7 PROJECT ALTERNATIVES

7.1 Introduction

In terms of the EIA Regulations published in Government Notice R543 of 2 August 2010 in terms of Section 24 of the National Environmental Management Act (Act No. 107 of 1998), feasible and reasonable alternatives have to be considered within the Environmental Scoping Study, including the 'No Go' option. All identified, feasible and reasonable alternatives are required to be identified in terms of social, biophysical, economic and technical factors.

A key challenge of the EIA process is the consideration of alternatives[1]. Most guidelines use terms such as 'reasonable', 'practicable', 'feasible' or 'viable' to define the range of alternatives that should be considered. Essentially there are two types of alternatives:

- incrementally different (modifications) alternatives to the Project; and
- fundamentally (totally) different alternatives to the Project.

Fundamentally different alternatives are usually assessed at a strategic level, and EIA practitioners recognise the limitations of project-specific EIAs to address fundamentally different alternatives.

7.2 The 'no go' alternative

The 'no go' alternative is the option of <u>not</u> proceeding with the continuous ashing project at Tutuka Power Station.

Eskom's core business is the generation, transmission and distribution of electricity throughout South Africa. Electricity by its nature cannot be stored and must be used as it is generated. Therefore electricity is generated according to supply-demand requirements. The reliable provision of electricity by Eskom is critical to industrial development and poverty alleviation in the country.

Tutuka Power Station envisages the continuation of dry ash disposal over Eskom owned land, ideally, which was purchased before the commencement of environmental laws, the Environment Conservation Act, in particular. As part of its planning processes, Eskom developed designs which were approved internally, during this time. With the promulgation of the environmental laws, and the National Environmental Management

[1] In terms of the EIA Regulations published in Government Notice R543 of 2 August 2010 in terms of Section 24 (5) of the National Environmental Management Act (Act No. 107 of 1998), the definition of "alternatives" in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity which may include alternatives to: (a) the property on which or location where it is proposed to undertake the activity; (b) the type of activity to be undertaken; (c) the design or layout of the activity; (d) the technology to be used in the activity; (e) the operational aspects of the activity and (f) the option of not implementing the activity.

Waste Act, Act 59 of 2008, in particular, Eskom would like to pro-actively align its continued ashing activities with the requirements of the waste licensing processes.

The need for this project is to allow Tutuka Power Station to continue ashing in an environmentally responsible and legally compliant manner for the duration of the operating life of the power station.

In the event that the continuous ashing project does not proceed either the power station will run out of land to legally dispose of its ash and the power station will ultimately be required to close down, which would contribute negatively to the provision of reliable base load power to the national grid, and the country's plans.

Even though the no-go alternative is considered to be unfeasible, the 'no go' alternative will, still be investigated further in the EIA phase as an alternative as required by the EIA Regulations.

7.3 Technical Alternatives

The coal-fired power generation process results in large quantities of ash, which is disposed of in an ash disposal facility. Generally, Eskom has access to, and uses, coal of a low grade (called middlings coal) which produces a larger mass of ash during combustion. Over time, the quality of the coal provided to Eskom has degraded, due to higher ash quantities in the coal. The Tutuka Power Station utilises a dry ashing disposal method.

The waste product is deposited onto the disposal site by means of a stacker, which handles some 85% of the total ash whilst the remaining 15% is placed by a standby spreader system.

As the ash disposal progresses from west to east, the two extendible conveyors will be extended to its final lengths of 4 000 m each. The ash disposal facility is built out in two layers. The front stack is deposited by the stacker and spreader to a height of approximately 45 m. The ash is bulldozed out to a slope of 1:3 for dust suppression and rehabilitation purposes. The stacker then moves around the head – end of the shiftable conveyor to dump another 20 m high back stack. The total ash disposal facility height is then approximately 65 m.

As the ash disposal advances, the topsoil is stripped ahead of the activities and is taken by truck and placed on top of the final ash disposal facility height. Grass is then planted in this top soil.

The existing ash disposal facility has the required dirty and clean water channels and the clean storm water flows to the north and south clean water dams. The dirty water flows to the south settling dam and then to the south dirty water dam.

Due to the fact that Tutuka Power Station utilises dry ashing disposal method, it stands to reason that in order to continue ashing a dry ashing method should still be utilised.

A further technical alternative to limit the need for ash disposal facilities includes the use of higher grade coal which would reduce the amount of ash produced in the power generation process. The power station was originally designed for 35 years and now its life time is extended to 60 years. The boilers are designed to use a specific grade of coal and the boiler plant would require a redesign for higher grade coal. In order for this alternative to be implemented would require the complete redesign and reconstruction of the power station. The combination of the costs involved in the reconstruction of the power station as well as the higher price of the higher grade coal would have a knock on effect in terms of the country's electricity prices. Therefore, this alternative is therefore not considered feasible.

7.4 Location Alternatives

Tutuka Power Station is located approximately 25 km north-north-east (NNE) of Standerton in the Mpumalanga Province. The power station falls within the Lekwa Local Municipality which falls within the Gert Sibande District Municipality.

The proposed continuous development is an ash disposal facility with the following specifications:

- Capacity of airspace of 353,1 million m^3 (Existing and remaining); and
- Ground footprint of 2 500 Ha (Existing & Remaining ash disposal facility & pollution control canals)

Figure 7.1 below illustrates the ash disposal facility layout as currently constructed (blue) and outlines the footprint of the proposed future extent of the facility (orange), which is also the Eskom land identified and purchased for ashing.

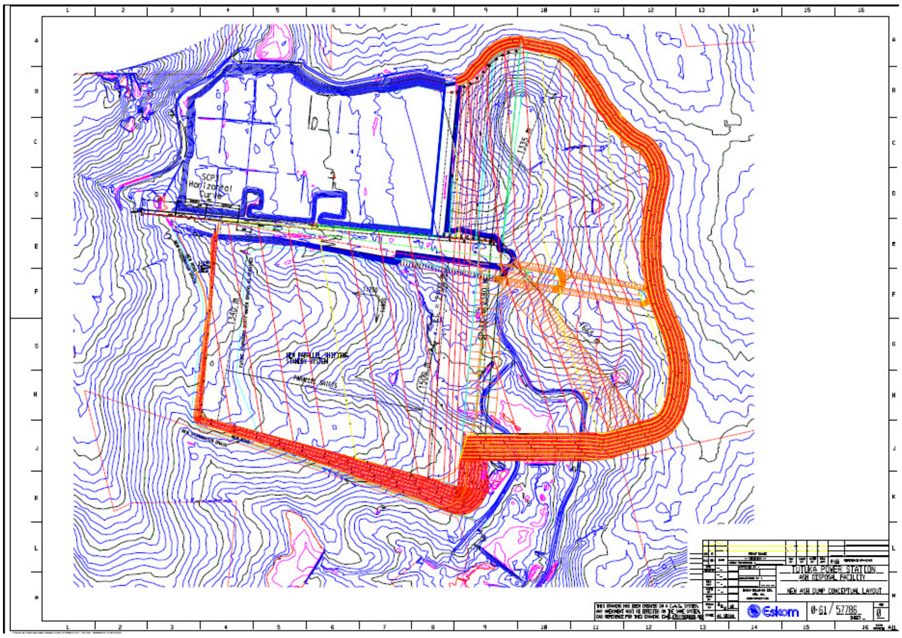


Figure 7.1: The ash disposal facility layout as currently constructed and the footprint of the proposed future extent of the facility

The particular area required for the continuous ashing facility is approximately 759ha, which is located on the eastern and southern portion of the existing Tutuka Power Station ash disposal facility.

However, in order to allow for a robust environmental process, while taking Eskom's proposed site into consideration, all land within a radius of 8 km was assessed in order to identify potential alternatives sites should any sensitive environmental aspects limit the suitability of Eskom's proposed site/land. The Tutuka Continuous Ashing EIA study area is therefore located within an 8 km radius around the source of ash at Tutuka Power Station (**Figure 7.2**).

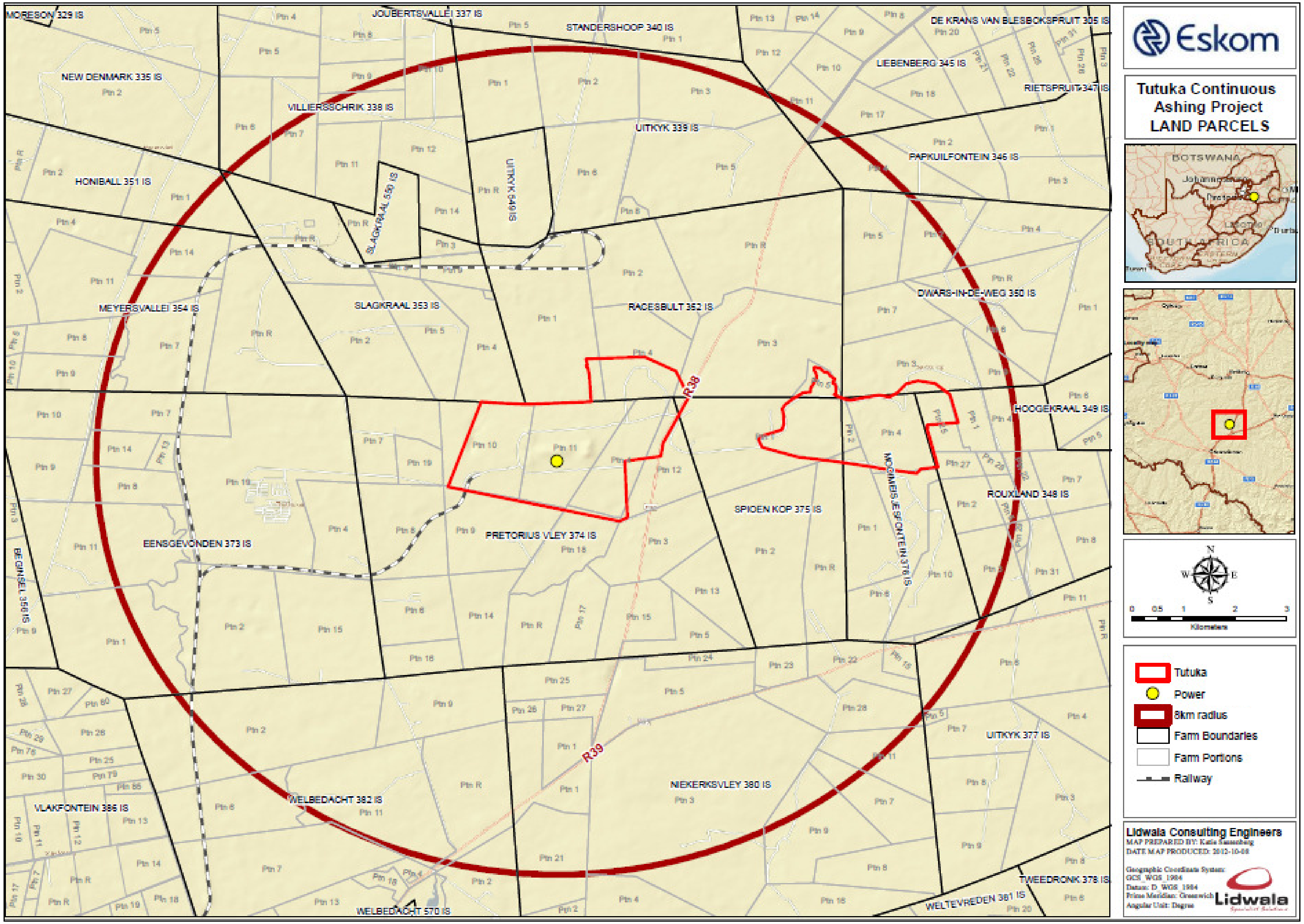


Figure 7.2: Proposed Study Area within which potential alternative sites were to be identified

7.4.1 Screening Analysis and Methodology

A screening study was initiated in order to assess where potential alternative sites are located within the study area that would be suitable for use for the proposed continuous ashing project. The study area was demarcated using an 8 km radius around Tutuka Power Station.

