8 IMPACT IDENTIFICATION

8.1 Introduction

As required in section 31(2) of the NEMA EIA Regulations, 2010, this section includes a description of the manner in which the biophysical, social, economic and cultural aspects of the environment may be affected by the proposed activity as well as a description of the environmental issues that were identified during the impact assessment process.

These impacts have been identified in accordance with the proposed process (Disposal of Dry Ash) and are not linked to any of the proposed alternatives directly. The impacts are applicable to all the land forming part of the proposed alternative sites (hereafter referred to as the "Study Area"). The Identified Impacts will be assessed against all the site alternatives individually in the next chapter. The proposed mitigation measures are applicable to the process and not to the individual alternatives. Mitigation measures applicable to the **preferred** alternative have been listed in the EMPr.

8.2 Topography

8.2.1 Potential Impacts

Due to the fact that the natural topography of the area is already disturbed by agriculture, two potential impacts are considered to be significant in terms of this project. The first impact considers the potential change of drainage patterns due to construction related earthworks and newly introduced stormwater patterns.

The second impact is related to the planning phase of the project in terms of the design of the facility which will need to take the existing topography into account with regards to allowing for effective stormwater and seepage collection systems.

8.2.2 Recommended Mitigation and Management Measures

The following mitigation and management measures are considered applicable:

- The contractor must ensure that adequate measures are put into place to control surface water flows across and around the site during earthworks.
- The quantity of uncontaminated stormwater entering cleared areas will be minimised by appropriate site design and by installation of control structures and drains which

direct such flows away from cleared areas and slopes to stable (vegetated) areas or effective treatment installations.

- Areas susceptible to erosion must be protected by installing the necessary temporary and/or permanent drainage works as soon as possible. Areas susceptible to erosion must also be rehabilitated (re-vegetated) as quickly as possible.
- Any erosion channels developed during the construction period or during the vegetation establishment period shall be backfilled and compacted, and the areas restored/rehabilitated to a proper condition.
- Anti-erosion compounds shall consist of an organic or inorganic material to bind soil particles together and shall be a proven product able to suppress dust and erosion. The application rate shall conform to the manufacturer's recommendations. The material used shall be of such quality that grass seeds may germinate and not prohibit growth.
- These erosion control measures, including stormwater drainage systems, will be installed before construction commences.
- Installed erosion control measures will be appropriate to site conditions to handle a one-in-two-year storm event for temporary structures, and a one-in-fifty year storm event for permanent structures which provide ongoing sediment control after a site has been rehabilitated.
- Contingency plans will be in place for extreme storm events.
- Blocking of stormwater drainage systems must be prevented and storm water must be managed to prevent soil erosion.
- All cleared areas will be promptly rehabilitated and in accordance with specific instructions from the Construction Manager.
- Soil must be exposed for the minimum time possible once cleared of invasive vegetation. The timing of clearing and grubbing must be co-ordinated as much as possible to avoid prolonged exposure of soils to wind and water erosion.

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix D**.

8.3 Climate and Air Quality

The Air Quality Report has been included in **Appendix I**.

8.3.1 Potential Impacts

The main pollutant of concern associated with the proposed operations is particulate matter. Particulates are divided into different particle size categories with Total Suspended Particulates (TSP) associated with nuisance impacts and the finer fractions of PM_{10} and $PM_{2.5}$ linked with potential health impacts. PM_{10} is primarily associated with mechanically generated dust whereas $PM_{2.5}$ is associated with combustion sources. Gaseous pollutants (such as sulphur dioxide, oxides of nitrogen, carbon monoxide, etc.) derive from vehicle exhausts and other combustions sources. These are however insignificant in relation to the particulate emissions and are not discussed in detail.

The establishment of the ash disposal facility will result in particulate emissions (listed in Error! Reference source not found.) during the following operations:

- land preparation during establishment and progression of the ash disposal facility;
- freshly exposed topsoil, as a step in rehabilitation of the ash disposal facility, that will be prone to wind erosion before establishment of vegetation; and,
- movement of vehicles across exposed soil or ash, will also be a source of pollution.

The subsequent sections provide a generic description of the parameters influencing dust generation from the various aspects identified.

Table 8.1: Activities and aspects identified for the construction, operational and closure phases of the proposed operations

Pollutant(s)	Aspect	Activity
Construction		
Particulates	Construction of progressing ash disposal facility site	Clearing of groundcover
		Levelling of area
		Wind erosion from topsoil storage piles
		Tipping of topsoil to storage pile
	Vehicle activity on-site	Vehicle and construction equipment activity during construction operations
Gases and particles	Vehicle and construction equipment activity	Tailpipe emissions from vehicles and construction equipment such as graders,

Pollutant(s)	Aspect	Activity
		scrapers and dozers
Continuous ash disposal		
Particulates	Wind erosion from ash disposal facility	Exposed dried out portions of the ash disposal facility
	Vehicle activity on-site	Vehicle activity at the ash disposal facility
Gases and particles	Vehicle activity	Tailpipe emissions from vehicle activity at the ash disposal facility
Rehabilitation		
Particulates	Rehabilitation of ash disposal facility	Topsoil recovered from stockpiles
		Tipping of topsoil onto ash disposal facility
	Wind erosion	Exposed cleared areas and exposed topsoil during rehabilitation
	Vehicle activity on unpaved roads and on-site	Truck activity at site during rehabilitation
Gases and particles	Vehicle activity	Tailpipe emissions from trucks and equipment used for rehabilitation

i. Construction phase

The construction phase is relevant as the ash disposal facility is established and during continuous ash disposal, as this would normally comprise a series of different operations including land clearing, topsoil removal, road grading, material loading and hauling, stockpiling and compaction. Each of these operations has a distinct duration and potential for dust generation. It is anticipated that the extent of dust emissions would vary substantially from day to day depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

It is not anticipated that the various construction activities will result in higher off-site impacts than the operational activities. The temporary nature of the construction activities, and the likelihood that these activities will be localised and for small areas at a time, will reduce the potential for significant off-site impacts. The Australian

Environmental Protection Agency recommends a buffer zone of 300 m from the nearest sensitive receptor when extractive-type materials handling activities occur (AEPA, 2007).

ii. Continuous ash disposal

Wind erosion is a complex process, including three different phases of particle entrainment, transport and deposition. It is primarily influenced by atmospheric conditions (e.g. wind, precipitation and temperature), soil properties (e.g. soil texture, composition and aggregation), land-surface characteristics (e.g. topography, moisture, aerodynamic roughness length, vegetation and non-erodible elements) and land-use practice (e.g. farming, grazing and mining) (Shao, 2008).

Windblown dust generates from natural and anthropogenic sources. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity (Shao, 2008).

Estimating the amount of windblown particles to be generated from the proposed ash disposal facility is not a trivial task and requires detailed information on the particle size distribution, moisture content, silt content and bulk density. Dust will only be generated under conditions of high wind speeds and from areas where the material is exposed and has dried out (US-EPA, 1995a). Annual emissions were quantified for four scenarios where mitigation practices were calculated to have control efficiencies (CE) greater than 70% (Error! Reference source not found.).

Table 8.2: Annual emissions for each site alternative for each of the modelled scenarios

Scenario	Particulate fraction	Annual emissions (tons per annum – tpa)		
		Alt A	Alt B	Alt C
		756.89 ha	764.94 ha	534.41 ha
Unmitigated	TSP	77 331	234 461	109 201
	PM_{10}	28 876	87 549	40 776
	$PM_{2.5}$	8 594	26 055	12 135
Re-vegetation CE = 97%	TSP	2 326	7 052	3 284
	PM_{10}	869	2 633	1 226
	$PM_{2.5}$	258	784	365

Wetting CE = 78%	TSP	17 159	52 025	24 231
	PM_{10}	6 408	19 429	9 049
	$PM_{2.5}$	1 907	5 781	2 693
Both (re-vegetation & wetting) CE = 99%	TSP	516	1 565	729
	PM_{10}	193	584	272
	$PM_{2.5}$	57	174	81

iii. Rehabilitation

Rehabilitation is planned to occur continuously throughout the disposal of ash and will include the removal and tipping of topsoil onto the completed ash disposal facility surface areas. Dust may be generated from the dried out exposed ash surfaces before it is covered with topsoil. Once vegetation is established the potential for dust generation will reduce significantly. The tipping of topsoil and vehicle entrainment on associated unpaved roads will also result in dust generation.

It is assumed that all ash disposal activities will have ceased during closure phase, when the power station has reached end of life. Because most of the rehabilitation is undertaken during the operations, the ash disposal facility should be almost completely rehabilitated by the closure phase. The potential for impacts after closure will depend on the extent of continuous rehabilitation efforts on the ash disposal facility.

The significance of the rehabilitation activities is likely to be linked to impacts from windblown dust from the exposed dried out ash, topsoil and vehicle entrainment during the rehabilitation process. Windblown dust is likely to only impact off-site under conditions of high wind speed with no mitigation in place. If rehabilitation as indicated takes place, i.e. vegetation cover, the impacts should be limited to be within the site boundary. As vegetation cover increases, the potential for wind erosion will decrease.

