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Biophysical Specialist Study Report for the Bravo 3 Power Line Route Alternatives

Draft Report

This is a report compiled for Zitholele Consulting

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Promoting environmental conservation and sustainable development

...THROUGH RESPONSIBLE CUSTODIANSHIP OF OUR NATURAL RESOURCES

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PURPOSE OF THIS DOCUMENT

In order for the Bravo power station to be integrated within the existing Eskom infrastructure, Eskom propose to construct a new 400 kV power line from the new Bravo Power Station to the existing Lulamisa substation, near Diepsloot. This line will be approximately 100 km in length. The construction of this proposed 400 kV power line is aimed to ensure sufficient electricity supply to the Diepsloot and Johannesburg North areas, where currently frequent electricity shortages are experienced. The alternative Bravo power line corridors are located on the eastern Highveld of Southern Africa. The corridors cover an area from Witbank in the east, to Diepsloot in the west.

As part of the environmental authorisation specialist studies have to be undertaken in order to inform the Environmental Impact Assessment Report (EIR). This report details the findings for Geology, Climate, Surface Water, Topography, Soils, Land Capability, Land Use, Flora, Fauna (especailly avifauna), Wetlands and Visual Impacts.

Zitholele Consulting appointed Cymbian Enviro-Social Consulting Services to undertake the aformentioned specialist studies. The purpose of this document is therefore to present the findings of the aforementioned assessments and to provide management measures to protect sensitive features located on site.

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1.0 INTRODUCTION

1.1 Project background

The growing demand for electricity is placing increasing pressure on Eskom's existing power generation and transmission capacity. Eskom is committed to implementing a Sustainable Energy Strategy that complements the policies and strategies of National Government. Eskom aims to improve the reliability of electricity supply to the country, and in particular to provide for the growth in electricity demand in the Gauteng and Mpumalanga provinces. For this reason, Eskom obtained environmental authorisation to construct the new 400 kV Bravo Power Station between Bronkhorstspruit and Witbank in 2007. Construction of this power station is scheduled to commence in 2008.

The construction and operation of the Bravo Power Station requires not only the construction of the Power Station itself, but also the construction of additional auxiliary structures such as power lines. The Bravo Integration Project spans the provinces of Gauteng and Mpumalanga and will be handled as five individual Environmental Impact Assessments (EIA), namely (Figure 1):

Phase 1: Sol – Camden By-Pass Power Line

The intention of Bravo 1 is to build two 400 kV bypasses lines for Zeus substation, the two 400kV lines from Sol Substation and the two 400 kV power lines from Camden power station will be disconnected from Zeus substation and joined to each other to form two Camden- Sol 400 kV power lines. The location of the two by-pass lines is planned to be within approximately 10 km radius of the Zeus substation. The project is located within the Govan Mbeki District Municipality.

Phase 2: Apollo and Kendal loop in and loop out lines

Eskom propose to construct four new 400 kV overhead power lines, located within the Emalahleni Local Municipality in Mpumalanga, to loop in and out of Bravo Power Station. The existing Kendal-Apollo line will be looped in and out of Bravo to form the Bravo-Apollo and Bravo-Kendal lines. In addition, the existing Duvha-Minerva 400 kV overhead power line will be looped in and out of Bravo Power Station, to form the Bravo-Duvha and Bravo-Minerva lines. The study area in which the alternatives were selected is within the 10 km radius surrounding the new Bravo Power Station and each of the alternative 400 kV power lines will be not exceed 10 km in length.

Phase 3: Construction of a 400 kV power line from Bravo Power Station to Lulamisa Substation

In order for the Bravo power station to be integrated within the existing Eskom infrastructure, Eskom propose to construct a new 400kV power line from the new Bravo Power Station to the existing Lulamisa substation, near Diepsloot. This line will be approximately 100 km in length. The construction of this proposed 400 kV power line is aimed to ensure sufficient electricity supply to the Diepsloot and Johannesburg North areas, where currently frequent electricity shortages are experienced. The alternative Bravo power line corridors are located on the eastern Highveld of Southern Africa. The corridors cover an area from Witbank in the east, to Diepsloot in the west. **This report details the biophysical findings for the Bravo 3 project**.

Phase 4: Two new 90 km Kendal –Zeus 400 kV Power Lines

Eskom propose to construct two new 400 kV power lines, one from Bravo to Zeus and the other one from the Kendal Power Station (near Ogies) to the Zeus substation (near Secunda), Mpumalanga. These lines will run parallel to each other and will be approximately 90 km in length. The three alternative route corridors will be 5 km wide. These three alternative corridors merge into two corridors approximately 30 km from the Zeus substation.

Phase 5: New 10 km Bravo-Vulcan Power Line

Eskom propose to construct a 400 kV overhead power line, by-passing the existing Duvha substation, to form a new Bravo-Vulcan line near Middelburg, Mpumalanga. This by-pass line is planned to be approximately 10 km in length. The area to be investigated for this by-pass line is a 10 km radius surrounding the existing Duvha substation.

Eskom Transmission has appointed Zitholele Consulting (Pty) Ltd, an independent company, to conduct an EIA to evaluate the potential environmental and social impacts of the proposed project. Zitholele Consulting has in turn appointed Cymbian Enviro-Social Consulting Services to undertake the bio-physical specialist studies required, including:

- Vegetation Assessment;
- Soil and Land Capability Assessment; and
- Wetland Delineation.
- Geology
- Visual
- Avifauna

Additional to the abovementioned assessments, all fauna observed were noted. These were noted to further inform the occurrence of sensitive species.

1.2 Regional setting and project locality

The Bravo Integration Project will span the provinces of Gauteng and Mpumalanga, stretching from Secunda, Ogies and Middelburg in Mpumalanga, to Bronkhorstspruit, Midrand and Kayalami in Gauteng. Refer to Figure 1 for a locality map for the entire Bravo Integration Project.

This report details the biophysical assessments undertaken for the Bravo 3 study area. The Bravo 3 site is located half way between Bronkhorstspruit and Witbank just east of the Bravo Power Station site. This study area will include 3 route alternatives connecting the Bravo Power Station to the existing grid as shown in Figure 2.

1.3 Study scope

As part of the environmental authorisation process for the aforementioned project it is required for the Environmental Impact Assessment Process that certain biophysical specialist studies be undertaken. Zitholele Consulting appointed Cymbian Enviro-Social Consulting Services to undertake the following biophysical specialist studies:

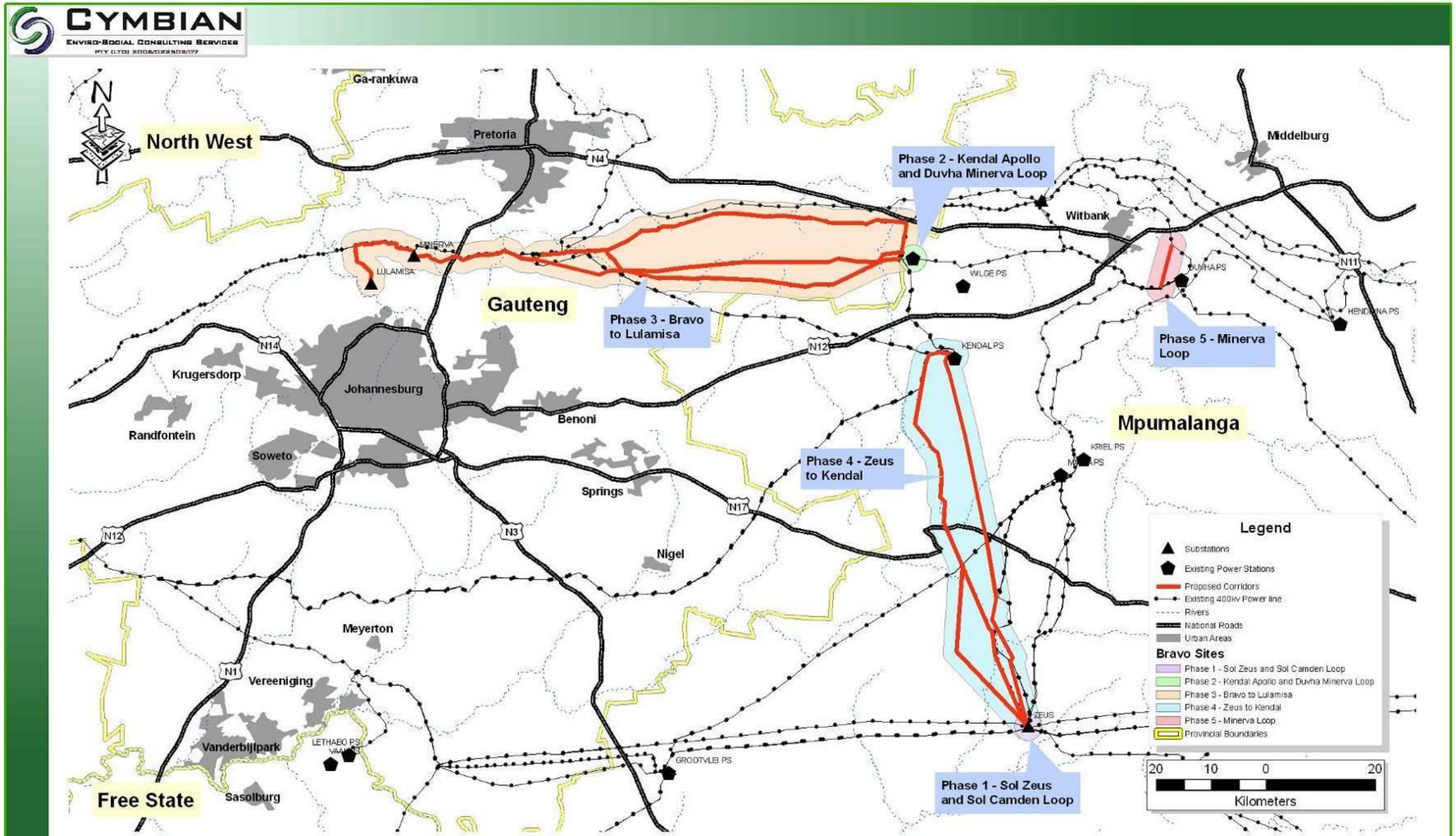
- A Geology, Soil and Land Capability Assessment;
- A Topographical Assessment;
- A Visual Assessment;
- An Ecological Assessment and
- An Ornithological Assessment.

The Geology, Soil and Land Capability Assessments were conducted using a Geographic Information System (GIS) as well as a site investigation to identify soils on site. The Topographical and Visual assessment were completed using a GIS. The Ecological and Ornithological assessment were conducted by first undertaking a literature review and then followed up with site investigations to confirm the findings of the literature review. During the Ecological and Ornithological site investigations, all fauna were noted and identified.

1.4 Study approach

Cymbian undertook the aforementioned specialist studies during a week site visit conducted from the 10^{th}-14^{th} and 18^{th} – 20^{th} November 2008. The Bravo 3 power line corridors connect the new Bravo power station with the Apollo, Minerva and finally Lulamisa substations. This corridor is the longest corridor applied for and the three alternative power lines routes run along the centre of the corridors.

The route starts at the new Bravo power station and heads east towards the main economic district of Pretoria, Midrand and Johannesburg.



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ZIT001	228	01	AUTHOR: K. Kruger	WGS 84 Hartebeesthoek	1:650,000	Surveyor General's Office Eskom SANBI Vegmap CSIR Land Cover Database

Figure 1: Site Location

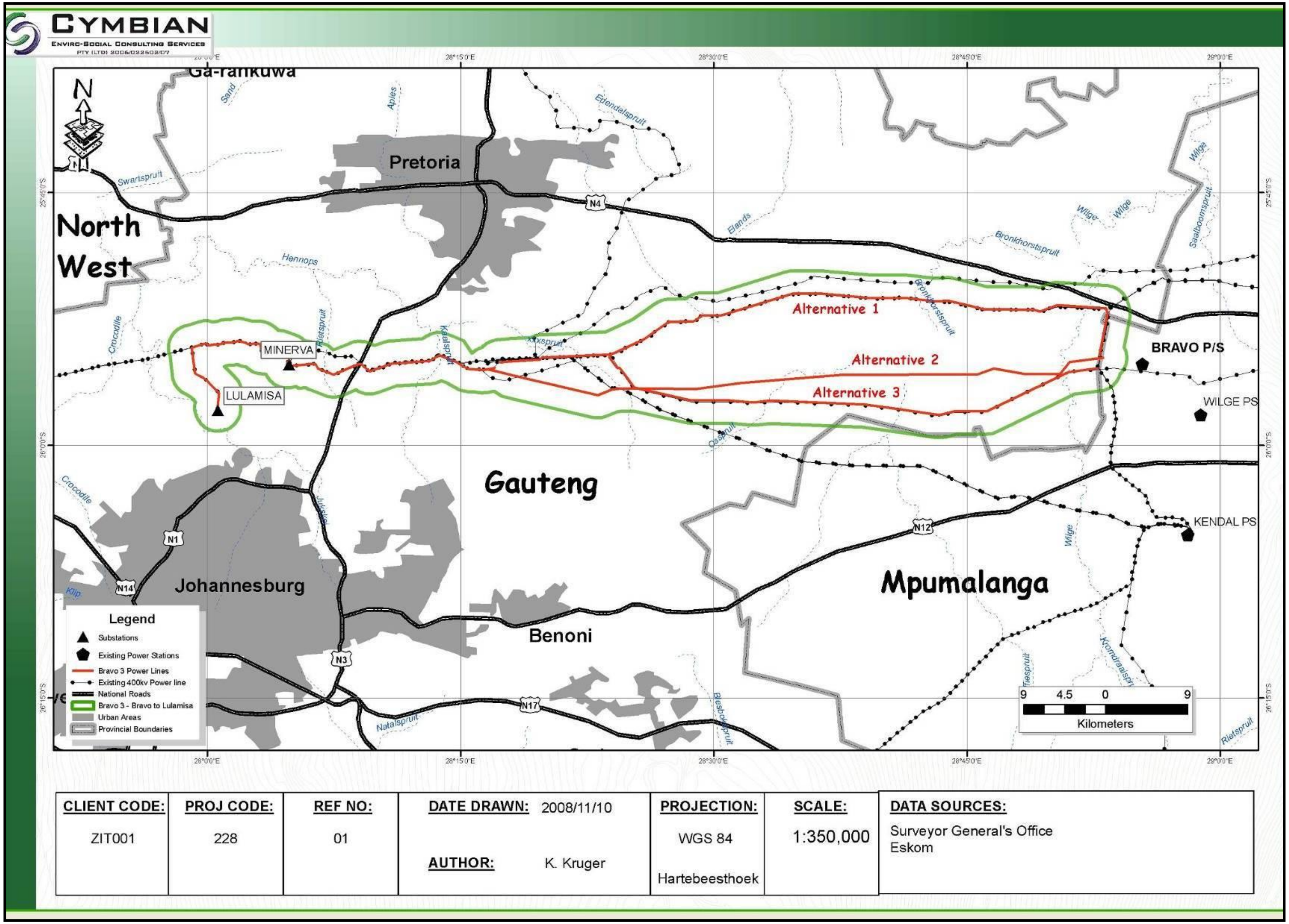

Figure 2: Site Map

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Transects were walked on either side of the power line alternatives in which vegetation, soil, fauna and wetland characteristics were sampled. Each sampling point was marked using a GPS for mapping purposes, photos of each sampling point were also taken.

1.5 Project team

The technical project team consists of:

- **Konrad Kruger** – Landscape Ecologist and Environmental Consultant
- **Glen Louwrens** – Conservation Ecologist and Junior Environmental Consultant
- **Brett Coutts** – Conservation Ecologist and Junior Environmental Consultant

Konrad Kruger graduate from the University of Pretoria with a BSc Honours in Geography in 2003. Konrad has been involved in a variety of environmental projects in the last three years and has become specialised in undertaking specialist studies, mapping and environmental consulting. Konrad has undertaken GIS mapping for mining, residential as well as industrial developments. Konrad is also an experienced land ecologist and will provide expertise for this project in terms of soil surveys, land capability assessments and mapping. He is currently in the process of acquiring his MSc in Geography (Landscape Ecology) from the University of Pretoria.

Glen Louwrens graduated from the University of the Witwatersrand with a BSc Honours in Zoology and Ecology in 2007. Currently a Junior Environmental Consultant at Cymbian Enviro-Social Consulting Services, he is experienced in GIS mapping and can provide expertise in terms of faunal and floral surveys.

Brett Coutts graduated from the University of the Witwatersrand with a BSc Honours in Zoology and Ecology in 2007. His Honours year was based with the Endangered Wildlife Trust (EWT), working on the porcupine quill trade. He has worked for Hydromulch between 2007 and 2008 as a junior project manager on environmental rehabilitation projects. Currently a Junior Environmental Consultant at Cymbian Enviro-Social Consulting Services, he is experienced in rehabilitation projects, population dynamics of small mammals and can provide expertise in terms of faunal and floral surveys.

1.6 Assumptions and Limitations

The following assumptions were made during the assessment:

- The information provided regarding the provided by Zitholele Consulting and ESKOM is accurate;

- If the corridors could not be accessed, data from adjacent sites could be used;
- A corridor width of 5 km was used;
- Fauna, flora and wetland delineation studies can only be completed during the summer months;
- Power line design will be similar to the existing high voltage power lines on site.

2.0 DETAILED PROJECT DESCRIPTION

2.1 Project Alternatives

Several strategic alternatives were considered at the conceptual phase of the Bravo Power Station EIA. This strategic information was again revisited during the planning phase of the Bravo Integration Project. The following project alternatives were excluded during the planning phase due to the significant cost implications:

1.) Two new power lines from Bravo Power Station to Zeus substation were replaced with:

a. A loop in line from Apollo substation to Bravo substation;
b. A loop in line to Kendal Power Station;
c. Two new lines from Kendal Power Station to Zeus Substation.

These alternatives were selected as they represent a total cost saving of R30 million.

2.2 Design Alternatives

The primary motivating factors behind the consideration of underground power lines include the following:

1.) Areas prone to significant infrastructure damage due to extreme weather conditions, on an annual basis, usually consider underground power lines. The cost of power line replacement over the life of the infrastructure is usually more cost effective in such areas;

2.) The visual impact of underground power lines is much less than those of overhead power lines, and are usually considered in highly sensitive visual landscapes, such as wide open wilderness spaces and tourism facilities e.g. game farms and nature reserves.

The primary motivating factors behind the consideration of overhead power lines include the following:

1.) The cost of overhead lines is between 250 % and 400 % less. Eskom have a responsibility to provide cost effective and reliable energy resources;

2.) Overhead circuits can often be worked on while they are still energized. Nearly all work on underground circuits is performed while things are de-energized and grounded.

3.) Underground cables need a larger conductor to handle the same amperage as a smaller overhead conductor. This is due to the difficulty of dissipating heat to the earth. Larger conductor's means higher cost.

4.) Overhead distribution circuits are much easier to modify to serve customers or make other changes. A simple set of fuses on an overhead circuit might cost ~R2 000.00, yet the underground equivalent costs over ~R10 000.00.

5.) An overhead line can generally span and not disturb sensitive features such as cultural resources sites, streams, most wetlands, isolated steep slopes, or a sensitive species location to mention a few. Underground lines however require the construction of a trench and results in a disturbed area of approximately 15 m in width for the entire length of the line.

As none of the areas affected by the proposed Bravo Integration Project are annually affected by extremely damaging environmental events, or fall within highly sensitive visual environments it was decided to implement the more cost effective overhead power line alternative.

2.3 Route Alternatives

The three alternatives that are considered have been selected on the basis of existing environmental information, engineering feasibility and considered because of existing Eskom servitudes power lines. Three alternatives have been identified (Figure 2) all the alternatives merge into one corridor after the Apollo sub station towards the Lulamisa substation because there is an existing 400 kV Eskom servitude

Alternative 1:

Alternative 1 is to construct the proposed 400 kV power line approximately 106.8 km along a north alignment. Alternative 1 will run furthest to the north. This alternative is the longest alternative, and follows and existing servitude.

Alternative 2:

Alternative 2 is to construct the proposed 400 kV power line approximately 102.3 km along a central alignment. The alternative will lead to the shortest power line length, which runs primarily outside Eskom's property. . Alternative 2 is currently the preferred alternative by Eskom.

Alternative 3:

Alternative 3 is to construct the proposed 400 kV power line approximately 102.7 km along a southern alignment. Alternative 3 will be shorter than Alternative 1 but longer than Alternative 2. This route follows an existing servitude partially and to place the route primarily on Eskom property. This route is less favourable than Alternative 2 but more favourable than Alternative 1.

2.4 No-Go Alternative

The No-Go alternative will also be assessed further in the EIA. In the case that none of the three alternatives is suitable for the proposed power lines, the recommendation would be that the proposed power line not be constructed and further alternative alignments, or project solutions be generated.

2.5 Preferred Project Description – Alternative 2

Route Alignment and Length

The length of the new 400 kV power line will be approximately 102.3 km. The preferred route alignment is currently Alternative 2 as shown on Figure 2.

Construction area

The servitude width is 55 m. Construction activities will be limited to the width of the servitude in which the line will be constructed. The power line servitude will be placed within a 5 km corridor identified at during the EIA phase of the project. The exact route alignment will be determined during the detailed phase of the engineering for the project, and will be governed by the Environmental Management Plan (EMP) compiled for the EIA for this project.

Tower Parameters and Design

During the detailed EIA phase of the project the following information will be determined with regard to electrical towers: Tower spacing and positions, tower type, tower height, conductor attachment height, and conductor type. A likely cross sectional profile of the servitude and probable tower design will be included in the EIA.

2.6 Major Activities of the Project

The project involves 21 major activities:

- Environmental Impact Study.
- Negotiations for the servitude.
- Land survey to determine the exact routing of the line and tower placement.
- Profiling work to produce the profiles for construction.
- Pegging of bend tower by a Transmission surveyor.
- Erection of camp sites for the Contractors' workforce.
- Negotiations with landowners for access roads to the servitude.
- Servitude gate installation to facilitate access to the servitude.
- Vegetation clearing to facilitate access, construction and the safe operation of the line.
- Establishing of access roads on the servitude where required as per design parameters inTRMSCAAC1 rev 3.
- Pegging of tower positions for construction by the contractor.
- Transportation of equipment, materials and personnel to site and stores.
- Installation of foundations for the towers.
- Tower assembly and erection.
- Conductor stringing and regulation.
- Taking over the line from the contractor for commissioning.
- Final inspection of the line, commissioning and hand over to the Grid Line and Servitude
- Manager for operation.
- Rehabilitation of disturbed areas.
- Signing off of all Landowners upon completion of the construction and rehabilitation.
- Handing over and taking over of the servitude by the Grid Environmental Manager.
- Operation and maintenance of the line by the Grid.

2.7 Project Timeframes

The primary project milestones are represented in Table 1 below.

Table 1: Primary Project Milestones for Bravo 3

Milestones	Date
Final Scoping Report	12 September 2008
Undertake Specialist Studies	26 September 2008
Draft EIR and EMP	10 October 2008
Stakeholder Engagement on EIR / EMP	19 November 2008
Finalise EIR and EMP	28 November 2008
Submission to Relevant Authorities	2 December 2008
Environmental Authorisation	14 January 2009
Appeal Period	18 March 2009
Commence with Construction	July 2009
Construction (including EMP Auditing)	August 2009
Completion of Construction (including Rehabilitation)	October 2009
Close out Audit	December 2009

3.0 RECEIVING ENVIRONMENT

This section details the receiving environment at the project location. Although the aim of this report is to detail the vegetation, wetlands and, soil and land capability component of the receiving environment; certain additional factors have been included, as they provide perspective to the soil and vegetation study. These include geology, topography, climate, surface water and land use.

3.1 Geology

3.1.1 Data Collection

The geological analysis was undertaken through the desktop evaluation using a Geographic Information System (GIS) and the relevant data sources. The geological data was taken from the Environmental Potential Atlas Data from the Department of Environmental Affairs and Tourism (DEAT) as well as the Geological Desk Study Report for the EIA for the proposed alternative routes and infrastructure[1].

3.1.2 Regional Description

The results from the assessment are graphically represented in Figure 3 below.

The geology towards the western section of the proposed power lines, incorporating Minerva and Lulamisa substations, is dominated by Archean granite, Meinhardskraal granite, Sand River gneiss and gneiss of the Halfway House granite.

The central part of the route overlies large sections of dolomite just south of Pretoria. These sections should be seen as sensitive as the dolomite provides a risk of sinkhole formation. The geology of the central section of the proposed power lines includes formations of the Transvaal, Rooiberg and Griqualand-West super groups and groups, while the eastern section of the of the proposed power lines is dominated by formations of the Dwyka group

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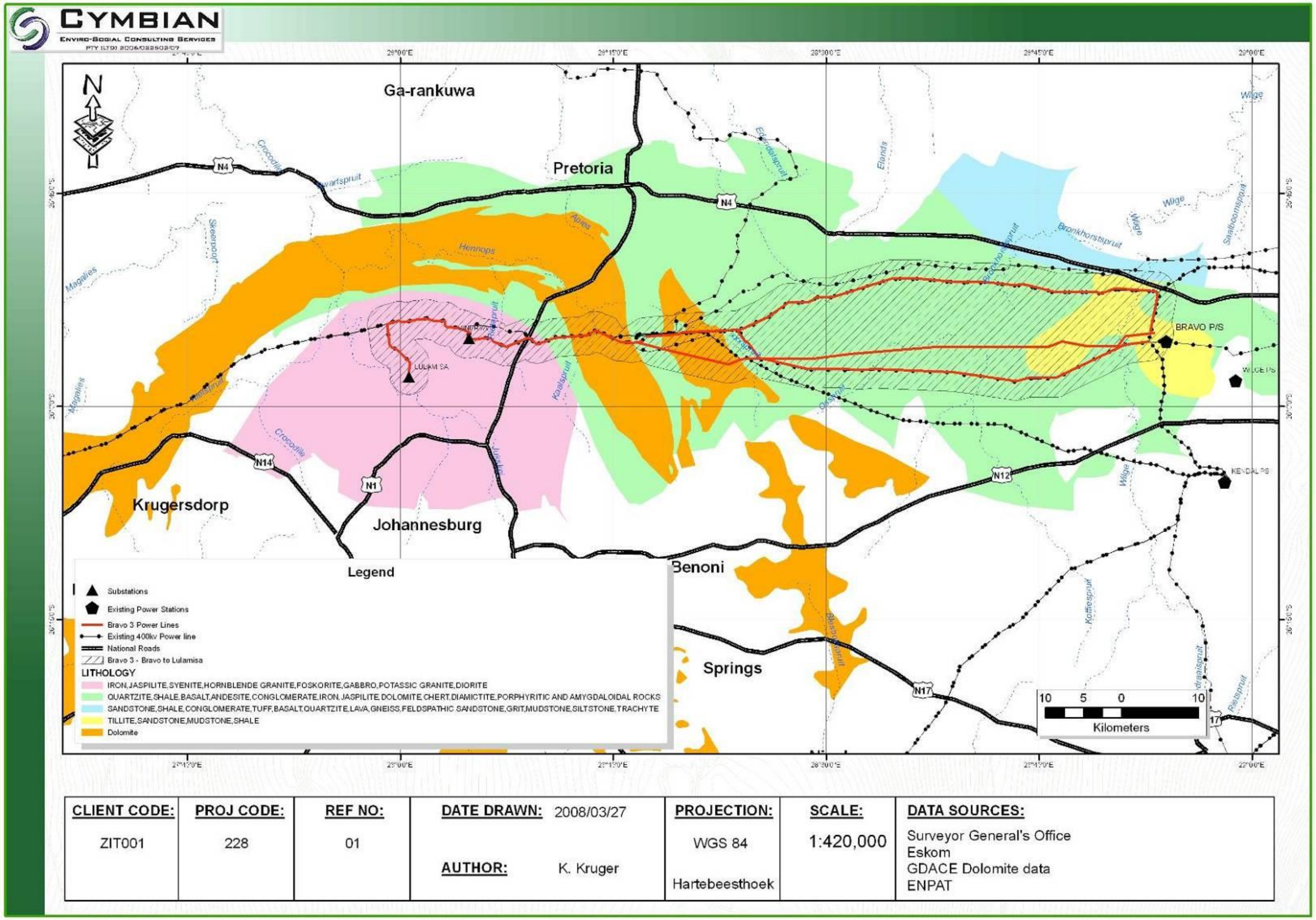

Figure 3: Geological Lithology of the Study Area

3.2 Climate

3.2.1 Data Collection

Climate information was attained using the climate of South Africa database, Land Types of the Maps 2526 Rustenburg, 2528 Pretoria (Land Type Survey Staff 1987)[2], as well as from The Vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006).

3.2.2 Regional Description

The region experiences strongly seasonal summer-rainfall with very dry winters. Mean Annual Precipitation (MAP) varies between 570 mm and 730 mm. The area has a warm temperate climate, with mean monthly minimum temperature of 11.7°C and a mean monthly maximum temperature of 24.0°C. A mean annual temperature (MAT) of 15.8°C is recorded.

Incidences of frosts are frequent, however it is higher in the west (30-40 days), than in the east (10-35 days). The mean annual potential evaporation (MAPE) is approximately 2 184 mm.

3.2.3 Regional Description

The MAP for Funda Muni Training Centre, the nearest official recording station to the study site is approximately 678 mm. Maximum and minimum temperatures recorded at the station are 35.0°C and -2.5°C respectively. Below for rainfall and temperature data for the Funda Muni Training Centre weather station.

3.2.4 Ambient Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers.

[2] Land Type Survey Staff (1987). Land Types of the Maps 2526 Rustenburg, 2528 Pretoria. Memoirs of the Agricultural Natural Resources of South Africa No. 8

Table 2: Rainfall and temperature data for the Funda Muni Training Centre weather station

Month	Average Rainfall (mm)	Max Rainfall 24hrs (mm)	Mean Monthly Temperature (°C)	Ave Daily Temp (°C) Max	Min
Jan	75	44	21.7	27.4	16.0
Feb	98	71	21.3	26.9	15.8
Mar	60	41	20.5	26.3	14.7
Apr	73	158	17.8	23.7	11.9
May	6	17	15.2	21.8	8.6
Jun	11	26	12.2	18.7	5.7
Jul	3	8	12.4	19.2	5.6
Aug	8	18	15.2	22.0	8.4
Sep	44	73	16.9	23.8	10.4
Oct	72	51	19.0	25.5	12.5
Nov	101	37	20.5	26.1	14.9
Dec	127	67	20.9	26.5	15.4
Annual	**678**	**158**	**17.8**	**24.0**	**11.7**

3.3 Surface Water

3.3.1 Data Collection

Surface water data was taken from the WR90 Data supplied by the Department of Water Affairs and Forestry (DWAF) as well as data supplied by GDACE.

3.3.2 Regional Description

The area covered by the three alternative power line corridors run over several main drainage networks (Figure 4), but majority of the water drains in two major directions. The first is found in the central to western parts of the site and all the drainage flows northwest towards the Hartbeesport Dam and the Crocodile River. The second drainage network drains towards the northeast and culminates in the Olifants River.

