area.

IMPACT 1: IMPACT ON FLORAL HABITAT

Placement of infrastructure and mining activities within intact floral habitat in areas such as the Montane Grassland, Northern Afrotemperate Forest and wetland areas is highly likely to have a detrimental impact on floral habitat conservation. The focus area is associated with Critical Biodiversity Areas (KZN C-Plan 2010) and vegetation types which are classified as vulnerable. Furthermore, the baseline floral assessment confirmed the presence and habitat integrity of these areas.

The data gathered during the baseline floral ecological assessment indicate that the Montane Grassland, Northern Afrotemperate Forest and wetland areas are of high sensitivity in terms of ecological functioning and floral habitat integrity.

Activities which are likely to negatively affect the floral habitat integrity of the subject property include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Destruction of floral habitat during construction and operational activities;
- Dust generated by mining activities;
- Alien floral invasion and erosion in disturbed areas;
- Dewatering and pollution of watercourses leading to altered riparian and wetland floral habitat;
- Increased human populations in the area leading to greater pressure on natural floral habitat.

The above activities are highly likely to have a significant detrimental impact on floral habitat within and around the subject property as the physical destruction of floral habitat will be unavoidable within this sensitive area. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential poor planning of infrastructure placement and design in sensitive floral habitat units.	Site clearing and the removal of vegetation leading to a loss of sensitive floral habitat.	On-going disturbance of soils due to operational activities leading to altered floral habitat.	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of floral habitat.
Failure to initiate the development of a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Loss of floral biodiversity through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of natural habitat	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on floral habitat.

Pre-Construction	Construction	Operational	Decommissioning & Closure
Placement of topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive floral habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of floral habitat.	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered floral habitat	On-going seepage and runoff may affect the groundwater regime and wetland habitats beyond closure
	Movement of construction vehicles and access road construction through sensitive floral habitat	Seepage affecting soils and the groundwater regime leading to altered floral habitat	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss of sensitive floral habitat	On-going disturbance may lead to erosion and sedimentation	
	Compaction of soils reducing efficiency of floral re-establishment	Additional pressure on floral habitat by increased human populations associated with the proposed mine leading to a loss of floral habitat.	
	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Increased fire frequency during construction leading to a loss of sensitive floral habitat	Dust generation during operational activities leading to a loss of floral habitat.	
	Dust generation during construction leading to a loss of floral habitat.	Increased fire frequency during operation leading to a loss of sensitive floral habitat	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	5	5	4	3	10	12	120 (High)
Operational phase	5	5	4	3	4	10	11	110 (High)
Decommissioning and closure phase	5	5	4	4	5	10	13	130 (Very High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	5	5	3	3	2	10	8	80 (Medium-High)
Operational phase	4	5	3	2	4	9	9	81 (Medium-High)
Decommissioning and closure phase	3	5	3	2	4	9	9	81 (Medium-High)

IMPACT 2: IMPACT ON FLORAL DIVERSITY

Placement of infrastructure, construction of the mine and mining activities within intact floral habitat in areas such as the Montane Grassland, Northern Afrotemperate Forest and wetland areas is highly likely to have a detrimental impact on floral diversity. Furthermore, during the baseline floral assessment a high diversity of floral species was recorded, especially within the Montane Grassland, Northern Afrotemperate Forest and wetland areas, which are of high sensitivity in terms of ecological functioning and floral habitat integrity.

Activities which are likely to negatively affect the floral diversity of the subject property include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Destruction of floral habitat during construction and operational activities;
- Dust generated by mining activities leading to altered floral species diversity;
- Alien floral invasion and erosion in disturbed areas;
- Dewatering and pollution of watercourses leading to altered riparian and wetland floral communities;

The above activities are highly likely to have a significant detrimental impact on floral diversity within and around the subject property as the alteration of floral diversity will be highly likely within this sensitive area. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential poor planning of infrastructure placement and design in sensitive floral habitat units	Site clearing and the removal of vegetation leading to a loss of floral diversity	On-going disturbance of soils due to operational activities leading to altered floral diversity	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of floral diversity
Failure to initiate a biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Loss of floral biodiversity through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of floral diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on floral diversity.
Placement of topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive floral habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of floral diversity.	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered floral diversity.	On-going seepage and runoff may affect the groundwater regime beyond closure.
	Movement of construction vehicles and access road construction through sensitive floral habitat.	Seepage affecting soils and the groundwater regime leading to altered floral diversity	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Construction of topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss floral diversity.	On-going disturbance may lead to erosion and sedimentation	
	Compaction of soils reducing efficiency of floral re-establishment	Additional pressure on floral diversity by increased human populations associated with the proposed mine	
	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Increased fire frequency during construction leading to a loss of floral diversity	Dust generation during operational activities leading to a loss of floral diversity	
	Dust generation during construction leading to a loss of floral diversity.	Increased fire frequency during operation leading to a loss of floral diversity	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	5	5	4	3	10	12	120 (High)
Operational phase	5	5	4	3	4	10	11	110 (High)
Decommissioning and closure phase	5	5	4	4	5	10	13	130 (Very High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	5	5	3	3	2	10	8	80 (Medium-High)
Operational phase	4	5	3	2	4	9	9	81 (Medium-High)
Decommissioning and closure phase	3	5	3	2	4	9	9	81 (Medium-High)

IMPACT 3: IMPACT ON FLORAL SPECIES OF CONSERVATION CONCERN

Placement of infrastructure, construction of the mine and mining activities are highly likely to have a detrimental impact on floral species of conservation concern such as *Eucomis autumnalis, Gladiolus dalenii, Gladiolus crassifolius* and *Gladiolus ecklonii, Habenaria filocornis, Eulophia sp., Cyathea dregei, Satyrium longicauda, Ilex mitis, Podocarpus henkelii and P. falcatus,* among others. Furthermore, the subject property is highly likely to harbour additional protected species.

Activities which are likely to negatively affect the flora of conservation concern within and around the focus area include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Destruction of floral habitat during construction and operational activities;
- Dust generated by mining activities leading to altered floral species diversity;
- Alien floral invasion and erosion in disturbed areas;
- Increased harvesting pressure on protected and medicinal floral communities;
- Dewatering and pollution of watercourses leading to altered riparian and wetland floral communities;

The above activities are highly likely to have a significant detrimental impact on species of conservation concern within and around the subject property. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potentially poor planning of infrastructure placement and design in sensitive floral habitat units	Site clearing and the removal of vegetation leading to a loss of sensitive and medicinal species	On-going disturbance of soils due to operational activities leading to a loss of sensitive and medicinal species	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of sensitive and medicinal species
Failure to initiate a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Loss of sensitive and medicinal species through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of floral diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on sensitive and medicinal
Placement of topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive floral habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of sensitive and medicinal species	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered floral diversity	On-going seepage and runoff may affect the groundwater regime beyond closure

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Movement of construction vehicles and access road construction through sensitive floral habitat.	Seepage affecting soils and the groundwater regime leading to a loss of sensitive and medicinal species	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss of sensitive and medicinal species.	On-going disturbance may lead to erosion and sedimentation	
	Compaction of soils reducing efficiency of floral re-establishment	Additional pressure on sensitive and medicinal species by increased human populations associated with the proposed mine	
	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Increased fire frequency during construction leading to a loss of sensitive and medicinal species	Dust generation during operational activities leading to a loss of sensitive and medicinal species	
	Dust generation during construction leading to a loss of sensitive and medicinal species	Increased fire frequency during operation leading to a loss of sensitive and medicinal species	

Unmanaged	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	5	5	5	4	3	10	12	120 (High)
Operational phase	5	5	4	3	4	10	11	110 (High)
Decommissioning and closure phase	5	5	4	4	5	10	13	130 (Very High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	5	5	3	3	2	10	8	80 (Medium-High)
Operational phase	4	5	3	2	4	9	9	81 (Medium-High)
Decommissioning and closure phase	3	5	3	2	4	9	9	81 (Medium-High)

3.2 Faunal Impact Assessment

The impact assessment was undertaken on all aspects of faunal ecology deemed likely to be affected by the proposed Commissiekraal coal mining development. The sections below present the results of the findings per identified risk/impact for the faunal ecology of the subject property.

IMPACT 1: IMPACT ON FAUNAL HABITAT

Placement of infrastructure and mining activities within sensitive faunal habitat such as the Afrotemperate Forest habitat, Wetland areas, Montane grasslands and to a degree the Transformed grasslands is highly likely to have a detrimental impact on faunal habitat and migratory corridors. Several protected faunal species, along with a high diversity of more common faunal species, rely on these habitat types for foraging, migratory and breeding purposes.

