6. DESCRIPTION OF THE AFFECTED ENVIRONMENT

6.1 INTRODUCTION

This Chapter provides a description of the biophysical, socio-economic and cultural/historical environment of both Alternative 1 and 9, collectively described as the study area.

6.2 CLIMATE

South Africa experiences some of the highest levels of solar radiation in the world. The average daily solar radiation in South Africa varies between 4.5 and 6.5 kWh/m^2 (DoE, Web 2). **Figure 13** shows the annual solar radiation for South Africa, which reveals considerable solar resource potential for solar PV power generation.

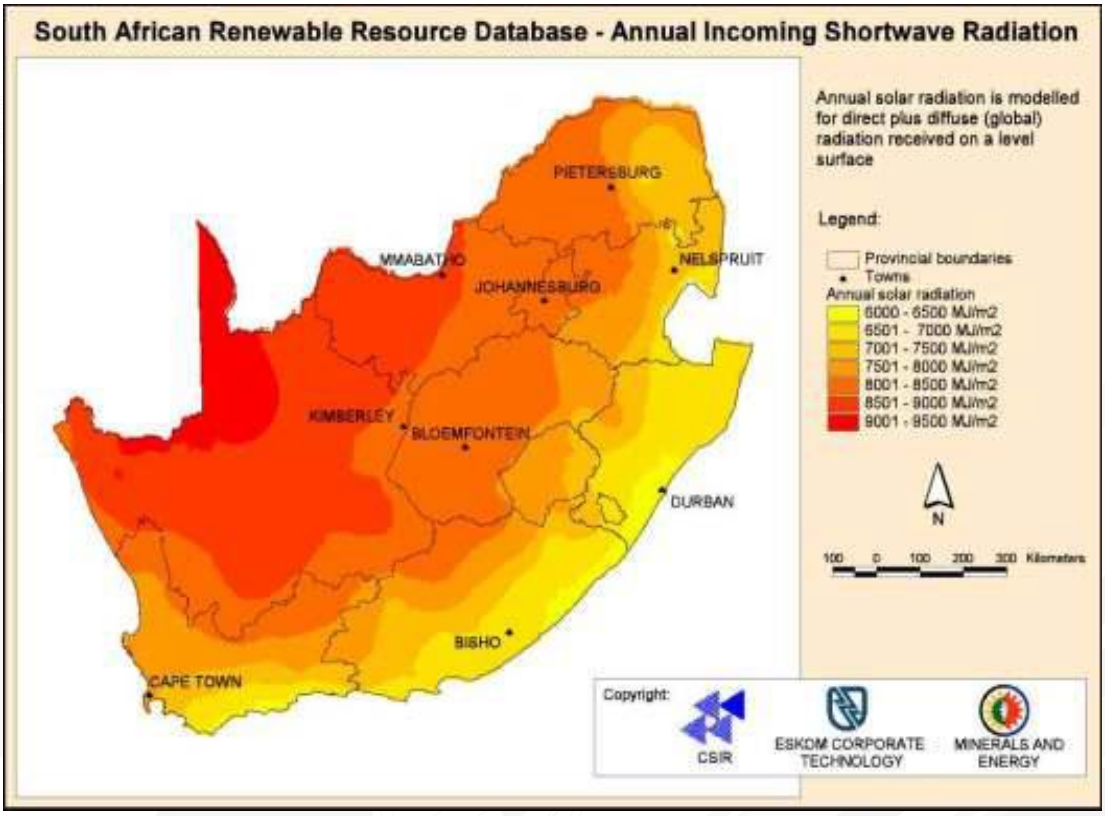

Figure 13: Annual direct and diffuse solar radiation (DoE, Web 2)

The study area displays warm summers and cold winters typical of the Highveld climate. The average maximum summer and winter daytime temperatures are 25 ^{0}C and 20 ^{0}C, respectively. Rainfall occurs mainly as thunderstorms and drought conditions occur in approximately 12 % of all years. The Environmental Potential Atlas for Mpumalanga places rainfall at site as ranging between 621 mm and 750 mm per year. The prevailing wind direction is north-west during the summer and east during winter. Winds are usually light to moderate.

6.3 GEOLOGY AND SOILS

The study area is underlain by geology consisting of sandstone of the Vryheid Formationthe Ecca Group of the Karoo Supergroup contains bands of coal within the sedimentary layers **(Figure 14).**

The soils are classified according to MacVicar et al (1977). The study area is covered by two (2) land types, namely Ba4, which can be described as red, highly weathered, structure-less plinthic soils, and Fa8, which can be described as mainly shallow soils with no lime and some rock.

The landscape represented by land type Ba4 is dominated by soils with high (occasionally moderate) agricultural potential, with very few low potential soils, However, the area covered by land type Fa8 is predominantly low potential, generally due to shallow soil depth and occasional rockiness.

6.4 FLORA

6.4.1 Biomes and Bioregion

The study area falls within the Grassland and Azonal Vegetation biomes and the Mesic Highveld Grassland Bioregion and Freshwater Wetlands Bioregions **(Figure 15).** While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that are expected to be found in an area.

6.4.2 Vegetation type

Knowing which vegetation type an area belongs to provides an indication of the floral composition that would be found if the study area was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site. The study area falls within the Rand Highveld Grassland, Eastern Temperate Freshwater Wetlands and the Eastern Highveld Grassland vegetation types (Mucina and Rutherford, 2006). The characteristics of these vegetation types are discussed further.

<u>Rand Highveld Grassland</u>

Rand Highveld Grassland occurs in Gauteng, North-West, Free State and Mpumalanga Provinces. In areas between rocky ridges from Pretoria to Witbank, extending onto ridges in the Stoffberg and Roossenekal regions as well as west of Krugersdorp centred in the vicinity of Derby and Potchefstroom, extending southwards and northwards from there. Altitude 1 300-1 635 m, but reaches 1 760 m in places (Mucina & Rutherford, 2006). The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrub land on rocky outcrops and steeper slopes. Most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. High diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra, Protea welwitschii*, *Acacia caffra* and *Celtis africana*, accompanies by a rick suite of shrubs among which the genus *Sersia* (*S. magalismonata*) is most prominent.

