FIGURE 5: PUBLIC TRANSPORTATION NETWORK
In essence, freeways and arterials are highly mobile and therefore aim to connect people over large distances to activity areas and neighboring settlements. Collector roads and local streets provide good accessibility and therefore aim to connect people and land uses to the more mobile roads. Road-based public transportation systems (minibus taxis and buses) mostly use arterials and collector roads, as these provide an efficient balance between mobility and land use accessibility.

Figure 4 depicts the road network serving Emfuleni area. The N1 freeway passes through the centre of Emfuleni, linking Emfuleni to Johannesburg and Soweto. The primary role of this freeway is link Gauteng Province to the Free State Province and the Western Province and therefore fulfills a through-traffic function, rather than serving Emfuleni specifically. The P156 freeway, on the other hand, primarily serves Emfuleni, linking Vanderbijlpark and Vereeniging to Ekurhuleni and the OR Tambo International Airport. Due to function; corridor development is increasingly occurring along the P156 freeway, especially in the Vereeniging and Meyerton areas. The P156 freeway is located on the eastern boundary of Emfuleni.

Characteristic of Emfuleni is the fact that much of its planned K-route network has been developed, although not all the K-routes have been to a dual carriageway level. Many of the K-routes are also in need of rehabilitation, especially K-routes such as the K174 (Barrage Road). Despite this, the complete K-route network allows urban infill and expansion to take place in almost any part of Emfuleni, providing the access needed for urban development. There are four K-routes that can be highlighted as prominent K-routes serving Emfuleni. The first is the K53 (Moshoeshoe Road that become the Golden Highway), which runs between Vanderbijlpark and Sebokeng. This is an important commuter spine serving Emfuleni. The second K-route worth mentioning is the K174 (Barrage Road), linking Vanderbijlpark to Vereeniging. This is considered by Emfuleni to be a gateway route into Emfuleni, and the Municipality is thus concerned over the type and development that take place along this route. The K 178 link Sebokeng to Vereeniging and the shopping and employment opportunities found within Vereeniging. As was mentioned, it is expected that the importance of this route will increase in the near future as urban development and infill occurs along this route. This K-route is expected to become a major commuter spine, as urban development intensifies along this route. The fourth K-route is the K164, which links Evaton to Meyerton. Savanna City (a 14000 residential unit development) will be situated on and have access from the K164, which will increase the prominence of this K-route.

**2.4.3. RAIL NETWORK**

Emfuleni is served by a rail network that connects Emfuleni to neighbouring areas in Gauteng and the Free State. As depicted by Figure 4, this rail network consists of 3 lines. The first rail line stretches along the P156 (R59) freeway and links Sasolburg to Vereeniging, Meyerton and Germiston. This rail line is primarily a freight line, but does contain commuter railway stations along
the line. The second railway line stretches from Sasolburg, via Vereeniging towards Sebokeng, Orange Farm and Johannesburg. This railway line also functions as a freight railway line, although it also fulfills a significant commuter railway line function. The third railway line stretches from Sebokeng towards Westonarea. This railway line is exclusively used for rail freight purposes.

2.4.4. PUBLIC TRANSPORTATION

The Diagram below provides an indication of the modes of transport that commuters within Emfuleni area use to access employment opportunities and social amenities. According to this Diagram, most people within Emfuleni access employment opportunities and social amenities by mini-bus, but also by bus and by train, making Emfuleni a predominantly public transport-reliant community. Cars also make up a significant portion of the transportation modes used to access employment opportunities and social amenities within Emfuleni. Pedestrians are non-motorised transport and are, within the context of the entire transportation market, the most significant means of accessing employment opportunities and social amenities within Emfuleni.

