# MEDUPI POWER STATION
# NEW RAW WATER RESERVOIR AND PIPELINES PROJECT

## VISUAL IMPACT ASSESSMENT

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**Eskom Holdings Limited**


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Lourens du Plessis from MetroGIS (Pty) Ltd undertook the visual impact assessment in his capacity as a visual assessment and Geographic Information Systems specialist. Lourens has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modelling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His GIS expertise are often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd. as an independent specialist consultant to undertake the Visual Impact Assessment and neither the author, nor MetroGIS will benefit from the outcome of the project decision-making.

## 1. INTRODUCTION

Eskom Holdings intends constructing a new raw water reservoir on the farm Kuipersbult 511 LQ south-west of the Medupi power station (currently under construction) in the Lephalale Local Municipality of the Limpopo Province. The reservoir is similar in design to the existing raw water reservoir at the Matimba power station. The dimensions of the reservoir are approximately 400m by 270m (length and width) and 5m above average ground level (based on the dimensions of the existing Matimba reservoir). The outer sidewalls of the reservoir will, once it's constructed, consist of landscaped berms that are re-vegetated to ensure soil stability and minimal visual intrusion.

**Figure 1:** The Matimba power station raw water reservoir adjacent to the parking area. (Note: landscaped and re-vegetated outer wall).

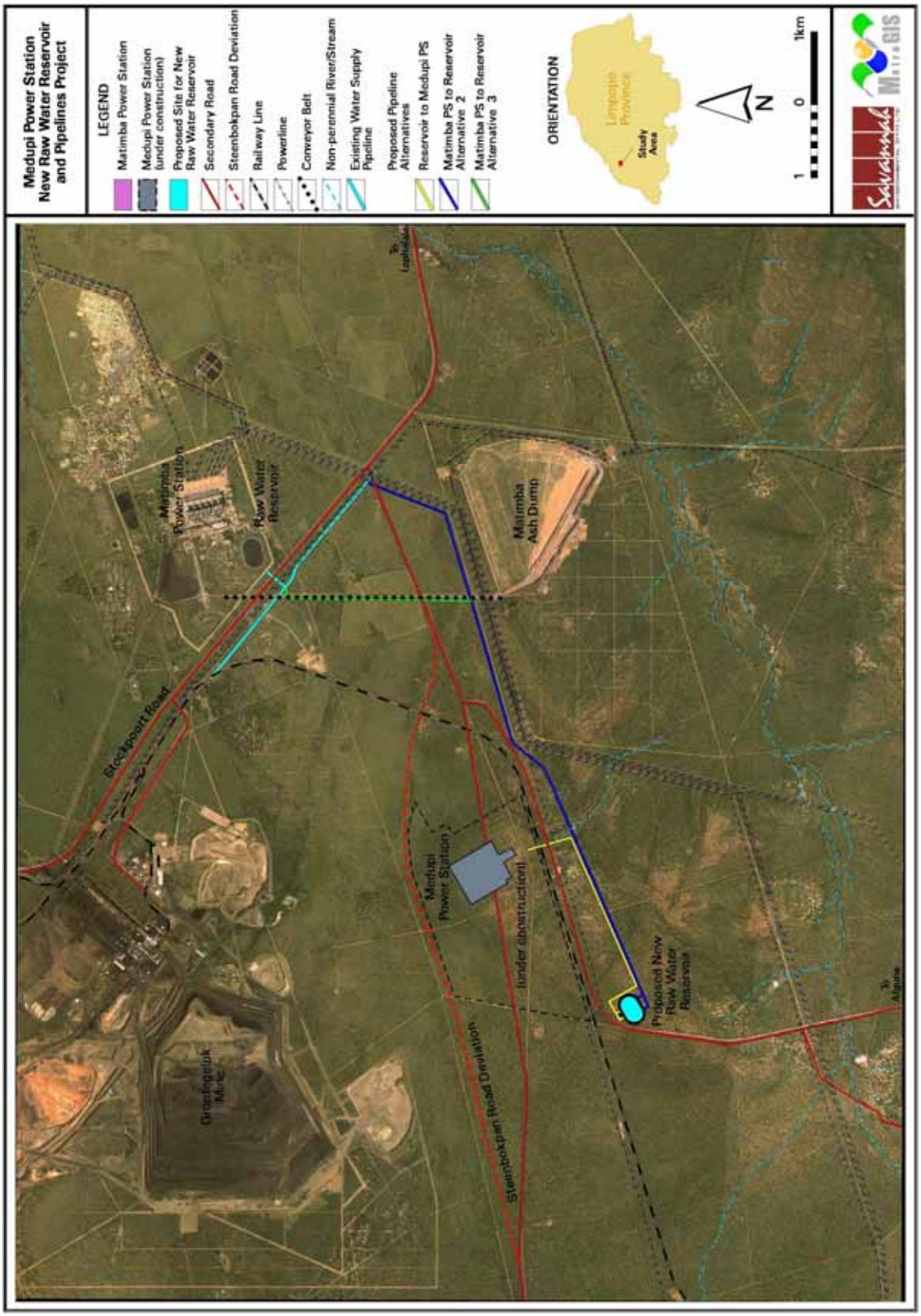


**Figure 2:** Map indicating the position of the proposed new raw water reservoir and the pipeline alternatives.

Additional to the reservoir Eskom intends supplying the Medupi power station with water by means of the construction of an underground pipeline. The source of the water is the existing reservoir at the Matimba power station for which an

underground pipeline will also be constructed in order to supply water to the Medupi reservoir. Two alternative alignments are proposed for the formerly mentioned (Matimba to reservoir) pipeline. These alternatives will be described in greater detail in the report in order to assist in the selection of the preferred alignment.