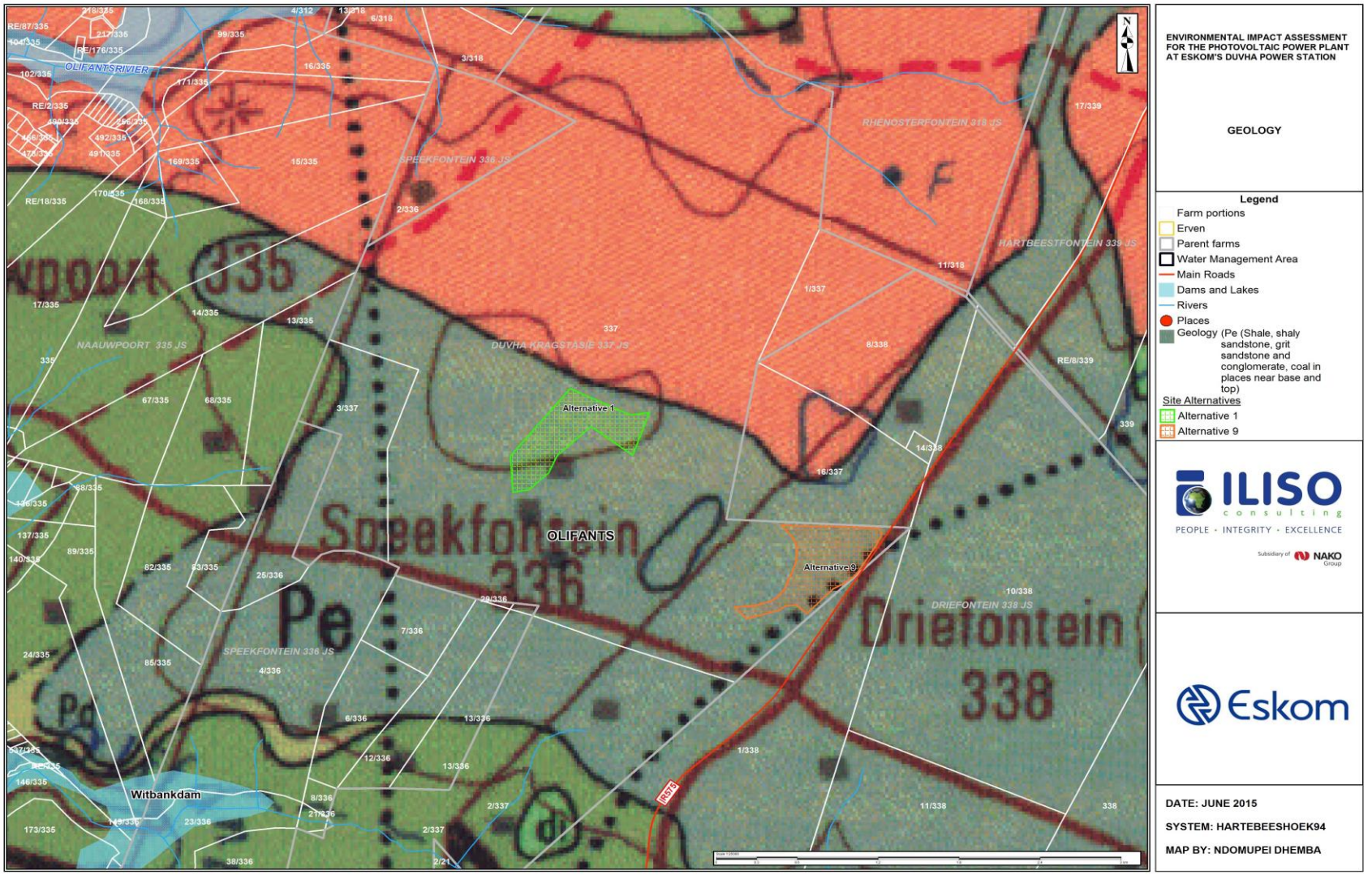

Figure 14: Geology

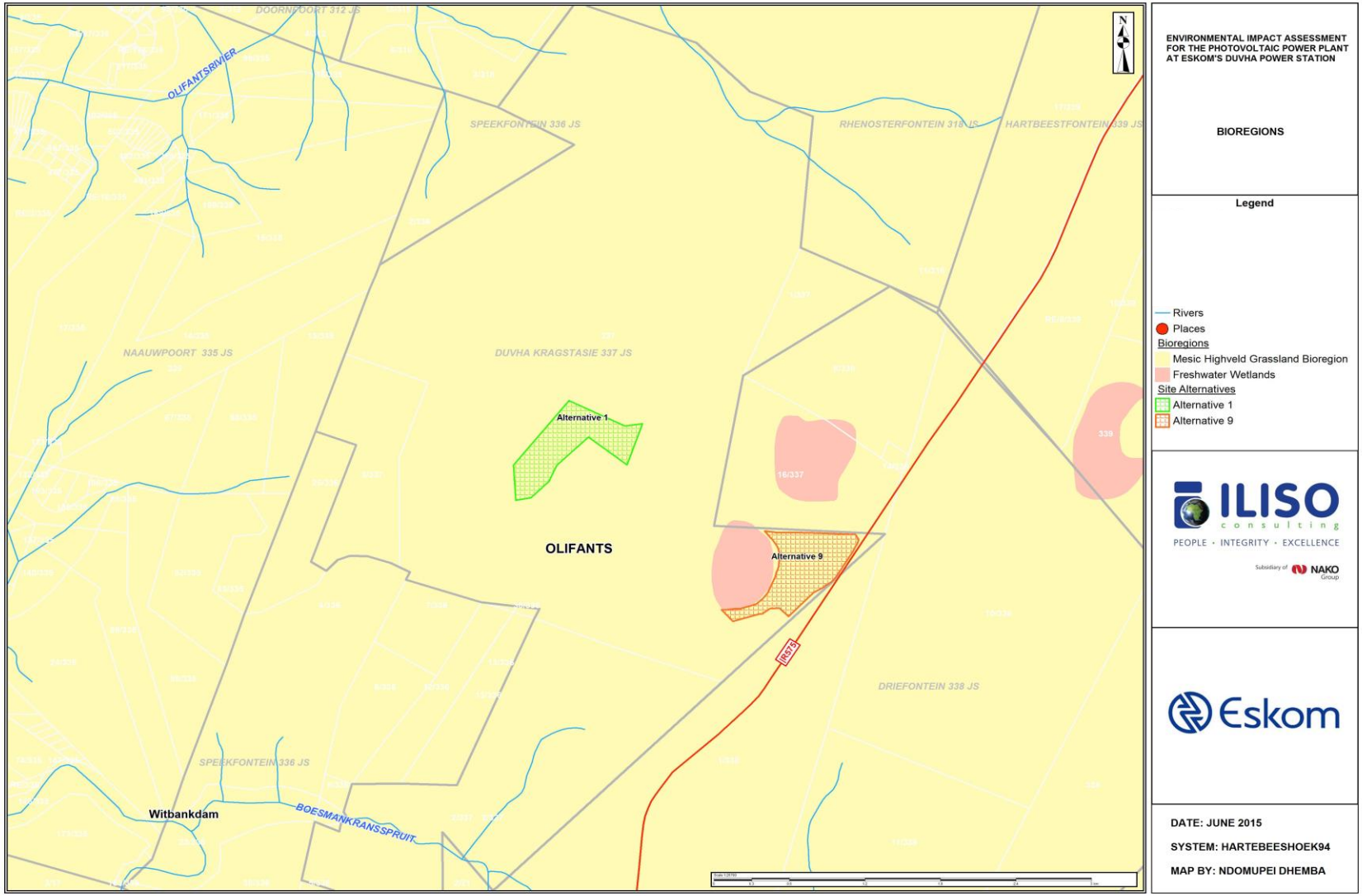

Figure 15: Bioregion

Eastern Highveld Grassland

Eastern Highveld Grassland occurs in the Mpumalanga and Gauteng Provinces: It occurs in 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. Altitude ranges from 1520 m to 1780 m, but also declines as low as 1300 m (Mucina & Rutherford, 2006). The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrub land on rocky outcrops and steeper slopes. Most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. High diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra, Protea welwitschii*, *Acacia caffra* and *Celtis africana*, accompanies by a rick suite of shrubs among which the genus *Sersia* (*S. magalismonata*) is most prominent.

Eastern Temperate Freshwater Wetlands

The Eastern Temperate Freshwater Wetlands vegetation type occurs within the Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Swaziland, within areas around stagnant water with stagnant water (lakes, pans, periodically flooded vleis, edges of calmly flowing rivers) and embedded within the Grassland Biome. The altitude ranges from 750 m to 2 000 m (Mucina & Rutherford, 2006).

Taxa of Eastern Temperate Freshwater Wetlands are composed of the following:

- Megagraminoid: *Cyperus congestus* (d), *Phragmites australis* (d), *Schoenoplectus corymbosus* (d), *Typha capensis* (d), *Cyperus immensus;*
- Graminoids: *Agrostis lachnantha* (d), *Carex acutiformis* (d), *Eleocharis palustris* (d), *Eragrostis plana* (d), *E. planiculmis* (d), *Fuirena pubescens* (d), *Helictotrichon turgidulum* (d), *Hemarthria altissima* (d), *Imperata cylindrica* (d), *Leersia hexandra* (d), *Paspalum dilatatum* (d), *P. urvillei (*d), *Pennisetum thunbergii* (d), *Shoenoplectus decipiens* (d), *Scleria dieterlenii* (d), *Setaria sphacelata* (d), *Andropogon appendiculatus, A. eucomus, Aristida aequiglumis, Ascolepis capensis, Carex astro-australis, C. cernua, C. schlechteri, Cyperus cyperoides, C. distans, C. longus, C. marginatus, Echinochloa holubii, Eragrostis micrantha, Ficinia acuminata, Fimbristylis complanata, F. ferruginea, Hyparrhenia dregenana, H. quarrei, Ischaemum fasciculatum, Kyllinga erecta, Panicum schinzii, Pennisetum sphacelatum, Pycreus macranthus, P. nitidus, Setaria pallide-fusca, Xyris gerrardii;*
- Herbs: *Centella asiatica* (d), *Ranunculus multifidus* (d), *Berkeya radula, B. speciosa, Berula erecta subsp, thunbergii, Centella coriacea, Chironia palusris, Equisetum ramosissimum, Falckia oblonga, Haplocarpa lyratam, Helichrysum*

difficile, H. dregeanum, H. mundtii, Hydrocotyle sibthorpioides, H. verticillata, Lindernia conferta, Lobelia angolensis, L. flaccida, Marsilea farinosa subsp. *farinosa, Mentha aquatica, Monopsis decipiens, Pulicaria scabra, Pycnostachys reticulata, Rorippa fluviatilis* var *fluviatilis, Rumex lanceolata, Senecio inornatus, S. microglossus, Sium repandum, Tehlypteris confluens, Wahlenburgia banksiana;*

- Geophytic herbs: *Cordylogyne globosa, Crinum bulbispermum, Gladiolus papilio, Kniphoia ensifolia, K. fluviatilis, K. linearifolia, Neobolusia tysonii, Satyrium hallackii* subsp. *Hallackii;*
- Aquatic herbs: *Aponogeton junceus, Ceratophyllum demersum, Lagarosiphon major, L. muscoides, Marsilea capensis, Myriophyllum spicatum, Nymphaea lotus, N. nouchali var caerulea, Nymphoides thunbergiana, Potamogeton thunbergii;*
- Carnivorous herb: *Utriculata inflexa;*
- Biogeographically important taxon: *Rorippa fluviatilis* var *caldonica*

6.4.3 Habitat Units

Two main habitat units were identified during the assessment, which are defined below:

- Habitat considered to be transformed due to agricultural activities and alien/weed encroachment; and
- Wetland habitat.

The following sections describe the habitat units in more detail.

