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Ecologists & Environmental Services

Report on the ecological and biodiversity assessment for the proposed bulk water pipeline for the Greenfields residential development in Postmasburg, Northern Cape Province.

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DECLARATION OF INDEPENDENCE

DPR Ecologists and Environmental Services is an independent company and has no financial, personal or other interest in the proposed project, apart from fair remuneration for work performed in the delivery of ecological services. There are no circumstances that compromise the objectivity of the study.

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Title	Report on the ecological and biodiversity assessment for the proposed bulk water pipeline for the Greenfields residential development in Postmasburg, Northern Cape Province.		
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Executive Summary

The proposed development will consist of a small water reservoir and bulk water transport pipeline on the eastern outskirts of the town of Postmasburg (Appendix A: Map 1 & 2). The pipeline will be situated on the Remainder of Erf 1 and will have an approximate length of 2 km. It will be situated from the existing reservoir complex on top of a low hill, will extend toward the west, where it will connect to the new proposed Greenfields residential development.

The proposed pipeline route falls within a Critical Biodiversity Area 1 (CBA 1) and is therefore of high conservation value (Appendix A: Map 2). The reason for being listed as CBA 1 is due to the Groenwaterspruit, a listed National Freshwater Ecosystem Priority Area (NFEPA), being situated to the south of the site and the site itself also forming part of the immediate catchment of this river. Furthermore, this area also forms part of the Southern Ghaap Plateau Strategic Water Source Area (SWSA) and also contributes towards the high conservation value for the catchment of the river. However, given the nature of the development, small footprint of the proposed pipeline and the distance from the river, approximately 700 meters, it is highly unlikely that the development will compromise the functioning of this watercourse.

Although the pipeline route still consists of natural vegetation it is however quite substantially degraded by heavy and sustained communal overgrazing and -browsing. This has quite significantly altered the vegetation composition and structure. It is notable that palatable grass species are rare while pioneer grasses now dominate. Exotic weeds have become more prominent due to the overgrazing. The shrub layer has also become denser and it is prominent that all of the more palatable shrubs are heavily browsed and dwarfed.

Endangered or Red Listed species are absent from the site and also considered somewhat unlikely to occur due to the high levels of overgrazing and -browsing by domestic livestock. Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development. However, as indicated, several protected plant species do occur along the pipeline route (Appendix C). These are all relatively widespread but do still retain a significant conservation value.

From the description of the vegetation it is clear that although it is largely natural, it has been disturbed or degraded to a significant extent by continuous overgrazing and -browsing. It would therefore seem that the proposed pipeline route does not have a high conservation value. In addition, the natural vegetation type in the area, Kuruman Thornveld is also not currently considered to be of high conservation concern and is listed as being of Least Concern (LC) (Appendix A: Map 1 & 2). However, as indicated the pipeline route does contain several protected species of significant conservation value and adequate mitigation will be required to alleviate the impact on these (Appendix C). Furthermore, the area is also listed as a Critical Biodiversity Area 1 (CBA 1) as a result of the Groenwaterspruit, a National Freshwater Ecosystem Priority Area (NFEPA), to the south and the site itself also forming part of the immediate catchment of this river (Appendix A: Map 1 & 2). However, given the nature of the development, small footprint of the proposed pipeline and the distance from the river, approximately 700 meters, it is highly unlikely that the development will compromise the functioning of this watercourse. Therefore, in conclusion, although elements of conservation value do occur, overall the proposed pipeline route does not have a high conservation value or unique features requiring exclusion and should not result in any high impacts on the vegetation and ecology of the site and immediate surroundings.

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Ecological and biodiversity assessment

1. INTRODUCTION

1.1 Background

Natural vegetation is an important component of ecosystems. Some of the vegetation units in a region can be more sensitive than others, usually as a result of a variety of environmental factors and species composition. These units are often associated with water bodies, water transferring bodies or moisture sinks. These systems are always connected to each other through a complex pattern. Degradation of a link in this larger system, e.g. tributary, pan, wetland, usually leads to the degradation of the larger system. Therefore, degradation of such a water related system should be prevented.

Though vegetation may seem to be uniform and low in diversity it may still contain species that are rare and endangered. The occurrence of such a species may render the development unviable. Should such a species be encountered the development should be moved to another location or cease altogether.

South Africa has a large amount of endemic species and in terms of plant diversity ranks third in the world. This has the result that many of the species are rare, highly localised and consequently endangered. It is our duty to protect our diverse natural resources.

South Africa contains 19 known centres of endemism. These areas contain a high number of species endemic to this specific area. Due to the limited range of most of these species many are rare, protected or endangered. The proposed power line is situated within the Griqualand West Centre of Endemism. Many species occurring within this centre is unique and localised to this area. Development in such centres of endemism should be done with careful investigation of the biodiversity and species composition of the area. Areas with rare, endangered or endemic species and areas with a high biodiversity should be avoided when planning a development.

Development around cities and towns are necessary to accommodate an ever-growing population. Areas along the boundaries of cities and towns are usually in a degraded state due to the impact of the large population these areas house. Though this may be the case in most situations there may still be areas that consist of sensitive habitats such as watercourses, wetlands or rare vegetation types that need to be conserved. These areas may also contain endangered fauna and flora.

The proposed development will consist of a small water reservoir and bulk water transport pipeline on the eastern outskirts of the town of Postmasburg (Appendix A: Map 1 & 2). The pipeline will be situated on the Remainder of Erf 1 and will have an approximate length of 2 km. It will be situated from the existing reservoir complex on top of a low hill, will extend toward the west, where it will connect to the new proposed Greenfields residential development. The footprint of the proposed pipeline still consists of natural vegetation but which has been affected by high levels of overgrazing and -browsing by livestock as the site is situated within a communal grazing area.

A site visit was conducted on 8 April 2021. The entire footprint and length of the pipeline route was surveyed as well as the immediate surroundings. The site survey was conducted during autumn after sufficient rains and the plant identification on the site was considered optimal.

For the above reasons it is necessary to conduct an ecological assessment of an area proposed for development.

The report together with its recommendations and mitigation measures should be used to minimise the impact of the proposed development.

1.2 The value of biodiversity

The diversity of life forms and their interaction with each other and the environment has made Earth a uniquely habitable place for humans. Biodiversity sustains human livelihoods and life itself. Although our dependence on biodiversity has become less tangible and apparent, it remains critically important.

The balancing of atmospheric gases through photosynthesis and carbon sequestration is reliant on biodiversity, while an estimated 40% of the global economy is based on biological products and processes.

Biodiversity is the basis of innumerable environmental services that keep us and the natural environment alive. These services range from the provision of clean water and watershed services to the recycling of nutrients and pollution. These ecosystem services include:

- Soil formation and maintenance of soil fertility.
- Primary production through photosynthesis as the supportive foundation for all life.
- Provision of food, fuel and fibre.
- Provision of shelter and building materials.
- Regulation of water flows and the maintenance of water quality.
- Regulation and purification of atmospheric gases.
- Moderation of climate and weather.
- Detoxification and decomposition of wastes.
- Pollination of plants, including many crops.
- Control of pests and diseases.
- Maintenance of genetic resources.

1.3 Details and expertise of specialist

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Membership with relevant societies and associations:

- South African Society of Aquatic Scientists (SASAQS0091)
- South African Association of Botanists
- South African Wetlands Society (3SLY4IG4)

Expertise:

- Qualifications: B.Sc. (Hons) Botany (2008), M.Sc. in Vegetation Ecology (2012) with focus on ephemeral watercourses.
- Vegetation ecologist with over 10 years experience of conducting ecological assessments.
- Founded DPR Ecologists & Environmental Services (Pty) Ltd in 2016.
- Has conducted over 200 ecological and wetland assessments for various developments.
- Regularly attend conferences and courses in order to stay up to date with current methods and trends:

2017: Kimberley Biodiversity Symposium.

2018: South African Association of Botanists annual conference.

2018: National Wetland Indaba Conference.

2019: SASS5 Aquatic Biomonitoring Training.

2019: Society for Ecological Restoration World Congress 2019.

2019: Wetland rehabilitation: SER 2019 training course.

2020: Tools For Wetlands (TFW) training course.

2. SCOPE AND LIMITATIONS

- To evaluate the present state of the vegetation and ecological functioning of the area proposed for the development.
- To identify possible negative impacts that could be caused by the proposed development.

2.1 Vegetation

Aspects of the vegetation that will be assessed include:

- The vegetation types of the region with their relevance to the proposed site.
- The overall status of the vegetation on site.
- Species composition with the emphasis on dominant-, rare- and endangered species.

The amount of disturbance present on the site assessed according to:

- The amount of grazing impacts.
- Disturbance caused by human impacts.
- Other disturbances.

2.2 Fauna

Aspects of the fauna that will be assessed include:

- A basic survey of the fauna occurring in the region using visual observations of species as well as evidence of their occurrence in the region (burrows, excavations, animal tracks, etc.).
- The overall condition of the habitat.
- A list of species that may occur in the region (desktop study).