In order to ensure that sites are identified in the most objective manner possible, a sensitivity mapping exercise was undertaken for the study area. The purpose of such an exercise was to identify suitable areas within the study area that could accommodate the proposed ash disposal facility and associated infrastructure and to pro-actively identify sensitive areas (i.e. fatal flaws) that should be avoided.

- ***Sensitivity Mapping***

The qualitative sensitivity mapping exercise divided the study area into three categories *viz.* lower, medium and higher sensitivity areas. A sensitivity map for the study area was requested from each of the following specialist fields:

Biophysical
- Biodiversity (fauna and flora)
- Surface Water
- Groundwater
- Avifauna
- Agricultural Potential

Social
- Social (including Visual and noise)
- Air Quality

Table 7.1 provides a description of the various categories used in the sensitivity mapping.

Table 7.1 Description of the various categories used in the sensitivity mapping

Study Component	Category	Description
Biophysical Components		
Fauna and Flora	Higher Sensitivity	Indigenous natural vegetation that comprehend for a combination of the following attributes: - The presence of plant species of conservation importance, particularly threatened categories (Critically Endangered, Endangered, Vulnerable); - Areas where 'threatened' plants are known to occur, or habitat that is highly suitable for the presence of these species; - Regional vegetation types that are included in the 'threatened' categories (Critically Endangered, Endangered, Vulnerable), particularly prime examples of these vegetation types; - Habitat types are protected by national or provincial legislation (Lake Areas Act, National Forest Act, draft Ecosystem List of NEMBA, Mountain Catchment Areas Act, Ridges Development Guideline, Integrated Coastal Zone Management Act, etc.); - Areas that have an intrinsic high floristic diversity (species richness, unique ecosystems), with particular reference to Centres of Endemism; These areas are also characterised by low transformation and habitat isolation levels and contribute significantly on a local and regional scale in the ecological functionality of nearby and dependent ecosystems, with particular reference to catchment areas, pollination and migration corridors, genetic resources. A major reason for the high conservation status of these areas is the low ability to respond to disturbances (low plasticity and elasticity characteristics)
	Medium Sensitivity	Indigenous natural habitat that comprehend habitat with a high diversity, but characterised by moderate to high levels of degradation, fragmentation and habitat isolation. This category also includes areas where flora species of conservation importance could potentially occur, but habitat is regarded marginal
	Lower Sensitivity	No natural habitat remaining; this category is represented by developed/ transformed areas, nodal and linear infrastructure, areas of agriculture or cultivation, areas where exotic species dominate exclusively, mining land (particularly surface mining), etc. The possibility of these areas reverting to a natural state is impossible, even with the application of detailed and expensive rehabilitation activities. Similarly, the likelihood of plant species of conservation importance occurring in these areas is regarded negligent
Surface Water	Higher Sensitivity	100 m zone from the edge of the permanent wet zone for valley bottom and pan systems.
	Medium Sensitivity	100 m buffer zone from the edge of the temporary zones, or the edge of the riparian zones.

Study Component	Category	Description
	Lower Sensitivity	Higher lying areas, reflecting terrestrial soils and no obligate, facultative hydrophilic vegetation
Ground Water[2]	Higher Sensitivity	Lies within the 250 m river buffer zones, or falls on D3 aquifer type, or on Quaternary sediment.
	Lower Sensitivity	Areas falling outside of the 250 m buffer around surface water features, outside of mapped Quaternary sediment, and outside of the area classified as "D3" on the general hydrogeology map series (GRA1 data)
Avifauna	Higher Sensitivity	Wetlands, rivers and streams, farm dams, CWAC sites,
	Medium Sensitivity	Remaining cultivated lands and farm lands
	Lower Sensitivity	Built up areas, roads, mines, existing ash disposal facilities, railway lines and high voltage power lines
Agricultural Potential	Higher Sensitivity	High Agricultural Potential
	Medium Sensitivity	Medium Agricultural Potential
	Lower Sensitivity	Low Agricultural Potential
<u>Social Components</u>		
Social: Demographic	Higher Sensitivity	Displacement and resettlement of people are necessary.
	Medium Sensitivity	Visual, noise, air quality and traffic impacts on affected parties are acceptable during operation.
	Lower Sensitivity	No displacement and resettlement of people are necessary.
Social: Economic and Land use	Higher Sensitivity	Land use is affected in such a way that those who are dependent on the land to make a living are affected, and mitigation measures cannot neutralise the impacts. Good agricultural land is lost. Potential mining land is lost.
	Medium Sensitivity	Land use is affected in such a way that those who are dependent on the land to make a living are affected, but mitigation measures can neutralise the impacts. Land that was mined and which is stable, not potentially putting people's safety at risk.
	Lower Sensitivity	Land use activities can carry on, and people who are dependent on the land to make a living can carry on with their activities. Good agricultural land is not affected. Potential mining land is not affected.
Social: Noise impact	Higher Sensitivity	Closer than 4 km to urban areas and any informal settlement.
	Medium Sensitivity	Areas where construction is possible, as the Tutuka power station is already the centre of a noise degraded area.
	Lower Sensitivity	Area at or within an 8 km radius of the Tutuka Power Station. Subject to consideration of isolated noise sensitive sites.

[2] Depth of groundwater across the site is not known with accuracy, but is almost certainly shallower closer to surface water features - hence the higher sensitivity assigned to a 250 m buffer zone adjacent to surface water features. Permeability (rate at which water can "penetrate" ground) is covered by the DWA hydrogeological classification - essentially the same across the site ("D2"), except for the small area classified as "D3" - which has higher borehole yields and likely higher permeability, and has therefore been classified as medium sensitivity rather than lower sensitivity. The 250 m buffer is a horizontal distance, not a depth.

Study Component	Category	Description
Social: Visual Impact	Higher Sensitivity	Restricted location for the proposed development with highest visual sensitivity – no positive criteria and one or more restrictions (negative criteria).
	Medium Sensitivity	Acceptable or suitable location for the proposed development with neutral visual sensitivity – no positive criteria, but no restrictions (negative criteria) either.
	Lower Sensitivity	Preferred or ideal location for the proposed development with lowest visual sensitivity – complies with the positive criteria with no restrictions (negative criteria)
Air Quality	Higher Sensitivity	Zone containing potentially expanding and permanent residential settlements within the direction of the prevailing winds
	Medium Sensitivity	Zone with potentially sensitive receptors but out of the prevailing wind direction
	Lower Sensitivity	Zone within the expected exceedance area with no potentially sensitive receptors.

- ***<u>GIS Layer Amalgamation and Sensitivity Indice Calculation</u>***

In order to calculate a combined sensitivity rating for the study area, all the GIS layers received from each specialist area of study (e.g. ground water, biosensitivity etc) were combined to form one integrated layer (**Figure 7.3**). During this integration, string arrays were built containing information on the layer name, the assigned sensitivity rating for each particular area and the adjustment factor for the particular layer (**Figure 7.4**).

Three results (**Figure 7.4**) were then calculated from the integrated layer (**Figure 7.3**) by unnesting and summarising the string array data using the following logics:

- **maximum sensitivity wins:**
  The maximum sensitivity rating found in the array became the sensitivity index.
- **sum of all sensitivity ratings:**
  The sensitivity index was the sum of each sensitivity rating found in the array.
- **sum of all adjusted sensitivity ratings:**
  Each sensitivity rating found in the array was adjusted by the assigned adjustment factor for each particular layer. The sensitivity index was then the sum of these.

The presented maps were then created by reclassifying each logic result into five classes, namely:

- low sensitivity (green),
- low-medium sensitivity (light-green)
- medium sensitivity (yellow)
- medium-high (orange)
- high sensitivity (red).

Finally, the reclassified layer was clipped with the pre-determined no-go areas layer (to remove them from consideration – **Figure 7.5**) and further clipped with the 8km radius study area buffer to remove any extraneous features.

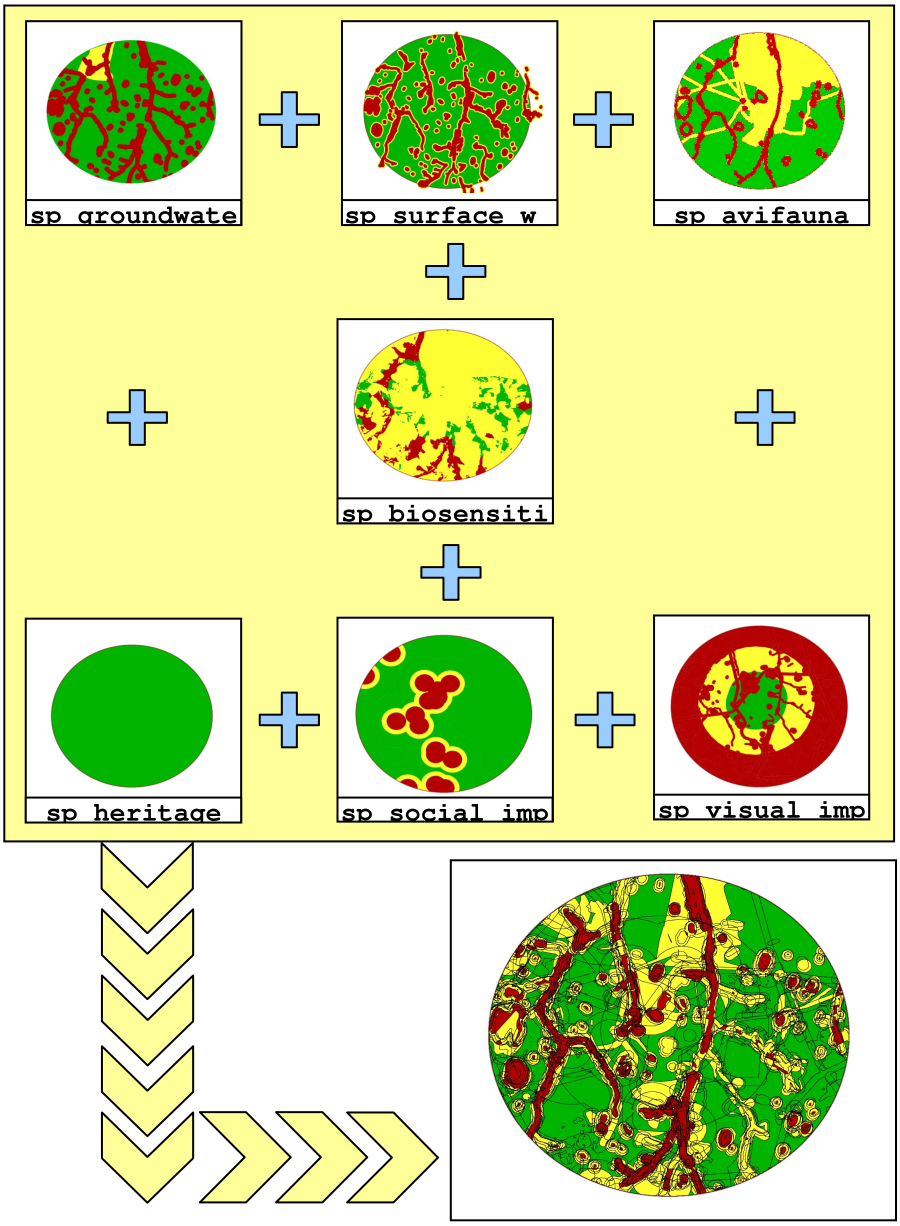
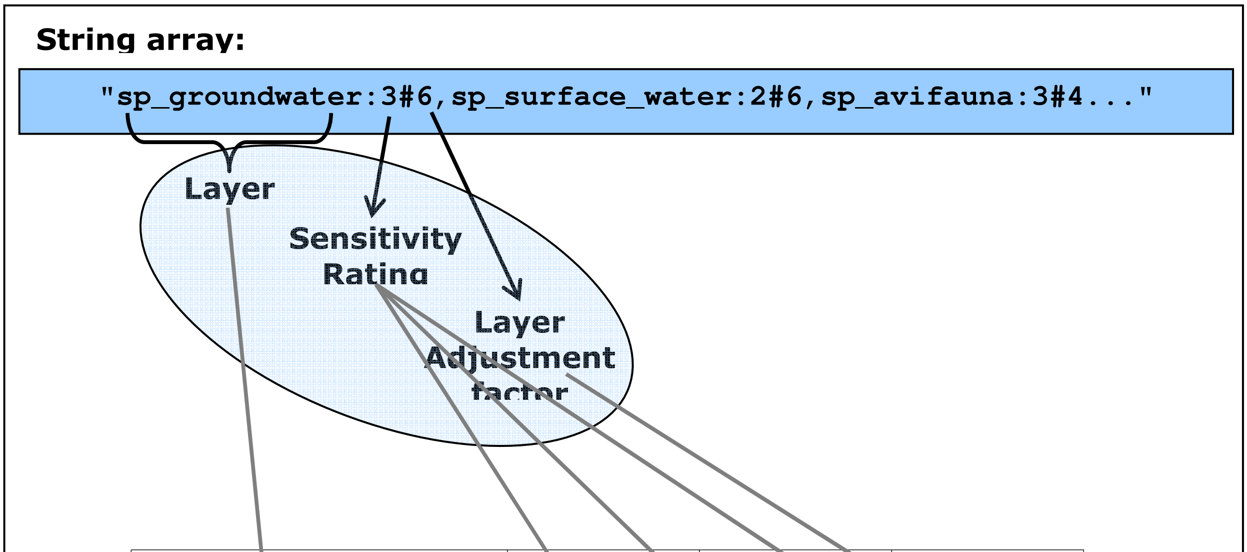