This report sets out to identify, quantify and offer potential mitigation measures for the possible visual impacts related to the proposed infrastructure mentioned above.

## 2. SCOPE OF WORK

The study area for the new raw water reservoir and the proposed pipelines covers a 175km$^2$ geographical area that includes the Grootegeluk mine and both the Matimba and Medupi power stations.

The scope of work includes the determination of the potential visual impacts in terms of nature, extent, duration, magnitude, probability and significance of the construction and operation of the proposed infrastructure. In this regard specific issues related to the visual impact were identified during a site visit to the affected environment. Issues related to the new raw water reservoir include:

- The potential visual exposure and proximity of the proposed reservoir to observers travelling along the Afguns road.
- The potential visual impact of security and operational lighting at the reservoir.
- The potential visual impact of the construction of security fencing along the perimeter of the reservoir.
- The visual absorption capacity of the natural vegetation and its potential to mitigate visual impacts.

The issue identified for the construction and operation of underground pipelines include:

- The potential visual impact of the removal of natural vegetation for the pipeline servitudes.

## 3. METHODOLOGY FOR THE ASSESSMENT OF THE VISUAL IMPACT

### 3.1. General

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from a combination of the 20 m and 5 m interval contours, supplied by the Surveyor General, Eskom Holdings Limited and Kumba Resources.

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The results of the spatial analysis and other relevant orientation data are displayed on a number of supplementary maps, which will be referred to in the text.

## 3.2. Potential visual exposure

The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed infrastructure, or evidence thereof, weren't visible, no impact would occur.

Viewshed analyses of the proposed reservoir, based on a combined 20m and 5m contour interval digital terrain model of the study area, indicate the potential visual exposure. The visibility analyses were undertaken at an offset of 5m above average ground level (approximate height of the reservoir). Two viewshed analyses were done in order to model the effectiveness of the natural vegetation in containing the visual exposure of the reservoir. In the first viewshed analysis the topography alone determined the exposure of the reservoir, whilst the visual absorption capacity of the vegetation in close proximity to the reservoir were considered during the calculation of the second viewshed analysis.

The first viewshed analysis (Figure 3 - not incorporating vegetation cover) indicates large areas of exposure south and west of the proposed reservoir, including the entire length of the Afguns road. The second viewshed analysis (Figure 4 - including the visual absorption capacity of the vegetation at an average height of 5m above ground level) shows a dramatically reduced area of visual exposure. The reservoir is virtually shielded from any short distance visibility and will only be visible from higher-lying vantage points at viewing distances exceeding 4km.

This exercise clearly indicates the importance of retaining the natural vegetation cover in order to mitigate the potential visual impact of the reservoir.

Viewshed analyses were not undertaken for the pipeline alternatives due to the fact that the infrastructure will be placed underground for the entire length of the proposed alignments and that no pump stations will be erected.

## 3.3. Visual distance / Observer proximity to the facility

The principle of reduced impact over distance is applied in order to determine the core area of visual influence for this type of structure. It is envisaged that the design and the subsequent landscaping/earthing and re-vegetation of the outer walls of the reservoir would not create a significant contrast with the natural environment surrounding the reservoir site. This would not be the case if the reservoir consisted of concrete walls with stark, ridged lines and colours contrasting with the natural vegetation of the region.

