Invertebrate sensitivity scan for the proposed Anderson-Dinaledi transmission line

prepared by

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Commissioned by

NEMAI CONSULTING

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To Nemai Consulting

INVERTEBRATE SENSITIVITY SCAN FOR THE PROPOSED ANDERSON-DINALEDI TRANSMISSION LINE

We have the pleasure in submitting herewith our report as requested and as per your correspondence and appointment dated 24th August 2012. This study has been carried out in accordance with regulations stated in *DEAT (2005) Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005, Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism (DEAT), Pretoria.*

The aim of this report was to:

1. provide the client with a description of potential status of Red Data Invertebrate species and habitat that could be potentially suitable for their presence along the alternative routes for the proposed 40km Anderson-Dinaledi transmission line
2. recommend a preferred route from the 7 alternative routes identified for the proposed transmission line.

The proposed transmission line will traverse land currently utilised for mining, conservation, tourism, commercial, recreational and residential purposes, as well as vacant land. Results obtained from the sensitivity scan are considered sufficient to highlight sensitive habitat types and potential Red Data habitat. None of the eight invertebrate species of conservation concern known to occur in the vicinity of the site were observed during site visits. It must however be mentioned that surveys were not carried out during the known flight period of *Trichocephala brincki* and *Acraea machequena*. Although *Lepidochrysops praeterita* is known to be on the wing from early September, there is a possibility that this species may have emerged after the time of surveying. The sensitivity scan was conducted just before and just after the first spring rains. Initial site visits were carried out during a very dry time of the year when invertebrate activity is greatly reduced. Follow up surveys are recommended in late October 2012 in order to confidently establish the absence of *Trichocephala brincki, Lepidochrysops praeterita* and *Lepidochrysops hypopolia*. Additional surveys are also recommended in late summer to confidently establish the absence of *Acraea machequena* from area that the transmission line will traverse.

The site was visited on the 25th of August 2012 by Vincent van der Merwe and Clayton Cook. Follow up site visits were carried out on the 8th, 9th and 10th of September by Vincent van der Merwe. The proposed transmission line will traverse two mountainous areas (Magaliesberg and Witwatersberg) that have not been heavily impacted by anthropogenic activities and are in a largely natural state. The is a strong possibility that invertebrate species of conservation concern are present in these natural areas. There are a large number of Norite koppies in the close vicinity of the existing Dinaledi

substation. Although heavily impacted by granite mining, these koppies may constitute suitable habitat for the presence of invertebrate species of conservation concern.

It is recommended that the transmission line follow the western route. The possible southern, eastern or western deviations do not need to be followed. The main reason for the recommendation is that this route has been most impacted by anthropogenic activities. The establishment of a transmission line along a route heavily impacted by the development of roads and existing powerlines will have reduced impact on invertebrate diversity compared to its establishment along a route that has been considerably less impacted by anthropogenic activities. The existing Lomondt De Wildt 88kV line (with a servitude of 22m) that traverses the eastern route will be decommissioned by Eskom in 2014. Relatively natural areas currently traversed by these powerlines could then return to a healthier level of ecosystem functioning with reduced anthropogenic disturbance. It is preferable to have multiple transmission lines following a single route rather than several transmission lines following several routes. This makes sense from an environmental and a transmission line maintenance point of view. Environmental disturbance could then be focused in the same areas rather than disturbance along multiple routes. The western route also traverses less natural Marikana Thornveld, the most threatened vegetation type transverse by the alternative routes.

CONTENTS

INVERTEBRATE DIVERSITY AND ITS ECOLOGICAL SIGNIFICANCE

Biodiversity is the variability among living organisms on earth, including the variability within and between species and within and between ecosystems. The biodiversity of North West province is under constant threat from human settlement and societal development. Natural land is degraded and transformed by the rapid expansion of human settlements, such as residential areas, mines, manufacturing plants, storage dams, transport and agricultural infrastructure, that have an ever-increasing demand for space. The loss, fragmentation and degradation of natural habitat through urbanisation and an increase in human population numbers, represent the greatest threats to rare and endangered invertebrate species in North West province.

Sustainable development is an evolving concept, which is continually being redefined and reinterpreted and should form the basis of the planning processes of new developments. Reducing the burden of environmental impacts is necessary if development is to become sustainable. The process of planning new developments should be based on scientific, ecological principles and used as a planning tool to promote sustainable development by integrating environmental considerations into a wide range of proposed actions. Development planning must be intended to ensure that development proposals do not undermine critical resource and ecological functions, by improving the way these environmental resources are utilised, or the well being, lifestyle and livelihood of the communities who depend on them.

Invertebrates dominate terrestrial and freshwater ecosystems, with insects being the most speciose class, comprising more than 75% of all known species in the Animal Kingdom. Insects, myriapods and arachnids form part of the diverse and essential natural processes that sustain biological systems. The insect-plant interaction is the most common biotic interaction on Earth, and indeed, our present ecosystems would not function without these invertebrates. The worldwide Red List of Threatened Species (http://www.iucnredlist.org/) contains approximately 560 insects. This is a meagre 7% of the faunal list, which when one consider that insects make up over 70% of the worlds fauna, is tremendously biased. In a study carried out by Black and Vaughn (2003), it was noted that of the world's insects, very few groups have been assessed on a worldwide scale. Approximately 10% of Swallowtail butterflies, for example, are considered globally threatened. Based on a mathematical model, McKinney (2003), predicted that 10% of all butterflies were threatened strongly contrasting the 1% currently listed. At National levels, figures between 10% and 34% are given for the number of threatened indigenous insect species, suggesting that the overall number of threatened insect species could be in excess of 100, 000. Globally countries such as Australia, France, Spain, the United States and South Africa have among the highest numbers of threatened invertebrates. This is however, more a reflection of the effort made by these countries to assess their biodiversity and hence distinguish those that are threatened rather than a true overall indication.

Invertebrates have an enormous functional value because of the numerous individuals and the great intra- and interspecific variety. The ecological importance of this great variety of invertebrate makes

them valuable to assess disturbances or environmental impacts. A sound knowledge of arthropods is crucial to the conservation and management of ecosystems because a skewed focus only on the larger organisms will misrepresent ecosystem dynamics. The lack of human appreciation of the importance of invertebrates and their general disregard and dislike, coupled to the fact that only about 7-10% of insects are scientifically described, must be overcome to realistically conserve biodiversity.

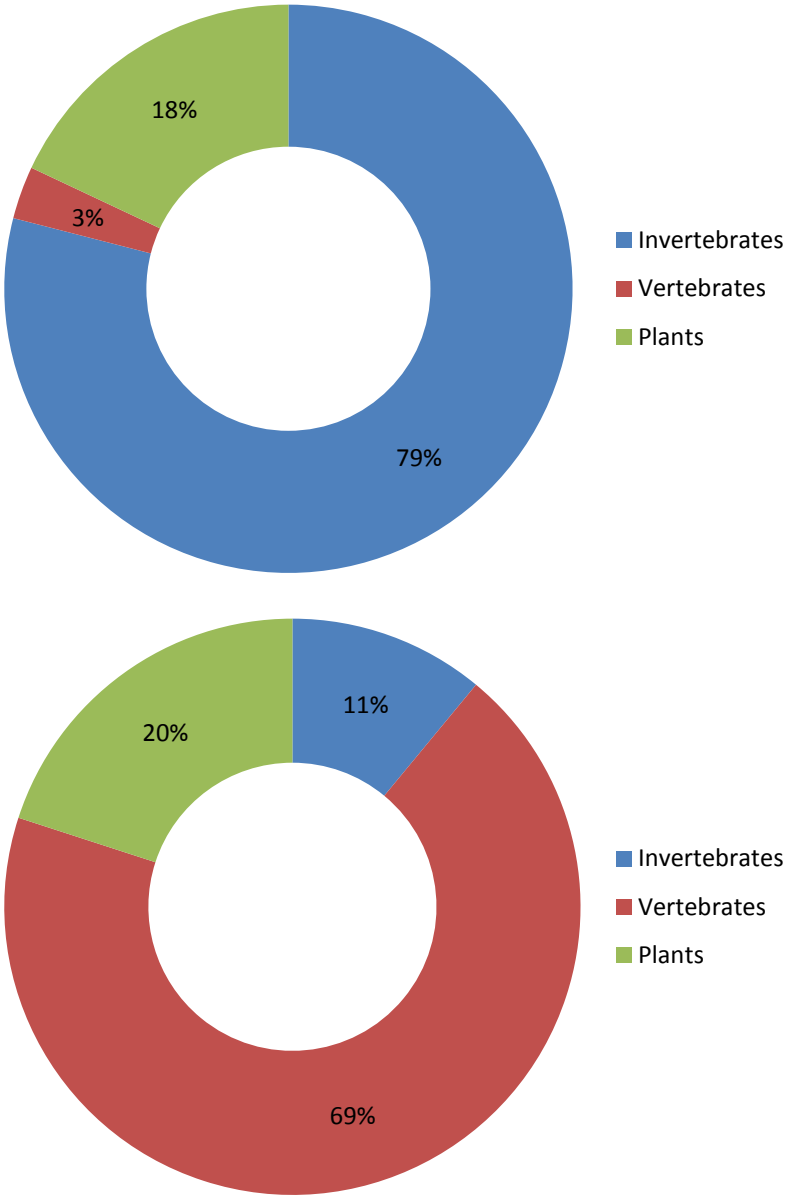

Figure 1. Proportion of major organismal taxa (top) versus conservation literature (bottom). Taken from Collen *et al.* 2012.