8.3.2 Recommended Mitigation and Management Measures

Appropriate mitigation and management measures will not be influenced by the final location of the ash disposal facility. The following sections describe the mitigation and management measure appropriate to each stage of the ash disposal facility development.

i. Construction phase

The construction of the ash disposal facility will be a mostly sporadic process, including vegetation and top-soil removal ahead of the active disposal area. The complexity of estimating dust emissions during this phase is a result of the types of activities, the varying duration and extent of each activity. The impact of the construction phase on air quality is expected to be limited to on-site impacts. Typical dust suppression techniques, for example, water sprays, will reduce dust emissions further, especially during dry and windy conditions.

ii. Operational phase

Irrespective of the location of the ash disposal facility the model simulations show that mitigation of dust emissions will be critical to maintain PM10 concentrations with the South African NAAQS. The re-vegetation and watering scenario described in preceding sections is based on the Tutuka Ash Disposal Operations Manual (SRK, 1984). In order to ensure that mitigation is effective it is recommended that dust fall monitoring around the perimeter of the ash disposal facility continues, especially in the direction of the prevailing winds and near any sensitive receptors. It is also recommended that PM10 be monitored near the ash disposal facility, especially if this is away from any monitoring undertaken by the power station. The PM10 filters and dust fall-out can further be analysed for heavy metals.

iii. Decommissioning phase

The mitigation measures applied during the operational phase should continue during the decommissioning phase to limit dust emissions from the ash disposal facility. This will include dust suppression by watering and covering with top-soil and replanting of grass seeds. Decommissioning should also include inspection of the entire disposal facility to ensure that vegetation coverage is complete and effective in minimising dust emissions.

8.4 Soil and Agricultural Potential

The Agricultural Report has been included in **Appendix P.**

During the construction and operational phases of the proposed ash disposal facility a number of environmental impacts and issues with reference to soils and agricultural potential will take place. Potential impacts on soils and agricultural potential could include:

- Pollution of soil due to handling, use and storage of hazardous substances during construction and operation.
- The loss of available top soil.

- Key variables that determine the land capability of the study area such as soil fertility reduced and disturbed due to the potential activities related to the ash disposal facility.
- The loss of viable agricultural land.

8.4.1 Soil Analysis Results

As expected from the scoping study and other available sources, the soils are dark clays, with shrink-swell properties. The soils are alkaline, with a high pH and have moderate to strong structure, caused mainly by the high clay content inherited from the parent material. The clay content means that water movement through the soil is slow and the soils remain moist for a long time following rain. However, in wet periods, there is a significant waterlogging hazard, which can often lead to crop roots becoming saturated, and causing problems for cultivation. **Table 8.3** provide a summary of the soil analysis results within the study area.

Table 8.3: Soil analysis results from specific sampling points within the study area.

Sample site		**S1**		**S2**		**S3**		**S4**		**S5**	
Co-ordinates (Lat/Long)		26° 46′ 00.7″S 29° 25′ 16.9″E		26° 47′ 07.9″S 29° 25′ 31.4″E		26° 47′ 09.8″S 29° 24′ 25.3″E		26° 47′ 27.3″S 29° 23′ 45.6″E		26° 46′ 48.5″S 29° 23′ 33.1″E	
Soil Form		***Arcadia***		***Arcadia***		***Rensburg***		***Arcadia***		***Bonheim***	
Horizon		A1	A2	A1	A2	A1	G	A1	A2	A1	B1
Depth (mm)		0-350	350-900	0-300	300-800	0-250	250-600	0-350	350-650	0-300	300-750
Sa	**%**	36	32	19	20	14	11	26	20	20	28
Si		25	26	27	24	47	45	23	26	28	35
Cl		39	42	54	56	39	46	51	54	52	37
Na	**cmol kg⁻¹**	0.36	0.99	2.99	3.83	1.34	3.83	0.38	0.86	0.54	0.16
K		0.27	0.22	0.45	0.54	0.55	0.24	0.31	0.62	0.42	0.46
Ca		8.43	11.53	13.05	22.05	13.44	18.88	20.80	22.39	13.00	8.43
Mg		6.03	8.07	28.71	35.16	9.45	13.43	33.42	31.25	12.40	5.96
CEC		18.02	22.81	42.98	61.58	26.60	36.38	52.14	50.66	28.87	18.47
P (ppm)		1.88	0.77	2.06	0.78	1.66	0.92	2.36	0.99	1.16	0.54

pH (H_2O)	5.81	7.48	8.81	8.84	6.40	7.84	8.26	8.41	7.46	6.58
Org C (%)	1.44	0.53	2.21	1.17	1.33	0.84	1.67	0.73	1.36	0.66

8.4.2 Agricultural Potential

The general agricultural potential class of each map unit, and the main limiting factors, are given in **Table 8.4** below.

Table 8.4: Agricultural Potential across the study area.

Agricultural Potential	Map Unit(s)	Limitations	Area %
Low to moderate	**Ar**	Strong structure and high clay content with shrink-swell properties makes cultivation difficult despite natural fertility	***(85.4%)***
Low	**Rg**	As for **Ar** unit, but with surface and subsurface wetness being more common due to landscape position	***(8.9%)***
Very low	**Rg/D**	As for **Rg** unit, but with disturbance and/or excavation	***(5.7%)***

The area surrounding Tutuka is dominated by low to moderate potential soils **Table 8.4**, due to the high clay content and associated strong, blocky soil structure. The soils are fertile, but there are significant management requirements required to sustainably cultivate these heavy, swelling clays. These soils are not suited to maize, but sunflowers, wheat and possibly soya beans or some vegetables could be grown.

8.4.3 Recommended Mitigation and Management Measures

The following mitigation measures are recommended with regards to top soil management. More detailed mitigations measures with regards to soil management in general are included in the EMPr (**Appendix D**).

- Topsoil[1] will be sourced from areas which are cleared for construction, conserved and used judiciously in the rehabilitation of disturbed land.

[1] Topsoil is defined as the top layer of soil that can be mechanically removed to a depth of about 100mm without ripping or blasting.

- The Contractor is required to strip topsoil together with grass from all areas where permanent or temporary structures are located, construction related activities occur, and access roads are to be constructed. Topsoil must be stockpiled for later use.
- Topsoil is to be handled twice only - once to strip and stockpile, and secondly to replace, level, shape and scarify.
- Topsoil must not be compacted in any way, nor should any object be placed or stockpiled upon it. No vehicles may be allowed access onto the stockpiles after they have been placed.
- Land to which topsoil has been applied will be vegetated as soon as possible after application. Re-vegetation should be undertaken as required by Eskom's Rehabilitation procedures.
- Stockpiled topsoil must be either vegetated with indigenous grasses or covered with a suitable fabric to prevent erosion and invasion by weeds.
- As far as possible, stored topsoil will be free of deleterious matter such as large roots, stones, refuse, stiff or heavy clay and noxious weeds which would adversely affect its suitability for planting.
- Topsoil stockpiles are expected to be similar to the existing Eskom topsoil stockpiles. Topsoil, which is to be stockpiled for periods exceeding 28 days, must be treated with mulch, roughened and seeded with an approved grass mixture or ground cover specified by the ECO. The mulch cover must be kept free of alien vegetation/seeds.

8.5 Geology

8.5.1 Potential Impacts

The construction and operation of the facilities and infrastructure associated with the ash disposal facility project is not anticipated to impact the underlying geology of the area due to the fact that it entails the establishment of **mainly** surface infrastructure. However, the following potential impacts on the geological features of the study area have been identified, specifically with regards to surface geological features:

- Impacts associated with the construction related earth works
- Impacts associated with the pollution of geological features in case of spillage / leakage of hydrocarbon and other hazardous material (oils, fuels and lubricants) from storage facilities

Due to the existing disturbed nature of the study area, both these impacts are considered to have a medium significance without the implementation of mitigation measures.

8.6 Surface Water

The Surface Water / Aquatic Ecology Report has been included in **Appendix Q**.

As mentioned previously in Section of the primary study areas occupied the following space: Alternative A= 672.68 Ha; B= 764.94 Ha and C = 534.41 Ha. The fractional representations of wetlands were: Alternative A= 12.0%; B= 3.0% and C= 4.0%. Wetlands which will directly be affected by the proposed ash disposal facility are ecologically impaired to different degrees due to current land use activities. These wetlands mostly retain a stream flow regulation and water purification function.

Wetlands in the secondary study area are also ecologically impaired in most instances. The hydrological characteristics of the two valley bottom systems have been greatly altered by additional water input and a number of impeding structures (roads and dams). Simultaneously, seep zones have been infringed on by agricultural activity on nearly all alternatives. Most wetlands in the secondary study area are vulnerable to changes in hydrology and geomorphology in their respective catchments.

Impacts on the wetlands may be summarised under three main factors: alteration to (1) hydrology, (2) geomorphology and (3) wetland vegetation. Changes to any of these factors, due to ashing and related activities will elicit a change in the PES. The intensity of the response will be proportional to the sensitivity of the wetlands to these changes. The wetland impact assessment therefore considers six main impacts (listed below), in relation to the sensitivity of wetlands on all three Alternatives.

- Impacts on hydrology;
- Impacts on surface water quality;
- Impacts related to erosion and sedimentation;
- Impacts on wetland vegetation and disturbance of wetland habitat;
- Impact related to increase alien/pioneer vegetation in disturbed areas;
- Impacts on residual wetland ecosystem services.

i. Alternative A

Construction Phase

The construction phase on Alternative A will impact directly on parts of Wetland 5, 6 and 10. Main anticipated impacts during the construction phase relate to direct loss in wetland habitat and functionality for Wetlands 5 and 6, as well as changes to the hydrology, water quality and sediment loads of downstream receiving wetlands. Wetland 6 retains little hydrological integrity and mainly functions as a pollution control facility at the moment.