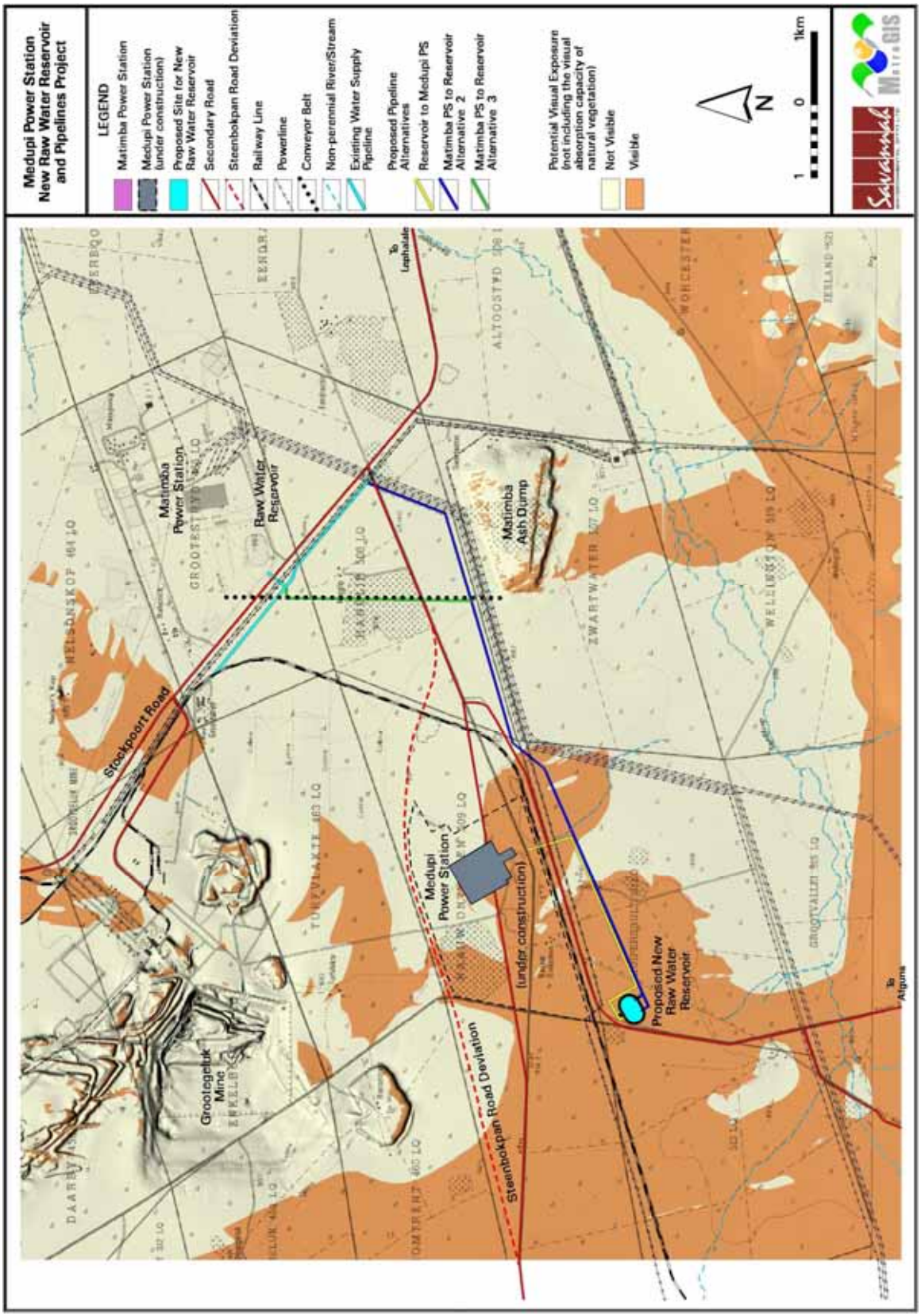


**Figure 3:** Potential visual exposure of the proposed Medupi reservoir (not incorporating vegetation cover).

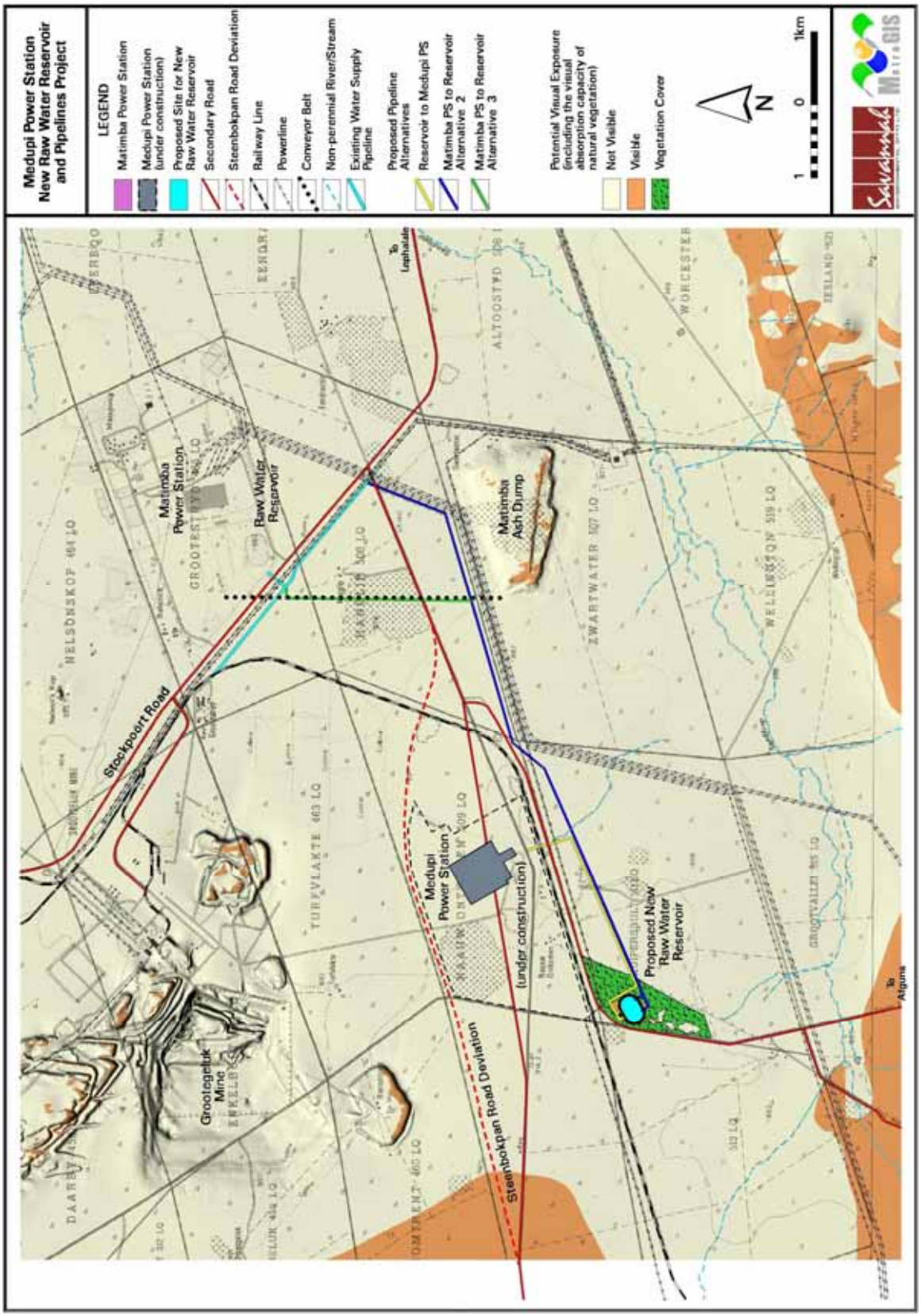


**Figure 4:** Potential visual exposure of the proposed Medupi reservoir (including the visual absorption capacity of vegetation).

