PROPOSED RIEMVASMAAK HYDRO ELECTRIC POWER PROJECT
NORTHERN CAPE

VISUAL IMPACT ASSESSMENT

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On behalf of:
Aurecon South Africa (Pty) Ltd.

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EXECUTIVE SUMMARY

Introduction:

RVM 1 Hydro Electric Power (Pty) Ltd (hereinafter referred to as RVM1) wishes to construct a 40 Megawatt (MW) hydropower station on the Orange River, on the farm Riemvasmaak (Remainder of Farm no. 497 and Portion 1 of Farm no. 498), north of the Augrabies Falls within the Augrabies Falls National Park (AFNP), approximately 40 km north west of Kakamas in the Northern Cape Province of South Africa.

Aurecon South Africa (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the Proposed hydropower stations on the Farm Riemvasmaak (Remainder of Farm No. 497 and Portion 1 of Farm 498) on the Orange River in the vicinity of Augrabies, Northern Cape.

The proposed infrastructure is located primarily on Riemvasmaak land, but the water extraction point, the weir, the 33kV power lines and parts of the water conveyance infrastructure traverse SANParks and government land in places. The 33kV-132kV substation and the 132kV overhead power line to the Renosterkop Substation are located primarily on private land.

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed facilities, including related infrastructure, as well as offer potential mitigation measures, where required.

The proposed Riemvasmaak Hydro-Electric Power Project is located on Remainder of Farm no. 497 (private land) and Portion 1 of Farm no. 498 (SANParks land) within the Augrabies Falls National Park, and the infrastructure would be located within an area which is currently zoned as either Primitive or Remote, as demarcated in the Augrabies Falls National Park (AFNP) Management Plan (2013). The proposed options also fall within the priority natural areas buffer as well as the viewshed protection areas.

In terms of the above, the proposed project would ordinarily be fatally flawed from a visual perspective and from a Conservation Management perspective, as it would compromise infrastructure incompatible with the AFNP overall, and its land use zoning. However, the applicant has obtained legal opinion indicating that the AFNP Management Plan may be revised to accommodate the infrastructure pending an Environmental Authorisation.

This VIA therefore assumes the following:

- That the location of the proposed infrastructure within a National Park (and thus also within the demarcated buffer zone) is acceptable in principle and
- That the approved AFNP Management Plan may be revised to accommodate the proposed infrastructure if environmental authorisation is received. It must be noted that amendments to the Management Plan and Zoning must be done according to a legislated process and in terms of the National Protected Areas Act.

The following methodology has been followed for the assessment of visual impact:

- Determine potential visual exposure
- Determine visual distance/observer proximity to the facility
- Determine viewer incidence/viewer perception
- Determine the Visual Absorption Capacity of the natural vegetation
- Determine the visual impact index
- Determine impact significance

Project Description:

Run-of-river hydropower schemes, similar to the proposed intervention, uses the natural flow and drop in elevation a river to produce electricity. A portion of the river's flow is channelled through the hydropower station and through turbines. The spinning of the turbines generate electricity.

A run-of-river hydropower station, like the proposed, consists of the following main components:

- Intake infrastructure (i.e. weir and off-take structure);
- Water conveyance infrastructure (i.e. canal or pipeline);
- Head pond/fore-bay;
- Power station intake structure/penstock;
- Powerhouse; and
- Outlet works/tailrace.

Ancillary infrastructure includes access roads for use during construction and for maintenance purposes during operation, a transmission line for evacuating the energy produced by the hydropower station, a switch-room and transformer yard.

Infrastructure that would be constructed on Riemvasmaak Trust land includes:

- The powerhouse and electrical infrastructure;
- The head-pond (fore-bay);
- A section of the pipeline;
- A section of the underground transmission line; and
- The tailrace.

The following ancillary infrastructure would be constructed on land owned by SANParks:

- Access road;
- A section of the underground transmission line; and
- A section of the pipeline.

Temporary construction infrastructure and roads for the removal and the disposal/transportation of spoil material include the following options:

- Access road to the tailrace, located partially on SANParks land;
- A tunnel between the portal and tailrace;
- A conveyor or haulage-way/cableway;
- Localised depositing (in the river bed) of the material; and
- A stockpile (crusher site) located adjacent to the AFNP.

The electricity generated by the hydropower station will be evacuated via an overhead 132kV power line, spanning between a 33kV to 132kV a substation (located on private land) and the existing Renosterkop substation.

In addition to the above, certain infrastructure would be required during the construction phase to allow for the construction of the weir. This includes temporary caissons (or coffer dams) both upstream and downstream of the infrastructure. It is estimated that these caissons would be at least 7m in height.

Scope of Work:

The scope of work for this assessment 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 hydroelectric power station. Mitigation measures are recommended where appropriate.

In addition, the scope includes a comparative assessment of all alternatives, and a recommendation of the preferred alternatives from a visual perspective.

Issues related to the proposed hydroelectric power stations include the following:

- The visibility of the hydroelectric power station and associated infrastructure to, and potential visual impact on users of roads, including secondary and other roads.
- The visibility of the hydroelectric power station and associated infrastructure to, and potential visual impact on residents of built up areas and towns.
- The visibility of the hydroelectric power station and associated infrastructure to, and potential visual impact on farmsteads and settlements.
- The visibility of the hydroelectric power station and associated infrastructure to, and potential visual impact on tourists and visitors to the Augrabies Falls, with specific reference to the AFNP Tourist Complex, game viewing roads, local hikes and walks along the gorge, and lookout points.
- The potential impact of the hydroelectric power station and associated infrastructure on tourism potential north of the Orange River.
- The potential impact of the hydroelectric power station and associated infrastructure on the visual character of the landscape and the sense of place of the region.
- The potential visual impact of associated infrastructure (i.e. the 132 kV power lines and the 33kV-132kV substation) on sensitive visual receptors.
- Potential cumulative visual impacts.
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts and inform the design process.

The Affected Environment:

On a regional level the study area encompasses the south-eastern section of the Augrabies Falls National Park (AFNP) which is located in the Northern Cape, approximately 120 km west of Upington and west of Kakamas, along the southern edge of the Kalahari Desert and the eastern border of Namibia. Refer to **Map 1**.

In terms of land cover, most of the study area is shrubland, with small patches of thicket and bushland, and large areas of irrigated agriculture along the Orange River. The towns of Augrabies, Witklip, Rooipad lie to the south of the AFNP, and account for the highest population concentration in the region. Settlements and homesteads are limited in number, and clustered along the secondary roads.

The very limited large scale electricity and industrial infrastructure within the region includes the Renosterkop Substation in the south east and the Blouputs to Renosterkop 1 132kV power line.

Refer to **Map 3**. This map illustrates the Augrabies Falls National Park Use Zones, as well as Special Management Areas. Of note is that the use zones include the Riemvasmaak (Melkbosrant) section that is managed as part of the AFNP. The purpose of the park zoning is, "*To establish a coherent spatial framework in and around a park to guide and co-ordinate conservation, tourism and visitor experience initiatives*". The zoning of AFNP was based on an analysis and mapping of the sensitivity and value of the park's biophysical, heritage and scenic resources; an assessment of the regional context; and an assessment of the park's current and planned infrastructure and tourist routes / products; all interpreted in the context of park objectives.

The proposed RVM hydroelectric project is located within the *Primitive* and *Remote* zones of the park. The power station and associated infrastructure, although located on Riemvasmaak land, is situated within the *Remote* zone while the water conveyance and electricity distribution infrastructure and access road span across the *Primitive* zone. The weir for water abstraction from the Orange River is also situated within this zone.

The *Remote* zone's characteristics are summarised as: "*Retains an intrinsically wild appearance and character, or capable of being restored to such*", where the experience should be one of solitude and awe inspiring natural characteristics. Aesthetic and recreational conservations objectives for this zone is: "*The area should be kept in a natural state, and activities which impact on the intrinsically wild appearance and character of the area, or which impact on the wilderness characteristics of the area (solitude, remoteness, wildness, serenity, peace etc.) should not be allowed*".

The *Primitive* zone should "*generally retain its wilderness qualities, but with basic self-catering facilities (concession facilities may be more sophisticated). Access is controlled. Provides access to the Remote Zone, and can serve as a buffer*". This zone is suitable for small, basic, self-catering; or limited concessions with limited numbers (concession facilities may be more sophisticated); 4x4 trails; hiking trails.

The power station and associated infrastructure is further located within the *Visual Protection* Special Management Area. This area is described as "*Areas where developments could impact on the aesthetic quality of a visitors experience in a park. This zone is particularly concerned with visual impacts (both day and night), but could also include sound pollution".*

<u>Results: Potential Visual Exposure</u>

The visual exposure and ultimately the visual impact of the power station and pipeline, is expected to be predominantly relevant for the construction phase (two years). This is if the infrastructure is buried underground for the entire operational phase of the project. Visual exposure is expected to be restricted to tracks and pipeline servitudes (i.e. features without any vertical dimensions) only and vehicular movement (and human activity) along the linear infrastructure and at the power station site should be very limited (i.e. virtually negligible).

Activities and equipment at the crusher site (stockpile – spoil disposal option B) may however only abate after ten years. The 33kV-132kV substation and overhead power line would be visible for their entire lifespan. The weir would similarly be exposed for the duration of the operational phase of the project, albeit within a very contained area of exposure due to its low-lying position in the river.

Maps 4 to **8** sequentially indicate the visual exposure of:

- The weir and water conveyance pipelines;
- The access road to the tailrace (proposed spoil transport option 1);
- The conveyor or cableway/haulage-way (proposed spoil transport options 3 & 4);
- The stockpile/crusher site (spoil disposal option B); and
- The 33kV-132kV substation and overhead power line.

In each case the height of the proposed structures/activities were used to model the potential visual exposure (e.g. the offset above ground level of the stockpile was indicated as 3m and thus modelled). These offsets are indicated in the legend for each map.

Viewshed analyses for the large scale study area were done utilising a very accurate Lidar DTM that incorporates both surface elevation and structures/vegetation cover. The DTM for the small scale study area is based on the 5m interval contours data, which is still very accurate, but does not incorporate vegetation cover of man-made structures.

Results: Visual distance / observer proximity

MetroGIS determined proximity offsets based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger facilities and downwards for smaller facilities (i.e. depending on the size and nature of the proposed infrastructure).

The proximity offsets (calculated from the centre line of the project infrastructure) are as follows:

- 0 – 1km - Short distance view where the infrastructure would dominate the frame of vision and constitute a very high visual prominence.
- 1km – 2km - Medium distance views where the infrastructure would be easily and comfortably visible and constitute a high visual prominence.
- 2km – 4km - Medium to longer distance view where the infrastructure would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 4km - Long distance view where the infrastructure would still be visible though not as easily recognisable. This zone constitutes a low visual prominence for the infrastructure.

Results: Viewer incidence / viewer perception

Viewer incidence is calculated to be the highest within the built-up areas (i.e. where there are concentrations of people). In addition, a higher incidence of visual receptors is expected along the roads within the study area. Commuters and tourists using these roads could be negatively impacted upon by visual exposure to the project infrastructure/activities, and are thus considered to be sensitive to visual intrusion.