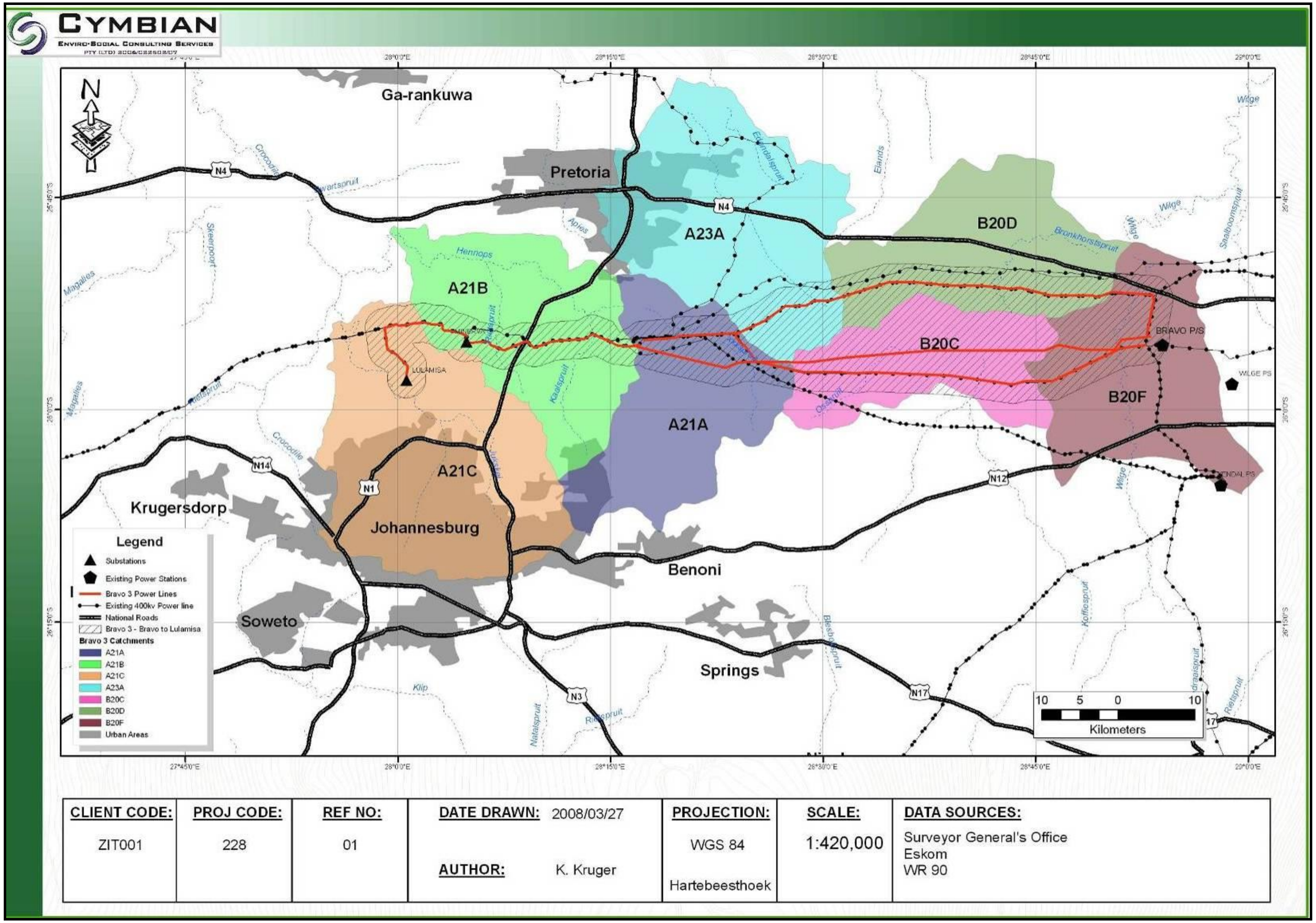

Figure 4: Surface water and catchments

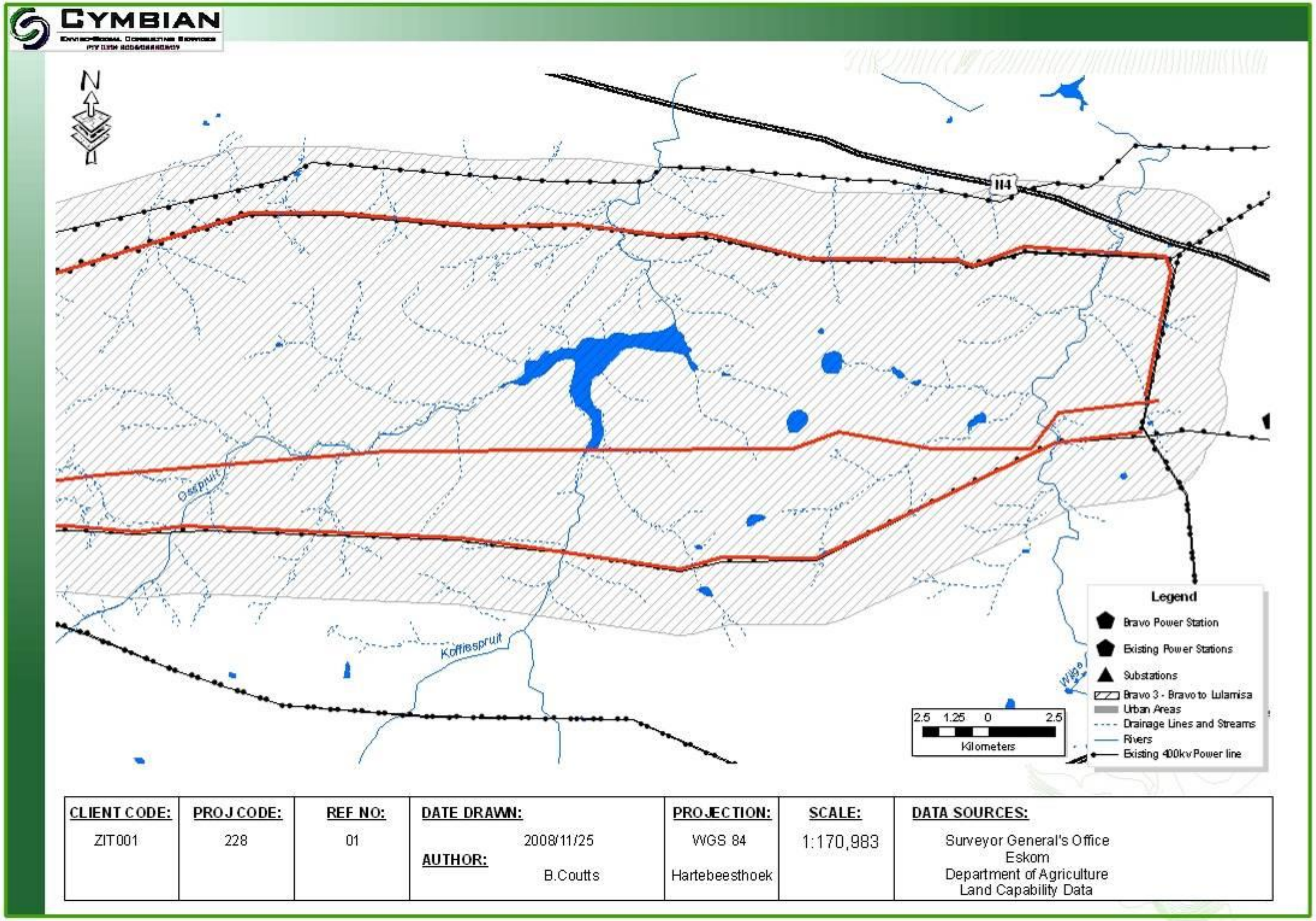

Figure 5: Surface water and drainage features of the eastern section of the site

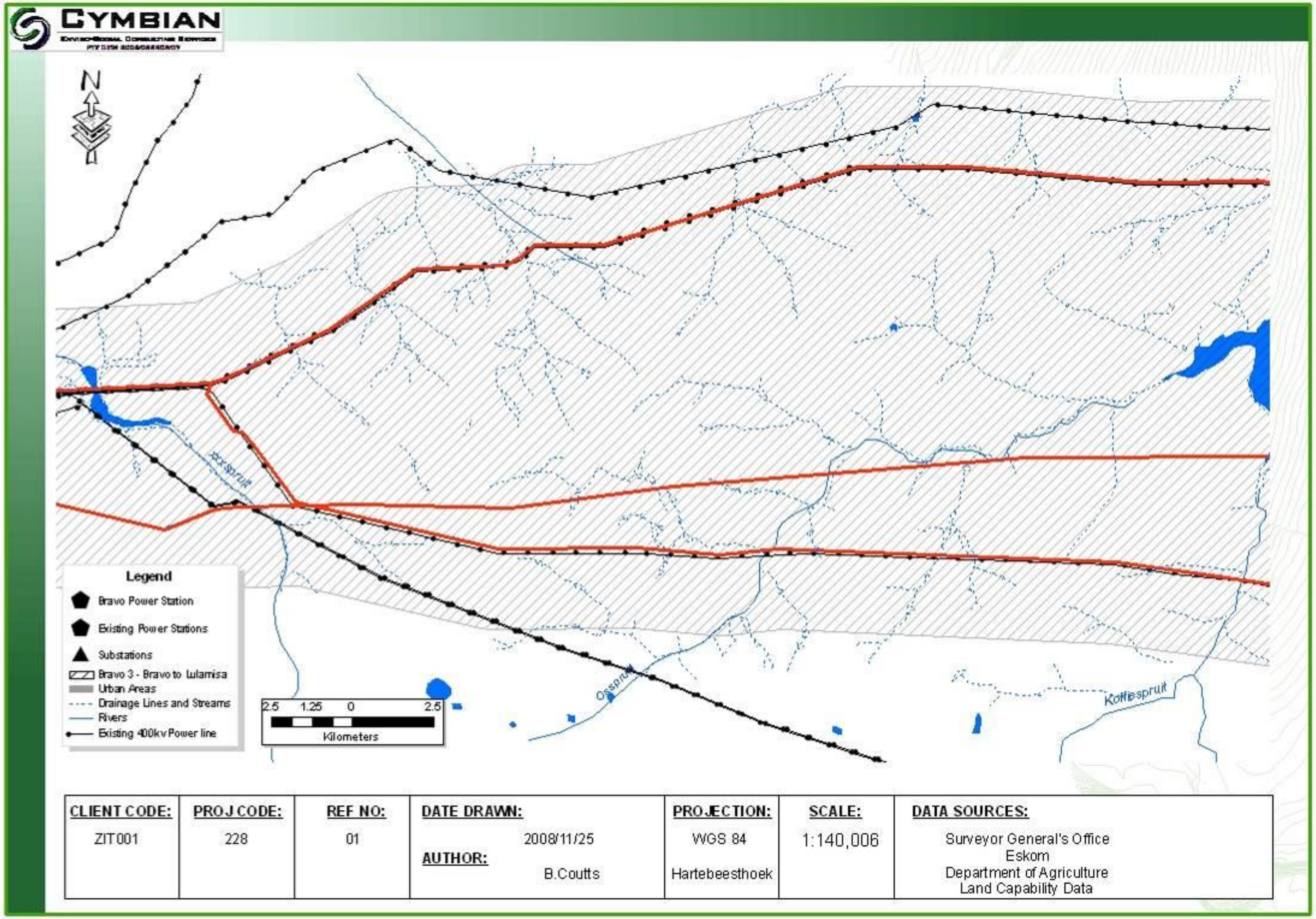
CYMBIAN
N
Legend
Bravo Power Station
Existing Power Stations
Substations
Bravo 3 - Bravo to Lulamisa
Urban Areas
Drainage Lines and Streams
Rivers
Existing 400kv Power line
2.5 1.25 0 2.5
Kilometers
Koffiespruit
CLIENT CODE: ZIT001
PROJ CODE: 228
REF NO: 01
DATE DRAWN: 2008/11/25
AUTHOR: B.Coutts
PROJECTION: WGS 84 Hartebeesthoek
SCALE: 1:140,006
DATA SOURCES: Surveyor General's Office
Eskom
Department of Agriculture
Land Capability Data

Figure 6: Surface water and drainage features of the central part of the site

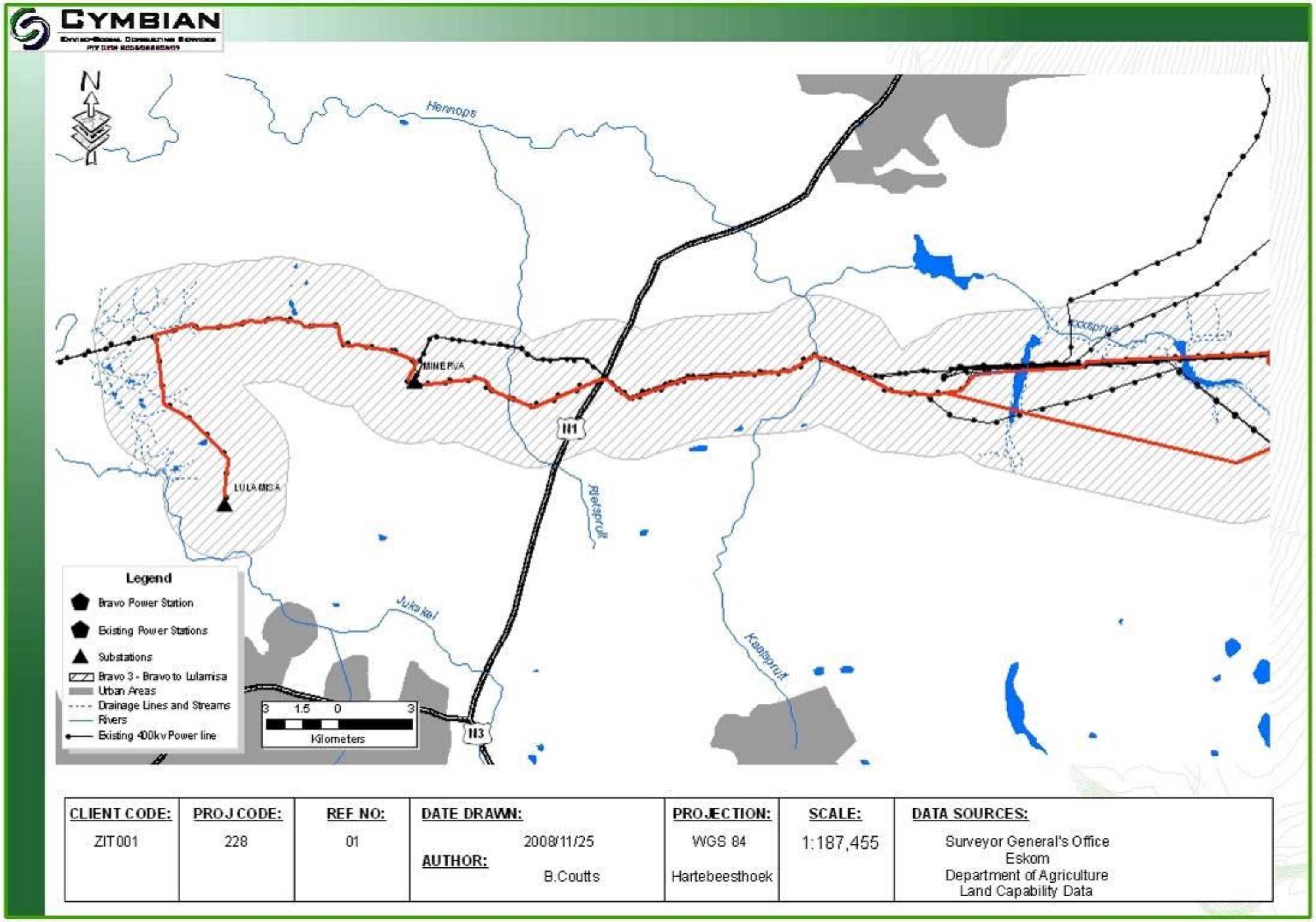

Figure 7: Surface water and drainage features of the western part of the site

3.3.3 Site Description

Three maps were generated to provide clarity because of the scale of the area that needed to be covered. From Figure 5, Figure 6 and Figure 7, there are several rivers and dams that all three alternative routes cross over. The Bronkhorstspruit River intersects all three alternatives and Bronkhorstspruit Dam intersects Alternative 2. Other rivers and streams that are intersected by the three alternative routes are the Wilge, Osspruit, Kaalspruit, Rietspruit and other small streams that follow drainage lines as indicated in Figure 5, Figure 6 and Figure 7. Figure 8 below clearly indicates existing river crossings along the route. The aim of the crossings is to always remain outside the flood line

Figure 8: Existing Power Line river crossings

All water bodies including drainage lines that occur in the area have particular fauna and flora that are adapted to survive in these particular conditions. All these areas are earmarked as sensitive areas and should be avoided as far as possible by placing a buffer zone around each sensitive area

Particular attention needs to be focused on Alternative 2 because of the locality and the difficulty that will arise in the construction phase of the power line. This alternative runs straight across the Bronkhorstspruit Dam which will be a large problem to overcome in the future both from a construction and environmental scope.

3.4 Topography

3.4.1 Data Collection

The topography of the area was taken from the Surveyor General 1:50 000 topocadastral map sheets of the area, namely 2528 CC, CD, DD, DC, and 2527 DD.

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Using the Arcview GIS software the contour information was used to develop a digital elevation model of the region as shown in Figure 10, Figure 11 and Figure 12 below.

3.4.2 Regional Description

The topography of the area exhibits a highly variable landscape with extensive sloping plains and ridges elevated over undulating surrounding plains. The undulating plains include some low hills and pan depressions.

A TIN model of the contours on site is represented in Figure 10, Figure 11 and Figure 12, illustrating the elevations found on site. The elevation ranges from 1 180 to 1 660 mamsl on site with the western sections of the route located in the lower lying areas that drain towards the Hartbeespoort Dam. The central part of the corridors traverse several ridges and high-lying areas, while the eastern section traverses relatively flat areas with east-west running ridges prominent.

3.4.3 Site Description

A number of ridges occur in the area as indicated in Figure 13 below. In several places the proposed corridors traverse along ridges, especially in the Bronkhorstspruit area. The ridges are the only land in the area that is not suitable for agriculture and therefore the power line servitudes have been placed along the ridges. This has had the added bonus that the ridges have remained relatively undisturbed, barring the power line pylon footings. The vegetation along the ridges is in good condition as the servitudes are not open for grazing. Refer to Figure 9 for photographs of the power lines on ridges.

Figure 9: Power Lines located on a ridge

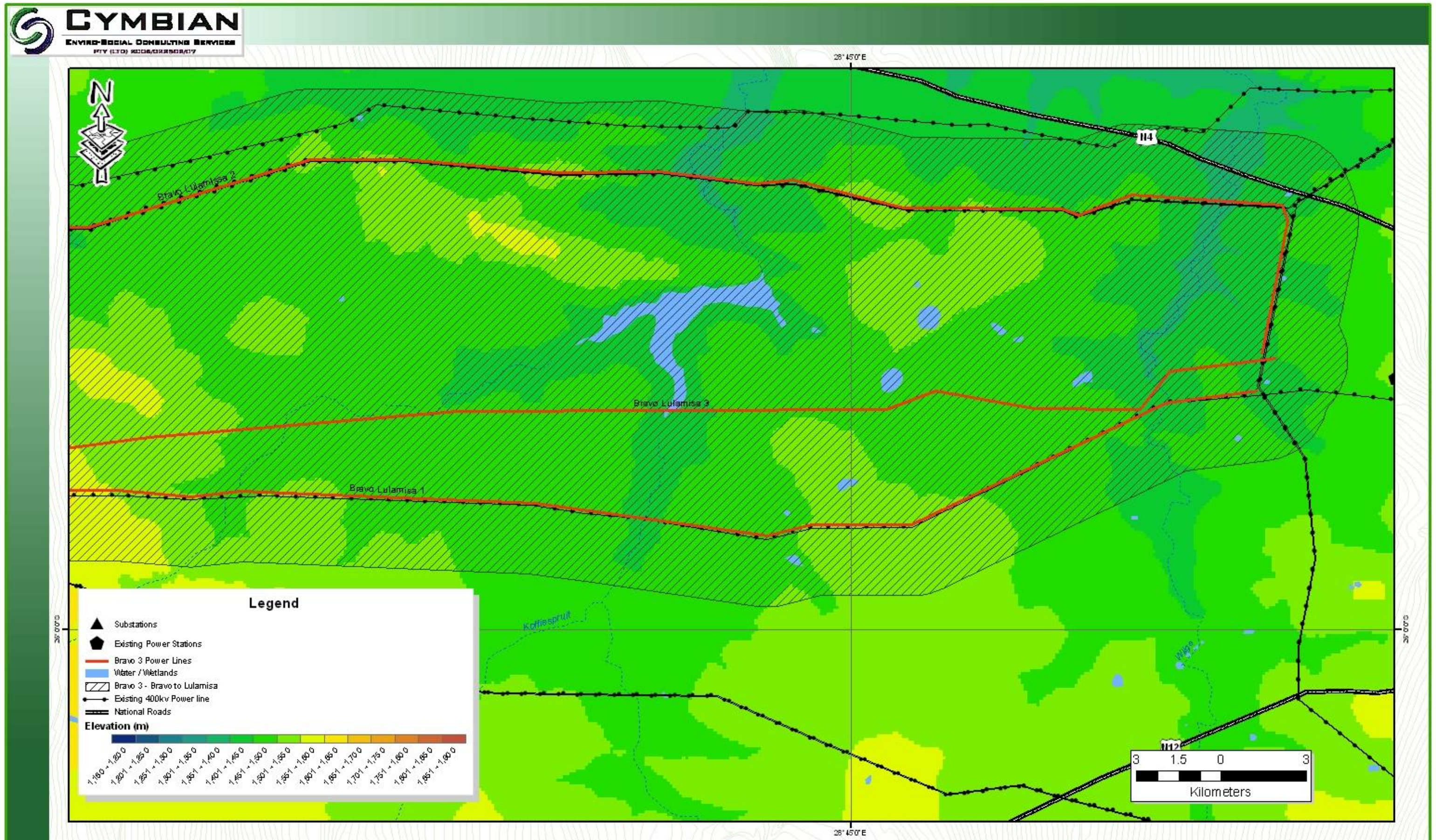

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Figure 10: Eastern Topography of Site

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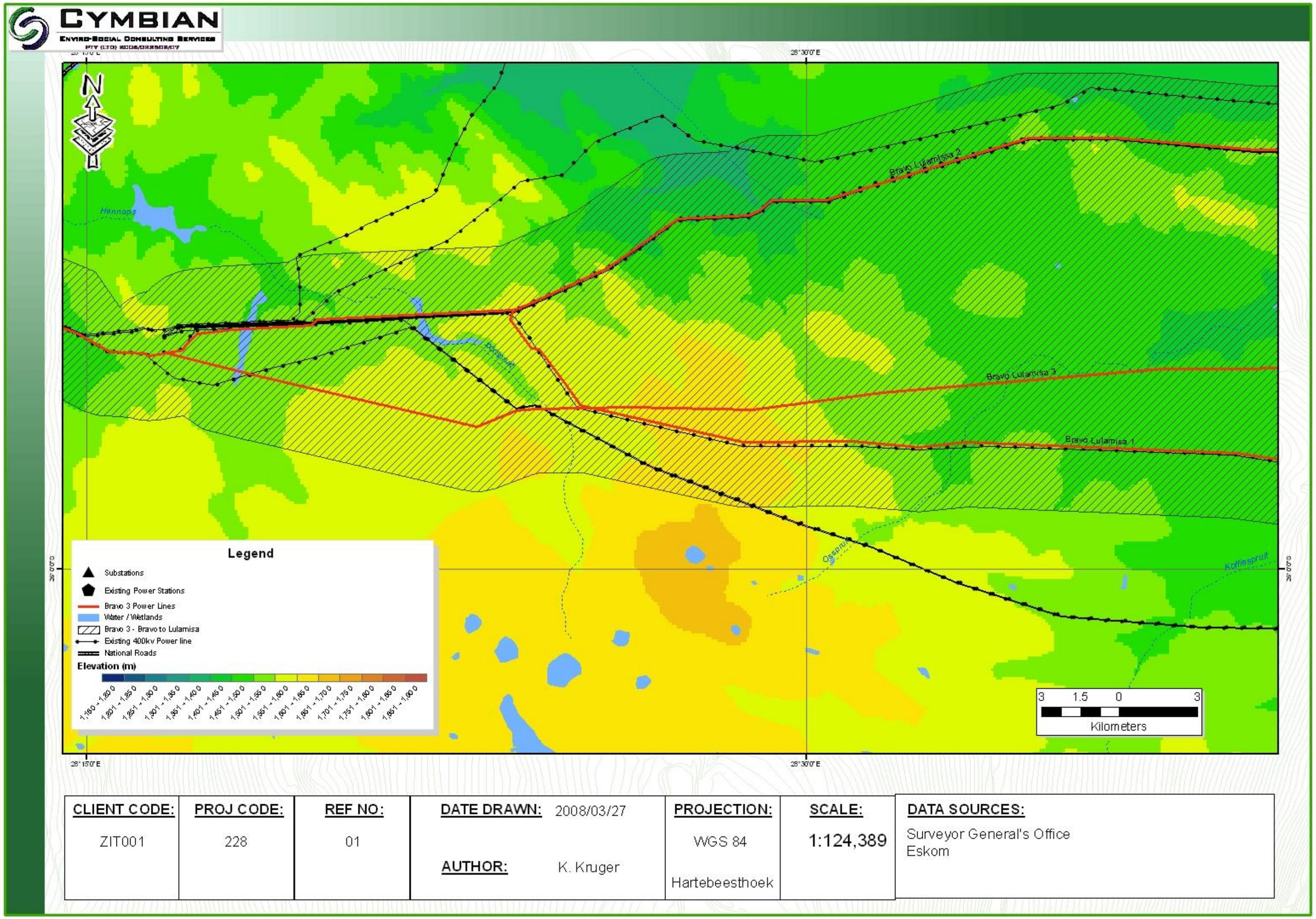

Figure 11: Central Topography of Site

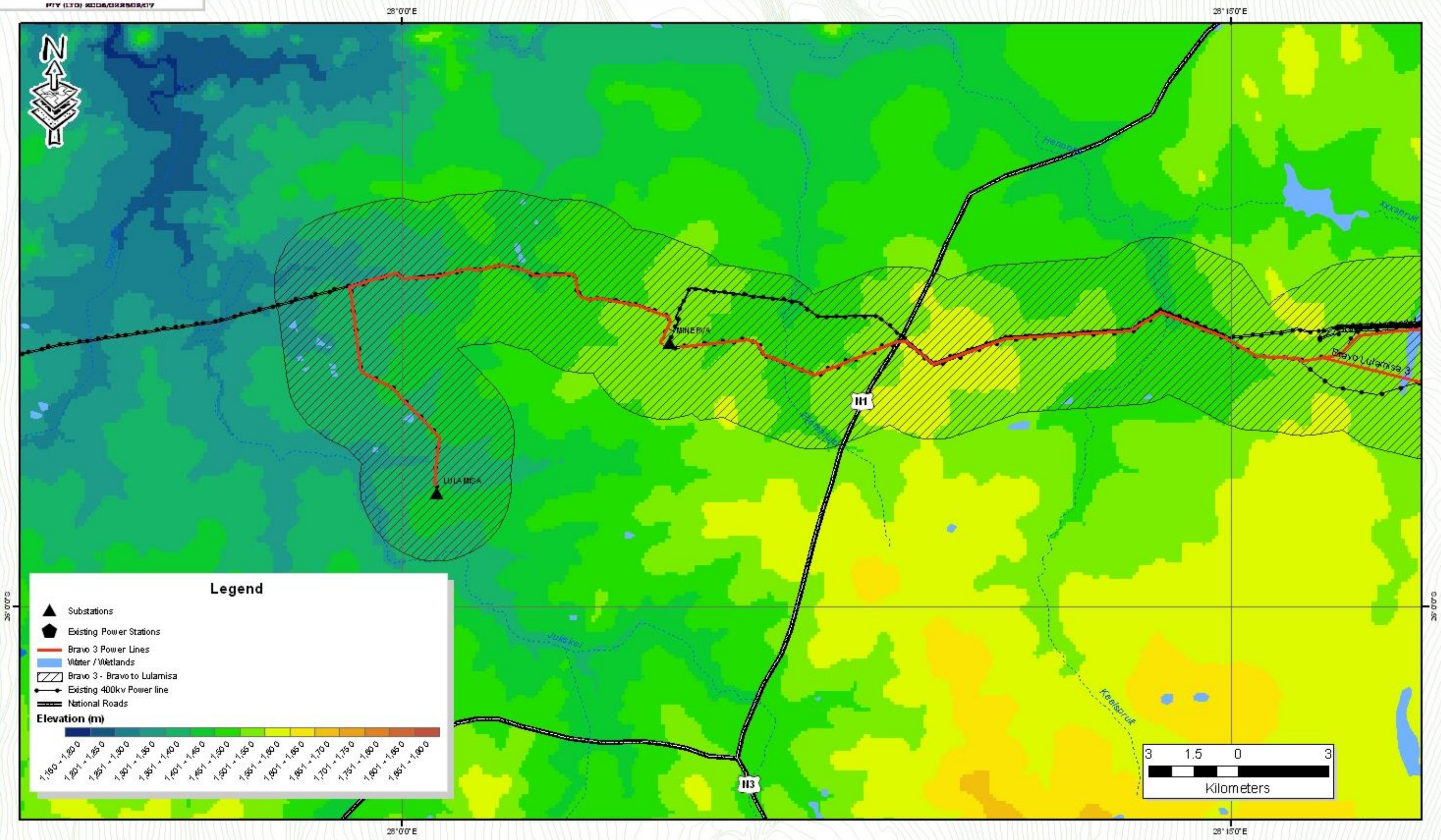

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Figure 12: Western Topography of Site

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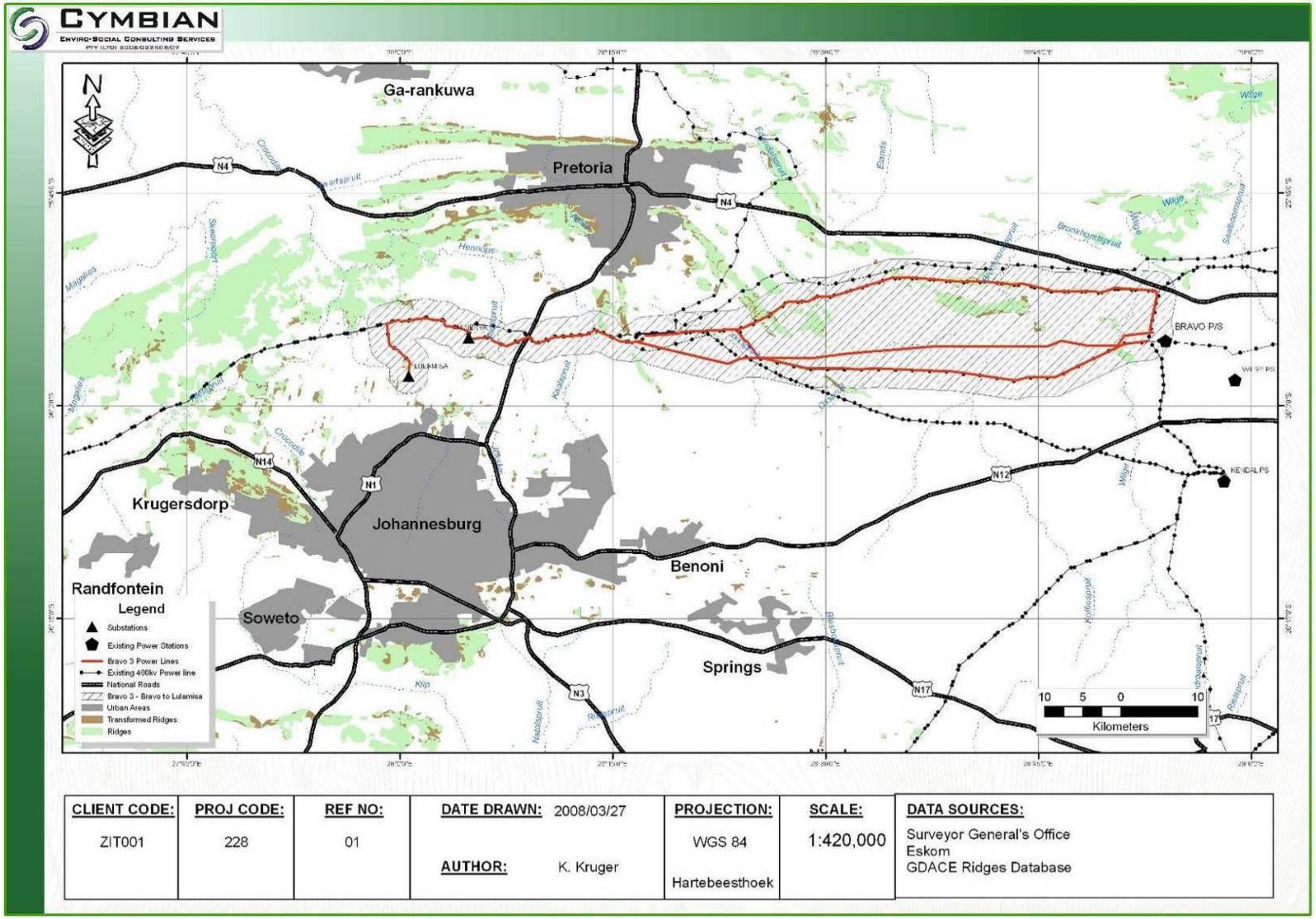

Figure 13: Ridges Map

3.5 Soils

3.5.1 Data Collection

The site visit was conducted on the 10th and 14th and 18th-20th of November 2008. Soils were augered at random intervals along the porposed powerline routes. Soils were augered using a 150 mm bucket auger, up to refusal or 1.5 m. Soils were identified according to Soil Classification; a taxonomic system for South Africa (Memoirs on the Natural Resources of South Africa, no. 15, 1991). The following soil characteristics were documented:

- Soil colour;
- Soil depth;
- Soil texture (Field determination)
- Wetness;
- Occurrence of concretions or rocks; and
- Underlying material (if possible).

Information was also obtained from the Land Type Maps 2526 Rustenburg, 2528 Pretoria (Land Type Survey Staff 1987)[2], as well as GIS data sources. Data were obtained from the National Department of Agriculture's Land Capability Classification System for South Africa (Schoeman et al 2002)[3] as well as the Land Type survey map.

3.5.2 Regional Description

The land types occurring in the region included Ab1, Ab2, Ab5, Ba2, Ba3, Ba5, Ba6, Ba9, Bb1, Bb12, Bb2 and Ib7. Table 3 below lists the terrain units of each land type identified and the soil form/s associated with the terrain unit. Please note that the terrain is broken into crest, scarp, midslope, footslope and valley bottom.

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[3] Schoeman, J.L., van der Walt, M., Monnik, K.A., Thackrah, A., Malherbe, J., and Le Roux, R.E. 2002. Development and Application of a Land Capability Classification System for South Africa. ARC-Institute for Soil, Climate and Water, Pretoria.

Table 3: Terrain units and associated Soil Forms

Terrain Unit	Soil Forms
1 (=Crest)	Rock, Mispah, Hutton, Avalon, Glencoe, Kroonstad, Westleigh, Wasbank, Glenrosa, Clovelly, Cartref
3 (=Midslope)	Rock, Mispah, Hutton, Valsrivier, Avalon, Glencoe, Kroonstad, Westleigh, Wasbank, Longlands, Pans, Swartland, Cartref
4 (=Footslope)	Hutton, Valsrivier, Avalon, Bonheim, Shortlands, Swartland, Glencoe, Kroonstad, Westleigh, Wasbank, Mispah, Longlands, Estcourt, Clovelly, Bainsvlei, Cartref
5 (=Valley bottom)	Hutton, Valsrivier, Oakleaf, Willowbrook, Bonheim, Rensburg, Arcadia, Streambeds, Kroonstad, Katspruit, Westleigh, Rensburg, Longlands, Dundee, Champagne,

From the soil information above the Department of Agriculture's data provides an indication as to the land capability of these soils, as indicated in Figure 13. The route traverses areas with mostly arable soils (green and light green) that is used for growing of mainly maize.

3.5.3 Site Description

During the site visit large quantity of soil forms were identified. The soils forms were grouped into management units and are described in detail in the sections below and Figure 14, Figure 15 and Figure 16 illustrates the location of the management units. The land capability (agricultural potential) of the abovementioned soil form is described in more detail in Section 3.6.

The management units are broken up into:

- Agricultural Soils;
- Clay Soils;
- Rocky Soils;
- Transitional Soils
- and Disturbed Soils

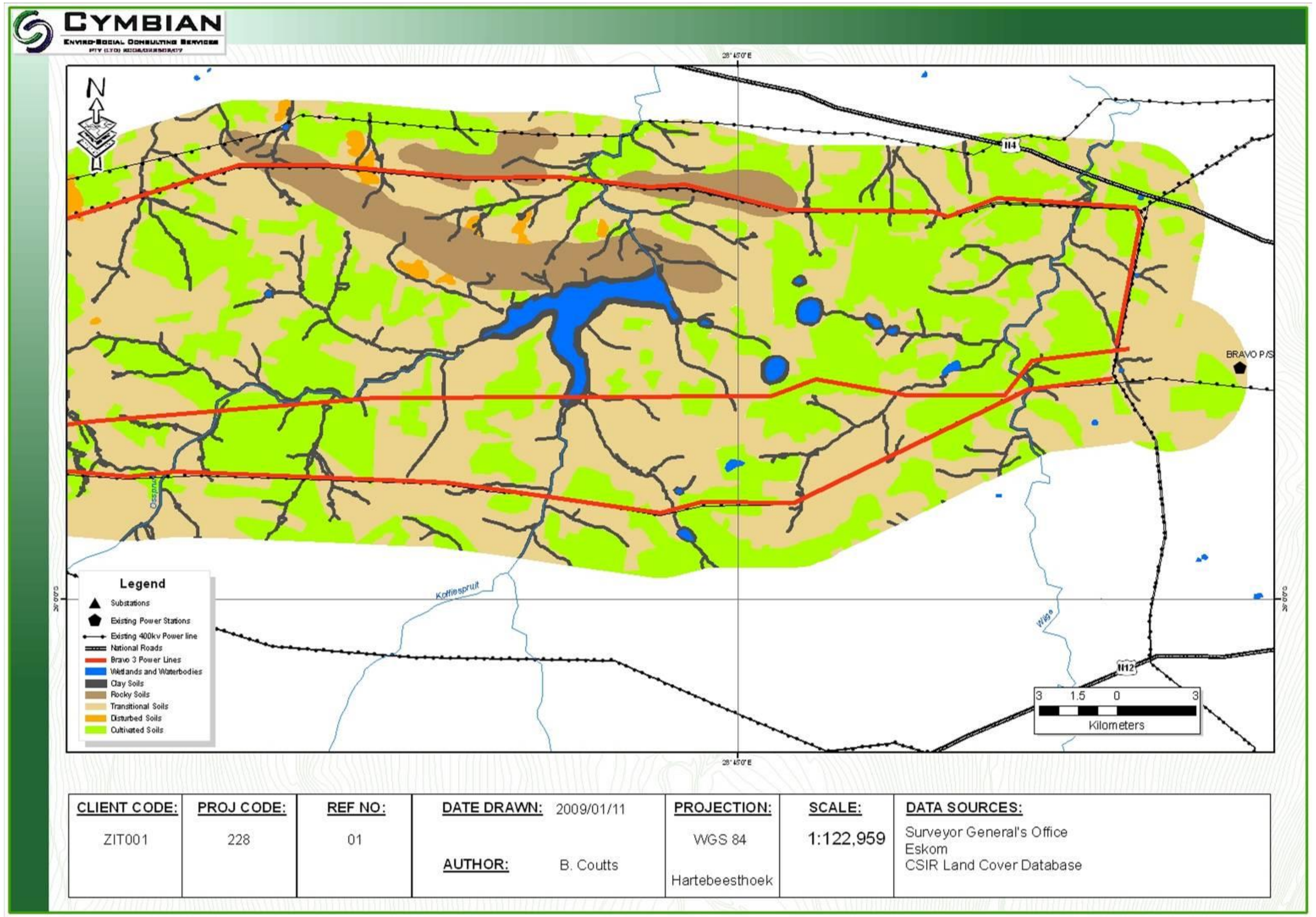

Figure 14: Soil Type Map for the eastern part of the site

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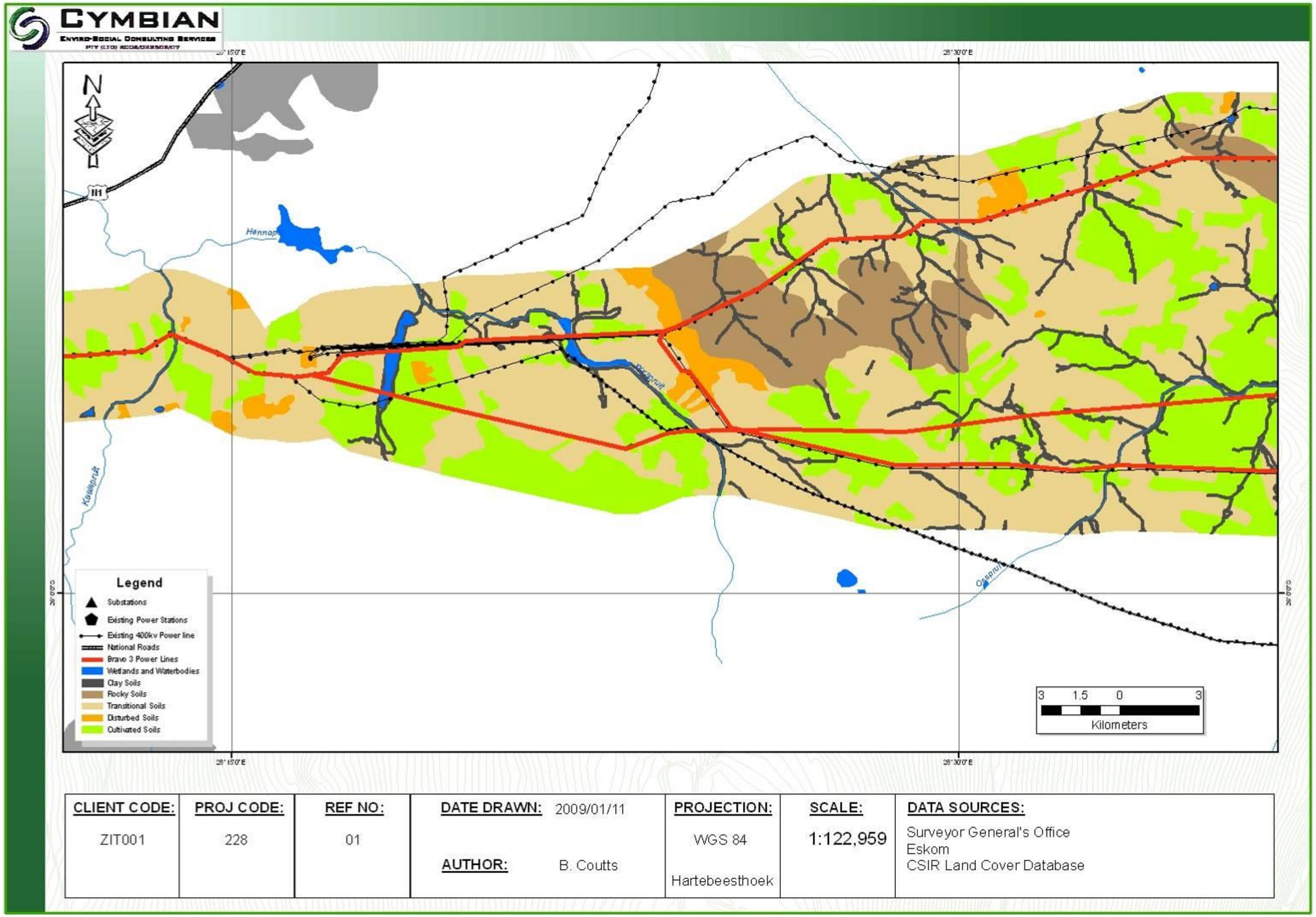