The data gathered during the field assessments indicates that the subject property should be considered important and sensitive in terms of habitat provision for faunal species, both protected and common, across all ranges of habitat requirements. The only habitat that may be considered less sensitive is that of the transformed grasslands; however these areas are known to be utilised by avifaunal SCC for foraging, namely *Anthropoides paradiseus* (Blue Crane), *Balearica regulorum* (Grey Crowned Crane) and *Geronticus calvus* (Southern Bald Ibis).

Activities which are likely to negatively affect the faunal habitat integrity of the subject property include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive faunal habitat;
- Destruction of faunal habitat during construction and operational activities;
- Dust generated by mining activities;
- Alien floral invasion and erosion in disturbed areas;
- Dewatering and pollution of watercourses leading to altered riparian and wetland faunal habitat; and
- Increased human populations in the area leading to greater pressure on natural faunal habitat.

The above activities are likely to have a significant impact on faunal habitat within and around the subject property if mitigation measures are not adhered to and infrastructure is placed within sensitive habitats. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potentially poor planning of infrastructure placement and design in sensitive faunal habitat	Site clearing and the removal of vegetation leading to a loss of sensitive faunal habitat	On-going disturbance of soils due to operational activities leading to altered faunal habitat	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of faunal habitat
Failure to initiate a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Loss of faunal habitat through invasion of alien species in disturbed areas	Increased introduction and proliferation of alien plant species and further transformation of natural habitat	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on faunal habitat.
Placement of topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive faunal habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of faunal habitat.	Risk of contamination and contamination from all operational facilities may pollute receiving environment leading to altered faunal habitat	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive faunal habitat	Seepage affecting soils and the groundwater regime leading to altered faunal habitat	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien plant control plan during the decommissioning and closure phase.
	Construction of topsoil stockpiles, overburden dumps and other surface infrastructure leading to edge effect impacts on sensitive faunal habitat.	On-going disturbance may lead to erosion and sedimentation	
	Failure to implement a well-conceived biodiversity action plan, rehabilitation plan and alien plant control plan during the construction phase.	Additional pressure on faunal habitat by increased human populations associated with the proposed mine leading to a loss of faunal habitat.	
	Increased fire frequency during construction leading to a loss of sensitive faunal habitat	Increased fire frequency during operation leading to a loss of sensitive faunal habitat	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	4	4	4	9	12	108 (High)
Operational phase	5	4	4	4	4	9	12	108 (High)
Decommissioning and closure phase	5	4	4	4	5	9	13	117 (High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	4	4	3	2	4	8	9	72 (Medium-Low)
Operational phase	3	4	3	2	4	7	9	63 (Medium-Low)
Decommissioning and closure phase	3	4	3	2	4	7	9	63 (Medium-Low)

IMPACT 2: IMPACT ON FAUNAL DIVERSITY

Mining construction and mining activities within the subject property is highly likely to have a high impact on faunal diversity, especially within the wetland, afrotemperate forests and montane grassland areas, which are sensitive in terms of ecological functioning and faunal habitat provision.

Activities which are likely to negatively affect the faunal diversity of the subject property include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive habitats;
- Destruction of faunal habitat during construction and operational activities;
- Collision of mining vehicles with faunal species;
- Trapping and poaching of faunal species;
- Alien floral invasion and erosion in disturbed areas;
- Uncontrolled fires leading to the deaths of ground dwelling and breeding species; and
- Dewatering and pollution of watercourses leading to altered riparian and wetland faunal communities;

The above activities are likely to have a significant impact on faunal diversity within and around the subject property. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potentially poor planning of infrastructure placement and design in sensitive faunal habitat	Site clearing and the removal of vegetation leading to a loss of faunal habitat and faunal diversity	On-going disturbance of soils due to operational activities leading to altered faunal diversity	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of faunal diversity
Failure to initiate a well-conceived biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Altered faunal diversity as a result of the loss of faunal habitat through invasion of alien plants	Increased introduction and proliferation of alien plant species and further transformation of faunal habitat and diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on faunal diversity.
Placement of topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive faunal habitat.	Erosion as a result of mining development and storm water runoff leading to a loss of faunal habitat and diversity.	Risk of contamination from operational facilities may pollute receiving environment leading to altered faunal diversity	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive faunal habitat.	Seepage affecting soils and the groundwater regime leading to altered faunal diversity	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Collision of faunal species with construction vehicles	Increased fire frequency during operation leading to a loss of faunal diversity	
	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase.	Poaching and trapping of faunal species	
	Increased fire frequency during construction leading to a loss of faunal diversity	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
	Poaching and trapping of faunal species	Collision of faunal species with operational vehicles	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	4	4	3	5	8	12	96 (Medium High)
Operational phase	4	4	4	3	5	8	12	96 (Medium High)
Decommissioning and closure phase	4	4	4	3	5	8	12	96 (Medium High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	3	4	3	2	4	7	9	63 (Medium-Low)
Operational phase	3	4	3	2	4	7	9	63 (Medium-Low)
Decommissioning and closure phase	3	4	2	2	4	7	8	56 (Medium-Low)

IMPACT 3: IMPACT ON FAUNAL SPECIES OF CONSERVATION CONCERN

Placement of infrastructure, construction of the mine and mining activities are likely to have an impact on faunal species of conservation concern (SCC) such as *Cercopithecus mitis labiatus* (Samango Monkey), *Anthropoides paradiseus* (Blue Crane), *Balearica reguloru* (Grey Crowned Crane), *Geronticus calvus* (Southern Bald Ibis), and *Sagittarius serpentarius* (Secretarybirds), among others. The subject property is highly likely to be utilised by additional protected species. Loss of habitat as well as poaching/ trapping will have the greatest impact on these species throughout the development and operation of the mine. The potential water quality impacts and sedimentation of the river systems as a result of the mining activities are likely to have a negative impact on the fish species *Chiloglanis emarginattus* if mitigation measures are not carried out. Mitigation measures and specific aquatic impacts are discussed further in the aquatic impact section below.

Activities which are likely to negatively affect SCC within and around the subject property include, but are not limited to, the following:

- Placement of mining infrastructure within sensitive faunal habitat;
- Destruction of faunal habitat during construction and operational activities;
- Blasting and vibrations from mining affecting fossorial mammals and nesting bird species;
- Alien floral invasion and erosion in disturbed areas;
- Impacts on water quality in wetlands and rivers; and
- Increased risk of poaching and trapping.

The above activities are likely to have a significant impact on SCC within and around the subject property. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potentially poor planning of infrastructure placement and design in sensitive faunal habitat	Site clearing and the removal of faunal habitat leading to a loss of sensitive species	On-going disturbance of habitat due to operational activities leading to a loss of sensitive species	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of sensitive species
Failure to initiate a biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Collision of vehicles with faunal species.	Increased introduction and proliferation of alien plant species and further transformation of faunal diversity	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on medicinal species

Pre-Construction	Construction	Operational	Decommissioning & Closure
Placement of topsoil stockpiles, overburden dumps and other surface infrastructure in sensitive faunal habitat.	Increased risk of poaching and trapping of sensitive species	Risk of contamination from operational facilities may pollute receiving environment leading to a loss of faunal SCC	On-going seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction through sensitive faunal habitat.	Increased risk of poaching and trapping of sensitive species	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.
	Construction of topsoil stockpiles, overburden dumps and other surface infrastructure leading to a loss of sensitive species.	Collision of vehicles with faunal species.	
	Increased fire frequency during construction leading to a loss of sensitive species	Additional pressure on sensitive species by increased human populations associated with the proposed mine	
	Failure to implement a biodiversity action plan, rehabilitation plan and alien plant control plan during the construction phase.	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase.	
		Increased fire frequency during operation leading to a loss of sensitive species	

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	4	4	4	4	8	12	96 (Medium High
Operational phase	4	4	4	4	4	8	12	96 (Medium High
Decommissioning and closure phase	4	4	4	4	4	8	12	96 (Medium High
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	3	4	3	2	3	7	8	56 (Medium-Low)
Operational phase	3	4	3	2	3	7	8	56 (Medium-Low)
Decommissioning and closure phase	3	4	2	2	3	7	7	49 (Low)

3.3 Wetland and Riparian Impact Assessment

The impact assessment was undertaken on all aspects of wetland ecology deemed likely to be affected by the proposed Commissiekraal coal mining development. The sections below present the results of the findings per identified risk/impact for the wetland ecology of the focus area.

IMPACT 1: LOSS OF WETLAND AND RIPARIAN HABITAT AND ECOLOGICAL STRUCTURE

Construction related activities that will be undertaken, such as the removal of the topsoil and construction of mining infrastructure, will lead to destruction of habitat and overall loss of wetland habitat and ecological structure. Impacts on the wetlands will lead to a loss of migratory routes for faunal species. All these activities will result in permanent impact on the wetland features and will most likely extend to downstream/downgradient areas.