PROJECT BACKGROUND AND STUDY AREA

Eskom Holdings Limited is proposing the construction of a new 400kV transmission line and a proposed new 400kV Substation as part of their Tshwane Strengthening Scheme Project. The proposed powerline will be approximately 40km in length and will run between the proposed new Anderson Substation and the existing Dinaledi substation. The proposed Anderson substation will be located immediately north east of the junction between the N4 (Magaliesberg Freeway) and the R511 whilst the the existing Dinaledi Substation is located approximately 8km North East of Brits. The proposed powerline will be constructed in the following two municipal areas: Madibeng Local Municipality (North West) and the City of Tshwane Local Municipality (Gauteng). A separate Environmental Impact Assessment (EIA) process has been undertaken for the proposed Anderson substation. The following alternative routes have been identified for the proposed transmission line:

1. Eastern Route

The Eastern route alternative is approximately 35km in length and runs between the existing Dinaledi Substation and the proposed new Anderson Substation. The eastern route alternative originates on Portion 25 of the Farm Welgedund 491 JQ which is located north of Pelindaba. Portion 25 of the Farm Welgedund 491 JQ is one of the properties which is earmarked for substation construction. From here the route runs in an eastern direction and traverse Portion 82 of the Farm Weldaba 567 JQ and Portion 17 of the Farm Schurveberg 488 JQ. On Portion 17 the route turns in a north eastern direction and traverse Portions 81 and 112 of the Farm Schurveberg 488 JQ. From here the route runs in an eastern direction and traverse Portions 113, 114, 108, 115 and 116 of the Farm Schurveberg 488 JQ. On Portion 116 of the Farm Schurveberg the route turns in a north eastern direction, and runs in close proximity to the boundaries of Portions 75 and 76 of the Farm Elandsfontein 352 JR for approximately 60m before turning in a northern direction on Portion 76. From here the route traverses Portions 77, 145, and 146 of the Farm Elandsfontein 352 JR. On Portion 146 the route turns slightly in a north western direction and traverse Portions 142, 141, 143, 144, 145, and 78 of the Farm Uitzicht Alias Rietvalei 314 JR. From here the route continues in a slight north western direction and traverse Portions 65, 62, 270, and 268 of the Farm Kameeldrift 313 JR. From here the route turns further in a north western direction and traverse Portions 324 and 50 of the Farm Rietfontein 485 JQ. From here the route continues in a north western direction and traverse Portions 44 of the Farm Schietfontein 437 JQ and turns further in a north western direction where it traverses Portions 49 and 23 of the Farm Zilkaatsnek 439 JQ. On Portion 23 the route turns in a north eastern direction and runs back to Portion 44 of the Farm Schietfontein 437 JQ. From here the route runs in a slight north western direction in close proximity to the boundary of Portion 44 and traverse Portions 71, 73, 74, 91, 16, and 13 of the Farm Schietfontein 437 JQ. From here the route turns further in a north eastern direction and traverse Portion 15 of the Farm Elandsfontein 440 JQ. On Portion 15 the route turns in a western direction and traverse Portions 58, 63, 59 and 61 of the Farm Elandsfontein 440 JQ. On Portion 61 the route turns in a north western direction and traverse Portions 18, and 19 of the Farm Elandsfontein 440 JQ. From here the route turns in a northern direction and traverse Portions 44, 47,

and 55 of the Farm Elandsfontein 440 JQ. On Portion 55 of the Farm Elandsfontein 440 JQ (Portion 55 of the Farm Boekenhoutfontein 44-JQ) the route turns slight north east and runs in close proximity to the boundary of Portion 55. On the northern boundary of the Portion 55, the route turns in a north western direction and traverse Portions 855, 854, 853, 852, 851, 850, 849, 848, 847, 846, 845, 844 and 843 of the Farm Roodekopjes of Zwartkopjes 427 JQ. The route terminates on Portion 843 of the Farm Roodekopjes of Zwartkopjes 427 JQ where the Dinaledi Substation is located. The Eastern Route Alternative traverses the Gauteng and North West Provinces and is located within the City of Tshwane and Madibeng Local Municipal areas. This route alternative traverses the North West Province, and Madibeng Local Municipal area for approximately 21.68km and the Gauteng Province and the City of Tshwane Local Municipal area for approximately 5.6km. A total of 59 properties are currently directly affected by this proposed route alternative. The property of the Xsrata Eland Platinum Mine is located between the Eastern and Western route alternatives. During the Eskom route selection process, one deviation was made to the Eastern Route to accommodate the Eland Platinum Mine. Various deviations were made to the Western Route Alternative which is discussed in detail in Section 1.4.4 below. These deviations were created in order to avoid mining areas and to provide the mine with various options on how the route could traverse their property should the routes not interfere with already approved future mine expansions and to avoid traversing of surfaces earmarked for future open cast mining. The Eastern Route Deviation is discussed below.

2. Eastern Route Alternative Deviation

The deviation to the eastern route originates on Portion 16 of the Farm Schietfontein 437 JQ where it turns from the original eastern route alternative in a north eastern direction, and then in a northern direction from where it traverses Portion 13 of the Farm Schietfontein 437 JQ. The route runs along the eastern boundary of Portion 13 for approximately 1.4km before it turns in a north western direction where it joins the original eastern route alternative on Portion 13. The Eastern Route Alternative Deviation is located within the North West Province and the Madibeng Local Municipal area. A total of 2 properties are currently directly affected by this proposed route alternative.

3. Central Route Alternative

The Central Route Alternative originates on Portion 843 of the Farm Roodekopjes of Zwartkopjes 427 JQ where the Dinaledi Substation is located. From here it turns in a south western direction and traverses Portions 843, 844, 845, 846, 847, 848, 849, 850, 851, 853, 853, 854 and 855 of the Farm Roodekopjes of Zwartkopjes 427 JQ and Portion 17 of the Farm Elandsfontein 440 JQ. On Portion 17 the route turns in a south eastern direction and traverse Portions 18, 43, 46, 47 and 55 of the Farm Elandsfontein 440 JQ. On Portion 55 of the Farm Elandsfontein 440 JQ (Portion 55 of the Farm Boekenhoutfontein 44-JQ) the route joins the eastern route alternative. The Central Route Alternative is located within the North West Province and the Madibeng Local Municipal area. A total of 19 properties are currently directly affected by this proposed route alternative.

