4. GENERAL DESCRIPTION OF THE STUDY AREA ENVIRONMENT

4.1. The Biophysical Environment

4.1.1. Locality

The proposed project falls in the Mpumalanga Province in Ward 7 of the Pixley ka Seme Local Municipality (MP304) within the Gert Sibande District Municipality (DC30). The Pixley Ka Seme Local Municipality is situated on the eastern border between Mpumalanga and KwaZulu-Natal. Furthermore, the municipal area is framed by the Mkhondo Municipality in the east, Msukaligwa Municipality to the north and Lekwa Municipality to the west (refer to Figure 4.1). The Pixley Ka Seme Local Municipality comprises an area of approximately 5227,98 km² which includes the following major urban areas or towns: Amersfoort; Ezamokuhle; Perdekop; Siyazenzela; Volksrust; Vukuzakhe; Wakkerstroom and eSizameleni. Other residential areas include Daggakraal ext 1, 2 and 3 as well as Sinqobile A, B, C, and D.

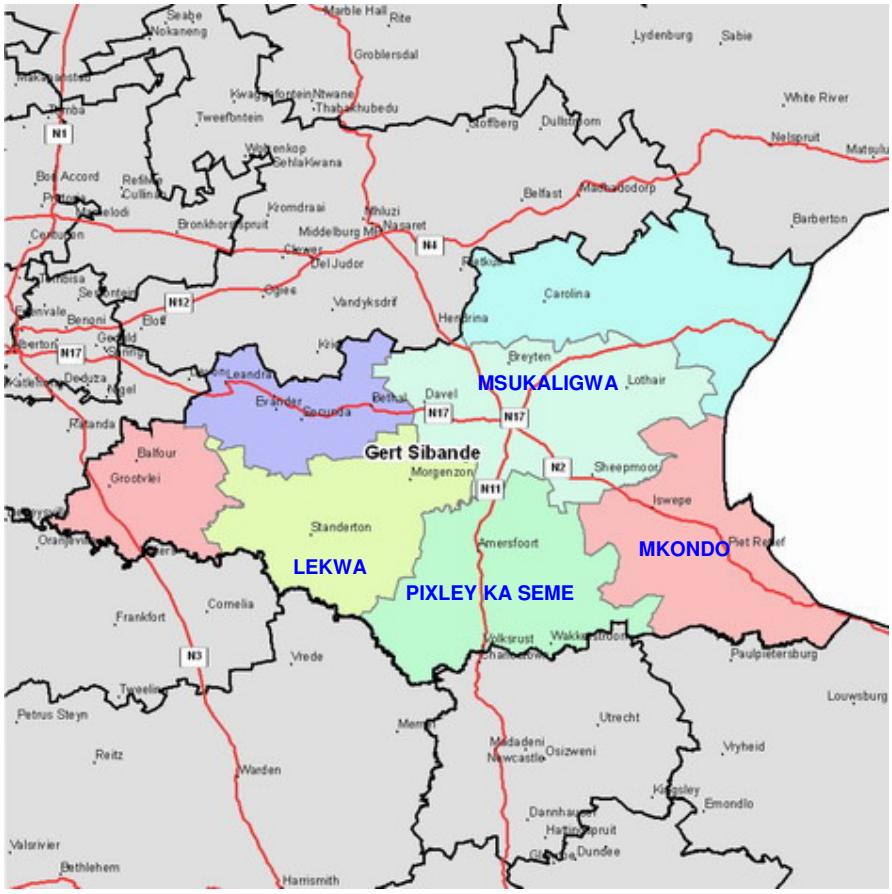


Figure 4.1 Map indicating the Pixley ka Seme Local Municipality and surrounding municipalities

4.1.2. Climate and Rainfall

The study area is characterised by daily summer temperatures that range between ~2 °C and ~32 °C with an average of ~17 °C. Winter temperatures range between ~-8 °C and ~23 °C

with an average of ~7 ℃. Figure 4.2 illustrates the average monthly maximum and minimum temperatures recorded in the Majuba area, respectively.

