Chapter E: Vegetation

Information on vegetation as contained under this section has been obtained from the following sources:

- The report titled: "*Biodiversity Action Plan for Kleinkopje Colliery*", dated February 2014, compiled by Digby Wells[74];
- The report titled, *"Flora and Fauna Baseline Survey for the Landau Colliery Life Extension Project Study Area (Clewer, Mpumalanga)",* dated April 2013, compiled by De Castro & Brits c.c.
- The report titled: "*Wetland Baseline and Mitigation Report for the proposed Kleinkopje Colliery Opencast Extension Project*", dated August 2016, and compiled by Wetland Consulting Services (Pty) Ltd.; and
- The report titled: "*Terrestrial Ecology Assessment of the proposed Khanyisa Power Plant and Ash pit, Witbank, Mpumalanga*", dated November 2010, and compiled by Ecorex Consulting Ecologists cc

1 Biome and vegetation types

The project area is situated within the Grassland Biome of South Africa (Rutherford & Westfall, 1986, Mucina & Rutherford 2006). The Grassland Biome is found on the high central plateau of South Africa, and the inland areas of Kwazulu-Natal and the Eastern Cape. The topography is mainly flat and rolling, but includes the escarpment itself.

The vegetation type consists of a simple, single-layered herbaceous community of mainly tussocked grasses, herbs and forbs. High rainfall on the cold, frosty, Mpumalanga highveld, together with sandy soils, controls the distribution of this vegetation type.

Grasslands are dominated by a single layer of grasses (Rutherford & Westfall, 1986). The amount of cover depends on rainfall and the degree of grazing. Trees are absent, except in a few localized habitats. Geophytes are often abundant. Frost, fire and grazing maintain the grass dominance and prevent the establishment of trees (Rutherford & Westfall, 1986).

The study area is situated within an area vegetated by the Moist Sandy Highveld Grassland vegetation type according to Low & Rebelo (1998) with the most recent vegetation classification, classifying it as Eastern Highveld Grassland (Mucina & Rutherford 2006). Refer to Figure 27 for the general vegetation map. The vegetation type is considered to be endangered nationally with none conserved and 55% altered, primarily by cultivation. The conservation status of this vegetation type is very poor, with large parts that are either currently cultivated or have been previously ploughed, and the remaining untransformed vegetation that occurs as patchy remnants that are often heavily grazed.

[74] Flora Assessment done for Greenside Colliery (2012), only includes map on Biodiversity values (and excludes area associated with the Khanyisa IPP infrastructure). Figure 29 below provides the biodiversity value of the area associated with Klippan and surrounds (as per the Khwezela Bokgoni Biodiversity Action Plan, 2014)

Moist Sandy Highveld Grassland is dominated by the grasses *Eragrostis plana*, *Eragrostis curvula*, *Heteropogon contortus*, *Trachypogon spicatus* and *Themeda triandra*. Acocks (1988) describes the same area as Bankenveld and considers it to be a sour vegetation type in which forbs play an important part. He described three variations of which the eastern variation occurs in the study area. This variation occurs on flattish sandy country in which the dominant species include *Tristachya leucothrix*, *Eragrostis racemosa*, *Heteropogon contortus*, *Trachypogon spicatus*, *Digitaria tricholaenoides*, *Themeda triandra* and others. *Tristachya biseriata* may be abundant on ridges.

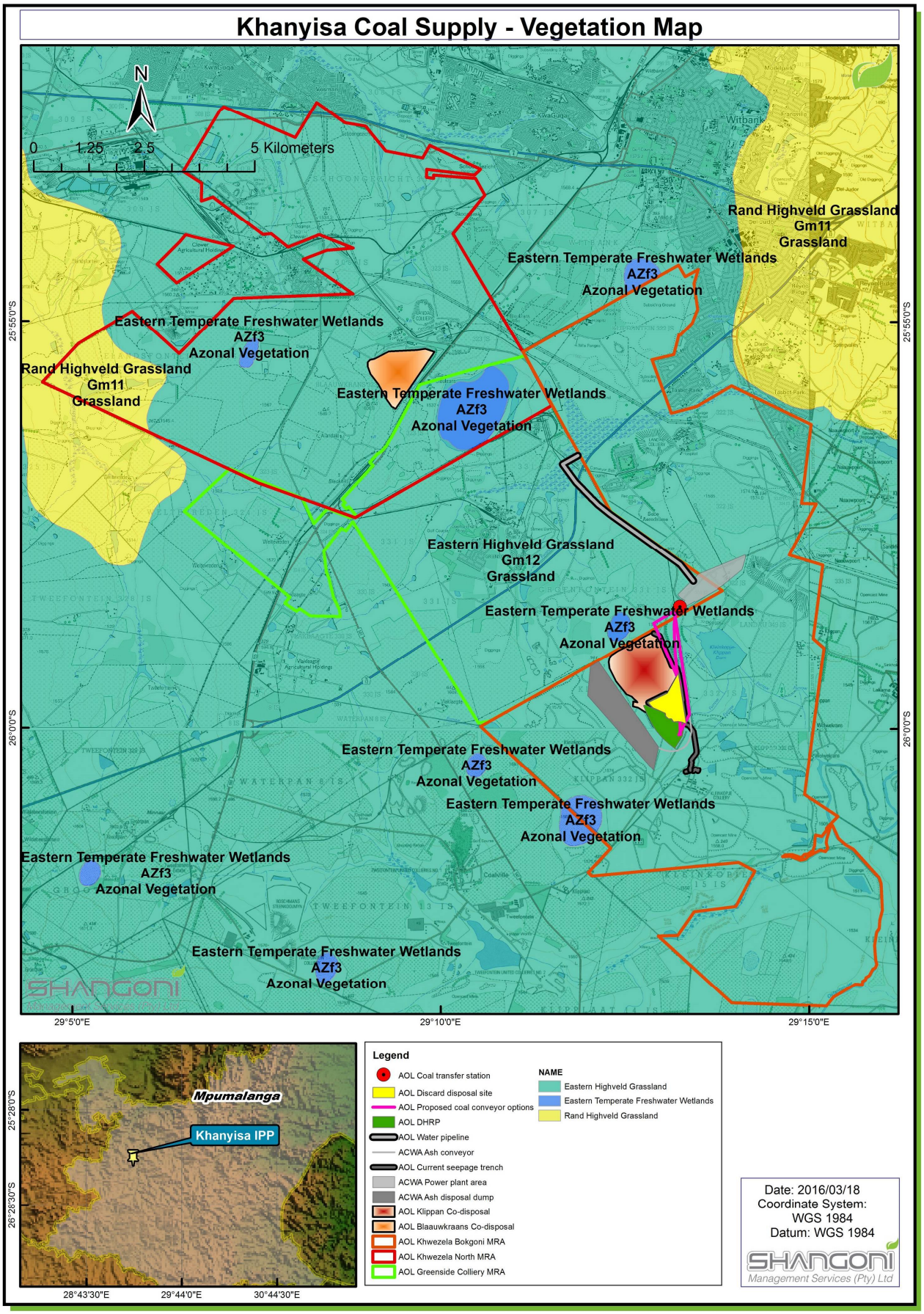

Figure 27: General vegetation map

1.1 Klippan co-disposal facility and project development area

The Kleinkopje (Khwezela Bokgoni) Colliery Vegetation Types map is provided in Figure 28 below (as sourced from the "*Biodiversity Action Plan for Kleinkopje Colliery*", dated February 2014, compiled by Digby Wells). For the purpose of the Biodiversity Action Plan the mining area was divided into different sites. Site 2 incorporates the area around Berry's Pan (which is located to the north of the existing Klippan Co-disposal Facility), with extensive areas of Wattle invasion to the west and south west, and cultivated land to the east.

A road constructed of discard leads to the pan. Wild tomato (*Solanum sysimbriifolium*) has invaded the area. The natural vegetation is only evident on the eastern side of the pan catchment and is disturbed. Dominant grasses included *Eragrostis curvula*, *Sporobulus nitens*, *Pogonarthria squarrosa* and *Aristida diffusa*, all of which are increaser species that indicate disturbance, usually overgrazing.

To the north of the pan, the Black Wattle encroaches on the pan catchment. Some *Eucalyptus camaldulensis* was also recorded to the north of the pan.

As can be seen in Figure 28 below, the area associated with the proposed location of the discard disposal site for the Khanyisa IPP Coal Supply project is characterised as 'alien invasive plants'. The proposed location of the DHRP falls within a disturbed area, as well as the existing Klippan Co-disposal Facility.

Both the proposed powerline (refer to Annexure A for the preliminary route) that will run from the Eskom Khwezela Bokgoni substation to the DHRP, and the conveyor and associated road (that will run from the DHRP site to the ACWA Khanyisa IPP) will cross a combination of disturbed area, wetland, and cultivated land (refer to Figure 28).

As per the report titled: "*Wetland Baseline and Mitigation Report for the proposed Kleinkopje Colliery Opencast Extension Project*", dated August 2016, and compiled by Wetland Consulting Services (Pty) Ltd., the northern and eastern portions of the hillslope seepage wetland delineated within the area, are typically temporary to seasonal wetland habitat and seldom have areas of surface water, with flows taking place within the soil profile (interflow) or as diffuse sheet flow following large storm events. As such, these wetlands are often classed as moist grasslands. Within the project area, these wetlands are characterised by a typical Highveld assemblage of grass species with occasional sedges. Key wetland indicator species observed included *Imperata cylindrica*, *Eragrostis gummiflua*, *Cynodon dactylon*, *Agrostis lachnantha*, and *Kyllinga erecta*. The small shrub *Seriphium plumosum* typically occurred along and just outside the wetland edge.

In contrast, large sections of the western portions of the hillslope seepage wetland are permanently or near-permanently wet. This is however related to both seepage derived from the upslope discard dump (Klippan Co-disposal Facility) as well as overflow and discharge from reservoirs associated with

pumping stations pumping water to the eMalahleni Water Reclamation Plant. Large stands of *Phragmites australis* and *Typha capensis* occur in these areas, as well as stands of the alien tree *Populus x canescens*.