The modes of transport used as set out above points to a situation where most households within Emfuleni are reliant on public transport to access employment opportunities and social amenities. In a certain sense, this is a desirable situation, because there are very specific and valid reasons for providing and promoting the use of public transport within urban areas. One such reason is to lessen carbon emission, which is the primary cause of climate change. As depicted by Figure 5, three municipal-level public transport networks serve Emfuleni. These are the following:

a. Metrorail

Emfuleni is served by a commuter rail network that connects Emfuleni to neighbouring areas in Gauteng. This commuter rail network consists of 2 lines. The first railway line stretches from Vereeniging to Meyerton and towards Germiston. This commuter railway line contains commuter railway stations, with prominent stations being the Vereeniging Station, the Duncanville Industrial Hal Station and the Meyerton Station. The use of this railway line as a commuter railway line is limited due to fragmented urban development and low residential densities along this railway line. The second commuter railway line stretches from Vereeniging towards Sebokeng, Orange Farm and Johannesburg. Prominent stations along this line are Houtheuwel Station, Residentia Station and Stredford Station. This railway line traverses densely built-up urban areas, as is found in Sebokeng and Orange Farm, and it therefore fulfills a significant commuter railway line function. However, the full potential of this railway line to function as a commuter railway line is impeded by the following factors:
• Large undeveloped areas between Vereeniging and Sebokeng, with low residential densities
• The lack of urban development on both sides of the railway line, in particular in the Sebokeng and Evaton region
• Gaps in the spacing of commuter railway stations, in particular between the Leeuhof Halt and Kleigrond Stations and between the Houtheuwel and Kwaggastroom Stations
Urban development along the Vereeniging-Sebokeng-Orange Farm commuter railway line will provide the necessary commuter thresholds needed to ensure the viable operation and expansion of this commuter railway line. In turn, this will provide opportunities for Transit Oriented Development (TOD) along this line.

b. Bus network

Emfuleni comprises an extensive bus network that serves the municipal area. A prominent bus route is the bus route linking Vereeniging to Sebokeng along the K53 (Moshoeshoe Road) and the K45 (Golden Highway). This bus route links Evaton and Sebokeng to the Vereeniging CBD and the industrial areas located within Vereeniging. Other bus routes worth mentioning are the bus route linking Vereeniging to Meyerton, the bus route linking Vereeniging to Residentia Station, and the bus route linking Evaton to Meyerton. This bus network provides a platform for future urban development and expansion within Emfuleni area. Also, linking the bus network to the commuter rail network will enable the bus network to act as a feeder system to the commuter rail network. This will give Emfuleni access to an integrated hierarchy of public transportation modes servicing different geographic levels (local to regional levels). This will greatly improve the current public transportation network serving Emfuleni and provide strong spatial structuring elements to guide and shape future urban development within Emfuleni.

c. Mini-bus taxi network

Emfuleni comprises an extensive minibus taxi network. This network largely serves the route and areas within the municipal area that the bus network does. The only significant exception is that a minibus taxi route links the Vanderbijlpark CBD to Sebokeng via Mittal Steel; a route which the bus network does not serve. A disadvantage of the minibus taxi network is that the minibus taxi routes are not dedicated and fixed, thus they are potentially subject to change in future. This limits the certainty of where to densify parts of Emfuleni to support the use of public transportation. Bus routes and in particular commuter railway lines provide much better indication and certainty of where to density within Emfuleni in the future.

### 2.4.5. AIRPORTS

Emfuleni comprises 2 light aircraft airports. The Vanderbijlpark Airport is located on the western boundary of Bophelong and the Vereeniging Airport (Aerovaal) is located on the eastern boundary of Roshnee. The Vereeniging Airport has two runways and hangar facilities to accommodate approximately 64 planes. It has the capacity to handle freight and handles an average of
80 tons of freight per month. The airport is situated within the airspace of the OR Tambo International Airport, requiring air traffic from Vereeniging Airport to be co-coordinated from the OR Tambo International Airport control tower. OR Tambo International Airport is located approximately 80km from Emfuleni and is accessed via the P156 (R59 freeway).

### 2.5. MUNICIPAL SERVICES

The primary municipal services (water, electricity and sanitation) are briefly discussed below. It illustrates the level of municipal services provision within Emfuleni, as well as the bulk network serving Emfuleni. The level of service is derived from Census 2001 and only shows the existing number of municipal services connections by 2001. It does not show the capacity of the bulk municipal services network to accommodate urban expansion and densification. The following information was extracted from the Emfuleni Annual Report 2007/8 and the Emfuleni IDP 2007-12.

#### 2.5.1. INFRASTRUCTURE CHALLENGES

Emfuleni’s existing infrastructure is overburdened, largely due to population growth and the poor state of the infrastructure within Emfuleni. In addition, the replacement, rehabilitation and preventative maintenance of existing infrastructure has suffered due to persistent focus on the extension of infrastructure and ad hoc repairs.