2.3 Limitations

- Some geophytic or succulent species may have been overlooked due to a specific flowering time or cryptic nature.
- Some animal species may not have been observed as a result of their nocturnal and/or shy habits.
- Although a comprehensive survey of the site was done it is still likely that several species were overlooked.

3. METHODOLOGY

3.1 Several literature works were used for additional information.

General ecology:

- Red Data List (Raymondo *et al.* 2009).
- Vegetation types (Mucina & Rutherford 2006).
- NBA 2018 Technical Report Volume 1: Terrestrial Realm.
- SANBI (2011): List of threatened ecosystems.
- NEM:BA: List of threatened ecosystems and Threatened Or Protected Species (TOPS).
- Northern Cape Critical Biodiversity Areas Plan (2016)

Vegetation:

Field guides used for species identification (Adams 1976, Bromilow 1995, 2010, Coates-Palgrave 2002, Court 2010, Fish *et al* 2015, Gibbs-Russell *et al* 1990, Manning 2009, Roberts & Fourie 1975, Shearing & Van Heerden 2008, Van Oudtshoorn 2004, Van Rooyen 2001, Van Rooyen & Van Rooyen 2019, Van Wyk & Van Wyk 1997).

Terrestrial fauna:

Field guides for species identification (Smithers 1986a, Child *et al* 2016, Cillié 2018).

3.2 Survey

The site was assessed by means of transects and sample plots.

Noted species include rare and dominant species.

The broad vegetation types present on the site were determined.

The state of the environment was assessed in terms of condition, grazing impacts, disturbance by humans, erosion and presence of invader and exotic species.

Animal species were also noted as well as the probability of other species occurring on or near the site according to their distribution areas and habitat requirements.

The state of the habitat was also assessed.

3.3 Criteria used to assess sites

Several criteria were used to assess the site and determine the overall status of the environment.

Vegetation characteristics

Characteristics of the vegetation in its current state. The diversity of species, sensitivity of habitats and importance of the ecology as a whole.

Habitat diversity and species richness: normally a function of locality, habitat diversity and climatic conditions.

Scoring: Wide variety of species occupying a variety of niches – 1, Variety of species occupying a single nich – 2, Single species dominance over a large area containing a low diversity of species – 3.

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species can potentially be a fatal flaw.

Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely – 3.

Ecological function: All plant communities play a role in the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones, etc.

Scoring: Ecological function critical for greater system – 1, Ecological function of medium importance – 2, No special ecological function (system will not fail if absent) – 3.

Degree of rarity/conservation value:

Scoring: Very rare and/or in pristine condition – 1, Fair to good condition and/or relatively rare – 2, Not rare, degraded and/or poorly conserved – 3.

Vegetation condition

The sites are compared to a benchmark site in a good to excellent condition. Vegetation management practises (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of the vegetation.

Percentage ground cover: Ground cover is under normal and natural conditions a function of climate and biophysical characteristics. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.

Scoring: Good to excellent – 1, Fair – 2, Poor – 3.

Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. The ratio could be affected by grazing and browsing by animals.

Scoring: All layers still intact and showing specimens of all age classes – 1, Sub-shrubs and/or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) – 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) – 3.

Infestation with exotic weeds and invader plants or encroachers:

Scoring: No or very slight infestation levels by weeds and invaders – 1, Medium infestation by one or more species – 2, Several weed and invader species present and high occurrence of one or more species – 3.

Degree of grazing/browsing impact:

Scoring: No or very slight notable signs of browsing and/or grazing – 1, Some browse lines evident, shrubs shows signs of browsing, grass layer grazed though still intact – 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent – 3.

Signs of erosion: The formation of erosion scars can often give an indication of the severity and/or duration of vegetation degradation.

Scoring: No or very little signs of soil erosion – 1, Small erosion gullies present and/or evidence of slight sheet erosion – 2, Gully erosion well developed (medium to large dongas) and/or sheet erosion removed the topsoil over large areas – 3.

Faunal characteristics

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species or very unique and sensitive habitats can potentially be a fatal flaw.

Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely.

3.4 Biodiversity sensitivity rating (BSR)

The total scores for the criteria above were used to determine the biodiversity sensitivity ranking for the sites. On a scale of 0 – 30, six different classes are described to assess the suitability of the sites to be developed. The different classes are described in the table below:

Table 1: Biodiversity sensitivity ranking

BSR	BSR general floral description	Floral score equating to BSR class
Ideal (5)	Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and potential for successful rehabilitation is very low. The site is ideal for the proposed development.	29 – 30
Preferred (4)	Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low. The area is preferred for the proposed development.	26 – 28
Acceptable (3)	Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low. The area is acceptable for the proposed development.	21 – 25
Not preferred (2)	The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological function is intact and very little rehabilitation is needed. The area is of medium conservation importance. The area is not preferred for the proposed development.	11 – 20
Sensitive (1)	The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high. The area is regarded as sensitive and not suitable for the proposed development.	0 - 10

4. ECOLOGICAL OVERVIEW OF THE SITE

4.1 Overview of ecology and vegetation types

Refer to the list of species encountered on the pipeline route and surroundings in Appendix B.

According to Mucina & Rutherford (2006) and utilising current mapping resources (National Biodiversity Assessment 2018) the site is indicated to fall within Kuruman Thornveld (SVk 9) (Appendix A: Map 1 & 2). This vegetation type is characterised by an undulating, rocky terrain with low hills with a well-developed shrub layer and scattered trees. This vegetation type is currently listed as being of Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Appendix A: Map 2). The vegetation type is not under sufficient development pressures to be considered a threatened ecosystem. This will also decrease the conservation value of remaining natural vegetation. In addition, the natural vegetation is also degraded to a significant extent by overgrazing and -browsing by domestic livestock.

The Northern Cape Critical Biodiversity Areas Plan (2016) has been published in order to identify areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas (CBA). The proposed pipeline route falls within a Critical Biodiversity Area 1 (CBA 1) and is therefore of high conservation value (Appendix A: Map 2). The reason for being listed as CBA 1 is due to the Groenwaterspruit, a listed National Freshwater Ecosystem Priority Area (NFEPA), being situated to the south of the site and the site itself also forming part of the immediate catchment of this river. Furthermore, this area also forms part of the Southern Ghaap Plateau Strategic Water Source Area (SWSA) and also contributes towards the high conservation value for the catchment of the river. However, given the nature of the development, small footprint of the proposed pipeline and the distance from the river, approximately 700 meters, it is highly unlikely that the development will compromise the functioning of this watercourse. Furthermore, Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development.

The proposed development will consist of a small water reservoir and bulk water transport pipeline on the eastern outskirts of the town of Postmasburg (Appendix A: Map 1 & 2). The pipeline will be situated on the Remainder of Erf 1 and will have an approximate length of 2 km. It will be situated from the existing reservoir complex on top a of low hill, will extent toward the west, where it will connect to the new proposed Greenfields residential development. The footprint of the proposed pipeline still consists of natural vegetation but which has been affected by high levels of overgrazing and -browsing by livestock as the site is situated within a communal grazing area. No watercourses or wetlands could be identified on or near the proposed site, with the Groenwaterspruit being situated approximately 700 meters to the south and therefore highly unlikely that it will be affected by the development.

The entire pipeline route is still dominated by natural vegetation and consists of a well-developed grass layer, prominent and dense shrub layer and scattered larger tree specimens. Furthermore, the eastern portion of the pipeline route and the small reservoir complex is situated on a low hill, descending toward the lower lying plain which dominates the central and western portion of the pipeline route. The geology, soils and vegetation composition is also quite different between these two differing habitats. The eastern portion situated on the low hill contains a much denser shrub cover, a decreased and poorly developed grass layer and a

significant proportion of succulent species which is adapted to shallower soils with a much higher degree of surface rock. In contrast, the western and central portion on the lower lying plain contains a quite dense shrub layer but with a well-developed grass layer, large but scattered trees and a more prominent geophyte component which is adapted to much deeper, sandy soils with scattered surface rock.

Although the pipeline route still consists of natural vegetation it is however quite substantially degraded by heavy and sustained communal overgrazing and -browsing. This has quite significantly altered the vegetation composition and structure. It is notable that palatable grass species are rare while pioneer grasses now dominate. Exotic weeds have become more prominent due to the overgrazing. The shrub layer has also become denser and it is prominent that all of the more palatable shrubs are heavily browsed and dwarfed. This has caused substantial degradation of the natural vegetation though elements of conservation value are clearly still present.