Transformed Habitat

The transformed habitat unit comprises areas where historical agricultural activities have occurred and where vegetation has been cleared/mowed as part of maintenance activities around the power station. Additional vegetation transformation has also taken place due to the establishment of alien and invasive floral communities, and overgrazing **(Figure 16)**. This habitat unit covers the majority of the study area and has been transformed by edge effects associated with historic agricultural activities, alien floral invasion and edge effects from roads and power station infrastructure, vegetation clearing and woody encroachment by Seriphium plumosum. This has led to the alteration of the floral community structure and the establishment of a sub-climax grass community. Ecological functioning, although not completely absent, was found to be low in most areas. Dominant grass species included *Hyparrhenia hirta, Eragrostis curvula and E. chloromelas*. These species are associated with transformation and usually grow in disturbed places such as old cultivated lands and along roadsides. Additionally, these areas have a significant

build-up of moribund material due to the natural burning regime being altered, which significantly reduces forb diversity **(Table 9).**

The likelihood of floral SCC occurring within this habitat unit is considered to be low, and none were encountered. Furthermore, the ecological functionality and habitat integrity of the transformed habitat unit is regarded as being moderate to low, and development within this habitat unit is supported. However, edge effects from any activities occurring in this habitat unit must be effectively mitigated in order to prevent adverse impacts on the surrounding wetland habitat unit.

Figure 16: Transformed habitat unit around Alternative 1.

Table 9: Dominant species encountered in the transformed habitat unit. Alien species are indicated with an asterisk (*).

Grass/sedge/reed species	Forb species	Tree/Shrub Species
Aristida bipartata	*Acalypha angustata*	*Seriphium plumosum*
Aristida congesta subsp. barbicollis	**Tagetes minuta*	**Acacia mearnsii*
Aristida congesta subsp. congesta	*Berkheya radula*	
Cynodon dactylon	**Bidens pilosa*	
Digitaria tricholaenoides	**Bidens formosa*	
Eragrostis curvula	**Plantago lanceolata*	
Eragrostis chloromelas	*Pelargonium luridum*	
Hyparrhenia hirta	*Helichrysum kraussii*	
Themeda triandra	*Monopsis decipiens*	
Tristachya leucothrix	*Senecio coronatus*	
Pogonarthria squarrosa	*Hypoxis angustifolia*	

Grass/sedge/reed species	Forb species	Tree/Shrub Species
Imperata cylindrica	*Hypoxis acuminata*	
	**Taraxacum officinale*	
	Ledebouria cooperii	
	Ledebouria ovatifolia	

Wetland habitat

One wetland feature was identified within the footprint of Alternative Site 9, namely a depression wetland. Adjacent to Alternative 1 an artificial wetland was encountered which has formed as a result of altered topography associated with the construction of the Duvha Power Station, which has led to localised ponding and the establishment of facultative and obligate wetland floral species **(Figure 17).** This feature was not considered to be a natural wetland as defined in the DWAF, 2005: "A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". However, it was still assessed as it provides habitat for faunal and floral species within the Duvha Power Station footprint.

All of the features have been affected to varying degrees by edge effects from the power station, road construction, historic agriculture and general anthropogenic activities, which has negatively affected the habitat integrity of these systems.

Dominant floral species within the wetlands include *Typha capensis, Juncus effusus, Cyperus rupestris, Leersia hexandra, Imperata cylindrica, Eragrostis plana, Schoenoplectus paludicola, Hyparrhenia tamba* and *Persicaria lapathifolia* **(Table 10)**. The depression wetland is considered to be in a largely natural state, with limited change in ecosystem processes and loss of natural habitats having taken place and the natural habitat remains predominantly intact. The artificial wetland is considered to be extensively modified, however since it provides niche habitat for faunal and floral species within the Duvha Power Station footprint, it is considered to be of importance from an ecological perspective in relation to the surrounding terrestrial areas.

Thus, where any activities or edge effects associated with the proposed project or infrastructure are likely to affect wetlands, it must be ensured that the disturbance footprint is minimised and that the duration of disturbance is limited.

Figure 17: Typical view of the wetland habitat unit with the depression Alternative site 9 (top) and artificial wetland (bottom)

Table 10: Dominant species encountered in the wetland habitat unit, alien species are marked with an asterisk (*)

Terrestrial zone	Temporary / Seasonal Zone	Permanent Zone
Hyparrhenia hirta	**Verbena bonariensis*	*Mariscus congestus*
Eragrostis curvula	*Sporobolus africanus*	*Imperata cylindrica*
Eragrostis chloromelas	*Juncus effusus*	*Kylinga alba*
Harpochloa falx	*Schoenoplectus corymbosus*	*Cyperus rupestris*
**Asclepias fruticosa*	*Imperata cylindrica*	*Typha capensis*
Cymbopogon plurinodis	*Helichrysum* species	*Juncus effusus*
**Cosmos bipinnata*	*Habenaria nyikana*	*Schoenoplectus corymbosus*
**Conyza bonariensis*	*Eragrostis plana*	*Phragmites australis*
Eragrostis plana		*Leersia hexandra*

6.4.4 Vegetation Index Score

The information gathered during the assessment of the study area was used to determine the Vegetation Index Score (VIS). Due to variation between the different habitat units within each alternative site, all habitat units were assessed separately. The table below lists the results of each habitat unit. **Table 11 and Table 12** lists the results of each habitat unit.

Table 11: Scoring for the Vegetation Index Score

VIS	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications.
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The extensive loss of natural habitat
<5	**F**	Modified completely

Table 12: Vegetation Index Score for each habitat unit assessed

Habitat unit	Score	Class	Motivation
Transformed habitat	13	**D – Largely modified**	Transformation has occurred within this habitat unit to the degree that secondary grassland conditions prevail and alien and invader species abundance is high. Therefore, this habitat unit is classified as largely modified.
Wetland habitat	15	**C – Moderately modified**	Transformation of the wetland systems include hydrological changes, vegetation transformation and sedimentation. The wetland systems have an important ecological function in terms of habitat provision for faunal and floral species.

6.4.5 Floral Species of Conservational Concern (SCC) Assessments

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS (Pretoria Computer Information Systems) red data plant list for the grid references (*2529CD*) was acquired from South African National Biodiversity Institute (SANBI) **(Table 13).**

Table 13: PRECIS plant list for the QDS 2529CD

Species	Threat status	Growth forms
Crinum bulbispermum	Declining	Geophyte, hydrophyte
Crinum macowanii	Declining	Geophyte
Pachycarpus suaveolens	Vulnerable	Herb, succulent
Ilex mitis var. mitis	Declining	Shrub, tree
Callilepis leptophylla.	Declining	Herb
Hypoxis hemerocallidea	Declining	Geophyte
Khadia carolinensis	Vulnerable	Succulent
Pavetta zeyheri subsp. middelburgensis	Rare	Dwarf shrub
Encephalartos lanatus	Near threatened	Shrub, tree

Hypoxis hemerocallidea and the two *Crinum* species are the most likely Red Data Lists (RDL) of floral species to occur in the study area, especially around the wetland depression associated with Alternative Site 9. Due to the severe vegetation transformation associated with Alternative Site 1, it is unlikely that these species will occur within this footprint.

6.4.6 Alien and Invasive Floral Species

Alien invaders are plants that are of exotic origin and are invading previously pristine areas or ecological niches (Bromilow, 2001). The study area exhibits a moderate to high diversity of alien species, especially within the transformed areas. A list of alien species is presented in **Table 14.** Alien species located in the study area need to be removed on a regular basis as part of maintenance activities according to the National Environmental Management Biodiversity Act 2004 (Act No.10 of 2004) Alien and Invasive Species Regulations, 2014. The various category of weeds must be controlled as follows:

- Category 1 – Declared weeds. Prohibited plants, which must be controlled or eradicated.
- Category 2 – Declared invader plants with a value. “Invaders” with certain useful qualities (i.e. commercial), only allowed in controlled, demarcated areas.
- Category 3 – Mostly ornamental plants. Alien plants presently growing in, or having escaped from, areas such as gardens, but are proven invaders. No further planting or trade in propagative material is allowed (Bromilow, 2001).

Table 14: Exotic or invasive species found within the study area

Species	English name	Type or Origin	Category*
Tress/ shrubs			
Salix babylonica	Weeping willow	Invader	2
Acacia mearnsii	Black wattle	Native to Australia	2
Eucalyptus camuldulensis	Red river gum	Invader	2
Melia azederach	Syringa	Native to India	3
Forbs			
Bidens pilosa	Common blackjack	Native to S America	NA
Bidens formosa	Cosmos	Native to Central America	NA
Rumex acetosella	Sheep sorrel	Native to Europe	NA
Conyza albida	Tall fleabane	Native to America	NA
Conyza Canadensis	Horseweed fleabane	Native to America	NA
Datura stramonium	Common thornapple	Native to N America	1
Schkuhria pinnata	Dwarf marigold	Native to S America	NA
Tagetes minuta	Tall khakiweed	Native to S America	NA
Verbena bonariensis	Purple top	Native to S America	NA
Trifolium repens	White clover	Native to Europe	NA
Solanum elaeagnifolium	Silverleaf bitter apple	Native to America	1
Solanum sisymbrifolium	Dense thorned bitter apple	Weed	1
Hibiscus trionum	Wild stockrose	Native to Asia	NA
Datura ferox	Large thorn apple	Native to N America	1
Bidens formosa	Cosmos	Native to Central America	NA
Asclepias fruticosa	Shrubby milkweed	Weed	Na
Reeds/Grasses			
Cyperus esculentis	Yellow nut sedge	Unknown origin	
Bromus catharticus	Rescue grass	Native to S. America	

6.4.7 Medicinal Plant Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The medicinal species are all commonly occurring species and are not confined to the study area.