The proximity radii for the proposed reservoir are indicated on Figure 5 in order to indicate the scale and viewing distance of the facility and to determine the prominence of the structure in relation to its environment.

The proximity radii chosen for the reservoir, based on its dimensions, are:

- 0 - 500m. Short distance view where the reservoir could potentially dominate the frame of vision and constitute a high visual prominence.
- 500 - 1000m. Medium distance view where the reservoir could potentially be easily and comfortably visible and constitute a medium visual prominence.
- 1000 - 2000m. Medium to longer distance view where the reservoir would become part of the visual environment, but could still be visible and recognisable. This zone constitutes a low visual prominence.
- Greater than 2000m. Long distance view of the reservoir where the structures would more than likely not be visible or recognisable. This zone constitutes a low to negligible visual prominence.

The visual distance theory and the observer's proximity to the facility are closely related, and especially relevant when considered from areas with a high viewer incidence and a potentially negative visual perception of the proposed reservoir.

### 3.4. Viewer incidence / Viewer perception

The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers or if the visual perception of the structure is favourable to all the observers, there would be no visual impact.

It is necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's potential visual sensitivity towards the proposed reservoir. It would be impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer; regularity of sighting, cultural background, state of mind, purpose of sighting, etc. which would create a myriad of options.

Only one area of higher viewer incidence and potentially negative perception of the reservoir was identified (see Figure 5). This area is delineated as a 200m buffer zone along the Afguns road that represents the area with the highest potential sightings of the reservoir (by people travelling along this road). Landowners residing on farms located south of the reservoir site mainly use this road. It is thus not regarded as either a scenic or high volume tourist road, but is still included in the visual impact assessment as a potential worst-case scenario.

The area surrounding the reservoir site, excluding the abovementioned zone, is greatly devoid of random observers or sensitive visual receptors.

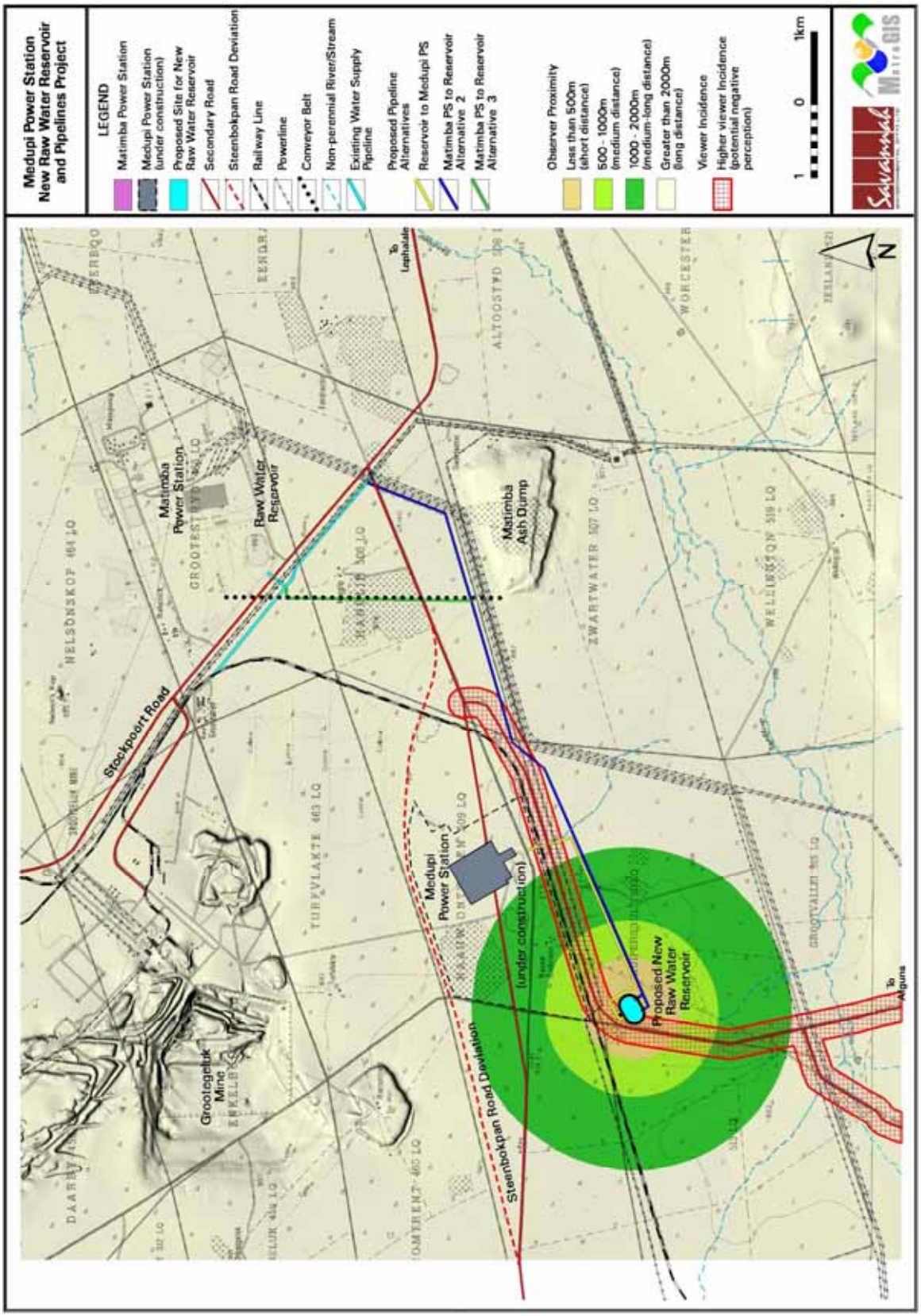


**Figure 5:** Observer proximity to the proposed reservoir and areas of high viewer incidence (discussed under the next heading).