In order to address this problem, the Municipality appointed consultants to compile an infrastructure master plan with the intention to look at the current status of the existing infrastructure, deliberate ways of addressing the challenges and to make proposals to cater for future developments. The study also intended to assist in linking water, sanitation and electricity development in an integrated manner.

The Regional Sewer Scheme is a project aimed at addressing the sewer problems of the Sedibeng district municipal area and its locals: Emfuleni, Midvaal and Lesedi. The project will be constructed over a period of five years and it is estimated that the project will cost approximately R2 billion.
2.5.2. WATER SUPPLY

According to the Diagram below, the majority of households that live in Emfuleni have access to tapped water within their house or a tap inside their yard. A relatively small number of households acquire water from a standpipe.

DIAGRAM 9: WATER SUPPLY
Source: Census 2011
The distribution of potable water, collection of wastewater and the treatment of waste water are outsourced by the Emfuleni Local Municipality to private contractors. In addition to these functions, the private contractors are responsible for maintenance of the water services system, including maintenance and running costs.

The water system consists of pipe networks, 9 reservoirs, and a small potable water treatment plant. Emfuleni borders the Vaal River and therefore extracts water from the river for consumption within Emfuleni. However, only a small amount of the required quantity extracted from the Vaal River and purified (0.2 Ml/day). Most potable water required by Emfuleni is supplied by Rand Water (205 Ml/day). The bulk water network is illustrated on Figure 6.

The bulk water network is old and it is overworked due to the demand for potable water. The age of the networks varies between 60 -70 years across the municipal area. Parts of Sebokeng and Evaton have recently been installed with new water infrastructure.

There are no backlogs in the supply of water connections. Additional water connections have largely been provided to informal settlement households to cope with growth of those settlements. In addition, water connections are continuously being provided to new housing development within Emfuleni.

### 2.5.3. SANITATION SUPPLY

As depicted by the Diagram below, flush toilets that are connected to a sewer network are the most common form of sanitation provision within Emfuleni. The only other significantly used sanitation system in use in Emfuleni is the ventilate pit latrine system, which is most probably used in the informal settlement of Emfuleni.

The bulk sanitation network is illustrated on Figure 6. The sanitation system consists of gravity pipelines and, due to the flat terrain; it also consists of 49 sewage pump stations. The waste water system consists of 3 wastewater treatment works. The Sebokeng wastewater treatment works, located in Sebokeng next to the Rietspruit, is the largest waste water treatment works within Emfuleni. This wastewater treatment facility has a capacity of 19 Ml/day. Significant parts of the sanitation system infrastructure, including the Rietspruit and Leeuwkuil wastewater treatment works, need to be upgraded and rehabilitated. A summary of the wastewater treatment facilities is shown in the Table below.
The bulk sanitation network is old and it is overworked due to the demand for sanitation services. The age of the networks varies between 60 - 70 years across the Municipal area. Parts of Sebokeng and Evaton have recently been installed with new bulk sanitation infrastructure.

The short-term sanitation infrastructure plans involves the rehabilitation of existing infrastructure, including sewer pump stations to minimize sewer spills. While this will give a significant improvement to overall performance, problems which could result in raw
sewage spillage cannot be ruled out. Existing sanitation infrastructure has reached the end of its life-span and can only be kept operational with a high risk of sewer spills. New infrastructure needs to be constructed in order to prevent future sewer spills.

**TABLE 3: EXISTING WASTE WATER TREATMENT PLANTS**

<table>
<thead>
<tr>
<th>Waste Water Treatment Works</th>
<th>Service Area</th>
<th>Capacity</th>
<th>Discharge Locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rietspruit</td>
<td>Vanderbijlpark, Boipatong</td>
<td>23 MI/day</td>
<td>Discharges into the Rietspruit and Vaal River, below the Barrage</td>
</tr>
<tr>
<td>Leeuwkuil</td>
<td>Vereeniging, Sharpeville, Tshepiso</td>
<td>32 MI/day</td>
<td>Discharges into the Vaal River</td>
</tr>
<tr>
<td>Sebokeng</td>
<td>Sebokeng, Evaton, Palm Springs, Orange Farm and areas of Johannesburg</td>
<td>119 MI/day</td>
<td>Discharges into the Rietspruit</td>
</tr>
</tbody>
</table>