Figure 7.3: An example of typical layer integration process



Layer	Max Wins	No Factor	With Adjustment Factor
sp_g roundwater	3	3 x 1 (3)	3 x 6 (18)
sp_s urface_water	2	2 x 1 (2)	2 x 6 (12)
sp_a vifauna	3	3 x 1 (3)	3 x 4 (12)
sp_b iosensitivity	1	1 x 1 (1)	1 x 4 (4)
sp_h eritage	2	2 x 1 (2)	2 x 2 (4)
sp_v isual_impact	1	1 x 1 (1)	1 x 2 (2)
sp_s ocial_impact	1	1 x 1 (1)	1 x 2 (2)
Sensitivity Rating	**3**	**13**	**54**

Figure 7.4: String array parts and resultant indice calculations: max wins; sensitivity rating as is and sensitivity with an applied factor.

- ***Adjustment Factor / weighting factor Methodology***

In order to give each component a weighting factor with which to adjust the layers, the following methodology was utilised.

In a weighted matrix each variable / component is given a different importance weighting. In order to ensure that consensus is obtained with regards to the weighting / adjustment factors input from the project team and all specialists was obtained. Each member of the Project team was asked to rank each variable according to their own understanding of its significance, utilising the following ratings:

- 1 - low significance
- 2 - medium significance
- 3 - high significance

Once all the input was received, the rating provided for each variable was added and then divided by the number of people that took part in the exercise in order to obtain an average rating. Three sets of ratings were collected, namely:

- Specialist and Lidwala Project Team ratings (**Table 7.2**)
- Client ratings (**Table 7.3**)
- Combined ratings (**Table 7.4**)

The final decision to utilise the combined rating as the final weighting factors for the sensitivity analysis was due to the fact that the client's ratings did not dilute the weighting factors, they actually made the weighting factors stricter.

Table 7.2: Specialist and Lidwala Project Team ratings

Aspect	Social	Visual 1	Visual 2	Fauna	Flora	Surface Water 1	Ground water 1	Ground water 2	Design	Air	Avifauna	Project Manager	PPP1	PPP2	EIA Team	GIS	Legal	Soil	Final Total	Number participants	Average Rating
Social (including visual and noise)	1	2	1	1	1	1	2	1	2	3	1	1	3	3	1	1	1	1	27	18	1.50
biodiversity (Fauna and flora)	2	3	2	2	2	3	2	2	1	2	2	3	2	2	1	2	3	2	38	18	2.11
surface water	2	3	3	2	2	3	2	2	2	2	2	3	3	3	2	2	2	2	42	18	2.33
groundwater	2	3	3	2	2	3	2	2	2	1	2	2	2	3	2	2	2	3	40	18	2.22
agricultural potential	1	2	2	2	2	1	2	2	1	2	1	2	2	1	1	2	2	3	31	18	1.72
air quality	2	2	3	1	1	2	2	2	3	3	2	1	3	1	2	3	3	3	39	18	2.17
Avifauna	2	2	1	2	2	3	2	2	2	2	2	3	2	2	2	2	2	2	37	18	2.06

Table 7.3: Client ratings

	Eskom Team															
Aspect	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	Final Total	Number participants	Average Rating
Social (including visual and noise)	3	3	2	3	1	1	2	2	1	1	2	1	1	23	13	1.77
biodiversity (Fauna and flora)	3	3	3	3	2	1	1	2	2	3	2	2	3	30	13	2.31
surface water	3	3	2	2	2	1	1	3	2	3	3	2	2	29	13	2.23
groundwater	3	3	3	3	2	2	1	3	2	3	3	2	3	33	13	2.54
agricultural potential	1	3	3	3	1	2	2	2	1	2	1	1	1	23	13	1.77
air quality	3	3	3	3	1	1	3	3	2	3	3	1	2	31	13	2.38
Avifauna	3	1	3	3	1	1	1	2	2	3	2	1	2	25	13	1.92

Table 7.4: Combined ratings

	Specialists and Lidwala Project Team			Eskom Team			Final Combined Ratings		
Aspect	Final Total	Number participants	Average Rating	Final Total	Number participants	Average Rating	Final Total Combined	Number participants	Final Average Rating
Social (including visual and noise)	27	18	1.50	23	13	1.77	50	31	1.61
biodiversity (Fauna and flora)	38	18	2.11	30	13	2.31	68	31	2.19
surface water	42	18	2.33	29	13	2.23	71	31	2.29
groundwater	40	18	2.22	33	13	2.54	73	31	2.35
agricultural potential	31	18	1.72	23	13	1.77	54	31	1.74
air quality	39	18	2.17	31	13	2.38	70	31	2.26
Avifauna	37	18	2.06	25	13	1.92	62	31	2.00

The final weighting factors for each aspect are therefore as follows:

- Social = 1.61
- Fauna and Flora = 2.19
- Surface Water = 2.29
- Ground Water = 2.35
- Agricultural Potential = 1.74
- Air Quality = 2.26
- Avifauna = 2.00

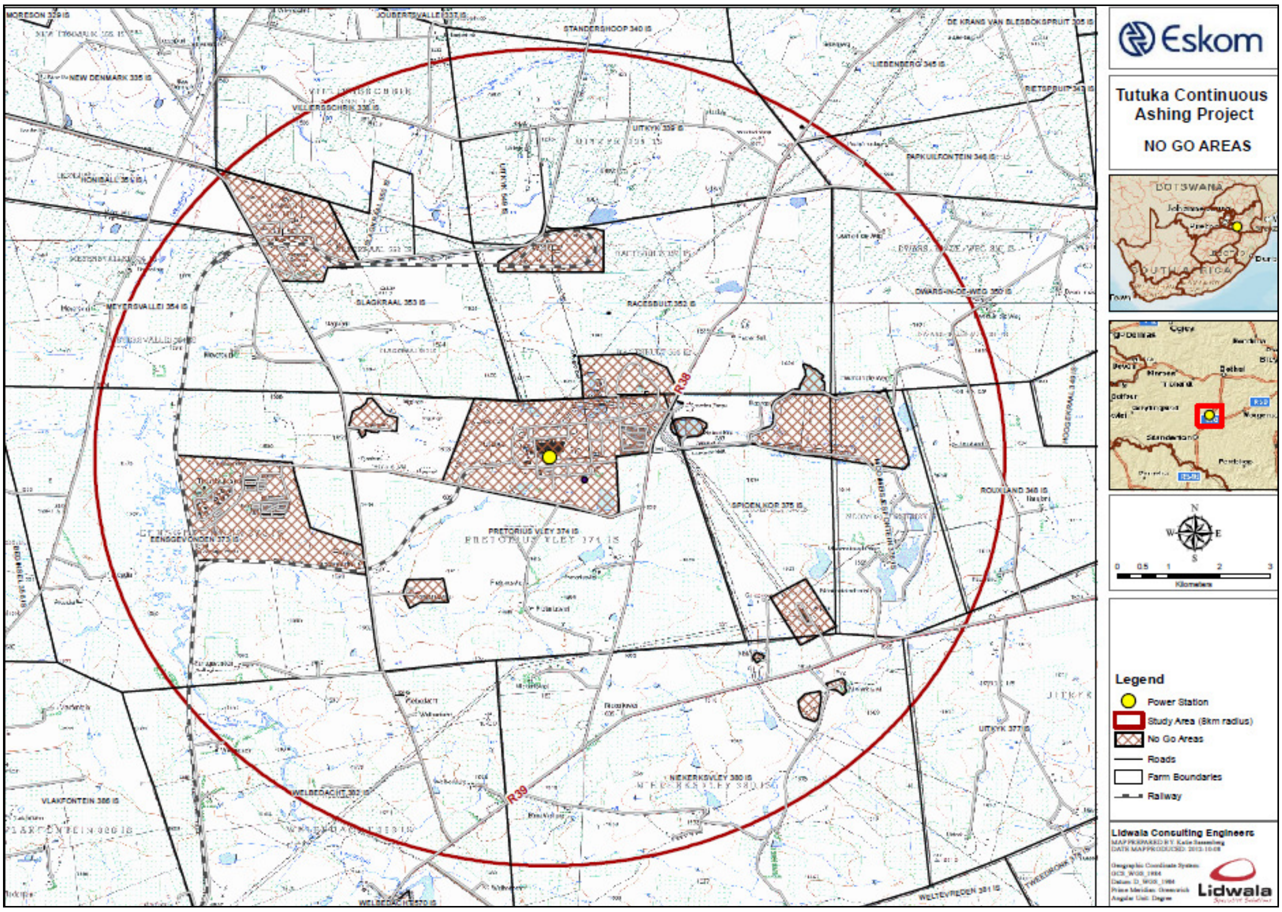


Figure 7.5: No-go Areas Layer

7.4.2 Specialist Study Screening Results

- ***Biodiversity (Fauna and flora)***

The ecological importance ascribed to existing protected areas and species are simple and self-explanatory. Outside of protected areas but within areas that are clearly of value for biodiversity, the evaluation of importance or sensitivity is more complex and vague. The absence of protected status should therefore never be interpreted as low biodiversity importance; many areas of international biodiversity importance lie outside of protected areas.