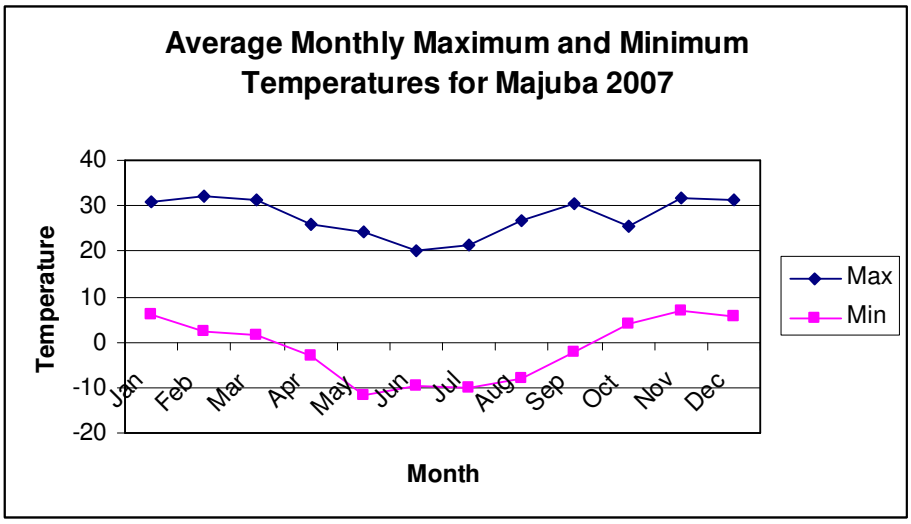


Figure 4.2 Average monthly maximum and minimum temperatures recorded in the Majuba area (Weather Services Station, 2007)

The study area can be characterised as being a summer rainfall area with the warmer months being October to April. The mean annual rainfall for the Majuba area is 1008 m. Total monthly rainfall figures for modelled South African Weather Services (SAWS) data are illustrated in Figure 4.3.

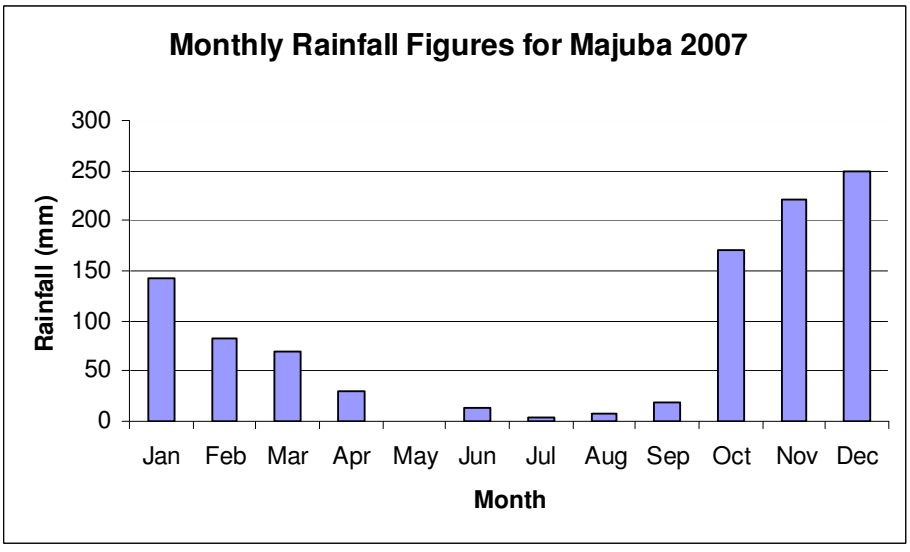


Figure 4.3 Monthly rainfall figures for Majuba area (Weather Services Station, 2007)

4.1.3. Topography and Landscape

The region is known for its rolling grass landscapes and the study area is a typical example thereof (Photograph 4.1). The area is situated within the Highveld Region, consisting of undulating hill landscapes of an elevation of about 1550 m above sea level. The area drains into streams of mainly the Mahawane Stream, which in turn falls in the perennial catchment area of the perennial Buffalo river catchment area.

Photograph 4.1 Study area showing the rolling grass landscape

4.1.4. Geology

The majority of the study area is underlain by Karoo Supergroup sedimentary rocks of the Vryheid and Volksrust Formations of the Ecca Group. These are largely comprised of sandstone, mudstone, shale, siltstone, and coal seams.