Operational activities will likely, if unmitigated result in the contamination of wetland soils and water, which will lead to the alteration or loss of habitat for wetland associated floral and faunal species.

Activities which are likely to negatively affect wetland and riparian systems within and around the focus area include, but are not limited to, the following:

- Placement of mining infrastructure within wetlands and riparian areas;
- Destruction of wetland and riparian habitat during construction and operational activities;
- Dewatering;
- Discharge and/or spills and seepage from mining infrastructure;
- Diversion of surface water systems;

The above activities are highly likely to have a significant detrimental impact on wetland and riparian habitat within and around the subject property and also downstream. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Planning of infrastructure within wetland and riparian areas	Site clearing and the removal of vegetation leading to increased runoff and erosion	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potentially inadequate design of infrastructure leading to risks of pollution	Site clearing and the disturbance of soils leading to increased erosion	Spillages and seepage of hazardous waste material into the groundwater	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
Potentially inadequate design of infrastructure leading to changes to wetland and riparian habitat	Earthworks in the vicinity of wetland and riparian areas leading to increased runoff and erosion and altered runoff patterns	Risk of contamination from the mining infrastructure	Ongoing risk of contamination from mining infrastructure beyond closure
	Construction of stream crossings altering stream and base flow patterns and water velocities	Potential contamination from mining infrastructure	Potential contamination from the decommissioning of mining infrastructure
	Topsoil stockpiling adjacent to wetland and riparian areas and runoff from stockpiles	Runoff, seepage and potential contamination from mining infrastructure such as clean and dirty water systems	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
	Movement of construction vehicles within wetland and riparian areas	Dumping of hazardous and non-hazardous waste into the wetland and riparian areas	Decommissioning activities may lead to wetland and riparian habitat transformation and alien plant species proliferation
	Dumping of hazardous and non-hazardous waste into the wetland and riparian areas	Erosion and sedimentation of wetland and riparian areas leading to loss of wetland and riparian habitat	Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment
	Waste material spills and waste refuse deposits into the wetland and riparian features	Sedimentation and incision leading to altered habitats	Ongoing erosion and sedimentation of wetland and riparian areas
		Loss of wetland and riparian floral biodiversity	Loss of wetland and riparian floral biodiversity

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	5	5	4	3	10	12	120 (High)
Operational phase	5	5	4	4	4	10	12	120 (High)
Decommissioning and closure phase	5	5	4	4	5	10	13	130 (Very High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	4	5	3	3	2	9	8	72 (Medium-Low)
Operational phase	3	5	2	2	4	9	8	72 (Medium-Low)
Decommissioning and closure phase	3	5	2	2	4	9	8	72 (Medium-Low))

IMPACT 2: CHANGES TO WETLAND ECOLOGICAL AND SOCIOCULTURAL SERVICE PROVISION

Construction related activities that will be undertaken, such as the removal of the topsoil and construction of mining infrastructure, will lead to destruction of habitat and overall loss of wetland and riparian ecological and sociocultural service provision such as cultural value, biodiversity maintenance and nutrient and toxicant assimilation. All these activities will result in permanent impact on the wetland features and will most likely extend to downstream/downgradient areas.

Operational activities will likely result in the contamination of wetland soils and water, which will lead to the alteration or loss of wetland and riparian ecological and sociocultural service provision.

Activities which are likely to negatively affect wetland and riparian systems within and around the subject property include, but are not limited to, the following:

- Placement of mining infrastructure within wetlands and riparian areas;
- Destruction of wetland and riparian habitat during construction and operational activities;
- Dewatering;
- Discharge and/or spillage and seepage from mining infrastructure;
- Diversion of surface water systems;

The above activities are highly likely to have a significant detrimental impact on wetland and riparian ecological and sociocultural service provision within and around the focus area and also downstream. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Planning of infrastructure within wetland and riparian areas	Site clearing and the removal of vegetation leading to increased runoff and erosion	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities
Potentially inadequate design of infrastructure leading to risks of pollution	Site clearing and the disturbance of soils leading to increased erosion	Spillages and seepage of hazardous waste material into the groundwater	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
Potentially inadequate design of infrastructure leading to changes to wetland and riparian habitat	Earthworks in the vicinity of wetland and riparian areas leading to increased runoff and erosion and altered runoff patterns	Risk of contamination from the mining infrastructure	Ongoing risk of contamination from mining infrastructure beyond closure

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Construction of stream crossings altering stream and base flow patterns and water velocities	Potential contamination from mining infrastructure	Potential contamination from the decommissioning of mining infrastructure
	Topsoil stockpiling adjacent to wetland and riparian areas and runoff from stockpiles	Runoff, seepage and potential contamination from mining infrastructure such as clean and dirty water systems	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
	Movement of construction vehicles within wetland and riparian areas	Dumping of hazardous and non-hazardous waste into the wetland and riparian areas	Decommissioning activities may lead to wetland and riparian habitat transformation and alien plant species proliferation
	Dumping of hazardous and non-hazardous waste into the wetland and riparian areas	Erosion and sedimentation of wetland and riparian areas leading to loss of wetland and riparian habitat	Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment
	Waste material spills and waste refuse deposits into the wetland and riparian features	Sedimentation and incision leading to altered habitats	Ongoing erosion and sedimentation of wetland and riparian areas

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	5	5	4	3	10	12	120 (High)
Operational phase	5	5	4	4	4	10	12	120 (High)
Decommissioning and closure phase	5	5	4	4	5	10	13	130 (Very High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	4	5	3	3	2	9	8	72 (Medium-Low)
Operational phase	3	5	2	2	4	9	8	72 (Medium-Low)
Decommissioning and closure phase	3	5	2	2	4	9	8	72 (Medium-Low))

IMPACT 3: IMPACTS ON WETLAND HYDROLOGICAL FUNCTION AND SEDIMENT BALANCE

Mining and construction activities that will be undertaken, such as the removal of the topsoil and construction of mining infrastructure, will lead to disturbances of wetland hydrological function and sediment balance. Furthermore, as the systems are interconnected, any impacts are likely to affect the entire system. All these activities will result in permanent impact on the wetland features.

Activities which are likely to negatively affect wetland and riparian systems within and around the subject property include, but are not limited to, the following:

- Placement of mining infrastructure within wetlands and riparian areas;
- Destruction of wetland and riparian habitat during construction and operational activities;
- Dewatering;
- Discharge and/or spills and seepage from mining infrastructure;
- Diversion of surface water systems;

The above activities are highly likely to have a significant detrimental impact on wetland and riparian habitat within and around the subject property and also downstream. The following tables provide an indication of the anticipated impact significance pre- and post-mitigation.

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential planning of infrastructure within wetland and riparian areas	Site clearing and the removal of vegetation leading to increased runoff and erosion	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities
Potentially inadequate design of infrastructure leading to risks of pollution	Site clearing and the disturbance of soils leading to increased erosion	Spillages and seepage of hazardous waste material into the groundwater	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
Potentially inadequate design of infrastructure leading to changes to wetland and riparian habitat	Earthworks in the vicinity of wetland and riparian areas leading to increased runoff and erosion and altered runoff patterns	Risk of contamination from the mining infrastructure	Ongoing risk of contamination from mining infrastructure beyond closure
	Construction of stream crossings altering stream and base flow patterns and water velocities	Potential contamination from mining infrastructure	Potential contamination from the decommissioning of mining infrastructure

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Topsoil stockpiling adjacent to wetland and riparian areas and runoff from stockpiles	Runoff, seepage and potential contamination from mining infrastructure such as clean and dirty water systems	Ongoing seepage and runoff from mining infrastructure to the groundwater regime beyond closure
	Movement of construction vehicles within wetland and riparian areas	Dumping of hazardous and non-hazardous waste into the wetland and riparian areas	Decommissioning activities may lead to wetland and riparian habitat transformation and alien plant species proliferation
	Dumping of hazardous and non-hazardous waste into the wetland and riparian areas	Erosion and sedimentation of wetland and riparian areas leading to loss of wetland and riparian habitat	Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment
	Waste material spills and waste refuse deposits into the wetland and riparian features	Sedimentation and incision leading to altered habitats	Ongoing erosion and sedimentation of wetland and riparian areas
		Loss of wetland and riparian floral biodiversity	Loss of wetland and riparian floral biodiversity

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	5	5	4	3	10	12	120 (High)
Operational phase	5	5	4	4	4	10	12	120 (High)
Decommissioning and closure phase	5	5	4	4	5	10	13	130 (Very High)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	4	5	3	3	2	9	8	72 (Medium-Low)
Operational phase	3	5	2	2	4	9	8	72 (Medium-Low)
Decommissioning and closure phase	3	5	2	2	4	9	8	72 (Medium-Low))

3.4 Aquatic Impact Assessment

The impact assessment was undertaken on all aspects of aquatic ecology deemed likely to be affected by the proposed Commissiekraal coal project development. The sections below present the results of the findings per identified risk/impact for the instream and riparian zones of the mining rights area.