Operational Phase

The residual hectare extent of functional wetlands associated with the primary and secondary catchment is 63 ha for Alternative A. This is substantially less than the fractional representation of wetlands per Alternative. The loss of wetland functions will mostly be expressed during the operational phase. It is assumed that runoff generated by the footprint will be treated as polluted water and redirected to a pollution control facility. This will greatly reduce the runoff received by Wetlands 5 and 6. Existing dams on both systems already intercept relatively large amounts of the runoff. It follows that this impact is unlikely to contribute significantly to the downstream receiving systems. Dams, however, will reduce in volume and this might have implications for current abstraction activities.

Additional consideration should be given to the likelihood of surface water pollution due to runoff or malfunctioning of the pollution control system, in which case polluted water will accumulate in the dam downstream of Wetland 5, 6 and 10. Current water quality for Wetland 5 and 10 is considered good and impacts related to water quality thus scored a higher severity for these two wetlands.

De-commissioning Phase

Activities that will take place during the de-commission phase have not been disclosed. It is assumed that the dry ash disposal facility will be stabilised pre-decommissioning, with the aim of increasing surface roughness. Changes to the drainage system are also expected. The long term impacts of the decommissioned disposal facility on surface water quality will rely on leachate and/or runoff quality, as well as the probability of surface water pollution.

Cumulative Impacts

Receiving watercourses linked to the Alternative A include the Groot Draai Dam. Wetland 5 and 10 drains into the same tributary as Wetland 6 (a tributary of Groot Draai Dam), which reflects a desktop PES of an E ecological category. The PES for this wetland itself retains a Medium integrity.

ii. Alternative B

Construction Phase

Alternative B will directly impact on parts of Wetland 7 and 12 and indirectly on Wetlands 8, 9, 11 and part of Wetland 6. Of the wetlands to be impacted on, Wetland 7 is more sensitive as it yielded a B PES and even though the system does reflect some alien vegetation its main hydrological workings are preserved. The main perceived impacts during the construction phase are similar to that of Alternative A, however the extent to which wetland habitat will directly be affected is less. Loss in wetland habitat, erosion and sedimentation, hydrology and water quality is also expected during the construction phase.

Operational Phase

Alternative B drains more individual catchments than alternative A, albeit smaller catchments. The operational activities within these catchments will result in a decrease in the PES, and wetland services of affected wetlands. Affected wetlands are mostly in a Moderately Modified state, but retain functions relating to stream flow regulation, water purification and maintenance of biodiversity.

De-commissioning Phase

It is unlikely that the post-ashing landscape will reclaim lost wetland functions. Long term impacts relate to water quality through leachate, erosion and sedimentation of ash disposal facility. It is also possible that these impacts might increase in extent and further impair receiving watercourses over the long term. This might be expressed in a further loss of services and integrity in downstream wetlands.

Cumulative Impacts

Currently Alternative B does not drain runoff from the existing ash disposal facility and the modified state of wetlands is mostly the result of agricultural activity. Similarly the two large receiving watercourses (the Leeuspruit to the west and the Blesbokspruit to the north east) retain a Moderate PES, compared to the seriously modified PES associated with receiving watercourse of Alternative A. The capacity for the cumulative impacts on the receiving environment is thus greater for Alternative B. The number of internal catchments draining this alternative further increases the probability of contamination.

iii. Alternatives C

Construction Phase

Construction on Alternative C will impact directly on Wetlands 3 and 4 and indirectly on Wetlands 1, 2 and 5. During construction, this alternative poses additional impacts related to the realignment of the current power line. As with the previous two Alternatives the expected impacts remain the same and relates to a direct loss in wetland habitat, decrease in PES and ecosystem services. Receiving wetlands will experience an alteration in hydrology, possible decline in surface water quality, erosion and sedimentation. The extent and severity of anticipated impacts are smaller compared to that of Alternative B. Due the lower PES and EIS scores associated with this alternative.

Operational Phase

Alternative C is comparable to Alternative B in the number and type of wetlands present; however, the amount of functional wetland size is the smallest for Alternative C. This suggests a lower severity for impacts during the operational phase.

De-commissioning Phase

Long term hydrological impacts for downstream watercourses are less likely than possible water quality issues. An initial hydrological adjustment is expected in receiving watercourses, but this is unlikely to carry on indefinitely. Water quality impacts linked to possible leeching and ground water contamination are the main consideration during the de-commissioning phase.

Cumulative Impacts

The majority of Alternative C drains west towards the Leeuspruit, which reflects a Moderate PES, while the rest drains into the same degraded tributary as Alternative A. At the same time wetlands on alternative C retain less integrity than wetlands on Alternative B and reflect poorer surface water conditions. It follows that the extent and intensity for cumulative impacts on this Alternative falls somewhere between that of Alternative B (more sensitive) and Alternative A (less sensitive).

iv. No-Go Alternative

A comparison between the 1968 aerial image and more recent images highlights four main points: (1) all three alternatives have been subjected to agricultural transformation pre-dating the 1960's. (2) With the exception of Wetlands 4 and 6, the majority of other wetlands adjusted to this alteration and are unlikely to further decline in PES, (3) both

Wetlands 4 and 6 reflect an increase in deep flooding due to dams constructed somewhere between 1968 and 1991, (4) the current ash disposal facility has encroached and impacted on Wetland 6 and its catchment. Residual functions linked to Wetland 6 relate to its capacity to control pollution and buffer the downstream receiving environment. It follows that if the No-go Alternative applies, the majority of the wetlands will maintain a neutral trajectory. Continuous encroachment on and contamination of Wetland 6 might result in a further loss of residual wetland integrity and functionality of this system.

8.6.1 Recommended Mitigation and Management Measures

i. General Recommendations

- Minimize both the area that will be exposed and the exposure time during construction (LRRB, Mn/DOT and FHWA, 2003).
- Pollution prevention, minimisation of impacts, water reuse and reclamation, water treatment and discharge activities should be according to the DWAF Best Practise Guidelines (DWAF- H series, 2007). Storm water management, water and salt balancing, water monitoring and water treatment plans should, be consistent with DWAF best practise guidelines (DWAF- G-series, 2006). Pollution control dams, water management for residue deposits and water management for surface activities should be in line with DWAF Best Practise Guidelines (DWAF- A series, 2007).
- Discharge into surface water systems, for whatever reason and withstanding water quality restraints, should consider the hydrological capacity and seasonality of associated watercourses. Maximum hydrological capacity of systems should not be exceeded. It is also pertinent that base flows should not be altered by discharge activity. This will result in a change in bed load capacity of the system and will ultimately result in system instability.
- Erosion control measures should be implemented as the primary means of sediment control throughout the construction and operational phase. Increased turbidity and sedimentation resulting from erosion have several adverse effects on the aquatic environment.
- Surface water systems should be protected from contamination with volatile hydrocarbons and lubricants at all times.
- Contingency plans need to be established in case of fuel or hazardous waste spills, storm water run-off and flood events.
- No dumping of any building rubble, soil, litter, organic matter or chemical substances may occur within the associated wetland. Dumping and temporary storage of the above should only occur at predetermined locations.
- All excavated material should be deposited and stabilised in an approved area.

ii. Construction Phase

During the design phase, considerations should be given to environmental least cost options for the proposed activity. The strategic placement of related infrastructure and the proper design thereof will be the first course of action in impact mitigation. Before construction is initiated, a detailed construction method statement should be provided in accordance with all the applicable authorisations, for all of the proposed activities. The method statement should address the following components related to wetlands:

- Highlight the presence, extent and sensitivity of associated watercourses, as well measures to avoid any unnecessary damage or loss to these systems during construction. Physical demarcation of wetlands, and general "wetland" awareness should be included;
- Provide a biophysical description of the construction site and potentially affected wetlands (vegetation cover and biotic composition etc.);
- Provide a list of the typical types of equipment that will be used for the construction activity and for the control of water if it is present;
- Provide a detailed course of action for accidental spills or surface water contamination and describe detailed measures to control risks related to suspended sediment and turbidity (e.g. berms, hay bales, silt curtains, river diversions, and settling ponds), damage to riparian vegetation and spillage of fuels and oils, cement and other foreign materials;
- Provide details for environmental monitoring during the construction phase. It should provide information on what environmental aspects are to be monitored (in situ water quality, erosion, soil and slope stability), how it should be monitored (quantitative or qualitative), at what frequency it should be monitored (daily, weekly, monthly), who is responsible for the monitoring and how to communicate and respond to information generated by the monitoring reports;
- Provide details of appropriate responses for monitoring results. The end of the construction phase should be marked by a clean-up and rehabilitation program for all wetlands located adjacent to the construction servitudes.

Hydrology

- The lateral extent of wetlands should be delineated prior to construction and the temporary access roads to cross points should be designed to minimise soil compaction, thus not impeding the horizontal movement of water through the soil;
- Reinstate hydrological functionality of affected systems after construction activity, as far as possible. This will require rehabilitation of disturbed downslope areas where attention is paid to increase surface roughness and energy dissipation.

Water Quality

- No dumping of any building rubble, soil, litter, organic matter or chemical substances should occur within watercourses. Dumping and temporary storage of the above should only occur at predetermined locations;
- Construction workers should not use watercourses for sanitation purposes;
- In the case of dewatering of a construction site, water should be treated and all suspended particles should be removed. Water removed from a construction site should not be released directly into a watercourse. The discharge should occur onto a well vegetated area, which will help trap sediment and residual contaminants; and
- Construction equipment should not be serviced or refuelled near watercourses.