Other than the above, viewer incidence will be concentrated within the agricultural homesteads and settlements and tourist complexes within the study area. Residents of these homesteads and settlements (who will be exposed while at home) are considered sensitive to visual impact.

Tourists visiting the Augrabies Falls and the National Park are considered to be very sensitive to visual impacts, especially those exposed to the infrastructure from elevated vantage points and trails along the gorge.

The scenic nature of the area and the tourism within the region implies that some homesteads may operate as tourist facilities, and that many roads may be used by tourists as scenic drives and/or tourist access routes.

The severity of the visual impact on visual receptors decreases with increased distance from the proposed infrastructure/activities.

Overall, due to the scenic nature of the Augrabies National Park, and the unique landmark status of the Augrabies Falls themselves (which are considered to have an irreplaceable scenic value), it is assumed that the perception of the proposed infrastructure will be negative by all receptors.

<u>Results: Visual absorption capacity:</u>

Overall, the Visual Absorption Capacity (VAC) of the receiving environment is generally deemed low by virtue of the nature of the vegetation and the low occurrence of urban development.

Within the towns, VAC will be of some relevance, due to the presence of buildings and structures, referred to as visual clutter. In this respect, the presence of the built-up environment will 'absorb' the visual impact to some extent. Therefore, VAC will be taken into account within the towns and built up areas only.

<u>Results: Visual impact index:</u>

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed infrastructure are displayed on the Visual Impact Index Maps that follow.

Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values have been assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

An area with short distance, high frequency of visual exposure to the proposed infrastructure, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

<u>Visual impact assessment:</u>

For each impact, the EXTENT (spatial scale), MAGNITUDE and DURATION (time scale) would be described. These criteria would be used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the EIAR would represent the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented.

The following assessments are relevant for this project:

- Potential visual impact on users of secondary and other roads in close proximity of the proposed power stations (i.e. where visible within a 1km of the proposed infrastructure) is expected to be of **moderate** significance for all options and may be mitigated to **low**.
- The potential visual impact on residents of built-up areas and towns within the region is expected to be of **low** significance for all options, before and after mitigation.
- The visual impact on sensitive visual receptors (i.e. users of roads and residents of homesteads and settlements) within the region beyond the 1km offset is expected to be of **low** significance for all options, before and after mitigation.
- Potential visual impact on tourists and visitors to the Augrabies Falls (especially the AFNP Tourist Complex and local hikes and walks along the gorge) are expected to be of **moderate** significance and may be mitigated to **low.**
- The visual impact of the 132kV overhead power line expected to be of **moderate** significance. No mitigation is possible.

- The anticipated visual impact of construction is likely to be of **moderate** significance, both before and after mitigation.
- The anticipated visual impact of the facility on the regional visual quality, and by implication on the sense of place of the region is expected to be of **moderate** significance during the construction phase and **low** during the operational phase.
- Potential visual impact on tourism potential north of the Orange River is expected to be **low** as the project infrastructure will be placed below ground.

<u>Conclusion:</u>

The proposed Riemvasmaak Hydro Electric Power Station, substation, associated overhead power line and additional infrastructure (e.g. possible stockpile, conveyor, etc.) have the potential to negatively impact on the scenic resources of the region. This is especially relevant for the construction phase of the project. The movement of equipment and large construction vehicles, as well as the activities related to the construction phase (e.g. the transportation of spoil material) is expected to be visible from areas considered sensitive to visual intrusion. During the operational phase of the project, the visual impact is expected to be virtually entirely negated due to the placement of the project infrastructure underground, the limited servicing and maintenance requirements of the equipment, and the absence of night-time lighting.

The substation, overhead power line and stockpile/crusher site (if required) may be the only structures evident for the duration of the operational phase. These are not situated within the AFNP, are generally remotely located away from sensitive visual receptors and are not overtly intrusive.

Considering the above, it is the opinion of the author that the significance of impacts may be reduced to an acceptable level by implementing recommended mitigation measures. In this respect, the proposed project is considered acceptable from a **purely visual perspective** (i.e. not considering potential land use conflicts).

The outcome of the visual impact assessment report (i.e. whether the project proposal should be supported or rebutted) still hinges on the principle of whether it is desirable to construct commercial power generation infrastructure within areas that have specifically been earmarked for conservation and tourism activities.

<u>Impact Statement:</u>

The proposed Riemvasmaak Hydro-Electric Power Project is located on Remainder of Farm no. 497 (private land) and Portion 1 of Farm no. 498 (SANParks land) within the Augrabies Falls National Park, and the infrastructure would be located within an area which is currently zoned as either Primitive or Remote, as demarcated in the Augrabies Falls National Park (AFNP) Management Plan (2013). The proposed options also fall within the priority natural areas buffer as well as the viewshed protection areas.

In terms of the above, the proposed project would ordinarily be fatally flawed from a visual perspective and from a Conservation Management perspective, as it would compromise infrastructure incompatible with the AFNP overall, and its land use zoning. However, the applicant has obtained legal opinion indicating that the AFNP may be rezoned to accommodate the infrastructure pending an Environmental Authorisation.

Therefore, the recommendation of this VIA is that the project as proposed be supported, provided the following is in place:

- That all mitigation of visual impacts as proposed during planning, construction, operation and decommissioning is implemented;
- That the SANParks authority endorses the proposal and

- That the Augrabies Falls National Park Zoning Plan is legally and successfully revised to accommodate the development.

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1. STUDY APPROACH

1.1. Qualification and Experience of the Practitioner

MetroGIS (Pty) Ltd, specialising in visual assessment and Geographic Information Systems, undertook this visual assessment.

Lourens du Plessis, the lead practitioner undertaking the assessment, has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990.

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

The visual assessment team is familiar with the "Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes" (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning) and utilises the principles and recommendations stated therein to successfully undertake visual impact assessments. Although the guidelines have been developed with specific reference to the Western Cape Province of South Africa, the core elements are more widely applicable.

Aurecon South Africa (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the Proposed Riemvasmaak Hydro-Electric Power Project in the Northern Cape.

Neither the author nor MetroGIS will benefit from the outcome of the project decision-making.

1.2. Assumptions and Limitations

This assessment was undertaken during the planning stage of the project and is based on information available at that time.

In addition to the fact that the proposed Riemvasmaak Hydro-Electric Power Project is located on Remainder of Farm no. 497 (private land) and Portion 1 of Farm no. 498 (SANParks land) within the Augrabies Falls National Park, the infrastructure would be located within an area which is currently zoned as either Primitive or Remote, as demarcated in the Augrabies Falls National Park (AFNP) Management Plan (September 2013) and falls in the 'special management area' category of visual protection. Further to restricting infrastructural development for tourism, this zone also requires that a 'wilderness quality' be retained.

The proposed options also fall within the priority natural areas buffer as well as the viewshed protection areas. Consideration should therefore also be given to the National Strategy on Buffer Zones around National Parks.

In terms of the above, the proposed project would ordinarily be fatally flawed from a visual perspective[1] and from a Conservation Management[2] perspective, as it would

[1] The Protected Areas Act controls development in protected areas and areas adjacent thereto. Until such a time as the AFNP Management Plan is revised, the proposed site is still located within and / or close to a Protected Area.

[2] Until such a time as the AFNP Mangement Plan is revised, the proposed site is still located within land use zones incompatible with such development.

comprise infrastructure incompatible with the AFNP overall, and its land use zoning. However, the applicant has obtained legal opinion indicating that the AFNP may be rezoned to accommodate the infrastructure pending an Environmental Authorisation. This VIA therefore assumes the following:

- That the location of the proposed infrastructure within a National Park (and thus also within the demarcated buffer zone) is acceptable in principle and
- That the approved AFNP Management Plan may be revised to accommodate the proposed infrastructure if environmental authorisation is received. It must be noted that amendments to the Management Plan and Zoning must be done according to a legislated process and in terms of the National Protected Areas Act.

In this respect, the VIA will consider all visual aspects independently of the above, which would ordinarily comprise a fatal flaw from a visual perspective.

The entire project infrastructure, located within the Riemvasmaak and SANParks land, are planned to be located below ground for the duration of the operational lifespan of the facility. This is not considered a mitigation measure but rather the point of departure for the visual impact assessment (VIA). This report will not address/entertain the placement of any aboveground infrastructure within these areas during the assessment of operational phase visual impacts. Aboveground structures, activities and equipment are assessed for the construction phase of the project.

According to the client, no lighting whatsoever will be associated with this development, therefore the potential visual impact of lighting will not be assessed as part of this VIA.

Lastly, the potential visual impact of a the proposed development limiting the flow of water over the Augrabies Falls will in all likelihood be a perception (or perceived visual impact) amongst a limited number of observers that are aware of the hydro-power schemes. There are a number of factors (e.g. periods of low rainfall and other water retaining developments or water extraction upstream from this point) that may influence the flow of water over the falls that are not related to the development. Therefore it is very difficult to quantify this potential visual impact either during daytime operations, or night-time water extraction. It is however necessary to state this potential visual impact as this issue may arise during public consultation.

1.3. Level of Confidence

Level of confidence[3] is determined as a function of:

- The information available, and understanding of the study area by the practitioner:

    - 3: A high level of information is available for the study area and a thorough knowledge base could be established during site visits, surveys etc. The study area was readily accessible.
    - 2: A moderate level of information is available for the study area and a moderate knowledge base could be established during site visits, surveys etc. Accessibility to the study area was acceptable for the level of assessment.
    - 1: Limited information is available for the study area and a poor knowledge base could be established during site visits and/or surveys, or no site visit and/or surveys were carried out.

[3] Adapted from Oberholzer (2005).

- The information available, understanding of the project and experience of this type of project by the practitioner:

  - 3: A high level of information and knowledge is available of the project and the visual impact assessor is well experienced in this type of project and level of assessment.
  - 2: A moderate level of information and knowledge is available of the project and the visual impact assessor is moderately experienced in this type of project and level of assessment.
  - 1: Limited information and knowledge is available of the project and the visual impact assessor has a low experience level in this type of project and level of assessment.

These values are applied as follows:

Table 1: Level of confidence.

	Information on the project & experience of the practitioner			
Information on the study area		**3**	**2**	**1**
	3	9	6	3
	2	6	4	2
	1	3	2	1

*The level of confidence for this assessment is determined to be **6** and indicates that the author's confidence in the accuracy of the findings is moderate to high:*

- The information available, and understanding of the study area by the practitioner is rated as **2** and
- The information available, understanding and experience of this type of project by the practitioner is rated as **3**.

1.4. Methodology

The study was undertaken using Geographic Information Systems (GIS) technology as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. Detailed Digital Terrain Models (DTM) for the study area was created from 5m interval contours supplied by the Chief Directorate National Geo-Spatial Information and from Lidar data supplied by the client.

The approach utilised to identify potential issues related to the visual impact included the following activities:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment;
- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.;
- The identification of sensitive environments upon which the proposed facility could have a potential impact;
- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed facility, including related infrastructure, as well as offer potential mitigation measures, where required.