4. Western Route Alternative

The Western Route Alternative is approximately 31km in length and originates at the same position as the eastern route alternative, on Portion 25 of the Farm Welgedund 491 JQ which one of the alternative properties earmarked for substation construction. The Western Route Alternative runs between the proposed new Anderson Substation which is earmarked for development north of Pelindaba and the existing Dinaledi Substation which is located approximately 8km north east of Brits. The Western Route Alternative follows the Eastern Route Alternative for approximately 2.8km before it turns in a north eastern direction on Portion 82 of the Farm Weldaba 567 JQ, and traverse Portion 2 of the Farm Welgedund 491 JQ. On Portion 2, the route turns in a northern direction and run in close proximity to the boundaries of Portions 2, and 88 of the Farm Welgedund 491 JQ. From here the route turns in a slight north eastern direction and traverse Portion 59 of the Farm Rietfontein 485 JQ. On Portion 59 the route turns in a northern direction and traverse Portions 236, 237 and 67 of the Farm Rietfontein 485 JQ. On the northern boundary of Portion 67, the route turns in a north western direction and traverse Portions 218 and 108 of the Farm Rietfontein 485 JQ. On Portion 108 the route turns in a northern direction and traverse Portions 111 and 70 of the Farm Rietfontein 485 JQ. On Portion 70 the route turns in a western direction and traverses Portions 71, 57, 28, 47, and 27 of the Farm Rietfontein 485 JQ, Portions 3 and the Remaining Extent of the Farm Uitval 484 JQ, and Portions 38, 37, 35, 34, 51 and 30 of the Farm Zilkaatsnek 439 JQ. On Portion 30 the route turns in a north western direction and traverses Portions 127, 29, 52, 53, 159, 160, 134 and 108 of the Farm Zilkaatsnek 439 JQ. On Portion 108 the route turns on a northern direction and runs in close proximity to the western boundary of Portion 108 from where it traverses Portion 14 of the Farm Zilkaatsnek 439 JQ. From here the route traverses Portion 0 (or the Remaining Extent) of the Farm Elandsfontein 440 JQ. From here the route turns in a north eastern direction and traverses Portion 52 of the Farm Elandsfontein 440 JQ. From here the route continues in a north eastern direction and traverse Portions 707, 0, 626, 163, 164, 165, 166, 167, 168, 169, 568, 860, and 814 of the Farm Roodekopjes of Zwartkopjes 427 JQ. On Portion 814 the route turns into an eastern direction where it traverse Portion 843 of the Farm Roodekopjes of Zwartkopjes 427 JQ. The route terminates on Portion 843 of the Farm Roodekopjes of Zwartkopjes 427 JQ where the Dinaledi Substation is located. The Western Route Alternative is located within the North West Province and the Madibeng Local Municipal area. A total of 49 properties are currently directly affected by this proposed route alternative. As mentioned previously, the property of the Xsrata Eland Platinum Mine is located between the Eastern and Western route alternatives. During the Eskom route selection process, one deviation was made to the Eastern Route to accommodate the Eland Platinum Mine, and two of the three deviations to the Western Route alternative were made to accommodate the Eland Platinum Mine. These deviations were created in order to avoid mining areas and to provide the mine with various options on how the route could traverse their property should the routes not interfere with already approved future mine expansions and to avoid traversing of surfaces earmarked for future open cast mining. The third deviation made to the Western Alternative was created as this deviation follows existing roads and powerline infrastructure. The deviations to the Western Route Alternative are discussed below.

5. Western Route Alternative – Deviation 1 (Western Deviation)

This deviation originates on Portion 104 of the Farm Zilkaatsnek 439 JQ from where it links from the Western Route Alternative Deviation 3 (Southern Deviation). From the point of origin, the route runs in a north western direction and traverses Portions 93, 92, 91, 90, 105, 106, 107and 85 of the Farm Hartbeesfontein 445 JQ. From here the route traverses the suburb of Madibeng where it traverses Erf 2. From here the route traverses Portions 207, 60, 97, and 96 of the Farm Hartebeesfontein 445 JQ. On Portion 96 the route turns in an eastern direction and traverses Portion 137 of the Farm Hartebeesfontein 445 JQ. On Portion 137 the route turn in a north eastern direction and traverses Portions 101, 184, 176, 175, 174, 191, 100, and 46 of the Farm De Kroon 444 JQ. On Portion 46 the route turns in a north western direction and traverses Portions 231, 173, 52, 51, 122, and 121 of the Farm De Kroon 444 JQ, and Portion 81 of the Farm Elandsfontein 440 JQ. On the northern boundary of Portion 81 the route turn further in a north eastern direction and traverses Portions 2, 24, 10, 64 and 0 of the Farm Elandsfontein 440 JQ. This deviation terminates on Portion 0 of the Farm Elandsfontein 440 JQ where it joins the original Western Route Alternative. The Western Route Alternative – Deviation 1 (Western Deviation) is located within the North West Province and the Madibeng Local Municipal area. A total of 35 properties are currently directly affected by this proposed route alternative.

6. Western Route Alternative – Deviation 2 (Eastern Deviation)

This deviation originates on Portion 14 of the Farm Zilkaatsnek 439 JQ where it links from the original Western Route Alternative. From here the route runs in an eastern direction and traverses a very small section of Portion 0 (or Remaining Extent) of the Farm Elandsfontein 440 JQ. On Portion 0 the route turns back to traverse Portion 14 of the Farm Zilkaatsnek 439 JQ and continues in an eastern direction to traverse Portions 113, 86, 88, 89, 87, 80 and 98 of the Farm Zilkaatsnek 439 JQ. On Portion 98 the route turns in a north eastern direction where it intersects with the original Eastern Route alignment on Portion 13 of the Farm Schietfontein 437 JQ and where it joins the Eastern Route Deviation on Portion 13 of the Farm Schietfontein 347 JQ. The Western Route Alternative – Deviation 2 (Eastern Deviation) is located within the North West Province and the Madibeng Local Municipal area. A total of 11 properties are currently directly affected by this proposed route alternative.

7. Western Route Alternative – Deviation 3 (Southern Deviation)

This deviation originates on Portion 70 of the Farm Rietfontein 485 JQ where it links from the original

Western Route Alternative. From here the route turns in a western direction and traverse Portions 71, 186, 185, 28, 47, and 27 of the Farm Rietfontein 485 JQ and Portions 3 and Portion 0 (Remaining Extent) of the Farm Uitval 484 JQ. From here the route traverses Portions 2, 127 and 105 of the Farm Zilkaatsnek 439 JQ. On Portion 105 the route turns in a north western direction and runs in close proximity to the boundary of Portion 104 of the Farm Zilkaatsnek 439 JQ. On Portion 104 the route turns in a northern direction where it intersects with the original Western Route Alternative on Portion 108 of the Farm Zilkaatsnek 439 JQ. The route then turns in a north eastern direction where it joins

the original Western Route Alternative on Portion 108 of the Farm Zilkaatsnek 439 JQ. The Western Route Alternative – Deviation 3 (Southern Deviation) is located within the North West Province and the Madibeng Local Municipal area. A total of 14 properties are currently directly affected by this proposed route alternative.