Source: Emfuleni IDP, 2007-12

The long-term solution includes the elimination of sewer pump stations and the construction of a new gravity pipe next to the Klip and Vaal Rivers. The replacement of the 3 Emfuleni waste water treatment plants (Sebokeng, Leeuwkuil and Rietspruit), as well as Midvaal’s waste water treatment plants that serve Roshnee, are also included in the long-term sanitation infrastructure plans. The long-term plans aim to reduce sewer spillages and reduce the high bulk infrastructure costs associated with urban development in Emfuleni. The long term solution is estimated to take at least 8-10 years to implement.

The provision of a basic level of sanitation service (e.g. VIP’s), is not acceptable to many communities living within informal settlements. However, it is not practical and sometimes impossible to provide a higher level of sanitation service in these settlements. The sanitation backlogs in the informal settlements can therefore not be eliminated and can only be addressed through formal township establishment and relocation.

Another concern is service delivery to the households living in backyards shacks, mainly Evaton. These households make use of unimproved pit latrines. Since this is on private property the Emfuleni Local Municipality can not provide any kind of service to these backyard shacks dwellers, except for the main service networks available on the boundary of these stands. This issue needs to be addressed by the Evaton Renewal Project (ERP).

Ample funds in the form of grants (MIG, D WAF and Res structuring Grant) and new housing developments (funded by the Department of Housing) are available to spend on the provision of new infrastructure. However funds for the systematic replacement of existing water networks and other related infrastructure elements are not made available through these funds.
2.5.4. SEDIBENG PLANNED REGIONAL SEWER SYSTEM

The Sedibeng district, which includes Emfuleni, is growing at a faster rate than many anticipated. In addition, Johannesburg is expanding southwards, putting pressure for the provision of municipal services to the south of Johannesburg. As a result, the capacity of the sewer network in Sedibeng is increasingly unable to serve the current needs, let alone the needs of future urban developments. This creates numerous problems. For example, the sewer system of Emfuleni and Midvaal is currently running at its full capacity, which means that any breakdown in the system due to mechanical failure reduces the system capacity to treat effluent to the required standards. As a result, R and Water (in consultation with D WAF) placed a moratorium on development within Sedibeng until the sewer system capacity has been increased to cater for the current needs and future growth within Sedibeng.

Restricting urban development within a municipal area due to municipal services constraints is always problematic, because people need to be housed, regardless of whether there is municipal services capacity or not. In addition, the municipalities themselves have ambitious growth and development plans, which are in danger of collapsing if sufficient municipal services capacity is not provided. For example, the Sedibeng Growth and Development Strategy have put forward ambitious development strategies, some of which have been translated into strategic urban, river, and township development programmes. These programmes can only materialize if its development potential can be supported by municipal services provision and in particular sewer system capacity. Given the challenges of sanitation services described above, this implies that the planned Sedibeng Regional Sewer Scheme project needs to be implemented as soon as possible.

The planning of the Sedibeng Regional Sewer Scheme is far advanced wherein service providers have been appointed to deal with the technical, institutional and financing issues relating to the project. The proposed design capacity of the planned Waste Water Treatment Works of the Sedibeng Regional Sewer Scheme will be 150 Ml/day up to the year 2025. The site for the location of the planned Waste Water Treatment Works has been identified and approved, awaiting implementation.

2.5.5. ENERGY SUPPLY

As depicted by the Diagram below, Emfuleni population mostly uses electricity as their source of energy supply. A relatively small portion of the population uses candles as their primary source of energy. The use of candles can either be attributed to households that are not connected to the electricity grid or households that cannot afford electricity.
Emfuleni Local Municipality is licensed to provide electricity in the Vanderbijlpark, Bophelong, Boipatong, Ironsyde, Eatonside, Roshnee, Rust-ter-Vaal and Vereeniging areas. Eskom has been licensed to provide electricity in the remaining areas. Between Eskom and the Municipality there is 100% coverage of Emfuleni as far as the provision of electricity is concerned.