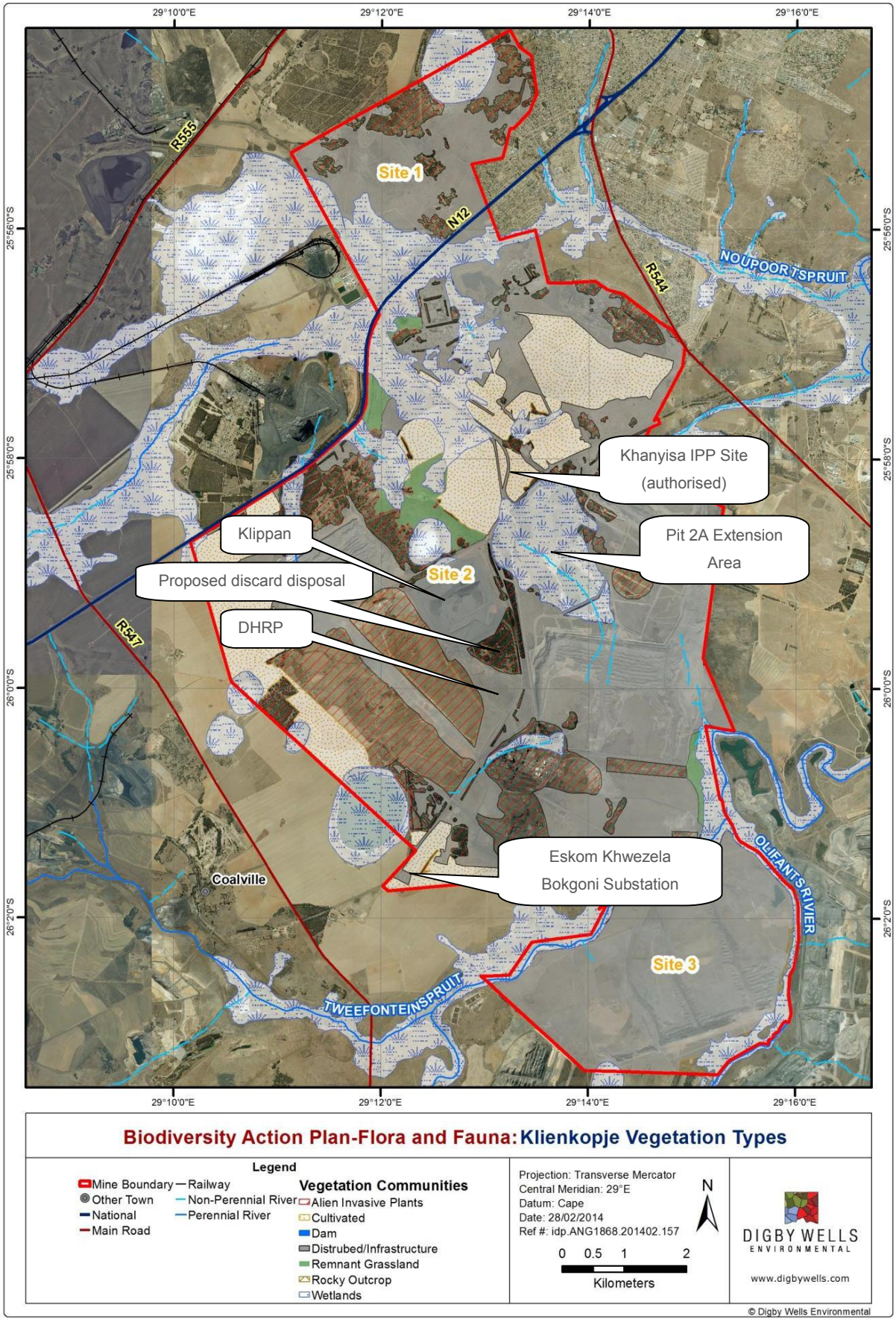

Figure 28: Khwezela Bokgoni vegetation types (as per the Biodiversity Action Plan, 2014) (source: Digby Wells, 2014).

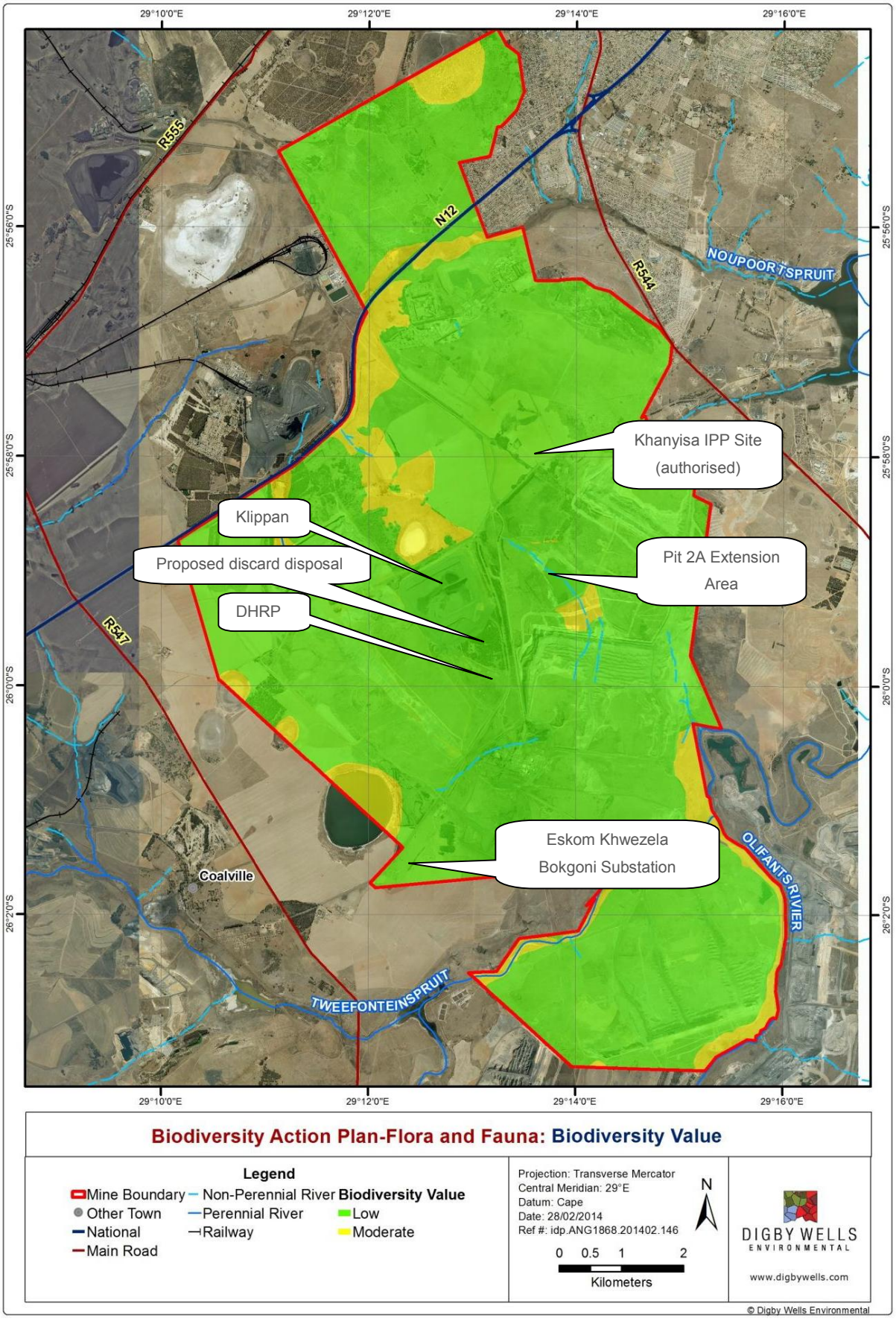

Figure 29: Khwezela Bokgoni biodiversity value map (as per the Biodiversity Action Plan, 2014) (source: Digby Wells, 2014).

As per the report titled: "*Terrestrial Ecology Assessment of the proposed Khanyisa Power Plant and Ash pit, Witbank, Mpumalanga*", dated November 2010, and compiled by Ecorex Consulting Ecologists cc, the *Seriphium – Imperata* Secondary Grassland vegetation community is dominant at the proposed Khanyisa IPP - power plant site, covering an area of approximately 44 ha (Figure 30). It appears to represent secondary grassland on old cultivated lands. Vegetation structure is Low Closed Grassland to Low Closed Shrubland (sensu Edwards, 1983). The invasive indigenous shrub, *Seriphium plumosum,* is dominant in many parts of this community, sometimes even forming closed shrubland. Elsewhere, *Imperata cylindrica* is dominant, often in association with *Helichrysum aureonitens*; this species association often indicates temporarily / seasonally wet soils. *Eragrostis curvula* is also very common, indicating past disturbance. Only 24 species were recorded in this vegetation community, of which 4 (17%) are invasive alien species. Species richness in sample quadrats varied from 8-11 species per 100m² (n=2), which is much lower than typical untransformed Highveld grassland.

The *Themeda - Tristachya* Untransformed Grassland vegetation community is confined to the southern half of the power plant site and covers approximately 21 ha. This community does not appear to be have been transformed historically. Vegetation structure is Low Closed Grassland (sensu Edwards, 1983). The dominant grasses are *Themeda triandra*, *Tristachya leucothrix*, *Harpochloa falx* and *Eragrostis curvula*, while other common grasses include *Melinis repens, Brachiaria serrata*, *Digitaria tricholaenoides*, *Elionurus muticus*, *Eragrostis racemosa* and *Loudetia* simplex. A much higher proportion of forbs and geophytes are present in comparison with other vegetation communities in the study area. These include *Felicia muricata*, *Helichrysum rugulosum, Hypoxis rigidula*, *Kohautia amatymbica*, *Haplocarpha lyrata* and *Pygmaeothamnus zeyheri*. Forty species were recorded in this vegetation community, of which one (2.5%) is an invasive alien species. Species richness in the single sample quadrat was 28 species per 100m², which is typical of untransformed Highveld grassland.

Even though the overall species list for this community is quite low, species richness per 100m² is high. The floristic composition is representative of Eastern Highveld Grassland, with three of the four dominant grasses being listed as dominant species in Eastern Highveld Grassland by Mucina & Rutherford (2006). Two species of conservation concern were confirmed. The first is a Crinum species that could not be identified with certainty as it was not in flower. However, both the likely species (*Crinum macowanii* and *Crinum bulbispermum*) have a status of Declining and thus are of conservation concern. The second is the Ox-eye Daisy *Callilepis leptophylla*, which also has a status of Declining (Raimondo et al., 2009). Even though no threatened plant species were discovered, this community is representative of an Endangered vegetation type and a listed threatened ecosystem. It is thus allocated a Med-High significance for plant species of conservation importance.

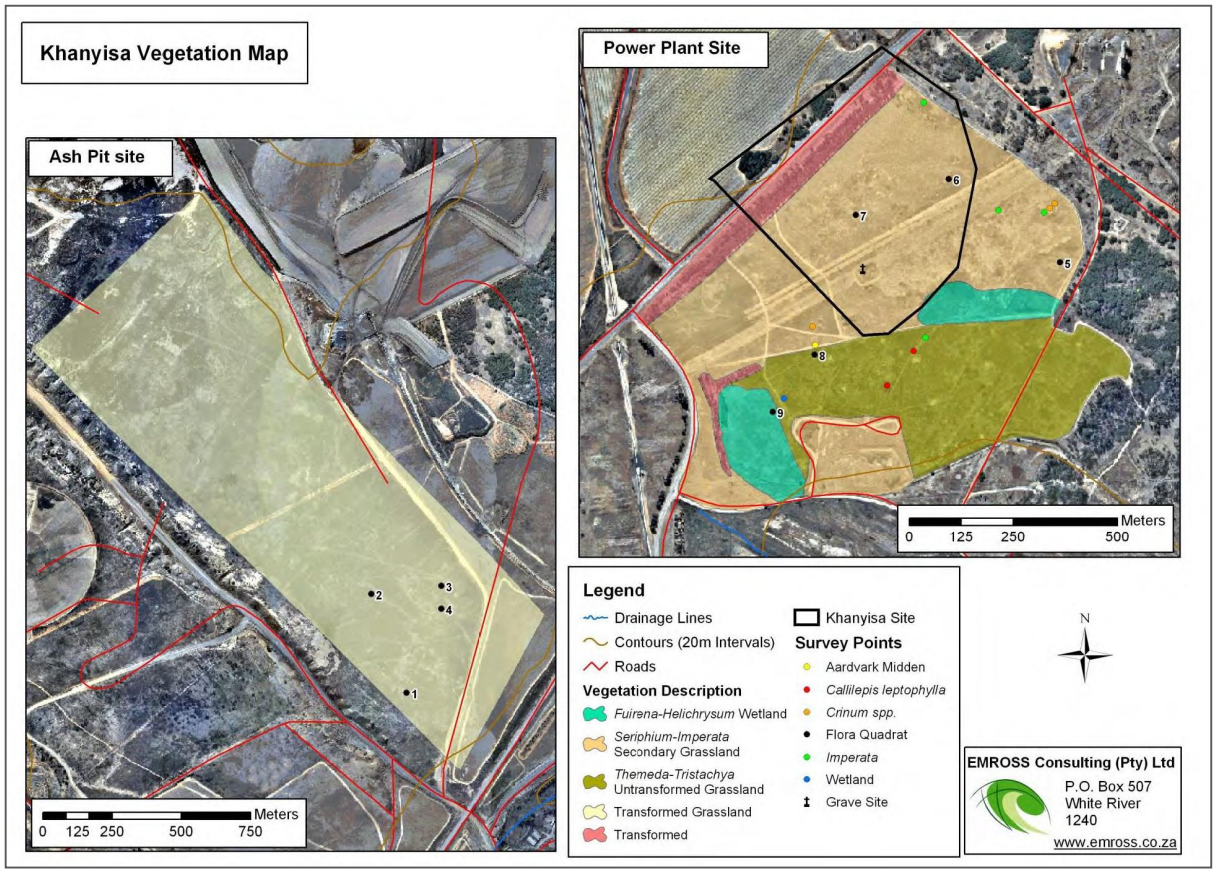

Figure 30: Vegetation map of Khanyisa IPP Power plant site and ash disposal site (source: Ecorex Consulting Ecologists, 2010).

