There is general agreement regarding the physical composition of the neighbourhood model. First and foremost, the neighbourhood is limited in area and structured around a defined center. While the population density of the neighbourhood may vary, depending on its context, each neighbourhood offers a balanced mix of dwelling typologies, workplaces, shops, public buildings and parks. The following are the principles of a neighbourhood design:

a. Neighbourhood Centre and Edge

The neighbourhood has a center and an edge. The combination of a focus and a limit help define a community identity. The center is a necessity, but the edge not always so. The center always acts as public space, which may comprise a public space, a park, or an important street intersection. The centre is always located near the middle of the neighbourhood, unless compelled by some geographic circumstance to be elsewhere. The centre is the focus of the neighbourhood’s public buildings, such as a post office, a community hall and a library. Shops and workplaces are usually associated with the centre.

Neighbourhood edges may vary in character: it can be natural, such as a river, or man-made, such as a freight rail line. The former, if generously lined with trees, can reinforce the legibility of the edge. The edge may be assigned to low-density residential uses, it can be designated for rural purposes, such as agricultural holdings, or it can be set aside for the conservation of natural open space. These low-intensity areas can form part of a larger network of open space corridors, connecting urban open spaces with the rural surroundings.

b. Optimal neighbourhood size

The optimal size of a neighbourhood is determined by the walking distance from the centre to the edge of the neighbourhood. In this regard, the following three critical distances apply (see Diagram below):

- 4 minute walk: The 4 minute walk basically delineates the centre of the neighbourhood. Within this centre, pedestrians walk between the various public facilities, shops and workplaces located within the centre.
- 10 minute walk: The 10 minute walk delineates the area surrounding the centre, which is usually reserved for higher-density residential uses. This places a larger number of households within walking distance of their daily needs, such as a convenience store, post office, police station, automatic teller, school, day-care centre and commuter railway station.
• 20 minute walk: Whereas the 4 and 10 minute walk is a predominantly a pedestrian environment, the 20 minute walk delineates a more vehicle oriented environment of the neighbourhood. Although this outer ring is still within walking distance of the centre, vehicles (public or private) are more frequently used to access the centre. This outer ring is needed to provide the threshold household numbers needed to sustain the public facilities and business enterprises located within the centre of the neighbourhood.

DIAGRAM 17: NEIGHBOURHOOD SIZE
The location of a public transportation station or stop within the centre of a neighbourhood places such a facility within walking distance and therefore makes the public transportation system accessible for all the residents living within the neighbourhood. Studies have found that when a vehicle trip is necessary to arrive at a transit stop, most potential users of the public transportation system will simply continue driving to their destinations. By contrast, a neighbourhood places the potential public transportation commuters within walking distance of the transit stop, making public transportation more viable than typical suburban areas would.

c. Mix of activities

The neighbourhood has a balanced mix of activities: dwelling, shopping, working, schooling and recreation. This mix thus places all the activities needed in daily life within walking distance of the neighbourhood residents. For instance, children are able to walk or bicycle to school and other activities. In addition, the proximity and convenience of a public transportation station, such as commuter railway stations, reduces the number of motorized vehicle trips needed to access social amenities, shopping facilities and employment opportunities.

The land use mix of a neighbourhood should preferably include a range of housing typologies catering for a variety of household and income categories. By contrast, typical suburban areas tend to be segregated by household type and income. In the case of Emfuleni, it is imperative that a wide range and variety of affordable housing choices are made available to local residents. This is because not all households within Emfuleni that require affordable housing consist of families that require detached housing units (as the demography study in the Status Quo section of this report has shown). Logically, these different household typologies require different housing typologies that differ in layout design and size.