The following methodology has been followed for the assessment of visual impact:

- **Determine Potential visual exposure**

  The visibility or visual exposure of any structure or infrastructure is the point of departure for the visual impact assessment. It stands to reason that if the proposed infrastructure were not visible, no impact would occur.

  Viewshed analyses of the proposed infrastructure indicate the potential visibility.

- **Determine Visual Distance/Observer Proximity to the facility**

  In order to refine the visual exposure of the infrastructure on surrounding areas/receptors, the principle of reduced impact over distance is applied in order to determine the core area of visual influence.

  Proximity radii for the proposed infrastructure are created in order to indicate the scale and viewing distance of the infrastructure and to determine the prominence thereof in relation to their environment.

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

- **Determine 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, then there would be no visual impact, although potential visual receptor (i.e. future use) will need to be considered. If the visual perception of a structure is favourable to all observers, then the visual impact would be positive.

  It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed facility and its related infrastructure.

  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, and purpose of sighting which would create a myriad of options.

- **Determine the Visual Absorption Capacity of the natural vegetation**

  This is the capacity of the receiving environment to absorb the potential visual impact of the proposed infrastructure. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing sparse and patchy vegetation will have a low VAC.

  The VAC would also be high where the environment can readily absorb the structure in terms of texture, colour, form and light / shade characteristics of the structure. On the other hand, the VAC for a structure contrasting markedly with one or more of the characteristics of the environment would be low.

The VAC also generally increases with distance, where discernible detail in visual characteristics of both environment and structure decreases.

- **Determine the Visual impact index**

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

- **Determine Impact significance**

  The potential visual impacts identified and described are quantified in their respective geographical locations in order to determine the significance of the anticipated impact. Significance is determined as a function of extent, duration, magnitude and probability.

2. BACKGROUND

*The following background information and project description has been adapted from the Aurecon document referenced as: '**Project** 108361 **File** Document3 **1 October 2013** Revision 1'.*

RVM 1 Hydro Electric Power (Pty) Ltd (hereinafter referred to as RVM1) wishes to construct a 40 Megawatt (MW) hydropower station on the Orange River, on the farm Riemvasmaak (Remainder of Farm no. 497 and Portion 1 of Farm no. 498), north of the Augrabies Falls, approximately 40 km north west of Kakamas in the Northern Cape Province of South Africa.

The proposed infrastructure is located primarily on Riemvasmaak land, but the water extraction point, the weir, the 33kV power lines and parts of the water conveyance infrastructure traverse SANParks and government land in places. The 33kV-132kV substation and the 132kV overhead power line to the Renosterkop Substation are located primarily on private land.

Description of a general run-of-river hydropower scheme:

Run-of-river hydropower schemes, similar to the proposed intervention, use the natural flow and drop in elevation of a river to produce electricity. A portion of the river's flow is channelled through the hydropower station and through turbines. The spinning of the turbines generate electricity.

Figure 1 below is a schematic illustration of a general run-of-river hydropower scheme. The second illustration gives a rough indication of the same components/infrastructure as envisaged for the Riemvasmaak hydropower project. It should be noted that the latter's infrastructure is located below ground.

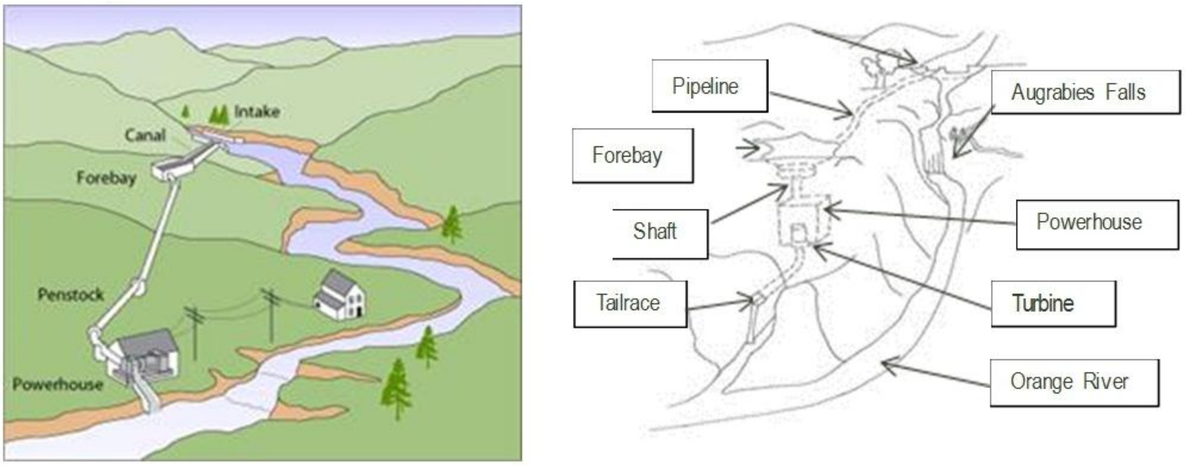


Figure 1: Schematic representation of a run-of-river hydropower scheme.

Works to be constructed:

A run-of-river hydropower station, like the proposed, consists of the following main components:

- Intake infrastructure (i.e. weir and off-take structure);
- Water conveyance infrastructure (i.e. canal or pipeline);
- Head pond/fore-bay;
- Power station intake structure/penstock;
- Powerhouse; and
- Outlet works/tailrace.

Ancillary infrastructure includes access roads for use during construction and for maintenance purposes during operation, a transmission line for evacuating the energy produced by the hydropower station, a switch-room and transformer yard.

Infrastructure that would be constructed on Riemvasmaak Trust land includes:

- The powerhouse and electrical infrastructure;
- The head-pond (fore-bay);
- A section of the pipeline;
- A section of the underground transmission line; and
- The tailrace.

The following ancillary infrastructure would be constructed on land owned by SANParks:

- Access road;
- A section of the underground transmission line; and
- A section of the pipeline.

Temporary construction infrastructure and road for the removal and the disposal/transportation of spoil material include the following options:

- Access road to the tailrace, located partially on SANParks land;
- A tunnel between the portal and tailrace;
- A conveyor or haulage-way/cableway;
- Localised depositing (in the river bed) of the material; and
- A stockpile (crusher site) located adjacent to the AFNP.

The electricity generated by the hydropower station will be evacuated via an overhead 132kV power line, spanning between a 33kV to 132kV substation (located on private land) and the existing Renosterkop substation.

Description of scheme arrangements/alternatives for this project

Please refer to **Maps 1** and **2** for the location of the proposed infrastructure. The proposed infrastructure and alternatives/options as numbered on the maps correlate with the numbers indicated below.

Abstraction point in the Orange River (1)

The proposed intervention would entail the construction of a weir (of a height not greater than 5m) and off-take structure for the abstraction of water at a maximum rate of not more than 35 cubic meters per second (m^3/s). The takeoff structure may include an operable gate to provide a precise control of water to be diverted away from the Augrabies Falls and down the dry watercourse. This would be operated in such a way as to allow agreed reserve flows to pass the weir and remain within the Orange River and only take water for the purpose of power generation that is surplus to the environmental reserve flow requirement.

The takeoff structure would consist of a predominantly concrete structure built into the right side of the weir. In addition to the concrete weir, the takeoff structure would comprise a trash rack and an operable gate. The takeoff structure would form part of the weir as one homogenous structure.

In addition to the above, certain infrastructure would be required during the construction phase to allow for the construction of the weir. This includes temporary caissons (or coffer dams) both upstream and downstream of the infrastructure. It is estimated that these caissons would be at least 7 m in height.

Water conveyance infrastructure (underground pipeline – 2, 3 and 4)

There are two alternative alignments and one mitigation deviation proposed for the underground pipeline. The **preferred alternative** (2) is an approximately 4.6km alignment traversing between the weir and the power chamber. The **alternative alignment** (3) follows an existing road and is marginally longer than the former alternative. The **mitigation alternative** (4) suggests a slight deviation from the previous alternatives near the power chamber in order to circumvent potentially sensitive heritage sites.

A head-pond (fore-bay) would be located downstream of the water conveyance infrastructure and immediately upstream of the penstock for the power station. The head-pond accumulates water and controls the rate of flow of water into each penstock. An overflow from the head-pond would be required in the event of machine shutdown or in the event that the flow of water in the water conveyance infrastructure is greater then what the turbines could utilise. After running through the turbine, the abstracted water would be returned to the Orange River through the outlet works (tail-race).

Figure 2: Forebay. (*Note for the proposed project this structure will measure as much as 20m x 20m in plan.)*

Figure 3: Underground power house. (*Note for the proposed project the infrastructure would be smaller.)*

Figure 4: Outfall from the underground power station. (*Note for the proposed project this infrastructure would be smaller, approximately 4m in diameter.)*

High voltage distribution infrastructure (33kV underground power line - 5 and 6), 33kV-132kV substation and 132kV overhead power line

The electricity generated by the power station is intended to be evacuated via an underground power line located in the same trenching used for the water conveyance infrastructure for the most part. The **route option 1** (9.7km) will then follow the upgraded access road and the AFNP boundary to the proposed 33kV-132kV substation near the Rhino gate. The **route option 2** (7.4km) also follows an existing road but is the shorter of the two, with a straighter approach.

Electricity from the 33kV-132kV substation will connect with the national grid at the Renosterkop substation south-east of Augrabies by means of a 16km overhead power line. The alignment traverses north of the Orange River, before crossing the river north-east of Augrabies and continuing southwards towards the existing Renosterkop substation.