Figure 15: Soil Type Map for the central part of the site

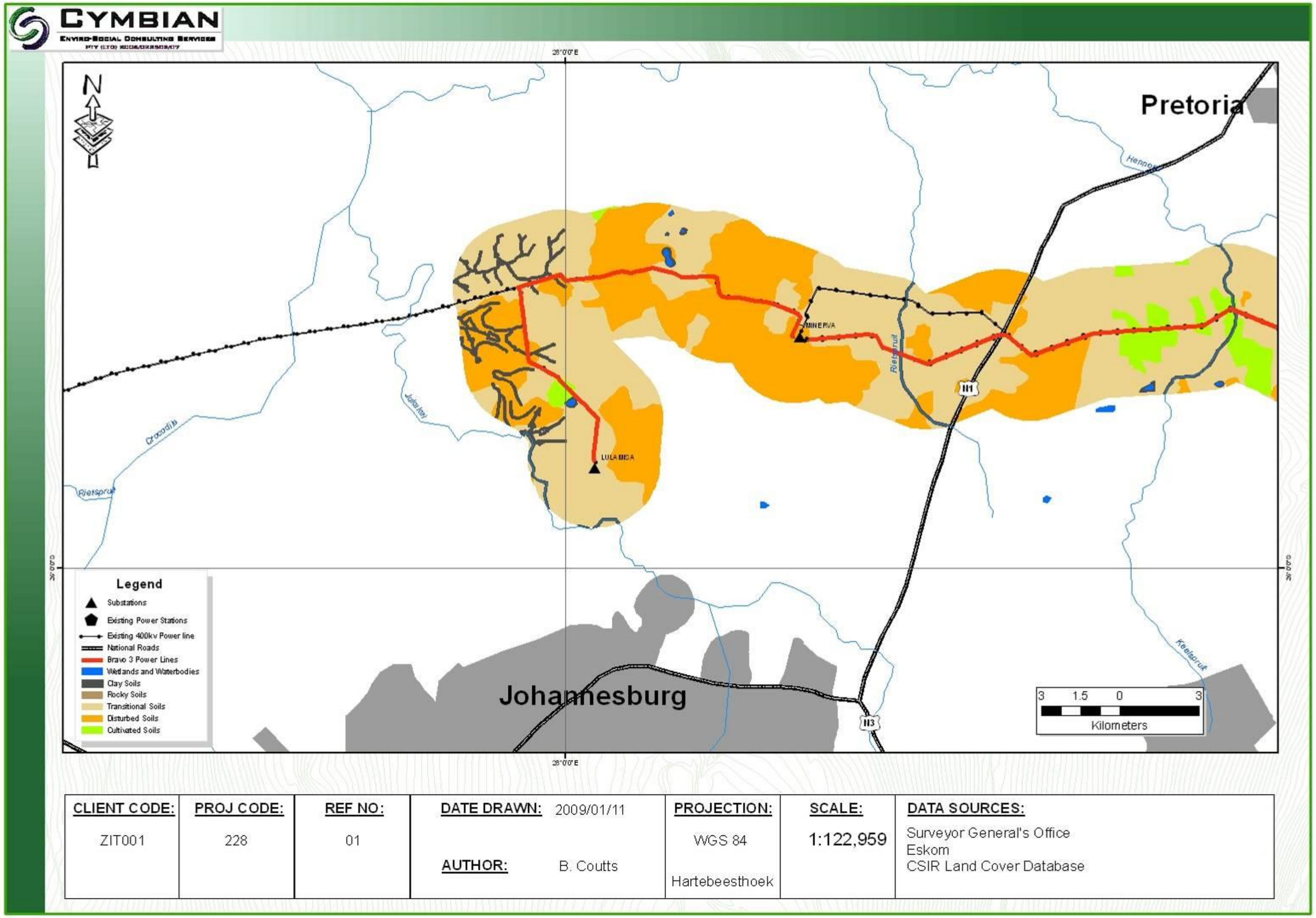

Figure 16: Soil Type Map of the western part of the site

Agricultural Soils

The agricultural soils found on site support an industry of commercial maize production. These soils include Hutton, Clovelly, Avalon, Bainsvlei, Glencoe and Shortlands. These soils have deep red or yellow-brown B-horizons with minimal structure, but in the case of Shortlands soils the B-horizon has some degree of structure. These soils drain well and provide excellent to moderate cultivation opportunities. Each of the soils is described in detail below.

Hutton Soil Form

Hutton's are identified on the basis of the presence of an apedal (structureless) "red" B-horizon as indicated in Figure 17 below. These soils are the main agricultural soil found in South Africa, due to the deep, well-drained nature of these soils. The Hutton soils found on the site are restricted to the midslopes of the site.

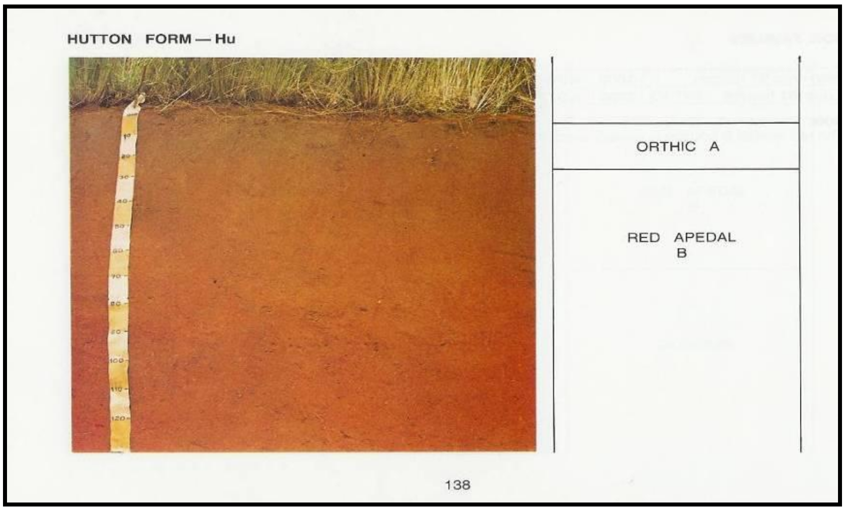

Figure 17 : Hutton Soil Form (Soil Classification, 1991)

Clovelly Soil Form

Clovelly soils can be identified as an apedal "yellow" B-horizon as indicated in Figure 18 below. These soils along with Hutton soils are the main agricultural soil found within South Africa, due to the deep, well-drained nature of these soils.

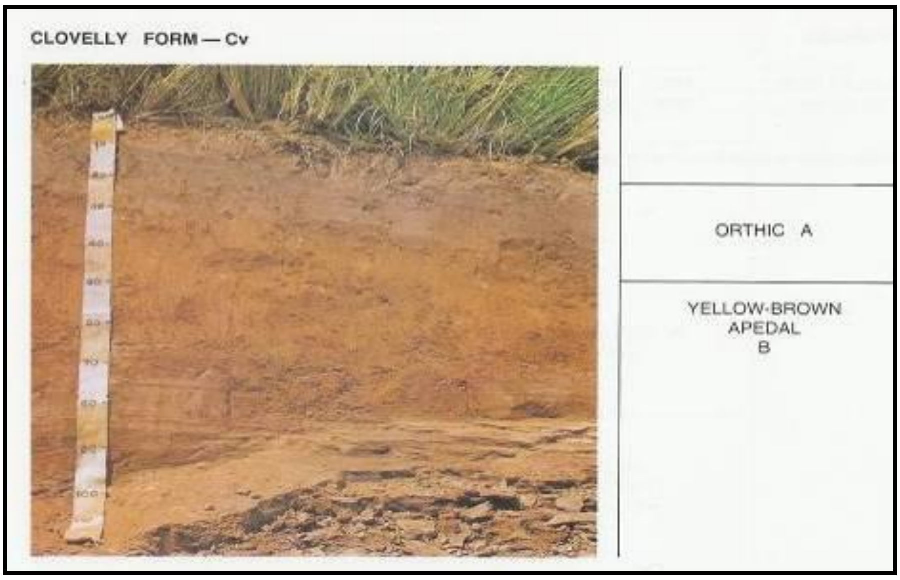

Figure 18: Clovelly soil form (Soil Classification, 1991)

Avalon Soil Form

The Avalon soil form is characterised by the occurrence of a yellow-brown apedal B-horizon over a soft plinthic B – horizon (See Figure 19). The yellow-brown apedal horizon is the same as described for the Clovelly soil form and the plinthic horizon has the following characteristics:

- Has undergone localised accumulation of iron and manganese oxides under conditions of a fluctuating water table with clear red-brown, yellow-brown or black strains in more than 10% of the horizon;
- Has grey colours of gleying in or directly underneath the horizon; and
- Does not qualify as a diagnostic soft carbonate horizon.

These soils are found between lower down the slopes than the Clovelly soils and indicate the start of the soils with clay accumulation.

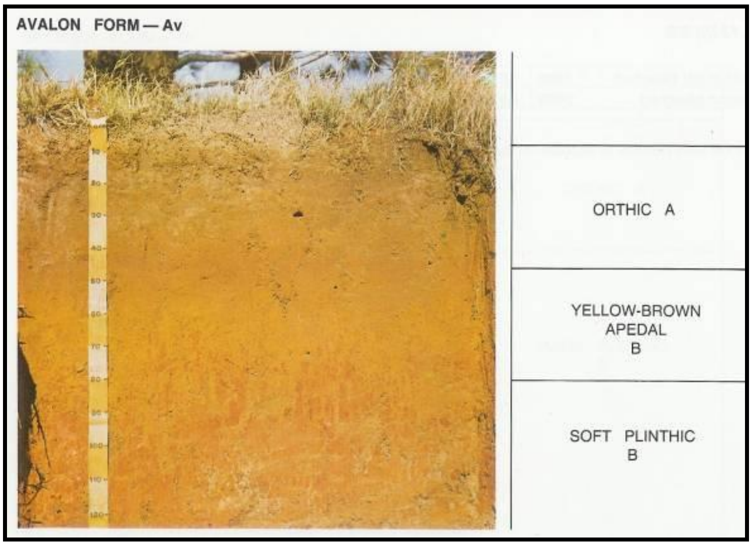

Figure 19: Avalon Soil Form (Soil Classification, 1991)

Griffin Soil Form

Griffin soils are characterised by a yellow-brown apedal B-horizon over a red apedal B-horizon as described in the Hutton and Clovelly soils above. These soils form part of agricultural soils and are suitable for cultivation.

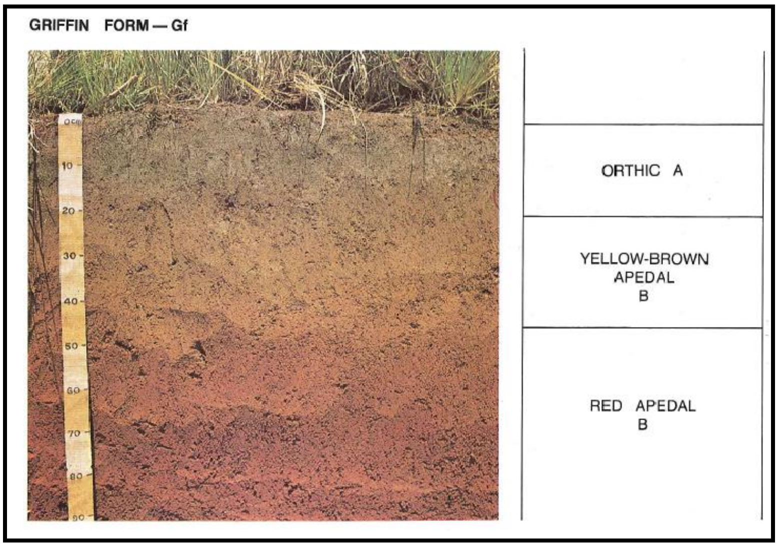

Figure 20: Griffin Soil Form (Soil Classification, 199)

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Bainsvlei Soil Forms

Bainsvlei soils are characterised by a red apedal B-horizon over a soft plinthic B-horizon, as described in the Avalon soil form.

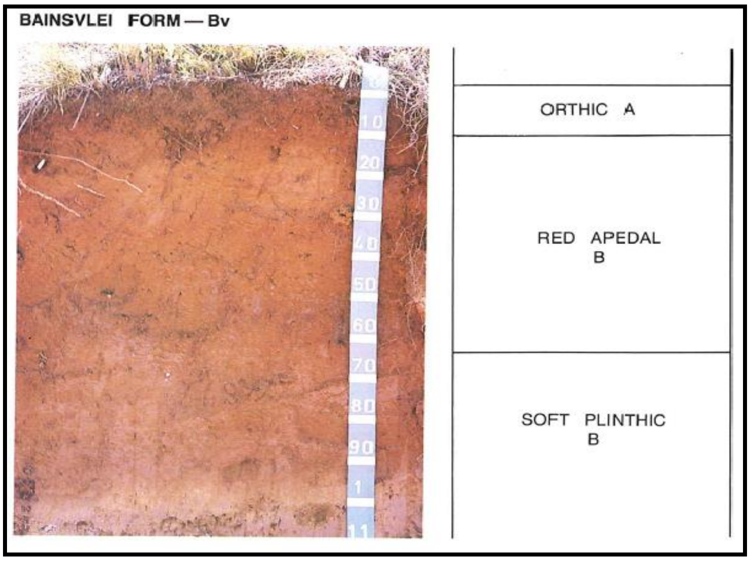

Figure 21: Bainsvlei Soil Form (Soil Clasiffication, 1991)

Shortlands Soil Form

Shortlands soils are characterised by on orthic A-horizon over a red structured B-horizon. This soil is very similar to Hutton soils, but it characterised with a bit more structure in the B-horizon.

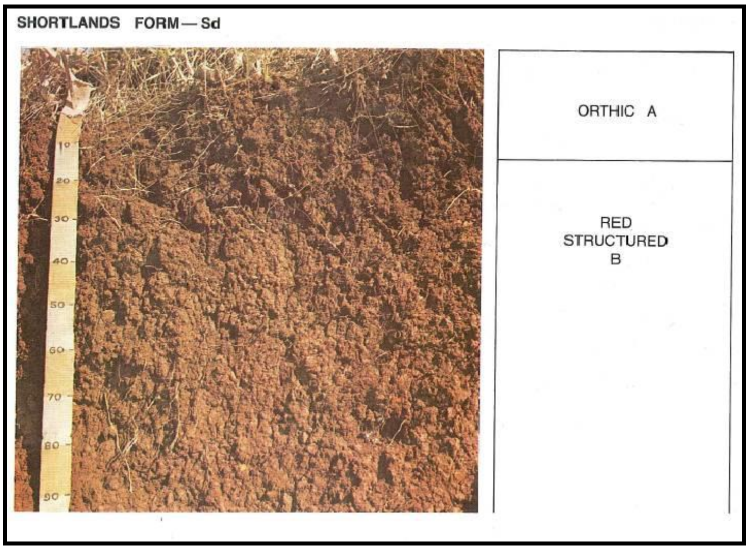

Figure 22: Shortlands Soil Form (Soil Classification, 1991)

Rocky Soils

The rocky soil management unit is made up of soils that are generally shallow and that overlie an impeding layer such as hard rock. These soils are not suitable for cultivation and in most cases are only usable as light grazing. The main soil forms found in rocky soils were Mispah and Glenrosa, each form is described below.

Mispah Soil Form

The Mispah soil form is characterised by an Orthic A – horizon overlying hard rock. Please refer to Figure 23 for an illustration of a typical Mispah soil form.

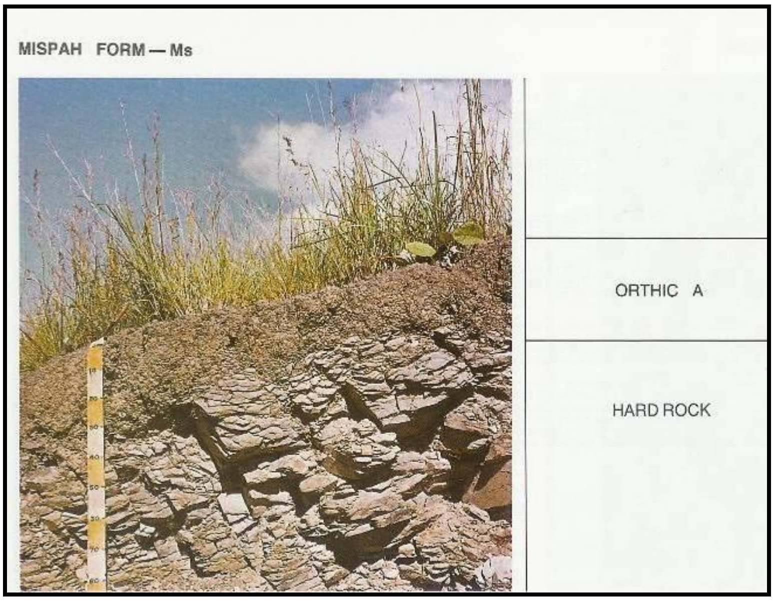

Figure 23: Mispah soil form (Memoirs on the Natural Resources of South Africa, no. 15, 1991).

Glenrosa Soil Form

The Glenrosa soil form is a combination of an Orthic A horizon overlying a lithocutanic B horizon as indicated in Figure 24 below. A lithocutanic B has several characteristics that separate it from other horizons, namely:

- It merges into the underlying weathering rock;
- Has a general organisation in respect of colour, structure or consistency that has distinct affinities with the underlying parent rock;

- Has cutanic character expressed usually as tongues or prominent colour variations caused by residual soil formation and illuviation resulting in localization of one or more of clay, iron and manganese oxides;
- Lacks a laterally continues horizon which would qualify as either a diagnostic podzol B, neocarbonate B, pedocutanic B, pedocutanic B, hardpan carbonate or dorbank; and
- If the horizon shows signs of wetness, then more than 25% by volume has saprolite character.

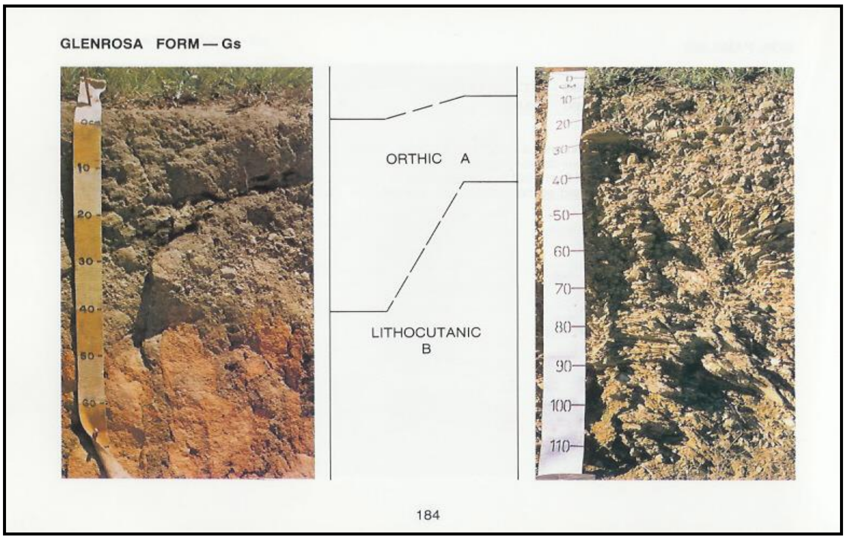

Figure 24: Glenrosa Soil Form (Soil Classification, 1991)

Disturbed Soils

The main soil form found in disturbed soils is Witbank and, is described below.

Witbank

The Witbank soil form is most commonly found in areas of man made activities and is a man made soil. The thickness of the orthic A horizon plus man made soil deposits must be more than 500 mm if these overlie a classifiable buried soil.

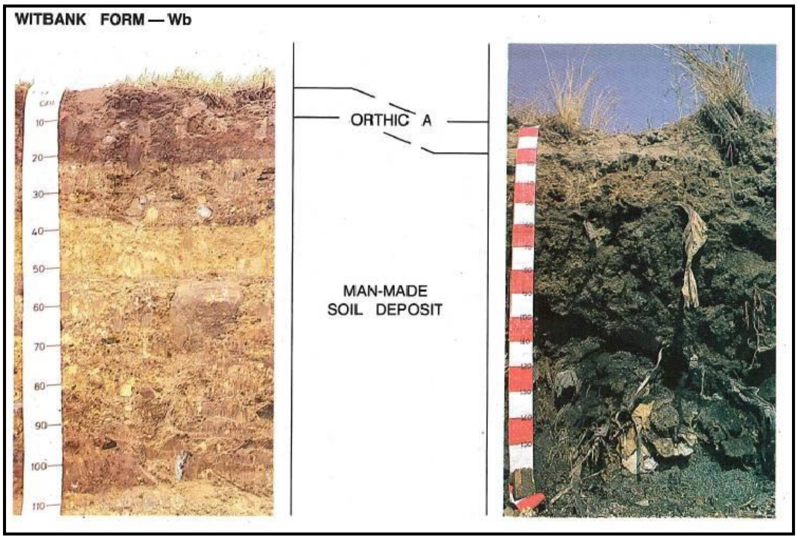

Figure 25: Witbank Soil Form (Soil Classification, 1991)

Transitional Soils

The transitional soil management unit comprises the soils found between clay soils and the agricultural soils. These soils often have signs of clay accumulation or water movement in the lower horizons. These soils are usually indicative of seasonal or temporary wetland conditions. The main soil forms found in transitional soils were Kroonstad, Wasbank, Longlands and Westleigh, each form is described below.

Kroonstad Soil Form

The Kroonstad soil form is most commonly found in areas of semi-permanent wetness. The soil is made up of an Orthic A horizon over a diagnostic E-horizon over a G-horizon, as indicated in Figure 26 below. The G-horizon has several unique diagnostic criteria as a horizon, namely:

- It is saturated with water for long periods unless drained;
- Is dominated by grey, low chroma matrix colours, often with blue or green tints, with or without mottling;
- Has not undergone marked removal of colloid matter, usually accumulation of colloid matter has taken place in the horizon;
- Has a consistency at least one grade firmer than that of the overlying horizon;
- Lacks saprolitic character; and
- Lacks plinthic character.

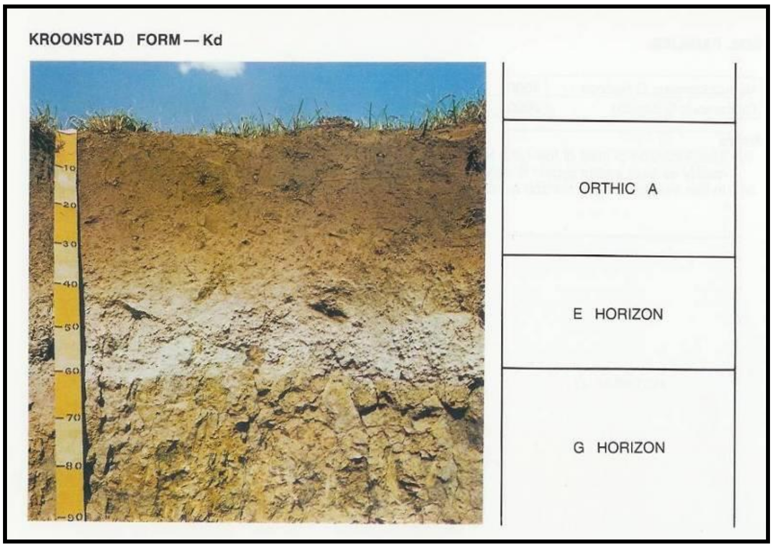

Figure 26: Kroonstad Soil Form (Soil Classification, 1991)

Wasbank Soil Form

The Wasbank soil form is found in close proximity to the Longlands soil form and is typified by an Orthic A-horizon over an E-horizon (as described above) over a Hard Plinthic B-horizon. The Hard Plinthic B-horizon develops when a Soft Plinthic horizon is subjected to a prolonged dry period and the accumulated colloidal matter hardens, almost irreversibly. The Wasbank soil form is illustrated in Figure 27 below.

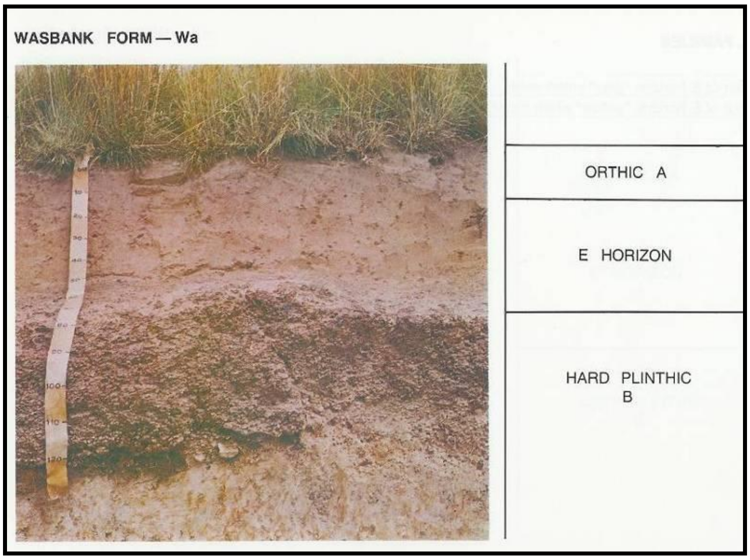

Figure 27: Wasbank Soil Form (Soil Classification, 1991)

Longlands Soil Form

The Longlands soil forms are all typified by an eluvial (E) horizon over a soft plinthic horizon (as described above). The E-horizon is a horizon that has been washed clean by excessive water movement through the horizon and the plinthic horizon as undergone local accumulation of colloidal matter (refer photo below). In Please refer to Figure 28 and Figure 29 for an illustration of the soil form.

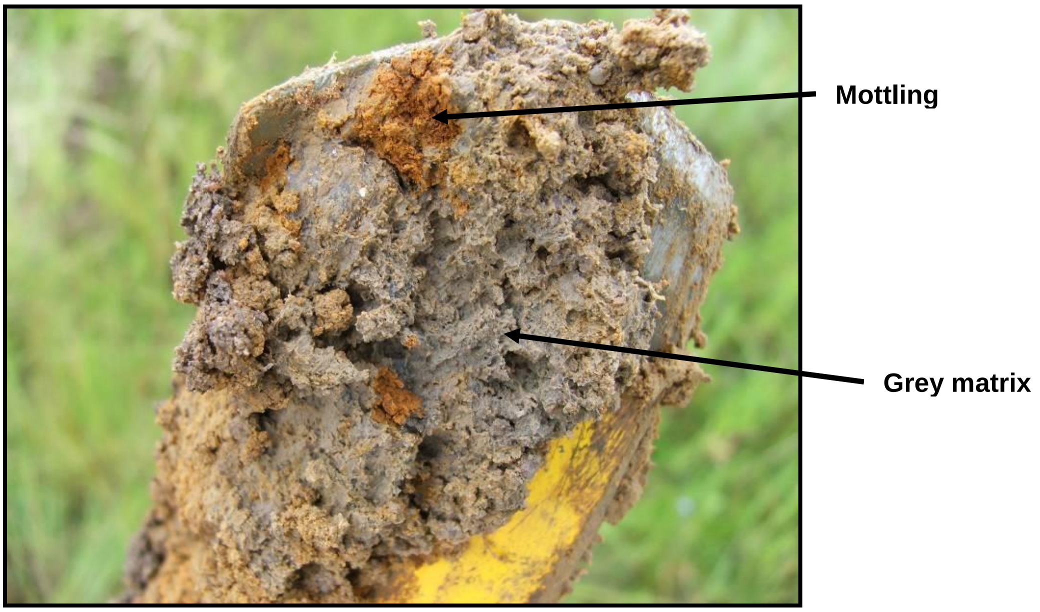

Figure 28: Soft plinthic B-horizon.

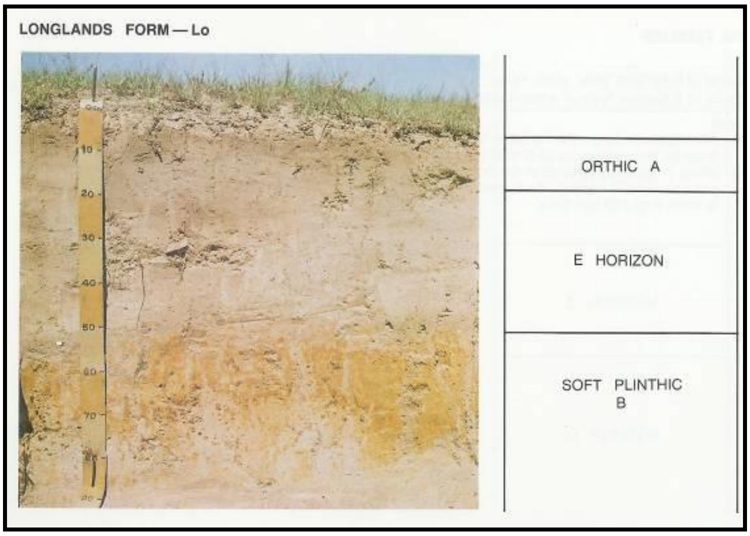

Figure 29: Longlands Soil Form (Soil Classification, 1991)

Westleigh Soil Forms

Westleigh soils are characterised by an orthic A-horizon over a soft plinthic B-horizon and is found in areas between good agricultural soils and clay soils and the movement of water determines the characteristics of the soil.

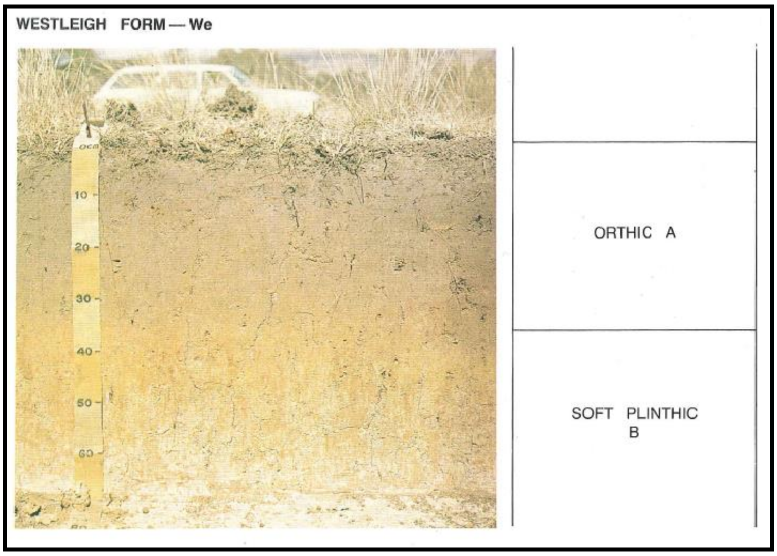

Figure 30: Westleigh Soil Form (Soil Classification 1991)

Clay Soils

The clay soil management unit is found in areas where clays have accumulated to such an extent that the majority of the soil matrix is clays. These soils are usually indicative of seasonal or permanent wetland conditions. The main soil forms found in clay soils were Katspruit and Rensburg, Arcadia and Willowbrook, each form is described below. These soils are saturated with water and must be noted to be unstable for construction and are sensitive.

Katspruit Soil Form

The Katspruit soil form is most commonly found in areas of semi-permanent wetness. The soil is made up of an Orthic A-horizon over a diagnostic G-horizon and is indicated in Figure 31 below. The G-horizon has several unique diagnostic criteria as a horizon, namely:

- It is saturated with water for long periods unless drained;
- Is dominated by grey, low chroma matrix colours, often with blue or green tints, with or without mottling;

- Has not undergone marked removal of colloid matter, usually accumulation of colloid matter has taken place in the horizon;
- Has a consistency at least one grade firmer than that of the overlying horizon;
- Lacks saprolitic character; and
- Lacks plinthic character.

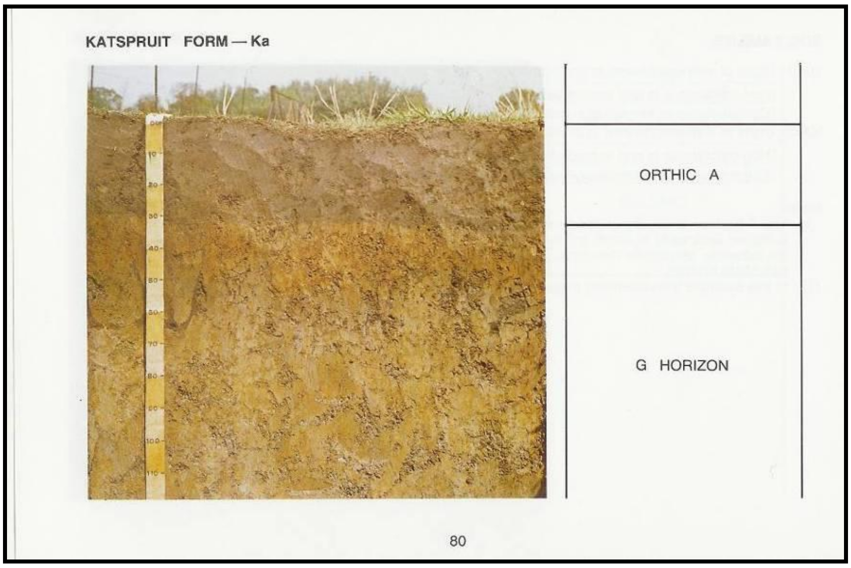

Figure 31: Katspruit Soil form (Soil Classification, 1991)

Arcadia Soil Form

Arcadia soils are characterised by a vertic A-horizon, which frequently overlies weathering rock or yellowish brown block clay. The Vertic horizon has several unique diagnostic criteria as a horizon, namely:

- Has strong developed structure
- Has at least one of the following:
    - Clearly visible, regularly occurring slicken sides in some part of the horizon or in the transition to an underlying layer
    - A plasticity index greater than 32 (using the SA Standard Casagrande cup to determine liquid limit), or greater than 36 (using the British Standard cone to determine liquid limit).

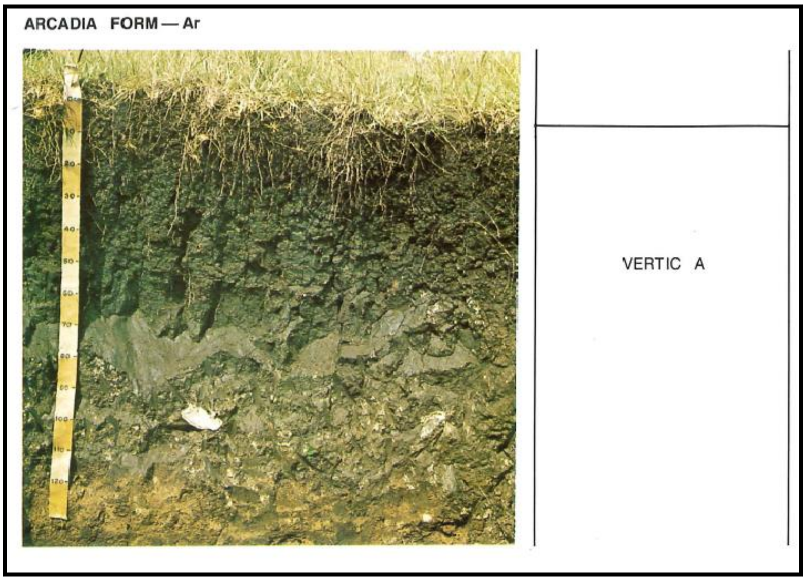

Figure 32: Arcadia Soil Form (Soil Classification, 1991)

Rensburg Soil Form

Rensburg soils are characterised by a vertic A-horizon over a G horizon. The vertic A-horizon is characterised by shrinking and swelling of the soils and the G-horizon has characteristics described above.

