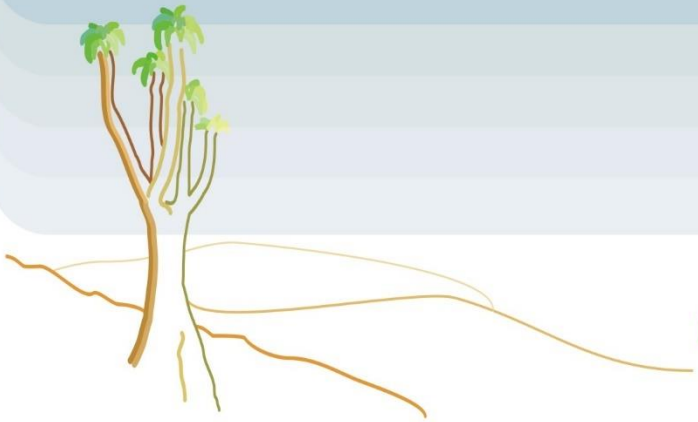

DPR

Ecologists & Environmental Services

Landscape Maintenance Plan for alluvial diamond mining operations at Rooipoort on the farms Zandplaats 102/5, Vogelstruis Pan 101/0, Vogelstruis Pan 98/0, Bergplaats 100/0 and Klipfontein 99/0 near Schmidtsdrif, 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.

Report Version	Final 1.0		
Title	Landscape Maintenance Plan for alluvial diamond mining operations at Rooipoort on the farms Zandplaats 102/5, Vogelstruis Pan 101/0, Vogelstruis Pan 98/0, Bergplaats 100/0 and Klipfontein 99/0 near Schmidtsdrif, Northern Cape Province.		
Author	DP van Rensburg (Pr.Sci.Nat)		Aug'18

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1 INTRODUCTION

The purpose of the report is to develop a Landscape Maintenance Plan to inform the **WULA** Water Use License that is required for the proposed operation of the alluvial diamond mining for which a mining authorization was obtained in terms of the **MPRDA** (Mineral and Petroleum Resources Development Act) (Map 1). The landscape maintenance plan should specifically be used during rehabilitation of the site.

1.1 Mining processes

The mining processes entails the following:

- The various identified mining sites, demarcated by an extensive prospecting programme conducted by De Beers, will be mined by conventional open cast alluvial mining methods.
- All of the gravel resources on Rooipoort will be mined using the strip mining method, which utilises excavators, front-end loaders and dumper trucks.
- The areas to be mined will be surveyed and a survey base line will be established across the working area of each resource. 100m X 200m strips will be demarcated for each of the deposits (M5, M6 and L2) which will be mined. The width of these cuts will probably not be 100 m as it becomes difficult to clear overburden over such a large area. One block at a time will be opened for each deposit, but three blocks will be open at any given time. One block will be stripped of overburden, gravel will be removed from a second block and a third block will be backfilled and rehabilitated. Any topsoil from these blocks will be removed and stockpiled on the high ground side of the excavation. Overburden will also be removed and kept separate from the topsoil. The landowner permits the applicant to have a maximum of 6 ha of voids open at any given time.
- The gravels will be extracted from each block using a 70 ton excavator. The gravels will be transported to the Dense Medium Separator (DMS) plant by haul trucks where it will be screened through rotary barrel screens to <75mm. The remaining <75mm material will be scrubbed and screened to -32mm, +2mm, whereafter it will be processed through the DMS plant and the final recovery section. The DMS units have

been reduced from 4 units to only 2 units with the addition of the Bourevestnik Plant (BV). The BV plant is an X-Ray machine treating -50 mm to +5 mm material and uses little water making the plant water. The BV only uses water for cooling purposes and will top-up a small volume of water every hour. This is minimal.

- Once processed, the plant tailings and oversize material will be hauled back to the excavation and backfilled into the same trench from which it was extracted. This will be performed by the haul trucks that were used to transport the gravels from the excavation site to the Plant.
- Figure 1 indicates the process and the products produced by the process. During the processing of the material, the grits and fine material will continuously be pumped to the First Cut on site. The First Cut was designed to allow the suspended fine material to settle in the first pond. Water will flow through a stone diversion between the two ponds. Clean water will be pumped from the second pond back to the PWD to be re-used in the process plant or for dust suppression. When the mining in the area is completed the First Cut will be left to dry and will be backfilled with oversized material, overburden and soil. The overburden and topsoil will be replaced to the voids to cover the backfilled dry fine gravel and plant gravels.

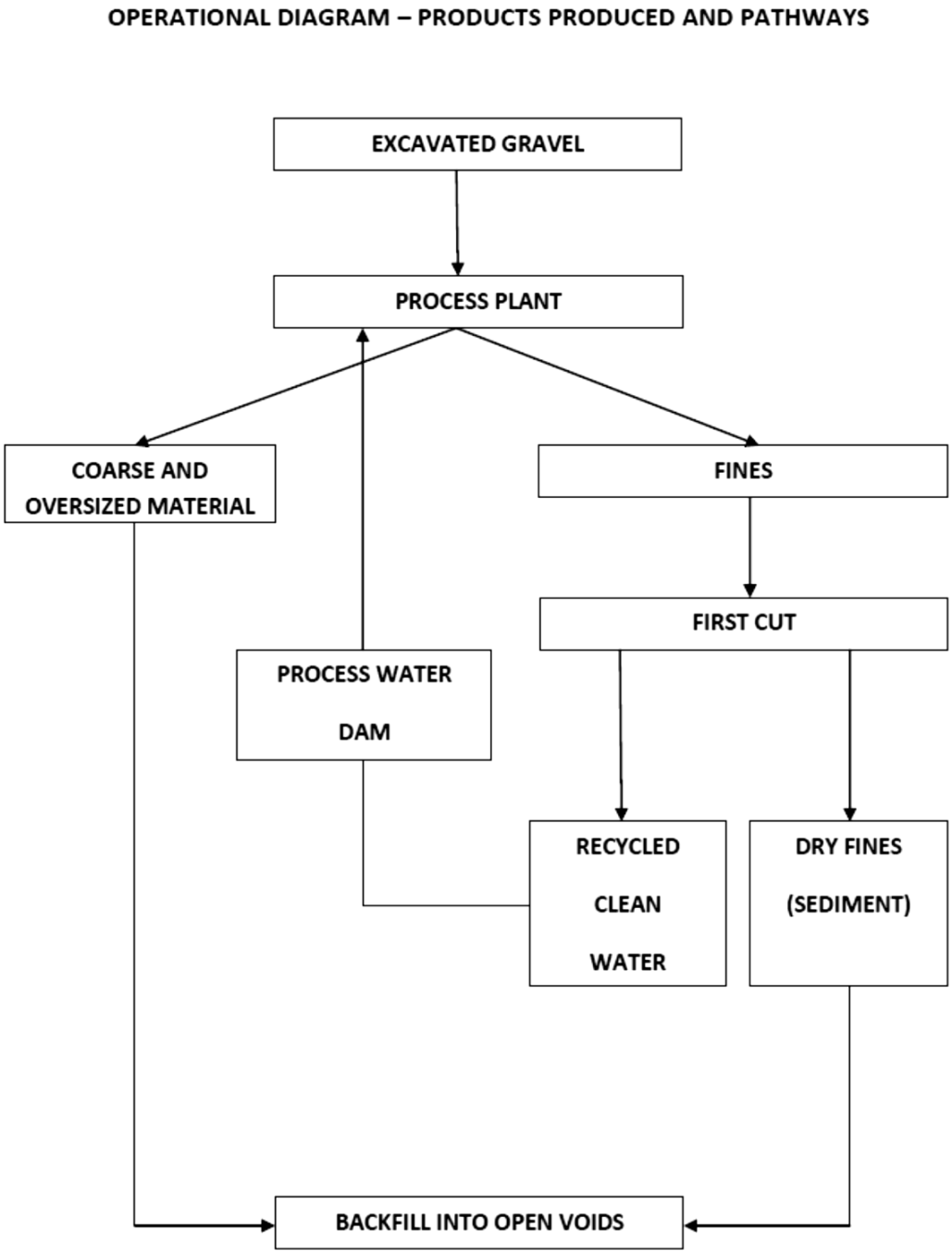


Figure 1: Diagram illustrating the mining process.

1.2 Scope of Work

Rooipoort Developments (Pty) Ltd proposes to mine alluvial diamonds on the farms Zandplaats 102/5, Vogelstruis Pan 101/0, Vogelstruis Pan 98/0, Bergplaats 100/0 and Klipfontein 99/0. The

study area is located on the eastern banks of the Vaal River to the east of the town of Schmidtsdrif and approximately 60 km to the west of Kimberley. The extent of the study is approximately 40 000 ha with the portions where mining will mostly take place covering 25 000 ha (Map 1).