Table 15 presents a list of plant species with traditional medicinal value, (plant parts traditionally used and their main applications), which were identified during the field assessment. All of the medicinal species identified are considered to be common and widespread species and were not confined to any specific habitat unit. Therefore, the proposed development is not likely to have a significant impact on medicinal flora species conservation.

Table 15: Traditional medicinal plants identified during the field assessment.

Species	Name	Plant parts used	Medicinal uses
Gnidia kraussiana	Yellow head	Rootstock and roots	There are many medicinal uses for this highly toxic plant, ranging from the topical treatment of burns and snake bites to enemas for stomach complains and decoctions used to ensure and easy childbirth
Helichrysum nudifolium	Everlasting	Leaves and twigs	Mainly ailments are treated, including coughs, cold, fever, infections, headache and menstrual pains. It is a popular ingredient for wound dressing.
Vernonia oligocephala	Bitterbossie	Leaves and twigs	Abdominal pain and colic. Rheumatism, dysentery, and diabetes.
Asclepias fruticosa	Milkweed	Mainly leaves, sometimes roots.	Snuff is prepared from ground leaves and used for treatment of headaches, tuberculosis and a general emetic to strengthen body.
Datura stramonium	Thornapple	Leaves and rarely the green fruit.	Generally as asthma treatment and pain reduction.
Leonotis microphylla	Wild dagga	Leaves and stems, sometimes roots.	Dried parts smoked for relief of epilepsy. Leaves and roots widely used for a remedy for snake bite and other stings and bites. External decoctions used as a treatment for boils, eczema, skin diseases, itching and muscular cramps. Internal decoctions used for coughs, colds and influenza, bronchitis, high blood pressure and headaches. Leaf infusions have been used for asthma and viral hepatitis.
Plantago lanceolata	Ribwort plantain	Leaves	Anti-inflammatory and expectorant. Used to treat wounds, inflammation of skin and against catarrhs of the respiratory tract and inflammation of mouth and throat.
Conyza canadensis	Horseweed fleabane	Herb	Astringent, diarrhoea, diuretic, colds, insect repellent

6.5 FAUNA

6.5.1 Mammals

No mammal SCC were observed during the site survey. In terms of conservation, the likelihood that any threatened mammal SCC that are listed by Mpumalanga Province could be encountered is deemed low, due to the relatively small surface area and high levels of habitat transformation of the majority of the study area, as well as they proximity to the Duvha Power Station and associated anthropogenic activities. **Table 16** lists the mammal species encountered during the assessment as well as their International Union for Conservational Concern (IUCN) status.

Table 16: Mammal species recorded during the field surveys

Scientific Name	Common Name	IUCN
Damaliscus pygargus phillipsi	Blesbok	LC
Equus quagga	Palins Zebra	LC
Lepus saxatilis	Scrub hare	LC
Cryptomys hottentotus	African Mole Rat	LC
Galerella sanguinea	Slender mongoose	LC

Scientific Name	Common Name	IUCN
Rhabdomys pumilio	Four-striped Grass Mouse	LC

LC = Least Concern

Due to the transformed nature of the majority of the study area, it is unlikely that RDL or sensitive mammal species will utilise the site for habitation or foraging purposes. No Mpumalanga SoER (2003) threatened mammal species were determined to have a greater than 60% Probability of Occurrence (PoC) for the study area.

The presence of both *Damaliscus pygargus phillipsi* (Blesbok) and *Equus quagga* (Palins Zebra) within the Duvha Power Station boundaries is artificial, and is maintained as such. If Alternative Site 1 is selected as the site for the PV Plant, the numbers of both the afore mentioned species needs to be halved, as Alternative 1 comprises a large grazing portion of the property for these species. It is recommended that the genetics of the current populations also be considered, and that whilst removing excess animals, new ones are brought in to enrich the gene pool of the small populations to prevent further inbreeding.

6.5.2 Avifauna

According to Birdlife South Africa (BLSA), the study area does not fall within any Important Bird Areas (IBA), which has been highlighted as important conservation areas within South Africa (Birdlife South Africa, 2014). All avifaunal species seen or heard during the time of the assessment were recorded. Surveys were conducted across the entire study area and in the immediate surroundings. It must be noted that some migratory birds may not have been identified during the site survey period.

The majority of the study area comprises of habitat suitable for grassland and wetland birds. Several bird species were identified, primarily throughout the transformed habitat areas and in and around the wetland areas and pans located in the study area.

Favourable short grass habitat for the *Geronticus calvus* (Southern Bald Ibis), which is considered to be Vulnerable by the IUCN, is created by the high grazing impact of *Equus quagga* (Plains Zebra) and *Damaliscus pygargus phillipsi* (Blesbok). Southern Bald Ibis being present during the site visit indicates how species can adapt to environments that have been rehabilitated and favoured habitat is present.

The avifaunal species found in the study area are all commonly occurring species and are presented in **Table 17** together with their 2015 IUCN status.

Table 17: Avifaunal species recorded during the field surveys

Scientific Name	Common Name	IUCN
Upupa africana	African Hoopoe	*LC*
Threskiornis aethiopicus	African Sacred Ibis	*LC*
Saxicola torquatus	African StoneChat	*LC*
Hirundo rustica	Barn Swallow	*LC*
Elanus caeruleus	Black-shouldered Kite	*LC*

Scientific Name	Common Name	IUCN
Lamprotornis nitens	Cape Glossy Starling	*LC*
Passer melanurus	Cape Sparrow	*LC*
Streptopelia capicola	Cape Turtle Dove	*LC*
Motacilla capensis	Cape Wagtail	*LC*
Cisticola textrix	Cloud Cisticola	*LC*
Acridotheres tristis	Common Myna	*LC*
Apus apus	Common Swift	*LC*
Vanellus coronatus	Crowned Lapwing	*LC*
Pycnonotus tricolor	Dark-capped Bulbul	*LC*
Cisticola aridulus	Desert Cisticola	*LC*
Mirafra fasciolata	Eastern clapper Lark	*NYBA*
Cecropis cucullata	Greater Striped Swallow	*LC*
Ardea cinerea	Grey Heron	*LC*
Bostrychia hagedash	Hadeda Ibis	*LC*
Numida meleagris	Helmeted Guineafowl	*LC*
Passer domesticus	House Sparrow	*LC*
Streptopelia senegalensis	Laughing Dove	*LC*
Apus affinis	Little Swift	*LC*
Euplectes progne	Long-tailed Widowbird	*LC*
Cisticola fulvicapilla	Neddicky	*LC*
Columba livia	Rock Dove	*LC*
Geronticus calvus	Southern Bald Ibis	*VU*
Euplectes orix	Southern Red Bishop	*LC*
Prinia subflava	Tawny-flanked Prinia	*LC*
Ploceus cucullatus	Village Weaver	*LC*
Cisticola juncidis	Zitting Cisticola	*LC*

LC = Least concern
NYBA = Not Yet Been Assessed
VU = Vulnerable

In terms of avifaunal SCC, only *Geronticus calvus* (Southern Bald Ibis) was identified during the site survey **(Figure 18)**. There is however a high probability that *Circus ranivorus* (African Marsh Harrier) and *Tyto capensis* (African Grass Owl) may possibly utilise the study area specifically for foraging purposes, especially around the wetland depression associated with Alternative Site 9. The avifaunal SCC found in the study area are presented in **Table 18.**

Table 18: Avifauna SCC with a POC of more than 60%

Common Name	Scientific Name	Mpumalanga RDL status	IUCN Status	POC %
African Grass Owl	*Tyto capensis*	VU	LC	65
African Marsh Harrier	*Circus ranivorus*	VU	LC	63
Southern Bald Ibis	*Geronticus calvus*	VU	VU	100

Figure 18: *Geronticus calvus* (Southern Bald Ibis) encountered during the assessment close to Alternative 1

6.5.3 Amphibian

Only one amphibian species was identified during the assessment periods namely the Natal sand frog *(Tomopterna natalensis).* Other common amphibian species which are known to occur in the surrounding regions include the Plain Grass Frog *(Ptychadena anchietae),* Common Caco *(Cacosternum boettgeri),* Red toad *(Schismaderma carens),* Tremolo sand frog *(Tomopterna cryptotis),* Guttural toad *(Amietophrynus gutturalis),* and the Striped grass frog *(Ptychadena mossambica).* The above mentioned amphibians are not considered to be threatened in the Mpumalanga Province (NW SoER, 2003) and Least Concern by the IUCN.

The only amphibian species listed as being of conservation concern is the Giant Bullfrog *(Pyxicephalus adspersus)* (Appendix 3, MP SoER, 2003). No Giant Bullfrogs were identified on or within the vicinity of the study area. Giant Bullfrogs are known to occur within and nearby riparian and wetland zones, where they remain in cocoons submerged underground during the winter periods, preferably in sandy soils, and only emerge at the start of the rainy season. They breed in shallow waters and can occupy temporary floodplains and rapidly drying pool areas. Giant bullfrogs are also known to travel vast distances and may utilise wetlands as migratory corridors. The only suitable habitat present for this species within the study area is the wetland depression associated with Alternative Site 9.