### 3.5. Visual absorption capacity of the natural vegetation

It is has become apparent from site inspections that the visual absorption capacity of the natural veld (thicket, bushland and woodland) would be considerable in mitigating the visual impact of the proposed reservoir. This is true for large tracts of land where the natural vegetation is still intact. The observer would effectively be shielded from the reservoir by dense vegetation adjacent to the road. It is thus imperative that natural vegetation cover, especially along the Afguns road, be retained in order to benefit from the high visual absorption capacity of this region.

### 3.6. Visual impact index

The results of the above analyses were merged in order to determine where the areas of likely visual impact would occur. These areas were further analysed in terms of the previously mentioned issues (related to the visual impact) and in order to judge the severity of each impact.

## 4. REGIONAL OVERVIEW

### 4.1. Description of the affected environment

Cattle and game farming practises dominate the general land-use character of the immediate area south of the proposed reservoir site. The existing Matimba power station, the Grootegeluk coal mine, and the new Medupi power station are located within a 10 km radius north of the reservoir site. The farm immediately north-west of the reservoir site will host the future Medupi ash dump. These power generating and the mining activities have to a large degree set the trend for industrial and mining related land uses in this area.

The dominant topographical unit or terrain type of the study area is plains (i.e. areas with little topographical relief and even slopes). Large man-made topographical features, in the form of the Grootegeluk mining pit and mine dumps, and the Matimba ash dump have altered the relatively flat topography of the area.

The natural vegetation type is woodland, thicket and bushland (generally referred to as bushveld). The natural vegetation cover (for the greater portion of the study area) is relatively undisturbed due to the low success rate with dry-land agriculture in this region.

### 4.2. Site location and description

The reservoir site is located on a weak ridge in the north-western corner of the farm Kuipersbult 511 LQ adjacent to the Afguns road (approximately 50m from the road at the closest point). The natural vegetation on the site has largely been altered through overgrazing, although the vegetation adjacent to the road reserve is still relatively undisturbed. The Afguns road runs alongside the western and northern boundaries of the farm, while transmission line infrastructure spans along the northern, eastern and southern boundaries. A railway line runs parallel to the section of the Afguns road that forms the northern boundary of the farm.

**Figure 6:** Proposed Medupi new raw water reservoir site.

The reservoir to Medupi power station pipeline exits the reservoir on the northern side and runs parallel (south) of the Afguns road (at distances ranging between 600m and 350m) for approximately 2.2km before it veers north underneath the road and railway line towards the Medupi power station.

The Matimba power station to reservoir pipeline Alternative 2 originates at the water supply pipeline south of the Matimba power station. It follows a number of transmission line servitudes (Matimba to Spitskop, Matimba to Pluto, etc.) for almost 4.5km before it veers in a south-easterly direction until it joins with the common section of the reservoir to Medupi pipeline south of the Medupi power station.

The Matimba power station to reservoir pipeline Alternative 3 is a 2.3km connector between the second alternative and the water supply pipeline. It runs adjacent (east) of the Matimba ash conveyor belt until it joins Alternative 2 near the ash dump.

## 5. RESULTS

### 5.1. Visual impact indexes

The visual impact index is a combined weighted index of the visual exposure, the observer proximity and the viewer incidence/perception of the proposed reservoir. The result of the combination of the above criteria gives an indication of the likely area of visual impact. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

Figure 7 shows the visual impact index should the vegetation cover surrounding the reservoir site be removed (i.e. a worst case scenario viewshed analysis). The area of highest potential visual impact is indicated along the Afguns road at a distance of 500m or less from the reservoir. The visual impact rapidly subsides at a distance of a 1000m where the impact is expected to become low and very low beyond the 2000m mark.