The purpose is to develop a Landscape Maintenance Plan for the alluvial diamond mining operations in support of the water use application in terms of the National Water Act, 1996. The main objectives of the Landscape Maintenance Plan are to ensure:

- Provide a description of the landscape and river bank morphology in order to rehabilitate the site to a representative landscape. This will focus on the Vaal River but will also include watercourses in the interior of the study area as well as the overall catchment.
- Describe vegetation structure on the site so that a representative structure can be obtained during rehabilitation

1.3 Methodology

- Survey of the proposed mining site to evaluate the river bank, watercourses and catchment geomorphology in order to determine landscape maintenance at the site.
- Assessment of the vegetation structure to establish differing vegetation structure in terms of the bank morphology/landscape.

1.4 Principles that were considered during the development of the landscape maintenance plan

- Riparian vegetation is continuously subjected to disturbance caused by annual flooding which will influence the vegetation structure along the bank of the affected watercourses, both longitudinally and laterally.
- Vegetation structure varies laterally from the water's edge up to the floodplain.
- Watercourses contain a marginal, lower and upper zone which differ in their vegetation structure.
- The catchment will contain a specific vegetation structure composed exclusively of terrestrial plant species.

2 OVERVIEW OF THE WATERCOURSE SYSTEMS AND ASSOCIATED WETLAND AND RIPARIAN VEGETATION

2.1 Watercourse morphology

The term watercourse refers to a river, stream, wetland or pan. The National Water Act (NWA, 1998) includes rivers, streams, pans and wetlands in the definition of the term watercourse. This definition follows:

Watercourse means:

- A river or spring.
- A natural channel in which water flows regularly or intermittently.
- A wetland, lake or dam into which water flows.
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

River systems can be divided into different riparian zones within the lateral section of the system. These zones are as follows:

- The marginal zone is the lowest zone and is always present in river systems while the other two zones may not always be present. The zone is situated from the water level at low flow, if present, up to the features that are hydrologically activated for the most of the year.
- The lower zone is characterised by seasonal features and extends from the marginal zone up to an area of marked elevation. This area may be accompanied by a change in species distribution patterns. The lower zone consists of geomorphic features that are activated on a seasonal basis.
- The upper zone is characterised by ephemeral features as well as the presence of both riparian and terrestrial species. The zone extends from the lower zone to the riparian corridor. The upper zone contains geomorphic features that are hydrologically activated on an ephemeral basis.

2.2 Terrestrial environment

Almost the entire study area still consists of natural vegetation except portions along the western border, especially along the floodplain of the Vaal River, where current and previous mining has occurred. The majority of the study however remains natural and the ecological function is largely intact. The study area is situated within the Savanna Biome and therefore the landscape contains a well-developed tree layer with grass and dwarf shrub understorey. The tree layer may be quite dense in areas but varies from open to closed. Areas with low or no tree cover also occur in the north eastern portion of the study area. These areas are dominated by grassland. Small portions dominated by dwarf karroid shrubs are also present although in small extent. The region is considered to have a low rainfall and forms part of an arid area.

The study area contains a varied topography also due to the large size of the area. Topography includes relatively flat plains with uneven and rocky terrain in the central portion of the study area with a high amount of ridges and hills. Altitude varies from 1009 m to 1150 m and should illustrate that topography varies considerably over the study area. The majority of the study area contains a gradual slope toward the river except for hills and ridges where the slope can become quite steep. The general slope of the study area is toward the Vaal River. Where a gradual slope occurs such as in the south and north of the study area, watercourses are few. There is a definite increase in drainage lines closer to the river as the slope increases and flood sediments promote the formation of drainage lines. Uneven terrain such as occur in the central portion of the sturdy area contains a high amount of watercourses (Map 3). The north eastern portion contains a very low slope and deep sandy soils. In this area watercourses are largely absent although a few drainage lines and pans occur. The floodplain of the Vaal River can also become quite extensive in areas of the study area.

The topography and landscape of the study area can divide it into roughly three separate areas (Map 2). The **south western portion** of the study area consists of an undulating plain with soils varying from shallow to deep and a relatively high percentage surface rock in most areas. The **central and south eastern portion** of the study area is dominated by uneven, rocky terrain with shallow soils and high percentage surface rock dominated by andesitic lava. The **northern and eastern portion** of the study area contains a relatively flat area which contains areas of much deeper sandy soils but also shallow soils with high percentage calcrete. The

northern and southern portions with several similarities and the central, rocky area being more distinct.

South western portion

The south western portion of the study area consists of an undulating plain with prominent hills and ridges mostly absent (Map 2). However, due to the undulating topography low stony ridges is present. Soils consists of deep sandy to clayey soils in the southern portion of this area as well as along the floodplain of the river with more shallow, stony soils dominating the northern and western portion of the area. The vegetation structure consists of a well-developed tree layer and sparse grass layer with a dwarf karroid shrub layer becoming prominent in the norther portion where stony soils are common. Here the tree layer also decreases in height, most likely also attributed to the shallower, stonier soils.

Areas with deeper soils contain, overall, a higher tree canopy, well-developed but may be somewhat sparser than more rocky areas. The grass layer is much better developed in these areas although it may also be quite sparse in areas. A distinction in the description of this area will be made between the floodplain with clay soils and interior with more sandy soils.

The floodplain of the Vaal River in this portion is quite easily discerned as a distinct vegetation community. Remaining natural vegetation is composed of a short, sparse grass layer dominated by pioneer grasses, a prominent, low shrubs layer dominated by *Vachellia tortilis* and scattered larger trees. The grass layer is dominated by *Chloris virgata*, with other abundant grasses including *Tragus berteronianus, Eragrostis obtusa, Aristida congesta, Eragrostis lehmanniana* and *Enneaogon desvauxii*. All of these are pioneer grass species. Other dwarf shrubs occurring here include *Salsola rabieana, Pentzia incana, Rosenia humilis, Lycium horridum, Cadaba aphylla, Gnidia polycephala* and *Felicia muricata*. As already mentioned the shrub layer is dominated by *Vachellia tortilis*, though a few specimens of *Senegalia mellifera* and *Grewia flava* is also present. Larger trees are represented by *Diospyros lycioides, Ziziphus mucronata* and *Vachellia erioloba*. The understorey beneath trees and shrubs consist of a few species adapted to shadier conditions and include *Cenchrus ciliaris, Pupalia lappachea* and *Phyllanthus parvulus*. This species composition indicates a climax tree layer with a pioneer grass layer. This is considered largely natural to such floodplain communities where the clayey

silt deposited by flooding is rich in nutrients and promote the establishment of a pioneer species assemblage which is adapted to periodic disturbance.

The southern and western portions in this area contains deeper soils with less surface rock (though not everywhere) and this also intergrades with areas of shallower soils with a high percentage of surface rock in the northern portion of the area, especially around the area called "diamantkoppie". The vegetation structure in the southern portion is dominated by a tree/shrub layer which may vary from open to closed but may become quite dense in some areas. A sparse grass layer is also present with scattered dwarf karroid shrubs. Dominant shrubs/trees include *Vachellia tortilis, Grewia flava, Senegalia mellifera* and *Rhigozum trichotomum*. The protected Camel Thorn (*Vachellia erioloba*) is rare but scattered individuals do occur. Grasses include *Aristida congesta, Eragrotsis lehmanniana, E. obtusa, Enneapogon desvauxii* and *Schmidtia pappophoroides*. The last named, *S. pappophoroides*, is considered a reliable indicator of sandy soils and will therefore reliably indicate the vegetation communities associated with these areas. The dwarf karroid shrub, *Pentzia incana*, and herb, *Sericorema remotiflora*, is scattered within the grass layer.

Towards the northern and eastern portions of this area soils become shallower with surface rock becoming much more dominant. Surface stones, rock and pebbles can become quite dominant on the surface of this area and often limestone/calcrete is dominant. This also includes the area called "diamantkoppie" which was previously also subjected to diamond mining operations. The vegetation structure is again dominated by a shrub/tree layer which can be quite dense in many areas. A sparse grass layer is present and the dwarf karroid shrub component is also much more prominent. The shrub/tree layer is dominated by *Vachellia tortillis* and *Senegalia melifera* with *Tarchonanthus camphoratus* and *Grewia flava* scattered. The protected shepherds tree (*Boscia albitrunca*) is also scattered and of some conservation significance. The understorey underneath trees and shrubs is represented by grasses and herbs adapted to shadier conditions and include *Cenchrus ciliaris, Phyllanthus parvulus, Pupalia lappachea, Setaria verticillata, Lantana rugosa* and *Pavonia burchellii*. The grass layer is dominated by *Eragrostis obtusa, E. lehmanniana, Enneapogon desvauxii* and *Aristida congesta*. Other common but not dominating grasses include *Cymbopogon pospischillii, Fingerhuthia africana, Stipagrostis obtusa, Sporobolus coromandelianus* and *Eragrostis*

truncata. The last named is also an indicator of limestone soils and indicative of these habitats. The dwarf karroid shrub component is represented by *Pentzia incana, Eriocephalus ericoides, Rhigozum trichotomum, Pteronia sordida, Lycium horridum* and *Barleria rigida*. The herb, *Geigeria foilifolia*, is also common.