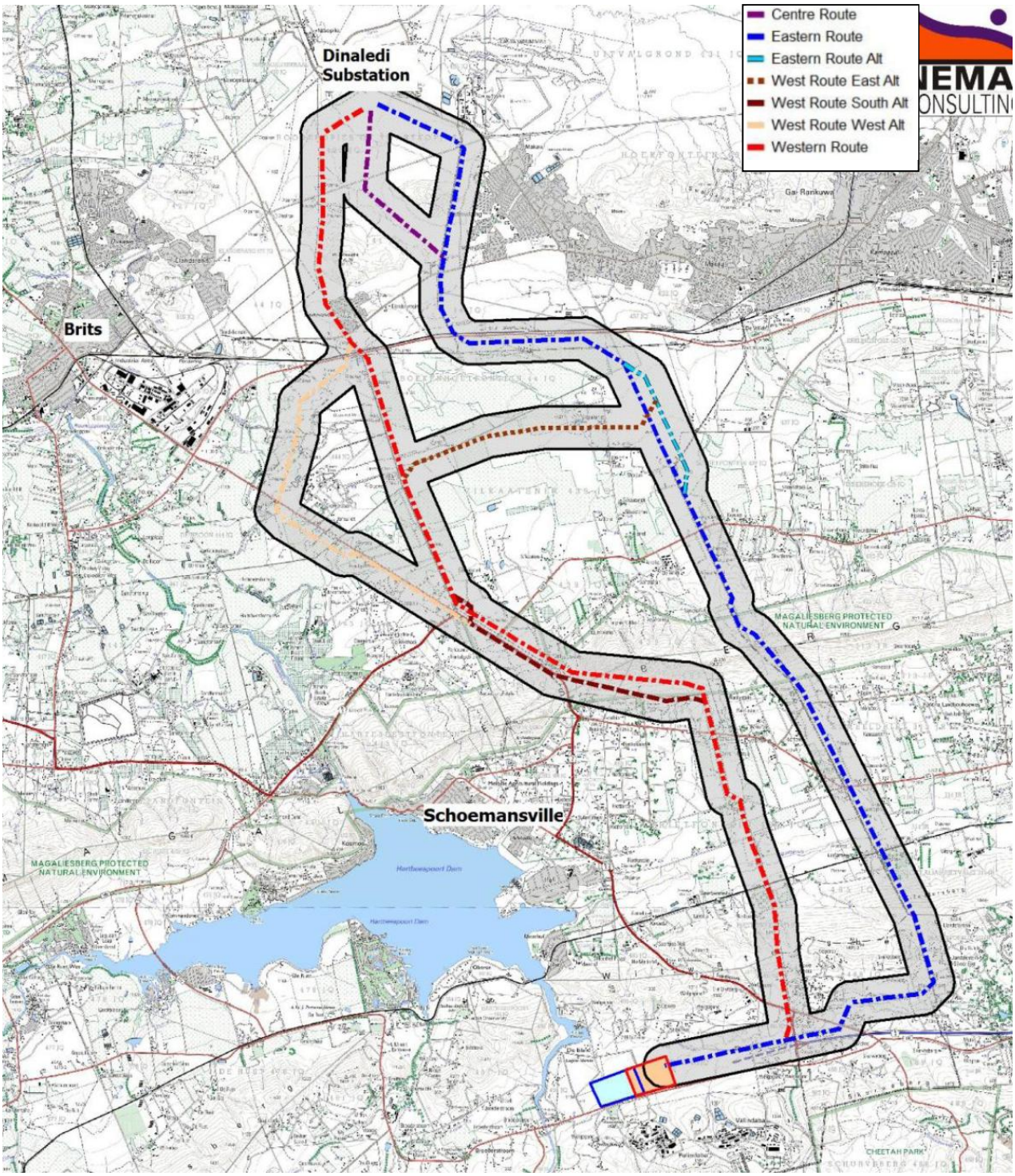

Figure 2. Location of the study area.

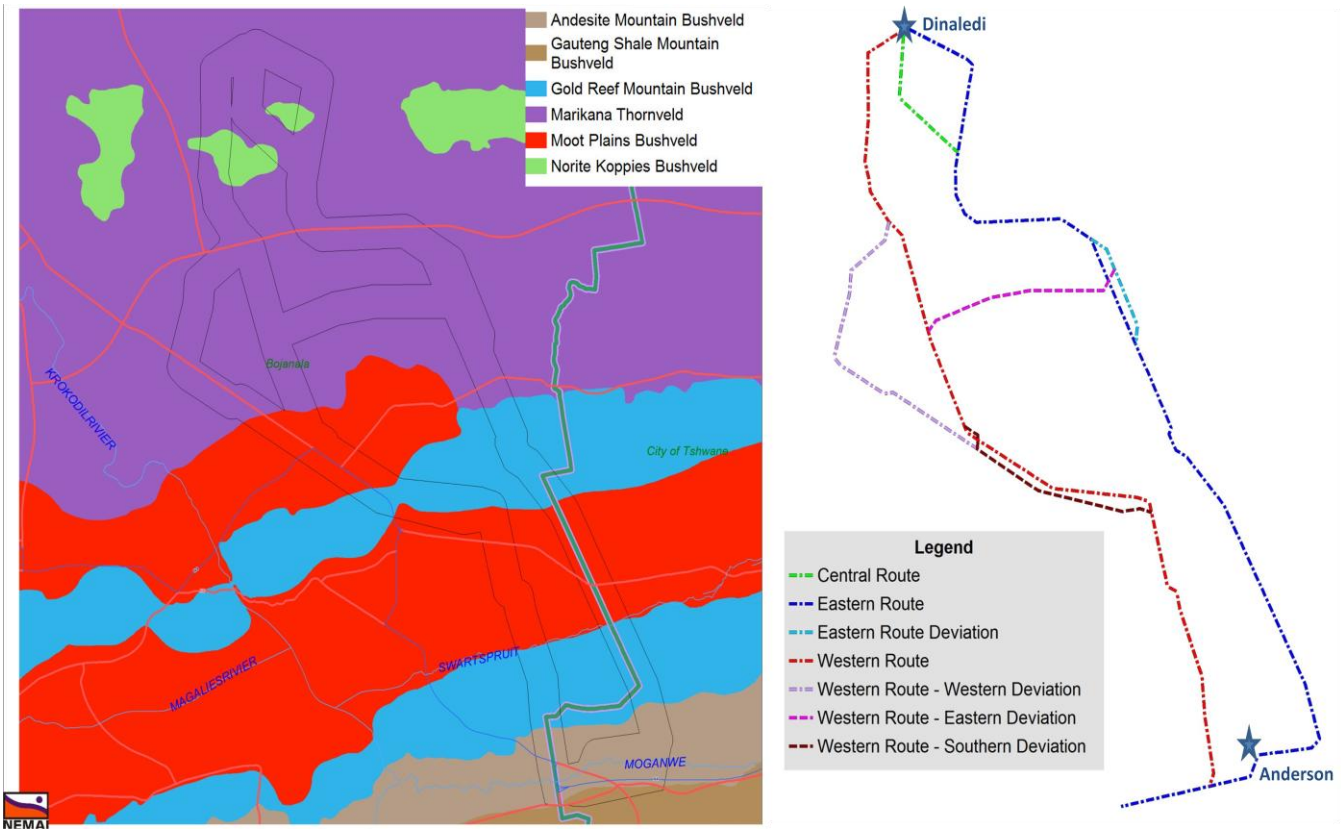

Figure 3. Location of the study area indicating alternative routes and the vegetation units and rivers that they will traverse.

Duration of survey: The site was visited on the 24th of August 2012 by Vincent van der Merwe and Clayton Cook. Follow up site visits were carried out on the 8th, 9th and 10th of September by Vincent van der Merwe. The purpose of the site visit was to become acquainted with the development area and to investigate the possibility of invertebrate species of conservation concern occurring on the site. The initial site visit took place before the first spring rains when invertebrate activity is greatly reduced. Transect sweepnetting was carried out and pitfall traps where put out at three site along the proposed alternative routes. Ten traps were put out 200m to the east of the the R104 as it crosses the Witwatersberg, 200m to the east of the R511 as it crosses Zilkaatsnek and adjacent to a Norite koppies close to Damonsville.

Conditions during survey: Conditions for invertebrate survey were sub-optimal during the initial site visit. Although it was sunny with minimum cloud cover, temperatures did not exceed 24°C. Follow up site visits were carried out after the first spring rains and invertebrate activity was considerably higher. Temperatures nevertheless remained below 25°C.

Topography & Climate: All proposed alternatives for the transmission line will traverse both the Witwatersberg and Magaliesberg mountain range. All proposed alternative transmission line routes traverse areas in close vicinity of the Norite koppies located just south of the existing Dinaledi substation. The general area receives rainfall mainly in the form of rainstorms, with an average of 650 mm annually. Frost occurs frequently in winter.

Vegetation

All alternative routes for the proposed transmission lines will traverse six different vegetation types summarised in Table 1. and indicated in Figure 3. The invertebrate species of conservation concern known to occur in each of these vegetation types are indicated in Table 1. The northern areas of all proposed routes (i.e. those in close vicinity of the existing Dinaledi substation) will transverse Marikana Thornveld. This vegetation type that has been heavily transformed by mining activities in North West Province and has been classified as endangered. Most of the Marikana Thornveld traversed by all alternatives for the proposed transmission lines has been degraded by mining and the construction of infrastructure closely associated with mining (e.g. residential areas for miners). Some less disturbed Marikana Thornveld is however present in close vicinity to the existing Dinaledi substation. As indicated by the sensitivity map (Figure 10.), this area can be considered as having high conservation value. However, even more natural portions of Marikana Thornveld have been impacted by the chopping down of trees for firewood, grass harvesting and the dumping of waste materials.

The only vegetation type that remains largely in a natural condition on the site the Gold Reef Mountain Bushveld. The steep slopes and rocky nature of the Magaliesberg and Witwatersberg, on which this vegetation is found, have posed major challenges to development and therefore remain in a largely natural condition. This unit constitutes suitable habitat for four invertebrates of conservation concern. The more natural condition of this unit implies that invertebrates of conservation concern are more likely to be present here than in any of the other five vegetation units that the alternative routes will transverse. Much of the collecting effort focused on portions of the Magaliesberg and Witwatersberg that will be traversed by alternative routes for the proposed transmission line.

Figure 4. Some relatively natural Marikana Thornveld (left) remains around the Norite Koppies in the vicinity of the existing Dinaledi substation. Much of the Gold Reef Mountain Bushveld that is traversed by the alternative routes remains in a natural condition on both the Magaliesberg and Witwatersberg mountain ranges.