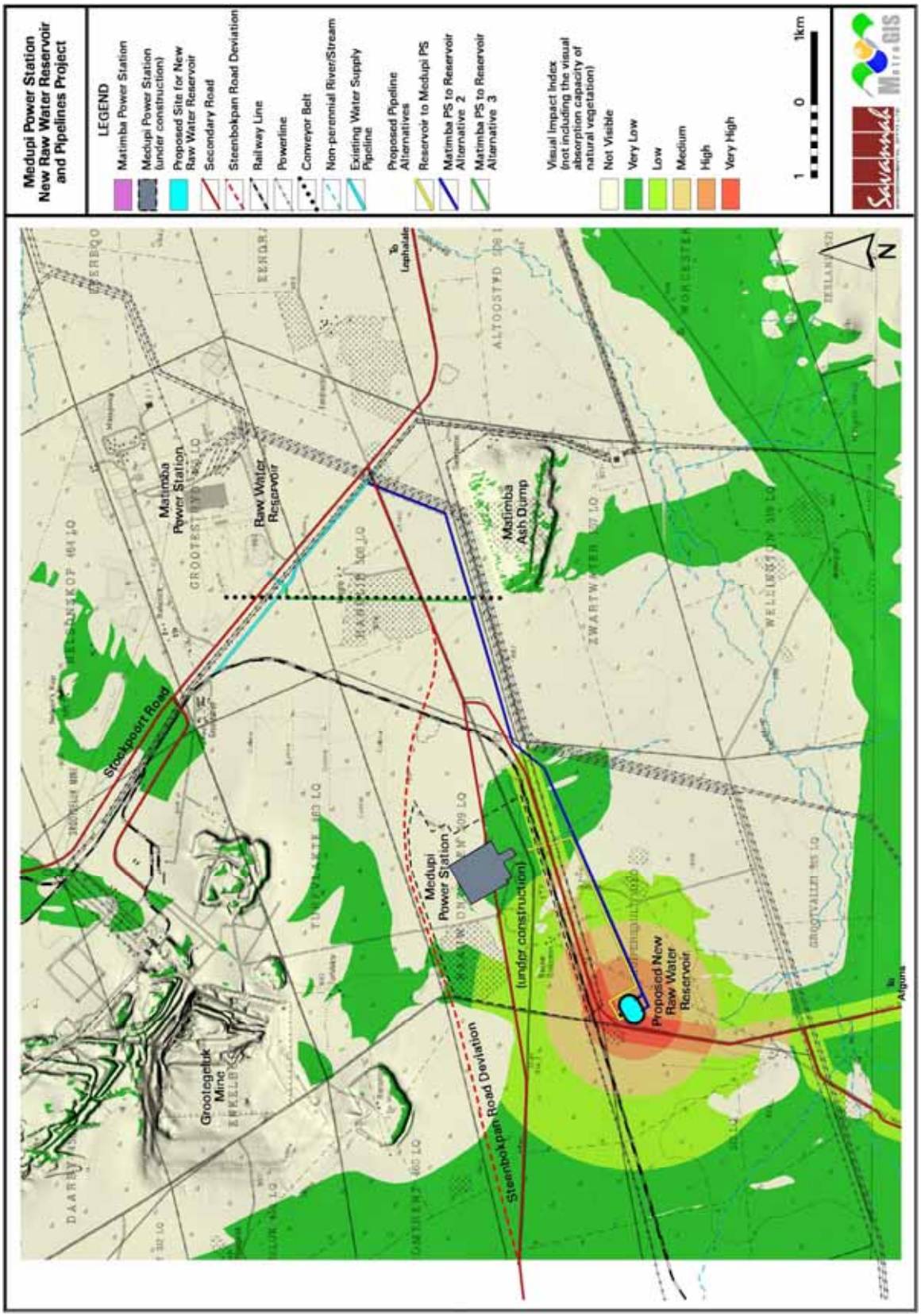


**Figure 7:** Potential visual impact of the proposed Medupi reservoir (not incorporating vegetation cover).

The visual impact index (Figure 8) that includes the viewshed analysis where the vegetation cover was mapped for the area surrounding the reservoir site shows a dramatically reduced area of potential visual impact. The short distance visibility,

where the highest visual impact would normally occur, is absent from this index. The highest visual impact value is indicated as "low" on the index and occurs along the Afguns road where observers travelling north could potentially view the reservoir from a distance of approximately 2000m. This visual impact index clearly illustrates that the visual impact of the reservoir could potentially be mitigated or even negated if proper pre-construction planning is undertaken in order to minimise disturbance to the natural vegetation.

## 5.2. Visual impact assessment

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues related to the visual impact.

The methodology for the assessment of potential visual impacts states the nature of the potential visual impact (e.g. the visual impact on users of the Afguns road) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent (E)** - local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)
- **Duration (D)** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5)
- **Magnitude (M)** - low (= 0-4), medium/moderate (= 4-6), high (= 6-8) and very high (= 8-10)
- **Probability (P)** - very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5)
- **Status** (positive, negative or neutral)
- **Significance (S)** - low, medium or high, where the significance is determined by combining the above criteria in the following formula: S = (E+D+M) P

The significance weighting for each potential visual impact (as calculated above) is as follows:

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 31-60 points: Medium (where the impact could influence the decision to develop in the area)
- >60: High (where the impact must have an influence on the decision to develop in the area)