Figure 2: Areas with deeper sandy soils are clearly devoid of surface rock, a sparse grass layer, well-developed shrub layer, with scattered trees are clearly visible.

Figure 3: View of another portion of this area where the tree/shrub canopy cover is much higher. Note again an increase in superficial calcrete.

Central and south eastern portion

The central and south eastern portion consists and is dominated by a very uneven rocky terrain dominated by hills and ridges (Map 2). A high amount of ravines and drainage lines also drain this portion (Map 3). Overall, soils are considered relatively shallow with a high percentage surface and below-surface rock content. Areas with somewhat deeper soils occur within basins formed within the interior of this mountainous portion. The vegetation structure is dominated by a well-developed and relatively dense tree/shrub layer. This layer is relatively low and dominated largely by Blackthorn (*Senegalia mellifera*) and is relatively dense though this still varies between different slope aspects. A grass layer is also well-developed and often

dominated by *Cenchrus ciliarus*. This mountainous portion essentially divides the study area into the south western portion and northern and eastern portion.

The hills in the eastern area of this portion have a predominately east facing aspect. Vegetation here is dominated by a relatively dense canopy cover with a significant and well-developed grass layer. The shrubs/tree layer is well-developed but has a low height and is dominated by *Senegalia mellifera*. Other shrubs scattered within this layer include *Ehretia rigida, Vachellia tortilis, Tarchonanthus camphoratus, Boscia albitrunca, Searsia ciliata* and *Rhigozum obovatum*. Of these *B. albitrunca* is also a protected species also identified as occurring in the southwestern portion of the study area. In addition, a few scattered individuals of the Lantern Bush (*Nymania capensis*) were also identified. The grass layer in these hills are also represented by a variety of species with *Cenchrus ciliaris* becoming a dominant feature with altitude, i.e. plateaus. Grass species include *Heteropogon contortus, Cenchrus ciliaris, Cymbopogon pospischillii, Eragrostis obtusa, E. lehmanniana, Aristida congesta, A. diffusa, Enneapogon scoparius* and *Digitaria eriantha*. Herbs, dwarf shrubs and geophytes are also common within the understorey. Small herbs and dwarf shrubs include *Chascanum pinnatifidium, Barleria lictensteiniana, B. rigida, Felicia muricata, Phyllanthus parvulus, Sericorema remotiflora, Corbichonia decumbens, Hermannia vestita, Pollichia campestris* and *Euryops subcarnosus*. On shadier slopes and underneath boulders, etc. small ferns are present including *Pellaea calomelanos* and *Cheilanthes hirta*. Small geophytes include *Eriospermum porphyrium, Oxalis sp., Haemanthus humilis, Freesia andersoniae, Moraea polystachya* and *Ornithoglossum sp.* Succulent species present are represented by *Mestoklema tuberosum* and *Ruschia sp.*

The portion of the mountainous area consisting of the hills in the central and north western section is much the same as the east facing hills. Dominant shrubs/trees remain the same although the shrubs, *Grewia flava, Phaeoptilum spinosum* and *Rhigozum obovatum*, becomes more prominent in some areas. The grass layer also remains largely unchanged, though north and west facing aspects may contain a much sparser grass layer. Additional grass species observed include *Fingerhuthia africana* and *Pogonarthria squarrosa*. The herb and dwarf karroid shrubs assemblage is also much the same with a few additional species observed

including *Pentzia virides, Blepharis integrifolia, Lantana rugosa, Pupalia lappacea, Aptosimum lineare* and the succulent *Sansevieria aethiopica*.

As previously mentioned the quartzite outcrop along the north eastern border of the central portion is considered significantly different from the larger mountainous area. This quartzite outcrop is relatively narrow with a longitudinal shape approximately 4 km in length. It has a relatively low elevation with moderate slopes and an extensive plateau portion with flat gradient. The percentage rock surface coverage is also high. The vegetation structure consists of a relatively open shrub/tree canopy with a relatively dense grass layer. The shrubs/tree layer is composed of species such as *Senegalia melifera, Vachellia tortilis, Ehretia rigida, Tarchonanthus camphoratus, Ziziphus mucronata* and *Boscia albitrunca*. The grass layer consists of *Eragrostis lehmanniana, E. nindensis, Cymbopogon pospischillii, Digitaria eriantha, Enneapogon cenchroides, Anthephora pubescens, Aristida diffusa* and *Heteropogon contortus*. A variety of herbs and other growth forms also occur and include herbs such as *Pollichia campestris, Sebaea exigua, Helichrysum zeyheri, Cleome rubella, Dianthus micropetalus* and *Pegolettia retrofracta*, the sedge *Bulbostylis hispidula,* the ferns *Pellaea calomelanos* and *Mohria sp.* and succulents *Anacampseros filamentosa* and *Portulaca kermersina*. Of these *D. micropetalus* and *Anacampseros filamentosa* are also protected species. A few geophytic species also occur and include *Moraea polystachya, Drimia platyphylla* and *Babiana hypogaea*. The species composition along this ridge is clearly significantly different from the surroundings and contain numerous species confined to it.

Figure 4: Panorama of the hills in the central portion of the area. Note the relatively dense canopy cover dominated by *Senegalia melifera*.

Northern and eastern portion

The northern and eastern portion of the study area consists of a relative flat to slightly undulating plain with prominent hills and ridges mostly absent (Map 2). This portion can relatively easily be sub-divided into two distinct areas based on soil with the north eastern section containing deeper, sandy soils without visible surface rock and the south western section with shallower soils and a high percentage calcrete rock covering quite prominent. The vegetation structure, though represented by savannah over this entire portion, also differs significantly between these two areas. The north eastern section contains a well-developed, dense grass layer with a sparse but well-developed, open woodland with tall trees common whilst the south western section contains a much sparser grass layer with more closed canopy shrub/tree layer but with a significantly lower height.

The north eastern portion with deeper, sandier soils is dominated by a well-developed grass layer which can become quite dense with a well-developed but open woodland layer. Variations within this area do occur with the most northern portion consisting of a striking savannah landscape of well-developed woodland community, portions of the central area dominated by a dense grass layer almost devoid of trees/shrubs and the southern portion containing a much denser but low shrub layer. The woodland portion in the north contains a dense grass layer dominated by *Scmidtia pappophoroides* with scattered clumps of *Themeda triandra, Cymbopogon pospischillii, Cenchrus ciliaris* and *Eragrostis pallens*. The suffrutex, *Elephantorrhiza elephantina*, is also common in the grass layer. The open, woodland tree layer is dominated by large specimens of *Vachellia erioloba* (Camel Thorn) with clumps of the low shrub, *Grewia flava* and *Tarchonanthus camphoratus*, also scattered. Longitudinal patches in the central area of this north eastern portion is dominated by a dense grass layer with the woodland component largely absent. The grass layer is dominated by *Schmidtia pappophoroides* with *Aristida congesta* also abundant. The southern portion of this area is much the same but contains a much more prominent and denser shrub layer in addition to the grass and woodland layers dominated by *Tarchonanthus camphoratus*. Other abundant shrubs include *Grewia flava, Vachellia tortilis, Phaeoptilum spinosum* and *Searsia ciliata*. Dwarf karroid shrubs such as *Pentzia incana*, also become more prominent in this area. From the above it should be evident that the area is relatively uniform in terms of species composition but that

some variation in terms of the vegetation structure is evident and easily distinguished between these areas.

The south western section within this portion consists of shallower, well-drained, rocky soils dominated by a sparse grass layer with a prominent shrub layer. The karroid layer is also more prominent and represented by a dwarf karroid shrub component. Dominant shrubs are *Tarchonanthus camphoratus* and *Grewia flava* with scattered specimens of *Zizizphus mucronata* also present. The grass layer is dominated by *Eragrostis lehmanniana* and *Enneapogon desvauxii*. The dwarf karroid shrub element includes *Pentzia virides, Zygophyllum incrustata, Lycium horridum* and *Microloma armatum*. Other smaller herbs and geophytes include *Nemesia sp., Oxalis sp., Drimia sp.* and *Geigeria filifolia*.

Figure 5: View of the northern portion within the study area. Note an open tree layer with large specimens of *V. erioloba*, a dense, well-developed grass layer and scattered shrubs.

Figure 6: Panorama of the south western area in this portion. Note the high percentage of surface calcrete covering. A sparse grass layer and dense shrub layer is evident.

2.3 Watercourses

The study area consists of the entire diamond mining area and contains floodplains, seasonal streams, pans, wetland areas and numerous drainage lines especially the areas closer to the Vaal River (Map 3).