IMPACT 1: LOSS OF INSTREAM FLOW

Groundwater contributes to baseflow throughout the upper Pandana River catchment via sub-surface seepage into surface water courses. A manual flow measurement was determined in September 2015 downstream of the Commissiekraal proposed mine workings. The flow volume calculated by SAS at the section site was approximately 29 L/s. Based on the modelling results of the groundwater study the groundwater contribution of 17.3 L/s is 59 % of the surface flow measured. It must be noted that the modelling results is averaged over the year and seasonally it will fluctuate according to the wet and dry season.

Impacts on reduced instream flow will in turn affect aquatic refugia, loss of flow dependant taxa along with deterioration in water quality. In terms of aquatic and riparian zone ecology relating to the mining rights area, the Pandana River (sites CK3 to CK1, CK5 and CK6) is most significant. However, other potential drainage lines should also be taken into account when planning of the proposed mine takes place, as the surrounding systems (such as the Sibabe River, site CK4) is also considered to be in a largely natural condition.

It is expected that activity proposed to take place within the mining rights area may negatively affect flow rates and result in unnatural peak flows in the Pandana River downstream of the mining rights area. Factors which may play a role are indicated below:

- Change in surface coverage. Development of the mining rights area will change the surface coverage in some areas from vegetated soil to buildings, hardened gravel roads, paved areas (parking), and compacted earth. However, the implementation of and underground mining operation as opposed to a surface mining operation, already greatly decreases the impacted surface area;
- Inadequate separation and management of clean and dirty water may lead to unnatural instream flow changes, which may affect the flow characteristics and ultimately lead to loss of catchment yield;
- Capture of run-off and capture of rainfall (inundation) in the ‘dirty’/impacted areas would lower instream flow in the receiving environment;

- Closely related to inundation is the canalisation of run-off in other areas. Intercepting run-off around mining activities and infrastructure could reduce the amount of time that water would take to reach the Pandana River and may lead to "flash flood" events on varying scales. This is likely to occur due to:
  - the decreased friction on the water associated with concentrated flow in a concrete-lined canal, as opposed to sheet flow on hill slopes;
  - the consequently lower flow velocities.

The above factors are likely to lead to altered riverine recharge flood peaks and a general loss of runoff volumes successfully reaching the Pandana River system as well as the other drainage systems in the area. This in turn may lead to the loss of aquatic biota such as fish and aquatic macro-invertebrates which rely on the presence of surface water. Fish such as *C. emarginatus* and *C. anoterus* are dependent on clear water of adequate depth and velocity over suitable substrate for long-term survival.

Activities potentially leading to impact

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potentially poor planning leading to extensive dirty water areas which need to be managed which may reduce the mean annual run-off (MAR) to the non-perennial drainage systems in the area.	Construction of possible small stream diversions may impact on the instream flow of the receiving systems.	Loss of MAR from dirty water areas may impact on the instream flow of the receiving systems.	Loss of MAR from latent dirty water areas may still impact on the flow even after operational phase.
Potentially inadequate design of temporary stream diversions which may lead to loss of recharge of the larger systems.	Construction of clean and dirty water separation structures for pollution control purposes may lead to altered flow levels.	Loss of water through clean and dirty water separation may alter instream flow on the receiving systems.	Loss of water to inadequately rehabilitated areas such as discard dumps may still have an impact on the flow post operational phase. However, the absence of open pits will already reduce potential impact.
Design of canals leading to rapid release of water which in turn may lead to a loss of streamflow regulation capabilities in the area	-	Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may lead to altered instream flow	Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may impact on the flow post operational phase
Use of surface runoff and groundwater sources for the supply of production water for the mining project may alter the flow in the receiving systems	-	-	-

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potentially poor planning leading to extensive dirty water areas which need to be managed which may reduce the mean annual run-off (MAR) to the non-perennial drainage systems in the area.	Construction of possible small stream diversions may impact on the instream flow of the receiving systems.	Loss of MAR from dirty water areas may impact on the instream flow of the receiving systems.	Loss of MAR from latent dirty water areas may still impact on the flow even after operational phase.
Potentially inadequate design of temporary stream diversions which may lead to loss of recharge of the larger systems.	Construction of clean and dirty water separation structures for pollution control purposes may lead to altered flow levels.	Loss of water through clean and dirty water separation may alter instream flow on the receiving systems.	Loss of water to inadequately rehabilitated areas such as discard dumps may still have an impact on the flow post operational phase. However, the absence of open pits will already reduce potential impact.
Design of canals leading to rapid release of water which in turn may lead to a loss of streamflow regulation capabilities in the area	-	Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may lead to altered instream flow	Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may impact on the flow post operational phase
Use of surface runoff and groundwater sources for the supply of production water for the mining project may alter the flow in the receiving systems	-	-	-
Design of canals leading to rapid release of water which in turn may lead to a loss of streamflow regulation capabilities in the area	-	Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may lead to altered instream flow	Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may impact on the flow post operational phase
Use of surface runoff and groundwater sources for the supply of production water for the mining project may alter the flow in the receiving systems	-	-	-

Aspects of instream flow affected

Construction	Operational	Decommissioning and Closure
Loss of instream surface and base flow	Loss of instream surface and base flow	Loss of instream surface and base flow
Loss of streamflow regulation and stream recharge	Loss of streamflow regulation and stream recharge	Loss of streamflow regulation and stream recharge
Loss of aquatic habitats and refugia for aquatic macro-invertebrates and fish	Loss of aquatic habitats and refugia for aquatic macro-invertebrates and fish	Loss of aquatic habitats for aquatic macro-invertebrates and fish
Increased moisture stress on riparian vegetation	Increased moisture stress on riparian vegetation	Increased moisture stress on riparian vegetation

Unmanaged	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	5	4	4	3	3	9	10	**90 (Medium high)**
Operational phase	5	4	5	4	4	10	12	**120 (Very High)**
Decommissioning and closure phase	5	4	5	4	5	10	13	**130 (Very High)**
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	3	4	2	2	3	7	7	**49 (Low)**
Operational phase	3	4	4	3	4	8	10	**80 (Medium-High)**
Decommissioning and closure phase	3	4	4	3	3	8	9	**72 (Medium-low)**

IMPACT 2: IMPACTS ON WATER QUALITY

The potential for post-closure impacts on water quality are of concern. With a simulated steady-state groundwater inflow rate of 20.1 l/s), it would take theoretically 22 years before the mine voids are completely flooded. It is widely accepted that the underground mines also decant, usually at the same rate as recharge (inflows) and a significant impact on water quality can be expected which in turn will impact on the aquatic ecology of the Pandana River system.

If all constituents in the cumulative discharge from the proposed Commissiekraal mining activities are within the applicable target water quality ranges (DWAF, 1996), then the activities will not contribute significantly to an unacceptable cumulative impact. Thus a conservative approach is to be taken, in this case to account for possible discharge of pollutants by future activities in the river catchment. The Pandana River is the most significant aquatic system linked to the mining rights area which may be impacted on and requires the most attention when considering impacts on reduced water quality and the impact it may have on the aquatic community. Close monitoring of any spatial or temporal trends is advised.

Increased sediment load

Increased erosion of disturbed surfaces means that the run-off contains a higher silt or sediment load which may be discharged into the Pandana River. As a result of the current natural state of the mining rights area, the vegetation cover causes friction to rainfall run-off. This reduces flow velocities and consequently shear forces between the water and the ground surface, resulting in the ground surface remaining intact and not being eroded away. If for any reason the ground surface is disturbed and the flow velocities are increased, then there is potential for increased erosion to occur. Increased sediment load contains suspended solids. If there are too many suspended solids in the water this can negatively affect biological life.

The following activities are likely to cause an increase in movement of sediment loads, or directly increase erosion:

- Stripping (vegetation clearance) of mining areas prior to excavation of stockpile areas;
- Construction of hard-standing areas that increase run-off volumes, including roads, buildings and paved areas;

- Canalisation of run-off, particularly if canals do not discharge directly into the Pandana River and
- Construction activities that loosen the ground surface.

Impaired water quality due to pollutants discharged from processing plant

Wastewater from the coal ore beneficiation process would contain pollutants in excess of the target water quality ranges for the water uses of the receiving water body. Discharge of wastewater would thus impact negatively on the surface water quality.