Spoil transport options (7, 8 and 9)

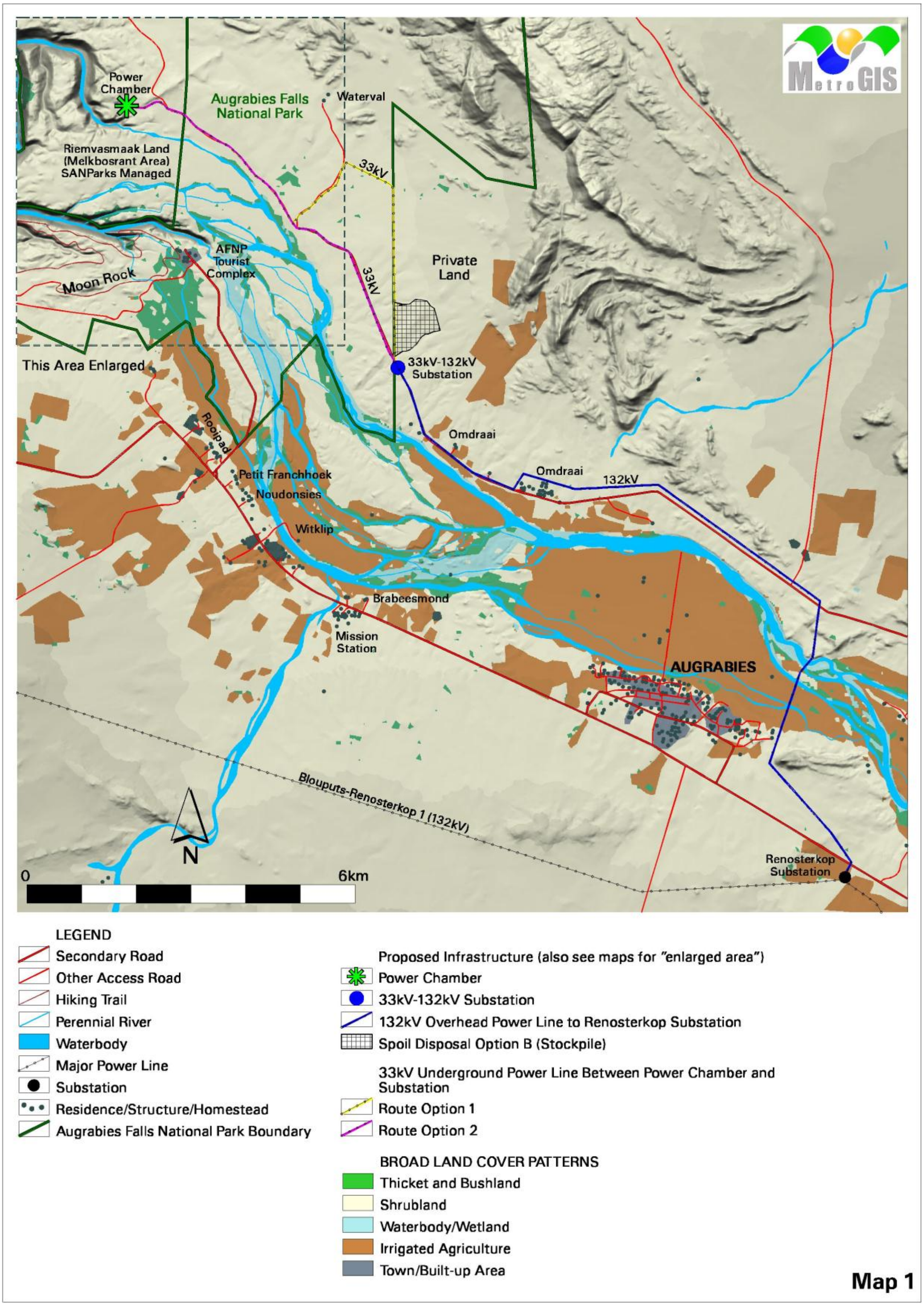
The spoil transport **option 1** is a new 8.4km road connecting between the tail-race and the site access road. Trucks will transport the spoil material along this road for the entire duration of the construction phase of the project. Alternatively a tunnel between the tunnel portal and the tail-race is suggested as **option 2** for the removal of spoil material from the construction site. **Options 3** and **4** are the construction of a temporary conveyor (3) or cableway/haulage-way (4). Both of these options will have the same alignment as indicated on **Map 2**. The spoil material for Options 2, 3 and 4 will be carted away along the existing/upgraded access road.

Figure 5: Example of a haulage-way utilised to remove spoil material from a dam construction site. (The skip in this photo is likely to be an open bin at the RVM site).

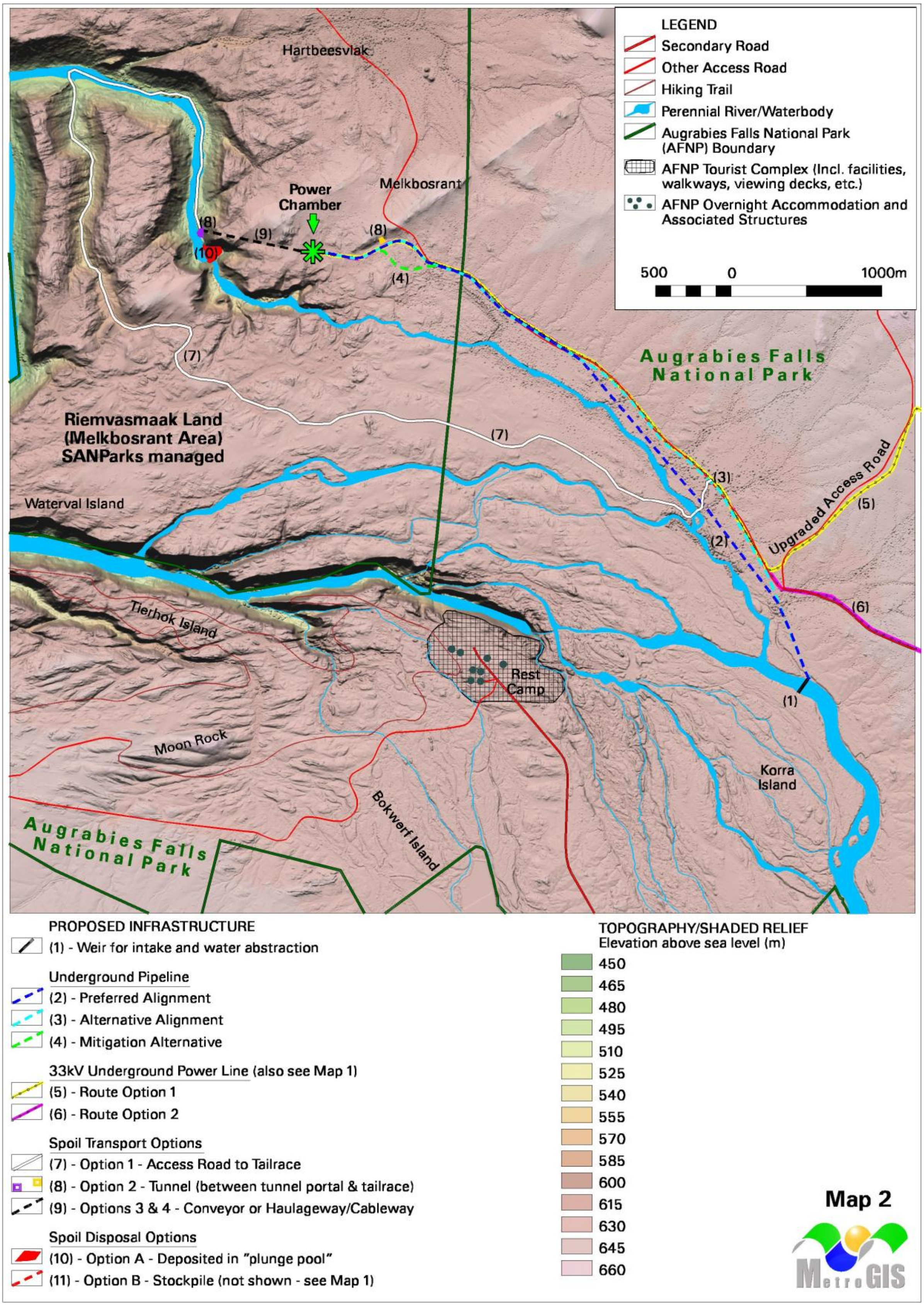
Figure 6: Example of a conveyor utilised for spoil transportation.

Spoil disposal options (10 and 11)

Spoil material removed from the construction site can either be deposited in a "plunge pool" located near the tail-race (**option 10**), or it can be transported by means of one of the transport options discussed above, to be stored at a site until such time as it can be reused. The intention is to crush the spoil material for utilisation in the building of roads. The location of the stockpile (**option 11**) and crusher site is near the AFNP Rhino Gate and is indicated on **Map 1**.



Map 1: Regional locality and broad land cover patters.



Map 2: Shaded relief.

3. SCOPE OF WORK

The project infrastructure for the proposed Riemvasmaak Hydro Electric Project covers an expansive surface area. The project is therefore addressed at two different scales. The first study area covers a surface area of 266km^2 and provides a regional perspective of the entire project infrastructure, from the power station located in the north-west to the Renosterkop substation in the south-east. The second larger scale study area (36km^2) focusses on the detailed infrastructure located between the power station and the water abstraction point along the Orange River.

The scope of work for this assessment 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 hydroelectric power station. Mitigation measures are recommended where appropriate.

In addition, the scope includes a comparative assessment of all alternatives, and a recommendation of the preferred alternatives from a visual perspective.

Issues related to the proposed hydro electric power stations include the following:

- The visibility of the hydro electric power station and associated infrastructure to, and potential visual impact on users of roads, including secondary and other roads.
- The visibility of the hydro electric power station and associated infrastructure to, and potential visual impact on residents of built up areas and towns.
- The visibility of the hydro electric power station and associated infrastructure to, and potential visual impact on farmsteads and settlements.
- The visibility of the hydro electric power station and associated infrastructure to, and potential visual impact on tourists and visitors to the Augrabies Falls, with specific reference to the AFNP Tourist Complex, game viewing roads, local hikes and walks along the gorge, and lookout points.
- The potential impact of the hydro electric power station and associated infrastructure on tourism potential north of the Orange River.
- The potential impact of the hydroelectric power station and associated infrastructure on the visual character of the landscape and the sense of place of the region.
- The potential visual impact of associated infrastructure (i.e. the 132 kV power lines and the 33kV-132kV substation) on sensitive visual receptors.
- Potential cumulative visual impacts.
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts and inform the design process.

4. RELEVANT LEGISLATION AND GUIDELINES

The following legislation and guidelines have been considered in the preparation of this report:

- The Environmental Impact Assessment Amendment Regulations, 2010;
- Guideline on Generic Terms of Reference for EAPs and Project Schedules (DEADP, Provincial Government of the Western Cape, 2011).
- The Augrabies Falls National Park Management Plan, 2013.
- Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning).

5. THE AFFECTED ENVIRONMENT

On a regional level the study area encompasses the south-eastern section of the Augrabies Falls National Park (AFNP) which is located in the Northern Cape, approximately 120 km west of Upington and west of Kakamas, along the southern edge of the Kalahari Desert and the eastern border of Namibia. Refer to **Map 1**.

In terms of land cover, most of the study area is shrubland, with small patches of thicket and bushland, and large areas of irrigated agriculture along the Orange River. The towns of Augrabies, Witklip, Rooipad lie to the south of the AFNP, and account for the highest population concentration in the region. Settlements and homesteads are limited in number, and clustered along the secondary roads.

The very limited large scale electricity and industrial infrastructure within the region includes the Renosterkop Substation in the south east and the Blouputs to Renosterkop 1 132kV power line.

(*The following description has been adapted from the 'Augrabies National Park, Park Management Plan' dated 2013.*)

The local municipalities within the study area include the Siyanda District Municipality and the Kai! Garieb Municipality. Integrated Development Plans (IDP) and Spatial Development Frameworks (SDF) exist for this area. The IDP refers to the AFNP as a popular tourism attraction for the area. The AFNP Park Management Plan strives to relate to the social analysis (poverty situation and gender specific issues) with specific reference to the tourism sector as stated in the IDP of both municipalities.

The Park was initially proclaimed in 1966 primarily to protect the geological interest of the Waterfall. Another objective was to keep its surroundings in a pristine state, to preserve a section of the Orange River Broken Veld and its associated flora and fauna, to provide opportunities for environmental education, and to present an area for research. This includes the Augrabies Falls, which is the largest waterfall on the Orange River and its associated downstream gorge, which stretches over 20 km and offers breath-taking views. The Park has now been substantially enlarged. It is divided by the Orange River into a northern and southern section. The Orange River flows through the extensive arid plains of Bushmanland.

