

# **IDENTIFICATION AND EVALUATION OF CANDIDATE SITES FOR A REGIONAL LANDFILL SITE IN THE NORTHERN AREA OF CITY OF TSHWANE MUNICIPALITY**

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# **IDENTIFICATION AND EVALUATION OF CANDIDATE SITES FOR A REGIONAL LANDFILL SITE IN THE NORTHERN AREA OF CITY OF TSHWANE MUNICIPALITY**

## **1. BACKGROUND**

Site selection is a minimum requirement for selecting a specific landfill site or sites before more detailed investigations are carried out. In this particular case, and in many other instances, the situation is different in that a specific site for development of a landfill is available and desk top studies up to now have not indicate any fatal flaws. The purpose of this landfill site selection process is therefore slightly different as it is considered to have two objectives:

- 1) Show that with the existing landfills being used by the City of Tshwane in the specific area there is highly likely to be a need for an additional landfill site;
- 2) Show that by doing a study in the region of the proposed landfill site on which the desk top study has been done, that there are no other more suitable sites that should obviously be studied in preference to the site referred to.

The region selected for this study is mainly the City of Tshwane area north of the Magaliesberg mountain. Two sites just outside the (previous) Tshwane area and two just south of the mountain have also been included.

## **2. EXISTING SITES**

### **2.1 Summary of existing and recently operational sites**

The main source of information on existing sites is a November 2004 study done for the City of Tshwane done by Felehetsa and BKS (2004). There does not seem to be more recent available studies. The sites

were also studied using recent Google images. The locations of the existing sites are indicated on Figure 1.

A summary of the existing sites, their classification and current status is presented below:

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<b>Landfill Site</b>	:	Derdepoort
<b>Location (coordinates of approximate centroid)</b>	:	25 40 47S, 28 17 16E
<b>Classification</b>	:	G:M:B
<b>Status</b>	:	To be closed in 3 years from 2004 i.e. 2007. Site is closed.
<b>Landfill Area (ha)</b>	:	12,4 ha
<b>Remarks</b>	:	None

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<b>Landfill Site</b>	:	Ga-Rankuwa
<b>Location (coordinates of approximate centroid)</b>	:	25 34 57S, 27 59 05E
<b>Classification</b>	:	G:M:B
<b>Status</b>	:	Estimated to be operational for 20-25 years from 2004 i.e 2024 to 2029. Surrounded by townships to north and south.
<b>Landfill Area (ha)</b>	:	41,9 ha
<b>Remarks</b>	:	Life of site must be re-evaluated.

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<b>Landfill Site</b>	:	Onderstepoort
<b>Location (coordinates of approximate centroid)</b>	:	25 39 02S, 28 09 07E
<b>Classification</b>	:	G:L:B
<b>Status</b>	:	Estimated to be operational for 20-25 years from 2004 i.e 2024 to 2029. Site is surrounded by major transport links i.e. N4 route, road R566 and a railway line as well as nature reserves and a spruit.

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		The site seems to be very active because of its central location, but it appears as if almost all the space has been used. An increase in height may provide more space.
<b>Landfill Area (ha)</b>	:	51,8 ha
<b>Remarks</b>	:	The life of the site must be re-evaluated.

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<b>Landfill Site</b>	:	Soshanguve
<b>Location (coordinates of approximate centroid)</b>	:	25 27 26S, 28 06 33E
<b>Classification</b>	:	Permitted as Class 2 under old system
<b>Status</b>	:	Estimated to be operational for 10-15 years from 2004 i.e 2014 to 2019. Site is situated adjacent to and east of a spruit. Housing is close to the northern and southern boundaries with squatter type housing encroaching from the southern boundary. Institution type development is present east of Soutpans Road (M35) on the eastern side.
<b>Landfill Area (ha)</b>	:	39,2 ha
<b>Remarks</b>	:	The life of the site must be re-evaluated.

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<b>Landfill Site</b>	:	Temba
<b>Location (coordinates of approximate centroid)</b>	:	25 23 05S, 28 15 01E
<b>Classification</b>	:	G:S:B
<b>Status</b>	:	To be closed within 6-12 months from 2004 i.e. before end 2005. Residential development is present on all sides of the small site. The site seems to be still active but will be closed within months.
<b>Landfill Area (ha)</b>	:	3,7 ha
<b>Remarks</b>	:	None.