1.1.1 Dominant species

Important taxa that may be present in the project area associated with the Klippan Co-disposal Facility location and project development area, include:

Graminoids: *Aristida aequiglumis; A.congesta; A.junciformis subsp galpinii; Brachiaria serrate; Digitaria monodactyla; D.tricholaenoides; Elionurus muticus; Eragrostis chloromelas; E.curvula; E.plana; E.racemosa; E.sclerantha; Heteropogon contortus; Loudetia simplex; Monocymbium ceresiiforme; Setaria sphacelata; Sporobolus africanus; S.pectinatus; Themeda triandra; Trachypogon spicatus; Tristachya leucothrix; T.rehmannii; Alloteropsis semialata; Andropogon appendiculatus; A.schirensis; Bewsia biflora; Ctenium concinnum; Diheteropogon amplectens; Eragrostis capensis; E.gummiflua; E.patentissima; Harpochloa falx; Panicum natalensis; Rendlia altera; Schizachyrium sanguineum; Setaria nigrirostris; Urelytrum agropyroides.*

Herbs: *Berkheya setifera; Haplocarpha scaposa; Justicia anagalloides; Pelargonium luridum; Acalypha angustata; Chamaecrista mimosoides; Dicoma anomala; Euryops gilfillanii; E.transvaalensis; Helichrysum aureonitens; H.caespititium; H.callicomum; H.oreophilum; H.rugulosum; Ipomoea crassipes; Pentanisia prunelloides; Selago densiflora; Senecio coronatus; Vernonia oligocephala; Wahlenbergia undulata.*

Geophytic Herbs: *Gladiolus crassifolius; Haemanthus humilis; Hypoxis rigidula; Ledebouria ovatifolia.*
Succulent Herbs*: Aloe ecklonis*
Low Shrubs: *Anthospermum rigidum subsp. pumilum; Stoeboe plumosa (Mucina and Rutherford, 2006).*

Refer also to discussions above regarding the dominant species associated with Khanyisa IPP power plant site.

1.1.2 Threatened Flora

A list of threatened species that are likely to occur within the project area is shown in Table 15. Only one species *Gladiolus macneilii*, which is include here even though it does not occur on the National Herbarium of Pretoria (PRE) Computerised Information system (PRECIS) list for the area, is endangered, and may require special measures to protect any populations that are positively identified. The remainder of the threatened species are in the vulnerable and near threatened categories indicating that conservation efforts aimed at the level of habitat conservation are adequate in the surface rights area.

Table 15: Threatened species that are likely to occur on the Khwezela Bokgoni Colliery surface rights area (Source: Digby Wells, 2014)

Scientific name	Common name
Gladiolus macneilii	Gladiolus
Gladiolus rufomarginatus	
Gladiolus varius	
Satyrium microrrhynchum	Orchid
Ledebouria appresifolia	Ledebouria
Eulophia leachii	Orchid
Gladiolus vernus	Gladiolus
Kniphofia triangularis	Red hot poker
Nerine gracilis	Nerine

The low overall species list, low species richness per 100m² and the dominance of *Seriphium plumosum* within and surrounding the area associated with the proposed Khanyisa IPP – power plant site, reflects the transformed and degraded nature of this site. The floristic composition is not in any way representative of Eastern Highveld Grassland. The only species of conservation concern recorded was a *Crinum species* that could not be identified with certainty as it was not in flower. However, both the likely species (*Crinum macowanii* and *Crinum bulbispermum)* have a status of Declining and thus are of conservation concern. Even so, since the vegetation community is not

representative of a threatened grassland type, and shows evidence of a long history of degradation, it is only allocated a Low-Medium significance for plant species of conservation importance.

Refer also to discussions above regarding the dominant species associated with Khanyisa IPP power plant site

1.1.3 Medicinal Plants

According to the PRECIS list one medicinal plant may occur on the Khwezela Bokgoni surface rights area. However, this species was not found during the field visit. Refer to Table 16 below.

Table 16: Medicinal plants found on the Khwezela Bokgoni Colliery surface rights area (source: Digby Wells, 2014)

Scientific name	Common name	Uses	Habitat	Observed
Hypoxis hemerocallidea	Gifbol	Medicinal	Grassland	No, related species Hypoxis interjecta was observed.

1.1.4 Invader or exotic species

The Khwezela Bokgoni surface rights have been extensively invaded by alien plants in places particularly wattles as indicated in Table 17. In 1995 PPRI issued a report entitled '*Management Plan for the Control of Alien Plants at Kleinkopje*' by P Campbell and D Naude. The study found that the main alien species within the area include: Black and silver wattle; Eucalyptus species; Wild tomato; Bugweed; Bitter apple; Pluisbossie; Prickly Pear; Sesbania; Pampas grass; Pine species; Weeping willow; Peach trees; Blackwood trees; and Poplar trees. Species noted during the Biodversity study conducted in 2013 are listed in Table 17.

Table 17: Alien plants found on the Khwezela Bokgoni Colliery Surface rights area (source: Digby Wells, 2014)

Scientific name	Common name	Status	Habitat
Acacia mearnsii	Black Wattle	Transformer and declared weed (category 2)	Invades most habitats, particularly watercourses, roadsides, disturbed grassland.
Acacia dealbata	Silverwattle	Category 2	Invades most habitats, particularly watercourses, roadsides, disturbed grassland.

Scientific name	Common name	Status	Habitat
Acacia decurrens	Greenwattle	Category 2	Invades most habitats, particularly watercourses, roadsides, disturbed grassland.
Solanum sisymbriifolium	Wild tomato	Declared.	Invades disturbed landscapes such as road sides, cultivated fields, disturbed grassland.
Tagetes minuta	Kakiebos	Declared weed	Invades disturbed grassland, cultivated land, roadsides.
Eucalyptus camaldulensis	Red river gum	Transformer and declared invader (category 2)	Invades forest gaps, plantations, watercourses and roadsides.
Bidens pilosa	Blackjack	Cosmopolitan weed	Invades cultivated land, disturbed watercourses and grasslands
Cirsium vulgare	Scottish thistle	Declared weed	Invades grasslands, roadsides, old lands, vleis, wetland margins
Argemone mexicana	Mexican Poppy	Declared weed	Invades roadsides, wastelands, river margins, cultivated lands.
Solanum mauritanum	Bugweed	Category 1 invader, agricultural weed.	Invades disturbed grassland, cultivated land, roadsides, plantations.
Solanum elaeagnifolium	Bitter apple	Category 1 invader, agricultural weed.	Invades disturbed grassland, cultivated land, roadsides, plantations.
Opuntia ficus-indica	Prickley Pear	Category 1, invader	-
Lopholaena coriifolia	Pluisbossie	Not listed	-

Scientific name	Common name	Status	Habitat
Sesbania punicea	Sesbania	Category 1, invader	-
Cortadaria selloana	Pampas grass	Category 1, invader	-
Pinus patula	Patula Pine	Category 2, invader	Grassland, Forest margins, road cuttings
Salix Babylonica	Weeping Willow	Category 2, invader	Waterways
Prunus persica	Peach	Not listed	Roadsides, riverbanks, waste places, urban areas.
Acacia melanoxylon	Blackwood	Category 2, invader	Roadsides, riverbanks, waste places, urban areas
Populus canescens, P. deltoids, P. nigra	Poplar	Declared invader category 2)	Invades riverbanks and marshes

Refer also to discussions above regarding the dominant species associated with Khanyisa IPP power plant site

1.2 Blaauwkrans co-disposal facility and surrounds

Information contained in this section was sourced from the report titled, *"Flora and Fauna Baseline Survey for the Landau Colliery Life Extension Project Study Area (Clewer, Mpumalanga)",* dated April 2013, compiled by De Castro & Brits c.c.

De Castro & Brits (2014) identified five different vegetation units within the study area, and were derived on the basis of structural and functional criteria. Refer to Figure 31. The Blaauwkrans Co-disposal Facility falls within the "Transformed area"[75]. The facility also falls within an area characterised as having low biodiversity value (refer to Figure 32).

[75] Transformed areas: Include plantations and invasive stands of alien trees, all mine infrastructure, homesteads, dams and currently cultivated fields.

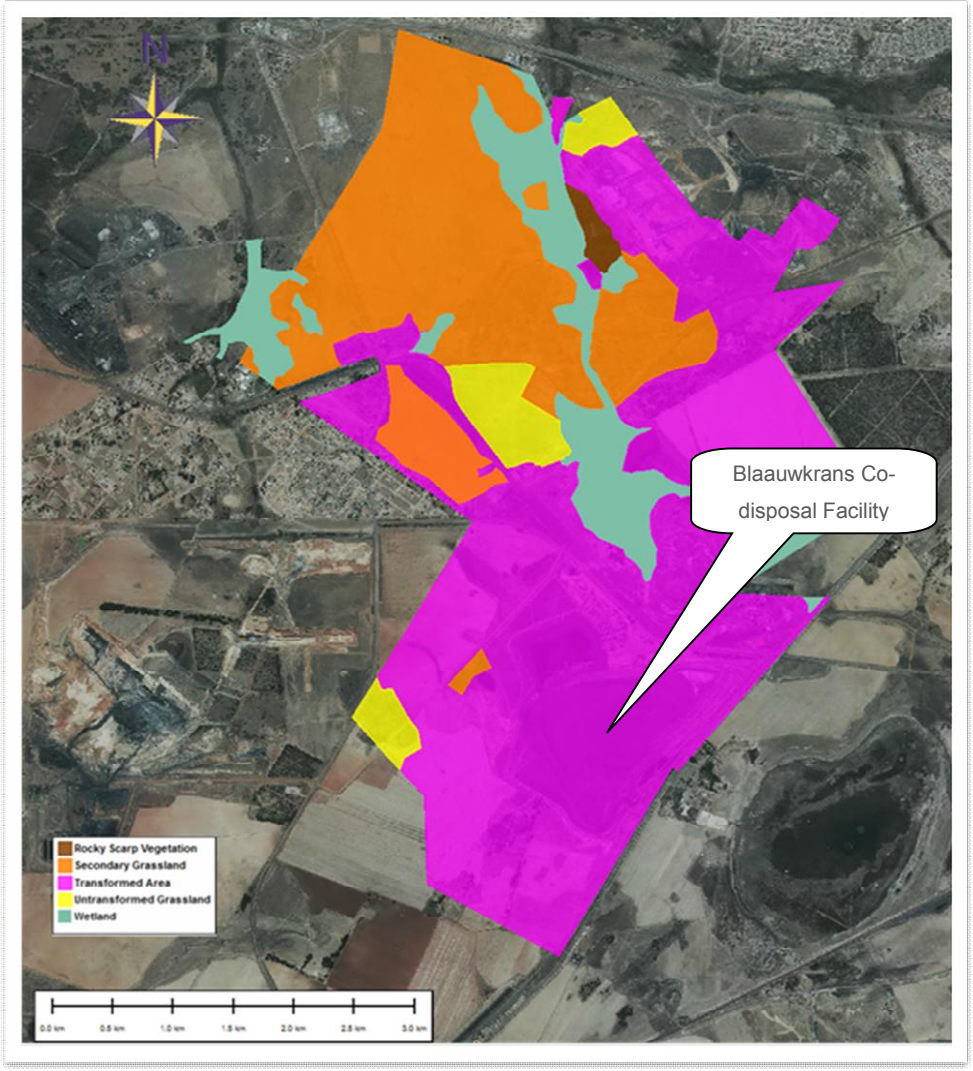

Figure 31: Vegetation map of identified broad-scale vegetation and land-cover type units (source: De Castro & Brits, 2014).