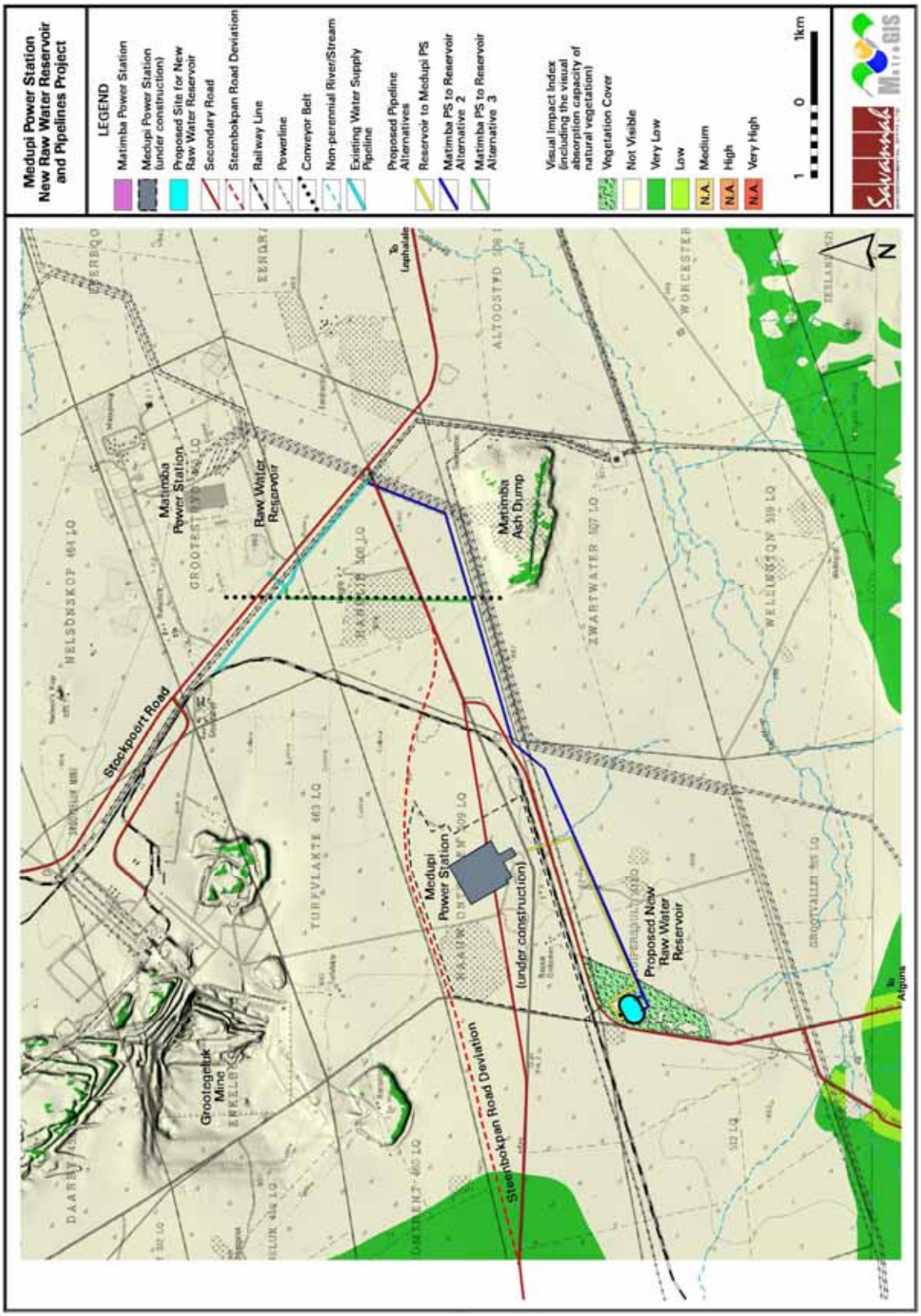


**Figure 8:** Potential visual impact of the proposed Medupi reservoir (including the visual absorption capacity of vegetation).

**Visual impact on users of the Afguns road**

As indicated the primary area of potential visual impact would occur along this section of road within a 500m radius of the reservoir. It was also proven that the mitigation potential for this visual impact is very high if the visual absorption capacity of the natural vegetation along this road is properly utilised (refer 5.1.). To this end the visual impact table shown below indicates the visual impact should the natural vegetation cover be removed between the reservoir site and the road (i.e. no mitigation), as well as the second column that assumes the responsible "protection" of the vegetation cover as a visual barrier between the road and the reservoir (i.e. with mitigation).

**Table 1**: Impact table summarising the significance of visual impacts.

| ***Nature of Impact:*** Potential visual impact on users of the Afguns road | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Local **(4)** | Local **(4)** |
| ***Duration*** | Long term **(4)** | Long term **(4)** |
| ***Magnitude*** | Moderate **(6)** | Low **(2)** |
| ***Probability*** | Probable **(3)** | Improbable **(2)** |
| ***Significance*** | Medium **(42)** | Low **(20)** |
| ***Status (positive or negative)*** | Negative | Negative |
| ***Reversibility*** | None | None |
| ***Irreplaceable loss of resources?*** | No | No |
| ***Can impacts be mitigated?*** | Yes | N.A. |
| ***Mitigation:*** Vegetation cover surrounding the reservoir must be protected in order to act as a visual barrier between the road and all components of the reservoir (including security fencing, lighting structures and access roads). | | |
| ***Cumulative impacts:*** The study area is visually impacted on by an increasing number of mining and power generating activities. Structures and activities in relative close proximity of the proposed reservoir include; two power stations, assorted mining infrastructure, railway lines, power lines, substations, conveyor belts, slimes dams, ash dumps, coal stockpiles, mine dumps, etc. | | |
| ***Residual impacts:*** N.A. | | |

**Figure 9:** Travelling north along the Afguns road. (Note: The proposed reservoir site is situated approximately 50m (at the closest) behind the vegetation cover on the right-hand side of the road).

**The potential visual impact of security fencing and lighting**

It was previously mentioned that the landscaping of the outer walls of the reservoir effectively hides the functional concrete design and structures of the reservoir. Once re-vegetated the reservoir itself virtually disappears "underground". If enough natural vegetation shields the vegetated berms the structure is quite inconspicuous. The photograph below (Figure 10) shows the Matimba power station raw water reservoir and clearly illustrates this point. It does however highlight the presence and prominence of the security fencing and lighting structures associated with this structure. The barbed wire and electrified fence creates a greater visual intrusion than the actual reservoir itself.

**Figure 10:** Matimba power station raw water reservoir security fencing. (Note: The reservoir itself is hardly visible behind the natural vegetation cover).

Should the fencing and lighting have been placed between the reservoir and the natural vegetation coverage the impact of these structures could also have been mitigated or even negated. It is recommended that the security barrier for the new raw water reservoir be offset away from the Afguns road and that a 30m "green" buffer zone is kept in place to shield the observers along this road from both the reservoir and the security structures.

The need for lighting fixtures (flood lights) should be carefully planned and installed in order to avoid the potential visual impact of glare (the effect of staring into the light source) and light trespass (spill light that illuminates adjacent properties). A lighting engineer must be appointed to design the lighting layout for the reservoir and to oversee the placement and construction of these structures. A plan for periodic inspection and timely maintenance of light fixtures must also be implemented and adhered to.

### 5.3. Pipeline alternatives

The clearing of vegetation and the resultant aboveground cleared servitude is the single most visible evidence of the presence of underground infrastructure and the only long-term visual impact of the proposed pipelines. It therefore stands to reason that the utilisation of existing servitudes (i.e. the power line servitudes, the conveyor belt servitude or the railway line servitude) would not cause additional visual impacts. The removal of natural vegetation where the alignments traverse "green fields" sections creates highly visible cut lines. Both of the pipeline alternatives utilise existing servitudes for large sections of their alignments. The section along the ash conveyor belt (Alternative 3) is preferred

from a visual impact perspective, as this servitude is very wide (over 90 metres) and can easily accommodate the pipeline servitude as well.