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## **2.2 Discussion of existing sites**

From the above it is clear that very few sites have a long life expectancy, the only sites with a medium life expectancy being Ga-Rankuwa, Onderstepoort and Soshanguve. No new landfills in the area are in the process of being licensed. Even though alternative waste management options like recycling and composting are being promoted, a new large capacity well operated landfill will be of great benefit to the region.

## **3. OTHER CANDIDATE SITES**

### **3.1 Background**

A desk top study has been done to identify other potential landfill sites in the area. As usual areas of disturbed ground e.g. quarries or sand works or clay pits rather than green field sites were targeted as potential areas for development of waste disposal sites. Such sites are more suitable to obtain increased air space and at the same time to carry out controlled rehabilitation of disturbed areas. Fairly recent Google images were mainly used in the study. The 1:50 000 published geological maps 2527DB, 2528CA and 2528CB as well as the 1:250 000 published Pretoria map (2528) were used to describe the geology. The locations of the sites identified are indicated on Figure 2. The preferred site on which a more detailed desk top study has been carried out is indicated as site number 1.

### **3.2 Description and assessment of candidate sites**

The desk top study information was interpreted under the following headings:

- Location (Latitude Longitude)
- Type of feature
- Description e.g. operating quarry, sand works etc.

- Approximate area in hectares (and depth currently excavated/quarried)
- Potential fatal flaw(s)
- Underlying geology
- Hydrogeology
- Remarks (where appropriate).

The candidate sites identified are as follows:

<b>Candidate site 1</b>	
<b>Location</b>	: 25 38 26S, 27 59 22E
<b>Type of feature</b>	: Excavations for sand and aggregate.
<b>Description</b>	: Shallow excavation into sand and deep excavations into rock to mine sand for construction and quartzite for use in chrome smelters.
<b>Approx size and depth</b>	: Two quarries, large areas mined for sand and silting ponds for fines. Disturbed area approximately 150 ha and quarries up to 40 m deep.
<b>Potential Fatal flaw</b>	: None evident but must be investigated in detail.
<b>Underlying geology</b>	: Sand and quartzite deposits from the Smelterskop Formation occurring as isolated "inclusions" in the Bushveld Complex. The Smelterskop Formation is also correlated to the Rayton Formation, but considered by some as being part of the Rooiberg Group. To the south and north of the quartzite hills of the Smelterskop Formation, mafic rocks of the Bushveld Complex are present.
<b>Hydrogeology</b>	: The groundwater potential of the Smelterskop Formation is generally classified as low. Water level depth appears to be deeper than 20m as existing quartzite quarries are dry. Rocks of the Bushveld Complex are also considered to have a low ground

water potential.

**Remarks** : Although the quarries are still in operation, there are areas where waste disposal can commence without sterilisation of remaining resources.

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### Candidate site 2

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**Location** : 25 41 44S, 28 16 35E

**Type of feature** : Very large quarry in Magaliesberg quartzite east of the N1 highway.

**Description** : Deep excavation with benches on northern, western and southern sides. Screened from residential areas but close to residences.

**Approx size and depth** : 1200 x 320 m (38 ha) at surface. Depth >50 m.

**Potential Fatal flaw** : Close to residential development. There may also be other preferred uses. Could be developed in future as disposal facility, but quarry is currently still operating.

**Underlying geology** : Quartzite of the Magaliesberg Formation.

**Hydrogeology** : The quarry is developed in a prominent ridge formed by the Magaliesberg Formation, and the depth to the ground water level is expected to be deep. Ground-water potential in the quartzite is low as confirmed by the current relatively dry mining conditions.

**Remarks** : The limited size of the disturbed area would not allow for development of a landfill without sterilisation of remaining resources.

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### Candidate site 3

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**Location** : 25 40 22S, 28 26 20E (Just east of (previous) Tshwane boundary).