d. Neighbourhood street network

Whereas the typical residential area utilizes loops and cul-de-sacs, the neighbourhood uses a network of interconnecting streets. Neighbourhood streets are configured to create street blocks and shorten pedestrian routes. They are designed to calm local traffic, because an interconnected street pattern provides multiple routes and options that tend to diffuse traffic. Neighbourhood streets are detailed and layered to provide for pedestrian comfort, as well as for vehicle movement. Slowing and diffusing vehicle movement and increasing pedestrian activity encourages the casual meeting of residents, which forms the bonds that create a community.
e. Public space

The neighbourhood gives priority to public space and to the appropriate location of public buildings. Public spaces and buildings represent community identity and tend to foster community pride. A neighbourhood structures its streets and street blocks to create a hierarchy of public spaces and provides visual locations for public buildings. In other words, squares and streets are arranged in terms of size and layout with the intention of creating special places. The importance of these public and community buildings is enhanced by suitable and prominent locations, for example, placing a public building at the end of an activity street.

5.1.2. BUSINESS DEVELOPMENT

Emfuleni has 3 Central Business Districts (CBDs) serving the municipal area. These are the established Vanderbijlpark CBD, the established Vereeniging CBD and the emerging Sebokeng CBD. Both the Vanderbijlpark CBD and the Vereeniging CBD have large concentrations of retail and office space. Much of this retail and office space has become vacant in recent years due to the decentralization of retail and office space to suburban areas of Emfuleni. Further expansion of these established CBDs are therefore not encouraged.

The Sebokeng CBD, on the other hand, is an emerging Central Business District within Emfuleni. Existing land uses within this CBD, such as the Sebokeng Hospital and a newly-built regional retail centre, provide a strong platform for the further development of this CBD. The Sebokeng CBD requires further strengthening through the development of addition retail and office space within this CBD, as well as the development of higher-density housing component to complete the land use mix of this CBD.

Apart from the abovementioned, a more access-equitable nodal structure needs to be established within Emfuleni, which can also better support public transportation within the municipal area. To enable this, a regional business node structure is proposed, comprising a total of 5 existing and 4 proposed regional business nodes. The is existing regional business nodes include, amongst others, the business node located in Three Rivers, the business nodes on the K174 (Barrage Road) located at the Vaal Mall and the Bedworthpark Shopping Centre, and the business node located west of Evaton situated on the K45 (Golden Highway). The land use composition of these existing regional business nodes need to be diversified by adding uses such as office, community facilities and high-density housing to its land use mix. The 5 nodes newly proposed regional business nodes include Sonlandpark, Boitumelo, Kwaggastroom, Roshnee and Lochvaal. Retail and office space needs to be allocated
to each of these nodes in accordance with the needs of the surrounding urban environment, the nature of its potential consumer base, and the location characteristics of each node.

It will be necessary to design and develop the regional business nodes mentioned above in a manner that leads to the integration of these business nodes with the surrounding residential neighbourhood that is serves, as illustrated in the neighbourhood model presented in this report. This implies developing an ‘open’ land use arrangement, which allows pedestrians too freely and conveniently access the business node. Creating a closed-off, security estate development within these regional business nodes will certainly not contribute to a pedestrian environment and will limit the positive impact that these business nodes will have on the surrounding residential environments they serve. Importantly, the proposed business node must have good access to public transport stations and facilities where possible. This requires orientating the business node layout and buildings towards such stations and major intersections carrying road-based public transportation. In general, it can be said that the proposed regional business node structure should have many positive spin-offs for Emfuleni; stimulating diversified economic development within Emfuleni and enabling residential development and densification within Emfuleni. In addition, the development of these business nodes will, if dealt with correctly, enhance the character and spatial identity of Emfuleni.

5.1.3. INDUSTRIAL AND COMMERCIAL DEVELOPMENT

As depicted by the Table below, it was estimated that Emfuleni requires approximately 200ha of land for industrial and commercial development during the period 2010-2015. It requires an estimated additional 325ha of land for industrial and commercial development during the period 2015-2020. An oversupply of land is made available within Emfuleni for industrial and commercial development during these periods, simply by allowing existing, undeveloped or partly developed industrial and commercial areas to develop.