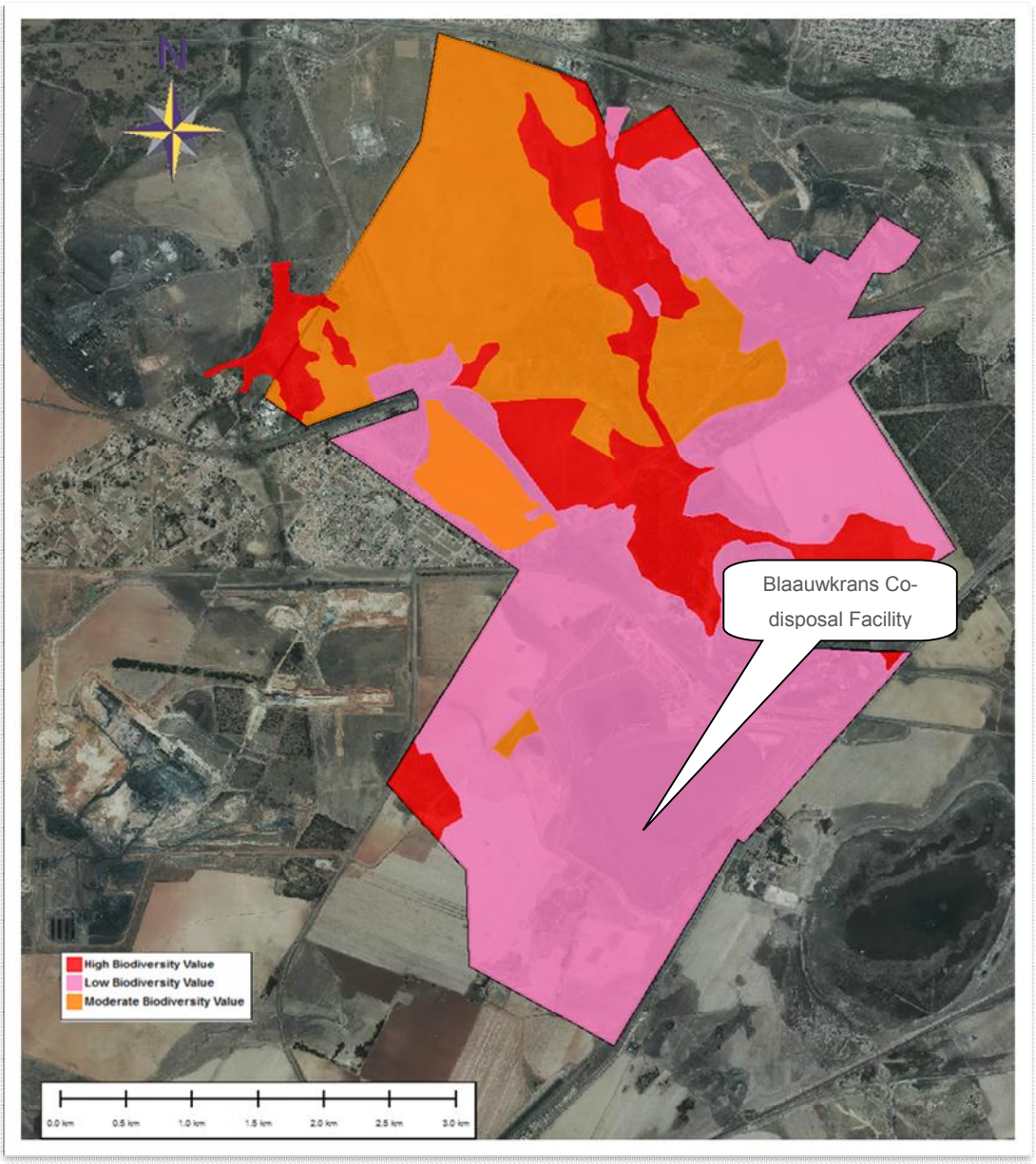

Figure 32: Biodiversity value map (Blaauwkrans and surrounds) (source: De Castro & Brits, 2014).

1.2.1 Threatened, near threatended and declining species

Species of conservation concern include species that are regarded as being threatened with extinction in accordance with IUCN Version 3.1 criteria (IUCN, 2001), as well as species that are considered Near Threatened, and species not currently considered threatened or near threatened, but which considered to be in need of monitoring and some conservation effort.

Historically recorded species within the applicable quarter degree grid(s) included one threatened species, namely *Frithia humilis* (Endangered), and one Declining species, namely *Callilepis leptophylla*. Five other Declining species were either recorded within the greater Landau (Khwezela North) Colliery study area by De Castro (2010) (*Eucomis autumnalis subsp*. clavata and *Hypoxis hemerocallidea*) or were recorded during a recent survey of the nearby Tweefontein Colliery which is situated a few kilometres to the south (*Crinum bulbispermum*, *Gunnera perpensa* and *Boophone disticha*). Relevant information on flowering season, known habitat requirements, known

geographical distribution and current conservation status of the identified potentially occurring species of conservation concern is given in Table 18 below. *Frithia humilis*, which is classified as Endangered by Raimondo et al. (2009), is the only potentially occurring threatened plant and is discussed separately below.

Of the six Declining species listed in Table 18 below, five species have widespread distributions, which extend over the eastern half of South Africa, namely *Boophone disticha*, *Crinum bulbispermum*, *Eucomis autumnalis subsp*. *clavata*, *Gunnera perpensa* and *Hypoxis hemerocallidea*. However, while these species are not under any immediate threat of extinction, they are heavily utilised medicinal plants, giving rise to concerns that long-term over utilisation of wild plants is leading to a decline in many of the sub-populations of these species. In addition, Boophone disticha, *Crinum bulbispermumand Eucomis autumnalis subsp. clavata* are also protected under Schedule 11 of the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998), and permits are required prior to its removal.

Table 18: List of Threatened and Declining species potentially occurring within the Khwezela North Colliery Life Extension Project study area (De Castro & Brits, 2014)

Species	Family	Habitat	Flowering Season	Threat Status (Raimondo *et al*., 2009)	Vegetation or land-cover type unit where considered likely or confirmed to occur
Boophone disticha	Amaryllidaceae	Open grassland and occasionally rocky grassland.	Oct-Jan	Declining	Untransformed grassland
Callilepis leptophylla	Asteraceae	Open grassland.	Aug-Jan	Declining	Untransformed grassland
Crinum bulbispermum	Amaryllidaceae	Along rivers and streams or in damp depressions in black clay or sandy soil.	Sep-Nov	Declining	Wetlands
Eucomis autumnalis subsp. *clavata*	Hyacinthaceae	On hillslope seeps in open grassland, and also along the margins of marshes.	Nov-Apr	Declining	Wetlands and Untransformed grassland
Frithia humilis	Mesembryanthemaceae	On rocky outcrops and associated	Dec-Feb	Endangered	Rocky Scarp

Species	Family	Habitat	Flowering Season	Threat Status (Raimondo *et al*., 2009)	Vegetation or land-cover type unit where considered likely or confirmed to occur
		with sheets of rock in grassland. In shallow pockets of sandy soil.			
Gunnera perpensa	Gunneraceae	Valley-bottom wetlands, often in upper reaches	Oct-Mar	Declining	Wetlands
Hypoxis hemerocallidea	Hypoxidaceae	Grassland and mixed woodland, including secondary grassland of historically cultivated soils.	Sep-Mar	Declining	Untransforme d grassland

Discussion of *Frithia humilis* (Endangered)

Frithia humilis is endemic to Mpumalanga and Gauteng, and it has been recorded from a total of 11 severely fragmented subpopulations. These subpopulations continue to decline because of expanding informal settlements, overgrazing, invasion by alien plants and harvesting for horticultural purposes. In De Castro & Brits' experience, mining also poses a significant threat to this species. Of the 11 known sub-populations, three have been lost subsequent to its discovery as a result of habitat destruction (personal communication with Ms P. Burgoyne of SANBI). De Castro (2010) found small colonies of *Frithia humilis* at two sites within the Umlalazi Conference Centre reserve which is situated within the Farm Elandsfontein 389 J.S., which is within the existing Navigation Section mine boundary area, but outside of the Khwezela North Colliery Life Extension Project boundary area.

1.2.2 Protected plant species

Four species recorded within the Khwezela North Colliery Life Extension study area are protected plants for which, under Schedule 11 of the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998), a permit is required prior to its removal. These protected species are listed in Table 19, below, together with vegetation units in which they have been recorded and those in which they are considered likely to occur.[76]

[76] None within the transformed unit

Table 19: Plants occurring in the study area that are protected under Schedule 11 of the Mpumalanga Nature Conservation Act (No.10 of 1998) (De Castro & Brits, 2014)

Species	Family	Vegetation / land-cover type unit
Gladiolus sp.	Iridaceae	Rocky scarp vegetation, Untransformed grassland.
Habenaria nyikana	Orchidaceae	Rocky scarp vegetation, Untransformed grassland.
Unknown genus (shrivelled specimen)	Orchidaceae	Wetland.
Satyrium cf. *longicauda*	Orchidaceae	Untransformed grassland.

1.2.3 Alien and invasive species

A total of 293 plant species and infraspecific taxa were recorded during the April 2014 survey of the proposed Khwezela North Colliery Life Extension Project study area, of which 228 are indigenous taxa and 65 (22%) are naturalised aliens. Of the 65 alien species listed, 12 are Declared Weeds (Category 1), eight are Declared Invaders in Category 2, one is a Declared Invader in Category 3, as defined by the Conservation of Agricultural Resources Act (CARA), 1983 (Act 43 of 1983) and listed by Henderson (2001). Many of the recorded species are planted ornamentals, ruderal and agrestal weeds or minor environmental weeds. A few species are, however, serious invaders that transform indigenous vegetation within the study area, or species that can be regarded as potential transformers within the study area and adjacent habitats.