**Type of feature** : Operating sand and aggregate works.

**Description** : Large shallow sand works with minor quarry areas.



	:	Water (probably storm water) in some deeper excavations. Some settling ponds also contain water.
<b>Approx size and depth</b>	:	Roughly 30 ha mainly shallow excavations but minor deeper rock quarries.
<b>Potential Fatal flaw</b>	:	None clearly evident but works are operational.
<b>Underlying geology</b>	:	Probably hill wash from Rayton quartzite Formation outcrop areas.
<b>Hydrogeology</b>	:	Shallow groundwater in the unconsolidated sand and weathered quartzite occurring as a perched aquifer on the underlying solid quartzite could be expected.
<b>Remarks</b>	:	The limited size of the disturbed area would not allow for development of a landfill without sterilisation of remaining resources.

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#### **Candidate site 4**

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<b>Location</b>	:	25 33 47S, 28 26 35E (East of previous Tshwane boundary)
<b>Type of feature</b>	:	Probably sand works area (multitude of works distributed over a large area)
<b>Description</b>	:	Mainly shallow excavations, probably still operational
<b>Approx size and depth</b>	:	About 131 ha (Area surrounded by similar operations in 500 ha area).
<b>Potential Fatal flaw</b>	:	Probably still operating. Spruit on western side of works
<b>Underlying geology</b>	:	Sand deposits and hill wash originating from weathering of the Wilge River sandstone Formation, Waterberg Group.
<b>Hydrogeology</b>	:	Ground water expected to occur at shallow depths in the unconsolidated and weathered sandstone, and draining towards the two streams on the

western and eastern sides of the sand mining operations.

**Remarks** : Although the quarries may still be in operation, the site is large enough for waste disposal to commence without sterilisation of remaining resources.

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**Candidate site 5**

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**Location** : 25 38 21S, 28 00 43E

**Type of feature** : Excavation for sand and aggregate

**Description** : Shallow excavations into sand and deeper quarries into quartzite rock. Aggregate probably supplied to chrome smelters.

**Approx size and depth** : 105 ha and approximately 20 m deep excavations

**Potential Fatal flaw** : Excavations and quarries still operational.

**Underlying geology** : Sand and two prominent quartzite ridges of the Smelterskop (Rayton) quartzite Formation. Area between the two quartzite ridges is underlain by ferrogabro of the lower Main Zone of the Bushveld Complex.

**Hydrogeology** : The groundwater potential of the Smelterskop Formation is generally classified as low. Water level depth appears to be deeper than 20m as existing quartzite quarries are dry. Rocks of the Bushveld Complex are also considered to have a low groundwater potential.

**Remarks** : Although the quarries may still be in operation, the site is large enough for waste disposal to commence without sterilisation of remaining resources.

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**Candidate site 6**

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**Location** : 25 36 20S, 28 02 59E

<b>Type of feature</b>	:	Deep stone quarry
<b>Description</b>	:	Deep quarry with crushers. Some water on quarry floor
<b>Approx size and depth</b>	:	280 x 260 m i.e. 7.2 ha on surface, > 20 m deep
<b>Potential Fatal flaw</b>	:	Still operating. Cover material. Small size.
<b>Underlying geology</b>	:	Underlain by the Pyramid Gabbro-norite of the Main Zone, Bushveld Complex.
<b>Hydrogeology</b>	:	Unweathered and solid gabbro-norite not considered a potential aquifer as low borehole yield are normally encountered. Water observed at base of quarry probably due to seepage from micro-fractures in the norite.
<b>Remarks</b>	:	The limited size of the disturbed area would not allow for development of a landfill without sterilisation of remaining resources.

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### **Candidate site 7**

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<b>Location</b>	:	25 37 17S, 28 03 47E
<b>Type of feature</b>	:	Irregularly shaped deep excavation with water on floor
<b>Description</b>	:	Probably excavation for sand and rock. Possibly material for brickworks just east of excavation
<b>Approx size and depth</b>	:	3 ha
<b>Potential Fatal flaw</b>	:	Small size, just 250 m north of road and township. Lacking cover material. Small size problematic.
<b>Underlying geology</b>	:	The site is situated on what appears to be an isolated dunite inclusion within the gabbro-norite of the Main Zone, Bushveld Complex
<b>Hydrogeology</b>	:	Groundwater only expected to occur in the upper weathered profile of the gabbro-norite, but this profile has a low groundwater yield potential due to the very low permeability of the weathered product. The Main Zone of the Bushveld Complex is not

**Remarks** : regarded as a potential aquifer of any significance  
 : The limited size of the disturbed area would not allow for development of a landfill without sterilisation of remaining resources.