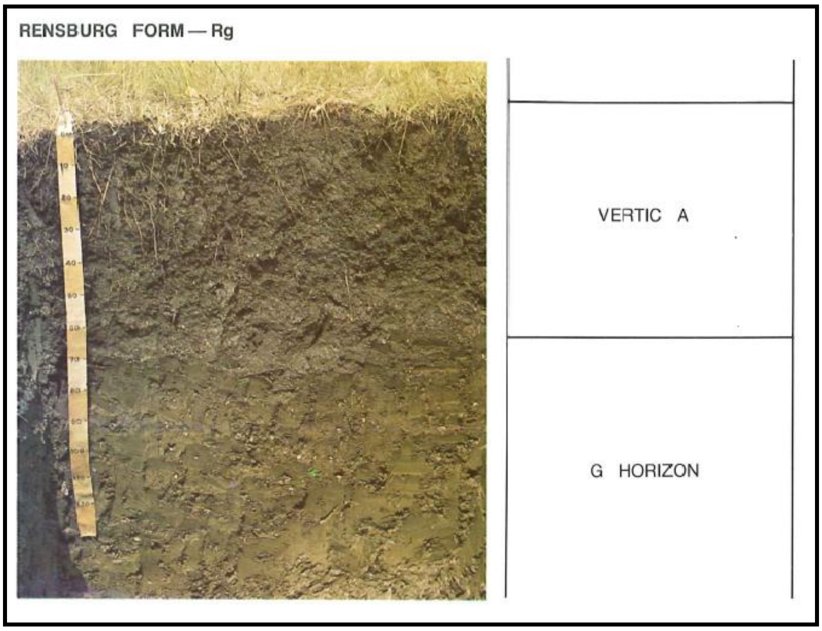

Figure 33: Rensburg Soil Form (Soil Classification, 1991)

Willowbrook Soil Form

Willowbrook soils are characterised by Melanic A-horizon over a G-horizon. The G-horizon is invariably firm or very firm and it's characteristics are described above. The Melanic horizon has several unique diagnostic criteria as a horizon, namely:

- Has dark colours in the dry state.
- Lack slickensides that are diagnostic of vertic horizons.
- Has les organic carbon than required for diagnostic organic O horizon.
- Has structure that is strong enough so that the major part of the horizon is not both massive and hard or very hard when dry.

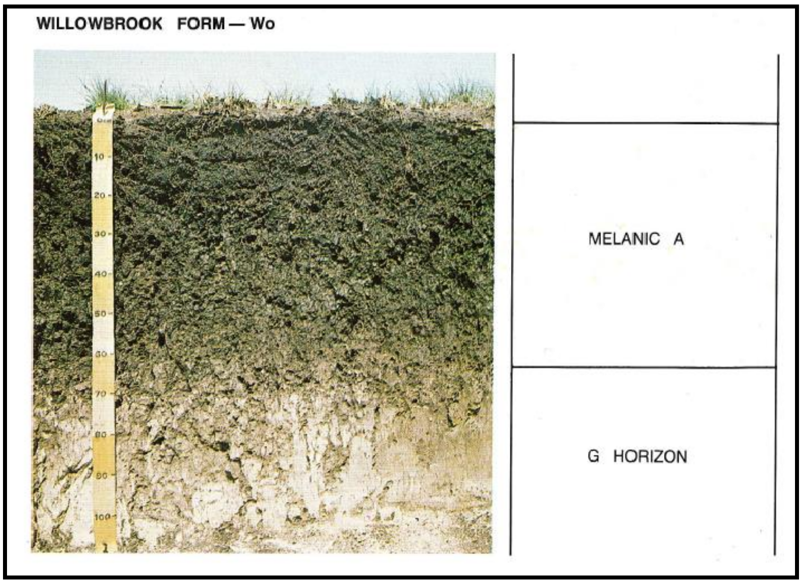

Figure 34: Willowbrook Soil Form (Soil Classification 1991)

3.6 Land Capability

3.6.1 Data Collection

A literature review was conducted in order to obtain any relevant information concerning the area, including information from the Environmental Potential Atlas (ENPAT), Weather Bureau and Department of Agriculture. Results from the soil study were taken into account when determining the land capability of the site.

The land capability assessment methodology as outlined by the National Department of Agriculture was used to assess the soil's capability on site.

3.6.2 Regional Description

The region has historically been used for cultivation of crops and grazing of livestock, because of the arable soils present. Some of the areas have been used for mining, industrial areas and urban zones and therefore the land capability in those areas have been changed permanently.

3.6.3 Site Description

The soils identified on site were classified according to the methodology proposed by the Agricultural Research Council – Institute for Soil, Climate and Water (2002). Factors evaluated are tabled below.

The soils on site were identified to have a land capability of being good arable soils. From Figure 35, Figure 36 and Figure 37 below it is clear that large sections of the site are made up of good arable soils. This indicates that these soils are good to cultivate a variety of crops such as maize. Approximately 30% of the area is used for agricultural purposes; such crops as maize are grown in these areas because of the good quality of the soils. Approximately 50% of the Transitional soils are used for mixed land use; such as grazing for livestock and other crops besides maize.

Table 3: Land Capability of the soils on site for agricultural use

Soil	Cultivated	Transitional	Rocky	Clay	Disturbed
% on Site	26	53	6	8	7
Rock Complex			X		X
Flooding Risk	F1	F1	F1	F4	F4
Erosion Risk	E2	E5	E5	E1	E4
Slope %	3.9	3.7	4.0	0.5	10-30
Texture	T2	T2	T2	T1	T3
Depth	D1	D2	D4	D4	D4
Drainage	W2	W4	W2	W4	W2
Mech Limitations	MBO	MBO	MB3	MBO	MB3
pH	P2	P1	P1	P1	P1
Soil Capability	II	III	VI	V	VII
Climate Class	C2	C2	C2	C2	C2
Land Capability	II	III	VI	V	VII

No limitation	Low to Moderate	Moderate	High	Very Limiting

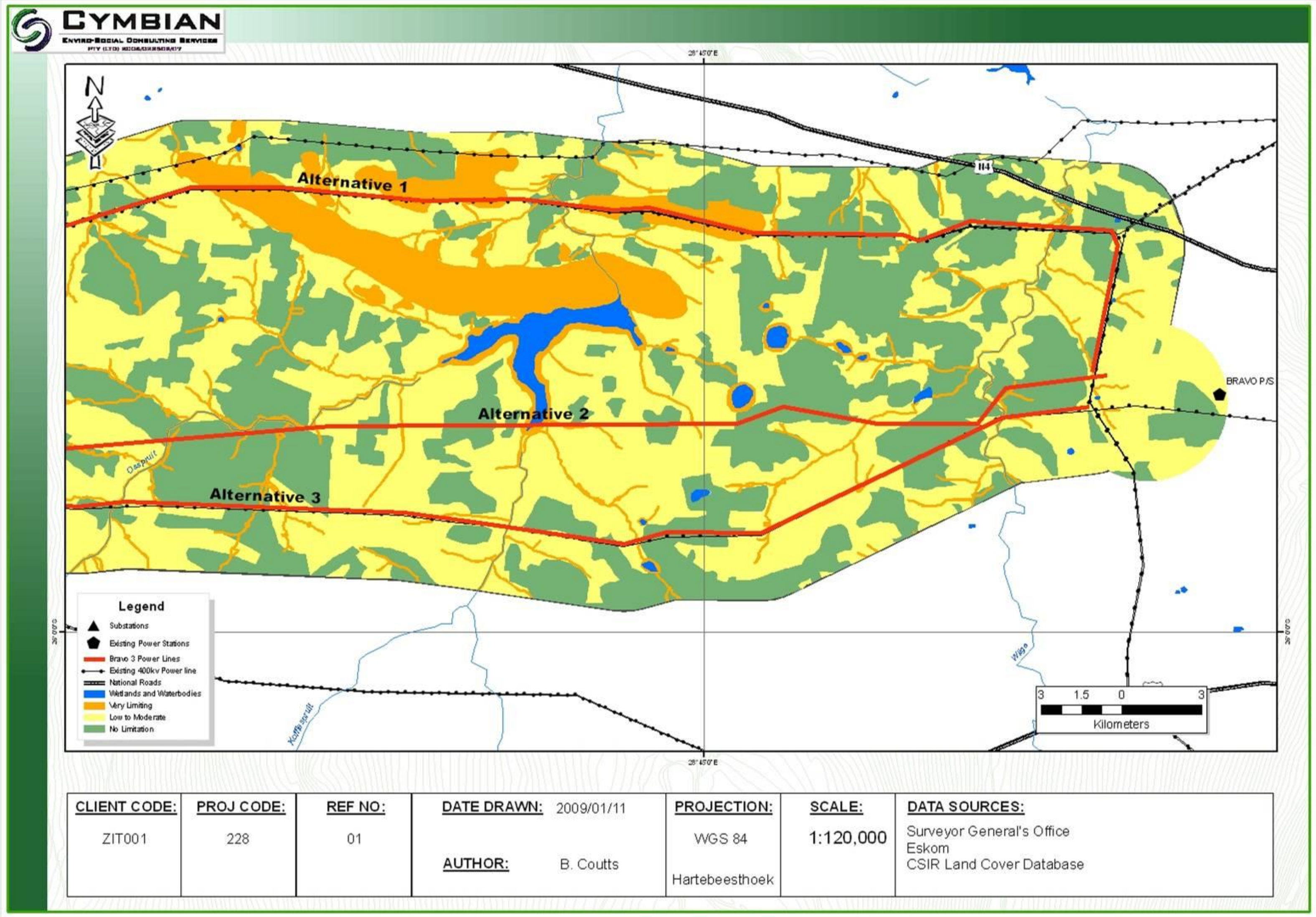

Figure 35: Eastern Land Capability Map

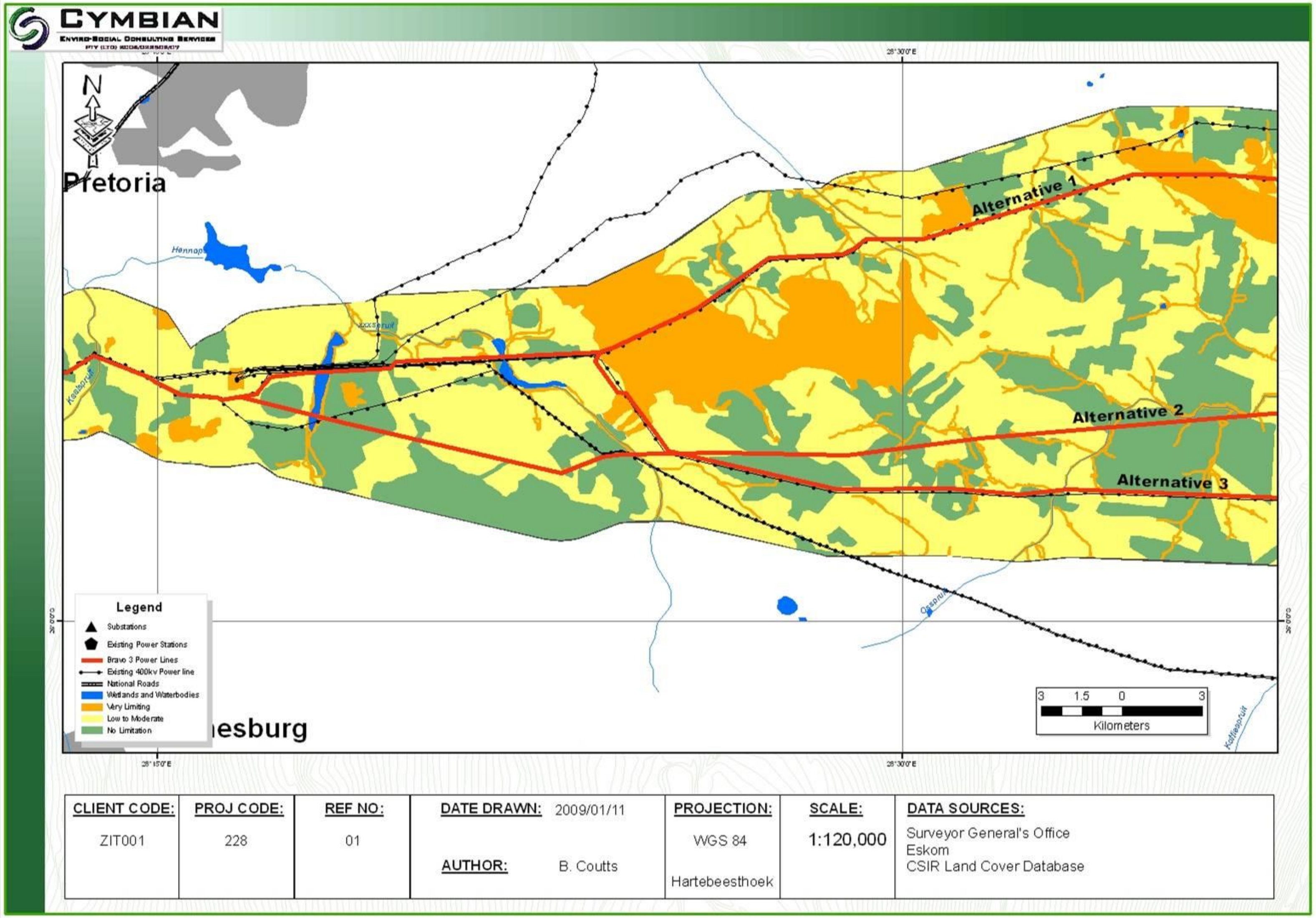

Figure 36: Central Land Capability Map

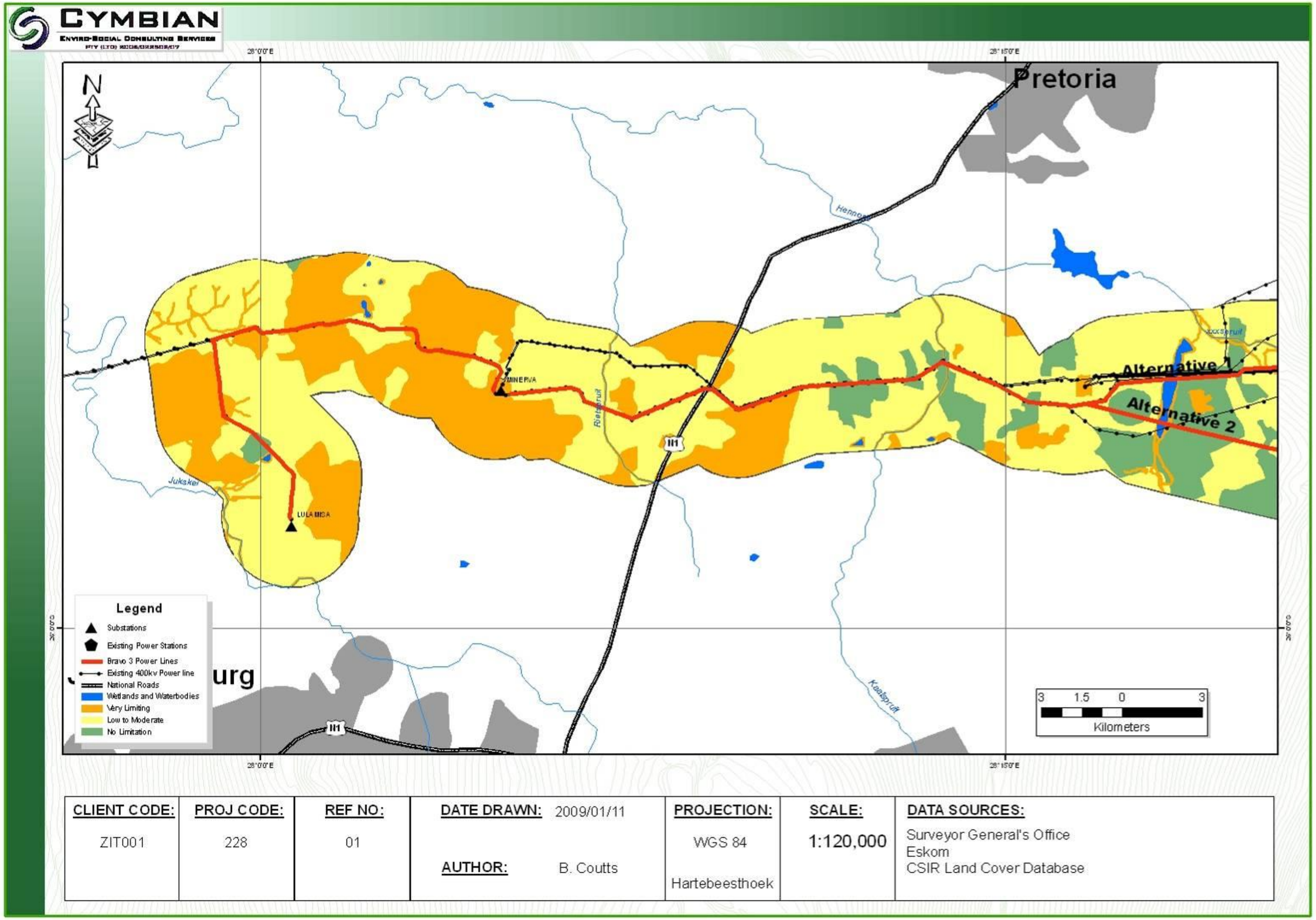

Figure 37: Western Land Capability Map

3.7 Land Use

3.7.1 Data Collection

Land Use was determined utilizing a GIS desktop study and confirmed during the site investigations conducted on the 28th-29th February 2008. The site investigation involved ground truthing the Land Use according to the maps produced using the desktop analysis. The data was obtained from the Council for Scientific Investigation and Research (CSIR). Their Land Cover database was used create the desktop maps.

3.7.2 Regional Description

The land use for the region is illustrated in Figure 35 below and the land used have been grouped into urban, cultivation, grassland/plantations, mines/erosion and water bodies/wetlands. From the map it is clear that the Gauteng area is dominated by urban developments, and upon moving to the east the dominance moves towards farming (grazing and cultivation) and open grasslands. Almost 80 % of the power line corridors cover areas used for farming or grasslands while the section of the corridor west of the N1 Highway moves into the urban areas

3.7.3 Site Description

When focusing on site specific descriptions the potential sensitivities arise due to the land use along the power line corridor. These sensitivities originate from two areas. Firstly public perception of power lines is often negative, and hence the "sensitivity" to power lines is usually higher in areas of higher population densities. The main sensitivities in this regard are the informal settlements located in Diepsloot and Olivienhoutbosch, the residential estate of Midrand Estates and a couple of planned developments just south-east of Pretoria (Celtic Village and Blue Crane Country Estate).

Secondly sensitivity can arise from current land use, where the land use itself poses a threat to the new power lines. This is the case in areas of mining, quarrying and water bodies. Immediately Alternative 2 has to be highlighted here, as the proposed alignment traverses over the Bronkhorstspruit Dam. The area around Bronkhorstspruit dam needs to be avoided during the detailed route planning of the power line alignments in the corridors. Not only is this of financial concern, but of aesthetics. On the ridge location adjacent to Bronkhorstspruit Dam there are upmarket houses built. Having a power line running through this area is of financial concern and destroys the aesthetics of the area; due to upmarket residential houses around the dam. The sentiment from residents could be negative, especially if the relatively pristine view of the dam is compromised by the proposed power line.

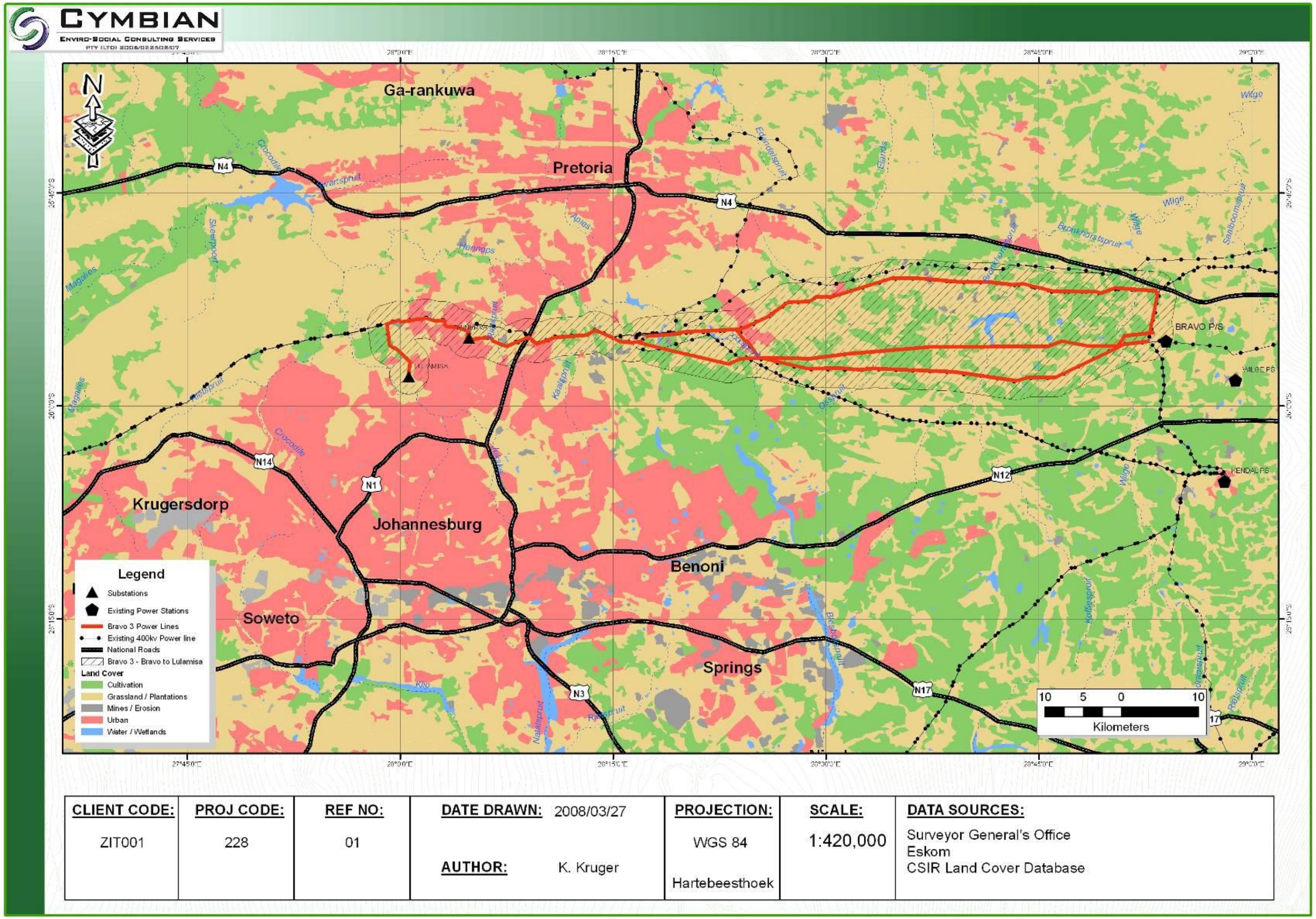

Figure 38: Land Use Map

In addition to the sensitivities noted above, it was observed during the site assessment that a number of the servitudes are located within an area of existing development, too such an extent that placing another power line along the existing lines might be impossible. This was particularly evident in the Midrand area between Olivienhoutbosch and Midstream estates. In addition the crossing of the N1 highway is already severely congested and will pose additional challenges. Further along the route to the west, adjacent to the N14 highway, the route traverse through Highveld Mushroom's property and thereafter crosses over the highway, onto land that is currently being mined for sand. In both these areas space is also limited. Lastly the informal settlements of Diepsloot and Olivienhoutbosch have a history of people trying to build houses in the existing servitudes and once again, space for additional lines is limited.

Even though these limitations exist, it does not influence the alternative selection, as this section of the route has only one alternative available. It is however, recommended that a detailed route analysis be undertaken by Eskom, as this report is part of an application for the entire corridor, more detailed work will be required.

3.8 Vegetation

3.8.1 Data Collection

The floral study involved extensive fieldwork, a literature review and a desktop study utilizing GIS. The site was investigated during two one week site visit, conducted from the 10^{th}-14^{th} March and from the 17^{th}-20^{th} of November 2008, in late summer and early spring respectively. The area within the servitude was sampled using transects placed at 300 m intervals. At random points along the transect an area of 20 m x 20 m was surveyed. All species within the 20 m x 20 m quadrant were identified, photographed and their occurrence noted. Sensitive features such as ridges or wetlands were sampled by walking randomly through the area concerned and identifying all species within the area.

The floral data below is taken from The Vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006). Also, while on site, the following field guides were used:

- Guide to Grasses of Southern Africa (Frits van Oudtshoorn, 1999);
- Field Guide to Trees of Southern Africa (Braam van Wyk and Piet van Wyk, 1997);
- Field Guide to the Wild Flowers of the Highveld (Braam van Wyk and Sasa Malan, 1998);
- Problem Plants of South Africa (Clive Bromilow, 2001);
- Medicinal Plants of South Africa (Ben-Erik van Wyk, Bosch van Oudtshoorn and Nigel Gericke, 2002)

The occurrence of the species was described as either:

- Very common (>50 % coverage);
- Common (10 – 50 % coverage);
- Sparse (5 – 10 % coverage); and
- Individuals (< 5 % coverage).

3.8.2 Regional Description

The area under investigation straddles two Biomes, namely the Savanna and the Grassland Biomes. Each biome comprises several bioregions which in turn has various vegetation types within the bioregion. The Grassland Biome is represented by Dry Highveld Grassland bioregion and Mesic Highveld Grassland bioregion, while the Savanna Biome is represented by Central Bushveld bioregion. Each of these bioregions is described below. These descriptions are adapted from Mucina and Rutherford, 2006.

Dry Highveld Grassland

Dry Highveld Grassland prevails in the western region of the Grassland Biome where the annual rainfall is below 600 mm per annum. These grasslands fall within the "sweet" grassland type with a predominance of chloridoid grasses.

In terms of conservation and disturbance, 44 % of the vegetation type is already transformed by cultivation, plantations, mines, and urbanisation. No serious alien invasion, but *Acacia mearnsii* can dominate in certain areas

Eastern Highveld Grassland

Highveld grasslands are found on the extensive central plateau of South Africa with its flat to undulating topography. The major environmental factors controlling vegetation patterns and the recognition of different vegetation types is annual rainfall, which forms an east to west gradient of decreasing moisture across the Highveld.

Mesic Highveld Grassland

Mesic Highveld Grassland is found mainly in the eastern, high rainfall regions of the Highveld, extending all the way to the northern escarpment. These are considered to be "sour" grasslands and are dominated by primarily andropogonoid grasses. The different grassland types are distinguished on the basis of geology, elevation, topography and rainfall. Shrublands are found on outcrops of rock within the bioregion, where the surface topography creates habitat in which woody vegetation is favoured above grasses.

Central Bushveld

The savanna bioregions in South Africa are distinguished by location. The Central Bushveld extends from the northern sections of the Gauteng Province northwards into the Limpopo Province. The savanna is typified by an herbaceous layer dominated by grasses and a discontinuous to open tree layer.

As mentioned above the corridors were visited for a lengthy period of time and the following vegetation types were identified along the route:

- Egoli Granite Grassland
- Rand Highveld Grassland
- Eastern Highveld Grassland
- Cartonville Dolomite Grassland
- Gold Reef Mountain Bushveld
- Andesite Mountain Bushveld
- Marikana Thornveld and
- Eastern Temperate Freshwater Wetlands

Although the above mentioned vegetation types occur, the vegetation within the corridors were often severely transformed with few remaining patches of natural vegetation. The routes are also heavily invaded by species such as *Eucalyptus* and black wattle (*Acacia mearnsii*), the latter forming dense stands throughout the site. The vegetation types identified on site are indicated in Figure 39, Figure 40 and Figure 41 below and described in detail in the site description taking into account areas that had been transformed.

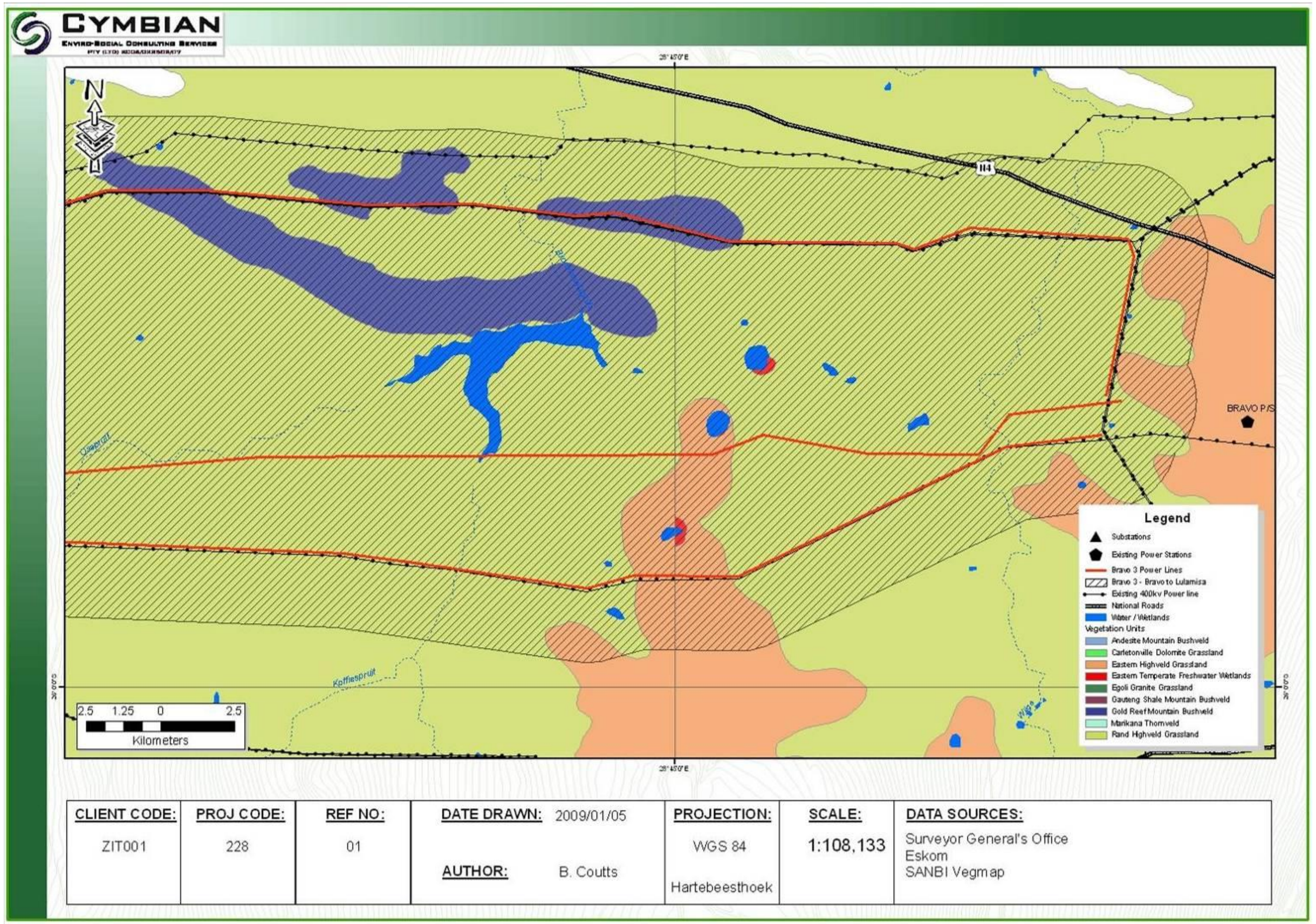
CYMBIAN
N
BRAVO P/S
Legend
Substations
Existing Power Stations
Bravo 3 Power Lines
Bravo 3 - Bravo to Lulamisa
Existing 400kv Power line
National Roads
Water / Wetlands
Vegetation Units
Andesite Mountain Bushveld
Carletonville Dolomite Grassland
Eastern Highveld Grassland
Eastern Temperate Freshwater Wetlands
Egoli Granite Grassland
Gauteng Shale Mountain Bushveld
Gold Reef Mountain Bushveld
Marikana Thornveld
Rand Highveld Grassland
2.5 1.25 0 2.5
Kilometers
CLIENT CODE: ZIT001
PROJ CODE: 228
REF NO: 01
DATE DRAWN: 2009/01/05
AUTHOR: B. Coutts
PROJECTION: WGS 84 Hartebeesthoek
SCALE: 1:108,133
DATA SOURCES: Surveyor General's Office Eskom SANBI Vegmap

Figure 39: Vegetation Unit Map

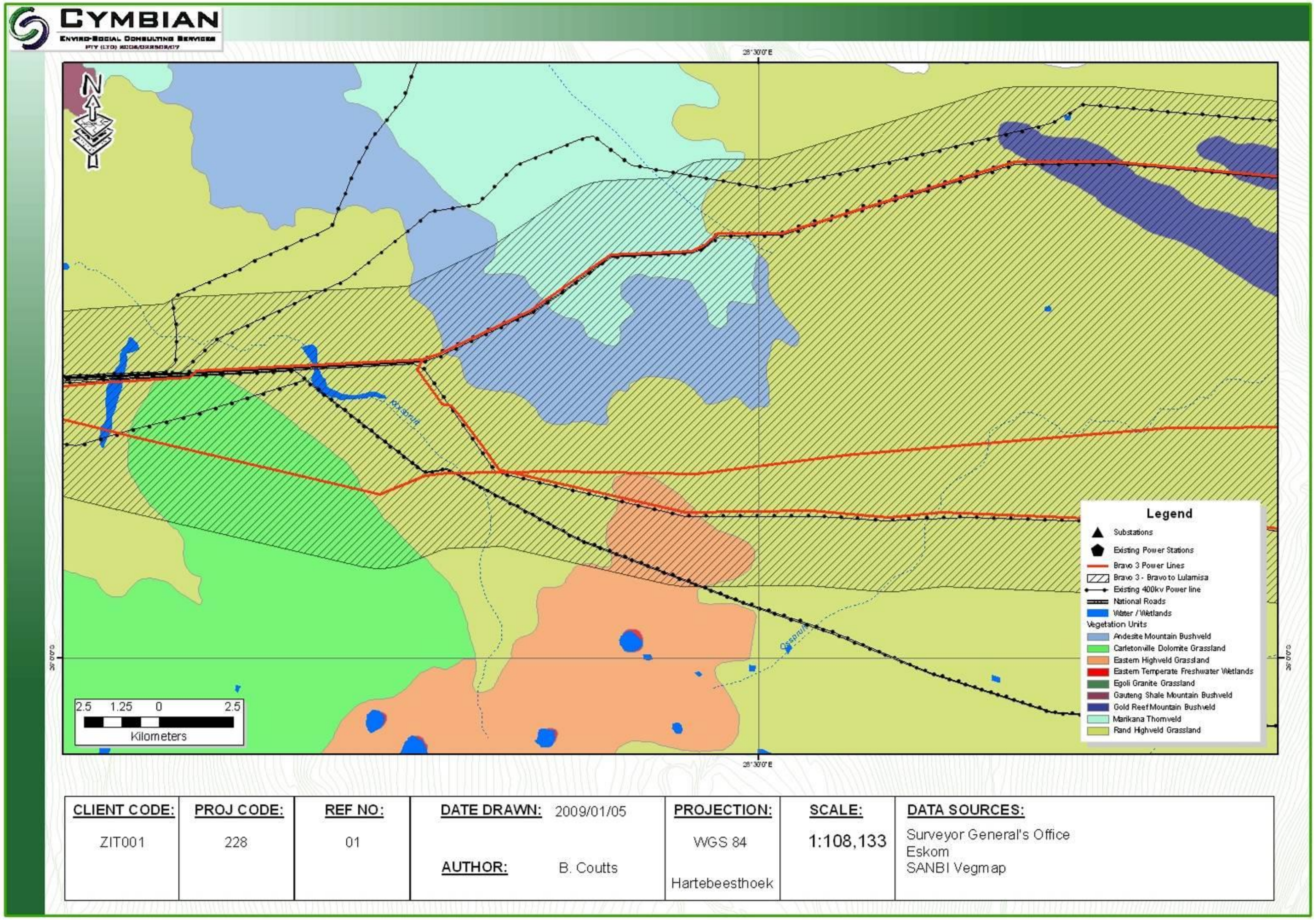

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Figure 40: Vegetation Unit Map

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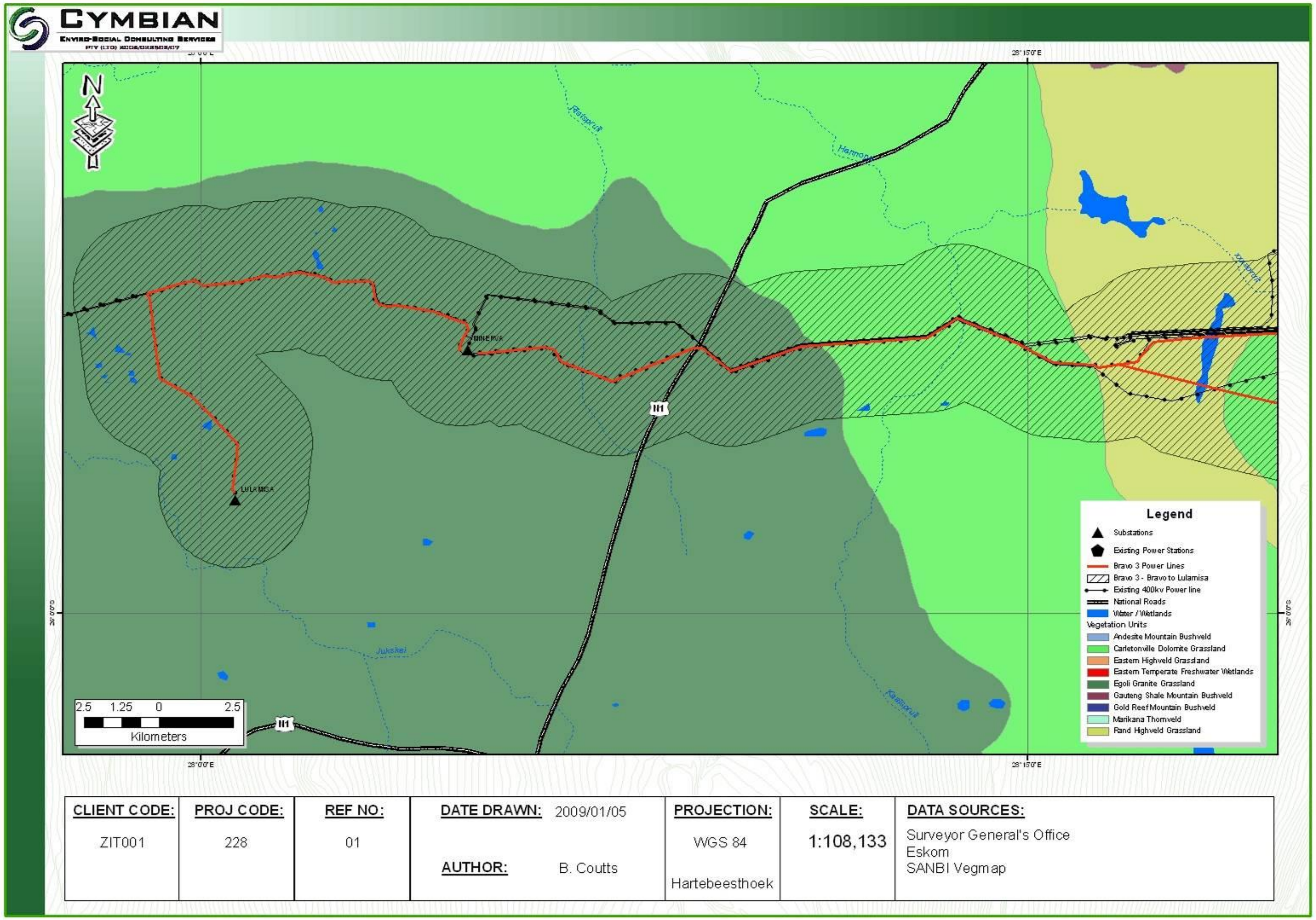

Figure 41: Vegetation Unit Map

3.8.3 Site Description

At the time of the site visit it was found that large sections of the area were being used for cultivation of crops, livestock and grazing lands, which can be seen from Figure 46, Figure 47 and Figure 48. Portions of the site were located on ridges where natural vegetation had very little disturbance in terms of grazing from livestock.