Electricity is an essential service and is a catalyst for development in the Emfuleni area. Emfuleni Local Municipality provides 75% of its electricity supply to industrial enterprises and 25% of its electricity supply to domestic users. The highest maximum demand registered within Emfuleni to date was 390MW.
The electrical infrastructure network consists of 88/22kV and 11/6.6kV overhead power lines, 31 primary substations (88/33/22kV). Major portions of Emfuleni’s distribution networks have been in service for more than 50 years and much of this network is approaching or exceeding its design life-span. As a result, the existing networks have begun to exhibit a reduction in its performance reliability and even obsolete deterioration. The extent of the refurbishment needed is presently unknown. The bulk electrical network is illustrated on Figure 6.

Although the Municipality has been able to provide all developers with electricity to date, the low level of investment in the upgrading, refurbishment and expansion of the bulk electricity infrastructure network has led to a situation where new developments cannot longer be accommodated without major capital investments in bulk electricity infrastructure. This situation is being aggravated by the densification of existing developments, which is placing a huge demand on the provision of electricity. Daily maintenance on infrastructure, as well as preventative maintenance, is done on a continued basis. To ensure the sustained provision of electricity within Emfuleni, it is essential that:

- Sufficient capital is made available annually for network maintenance, upgrading and expansion.
- Continuation of preventative maintenance.
- Meet the demand for electricity by developers.

Some of the major problems that are encountered with electricity provision within Emfuleni can be related to lack of maintenance over previous years, the poor condition of infrastructure and theft of parts of the infrastructure. This situation led to power failures, which affected large parts of Emfuleni. In addition, the current delivery of electricity to Emfuleni is at risk of getting worse, as rapid growth in the demand for electricity is caused by urban expansion and densification. This is a cause for concern, as the existing electricity network is incapable of accommodating this growth.

### 2.6. NATURAL ENVIRONMENT

#### 2.6.1. TOPOGRAPHY

As depicted by Figure 7, Emfuleni has a undulating, but relatively flat topography. This topography forms a number of watersheds within Emfuleni. The most significant watershed is located between Sebokeng and Vereeniging. Its location affects
urban development and in particular the servicing of urban areas with bulk sewer reticulation. The hydrological system of the municipal area drains from these watershed into a number of rivers, which in turn flow into the Vaal River. Apart from the Vaal River, 3 rivers are of importance within Emfuleni: the Klip River, which flows from Meyerton towards Three Rivers, the Rietspruit, which flows past the western boundary of Sebokeng towards Lochvaal Barrage, and the Leeuspruit that flows from Carltonville into the Rietspruit. Apart from the hydrological function, the undulating topography and the Vaal River provide a picturesque environment, which lends Emfuleni a significant tourism potential.

2.6.2. MOUNTAINS AND RIDGES

Emfuleni comprises a relatively flat topography. As a result, not many ridges are found within Emfuleni. The GDARD Ridges Policy (GDACE, 2001), basically identifies 2 major ridges within Emfuleni. These ridges are depicted on Figure 8. A significant ridge, in terms of size, is found on the southwestern boundary of Emfuleni, directly north of the Vaal Oewer settlement. Most of this ridge is categorized a low priority ridge. A few pinicles of this ridge are considered of high protection value and it is therefore categorized as a high priority ridge. A significant ridge is also found situated between Sebokeng and Sonlandpark. Most of this ridge is categorized a low priority ridge, with the exception of some of the edges of this ridge, which is categorized a high priority ridge.

Despite the fact that the abovementioned ridges are predominantly classified as low priority ridges (Class 2-4 ridges), these ridges are all deemed sensitive until verified by GDARD. Low impact developments will be considered only on submission of full EIA and specialist studies. Any proposed developments must include a management plan to maintain the ecological integrity of the remaining property. No exemption from the EIA process will be given if a Red Data species is recorded on the ridge, the open space is 4 ha or larger, and/ or the surrounding landowners object to proposed development.

No development is permitted on a part of the ridge classified as high priority (Class 1 ridges). If a developer wishes to deviate from the strict no-go policy, a full EIA is required (including public participation exercise) with a full set of specialist reports including an ecological study, including both functional (ecological processes including connectivity of ridge at a landscape level perspective) and compositional (biodiversity) aspects, which usually include:

- A Red Data study for both fauna and flora
- An invertebrate study
- A hydrological/ geo-hydrological study
• A geotechnical study
• A pollution study, including both air and water pollution
• A social study, including cultural, historical and open space value aspects
• A visual study
• A study of service provision and access

2.6.3. GEOTECHNICAL SUITABILITY

Figure 9 shows Emfuleni is largely underlain by Alluvial, Andesite and Sandstone geological formations. Dolomite areas are found in the region of Sonlandpark, in the region of Roshnee, and north of Vaal Oewer. However, these areas are relatively small compared to the entire Emfuleni area and should not affect urban expansion severely due to the amount of land that is available for urban expansion.