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**Candidate site 8**

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**Location** : 25 37 15S, 28 04 16E  
**Type of feature** : Large irregularly shaped backfilled area  
**Description** : Possibly old waste site. Not operational  
**Approx size and depth** : 17 ha  
**Potential Fatal flaw** : Too close to industrial and residential townships.  
 Closed, unlined waste disposal site.  
**Underlying geology** : Situated on what appears to be an isolated dunite inclusion within in the gabbro-norite of the Main Zone, Bushveld Complex (similar to Site 7 above).  
**Hydrogeology** : Groundwater only expected to occur in the upper weathered profile of the gabronorite, but this profile has a low groundwater yield potential due to the very low permeability of the weathered product. The Main Zone of the Bushveld Complex is not regarded as a potential aquifer of any significance  
**Remarks** : No option for further mining of resources.

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**Candidate site 9**

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**Location** : 25 37 36S, 28 11 54E  
**Type of feature** : Small deep quarry with water on floor  
**Description** : Deep stone quarry about 330 m east of Bon Accord dam. Not operational.  
**Approx size and depth** : 5 ha on surface > 25 m deep  
**Potential Fatal flaw** : Proximity to Bon Accord dam. Small size.  
 Insufficient availability of daily cover material.  
**Underlying geology** : Underlain by an upper weathered and deeper hard rock sequence of gabbronorite on the northern

- slope of the E-W striking ridge formed by the Pyramid Gabbro-norite unit of the Main Zone, Bushveld Complex.
- Hydrogeology** : Unweathered and solid gabbro-norite not considered a potential aquifer as low borehole yields are normally encountered due to low permeabilities. Water observed at base of quarry probably due to seepage from micro-fractures in the norite
- Remarks** : The limited size of the disturbed area would not allow for development of a landfill without sterilisation of remaining resources.

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### Candidate site 10

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- Location** : 25 26 42S, 28 17 32E
- Type of feature** : Large disturbed area of unknown origin just west of N1 road.
- Description** : Large area with mainly shallow surface works with large irregular shaped dumps. Some holes water filled. Minor deeper rock excavations. Clay quarry according to geological maps. Limited operations.
- Approx size and depth** : 76 ha
- Potential Fatal flaw** : (1) Extensive work required to develop facility mainly above ground.  
(2) 1 km in direct approach path of a private landing strip.
- Underlying geology** : Shale and mudstone of the Hammanskraal Formation of the Ecca Group, Karoo Supergroup. Could be correlated with the Vryheid Formation in the main Karoo Basin.
- Hydrogeology** : The groundwater yield potential of the Hammanskraal (Vryheid) Formation is considered to be low with >80% of boreholes on record that

produce less than 2 l/s. Shallow perched water level conditions can however be expected.

**Remarks** : Although the quarries are still in operation, the site is large enough for waste disposal to commence without sterilisation of remaining resources.

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**Candidate site 11**

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**Location** : 25 26 06S, 28 16 49E

**Type of feature** : Large disturbed area of unknown origin

**Description** : Irregularly shaped deep excavations with some water. Minor deep quarries in large disturbed area

**Approx size and depth** : 36 ha

**Potential Fatal flaw** : 450 m south east of “educational” facilities. Water may be fatal flaw if not storm water.

**Underlying geology** : Shale and mudstone of the Hammanskraal Formation of the Ecca Group, Karoo Supergroup. Could be correlated with the Vryheid Formation in the main Karoo Basin.

**Hydrogeology** : The groundwater yield potential of the Hammanskraal (Vryheid) Formation is considered to be low with >80% of boreholes on record produce less than 2 l/s. Shallow perched water level conditions can however be expected.

**Remarks** : There is no indication as to the type of mining done and whether resources may be sterilised by development of landfill.