The 55 383 ha Park lies mainly south of the Orange River, but also includes Melkbosrant (which is part of the Riemvasmaak land claim), and Waterval, a property north of the river. This settlement is however currently uninhabitated. SANParks briefly managed the Riemvasmaak section. It was then handed over to the Riemvasmaak community as part of the country's first successful land restoration actions.

Densely populated and intensively managed grape farms adjacent to the Orange River characterize the area around the AFNP. The economy of the area is mainly dependent on the seasonal viticulture farming. The local people centre their survival on temporary labour during the picking-times.

Infrastructural support in the form of power, roads and the Upington airport sustains the viticulture operations along the river. The AFNP maintains a good relationship with the local farmers and people living on both sides of the Orange River and in Riemvasmaak and Waterberg. In addition, the AFNP plays a prominent role in the culture and traditions of the human settlements in the area and are involved in many of the direct educational and communicational outputs.

On a socio-economical level the Augrabies Falls provides an important commercial focus with a relatively well-established tourism product with potential for cultural heritage tourism. It is situated in the same region as other important tourism (Namaqualand flower and Kalahari) routes and within relatively close proximity to important commercial routes to Namibia and Cape Town. The study area is also situated within an economically important agricultural region with potential to create sustainable Small, Medium and Micro Enterprises (SMMEs) through Economic Empowerment and conservation linkages.

Rainfall, which mainly falls during summer, is erratic and can be as high as 400 mm per year, but also as low as 40 mm per year. The average annual rainfall of 211 mm is based on the South African Weather Bureau records since 1946. Temperature is less erratic with cold winter temperatures (coldest months June - July) as low as -2.9°C, while the summer temperatures (warmest months December, January and February) are as high as 42.9°C (Bezuidenhout 1996).

Because of the sparse vegetation cover, topographical features / relief and geological features play a major role in the visual character of the receiving environment. A thorough description of the geomorphology sets the basis for understanding the landscape character and its uniqueness. The study area is located between 450m.a.s.l. and 660m.a.s.l. (Refer to **Map 1**).

The topography consists of large rock domes scattered in a landscape with an otherwise very low relief. The flat areas in between contain the gently undulating pink gneiss. Drainage lines are sandy and dry. A range of steep rocky hills in the central portion of the Park is formed by dark-weathering quartz-rich granulite. This rock is invariably white on fresh surfaces, but with weathering becomes black. A fairly large flat sandy area occurs north and west of the black hills. Recent river terrace gravel and alluvium consisting of silt and fine sand occurs along the Orange River. The alluvium also forms large islands in the river (Werger & Coetzee 1977). Most of the Park is composed of red biotite granite gneiss, which is one of the three types of granite gneiss called pink gneiss and has a typical brown colour of weathered surfaces.

The Augrabies landscape is largely made up of granite and metagabbro shaped by interesting weathering patterns. Granite is a light grey rock consisting of quartz, feldspar, and dark minerals. Due to intense pressure during the metamorphic event, dramatic zigzag folds are visible in the granite throughout the Park. Metagabbro is a metamorphosed igneous rock, which contains no quartz and is made up entirely of dark ferromagnesian minerals and feldspar. This rock is found in the western part of the Park in an area known as the "Swartrante" (Black Ridges).

Different weathering patterns can be seen in the Park, such as hollows in the rock, exfoliation domes, and "popups". Hollows occur when decomposing feldspar causes hard granite to become crumbly, and wind and rainwater wear away parts of the rock. Exfoliation domes are created by chemical weathering stress along sub horizontal joints, which causes thin slabs of rock to detach from the rock surface. "Popups" appear when thin slabs of rock detach from the rock surface due to extreme changes in the rock, pop up, and lean against another thin slab, forming an "A-tent" shape. The Falls were formed about 1.8 million years ago, progressively cutting back eastwards along faults in the pink gneiss (Werger & Coetzee 1977).

In terms of hydrology, the Park is drained by the Orange River, which is normally a perennial stream. Between Kakamas and the AFNP, a distance of approximately 35km, the River flows through a wide, flat, cultivated valley. From the 146m high Falls it flows into a deep, 100m narrow gorge. The main incision of the peneplain to form the Orange River Gorge and the evolution of the Augrabies Falls, which are correlated with the continental uplift during the late Tertiary, is discussed in Werger & Coetzee (1977).

Seven land types have been identified in the Park (Land Type Survey Staff 1986). The delineation of an area into land types at a 1: 250 000 scale indicates that the land type displays a marked degree of uniformity regarding terrain form, soil pattern and climate. Three major geomorphologic features are recognized, namely:

- the mountain veld;
- the plain veld; and
- the Orange River and adjacent floodplain.

Five major vegetation units have been identified in the Park (Bezuidenhout, 1996; Werger & Coetzee 1977), namely:

- *Aloe dichotoma*: Sparse woodland that is strongly associated with the hills.
- *Schotia afra*: Open woodland occurring in the undulating rocky hills.
- *Acacia mellifera*: Open shrubland that is associated with the undulating rocky plains.
- *Stipagrostis species*: Open grassland restricted to the sandy plains.
- *Ziziphus mucronata*: Closed woodland that grows in the wetter drainage lines of the floodplains and islands in the Orange River.

On an environmental level the AFNP has valuable significance due to it:

- being a protected area conserving the Gariep centre of endemism;
- hosting the unique Augrabies Falls;
- hosting contrasting above and below Falls riverine landscapes;
- hosting distinguishable geological formations;
- several endemic fish species below Falls;
- the undisturbed riverine fans;
- unparalleled arid vistas;
- great potential to expand the Park area;
- trans-frontier potential;
- minimal population pressures.

Refer to **Map 3**. This map illustrates the Augrabies Falls National Park Use Zones, as well as Special Management Areas. Of note is that the use zones include the Riemvasmaak (Melkbosrant) section that is managed as part of the AFNP. The purpose of the park zoning is, "*To establish a coherent spatial framework in and around a park to guide and co-ordinate conservation, tourism and visitor experience initiatives*". The zoning of AFNP was based on an analysis and mapping of the sensitivity and value of the park's biophysical, heritage and scenic resources; an assessment of the regional context; and an assessment of the park's current and planned infrastructure and tourist routes / products; all interpreted in the context of park objectives.

The proposed RVM hydroelectric project is located within the *Primitive* and *Remote* zones of the park. The power station and associated infrastructure, although located on Riemvasmaak land, is situated within the *Remote* zone while the water conveyance and electricity distribution infrastructure and access road span across the *Primitive* zone. The weir for water abstraction from the Orange River is also situated within this zone.

The *Remote* zone's characteristics are summarised as: "*Retains an intrinsically wild appearance and character, or capable of being restored to such*", where the experience should be one of solitude and awe inspiring natural characteristics. Aesthetic and recreational conservations objectives for this zone is: "*The area should be kept in a natural state, and activities which impact on the intrinsically wild appearance and character of the area, or which impact on the wilderness characteristics of the area (solitude, remoteness, wildness, serenity, peace etc.) should not be allowed*".

The *Primitive* zone should "*generally retain its wilderness qualities, but with basic self-catering facilities (concession facilities may be more sophisticated). Access is controlled. Provides access to the Remote Zone, and can serve as a buffer*". This zone is suitable for small, basic, self-catering; or limited concessions with limited numbers (concession facilities may be more sophisticated); 4x4 trails; hiking trails.

The power station and associated infrastructure is further located within the *Visual Protection* Special Management Area. This area is described as "*Areas where developments could impact on the aesthetic quality of a visitors experience in a park. This zone is particularly concerned with visual impacts (both day and night), but could also include sound pollution".*

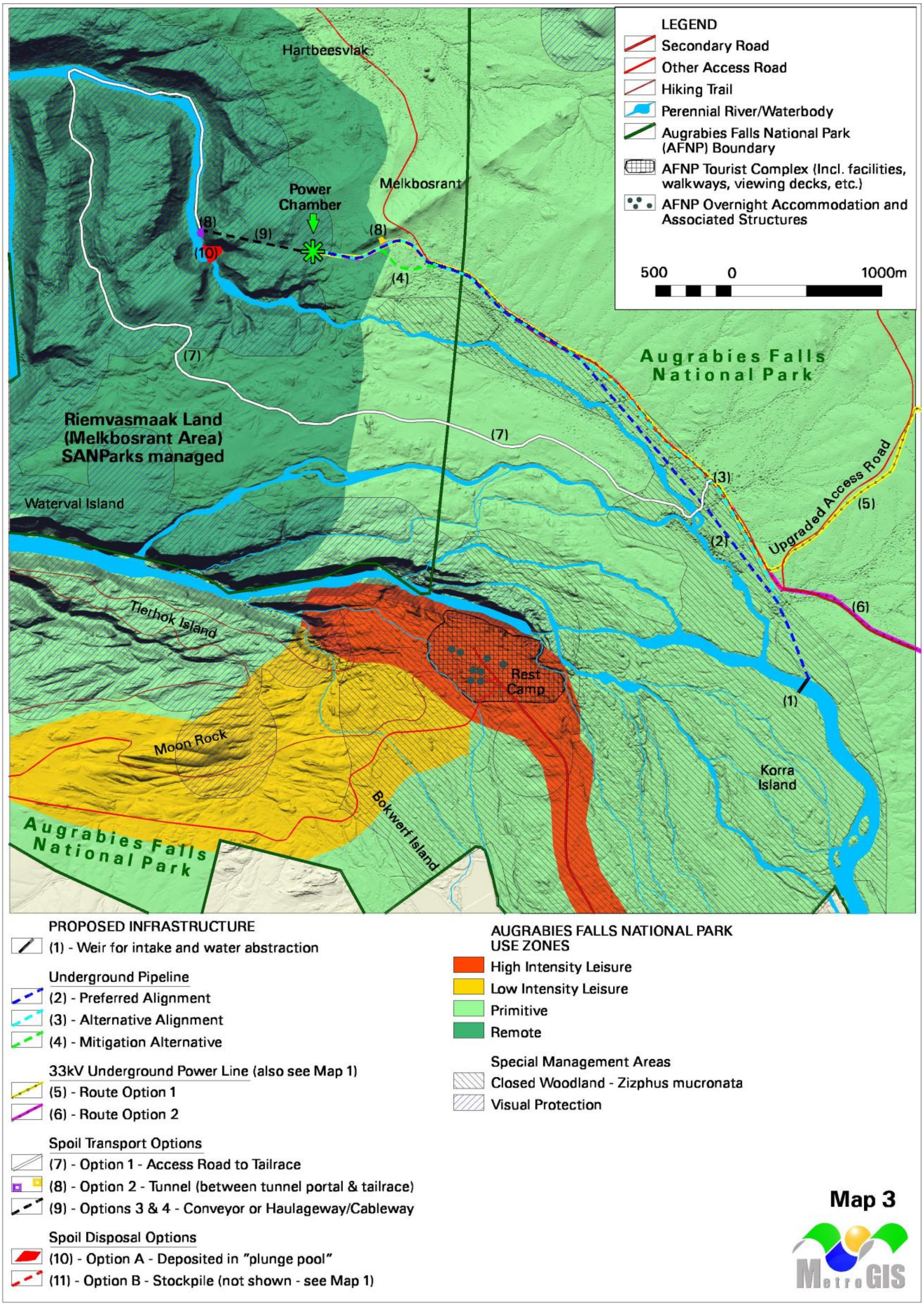
Figure 7: View of the environment on the road to Waterval.