Though the Eucalyptus species planted in plantations and small stands throughout the study area have not yet spread and invaded natural ecosystems of the study area to a significant level, these plantations should be removed over time, as they are a source of propagules which can cause invasion and transformation of untransformed vegetation, and they also cause increased ground water abstraction and desiccation of surrounding habitats, especially wetlands.

Acacia mearnsii and *Acacia dealbata*, two very similar species that can only be distinguished by examination of the leaves, are the most widespread and significant invaders of the more sensitive habitats within the study area, especially Untransformed Grassland and Rocky Scarp Vegetation, and should form the focus of control efforts within these habitats.

Populus xcanescens, though not currently widespread, is the most significant invader of the wetlands within the study area. Dense stands of this species have already completely transformed a hillslope seep situated in the eastern parts of the study area. Seeps situated within the highly sensitive Rocky Scarp vegetation unit are especially vulnerable to invasion by *Populus canescens*, and many such in the nearby Tweefontein Colliery have already been completely transformed by this species. This species grows in dense stands that reproduce and spread vegetatively. Most of the recommended

control effort by the mine, in terms of labour allocation, should therefore been focused on this species and *Acacia dealbata* and *Acacia mearnsii*.

Pennisetum clandestinum is also a widespread and serious invader of the sensitive hillslope seep habitats within the Untransformed Grassland, Scarp Vegetation and in Valley-bottom Wetland units within the proposed Life Extension Project study area. *Robinia pseudoacacia* is currently uncommon and localised within the study area (recorded just beyond the eastern boundary), but also poses a significant threat to hillslope seeps. All of the aforementioned species should therefore be eradicated or at least controlled wherever they are found.

Chapter F: Fauna

Information on fauna as contained under this section has been obtained from the following:

- The report titled: "*Biodiversity Action Plan for Kleinkopje Colliery*", dated February 2014, compiled by Digby Wells[77];
- The report titled, *"Flora and Fauna Baseline Survey for the Landau Colliery Life Extension Project Study Area (Clewer, Mpumalanga)",* dated April 2013, compiled by De Castro & Brits c.c; and
- The report titled: "*Terrestrial Ecology Assessment of the proposed Khanyisa Power Plant and Ash pit, Witbank, Mpumalanga*", dated November 2010, and compiled by Ecorex Consulting Ecologists cc

1 Klippan co-disposal facility and project development area

The Khwezela Bokgoni Section provides varied habitats for a number of species, despite the terrestrial ecology of the area being largely modified. The species present are however lower than would be expected of a pristine area which is reflective of a history of anthropogenic activity which has negatively impacted biodiversity within the area.

The natural areas which exist within the area provide habitat for these species, while the transformed areas may provide a source of food. Natural areas are priorities for conservation of species and should be maintained in order that biodiversity is enhanced. Wetlands are particularly high priority natural areas as a result of the significant role they play in provision of habitat and support of Biodiversity furthermore, they provide potential habitat for the Red Data listed amphibian, the Giant Bullfrog. Furthermore, the wetland areas provide habitat for the owl species that are planned to be reintroduced to the area.

Mining and agriculture have transformed much of the natural vegetation, which has resulted in alteration of the natural ecology however positive outcomes have been that different species have colonised in these areas which formerly did not provide suitable habitat, such as the Giant Kingfisher and Black Sparrow-hawk. These species are comfortably sustained in these locations; however its habitat could be vastly improved in a number of situations through various means. Habitat improvement could be initiated through various activities such as increased 'natural' areas, corridor creation, decreased disturbances to habitat, water quality improvement and rehabilitation. Furthermore mechanisms such as bat boxes and owl boxes could be implemented in order to attract species to the area.

[77] Flora Assessment done for Greenside Colliery (2012), only includes map on Biodiversity values (and excludes area associated with the Khanyisa IPP infrastructure). Figure 29 below provides the biodiversity value of the area associated with Klippan and surrounds (as per the Khwezela Bokgoni Biodiversity Action Plan, 2014)

Faunal surveys revealed that black-backed jackal, yellow mongoose, and scrub hare inhabit the natural areas. Evidence in the form of spoor, quills, droppings, soil mounds and grass clippings indicated the presence of porcupine, Cape clawless otter, common duiker, Hottentot golden mole, Highveld gerbil, and vlei rat.

Protected faunal species that could occur in the area are outlined in Table 20 below. The vegetation type determines which animals can be supported on the land area, Figure 28 details the vegetation types (as referred to in the Biodiversity Action Plan, dated 2014) present on Khwezela Bokgoni.

Table 20: Protected fauna species that could possible occur in the area associated with the Khanyisa IPP Coal Supply project area (within the Khwezela Bokgoni surface rights area) (Source: Digby Wells, 2014)

Scientific name	Common name	Observed	Habitat on site
Mammal species			
Chrysospalax villosus	Rough-haired Golden Mole	No	All natural sites
Orycteropus afer	ardvark	No	All natural sites
Proteles cristatus	Aardwolf	No	All natural sites
Poecilogale albinucha	African Striped Weasel	No	All natural sites
Atelerix frontalis	Southern African Hedgehog	No	All natural sites
Felis serval	Serval	Yes	All natural sites
Mystromys albicaudatus	Whitetailed Mouse	No	All natural sites
Reptile species			
Python sebae	African Rock Python	No	All natural sites
Tetradactylus africanus	Beyer's Longtailed Seps	No	All natural sites
Homoroselaps dorsalis	Striped Harlequin Snake	No	All natural sites
Bird species			

Scientific name	Common name	Observed	Habitat on site
Podica senegalensis	African Finfoot	No	Pans/Wetlands/River
Circus ranivorus	African Marsh Harrier	No	Pans/Wetlands/River/Grassland
Geronticus calvus	Bald Ibis	Yes	Grasslands and agriculture for feeding, requires cliffs for breeding.
Circus maurus	Black Harrier	No	Pans/Wetlands/River/Grassland.
Ciconia nigra	Black Stork	No	Pans/Wetlands/River/Grassland. Requires cliffs and gorges for breeding.
Glareola nordmanni	Blackwinged Pranticole	No	Pans/Wetlands/River/Grassland.
Anthropoides paradiseus	Blue Crane	Yes	Pans/Wetlands/River/Grassland. Feeding and breeding.
Eupodotis caerulescens	Blue Korhaan	No	Pans/Wetlands/River/Grassland. Feeding and breeding.
Spizocorys fringillaris	Botha's Lark	No	Pans/Wetlands/River/Grassland. Feeding and breeding
Balearica regulorum	Crowned Crane	No	Pans/Wetlands/River/Grassland. Feeding and breeding.
Tyto capensis	Grass owl	No	Pans/Wetlands/River/Grassland. Feeding and breeding
Phoenicopterus ruber	Greater Flamingo	No	Wetland/Pan areas
Alcedo semitorquata	Halfcollared Kingfisher	No	Pans/Wetlands/River/Grassland. Feeding and breeding
Phoenicopterus minor	Lesser Flamingo	No	Wetland/Pan areas
Phoenicopterus ruber	Greater Flamingo	Yes	Wetland/Pan areas, 2A dam, Klippan discard dump
Falco naumanni	Lesser Kestrel	No	Pans/Wetlands/River/Grassland. Feeding and breeding
Pelecanus rufenscens	Pinkbacked Pelican	No	Wetland/Pan areas
Sagittarius	Secretary Bird	Yes	Pans/Wetlands/River/Grassland. Feeding and

Scientific name	Common name	Observed	Habitat on site
serpentarius			breeding
Neotis denhami	Stanley's Bustard	No	Pans/Wetlands/River/Grassland. Feeding and breeding
Grus carunculata	Wattled Crane	No	Pans/Wetlands/River/Grassland. Feeding and breeding
Eupodotid cafra	Whitebellied Korhaan	No	Pans/Wetlands/River/Grassland. Feeding and breeding
Mycteria ibis	Yellowbilled Stork	No	Pans/Wetlands/River/Grassland. Feeding and breeding

Fauna associated with the proposed Khanyisa IPP-power plant site:

Mammals

Fifteen mammal species have been recorded within the study area and adjacent or nearby properties related to the power plant site. Four of these have a provincial or national conservation status of Near Threatened: Aardvark (*Orycteropus afer*), Bat-eared Fox (*Otocyon megalotis*) Highveld Golden Mole (*Amblysomus septentrionalis*) and Serval (*Leptailurus serval*). A large burrow complex of Aardvark was located at the edge of the untransformed grassland vegetation community on the power plant site. The golden mole was reported from the adjacent Khwezela Bokgooni Colliery (Oryx 2004), although called Hottentot Golden Mole (Amblysomus hottentotus) in that report. *Amblysomus hottentotus septentrionalis* has since been raised to species level (*A. septentrionalis*) and Amblysomus hottentotus (*sensu stricto*) does not occur on the Mpumalanga Highveld. No evidence of this species was located within the power plant site and it is highly unlikely to occur on the Ash dump site. Bat-eared Fox was reported from the adjacent Khwezela Bokgooni property and possibly is a rare visitor to the area. Serval is listed for nearby farms in the MTPA database and has been regularly recorded in the Witbank – Delmas area on various biodiversity assessments undertaken by Ecorex Consulting Ecologists cc. It is most likely to occur in the untransformed grassland and wetland in the south-western part of the power plant site.

Birds

Data from the Southern African Bird Atlas Project (SABAP2), indicate fairly high species richness for some of the mapping units (pentads) around the study area. A pentad covers approximately 61km² (8km x 7.6 km) and the species richness per pentad in the immediate vicinity of the study area varies from 41-118 species per pentad1. Numerous microhabitats associated the high level of fragmentation in the general area do contribute to this high species richness. However, few of these species are restricted-range grassland specialists, most being generalist species that do well in disturbed or degraded areas. Some of the few grassland / wetland specialists that do occur include African Grass Owl (*Tyto capensis*), African Marsh Harrier (*Circus ranivorus*), Southern Bald Ibis (*Geronticus calvus*),

Cloud Cisticola (*Cisticola textrix*), Cuckoo Finch (*Anomalospiza imberbis*), Jackal Buzzard (*Buteo rufofuscus*), Levaillant's Cisticola (*Cisticola tinniens*), Long-tailed Widowbird (*Euplectes progne*), Orange-breasted Waxbill (*Amandava subflava*), Red-chested Flufftail (*Sarothrura rufa*) and Wing-snapping Cisticola (*Cisticola ayresii*).

Species totals during SABAP2 for quarter-degree grids in the general vicinity of the study area (2529CC, 2529CD, 2629AA, 2629AB) vary from 155-250 species. However, a number of these species are confined to large waterbodies and other habitats not represented within the study area. A revised list of 170 potentially occurring species is provided in the ecological report of the Khanyisa IPP project (power plant and ash dump site), including species added during fieldwork in this study. Five of these have Red Data status: African Grass Owl, African Marsh Harrier, Southern Bald Ibis, Lesser Kestrel (*Falco naumannii*) and Lanner Falcon (*Falco biarmicus*). The first four species have a conservation status of Vulnerable, and limited habitat for these is present in the south-west part of the power plant site, although none are likely to be resident but rather infrequent visitors. Lanner Falcon is classified as Near Threatened and is potentially an infrequent visitor hunting small birds over the study area. None of these species was confirmed within the study are during fieldwork.