Erosion and Sedimentation Impacts

- Erosion and silt control mechanisms must be in place prior to the onset of construction within any watercourse. This includes the elimination of surface flow through the construction site. Silt fences or hay bales or other appropriate measures need to be placed near the base of a slope in order to limit the amount of silt entering the watercourse;
- Similarly, the erection of silt barriers along all of the drainage lines must be undertaken to curb any sediment and silt run-off in the preparation activities of the ash disposal facility. Ideally, the amount of land that will be disturbed should be kept to an absolute minimum;
- Non-erodible materials should be used for the construction of any berms, coffer dams or any other isolation structures to be used within a flowing watercourse;
- Spoil piles should be placed above the high water mark in distinct piles and adequate erosion measures need to be implemented in order to minimise and reduce erosion and siltation into the watercourse from spoil piles;
- It is also recommended that construction activities should make use of the dry seasonal construction window. This will further reduce the risk associated with erosion / siltation; and
- Erosion control measures should be inspected regularly during the course of construction and necessary repairs need to be carried out if any damage has occurred.

iii. Operational Phase

General recommendations applicable to operational activities include the environmental education and awareness associated with the importance and value of wetlands, and wetland monitoring:

- All employees should be educated regarding environmental risks and proper cause of action should such risks be presented during day to day activities; and
- A wetland monitoring plan should be implemented for all operational activities possibly impacting on wetland systems. The monitoring plan should provide details on strategic test- and control sites, uniform and repeatable sampling efforts, response metrics to be used, data processing and dissemination of monitoring results.

Hydrology

The hydrological functions associated with wetlands that fall within the footprint of the preferred alternative will be lost. In most instances this impact was not considered of High significance, due to the location of the alternatives and the transformed state of wetlands within them.

Water Quality

- Isolate contaminated water. Any water with a chemical signature different to that of the receiving aquatic environment should be considered contaminated and should be isolated. Ashing processes and activities should make a clear distinction between clean and contaminated water and systems to deal with both should be in place;
- Pollution prevention, minimisation of impacts, water reuse an reclamation, water treatment and discharge activities should be according to Best Practise Guidelines (DWAF- H series, 2007);
- Storm water management, water and salt balancing, water monitoring and water treatment plans should be consistent with Best Practise Guidelines (DWAF- G-series, 2007);
- Pollution control dams, water management for residue deposits and water management for surface activities should be in line with Best Practise Guidelines (DWAF- A series, 2007);
- Threshold criteria for water quality should not just consider potable standards. Background concentrations of TDS, in particular, should be considered. It is pertinent that receiving surface systems do not incur TDS variations greater than 15 % of that of background concentrations;

Erosion and Sedimentation Impacts

- Routine monitoring of turbidity in receiving watercourses should not yield values greater than background values;
- Wetland buffer zones should be pre-determined and placed on all of the drainage lines associated with the proposed development;
- Design runoff control features to minimize soil erosion and avoid placement of infrastructure and sites on unstable slopes and consider conditions that can cause slope instability, such as groundwater aquifers, precipitation and slope angles.

iv. De-commissioning Phase

A detailed activity description for de-commissioning phase should be provided prior to the onset of de-commissioning. Highlighted risks after decommissioning mainly relate to long term leachate and surface water contamination. This impact will be mitigated by procedures already in place during the operational phase. Lining of the ash disposal facility will be one of the main recommendations for curtailing long term, chronic impacts of this nature.

8.7 Groundwater

The Ground Water Report has been included in **Appendix N**.

8.7.1 Site Specific Impacts

Alternative site A

This site is located to the south and east of the existing ash disposal facility. The site is predominantly underlain by the Vryheid Formation (arenaceous sandstones); although a substantial percentage of the footprint is underlain by the Karoo dolerite. Both geological units exhibit low permeability which suggests low risk to groundwater, although the dolerite is likely to exhibit fractures and fissures, with a higher permeability associated with the contact between an intrusion and the host rock which could increase the risk to groundwater. Notwithstanding, anticipated borehole yields are reasonably low.

A number of non-perennial rivers flow through the footprint, however it is noted that the existing ash disposal facility covers the end sections of these water courses.

Alternative Site B

Alternative site B is located to the north of the existing ash disposal facility and comprises an area of 764.94 hectares.

The site is predominantly underlain by the Vryheid Formation (arenaceous sandstones); although a small percentage of the footprint is underlain by the Karoo dolerite. As previously discussed, both geological units exhibit low permeability's which suggests low risk to groundwater, although higher permeability may exist at the contact between an intrusion and the host rock which could increase the risk to groundwater. Notwithstanding, anticipated borehole yields are reasonably low.

One non-perennial river flows through the footprint of the site, towards the north-east corner. The source of two other non-perennial streams lie on the edge of Alterative Site B; one on the east and one on the west.

Alternative Site C

Alternative site C is located to the south-west of the existing ash disposal facility and comprises an area of 534.41 hectares.

The site is underlain predominantly by the Vryheid Formation (arenaceous sandstones); although a small percentage of the footprint is underlain by the Karoo dolerite. As previously discussed, both geological units exhibit low permeability's which suggests low risk to groundwater, although higher permeability may exist at the contact between an intrusion and the host rock which could increase the risk to groundwater. Notwithstanding, anticipated borehole yields are reasonably low.

A small section of a non-perennial river is shown to flow through the footprint of the site (towards the north); however the remaining section falls within the footprint of the existing ash disposal facility.

i. Construction phase

- The construction Phase is expected to consist of:
    - clearing the site
    - removal of any infrastructure at the site;
    - installation of under-drain systems and related pipework;
    - installation of piezometers for groundwater monitoring

- The use of earth-moving plant and trucks brings a risk of hydrocarbon spillages and other polluting fluids during the construction phase.
- Removal of topsoil during the construction phase can worsen any spillages that may subsequently occur as the soil zone is an important barrier to the downward migration of potential groundwater contaminants (both a physical barrier and a microbiological and chemical barrier).

ii. Operational phase

- Even though dry ashing technique will be used, precipitation will collect on top of the ash disposal facility and some might infiltrate through the liner. Water may be stored within the ash disposal facility and subsequently increase the 'recharge' within the footprint of the facility which may cause mounding of groundwater. This may have the potential to cause a rise in the water table beneath the ash disposal facility and may impact local groundwater flow directions. Notwithstanding, it is considered unlikely that a significant rise in the water table beneath the ash disposal facility will occur as a direct result of the ash itself.
- The quality of groundwater beneath the site is likely to deteriorate, since natural groundwater will be mixing with the poorer quality ash leachate (either directly draining from the ash disposal facility, or leaking from surface water impoundments). Typical constituents of concern (elements that are elevated above water quality standards) are As, B, Cr, Mo, Sb, Se, V and W. In addition, the pH of water is likely to be impacted. It is noted however the proposed alternative sites at Tutuka are, adjacent to the existing ash disposal facility. Groundwater quality data show that groundwater quality has been impacted by the existing ash disposal facility.
- If contaminated water is impounded at the surface in unlined ponds, there lies a risk to both groundwater and surface water resources. Existing data show that boreholes located near ponds are impacted both in groundwater levels and quality.
- If infrastructure designed to minimize and contain contaminated runoff from the ash disposal facility and surrounds falls into disrepair, the risk to groundwater and / or surface water contamination would occur.

- Diesel spills from equipment or plant (e.g. ash stackers) carry a risk of hydrocarbon contamination, and standard precautions i.e. availability of appropriate sorbent material and prompt clean-up should be taken to minimize this risk. Hydrocarbons and fuels should be stored in bunded areas.

iii. De-commissioning phase

- Decommissioning of the ash disposal facility will involve halting ash disposal and removing ash disposal equipment (e.g. stackers). The use of plant and trucks brings a risk of hydrocarbon spillages.
- If infrastructure designed to minimize and contain contaminated runoff from the ash disposal facility and surrounds falls into disrepair, the risk to groundwater and / or surface water contamination would occur.

iv. Cumulative impacts

- a rise in water table in the vicinity of the site due to increased recharge from stored water within the ash disposal facility and any associated surface water impoundments; and
- Deterioration in groundwater quality.

8.7.2 No-go Alternative:

If the ash disposal facility is not constructed ("no-go" option) then there will be no additional impacts on groundwater at the site, provided no other activities are carried out at the site which could affect the groundwater.

8.8 Biodiversity

The Biodiversity Report has been included in **Appendix M**.

Results of the floristic and faunal investigations were interpreted holistically in order to assess the potential impact on the ecological environment. The impact assessment is aimed at presenting a description of the nature, extent significance and potential mitigation of identified impacts on the biological environment.

8.8.1 Potential Impacts

No impacts were identified that could lead to a beneficial impact on the ecological environment of the study area since the proposed development is largely destructive, involving the alteration of natural habitat or degradation of habitat that is currently in a climax status.

Impacts resulting from the proposed development on floristic and faunal attributes of the study area are largely restricted to the physical effects of habitat clearance the establishment of artificial habitat. Direct impacts include any effect on populations of individual species of conservation importance and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern. In addition, impacts on sensitive or protected habitat are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof are immediately visible and can be determined to an acceptable level of certainty.