A small portion of Andesite Mountain Bushveld is located in the vicinity of the proposed Anderson substation. This vegetation unit constitutes suitable habitat to four invertebrate species of conservation concern indicated in Table 1. It has however been completely transformed by a variety

of anthropogenic activities and only very small fragments of natural vegetation remain. No invertebrates of conservation concern were observed in this unit and their presence is unlikely.

Although no Gauteng Shale Mountain Bushveld will be traversed by the alternative routes for the proposed transmission line, a small area of this vegetation type is located within the 1km corridor of the transmission line in the vicinity of the proposed Anderson substation. Although this small area has been largely transformed, a small area of natural Gauteng Shale Mountain bushveld remains immediately south east of the proposed Anderson substation. Moot Plains Bushveld is the most degraded vegetation unit that the alternative routes for the proposed transmission line will traverse. This unit has been almost completely transformed by agricultural activities. The presence of invertebrate species of conservation concern in this unit is highly unlikely.

Figure 5. Moot Plains Bushveld traversed by the alternative routes has been completely transformed by agricultural activities (right). Much of the Marikana Bushveld to be traversed by the alternative routes has been transformed by mining activities (left).

The Norite Koppies located near to the existing Dinaledi substation and those close to Mathutlung have been heavily impacted by granite mining. Those located immediately north of Damonsville are in a more natural condition. *Hadogenes gunningi*, a known Gauteng endemic, was not observed in these rocky outcrops. *Hadogenes gracilis*, a closely related species, was however observed. The time of sampling however took place outside of the flight period of *Acraea machequena*, a butterfly of conservation concern known to frequent Norite Koppies.

Figure 6. Large areas between Damonsville, Mathutlung and the existing Dinaledi substation are dominated by Norite Koppies. Some of these koppies remain in a largely natural condition (left) whilst others have been heavily impacted by granite mining (right).

Table 1. Vegetation types that will be transverse by all alternative routes for the proposed transmission line.

Vegetation type	Associated Landscape Character	Conservation status	Potential invertebrates of conservation concern	Environmental status along the alternative routes for proposed transmission line
Andesite Mountain Bushveld	Undulating landscape with hills and valleys.	Least threatened	*Lepidochrysops praeterita, Lepidochrysops hypopolia, Platylesches dolomitica, Spialia paula*	<5% natural. Almost completely transformed and highly degraded
Gauteng Shale Mountain Bushveld	Low broken ridges varying in steepness with high surface rock	Vulnerable	*Ichnestoma stobbiai*	Small proportion of development area. <10% natural. Degraded but some natural vegetation remains
Gold Reef Mountain Bushveld	Rocky hills and ridges often west east trending.	Least threatened	*Spialia paula, Ichnestoma stobbiai, Trichocephala brincki*, *Hadogenes gunningi*	Approx 70% natural. Largely undistustbed
Marikana Thornveld	Valleys and slightly undulating plains with some low hills.	Endangered	-	Approx 10% natural. Remaining portions completely transformed
Moot Plains Bushveld	Plains and some low hills.	Vulnerable	*Spialia paula*	<5% natural. Highly degraded
Norite Koppies Bushveld	Plains, koppies and noritic outcrops.	Least threatened	*Acraea machequena*	Approx 50% natural. Some areas heavily impacted by granite mining.

Figure 7. Large scale harvesting of wood and grass (top) and the dumping of building rubble (bottom right) have degraded some of the relatively natural Marikana Thornveld in the vicinity of Damonsville, Mathutlung and the existing Dinaledi substation. Granite mining is a thriving commercial activity (bottom left) on the Norite koppies close to Mathutlung.

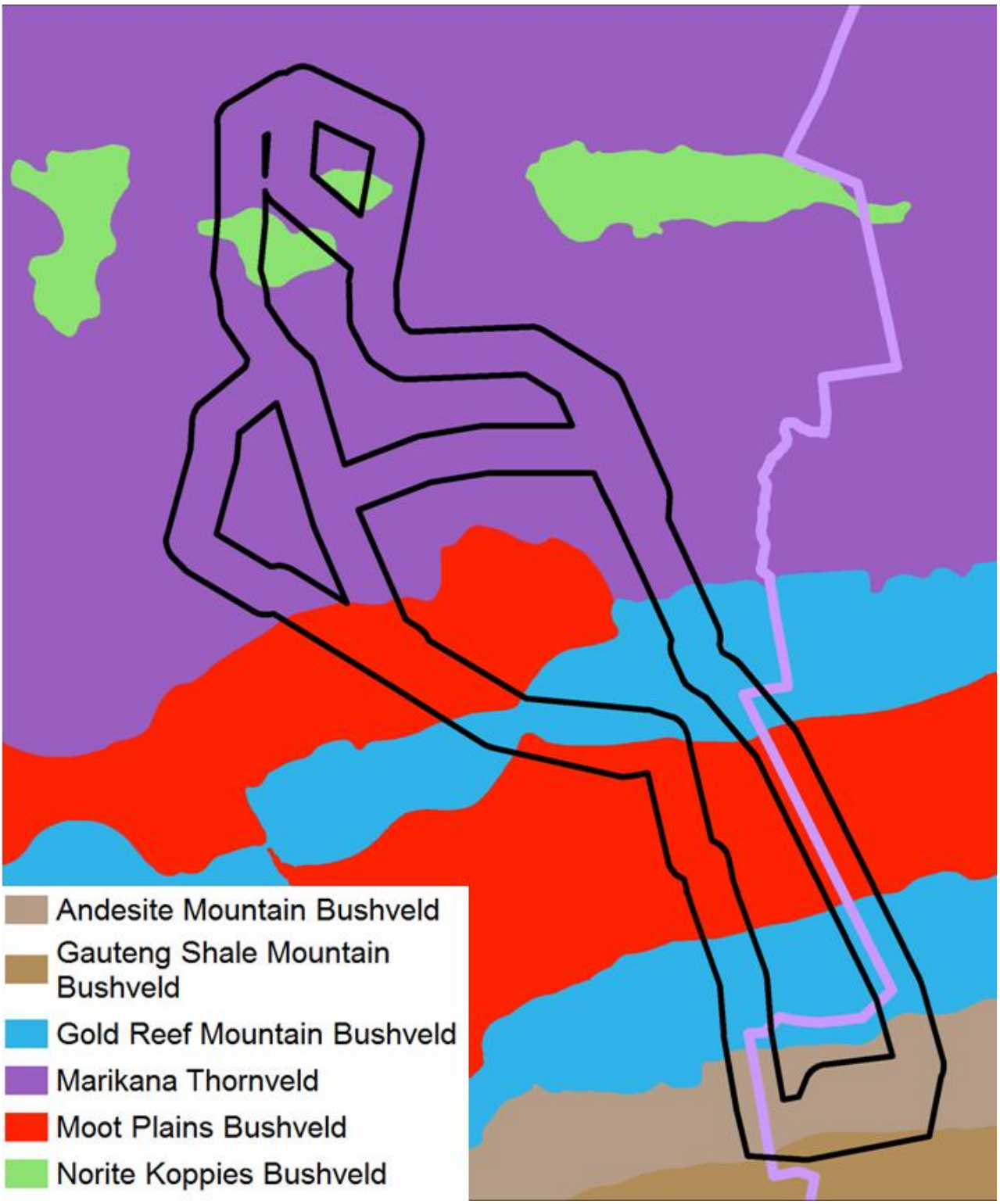

Figure 8. Map indicating vegetation units that will be traversed by the various alternative routes for the proposed powerline. All alternative routes proposed will traverse both Gauteng and North West Provinces.

MATERIALS & METHODS

Invertebrates were sampled using active and passive methods. Active methods entail collection by an individual using various kinds of equipment, while passive methods involve specialised types of traps at specific sites in the field, which are visited at given time intervals.

Passive collection

Pitfall traps

Ten pitfall traps were placed ten meters apart, in a single transect about 200m to the east of the R104 as it crosses the Witwatersberg, 200m to the east of the R511 as it crosses Zilkaatsnek and adjacent to a Norite koppies close to Damonsville. The pitfall traps were baited with rotting fruit as well as pig dung. The plastic buckets used for traps had a 1000 mL capacity and were 11 cm in diameter and 12 cm deep. All the traps were sunk into the ground so that the buckets' rims were level with the soil surface. Buckets were filled to about one fifth their volumes with a solution of liquid soap and water to immobilise trapped invertebrates. Trap contents were collected 24 hours after the traps had been set. Only insects and arachnids were collected from the traps. Specimens of interest were preserved in absolute ethanol and transported to the laboratory for identification. Morphospecies were identified to order level and family level where possible.