Three additional vegetation management units were identified; namely, cultivated fields/grazed pastures wetland/riparian zones, and disturbed areas. Each of these vegetation units are described in more detail below and illustrated in Figures below. The species list for the site is attached in Appendix 1. The species that could occur in the quarter degree grid was obtained from the Plants of Southern Africa (POSA) online database upheld by the South African National Botanical Institute (SANBI) and supplemented with field notes

Egoli Granite Grassland

The Egoli Granite Grassland vegetation type is found the Gauteng Province in the region between Johannesburg in the south, Muldersdrift in the west, Centurion in the north and Tembisa in the east. The moderately undulating plains and low hills support tall grassland, usually dominated by *Hyparrhenia hirta* with some woody species on rocky outcrops.

The vegetation type is listed as endangered as the vegetation type has a conservation target of 24 % conserved, while only 3 % is currently conserved. More than two thirds of the unit has already undergone transformation mostly by urbanisation, cultivation or by building of roads. Current rates of transformation threaten most of the remaining unconserved areas. There is no serious alien infestation in this unit, although species such as *Eucalyptus grandis*, *E. camaldulensis* and *E. sideroxylon* are commonly found. A species list with all the species identified for each vegetation type is attached in Appendix 1 and photos are given Figure 42 below. Approximately 25 % of the corridors fall within this vegetation unit.

Figure 42 Photos of Egoli Granite Grassland vegetation along the corridors

Rand Highveld Grassland

Rand Highveld Grassland is found in the highly variable landscape with extensive sloping plains and ridges in the Gauteng, North-West, Free State and Mpumalanga Provinces. The vegetation type is found in areas between rocky ridges from Pretoria to Witbank, extending onto ridges in the Stoffberg and Roossenekal regions as well as in the vicinity of Derby and Potchefstroom, extending southwards and northeastwards from there. The vegetation is species rich, sour grassland alternating with low shrubland on rocky outcrops. The most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon and Elionurus*. High numbers of herbs, especially *Asteraceae* are also found. In rocky areas shrubs and trees also prevail and are mostly *Protea caffra, Acacia caffra, Celtis africana and Rhus spp.*

This vegetation type is poorly conserved (approx 1 %) and has a target of 24 % of the vegetation type to be conserved. Due to the low conservation status this vegetation type is classified as endangered. Almost half of the vegetation type has been transformed by cultivation, plantations, urbanisation or dam-building. Scattered aliens (most prominently *Acacia mearnsii*) are present in the unit. Approximately 60 % of the corridors traverse Rand Highveld Grassland, thus the largest section of the route comprises this vegetation type. Photos are provided in Figure 42 below.

Figure 43:Photos of Rand Highveld Grassland

Eastern Highveld Grassland

The Eastern Highveld Grassland is found in the Mpumalanga and Gauteng Provinces on the plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. The landscape is dominated by undulating plains and low hills with short dense grassland dominating belong to the genera *Themeda, Aristida, Digitaria, Eragrostis, Tristachya etc*. Once again woody species are prevalent on the rocky outcrops.

In terms of conservation and disturbance, 44 % of the vegetation type is already transformed by cultivation, plantations, mines, and urbanisation. No serious alien invasion, but *Acacia mearnsii* can dominate in certain areas. For a complete species list, please refer to Appendix 1. Approximately 1.5 % of the route is covered by Eastern Highveld Grassland.

Carletonville Dolomitic Grassland

The Carletonville Dolomitic Grassland, as indicated by the name, is limited to the dolomitic regions of Potchefstroom, Ventersdorp and Carletonville, extending westwards to the vicinity of Ottoshoop, but also occurring as far east as Centurion and Bapsfontein in the Gauteng Province. This vegetation type is found on slightly undulating plains dissected by prominent ridges. Species rich grasslands forming a complex mosaic patterns dominate the vegetation type.

This vegetation type is poorly conserved (1.8 % and rated as vulnerable) and almost a quarter of the vegetation type is already transformed by cultivation, urban sprawl or by mining activities

Marikana Thornveld

The Marikana Thornveld vegetation type occurs on plains from the Rustenburg area in the west, through Marikana and Brits to the Pretoria area in the east. The vegetation type is typified by open *Acacia karroo* woodland occurring in the valleys and undulating plains. Shrubs are denser along drainage lines and it is common for the drainage lines to be infested with aliens. Refer to Figure 44 for photos of the Marikana Thornveld encountered along the route.

Marikana Thornveld is considerably impacted, with 48 % of the vegetation type being transformed, mainly due to cultivated and urban or built-up areas. Most agricultural development of this unit is in the western regions towards Rustenburg, while in the east (near Pretoria) industrial development is a greater threat of land transformation. This vegetation type is rated as endangered as only 0.7 % of the unit is conserved. Approximately 2.5 % of the route is covered by Marikana Thornveld.

Figure 44: Marikana Thornveld encountered along the route

Gold Reef Mountain Bushveld

Occurs along rocky quartzite ridges of the Magaliesberg and the parallel ridge to the south, from around Boshoek and Koster in the west to near Bronkhorstspruit in the east. The west-east-trending ridge of the Witwatersrand from around Krugersdorp in the west, through Roodepoort and Johannesburg to Bedfordview (Germiston District). Inner ridges (e.g. Dwarsberg and Witkop) of the Vredefort Dome on the Vaal River northwest of Parys and part of the Suikerbosrand and some other hills around Heidelberg.

The unit is typical mountain vegetation that is woodier than the surrounding plains, often with more dense woody vegetation on the south-facing slopes with distinct floristic differences. About 15 % of the unit is transformed by cultivation and urban built-up areas. Some areas have dense stands of the alien *Melia azedarach* which is often associated with drainage lines. Some 22 % of the unit is conserved and therefore the unit is rated as least threatened. Approximately 2.5 % of the route is covered by Gold Reef Mountain Bushveld.

Andesite Mountain Bushveld

The Andesite Mountain Bushveld vegetation unit is found in several separate occurrences of which the main are: the Bronberg Ridge in eastern Pretoria extending to Welbekend; from Hartebeesthoek in the west along the valley between the two parallel ranges of hills to Atteridgeville; hills in southern Johannesburg; several hills encompassing Nigel, Willemsdal, Coalbrook and Suikerbosrand (in part); and the outer ring of ridges of the Vredefort Dome and some hills to the northwest around Potchefstroom. The unit is typified by dense, medium-tall thorny bushveld with a well developed grass layer.

The unit is rated as least threatened due to the conservation of 6.8 % of the unit. The main sources of transformation are cultivation and urban development. Approximately 2.5 % of the route is covered by Andesite Mountain Bushveld.

Eastern Temperate Freshwater Wetlands

This vegetation unit is found throughout the Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Swaziland. It is based around water bodies with stagnant water (lakes, pans, periodically flooded vleis, and edges of calmly flowing rivers) and embedded within the Grassland Biome. These water bodies support zoned systems of aquatic and hygrophillous vegetation of temporary flooded grasslands and ephemeral herblands.

Due to the recent efforts of organisations such as Ramsar, this vegetation unit is now 4.6 % conserved and rated as least threatened. The following aliens are encountered in this type of wetland: *Bidens bidentata, Cirsium vulgare, Conyza bonariensis, Oenothera rosea, Physalis viscosa, Plantago lanceolata, Rumex crispus, Sesbania punicea, Schkuhria pinnata, Stenotaphrum secundatum* (native on South African coast, alien on Highveld*), Trifolium pratense, Verbena bonariensis, V. brasiliensis, and Xanthium strumarium*. Approximately 1 % of the route traverses through areas that could be classified as Wetlands (Refer Figure 45 below for photographs).

Areas around drainage lines/seepage areas were also added to this unit because of the similar vegetation that may occur in these areas. Seepage areas are seasonally wet areas that occur in sandy areas where water seeps into lowlying drainage lines after rains. These areas are usually covered by hygrophytes such as sedges and reeds. The dominant sedge in the study area is *Juncus rigidus*. Sometimes bulrush (*Typha capensis*) and reeds (*Phragmites australis*) also occurs.

Wetlands are of a more permanent nature and occur in low-lying areas such as tributaries of streams and rivers. Here hydrophytes can be found. Typical plants are the Orange River Lily (*Crinum bulbispermum*), bulrush (*Typha capensis*) and reeds (*Phragmites australis*), sedges of the *Cyperus, Fuirena and Scirpus* genera also occur. The site had many drainage and seepage lines running into large streams and into dams. Many of the site drainage and seepage lines had associated wetland and riparian flora. This made these areas have a high species diversity in terms of both plants and animals and makes them have a high conservation leve

Figure 45:Wetlands Found along the Power Line Corridors

Cultivated Fields

This was the main vegetation type found upon the site visit, were 80% of the site was cultivated land. Majority of the crops were maize and were being prepared for plantation of seeds. Very little to no natural occurring vegetation was located within the cultivated fields, besides invasive species such as *Tagetes minuta* (Langkakiebos).

Disturbed areas/vegetation

This area was located in areas that were highly disturbed from anthropogenic causes, such as overgrazing and bad land use management. Some of the species that exist in these plantations are *Acacia decurrens* (Sliver wattle) and *Acaia mearnsii* (Black wattle). These two species were originally used in the commercial field to produce tannins (Bromilow 2001). Like these species and other invasive trees that have became invaders of veld and indigenous bush, these plants are hard to remove and are fast growing. Invasive trees use a lot of water, which is already a valuable resource. Around these areas very little indigenous vegetation grew because of the dense forest these invaders can form. Other areas that were included are urban and industrial areas.

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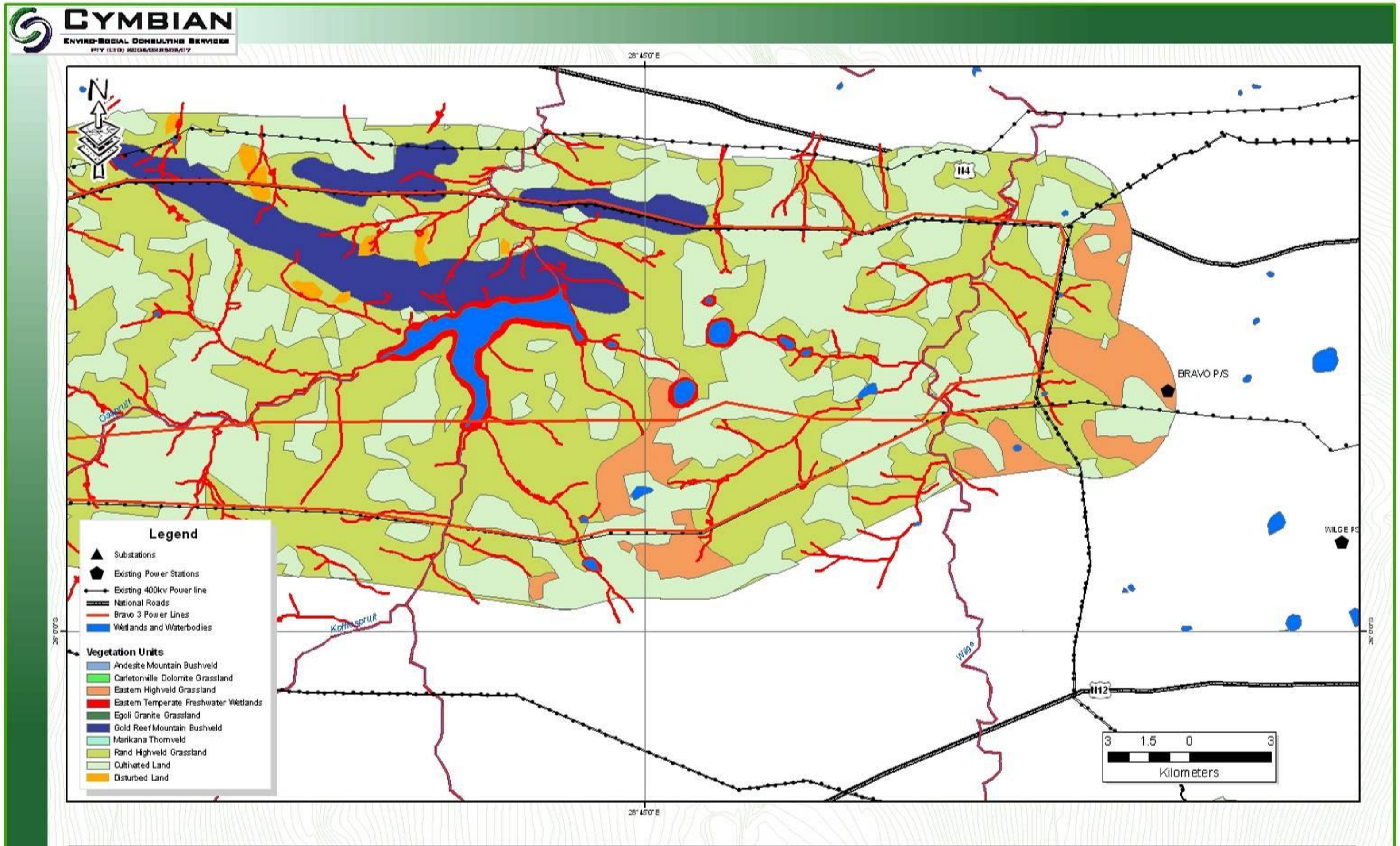

CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2009/01/13	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	228	01	AUTHOR: B. Coutts	WGS 84 Hartebeesthoek	1:126,498	Surveyor General's Office Eskom SANBI Vegmap

Figure 46: Western Vegetation Map

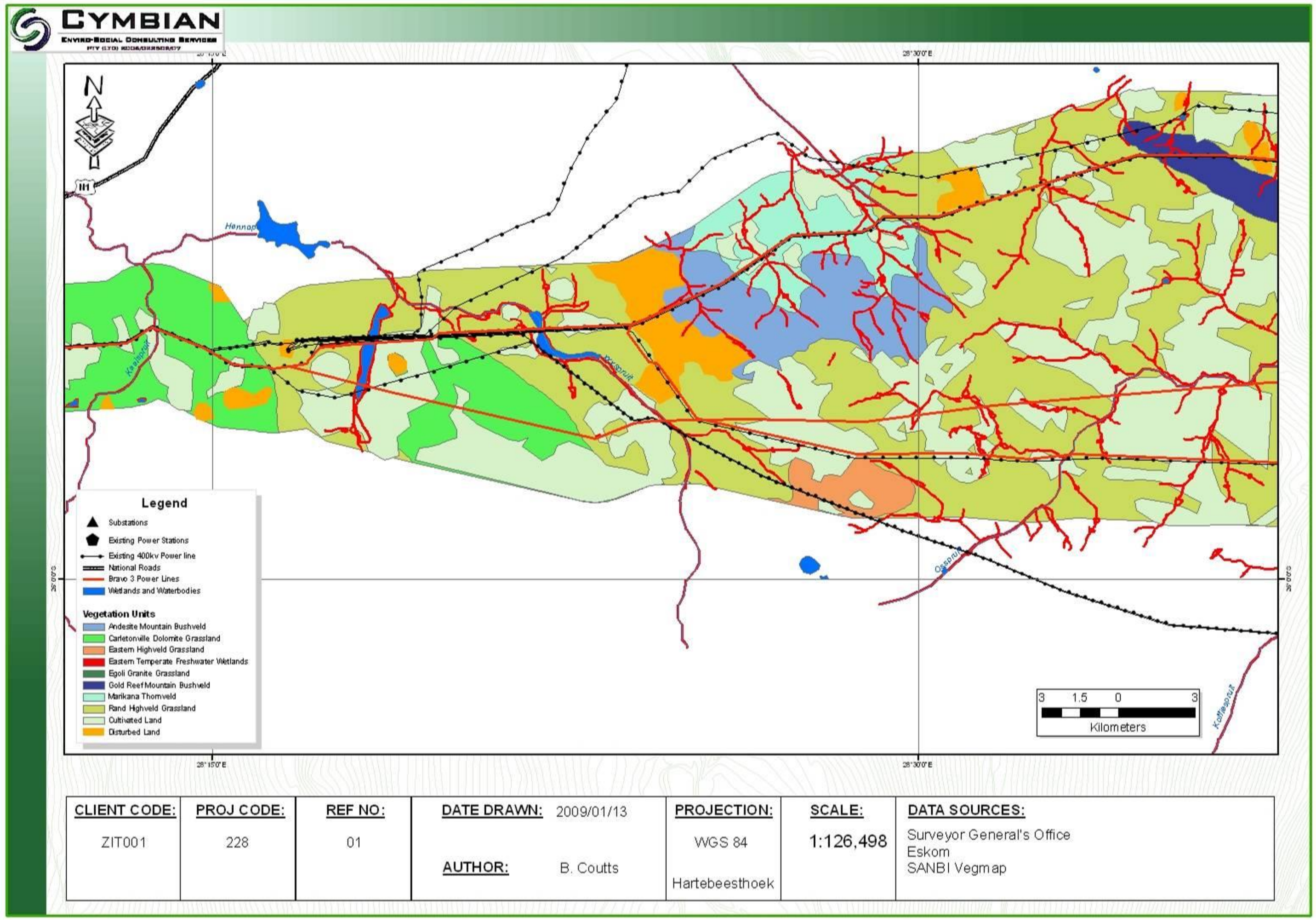

Figure 47: Central Vegetation Map

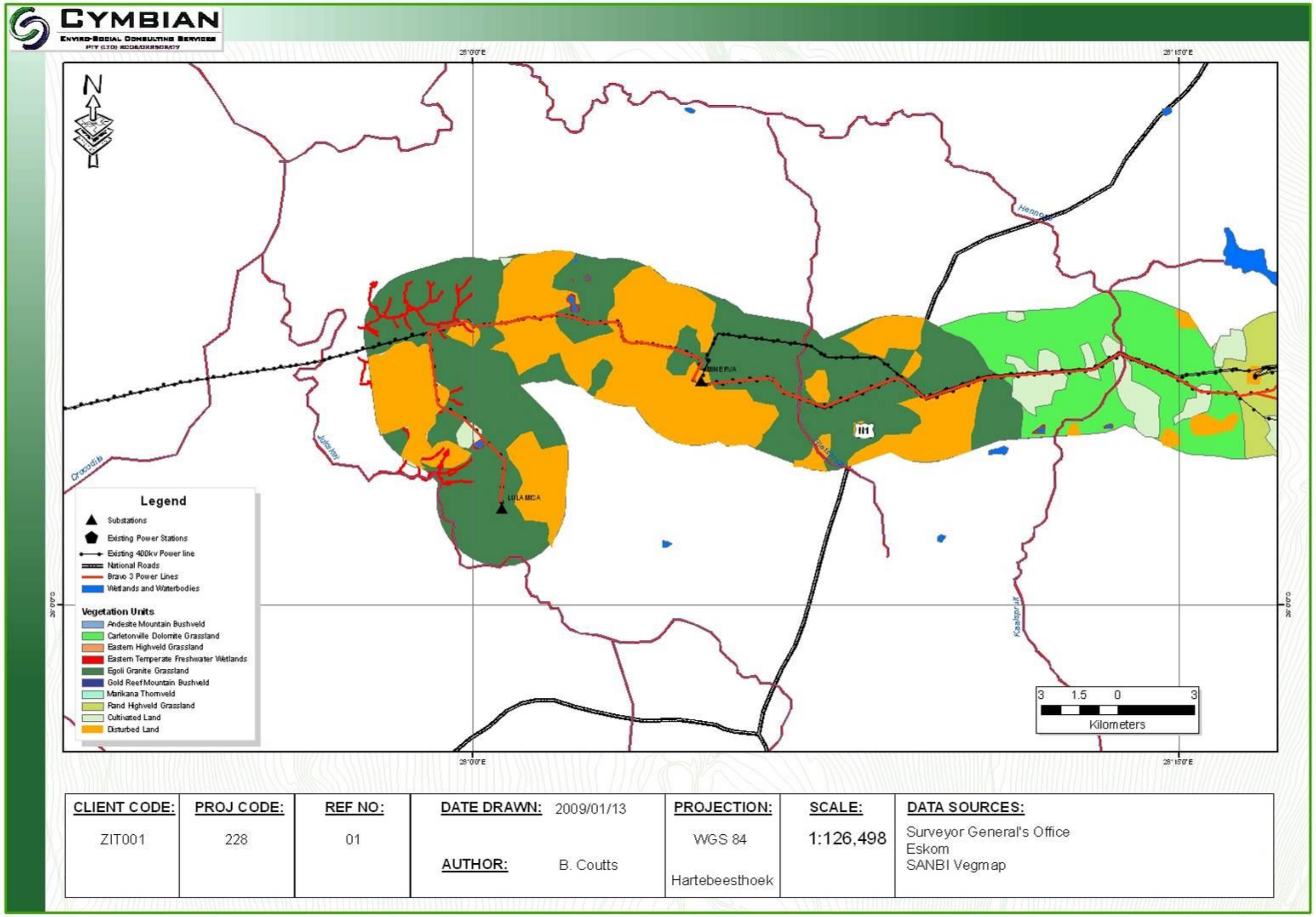

Figure 48: Western Vegetation Map

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3.8.4 Sensitivities

The ratings mentioned above in the site description are derived from the level of conservation of that specific vegetation type. This is useful for an overview perspective, but for detailed sensitivities the focus moves to red/orange data species. Due to the endangered status of the plants, their specific occurrence is kept confidential by GDACE. For guidance, the department has issued the Conservation Plan (CPlan) data which provides an indication as to the locality of red/orange data fauna or flora. Figure 49 illustrates the areas identified by CPlan as being sensitive. These areas have been investigated in detail for sensitive flora. It was found that the areas highlighted in Figure 49 are mostly wetlands, the Bronkhorstspruit Dam and ridges. All of these areas could provide habitat to sensitive species.

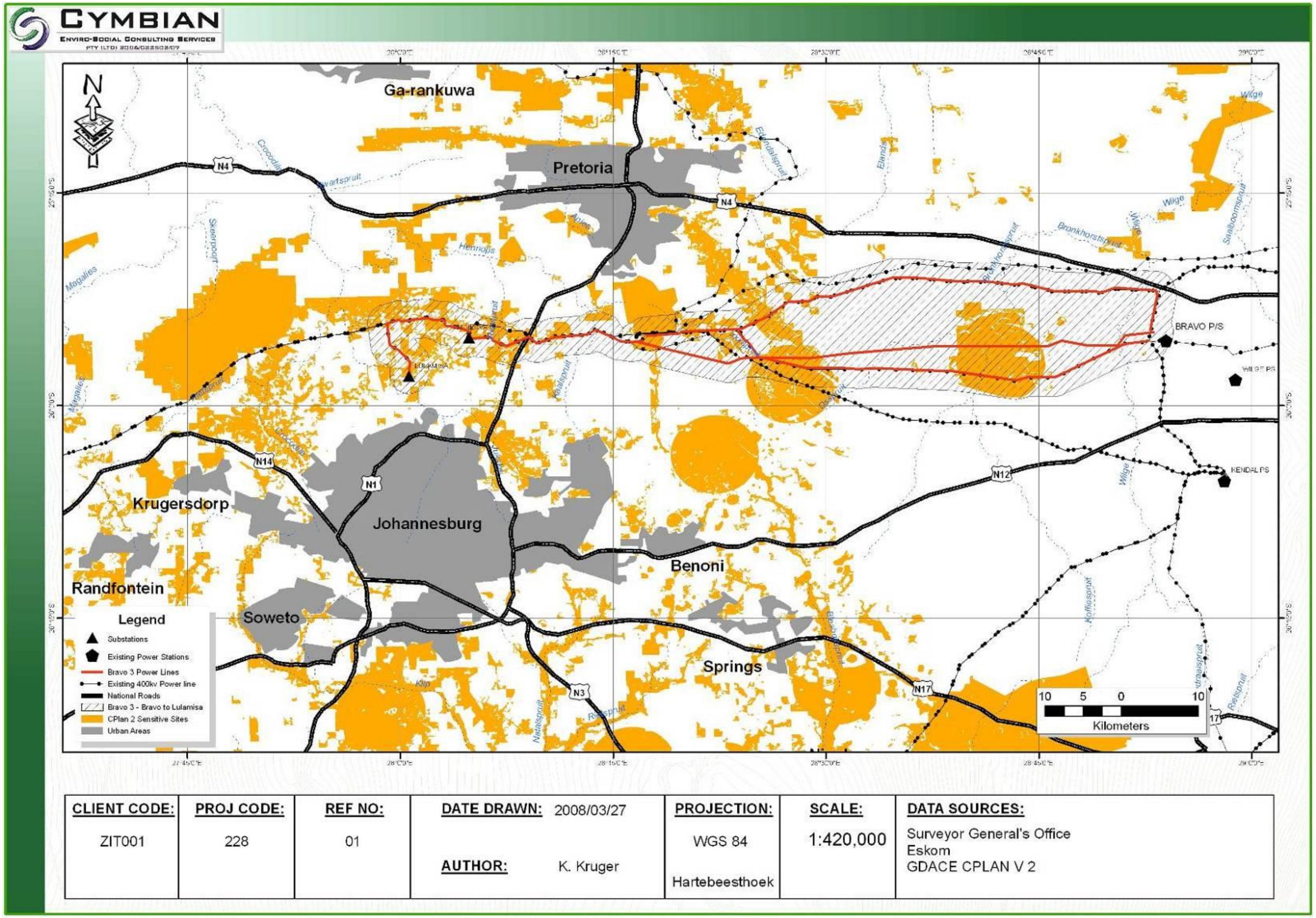

Figure 49: Sensitive Vegetation units found on site

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3.9 Fauna

3.9.1 Data Collection

A literature review of the faunal species that could occur in the area was conducted. C-Plan data provided from the Mpumalanga provincial department was used to conduct a desktop study of the area. This data consists of terrestrial and aquatic components, ratings provide an indication as to the importance of the area with respect to biodiversity. Additionally, all fauna were noted during the site visit conducted on the 10^{th}-14^{th} March and 18^{th} – 20^{th} November 2008.

3.9.2 Regional Description

As a consequence of mining and farming in the area, it appears that only small animals are to be found at the site. Small mammals known to occur in the area include hedgehog, rabbits, polecat, meerkat and the ubiquitous rats and mice. Given the habitat, it is likely that korhaans, larks, longclaws, species of Euplectes (bishops and widows), weavers, starlings and sparrows occur in the grassland.

The area surrounding the proposed loop in lines does include areas of terrestrial and aquatic habitats. These areas should be treated as sensitive and should therefore be managed accordingly; if feasible they should be avoided.

3.9.3 Site Description

The scope of work indicated that an avifauna assessment was required. An avifaunal assessment will be undertaken and the report will be provided as part of the EIA. All herpetofauna and mammals observed on site were noted during the site visit.

Habitat

The habitat on site is described in the vegetation site description in Section 3.8.3 above. All of the vegetation types identified have been disturbed to a certain extent, as the main land use in the area is grazing of livestock. Disturbed Grasslands, Riparian and Wetland areas were found on site. All of these are suitable habitat to a number of protected species found in the region.

Species potentially occurring on site

A detailed list of the species potentially occurring on site is attached in Appendix 2.

Herpetofauna

Herptofauna could potentially occur in all the habitat types. The Riparian and Wetland zones could potentially support amphibians representative of the region, specifically *Pyxicephalus adspersus* (African Bullfrog) which is a species rated as "near threatened" and is a protected species in South Africa.

The area can potentially contain *Geochelone pardalis* (Leopard tortoise), *Aparallactus capensis* (Cape Centipede Eater), *Atractaspis bibronii* (Southern or Bibron's Burrowing Asp), *Causus rhombeatus* (Common Night Adder), *Crotaphopeltis hotamboeia* (Herald or Red-lipped Snake), *Dasypeltis scabra* (Common or Rhombic Egg Eater), *Hemachatus haemachatus* (Rinkhals), *Lycodonomorphus rufulus* (Common Brown Water Snake), *Naja annulifera annulifera* (Snouted Cobra), *Psammophylax tritaeniatus* (Striped Skaapsteker), *Agama atra (*Southern Rock Agama*), Bitens arietans* (Puff Adder)*, Cordylus vittifer* (Transvaal Girdled Lizard)*, Gerrhosaurus flavigularis* (Yellow Throated Plated Lizard), *Lygodactylus ocellatus* (Spotted Dwarf Gecko), *Pachydactylus affinis* (Transvaal Thick-toed Gecko), *Telescopus semiannulatus semiannulatus* (Eastern Tiger Snake), *Psammophis brevirostris brevirostris* (Leopard or Short-snouted Grass Snake) and *Varanus niloticus (*Water Monitor). *Hemachatus haemachatus* (Rinkhals), *Psammophis brevirostris brevirostris* (Leopard or Short-snouted Grass Snake) and *Cordylus vittifer* (Transvaal Girdled Lizard) are endemic to Southern Africa, while *Lygodactylus ocellatus* (Spotted Dwarf Gecko) and *Pachydactylus affinis* (Transvaal Thick-toed Gecko) are endemic to South Africa.

None of the above mentioned Herpetofauna were encountered on site during the site visit that took place from the 10th-14th March and 18th to 20th November 2008.

Avifauna

A number of power line sensitive, Red Data species could potentially occur along any of the corridors in small densities, mostly in the remaining natural grassland (Refer to Table 4). The biggest potential risk that the proposed power line will pose, unless mitigated, is bird collisions with the earth wire of the proposed line. Other potential risks are the destruction of sensitive habitat through the construction of access roads, and disturbance of breeding birds during construction operations. The proposed corridors run through very similar habitat, which means that the potential bird impacts are likely to be similar in nature (but not in extent) along all the proposed corridors. The preferred corridor would be one that strives to avoid natural grassland or wetlands, or alternatively, is situated within the zone of influence of factors that lessen the risk of interactions for example, close to existing transmission lines or within urban areas. There is reason to believe that the impact of existing power lines may have been a major contributory factor to the low density and/or absence of power line sensitive grassland species such as cranes in the study area.

Table 4: Avifauna Red Data Species List

Species	Common Name	Conservation Status
Mycteria ibis	Yellow-Billed Stork	Near Threatened
Leptoptilos crumeniferus	Marabou Stork	Near Threatened
Gyps coprotheres	Cape Vulture	Vulnerable
Gyps africanus	White-Backed Vulture	Vulnerable
Aquila rapax	Tawny Eagle	Vulnerable
Aquila ayresii	Ayre’s Hawk-Eagle	Near Threatened
Polemaetus bellicosus	Martial Eagle	Vulnerable
Falco peregrinus	Peregrine Falcon	Near Threatened
Falco biarmicus	Lanner Falcon	Near Threatened
Bugeranus carunculatus	Wattled Crane	Critically Endangered
Crex crex	Corn Crake	Near Threatened
Podica senegalensis	African Finfoot	Vulnerable
Eupodotis caerulescens	Blue Korhaan	Near Threatened
Rostratula benghalensis	Greater Painted Snipe	Near Threatened
Glareola nordmanni	Black-Winged Pratincole	Near Threatened
Alcedo semitorquata	Half-Collared Kingfisher	Near Threatened
Mirafra cheniana	Melodious Lark	Near Threatened
Ciconia nigra	Black Stork	Near Threatened
Sagittarius serpentarius	Secretarybird	Near Threatened
Eupodotis senegalensis	White-Bellied Korhaan	Vulnerable
Phoenicopterus minor	Lesser Flamingo	Near Threatened
Phoenicopterus ruber	Greater Flamingo	Near Threatened
Falco naumanni	Lesser Kestrel	Vulnerable
Tyto capensis	African Grass-Owl	Vulnerable
Anthropoides paradiseus	Blue Crane	Vulnerable
Sterna caspia	Caspian Tern	Near Threatened
Circus ranivorus	African Marsh-Harrier	Vulnerable

Mammals

Large mammals have to a large extent been removed from the area and the only indication of large mammal species that could have previously occurred in the area are re-introduced mammals found on a few game farms and lodges encountered during the site visit. Such game farms can be found around the Apollo sub station. These include Springbok (*Antidorcas marsupialis*), Blesbok (*Damaliscus dorcas phillipsi*), Blue Wildebeest (*Connochaetes taurinus*) and Burchell's Zebra (*Equus burchelli*). During the site visit, Yellow Mongoose (*Cynictis pencillata*) was spotted as well as signs of other small mammals such as droppings. Other small mammals known to occur in the area include Hedgehog (*Atelerix frontalis*), Striped Polecat (*Ictonyx striatus*), Suricate / Meerkat (*Suricata suricatta*), Aardvark / Antbear (*Orycteropus afer*) and the ubiquitous rats and mice. Sensitive mammal species that could occur in the quarter degree square 2529CD include *Genetta tigrina* (Large-spotted Genet), *Lepus saxatilis* (Scrub hare), Hyaena *brunnea* (Brown Hyaena), *Sylvicapra grimmia* (Common/Grey Duiker), Tragelaphus scriptus (Bushbuck), Vulpes chama (Cape Fox). None of these species were identified on site.

3.10 Wetland and Riparian Zone Delineation

3.10.1 Riparian Zones vs. Wetlands

Wetlands

The riparian zone and wetlands were delineated according to the Department of Water Affairs and Forestry (DWAF) guideline, 2003: A practical guideline procedure for the identification and delineation of wetlands and riparian zones. According to the DWAF guidelines *a wetland* is defined by the National Water Act as:

"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

In addition the guidelines indicate that wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and
- A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50 centimetres of the soil.