6.5.4 Reptiles

One non threatened reptile species was identified during the assessment of the study area, namely *Trachylepis punctatissima* (Montane Striped Skink). This species is found in a variety of habitats, wet and dry, from grassland and savanna to shrubland. The above mentioned reptile specie is not a SCC (Appendix 4, MP SoER, 2003) and is classified as Least Concern by the IUCN (2015). Very little suitable reptile habitat

(such as rocky areas) is present in the study area, and the proposed PV Plant is unlikely to affect surface habitat. Thus, the proposed project is unlikely to have a significant impact on reptile conservation within the region.

6.5.5 Invertebrates

The invertebrate assessment conducted was a general assessment with the purpose of identifying common species and taxa in the study area. As such, the invertebrate assessment will not be an indication of the complete invertebrate diversity potential of the proposed development site and surrounding area. No invertebrate SCC were found during the faunal survey. A representation of commonly encountered families in the Insecta class that were observed during the assessment is listed in **Table 19**.

Table 19: Invertebrate species recorded during the site survey.

Order	Family	Scientific Name	Common Name	IUCN 2015
Lepidoptera	Pieridae	*Belenois aurota*	Brown-veined White	NYBA
		Eurema hecabe	Common grass Yellow	NYBA
	Geometridae	*Rhodometra sacraria*	Vestal	NYBA
	Nymphalidae	*Junonia hierta*	Yellow pansy	LC
		Danaus chrysippus	African monarch	NYBA
Isoptera	Termitidae	*Odontotermes latericus*	Harvester Termites	NYBA
Diptera	Calliphoridae	*Musca domestica*	House fly	NYBA
Orthoptera	Acrididae	*Ancanthacris ruficornis*	Garden locust	NYBA
Hymenoptera	Apidae	*Apis mellifera scutellata*	African honey bee	NYBA
	Vespidae	*Belanogaster junceus*	Paper wasp	NYBA
Odonata	Gomphidae	*Ictinogomphus ferox*	Common Tigertail	LC
	Libellulidae	*Trithemus annulata*	Violet Dropwing	NYBA
		Orthetrum julia	Julia Skimmer	LC

LC = Least Concern, NYBA = Not yet been assessed by the IUCN

Metisella meninx, commonly known as the Marsh Sylph (Butterfly) is an invertebrate which is listed as Vulnerable in the MP SoER, 2003 report and is not yet listed on the IUCN listings. The study area falls within the distribution range noted for the M. meninx however, no populations of this species were identified during the site assessments. Its preferred habitat comprises of wetlands where marsh grass (Leersia hexandra) are dominant. The only suitable habitat present for this species within and around the study area is the wetland depression associated with Alternative Site 9.

6.5.6 Arachnids and Scorpions

No threatened spider or scorpion species lists for the Mpumalanga Province are as yet available (MP SoER, 2003). Therefore, a record of threatened spiders and scorpions was acquired from the most recent RDL spider and scorpion data available for South Africa using the SANBI threatened species database (http://www.speciesstatus.sanbi.org).

Trapdoor and Baboon spiders are listed as threatened throughout South Africa (Dippenaar-Schoeman, 2002). All baboon spider species form the genus; Ceratgyrus,

Harpactira and Pterinochilus are protected under the National Environmental Management: Biodiversity Act, No. 10 of 2004 (NEMBA) for South Africa. All scorpion species from the genus; Hadogenes, Opisthacanthus and Opistophthalmus are also protected under NEMBA for South Africa.

During the assessment, specific attention was paid to the identification of suitable habitat for spiders and scorpions. After thoroughly searching, no scorpion or spider species were observed within the study area.

As such, it is highly unlikely that the PV Plant will impact negatively upon any spider or scorpion species within the study area.

6.5.7 Faunal Species of Conversational Concern (SCC) Assessment

Although no SCC were observed within the study or surrounding areas, there remains the possibility that some avifaunal SCC may utilise the study area for foraging purposes from time to time. The Species of Conservational Concern Sensitivity Index Score (SCCSIS) assessment of the study areas potential faunal SCC yielded a score of 45%, indicating a medium importance with regards to faunal SCC within the region. All species with a POC of 60% or more have an increased probability of either permanently or occasionally inhabiting the study area. The species listed in **Table 18** are the only species that attained a POC of greater than 60%. These species are likely to occur around the wetland depression associated with Alternative Site 9. Thus, from a faunal SCC conservation perspective, Alternative Site 9 is not supported. However, should Alternative 1 be pursued, the anticipated impact on faunal SCC is likely to be low.

6.6 SURFACE WATER RESOURCES

6.6.1 Ecoregion

The site falls within the B11G quaternary catchment in the Upper Olifants sub-Water Management Area (sub-WMA) of the Olifants Water Management Area (WMA**) (Figure 19)**.

According to the SANBI Wetland Inventory (2006) National Freshwater Ecosystem Priority Areas (NFEPA) (2011), the subWMA is not regarded important in terms of fish sanctuaries, rehabilitation or corridors. In addition it is not considered important in terms of translocation and relocation zones for fish. The subWMA is not listed as a fish Freshwater Ecosystem Priority Area (FEPA). No wetland features were indicated by the NFEPA wetland database layer within the study area, but there are NFEPA wetlands indicated within close proximity of the study area, especially adjacent to Alternative Site 9 **(Figure 20)**.

6.6.2 Wetlands

The wetlands occurring within the study area have been classed into broad Hydrogeomorphic (HGM) units according to the classification system compiled by SANBI (Ollis *et al*., 2013) **(Table 20),** namely:

- Channelled valley bottom wetland; and
- Depression Wetland.

Table 20: Classification system for wetland features identified within the study area.

Level 1: System	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: (HGM) unit
			HGM Type
Inland: An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically.	**Highveld Aquatic Ecoregion:** The study area falls within the Highveld Aquatic Ecoregion **WetVeg**: Mesic Highveld Grassland Group (Endangered) 4	**Valley floor:** The typically gently sloping, lowest surface of a valley	**Channelled valley bottom wetland:** A valley bottom wetland with a river channel running through it.
Inland: An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically.	**Highveld Aquatic Ecoregion:** The study area falls within the Highveld Aquatic Ecoregion **WetVeg:** Mesic Highveld Grassland Group 4 (Endangered)	**Valley floor:** The typically gently sloping, lowest surface of a valley.	**Depression:** A landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.

All wetland features have been affected by historical agricultural activities and edge effects from the power station and adjacent roads such as storm water runoff, resulting in inundation, augmentation of sediment deposition and vegetation clearing within the wetlands. **Figure 17** presented typical views of the seepage and channelled valley bottom wetlands.