Figure 9. Pit fall traps are not an ideal method for collecting any of the invertebrates of conservation concern known to occur in the vicinity of the alternative routes. They were nevertheless placed in habitat most likely to contain populations of *Ichnestoma stobbiai*. Few invertebrates were caught during the initial site visit. Traps were flooded with water after heavy rains in subsequent site visits.

Active collection

Sweepnetting

Transect sweepnetting was carried out on the 25th of August as well as the 8th and 9th of September 2012. An insect net with a diameter of 40 cm were used for collecting insects and arachnids. At least three transects were swept in all vegetation units and for the sake of standardisation, 20 sweeps of 180° constituted one transect (and thus one sample). Less disturbed areas of each vegetation unit were swept. Where necessary, insects and arachnids from the samples were preserved in absolute ethanol and transported to the laboratory for identification. Morphospecies were identified to order level and family level where possible.

Beating

This method of collecting was not employed as it is unlikely that this method will retrieve any invertebrates of conservation concern known to occur in the vicinity of the site.

Physical searches

Physical ground and rock searches were undertaken in order to identify arachnids, scorpions and various insects which take refuge underground in burrows or under rocks. The scorpions species *Hadogenes gracilis* and *Uroplectes triangulifer* were observed along the alternative routes using these techniques.

Data recorded and red data species

A list of all identifiable insects and arachnids caught or seen on the site was compiled and is included in the report.

A list of invertebrate species of conservation concern that are known to occur in the vicinity of all alternative routes is included in Appendix A.

Data processing

The conservation priority of each vegetation unit was determined by evaluating:

1. The general condition of the vegetation unit
    a. How much natural vegetation remains
    b. The degree to which the it has been degraded by human activities or invasion by exotic species
2. The invertebrate species composition of the unit
    a. General species diversity
    b. Presence of species of conservation concern
3. The conservation status of the vegetation type in North West Province.

Based on these criteria a sensitivity map was produced and is included in the recommendations section.

INVERTEBRATE DIVERSITY RECORDED ALONG THE ALTERNATIVE ROUTES FOR THE PROPOSED ANDERSON-DINALEDI TRANSMISSION LINE

Observations of invertebrate (classes Insecta and Arachnida) activity were relatively infrequent during the initial site visit. An increase in activity was clearly evident following the first spring rains. Data for those that were seen active on the surface or sampled by any of the collecting methods utilised are listed in Tables 1 and 2. A large number of insects representing 63 families and 15 orders were recorded during the survey period. Representatives from nine Arachnid families were collected or observed. All invertebrates sampled were stored in absolute ethanol and positively identified to family (or subfamily) level in the laboratory. When a particular specimen was found to belong to a family that contained invertebrates of conservation concern known to occur in the vicinity of the site, then further identification to genus or species level was carried out.

Table 2. Insects that were observed or collected on the site of the proposed development.

Order	Family	Collecting method
Thysanura	Lepismatidae	Lifting rocks
Ephemeroptera	Leptophlebiidae	Observed
Odonata	Gomphidae	Sweepnetting
	Aeshnidae	Observed
	Libellulidae	Sweepnetting
Blattodea	Blattellidae	Lifting rocks
Isoptera	Termitidae: Macrotermitinae	Observed
	Nasutitermitinae	Observed
	Hodotermitiidae	Observed
Mantodea	Mantidae	Sweepnetting
	Thespidae	Sweepnetting
Dermaptera	Labiduridae	Lifting rocks
Orthoptera	Gryllidae	Observed
	Pyrgomorphidae	Observed
	Acrididae	Observed
	Pamphagidae	Sweepnetting
Phasmatodea	Bacillidae	Sweepnetting
Hemiptera	Pentatomidae	Active search
	Reduviidae	Observed
	Coreidae	Active search
	Lygaeidae	Sweepnetting
	Gerridae	Observed
	Cercopidae	Sweepnetting
	Cicadellidae	Sweepnetting

	Aphidae	Observed
Neuroptera	Myrmeliontidae	Sweepnetting
	Chrysopidae	Sweepnetting
Coleoptera	Scarabaeidae: Scarabaeinae	Active search
	Cetoniinae: *Leucocelis*, *Pachnoda*	
	Tenebrionidae	Active search
	Coccinellidae (larval / adult stage)	Active search
	Cerambycidae	Observed
	Chrysomelidae	Sweepnetting
	Carabidae	Observed
	Dytiscidae	Observed
	Histeridae	Active search
	Trogidae	Active search
	Lycidae	Sweepnetting
	Bostrichidae	Sweepnetting
	Melyridae	Sweepnetting
	Meloidae	Sweetnetting
	Curculionidae	Sweepnetting
Diptera	Tipulidae	Sweepnetting & observed
	Muscidae	Sweepnetting
	Calliphoridae	Sweepnetting
	Tabanidae	Observed
Lepidoptera	Psychidae	Active search
	Noctuidae	Observed
	Crambidae	Sweepnetting
	Alucitidae	Sweepnetting
	Geometridae	Sweepnetting
	Saturniidae	Sweepnetting
	Hesperiidae	Sweepnetting
	Nymphalidae: *Danaus,*	Sweepnetting
	Papilionidae: *Papilio*	Sweepnetting
	Pieridae: *Colotis, Eurema, Junonia, Cynthia*	Sweepnetting
Hymenoptera	Vespidae	Sweepnetting
	Ichneumonidae	Sweepnetting
	Mutillidae	Observed
	Pompilidae	Observed
	Apidae	Sweepnetting
	Formicidae	Observed

Table 3. Arachnids that were collected during the survey on the site of the proposed development.

Order	Family	Collecting method
Araneae	Araneidae	Observed
	Pholicidae	Observed
	Lycosidae	Sweepnetting
	Thomsidae	Sweepnetting
	Salticidae	Observed
Scorpiones	Buthidae: *Hadogenes gracilis*	Active search
	Liochelidae	Active search

DISCUSSION

It is usually not feasible to sample invertebrate diversity adequately over a relatively short period of time or during the drier and colder winter months. Such conditions are characterised by a general absence of adult insects. Maximum insect activity is correlated with the onset of the rainy season. Many organisms respond rapidly to rainfall events to complete parts of their life cycle, such as the synchronised mass emergence of secondary reproductives in termites (Isoptera). Furthermore, millipedes (Diplopoda) have a limited tolerance of extended dry periods, leading to a periodicity in their surface activity. Adults aestivate through the dry season and emerge in response to significant rainfall events to remain surface active for several days thereafter. Spider abundance generally follows this same pattern, with maximum activity reached during the wet (summer) season.

The initial site visit was carried out a week before the first spring rains. Consequent site visits were carried out just after these rains and invertebrate activity was observed to be considerably higher. Different species emerge at different times of a season, often depending on the weather. Thus, increased invertebrate abundance (and subsequently increased probabilities of them being collected) is dependent on favourable climatic conditions.

Most sampling devices or techniques target only a single stage of the life cycle. The adult stages of most invertebrates are usually more conspicuous and easier to collect than when individuals are present in egg, juvenile (nymphal or larval), pupal or sub-adult stages. However, some adult insects live for a very limited time and when emergence of a population is synchronised; adults may only be present in the field for a week or less. *Ichnestoma stobbiai,* a Cetonid species of conservation concern known to occur in the vicinity of the alternative routes, is a good example of a species that emerges for a very short period of time. Due to time constraints, certain sampling methods were not employed. One such method is light trapping, thus excluding various nocturnal species from being identified by the collection effort.

It is preferable to identify specimens to the species level, because for nearly all objectives it is better to have specific information on carefully chosen groups than family-level information on many.

However, securing reliable identification to the species-level is the greatest single difficulty in invertebrate biodiversity. Except in some of the best known groups, expert knowledge is required to ensure that identifications are accurate. Such expertise is often both extremely limited and in great demand for a great many activities.

Invertebrate species of conservation concern known to occur in the vicinity of the site

Records indicate that a six Red Data lepidopteran species of conservation concern are known to occur in the vicinity of the alternative routes for the proposed transmission line, namely *Spialia paula*, *Metisella meninx*, *Acraea machequena*, *Lepidochrysops hypopolia*, *Lepidochrysops praeterita* and *Platylesches dolomitica*. Two cetonid beetles of conservation concern are known to occur in the area, namely *Ichnestoma stobbiai* and *Trichocephala brincki*. *Hadogenes gunningi*, formerly listed as a scorpion species of conservation concern is also known to occur in the vicinity of the site.