During the site investigation the following indicators of potential wetlands were identified:

- Terrain unit indicator;
- Soil form Indicator;
- Soil wetness indicator; and
- Vegetation indicator.

Riparian Areas

According to the DWAF guidelines *a riparian area* is defined by the National Water Act as:

"Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas"

The difference between Riparian Areas and Wetlands

According to the DWAF guidelines the difference between a wetland and a riparian area is:

"Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a number of important functions, which need to be safeguarded… Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands display more diffuse flow and are lower energy environments."

3.10.2 <u>Delineation</u>

The site was investigated for the occurrence of wetlands and riparian areas, using the methodology described above and described in more detail in the DWAF guidelines.

Terrain Unit Indicator

The terrain on site varies from 1 520 mamsl to 1 420 mamsl as illustrated in Figure 10, Figure 11 and Figure 12. From the figures it can be seen that the site is located in an area of undulating hills with the dominant terrain units on site being the midslope, footslope and valley bottom units. According to the DWAF guidelines the valley bottom is the terrain unit where wetlands are most likely to occur, but they are not excluded from any of the other terrain units.

Soil Form Indicator

The majority of the site can be described as a typical Highveld plinthic catena. In the top parts of the slopes you find the rocky soils and then as the soil weathers and moves down the slope you start finding you agricultural soils. From here the action of water movement through the slope typifies the soils of the largest part of the site (eluvial and plinthic soils). Closer to the valley bottom terrain unit the soils gradually deepen due to the down-slope transport of soil (colluvium). In addition these soils have gradually higher percentages of clays that over time have been washed down-slope and accumulate at the valley bottom where the slope angle reduces.

During the site visit the soils on site were identified and mapped (Refer to Section 3.5). Of the soils identified on site the Katspruit, Willobrook, Arcadia and Rensburg soil form is indicative of the permanent wetland zone, while the Wasbank Longlands Kroonstad and Westleigh soil forms are indicative of the temporary wetland zone. There is also a possibility that the Avalon soil form can be indicative of the temporary zone.

Soil Wetness Indicator

The soils on site were subjected to a soil wetness assessment. If soils showed signs of wetness within 50 cm of the soil surface, it was classified as a hydromorphic soil and divided into the following groups:

Temporary Zone

- Minimal grey matrix (<10%);
- Few high chroma mottles; and
- Short periods of saturation.

Seasonal Zone

- Grey matrix (>10%);
- Many low chroma mottles present; and
- Significant periods of wetness (>3 months / annum).

Permanent Zone

- Prominent grey matrix;
- Few to no high chroma mottles;
- Wetness all year round; and
- Sulphuric odour.

The Katspruit, Wasbank, Willobrook, Arcadia; Rensburg and Longlands soil forms have signs of wetness in the soil profile. The Avalon soil form however did not have any signs of wetness. The Katspruit soil form was classified as the permanent zone, while the Wasbank and Longlands were classified as the temporary and seasonal zone. The soil forms are illustrated in Figure 14.

Vegetation Indicator

The vegetation units on site are described in Section 3.8.3 above and illustrated in. Figure 39, Figure 40 and Figure 41. The vegetation found in the moist grassland and the seepage zone vegetation units both have species present to indicate the presence of wetlands.

3.10.3 Wetlands and Buffer Zones

According to the methodology that was followed for delineation of wetlands by DWAF, there are wetlands present on site. It should however be noted that several of the so-called wetlands could also be classified as riparian zones as they follow the drainage path of the non-perennial streams on site. All the areas identified above perform critical ecosystem functions and also provide habitat for sensitive species. It is suggested that a 100m buffer be placed from the edge of the seasonal zone in order to sufficiently protect the wetlands and riparian zones. Alternative 2 is the best alignment, as it avoids most the sensitive wetlands as well as the buffer zones.

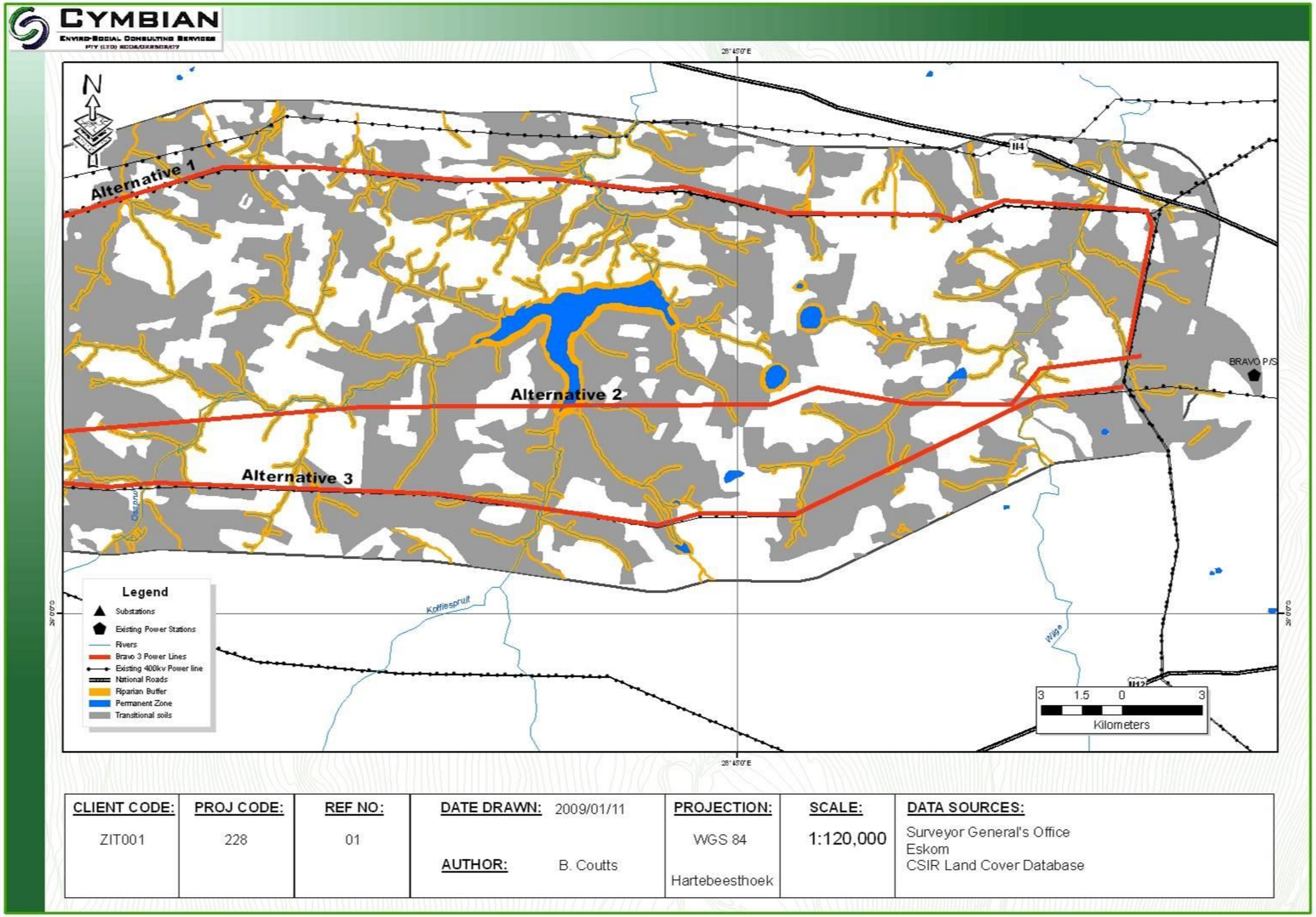

Figure 50: Riparian and wetland delineation map of the eastern section

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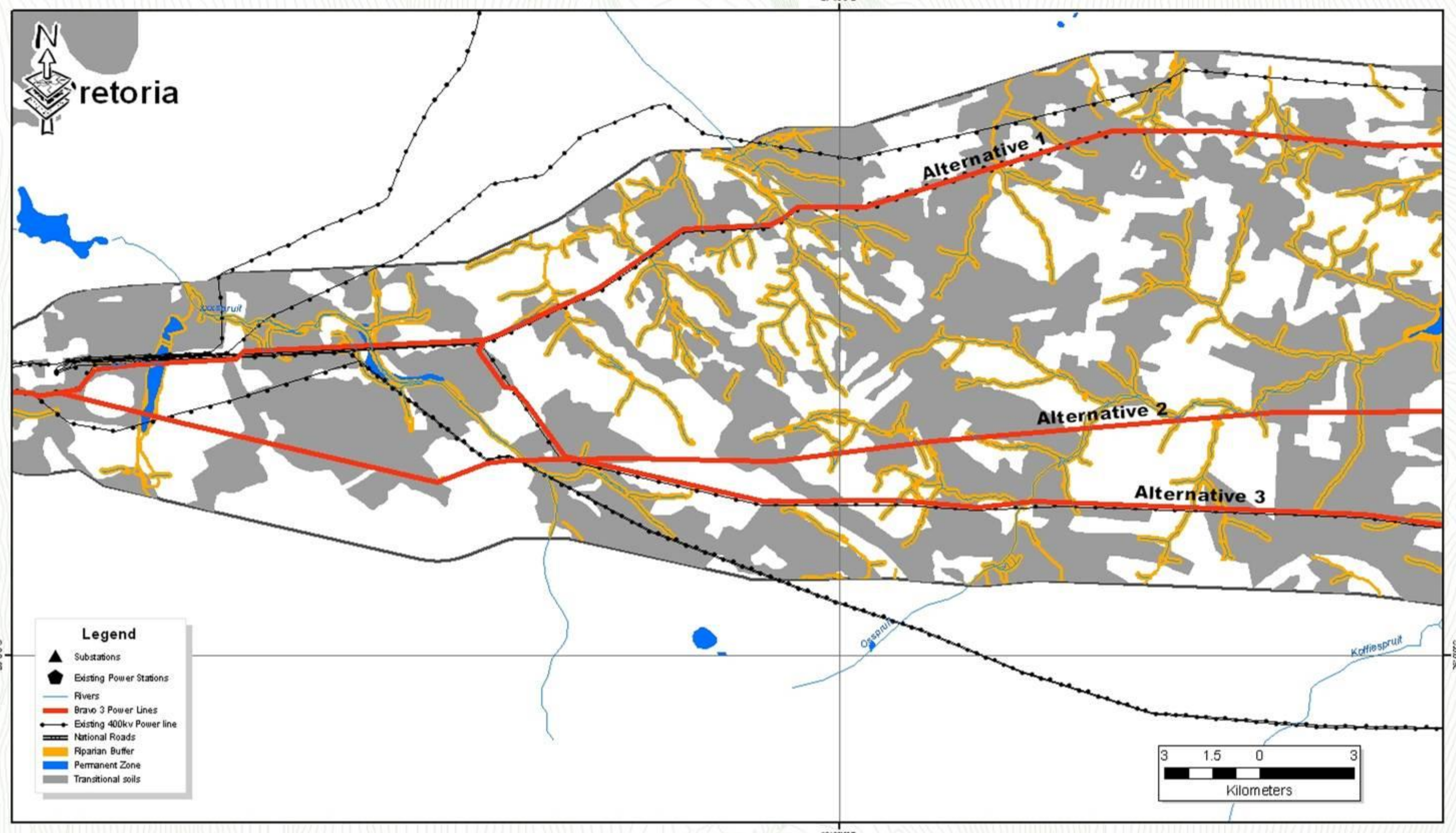


CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2009/01/11 AUTHOR: B. Coutts	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	228	01		WGS 84 Hartebeesthoek	1:120,000	Surveyor General's Office Eskom CSIR Land Cover Database

Figure 51: Riparian and wetland delineation map of the central section

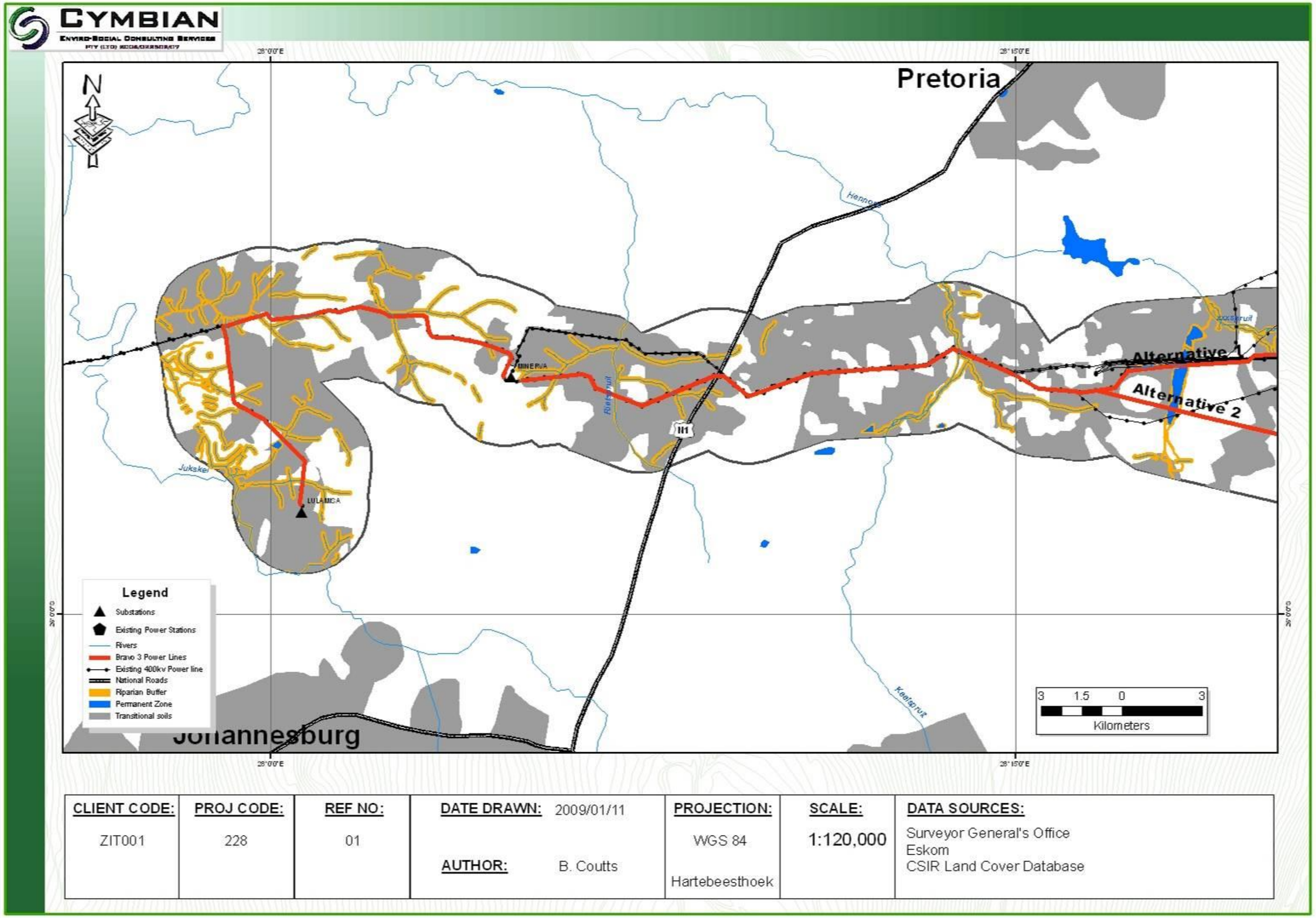


Figure 52: Riparian and wetland delineation map of the western section

3.11 Biodiversity Rating

In order to quantify the sensitivity of the fauna, flora and wetlands, a biodiversity assessment is undertaken.

3.11.1 Biodiversity Assessment Methodology

Each vegetation unit and its associated fauna were subjected to a biodiversity assessment according to the following methodology. The biodiversity of an area is measured as a combination of the variety of species and habitats within the area, as well as the ecological processes and functional value of the site. This can be captured in two broader categories namely conservation status and functional status. The conservation status encompasses species diversity, habitat diversity and ecological processes. The functional status encompasses ecological services and human use services.

It is suggested, due to the number of variables to be considered, that the following scoring system is used to first determine the value of each of the components (conservation status and functional status) from which the overall biodiversity value is determined.

Conservation status

The conservation status of a particular habitat / vegetation unit is determined using the methodology described in Table 5 below. The conservation status encompasses species diversity, habitat diversity and ecological processes. Each of the habitats found on site are rated accordingly in the Sections below.

Table 5: Conservation Status Determination

A. How much of the larger vegetation type or system of which the defined area is a representative example, still exists?	**Rating**
Only a small area still exists (< 500km^2)	5
A moderate area still exists (500 to 1000 km^2)	3
A large areas still exist (> 1000 km^2)	1
B. What is (based on a qualitative assessment) the species and habitat diversity of the defined area?	**Rating**
Noticeably high	5
Difficult to assess	3
Obviously low	1
C. What is the condition (qualitative assessment) of the defined area?	**Rating**
Pristine and largely undisturbed	5
Moderately disturbed	3
Highly disturbed	1

The possible results for the conservation status of the defined area are based on a combination of the attributes, as follows.

A (Size) + B (Diversity) + C (Condition) = Conservation Status

Based on the combined score, the conservation status can range from very high to low, as described below in Table 6:

Table 6: Conservation Status Rating

Conservation Status	Rating
High conservation status, needs to be maintained and improved	11 – 15
Moderate conservation status, heavily disturbed and will require improvement	6 – 10
Low conservation status, heavily reduced and of limited value.	3 – 5

Functional status

The functional status encompasses ecological services and human use services. All these elements are rated according to the methodology described in Table 7 below. A detailed rating of each habitat is given in Section 3.11.2 below.

Table 7: Functional Status Determination

A. Are there currently any signs of obvious recreational use of the area, such as walking/hiking, bird watching, mountain biking, fishing, etc?	Rating
Obvious signs of regular use	5
Signs of periodic use	3
No noticeable signs of use	1
B. Does the area carry out any ecological service, such as water purification, flood attenuation, riverbank stabilisation, soil stabilisation, etc?	**Rating**
Has an obvious functional role	5
Difficult to determine its functional role	3
Clearly has no to very limited functional role	1
C. Does the area serve an aesthetic role?	**Rating**
Forms part of a larger landscape that is widely visible and has a high aesthetic appeal	5
Forms part of a landscape that has high aesthetic appeal but which is not widely visible	3
Forms part of a landscape that has low aesthetic appeal	1

The possible results for the functional status of the defined area are based on a combination of the attributes, as follows.

A (recreational use) + B (ecological service) + C (aesthetic value) = Functional Status

Based on the combined score, the functional status can range from very high to low as illustrated in Table 8 below:

Table 8: Functional Status Rating

Functional Status	Rating
High service value	11 – 15
Moderate service value	6 – 10
Low service value	3 – 5

Biodiversity value

The perceived biodiversity value of an area to human development is not always easy to describe, but it includes the natural system and its variety of species, the ecological processes and the service or functional value that it provides. The combination of the conservation status and functional status scores provides a ranking of the overall biodiversity value for a defined area, as shown in the matrix in Table 9 below.

Table 9: Biodiversity Value Rating

	Functional status		
Conservation status	High service value	Moderate service value	Low service value
High	High	High	Moderate
Moderate	Moderate	Moderate	Low
Low	Moderate	Low	Low

3.11.2 <u>Biodiversity Rating</u>

Eight vegetation units were found on site and are given below:

- Egoli Granite Grassland
- Rand Highveld Grassland
- Eastern Highveld Grassland
- Cartonville Dolomite Grassland
- Gold Reef Mountain Bushveld

- Andesite Mountain Bushveld
- Marikana Thornveld and
- Eastern Temperate Freshwater Wetlands

Each of the abovementioned vegetation units are rated for their biodiversity value below.

Egoli Granite Grassland

This vegetation unit has a **High** biodiversity rating as indicated in Table 10 below. The **high** conservation value is attributed to the grassland species diversity and composition in the unit and the small area of Egoloi Granite Grassland remaining. The **high** functional rating is attributed to the obvious ecological services and the high aesthetic value of the Egoli Granite Grassland.

Table 10: Biodiversity Rating for the *Egoli Granite Grassland* unit

Conservation status	Size of vegetation unit	Species diversity	Condition
	5 – Small	5 - High	1 – Highly Disturbed
Functional status	Use	Ecological service	Aesthetic value
	3 – Periodic	5 – Obvious	3 - Moderate
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	11 – High	11 - High	High

Rand Highveld Grassland

This vegetation unit has a **moderate** biodiversity rating as indicated in Table 10 below. The **moderate** conservation value is attributed to the grassland species diversity and large percentage of grassland present. The **high** functional rating is attributed to the obvious ecological services and the high aesthetic value of the Rand Highveld Grassland.

Table 11: Biodiversity Rating for the *Rand Highveld Grassland unit*

Conservation status	Size of vegetation unit	Species diversity	Condition
	3 – Moderatel	5 - High	1 – Highly Disturbed
Functional status	Use	Ecological service	Aesthetic value
	3 – Periodic	5 – Obvious	5 - High
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	9 –Moderate	13 - High	Moderate

Eastern Highveld Grassland

This vegetation unit has a **low** biodiversity rating as indicated in Table 12 below. The **moderate** conservation value is attributed to the moderate grassland species diversity. The **low** functional rating is attributed to the low ecological services and the moderate aesthetic value of the grassland. Eastern Highveld Grassland makes up a very small part of the route and therefore has a low Biodiversity rating.

Table 12: Biodiversity Rating for the *Eastern Highveld Grassland* unit

Conservation status	Size of vegetation unit	Species diversity	Condition
	5 – High	3 - Moderate	1 – Highly Disturbed
Functional status	Use	Ecological service	Aesthetic value
	1 – none	1 - Low	3 - Moderate5 - High
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	9 – Moderate	5 - Low	Low

Cartonville Dolomite Grassland

This vegetation unit has a **moderate** biodiversity rating as indicated in Table 10 below. The **moderate** conservation value is attributed to the high species diversity and percentage of grassland present. The **moderate** functional rating is attributed to the ecological services that are difficult to determine and the moderate aesthetic value of the Cartonville Dolomite Grassland.

Table 13: Biodiversity Rating for the *Cartonville Dolomite Grassland unit*

Conservation status	Size of vegetation unit	Species diversity	Condition
	3 – Moderatel	5 - High	1 – Highly Disturbed
Functional status	Use	Ecological service	Aesthetic value
	3 – Periodic	3 - Undetermined	3 - Moderate
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	9 –Moderate	9 –-Moderate	Moderate

Gold Reef Mountain Bushveld

This vegetation unit has a **high** biodiversity rating as indicated in Table 14 below. The **high** conservation value is attributed to the Moderate species diversity and the low level of disturbance. The **high** functional rating is attributed to the aesthetic value of the vegetation unit.

Table 14: Biodiversity Rating for the *Gold Reef Mountain Bushveld* unit

Conservation status	Size of vegetation unit	Species diversity	Condition
	3 - Moderate	3 - Moderate	5 – Low disturbance
Functional status	Use	Ecological service	Aesthetic value
	3 - Periodic	3 - Undetermined	5 - High
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	11 - High	11 - High	High

Andesite Mountain Bushveld

This vegetation unit has a **high** biodiversity rating as indicated in Table 14 below. The **high** conservation value is attributed to the Moderate species diversity and the low level of disturbance. The **high** functional rating is attributed to the aesthetic value of the vegetation unit.

Table 15: Biodiversity Rating for the *Gold Reef Mountain Bushveld* unit

Conservation status	Size of vegetation unit	Species diversity	Condition
	3 - Moderate	3 - Moderate	5 – Low disturbance
Functional status	Use	Ecological service	Aesthetic value
	3 - Periodic	3 - Undetermined	5 - High
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	11 - High	11 - High	High

Marikana Thornveld

This vegetation unit has a **high** biodiversity rating as indicated in Table 10 below. The **high** conservation value is attributed to the species diversity and in the unit and the small area of Marikana Thornveld remaining. The **moderate** functional rating is attributed to the undefined ecological services and the moderate aesthetic value of the Marikana Thornveld. This vegetation unit has been classified as endangered.

Table 16: Biodiversity Rating for the *Marikana Thornveld* unit

Conservation status	Size of vegetation unit	Species diversity	Condition
	5 – Small	5 - High	1 – Highly Disturbed
Functional status	Use	Ecological service	Aesthetic value
	3 – Periodic	3 -Undefined	3 - Moderate
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	11 – High	9 - Moderate	High

Eastern Temperate Freshwater Wetlands

This vegetation unit has a **high** biodiversity rating as indicated in Table 17 below. The **high** conservation value is attributed to the high grassland species diversity in the unit and the small area of wetlands remaining. The **high** functional rating is attributed to the obvious ecological services and the high aesthetic value of the wetlands and seepage areas.

Table 17: Biodiversity Rating for the *Eastern Temperate Freshwater Wetlands*

	Size of vegetation unit	Species diversity	Condition
Conservation status	5 – Small	5 – High	3 – Moderately Disturbed
	Use	**Ecological service**	**Aesthetic value**
Functional status	1 – none	5 – Obvious	5 - High
	Conservation status	**Functional status**	**Biodiversity**
Biodiversity Rating	13 – High	11 - High	**High**

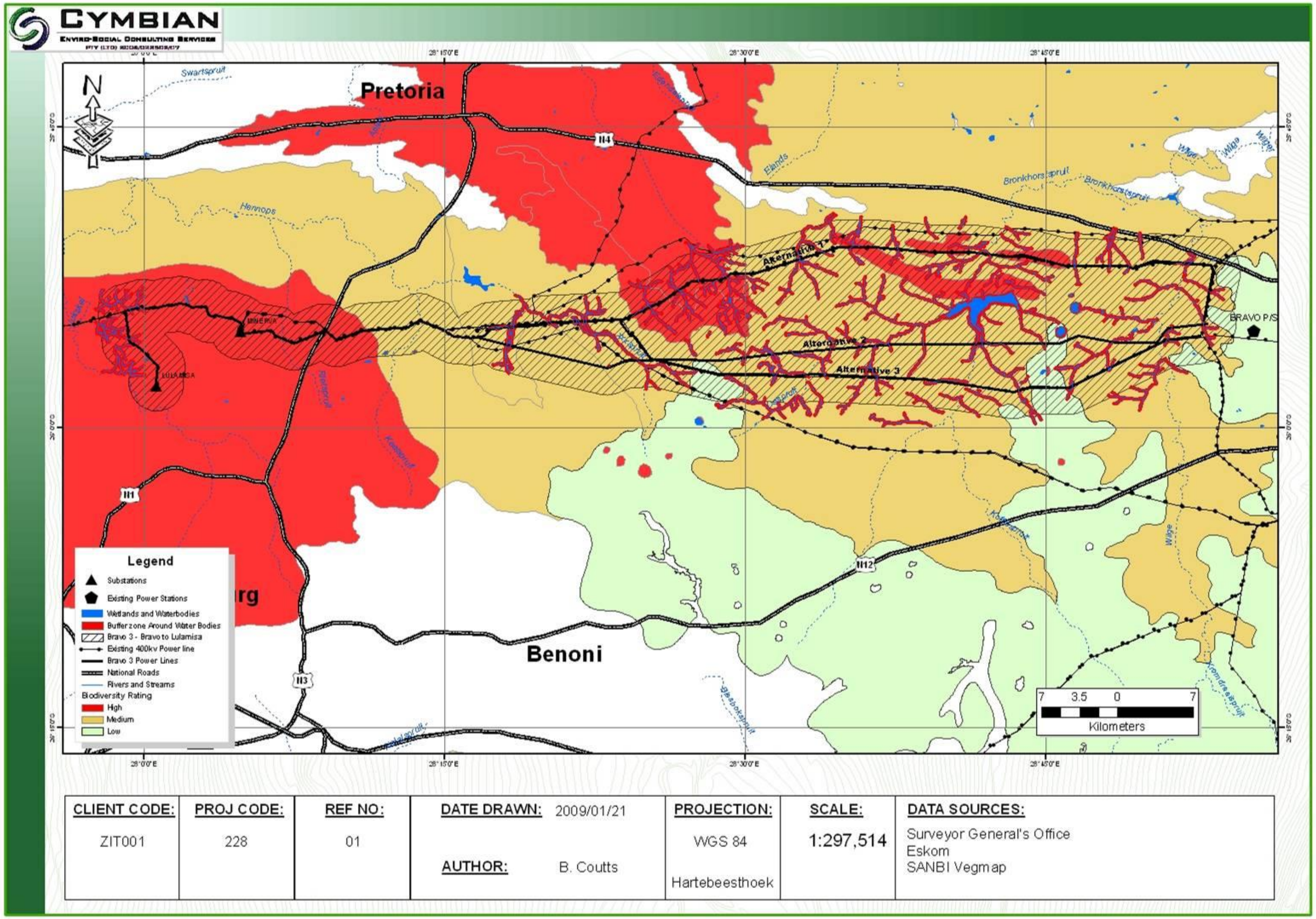


Figure 53: Biodiversity Rating Map

4.0 VISUAL IMPACT ASSESSMENT

4.1 Introduction

The site and surrounding are may be described as agriculultal land utilised mainly for fariming and grazing cattle. As the Powerlines move towards Pretoria and Midrand the land use changes to residential, commercial and industrial utilization, the topograpy of the site can be described as gently undulating to moderately undulationg landscape typical of the highveld region

The Proposed power lines are located to the west of the new Bravo Power station and traverse towards Pretoria and Midrand areas and connect to Lulimisa Sub station with the station and other existing power lines featuring prominently in the landscape. Other features the are prominet in the landscape are Johannesburg, Pretoria and Midrand.

4.2 Methodology

The methodology adopted for the visual assessment includes the following tasks:

- Examine the baseline information (contours, building dimensions, vegetation, inter alia);
- Determine the area from which any of the upgrade may be visible (viewshed);
- Identify the locations from which views of the upgrade may be visible (observation sites), which include buildings and roads;
- Analyse the observation sites to determine the potential level of visual impact that may result from the upgrade; and
- Identify measures available to mitigate the potential impacts.

Each component of the assessment process is explained in detail in the following sections of the Report.

4.2.1 The Viewshed

The viewshed represents the area from which the proposed site would potentially be visible. The extent of the viewshed is influenced primarily by the combination of topography and vegetation, which determine the extent to which the site would be visible from surrounding areas.

The viewshed was determined by Cymbian through the following steps and presumptions:

- The likely viewshed was determined by desktop study (ArcGIS) using contour plans (20 m interval); and

- ➲ An offset of 2 m (maximum) for the observer and an offset of 30 m (maximum) for the proposed power lines were utilized during the spatial analysis.

4.2.2 Visibility Assessment

Site visibility is an assessment of the extent to which the proposed upgrade would potentially be visible from surrounding areas. It takes account of the context of the view, the relative number of viewers, duration of view and view distance.

The underlying rationale for this assessment is that if the proposed upgrade (power lines) is not visible from surrounding areas then the development will not produce a visual impact. On the other hand if one or more power lines are highly visible to a large number of people in surrounding areas then the potential visual impact is likely to be high.

Based on a combination of all these factors an overall rating of visibility was applied to each observation point. For the purpose of this report, categories of visibility have been defined as high (H), moderate (M) or low (L).

4.2.3 Assessment Criteria

For the purpose of this report, the quantitative criteria listed in Table 18 have been determined and used in the Visibility Assessment. The criteria are defined in more detail in the subsection following.

Table 18: Visual Impact Assessment Criteria

CRITERIA	DEFINITIONS
Category of Viewer	
Static	***Farms, homesteads or industries***
Dynamic	***Travelling along road***
View Elevation	
Above	***Higher elevation then proposed upgrade.***
Level	***Level with upgrade view***
Below	***Lower elevation then upgrade viewed***
View Distance	
Long	***> 5 km***
Medium	***1 – 5 km***
Short	***200 m – 1000 m***
Very Short	***< 200 m***
Period of View	
Long Term	***> 120 minutes***
Medium Time	***1 – 120 minutes***
Short Term	***< 1 minute***

Category Viewer

The visibility of the upgrade will vary between static and dynamic view types. In the case of static views, such as views from a farmhouse or homestead, the visual relationship between an upgrade and the landscape will not change. The cone of vision is relatively wide and the viewer tends to scan back and forth across the landscape.

In contrast views from a moving vehicle are dynamic as the visual relationship between the upgrade and structures is constantly changing as well as the visual relationship between the upgrade and the landscape in which they are seen. The view cone for motorists, particularly drivers, is generally narrower than for static views.

View Elevation

The elevation of the viewer relative to the object observed, which in this case are the upgrade / structure, significantly influences the visibility of the object by changing the background and therefore the visual contrast. In situations where the viewer is at a higher elevation than the building/structure it will be seen against a background of landscape. The level of visual contrast between the upgrade and the background will determine the level of visibility. A white/bright coloured structure seen against a background of dark/pale coloured tree-covered slopes will be highly visible compared to a background of light coloured slopes covered by yellow/brown dry vegetation.

In situations where the viewer is located at a lower elevation than the proposed upgrade it will mostly be viewed against the sky. The degree of visual contrast between a white coloured structure will depend on the colour of the sky. Dark grey clouds will create a significantly greater level of contrast than for a background of white clouds.

View Distance

The influence of distance on visibility results from two factors:

- With increasing distance the proportion of the view cone occupied by a visible structure will decline; and
- Atmospheric effects due to dust and moisture in the air reduce the visual contrast between the structure and the background against which they are viewed.

Period of View

The visibility of structures will increase with the period over which they are seen. The longer the period of view the higher the level of visibility. However, it is presumed that over an extended period the level of visibility declines as people become accustomed to the new element in the landscape.

Long term views of the upgrade will generally be associated with rest camps located within the viewshed. Short term and moderate term views will generally relate to tourist moving through the viewshed mostly by vehicle.

Site Visibility

The procedure followed by Cymbian to assess Site Visibility involved:

- Generate a viewshed analysis of the area utilizing ArcGIS 9.
- Determine the various categories of observation points (e.g. Static, Dynamic).

4.2.4 Impact Assessment Methodology

Visual impact is defined as the significance and/or severity of changes to visual quality of the area resulting from a development or change in land use that may occur in the landscape.

Significance or severity is a measure of the response of viewers to the changes that occur. It represents the interaction between humans and the landscape changes that they observe. The response to visible changes in the landscape may vary significantly between individuals.

Perception results from the combination of the extent to which the proposed upgrade is visible (level of visibility) and the response of individuals to what they see. A major influence on the perception of people/tourist in relation to the proposed upgrade will be the visual character and quality of the landscape in which it would be located. Natural landscape areas such as national parks, mountain areas or undeveloped sections of coast are valued for their high visual quality. The introduction of buildings and associated infrastructure may be seen as a negative impact on these areas of high visual quality. In the case of rest camps many people perceive them in a positive manner because they represent tourism/conservation infrastructure usually elegantly designed, non-conspicuous and contributing the local and national economy.

The potential visual impact of the proposed upgrade will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on the level of the visual contrast between buildings/structures and the existing landscape within which they would be viewed.

The degree of contrast between the upgrade and the surrounding landscape will result from one or more of the following visual characteristics:

- Colour;
- Shape or form;
- Scale;
- Texture; and
- Reflectivity.

4.3 Visual Character

4.3.1 Landscape Character

The landscape character is described in detail above under the Topography section. Figure 54 below illustrates some of the existing power lines on site.

Figure 54: View of the existing power line on site

4.3.2 Viewshed

It should be noted that the viewsheds generated are only an approximation for each alternative that has been generated in Figure 55, Figure 56, Figure 57 and Figure 58. Proposed views for the upgraded maybe blocked by buildings, vegetation and changes in local topography. Potential glimpses of the proposed upgrade may be available outside of the generated viewshed maps because of high elevation localities. Each figure represents the visibility of each alternative. The colours indicate the visibility of each alternative from the surrounding landscape. The green represents a low visibility of the proposed upgrade and the red represents a high visibility of the upgrade from the surrounding environment. From Lulamisa to Minerva shows a low visibility from the surrounding area, which may be false because of the land use around and near the Lulamisa substation. Located around the area is a high informal residential area, which is not taken into account in the generating the viewshed.

Notable features of the viewshed are summarised by the following points:

- The viewshed extends a great distance south of the proposed upgrade
- To the north the viewshed is limited by a ridge, which Alternative 1 will run along
- To the west the viewshed has a higher visibility due to the locality of Pretoria, Johannesburg and Midrand
- The viewshed to the west extends approximately 60 km to the west

4.4 Impact Assessment

The visual simulations prepared by Cymbian illustrate the extent to which the upgrade will be visible from key observation points (static and dynamic views).

The vertical form/dimensions of the buildings/structures would be hidden by their location among existing buildings and within a well vegetated area. The visual contrast is increased by the “shape” and scale of the buildings/structures, which generally will not be viewed along the skyline.