Reptiles & Frogs

Fourty-three reptile species have been recorded within quarter-degree grids 2529CC, 2529 CD and 2629AA. It is highly unlikely that more than a small proportion of these occur within the study area (power plant area), because of the small size of the area and limited habitats present. Only one of the potentially occurring species has national conservation status of Near Threatened: Striped Harlequin Snake (*Homoroselaps dorsalis*). This poorly known snake is very rarely encountered and spends much of its life underground. While it is difficult to assess the likelihood of occurring, it can be stated that the most likely area of occurrence within the study area is the untransformed grassland and wetland in the south-western corner of the power plant site. Two other species recorded within the general vicinity have a provincial status of Vulnerable, namely Coppery Grass Lizard (*Chamaesaura aenea*) and Large-scaled Grass Lizard (*Chamaesaura macrolepis*). Both are also most likely to be encountered in the untransformed grassland portion of the study area.

Fourteen frog species were recorded in the relevant quarter-degree grids of the study area during the South African Frog Atlas Project. An additional species, Giant Bullfrog (*Pyxicephalus adspersus*), is listed for the grid 2629AA in the MTPA threatened species database, from a nearby farm to the south-west (Boschmansfontein 12IS). This frog has been classified as Near Threatened. While no ideal habitat is represented in the study area (IPP power plant area), there is a small chance of occurrence in the wetland adjacent the dam in the south-western corner of the power plant site.

Invertebrate Fauna

Very few invertebrate species currently considered of conservation concern are likely to occur within the project area (IPP power plant area):

- Baboon spiders; no protected baboon spider species are predicted to occur within the IPP power plant area and no baboon spider burrows were located during the site inspection.
- Scorpions; based on distribution records, three protected scorpion species could potentially occur in the IPP power plant area, but due to the sandy nature of the soil and lack of rocks and trees (apart from exotic bluegums) only one (*Opistophthalmus glabrifrons*) is considered to have a Low likelihood of occurrence, particularly considering the previously disturbed nature of the sites. No scorpions or scorpion burrows were located during the site visit.
- Dragonflies and Damselflies; of the ten dragonflies and damselflies of conservation importance that have been recorded from Mpumalanga, none have been recorded from or are predicted to occur in the Witbank area.
- Cicadas; no cicadas of conservation importance are predicted for the IPP power plant area.
- Beetles; several protected beetle species in the genera Dromica and Mantichora could potentially occur within the IPP power plant area, although insufficient distribution data are available to predict which species are the most likely. The sandy soils present, particularly on the proposed power station site, appear suitable for the larval burrows of these species. However, neither burrows nor adult beetles of these genera were observed during the site visit, despite this having been at an ideal time of year (early summer following good rains) for adult activity. It seems likely that the previously disturbed nature of the sites combined with the high level of transformation in the surrounding areas may have significantly reduced or eliminated populations of Dromica and Mantichora in the study area.
- Butterflies; of the 11 Red Data butterfly species known to occur in Mpumalanga Province, only one (the Marsh Sylph, *Metisella meninx*) could potentially occur in the Witbank area. Suitable habitat for this species is permanent wetlands supporting dense stands of its food plant (*Leersia hexandra*). None of this habitat was found within the IPP power plant area and no populations of *Metisella meninx* would be threatened by the development of the power station or ash dump. Only three butterfly species (*Belenois aurota aurota*, *Vanessa cardui* and *Leptotes brevidentatus*) were observed during the site visit; these are all very common and widespread.

No protected or Red Data invertebrates were observed during the site inspection of the proposed ash disposal and power station sites.

2 Blaauwkrans co-disposal facility and surrounds

A baseline assessment of the vertebrate fauna of the entire Landau Colliery study area (5 142 ha) was conducted by Engelbrecht (2010) and incorporated into De Castro (2011). Four zones within the entire Landau Colliery (Khwezela North) study area were designated as being important to fauna, one of which (the 'Schoongezicht zone') is relevant to the proposed Khwezela North Life Extension Project study area (which the Blaauwkrans Co-disposal Facility extension formed part of). The relatively large size of the untransformed vegetation fragments in this zone, as well as the presence of rocky scarps and valley-bottom wetlands result in a relatively rich faunal diversity and moderate potential for supporting species of conservation concern. However, habitat loss and fragmentation is continuing in

the general vicinity of the study area, resulting in a constant decrease in faunal diversity and reducing the capacity for species of conservation concern to move between fragments of untransformed vegetation.

In summary, the ecology study by De Castro & Brits (2014), revealed the following:

- Seven mammal species of conservation concern were identified as potentially occurring within the study area, namely:
  - Serval (*Leptailurus serval*) – Near Threatened. Confirmed to be present during fieldwork.
  - Spotted-necked Otter (*Lutramaculicollis*) – Near Threatened. Unlikely to be present, although may use wetlands within study area for foraging.
  - Brown Hyaena (*Hyaena brunnea*) – Near Threatened. Unlikely to occur.
  - South African Hedgehog (*Atelerix frontalis*). Near Threatened. Likely to occur in any untransformed vegetation unit within the study area.
  - Honey badger (*Mellivora capensis*) – Near Threatened. Unlikely to occur.
  - Highveld Golden Mole (*Amblysomus septentrionalis*) – Near Threatened. Moderate likelihood of being present in any untransformed grassland and short-grass wetland habitat within the study area.
  - Water Rat (*Dasymys incomtus*) – Near Threatened. Moderate likelihood of occurring in valley-bottom wetlands along Schoongezichtspruit and Tributary of the Brugspruit within the study area.

- Ten bird species of conservation concern were identified as potentially occurring within the study area, namely:
  - Secretarybird (*Sagittarius serpentarius*) - Near Threatened. Confirmed to be present during fieldwork, but likely to be an irregular non-breeding visitor.
  - Greater Flamingo (*Phoenicopterus roseus*) – Near Threatened. No habitat for Greater Flamingo is present within the study area. However, flamingos have previously been confirmed to be present at a pan on an adjacent property.
  - Southern Bald Ibis (*Geronticus calvus*) – Vulnerable. Suitable foraging habitat is present for Southern Bald Ibis, but it is only likely to be an irregular non-breeding visitor.
  - Peregrine Falcon (*Falco peregrinus*) – Near Threatened. Possibly occurs anywhere in the study area where flocks of seed-eating birds are present, but is unlikely that it would breed due to the lack of suitable nesting habitat.
  - African Grass Owl (*Tyto capensis*) –Vulnerable. Moderate likelihood of occurring in valley bottom wetlands within the study area.
  - The Lesser Kestrel (*Falco naumanni*)–Vulnerable. Low likelihood of occurrence.
  - Blue Crane (*Anthropoides paradiseus*) - Vulnerable. Low likelihood of occurrence.
  - White-bellied Korhaan (*Eupodotis cafra*) -Vulnerable. Low likelihood of occurrence.
  - Lanner Falcon (*Falco biarmicus*) – Near Threatened. High likelihood of occurrence.
  - Blue Korhaan (*Eupodotis caerulescens*) – Near Threatened. High likelihood of occurrence.

- Two reptiles of conservation importance were identified as potentially occurring within the study area, and include the:
  - Transvaal Grass Lizard (*Chamaesaura aenea*) – Vulnerable. Potentially occurs in untransformed grassland unit.
  - Striped Harlequin Snake (*Homoroselaps dorsalis*) – Near Threatened. May be present in untransformed grassland unit, but as it spends most of its time underground and is rarely seen, the presence or absence of this species in the study area could not be confirmed for the purpose of this study.

- The only frog species of conservation importance is the Giant Bullfrog (*Pyxicephalus adspersus*) - Near Threatened. This species was confirmed to be present during fieldwork, although likely only using the suitable habitat within the study area for foraging. The Giant Bullfrog is unlikely to be a breeding resident within the proposed Khwezela North Life Extension Project study area (including the area associated with the Blaauwkrans Co-disposal facility area and surrounds).

Chapter G: Surface Water

Information on surface water was sourced from the following documents:

- The report titled: "*Anglo American – Kleinkopje Colliery; Integrated Waste Water Management Plan*", dated April 2015 with report no.: KK/IWULA/02/2154 (here after referred to as the IWWMP, dated April 2015);
- Kleinkopje Colliery EMPr, 2012;
- Landau Colliery EMPr, 2010;
- The report titled: "*Anglo Coal Kleinkopje Colliery - Annual Water Quality Assessment Report*", dated December 2015 (for the period January – November 2015), compiled by Aquatico Scientific; and
- The report titled: "*Anglo American Coal – Landau Colliery – Department of Water and Sanitation (DWS) Quarter 1 and 2 of 2016 Water Quality Report No 15*".

1 Catchment areas and watercourses

The locations associated with the proposed Khanyisa IPP Coal Supply Project activities and infrastructure (on Khwezela Bokgoni and Greenside Collieries) are situated in quaternary catchment B11F (refer to Figure 33 below), which forms part of the Olifants River catchment area. The Olifants River, which is part of the regional drainage network of the province, leaves the Khwezela Bokgoni Colliery boundaries at the Wolverkrans weir (1,503masl).

The Standerspruit previously traversed the area that is now referred to as the Pit (Block) 2A mining area of the Khwezela Bokgoni Colliery.

The existing Blaauwkrans Co-disposal Facility is located in the B11G and B11K quaternary catchments (refer to Figure 33).

Quaternary catchment B11K is drained by the Klipspruit and its tributaries, the Brugspruit and Blesbokspruit. Quaternary catchment B11G is drained by the Noupoortspruit, which joins downstream with the Olifants River.

2 Mean annual runoff

Mean annual runoff (MAR) is based on the relevant quaternary catchment runoff as obtained from the WR2005. The MAR values for quaternary catchment B11F are presented in the Table 21 below.

Table 21: Mean Annual Runoff for quaternary catchment based on the WR2005

Catchment	Total Area km^2	Nett Area km^2	MAR $10^6m^3/a$	Unit MAR $10^6/m^3/a/km^2$
B11F	368	337	15.7	0.046

The gross Mean Annual Runoff (MAR) for the B11K quaternary catchment is 46 mm 35.8 for B11G. The expected MAR values for various B11K sub-catchments are presented in Table 22 below.

Table 22: Mean Annual Runoff – B11K sub-catchments (Jones and Wagener, 2014)

Node	Catchment Are (km^2)	MAR (x 10^6m^2)	% of MAR at Loskop Dam
S 1	15.58	1.03	0.27
S 2	11.90	0.79	0.21
S 3	7.34	0.49	0.13
S 4	19.57	1.29	0.34
S 7	7.86	0.51	0.13
S 4 (a)	2.87	0.19	0.05

3 Average dry weather flow

The average dry weather flows for the B11F catchment was again derived from the monthly quaternary flow data set derived in the WR2005 Report. Refer to Table 23 below.

Table 23: Computed dry weather flows of the relevant catchment

Catchment	Flow 103m3/m	Flow l/s
Quaternary B11F	130.3	50.3

The expected Dry Weather Flow (DWF) for the B11K catchments are shown in Table 24 below.

Table 24: Average dry weather flow for B11K sub-catchments (Jones and Wagener, 2014)

Catchment	Computed DWF (l/s average over month)
S 1	4.04
S 4	5.72

4. Surface water use

The main categories of water use within the surrounding area are:

- Industrial,
- Potable,
- Agricultural,
- Aquatic, and
- Recreational

The Witbank Dam, being the receiving water body, starts directly below the Wolwekrans weir, which is regarded as the position that the Olifants River leaves the Khwezela Bokgoni property.

Water from the watercourses downstream of Khwezela North Colliery is mainly used for livestock watering and for recreational uses, tourism such as hunting and guest housing, and small-scale irrigation of pasture, vegetables, flowers and trees. Informal settlements concentrated in the upper Brug- and Klipspruit used the water from the watercourses mainly for domestic use with potable water available at standpipes and water points within the settlements, but not excluding the possible use of stream water as potable water.