As is depicted on Figure 10, most of Emfuleni has geotechnical conditions that are favourable or intermediately favourable for urban development (DPLG, 2002). The only unfavourable geotechnical conditions are located on the mentioned dolomite area. As mentioned above, these dolomite areas are found within the region of Sonlandpark, Roshnee, and Vaal Oewer.

The geotechnical information presented above is only based on a broad desktop analysis of the geotechnical conditions affecting Emfuleni. Consequently, it cannot be determined conclusively whether the land parcels within Emfuleni that are deemed unsuitable for urban development are in actual fact no-go areas for urban development. Such an assessment can only be done through a detailed geotechnical survey that involves the digging of test-pits. On the other hand, there is enough land for urban expansion within Emfuleni, which provides the opportunity to avoid these dolomite areas altogether. This is the approach followed in the Emfuleni SDF.

Detailed geotechnical investigations will be required before considering any site within Emfuleni for development, whether within or neighbouring dolomite areas. Such a detailed study (involving drilling) will have to assess the risk of ground surface and structural damage due to dolomite conditions or any other geotechnical conditions. The results of such a study could have a decisive influence on the typology and intensity of land uses allowed within certain geological areas.
FIGURE 10: GEOTECHNICAL SUITABILITY
FIGURE 12: C-PLAN2 ENVIRONMENTAL AREAS

- **Study Area**
- **Important Site**
- **Irreplaceable Site**
2.6.4. AGRICULTURAL POTENTIAL

The agricultural potential of Emfuleni varies from high to low potential (GDACE, 2002). As illustrated on Figure 11, most of the high-potential agricultural soils found within Emfuleni are located within the southwestern quadrant of Emfuleni, in the vicinity of Lochvaal Barrage and Vaal River. GDARD has demarcated this region of Emfuleni as a provincial agricultural hub. This provincial initiative requires this hub to be protected from urban development and expansion. Because the Agricultural Hub is a Provincial initiative, it is considered a higher-order and therefore overriding land use initiative. Thus, all land use proposal made within this region of Emfuleni are subject to the requirements and guidelines of the Agricultural Hub Initiative.

The rest of Emfuleni, and in particular the Sonlandpark region, contains only scattered and sporadically located high-potential agricultural soil conditions. These pockets of high-potential agricultural soils are mixed with low and medium potential agricultural soil areas, thus not forming an identifiable agricultural region, as is found in the southwestern quadrant of Emfuleni. This reduces the legitimacy of protecting these high-potential agricultural areas for agricultural purposes, thus making these areas potentially suitable for urban development and expansion.

2.6.5. ENVIRONMENTAL SENSITIVITY

C-Plan2, which was compiled by GDARD (2005), provides an overview of ecologically sensitive sites within Gauteng and is used (in conjunction with site surveys) by GDARD to determine whether a site is suitable for urban development. It therefore provides an indication of the chances of having a township application approved within a specific area. C-Plan2 divides ecologically sensitive sites into two categories: ‘Irreplaceable Sites’, which contain fauna and flora that are not found elsewhere, and ‘Important Sites’, which are required for the healthy functioning of an eco-system.

An ‘Irreplaceable Site’ is defined as a site that is essential in meeting targets set for the conservation of biodiversity. Options for achieving these targets will be reduced should such a site not be protected. According to C-Plan2, which is depicted by Figure 12, there are a number of land parcels within Emfuleni that contain conservation-worthy habitats and have consequently been designated as ‘Irreplaceable Sites’. The most notable of these is the Sharpeville Dam. Although this dam has been polluted in the past by a neighbouring sewer works, it remains a significant ecological area within Emfuleni. In fact, a biodiversity study of the site is currently being conducted by WSP Environment and Energy South Africa. Preliminary findings have shown that the dam attracts a rich birdlife that is worth protecting. The future closure of the Leeuwenkuil waste water treatment works abutting