Static Views

The upgrade would potentially be visible from the Bronkhortspruit, and Bapsfotein areas with respect to viewshed Alternatives 1, 2 and 3. The visibility would potentially be low because the farmlands in the area are sparsely populated. These views would differ greatly depending on locality from the upgrade and the local topography. Site specific conditions need to be taken into account, such as vegetation, buildings and fences, which may hinder ones view of the power line upgrade

Dynamic Views

The power lines will potential be visible from the N4 highway mainly to those travelling along this route. The power lines cross over the N1 highway and at this stage will be visible for motorists travelling along this route for approximately 0.25 seconds travelling at 120km/h. other roads that intersect the power lines is the R42, R25, 515, R21, R55 and the R28, which all would have similar visibility to motorists. The traffic the road carries has to be taken into account. National roads, such as the N1 and N4 carry higher volumes of traffic resulting in higher visibility of the power lines. Surrounding atmospheric conditions would also affect the visibility of the power lines. Rainy days will result in a lower visibility. Table 19 gives a summary of the dynamic impacts. This is similar for both route Alternatives

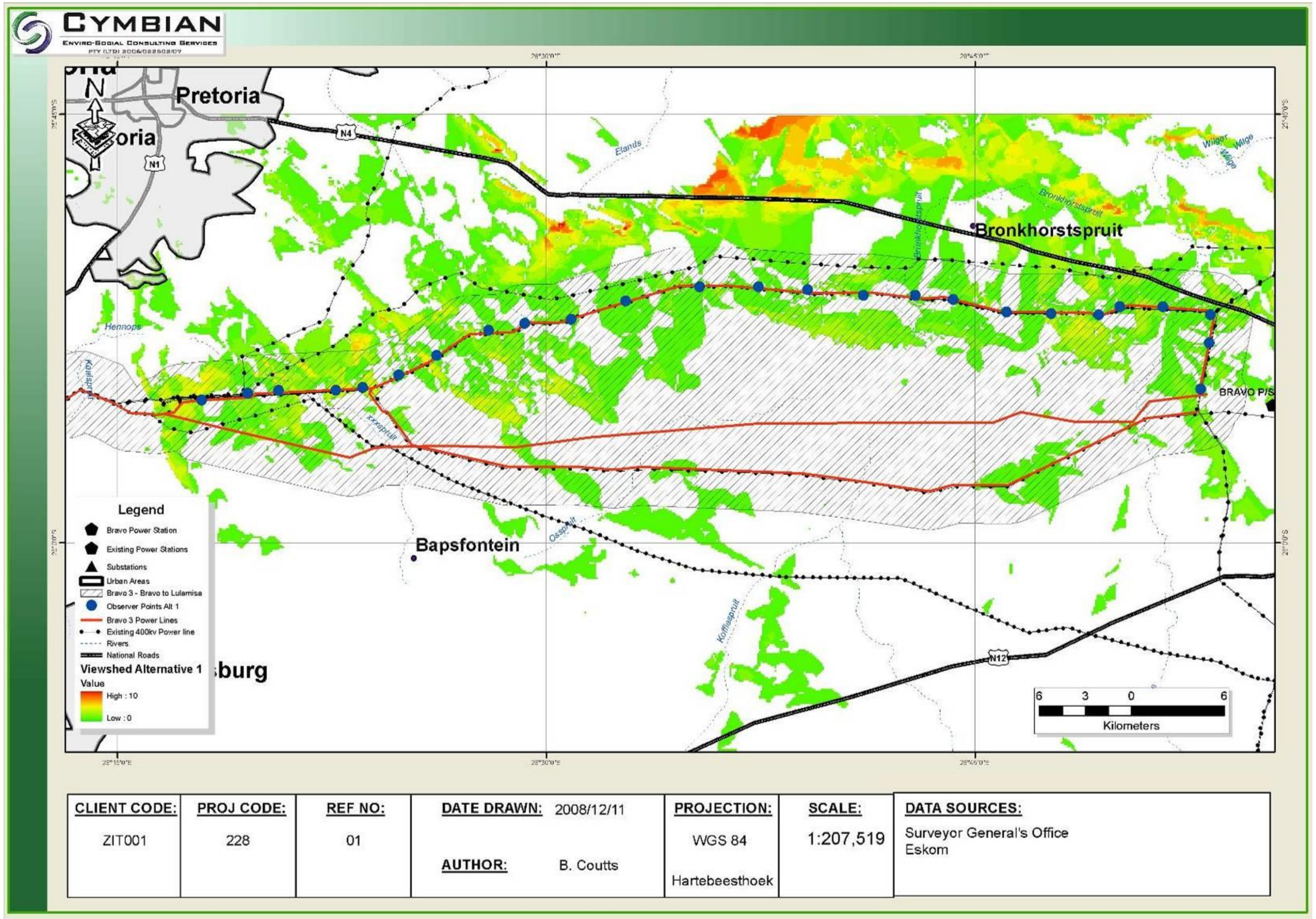
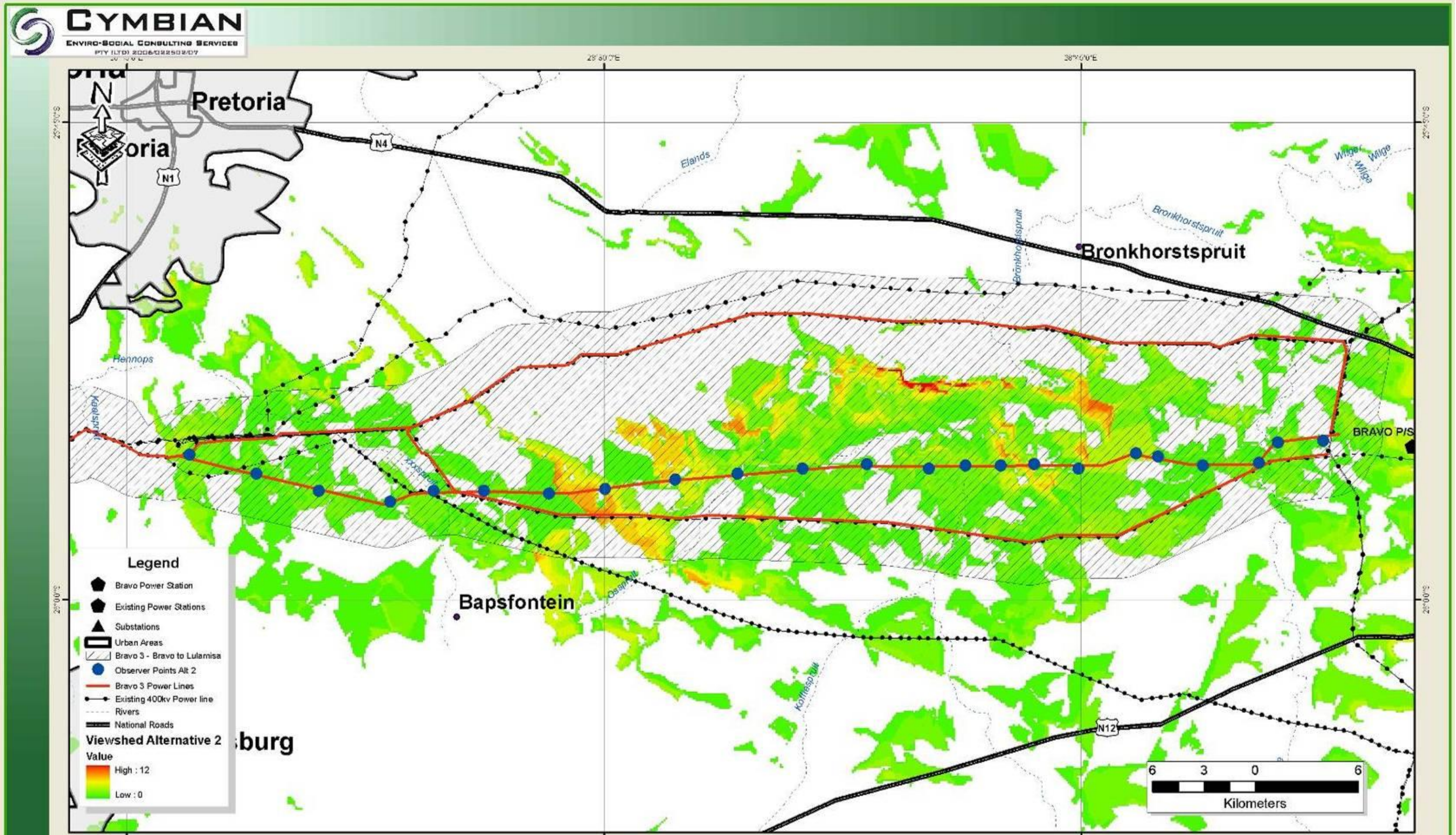


Figure 55: Viewshed from the Alternative 1 alignment.



CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2008/12/11	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	228	01	AUTHOR: B. Coutts	WGS 84 Hartebeesthoek	1:207,519	Surveyor General's Office Eskom

Figure 56: Viewshed from the Alternative 2 alignment

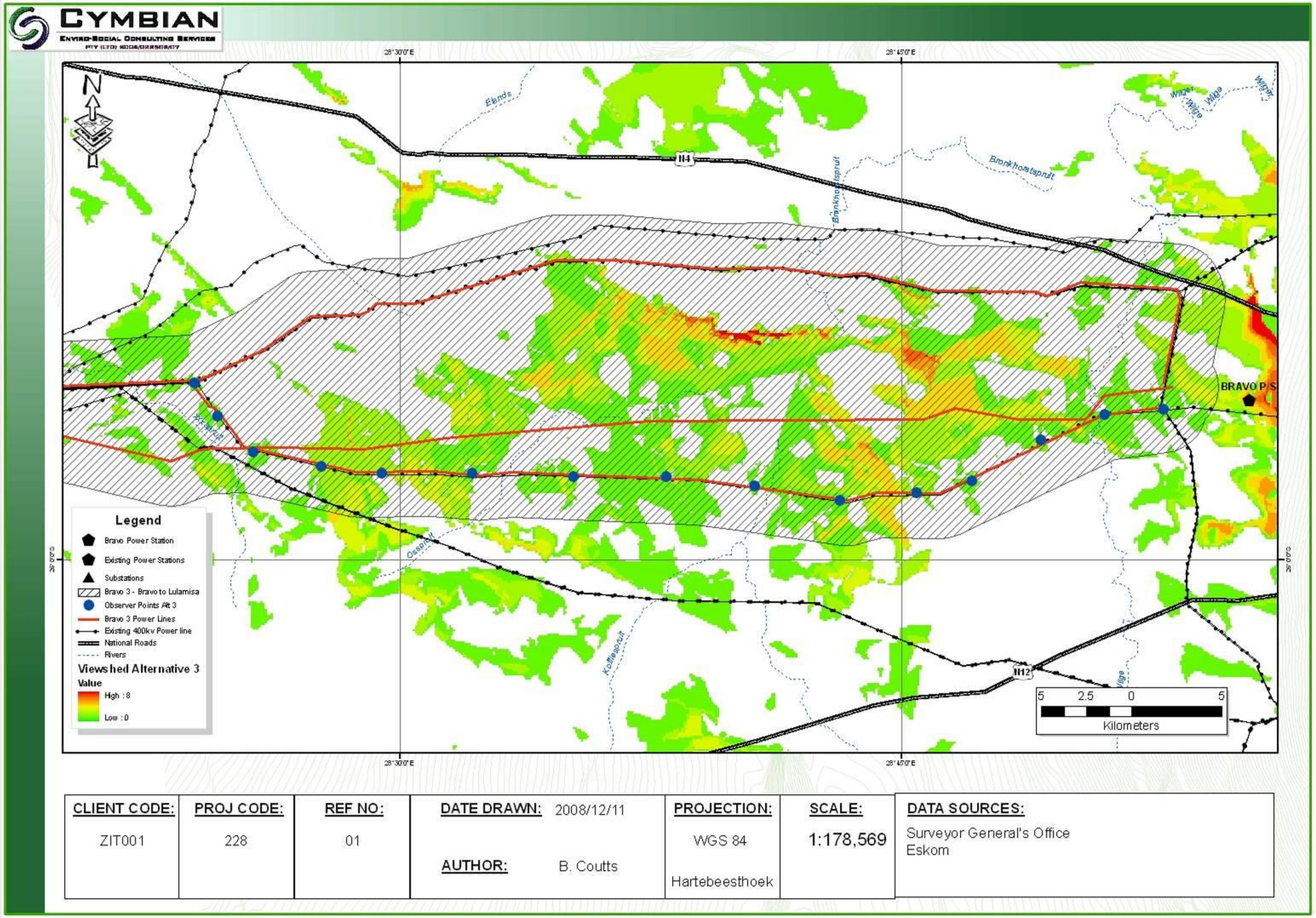
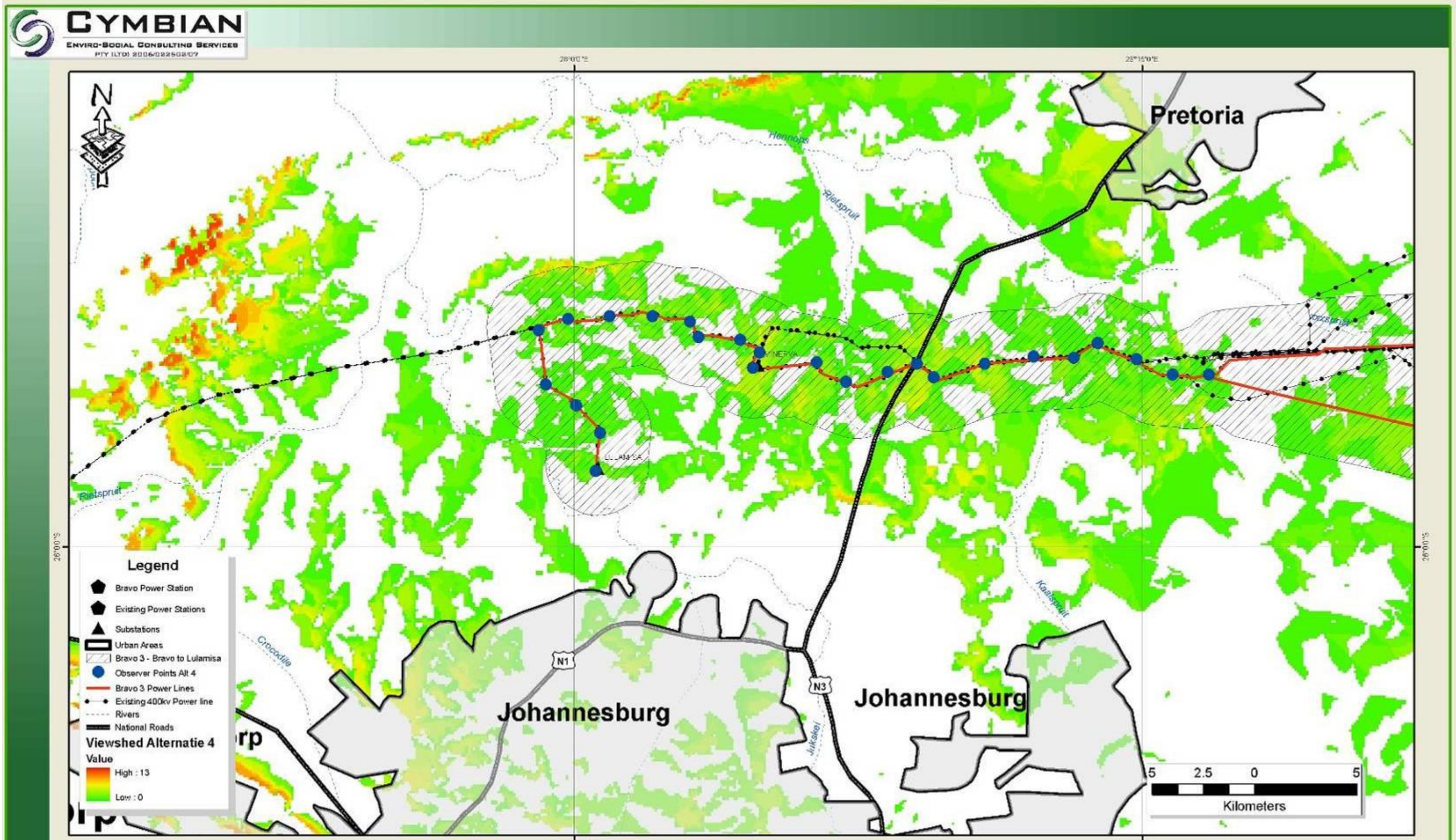


Figure 57: Viewshed from the Alternative 3 alignment



CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2008/12/11	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	228	01	AUTHOR: B. Coutts	WGS 84 Hartebeesthoek	1:174,163	Surveyor General's Office Eskom

Figure 58: Viewshed from the Alternative 4 alignment

Table 19: Dynamic Impact Table

Road Name	Speed limit (km/h)	Length of Road (km)	Approximate Period of View (sec)	View Distance
Alternative 1 N4	120	33.7	1011	3-6 km
Alternative 2 N4	120	8.1	243	10-14 km
Alternative 3 N4	120	5.5	165	15-16 km
Alternative 1 N12	120	4.4	132	19-27 km
Alternative 2 N12	120	26.6	798	11-18 km
Alternative 3 N12	120	24.4	732	10-13 km
Alternative 2 N3	120	1.9	57	0.5-3 km
Alternative 4 N3	120	18.1	543	0-1 km
Alternative 4 N1	120	10.6	318	15-18 km
Alternative 2 N17	120	2	60	50-52 km
Alternative 3 N17	120	3.9	117	40-50 km

Conclusion

Table 20 lists the observation points together with the category of viewer, context of view, relative numbers of viewers and approximate distance of observation point to the proposed site. The location of these observation points are shown in Figure 55, Figure 56, Figure 57 and Figure 58

Table 20: Visual Impact Matrix

Potential Observation Point	Category of Potential Receptor	Context of View	Approximate View Distance	Period of View	Visibility Rating
Surrounding Farmland	Static	Level	0 – 11 km	Long Term	Medium
Johannesburg/Pretoria	Static	Level Above	> 10 km	Long Term	Medium
Gravel Roads	Dynamic	Above & below	1 – 11 km	Medium	Low
Tar Roads	Dynamic	Level - Above	5 – 11 km	Short	Low

It should however be noted that there are a number of existing power lines in the study area as shown in the Figures above. Viewers in the viewshed have become accustomed to these power lines in the landscape and an additional 100 km of power line will not increase the impact significantly, however if Alternative 2 is selected the visual impact will be greater because there is no existing power line located on this route.

5.0 ALTERNATIVE SENSITIVITY ANALYSIS

This section provides a short sensitivity matrix, which compares the three different alternatives and their associated environmental sensitivities.

Table 21: Alternative Sensitivity Matrix

Sensitivity	Alternative 1	Alternative 2	Alternative 3	Lulamisa to Minerva
Geology	None	None	None	None
Climate	None	None	None	None
Topography	None	None	None	None
Land Use	Traverses short section of ridges land farmland	Traverses Bronkhorstspruit Dam and farmland	Traverses agricultural land and short section of residential area	Traverses short section of farmland and urban areas
Surface Water	Traverses over several rivers and small un-named tributaries on site	Traverses a large section of the Bronkhorstspruit Dam	Traverses over several rivers, small un-named tributaries and wetland areas on site	Traverses over one main river and vlei
Soils & Land Capability	Mainly agricultural, rocky soils and sensitive clay soils	Along sensitive wetland and clay soils	Along sensitive wetland and clay soils	Along disturbed soils
Flora	Sensitive vegetation units and plants present	Sensitive vegetation units and plants present	Sensitive vegetation units and plants present	Sensitive vegetation units and plants present in undisturbed areas
Fauna	None	None	None	None
Wetlands	Few sensitive wetlands	Traverses wetland	Traverses wetland	Transverse wetlands
Visual	Moderate Visibility	Moderate visibility	Moderate visibility	High visibility
Total Sensitivities	**2**	**4**	**4**	**4**

On the basis of the matrix presented above, it is suggested that the Bravo 3 Alternative 1 be utilised as the preferred alternative for the proposed project, as it has the least sensitive features associated with the alignment, but due to the locality of Alternative 1 located on the ridges and the space available limits the land use in the area an intern protects the indigenous fauna and flora

6.0 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology was utilised so that a wide rage of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- significance;
- spatial scale;
- temporal scale;
- probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in Table 22.

Table 22: Quantitative rating and equivalent descriptors for the impact assessment criteria

Rating	Significance	Extent Scale	Temporal Scale
1	VERY LOW	*Isolated sites / proposed site*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

6.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1000km^2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 23 below.

Table 23 : Description of the significance rating scale

Rating		Description
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

6.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 24.

Table 24 : Description of the significance rating scale

Rating		Description
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 5 km from the proposed study area.
2	Study Area	The impact will affect an area not exceeding the study area.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the power line alignments.

6.3 Duration Scale

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 25.

Table 25: Description of the temporal rating scale

Rating		Description
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium term	The environmental impact identified will operate for the duration of life of plant.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

6.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in Table 26 below.

Table 26 : Description of the degree of probability of an impact occurring

Rating	Description
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

6.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 27. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 27 : Description of the degree of certainty rating scale

Rating	Description
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

6.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

$$\textbf{\textit{Impact Risk}} = \frac{(\text{SIGNIFICANCE} + \textit{Spatial} + \text{Temporal})}{\mathbf{3}} \times \frac{\text{Probability}}{\mathbf{5}}$$

An example of how this rating scale is applied is shown below:

Table 28 : Example of Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	LOW	*Local*	Medium-term	*Could Happen*	
Impact to air	**2**	***3***	**3**	**3**	**1.6**

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2,67. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6.

The impact risk is classified according to five classes as described in the table below.

Table 29 : Impact Risk Classes

Rating	Impact Class	Description
0.1 – 1.0	**1**	**Very Low**
1.1 – 2.0	**2**	**Low**
2.1 – 3.0	**3**	**Moderate**
3.1 – 4.0	**4**	**High**
4.1 – 5.0	**5**	**Very High**

Therefore with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be considered to be a low impact.

6.7 Cumulative Impacts

It is a requirement that the impact assessments take cognisance of cumulative impacts. In fulfilment of this requirement the impact assessment will take cognisance of any existing impact sustained by the operations, any mitigation measures already in place, any additional impact to environment through continued and proposed future activities, and the residual impact after mitigation measures.

It is important to note that cumulative impacts at the national or provincial level will not be considered in this assessment, as the total quantification of external companies on resources is not possible at the project level due to the lack of information and research documenting the effects of existing activities. Such cumulative impacts that may occur across industry boundaries can also only be effectively addressed at Provincial and National Government levels.

Using the criteria as described above an example of how the cumulative impact assessment will be done is shown below:

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Initial / Existing Impact (I-IA)	**2**	**2**	**2**	*1*	0.4
Additional Impact (A-IA)	**1**	***2***	**0**	*1*	0.2
Cumulative Impact (C-IA)	**3**	***4***	**2**	*1*	0.6
Residual Impact after mitigation (R-IA)	**2**	***1***	**2**	*1*	0.3

As indicated in the example above the Additional Impact Assessment (A-IA) is the amount that the impact assessment for each criterion will increase. Thus if the initial impact will not increase, as shown for temporal scale in the example above the A-IA will be 0, however, where the impact will increase by two orders of magnitude from 2 to 4 as in the spatial scale the A-IA is 2. The Cumulative Impact Assessment (C-IA) is thus the sum of the Initial Impact Assessment (I-IA) and the A-IA for each of the assessment criteria.

In both cases the I-IA and A-IA are assessed without taking into account any form of mitigation measures. As such the C-IA is also a worst case scenario assessment where no mitigation measures have been implemented. Thus a Residual Impact Assessment (R-IA) is also made which takes into account the C-IA with mitigation measures. The latter is the most probable case scenario, and for the purpose of this report is considered to be the final state Impact Assessment.

6.8 Notation of Impacts

In order to make the report easier to read the following notation format is used to highlight the various components of the assessment:

Significance or magnitude- IN CAPITALS
Temporal Scale – in underline
Probability – *in italics and underlined*.
Degree of certainty - **in bold**
Spatial Extent Scale – *in italics*

7.0 ENVIRONMENTAL IMPACT ASSESSMENT

The Impact Assessment will highlight and describe the impact to the environment following the abovementioned methodology and will assess the following components:

- Geology;
- Climate;
- Surface Water;
- Topography;
- Soils;
- Land Capability
- Land Use;
- Flora;
- Fauna; and
- Visual Assessment.

The impact assessment was undertaken for the construction, operational and decommissioning phases of the project. The impact of each line/route alternative was also assessed separately, however, where the impact was not significantly different, only one impact assessment was undertaken. Also, at the time of writing this report, no technical data was available as to the type of tower to be used for the construction of the transmission lines. Therefore, it is assumed that the Self-supporting strain and suspension tower type would be used. Contained in this assumption is that the maximum distance between towers would be 300 m and that the tower would be erected on concrete footings with dimensions of 2 x 2 x 2 m (area = 4 m^2 and volume = 8 m^3).

7.1 Construction Phase

During the construction phase, the 400 kV power lines will be erected. A 400 kV Transmission line requires a servitude width of 55 m. Where there are physical constraints such as other power lines adjacent to the new servitude, a minimum of 35 m-separation distance from such lines is required. Without physical constraints, parallel lines will have at least 55 m-separation distance. The power line cables are strung between pylons / towers, which are steel structures erected on concrete footings fixed in the substrate (soil or rock) below the pylon.

The major impacts during construction are the construction activities associated with the erection of the power lines and include, amongst others, heavy vehicle movement, construction of an access road and any wastes generated.

7.1.1 Geology

Initial Impact

Impacts that could occur to geology are limited to the physical removal of geological strata, resulting in permanent damage to those strata. However when placing pylons on ridges damage may occur to the shallow strata. When placing pylons in valleys there no indication of damage due to the depth of the geological strata which lies well below the surface ground level. There are no present indications that any existing impacts to geology have ocurred and therefore there is no initial impact rating

Additional Impact

The additional impact resulting from the power line construction could occur because of power line construction on the rocky ridges (depending on which alternative is selected); the impact would be limited to the construction of the pylon footings. Impact to the geological strata may occur due to which alternative is selected. If Alternative 1 is selected, for example approximately 60 pylons could be placed on ridges, which would equate to 240 footings. This would result in a combined area 1 920 m^3 of geological strata would be disturbed. This Low impact could probably occur along other ridges as existing servitudes exist and these possible servitudes may provide alternative routes for the proposed constructed power lines. This results in a final impact class of **Low** as rated in the table below for a selected Alternative. If Alternative 1 is selected than the impacts would be much larger because of the greater distance covered.

Table 30: Geology Additional Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Geology	VERY LOW	*Isolated sites*	Long Term	*Probably*	Low
	1	**1**	**4**	**4**	**1.6**

Cumulative Impact

Since there is no initial impact, the cumulative impact is the same as rated for the additional impact above.

Mitigation Measures

The following mitigation measures are proposed:

- No blasting activities will be permitted;
- Topsoil and subsoil strata should be stripped separately;
- Disturbed areas are profiled and stabilised, and erosion control measures are installed in places identified as being at risk of erosion. Methods of stabilisation may include: brushcut packing, mulch or chip cover, straw stabilising, sodding, hydroseeding, soil binders, gabions, reno mattresses, armourflex, retaining walls;
- Excavation of any material on site is done in accordance with the relevant SANS codes;
- All disturbed areas are profiled and stabilised, and erosion control measures are installed in places identified as being at risk of erosion. Methods of stabilisation may include: brushcut packing, mulch or chip cover, straw stabilising, sodding, hydroseeding, soil binders, gabions, reno mattresses, armourflex, retaining walls; and
- Clear demarcation of excavation areas, topsoil storage areas, subsoil storage areas, and construction hard parks should be undertaken with painted stakes and / or fences prior to commencement of construction activities.

Residual Impact

If so for any reason geology is encountered, it should not be removed and the pylon footings must be place directly on the geology. The impact is **Very Low** over a <u>long period</u>. The impact class is <u>very low.</u> The only concern is the amount of pylons placed on ridges, which may lead to a much larger impact over a greater distance

Table 31: Geology Residual Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Geology	VERY LOW	*Isolated sites*	<u>Long Term</u>	*<u>Unlikely</u>*	Very Low
	1	***1***	**<u>4</u>**	**2**	**0.8**

7.1.2 <u>Topography</u>

Initial Impact

There are no initial impacts present on site except for existing infrastructure. These include existing roads fences and power lines. None of these has affected the topography as existing power lines follow the topography and no shaping of the landscape is need.

Additional Impact

As mentioned above the power lines follow the topography of the landscape and no landscaping is needed.

Table 32: Topography Additional Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Topography	VERY LOW	*Isolated sites / proposed site*	Long Term	*Practically impossible*	Very Low
	1	***1***	**4**	**1**	**0.4**

Therefore, from Table 32 above, the significance will be VERY LOW, occur in *Isolated sites / proposed site* and will be Long Term and is *Practically impossible* to occur, resulting in a rating of 0.4 or a Very Low impact class.

Cumulative Impact

Since there are no initial impacts the cumulative impacts are the same as above.

Mitigation Measures

- Temporary storm-water control measures should be installed in case a rain event should occur that has the potential to cause erosion of exposed soil;
- Cut-off drains must be installed to facilitate the control of surface water runoff velocities;
- Storm-water control barriers should be used to divert surface water runoff into grassland buffers and not directly into the exposed workings;
- Stockpiles of soils and material should be located on high ground out of the reach of flood flows; and
- Stockpiles will be sited in areas demarcated for such purposes prior to the commencement of construction activities.

Residual Impact

Should the need arise to grade the power line route, it can be mitigated by ensuring that the grading only takes place for the area immediately under the pylons. Thus, restricting the impacted area to a small footprint under the pylons.

Table 33: Topography Residual Impact Assesment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to	VERY LOW	*Isolated*	Long Term	*Unlikely*	Very Low

Topography		*sites / proposed site*			
	1	***1***	**<u>4</u>**	**2**	**0.8**

From Table 33 it can be seen that the Residual Impact Assesment will be VERY LOW, occur in *Isolated sites / proposed site* and will be <u>Long Term</u> and is <u>*Unlikely*</u> to occur. The rating of 0.8 places the Residual Impact Assesment in a Very Low impact class.

7.1.3 <u>Soils, Land Capability and Land Use</u>

Soils, land capability and land use need to be grouped together, because the type of soil will determine the capability of the land and what the land can be used for in the future. If the soil is arable, then it is suitable for farming and the land use will be farms.

The land use of the site is divided up into three sections. The land use in the area is divided up into land that is used for agriculture, land used for industry and land that are used for urban areas. Approximately 80% of the area that the existing servitudes and Alternative 2 run along is used for agriculture. Urban areas are located closer to Pretoria and Johannesburg. A Hard Park will need to be constructed but will be taken down after construction.

Agricultural areas and livestock grazing areas that are impacted due to existing power line servitudes. If other Alternatives are selected that don't run along existing servitudes there will be a greater impact compared to areas that have existing servitudes. Other existing impacts are the existing pylon footings and cultivation of soils.

Initial Impact

The soils within the study site have been impacted on already by the existing infrastructure and surrounding farmlands

Table 34: Soil and Land Capability Initial Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Soils	Moderate	*Study Site*	<u>Long Term</u>	<u>*Is ocurring/Has Occured*</u>	Moderate
	3	**2**	**4**	**5**	**3**

The Initial Impact Assesment to soils, land capability and land use as calculated in Table 34, is MODERATE, occurs in *Study sites*, is <u>Long term</u> and <u>*Has occurred*</u>, resulting in a rating of 3 or a Moderate impact class.

Additional Impact

The adittional-impact of the proposed power lines will be the loss of the soil as a resource and therefore render the land not suitable for any other use. This would occur under the power lines at the concrete footings, as well as along the access road. For Alternative 1 and 3 with existing servitudes, roads may not need to be consrtucted, but for Alernative 2 a haul road will need to be constructed for access. The road will remain and act as a servitude for Eskom employess and maintainace staff.

Table 35: Soil Impact

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Soil, Land Capability and Land Use	LOW	*Study Sites*	Long Term	*It's going to happen*	Moderate
	2	***2***	**4**	**5**	**2.6**

The additional impact to soils, land capability and land use will be LOW, occur in *Study Site* , is Long term and *It's going to happen*, resulting in a rating of 2.6 or a Moderate impact class

Table 36: Soil and Land Capability Additional Impact Assessment – Alternative 1 and 3

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Soil, Land Capability and Land Use	VERY LOW	*Isolated sites /proposed sites*	Long Term	*It's going to happen*	Moderate
	1	***1***	**4**	**5**	**2**

The addirional impact to soils, land capability and land use for Alternatives 1 and 3 will be VERY LOW, occur in *Isolated sites/proposed sites* , is Long term and *It's going to happen*, resulting in a rating of 2 or a Low impact class

Table 37: Soil and Land Capability Additional Impact Assessment – Alternatives 2

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Soil, Land Capability and Land Use	Moderate	*Study Sites*	Long Term	*It's going to happen*	Moderate
	3	***2***	**4**	**5**	**3**

The additional impact to soils, land capability and land use will be MODERATE, occur in *Study Site* , is Long term and *It's going to happen*, resulting in a rating of 3 or a Moderate impact class

Cumulative Impact

The cumulative impact, as rated in Table 38 below, will be LOW, occur in the *Study area* and will be Long Term and *It's going to happen / has occurred*

Table 38: Soil, Land Capability and Land Use Cumulative Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Soil, Land Capability and Land Use	MODERATE	*Study area*	Long Term	*It's going to happen / has occurred*	
	3	***2***	**4**	**5**	**3**

Mitigation Measures

- Demarcate topsoil and subsoil stockpile areas, berms, and storm-water management features prior to the commencement of construction activities;
- At least 300mm of topsoil (or until refusal) must be stripped and stockpiled separately;
- Strip sub-soils and stockpile adjacent to the working area in close proximity to the final footprint;
- Stockpiles are to be located on high ground out of the reach of flood flows;
- Sub-soil stockpiles should be sited upslope of the development site, and shaped to channel storm-water runoff around the site and disturbed areas;
- Topsoil stockpiles are to be sited outside of the development footprint;
- Use berms to minimise erosion where vegetation is disturbed, including hard parks, plant sites, borrow pit and office areas;
- Spread absorbent sand on areas where oil spills are likely to occur, such as the refuelling area in the hard park;
- Oil-contaminated soils are to be removed to a contained storage area and bio-remediated or disposed of at a licensed facility.

Residual Impact

Mitigation measures include, amongst others, the stripping and stockpiling of soil excavated for construction. This would ensure that the soil could be re-used elsewhere in the project area or utilized for rehabilitation purposes

7.1.4 Surface Water

Surface water features are demarcated as sensitive because of the high variety of fauna and flora that occur in the area. Areas such as rivers, dams and wetlands provide habitats for many plant and animal species that are endangered, which makes these areas very sensitive and of a high conservation status.

Initial Impact

There are a number of streams and drainage lines that have been dammed which may have caused damage to down stream aquatic life. The presents of agriculture and urban areas will also have had an affects on surface water flow. The construction of the existing power lines have had minimal affect on surface water flow

Table 39: Table 40: Surface water Initial Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Surface water	VERY LOW	*Isolated sites / proposed site*	Medium Term	*Could happen*	Low
	1	***1***	**3**	**3**	**1.6**

The initial impact for surface water is VERY LOW, occurs in *Isolated sites / proposed site* and will be Medium Term and *It's going to happen / has occurred*. This results in a rating of 1.6 or a Low impact class.

Additional Impact

The construction of the proposed power lines should have no affect on drainage lines because of the distance found between pylons, but it should be noted that many drainage, streams, rivers and wetlands cross over the proposed and existing lines, It must be noted that buffer zones should be in place to project sensitive aquatic areas

Waste generated during the construction phase may enter the environment through surface water runoff i.e. litter or pollution such as hydrocarbons can be washed into aquatic systems affecting those systems negatively. Storm-water flowing over the site will also mobilise loose sediments, which may enter the surface water environment affecting water quality. Storm-water containing sediment can be discharged to grassland buffers to ensure sediments fall out prior to water entering surface water bodies. Care must be taken that storm-water containing hydrocarbons and other pollution sources are not discharged.

Table 41: Surface water Additional-Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Surface water	VERY LOW	*Isolated sites / proposed site*	Medium Term	*Could Happen*	Very Low
	1	***1***	**3**	**3**	**1**

The additional impact for surface water is VERY LOW, occurs in *Isolated sites / proposed site*, will be Long Term and *Could Happen* to occur. This results in a rating of 1 or a Very Low impact class.

Cumulative Impact

Alternative 1 and 3 follow existing servitudes and Alternative 2 is the proposed line that does not follow an exiting servitude and crosses over the Bronkhorstspruit Dam. The distance that the line has to cross is estimated at 175 m, which falls within the maximum distance of the pylon construction.