TABLE 20: INDUSTRIAL LAND ALLOCATION

<table>
<thead>
<tr>
<th>Area</th>
<th>Year 2010-2015</th>
<th>Year 2010-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Need (ha)</td>
<td>Allocated (ha)</td>
</tr>
<tr>
<td>Industrial</td>
<td>200.3</td>
<td>1068.7</td>
</tr>
</tbody>
</table>

Source: Urban Dynamics Gauteng, 2012
Figure 22 illustrates the land parcels within Emfuleni that are proposed for industrial development. Four industrial and commercial expansion areas are proposed within Emfuleni. These industrial and commercial expansion areas are as follows:

a. Powerville

The southernmost proposed industrial and commercial area is situated south of Powerville and constitutes the expansion of Powerville up to the Vaal River, using up all unused land within this area. Because of the existing heavy industries in Powerville, as well as the contaminate nature of the land in question, it is proposed that the extension of Powerville be made available for heavy industrial and commercial development. However, due to the proximity of this area to the Vaal River, it is stressed that the highest environmental protection measures be enforced on the industries to be developed within this area. This industrial expansion area has access the K174 (Voortrekker Road).

b. Leeuwuil

Leeuwuil is situated west of the Vereeniging CBD. It is an established industrial area, which is still largely vacant. It is proposed that the vacant industrial stands within this industrial area and vacant land within Powerville become occupied before additional land is made available for industrial and commercial development within Emfuleni. Leeuwuil should be reserved for commercial and light industrial uses. Heavy industrial uses should be excluded from this development to avoid polluting uses next to the existing and proposed residential areas neighbouring this industrial area. The location of Leeuwuil next to the P156 (R59) makes it suitable for commercial uses, which often require visual access from freeways. The Leeuwuil industrial area has access to the K53 arterial, which connects this industrial area to the Vereeniging CBD and Sebokeng.

c. Boipatong

The proposed Boipatong industrial area is situated within the triangle bordered by the K45 (Frikkie Meyer Boulevard), K180 (Houtkop Road) and the K178 (Boy Louw Street). These roads provide this proposed industrial area with excellent accessibility. The development of this industrial area will constitute the northeastward expansion of the Mittal industrial area, creating an industrial band stretching from the P155 (Golden Highway) to the Vereeniging-Johannesburg railway line. The proposed Boipatong industrial area can be made available for commercial and light industrial uses.
d. Cyferpan

The Cyferpan industrial area is a small, proposed industrial area located on the intersection of the K178 (Boy Louw Street) and the K45 (Golden Highway). This industrial area will in future be severed by the PWV20 freeway. The part of this proposed industrial area located between the freeway and Mittal, can be used for heavy industrial and commercial uses. The part of this industrial area located between the PWV20 freeway and the K178 should be used for commercial and light industrial uses to enable a better interface between this proposed industrial area and Sebokeng. Both these portions will have access to the K45 (Golden Highway).

e. Sebokeng CBD

The Sebokeng CBD comprises a small industrial area, situated on Moshoeshoe Road. This industrial area is still largely vacant, comprising only a small number of SMME-type industries. It is proposed that the vacant industrial stands within this industrial area be developed as hive-industries, which can be rented out to the local population of Sebokeng and Evaton. This will further support SMME development within this part of Emfuleni. The massing and height of these industrial buildings can effectively be used to create urban form and character within the Sebokeng CBD.

The proposed industrial and commercial areas are aimed at generating employment opportunities in Emfuleni and thereby reducing the need for Emfuleni residents to travel large distances to access such employment opportunities in other parts of Gauteng. Allowing these industrial areas to develop will also help alleviate the pressure for industrial and commercial development and the need for industrial and commercial land within Emfuleni. It will also focus industrial and commercial development in specific areas and in this manner address the currently problem in Emfuleni whereby small holding owners are applying for industrial and commercial in part of Emfuleni that diminishes the aesthetic and environmental qualities of the municipal area. If such a scattered industrial pattern on agricultural holding were to be encouraged or even allowed, it will negatively impact on future residential expansion within Emfuleni, as well as the ability of the municipal area to promote other industries within Emfuleni, such as tourism.