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**Candidate site 12**

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**Location** : 25 29 13S, 28 08 56E

**Type of feature** : Large disturbed area about 600 m east of Soshanguve.

**Description** : Some irregular shaped water filled excavations with some deeper quarries. Possibly sand works or

	: borrowpit. Not operational.
<b>Approx size and depth</b>	: 11 ha
<b>Potential Fatal flaw</b>	: Spruit running east-west through area. Limited daily cover. Limited site size.
<b>Underlying geology</b>	: Granite of the Lebowa Granite Suite of the Bushveld Complex.
<b>Hydrogeology</b>	: Groundwater potential of the solid deeper granite is mostly low, but good yields could be expected if a well fractured contact between the fresh and weathered granite has developed. Shallow water levels can be expected in the weathered zone, often resulting in surface seepage during and shortly after the rainy season.
<b>Remarks</b>	: There is no indication as to the type of mining done and whether resources may be sterilised by development of landfill.

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### Candidate site 13

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<b>Location</b>	: 25 37 39S, 28 12 47E
<b>Type of feature</b>	: Stone quarry.
<b>Description</b>	: Deep stone quarry. No water on floor. Likely to be operational.
<b>Approx size and depth</b>	: 5.8 ha on surface and >30 m deep
<b>Potential Fatal flaw</b>	: Operational and close to smallholdings. Limited daily cover. Small site size.
<b>Underlying geology</b>	: Underlain by an upper weathered and deeper hard rock sequence of gabbronorite just north of the ridge formed by the Pyramid Gabbronorite unit of the Main Zone, Bushveld Complex.
<b>Hydrogeology</b>	: Unweathered and solid gabbronorite not considered a potential aquifer as low borehole yields are normally encountered due to low permeability of the material.

**Remarks** : The limited size of the disturbed area would not allow for development of a landfill without sterilisation of remaining resources.

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### **Candidate site 14**

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**Location** : 25 41 22S, 28 05 07E

**Type of feature** : Stone quarry.

**Description** : A group of three quarries used for the manufacturing of bricks.

**Approx size and depth** : Quarries west about 12 ha with 40 m high northern quarry face. Quarries east about 31 ha with 30 m high irregularly shaped northern faces.

**Potential Fatal flaw** : Currently operational.

**Underlying geology** : Northerly dipping shale of the Silverton Formation, Pretoria Group, with numerous E-W striking diabase sill intrusions.

**Hydrogeology** : Silverton Formation not considered to be a significant sustainable aquifer due to low permeability of shale, but groundwater seepage from the upper weathered profile can be expected due to the steep slope of the ground surface.

**Remarks** : Although the quarries are still in operation, the site is large enough for waste disposal to commence without sterilisation of remaining resources.

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### **Candidate site 15**

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**Location** : 25 41 22S, 28 03 08E

**Type of feature** : Large excavated quarries on southern slopes of Magaliesberg mountain range. Quarries almost at ground level on southern sides with high quarry faces in the northern (mountain) side.

**Description** : Three excavated areas, probably for producing clay for brickworks, are situated to the south of the



	quarries. Some water is present at the base of quarries, probably storm water.
<b>Approx size and depth</b>	: The adjacent quarries range in size from about 13 to 22 ha each and with high faces (probably >40 m) on the northern side.
<b>Potential Fatal flaw</b>	: Quarries still operating and may belong to different owners. Bordered by mountain in the north and surrounded by smallholdings with buildings.
<b>Underlying geology</b>	: Northerly dipping shale of the Silverton Formation, Pretoria Group. The shale is intruded by numerous E-W directed diabase sills.
<b>Hydrogeology</b>	: Silverton Formation not considered to be a significant sustainable aquifer due to low permeability of shale, but groundwater seepage from the upper weathered profile can be expected due to the steep slope of the ground surface.
<b>Remarks</b>	: Although the quarries are still in operation, the site is large enough for waste disposal to commence without sterilisation of remaining resources.