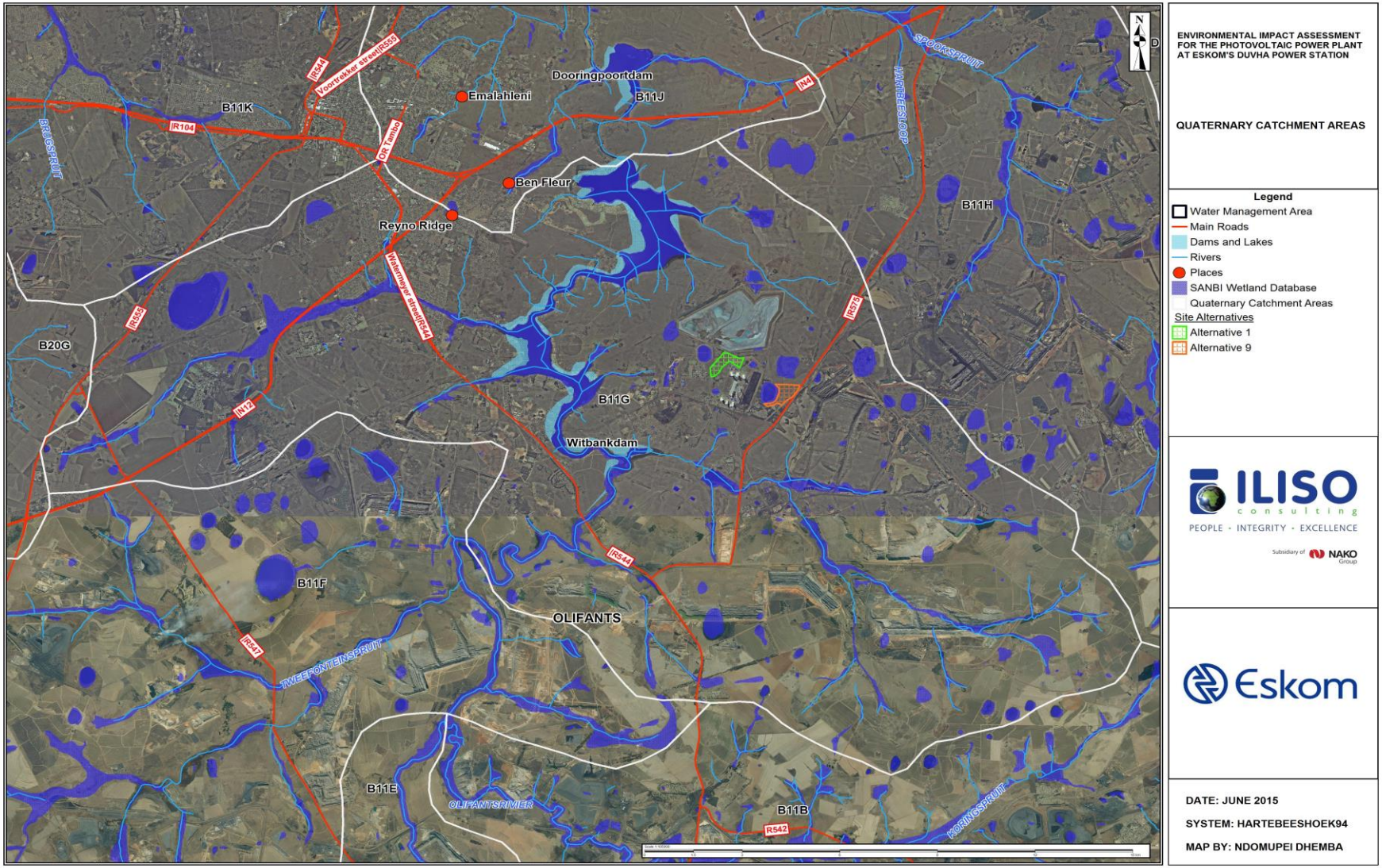

Figure 19: Quaternary Catchment Area

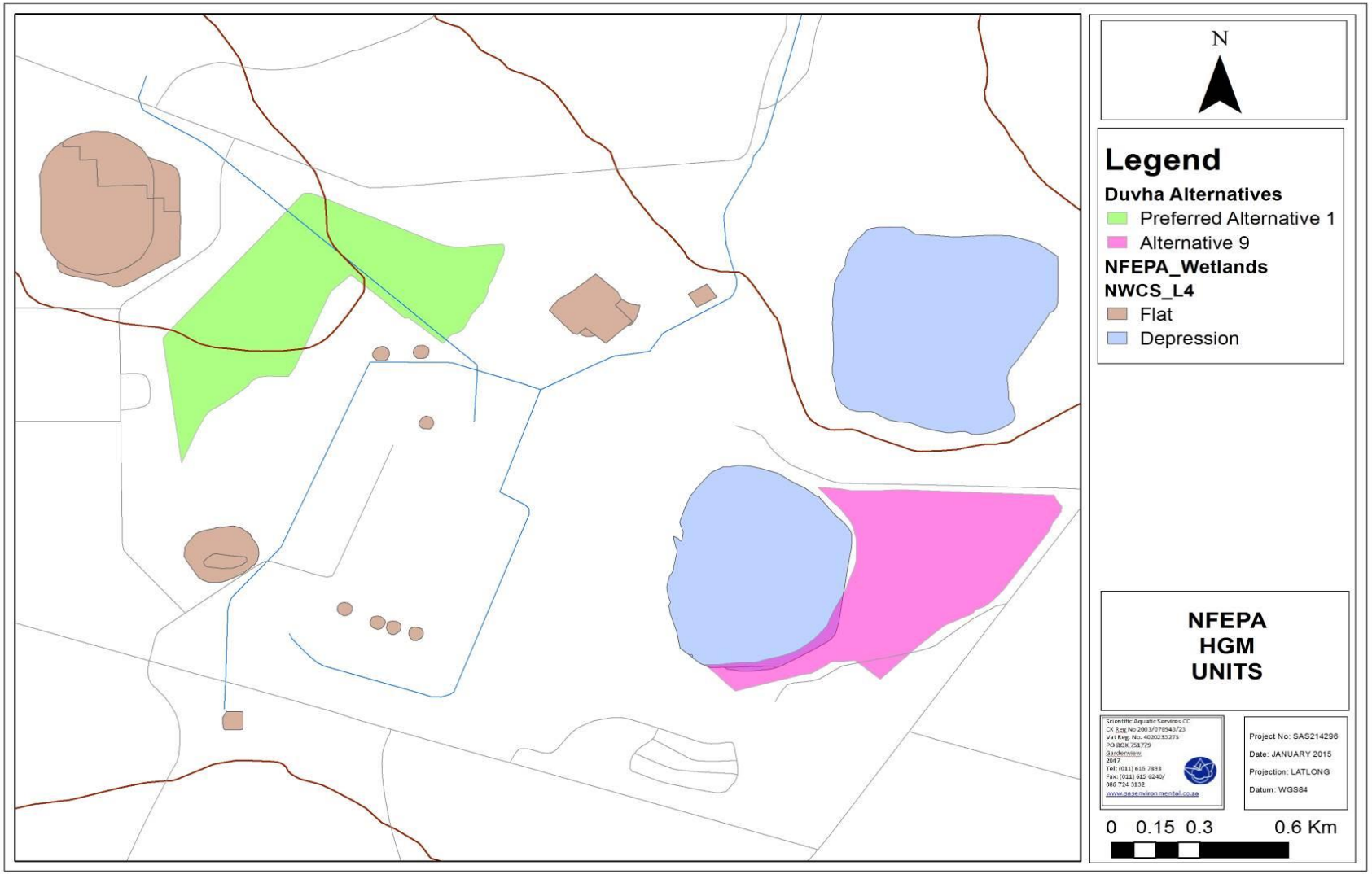

Figure 20: HGM units of the NFEPA wetlands

Wetland function and service provision were assessed for all of the wetland systems. The channelled valley bottom wetland feature obtained a moderately low score in terms of ecological function and service provision, as it is artificial and not fully functional as a true wetland. This wetland feature is the most important in terms of flood attenuation, streamflow regulation and Phosphate, Nitrate and toxicant assimilation as it is situated in an agricultural area. This system also plays an important role in erosion control, carbon storage and biodiversity maintenance.

The depression wetland falls into an intermediate class of service provision. The relatively low score for the depression wetland does not mean that it is unimportant from a service provision perspective. The opportunity for pans to attenuate floods is generally considered to be fairly limited, though some run-off is stored in pans. Some precipitation of minerals and de-nitrification is expected to take place within pans, which contributes to improving water quality. Some of the accumulated salts and nutrients can however be exported out of the system and deposited on the surrounding slopes by wind during dry periods. An important function usually performed by pans is the support of faunal and floral biodiversity which would otherwise not be supported within the study area.

Furthermore, wetlands contribute to the maintenance of biodiversity through the provision of habitat and maintenance of natural processes (Kotze, et. al. 2008). The 'vulnerable' status of the Eastern Highveld Grassland vegetation type, and the 'Critically Endangered' status of n the Mesic Highveld Grassland 4 WetVeg Group, contribute to the higher biodiversity maintenance weighting applied to the wetland system.

Hydrology, geomorphology and vegetation in the wetlands were assessed using wet health assessment. All three components have a present state of Category C (Moderately modified). Erosion and changes in runoff intensity as well as moderately modified vegetation composition contribute to these classifications.

The vegetation assemblage, which has undergone moderate to low levels of transformation as a result of surrounding agricultural activities and alien floral invasion, obtained a score which placed the module in a Category B.

The overall score for the wetland system that aggregates the scores for the three modules, namely hydrology, geomorphology and vegetation, was 2.8, falling within the Present Ecological State (PES) Category D (largely modified). The PES was then used as a benchmark for the identification of an appropriate category for the Recommended Ecological Category (REC).

The score achieved for the Ecological Importance and Sensitivity (EIS) assessment places the depression wetland within Category B (The biodiversity of these wetlands may be sensitive to flow and habitat modifications). The wetland feature is important in terms of wetland functionality and biodiversity maintenance. The channel valley bottom wetland feature falls within Category D (Wetlands that are not ecologically important or sensitive at any scale). This wetland feature did not score a high importance in terms of diversity, habitat and wetland function. However, due to the high score value (critical value) of the wetland vegetation group according to the

NFEPA protection stated, this increased the overall score and value of the EIS of the wetland feature.

The results of the wetland function assessment and IHI assessment, together with the results of the EIS assessment, were used to inform the REC. A Class B (largely natural with few modifications) category for the depression wetland is recommended while for the channeled valley bottom wetland, a Class D (largely modified) category is recommended. The depression wetland indicates intermediate levels of ecological service provision, with moderate impacts on hydrology and geomorphology observed. The channelled valley bottom wetland feature is of anthropogenic origin, however it does perform certain functions associated with natural wetlands such as biodiversity maintenance and storm water attenuation

During the assessment, various wetland vegetation components were identified. Dominant species were characterised as either wetland or terrestrial species, and were then further categorised as temporary, seasonal and permanent zone species. This characterisation is presented in the **Table 21**, and includes the terrestrial species identified near the wetland zones. Diversity and abundance of the terrestrial, temporary and seasonal zone floral species were considered uniform throughout the site with no discernible difference noted between the channelled valley bottom and the depression wetland.

Table 21: Dominant floral species identified during the wetland delineation.