5.1.4. AGRICULTURE

As was mentioned in the Status Quo section of this report, 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 Oewer. GDARD has
demarcated this region of Emfuleni as a provincial agricultural hub. Consequently, the properties that are located within the demarcated Agricultural Hub are designated for rural and rural residential purposes only. Township establishment is therefore not permitted in the area; be it for residential, commercial or industrial purposes. All land uses to be permitted within this Agricultural Hub are subject to the guidelines and regulations of the Gauteng Agricultural Hub initiative.

Although the Emfuleni SDF supports the Emfuleni Agricultural Hub, it does not support the inclusion of the Mantevrede Agricultural Holdings and Lochvaal Barrage into the Emfuleni Agricultural Hub. Instead, the Emfuleni SDF supports the residential densification of the Mantevrede Agricultural Holdings and the limited residential densification of Lochvaal Barrage. The Emfuleni SDF has done so for the following reasons: (a) the existing Lochvaal Barrage Spatial Development Framework (2009) has already allowed residential densification within this part of Emfuleni, (b) there is a need for weekend holiday housing associated with the recreation value of the Vaal River, and (c) the area is no longer being used for commercial agricultural purposes.

Apart from the farmland protected as part of the Emfuleni Agricultural Hub, a number of pockets of high-potential agricultural soils are scattered throughout the rest of Emfuleni, and in particular the Sonlandpark region. The scattered nature of the high-potential agricultural soils, as well as the fact that they are located within or near existing urban areas, reduces the legitimacy of protecting these high-potential agricultural areas for agricultural purposes. As a result, it is proposed that these pockets of land be considered for urban development and expansion, as and if required by the Land Use Budget of the Emfuleni SDF. Consideration can be given to retain these pockets of high-potential agricultural soils within township layouts for urban agricultural purposes. Urban agriculture is the practice of cultivating, processing and distributing food in or around urban or peri-urban areas. Urban agriculture is generally practiced for income-earning or food-producing activities by communities. Urban agriculture can have many benefits, which include:

- Urban agriculture expands the economic base of communities through production, processing, packaging, and marketing of consumable products.
- It increases entrepreneurial activities and the creation of job opportunities.
- It supports modern planning initiatives and fits within the current scope of sustainable design.
- Vacant urban areas with agricultural potential can be used for agriculture production.
- Local production of food allows savings in transportation costs and storage.
- Urban agriculture improves the quality of the urban environment through greening and therefore reduces pollution.
- Urban agriculture is a very efficient tool to fight against hunger and malnutrition since it facilitates access to food by impoverished sectors of the urban population.
- Urban agriculture provides food and creates savings in household expenditure on consumables, thus increasing the amount of income allocated to other uses.
5.1.5. OPEN SPACE CONSERVATION

An open space system fulfils a number of functions. These functions include hazard avoidance, resource conservation, ensuring community well-being and educational (see Table below). Open space and recreation within Emfuleni can be divided into 2 categories: passive and active open space. Passive open space consists of land that is unsuitable or undesirable for urban development due to topographical, ecological constraints or for flood protection. Active open space involves the recreational component of the open space system and is dealt with at a later stage in this report.