Figure 8: View of the environment on the road to the AFNP Tourist Complex.

Figure 9: View of the environment at the AFNP Tourist Complex (en route to viewpoints).

Figure 10: View of the environment along the hiking trail to the south west of the AFNP Tourist Complex.

Figure 11: View of the gorge along the hiking trail to the west of the AFNP Tourist Complex.



Map 3: Augrabies Falls National Park Use Zones.

6. RESULTS

6.1. Potential visual exposure

The visual exposure and ultimately the visual impact of the power station and pipeline, is expected to be predominantly relevant for the construction phase (two years). This is if the infrastructure is buried underground for the entire operational phase of the project. Visual exposure is expected to be restricted to tracks and pipeline servitudes (i.e. features without any vertical dimensions) only and vehicular movement (and human activity) along the linear infrastructure and at the power station site should be very limited (i.e. virtually negligible).

Activities and equipment at the crusher site (stockpile – spoil disposal option B) may however only abate after ten years. The 33kV-132kV substation and overhead power line would be visible for their entire lifespan. The weir would similarly be exposed for the duration of the operational phase of the project, albeit within a very contained area of exposure due to its low-lying position in the river.

Maps 4 to **8** sequentially indicate the visual exposure of:

- The weir and water conveyance pipelines;
- The access road to the tailrace (proposed spoil transport option 1);
- The conveyor or cableway/haulage-way (proposed spoil transport options 3 & 4);
- The stockpile/crusher site (spoil disposal option B); and
- The 33kV-132kV substation and overhead power line.

In each case the height of the proposed structures/activities were used to model the potential visual exposure (e.g. the offset above ground level of the stockpile was indicated as 3m and thus modelled). These offsets are indicated in the legend for each map.

Viewshed analyses for the large scale study area were done utilising a very accurate Lidar DTM that incorporates both surface elevation and structures/vegetation cover. The DTM for the small scale study area is based on the 5m interval contours data, which is still very accurate, but does not incorporate vegetation cover of man-made structures.

The weir and water conveyance pipelines

The visual exposure for the weir and the underground pipelines displays a very similar viewshed pattern, due to the close location of the three alternatives to each other. The activities and infrastructure will generally be exposed to observers travelling along the access road from very short distances. This road does not carry a high amount of traffic and is generally only frequented by residents of Riemvasmaak or SANParks officials. It is not utilised by the general public or visitors to the AFNP.

Longer distance exposure will include sightings of the infrastructure from higher-lying or elevated topographical units (i.e. hills and ridges) within the AFNP. Parts of the AFNP tourist complex (e.g. viewpoints and walkways) may also be exposed at distances of approximately 1.7km at the closest.

The infrastructure and activities will also be exposed from the Moon Rock which is a favourite elevated view point, often visited by tourists. The exposure is expected at a distance of 3.5km at the closest.

The access road to the tailrace

The proposed access road to the tailrace (transport option 1) generally traverses land that is devoid of observers. Therefore short distance viewing of the trucks and equipment utilising this road is generally not expected. The construction of this road and the subsequent heavy vehicle traffic may however be visible from the AFNP complex (at approximately 1.2km) and from the Moon Rock at distances of just over 2km.

The conveyor or cableway/haulage-way

The viewshed pattern of the proposed conveyor or cableway/haulage-way (transport options 3 and 4) is generally very contained due to the remote location of this alignment. Once again the proposed infrastructure is expected to be visible from the Moon Rock at a distance of approximately 3.3km. It is not expected to be visible from the AFNP tourist complex.

The stockpile/crusher site

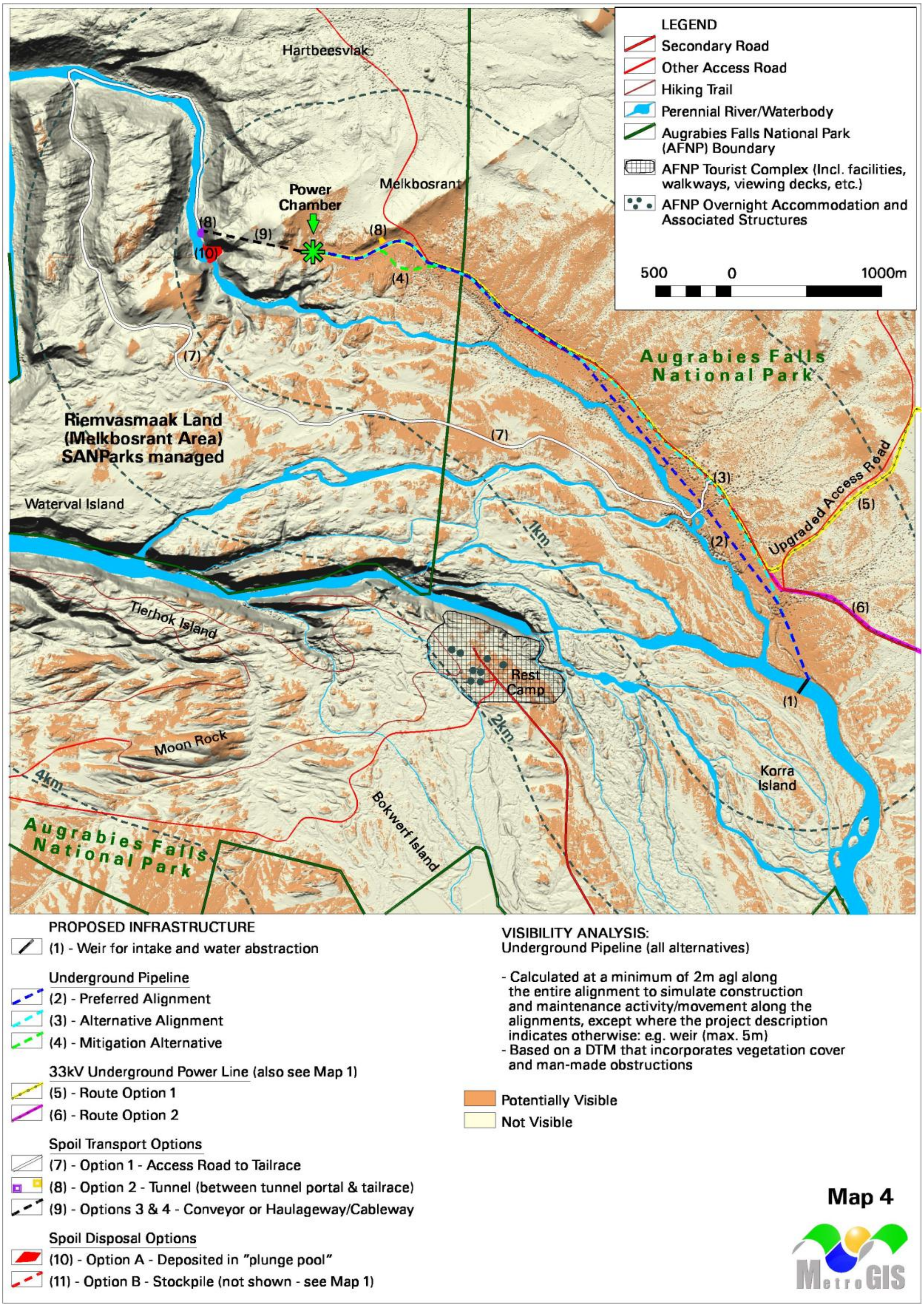
This spoil disposal site (option B) is located along the eastern border of the AFNP, north of the proposed substation site. It is generally remote but has the potential to be exposed to observers traversing along the secondary access road to the Riemvasmaak land. It is situated approximately 4km south-east of the AFNP tourist complex and is not expected to be intrusive from this distance, even if it should be visible.

The 33kV-132kV substation and overhead power line

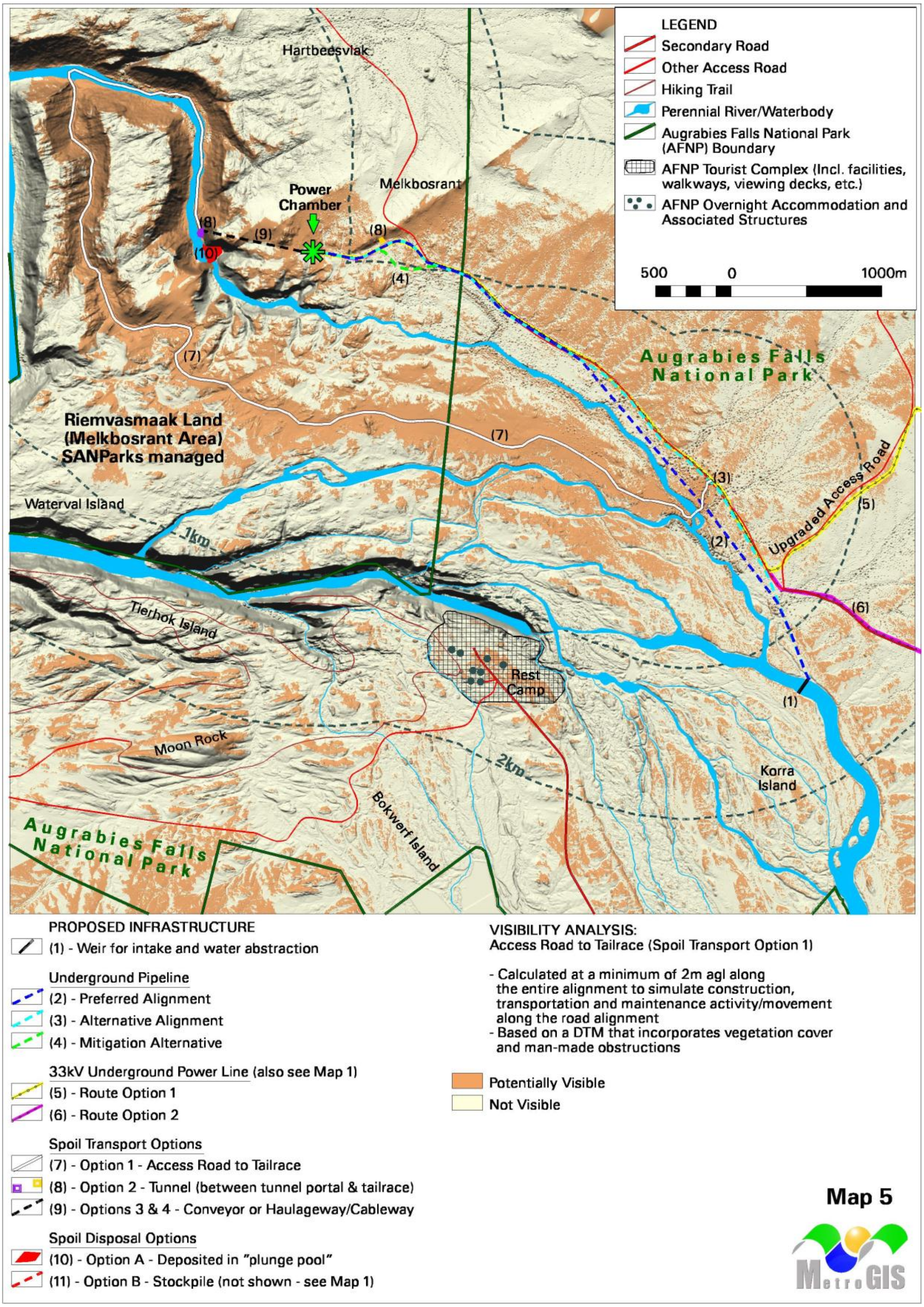
The zone of potential visual exposure of the proposed 132kV overhead power line, which run from the proposed new substation on the eastern boundary of the AFNP to the existing Renosterkop Substation in the far south east of the study area, is shown on **Map 8**.