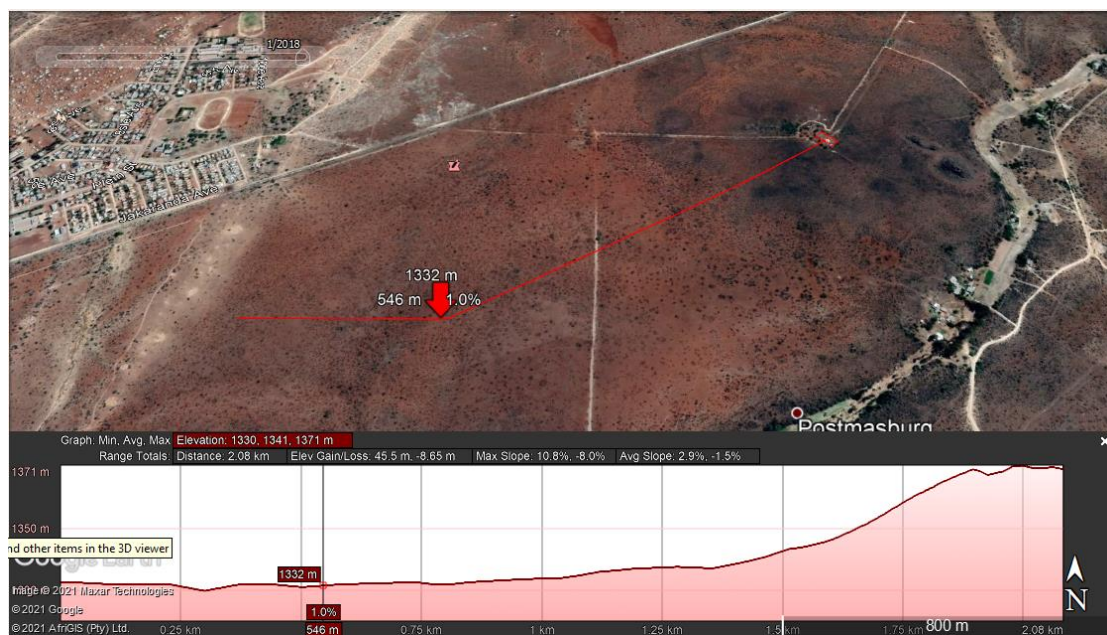


Figure 1: Aerial view of the proposed pipeline route (Google Earth 2018). The elevation profile clearly illustrates the hill in the eastern portion, descending to the plain in the central and western portion.



Figure 2: View of the vegetation along the pipeline route which is clearly still natural though note the decrease in the grass layer due to overgrazing by livestock.



Figure 3: Signs of overbrowsing among the smaller shrubs are common with most leaves being stripped and lower branches being devoid of any new growth.



Figure 4: Overgrazing and -browsing, especially by domestic goats, are well known to cause degradation of the natural vegetation.



Figure 5: View of the existing reservoir complex on top of the low hill at the eastern end of the pipeline route.

As previously indicated, the topography of the pipeline route is dominated by a sandy plain in the central and western portion of the pipeline route, with a low hill in the eastern portion of the pipeline route with a small reservoir complex on top of the hill. The slope along the pipeline route is therefore moderate along the slope of the low hill, then descending toward the plain which has a relatively flat topography up to the western end where the pipeline will connect to the Greenfields residential development. The topography is still largely intact with dirt tracks and the existing reservoir on top of the low hill being the only significant modifications. No watercourses or wetlands occur near the site and the pipeline route itself also does not contain any concentrated runoff patterns, wetlands or watercourses (Appendix A: Map 1 & 2). The Groenwaterspruit, a NFEPA listed watercourse, is located approximately 700 meters to the south. The proposed developments should therefore not result in any impact on it or any other wetland or watercourse. The pipeline route has an elevation of 1371 m on top of the hill which decreases to 1330 m in the lower lying plain. This also clearly illustrates the high lying hill with the adjacent lower lying plain.

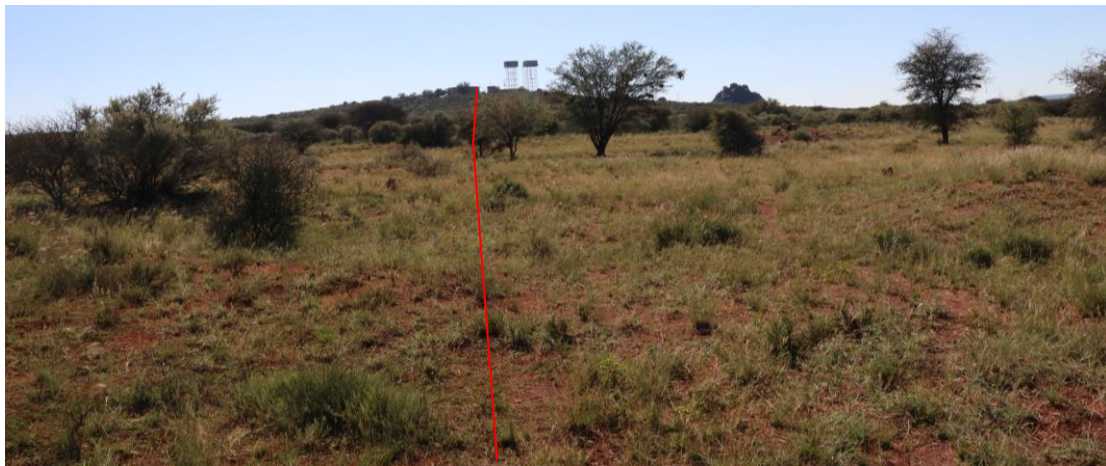


Figure 6: The majority of the pipeline route is situated along the lower lying plain with a low hill clearly visible along the eastern portion of the pipeline route.

The site has soils of the Hutton soil form which are shallow soils with an orthic A/red apedal B/hard rock. This soil type is generally resistant to erosion. The geology of the site consists of unconsolidated windblown sand of the Quarternary Kalahari Formation Precambrian and the Transvaal Supergroup underlain by the Campbell Rand Supergroup which in turn consists of cherts, shales, dolomites and carbonate rocks.

The following description of the vegetation on the site should give a good indication of the condition of the ecology on it.

As previously indicated, though the pipeline route still consists of natural vegetation it is being affected by overgrazing of domestic livestock. This is quite prominent in the grass layer where palatable species are scarce while pioneer grasses have become dominant. Pioneer grasses include *Aristida congesta*, *Eragrostis lehmanniana*, *Melinis repens*, *Pogonarthria squarrosa*, *Eragrostis echinichloidea*, *Eragrostis biflora*, *Cymbopogon pospischillii*, *Enneapogon cenchroides* and *Tragus berteronianus*. Climax grasses and more palatable grass species are now scattered and rare along the pipeline route and include *Sporobolus fimbriatus*, *Enneapogon desvauxii*, *Aristida diffusa*, *Stipagrostis uniplumis* and *Schmidtia pappophroides*. The impact caused by overgrazing is also prominent within the herbaceous layer where several pioneer herbs indicative of overgrazing have become numerous and prominent within the grass layer. These pioneer herbs include *Salvia verbenaca*, *Geigeria ornativa*, *Solanum incanum*,

Gisekia africana, *Sesamum triphyllum*, *Cleome rubella*, *Solanum supinum*, *Tribulus terrestris* and *Gomphocarpus tomentosus*. Though these would also naturally occur within this vegetation type an abundance, as is the case along the pipeline route, are clearly indicative of a degraded vegetation composition. Other herbaceous species which form part of this vegetation type is also present and include *Monechma divaricatum*, *Corchorus asplenifolius*, *Kyphocarpa angustifolia*, *Hermannia comosa*, *Lantana rugosa*, *Peliostomum leuchorrhizum*, *Dicoma capensis*, *Senna italica*, *Indigofera alternans* and *Oxygonum delagoense*. This vegetation type does not contain a high proportion of dwarf karroid shrubs. However, where overgrazing occurs this component may increase substantially and is also evident along the pipeline route. Several dwarf karroid shrubs are abundant and include *Chrysocoma ciliata*, *Pentzia virides*, *Lycium horridum*, *Eriocephalus ericoides* and *Gnidia polycephala*. The disturbance caused by overgrazing also enables the establishment of exotic weeds and invasive species such as *Prosopis glandulosa*, *Xanthium spinosum*, *Echinopsis schikendantzii*, *Verbesina encelioides*, *Chenopodium carrinatum* and *Alternanthera pungens*. As previously indicated, the vegetation is also dominated by a dense shrub layer with scattered larger trees. This is a natural component of the vegetation type though it is quite likely that overbrowsing causes a denser shrub layer. Shrub and tree species include *Vachellia erioloba*, *Boscia albitrunca*, *Tarchonanthus camphoratus*, *Senegalia mellifera* subsp. *detinens*, *Ziziphus mucronata*, *Searsia ciliata*, *Vachellia tortillis*, *Grewia flava*, *Searsia burchellii*, *Rhigozum obovatum* and *Cadaba aphylla*. Of these *B. albitrunca* and *V. erioloba* are also listed as protected species and though they are widespread and relatively common they still retain some conservation value (Appendix C). Where the pipeline will therefore require the removal of any of these trees, the necessary permits will have to be obtained to do so. The low hill contains a more prominent succulent plant component which includes *Pachypodium succulentum*, *Kalanchoe paniculata*, *Mestoklema tuberosum* and *Aloe hereroensis*. These are all also protected species, with *P. succulentum* also being regarded as somewhat rare (Appendix C). They therefore have a significant conservation value. They also transplant quite easily and prior to construction a walkthrough of the pipeline route should be undertaken, permits obtained for all affected specimens and those transplanted to adjacent areas where they will remain unaffected. The low lying plain with deeper sandy soils also contains numerous geophytic species, i.e. species with an underground storage organ. These include *Sanseveria aethiopica*, *Ammocharis coranica*, *Harpagophytum procumbens*, *Oxalis lawsonii*, *Eriospermum porphyrium* and *Albuca setosa*. Of these, *A. coranica*, *H. procumbens* and *O. lawsonii* are also listed protected species with a significant conservation value (Appendix C). They also transplant easily and it is therefore recommended that a walkthrough of the pipeline route should be undertaken, permits obtained for all affected specimens and those transplanted to adjacent areas where they will remain unaffected. From the above description of the vegetation along the pipeline route it is clear that though it still consists of natural vegetation this has been significantly degraded by sustained overgrazing and -browsing by domestic livestock. Despite this, elements of conservation significance (protected plant species) still remain and require adequate mitigation.