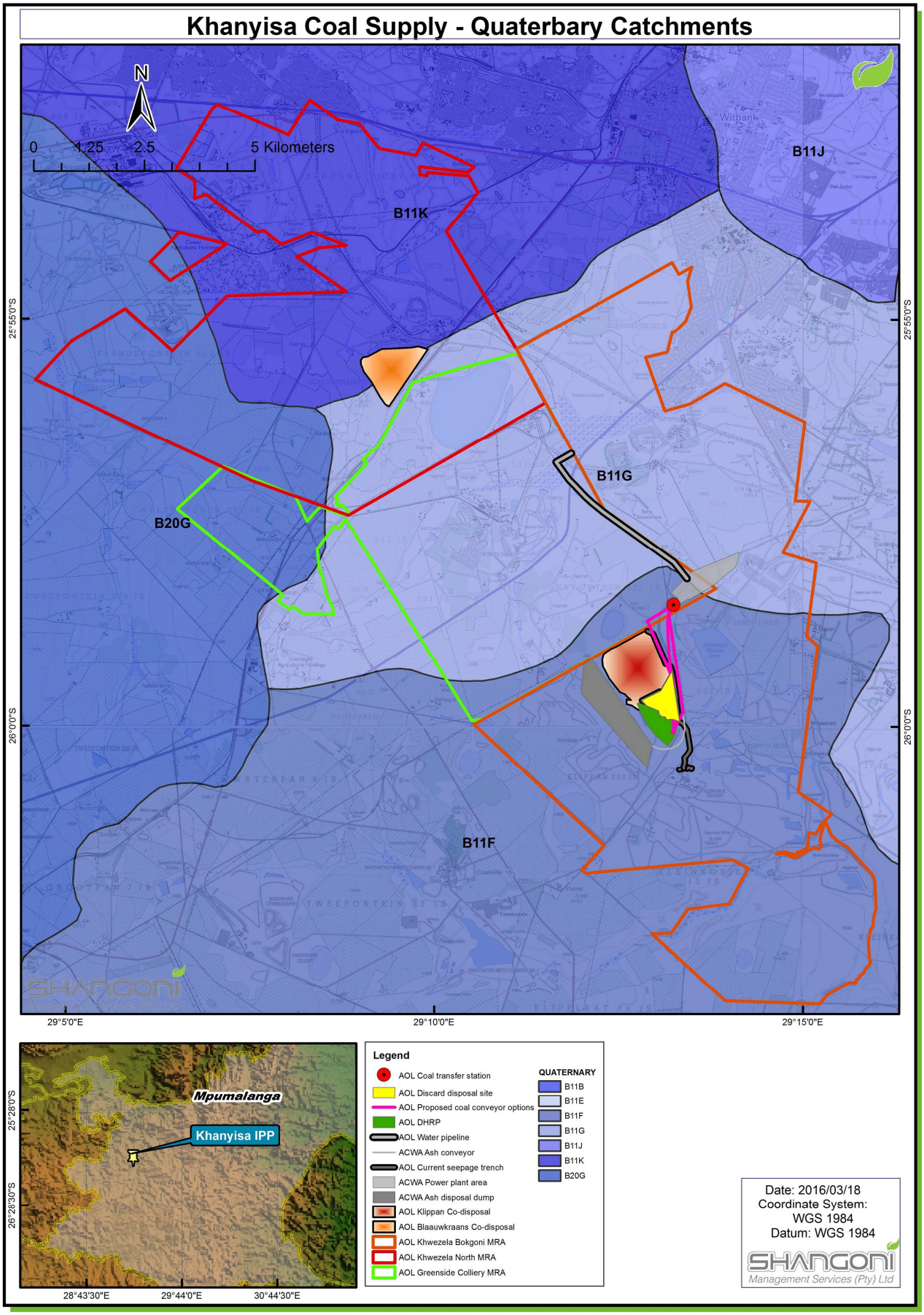

Figure 33: Quaternary catchments

5 Surface water quality

5.1 Klippan co-disposal facility and project development area

Surface water quality monitoring programme

Khwezela Bokgoni (Kleinkopje) Colliery has contracted Aquatico Scientific (Pty) Ltd. to conduct drinking water and surface water monitoring. The Annual Water Quality Report (AWQR) dated December 2015 describes the results of the water monitoring programme from January to November 2015. As indicated in the AWQR, the water monitoring localities of various variables were compared to that of the limits as set in SANS 241 – 1:2015 (Drinking Water Limits) and the Khwezela Bokgoni Colliery Integrated Water Use Licence (IWUL), dated December 2011 (Licence No. 04/B11J/AFGJ/1416).

Table 25 below provides a description of the surface water and process water monitoring localities. Furthermore, the surface water monitoring localities are indicated in Figure 34, and the process water monitoring localities are indicated in Figure 35 below.

Table 25: Description of the surface and process water monitoring localities at Kleinkopje Colliery

Monitoring locality	Description
Surface water monitoring localities	
WP042	Olifants River In
RW004	Olifants River Out
WP037 Upstream	Upstream of WP037
WP037	Tweefontein Spruit In
WP039	Tweefontein Spruit above 5 West HD
WP040	Tweefontein Spruit Out
WP074	Stander Spruit
WP033	North East Spruit Out
WP012	Naauwpoort Spruit where entering KK
WP008	Naauwpoort Spruit at Klipfontein Dump
WP011	Landau Under Highway Culvert
WP029	Naauwpoort Spruit Out
WP098	Roofcoal Dump Seepage Dam
Process water monitoring localities	
WP083	Klippan Return Water at Penstock
WP093	Clarified Tanks – Thickener Dam
WP095	Klippan Toe Seep
WP009	2A Dam
RW011	Surface Water
RW011B	Arms Tank

Monitoring locality	Description
RW011C	Erickson Dam 2
RW003	Plant Return Water Dam
WP096	Oil Separator
WP097	Oil Separator
WP036	Klipfontein Toe Trench

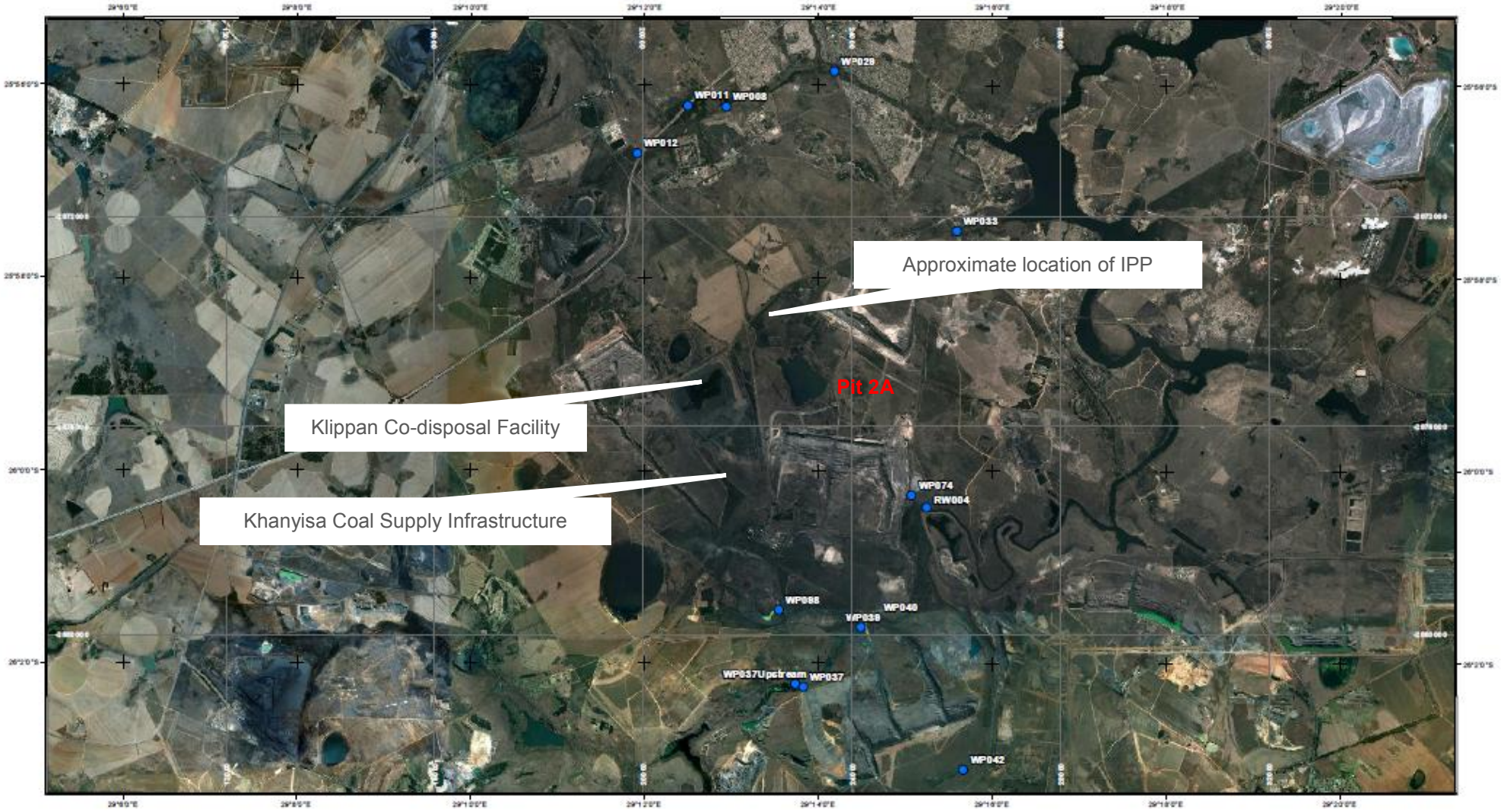

Figure 34: Surface water monitoring localities at Khwezela Bokgoni Colliery (modified from Aquatico AWQR; December 2015)

Figure 35: Process water monitoring localities at Khwezela Bokgoni Colliery (modified from Aquatico AWQR; December 2015)

Surface water quality monitoring results

Surface water quality

Physical water quality:

The majority of surface water localities can be described as neutral in terms of pH values obtained during the annual sampling period of 2015. The only exception was locality WP008 which could be described as acidic. Similarly, the majority of localities could also be described as very saline except for locality WP029 (non-saline) as well as localities WP042 and RW004 (saline). Classification based on total hardness showed that water from the surface water localities ranged from hard to extremely hard.

Chemical water quality:

The majority of the localities could be classified as either Poor or Unacceptable water quality due to elevated sulphate, calcium and manganese concentrations.

Bacteriological water quality:

All of the surface water localities could be classified as either Poor or Unacceptable water quality.

Summary:

None of the surface water localities complied fully with the limits set in the IWUL. The dominating exceeding variables included electrical conductivity, total dissolved solids, total alkalinity, sulphate and manganese. Although the limits set in the Integrated Water Use Licence are stringent, when the annual water quality is compared to the qualities of the region and qualities of the historic data, the water quality limits set in the IWUL will not be easily attainable.[78]

The most concerning localities were WP098 and WP008 which recorded excessively high concentrations of total dissolved solids, sulphate and manganese while locality WP074 (Stander Spruit) had high metals concentrations.

Microbiologically, all of the surface water localities could be classified as either Poor or Unacceptable water quality due to high faecal coliform numbers in multiple months during the 2015 annual sampling period.