In contrast, indirect impacts are not immediately evident and can consequently not be measured at a moment in time. In addition, the extent of the effect is frequently at a scale that is larger than the actual site of impact. A measure of estimation is therefore necessary in order to evaluate the importance of these impacts. Lastly, impacts of a cumulative nature place direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities. The following impacts were therefore identified as relevant to this proposed development:

- Impacts on flora species of conservation importance (including habitat suitable for these species);
- Impacts on fauna species of conservation importance (including habitat suitable for these species);
- Impacts on sensitive or protected flora & fauna habitat types (including loss and degradation);
- Displacement of fauna species, human-animal conflicts & interactions;
- Impacts on ecological connectivity and ecosystem functioning;
- Indirect impacts on surrounding habitat;
- Cumulative impacts on conservation obligations & targets (including national and regional);
- Cumulative increase in local and regional fragmentation/ isolation of habitat; and
- Cumulative increase in environmental degradation, pollution.

8.8.2 Nature of Impacts

Impacts that are likely to result from the development activities are described briefly below. This list was compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of this type of development on the floristic environment.

i. *Impacts on flora species of conservation importance (including suitable habitat)*

Development activities frequently result in direct impacts or destruction of conservation important plant species, communities of these species, areas where these species are known to occur or areas that are considered particularly suitable for these species. Plant species of conservation importance, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers, as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they represent an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance, particularly in moist habitat conditions.

Red Data species are particularly sensitive to changes in their environment, being adapted to a narrow range of specific habitat requirements. Changes in habitat conditions resulting from human-related activities is one of the greatest reasons for these species being in danger of extinction. Surface transformation/ degradation activities within habitat types that are occupied by flora species of conservation importance will ultimately result in significant impacts on these species and their population dynamics. Effects of this type of impact are usually permanent and recovery or mitigation is generally not perceived as possible.

One of the greatest limitations in terms of mitigating or preventing this particular impact, is the paucity of species specific information that describe their presence, distribution patterns, population dynamics and habitat requirements. To allow for an accurate assessment, it is usually necessary to assess the presence/ distribution, habitats requirements, etc. associated with these species in detail and over prolonged periods; something that is generally not possible during EIA investigation such as this. However, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, potential impacts will be limited largely.

The presence of several plants of conservation importance was established during the brief survey period, while habitat within most of the proposed areas is considered suitable for a number of other taxa that were not recorded during the survey. This impact will therefore likely be severe. Exclusion of red data habitat is the only sensible manner in which this impact can be mitigated.

ii. Impacts on fauna species of conservation importance (including suitable habitat)

Similarly, animal taxa of conservation importance generally do not contribute significantly to the species richness of a region, but do contribute significantly to the ecological diversity of a region as their presence usually provides an indication of a relatively pristine environment. Because animals are mostly mobile and are ultimately able to migrate away from impacts, developments rarely affect them directly. However, significant impacts result from losses and degradation of suitable habitat that is available to them. This represents a significant direct impact on these animals. Additional aspects that will be affected include migration patterns and suitable habitat for breeding and foraging purposes. Habitat requirements and preferences of conservation important species are much stricter than for common or generalist species and a higher conservation obligation is placed on these areas. Even slight changes to habitat in which these species persist are therefore likely to have significant effects on the presence and status of these taxa within the immediate region.

The presence of Red Data fauna species within as well as near to the proposed development areas was established during the survey period. Considering the brief period over which the survey was conducted, and taking cognisance of the habitat status and availability, the likelihood that other conservation important species would occur in the study area is regarded high. Exclusion of red data habitat is the only sensible manner in which this impact can be mitigated to some extent.

iii. Impacts on sensitive or protected flora & fauna habitat types (including loss and degradation)

The loss or degradation of natural vegetation or habitat that are regarded sensitive as a result of restricted presence in the larger region, represents a potential loss of habitat and biodiversity on a local and regional scale. Sensitive habitat types might include mountains, ridges, koppies, wetlands, rivers, streams, pans and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is generally ascribed to floristic communities that occupy these areas as they contribute significantly to the biodiversity of a region.

Natural faunal habitat of the study area will be affected adversely by direct impacts resulting from construction and operational activities. Particular reference is made to the loss of habitat resulting from surface clearing activities, the construction of infrastructure and contamination of natural habitat through the leaching of chemicals into the groundwater and surface water and generation of huge amounts of dust and spillages. Also of importance is the loss of habitat that are not necessarily considered suitable for Red Data species, but where high endemic species richness is likely to be recorded.

All wetland related habitat within the proposed development areas are regarded sensitive, particularly in view of the presence of several conservation important plant and animal taxa that were recorded within these areas during the survey period. In addition, particularly sensitive habitat was identified in proximity to some of the development alternatives, which will ultimately affect the preference rating and impact significance ascribed to the site alternatives.

This impact also includes adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Introduction of chemicals into the ground- and surface water through leaching;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;
- Changes to successional processes;
- Effects on pollinators; and
- Increased invasion by plants and animals not endemic to the area.

Changes to the natural habitat may lead to a reduction in the resilience of ecological communities and ecosystems and changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of the wetland habitat types, is particularly important. A high conservation value is generally ascribed to faunal assemblages that persist in these areas as they contribute significantly to the biodiversity of a region.

iv. Displacement of fauna species, human-animal conflicts & interactions

Activities that are known to transpire from human–animal conflicts are likely to affect animals that utilise surrounding areas. Unwanted activities might include poaching, snaring, killing by accidental contact, capturing, effects of domestic cats and dogs, escalation in numbers of exotic and non-endemic species, road kills, etc. While the tolerance levels of common animal species is generally of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from the area of impact, some species would not be able to relocate, such as ground living and small species. It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. An aspect that is of concern is the presence of vehicles on access roads, leading to accidental death of animals, particularly with regards to nocturnal animals.

The presence of personnel within the development area during construction and operational phases will inevitably result in some contact with animals. Therefore, encounters with dangerous animals (such as snakes) remain likely. In addition, the presence of domestic dogs and cats is generally associated with humans. These animals are frequently accountable for killing of natural fauna. It is also regarded moderately likely that the natural faunal component might be attracted to the artificial habitat that is created by the development. The establishment of human abodes generally result in the presence of foraging rodents, which is likely to attract smaller predators, raptors, owls, and snakes. The lack of understanding from personnel frequently results in the unnecessary killing of these animals.

v. *Impacts on ecological connectivity & ecosystem functioning*

The larger region is characterised by highly transformed and fragmented grassland habitat. This is also reflected in the study area and immediate surrounds. Therefore, the ecological connectivity that natural habitat provides within this regional setting of habitat fragmentation and isolation, is therefore particularly important in the effective functioning of the regional and local ecological processes. Evidence obtained during the investigation period revealed that the biodiversity aspects recorded within both the terrestrial grassland types and wetland related habitat is much higher than would be expected when looking at the study area in isolation, providing insight into the regional importance of these habitat types. It is therefore reasonable to assume that the animals that utilises these habitat types migrate extensively across the region for various reasons. Foraging, available water, food sources, breeding patterns and seasonal climate changes include some of the more obvious explanations for migration of animals. In order to ensure the persistence of animals within this system on a local and regional scale, it is critical that the basic characteristics of the system, such as a natural species composition, physiognomy, aquatic principles, contributions from surrounding habitat types, etc. are preserved. This is also particularly relevant for plant species of conservation consideration that could potentially occupy the area.

The ecological interconnectivity of terrestrial and wetland related habitat types is important for the functioning; without terrestrial grasslands, the reservoirs of water that feed wetland habitat types will disappear and the characteristics and features that makes these features suitable for a high biodiversity will disappear, effectively destroying the remaining biodiversity to a large extent.

While most of the larger mammal species (ungulates) are restricted in their movement by fences, small and medium sized animals, that include predators, burrowing species, small mammals, invertebrate species, reptiles, amphibians, etc. utilises all available natural habitat as either corridors, 'stepping stones' or habitat. Loss of current migration routes or connectivity areas ('stepping stones') within the study area will likely affect the migration pattern of some species on larger scale. Particular reference is made to the disruption of migration patterns of flightless animals.

vi. Indirect impacts on surrounding habitat

Surrounding areas and species present in the direct vicinity of the study areas will likely be affected adversely by indirect impacts resulting from construction and operational activities. These indirect impacts also include adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Introduction of chemicals into the ground- and surface water through leaching;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;
- Changes to successional processes;
- Effects on pollinators; and
- Increased invasion by plants and animals not endemic to the area.

These impacts lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases, these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor.

These impacts lead to a reduction in the resilience of peripheral ecological communities and ecosystems or loss or changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of drainage lines, is regarded important. It is well known that the status of a catchment is largely determined by the status of the upper reaches of the rivers. Small drainage lines might be insignificant on a regional scale, but the combined impact on numerous such small drainage lines will affect the quality of larger rivers further downstream adversely.

vii. Cumulative impacts on conservation obligations & targets (including national and regional)

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas or threatened areas. The importance of vegetation types is based on the conservation status ascribed to regional vegetation types (VEGMAP, 2006) and because impacts that result in irreversible transformation of natural habitat is regarded significant. The current conservation status is based on regional information relating to the status and availability of remaining natural habitat. This vegetation type is included in the 'Endangered' category.

It has been established that the available InfoBase inaccurately displays the status and availability of natural grasslands. Poor quality (degraded) grasslands, and cultivated pastures are frequently included in this category. Additionally, developments that have taken place subsequent to the compilation of the VEGMAP database have resulted in further decimation of natural grasslands, contributing to this cumulative impact. Ultimately, the current estimation of conservation level is therefore likely to be an underrepresentation of the conservation requirements that need to be applied to these vegetation types. The continued conservation of any area that is representative of these regional vegetation types should therefore be prioritised.

viii. Cumulative increase in local and regional fragmentation/ isolation of habitat

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation.