TABLE 21: FUNCTIONS OF AN OPEN SPACE SYSTEM

<table>
<thead>
<tr>
<th>Hazard avoidance</th>
<th>Resource conservation</th>
<th>Recreational and psychological</th>
<th>Educational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open spaces must reserve flood prone areas.</td>
<td>Open spaces must protect water sources.</td>
<td>Developed and maintained open space must be provided for recreational purposes.</td>
<td>Open spaces must be protected for environmental education purposes.</td>
</tr>
<tr>
<td>Open spaces must reserve steep slopes and geologically unstable ground.</td>
<td>Open spaces must protect linked areas of conservable indigenous vegetation.</td>
<td>Open space must be provided for community interaction and as symbols of community identity.</td>
<td>Well-equipped and designed open spaces must be provided for sport education.</td>
</tr>
<tr>
<td>Open spaces should protect drinking water sources from being contaminated.</td>
<td></td>
<td>Open spaces must be protected for psychological relief from the stresses of urban live.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Urban Dynamics Gauteng, 2012

The open space network proposed for Emfuleni is depicted on Figure 24. Emfuleni contains 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 River, the Rietspruit, which flows past the western boundary of Sebokeng towards Lochvaal Barrage, and the Leeuspruit that flows from Carltonville into the Rietspruit. The conservation of the Rietspruit is of utmost importance. This importance is not only due to ecological reasons, but also because it provides the neighbouring communities of Evaton and Sebokeng a vital psychological connection to the natural environment.

The conservation of the Emfuleni river system is also necessary for hazard avoidance. To this end, it is imperative that the natural drainage channels and banks of all the rivers within Emfuleni, as well as their tributaries, be protected up to the 100-year flood
line. This will protect Emfuleni communities from flooding; while at the same time ensure the protection of the ecological status of the river embankments, which is necessary for flood management.

A conservation plan is currently being prepared for Sharpeville Dam. This study found that the Sharpeville Dam has a rich birdlife, which needs to be protected. To do this, it is necessary to maintain reasonable open space buffer zones around the dam, which would allow the birds to take-off and land near the dam. This requires that buildings located near the dam be set back to maximize take-off and landing opportunities. In addition, it is necessary to retain a spatial linkage between the Sharpeville Dam and the Vaal River; this is despite the fact the Barrage Road already severs this linkage. The possibility exists that in future wide culverts can be constructed underneath Barrage Road, which would re-establish the linkage between the Sharpeville Dam and the Vaal River. Emfuleni is currently planning a corridor development along Barrage Road, which would affect the Sharpeville Dam and the planned conservation initiative around Sharpeville Dam is pursued. The Emfuleni SDF therefore proposes that the spatial link between the Sharpeville Dam and the Vaal River be established and that this linkage be protected as an open space. Although the part of the Barrage Road corridor in the R59 freeway will be sacrificed, retaining the Sharpeville Dam open space on this interchange will provide a suitable and aesthetically pleasing gateway to Vanderbijlpark.

5.1.6. SDF LIMITATIONS

Although an attempt was made to point out the constraints affecting Emfuleni, it has to be stressed that localized constraints could emerge once a site that is earmarked for development is investigated in more detail. Also, it may be that the constraints are more prohibitive than assumed in this report. Such issues may surface during the EIA process, during the township establishment application process, or during the construction phase, when building foundations are investigated. The following development constraints could emerge during these phases:

- **Geotechnical conditions:** Good geotechnical conditions underlie most of Emfuleni that is proposed for urban development, thus not prohibiting urban development. However, it may be that localized areas within Emfuleni may have geotechnical conditions that are not suitable for building construction, or would require specialized building foundations that may increase building cost.
- **Municipal services:** Besides the bulk municipal services network capacity (which was not been determined in this study) there may be localized areas within Emfuleni that cannot be directly be linked to the bulk network due to topographical constraints or other factors. To address this may require, for example the installation of sewerage pump stations, which could possibly become a condition for development in such areas.
Flooding: Although the protection of floor areas within Emfuleni have been taken into account in the open space network proposed in the Emfuleni SDF, it may be that certain properties within Emfuleni, which are located outside of this open space network, are subject to flood conditions.

Environmental constraints: Although the open space network has taken environmental constraints into account; localized environmental constraints could affect properties or portions of properties that are not located within these open spaces. Such environmental constraints could surface during site visits associated with applications for land use change.