Process water quality

Physical water quality:

The majority of water from the process water localities could be classified as neutral, extremely saline and extremely hard. The only exception was water from locality RW011B which could be classified as acidic in addition to being extremely saline and extremely hard.

[78] A draft water use licence document was received in April 2016 from the DWS where in an amendment was made to some of the water quality limits.

Chemical water quality:

In terms of the analysed chemical variables, all of the process water localities could be classified as Unacceptable water quality. This was due to high concentrations of sulphate, calcium and magnesium.

Bacteriological water quality:

None of the process water localities could be classified as Ideal water quality as faecal coliforms were detected at each sampling point. Locality RW003 was the only locality which could be classified as Marginal water quality while localities RW011, RW011B, RW011C, WP083, WP097 and WP009 could be classified as Poor water quality. The most problematic localities (WP093, WP095 and WP096) could be classified as Unacceptable water quality as numerous faecal coliforms were present on multiple occasions.

Summary:

All of the sampled process water localities exceeded the limits set in the IWUL for process/waste water. Additionally, the limits that are set in the IWUL are similar to the Good water quality (DWA Domestic Use) guidelines. Variables where limits were exceeded at all localities included electrical conductivity, total dissolved solids, calcium, magnesium and sulphate.

5.2 Blaauwkrans co-disposal facility and surrounds

Surface water quality monitoring programme

A comprehensive surface water monitoring program is undertaken at Khwezela North Colliery. It entails monthly sampling by the operation and quarterly catchment wide river and stream sampling by a third party, Aquatico Scientific.

Figure 36 below provides a visual representation of the surface monitoring points at Khwezela North – Navigation Section.

Figure 36: Surface water monitoring localities at Khwezela North Navigation Section (WQR; January – June 2016)

The Kopseer Dam is utilised to capture toe seep water emanating from the Blaauwkraans Co-Disposal Facility. The Toe Dam is used to contain seepage and polluted runoff from Blaauwkraans Co-Disposal Facility. Water from both dams is pumped for treatment at the Navigation Liming Plants before being re-used as make-up water at the Navigation Beneficiation Plant.

Surface water quality monitoring results:

Heavy Metals (Fe; Mn; Al):

All Navigation Dams are mostly below the average quality stated in the WUL for Fe, Mn and Al; expect Kopseer Dam. The exceedances on the average indicated in the WUL is expected due to the nature of the water (toe-seep from a Co-Disposal Facility) in these dams.

Minerals / Salts (Cl; Mg; Na; Ca; K; SO4):

For Cl qualities, all dams were within the average limits stated in the WUL. The Na and Mg quality results indicated exceedances on the average stated for Na and Mg in the WUL for the Toe Seep dam. For Ca, only the Toe Seep-; Umlalazi PCD- and Raw water dams exceed the limit. The K average qualities were exceeded in Umlalazi PCD and the Toe-seep Dam. No exceedances were noted for the average SO4 quality stated in the WUL. The exceedances on the average concentrations as indicated by the WUL are expected due to the nature of the water at Navigation (e.g. toe-seep water from the Blaauwkraans Co-Disposal Facility and acid mine drainage that seeps into Schoonie Dam; and mine water treated with limestone).

Other Water Quality Parameters (pH; TDS; Temperature; Acidity; Suspended Solids):

All dam water pH qualities were between the WUL stipulated average pH values. For Total Dissolved Solids (TDS) and acidity, only Kopseer Dam exceeded the average value stipulated in the WUL. All temperatures were within the average WUL limits. The Umlalazi Pollution Control Dam; Toe-, Raw- and Kopseer Dams, exceeded the average suspended solids value stipulated in the WUL (suspected due to slurry from Blaauwkraans to the Kopseer Dam; and yellowbuoy in the raw water dam after neutralisation). The high TDS and suspended solids are suspected in typical acid mine drainage-, plant run-off-, and lime neutralised water.

6 Resource class and river health

In South Africa, a river health classification scheme is used to standardise the output of different river systems. The document titled "*Resource Directed Measures for Protection of Water Resources: River Ecosystems Version 1.0.24*", dated September 1999, compiled by the Department of Water and Sanitation (DWS), provides the indexes of Attainable Ecological Management Classes as shown in Table 26 below. Each index is calibrated so that its results can be expressed in terms of ecological and management perspectives.

Table 26: Resource classes as set out by the Department of Water and Sanitation

River Health Class	Ecological perspective	Management perspective
Natural / Excellent (Class A)	No or negligible modification of in-stream and riparian habitats and biota.	Protected rivers; relatively untouched by human hands; no discharges or impoundments allowed.
Good (Class B)	Ecosystems essentially in good state; biodiversity largely intact.	Some human-related disturbance but mostly of low impact potential.
Fair (Class C)	A few sensitive species may be lost; lower abundances of biological populations are likely to occur, or sometimes, higher abundances of tolerant or opportunistic species occur.	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation.
Poor (Class D)	Habitat diversity and availability have declined; mostly only tolerant species present; species present are often diseased; population dynamics have been disrupted (e.g. biota can no longer reproduce or alien species have invaded the ecosystem).	Often characterised by high human densities or extensive resource exploitation. Management intervention is needed to improve river health – e.g. to restore flow patterns, river habitats or water quality.

The Upper reach of this section of the Olifants River Catchment falls into the Ecological Management Class D as defined in Table 26 above.

7 Aquatic environment

7.1 Klippan co-disposal facility and project development area

The information contained in this section of this report was sourced from the following document:

- The report titled: Specialist report: "*Biomonitoring and toxicity assessment of the Tweefonteinspruit, Naauwpoortspruit and Olifants River*", dated December 2015 and compiled by Nepid Consultants.

Biomonitoring is conoducted at Khwezela Bokgoni Colliery on a bi-annual basis (during the winter and summer months). Biomonitoring is undertaken at six sites (Table 27). Locations are shown in Figure 37 below.

Table 27: Details of monitoring sites in the vicinity of Khwezela Bokgoni Colliery

Code	Name	Wetland Type
WP012	Naauwpoortspruit IN	Non channelled Valley Bottom
WP029	Naauwpoortspruit OUT	Non channelled Valley Bottom
WP037	Tweefonteinspruit IN	Non channelled Valley Bottom
WP040	Tweefonteinspruit OUT	Non channelled Valley Bottom
WP042	Olifants River IN	Lowland River
RW004	Olifants River OUT	Lowland River

Results

Surface water quality:

Surface water quality in December 2015 showed a general improvement compared to the previous survey, conducted in June 2015. The improvement is attributed to a single and localised rainfall event that took place 42 days before the field survey. However, stormwater runoff that is likely to have been associated with this rainfall event contributed to elevated turbidity in the Tweefonteinspruit and Olifants River.

Benthic Diatoms:

Summary results of diatoms recorded in December 2015 are shown in Table 218.

Table 28: Summary results - Diatoms

Site	No. species	SPI score	Class	Category	PTV (%)	Valve deformities (%)
WP042	28	10.9	Moderate quality	C/D	32.3	1
RW004	45	9.4	Poor quality	D	28.5	0.75
WP037		13	Moderate quality	C	20.8	0
WP040		8.2	Poor quality	D	39.9	0

Site	No. species	SPI score	Class	Category	PTV (%)	Valve deformities (%)
WP012	18	6	Bad quality	E	80.3	1.25
WP029	14	4.6=8	Bad quality	E/F	79.3	1

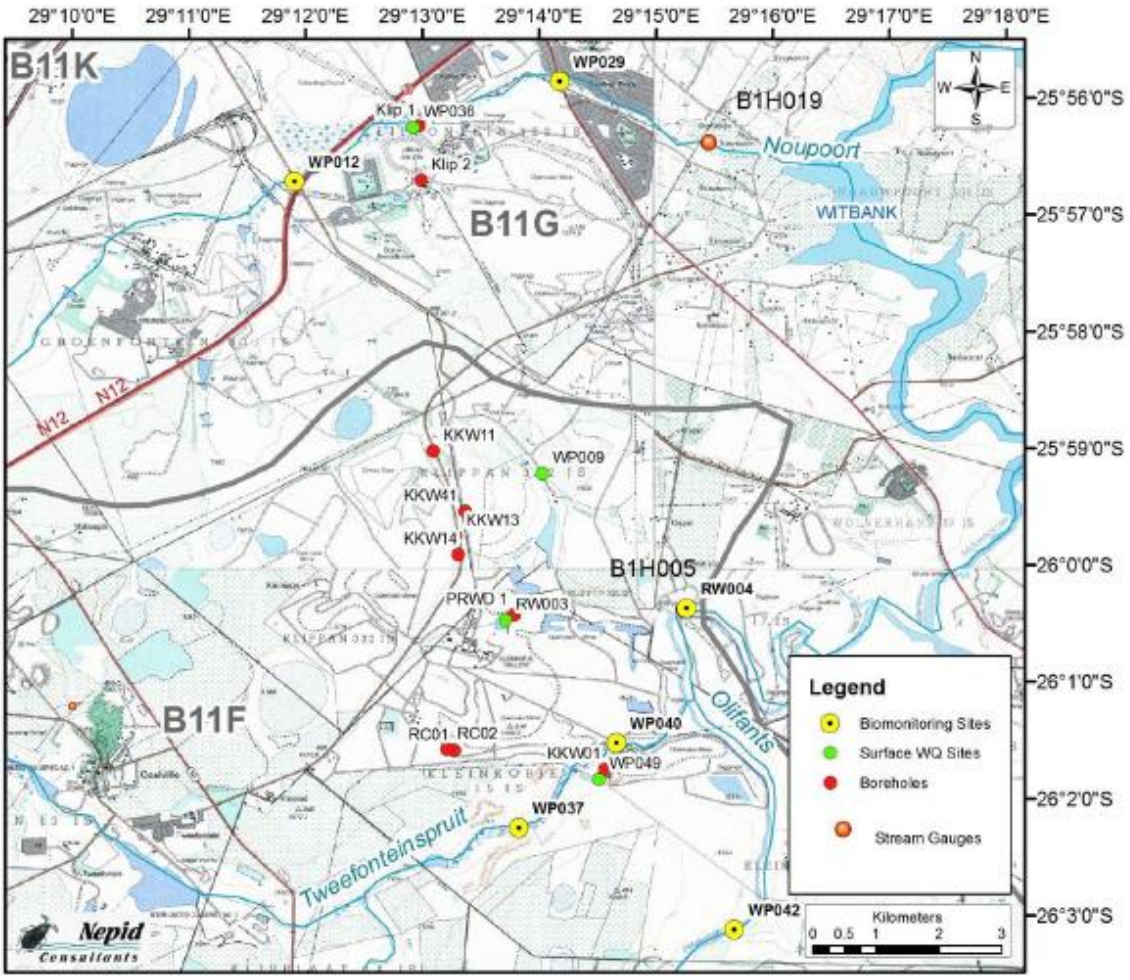

Figure 37: Biomonitoring sampling locations at Khwezela Bokgoni Colliery (Source: Nepid Consultants; December 2015)

Aquatic Macro Invertabrates:

The diversity of aquatic macroinvertebrates in Olifants River in December 2015 was similar at the two sites, with 8 taxa recorded upstream, and 10 taxa recorded downstream. Similar results were recorded during the previous survey. This was despite cessation of flow in the Olifants River for a period of 30 days in October/November 2015. The most sensitive taxon at both sites was freshwater shrimp (Atyidae), which has a moderate sensitivity score of 8/15.