A further consideration is the run-off of pollutants from the process plant area following rainfall, due to the activities within that area.

Impaired water quality due to pollutants in run-off from stockpiles

It is likely that run-off from the stockpiles will have a different chemical composition to natural run-off. In this event it is best practice to keep ‘dirty’ water from stockpile run-off separate from ‘clean’ water from natural run-off.

Impaired water quality due to petrochemical spills

Fuel or oil spills from vehicles could contaminate surface water resources. Leakages, spills or run-off from vehicle wash bays, workshop facilities, fuel depots or storage facilities of potentially polluting substances could contaminate surface water resources.

Heavy metal contamination

Increase in metal concentrations is commonly associated with tillage and blasting of the upper crust of the earth’s surface. Because this will not be an open cast mining operation, such an impact is expected to be of negligible severity. However, mining operations can still release metals into the associated surface and ground water systems. Under alkaline conditions, most of the metals remain biologically unavailable, however in the presence of acid mine drainage the metal-speciation changes and they become available.

This may alter the species composition of the aquatic biota inhabiting the surrounding rivers especially downstream of the proposed development.

Impaired water quality due to pollutants released from processing plant

Wastewater from the coal ore beneficiation process would contain pollutants in excess of the target water quality ranges for the water uses of the receiving water body. The potential release of wastewater would thus impact negatively on the surface water quality. A further consideration is the run-off of pollutants from the process plant area following rainfall, due to the activities within that area.

Impaired water quality due to pollutants in run-off from stockpiles

It is likely that run-off from the stockpiles will have a different chemical composition to natural run-off. In this event it is best practice to keep 'dirty' water from stockpile run-off separate from 'clean' water from natural run-off.

Impaired water quality due to pollutants in water released from voids

Overflow of water (decant), whether surface or ground, from the voids is likely to release pollutants to the surface water environment if geochemical testing indicates a possible acid mine drainage, elevated salts and/or other water quality issue.

Impaired water quality due to petrochemical spills

Fuel or oil spills from vehicles could contaminate surface water resources. Leakages, spills or run-off from vehicle wash bays, workshop facilities, fuel depots or storage facilities of potentially polluting substances could contaminate surface water resources.

Heavy metal contamination

Increase in metal concentrations is commonly associated with tillage and blasting of the upper crust of the earth's surface. This releases metals into the associated surface and ground water systems. Under alkaline conditions, most of the metals remain biologically unavailable, however in the presence of acid mine drainage the metal-speciation changes and they become available. This may alter the species composition of the aquatic biota inhabiting the surrounding rivers especially downstream of the proposed development.

Activities potentially leading to impact

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potentially poor planning leading to extensive and complex dirty water areas which need to be managed may impact on water quality.	Clean and dirty water systems not being constructed to the required specifications to prevent contamination of clean water areas may impact on water quality.	Mining activities and the establishment of mining waste may impact on water quality and thus needs to be managed to prevent pollution.	Inadequate closure and rehabilitation leading to ongoing pollution from contaminating sources such as discard dumps may impact on water quality.
Potentially poor planning leading to placement of polluting structures in non-perennial drainage lines which would increase mobility of pollutants and may impact on water quality.	Major earthworks and construction activities may lead to impacts on water quality.	Clean and dirty water systems not being maintained and operated to the required specifications to prevent contamination of clean water areas may impact on water quality.	Clean and dirty water systems not being maintained or decommissioned properly to the required specifications to prevent contamination of clean water areas may impact on water quality.

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potentially inadequate separation of clean and dirty water areas leading to contaminated water leaving the defined dirty water area may impact in water quality.	Poor housekeeping and management may lead to impacts on water quality.	Poor housekeeping and management during operational phase may lead to impacts on water quality.	Poor housekeeping and management during decommissioning phase may lead to impacts on water quality.
Clean and dirty water systems not being designed adequately to ensure protection of the water resources.	Spills and other unplanned events may impact on water quality.	Spills and other unplanned events during operational phase may impact on water quality.	Spills and other unplanned events during decommissioning phase may impact on water quality.
			Post closure decant from underground workings

Aspects of instream water quality affected

Construction	Operational	Decommissioning and Closure
Impact on riparian vegetation structures due to impaired water quality.	Impact on riparian vegetation structures due to impaired water quality.	Impact on riparian vegetation structure due to impaired water quality.
Build-up of contaminants in sediments leading to the creation of a sediment sink and chronic source of potential water contamination.	Build-up of contaminants in sediments leading to the creation of a sediment sink and chronic source of potential water contamination.	Latent release of contaminants in sediments leading to the formation of an ongoing source of potential water contamination.
-	Impacts on groundwater quality which could manifest in surface water sources.	Impacts on groundwater quality which could manifest in surface water sources.

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	4	3	3	9	10	**90 (Medium-high)**
Operational phase	5	4	4	4	4	9	12	**108 (High)**
Decommissioning and closure phase	5	4	4	4	5	9	13	**104 (High)**
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	2	4	2	2	2	6	6	**36 (Low)**
Operational phase	3	4	3	3	4	7	10	**70 (Medium-low)**
Decommissioning and closure phase	4	4	3	3	4	8	10	**80 (Medium-High)**

IMPACT 3: LOSS OF AQUATIC HABITAT

Habitat transformation and destruction is the alteration of a natural habitat to the point that it is rendered unfit to support species dependent upon it as their home territory. Loss or transformation of habitat may cause a reduction of biodiversity, due to organisms previously using the area being displaced or destroyed. Globally modification of habitats for agriculture is the chief cause of such habitat loss. Habitat destruction is presently ranked as the most significant cause of species population decrease and ultimately species extinction worldwide. Additional causes of habitat destruction include surface mining, deforestation, slash-and-burn practices, urban development, water pollution, introduction of alien species, over grazing and over harvesting of resources such as fishing. Riverine systems and particularly temporary riverine systems or river systems that have very low flows as part of their annual hydrological cycles are particularly susceptible to changes in habitat condition. The proposed mining activity of the proposed Commissiekraal coal project has the potential to lead to habitat loss and/or alteration of the aquatic and riparian resources on the mining rights area.

Activities potentially leading to impact

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potentially poor planning leading to the placement of infrastructure within non-perennial drainage lines, with special mention of the waste stockpile areas as well as roads, road crossings and bridges all may alter the aquatic habitat.	Site clearing and the removal of vegetation leading to increased runoff and erosion may alter the aquatic habitat.	Ongoing disturbance of soils during general operational activities may alter the aquatic habitat.	Disturbance of soils as part of demolition activities may alter the aquatic habitat.
Potentially inadequate design of infrastructure leading to changes to instream habitat.	Site clearing and road construction and the disturbance of soils leading to increased erosion may alter the aquatic habitat.	Inadequate separation of clean and dirty water areas may alter the aquatic habitat during the operational phase.	Inadequate separation of clean and dirty water areas may alter the aquatic habitat during the decommissioning phase.
Potentially inadequate design of infrastructure leading to changes to system hydrology may alter the aquatic habitat.	Earthworks in the vicinity of drainage systems leading to increased runoff and erosion and altered runoff patterns may alter the aquatic habitat.	Mining related activities leading to increased disturbance of soils and drainage lines may alter the aquatic habitat.	Ongoing pollution from inappropriately decommissioned structures may alter the aquatic habitat.
Potentially inadequate separation of clean and dirty water areas and the prevention of the release of sediment rich water may alter the aquatic habitat within the receiving environment.	Construction of bridge crossings altering streamflow patterns and water velocities may alter the aquatic habitat.	Any activities which lead to the reduction of flow in the system with special mention of the use of surface and groundwater sources for production water may alter the aquatic habitat.	Alien vegetation encroachment will impact on and alter the aquatic habitat.
	Alien vegetation encroachment will impact on and alter the aquatic habitat.	Alien vegetation encroachment will impact on and alter the aquatic habitat.	

Aspects of instream habitat affected

Construction	Operational	Decommissioning and Closure
Erosion and incision of riparian zone.	Erosion and incision of riparian zone.	Erosion and incision of riparian zone.
Altered wetting patterns leading to impacts on riparian zone continuity.	Altered wetting patterns leading to impacts on riparian zone continuity.	Altered wetting patterns leading to impacts on riparian zone continuity.
Loss of low flow refugia.	Loss of low flow refugia.	Loss of low flow refugia.
Altered substrate conditions from sandy conditions to more muddy conditions.	Altered substrate conditions from sandy conditions to more muddy conditions.	Altered substrate conditions from sandy conditions to more muddy conditions.
Altered depth and flow regimes in the major drainage systems.	Altered depth and flow regimes in the major drainage systems.	Altered depth and flow regimes in the major drainage systems.
Alien vegetation proliferation.	Alien vegetation proliferation.	Alien vegetation proliferation.