High-potential agricultural soils: High-potential agricultural soils to be protected have been pointed out in the Emfuleni SDF. However, this does not precluded GDARD to require the protection of localized pockets of high-potential agricultural soils, which could affect the manner and extent to which a property can be developed.

5.1.7. URBAN DEVELOPMENT BOUNDARY

Demarcating an Urban Development Boundary has numerous advantages, the primary being to prevent unchecked urban sprawl. Urban sprawl is undesirable because it increases pressure on local government resources to provide extended public transport services and municipal services infrastructure networks. An Urban Development Boundary can also protect valuable agricultural soils and ecologically sensitive areas from urban encroachment. Demarcating an Urban Development Boundary also has drawbacks. For example, it can restrict the supply of land for urban development within a municipal area, which could inflate land prices within the Urban Development Boundary. Care should therefore be taken when demarcating an Urban Development Boundary. A balance should be reach between providing enough land for urban development and the need for sustainable and managed urban development.

An Urban Development Boundary is proposed for Emfuleni, which is illustrated on Figure 23. The proposed Urban Development Boundary was first and foremost demarcated based on the Land Use Budget estimates for settlement expansion within Emfuleni. The Urban Development Boundary allows urban expansion within Emfuleni up to the year 2020. The Urban Development Boundary does not allow Emfuleni to sprawl beyond the spatial limits required by the estimated population growth of Emfuleni up to the year 2020. At the same time, it ensures that enough land is available within the proposed Urban Development Boundary to cater for the estimated growth within Emfuleni up to the year 2020. Apart from population growth, other principles used to demarcate the Urban Development Boundary include the following:
The containment of the urban sprawl and achieving urban integration and continuity through infill development and densification
The creation of urban corridors along public transportation routes, such as Vereeniging-Johannesburg commuter railway line
The integration of existing and planned affordable housing projects with other urban areas within Emfuleni
The availability of bulk services and the cost implications of establishing new infrastructure for new township developments in remote or isolated areas
Avoiding urban expansion over unsafe geological conditions
The conservation of environmentally sensitive areas and the protection of high-potential agricultural soils

The Urban Development Boundary specifically aimed to achieve the flowing spatial development objectives, as presented in the Emfuleni SDF. These spatial development objectives as follows:

a. Utilising existing municipal infrastructure

Emfuleni is currently experiencing major challenges with regard to providing municipal services to support urban expansion within the municipal area. It is therefore imperative that municipal services infrastructure expansion is rationalized in order to limit the cost of funding such expansion efforts. The Urban Development Boundary therefore aims to consolidate urban development and expansion in areas where bulk municipal services infrastructure already exists or where bulk municipal services infrastructure can easily be connected to existing bulk municipal services infrastructure network.

b. Strengthening the Vereeniging-Johannesburg commuter railway line

A primary aim of the Urban Development Boundary is to strengthen the Vereeniging-Johannesburg commuter railway line corridor, as envisaged in the Development Concept. The densification of the agricultural holdings and residential expansion areas in the Sonlandpark area in particular will strengthen this commuter railway line corridor. The Urban Development Boundary therefore allows for residential expansion in the Sonlandpark and Boipatong areas, and the further densification of the Unitas Park agricultural holding areas.
c. Promote the linking of Sebokeng to Vanderbijlpark

The primary aim for the Urban Development Boundary is to allow for the development of existing affordable and bonded housing initiatives within Emfuleni to proceed, especially where such development encourage the linking of Sebokeng to Vanderbijlpark and Vereeniging. This includes, amongst others, the further development of the Sebokeng CBD, the completion of the Golden Gardens and Johandeo extensions west of the Sebokeng CBD, and the completion of the Lethabong extension east of the Sebokeng CBD.