Figure 7: The vegetation on top of the low hill contains a much denser shrub layer. Note also a high percentage surface stones.



Figure 8: View from the low hill toward the western portion of the pipeline route. Note a quite dense shrub layer dominates the vegetation structure.



Figure 9: Within the lower lying plains portion of the pipeline route a well-developed grass layer is also evident.



Figure 10: The lower lying plain is dominated by a dense shrub layer with well-developed grass layer also being prominent.

Endangered or Red Listed species are absent from the site and also considered somewhat unlikely to occur due to the high levels of overgrazing and -browsing by domestic livestock. Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development. However, as indicated, several protected plant species do occur along the pipeline route (Appendix C). These are all relatively widespread but do still retain a significant conservation value. Where the two tree species (*Boscia albitrunca*, *Vachellia erioloba*) will be affected and will require removal, the necessary permits will have to be obtained to do so. The protected succulent and geophytic species along the pipeline route are all known to transplant easily and the impact on them should be mitigated by doing a walkthrough survey prior to construction, permits obtained for all affected specimens and those transplanted to adjacent areas where they will remain unaffected. These protected plants include *Pachypodium succulentum*, *Kalanchoe paniculata*, *Mestoklema tuberosum*, *Ammocharis coranica*, *Harpagophytum procumbens*, *Oxalis lawsonii* and *Aloe hereroensis*

From the description of the vegetation on the site it is clear that although it is largely natural, it has been disturbed or degraded to a significant extent by continuous overgrazing and -browsing by domestic livestock. The grass layer is dominated by pioneer species with unpalatable and pioneer herbs also being prominent. Dwarf karroid shrubs has increased substantially and the shrub layer has also become more dense than natural. The disturbance of the vegetation also promotes the establishment of several exotic weeds and invasive species. It would therefore seem that the proposed pipeline route does not have a high conservation value. In addition, the natural vegetation type in the area, Kuruman Thornveld is also not currently considered to be of high conservation concern and is listed as being of Least Concern (LC) (Appendix A: Map 1 & 2). The pipeline route does not contain any unique or sensitive habitats, does not have a significant species diversity and does not contain any sensitive or Red Listed species. However, as indicated the pipeline route does contain several protected species of significant conservation value and adequate mitigation will be required to alleviate the impact on these. Furthermore, the area is also listed as a Critical Biodiversity Area 1 (CBA 1) as a result of the Groenwaterspruit, a National Freshwater Ecosystem Priority Area (NFEPA), to the south and the site itself also forming part of the immediate catchment of this river (Appendix A: Map 2). This area also forms part of the Southern Ghaap Plateau Strategic

Water Source Area (SWSA) and also contributes towards the high conservation value for the catchment of the river. However, given the nature of the development, small footprint of the proposed pipeline and the distance from the river, approximately 700 meters, it is highly unlikely that the development will compromise the functioning of this watercourse. Therefore, in conclusion, although elements of conservation value do occur, overall the proposed pipeline route does not have a high conservation value or unique features requiring exclusion and should not result in any high impacts on the vegetation and ecology of the site and immediate surroundings.

4.2 Overview of terrestrial fauna (actual & possible)

Tracks and signs of mammals are not abundant along the pipeline route though signs of several species were still observed. It is considered highly likely that the mammal population has been affected by the adjacent residential areas and impacts associated with this such as feral dogs hunting small mammals and trapping of mammals using snares, etc. The site is also utilised for communal grazing and the farmers will undoubtedly hunt small carnivores such as Black Backed Jackal (*Canis mesomelas*). Furthermore the farmers make use of herding dogs which will also impact on the small mammals in the area. As a result it is considered unlikely that species of conservational importance will occur on the site. The mammal population is therefore anticipated to be dominated by generalist species which are better adapted to these disturbed areas. In addition, mammal species which are rare and endangered are often habitat specific and sensitive to habitat change. It is therefore considered unlikely that such species would occur on the site. Extensive natural areas to the north and east of the site should provide adequate habitat and the mammal population will still be largely natural here. It is also considered likely that the area will also contain several other mammal species but these were not observed on the site.

The mammal survey of the site was conducted by means of active searching and recording any tracks or signs of mammals and actual observations of mammals. From the survey the following actual observations of mammals were recorded:

- Soil mounds of the Common Molerat (*Cryptomys hottentotus*) were observed in the sandy plains portion. This is a widespread species which has even become adapted to urban areas. It is a generalist species anticipated to occur in this area.
- Foraging excavations which can most likely be associated with Porcupines (*Hystrix africaeaustralis*) were noted on the study area. This is also a generalist species, widespread and common in peri-urban areas. It is also able to inhabit disturbed habitats as occurs on the site.
- Dungheaps of small antelope, possibly Steenbok (*Raphicerus campestris*) or Duiker (*Sylvicapra grimmia*) were noted. Both are also common and widespread and therefore not of high conservation value. They are also not confined to the site and should easily vacate into the surrounding natural areas.
- A burrow of an Antbear (*Orycteropus afer*) was noted along the pipeline route. This is also a widespread species, not uncommon but very shy and very seldom observed. It is also a listed protected species and therefore of significant conservation value. They are however also abundant in the surrounding area and given the small extent of the pipeline footprint should not be affected by the development.

These species identified are all relatively widespread and common generalist species and confirm the anticipated mammal composition on the site. They do however indicate that mammals are still able to inhabit the site though it is highly unlikely that any species of conservation concern will occur as a result of the disturbed condition of the site and the current land use.

The impact that the proposed pipeline will have is mainly concerned with the loss of habitat. Transformation of the natural vegetation on the site will result in a decrease in the population size as available habitat decreases. However, the survey has indicated that the available habitat is already somewhat disturbed and will most probably support a population of generalist mammals. Large natural areas also occur around the site and any mammals on the site are likely to vacate the site into these adjacent areas should development take place. Furthermore, the footprint of the development will not be extensive and should therefore limit the impact on mammals. The impact would also be mostly temporary as long as adequate rehabilitation is undertaken. Similar pipeline projects have indicated that adequate rehabilitation and topsoil management allows the affected area to return to a close to natural condition which would therefore re-instate the habitat for fauna and minimise the impact on the faunal population.

In order to ensure no direct impact on the mammals on the site the hunting, capturing or trapping of mammals on the site should be strictly prohibited during construction.

Table 2: List of mammal species previously recorded in the region (Mammalmap & Child *et al* 2016).

Order	Family	Common name	Scientific name	
Phylum Vertebrata; Class Mammalia				
Macroscelidea	Macroscelididae	Round-eared Sengi	<i>Macroscelides proboscideus</i>	
Eulipotyphla	Erinaceidae	Southern African Hedgehog	<i>Atelerix frontalis</i>	
Pholidota	Manidae	Ground Pangolin	<i>Smutsia temminckii</i>	
Lagomorpha	Leporidae	Cape Hare	<i>Lepus capensis</i>	
		Scrub Hare	<i>Lepus saxatilis</i>	
Rodentia	Sciuridae	Southern African Ground Squirrel	<i>Xerus inauris</i>	
	Pedetidae	Southern African Springhare	<i>Pedetes capensis</i>	
	Bathyergidae	Common Mole-rat	<i>Cryptomys hottentotus</i>	
	Gliridae	Flat-headed African Dormouse	<i>Graphiurus (Graphiurus) platyops</i>	
	Hystricidae	Cape Porcupine	<i>Hystrix africaeaustralis</i>	
	Muridae		Woosnam's Desert Mouse	<i>Zelotomys woosnami</i>
			Pouched Mouse	<i>Saccostumus campestris</i>
			Grey Climbing Mouse	<i>Dendromus melanotis</i>
			Large-eared Mouse	<i>Malacothrix typica</i>
Cape Short-tailed			<i>Desmodillus</i>	