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	5	3	3	9	11	99 (Medium-high)
Operational phase	5	4	5	4	4	9	13	117 (High)
Decommissioning and closure phase	5	4	4	3	4	9	11	99 (Medium-high)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	3	4	2	2	3	7	7	49 (Low)
Operational phase	3	4	3	3	4	7	10	70 (Medium-low)
Decommissioning and closure phase	3	4	3	3	3	7	9	63 (Medium-low)

IMPACT 4: LOSS OF AQUATIC BIODIVERSITY AND SENSITIVE TAXA

The planned mining activities of the proposed Commissiekraal coal project have the potential to lead to a loss of aquatic biodiversity as impacts on instream flow, water quality and habitat will all affect species diversity and especially more sensitive taxa and species of conservation concern.

Loss or a decrease of aquatic biodiversity and sensitive taxa is largely driven by impacts stressed by instream flow, altered water quality and habitat loss. The aquatic ecosystems in the region of the subject property provide suitable habitat for rare and endangered species conservation and hence have a high significance with reference to sensitive taxa, most notably the presence of rock catlet fish populations. Whilst neither *C. emarginatus* nor *C. anoterus* are considered by the IUCN to be threatened species, they are very sensitive to changes in habitat conditions. This is evident from the fact that *C. emarginatus* has locally gone extinct from its type locality, the Lekkerloop stream, due to excessive water extraction by farmers during the dry season (http://www.iucnredlist.org/details/63366/0). This species is also described as "near threatened" by Skelton (2001). Local extinction of any populations that occur in the systems assessed, with specific reference to *C. emarginatus*, will have a significant impact on the conservation status of the species. Introduction of predacious alien fish species and habitat degradation from impacts such as water extraction, flow modification/river regulation and sedimentation from agro-forestry activities are considered serious threats to these species. Given the largely natural state of the aquatic resources within the larger area, the aquatic ecosystems are considered to be highly sensitive. Any mining activities, if not adequately mitigated, are expected to have a detrimental impact on aquatic ecosystems function, including fish communities, in the subject property. Mining in the direct vicinity of any aquatic ecosystems is thus discouraged and very well contemplated, executed and managed clean and dirty water separation systems will be required.

The monitoring of aquatic communities such as macro-invertebrates and fish within aquatic systems vary over season and other factors such as weather play a vital role when field studies are conducted. It is thus crucial to implement a regular monitoring strategy which will increase the data set and understanding of the aquatic community within the surrounding aquatic systems linked in the vicinity of the proposed mining area. It is recommended that a biannual high flow (Summer) and low flow (Winter) biomonitoring strategy be implemented as part of the ongoing monitoring program with an initial quarterly assessment prior to major construction in the area.

Activities potentially leading to impact

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potentially poor planning leading to the placement of infrastructure within non-perennial drainage lines with special mention of the overburden stockpile areas, road crossings and bridges may lead to a loss in aquatic biodiversity.	Site clearing and the removal of vegetation may lead to a loss in aquatic biodiversity.	Ongoing disturbance of soils with general operational activities may lead to a loss in aquatic biodiversity.	Disturbance of soils as part of demolition activities may lead to a loss in aquatic biodiversity.
Potentially inadequate design of infrastructure leading to changes to instream habitat may lead to a loss in aquatic biodiversity.	Site clearing and road construction may lead to a loss in aquatic biodiversity.	Inadequate separation of clean and dirty water areas may lead to a loss in aquatic biodiversity.	Inadequate separation of clean and dirty water areas may lead to a loss in aquatic biodiversity.
Potentially inadequate design of infrastructure leading to changes to system hydrology may lead to a loss in aquatic biodiversity.	Earthworks and other mining construction activities in the vicinity of wetland and riparian areas may lead to a loss in aquatic biodiversity.	Loss of instream flow due to abstraction for water for production may lead to a loss in aquatic biodiversity.	Seepage from any latent discard dumps and dirty water areas may lead to a loss in aquatic biodiversity.
Potentially inadequate design of infrastructure leading to contamination of water and sediments in the streams may lead to a loss in aquatic biodiversity.	Construction of bridge crossings altering streamflow patterns and water velocities may lead to a loss in aquatic biodiversity.	Seepage from the discard dumps and overburden stockpiles may lead to a loss in aquatic biodiversity.	Inadequate closure leading to post closure impacts on water quality may lead to a loss in aquatic biodiversity.
-	Placement of infrastructure within non-perennial drainage lines with special mention of the overburden stockpile areas, road crossings and bridges may lead to a loss in aquatic biodiversity.	Potential discharge from the mine process water system with special mention of RWD and any PCD's may lead to a loss in aquatic biodiversity.	Ongoing erosion of disturbed areas that have not been adequately rehabilitated may lead to a loss in aquatic biodiversity.
-	Inadequate separation of clean and dirty water areas may lead to a loss in aquatic biodiversity.	Sewage discharge from mine offices and camps may lead to a loss in aquatic biodiversity.	-
-	-	Nitrates form blasting leading to eutrophication of the receiving environment and may lead to a loss in aquatic biodiversity	-

Aspects of aquatic biodiversity affected

Construction	Operational	Decommissioning and Closure
Sedimentation and loss of natural substrates.	Sedimentation and loss of natural substrates.	Sedimentation and loss of natural substrates.
Altered stream channel forms.	Altered stream channel forms.	Altered stream channel forms.
Increased turbidity of water.	Increased turbidity of water.	Loss of refugia.
Loss of refugia.	Loss of refugia.	Deterioration in water quality with special mention of impacts from cyanide, heavy metals and salinisation.
Deterioration in water quality.	Deterioration in water quality with special mention of impacts from cyanide, heavy metals, AMD and salinisation.	Eutrophication of the aquatic ecosystems.
Loss of flow sensitive macro-invertebrates and fish.	Eutrophication of the aquatic ecosystems.	Loss of flow sensitive macro-invertebrates and fish.
Loss of water quality sensitive macro-invertebrates and fish.	Loss of flow sensitive macro-invertebrates and fish.	Loss of water quality sensitive macro-invertebrates and fish.
Loss of riparian vegetation species.	Loss of water quality sensitive macro-invertebrates and fish.	Loss of riparian vegetation species.
-	Loss of riparian vegetation species	-

Unmanaged	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	4	5	3	3	3	9	9	**81 (Medium-high)**
Operational phase	4	5	4	4	4	9	12	**108 (High)**
Decommissioning and closure phase	4	5	4	4	5	9	13	**117 (High)**
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction phase	2	5	2	2	3	7	7	**49 (Low)**
Operational phase	2	5	3	4	3	7	10	**70 (Medium-low)**
Decommissioning and closure phase	2	5	3	4	3	7	10	**70 (Medium-low)**

3.5 Impact assessment conclusion

Based on the above assessment there are four possible impacts that may have an effect on the overall ecological resources in the vicinity of the proposed Commissiekraal mine, three possible impacts on the floral resources, three possible impacts on the faunal resources, three possible impacts on the wetland and riparian resources and four possible impacts on the aquatic resources. The tables below summarise the findings indicating the significance of the impacts before mitigation takes place as well as the significance of the impacts if appropriate management and mitigation takes place.

From the results of the floral impact assessment it is evident that prior to mitigation all impacts on the receiving floral environment are high in the construction and operational phases and very high in the decommissioning and closure phase. Mitigation measures available will minimise the impacts on the receiving floral environment and impact significance is reduced to medium high after mitigation.

Table 5: Summary of impact significance on floral resources.

Construction Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for floral species	High	Medium High
2: Impact on floral diversity	High	Medium High
3: Impact on species of conservation concern	High	Medium High
Operational Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for floral species	High	Medium High
2: Impact on floral diversity	High	Medium High
3: Impact on species of conservation concern	High	Medium High
Decommissioning and Closure Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for floral species	Very High	Medium High
2: Impact on floral diversity	Very High	Medium High
3: Impact on species of conservation concern	Very High	Medium High
Summary	**High**	**Medium High**

From the results of the faunal impact assessment it is evident that prior to mitigation all impacts on the receiving faunal environment are very high in the construction and decommissioning and closure phases and high in the operational phase. Mitigation measures available will have limited ability to minimise the impacts on the receiving faunal environment and impact significance remains medium high to high after mitigation.

Table 6: Summary of impact significance on faunal resources.