Spialia paula, commonly know as the Mite Sandman, is a small butterly that is primarily brown with white spots on the dorsal side of its wings. It is rare and localised across it distribution range that streches from the extreme western part of the Northern Cape all the way through to central Limpopo. It frequently flatlands, hillsides and hilltops from August through to April but is observed most frequently from August to October. It favours patches of stony ground with low vegetation as observed on much of the recommended substation site. This species was not observed despite there being much suitable habitat on the site (Andesite Mountain Bushveld and Gold Reef Mountain Bushveld) and despite the survey being conducted during its peak flight period. Due to the sheer scale of the study area, there is a strong possibility that this butterly is present on the site.

Localized populations of *Metisella meninx* (Figure 3.1), commonly known as the Marsh Sylph butterfly are found in vleis throughout higher lying areas of North West province. This species is also known to occur in Gauteng, Mpumulanga (Amsterdam), KwaZulu-Natal (Newcastle) and the Free State (Sasolburg). Much of its habitat has been destroyed by urban development. Its larval foodplant *Leersia hexandra* (Rice Grass) is easily recognizable due to the presence of white hairs at its nodes. *Leersia hexandra* grows only around permanent sources of water. Despite the presence of many such features on the site, *Metisella meninx* was not observed.

Acraea machequena, commonly known as the Machequena Acraea is a relatively large butterfly that has been recorded in Zimbabwe, Mozambique, Malawi, south-eastern Tanzania, savanna areas of Limpopo and North West Provinces and lowland forest of northern KwaZulu-Natal. Large populations have been recorded to the north of the Soutpansberg. The wingspan is 48 to 55 mm for males and 50 to 56 mm for females. Adults are on wing in late summer and autumn in South Africa and year round in the rest of the range. This species is considered to of conservation concern in Limpopo, North West and KwaZulu-Natal. In North West Province it has been observed in Norite Koppies Bushveld, a vegetation type that is prevalent in the vicinity of the existing Dinaledi substation. The survey did not take place during the flight period of this species and further surveys are recommended in late summer to confidently establish it absence from the site.

Lepidochrysops hypopolia is only known from two complete specimens caught near Ladysmith (KwaZulu-Natal) and a partial specimen caught near Potchefstroom. Commonly known as Morant's Blue, this species has not been observed since 1879 and is now thought to be extinct. Proposed habitats for this butterfly are KwaZulu-Natal Highland Thornveld (Sub-Escarpment Grassland Bioregion) and Carletonville Dolomite Grassland (Dry Highveld Grassland Bioregion) in the Grassland Biome Unit. Its flight period is unknown although is most likely similar to that of its probable sister species, *Lepidochrysops praeterita* (early September to November). No specimens of this species were observed along the alternative routes and it presence is highly unlikely as much of the Andesite Mountain Bushveld on the site has been transformed.

Lepidochrysops praeterita, commonly known as the Highveld Blue, is rare and localized on highveld grassland between Potchefstroom in North West Province, Sasolburg in the Free State Province and Walkerville in Gauteng Province. This butterfly frequents hillsides on which *Becium grandiflorum* grows, flying fast and close to the ground from September to November. No specimens of this species were observed and it presence is highly unlikely as much of the Andesite Mountain Bushveld on the site has been transformed.

Platylesches dolomitica, commonly known as the Hilltop Hopper, is a butterfly that is only known from dolomite ridges near Steelpoort in Mpumulanga, Horn's Nek near Pretoria and Carletonville in Gauteng. The wingspan is 32–35 mm for males and 33–37 mm for females. Adults are on wing from August to September. The larvae of this species are thought to feed on the shrub *Parinari capensis*, commonly known as the Dwarf Mobola Plum. This foodplant was present on dolomite ridges along the proposed route however no specimens of *Platylesches dolomitica* were observed during the survey.

Ichnestoma stobbiai is a cetonid beetle that emerges in adult form for only 5 days of the year after the first spring rains. This species is a near Gauteng endemic with only one population found in the Magaliesberg region of North West province. Although in Gauteng, a large population is known from Horn's Nek which is relatively close to the recommended site for the proposed Anderson substation. Approximately 15mm of rain is considered sufficient to stimulate adults to emerge from the soil and start reproducing. The survey overlapped precisely with the flight period of this species although no specimens were observed.

Trichocephala brincki is the only representative of its genus in Southern Africa and is easily recognised by its small size and yellow, shiny, raised elytral costae. The biology of this cetonid is poorly known. Females are extremely rare and fly low between grasses. Males can be found in great numbers hovering between grass tussocks on mountains or hills. The flight period for this species is from October to December. Much suitable habitat is available for this species along the alternative routes and follow up survey are recommended in early summer to confidently establish the absence.

Hadogenes gunningi is a rare rock scorpion that has only been recorded in rocky outcrops and ridge areas in Gauteng. It has a unique flattened body shape adapted to living in these habitats. Although this species is considered a Gauteng endemic, specimens have been collected in close vicinity to the

site. A concerted effort was made to locate this species in rocky habitat present in three vegetation types on the site, namely Gold Reef Mountain Bushveld, Norite Koppies Bushveld and Marikana Thornveld. *Hadogenes gracilis* was located in Norite koppies close to Damonsville however no specimens of *Hadogenes gunningi* were found.

Figure 10. Six butterflies, two beetles and three scorpions of conservation concern are known to occur in the vicinity of the alternative routes for the proposed transmission line. Butterfly species include 1. *Spialia paula*, 2. *Metisella meninx*, 3. *Acraea machequena*, 4. *Lepidochrysops praeterita*, 5. *Platylesches dolomitica* and *Lepidochrysops hypopolia* (not observed since 1879). Two cetonid beetles of conservation concern recorded to occur in the vicinity of the site include 6. *Ichnestoma stobbiai* and 7. *Trichocephala brincki.* The only rare scorpion known to occur in the vicinity of the site is 8. *Hadogenes gunningi.*

RECOMMENDATIONS

Mid and late summer surveys are recommended to firmly establish the absence of *Acraea machequena*, *Lepidochrysops praeterita* and *Trichocephala brincki* from the site. These recommendations are important because the alternative routes for the proposed transmission line will traverse a number of threatened and sensitive habitats. Uncontrolled development in or around these habitats is expected to impact significantly on their associated Red Data species, populations, assemblages or communities. These sensitive habitats include river systems, seasonal wetlands, rocky ridges, relatively natural Marikana Thornveld and Norite koppies. They are indicated in the below sensitivity map for the alternative routes for the proposed transmission line.