Terrestrial zone	Temporary / Seasonal Zone	Permanent Zone
Hyparrhenia hirta	**Verbena bonariensis*	*Mariscus congestus*
Eragrostis curvula	*Sporobolus africanus*	*Imperata cylindrica*
Eragrostis chloromelas	*Juncus effusus*	*Kylinga alba*
Harpochloa falx	*Schoenoplectus corymbosus*	*Cyperus rupestris*
**Asclepias fruticosa*	*Imperata cylindrica*	*Typha capensis*
Cymbopogon plurinodis	*Helichrysum* species	*Juncus effusus*
**Cosmos bipinnata*	*Habenaria nyikana*	*Schoenoplectus corymbosus*
**Conyza bonariensis*	*Eragrostis plana*	*Phragmites australis*
Eragrostis plana		*Leersia hexandra*

6.6.3 Wetland Delineation and Sensitivity Mapping

It should be noted that not all indicators were collectively employed in all wetland features, since they were individually characterised by different indicators. During the assessment, the following indicators were used:

- Terrain units were used to determine in which parts of the landscape the wetland features are most likely to occur.
- The soil form indicator was used to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50 cm of the soil surface. This indicator

was used to identify gleyed soils where the soil is a greyish/greenish/bluish colour due to the leaching out of iron. Whilst mottling was not extensive, it was present in the temporary zone. These factors were utilised to aid in determining the location of the wetland zones and their boundaries. However it must be noted that the artificial wetland had very little to none of these soil characteristics as it is of anthropogenic origin.

- The vegetation indicator was used in the identification of the wetland boundary through the identification of the distribution of both facultative and obligate wetland vegetation associated with soils that are frequently saturated. Changes in vegetation density and levels of greening were also considered during the delineation process. This indicator was very useful in identifying the boundary of the temporary zone. This indicator was most useful in delineating the boundary of the artificial wetland, as localised ponding associated with altered topography has led to the establishment of facultative and obligate wetland vegetation.
- Surface water was not present in all wetland features, however, it was noted and taken into consideration in areas where it was observed.

The depression wetland associated with Alternative Site 9 is considered to be sensitive, as it provides niche faunal and floral habitat in an area characterised by transformation due to agriculture. The National Environmental Management Act (Act 107 of 1998) stipulates that no activity can take place within 32 m of a wetland without the relevant authorisation. In addition, the National Water Act (Act 36 of 1998) states that no diversion, alteration of bed and banks or impeding of flow in watercourses (which includes wetlands) may occur without obtaining a water use licence authorising the proponent to do so. Thus, a 32 m buffer was prescribed around the wetland depression associated with Alternative Site 9, and it is recommended that should this alternative be considered, that any activities fall outside of the buffer zone **(Figure 21).** This buffer zone is deemed sufficient to maintain the PES, limit any further impact that the proposed development could have and ultimately support the REC. A 500 m buffer around the wetlands is also indicated in **Figure 21** in terms of GN1199.

The channel valley bottom wetland adjacent to Alternative Site 1 was also allocated a 32 m buffer as the feature provides important faunal and floral habitat within the Duvha Power Station footprint area. However, the feature itself is considered to be of low sensitivity. From the **Figure 21**, it is clear that Alternative 1 falls outside the boundaries of the 32 m buffer but within the 500 m buffer and will require a WUL.

Figure 21: Wetland sensitivity mapping with associated buffers

6.7 HERITAGE RESOURCES

Heritage resources may be tangible, such as buildings and archaeological artefacts or intangible such as landscapes and living heritage. Their significance is based upon their aesthetic, architectural, historical scientific, social, spiritual, linguistic economic or technological values; their representation of a particular period; their rarity and their sphere of influence.

The towns of Middelburg, Belfast and Carolina were all established during the 1880s and served as regional centres for the farming community. Construction of the Duvha Power Station began in 1975. The last of six units was commissioned 1984. The surrounding areas was subjected to farming and urbanization which would have destroyed any pre-colonial or early colonial heritage features that might have occurred in the past. The only heritage sites known from the region are cemeteries, all of which are located well outside the area of the proposed development.

6.8 SOCIO- ECONOMIC ENVIRONMENT

This section provides a strategic understanding of the social profile of the study area and its surroundings.

There is only one settlement located within a 5 km radius from the study area, namely Speekfontein, situated within the Masakhane sub-place (SP). The nearest town to the study area is Witbank, which is comprised of the Emalahleni main-place (MP).
The following socio-economic indicators will be discussed:

- Demographic profile
- The economy and its structure
- The labour force and employment structure
- Status of infrastructure

6.8.1 Demographic profile

The Emalahleni Local Municipality (ELM) is the second largest Local Municipality in the Nkangala DM and covers a geographical area of 2 678 km². The municipality has the highest population among the six (6) local municipalities that form part of the Nkangala DM with 356 911 people **(Table 22).** There are 119 874 households in the ELM, which equates to one third of the district's number of households. The population of the ELM is predominantly concentrated in urban areas with Witbank (Emalahleni) and Middleburg being the largest towns in the municipality. The urbanised structure of the population is indicative of the labour concentrated around intense mining and manufacturing industries or other sources of employment.

The settlement of Speekfontein had approximately 1642 households in 2011 with an average household size of 2.3 persons. This settlement is the closest to the proposed PV power plant and is referred to as the Duvha informal settlement.

Table 22: Demographic Profile

GEOGRAPHY	DEMOGRAPHIC INDICATORS				
	Area (in km^2)	Total population	Total households	Household size	Population density (people/ km^2)
South Africa	1 220 813	51 770 560	14 450 161	3.58	42
Mpumalanga	76 495	4 039 939	1 075 488	3.76	53
Nkangala District	16 758	1 308 129	356 911	3.67	78
Emalahleni LM	2 678	1 107 028	119 874	9.23	413
Emalahleni MP	164	108 673	31 308	3.47	662
Masakhane SP	2	3 740	1 642	2.28	2 245

Since 2007, the population growth rate in the municipality has been consistently slowing down but it was still higher than the average population growth rate observed in the country. There is a clear trend of in-migration to nodes such as Emalahleni that offer services and employment opportunities that rural areas do not possess. Furthermore, inconsistencies with regard to population growth may occur due to a dramatic trend of out-migration of people from rural areas to urban areas. The type of long-term, permanent employment offered by industries in the local municipality may be the cause of migration towards its urban nodes.

Considering the concentration of manufacturing and mining activities in the ELM, one would expect the population growth rate of the local municipality to be rapidly increasing as people move into the area seeking employment opportunities. However, the population of the area is increasing at a slower rate than historically observed, which may be attributed to the declining number of employment opportunities available in the area supported by the increasing unemployment rate.

Given the above mentioned migratory trends, the disparity of negative employment growth rate and positive population growth rate within the study area is guaranteed due to the out-migration of the population in rural areas outweighing the in-migration to urban centres of the ELM.

According to the Census 2011, the ELM has a large youthful population between the age group of 0-14 constituting 25 % of the entire population. The working age between 15-64 age groups constitutes 71 % of the total population and the elderly (over 65) accounts for 4 % of the population. In terms of gender differentiation there is a slight imbalance between male and females. The Census 2011 revealed that approximately 53 % of the population are males with 47 % being females. A higher proportion of males are found in the urban areas in search of work opportunities. This trend can often be observed in mining towns where the mining industry is predominantly male orientated. **Table 23** presents the distribution of population by age and gender within the ELM.

Table 23: Distribution of population by age and gender, Emalahleni LM, 2011

AGE	Male	Female	Total
0-14 years	13%	13%	25%
15-64 years	39%	33%	71%
65+ years	2%	2%	4%
Total	53%	47%	100%

Source: Kayamandi calculations from Stats SA, Census 2011

With regards to energy usage, the share of energy use for households from Steve Tshwete in 2011 is presented in **Table 24**:

Table 24: Energy use for households from Emalahleni LM, 2011

Lighting		Heating		Cooking	
○ Electricity:	73.4%	○ Electricity:	63.1%	○ Electricity:	70.8%
○ Gas:	0.2%	○ Gas:	2.4%	○ Gas:	2.3%
○ Paraffin:	2.5%	○ Paraffin:	4.8%	○ Paraffin:	21.5%
○ Candles:	23.3%	○ Wood:	4.3%	○ Wood:	1.6%
○ Solar:	0.2%	○ Coal:	13.3%	○ Coal:	3.5%
○ None:	0.4%	○ Animal dung:	0.1%	○ Animal dung:	0.0%
		○ Solar:	0.2%	○ Solar:	0.1%
		○ None:	11.9%	○ None:	0.1%
Total:	**100%**	**Total:**	**100%**	**Total:**	**100%**

There is heavy reliance on electricity, coal, candles, wood, and paraffin as sources of energy with electricity as the most popular source of energy. There is limited use of solar power.

6.8.2 Employment Structure

The ELM consisted of 281 768 people within a working age in 2011. This accounts for 77 % of the total population, from which approximately 138 500 were employed. Compared to South Africa's labour participation rate of over 55 %, the ELM labour participation rate was higher and equal to 68 %. Essentially, just under one third of the working age population in the ELM was non-economically active, a significant portion of whom were discouraged job seekers (19%). Of the economically active population (190 662), 27 % were unemployed, which means that the unemployment rate in the municipality was lower than in the rest of the country. The number of unemployed people in the ELM, though, has been increasing since 1995 with a sharp rise in 2005, 2007, and 2011. Considering that the labour force participation rate in the ELM was greater than in South Africa, the lower unemployment rate indicates that the population of the ELM could be experiencing better socio-economic conditions compared to the rest of the country. This could also be as a result of labour in-migration in search of work in Emalahleni.