The available geological maps covering the study area did not indicate any major structural features such as faults or fractures. Limited tectonic activity is recognised within the study area, and the only evidence of secondary processes is outcrops of intrusive younger dolerite sills mapped in the Karoo sediments.

Four generations of dolerite intrusions are recognised within the study area, based on olivine or plagioclase content, alteration, and texture. The intrusive dolerite has produced large-scale devolatilisation and structural displacement of the coal. These adverse geological conditions caused the closure of the Majuba Colliery in 1993. The lithostratigraphy of the study area is presented in Table 4.1 below.

Table 4.1 Lithostratigraphy of the study area

Age	Supergroup	Group	Subgroup	Formation	Lithology
Jurassic					Dolerite
Permian	Karoo	Ecca		Volksrust	Mudstone, siltstone, shale
Permian	Karoo	Ecca		Vryheid	Sandstone, siltstone, shale, coal

4.1.5. Hydrogeology

The groundwater potential of the Karoo formations located in the study area is limited in their pristine state due to low permeability and storage capacity. Secondary processes, such as weathering, fracturing, etc., are required to enhance the groundwater potential.

Based on regional data, the hydrogeological resource maps, the following hydrogeological information is available for the formations within the study area: -

Volksrust Formation
- Upper and middle Ecca
- Predominantly argillaceous rocks
- Fractured aquifers
- Borehole yields 0.5 to 2.0 l/s

Vryheid Formation
- Lower Ecca
- Intergranular and fractured aquifers
- Borehole yields 0.1 to 0.5 l/s

Groundwater hydrochemistry associated with the sediments is variable; the groundwater salinity associated with the formations in the study area can have electrical conductivity concentrations of < 250 up to 1000 mS/m.

The sandstones of the Vryheid Formation of the Ecca Group can be massive and dense and have limited permeability and storage. It thus offers only moderate groundwater yield, especially in the absence of dolerite intrusions.

Contacts between different rock lithologies and bedding planes within the sediments often yield groundwater. The contact zone between the dolerites and the sandstone lithologies can be high yielding. Fractured fault zones, especially if related to tensional stresses, are potentially rich targets for groundwater development.

Groundwater occurs within the joints, bedding planes, and along dolerite contacts within the sediments (as recognised across the study area).

4.1.6. Hydrology

The region in which the CCGT power plant will be situated has a slope varying between from below 1 to above 100% and contains a number of streams and rivers. Most of these are small drainage lines that flow only periodically but a few are perennial rivers with a constant overview. The steeper slopes and the areas around the rivers are the most sensitive areas from a surface water point of view and hence a large area within the 12 km zone around the pilot UCG plant is sensitive from a hydrological point of view.

4.1.7. Biodiversity

The vegetation of the region is described in the VEGMAP database (Mucina and Rutherford; 2006) as Amersfoort Highveld Clay Grassland. This vegetation type extends in a north-south band from just south of Ermelo, down through Amersfoort to the Memel area in the south. It comprises undulating grassland plains, with small scattered patches of dolerite outcrops in areas. The vegetation is characterised by a short closed grassland cover; largely dominated by a dense *Themeda triandra* (Red Grass) sward, often severely grazed.

Although, the conservation status of this vegetation type is regarded as Vulnerable[1], no area is formally protected. Some 25% of the unit is transformed, predominantly by cultivation (22%). The area is not suited to afforestation. Silver and black wattle (*Acacia* species) and *Salix babylonica* invade the drainage lines and the erosion potential is generally low.

Over-grazing frequently leads to invasion of *Stoebe vulgaris* (Bankrupt Bush). Parts of this unit were once cultivated and now lies fallow and have been left to re-vegetate with pioneer species.

The Wakkerstroom region (Maputoland – Pondoland region) is considered an area of sensitive vegetation and faunal habitats and is situated approximately 25km towards the east and southeast of the study area, (ENPAT, 2001). This area of sensitive vegetation and associated faunal communities is not considered to be threatened by the proposed development. The study area is situated with the African Grasslands/ Ekengela Initiative Transition Zone, rendering all areas of natural grassland as being sensitive (ENPAT, National Database, Biosphere).