Table 42: Surface water Cumulative Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Surface water	LOW	*Study area*	Long Term	*Could happen*	Low
	2	***2***	**4**	**3**	**1.6**

The Cumulative impact, as rated in Table 42 aboce, will be LOW, occur in the *Study area* and will be Long Term and *It's going to happen / has occurred.* This results in a rating of 1.6 or a Low impact class

Mitigation Measures

- Demarcated areas where waste can be safely contained and stored on a temporary basis during the construction phase should be provided at the hard park;
- Waste is not to be buried on site;
- Hydro-carbons should be stored in a bunded storage area;
- All hazardous materials inter alia paints, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the environment;
- Spill-sorb or similar type product must be used to absorb hydrocarbon spills in the event that such spills should occur;
- Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented;

- A storm-water management plan, including sufficient erosion-control measures, must be compiled in consultation with a suitably qualified environmental practitioner / control officer during the detailed design phase prior to the commencement of construction; and
- The propagation of low-growing dense vegetation suitable for the habitat such as grasses, sedges or reeds is the best natural method to reduce erosion potential in sensitive areas.

Residual Impact

In order to mitigate for residual impacts it is important that no power lines cross drainage points. This is not feasible because of the amounts of drainage points the power lines will have to cross the mitigation measures should be able to regulate the amount of residual impact occurred on site however low these impacts are. The overall rating for the residual impacts is the same as that of the additional impacts.

7.1.5 Flora

Initial Impact

The vegetation in and around the study area has significantly been transformed by farming activities, urbanisation and industrial activities. In addition, the remaining natural vegetation is being utilised for grazing and is being invaded by alien invasive species.

Table 43: Flora Initial Impact Rating Scale

Impact	Significance	*Spatial Scale*	Temporal Scale	Probability	Rating
Impact to Flora	**MODERATE**	***Study Site***	**Long Term**	**Is occurring**	**Moderate**
	3	***2***	**4**	**5**	**3.00**

The initial impacts to flora include extensive grazing, cultivation and alien invasive colonisation. The initial impact to flora is **definitely** MODERATE negative impact acting over the long term, and is *presently occurring* in the *study area*. As indicated in Table 43 above the impact rating class is a Moderate Impact.

Additional Impact

Additional impacts will be the removal of vegetation for the construction of the new power lines and the associated haul roads. There is a major concern to the affects on endangered and threatened endangered vegetation types. Vegetation types that are of concern are Marikana Thornveld (rated as endangered and 2.5% of the route is covered by this vegetation type), Carletonville Dolomitic

Grassland (rated as vulnerable) and Egoli Grassland (rated as endangered and approximately 25% of the corridors fall within this vegetation type). There is concern about the loss of vulnerable and threatened vegetation types below illustrates the length that each route alternative will cross over each vegetation types identified.

Table 44: Flora Impact

Vegetation Type	Alternative 1	Alternative 2	Alternative 3	Minerva to Lulamisa
Egoli Granite Grassland	0 km	0 km	0	16.9 km
Rand Highveld Grassland	28.6 km	20.3 km	27 km	0 km
Eastern Highveld Grassland	0 km	0.8 km	3.7 km	0 km
Cartonville Dolomite Grassland	1.3 km	7.3 km	0 km	5.7 km
Gold Reef Mountain Bushveld	12.9 km	0 km	0 km	0 km
Andesite Mountain Bushveld	3.5 km	0 km	0 km	0 km
Marikana Thornveld	5.8 km	0 km	0 km	0 km
Eastern Temperate Freshwater Wetlands	0.5 km	3 km	1 km	0.3 km
Cultivated Lands	17.7 km	29.3 km	24.3 km	2.7 km
Disturbed Lands	3 km	2 km	1.4 km	12.2 km

Table 45: Vegetation Additional-Impact Rating ScaleAlternative 1

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Vegetation	LOW	*Study Site*	Short Term	*It's going to happen*	Moderate
	2	***2***	**2**	**5**	**2**

The additional impact to vegetation is LOW, occurs in *Isolated sites / proposed site* and will be Medium Term and *It's going to happen*. A rating of 2.2 gives an impact class of Moderate.

Table 46: Vegetation Additional-Impact Rating ScaleAlternative 2

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Vegetation	LOW	*Study Site*	Long Term	*It's going to happen*	Moderate
	2	***2***	**4**	**5**	**2.6**

The additional impact to vegetation is LOW, occurs in *Isolated sites / proposed site* and will be Medium Term and *It's going to happen*. A rating of 2.3 gives an impact class of Moderate.

Table 47: Vegetation Additional-Impact Rating ScaleAlternative 3

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Vegetation	LOW	*Study Site*	Short Term	*It's going to happen*	Moderate
	2	***2***	**2**	**5**	**2**

The additional impact to vegetation is LOW, occurs in *Isolated sites / proposed site* and will be Medium Term and *It's going to happen*. A rating of 2 gives an impact class of Moderate

Due to Alternative 1 and 3 following existing servitude, acces to these areas is easier and the resultant construction phase is shorter. For Alternative 2 the construction phase is longer because the line does not follow any existing servitudes, this results in a higher rating compared to Alternative 1 and 3. Alternative 3 does run over more cultivated land so the loss in endemic floral species would be less than Alternative 1 and 3.

Table 48: Vegetation Additonal-Impact Rating Scale: Minirva to Lulamisa

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Vegetation	HIGH	*Study Site*	Medium Term	*It's going to happen*	Moderate
	4	***2***	**3**	**5**	**3**

The additional impact for vegetation is HIGH, occurs in *Isolated sites / proposed site* and will be Medium Term and *It's going to happen*. A rating of 3 gives an impact class of Moderate

The Minerva to Lulamisa section traverses over sensitive grassland species and placement of pylons should be very particular in order to avoid these sensitive areas

Cumulative Impact

The cumulative impacts take into account the affects that the construction and the initial impacts have on the vegetation. Due to the construction of the power lines through sensitive vegetation the cumulative impacts by be higher than expected for sections of the power line.

Table 49: Vegetation Cumulative-Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Vegetation	LOW	*Study area*	Long Term	*It's going to happen / has occurred*	Moderate
	2	***2***	**5**	**5**	**3**

The cumulative impact as rated in Table 49 above, will be LOW, occur in the *Study area* and will be Long Term and *It's going to happen / has occurred*. This results in a rating of 3 or a Moderate impact class.

Mitigation Measures

- All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse);
- Topsoil and vegetation should be stripped together to a depth of 300mm on all areas earmarked for the new development to ensure the seed bank is maintained to facilitate with rehabilitation, especially in the area of the borrow pit.
- The entire borrow area should be rehabilitated to the same / better condition as before.
- A suitable seedmix of indigenous plants should be used in all rehabilitation programmes on the site.
- All alien invasive species on site should be removed and follow up monitoring and removal programmes should be initiated once construction is complete
- Minimal construction work should take place in sensitive areas.

Residual Impact

All impacted vegetation should be rehabilitated to its current state or original state before construction took place

Table 50: Vegetation Residual-Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Vegetation	VERY LOW	*Study Sute*	Medium Term	*Unlikely*	
	1	***2***	**3**	**2**	**0.8**

The residual-impact\, as calculated in Table 50 above, will be VERY LOW, occur in *Study sites* and will be Medium Term and is *Unlikely* to occur. A rating of 0.8 is a Very Low impact class.

7.1.6 Fauna

Initial Impact

As described in the habitat assessment in Section 3.9, the site is relatively disturbed with the disturbed/grazed grassland, the undisturbed/natural grassland and the wetland and riparian zones the main habitat still available for fauna. The site is disturbed and while this is not ideal habitat for fauna, it will still provide habitat for various fauna. The suitable areas did show high species diversity, indicating that the impact is limited to isolated sites throughout the study area.

The study area is criss crossed with existing high voltage power lines that could potentially impact on the faunal life, especially large avi-faunal species. While there appears to be no negative impacts associated with electro magnetic fields generated by the power lines, Eskom's document, *Transmission Bird Collision Prevention Guideline* (Ref. no.: TGL41-335)[5], the major impact to birds or avi-fauna is in the form of collisions with power lines. According to the document, it was found that the majority of birds affected are large flighted birds, which are also often endangered or threatened species.

These large flighted birds are also long lived, with low breeding rate and often mate for life. Therefore, a single mortality due to a collision with a power line should be viewed as a high impact. In addition some of the most sensitive species to power line collisions such as Blue Crane are found in the study site in addition to other sensitive species such as White-Bellied Korhaan and Secretary Birds.

The current impact on fauna on site is **probably** of a HIGH negative significance, affecting the *region*, and acting in the long-term. The impact can *likely occur*. The impact class is classified as a High impact.

Table 51: Fauna Initial Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Fauna	HIGH	*Region*	Long Term	*Likely*	High
	4	**4**	**4**	**4**	**3.2**

Additional Impact

The impact to fauna during the construction phase of the power lines will mostly be in the form of disturbance from the construction workers and vehicle noise. Due to the fact that the area is habitat to sensitive species, the impact could be quite high.

The additional impact to fauna is **probably** MODERATE negative impact acting over the short term, and *will occur* in *isolated sites*. As indicated in Table 52 below the impact rating class is a Low Impact.

Table 52: Fauna Additional Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Fauna	MODERATE	*Isolated Site*	Short Term	*Will occur*	Low
	3	**1**	**2**	**5**	**2**

Cumulative Impact

The cumulative impact to fauna remains as assessed for the initial impact assessment as the impacts are identical. Therefore the impact remains a High impact to Fauna.

Mitigation Measures

- All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse);
- The sensitive habitat should be avoided and construction limited to 50 m from the edge of the wetlands and streams;
- Alternative 1 should be considered as the preferred alternative;
- All alien invasive species on site should be removed and follow up monitoring and removal programmes should be initiated once construction is complete;
- Adhere to the ESKOM vegetation management guideline (Appendix 3); and
- Install power lines according to the ESKOM bird collision prevention guideline.

Residual Impact

The mitigation measures proposed above will ensure that the construction of the proposed power line remains a Moderate impact but the Residual Impact remains High. If the mitigation measures were to be extended into the existing power lines and bird flappers be installed, the residual impact could be mitigated to a Moderate Impact Class.

7.1.7 Wetlands

The impact assessment for wetlands is the same as for the surface water section, please refer to Section 7.1.4.

7.1.8 Visual Impact

At present the viewers in the viewshed are seeing the Lulamisa and Minerva Sub-station and the various mining activities including the coal collieries in the area. In addition to the Power Station there are numerous power lines already traversing the landscape. The initial impact to the visual environment is HIGH negative acting in the long term, and *has already occurred*. The impact has **definitely** impacted on the *local region*

Initial Impact

The study site has several existing high voltage power lines that impact on the visual character of the landscape.

Table 53: Visual Initial Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Visual	HIGH	*Local*	Long Term	*Has occurred*	High
	4	***3***	**4**	**5**	**3.6**

The initial impact to the visual landscape is High, occurs in *Local,* is Long Term and *Has occurred*. This results in a rating of 3.6 and a High impact class.

Additional Impact

During the construction phase, the local residents will be able to see the construction workings. This will impact negatively on the visual character of the landscape but is of short duration.

Table 54: Visual Visual Additional Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Visual	LOW	*Local*	Short Term	*It's going to happen*	Low
	2	***3***	**2**	**5**	**2**

The additional impact to the visual landscape is VERY LOW, occurs in *Local site* and will be Short termand *It's going to happen*. A rating of 2 gives an impact class of Low.

Cumulative Impact

The cumulative impact will not change and the cumulative impact remains a High impact.

Mitigation Measures

- Only the footprint of the proposed power line should be exposed. In all other areas, the natural vegetation should be retained;
- Dust suppression techniques should be in place at all times during the construction phase;
- Access roads should be minimised to prevent unnecessary dust; and
- Utilise non-shiny structures for the hard park and toilets, i.e. avoid unpainted roofs.

Residual Impact

The initial visual impact of the power lines can not be mitigated and therefore the mitigation measures merely ensure that the additional impact is managed responsibly. The residual impact remains a High impact.

7.2 Operational Phase

The main impacts during the operatational phase are the electro magnetic field associated with the power lines and the occurrence of the physical structures in the landscape. See *Electric and Magnetic Fields – A summary of Technical and Biological Aspects* (2006). for a detailed discussion regarding the impact of electro magnetic fields.

7.2.1 Geology

Once the power lines are constructed there should be no further impact to geology.

7.2.2 Topography

Once the power lines are constructed there should be no further impact to topography.

7.2.3 Soils, Land Capability and Land Use

The impact assessment does not change from that of the construction phase, refer to section 5.1.3 above.

7.2.4 Surface water

Once the power lines are constructed there should be no further impact to surface water.

7.2.5 Flora

Once the power lines are constructed there should be no further impact to flora.

7.2.6 Fauna

Initial impact

The initial impact remains the same as that calculated for the construction phase in section 5.1.6 above.

Additional impact

While there appears to be no negative impacts associated with electro magnetic fields in Eskom's document, *Transmission Bird Collision Prevention Guideline* (Ref. no.: TGL41-335), the major impact to birds or avi-fauna is in the form of collisions with power lines. In in Eskom's document, *Transmission Bird Collision Prevention Guideline* (Ref. no.: TGL41-335), it was found that the majority of birds affected are large flighted birds, which are also often endangered or threatened species.

These large flighted birds are also long lived, with low breeding rate and often mate for life. Therefore, a single mortality due to a collision with a power line should be viewed as a high impact.

The study area provides habitat or is potential to a number of mammals, birds, reptiles, amphibians and athropods. The initial impact to fauna is due to the loss of habitat and the region also contains threatened bird species such as Blue Crane, White-Bellied Korhaan and Secretary Birds.

Table 55: Fauna Additional Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Fauna	HIGH	*Regional / Provincial*	Long Term	*Could happen*	Moderate
	4	***4***	**4**	**3**	**2.4**

The additional impact to fauna is HIGH, occurs at *Regional / Provincial* spatial scale and will be Long Term and *Could happen*. This results in a rating of 2.4 and a Moderate impact class.

Cumulative impact

During the operational phase the proposed development will add approximately 100 km of high voltage power lines to the existing network of power lines in the area. The addition is relatively small in consideration of the approximately of existing high voltage powerlines in the area. The cumulative impact to fauna remains a High impact as assessed in the initial impact assessment.

Residual impact

In order to prevent power line collisions from birds, anti-collision devices can be installed to the power lines. These include static, dynamic, reflective and illuminated devices. As mentioned in (Ref bird collision) these devices have however only been reasonably successful and will not complete eliminate the impact or the risk to birds. If the mitigation measures in the reference can be implemented not only on the new lies but also on the existing lines, then the impact can be rated as illustrated in the table below.

Table 56: Fauna Residual Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Fauna	HIGH	*Regional / Provincial*	Long Term	*Unlikely*	Moderate
	4	***4***	**4**	**2**	**2.6**

The residual impact as calculated in Table 56 above, will be HIGH, impact that occurs in the *Regional / Provincial* scale and will be Long Term and is *Unlikely* to occur. A rating of 2.6 is a Moderate impact class.

Once again it must be emphasised the the residual impact is most likely going to be high. Only if the proposed mitigation measures can be implemented on the existing as well as the new power lines will the impact reduce to Moderate.

7.2.7 Visual

If Alternative 1 or 3 are chosen the power lines will form part of the existing visual disturbance in the region. The impact will therefore remain as assessed above in Section 7.1.7. If Alternative 2 is chosen this will be a new impact to a large portion of the route, as the route does not have existing power lines. If this is the case the impact would also be rated as a high impact but the percieved impact would be higher than the other two alternatives.

7.3 Decommisioning Phase

During the decomissioning phase the power lines will be removed from the servitude. For the sake of the assessment it is assumed that the exisitng power lines will remain.

7.3.1 Geology

There will be no impacts to geology during the decomissioning phase.

7.3.2 Topography

The impacts to topography during the decomissioning phase of the development remain as assessed in the construction phase in Section 7.1.2 above.

7.3.3 Soils, Land Capability and Land Use

The impacts to soils, land capability and land use during the decomissioning phase of the development remain as assessed in the construction phase in Section 7.1.3 above.

7.3.4 Surface water

The impacts to surface water during the decomissioning phase of the development remain as assessed in the construction phase in Section 7.1.4 above.

7.3.5 Flora

The impacts to flora during the decomissioning phase of the development remain as assessed in the construction phase in Section 7.1.5 above.

7.3.6 Fauna

Even though the removal of the 100 km of proposed power lines will reduce the number of power lines in the area that could impact on fauna, the impact after decomissioning will remain as assessed in Section 6.2.6 above due to the remaining network if high voltage power lines.

7.3.7 Visual

Even though the removal of the 100 km of proposed power lines will reduce the number of power lines in the area that impact on the visual landscape, the impact after decomissioning will remain as assessed in Section 6.2.7 above due to the remaining network if high voltage power lines.

8.0 ENVIRONMENTAL MANAGEMENT

This section describes the suggested commitments that should be included in the Environmental Management Plan (EMP) to be compiled by the environmental consultant responsible for the EIA.

8.1 Geology and Soils

Management Component	***Geology and Soils***
Primary Objective	
To ensure that the soils are stockpiled in the correct manner to prevent erosion and contamination of surface water runoff.	
Core Criteria:	***Monitoring Criteria***
No blasting is undertaken on site without a suitable blast design, compiled in line with relevant SANS codes and approved by an appropriately qualified professional.	***Site Development Plan, EMP monitoring and Intermittent observation***
Avoid placement of pylon footings in the clay soils on site	
Spread absorbent sand on areas where oil spills are likely to occur, such as the refuelling area in the hard park	
Oil-contaminated soils are to be removed to a contained storage area and bio-remediate or disposed of at a licensed facility	
If soils are excavated for the footing placement, ensure that the soil is utilised elsewhere for rehabilitation/road building purposes	
Ensure that soil is stockpiled in such a way as to prevent erosion from storm water.	

8.2 Fauna

Management Component	***Fauna – especially red data birds***
Primary Objective	
To ensure that the development minimises the potential impact to endangered species and their habitat.	
Core Criteria:	***Monitoring Criteria***
All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse)	
No construction activity and disturbance will be permitted in the seasonal seepage zone where the red data birds were observed.	
Bird flappers are to be installed on all power lines in order to prevent bird collisions.	
Construction activities, people and vehicles will not be allowed outside of the area demarcated for construction.	
No hunting, snaring or collection of eggs will be allowed.	
If any Blue Crane nests or young are found, contact the Mpumalanga Parks Board for assistance. Also avoid the area at all cost (250m buffer)	***Site Development Plan, EMP monitoring and Intermittent observation***
If adult birds are observed on site, avoid startling the birds, as they could fly into the already existing power lines.	
No animals/pets will be allowed in the construction site.	
Adhere to the ESKOM bird collision prevention guideline (Appendix 2)	
Poisoning of any sort is strictly forbidden.	
Remove all food wastes daily and discard at a licensed waste facility	
Provide vermin-proof bins for construction workers	
Designate eating areas and prevent food and waste build up	
No cooking fires will be permitted, the grassland is highly susceptible to veld fires and these destroy bird eggs	

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8.3 Vegetation

Management Component	*Vegetation*
Primary Objective	
To ensure the control of alien invasive species and that the rehabilitation of indigenous vegetation to as close to the original state as possible.	
Core Criteria:	***Monitoring Criteria***
All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse)	***Site Development Plan, EMP monitoring and Intermittent observation***
Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident.	
Control of alien invasive species in line with the requirements of Conservation of Agricultural Resources Act will be undertaken.	
Alien invasive plant material will be preferentially removed in entirety through mechanical means (e.g. chainsaw, bulldozer, hand-pulling of smaller specimens). Chemical control is only required as a last resort.	
If during the establishment period, any noxious or excessive weed growth occurs, such vegetation will be removed.	
No construction activity and disturbance will be permitted in the seasonal seepage zone.	
It is the developer's responsibility to implement a monitoring programme that will be instituted to ensure that re-growth of alien invasive plants species does not occur, or that such re-growth is controlled.	
The sensitive vegetation unit should be avoided and construction limited to 50 m from the edge of the wetlands and streams	
Adhere to the ESKOM vegetation management guideline (Appendix 3)	

8.4 Rivers, wetlands and Streams

<table>
<tr><td>Management Component</td><td colspan="2">Rivers and streams</td></tr>
<tr><td colspan="3">Primary Objective</td></tr>
<tr><td colspan="3">To ensure that the rivers and streams are protected and incur minimal negative impact from the development as possible.</td></tr>
<tr><td colspan="2">Core Criteria:</td><td>Monitoring Criteria</td></tr>
<tr><td colspan="2">The Contractor will minimise the extent of any damage to the flood plain that is necessary to complete the works, and will not pollute any river as a result of construction activities.</td><td rowspan="9">Storm water Management Plan, Site Development Plan, EMP monitoring and Intermittent observations</td></tr>
<tr><td colspan="2">The Contractor will not cause any physical damage to any aspects of a watercourse, other than that necessary to complete the works as specified and in accordance with the accepted method statement.</td></tr>
<tr><td colspan="2">No construction vehicles or activities will be allowed to work within 50 m of any of the streams or wetlands on site</td></tr>
<tr><td colspan="2">Demarcated areas where waste can be safely contained and stored on a temporary basis during the construction phase should be provided at the hard park</td></tr>
<tr><td colspan="2">When adequate volumes (not more than 1 month) have accumulated all waste is to be removed from site and disposed of at a licensed facility</td></tr>
<tr><td colspan="2">Waste is not to be buried on site</td></tr>
<tr><td colspan="2">All hazardous materials inter alia paints, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the environment</td></tr>
<tr><td colspan="2">Spill-sorb or similar type product must be used to absorb hydrocarbon spills in the event that such spills should occur</td></tr>
<tr><td colspan="2">Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented</td></tr>
</table>

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9.0 CONCLUSION

Cymbian was appointed to investigate the biophysical aspects of the proposed site as well as the potential visual impact of the development. The aspects investigated include topography, soils, land use, land capability, wetland, fauna, flora and the visual environment.

It was found that the major areas of concern were the sensitive wetlands and riparian zones on site, along with the sensitive avifaunal species that occur in these environments. In addition it was noted that the visual impact of the development could be high.

Upon review of the existing procedures and mitigation measures that Eskom have applied in the past and which are based on sound scientific research it was found that the impacts to fauna could be reduced.

The impacts to the wetland and riparian zones could be reduced by utilising the Alternative 1 route alignment, thereby avoiding most of the wetlands and seepage zones. Alternative 1 would be considered the best alignment, due to the fact that the placement of power lines on the ridges would limit the land use upon the ridges and intern protect the natural vegetation located upon those ridges from urbanization and cultivation.

The additional visual impact was found to be moderate, when considering the high number of existing power lines in the area.

In conclusion, the proposed development will impact on the environment, but these impacts can be managed and mitigated to the point where they are within acceptable norms. It is suggested that the Alternative 1 route alignment be utilised in order to decrease the risk of impacting in fauna, wetlands and existing farming activities.

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Appendix 1: Floral Species List

Download from POSA (http://posa.sanbi.org) on September 30, 2008, 11:24 am - Grid: 2529CD				
Family	*Species*	Common name	Present	Occurrence
AMARYLLIDACEAE	*Cyrthanthus breviflorus*	Yellow Fire lily	x	Individuals
ANACARDIACEAE	*Rhus magalismontana Sond. subsp. magalismontana*	Bergtaaibos		
ANACARDIACEAE	*Sclerocarya birrea (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro*	Marula		
APIACEAE	*Afrosciadium magalismontanum (Sond.) P.J.D.Winter*	Wild Parsley		
APIACEAE	*Heteromorpha arborescens (Spreng.) Cham. & Schltdl. var. abyssinica (Hochst. ex A.Rich.) H.Wolff*	Parsley Tree		
APOCYNACEAE	*Asclepias gibba (E.Mey.) Schltr. var. gibba*			
APOCYNACEAE	*Asclepias stellifera Schltr.*	Spring Stars		
APOCYNACEAE	*Brachystelma rubellum (E.Mey.) Peckover*			
APOCYNACEAE	*Pachycarpus schinzianus (Schltr.) N.E.Br.*	Bitterwortel		
APOCYNACEAE	*Parapodium costatum E.Mey.*			
APONOGETONACEAE	*Aponogeton natalensis Oliv.*	Wateruintjie	x	Individuals
AQUIFOLIACEAE	*Ilex mitis (L.) Radlk. var. mitis*	Cape Holly		
ASPHODELACEAE	*Kniphofia ensifolia Baker subsp. ensifolia*			
ASTERACEAE	*Bidens pilosa*	Blackjack	x	Common
ASTERACEAE	*Bidens formosa*	Cosmos	x	Individuals
ASTERACEAE	*Crassocephalum x picridifolium (DC.) S.Moore*			
ASTERACEAE	*Dicoma macrocephala DC.*			
ASTERACEAE	*Helichrysum aureonitens Sch.Bip.*		x	Individuals
ASTERACEAE	*Helichrysum nudifolium (L.) Less. var. nudifolium*	Hottentot's Tea		
ASTERACEAE	*Helichrysum setosum Harv.*	Yellow Everlasting		
ASTERACEAE	*Helichrysum splendidum (Thunb.) Less.*			
ASTERACEAE	*Nidorella hottentotica DC.*			
ASTERACEAE	*Stoebe vulgaris*	Bankrupt Bush	x	Sparse
ASTERACEAE	*Tagetes minuta*	Khaki weed	x	Common
ASTERACEAE	*Vernonia poskeana Vatke & Hildebr. subsp. botswanica G.V.Pope*			
BRYACEAE	*Bryum argenteum Hedw.*	Silver Moss		
CAPPARACEAE	*Maerua cafra (DC.) Pax*	Common bush-cherry, White-wood		
CARYOPHYLLACEAE	*Corrigiola litoralis L. subsp. litoralis var. perennans Chaudhri*			

CARYOPHYLLACEAE	*Dianthus mooiensis F.N.Williams subsp. mooiensis var. mooiensis*	Wild Pink		
CARYOPHYLLACEAE	*Dianthus transvaalensis Burtt Davy*			
CONVOLVULACEAE	*Ipomoea crassipes Hook. var. crassipes*			
CONVOLVULACEAE	*Ipomoea magnusiana Schinz*			
CRASSULACEAE	*Crassula setulosa Harv. var. setulosa forma setulosa*			
CYPERACEAE	*Bulbostylis densa (Wall.) Hand.-Mazz. subsp. afromontana (Lye) R.W.Haines*			
CYPERACEAE	*Bulbostylis hispidula (Vahl) R.W.Haines subsp. pyriformis (Lye) R.W.Haines*			
CYPERACEAE	*Cyperus esculentus*	Yellow Nutsedge	x	Sparse
CYPERACEAE	*Lipocarpha nana (A.Rich.) Cherm.*			
CYPERACEAE	*Pycreus pumilus (L.) Domin*			
DICRANACEAE	*Campylopus savannarum (Müll.Hal.) Mitt.*			
ERIOCAULACEAE	*Eriocaulon abyssinicum Hochst.*			
EUPHORBIACEAE	*Euphorbia inaequilatera Sond. var. inaequilatera*			
EXORMOTHECACEAE	*Exormotheca holstii Steph.*			
FABACEAE	*Eriosema psoraleoides (Lam.) G.Don*			
FABACEAE	*Indigofera arrecta Hochst. ex A.Rich.*			
FABACEAE	*Indigofera zeyheri Spreng. ex Eckl. & Zeyh.*			
FABACEAE	*Lotononis foliosa Bolus*		x	Individuals
FABACEAE	*Rhynchosia monophylla Schltr.*		x	Individuals
FABACEAE	*Rhynchosia nervosa Benth. ex Harv. var. nervosa*			
FABACEAE	*Virgilia divaricata Adamson*			
FABACEAE	*Zornia milneana Mohlenbr.*		x	Individuals
FOSSOMBRONIACEAE	*Fossombronia gemmifera Perold*			
HALORAGACEAE	*Myriophyllum aquaticum (Vell.) Verdc.*			
HALORAGACEAE	*Myriophyllum spicatum L.*			
HYACINTHACEAE	*Albuca setosa Jacq.*	Slymuintjie	x	Individuals
HYPOXIDACEAE	*Hypoxis acuminata*		x	Individuals
HYPOXIDACEAE	*Hypoxis filiformis Baker*		x	Individuals
HYPOXIDACEAE	*Hypoxis iridifolia*		x	Individuals
IRIDACEAE	*Gladiolus crassifolius Baker*		x	Individuals
IRIDACEAE	*Lapeirousia sandersonii Baker*			
ISOETACEAE	*Isoetes transvaalensis Jermy & Schelpe*			
LAMIACEAE	*Becium angustifolium (Benth.) N.E.Br.*			

LAMIACEAE	*Becium obovatum*		x	Individuals
LAMIACEAE	*Mentha aquatica L.*			
LAMIACEAE	*Pycnostachys reticulata (E.Mey.) Benth.*			
LENTIBULARIACEAE	*Utricularia arenaria*		x	Individuals
LENTIBULARIACEAE	*Utricularia stellaris L.f.*			
LILIACEAE	*Protasparagus setaceus*	Asparagus Fern	x	Individuals
LOBELIACEAE	*Monopsis decipiens*		x	Individuals
MALPIGHIACEAE	*Triaspis hypericoides (DC.) Burch. subsp. nelsonii (Oliv.) Immelman*			
MALVACEAE	*Pavonia transvaalensis (Ulbr.) A.Meeuse*	Klapperbossie		
MALVACEAE	*Triumfetta obtusicornis Sprague & Hutch.*	Maagbossie		
MENYANTHACEAE	*Nymphoides thunbergiana (Griseb.) Kuntze*			
MESEMBRYANTHEMACEAE	*Delosperma leendertziae N.E.Br.*			
MESEMBRYANTHEMACEAE	*Frithia humilis Burgoyne*			
MESEMBRYANTHEMACEAE	*Mossia intervallaris (L.Bolus) N.E.Br.*			
MOLLUGINACEAE	*Limeum viscosum (J.Gay) Fenzl subsp. viscosum var. glomeratum (Eckl. & Zeyh.) Friedrich*			
MORACEAE	*Ficus abutilifolia (Miq.) Miq.*			
MORACEAE	*Ficus salicifolia Vahl*			
MYRTACEAE	*Eucalyptus spp*	Blue Gum	x	Sparse
NYMPHAEACEAE	*Nymphaea nouchali Burm.f. var. caerulea (Savigny) Verdc.*			
OCHNACEAE	*Ochna gamostigmata Du Toit*			
ONAGRACEAE	*Epilobium hirsutum L.*			
ORCHIDACEAE	*Centrostigma occultans (Welw. ex Rchb.f.) Schltr.*			
ORCHIDACEAE	*Habenaria clavata (Lindl.) Rchb.f.*			
ORCHIDACEAE	*Satyrium hallackii Bolus subsp. ocellatum (Bolus) A.V.Hall*			
OROBANCHACEAE	*Striga gesnerioides (Willd.) Vatke*			
OXALIDACEAE	*Oxalis obliquifolia*	Sorrel	x	Individuals
PALLAVICINIACEAE	*Symphyogyna brasiliensis Nees & Mont.*			
PARMELIACEAE	*Canoparmelia pustulescens (Kurok.) Elix*			
PEDALIACEAE	*Dicerocaryum senecioides (Klotzsch) Abels*			
PHYLLANTHACEAE	*Phyllanthus maderaspatensis L.*	Kleurbossie	x	Individuals
POACEAE	*Andropogon eucomus Nees*	Old Man's Beard	x	Sparse
POACEAE	*Calamagrostis epigejos (L.) Roth var. capensis Stapf*			
POACEAE	*Cymbopogon excavatus*	Broad-leaved Turpentine Grass	x	Individuals
POACEAE	*Cynodon dactylon*	Coch Grass	x	Sparse

POACEAE	*Echinochloa jubata Stapf*			
POACEAE	*Elionurus muticus*	Wire Grass	x	Individuals
POACEAE	*Eragrostis capensis (Thunb.) Trin.*	Heart-seed Love Grass	x	Individuals
POACEAE	*Eragrostis chloromelas Steud.*	Narrow Curly leaf	x	Common
POACEAE	*Eragrostis hierniana Rendle*			
POACEAE	*Eragrostis inamoena K.Schum.*			
POACEAE	*Eragrostis plana*	Tough Love Grass	x	Sparse
POACEAE	*Eragrostis racemosa (Thunb.) Steud.*	Narow Heart Love Grass	x	Sparse
POACEAE	*Eragrostis tef (Zuccagni) Trotter*	Tef	x	Sparse
POACEAE	*Hyparrhenia hirta (L.) Stapf*	Common Thatching Grass	x	Common
POACEAE	*Hyparrhenia quarrei Robyns*			
POACEAE	*Hyparrhenia tamba (Steud.) Stapf*	Blue Thatching Grass		
POACEAE	*Hyperthelia dissoluta (Nees ex Steud.) Clayton*			
POACEAE	*Loudetia simplex*	Russet Grass	x	Sparse
POACEAE	*Miscanthus junceus (Stapf) Pilg.*	Wireleaf Daba Grass		
POACEAE	*Perotis patens Gand.*	Cat's Tail	x	Individuals
POACEAE	*Schizachyrium sanguineum*	Red Autumn Grass	x	Sparse
POACEAE	*Setaria nigrirostris (Nees) T.Durand & Schinz*			
POACEAE	*Setaria sphacelata var. sphacelata*	Common Bristle Grass	x	Individuals
POACEAE	*Sporobolus fimbriatus*	Dropseed Grass	x	Sparse
POACEAE	*Themeda triandra*	Red Grass	x	Sparse
POACEAE	*Urochloa brachyura (Hack.) Stapf*		x	Sparse
POLYGALACEAE	*Polygala ohlendorfiana Eckl. & Zeyh.*			
POLYGALACEAE	*Polygala transvaalensis Chodat subsp. transvaalensis*			
PORTULACACEAE	*Anacampseros subnuda Poelln. subsp. subnuda*			
PORTULACACEAE	*Portulaca hereroensis Schinz*			
PORTULACACEAE	*Portulaca quadrifida L.*			
POTAMOGETONACEAE	*Potamogeton schweinfurthii A.Benn.*			
PTERIDACEAE	*Cheilanthes involuta (Sw.) Schelpe & N.C.Anthony var. obscura (N.C.Anthony) N.C.Anthony*			
RANUNCULACEAE	*Ranunculus meyeri Harv.*		x	Individuals
RICCIACEAE	*Riccia atropurpurea Sim*			
RICCIACEAE	*Riccia okahandjana S.W.Arnell*			
RICCIACEAE	*Riccia volkii S.W.Arnell*			
RUBIACEAE	*Richardia scabra L.*			
SCROPHULARIACEAE	*Chaenostoma leve (Hiern) Kornhall*			

SELAGINELLACEAE	*Hebenstretia angolensis Rolfe*	Katstert	x	Individuals
SELAGINELLACEAE	*Selaginella dregei (C.Presl) Hieron.*			
SOLANACEAE	*Solanum sisymbrifolium*	Wild tomato	x	Individuals
THELYPTERIDACEAE	*Thelypteris confluens (Thunb.) C.V.Morton*			
THYMELAEACEAE	*Gnidia sericocephala (Meisn.) Gilg ex Engl.*			
XYRIDACEAE	*Xyris capensis Thunb.*			

Appendix 2: Fauna Species List

Faunal Species List	
Species	**Common name**
Reptiles	
Bitens arietans	Puff Adder
Varanus niloticus	Water Monitor
Birds	
Phalacrocorax africanus	Reed Cormorant
Ardea cinerea	Grey Heron
Ardea melanocephala	Blackheaded Heron
Bubulcus ibis	Cattle Egret
Bostrychia hagedash	Hadeda Ibis
Plegadis falcinellus	Glossy Ibis
Alopochen aegyptiacus	Egyptian Goose
Elanus caeruleus	Blackshouldered Kite
Francolinus swainsonii	Swainson's Francolin
Numida meleagris	Helmeted Guineafowl
Fulica cristata	Redknobbed Coot
Gallinula chloropus	Moorhen
Anthropoides paradisea	Blue Crane
Sagittarius serpentarius	Secretary Bird
Eupodotis cafra	Whitebellied Korhaan
Vanellus armatus	Blacksmith Plover
Vanellus coronatus	Crowned Plover
Streptopelia semitorquata	Redeyed Dove
Streptopelia senegalensis	Laughing Dove
Asio capensis	Marsh Owl
Colius striatus	Speckled Mousebird
Mirafra africana	Rufousnaped Lark
Corvus albus	Pied Crow
Saxicola torquata	Stone Chat
Phylloscopus trochilus	Willow Warbler
Cisticola fulvicapilla	Neddicky
Motacilla clara	Cape Wagtail
Anthus cinnamomeus	Grassveld Pipit
Passer domesticus	House Sparrow
Ploceus velatus	Masked Weaver
Euplectes orix	Red Bishop
Emberiza capensis	Cape Bunting
Mammals	
Antidorcas marsupialis	Springbok
Damaliscus dorcas phillipsi	Blesbok
Cynictis pencillata	Yellow Mongoose
Orycteropus afer	Aardvark / Antbear

Appendix 3: Vegetation Management Guideline

Appendix 4: Electric and Magnetic Fields – A summary of Technical and Biological Aspects

Appendix 5: Bird Impact Assessment Study: Bravo Integration Project Phase 3