		Gerbil	<i>auricularis</i>
		Pygmy Hairy-footed Gerbil	<i>Gerbillurus paeba</i>
		Bushveld Gerbil	<i>Gerbilliscus leucogaster</i>
		Highveld Gerbil	<i>Gerbilliscus brantsii</i>
		Red Veld Rat	<i>Aethomys chrysophilus</i>
		Four-striped Grass Mouse	<i>Rhabdomys spp</i>
		Black-tailed Tree Rat	<i>Thallomys nigricauda</i>
		Southern Multimammate Mouse	<i>Mastomys coucha</i>
		Xeric Four-striped Grass Rat	<i>Rhabdomys pumilio</i>
		Brant's Whistling Rat	<i>Parotomys brantsii</i>
		Littledale's Whistling Rat	<i>Parotomys littledalei</i>
Carnivora	Canidae	Cape Fox	<i>Vulpes chama</i>
		Bat-eared Fox	<i>Otocyon megalotis</i>
		Black-backed Jackal	<i>Canis mesomelas</i>
	Mustelidae	Honey Badger	<i>Mellivora capensis</i>
		African Striped Weasel	<i>Poecilogale albinucha</i>
		Striped Polecat	<i>Ictonyx striatus</i>
	Herpestidae	Slender Mongoose	<i>Galerella sanguinea</i>
		Yellow Mongoose	<i>Cynictis penicillata</i>
		Suricate	<i>Suricata suricatta</i>
	Viverridae	Small-spotted Genet	<i>Genetta genetta</i>
	Hyaenidae	Brown Hyaena	<i>Hyaena brunnea</i>
		Aardwolf	<i>Proteles cristatus</i>
	Felidae	African Wild Cat	<i>Felis silvestris</i>
		Small Spotted Cat	<i>Felis nigripes</i>
Caracal		<i>Caracal caracal</i>	
Leopard		<i>Panthera pardus</i>	
Tubulidentata	Orycteropodidae	Aardvark	<i>Orycteropus afer</i>
Cetartiodactyla	Bovidae	Common Eland	<i>Taurotragus oryx</i>
		Greater Kudu	<i>Tragelaphus strepsiceros</i>
		Springbok	<i>Antidorcas marsupialis</i>
		Steenbok	<i>Raphicerus campestris</i>
		Common Duiker	<i>Sylvicapra grimmia</i>



Figure 11: Tracks and signs of mammals on the site include clockwise from top left; Foraging excavations, most likely of a Porcupine (*Hystrix africaeaustralis*), soil mounds of the Common mole rat (*Cryptomys hottentotus*) and burrow of an Antbear (*Orycteropus afer*).

5. ANTICIPATED IMPACTS

Anticipated impacts that the development will have is primarily concerned with the loss of habitat and species diversity.

As previously discussed, from the description of the vegetation on the site it is clear that although it is largely natural, it has been disturbed or degraded to a significant extent by overgrazing and -browsing by domestic livestock. In addition, the natural vegetation type, Kuruman Thornveld (SVk 9), is also not currently considered to be of high conservation concern and is listed as being of Least Concern (LC) (Appendix A: Map 1 & 2). However, the pipeline route does fall within a Critical Biodiversity Area 1 as it forms part of the immediate catchment of the Groenwaterspruit, a National Freshwater Ecosystem Priority Area (NFEPA) system with very high conservation value (Appendix A: Map 2). Furthermore, this area also forms part of the Southern Ghaap Plateau Strategic Water Source Area (SWSA) and also contributes towards the high conservation value for the catchment of the river. However, given the nature of the development and small extent it is highly unlikely that it will affect the river or compromise its functioning. In addition, provided that adequate rehabilitation of the pipeline footprint is undertaken it will once again provide suitable, natural habitat. Therefore, in conclusion, although elements of conservation value do occur, overall the proposed pipeline route does not have a high conservation value or unique features requiring exclusion and should not result in any significant loss of habitat or diversity. The loss of habitat and diversity should therefore not exceed a moderate impact.

Endangered or Red Listed species are absent from the site and also considered somewhat unlikely to occur due to the high levels of overgrazing and -browsing by domestic livestock. Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development. However, several protected plant species do occur along the pipeline route (Appendix C). These are all relatively widespread but do still retain a significant conservation value. Furthermore, the footprint of the pipeline should only affect a small proportion of the population of these species in the area. The impact that the loss of these protected plants would have is still anticipated to be significant but can be easily mitigated to ensure a relatively low impact. Where the two tree species (*Boscia albitrunca*, *Vachellia erioloba*) will be affected and will require removal, the necessary permits will have to be obtained to do so. The protected succulent and geophytic species along the pipeline route are all known to transplant easily and the impact on them should be mitigated by doing a walkthrough survey prior to construction, permits obtained for all affected specimens and those transplanted to adjacent areas where they will remain unaffected. These protected plants include *Pachypodium succulentum*, *Kalanchoe paniculata*, *Mestoklema tuberosum*, *Ammocharis coranica*, *Harpagophytum procumbens*, *Oxalis lawsonii* and *Aloe hereroensis*

As indicated, the Groenwaterspruit to the south of the pipeline route is listed as a NFEPA system and any impacts that the development would have on it would therefore be considered as high (Appendix A: Map 1 & 2). However, the river is located approximately 700 meters from the pipeline route and in combination with the small footprint of the pipeline as well as the material being transported (potable water) it is highly unlikely that the development will have any impact on this watercourse. In addition, there are no watercourses or wetlands near the site and the pipeline route itself also does not contain any concentrated runoff patterns, wetlands or watercourses which could be adversely affected by it (Appendix A: Map 1 & 2).

As a result of overgrazing and -browsing several exotic weeds and invasive species have become established along the pipeline route (Appendix B). Construction activities will also increase disturbance and therefore increase the susceptibility for the establishment of weeds and invasive species and their spread into the surroundings. Monitoring of weed establishment and eradication should form a prominent part of management of the development. Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004. Unmitigated this is anticipated to be at least a moderate impact, though should be easily decreased through adequate weed control.

The impact that the proposed pipeline will have on the mammal population is mainly concerned with the loss of habitat. Transformation of the natural vegetation on the site will result in a decrease in the population size as available habitat decreases. However, the survey has indicated that the available habitat is already somewhat disturbed and will most probably support a population of generalist mammals. Large natural areas also occur around the site and any mammals on the site are likely to vacate the site into these adjacent areas should development take place. Furthermore, the footprint of the development will not be extensive and should therefore limit the impact on mammals. The impact would also be mostly temporary as long as adequate rehabilitation is undertaken. Similar pipeline projects have indicated that adequate rehabilitation and topsoil management allows the affected area to return to a close to natural condition which would therefore re-instate the habitat for fauna and minimise the impact on the faunal population.

The impact significance has been determined and without mitigation a few impacts may be moderate, with the loss of protected plant species also being moderate-high. However, with adequate mitigation which in most cases could be easily applied, all impact can be decreased to at least low-moderate.

Please refer to Appendix D for the impact methodology.

Significance of the impact:

Impact	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before Mitigation								
Loss of vegetation type and clearing of vegetation	3	4	2	4	4	4	4	12
Loss of protected species	4	5	2	3.6	5	4	4.5	16.2
Impact on watercourses	1	5	1	2.3	1	1	1	2.3
Infestation with weeds and invaders	3	4	3	3.3	4	3	3.5	11.5
Impact on Terrestrial fauna	2	4	1	2.3	3	3	3	6.9
After Mitigation								
Loss of vegetation type and clearing of vegetation	2	3	2	2.3	3	3	3	6.9
Loss of protected species	2	5	1	2.6	2	2	2	5.2
Impact on watercourses	1	5	1	2.3	1	1	1	2.3
Infestation with weeds and invaders	2	3	1	2	3	2	2.5	5
Impact on Terrestrial fauna	2	3	1	2	3	3	3	6

6. SITE SPECIFIC RESULTS

Habitat diversity and species richness:

The extent and length of the proposed pipeline route is not large and consequently habitats along it consists mainly of a sandy plain and rocky, low hill. In addition, overgrazing and -browsing by domestic livestock will also modify the natural vegetation and decrease species diversity. As a result, species diversity also does not exceed moderate values. Overall, habitat and species diversity is therefore only moderate.

Presence of rare and endangered species:

Endangered or Red Listed species are absent from the site and also considered somewhat unlikely to occur due to the high levels of overgrazing and -browsing by domestic livestock. Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development. However, as indicated, several protected plant species do occur along the pipeline route (Appendix C). These are all relatively widespread but do still retain a significant conservation value. These protected plants include *Boscia albitrunca*, *Vachellia erioloba*, *Pachypodium succulentum*, *Kalanchoe paniculata*, *Mestoklema tuberosum*, *Ammocharis coranica*, *Harpagophytum procumbens*, *Oxalis lawsonii* and *Aloe hereroensis*.