All of the watercourses within the interior of the study area which will be affected by the mining operations are seasonal but mostly ephemeral in nature. The interior of the study area contains a high amount of drainage lines and seasonal streams which increase in number in proximity to the Vaal River. The uneven rocky terrain in the central and south western portion of the study area also contain a high amount of drainage lines as a result of the undulating terrain. The north eastern and south western portions of the study area with a lower slope gradient contain much less watercourses although several are still present in these areas. All of the streams and drainage lines has their origin within the study area. Vegetation along the streams area readily identified as riparian vegetation. Tree species along the streams are characteristic of watercourses in these arid areas. These species include *Vachellia karroo* (Sweetthorn), *Ziziphus mucronata* (Buffalo Thorn), S*earsia lancea* (Karree) and *Diospyros lycioides* (Bluebush). Indicators of wetland conditions increase with proximity to the river as the amount of runoff increases.

Due to the arid climate and limited runoff the volume of water transport is low and not conducive to the formation of wetland conditions. Furthermore, these watercourses are characterised by flash flooding after heavy rainfall by which a relatively large amount of water is transported through these systems in a relatively short period. Where the larger streams mouth into the Vaal River, especially those in the central rocky portion, they form extensive alluvial fans which form part of the floodplain of the river. Here the silty soils cause significant gulley erosion which is natural in occurrence and forms part of the floodplain. As the stream exits the rocky terrain into the alluvial fan, the slope gradient is decreased to almost flat, water flow slows considerably and sediments in suspension is deposited, forming the alluvial fan. The slowdown in water flow also causes it to fan out and take on a form similar to a delta. The vegetation within the main channel of watercourses in the interior of the study area varies over their length as well as between them. This is due to the difference in slope, catchment size, pools, etc, within and between the watercourses. Although differing, all of the vegetation

consist of riparian species of grasses and sedges which support the presence of a watercourse. The streams are easily identifiable and distinguished from the surrounding terrestrial habitats by the presence of riparian trees and wetland species such as sedges and riparian grasses. The above description should give a general idea of the functioning of the watercourses in the interior of the study area and should also serve to indicate that although they may seem small and flow only occur sporadically they still have a complex functioning which provides several unique ecosystem services. They should consequently still be considered as sensitive systems which may be easily altered or affected by activities associated with the proposed mining activities.

The Vaal River forms the western border of the study area and will also form part of the mining area (Map 1 – 3). This is an extensive length of the river situated in the study area, approximately 30 km.

The floodplain and banks of the river is relatively uniform along the length of the study area though smaller portions with differing and, in some areas, rather unique riparian habitats occurring. Two distinct backwater systems are also associated with the river in the northern portion. These are represented by two separate, longitudinal systems situated parallel to the river and in close proximity to it (approximately 300 meters) and within the floodplain. The vegetation is dominated by a grass layer with the dwarf shrub, *Salsola rabieana*, also abundant. Trees and shrubs are largely absent. These areas contain a few Facultative- and one Obligate Wetland species. These areas are being considered as highly sensitive and especially the northern wetland area containing the outflow system. These areas still form part of the floodplain of the Vaal River and will play a vital role in terms of flooding and the functioning of the floodplain. They are also considered a more uncommon type of wetland system, further increasing their conservation value.

Soil samples taken along the banks of the river were investigated for the presence of anaerobic evidence which characterises wetland soils. The soil samples taken along the banks of the Vaal River are clearly indicative of wetland conditions on a perennial basis whilst the floodplain (Upper Zone) does not contain distinctive wetland soil indicators. An exception to this being the backwater systems associated with the river in the northern portion of the study area. The floodplain contains a minimal grey matrix, no mottles and is not considered as being a wetland

area. However, the marginal and lower portion of the lower zone of the Vaal River contains distinctive wetland soil indicators. The upper portion of the lower zone does not contain any distinctive wetland condition and this can therefore be taken as the border of wetland conditions. The lower portion of the lower zone shows indications of a seasonal zone of wetness whilst the Marginal Zone shows soil characters of a permanent zone of wetness. The Vaal River and its banks are clearly defined and easily identifiable although the boundary of the floodplain is not clearly defined.

The marginal zone within the Vaal River as it occurs within the study area is well defined and easily identifiable by the presence of a dense riparian and sedge layer which are inundated on an annual nature. These marginal areas may be quite extensive in many areas where they constitute a perennial wetland area. These areas are predominately consisting of alluvial deposits on the outside of the river bends and the inflows of tributary streams. The majority of this zone seems to be largely natural although the opposite bank has been affected by mining in close proximity to the marginal zone.

The lower zone along the Vaal River can also be clearly defined and is easily visible as a definite and steep increase in slope over a short distance where after it levels off into the upper zone. The lower zone is inundated infrequently and only during larger flooding events. In small sections of the river and especially where the marginal zone is extensive the lower zone extends over a larger distance and the increase in slope and elevation is more gradual. The boundary between the zones in these areas are more difficult to discern. It is also clearly defined by a grass layer often dominated by *Cynodon dactylon*. This can also be explained by the flooding of the lower zone. Large-scale flooding has a disturbance effect whereby vegetation is removed and allows for vegetation to re-establish through an ongoing cycle which is well known in river systems. Trees are also being affected most by flooding due to their increased volume presented to floods. Grasses, sedges and the like growth forms are much better adapted to flooding and able to withstand being uprooted to a much better degree. As a result the marginal and lower zones contain almost no trees whereas the upper zone is dominated by trees. The lower zone is largely natural within the study area.

The upper zone along the Vaal River is clearly visible as a decrease in slope and an increase in the woodland component. The tree species are able to attain height and age due to the deep

root systems still able to access the higher moisture levels and as flood disturbance in the upper zone is much less the trees are allowed to grow old without being removed by flood damage. The riparian tree species within the upper zone is dominated by *Vachellia karroo* (Sweetthorn), *Ziziphus mucronata* (Buffalo Thorn) and *Diospyros lycioides* (Bluebush) which then also indicate the border of the upper zone.

The upper zone consists of the *Diospyros lycioides - Acacia karroo* Woodland vegetation community (Bezuidenhout 2009). The description of the vegetation community accurately coincides with the upper zone of the river. The community is described as a well-developed tree layer up to 9 m tall, a shrub component up to 3 m tall and an understorey dominated by pioneer herbaceous species. The diagnostic tree species include *Vachellia karroo, Combretum erythrophyllum, Searsia lancea* and *Salix mucronata*. Other woody species include *Ziziphus mucronata* and *Diospyros lycioides*. The pioneer herbaceous layer is dominated by *Setaria verticillata, Cynodon dactylon, Ariplex semibaccata* and the exotic weeds *Argemone ochroleuca* and *Datura stramonium*.

The floodplain of the Vaal River can be extensive in areas, especially the southern portion of the study area. Here the floodplain is associated with the *Salsola rabieana - Diospyros lycioides* Shrubland vegetation community (Bezuidenhout 2009). The description of the vegetation community accurately coincides with the upper zone and floodplain of the Vaal River. Characteristic species of the community include the grasses *Chloris virgata, Panicum coloratum, Eragrostis lehmanniana* and *Aristida congesta* and the dwarf shrubs *Pentzia globosa* and *Salsola rabieana*. A tree/shrub layer is also present and consists of *Ziziphus mucronata* and *Diospyros lycioides*.

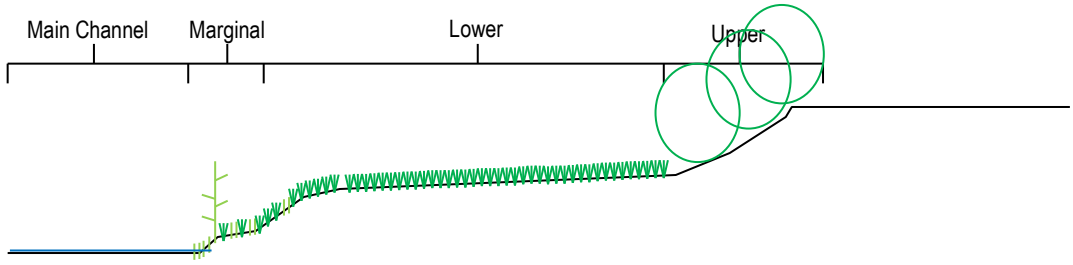


Figure 7: Illustration showing the different riparian zones of the Vaal River in the study area.

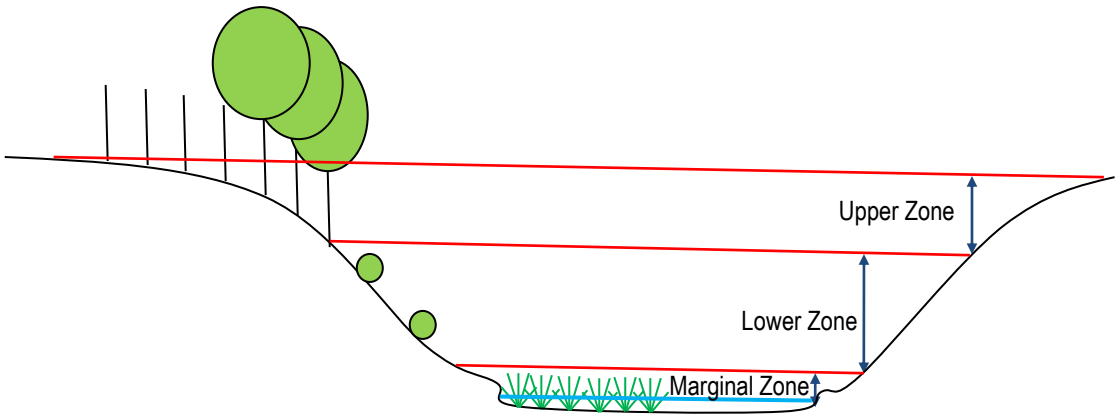


Figure 8: Illustration showing the different riparian zones of the of Vaal River in the study area. This is the situation over the majority of the section in the study area. Note the narrow marginal zone and steep lower zone.