For this particular screening assessment, the degree of transformation was used as a primary decision tool in determining the level of sensitivity of a particular site. A secondary decision was made based on the level of conservation importance ascribed to the regional vegetation type. Lastly, historic sampling records of conservation important flora and fauna taxa within the region were also implemented to ascribe a high level of importance/ sensitivity to a particular site. The ecological sensitivity of areas characterised by natural habitat was assessed using the application of the following criteria:

	YES	NO
The presence of Threatened and/or Protected:		
• plant species		X
• animal species		X
• ecosystems	X	
The presence of Critical conservation areas, including:		
• areas of high biodiversity	X	
• centres of endemism		X
The presence of Important Ecological Processes, including:		
• Corridors		X
• Mega-conservancy networks		X
• Rivers and wetlands	X	
• Important topographical features		X

Estimated ecological sensitivity values are presented in **Figure 7.6** and are categorised as follows:

Low (1) No natural habitat remaining; this category is represented by developed/ transformed areas, nodal and linear infrastructure, areas of agriculture or cultivation, areas where exotic species dominate exclusively, mining land (particularly surface mining), etc. The possibility of these areas reverting to a natural state is impossible, even with the application of detailed and expensive rehabilitation activities. Similarly, the likelihood of plant species of conservation importance occurring in these areas is regarded negligent.

Medium (2) Indigenous natural habitat that comprehend habitat with a high diversity, but characterised by moderate to high levels of degradation, fragmentation and habitat isolation. This category also includes areas where flora species of conservation importance could potentially occur, but habitat is regarded marginal;

High (3) Indigenous natural vegetation that comprehend for a combination of the following attributes:

- The presence of plant species of conservation importance, particularly threatened categories (Critically Endangered, Endangered, Vulnerable);
- Areas where 'threatened' plants are known to occur, or habitat that is highly suitable for the presence of these species;
- Regional vegetation types that are included in the 'threatened' categories (Critically Endangered, Endangered, Vulnerable), particularly prime examples of these vegetation types;
- Habitat types are protected by national or provincial legislation (Lake Areas Act, National Forest Act, draft Ecosystem List of NEMBA, Mountain Catchment Areas Act, Ridges Development Guideline, Integrated Coastal Zone Management Act, etc.);

- Areas that have an intrinsic high floristic diversity (species richness, unique ecosystems), with particular reference to Centres of Endemism;

These areas are also characterised by low transformation and habitat isolation levels and contribute significantly on a local and regional scale in the ecological functionality of nearby and dependent ecosystems, with particular reference to catchment areas, pollination and migration corridors, genetic resources. A major reason for the high conservation status of these areas is the low ability to respond to disturbances (low plasticity and elasticity characteristics).

Not Assessed (6) Areas not included in the assessment due to unsuitability for the proposed project include Tutuka Power Station and associated infrastructure.

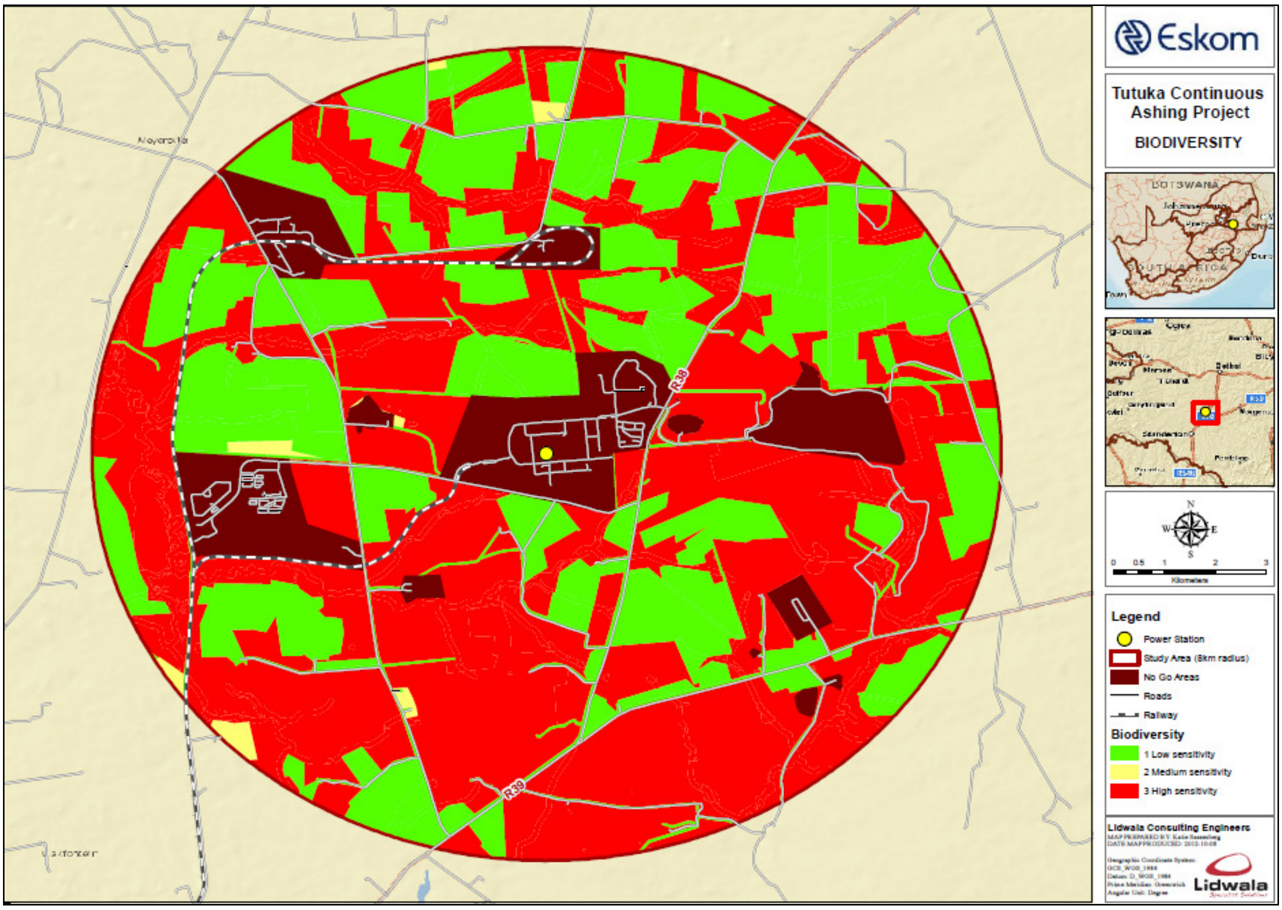


Figure 7.6: Biodiversity Sensitivity Map

Discussion & Recommendations

The sensitivity assessment indicates clearly the high sensitivity that is associated with remaining natural grassland within the study area. This is mainly the result of high land transformation and habitat fragmentation rates. It should however be noted that the high sensitivity of natural grassland is ascribed without taking cognisance of the current status of remaining portions. Visual evidence suggests that the status might not be as pristine as initially anticipated and that the suitability of certain portions is therefore more acceptable. This is particularly the case in point of the proposed Eskom site as visual observations revealed a moderately disturbed status of the portion of land under consideration. A preliminary recommendation is therefore that this portion of land is likely to be acceptable for the use of the proposed project, but EIA investigations still need to confirm the absence of conservation important flora and fauna taxa, and provide mitigation thereto.

- ***Surface Water***

The rationale applied with the aquatic sensitivity assessment is based on the premise that all watercourses or potential watercourse areas are sensitive. The catchment size, slope and position in the landscape predominantly determine the potential for water accumulation. Once accumulated other factors such as underlying geology and soil permeability also contribute towards the nature of particular wetness expressed. For the purpose of this assessment a Wetness Index was applied and superimposed by existing drainage lines and wetland areas. The result of the Wetness Index was consistent with known drainage lines and wetland areas and the application thereof is thus deemed suitable.

The SAGA Wetness Index, which is based on a modified catchment area calculation, is similar to the Topographic Wetness Index (TWI). The modified catchment area does not consider flow as very thin film and predicts raster cells situated in valley floors with a small vertical distance to a channel, a more realistic, higher potential soil moisture compared to the standard TWI calculation (Boehner et al., 2002).

The Wetness Index highlights areas with a propensity for water to accumulate within the study area, thereby indicating areas of low, moderate and high sensitivity from a surface water viewpoint (**Figure 7.7**). Areas highlighted in red have a high sensitivity and should be excluded during the planning of the proposed Tutuka Continuous Ashing Project. The construction and operational phase activities may result in potential alterations/impacts to the ecological integrity of the receiving aquatic ecosystems. Areas highlighted in orange are deemed moderately sensitive. If continuous ashing activities infringe on these areas, suitable mitigation measures are pertinent to limit the impacts on the receiving aquatic environment. The integrity and functioning of watercourses is directly dependant on their surrounding land area (Dodds & Oaks, 2008). Areas of low sensitivity are highlighted in green and will potentially have the least impact on the rivers/streams and wetlands located in the study area (**Figure 7.7**). The field verification that will be carried out during the EIA phase will provide additional information regarding the suitability of the identified low sensitivity areas

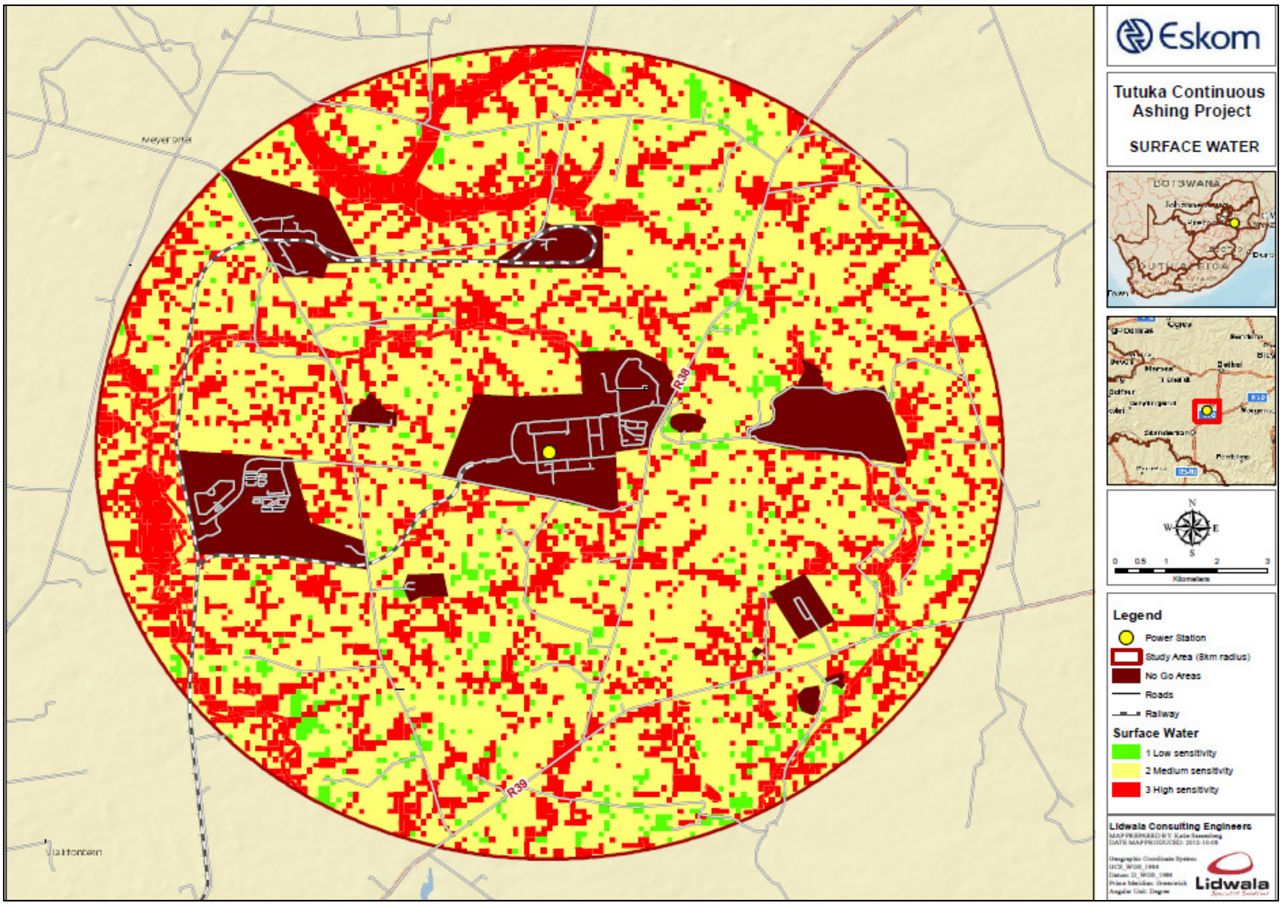


Figure 7.7: Surface Water Sensitivity Map

- ***Groundwater***

Ground Water

The study area is underlain predominantly by intrusive Karoo Dolerite and the sandstones of the Vryheid Formation.