Construction Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	High	Medium Low
2: Impact on faunal diversity	Medium High	Medium Low
3: Impact on species of conservation concern	Medium High	Medium Low
Operational Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	High	Medium Low
2: Impact on faunal diversity	Medium High	Medium Low
3: Impact on species of conservation concern	Medium High	Medium Low
Decommissioning and Closure Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	High	Medium Low
2: Impact on faunal diversity	Medium High	Medium Low
3: Impact on species of conservation concern	Medium High	Low
Summary	**Medium High**	**Medium Low**

From the results of the wetland and riparian impact assessment it is evident that prior to mitigation all impacts on the wetland and riparian systems are high throughout all phases. Mitigation measures available will minimise the impacts on the receiving wetland environment and impact significance is reduced to medium low after mitigation.

Table 7: Summary of impact significance on wetland and riparian resources.

Construction Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	High	Medium Low
2: Impact on faunal diversity	High	Medium Low
3: Impact on species of conservation concern	High	Medium Low
Operational Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	High	Medium Low
2: Impact on faunal diversity	High	Medium Low
3: Impact on species of conservation concern	High	Medium Low
Decommissioning and Closure Phase		
Impact	**Unmanaged**	**Managed**
1: Impact on habitat for faunal species	Very High	Medium Low
2: Impact on faunal diversity	Very High	Medium Low
3: Impact on species of conservation concern	Very High	Medium Low
Summary	**High**	**Medium Low**

The table below summarises the aquatic impact assessment. From the results of the assessment it is evident that prior to mitigation all impacts on the Pandana River are either high or medium-high. However, with mitigation, impacts on the Pandana River may be reduced to medium-low or low impact.

Table 8: Summary of impact significance on the aquatic resources (Pandana River).

Construction phase		
Impact	**Unmanaged**	**Managed**
1: Loss of instream flow	Medium - High	Low
2: Impacts on water quality	Medium - High	Medium - Low
3: Loss of aquatic habitat	Medium - High	Low
4: Loss of aquatic biodiversity	Medium - High	Low
Operational phase		
Impact	**Unmanaged**	**Managed**
1: Loss of instream flow	Very High	Medium - High
2: Impacts on water quality	High	Medium - Low
3: Loss of aquatic habitat	High	Medium - Low
4: Loss of aquatic biodiversity	High	Medium - Low
Decommissioning phase		
Impact	**Unmanaged**	**Managed**
1: Loss of instream flow	Very High	Medium - Low
2: Impacts on water quality	High	Medium - High
3: Loss of aquatic habitat	Medium - High	Medium - Low
4: Loss of aquatic biodiversity	High	Medium - Low
Summary	**High**	**Medium - Low**

4. INTEGRATED IMPACT MITIGATION

4.1 Floral Impact Mitigation

4.1.1 Mitigation measures

Based on the findings of the floral ecological assessment, several recommendations are made to minimise the impact on the floral ecology of the area, should the proposed mining project proceed:

- Any disturbance of sensitive floral habitat and species of conservation concern must be actively avoided;
- If any mining activities are to be authorised, it is strongly recommended that the surface footprint of the proposed mine be reduced to the minimum;
- The footprint and daily operation of surface infrastructure must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding sensitive floral habitat. The significance of the impact on the ecology of the area will be largely linked to the degree to which this can be implemented;
- Sensitive floral habitat and associated buffer zones beyond the immovable footprint areas must be designated as No-Go areas and no mining vehicles, personnel, or any other mining related activities are to encroach upon these areas;
- An effective dust management plan bust be designed and implemented in order to mitigate the impact of dust on flora throughout all mining phases;

- Adequate stormwater management must be incorporated into the design of the proposed development throughout all phases in order to prevent erosion of topsoil and the loss of floral habitat. In this regard, special mention is made of:
  - Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed;
  - Runoff from paved surfaces should be slowed down by the strategic placement of berms; and
  - All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff of the facilities;
- All affected riparian and wetland systems must be monitored for moisture stress and monitor all potentially affected riparian zones for changes in riparian vegetation structure;
- An alien floral control plan must be designed and implemented in order to monitor and control alien floral recruitment in disturbed areas. Furthermore, it is strongly recommended that alien floral control is implemented by the mine in the wider subject property. The alien floral control plan must be implemented for a period of 5 years after decommissioning and closure;
- No collection of firewood, RDL/Protected or medicinal floral species must be allowed by mining personnel;
- No illicit fires must be allowed during any phases of the proposed mining development;
- Concurrent/progressive rehabilitation must be implemented at all times and disturbed areas must be rehabilitated as soon as possible. This will not only reduce the total disturbance footprint, but will also reduce the overall rehabilitation effort and cost;
- A nursery must be developed in conjunction with a suitably qualified specialist where indigenous/endemic plant species must be propagated with focus on rehabilitation;
- Rehabilitation trials must be continuously undertaken from the commencement of construction in order to determine the efficiency of rehabilitation methods and the suitability of flora propagated in the nursery for rehabilitation;
- The nursery plan and rehabilitation plan must be continuously updated in accordance with the trial results in order to ensure that optimal rehabilitation measures are employed;
- Rehabilitation efforts must be implemented for a period of at least 5 years after decommissioning and closure;

- A protected and RDL floral relocation, monitoring and management plan must be designed and implemented by a suitably qualified specialist and should address all species which can be successfully rescued and relocated;
- During the surveying and site-pegging phase of surface infrastructure, all RDL/protected species which will be affected by surface infrastructure must be marked and where possible, relocated to suitable habitat surrounding the disturbance footprint. If relocation is impossible or any of the protected species are destroyed, 3 plants for every protected plant destroyed must be propagated in the nursery. The relevant permits must be applied for as indicated in the baseline floral assessment;

4.1.2 Probable Latent Impacts

Even with extensive mitigation, latent impacts on the receiving floral ecological environment are deemed likely. The following points highlight the key latent impacts that have been identified:

- Destruction of ecologically intact, irreplaceable floral habitat;
- Permanent loss of niche floral habitat;
- Permanent loss of floral habitat earmarked for conservation;
- Permanent loss of and altered floral species diversity;
- Alien floral invasion;
- Permanent loss of RDL/protected floral species and suitable habitat; and
- Disturbed areas are highly unlikely to be rehabilitated to pre-development conditions of ecological functioning and significant loss of floral habitat, species diversity and RDL/protected floral species will most likely be permanent.

4.1.3 Floral monitoring

A floral monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- Permanent monitoring plots must be established in areas surrounding the surface infrastructure and rehabilitated areas. These plots must be designed to accurately monitor the following parameters:
  - Measurements of crown and basal cover;
  - Species diversity;

- Species abundance;
- Impact of dust on flora;
- Recruitment of indigenous species;
- Alien vs. Indigenous plant ratio;
- Recruitment of alien and invasive species;
- Erosion levels and the efficacy of erosion control measures;
- Vegetation community structure including species composition and diversity which should be compared to pre-development conditions;

➢ Monitoring of rehabilitation trials in light of the above parameters must also take place throughout all phases of the proposed mining development and for a period of 5 years after decommissioning and closure;

➢ The rehabilitation plan must be continuously updated in accordance with the monitoring results in order to ensure that optimal rehabilitation measures are employed;

➢ Results of the monitoring activities must be taken into account during all phases of the proposed mining development and action must be taken to mitigate impacts as soon as negative effects from mining related activities become apparent.

➢ The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

4.2 Faunal Impact Mitigation

4.2.1 Mitigation measures

Based on the findings of the faunal ecological assessment, several recommendations are made to minimise the impact on the faunal ecology of the area, should the proposed mining project proceed. Please note that many of the mitigation measures applicable to floral ecology are applicable to faunal ecology and to avoid repetition were omitted. However, all floral mitigation measures must be implemented in conjunction with faunal mitigation measures:

➢ No areas falling outside of the footprint area may be cleared for construction purposes;

➢ As far as possible avoid placing any infrastructure within sensitive areas such as the wetland, afrotemperate forests and montane grassland habitat units;

➢ The footprint area of the proposed mine should be kept as small as possible;

- The footprint and daily operation of surface infrastructure must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding habitat units. The significance of the impact on the ecology of the area will be largely linked to the degree to which this can be implemented;
- No trapping, collecting or hunting of faunal species must be allowed during any phases of the proposed mining development;
- Sensitive habitats and associated buffer zones adjacent to footprint areas must be designated as No-Go areas and no mining vehicles, personnel, or any other mining related activities are to encroach upon these areas;
- Restrict vehicles to designated roadways to limit the ecological footprint of the construction and operational activities as well as to reduce the possibility of collisions with faunal species;
- Should any SCC be found within the footprint area, these species should be relocated to similar habitat within the vicinity of the subject property with the assistance of a suitably qualified specialist;
- Prohibit uncontrolled fires within the subject property; and
- Prohibit any trapping or poaching of faunal species within the subject property.