Ecological function:

The ecological function of the site has been somewhat modified to a degree. The site functions as habitat for fauna, sustains a specific vegetation type, i.e. Kuruman Thornveld and also forms part of the catchment of the Groenwaterspruit to the south (Appendix A: Map 1 & 2). The vegetation on the site has been modified to some degree by overgrazing by domestic livestock though overall is still representative of the natural condition. However, livestock herding and the adjacent urban areas will have a significant affect on the natural mammal population. The functioning as part of the catchment of the Groenwaterspruit will be largely intact. However, overgrazing and trampling will decrease the surface vegetation cover which in turn will promote erosion and sediment load. Overall, the ecological function is therefore regarded as moderately modified. Furthermore, the function of the site is not paramount to the continued functioning of the surrounding natural areas. In other words, development of the site should not impair the functioning of the surrounding area to a large extent.

Degree of rarity/conservation value:

The survey has confirmed that the area consists of Kuruman Thornveld (SVK 9). The vegetation type is currently listed as being of Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Appendix A: Map 1 & 2). This will also decrease the conservation value of remaining natural vegetation. The site does however fall within a Critical Biodiversity Area 1 (CBA 1) due to it forming part of the immediate catchment of the Groenwaterspruit, a National Freshwater Ecosystem Priority Area (NFEPA) system with very high conservation value. Furthermore, this area also forms part of the Southern Ghaap Plateau Strategic Water Source Area (SWSA) and also contributes towards the high conservation value for the catchment of the river. However, given the nature of the development and small extent it is highly unlikely that it will affect the river or compromise its functioning. Furthermore, Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development. Overall, the conservation value of the site is therefore considered as low.

Percentage ground cover:

The percentage ground cover is relatively low and has been adversely affected by sustained overgrazing by domestic livestock. The modification of the percentage ground cover is therefore regarded as at least moderate overall.

Vegetation structure:

The natural vegetation structure should consist of a shrub layer with well-developed grass layer interspersed. Overgrazing by domestic livestock has resulted in at least a moderate modification of this vegetation structure. The shrub component has become denser, the grass layer much sparser and dominated by pioneer species, an increase in dwarf karroid shrubs is evident and pioneer herbaceous species has also increased considerably. Overall the vegetation structure is therefore considered to be moderately modified.

Infestation with exotic weeds and invader plants:

The site contains several exotic weeds, though they do not yet form significant infestations (Appendix B). Some of these are however known to become problematic, especially in the Northern Cape, such as *Prosopis glandulosa* and *Echinopsis schikendantzii*. Overall the presence of exotic weeds and invasive species are therefore considered high.

Degree of grazing/browsing impact:

The area is utilised as communal grazing and browsing for domestic livestock and can be regarded as the most significant impact on the area. It is therefore regarded as high.

Signs of erosion:

Although signs of erosion are not prominent, the decrease in vegetation cover and general disturbance of the area will cause at least a moderate level of sheet erosion. This was quite evident along the dirt tracks on the site.

Terrestrial animals:

Tracks and signs of mammals are not abundant along the pipeline route though signs of several species were still observed. It is considered highly likely that the mammal population has been affected by the adjacent residential areas and impacts associated with this such as feral dogs hunting small mammals and trapping of mammals using snares, etc. The site is also utilised for communal grazing and the farmers will undoubtedly hunt small carnivores such as Black Backed Jackal (*Canis mesomelas*). Furthermore the farmers make use of herding dogs which will also impact on the small mammals in the area. As a result it is considered unlikely that species of conservational importance will occur on the site. The mammal population is therefore anticipated to be dominated by generalist species which are better adapted to these disturbed areas. In addition, mammal species which are rare and endangered are often habitat specific and sensitive to habitat change. It is therefore considered unlikely that such species would occur on the site. Overall, the mammal population on the site is considered to be largely modified.

Table 3: Biodiversity Sensitivity Rating for the proposed bulk water pipeline development.

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness		2	
Presence of rare and endangered species			1
Ecological function		2	
Uniqueness/conservation value	3		
Vegetation condition			
Percentage ground cover		2	
Vegetation structure		2	
Infestation with exotic weeds and invader plants or encroachers	3		
Degree of grazing/browsing impact	3		
Signs of erosion		2	
Terrestrial animal characteristics			
Presence of rare and endangered species	3		
Sub total	12	10	1
Total		23	

7. BIODIVERSITY SENSITIVITY RATING (BSR) INTERPRETATION

Table 4: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Greenfields Residential Bulk Water Pipeline	23	Acceptable	3

8. DISCUSSION AND CONCLUSION

The proposed site has been rated as being acceptable for the bulk water pipeline mostly as a result of the somewhat disturbed condition of the site, the small footprint of the development and the absence of any ecological aspects of high conservation value.

The proposed development will consist of a small water reservoir and bulk water transport pipeline on the eastern outskirts of the town of Postmasburg (Appendix A: Map 1 & 2). The pipeline will be situated on the Remainder of Erf 1 and will have an approximate length of 2 km. It will be situated from the existing reservoir complex on top of a low hill, will extend toward the west, where it will connect to the new proposed Greenfields residential development. The footprint of the proposed pipeline still consists of natural vegetation but which has been affected by high levels of overgrazing and -browsing by livestock as the site is situated within a communal grazing area. No watercourses or wetlands could be identified on or near the proposed site, with the Groenwaterspruit being situated approximately 700 meters to the south and therefore highly unlikely that it will be affected by the development.

According to Mucina & Rutherford (2006) and utilising current mapping resources (National Biodiversity Assessment 2018) the site is indicated to fall within Kuruman Thornveld (SVk 9) (Appendix A: Map 2). This vegetation type is currently listed as being of Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Appendix A: Map 1 & 2). This will also decrease the conservation value of remaining natural vegetation. In addition, the natural vegetation is also degraded to a significant extent by overgrazing and -browsing by domestic livestock. The Northern Cape Critical Biodiversity Areas Plan (2016) has been published in order to identify areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas (CBA). The proposed pipeline route falls within a Critical Biodiversity Area 1 (CBA 1) and is therefore of high conservation value (Appendix A: Map 2). The reason for being listed as CBA 1 is due to the Groenwaterspruit, a listed National Freshwater Ecosystem Priority Area (NFEPA), being situated to the south of the site and the site itself also forming part of the immediate catchment of this river. Furthermore, this area also forms part of the Southern Ghaap Plateau Strategic Water Source Area (SWSA) and also contributes towards the high conservation value for the catchment of the river. However, given the nature of the development, small footprint of the proposed pipeline and the distance from the river, approximately 700 meters, it is highly unlikely that the development will compromise the functioning of this watercourse. Furthermore, Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development.

Although the pipeline route still consists of natural vegetation it is however quite substantially degraded by heavy and sustained communal overgrazing and -browsing. This has quite significantly altered the vegetation composition and structure. It is notable that palatable grass species are rare while pioneer grasses now dominate. Exotic weeds have become more prominent due to the overgrazing. The shrub layer has also become denser and it is prominent that all of the more palatable shrubs are heavily browsed and dwarfed. This has caused substantial degradation of the natural vegetation though elements of conservation value are clearly still present.

The topography of the pipeline route is dominated by a sandy plain in the central and western portion of the pipeline route, with a low hill in the eastern portion of the pipeline route with a

small reservoir complex on top of the hill. The slope along the pipeline route is therefore moderate along the slope of the low hill, then descending toward the plain which has a relatively flat topography up to the western end where the pipeline will connect to the Greenfields residential development. No watercourses or wetlands occur near the site and the pipeline route itself also does not contain any concentrated runoff patterns, wetlands or watercourses (Appendix A: Map 1 & 2). The Groenwaterspruit, a NFEPA listed watercourse, is located approximately 700 meters to the south. The proposed developments should therefore not result in any impact on it or any other wetland or watercourse.

Endangered or Red Listed species are absent from the site and also considered somewhat unlikely to occur due to the high levels of overgrazing and -browsing by domestic livestock. Sensitive Species #249 has also been recorded in this area, however, suitable habitat is certainly not present along the pipeline route or surroundings and is therefore irrelevant to this development. However, as indicated, several protected plant species do occur along the pipeline route (Appendix C). These are all relatively widespread but do still retain a significant conservation value. Where the two tree species (*Boscia albitrunca*, *Vachellia erioloba*) will be affected and will require removal, the necessary permits will have to be obtained to do so. The protected succulent and geophytic species along the pipeline route are all known to transplant easily and the impact on them should be mitigated by doing a walkthrough survey prior to construction, permits obtained for all affected specimens and those transplanted to adjacent areas where they will remain unaffected. These protected plants include *Pachypodium succulentum*, *Kalanchoe paniculata*, *Mestoklema tuberosum*, *Ammocharis coranica*, *Harpagophytum procumbens*, *Oxalis lawsonii* and *Aloe hereroensis*

Tracks and signs of mammals are not abundant along the pipeline route though signs of several species were still observed. It is considered highly likely that the mammal population has been affected by the adjacent residential areas and impacts associated with this such as feral dogs hunting small mammals and trapping of mammals using snares, etc. As a result it is considered unlikely that species of conservational importance will occur on the site. The mammal population is therefore anticipated to be dominated by generalist species which are better adapted to these disturbed areas. In addition, mammal species which are rare and endangered are often habitat specific and sensitive to habitat change. It is therefore considered unlikely that such species would occur on the site. The impact that the proposed pipeline will have on the mammal population is mainly concerned with the loss of habitat. However, the survey has indicated that the available habitat is already somewhat disturbed and will most probably support a population of generalist mammals. Furthermore, the footprint of the development will not be extensive and should therefore limit the impact on mammals. The impact would also be mostly temporary as long as adequate rehabilitation is undertaken.