The Karoo dolerite is likely to exhibit low primary porosity and permeability which would suggest a low risk to groundwater; however the dolerite is likely to exhibit fractures and fissures, with higher permeabilities often associated with the contact between an intrusion and the host rock. These factors would increase the risk to groundwater.

Quaternary deposits are present in areas within 8km of the power station and are associated with the main water courses. Due to the assumed higher permeability of such deposits, these areas are considered to be 'higher risk' and 'less preferable'

Aquifer Characteristics

The entire 8 km study area is underlain by a 'd2' type aquifer which is an inter-granular and fractured aquifer with borehole yields in the range of 0.1 to 0.5L/s. Fractures within the underlying geology can increase the vulnerability to the aquifer as they act as significant pathways for contaminants to travel. However anticipated borehole yields are reasonably low and the porosity and / or permeability of the aquifer (i.e. the ability to transport contaminants) may be low.

Proximity to Surface Water Course

Perennial and ephemeral surface water courses derived from the 1:50 000 topography maps were buffered by 25 0m using ARC-GIS software since these zones were assumed to have shallower (and therefore more vulnerable) groundwater. In some cases it is possible that shallow groundwater is in hydraulic continuity with surface water features.

Summary

An area within an 8 km radius of the Tutuka power station was assessed in terms of the potential risk to groundwater from a proposed extension of the ash disposal facilities at the site. It is noted that this assessment has been based on limited data and a simple system based on the geology, hydrogeology map classification and buffer zones around surface water courses has been used to provide a preliminary classification into "less preferred" and "preferred" areas. The outcome of the assessment is presented in **Figure 7.8**.

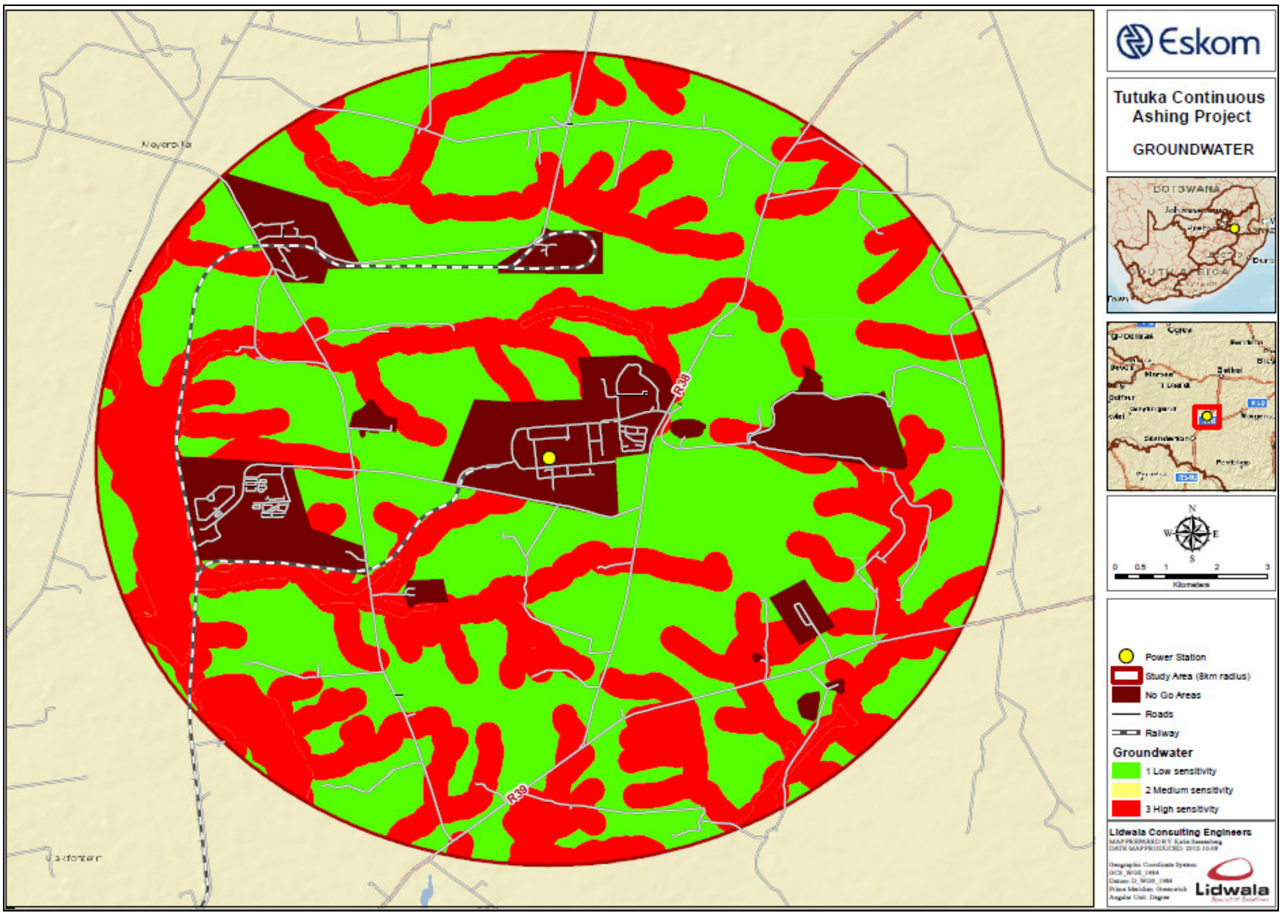


Figure 7.8: Groundwater sensitivity map

- ***Avifauna***

In general the site is moderate to highly sensitive in terms of avifauna, based on the occurrence of a number of listed bird and bat species in the study area, as well as the various micro-habitats available to avifauna. The sensitive zones are mapped and described below.

Figure 7.9 shows two features that have been buffered. These are the Rivers, and Wetland/dam areas. The rivers have been buffered by 100 m using GIS, while the dams and wetlands have been buffered by 200 m. The importance of these micro-habitats to avifauna has been discussed in earlier sections of this report. **All of these buffered zones are regarded as Medium-High Sensitivity areas and if possible should be avoided for construction activities. The remaining areas outside of these buffer zones are designated as Low – Medium sensitivity, although this is subject to change following the EIA phase site visit.**

Note that this sensitivity analysis is subject to change, following the site visit in the EIA phase, especially as some of the GIS layers may be outdated, and may not reflect the actual situation on the ground. Also note that certain natural grassland areas, as well as other drainage lines or wetland areas may also be designated as sensitive areas, should they be identified and mapped in the EIA phase.

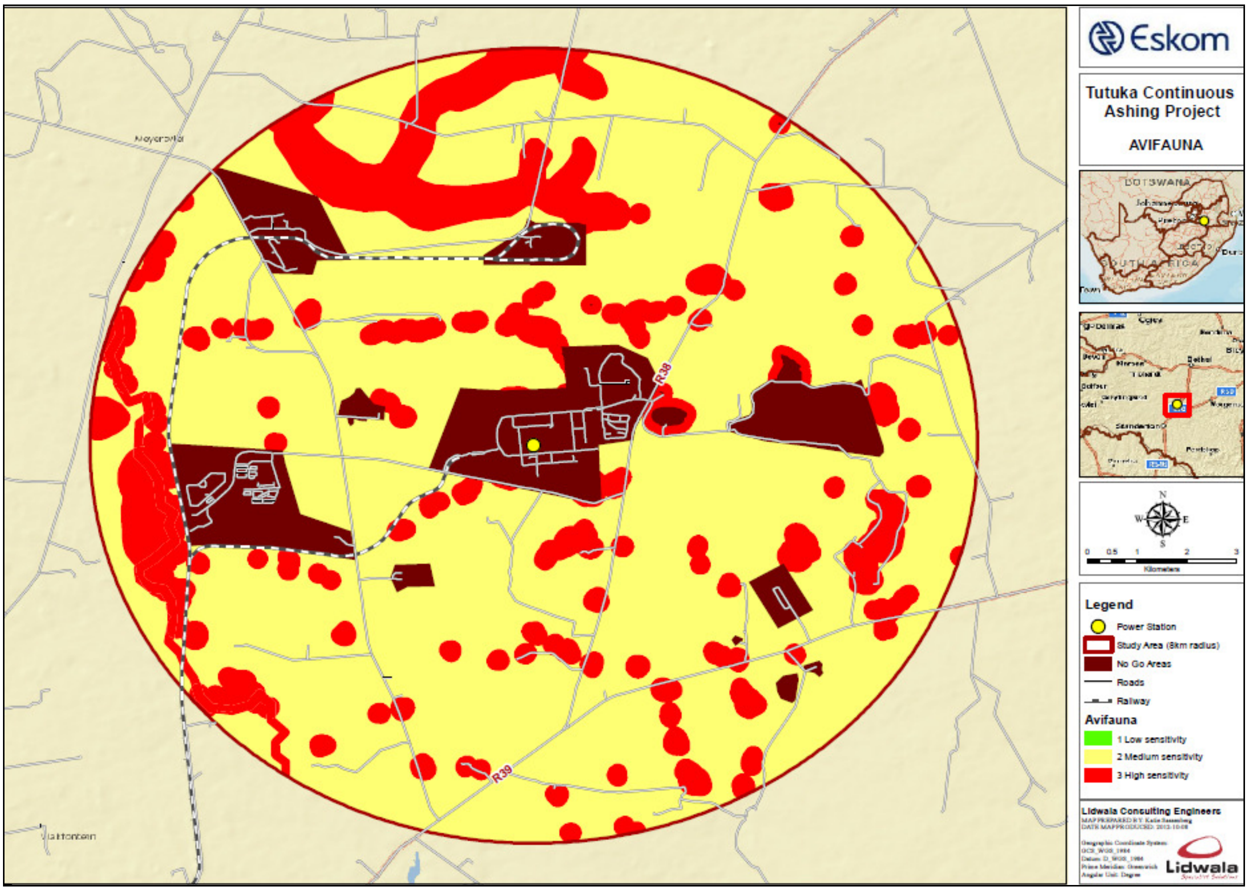


Figure 7.9: Avifauna Sensitivity Map

- ***Agricultural Potential***

The study area falls within the same land type (Ea17), which comprises dark clay soils of low to moderate agricultural potential. **Figure 7.10** illustrates the agricultural potential sensitivity of the study area.