d. Limiting urban expansion along the Vaal River

The Mantevrede Agricultural Holdings and Lochvaal Barrage are situated along the Vaal River, between the N1 freeway and the P155 freeway. This is a sought-after weekend holiday area associated with the recreation value of the Vaal River. Consequently, this predominantly agricultural holdings area is coming under increasing pressure for redevelopment at higher residential densities. The Urban Development Boundary Development allows for the densification of this area in order to provide for the development of the Vaal River waterfront. This is in contradiction with the Agricultural Hub Initiative of GDARD, which has identified this part of Emfuleni to be protected for commercial farming purposes. However, the Urban Development Boundary Development allows for this contradiction for the following reasons: (a) the existing Lochvaal Barrage Spatial Development Framework (2009) has already allowed residential densification within this part of Emfuleni, (b) there is a need for weekend holiday housing associated with the recreation value of the Vaal River, and (c) the area has for some time no longer been used for commercial agricultural purposes.

**TABLE 22: LAND USES AFFECTED BY THE URBAN DEVELOPMENT BOUNDARY**

<table>
<thead>
<tr>
<th>Inside Urban Development Boundary</th>
<th>Outside Urban Development Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban settlements</td>
<td>Extensive and intensive agriculture areas</td>
</tr>
<tr>
<td>Estate development</td>
<td>Conservation areas and nature reserves</td>
</tr>
<tr>
<td>Business and office nodes</td>
<td>Tourism facilities and related activities</td>
</tr>
<tr>
<td>Industrial and commercial areas</td>
<td>Agricultural holdings</td>
</tr>
<tr>
<td>Governmental uses</td>
<td></td>
</tr>
</tbody>
</table>

Source: Urban Dynamics Gauteng, 2012

A guideline for the type of land uses to be allowed inside and outside of the Urban Development Boundary are depicted in the Table above. As a rule, the Urban Development Boundary applies to all developments requiring a township establishment application, not allowing such development beyond (outside) the Urban Development Boundary.
5.1.8. LAND USE AND TRANSPORTATION INTEGRATION

Land use and transportation integration forms the backbone of an efficient urban structure. It not only ensures the cost-effective operation of the municipal area’s public transportation system, but it also tends to limit urban sprawl by concentrating urban development at higher densities close to public transportation routes. In addition, the mixing of land uses creates a better relationship between areas of residence and employment, which can lead to shorter commuter distances and a better two-way use of transport infrastructure.

5.1.8.1. TRANSIT ORIENTATED DEVELOPMENT (TOD)

The key to successful land use and transportation integration is obtaining higher land use densities at transit stations, such as commuter railway and bus stations. These are the points where access is obtained to the public transport systems and attempts should thus be made to optimally use these strategic locations. This can be done by locating higher-density land uses around these transit stations. This is known as Transit Oriented Development (TOD), which is essentially a node that is centred on a transit station. These higher-density land uses need to be located within walking distance of the transit station, which is generally accepted to be 400m from a station. This distance can also be considered the peripheral boundary of a TOD. In general, the elements that make up a TOD are (see Diagram below):

- A walkable design which considers pedestrians the highest form of movement
- A commuter rail station or bus station or minibus taxi rank as the central feature of the TOD
- A mixture of land uses in close proximity, including office, residential, retail, and community uses
- Higher-density, high-quality housing development within a 4 minute walk radius (400m) surrounding the transit station

TODs can essentially be implemented in one of two ways: TODs located within an existing township, forming part of a brownfield development, and TODs forming part of a new town development. TODs located within an existing township will involve the development of vacant stands that are within walking distance of a transit station with TOD-related uses, such as retail and higher-density housing. TODs located within existing townships are ideal for use as part of urban renewal initiatives. The Sebokeng CBD and its commuter railway station is an area that can typically be developed in this manner.
TODs associated with new-town development involve the deliberate planning, design and construction of TOD-structures as part of a new town development. Because these TODs are new developments, the opportunity exists to apply sound TOD principles to the design of these TODs from the start. Consequently, such TODs will better integrate land use and public transportation than would TODs created within existing townships. Development of a TOD around the planned Sonlandpark commuter railway station presents such an opportunity in Emfuleni.