The impact significance has been determined and without mitigation a few impacts may be moderate, with the loss of protected plant species also being moderate-high. However, with adequate mitigation which in most cases could be easily applied, all impact can be decreased to at least low-moderate.

From the description of the vegetation on the site it is clear that although it is largely natural, it has been disturbed or degraded to a significant extent by continuous overgrazing and -browsing by domestic livestock. It would therefore seem that the proposed pipeline route does not have a high conservation value. In addition, the natural vegetation type in the area, Kuruman Thornveld is also not currently considered to be of high conservation concern and is listed as being of Least Concern (LC) (Appendix A: Map 1 & 2). The pipeline route does not

contain any unique or sensitive habitats, does not have a significant species diversity and does not contain any sensitive or Red Listed species. However, as indicated the pipeline route does contain several protected species of significant conservation value and adequate mitigation will be required to alleviate the impact on these (Appendix C). Furthermore, the area is also listed as a Critical Biodiversity Area 1 (CBA 1) as a result of the Groenwaterspruit, a National Freshwater Ecosystem Priority Area (NFEPA), to the south and the site itself also forming part of the immediate catchment of this river (Appendis A: Map 1 & 2). This area also forms part of the Southern Ghaap Plateau Strategic Water Source Area (SWSA) and also contributes towards the high conservation value for the catchment of the river. However, given the nature of the development, small footprint of the proposed pipeline and the distance from the river, approximately 700 meters, it is highly unlikely that the development will compromise the functioning of this watercourse. Therefore, in conclusion, although elements of conservation value do occur, overall the proposed pipeline route does not have a high conservation value or unique features requiring exclusion and should not result in any high impacts on the vegetation and ecology of the site and immediate surroundings.

9. RECOMMENDATIONS

- The pipeline route contains numerous protected plant species which, although widespread, has significant conservation value and will require mitigation (Appendix C).
 - A suitably qualified ecologist or botanist should undertake a walkthrough survey of the pipeline route prior to construction to identify and locate all protected plants that will be affected by construction.
 - Where the two tree species (*Boscia albitrunca*, *Vachellia erioloba*) will be affected and will require removal, the necessary permits will have to be obtained to do so.
 - All protected succulent and geophytic plants will transplant easily and should be moved to an adjacent area where they will remain unaffected. These protected plants include *Pachypodium succulentum*, *Kalanchoe paniculata*, *Mestoklema tuberosum*, *Ammocharis coranica*, *Harpagophytum procumbens*, *Oxalis lawsonii* and *Aloe hereroensis*.
 - Care should be taken where geophytic species are deciduous as they will be difficult to see in winter.
- The footprint of disturbance and clearance of vegetation must always be kept to a minimum.
- When excavating trenches the upper 30 cm, or topsoil, should be removed together with the vegetation and stored on the site. These should then be replaced on top of the installed pipeline. Subsoil should be used as backfilling and not as top dressing. The soil surface should also be re-instated to the virgin soil level and not depressed or elevated as this will promote erosion and will hamper integration with the surrounding natural areas. After rehabilitation any excess soil or material should be removed and disposed of at a registered disposal facility.
- After construction of the pipeline the area must be rehabilitated. This includes removal of all construction material. Excavated rock may not be left in heaps and must be removed or distributed evenly over the terrain to represent a natural environment. Compacted areas must be ripped. Construction roads not being utilised afterwards must be rehabilitated.
- Despite the absence of any watercourses or wetlands, the construction of the pipeline should still implement adequate erosion monitoring and control.
- Adequate monitoring of weed and invasive species establishment and their continued eradication must be maintained (Appendix B). Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.
- The hunting, capturing and trapping of fauna should be prevented by making this a punishable offense during the construction phase of the development.

- Open trenches may act as pitfall traps to mammals, reptiles and amphibians and trenches should be daily monitored for trapped animals which should be removed promptly.
- In the event of poisonous snakes or other dangerous animals encountered on the site an experienced and certified snake handler or zoologist must remove these animals from the site and re-locate them to a suitable area.
- No littering must be allowed and all litter must be removed from the site.
- Monitoring of construction and compliance with recommended mitigation measures must take place.
- After construction has ceased all construction materials should be removed from the area.

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Annexure A: Maps



Locality map of a proposed bulk water pipeline for the Greenfields residential development in Postmasburg, Northern Cape Province.








Map 1: Locality map of the proposed bulk water pipeline in Postmasburg. The area clearly still consists of natural vegetation and falls within the Kuruman Thornveld vegetation type. Note the residential areas to the north west and the Groenwaterspruit located 700 meters to the south.



Prepared for:
Marguerite Cronje
Environmental Consultant
Tel: 082 702 0547

Legend:

-  Pipeline route
-  Watercourses
-  Wetlands and impoundments
-  Kuruman Thornveld
-  Postmasburg Thornveld

Map Information

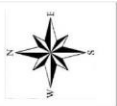
Spheroid: WGS 84

Quantum GIS

Scale: 1:20 000

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General ecology map of a proposed bulk water pipeline for the Greenfields residential development in Postmasburg, Northern Cape Province.



Map 2: General ecology map of the proposed bulk water pipeline in Postmasburg. The pipeline route is situated within a Critical Biodiversity Area 1 though it does not form part of a Threatened Ecosystem or NPAES Focus Area. The Groenwaterspruit located approximately 700 meters to the south is also visible. The area also falls within the Southern Ghaap Plateau Strategic Water Source Area (SWSA) though this is not indicated on the map.



Prepared for:
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Legend:

- Pipeline route
- Watercourses
- Wetlands and impoundments
- Critical Biodiversity Area 1
- Critical Biodiversity Area 2
- Ecological Support Area 1
- Ecological Support Area 2
- Protected Areas
- Other
- NPAES Focus Areas
- Threatened Ecosystems

Map Information

Spheroid: WGS 84

Quantum GIS

Scale: 1:20 000

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Appendix B: Species list

Species indicated with an * are exotic.

Protected species are coloured orange and Red Listed species red.

Species	Growth form
* <i>Alternanthera pungens</i>	Herb
* <i>Chenopodium carrinatum</i>	Herb
* <i>Echinopsis schikendantzii</i>	Succulent
* <i>Prosopis glandulosa</i>	Tree
* <i>Verbesina encelioides</i>	Herb
* <i>Xanthium spinosum</i>	Herb
<i>Albuca setosa</i>	Geophyte
<i>Aloe hereroensis</i>	Succulent
<i>Ammocharis coranica</i>	Geophyte
<i>Aristida diffusa</i>	Grass
<i>Asparagus larcinus</i>	Shrub
<i>Atistida congesta</i>	Grass
<i>Blepharis mitrata</i>	Herb
<i>Boscia albitrunca</i>	Tree
<i>Cadaba aphylla</i>	Shrub
<i>Chascanum pinnatifidum</i>	Herb
<i>Chrysocoma ciliata</i>	Dwarf shrub
<i>Citrillus lanatus</i>	Creeper
<i>Cleome rubella</i>	Herb
<i>Corchorus asplenifolius</i>	Herb
<i>Cymbopogon pospischillii</i>	Grass
<i>Dicoma capensis</i>	Herb
<i>Enneapogon cenchroides</i>	Grass
<i>Enneapogon desvauxii</i>	Grass
<i>Eragrostis biflora</i>	Grass
<i>Eragrostis echinchoidea</i>	Grass
<i>Eragrostis lehmanniana</i>	Grass
<i>Eriocephalus ericoides</i>	Dwarf shrub
<i>Eriospermum porphyrium</i>	Geophyte
<i>Geigeria ornativa</i>	Herb
<i>Gisekia africana</i>	Herb
<i>Glossochilus burchellii</i>	Herb
<i>Gnidia polycephala</i>	Dwarf shrub
<i>Gomphocarpus tomentosus</i>	Herb
<i>Grewia flava</i>	Shrub
<i>Harpagophytum procumbens</i>	Geophyte
<i>Hermannia comosa</i>	Herb
<i>Indigofera laternans</i>	Herb
<i>Kalanchoe paniculata</i>	Succulent
<i>Kleinia longiflora</i>	Succulent