[1] Vegetation types that have lost up to 20% of their original extent, which could result in some ecosystem function being altered.

4.2. The Social Environment

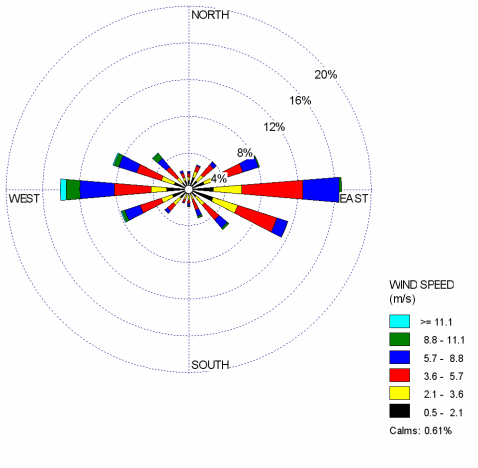
4.2.1. Air Quality

- ***Wind***

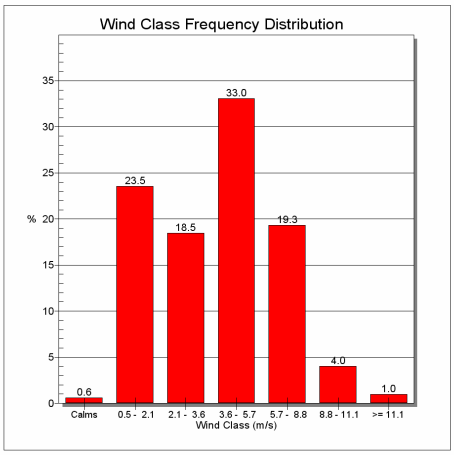
Wind is important in that it cleans by diluting and dispersing pollutants but it can also transport pollutants over large distances. For the proposed study area, both monitored meteorological data from the pilot UCG plant and modelled data from the South African Weather Services (SAWS) was made available.

According to the SAWS modelled meteorological data, winds predominated from the eastern and western sector (Figure 4.4c). The wind rose profile is typical of that experienced by low lying areas surrounded by an escarpment. The majority of the wind experienced within the study area is from the east (~15%). From the eastern vector wind speeds of between 3.7 and 5.8 m/s occurred most of the time (~6%). Wind speeds between 5.7 and 8.8 m/s also occurred but less frequently (~2%). From the west, winds are occurring ~12% of the time, with the majority of these falling between 3.8 and 5.7 m/s (~4%). Small percentages of wind speeds greater than 8.8 m/s were also experienced from the west. According to the frequency distribution graph presented in Figure 4.4d, wind speeds between 0.5 and 2.1 m/s occur for the majority of the time.

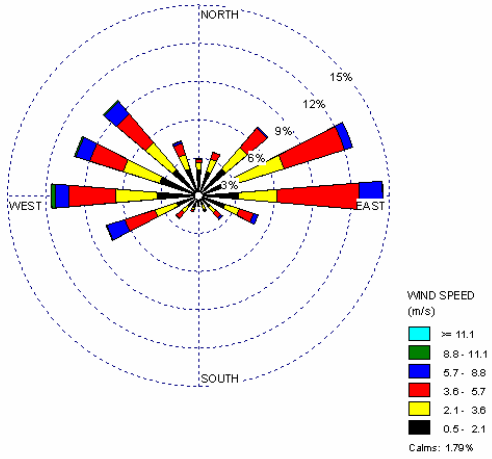
In comparison, the monitored data from the UCG site (Figure 4.4a and Figure 4.4b), also indicates winds predominating from the east and west but with the majority of the wind speeds experienced ranging between 3.8 and 5.7 m/s. This will result in a higher dispersion potential when assessing the impacts due to the release of pollutants to atmosphere, than would be case when assessing impacts using the SAWS modelled data.