The loss of natural habitat, even small areas, implies that endemic biodiversity have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances, might imply that the viable population of plants in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size.

The danger in this type of cumulative impact is that effects are not known or is not visible with immediate effect and normally when these effects become visible, they are usually beyond repair. Impacts on linear areas of natural habitat affect the migratory success of animals in particular.

The general region is characterised by high levels of transformation and habitat fragmentation.

8.8.3 Recommended Mitigation and Management Measures

i. Site Specific Mitigation Measures

Mitigation Measure 1 - Exclude all areas of high ecological sensitivity from the proposed development;

Mitigation Measure 2 - Prevent all and any effluent from the ashing facility into wetland habitat;

Mitigation Measure 3 - Prevent contamination of natural habitat, wetland and endorheic pans from any source of pollution;

Mitigation Measure 4 - Provide an adequate buffer between areas of development and surrounding natural habitat.

ii. General Aspects

Mitigation Measure 5 - Appoint an Environmental Control Officer (ECO) prior to commencement of construction phase. Responsibilities should include, but not necessarily be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting;

Mitigation Measure 6 - Compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Biodiversity monitoring should be conducted at least twice per year (Summer, Winter) in order to assess the status of natural habitat and effects of the development on the natural environment;

iii. Environmental Control Officer

Mitigation Measure 7 - Have overall responsibility for the implementation of the EMP;

Mitigation Measure 8 - Ensure that the developer and contractors are aware of environmental specifications, legal constraints and general standards and procedures;

Mitigation Measure 9 - Ensure that all stipulations within the EMP are communicated and adhered to by the developer and contractors;

Mitigation Measure 10 - Monitor the implementation of the EMP throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes;

Mitigation Measure 11 - Be fully conversant with the Environmental Impact Assessment for the project, the conditions of the RoD, all relevant environmental legislation and with the EMP;

Mitigation Measure 12 - Ensure that periodic environmental performance audits are undertaken on the project implementation;

Mitigation Measure 13 - Convey the contents of the EMP to the site staff and discuss the contents in detail with the Project Manager and Contractors;

Mitigation Measure 14 - Take appropriate action if the specifications contained in the EMP are not followed;

Mitigation Measure 15 - Monitor and verify that environmental impacts are kept to a minimum, as far as possible;

Mitigation Measure 16 - Compile progress reports on a regular basis, with input from the Site Manager, for submission to the Project Manager, including a final post-construction audit carried out by an independent auditor/consultant.

iv. Fences & Demarcation

Mitigation Measure 17 - Demarcate construction areas by semi-permanent means/ material, in order to control movement of personnel, vehicles, providing boundaries for construction and operational sites;

Mitigation Measure 18 - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required;

v. Fire

Mitigation Measure 19 - The Project team will compile a Fire Management Plan (FMP) and Contractors directed by the ECO will submit a FMP. The Project FMP shall be approved by local Fire Protection Association, and shall include *inter alia* aspects such as relevant training, equipment on site, prevention, response, rehabilitation and compliance to the National Veld and Forest Fire Act, Act No. 101 1998;

Mitigation Measure 20 - Prevent all open fires;

Mitigation Measure 21 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

Mitigation Measure 22 - Use of branches of trees, shrubs or any vegetation for fire making purposes is strictly prohibited;

vi. Roads & Access

Mitigation Measure 23 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 24 - A road management plan should be compiled prior to the commencement of construction and ash dump operation activities; Roads are required on the actual ash dump and around the total ash dump foot print.

Mitigation Measure 25 - Dust control on all roads should be prioritised;

Mitigation Measure 26 - No roads should be allowed within ecologically sensitive areas.

vii. Workers & Personnel

Mitigation Measure 27 - Provide sufficient on-site ablution, sanitation, litter and waste management and hazardous materials management facilities;

Mitigation Measure 28 - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted;

viii. Vegetation Clearance & Operations

Mitigation Measure 29 - The landowner must immediately take steps to remove alien vegetation as per Conservation of Agricultural Resource Act. This should be done based on an alien invasive management strategy that should be compiled by a suitable ecologist. The plan must make reference to:

- Uprooting, felling or cutting;

- Treatment with a weed killer that is registered for use in connection with such plants in accordance with the directions for the use of such a weed killer;
- The application of control measures regarding the utilisation and protection of veld in terms of regulation 9 of the Act;
- The application of control measures regarding livestock reduction or removal of animals in terms of regulations 10 and 11of the Act;
- Any other method or strategy that may be applicable and that is specified by the executive officer by means of a directive.
- According to the Conservation of Agricultural Resource Act (No. 43 of 1983) as amended, the person applying herbicide must be adequately qualified and certified as well as registered with the appropriate authority to apply herbicides.

Mitigation Measure 30 - The size of areas subjected to land clearance will be kept to a minimum;

Mitigation Measure 31 - Only areas as instructed by the Site Manager must be cleared and grubbed;

Mitigation Measure 32 - Cleared vegetation and debris that has not been utilised will be collected and disposed of to a suitable waste disposal site. It will not be burned on site;

Mitigation Measure 33 - All vegetation not required to be removed will be protected against damage;

Mitigation Measure 34 - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 35 - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and vice versa and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act (No 43 of 1983) and must be addressed on a continual basis, through an alien vegetation control and monitoring programme;

Mitigation Measure 36 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area. Removal of topsoil should be done to a depth of at least 1m;

Mitigation Measure 37 - Stored topsoil will be free of deleterious matter such as large roots, stones, refuse, stiff or heavy clay and noxious weeds, which would adversely affect its suitability for planting;

Mitigation Measure 38 - No spoil material will be dumped outside the defined site;

Mitigation Measure 39 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 40 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO;

Mitigation Measure 41 - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 42 - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 43 - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

Mitigation Measure 44 - Revegetated areas should be fenced to prevent damage by grazing animals;

Mitigation Measure 45 - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 46 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 47 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;

ix. Waste

Mitigation Measure 48 - As far as possible, waste should be avoided, reduced, re-used and/or recycled. Where this is not feasible, all waste (general and hazardous) generated during the construction of the power station may only be disposed of at appropriately licensed waste disposal sites (in terms of Section 20 of the Environment Conservation Act, No 73 of 1989 and in accordance with the new waste act: National Environmental Waste Management Act 2008);

Mitigation Measure 49 - Prevent and advocate against the indiscriminate disposal of rubbish, litter or rubble;

Mitigation Measure 50 - The burning of general waste material under any circumstances is not to be allowed;

Mitigation Measure 51 - The use of small on-site incinerators for waste burning should be investigated, and if found feasible, be implemented;

Mitigation Measure 52 - Waste will be sorted at source (i.e. the separation of tins, glass, paper etc); recycled waste of this sort will be collected by an accredited waste removal contractor;

Mitigation Measure 53 - A stormwater management plan will be compiled that will address, inter alia, capturing and storage of stormwater;

Mitigation Measure 54 - All runoff water from fuel deposits, workshops, vehicles washing areas and other equipment must be collected and directed through oil traps to settlement ponds. These ponds must be suitably lined and should be cleaned as soon as practicable, and the sludge disposed off at a suitable waste site;

Mitigation Measure 55 - No wastewater or water containing any chemical or pollutant should be released from, or escape as effluent, from the site;

Mitigation Measure 56 - All pit water removed from mining pits will be evacuated to a suitably lined and constructed evaporation dam. No pitwater shall be released into the wetland area.

x. Animals

Mitigation Measure 57 - No animal may be hunted, trapped, snared or captured for any purpose whatsoever. Fences and boundaries should be patrolled weekly in order to locate and remove snares/ traps;

Mitigation Measure 58 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;

Mitigation Measure 59 - Speed of vehicles should be limited to allow for sufficient safety margins;

Mitigation Measure 60 - Dangerous animals should be handled by a competent person;

Mitigation Measure 61 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction;

Mitigation Measure 62 - Sensitize all personnel to the presence, characteristics and behaviour of animals on the site;

Mitigation Measure 63 - Include suitable procedures in the event of encountering potentially dangerous animals on the site;

Mitigation Measure 64 - Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum;

Mitigation Measure 65 - No domestic pets should be allowed on the site

8.9 Avifauna & Bats

8.9.1 Predicted Impacts of Ash Disposal Facilities

The greatest predicted impacts of ash disposal facilities on avifauna are the destruction of habitat and disturbance of birds during construction and operation. However, both of these impacts can be minimized and mitigated to some extent by avoiding more sensitive areas where possible. Similarly, the above mentioned construction and maintenance activities impact on birds through disturbance, particularly during bird breeding activities. Disturbance of birds is anticipated to be of lower significance than habitat destruction. Leachate from fly ash disposal facilities can contain heavy metals (Theism and Marley, 1979) which could result in contamination of surrounding water sources, used by water birds in the study area. Correct placing of the new disposal facility, away from important wetlands, dams and water bodies, will help to mitigate this impact.

In addition to the continuous disposal of ash at the ash disposal facility, the project may also include the expansion of the relevant infrastructure associated with the ashing system, such as pipelines, storm water trenches, seepage water collection systems, pump stations, seepage dams and roads. The impacts of such associated infrastructure on avifauna are predicted to be minimal, so long as the infrastructure is within the proposed ash disposal facility footprint. **Infrastructure outside of the proposed footprint has not been assessed by this study.** If any additional linear infrastructure, especially power lines, is to be constructed, the EWT will assess the impact thereof, once the routings have been made known.