The section common to both Alternatives 2 and 3 (south of the Afguns Road) will need to traverse natural vegetation and would therefore require the removal of natural vegetation. This section of the pipeline is however relatively far removed from potential observer and is not expected to constitute a significant visual impact.

A similar scenario (i.e. the removal of natural vegetation) as mentioned above, is likely to occur closer to the reservoir site. It is suggested that the pipeline servitudes are offset from the Afguns road and that a green buffer zone be retained adjacent to the road (south of the road). It is further recommended that the pipeline servitudes function as an access road to the reservoir site and that no additional access roads be constructed.

Additional long-term mitigation measures of the pipeline servitudes include the proper re-instatement of the backfilled pipeline trenches to its original soil stability condition, together with the re-vegetation of the topsoil. This will greatly reduce the potential occurrence of unsightly erosion scarring. The pipeline servitude must be periodically revisited in order to determine whether the integrity of the re-instatement/rehabilitated areas remain intact. Problem areas must be identified and proper maintenance should be undertaken on an on-going basis.

## 6. CONCLUSION AND RECOMMENDATIONS

The vegetation cover of this region is possibly the single most important element in the construction and operation of the proposed new raw water reservoir and should be revered as a critical component in the mitigation and potential negation of the visual impact. The protection of the vegetation surrounding the reservoir should therefore be seen as a very high priority in the successful mitigation of the visual impact. It offers a visual impact mitigation opportunity that should be utilised and embraced from the outset lest it be destroyed by poor pre-construction planning and bad construction practises. The professional services of a landscape architect should be acquired in order to create a master plan for the detailed design of the reservoir. Green buffer zones should be reserved or created and maintained at critical areas surrounding the reservoir.

The removal of natural vegetation should be limited to the bare minimum and should not be undertaken without proper planning and delineation. Individual vegetation communities should be identified and earmarked as visual absorption buffer zones. The activities and movement of construction vehicles and personnel during the construction phase should be restricted to help prevent the wanton destruction of natural vegetation that could play an important role in the long term mitigation of visual impacts.

The clearing of vegetation for servitudes should be restricted to the bare minimum required for the servicing and maintenance of infrastructure. The general appearance of construction activities, construction camps (if required) and lay-down areas must be maintained by means of the timely removal of rubble and disused construction materials.

## 7. MANAGEMENT PLAN

The management plan tables aim to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts.

**Table 2**: Management plan - Medupi reservoir.

OBJECTIVE: The mitigation and possible negation of the potential visual impact of the construction and operation of the Medupi reservoir with specific reference to the potential exposure of the project structures to the Afguns road.

| | |
|---|---|
| Project component/s | Medupi reservoir, access roads, security fencing and lighting structures. |
| Potential Impact | The potential exposure to and visual impact on observers traveling along the Afguns road. |
| Activity/risk source | The viewing of the abovementioned project infrastructure from this road. |
| Mitigation: Target/Objective | The shielding of the reservoir and associated project infrastructure by means of the creation of vegetated berms to hide the reservoir and the creation/maintenance of a 30m wide green buffer zone between the project infrastructure and the Afguns road. |

| Mitigation: Action/control | Responsibility | Timeframe |
|---|---|---|
| Undertake proper pre-construction planning, including a master plan indicating site layout and infrastructure placement, proposed buffer zones and access road. | Eskom/landscape architect/lighting engineer. | Pre-construction. |
| Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the bare minimum. | Eskom/contractors. | During construction. |

| | |
|---|---|
| Performance Indicator | The effective concealment of the reservoir and project infrastructure from observers traveling along (especially northwards) the Afguns road. |
| Monitoring | N.A. |

**Table 3**: Management plan - Medupi reservoir underground pipelines.

OBJECTIVE: The mitigation and possible negation of the potential visual impact of the construction and operation of the Medupi reservoir pipelines with specific reference to the potential exposure of the pipeline servitudes to observers.

| | |
|---|---|
| Project component/s | Medupi reservoir pipeline servitudes. |
| Potential Impact | The potential visual impact of cleared servitudes where the pipelines traverse natural vegetation. |
| Activity/risk source | The viewing of the cleared servitudes especially from the Afguns road. |
| Mitigation: Target/Objective | The avoidance (as far as possible) of natural areas and the removal of natural vegetation for the pipeline construction. |

| Mitigation: Action/control | Responsibility | Timeframe |
|---|---|---|
| Restrict vegetation clearing to the bare minimum required for the servicing and maintenance of the pipeline infra-structure | Eskom/contractors. | Pre-construction and construction phases. |
| The general appearance of construction activities, construction camps (if required) and lay-down areas must be maintained by means of the timely removal of rubble and disused construction materials. | Eskom/contractors. | During construction. |
| Undertake proper re-instatement of the backfilled pipeline trenches to its original soil stability condition, together with the re-vegetation of the topsoil to avoid unsightly erosion scarring. | Eskom/contractors. | Construction phase. |
| Do regular inspections of the pipeline servitudes to determine if the integrity of the re-instatement/re-vegetation remains intact. Undertake maintenance if required. | Eskom/contractors. | Operational phase. |

| | |
|---|---|
| Performance Indicator | The pipeline servitudes should appear unobtrusive and not be highly noticeable to observers. |
| Monitoring | N.A. |

## 8. REFERENCES

Department of Environmental Affairs and Tourism, 2001. *Environmental Potential Atlas for the Limpopo Province (ENPAT Limpopo).*

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