Two large pans occur in the south eastern portion of the study area (Map 2 & 3). The larger of the two is named Hoffman's Pan situated along the southern border of the study area. The other, smaller though still large pan is situated to the north of Hoffman's Pan. The pans are situated along the eastern side of a rocky ridge which also drains into these pans by means of numerous small drainage lines. The Hoffman's Pan has a length of approximately 3.5 km with the pan to its north approximately 1 km in length. It should be evident that both are of exceptionally large size. These pans are flat-bottomed with their interiors mostly devoid of vegetation, relatively deep soils and without prominent surface stone. The floodplain or shore of these pans is quite extensive along their eastern borders. Here the vegetation is dominated by a short grass layer and karroid component represented by dwarf karroid shrubs. The hydrological regime of these pans are considered to be ephemeral and will only contain surface water after exceptional rainfall.

Figure 9: View of the central portion of the Hoffman's Pan. Due to the vast extent of the pan the shape and characteristics of the pan is not easily visible.

The northern portion of the study area consists of a relatively flat topography with the result that it contains few watercourses. However, a few are still present, especially one large stream draining the interior of this portion. Due to the flat topography areas of ponding is easily formed. As a result of this, wetland areas have formed in and around the main channel of this stream system (Map 3). These areas are mostly flat, without a channel, and contain a relatively dense vegetation layer dominated by hygrophilous grasses and sedges. The central portions of these wetland areas may also be devoid of vegetation. Obligate wetland vegetation is prominent and soil samples also indicate clear wetland conditions occurring. These wetland areas are considered to have a seasonal regime and will contain surface water on a seasonal basis.

Figure 10: View of one of the flat wetland areas situated within the large seasonal stream.

In close proximity to the above described wetland areas but considered a separate system is a very unique artesian fountain which seems to be entirely of natural origin (Map 3). Systems such as this is exceptionally rare and considered highly unique. The fountain originates within a quartzite outcrop and flows down a gentle slope into a small natural rocky depression from

where it overflows to the south into a sandy area. The extent of this entire fountain is no more than 1 hectare. During the survey surface water was present and a constant flow was also still present indicating that this fountain is a perennial system and provides a watersource throughout the year.

Figure 11: View of the rock pool formed by the fountain.

3 LANDSCAPE MAINTENANCE PLAN

3.1 Terrestrial landscape (Catchment)

Although this landscape maintenance plan is focussed on watercourses in the study area which will be affected by mining operations the catchment will also be discussed in brief as this will also affect the watercourses themselves.

Landscape maintenance of the terrestrial catchment will mostly entail re-instatement of the natural topography as far as possible. The terrestrial environment provides runoff which feeds the watercourses in the study area. The topography, substrate and shape of the terrestrial environment therefore determine the runoff patterns and influences the flow volumes within watercourses. It is therefore important to re-instate the natural topography as far as possible during rehabilitation. This can be done by surveying the portion proposed for mining prior to excavation and determining the slope, topography and profile of the landscape. A comprehensive photographic record should also be taken prior to mining commencing which will enable comparison with the rehabilitated topography. It is also important that this be done by using fixed point photography whereby several fixed points are marked and used for consecutive comparisons.

Re-establishing the natural topography is important but the establishment of vegetation is still dependant on a suitable substrate. This should be done by the correct backfilling of materials. Replacing of topsoil should be the last phase of backfilling. Were rocky surface covering or bedrock is present on the soil surface this should still be retained as topsoil since a seedbank will still be present and will allow the re-instatement of a similar habitat.

Once a topography and soil surface resembling the natural condition has been re-established the establishing of an indigenous vegetation layer resembling the natural condition can be attempted. It is also important to record the natural vegetation structure and species assemblage prior to mining. This can be obtained with 20 m x 20 m sampling plots using the Braun-Blanquet sampling method; a simple ecological method easily utilised to record vegetation structure and species composition. It is recommended that this be done for approximately every 20 hectares and within each vegetation community as identified by Bezuidenhout (2011).

Landscape maintenance should target the natural vegetation structure as well as species composition. A detailed description is provided in section 2.2 and the aim should be to re-instate similar topography, landscape, vegetation structure and species composition. In order to measure the relative success of landscape maintenance, comprehensive monitoring should be implemented by amongst others fixed photographic records and vegetation sample plots.

It is recommended that the grass, herb and dwarf shrub layer re-establish by itself, i.e. without supplemented propagation or planting techniques. This will allow for a natural and genetically similar vegetation layer establishing. Should this be found inadequate it can be supplemented by harvesting grass seeds from adjacent areas and spreading these over the rehabilitated area. This has also been discussed within the accompanying rehabilitation plan dated August 2018. Re-instatement of the vegetation structure entails the establishment of a tree/shrub layer. Under normal ecological succession this layer is however considered a climax condition. Therefore, although a grass layer may establish within only a few years the establishment of a woodland/savannah component will take several decades (Van der Maarel 2005). It is therefore recommended that the shrub/tree layer be supplemented by establishing saplings during rehabilitation. This has been discussed in depth in the accompanying rehabilitation plan.

3.2 Riparian landscape maintenance

Any watercourse will contain a marginal, lower and upper zone as discussed in Section 2.1 & 2.3. These zones influence the vegetation structure as a result of topography, soil and moisture. This will however be much more prominent along the Vaal River, a much larger system, than the smaller watercourses in the interior of the study area. Along the smaller watercourses these zones may be difficult to distinguish but will still be present. The landscape maintenance during rehabilitation should aim to re-instate this zonation and vegetation structure present in each zone. The Vaal River will be discussed first and followed by the smaller watercourses.

The marginal zone is relatively narrow and is situated from the water' edge up to the lower zone (Figure 12 & 13). The zone has a width varying from 1 to 5 meters and the slope gradient is moderate to low. It is permanently saturated and is subjected to environmental conditions which makes this a specialised habitat which can only be colonised by plant species adapted to waterlogged soils and flooding. As a result the zone contains a high amount of sedges,

hygrophilous grasses and reeds. These plants contain extensive rootstocks which enable them to subsist in these subterranean organs. Flooding may therefore remove above ground portions put they will re-establish from underground rootstocks. These species include *Cyperus longus, C. marginatus, Hemarthria altissima, Berula erecta, Juncus exertus, Pseudoschoenus sp., Paspalum distichum* and *Phragmites australis.* The tree, *Salix mucronata*, also occurs in this zone and is adapted to saturated soils and through a strong root system is able to withstand flooding. These species are all recommended for rehabilitation and will be easily propagated by means of sodding. Mining is also likely to affect this zone, where the slope and landscape within this zone is affected it should be re-instated to a close to natural condition.

Figure 12: View of the marginal zone (red). Note at this site the zone has a relatively steep slope, narrow width and dominance by sedges and hygrophilous grasses.

Figure 13: View of the marginal zone (red). Note in this area a much more extensive width, lower slope gradient and higher dominance of sedges and reeds.

The lower zone is also relatively narrow but significantly broader than the marginal zone (Figure 14 & 15). It is situated from the marginal zone up to the upper zone and has a width varying from 10 to 20 meters. A characteristic of this zone is the significant increase in slope of this zone. It is still subjected to annual flooding however soils are not saturated on a permanently waterlogged basis but only for short periods at a time. As a result the zone is able to sustain terrestrial species as well as hygrophilous (water loving) species. The zone is dominated by several grass species and has a relatively low diversity of species. These include *Chloris virgata, Cynodon dactylon, Cyperus sexangularis, Phyla nodiflora* and *Eragrostis lehmanniana*. These are also adapted to the annual flooding. *Chloris virgata* is an annual species and readily establish from seed and in this manner survive flood damage. *Cynodon dactylon* is a perennial grass with underground runners and is therefore able to survive underground if damaged by flooding. The zone also contains a high amount of exotic species which may dominate in certain areas. These species are all recommended for rehabilitation and will be easily propagated by means of seeding which is commercially available. The zone is likely to be affected by the mining activities and the slope of the lower zone should be re-instated as far as possible. Measures to re-instate the slope has been discussed in the rehabilitation plan dated August 2018.

Figure 14: View of the lower zone (red). Note absence of tree, steep slope and dominance by a short grass layer. Trees dominating the upper zone is clearly visible on its border.