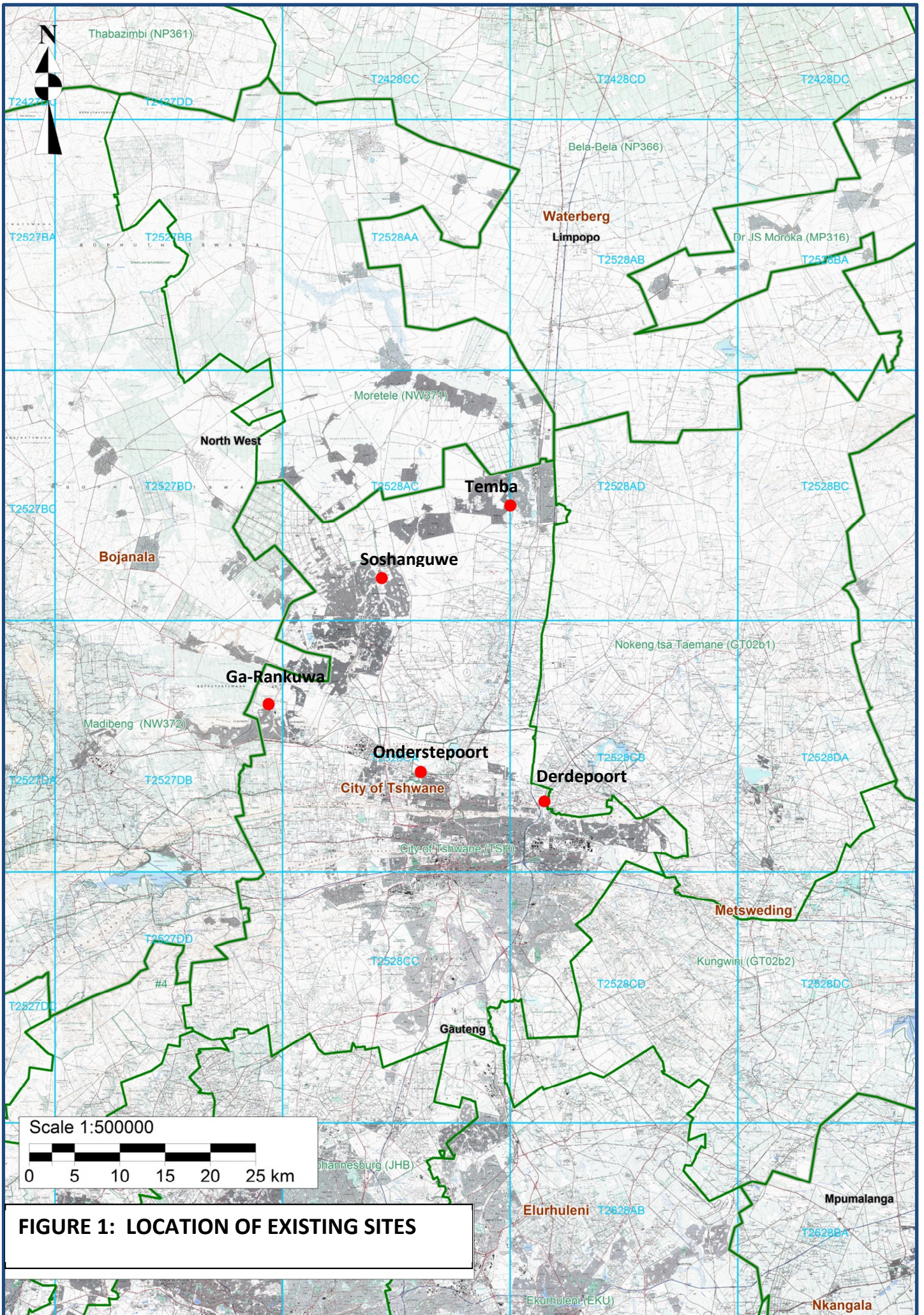
#### 4. CONCLUSION

The study of existing and potential waste disposal sites shows that:

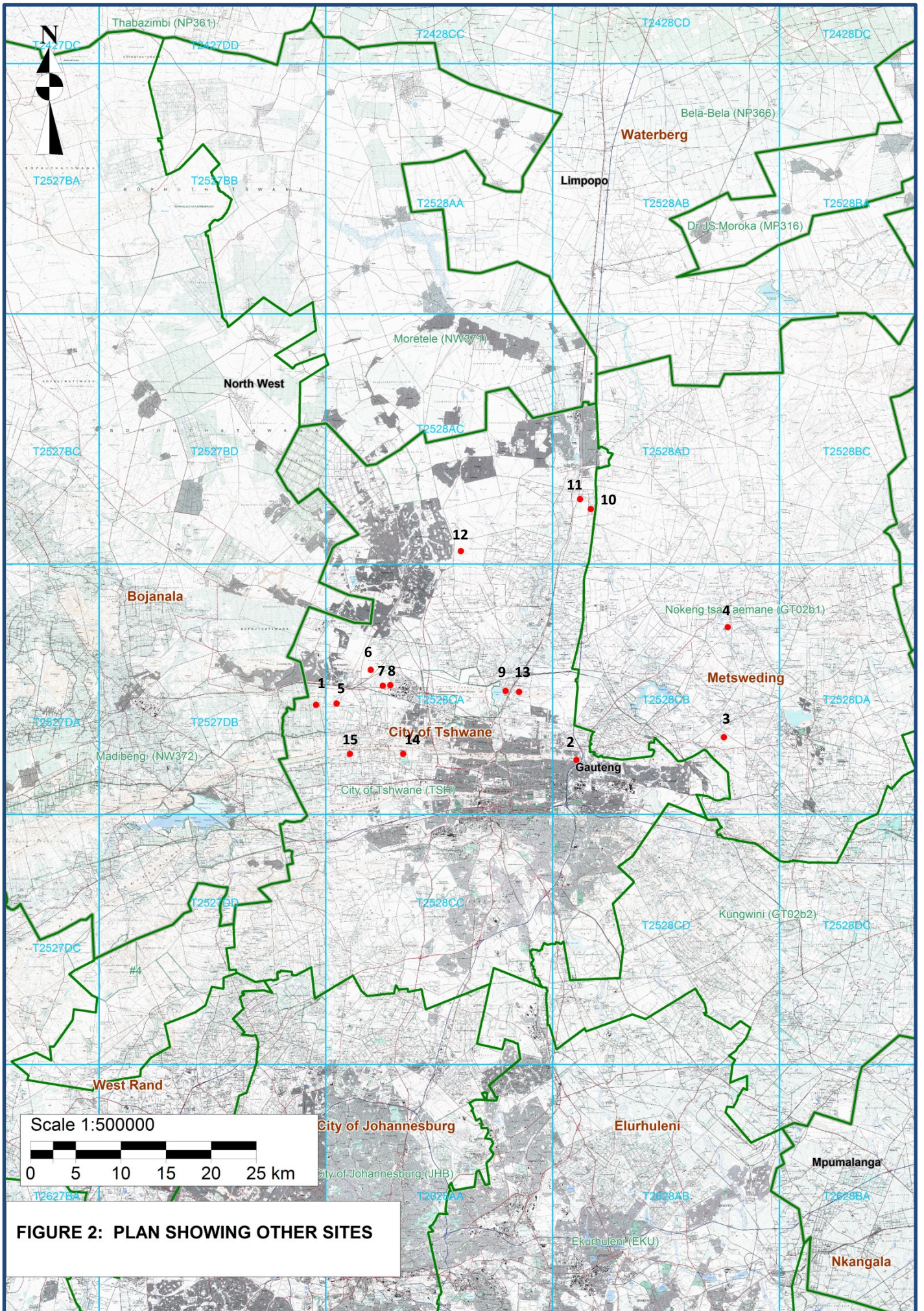
1. The existing landfills have a limited life and there is a demand for a long term well operated waste disposal facility in this region.
2. As far as the identification of new landfill sites is concerned some potential sites may be investigated. The desk study information does not, however, show any site with more promise than the preferred site (marked no.1 on Figure 2).

It is therefore concluded that the Multisand site (Site number 1 above) is the preferred site at present and the site should be investigated in detail to confirm the suitability of the site for development of a regional landfill and further determine its characteristics for this purpose.

## **Appendix A : Figures/Drawings**



**FIGURE 1: LOCATION OF EXISTING SITES**



**FIGURE 2: PLAN SHOWING OTHER SITES**