8.9.2 Recommended Mitigation and Management Measures

<u>Ash Disposal Facility</u>

Construction Phase

Impact	*Mitigation*
Habitat destruction	Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff. It is difficult to mitigate properly for this as habitat destruction covering the entire ash dam footprint is inevitable. However, it is important to ensure that the construction **Environmental Management Programme** incorporates guidelines as to how best to minimize this impact, and ensure that only designated areas are impacted upon, as per the design.
Disturbance	Strict control should be maintained over all activities during construction. It is difficult to

	mitigate properly for this as some disturbance is inevitable. **During Construction, if any of the "Focal Species" identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted for further instruction.**

Operational phase

Impact	*Mitigation*
Leachate contamination of surrounding water sources	Ensuring that the construction Operational Management Programme incorporates guidelines as to how best to minimize this impact. Eskom must implement its existing Environmental procedures accordingly.

Construction phase:

Impact	*Mitigation*
Habitat destruction	Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff. It is difficult to mitigate properly for this as some habitat destruction is inevitable. It is important to ensure that the construction **Environmental Management Programme** incorporates guidelines as to how best to minimize this impact.
Disturbance	Strict control should be maintained over all activities during construction. It is difficult to mitigate properly for this as some disturbance is inevitable. **During Construction, if any of the "Focal Species" identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted for further instruction.**

The Avifauna Report has been included in **Appendix J.**

8.10 Visual Aspects

The Visual Impact Assessment has been included in **Appendix S.**

Visibility of an object is one of the primary attributes by which visual impact can be concluded. This is determined by a line of sight where nothing obscures the view of an object. Exposure is defined by the degree of visibility, in other words "how much" or "which part" of an object is visible to the observer. This is influenced by topography and the incidence of objects such as trees and buildings that obscure the view partially or in total. Visibility can be modelled by making use of a digital terrain model (DTM), created from contour data, and performing a viewshed analysis using GIS software. It must be noted that the viewshed analysis only accounts for topographical influences, and that the screening effect of vegetation is not included. This indicates a worst-case scenario, where the possibility of visual exposure is mapped, from which possible sensitive viewer locations can be identified.

In addition to viewshed analyses as described above, a proximity analysis is required to incorporate the effect of reduced visibility over distance. By integrating the two types of analyses, an index of possible visual impact is generated. The spatial representation of the visual impact index for each of the assessed alternatives is given on maps in (**Figures 8.1-8.3)**.