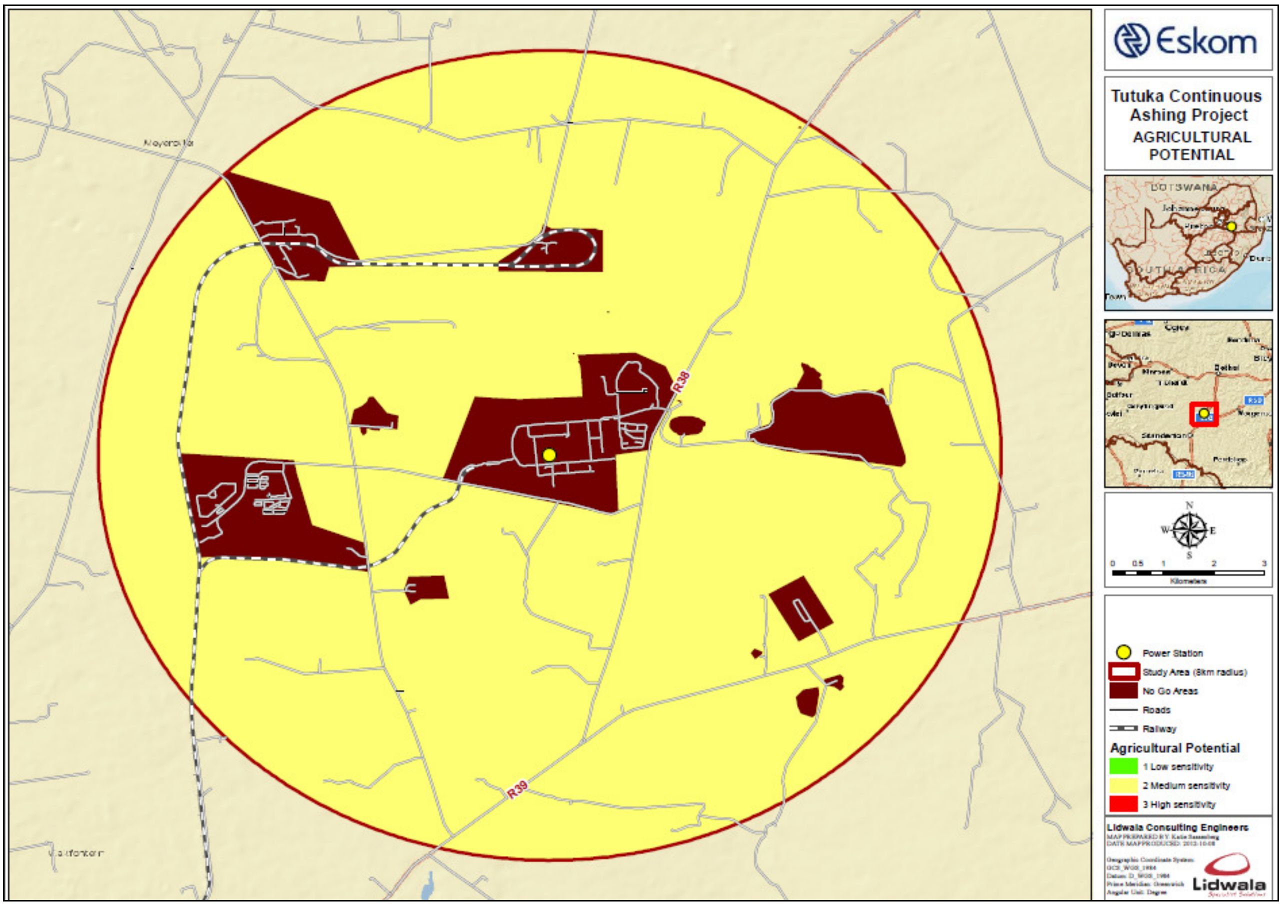


Figure 7.10: Agricultural Potential Sensitivity Map

- ***Social (including Visual and Noise)***

Demographic Processes

The study area is sparsely populated. The closest town is Standerton and falls outside of the study area. Isolated farm houses occur in the study area, as well as some small settlements such as Thuthukani and these are depicted on the sensitivity map (**Figure 7.12)**.

Economic and Land Use Processes

Farming activities consist of the grazing of cattle and cultivation of mealies. The IDP lists the the availability of agricultural land as an opportunity for growth. This gives an indication that the agricultural activities are important for the economic development of the area.

Visual

Sensitive receptors in the study area are associated with the occurrence of farmsteads and road users, which are widely spread across the study area. The location of these are presented on the map in **Figure 7.11**. The level of sensitivity is determined by proximity to the ash disposal facility and can be classified as follows:

- **0 – 1.5km.** Short distance view where the facility would dominate the frame of vision and constitute a very high visual prominence.
- **1.5 - 3km**. Medium distance view where the facility would be easily and comfortable visible and constitute a high to moderate visual prominence.
- **3 - 6km**. Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a moderate to low visual prominence.
- **Greater than 6km**. Long distance view of the facility where it could potentially still be visible though not as easily recognisable. This zone constitutes a very low visual prominence for the facility. It is anticipated that beyond 12 km from the facility any visibility thereof would be of no significance in terms of visual impact.

A number of farmsteads and sections of road fall within the 3 km buffer around the ash disposal facility, which is the zone containing high to medium visual sensitivity. These areas will be investigated in more detail during the EIA phase.

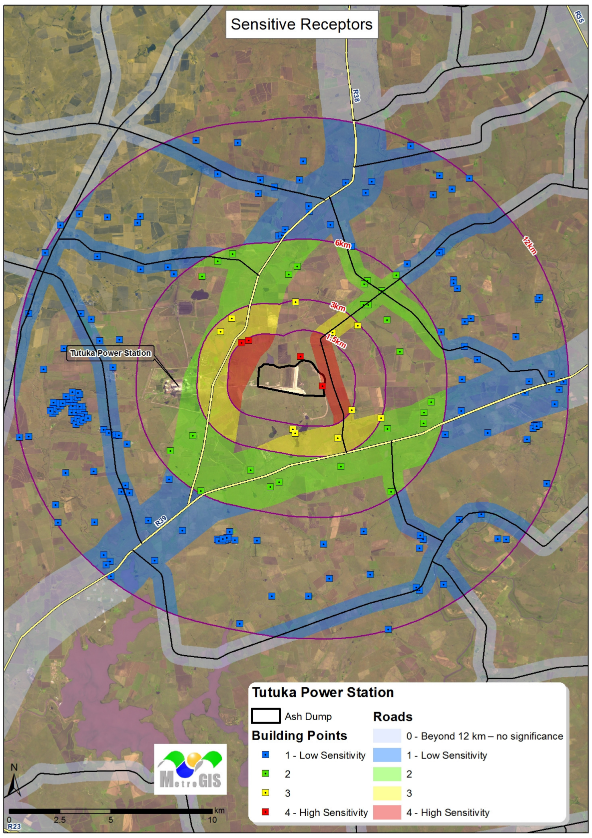


Figure 7.11: Location of possible sensitive receptor areas, i.e. farmsteads and roads.

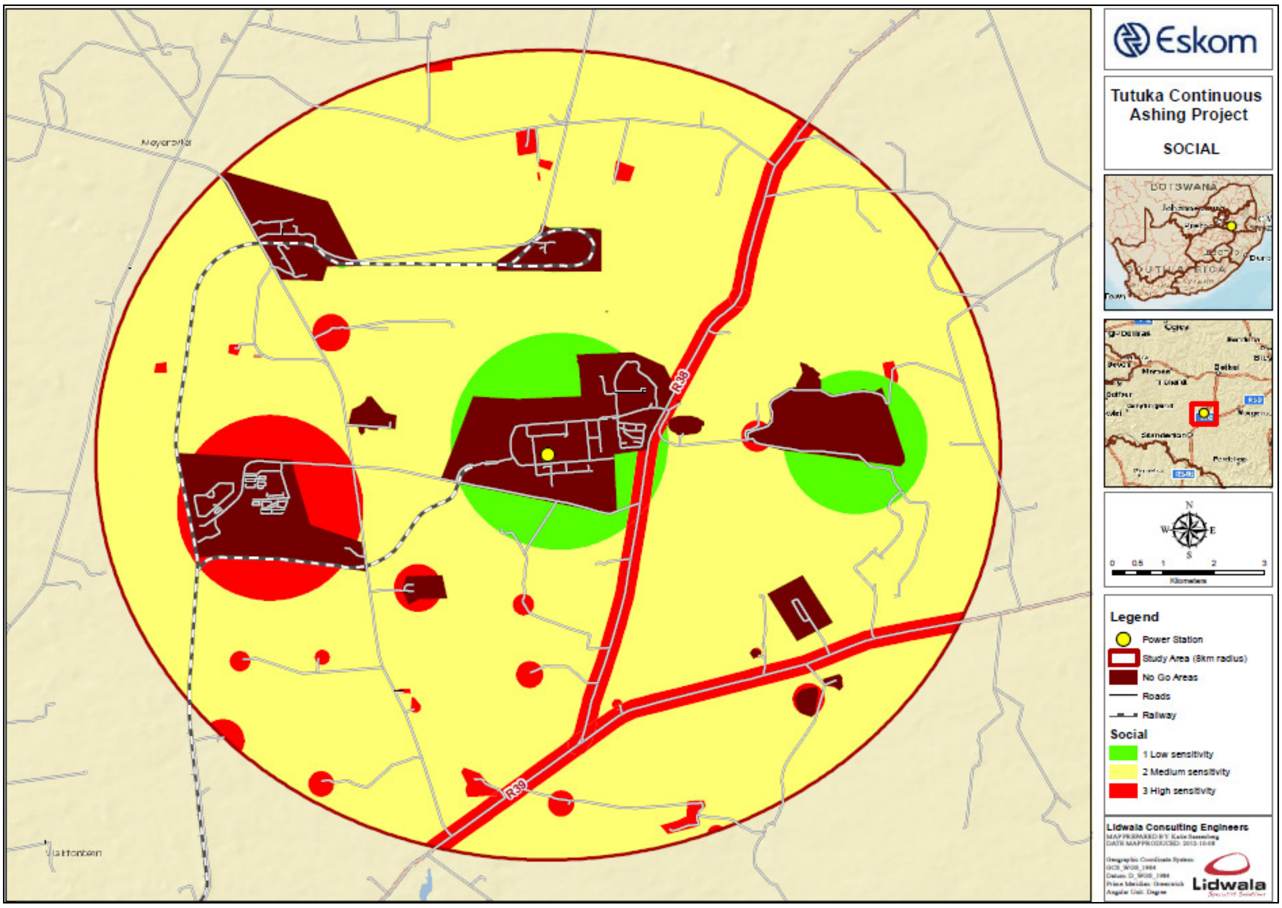


Figure 7.12: Social Sensitivity Map

- ***Air***

The predominant wind direction is east-south-easterly with a ~16% frequency of occurrence. Winds from the south-western sector are relatively infrequent occurring <4% of the total period. Calm conditions (wind speeds < 1 m/s) occur for 9.9% of the time. Winds from the nothwestern sector increases during day-time conditions. During the night-time an increase in east-southeast flow is observed with a decrease in westerly air flow. During summer months, winds from the east-southeast become more frequent, due to the strengthened influence of the tropical easterlies and the increasing frequency of occurrence of ridging anticyclones off the east coast. There is an increase in the frequency of calm periods (i.e. wind speeds <1 m/s) during the winter months of 19.1% with an increase in the westerly flow.