This zone of visual exposure is calculated at an offset height of 15 m above ground level (i.e. the approximate maximum height of the power lines), and within 1 km offset on either side of the alignment. With the exception of one or two hilly areas, practically the entire zone within the offset will be exposed to potential visual impact.

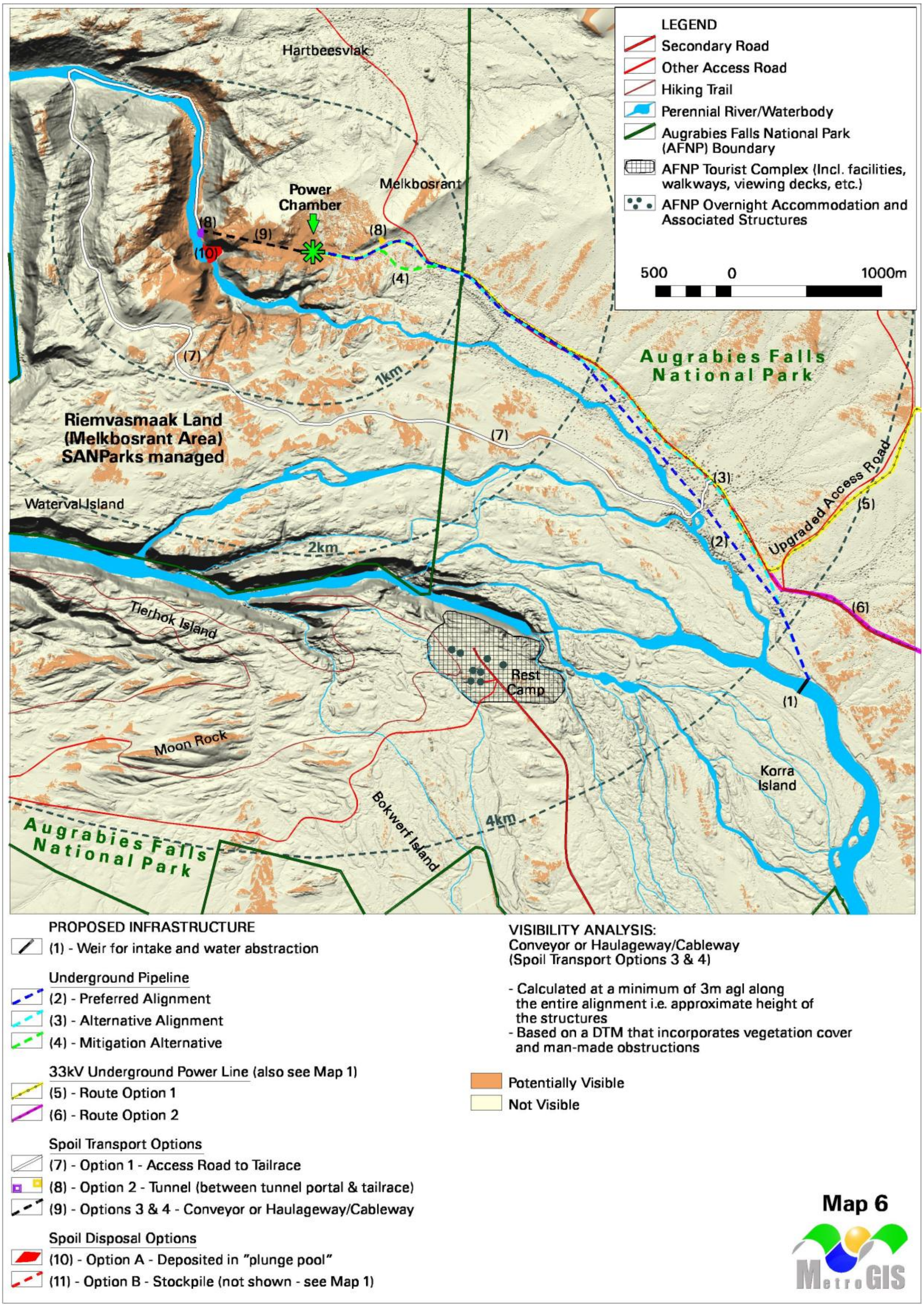
Within this visually exposed zone, potentially sensitive visual receptors include users of the secondary road along which the alignment traverses, residents of the settlement of Omdraai, and the eastern outskirts of the town of Augrabies.



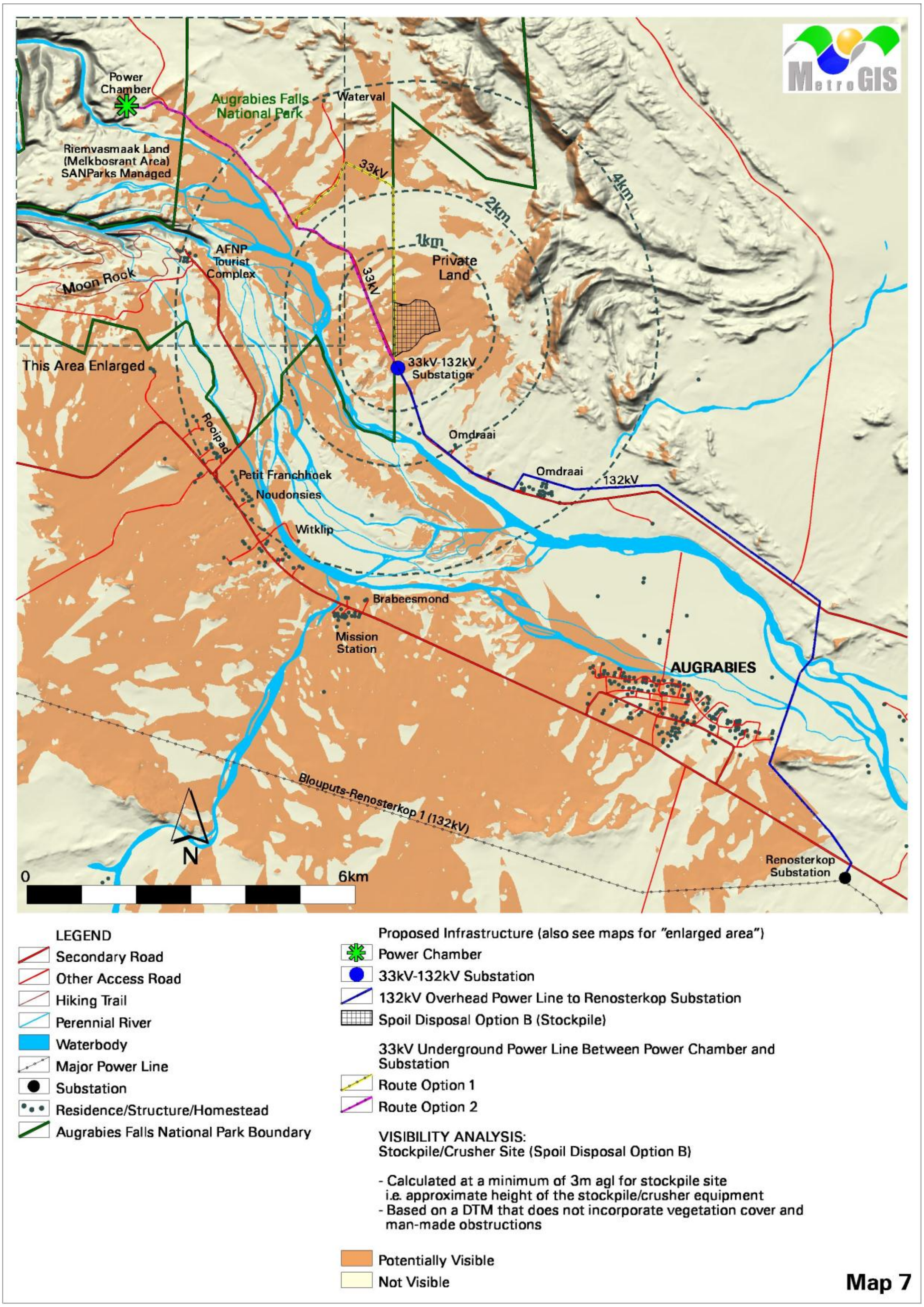
Map 4: Potential visual exposure of the weir and water conveyance pipelines.