<i>Kyphocarpa angustifolia</i>	Herb
<i>Lantana rugosa</i>	Herb
<i>Ledebouria</i> sp.	Geophyte
<i>Limeum viscosum</i>	Herb
<i>Lycium horridum</i>	Dwarf shrub
<i>Melinis repens</i>	Grass
<i>Mestoklema tuberosum</i>	Succulent
<i>Monechma divaricatum</i>	Herb
<i>Oxalis lawsonii</i>	Geophyte
<i>Oxygonum delagoense</i>	Herb
<i>Pachypodium succulentum</i>	Succulent
<i>Pegolettia retrofracta</i>	Dwarf shrub
<i>Peliostomum leucorrhizum</i>	Herb
<i>Pentzia virides</i>	Dwarf shrub
<i>Pogonarthria squarrosa</i>	Grass
<i>Rhigozum obovatum</i>	Shrub
<i>Salvia verbenaca</i>	Herb
<i>Sansevieria aethiopica</i>	Geophyte
<i>Schmidtia pappophoroides</i>	Grass
<i>Searsia burchellii</i>	Shrub
<i>Searsia ciliata</i>	Shrub
<i>Senegalia mellifera</i> subsp. <i>detinens</i>	Tree
<i>Senna italica</i>	Herb
<i>Sesamum triphyllum</i>	Herb
<i>Solanum incanum</i>	Herb
<i>Solanum supinum</i>	Herb
<i>Sporobolus fimbriatus</i>	Grass
<i>Stipagrostis uniplumis</i>	Grass
<i>Tarchonanthus camphoratus</i>	Shrub
<i>Tragus berteronianus</i>	Grass
<i>Tribulus terrestris</i>	Herb
<i>Vachellia erioloba</i>	Tree
<i>Vachellia hebeclada</i>	Shrub
<i>Vachellia tortillis</i>	Tree
<i>Ziziphus mucronata</i>	Tree

Appendix C: Protected species on the site

Protected species on the site may not be limited to these species but these species have identified on and around the site. Additional sources should be consulted to confirm the presence of protected species.



Aloe hereroensis
Herero Aloe/Sandaalwyn

Protected in the Northern Cape Province

National Red List Status: **Least Concern (LC)**

Method: The species is abundant on the site especially the low hill. Where they are affected by construction they should be removed and transplanted to an adjacent area where they will not be affected.



Ammocharis coranica
Seeroogblom/Ground Lily

Protected in the Northern Cape Province

National Red List Status: **Least Concern (LC)**

Scattered specimens occur in the sandy plains on the site. Where they are affected by construction they should be removed and transplanted to an adjacent area where they will not be affected. They have a large underground bulb which will have to be taken into account with the transplanting.



Pachypodium succulentum
Bobbejaankambroo/Dikvoet

Protected in the Northern Cape Province

National Red List Status: **Least Concern (LC)**

Method: **The species is abundant on the site especially the low hill. Where they are affected by construction they should be removed and transplanted to an adjacent area where they will not be affected. Large underground tubers need to be taken into account for this species.**



Boscia albitrunca
Shepherds Tree/Witgat Boom

Protected in the Northern Cape Province

National Red List Status: **Least Concern (LC)**

Method: **The species is abundant on the site especially the low hill. Where they are affected by construction permits must be obtained to removed them.**



Kalanchoe paniculata
Hasieoor/Krimpsiektebos

Protected in the Northern Cape Province

National Red List Status: **Least Concern (LC)**

Method: **Scattered on the on the site especially the low hill. Where they are affected by construction permits must be obtained to removed them.**



Oxalis lawsonii
Vlaktesuring

Protected in the Northern Cape Province

National Red List Status: **Least Concern (LC)**

Scattered specimens occur in the sandy plains on the site. Where they are affected by construction they should be removed and transplanted to an adjacent area where they will not be affected.



Mestoklema tuberosum
Donkievybossie

Protected in the Northern Cape Province

National Red List Status: **Least Concern (LC)**

Method: The species is abundant on the site especially the low hill. Where they are affected by construction they should be removed and transplanted to an adjacent area where they will not be affected.



Harpagophytum procumbens
Devil's Claw/Duiwelsklou

Protected in the Northern Cape Province/also listed as National TOPS: Protected Medicinal Species.

National Red List Status: **Least Concern (LC)**

Method: Numerous specimens occur in the sandy plains on the site. Where they are affected by construction they should be removed and transplanted to an adjacent area where they will not be affected. They have an exceedingly large taproot which will have to be taken into account with the transplanting.



Acacia erioloba
Camel Thorn/Kameeldoring

Listed as a protected tree species.

National Red List Status: **Least Concern (LC)**

The species is subjected to a continuing decline and is therefore listed as a **Declining** species.

Method: **Several specimens noted in the central sandy plains portion. Other trees may also occur. Where they are affected by construction permits must be obtained to removed them.**



Appendix D: Impact methodology

The environmental significance assessment methodology is based on the following determination:

Environmental Significance = Overall Consequence x Overall Likelihood

Determination of Consequence

Consequence analysis is a mixture of quantitative and qualitative information and the outcome can be positive or negative. Several factors can be used to determine consequence. For the purpose of determining the environmental significance in terms of consequence, the following factors were chosen: **Severity/Intensity, Duration and Extent/Spatial Scale**. Each factor is assigned a rating of 1 to 5, as described below and in tables 6, 7, 9 and 10.

Determination of Severity

Severity relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the biophysical and socio-economic environment.

Table 7 will be used to obtain an overall rating for severity, taking into consideration the various criteria.

Table 7: Rating of severity

Type of criteria	Rating				
	1	2	3	4	5
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / Non-harmful	Small Potentially harmful	Significant / Harmful	Great / Very harmful	Disastrous Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable/ Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/ High potential to mitigate impacts to level of insignificance / Easily reversible	Low cost to mitigate	Substantial cost to mitigate / Potential to mitigate impacts / Potential to reverse impact	High cost to mitigate	Prohibitive cost to mitigate / Little or no mechanism to mitigate impact Irreversible
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Moderate change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

Determination of Duration

Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.

Table 8: Rating of Duration

Rating	Description
1: Low	Almost never / almost impossible
2: Low-Medium	Very seldom / highly unlikely
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Determination of Extent/Spatial Scale

Extent refer to the spatial influence of an impact be local (extending only as far as the activity, or will be limited to the site and its immediate surroundings), regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders).

Table 9: Rating of Extent / Spatial Scale

Rating	Description
1: Low	Immediate, fully contained area
2: Low-Medium	Surrounding area
3: Medium	Within Business Unit area of responsibility
4: Medium-High	Within Mining Boundary area
5: High	Regional, National, International

Determination of Overall Consequence

Overall consequence is determined by adding the factors determined above and summarised below, and then dividing the sum by 4.

Table 10: Example of calculating Overall Consequence

Consequence	Rating
Severity	Example 4
Duration	Example 2
Extent	Example 4
SUBTOTAL	10
TOTAL CONSEQUENCE:(Subtotal divided by 4)	3.3

Likelihood

The determination of likelihood is a combination of Frequency and Probability. Each factor is assigned a rating of 1 to 5, as described below and in Table 11 and Table 12.

Determination of Frequency

Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken.

Table 11: Rating of frequency

Rating	Description
1: Low	Once a year or once/more during operation/LOM
2: Low-Medium	Once/more in 6 Months
3: Medium	Once/more a Month
4: Medium-High	Once/more a Week
5: High	Daily

Determination of Probability

Probability refers to how often the activity/event or aspect has an impact on the environment.

Table 12: Rating of probability

Rating	Description
1: Low	Almost never / almost impossible
2: Low-Medium	Very seldom / highly unlikely
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Overall Likelihood

Overall likelihood is calculated by adding the factors determined above and summarised below, and then dividing the sum by 2.

Table 13: Example of calculating the overall likelihood

Consequence	Rating
Frequency	Example 4
Probability	Example 2
SUBTOTAL	6
TOTAL LIKELIHOOD (Subtotal divided by 2)	3

Determination of Overall Environmental Significance

The multiplication of overall consequence with overall likelihood will provide the environmental significance, which is a number that will then fall into a range of LOW, LOW-MEDIUM, MEDIUM, MEDIUM, MEDIUM-HIGH or HIGH, as shown in the table below.

Table 14: Determination of overall environmental significance

Significance or Risk	Low	Low-Moderate	Moderate	Moderate-High	High
Overall Consequence X Overall Likelihood	1 - 4.9	5 - 9.9	10 - 14.9	15 - 19.9	20 - 25

Qualitative description or magnitude of Environmental Significance

This description is qualitative and is an indication of the nature or magnitude of the Environmental Significance. It also guides the prioritisations and decision making process associated with this event, aspect or impact.

Table 15: Description of the environmental significance and the related action required.

Significance	Low	Low-Moderate	Moderate	Moderate-High	High
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect. Acceptable.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to the company	Impact is real and substantial in relation to other impacts. Pose a risk to the company. Unacceptable	Impact is of the highest order possible. Unacceptable. Fatal flaw.
Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate to determine potential increase in risk. Where possible improve	Implement monitoring. Investigate mitigation measures and improve management measures to reduce risk, where possible.	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.