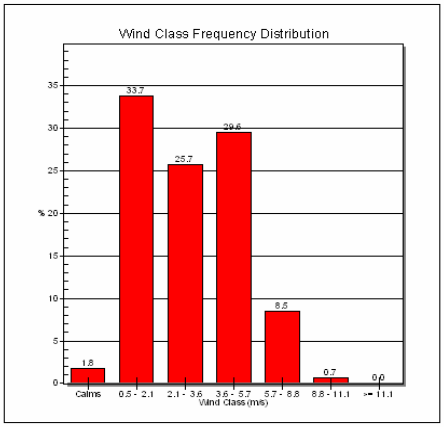
A. Period wind rose derived from monitored data from the UCG pilot plant.



B. Frequency distribution derived from monitored data.



C. Period wind rose derived from modelled data.



D. Frequency distribution derived from modelled data.

Figure 4.4 The period wind rose and wind frequency distribution for data taken at the UCG Pilot Plant and for modelled data received from the South African Weather Services respectively.

- ***Sensitive Receptors***

Those receptors identified during the current study are listed as follows:

* Amersfoort including eZamokuhle;
* Vlakplaats and Daggakraal communities; and
* adjacent surrounding livestock farms and associated farm houses (on farms Palmietspruit; Strydkraal; Mezig; Holfontein; Welgedacht; Rietpoort; Rietfontein; Werda and Bergvliet).

- ***Other Polluting Sources in the Area***

Based on a site visit and 1:50 000 topographical maps; the following sources of other air pollution have been identified:

- stack, vent and fugitive emissions from the existing Majuba power station operations;
- Flaring at the UCG operations;
- agricultural activities on the surrounding farms;
- vehicle entrained dust and exhaust emissions;
- domestic fuel burning; and
- veld fires.

4.2.2. Noise

* The *noise climate* (ambient noise condition) in the Amersfoort area is quiet and is representative of a rural (farming) noise district (SANS 10103). There is, therefore, a potential for an increase in noise impact with the introduction of a new facility such as the CCGT power plant. There are a number of major noise sources in the area namely the existing Majuba power station, the traffic on the main roads, coal trucks transporting coal to Majuba Power Station and the coal supply railway line to the power station. The noise sensitive sites/areas are Amersfoort town (approximately 12 km from the Majuba power station) and various farm houses and farm labourer residences in the surrounding area (on farms Palmietspruit; Strydkraal; Mezig; Holfontein; Welgedacht; Rietpoort; Rietfontein; Werda and Bergvliet).

4.2.3. Social

As mentioned earlier, the study area falls within the Pixley ka Seme Local Municipality. A total of 80 737 people reside within the area in 16 726 households (average 4.8 people per household). Of these residents, 68% of the people live in urban areas, with the remaining 32% residing in largely rural areas. In 2001, just over half (51%) of the people were unemployed, which differs significantly with the unemployment rate of 1996 where it was estimated that only 33% of the population were unemployed. Of those employed, the majority (24%) are employed in the agriculture/forestry and fishing economic sector. This is closely followed by those employed in private households (20%).

According to the IDP of the Pixley ka Seme Local Municipality (2000 Demarcation Data and 2001 Census Data), the ward is characterised by:

- About 5% of the Local Municipality's population falls in this ward;
- One (1) in Five (5) inhabitants is Indian;
- The majority of the population falls within the 15-64 year old age bracket;
- Approximately three quarters of the population do not have a personal income;
- Approximately $^{2}/_{3}^{rd}$ of households have water inside their yards;
- About 75% of the population in the ward has flush toilets;
- 80% of the population have electricity for lighting; and

- The water demand exceeds capacity.

4.2.4. Visual

The study area for the placement of the CCGT power plant is located in the Amersfoort region of the Mpumalanga province and encompasses the town of Amersfoort, the Majuba coal fired power station and two other predominantly agricultural settlements, namely Vlakplaats and Daggakraal.

The Majuba Power Station is the most prominent feature in the area, providing a distinct visual character to the environment. The township areas of Amersfoort and eZamokuhle, as well as the agricultural holdings Daggakraal and Vlakplaats, provide for a concentration of potential sensitive viewers

The study area has a rural character with dry-land agriculture and cattle and game farming as primary economic activities. It is situated within the grassland biome and the terrain morphological description is strongly undulating plains and hills and lowlands with mountains towards the south-west of the study area.

The N11 national road and the R23 arterial road affords access to the study area. Standerton and Volksrust are the two major towns in closest proximity to Amersfoort.