In Masakhane SP, the labour force was just less than 2000 workers in 2011 of which 32 % were unemployed. The mining industry, creates nearly a third of the employment opportunities in the ELM compared to the tertiary sector. The latter is the main employment sector nationally creating about two out of three employment opportunities in the country. In Emalahleni, the mining sector is followed by the government and community services sector that contributes 25 % to local

employment. Wholesale, retail and trade follows with 13 % of local employment. Electricity generation creates approximately 4 % of employment positions in the ELM

The figures provided for Emalahleni are almost on par with the other regions depicted. In 2013, however, only 16% of the formally employed population were highly skilled. The majority of the formal workers (45%) in Emalahleni in 2013 work in semi and unskilled jobs.

Approximately 30 % of employment in Emalahleni is in the informal economy. Informal trading activities allow for job creation and help to absorb the population in need of an income but who would otherwise be economically idle. Approximately 13 % of the households in Emalahleni earn no income, while approximately 19 % of households in Speekfontein Settlement (Masakhane SP) earn no income. Nearly half of the households (49 %) in ELM earn less than R38, 400 per annum, while for the District, Province and country these represent 60 %, 67 %, and 63 % respectively. These low income levels are largely a reflection of unemployment levels. A lower percentage of low-income earning households in the primary study area means that proportionally ELM had a greater number of households earning more than R3 200 per month in 2011 than other areas. This had a positive impact on the weighted average household income in the Local Municipality compared to that of the country or the Province.

Education plays a pivotal role in community development. It provides a set of basic skills for development, creativity and innovative abilities. The South African Constitution stipulates that everyone has a right to education. Education has a large influence on employment and income level, as it enables people through training to be more productive in the various sectors of the economy. **Table 25** provides an indication of the level of education as recorded in 2011 and reveals that approximately a third of the population aged 20 years and older that reside within Emalahleni have a matric qualification or higher. This is slightly higher than the average for the District, Province and the rest of the country. In addition to this, only 5 % of the population aged 20 years and older in ELM have no schooling, compared to 9 % of the District, and 10 % of the Province.

Table 25: Level of education of population aged 20 years and older, 2011

GEOGRAPHY	LEVEL OF EDUCATION						TOTAL
	No schooling	Some primary	Complete primary	Some secondary	Grade 12/std 10	Higher	
South Africa	7%	26%	5%	32%	21%	8%	100%
Mpumalanga	10%	27%	5%	31%	20%	6%	100%
Nkangala District	9%	25%	5%	32%	22%	7%	100%
Emalahleni LM	5%	21%	5%	34%	24%	10%	100%
Masakhane SP	8%	22%	6%	38%	24%	2%	100%

Education is an important factor to consider in a regional socio-economic analysis as it plays a crucial role in the potential rate for development, income levels of the community and the ability to begin to build a sustainable path out of poverty. Education and housing are considered to be obvious associations with asset accumulation as they equip households with vital resources to move out of chronic poverty. Employment opportunities are also necessary for a sustained development growth path for households.

6.8.3 Contribution to Gross domestic product per region (GDP-R)

The GDP-R contribution for Emalahleni between 2003 and 2013 increased from R15.8 billion to R50.3 billion. **Table 26** provides the GDP-R figures per year per area between 2003 and 2013.

Table 26: GDP-R (R billions) at current prices (2014 release), 2003-2013

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
South Africa	1155	1270	1401	1572	1792	2028	2180	2423	2635	2820	3030
Mpumalanga	78	85	93	105	119	143	155	172	189	205	213
Nkangala District	30	34	37	43	49	60	66	73	81	89	90
Emalahleni LM	15	17	19	22	25	33	35	40	45	50	50

Source: Quantec standardized regional data, 2011, Stats SA Census 2001 and Kayamandi calculations

Table 27 shows the average annual growth rates per region between 2003 and 2013. It can be highlighted that Emalahleni LM is experiencing a slightly lower growth rate than the other regions, with 2.6 % average growth per annum while the Province and South Africa are experiencing 2.8 %; and 3.4 % average annual growth respectively.

Table 27: Average annual GDP-R growth (at constant 2005 prices), 2003-2013

GEOGRAPHY	Average annual growth rate (2003-2013)
South Africa	3.4%
Mpumalanga	2.8%
Nkangala District	2.6%
Emalahleni LM	2.6%

Source: Quantec standardized regional data, 2011 and Kayamandi calculations.

Table 28 provides and an indication of the sectoral distribution of GDP-R and **Figure 22** indicates the GDP-R distribution per sector for ELM. Both show that in Emalahleni, the Nkangala District and the Mpumalanga Province, mining and manufacturing have the strongest GDP-R percentages. The government services sector in Emalahleni is particularly lower than in the other regions. This highlights that the local economy is fairly strong as government services play a smaller role in sustaining the economy through job creation in the public sector. The weakest sector in ELM is the agriculture sector.

Table 28: Percentage GDP-R distribution by sector at current prices, 2013

SECTOR		South Africa	Mpumalanga	Nkangala DM	ELM
Primary sector	Agriculture	2%	3%	1%	1%
	Mining	9%	30%	40%	52%
Secondary sector	Manufacturing	12%	11%	10%	8%
	Utilities	3%	7%	9%	10%
	Construction	4%	2%	3%	2%
Tertiary sector	Trade	17%	12%	8%	7%
	Transport	9%	8%	9%	6%
	Finance	22%	11%	9%	5%
	Government and community services	23%	16%	12%	9%
Total		**100%**	**100%**	**100%**	**100%**

Source: Quantec standardized regional data, 2011, Stats SA Census 2001 and Kayamandi calculations

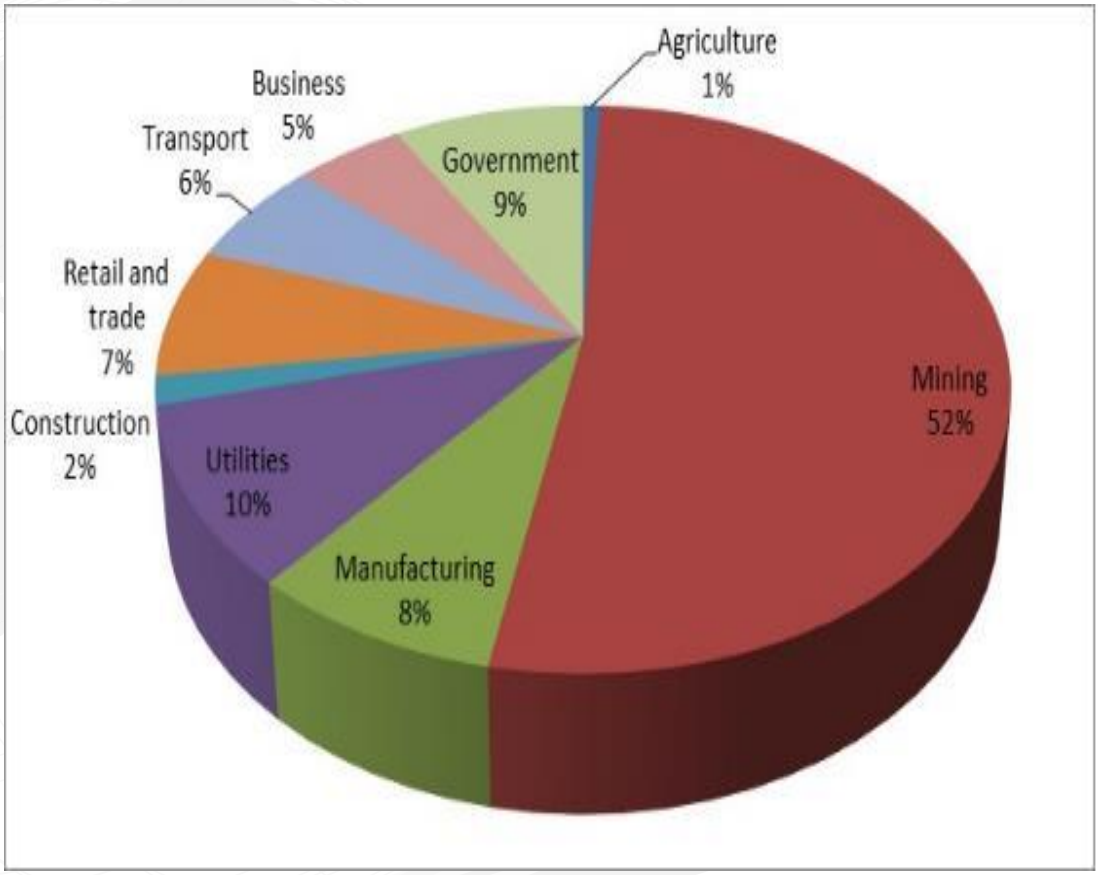

Figure 22: Sectoral GDP-R distribution at current prices for Emalahleni LM, 2013

Source: Quantec standardized regional data, 2015, and Kayamandi calculations