PM_{10} concentrations are likely to exceed the NAAQS 2015 limit of 75 µg/m³ for ~1000m from the source. $PM_{2.5}$ concentrations are likely to exceed the NAAQS 2030 limit of 25 µg/m³ for ~300m from the source. The predicted elemental concentrations from the windblown ash material is predicted to exceed the most stringent effect screening levels up to a distance of 3500m from the source. With water sprays in place for dust suppression, these impacts will reduce significantly. The potential for impacts at the sensitive receptors will also depend on the wind direction and speed which could not be accounted for in this assessment.

If unmitigated, the windblown dust from the ash disposal facility may result in exceedances of effect screening levels up to a distance of 3 500 m from the source with exceedances of PM_{10} NAAQ limits up to a distance of 1 000 m. As the background ambient PM_{10} ground level concentrations may also be elevated in the area it is recommended that the ash disposal facility be mitigated in order to minimise the impacts from this source on the surrounding environment. **Figure 7.13** shows the air quality sensitivity map.

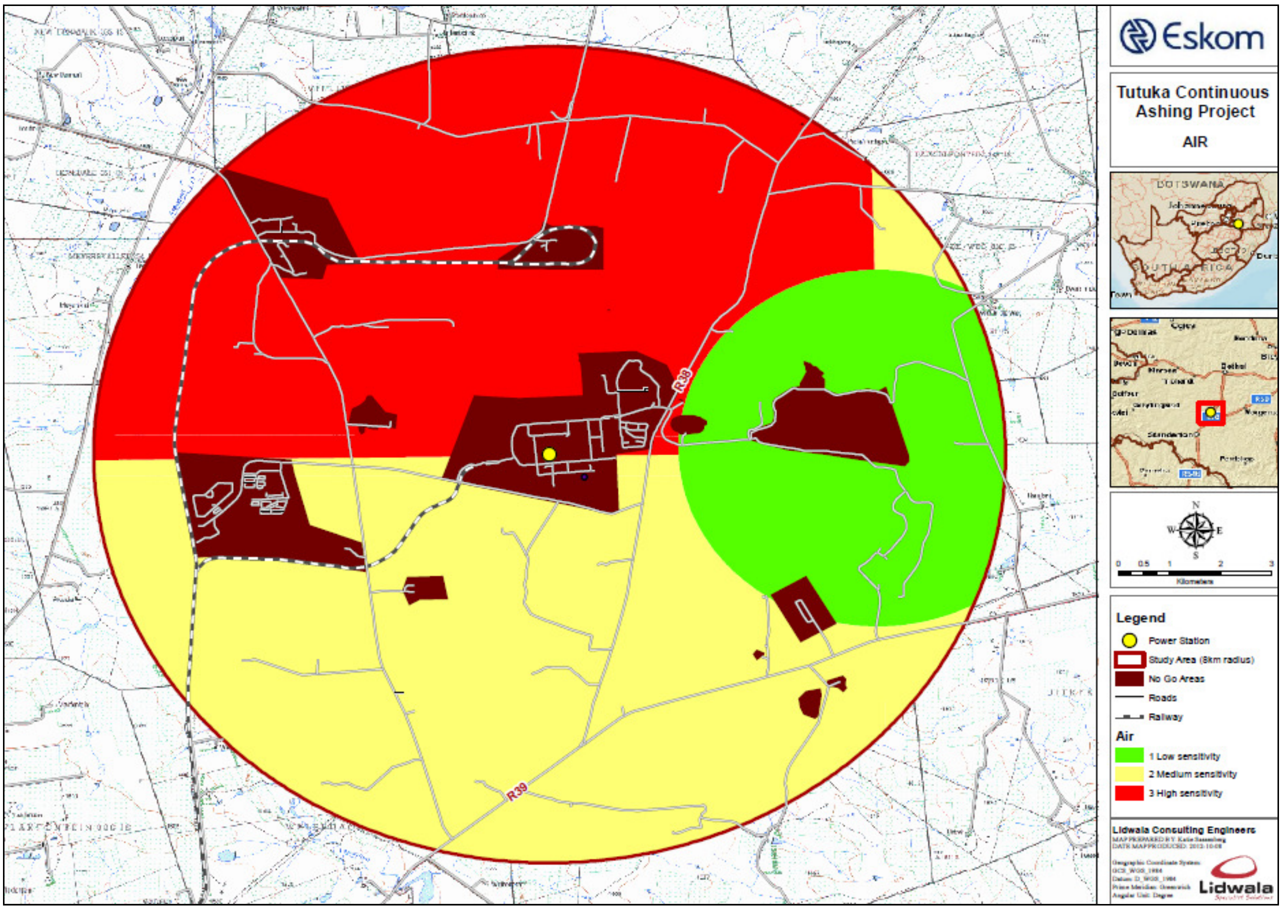


Figure 7.13: Air Quality Sensitivity Map

7.4.3 Final Screening Results

Figure 7.14, 7.15 and **7.16** are the results of overlaying all the specialist input maps together, thereby illustrating the overall environmental sensitivity of the area.

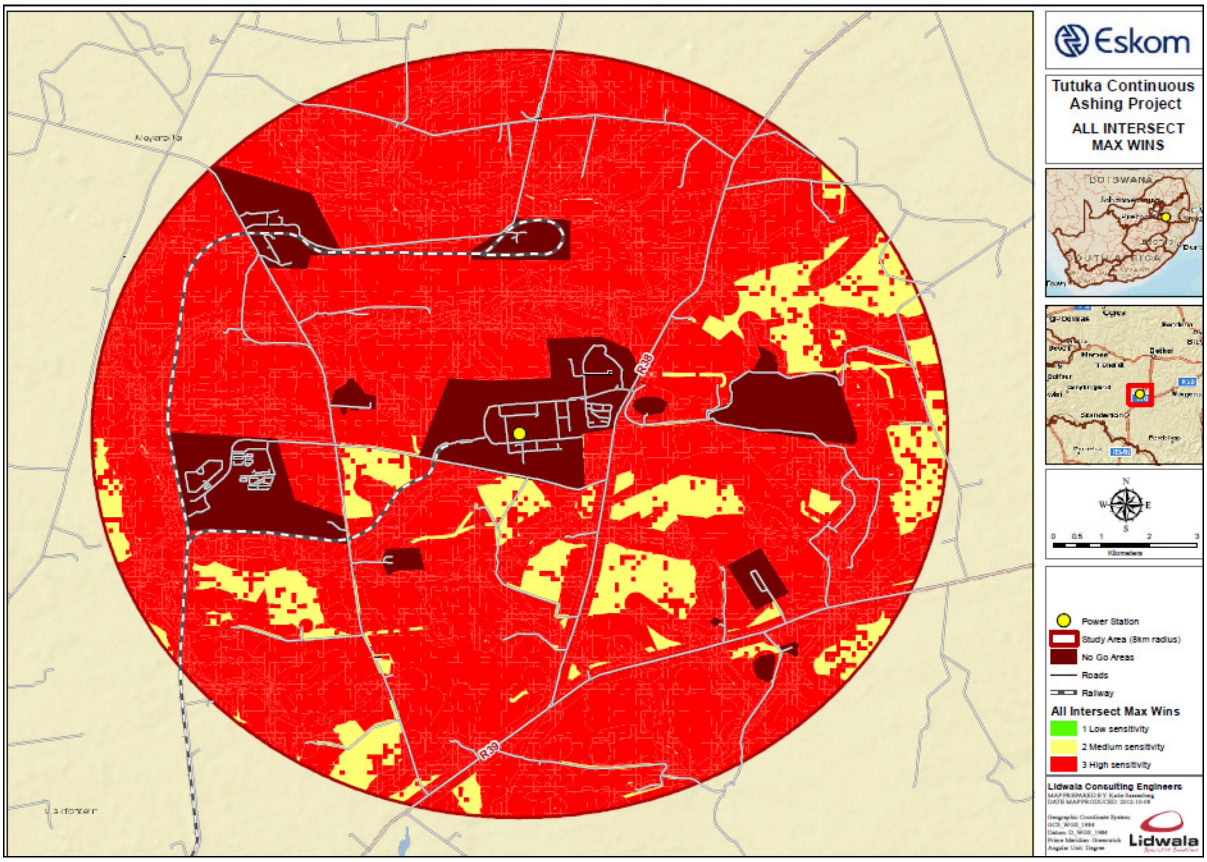


Figure 7.14: Overall Environmental Sensitivity (Max Wins)

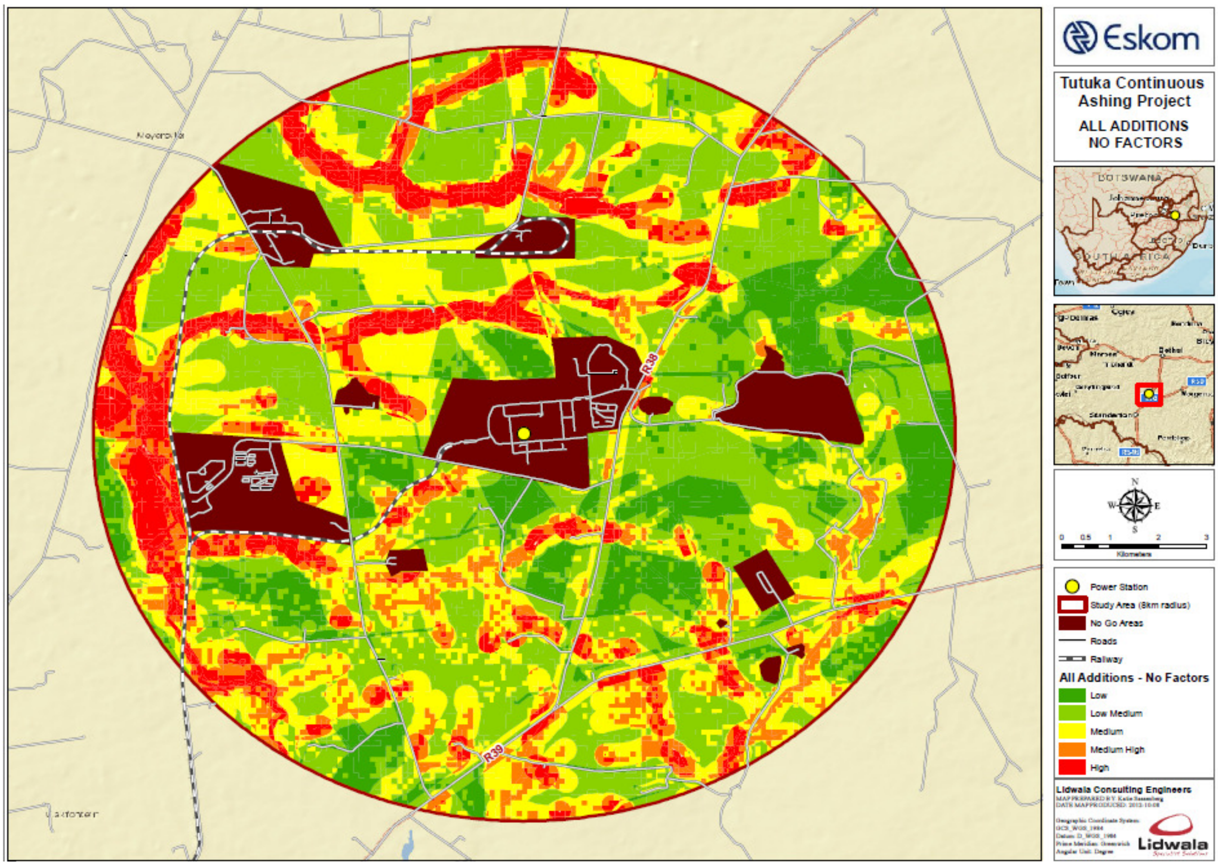


Figure 7.15: Overall Environmental Sensitivity (no factor)