4.2.5. Heritage

- Stone Age

No information about Stone Age habitation of the area is available. There might be two reasons for this. Firstly, it is unlikely that Stone Age people would have occupied the area, as it would have been too cold and no shelters or caves are known to exist in the area. Secondly, no systematic survey of the area has been done and, as a result, no sites have been reported. However, it is quite likely that a detailed survey would reveal traces of these early people's occupation of the area.

- Iron Age

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Silver Leaves, south east of Tzaneen dating to AD 270. However, Iron Age occupation of the eastern highveld area (including the study area) did not start much before the 1500s. Occupation of these areas became possible due to wide-scale climatic changes, as well as the introduction, from the east coast, of cereal crops such as maize. Some sites dating to the Late Iron Age are know to exist to the north-west of the study area, as well as approximately 15 km due south. These are typically stone walled sites. They were occupied by a number of related people, varying in size from twenty to as many as a few hundred individuals. The people cultivated various crops and kept large herds of cattle.

- Historic period

The historical period in this area started with the arrival of early explorers, hunters and traders, followed later by the Voortrekkers, who settled permanently and started to farm in the area and developed a number of towns. During the Anglo Boer War (1899-1902), some skirmishes took place in the region.

Apart form urban areas, such as Amersfoort, which have origin dates to the late 1880s, most heritage resources in this part of the world would be related to farming and infra-structural development. Most farmsteads were burned down by the British during the Anglo-Boer War, but were later rebuilt. Typically, these consist of the main house, outbuildings, stock enclosures and cemeteries. The housing of labourers were much more informal and once abandoned, quickly disintegrated.

4.2.6. Risk

The main hazards of the project would be exposure to toxic fumes of carbon monoxide and the thermal radiation of the fuel containing carbon monoxide and hydrogen. Carbon monoxide is an odourless and colourless gas having the same density of air. It is extremely flammable and mixes well with air easily forming an explosion hazard. When burnt, carbon monoxide produces carbon dioxide a less toxic material that is considered a simple asphyxiant.

In the presence of finely dispersed metal powders the substance forms toxic and flammable carbonyls. Carbon monoxide may react vigorously with oxygen, acetylene, chlorine, fluorine, nitrous oxide. In the presence of finely dispersed metal powders the substance forms toxic and flammable carbonyls. Carbon monoxide is absorbed into the body by inhalation and acts a chemical asphyxiant by combining with the haemoglobin in the blood displacing the oxygen. Short-term exposure may cause effects on the blood, cardiovascular system and central nervous system. Exposure to concentrations of over 1.3% may result in lowering of consciousness and death. Long-term exposure may have effects on the nervous system and the cardiovascular system, resulting in neurological and cardiac disorders.

Hydrogen is a colourless, odourless gas that is flammable over a wide range of vapour/air concentrations. Hydrogen vapour forms an explosive mixture with air. Vapours or gases may travel considerable distances to ignition source and flash back. Leaking hydrogen may ignite in the absence of any normally apparent source of ignition and if so, burns with a practically invisible flame that can instantly injure anyone coming in contact with it. Hydrogen gas is very light and rises rapidly in the air; concentrations may collect in the upper portions of buildings. Liquid hydrogen can solidify air and may create an explosion hazard.

4.2.7. Traffic

There are a number of major roads and secondary roads servicing the study area. These include:

i) National Road N11, which links Amersfoort to Volksrust is aligned in a north-south direction through the eastern sector of the study area.

ii) Road P48/2 (Route R35), which links Amersfoort to Morgenzon, is aligned in an east-west direction through the north-eastern sector of the study area.

iii) Road P97/1 which links Amersfoort to Perdekop, is aligned in a north-east to south-west direction through the western sector of the study area. It passes 4 kilometres to the north-west of the Majuba power station.

iv) Road D2514, which links from Road P97/1 to National Road N11, is aligned in a north-west to south-east direction through the central portion of the study area. It is the main access road to Majuba power station.

v) Road D284, which links from Road D2514 to National Road N11, is aligned in a south-west to north-east direction through the central portion of the study area. It is the main access road to Majuba Colliery (no longer in operation).