Figure 15: View of the lower zone (red). Note the more extensive width, lower slope gradient but again dominant short grass layer.

The upper zone is relatively narrow and distinguished from the floodplain by a dense riparian thicket characterised by a few riparian trees confined to this zone. It is situated from the lower zone up to the floodplain. It has a width of approximately 40 meters. The zone has distinct levelling off of the slope gradient and contains only a gradual slope, a steep portion may be present at the border with the lower zone. This zone will only be subjected to flooding during exceptionally large floods. The zone contains a lower soil moisture and consequently vegetation consists predominately of terrestrial species with few riparian species present. Vegetation is dominated by riparian trees and shrubs and include *Vachellia karroo, Ziziphus mucronata, Grewia flava, Lycium hirsutum, Asparagus larcinus, Lycium arenicola, Combretum erythrophyllum, Searsia lancea* and *Diospyros lycioides*. Of these, *V. karroo, C. erythrophyllum* and *S. lancea* are largely absent from the floodplain and confined to the upper zone. They are however also present along some of the large stream systems. The understorey beneath these riparian trees is dominated by a sparse layer of grasses and herbs adapted to a shadier environment. These include *Setaria verticillata, Chloris virgata, Eragrostis lehmanniana, Pancum coloratum, Dicliptera leistneri, Aristida congesta* and *Tragus berteronianus*. The majority of these are also annual, pioneer species. All of the above species are recommended to be utilised in landscape maintenance as they will be easily propagated. It will be important to re-establish the riparian thicket/tree layer by means of sapling establishment and an understorey can easily be seeded with the shade loving species present. The zone is likely to

be affected by mining and the topography of the upper zone should be re-instated as far as possible. Recommended rehabilitation measures has been discussed in the rehabilitation plan dated August 2018.

Figure 16: View of the upper zone. Note the tall and dense tree canopy.

Figure 17: View of the upper zone. Again, note the dense tree canopy and sparse understorey.

Figure 18: View of the upper zone (red). The border between lower and upper zones are clearly visible.

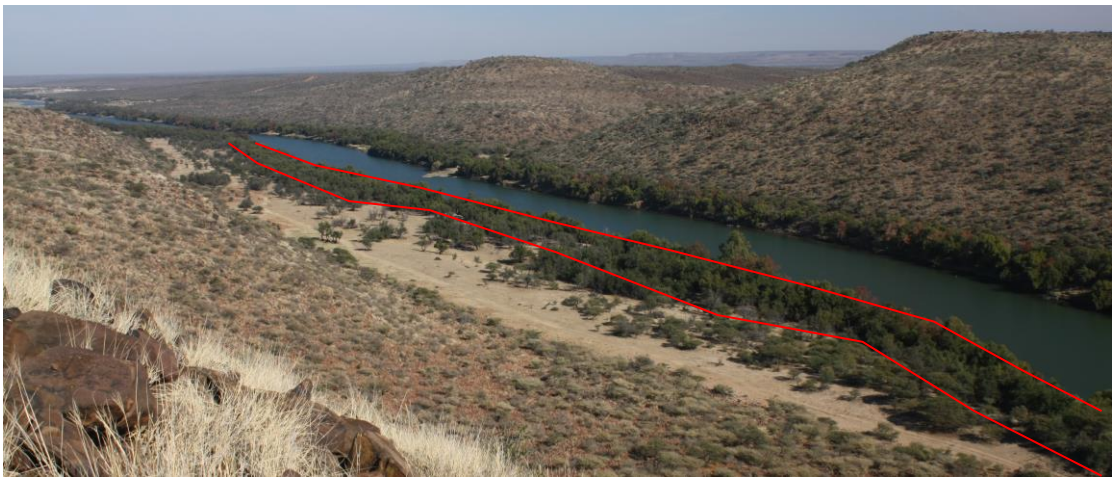


Figure 19: Aerial view of the upper zone (red). The riparian thicket is clearly visible. It is also noticeably narrow.

Watercourses within the interior of the study area also contain the same zonation as the Vaal River although at a much smaller scale. Furthermore, as a result of their variable flow the zonation is not distinct and may seem to consist of one zone. Study of the larger stream systems however indicate that these zones are clearly present. Within this landscape maintenance plan, it is however recommended that a simplified zonation be re-instated during rehabilitation. This should consist of a main channel with level slope vegetated with grasses, a combined marginal/lower zone consisting of several grasses and an upper zone dominated by riparian thicket. Figures 20 to 23 should also clearly illustrate the zonation along these streams and should indicate the desired landscape to re-instate.

Grass species which are readily available and which are considered likely to establish include *Cynodon dactylon, Chloris virgata, S. verticillata* and *Panicum coloratum*. Of these *C. dactylon* is a pioneer species often occurring along watercourses and impoundments and is abundant in the study area along watercourses. It is highly likely to establish on the post mining rehabilitated surfaces. *C. virgata* is also a pioneer grass adapted to disturbed environments although it is better suited to terrestrial environments it is included in order to establish in areas of the site where the soil moisture is not high enough to sustain the other grass species. The species is also abundant in the study area, especially along the smaller, ephemeral watercourses as well as floodplains. *S. verticillata* and *P. coloratum* is adapted to shaded areas and is normally found underneath trees along the banks of the larger watercourses. These species are included to be utilised underneath trees and shrubs as well as in conjunction with tree saplings.

Several riparian tree and shrub species occur in the upper zone along watercourses. Trees and shrubs are important binders of soil. Tree and shrub species occurring along the banks and which can be utilised in rehabilitation include *Ziziphus mucronata, Diospyros lycioides, Vachellia karroo* and *Searsia lancea*.

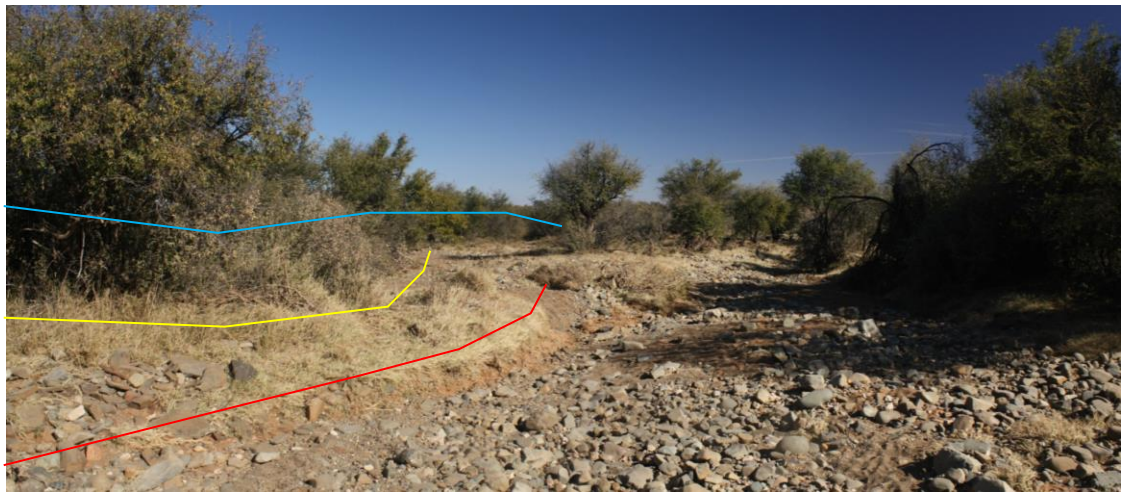


Figure 20: View of one of the streams in the study area. Note a level main channel without visible vegetation. Zonation of the streambank is present but not clearly visible. A marginal- (red), lower- (yellow) and upper zone (blue) is indicated. Note that the marginal- and lower zones are similar, consisting of grasses and the upper zone dominated by riparian trees.

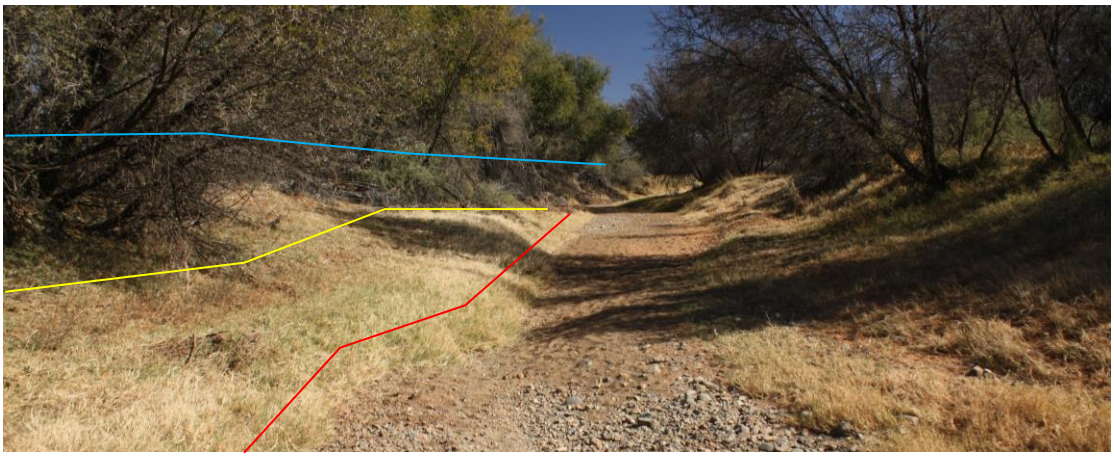


Figure 21: View of another stream in the study area. The zonation is again present and much similar as Figure 20.