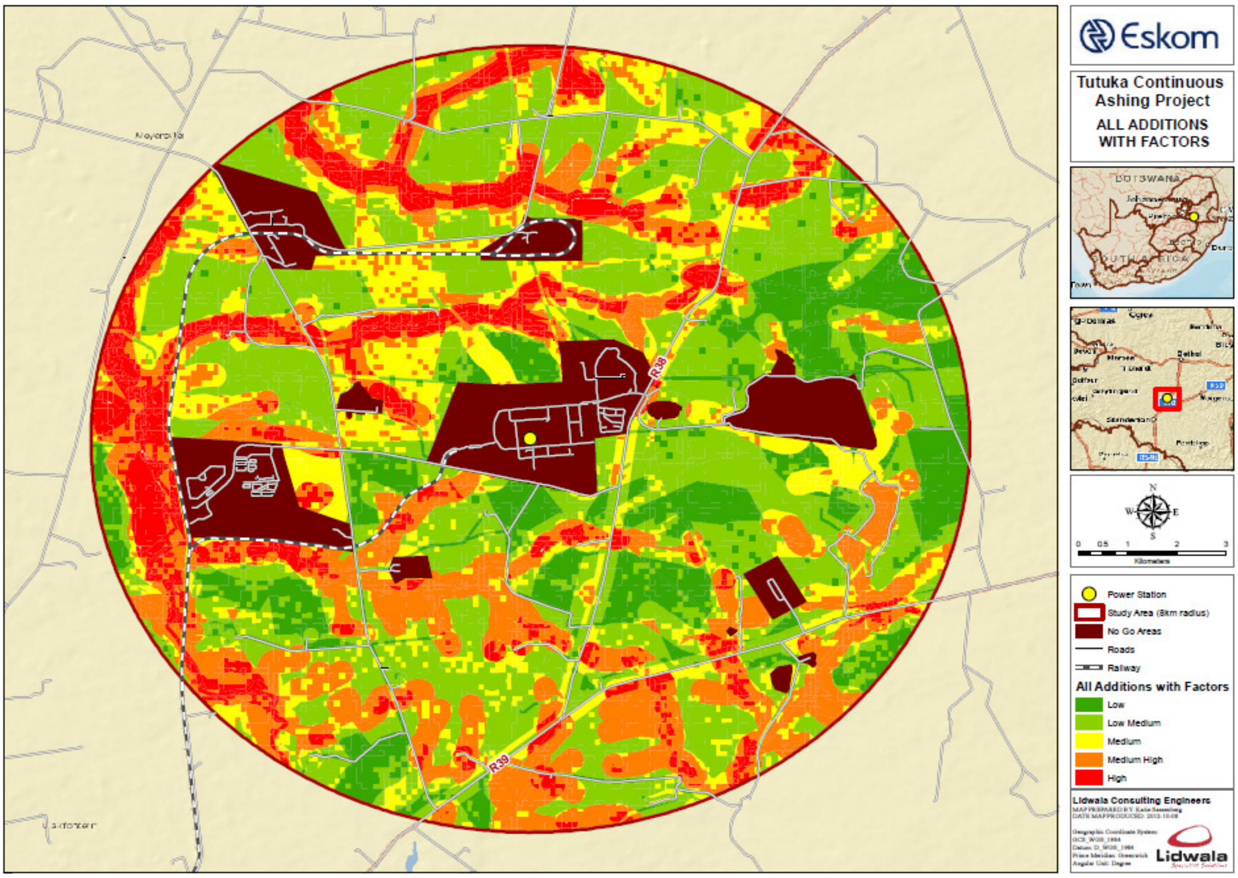


Figure 7.16: Overall Environmental Sensitivity (with adjustment factor)

Utilising the straight forward addition analysis (**Figure 7.15**) it can be concluded that the overall sensitivity of the study area falls within the Low to Medium sensitivity range with only small areas being considered of Medium-High or High sensitivity. However, if one utilises the "max wins" (**Figure 7.14**) mapping technique, where any area marked as sensitive is kept sensitive, it is clear that the majority of the study area can be deemed to be sensitive in one way or form with only a few medium sensitivity areas scattered across the study area.

The above maps were then utilized in order to determine the least sensitive areas of sufficient size that could be considered as alternative sites for the proposed ash disposal facility at Tutuka Power Station. Alternative sites are required to be at least 759 ha in size and are preferably required to fit within the low to low - medium sensitivity areas only and preferably without disturbing any existing infrastructure (**Figure 7.17**).

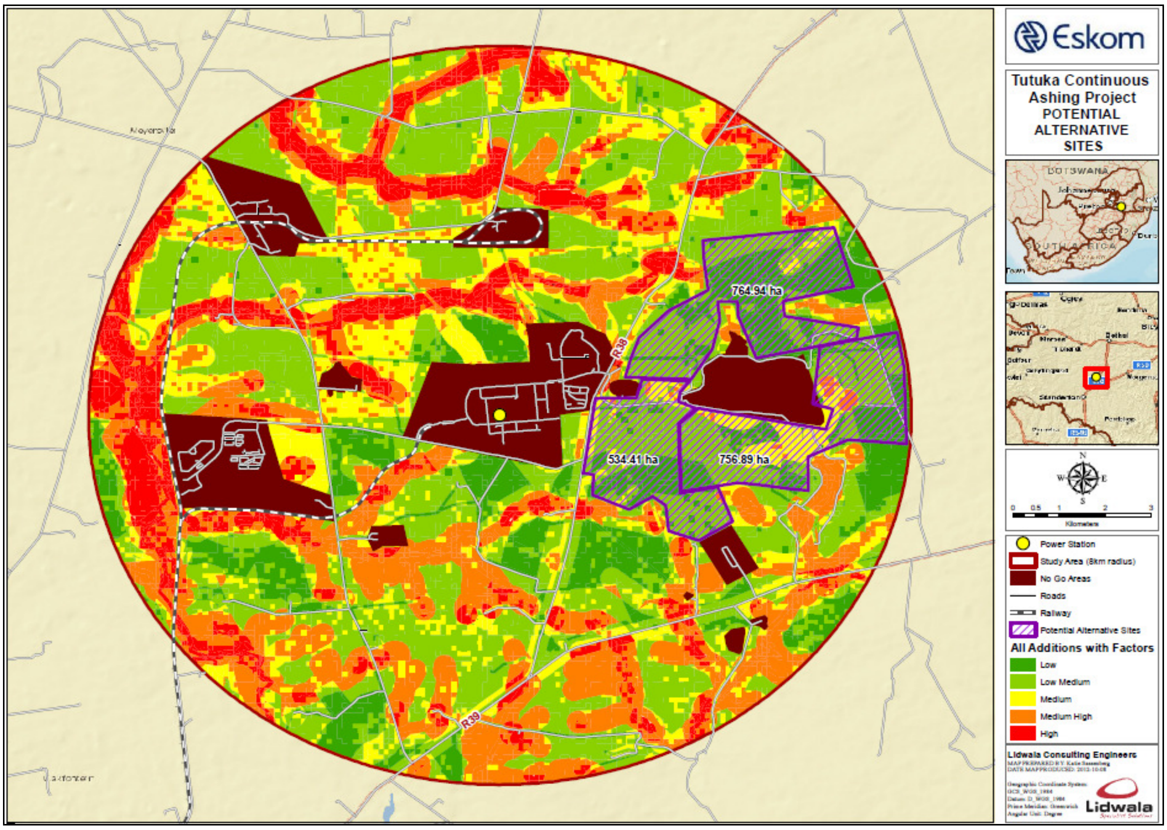


Figure 7.17: The potential areas, within the study area, large enough to accommodate the required area for the ash disposal facility (overlain on sensitivity map).

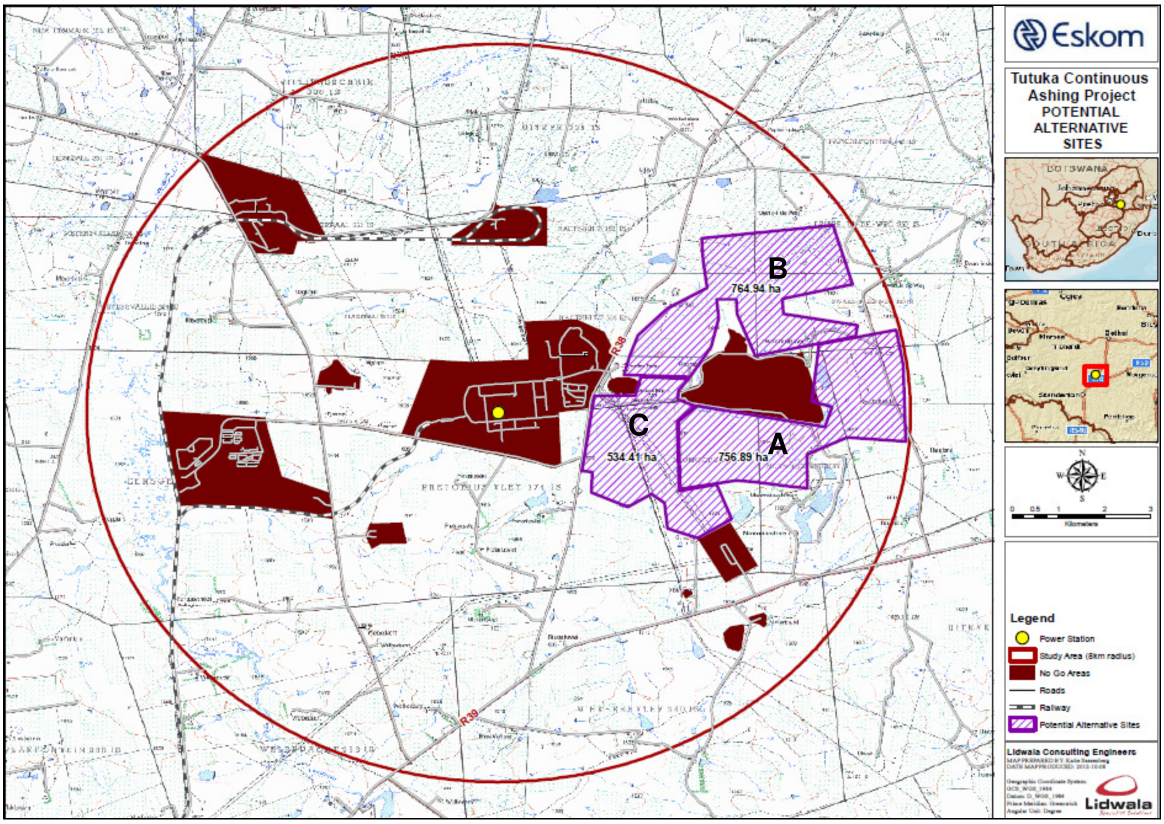


Figure 7.18: The three potential suitable alternative sites that can be evaluated and assessed in the EIA studies (overlain on 1 in 50 000 topographic map).

From the above analysis, three alternative sites can be identified as potentially suitable for the continuous ashing activities required at Tutuka Power Station. It is still noted that the proposed ash disposal facility should be placed as close to the existing ashing activities as possible to ensure that existing impacts are kept together and to limit the impact of associated linear infrastructure such as power lines and conveyor belts.

7.5 Conclusion

This chapter discussed the methodology of how the three potential site alternatives where identified through the use of sensitivity mapping during the scoping phase. These three alternative sites (or combinations thereof) will be investigated and assessed through detailed specialist studies during the EIA phase of the project.

Mitigation and layout alternatives will also form part of the EIA phase, during which a more in depth study will be undertaken as to the optimal mitigation of all potential significant environmental impacts.