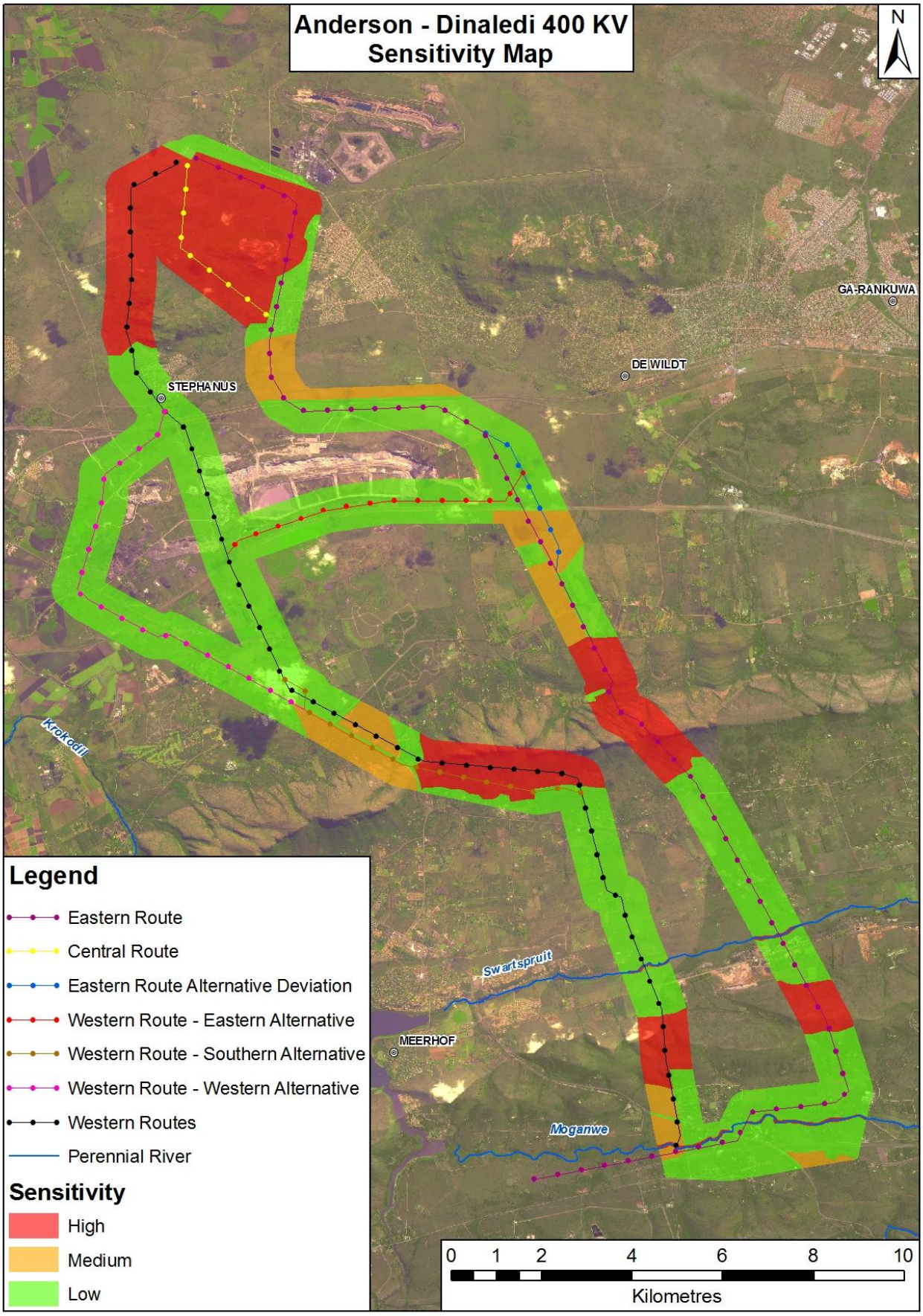

Figure 11. Sensitivity map for the alternative routes for the proposed transmission line.

Recommended route

It is recommended that the transmission line follow the western route. The possible southern, eastern or western deviations do not need to be followed. The main reason for the recommendation is that this route has been most impacted by anthropogenic activities. The establishment of a transmission line along a route heavily impacted by the development of roads and existing powerlines will have reduced impact on invertebrate diversity compared to its establishment along a route that has been considerably less impacted by anthropogenic activities. The existing Lomondt De Wildt 88kV line (with a servitude of 22m) that traverses the eastern route will be decommissioned by Eskom in 2014. Relatively natural areas currently traversed by these powerlines could then return to a healthier level of ecosystem functioning with reduced anthropogenic disturbance. It is preferable to have multiple transmission lines following a single route rather than several routes. This makes sense from an environmental and a transmission line maintenance point of view. Environmental disturbance could then be focused in the same areas rather than disturbance along multiple routes. The western route also traverses less natural Marikana Thornveld, the most threatened vegetation type transverse by the alternative routes.

General mitigation measures

Many areas along the proposed route are ecologically degraded and the landowner needs to take steps to remove all the alien invasive plant species and employ further restrictions and control, as specified by CARA Regulations. An ecological management plan must be compiled by a suitably qualified specialist for implementation by the appropriate management authority. This ecological management must include a fire management programme and an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species. Where removal of alien species may leave soil exposed, alternative indigenous species should be established to prevent any erosion. Plants growing naturally on the site must, as far as possible, be retained and incorporated into landscaping. When additional plant species are used for landscaping, special emphasis should be focused on forage and host plants required by herbivores and pollinators present in the area and must otherwise only be limited to those indigenous to South Africa (Refer to Table 2.). The integrity of natural vegetation that falls outside developed areas, such as indigenous grass species and leaf litter, should be preserved, as it provides a habitat, microclimate and food source to various smaller vertebrates and notably invertebrates. Moreover it also provides a habitat to many reptiles and invertebrates, some of which may be endangered and/or protected species. Several of these species may complete their entire life cycles in this specific niche.

Building activities must be restricted and carefully monitored to keep disturbance to a minimum, and must be appropriately rehabilitated and managed. This entails the removal and proper disposal of all rubble and litter previously dumped along the proposed route illegally (considerable dumping was observed in Marikana Thornveld close to Damonsville), as well as all scrap materials, building rubble and rubbish dumped on the route during construction, at official municipal dumping grounds. Dumping of any materials in undeveloped open areas should not be allowed and this must be actively

managed. Construction must preferably take place during the dry season and no temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment or any other use of the buffer/flood zone whatsoever, may be permitted during the construction phase. All construction-related impacts (including service roads) must be contained within the fenced-off development areas" (Phab, 2006).

Table 4. List of plants and shrubs are recommended for butterflies (nectar plants).

Pentas lanceolata and *Pentas lanceolata*
Buddleja salvifolia
Verbena spp.
Asclepias spp.
Bougainvillea spp. (Varieties such as Killie Campbell)
Plumbago auriculata
Impatiens spp.
Kalanchoe spp.
Lobelia species
Limonium spp.
Asystasia gangetica

It is imperative that adequate erosion preventative mechanisms are implemented throughout the construction phase. Erosion resulting from the development should be appropriately rehabilitated preventing further habitat deterioration. Stormwater runoff must be correctly managed during all phases of the development. Special care needs to be taken during the construction phase to prevent surface stormwater containing sediments and other pollutants from entering pans, drainage lines and wetlands. A surface runoff and stormwater management plan must be put in place. The total sealing of walkways, pavements, drive ways and parking lots should not be permitted in the free space system. These should form part of and be contained within the areas earmarked for development. This would aid in the minimising of artificially generated surface stormwater runoff.

The use of insecticides, herbicides and other chemicals should not be permitted within 200m of an open space system. An integrated pest management programme, where the use of chemicals is considered as a last option, should be employed. However, if chemicals are used to clear invasive vegetation and weedy species or for the control of invertebrate pests, species-specific chemicals should be applied and in the recommended dosages. General spraying should be prohibited and the application of chemicals as part of a control programme should not be permitted to take place on windy days.

Outside lighting should be designed to minimize impacts, both directly on especially rare or endangered invertebrate species and indirectly by impacts on populations of prey species. All outside lighting should be directed away from sensitive areas.

Ridges

Much of the Gold Reef Bushveld, Norite Koppies Bushveld and Marikana Thornveld traversed by the alternative routes is rocky in nature and must be subject to as little disturbance as possible. All these units displayed high invertebrate species richness and provide habitat for many indigenous plants, reptiles and invertebrates. Certain invertebrate species complete their entire life cycles in only one crevice of a seemingly lifeless rock formation. Rocky ridges also provide numerous smaller mammals with shelter and may serve as breeding sites for certain raptor species.

Drainage lines

Two perennial river systems (Swartspruit and Moganwe) and number of seasonal drainage lines will be traversed by the proposed powerline. It is imperative that these sensitive habitats are subject to as little disturbance as possible. The proposed powerline will not run parallel to any river systems or powerlines. Both the perennial river systems and the seasonal drainage lines have been heavily invaded by exotic vegetation. An effort should be made to remove these plants in order to return these areas to a healthier level of ecosystem functioning.

All disturbed drainage lines that the proposed route will traverse should be rehabilitated and maintained as important biological corridors or migratory passages. The crossing of natural drainage systems must be minimized and should only be constructed along the shortest possible route, perpendicular to the natural drainage system. Transmission line crossings must span the entire stretch of the flood line or buffer zone (see *Sensitivity Mapping Rules for Biodiversity Assessments* for buffer zone and flood line requirements)" (Phab, 2006).

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Appendix A

Invertebrates of conservation concern possibly occurring on or in the vicinity of the alternative routes for the proposed Anderson-Dinaledi transmission line

Class Insecta

Beetles

Order Coleoptera

Family Scarabaeidae

Subfamily Cetoniinae

Ichnestoma stobbiai

Trichocephala brincki

Butterflies

Order Lepidoptera

Family Nymphalidae

Tribe Acraeini

Acraea machequena

Family Lycaenidae

Subfamily Polyommatinae

Tribe Polyommatini

Lepidochrysops praeterita

Lepidochrysops hypopolia

Family Hesperiidae

Subfamily Hesperiinae

Metisella meninx

Platylesches dolomitica

Class Arachnida

Order Scorpiones

Family Ischnuridae

Hadogenes gunningi