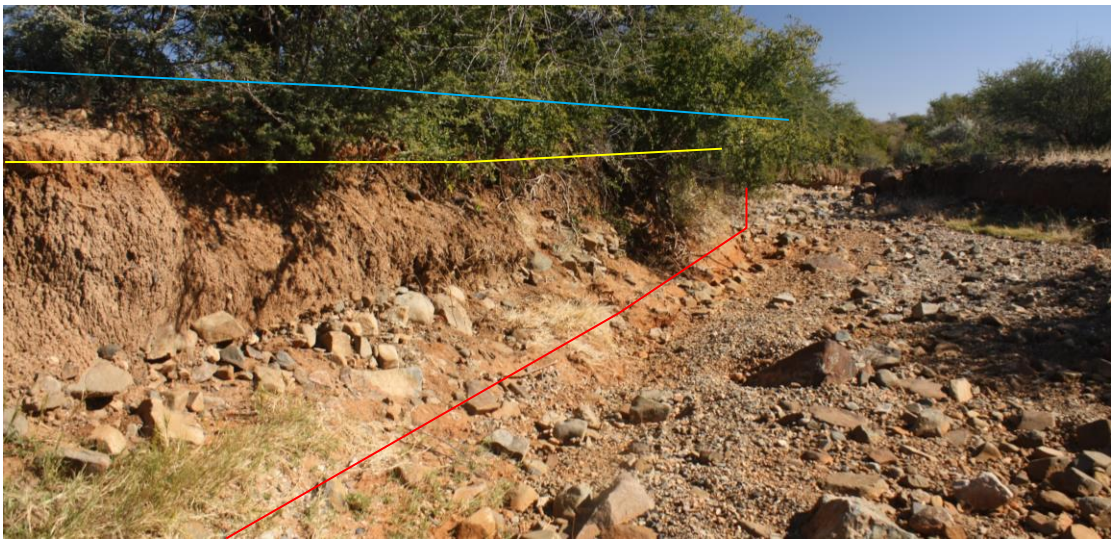
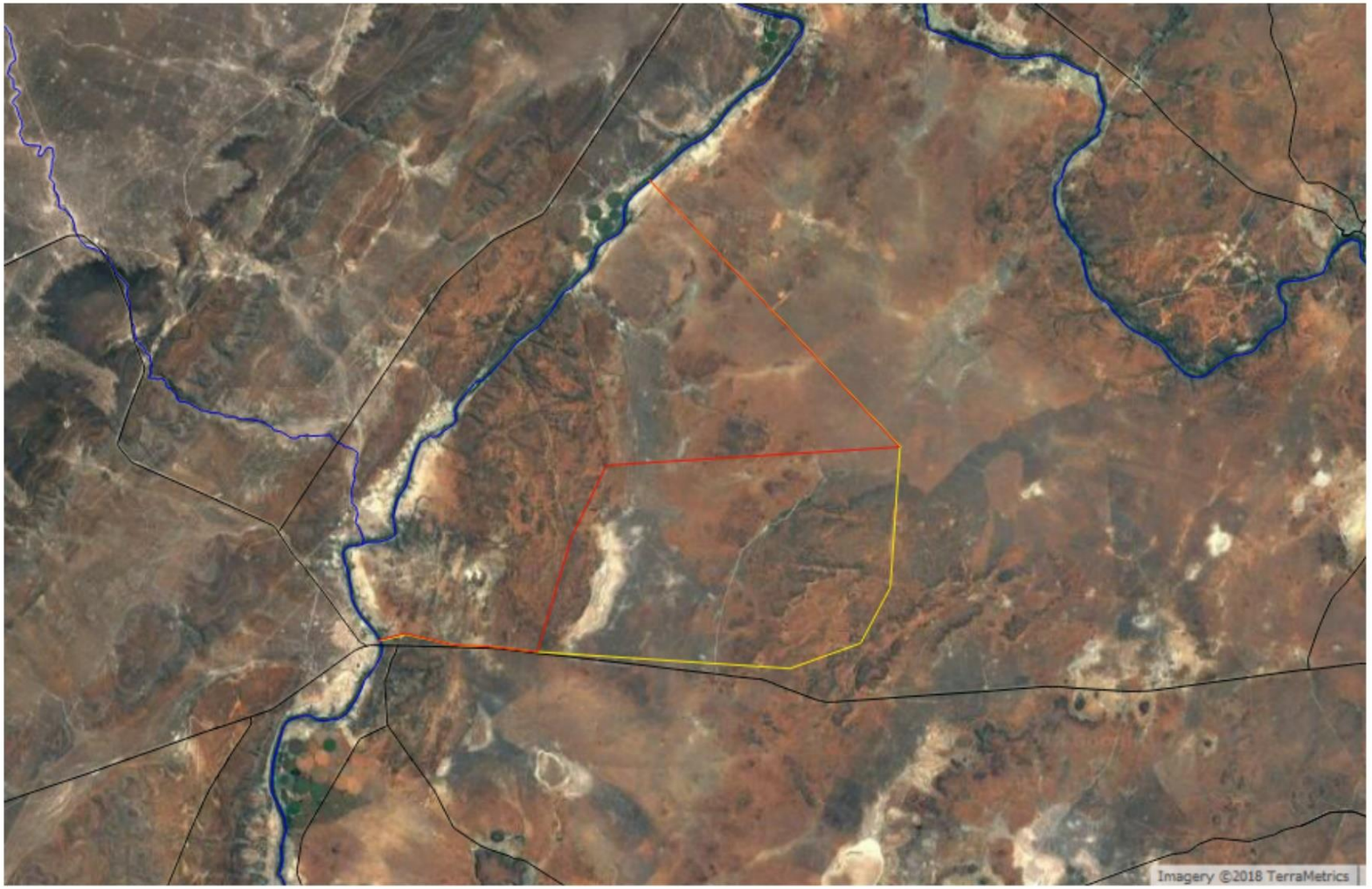


Figure 22: Some streams may contain much more steeper banks though the zonation is still present and remains similar. Here, natural erosion of the streambank causes a much lower density of grasses in the lower zone.

Figure 23: Although the majority of watercourses contain a main channel without vegetation, a few do contain a grassy main channel. However, zonation remains the same.

APPENDIX A

Locality of the alluvial diamond mining operations at Rooipoort on the farms Zandplaats 102/5, Vogelstruis Pan 101/0, Vogelstruis Pan 98/0, Bergplaats 100/0 and Klipfontein 99/0 near Schmidtsdrif, Northern Cape Province.



Preparred for:
Rooipoort Developments (Pty) Ltd
P.O. Box 110471
Hadison Park
8306

Legend:

- Mining Area (Study Area)
- Application area
- Road network
- Vaal River

Map Information

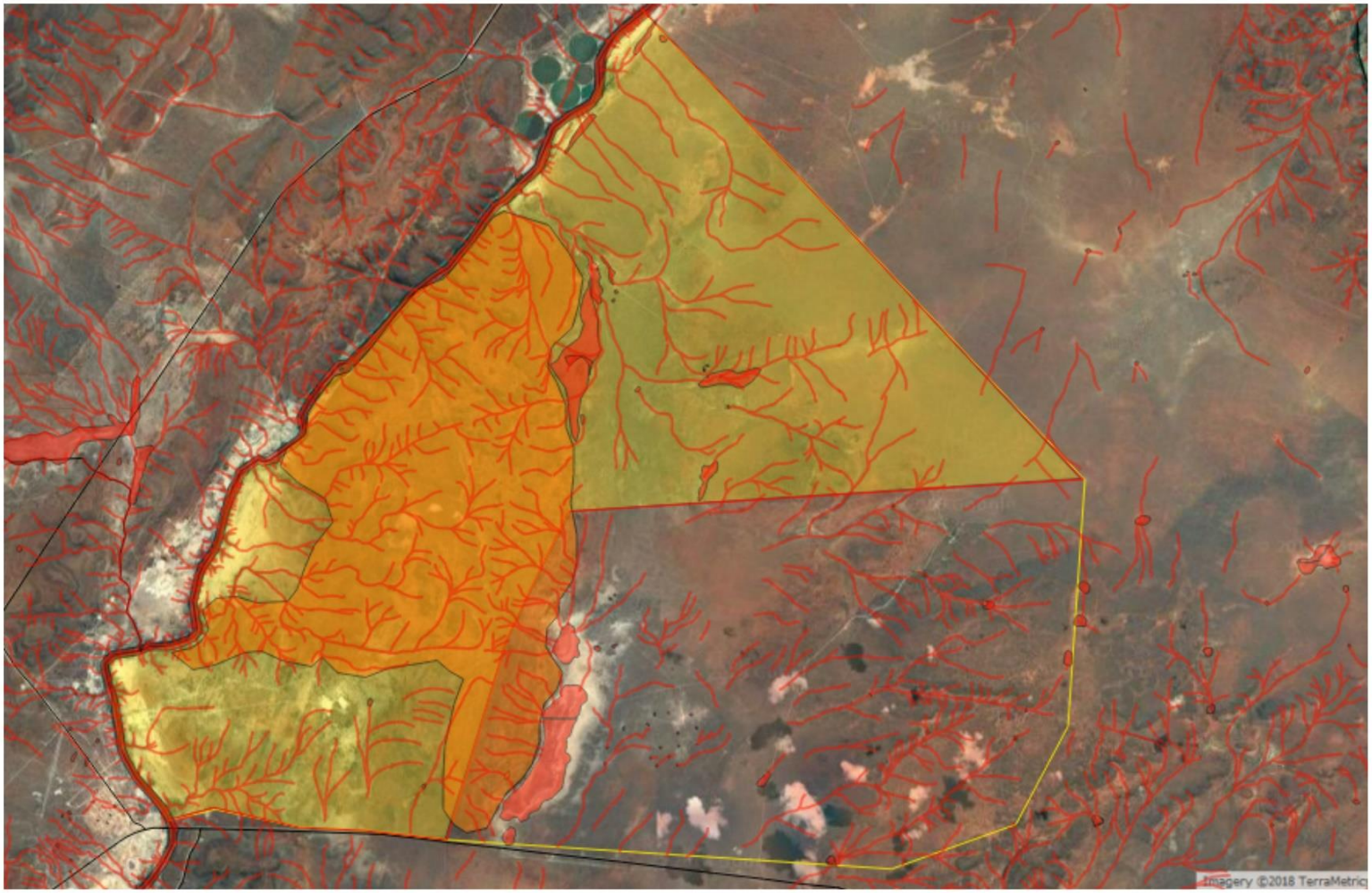
S 28.656145°
E 24.123029°

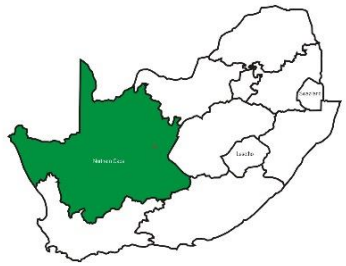
Spheroid: WGS 84
Scale: 1:200 000
Quantum GIS

DPR Ecologists
Contact Darius van Rensburg at:
darius@dprecologists.co.za
P.O. Box 12726, Brandhof, 9324
Tel: 083 410 0770

Map 1: Locality map for the proposed Rooipoort mining operations near Schmidtsdrif, Northern Cape Province. The application area and the mining area has both been indicated. Note also that the Vaal River forms the western border of the mining area.

Sensitivity map of the alluvial diamond mining operations at Rooipoort on the farms Zandplaats 102/5, Vogelstruis Pan 101/0, Vogelstruis Pan 98/0, Bergplaats 100/0 and Klipfontein 99/0 near Schmidtsdrif, Northern Cape Province.





Preparred for:
Rooipoort Developments (Pty) Ltd
P.O. Box 110471
Hadison Park
8306

Legend:

- Mining Area (Study Area)
- Application area
- Road network
- Vaal River
- Very High Sensitivity
- High Sensitivity
- Moderate Sensitivity
- Low Sensitivity

Map Information

S 28.656145°
E 24.123029°

Spheroid: WGS 84
Scale: 1:100 000
Quantum GIS

DPR Ecologists
Contact Darius van Rensburg at:
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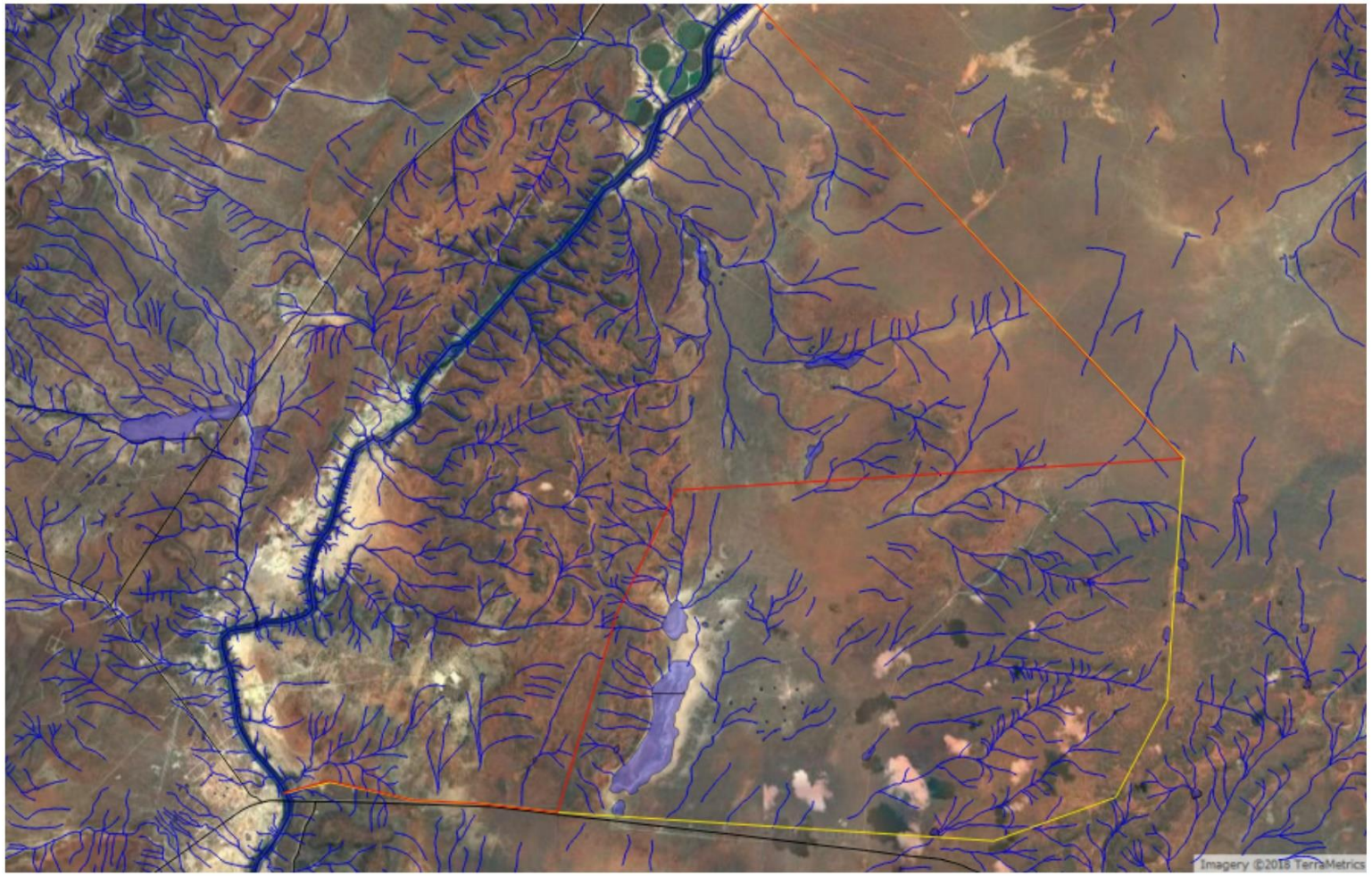
Tel: 083 410 0770

Map 2: Sensitivity map for the proposed Rooipoort mining operations near Schmidstdrif, Northern Cape Province. The vegetation types in the study area is indicated as well as watercourses and wetlands. Areas of very high sensitivity include all watercourses and wetland areas as well as the low quartzite ridge. Areas of high sensitivity consist of the central and south eastern rocky, mountainous portion of the study area. The plains in the south western portion and northern and eastern portions are considered to be of moderate sensitivity.

Wetlands and surface water map of the alluvial diamond mining operations at Rooipoort on the farms Zandplaats 102/5, Vogelstruis Pan 101/0, Vogelstruis Pan 98/0, Bergplaats 100/0 and Klipfontein 99/0 near Schmidtsdrif, Northern Cape Province.



Preparred for:
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P.O. Box 110471
Hadison Park
8306

Legend:

- Mining Area (Study Area)
- Application area
- Road network
- Watercourses
- Wetland areas

Map Information

S 28.656145°
E 24.123029°

Spheroid: WGS 84
Scale: 1:100 000
Quantum GIS

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Contact Darius van Rensburg at:
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Tel: 083 410 0770

Map 3: Wetlands and surface water map for the proposed Rooipoort mining operations near Schmidstdrif, Northern Cape Province. All watercourses and wetlands in the study area is indicated and survey locations corresponding to Table 6 is also indicated.