Transit Orientated Developments or TODs are best applied using a string-of-beads development pattern. A string-of-beads development pattern is usually shaped by a major public transportation route or commuter railway line, concentrating development (TODs) at intersections or transit stops or railway stations along the spine (see Diagram below). Consequently, the string-of-beads settlement configuration is ideal for the operation of public transportation systems. Such a string-of-beads settlement patterns can potentially be developed along the Vereeniging-Johannesburg commuter railway line.
The scale of the string-of-beads settlement configuration can vary. At its largest scale it can extend from one city to another. At the more local scale it can extend from one neighbourhood to the next. The degree to which this development pattern is identifiable within an urban area is often dependant upon whether it is deliberately promoted through development policies or not. Policies that aim to develop an urban area that is centred on promoting the use of public transport, often exhibits a more defined string-of-beads development pattern, than an urban area that promotes the use of private vehicles.
Public transit is best supported within TODs if both higher densities and a land use mix are employed. Simply increasing densities in an area may do less to improve accessibility if not mixed with other, uses such as shops and public amenities. Land uses can be mixed horizontally or vertically. Whereas the horizontal mixing of land uses is usually found in predominantly residential areas, the vertical mixing of land uses is more suited for CBDs, where transit-accessible land is limited, not allowing the development of certain uses on ground level. The Diagram above provides a conceptual illustration of the vertical mixing of land uses.

Another key to the development of TODs is the manner in which land uses within TODs are integrated with the public transportation station or stops located within these TODs. This involves creating pedestrian-friendly environments within TODs, using pedestrian walkways and public spaces, and using these pedestrian elements to link the public transport stations and stops to the surrounding land uses of the TODs. A grid road and pedestrian network best suites pedestrian movement within a TOD.
5.1.8.2. PROPOSED TRANSIT ORIENTED DEVELOPMENTS (TODs)

The locations of a TOD are governed by specific criteria, because the success of a TOD is largely depended upon its location. Based on the theoretical aspects set out above, the following guidelines were applied to determine suitable locations for TODs within Emfuleni area:

- TODs must be located on an existing or planned public transportation route.
- TODs must utilize existing or planned transit stations or stops, such as commuter railway stations or bus stops.
- TODs should comprise vacant land areas to enable the development of transit-supporting land uses.
- Ideally, TODs should contain existing or planned kick-start facilities, such as retail centres.

Figure 22 depicts the existing and future SPTN routes and commuter rail stations within Emfuleni. As depicted by the Table below, ten TODs are proposed for Emfuleni along these SPTN routes and at these commuter rail stations. Logically, the Vanderbijlpark CBD, the Vereeniging CBD and the Sebokeng CBD (although poorly developed) are existing TODs located within the municipal area. These TODs can be strengthened through infill development and the redevelopment of existing properties. This applies in particular to the Sebokeng CBD TOD.

In addition to the above, a number of TODs are proposed at the various regional nodes proposed within Emfuleni, which also have access to the Vereeniging-Johannesburg commuter railway line or a proposed SPTN routes. The most notable these proposed TODs is the one proposed situated at the proposed Sonlandpark regional node and commuter railway station. This TOD will serve the greater Sonlandpark and Boipatong areas. This will be a new node, thus providing the opportunity to apply sound TOD principles to the design of this TOD from the start.

It is proposed that the TOD concept be embraced by Emfuleni and implemented over the long term. Practically, this will involve facilitating the development of land uses that support the TOD concept. Apart from the Municipal Town Planning Departments, institutions that should be involved in developing TODs are the transit agencies (Department of Transport, minibus taxi associations and bus companies), provincial departments (housing, health and education), private developers (e.g. retailers), financiers and the local community. Because the success of TODs requires committed stakeholders, these bodies should be involved in all the planning stages of TODs.