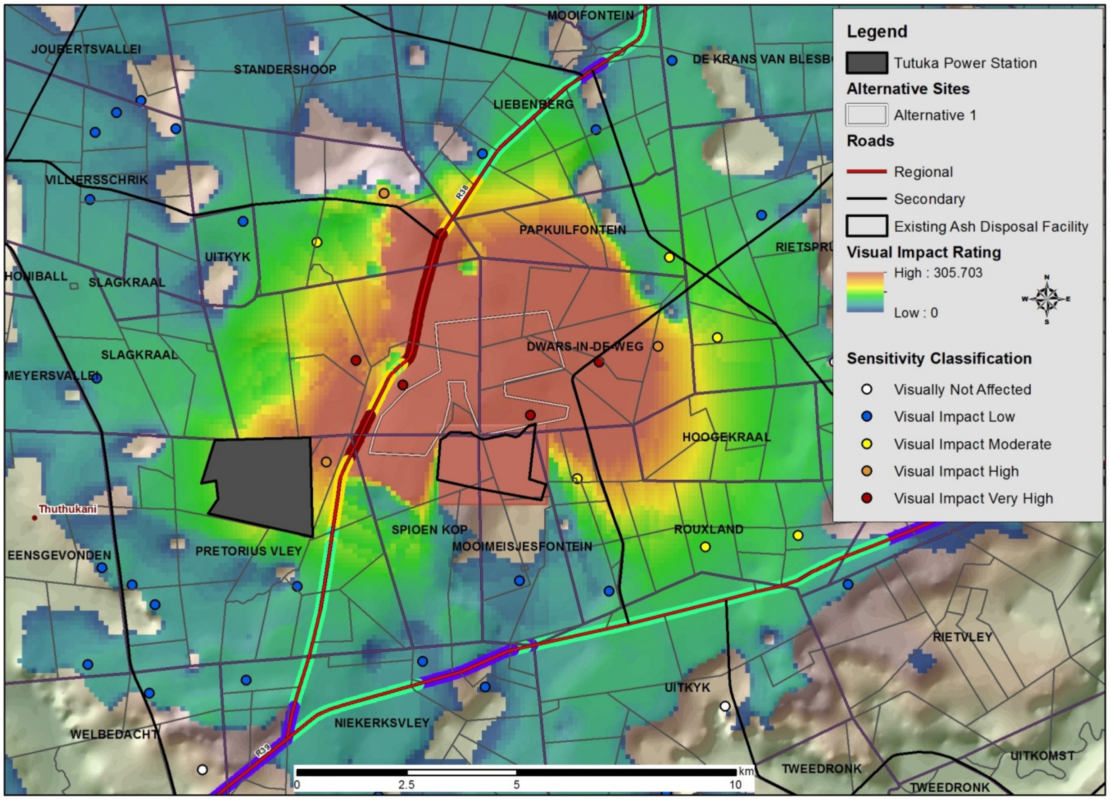

Figure 8.1: Visual Impact Index – Alternative B

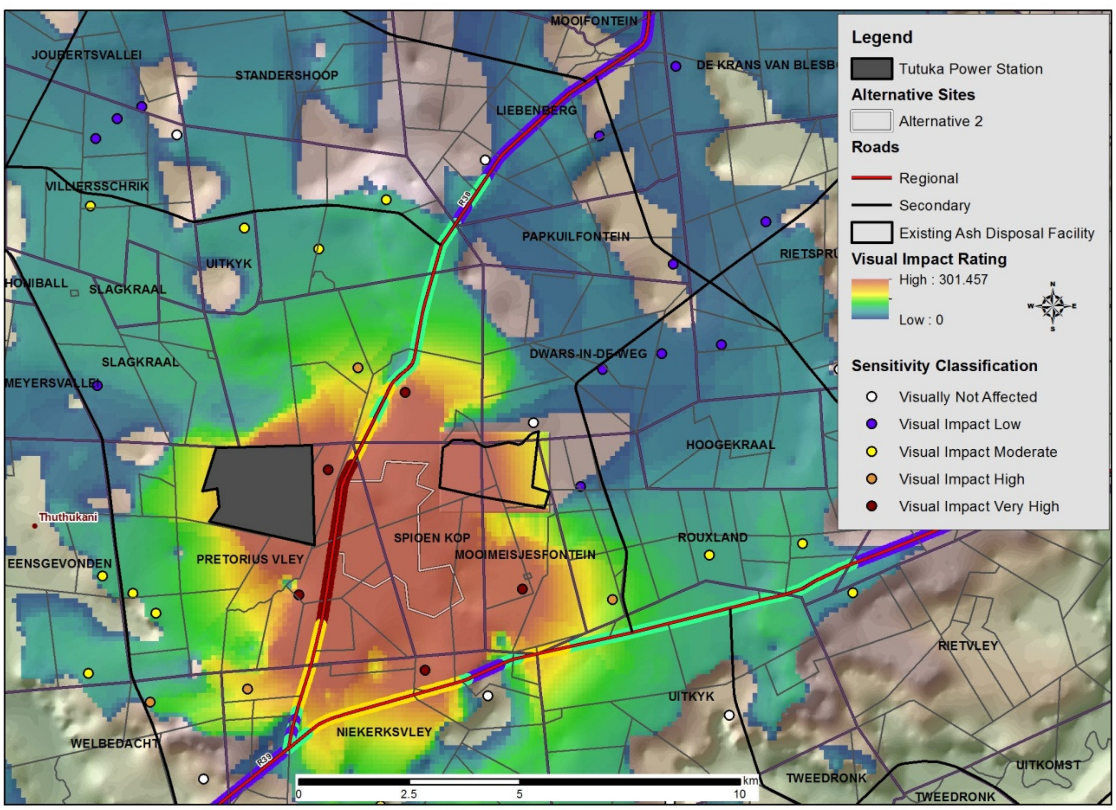

Figure 8.2: Visual Impact Index – Alternative C

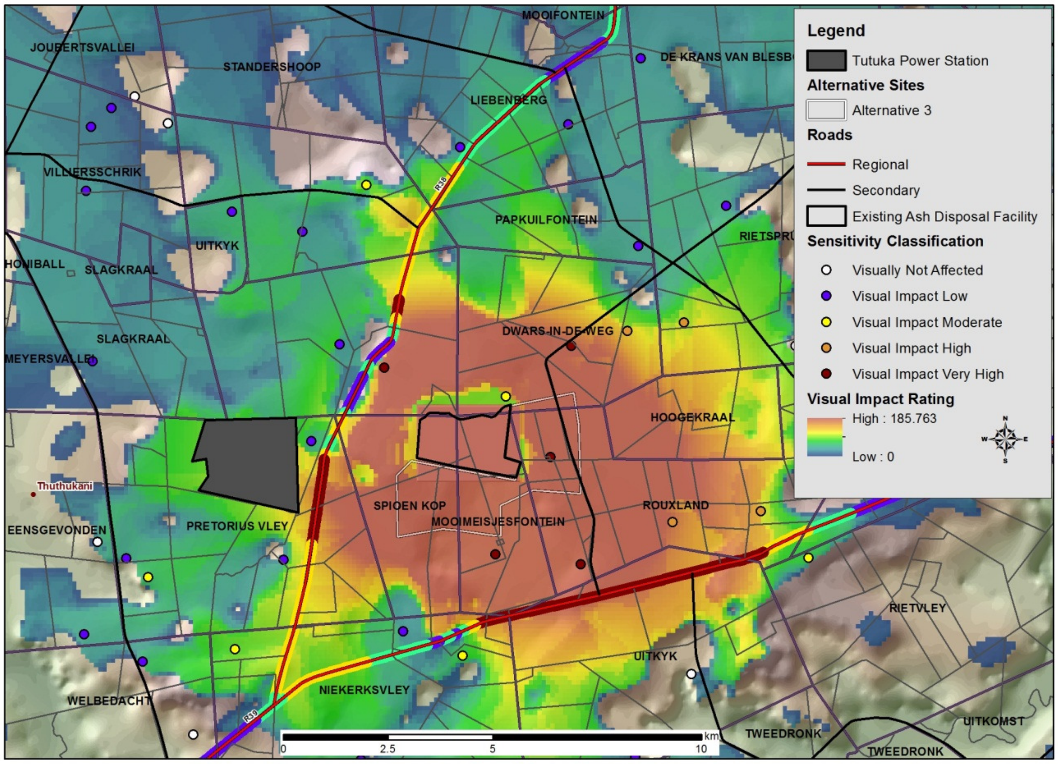

Figure 8.3: Visual Impact Index – Alternative A

8.10.1 Recommended Mitigation and Management Measures

Given the large vertical and horizontal dimensions of an ash disposal facility, mitigation possibilities are few and limited to the following:

- Minimizing the height and footprint of the facility;
- Rehabilitate the facility by actively vegetating the slopes with grass, shrubs and trees similar to what is found in the surrounding area.

As mentioned above, the impact will be further mitigated by its absorption into the landscape of a power station with existing ash disposal operations.

8.11 Sites of Archaeological, Historical and Cultural Interest

The Heritage Report has been included in **Appendix O**.

8.11.1 Potential Impacts

i. Construction phase

The proposed development would have a direct impact on the sites as indicated in the Heritage Report **(Appendix O)**

ii. Operational phase

No additional impacts on sites, features or objects of cultural heritage significance are expected during the operational phase of the project. This is conditional of all the identified sites having been subjected to required mitigation processes and that no changes are made to the project plan without an input by a heritage consultant.

iii. Decommissioning phase

No additional impacts on sites, features or objects of cultural heritage significance are expected during the operational phase of the project. This is conditional of all the identified sites having been subjected to required mitigation processes and that no changes are made to the project plan without an input by a heritage consultant.

iv. Cumulative impact

The cumulative effect of the development should be viewed in the context of other, as well as similar, projects also taking place, all of which are contributing to a process of "sanitation" through the gradual removal of sites, features and objects of cultural significance from the larger cultural landscape. The implication is that sites that now are viewed to have low significance might in the future have high significance, which would in all probability have serious constraints on later proposed developments. Therefore, avoidance of impacts in the present, where possible, might make things a bit easier in the future.

8.11.2 Recommended Mitigation and Management Measures

- *Impacts during construction*

Issue	Impact on heritage sites and features
Potential impact	Discovery of previously unknown heritage sites or features during construction can halt work in the vicinity of the finds
EMP	Management measures to be included in the EMP for actions to be taken on uncovering unknown sites and features

- *Impacts during operation*

Issue	Impact on heritage sites and features
Potential impact	Discovery of previously unknown heritage sites or features during construction can halt work in the vicinity of the finds

EMP	Management measures to be included in the EMP for actions to be taken on uncovering unknown sites and features

- *Impacts during decommissioning*

Issue	Impact on heritage sites and features
Potential impact	Discovery of previously unknown heritage sites or features during construction can halt work in the vicinity of the finds
EMP	Management measures to be included in the EMP for actions to be taken on uncovering unknown sites and features

More detailed mitigation and management measures can be found in the Environmental Management Programme included in **Appendix D**.

8.12 Socio-Economic

The key social issues that would need to be assessed during the SIA can be divided into:

- Perceptions and fears associated with the proposed project; and
- Local, site-specific issues (during construction and operation phases).

The local site-specific issues can in turn be divided into construction and operational related issues.

8.12.1 Perceptions and Fears

Social impacts are unique in that the mere introduction of information into the public domain can result in social impacts that manifest themselves in the form of perceptions, fears and expectations. In the case of the proposed continuous ashing project, the introduction of information into the public domain is likely to have resulted in social impacts, specifically for landowners and other stakeholders who may potentially be affected.

The extent and nature of these fears are likely to be linked to concerns related to the visual and sense of place impacts associated with the continuous ashing activities as well as fuelling existing issues and concerns that stakeholders have regarding the existing ash disposal facility in the study area.

These impacts could in turn have negative implications for property values, investments in tourism initiatives and the public's perception of Eskom in general etc. The SIA will seek to identify and assess the potential extent and severity of these fears and perceptions as part of the assessment process.

8.12.2 Local, Site-specific Issues

The potential impacts could include:

- The potential risks to personal safety, specifically for farmers, increase in stock theft, trespassing, poaching and fires;
- The impact of dust pollution on surrounding areas;
- Damage to productive farm lands and crops due to construction related activities;
- Damage to natural vegetation and grazing due to construction related activities;
- Impact on tourism related activities due to construction related activities;
- The impact of the bigger ash disposal facility on the visual character of the area and sense of place. These impacts will be felt at both a local, individual landowner level, and also at a larger, landscape level that affects visitors to the area;
- The impact of the proposed continuous ashing activities on farming activities and land use potential.
- The impact on current and future tourism and conservation related activities and potential. This will be closely linked to the visual and sense of place impacts associated with the proposed alignments;
- Impact on property values.

The broader social benefits for South Africa associated with the ongoing supply

8.13 Noise Impact

The major noise sources include a bulldozer, excavator, articulated truck and vibrating roller during construction; and a backhoe loader and vibrating compactor during operations.

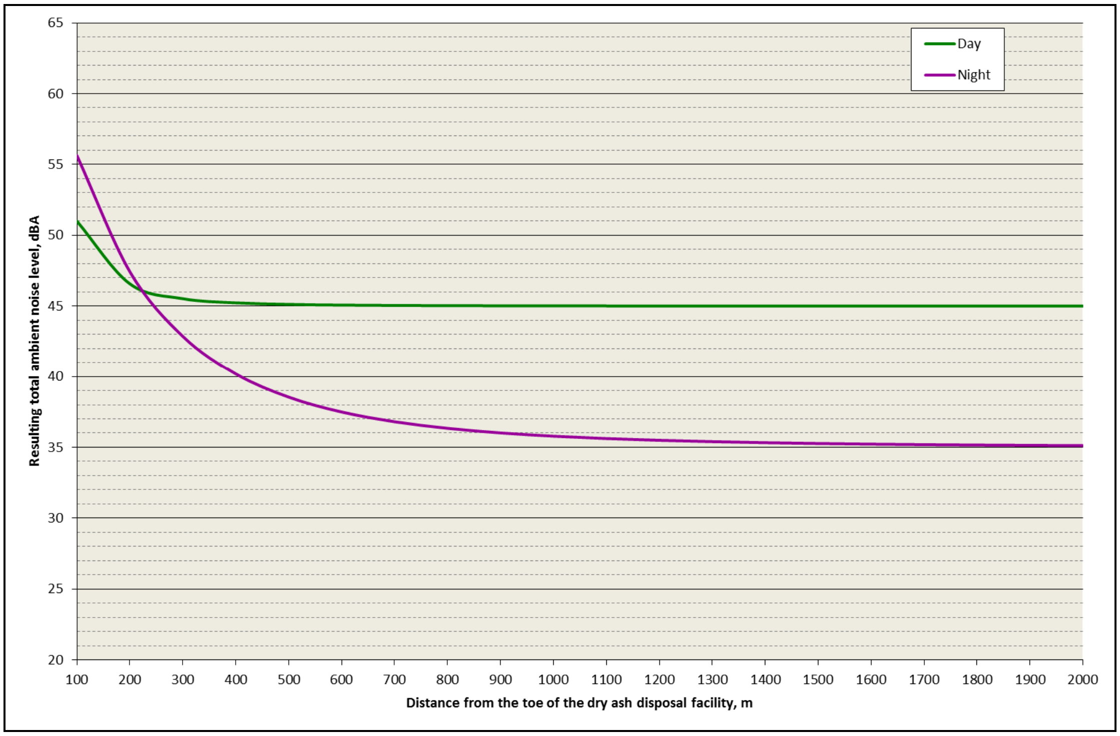

Figure 8.4: Graph representing the cumulative effect of the noise emissions on the existing ambient noise levels as a function of distance during the day and night, i.e. 45 dBA and 35 dBA, respectively at the Tutuka Power Station – Continues ADF.

The results in (**Figure 8.4**) indicate that the cumulative effect of the noise emissions from the dry ash disposal facility decreases exponentially with increasing distance, and asymptotically approaches the present ambient noise levels during the day and night.

This decrease is much more drastic during the day than at night, when meteorological and other atmospheric conditions favour the propagation of noise. During the day the resulting total ambient noise level approaches 45 dBA to within 1 dBA at a distance of around 300 m, whereas at night the corresponding distance is at approximately 1000 m.

The full noise study report is included in **Appendix T**.