4.2.2 Probable Latent Impacts

Even with extensive mitigation, significant latent impacts on the receiving faunal ecological environment are deemed likely. The following points highlight the key latent impacts that have been identified:

- Loss of ecologically important faunal habitat;
- Loss of faunal habitat diversity;
- Loss of and altered faunal species diversity;
- Loss of SCC and associated suitable habitat; and

4.2.3 Faunal Monitoring

A faunal monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- Permanent monitoring points must be established in conjunction with specialist conservation groups in areas surrounding the mining. These points must be designed to accurately monitor the following parameters:
  - Species diversity (mammal, invertebrate, amphibian, reptile and avifaunal);
  - Species abundance; and
  - Faunal community structure including species composition and diversity which should be compared to pre-development conditions.
- The following methods aim to guide the monitoring plan, although more detailed, site specific methods must be employed during the development and implementation of the monitoring plan:
  - Monitoring activities must take place on an annual basis as a minimum;
  - Pitfall traps can be installed to monitor invertebrate diversity;
  - Fixed and random points for bird counts to determine species composition and diversity trends;
- Results of the monitoring activities must be taken into account during all phases of the proposed mining development and action must be taken to mitigate impacts as soon as negative effects from mining related activities become apparent.
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

4.3 Aquatic and Wetland Ecological Impact Mitigation

4.3.1 Mitigation measures

Based on the findings of the aquatic and wetland ecological assessment, several recommendations are made to minimise the impact on the aquatic and wetland ecology of the area, should the proposed mining project proceed:

- A Desktop Reserve Model for the instream flows downstream of the mine should take place in order to better understand the impacts that will occur and the risk of a change in class of the Pandana River.
- Ensure that as far as possible all infrastructures are placed outside of drainage and river areas. In particular mention is made of the need to not encroach on the riparian systems near the Pandana River with a minimum buffer of 100m around all wetland and riparian systems should be maintained in line with the requirements of regulation GN704 of the national Water Act;
- No use of clean surface water or any groundwater which potentially recharges the watercourses in the area should take place. In this regard specific mention is made of

any water use which will affect the instream flow in the Pandana River and the associated tributaries;

- Very strict control of water consumption must take place and detailed monitoring must take place and where all water usage must continuously be optimised;
- Upstream dewatering boreholes should be considered to minimise the creation of dirty water and this clean water should be used to recharge the natural systems downstream of the mining rights areas;
- Pollution control dams should be off stream and tributary structures and not within the natural drainage system of the area, thereby minimising impacts loss of instream flow and downstream recharge;
- Permit only essential construction personnel within 100m of all riparian systems;
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development;
- Implement alien vegetation control program within wetland areas with special mention of water loving tree species;
- Very clear and well managed clean and dirty water separation must take place in line with the requirements of regulation GN704 of the national Water Act;
- Pollution control dams must be adequately designed to contain a 1:50 24 hour storm water event;
- All pollution control facilities must be managed in such a way as to ensure that storage and surge capacity is available if a rainfall event occurs;
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas and the concomitant recharge of streams in the area;
- Ensure that all spills are immediately cleaned up;
- All hazardous chemicals must be stored on specified surfaces;
- Ensure that all stockpiles are well managed and have measures such as berms and hessian sheets implemented to prevent erosion and sedimentation which may ultimately lead to transformation of aquatic habitat areas;
- Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts loss or transformation of aquatic habitat;
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development as well as during operational phase of the mine;
- Implement alien vegetation control program within wetland and riverine areas with special mention of water loving tree species.

- Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts from inundation and siltation;
- Use of water must be minimised as far as possible in order to minimise the loss of recharge of the Pandana River system;
- Limit the footprint area of the construction activity to what is absolutely essential in order to disturbance of soils leading to runoff, erosion and sedimentation and loss of instream flow and stream recharge;
- Prevent run-off from dirty water areas entering stream systems through ensuring clear separation of clean and dirty water areas;
- Ensure that the mine process water system is managed in such a way as to prevent discharge to the receiving environment and to prevent discharge of dirty water;
- Implement measures to contain seepage as far as possible to prevent contamination of the groundwater regime;
- Monitor all systems for erosion and incision;

4.3.2 Aquatic and Wetland Monitoring

- Monitor all affected riparian systems for moisture stress;
- Monitor all potentially affected riparian zones for changes in riparian vegetation structure;
- Ongoing aquatic ecological monitoring must take place on a 6 monthly basis by an SA RHP Accredited assessor
- Monitor all pollution control facilities using toxicological screening methods and implement the calculation of discharge dilution factors by means of the Direct Estimation of Ecological Effect Potential (DEEEP) protocol;
- Any areas where active erosion is observed must be rehabilitated and berms utilised to slow movement of water;
- Ongoing aquatic biomonitoring should take place in order to identify any emerging issues in the receiving environment;
- Toxicological monitoring of the receiving and process water systems on a quarterly basis.

4.3.3 Probable Latent Impacts

Even with extensive mitigation latent impacts on the receiving aquatic environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Reduced availability of refugia for aquatic and wetland biota;
- Altered riparian and wetland vegetation structures;
- Ongoing salinisation of the water courses in the area;
- Impacts on pH;
- Impacts on dissolved oxygen concentration and saturation;
- Loss of aquatic taxa intolerant to poor quality water;
- Sedimentation of the systems may occur for long after mining is completed;
- Eroded and incised streams are unlikely to be rehabilitated;
- Silted up refuge pools are unlikely to be naturally rehabilitated and are unlikely to be rehabilitated by the mine;
- Loss of some flow dependent species is likely;
- Loss of some species less tolerant of water quality changes is likely;
- Loss of some low flow refugia is possible.

5. IMPACT STATEMENT

This report, after consideration and description of the ecological integrity of the mining rights area and mining footprint area, must guide the Environmental Assessment Practitioner (EAP), authorities and potential developers, by means of recommendations, as to viability of the proposed mining development from an ecological point of view.

The Commissiekraal project is located within an area of increased ecological importance and sensitivity when compared to most potential and current mining localities in South Africa. The terrestrial and wetland features within the majority of the subject property are in a largely natural to natural condition. Therefore, on this basis, should the project proceed it will have an ecological impact of high significance both within and potentially beyond the boundaries of the project. The potential for post-closure impacts on water quality are of concern, along with the permanent alteration of extensive areas of land which is currently in a largely natural to natural condition. Therefore, unless it is considered economically feasible to treat and/or contain all potential sources of contaminated water which may affect the receiving environment post-closure indefinitely to pre-mining water quality standards in such a way as to support the post closure land use and land capability which supports the adjacent land uses and to ensure rehabilitation back to natural or largely natural land capability, the project is regarded as posing a very high long term impact on the region. It is highly recommended that should it nonetheless be deemed appropriate to mine the resource from a cumulative sustainable development point of view, as much infrastructure as possible be moved to the areas where historical disturbance as a result of anthropogenic activity has occurred. In addition the infrastructure required to access the resource must be kept to the absolute minimum. Furthermore, extensive mitigation must be applied during the construction and operational phases of the project to ensure that no impact takes place beyond the surface infrastructure footprint. In this regard particular mention is made of the management of surface water and the dirty water area of the mine footprint and the impact of mining related activities on surrounding sensitive terrestrial habitat. Exceptionally strict monitoring throughout the life of the mine and post-closure is required in order to ensure the health and functioning of the terrestrial, wetland and aquatic ecosystems is retained, and monitoring data must be utilised to proactively manage any identified emerging issues in a well-managed and overseen Biodiversity Action Plan (BAP), which must be implemented through an automated Environmental Management System (EMS). The rehabilitation of the infrastructure during closure of the mine must take place in such a way as to ensure that the post closure land use objectives are met and that adjacent land uses and land potential is supported. The water resources will need to be rehabilitated in such a way as to support the larger drainage and wetland systems at the same level as those evident in the pre-mining condition and with particular mention of ensuring that no significant impact takes place on the downstream WHS. In order to meet this objective, rehabilitation will need to be well planned and a suitably qualified ecologist must form part of the management team through the entire life cycle of the project and to guide the rehabilitation including concurrent rehabilitation) and closure objectives of the mine.

Of secondary concern is the potential for this project to create a precedent for further mining in this ecologically sensitive area. Mining within this area is contradictory to the Mining and Biodiversity Guidelines, as well as the NFEPA Guidelines, KZN C-Plan and the NPAES. This precedent could lead to future cumulative impacts in the region which could affect local and regional conservation initiatives significantly.

The objective of this study was to provide sufficient information on the ecology of the area, together with other studies on the physical and socio-cultural environment, in order for the Environmental Assessment Practitioner (EAP) and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to compared and considered along with the need to ensure economic development of the country.

It is the opinion of the ecologists that this study provides the relevant information required in order to implement IEM and to ensure that the best long term use of the resources on the subject property will be made in support of the principle of sustainable development.