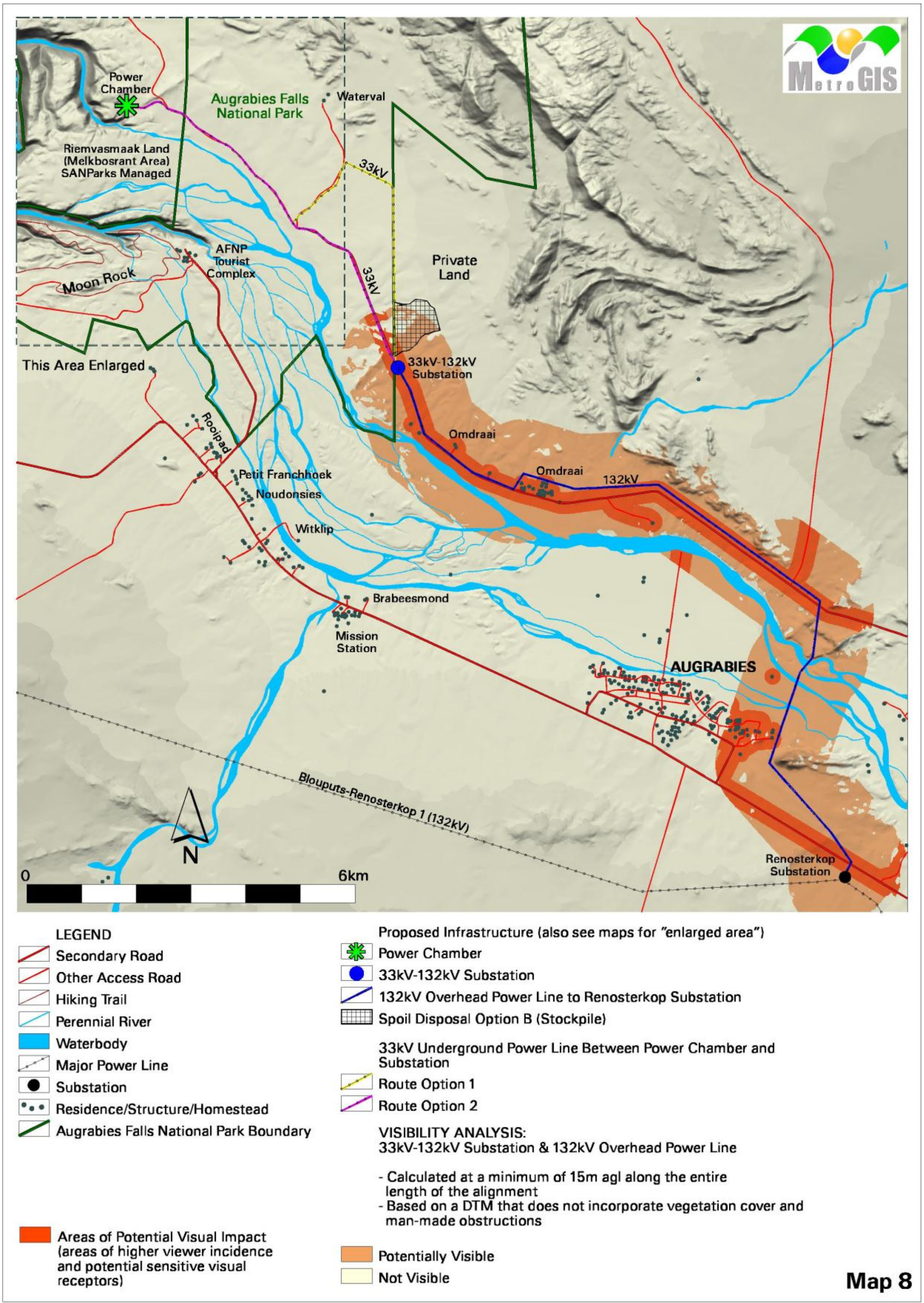
Map 5: Potential visual exposure of the access road to the tailrace.



Map 6: Potential visual exposure of the conveyor or cableway/haulageway.



Map 7: Potential visual exposure of the stockpile/crusher site.



Map 8: Potential visual exposure of the overhead power line.

6.2. Visual distance / observer proximity

MetroGIS determined proximity offsets based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger facilities and downwards for smaller facilities (i.e. depending on the size and nature of the proposed infrastructure).

The proximity offsets (calculated from the centre line of the project infrastructure) are as follows:

- 0 – 1km - Short distance view where the infrastructure would dominate the frame of vision and constitute a very high visual prominence.
- 1km – 2km - Medium distance views where the infrastructure would be easily and comfortably visible and constitute a high visual prominence.
- 2km – 4km - Medium to longer distance view where the infrastructure would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 4km - Long distance view where the infrastructure would still be visible though not as easily recognisable. This zone constitutes a low visual prominence for the infrastructure.

Refer to **Maps 4** to **8**, which show the proximity radii for the respective infrastructure alternatives.

6.3. Viewer incidence / viewer perception

Viewer incidence is calculated to be the highest within the built-up areas (i.e. where there are concentrations of people). In addition, a higher incidence of visual receptors is expected along the roads within the study area. Commuters and tourists using these roads could be negatively impacted upon by visual exposure to the project infrastructure/activities, and are thus considered to be sensitive to visual intrusion.

Other than the above, viewer incidence will be concentrated within the agricultural homesteads and settlements and tourist complexes within the study area. Residents of these homesteads and settlements (who will be exposed while at home) are considered sensitive to visual impact.

Tourists visiting the Augrabies Falls and the National Park are considered to be very sensitive to visual impacts, especially those exposed to the infrastructure from elevated vantage points and trails along the gorge.

The scenic nature of the area and the tourism within the region implies that some homesteads may operate as tourist facilities, and that many roads may be used by tourists as scenic drives and/or tourist access routes.

The severity of the visual impact on visual receptors decreases with increased distance from the proposed infrastructure/activities.

Overall, due to the scenic nature of the Augrabies National Park, and the unique landmark status of the Augrabies Falls themselves (which are considered to have an irreplaceable scenic value), it is assumed that the perception of the proposed infrastructure will be negative by all receptors.

6.4. Visual absorption capacity

This is the capacity of the receiving environment to absorb the potential visual impact of the proposed infrastructure. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing sparse and patchy vegetation will have a low VAC.

The VAC would also be high where the environment can readily absorb the structure in terms of texture, colour, form and light / shade characteristics of the structure. On the other hand, the VAC for a structure contrasting markedly with one or more of the characteristics of the environment would be low.

The broader study area is arid, and the natural vegetation type is mostly shrubland, with some irrigated agriculture along the river.

Overall, the Visual Absorption Capacity (VAC) of the receiving environment is generally deemed low by virtue of the nature of the vegetation and the low occurrence of urban development.

Where homesteads, settlements or tourist complexes occur, some more significant vegetation and trees may have been planted, which would contribute to visual absorption. As this is not a consistent occurrence, however, VAC will not be taken into account for any of the homesteads, settlements or tourist complexes, thus assuming a worst case scenario in the impact assessment.

Within the towns, VAC will be of some relevance, due to the presence of buildings and structures, referred to as visual clutter. In this respect, the presence of the built-up environment will 'absorb' the visual impact to some extent.

Therefore, VAC will be taken into account within the towns and built up areas only.

6.5. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed infrastructure are displayed on the Visual Impact Index Maps that follow.

Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values have been assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

An area with short distance, high frequency of visual exposure to the proposed infrastructure, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

Of note is that the majority of visual impacts displayed on the Visual Impact Index Maps will occur during the construction phase. The operational phase impacts have not been modelled separately, as these will fall within the scope illustrated for the construction phase impacts (i.e. they will cover the same area of exposure). Operational phase impacts are, however, expected to be of a much lower magnitude, especially if properly mitigated.

Maps 9 to **12** indicate the visual impact indexes of:

- The weir and water conveyance pipelines;
- The access road to the tailrace (proposed spoil transport option 1);
- The conveyor or cableway/haulage-way (proposed spoil transport options 3 & 4);
- The stockpile/crusher site (spoil disposal option B); and
- The 33kV-132kV substation and overhead power line.

The weir and water conveyance pipelines

The visual impact for the water conveyance pipelines is expected to be **high** along the secondary access road which will place observers (however limited) within close proximity of the structures/activities.

A **moderate** visual impact is indicated from the AFNP rest camp, access roads and tourist facilities. Further afield, the viewpoint at the Moon Rock is expected to have a **low** visual impact, due to its relatively long distance from the infrastructure/activities. Refer to **Map 9**.

The access road to the tailrace

Vehicular traffic along the access road to the tailrace is generally considered to have a **moderate** visual impact along the entire length of its alignment. This is due to relative absence of observers within the viewshed area of this road. It may have a **moderate** visual impact on observers situated at the AFNP complex and a **low** impact from the Moon Rock due to its relatively long viewing distance from this vantage point. Refer to **Map 10**.

The conveyor or cableway/haulage-way

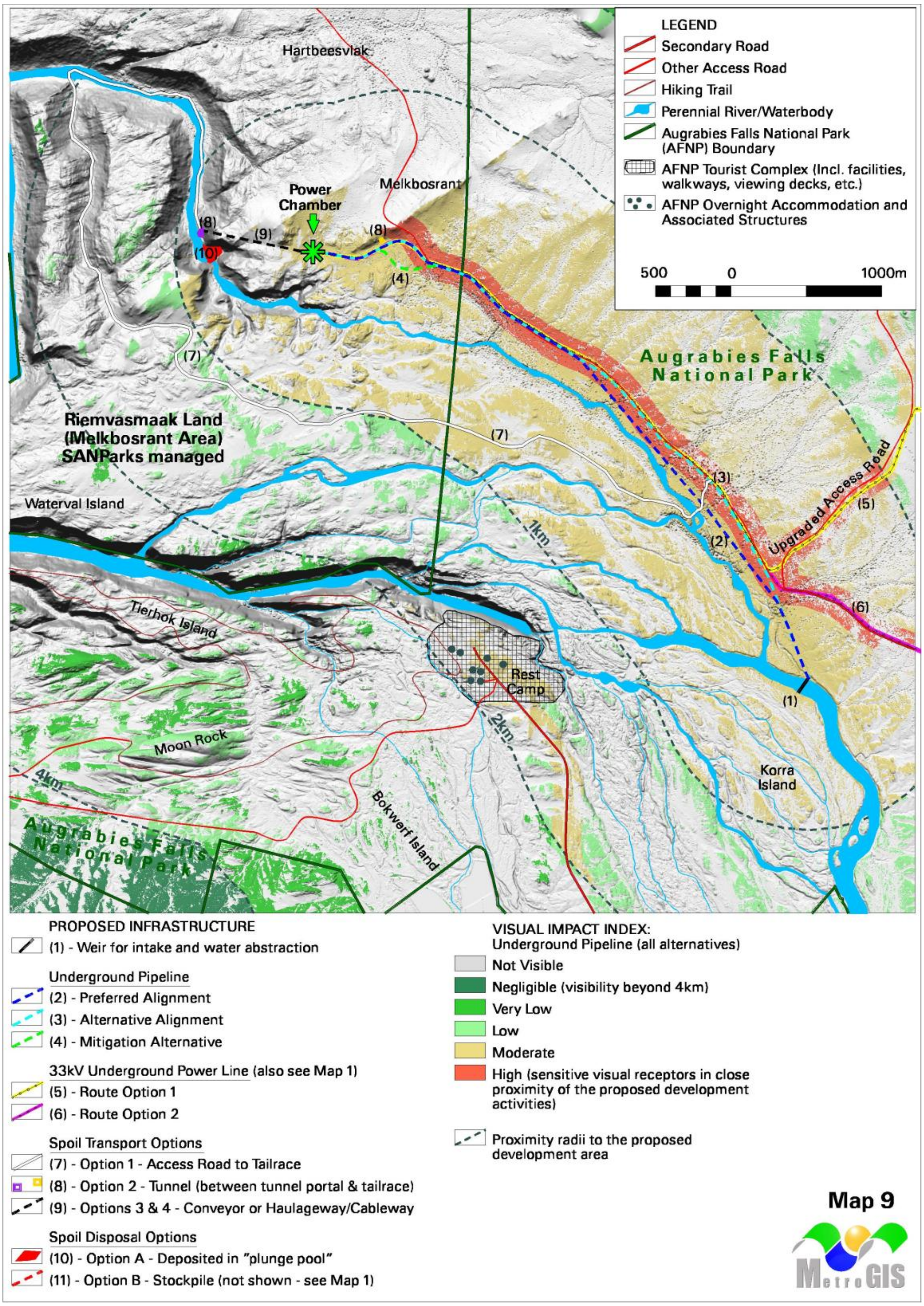
The remote location of the conveyor or cableway/haulage-way, away from potential sensitive visual receptors, indicates a **moderate** visual impact that is generally contained within the valley where it is located. Refer to **Map 11.**

The stockpile/crusher site

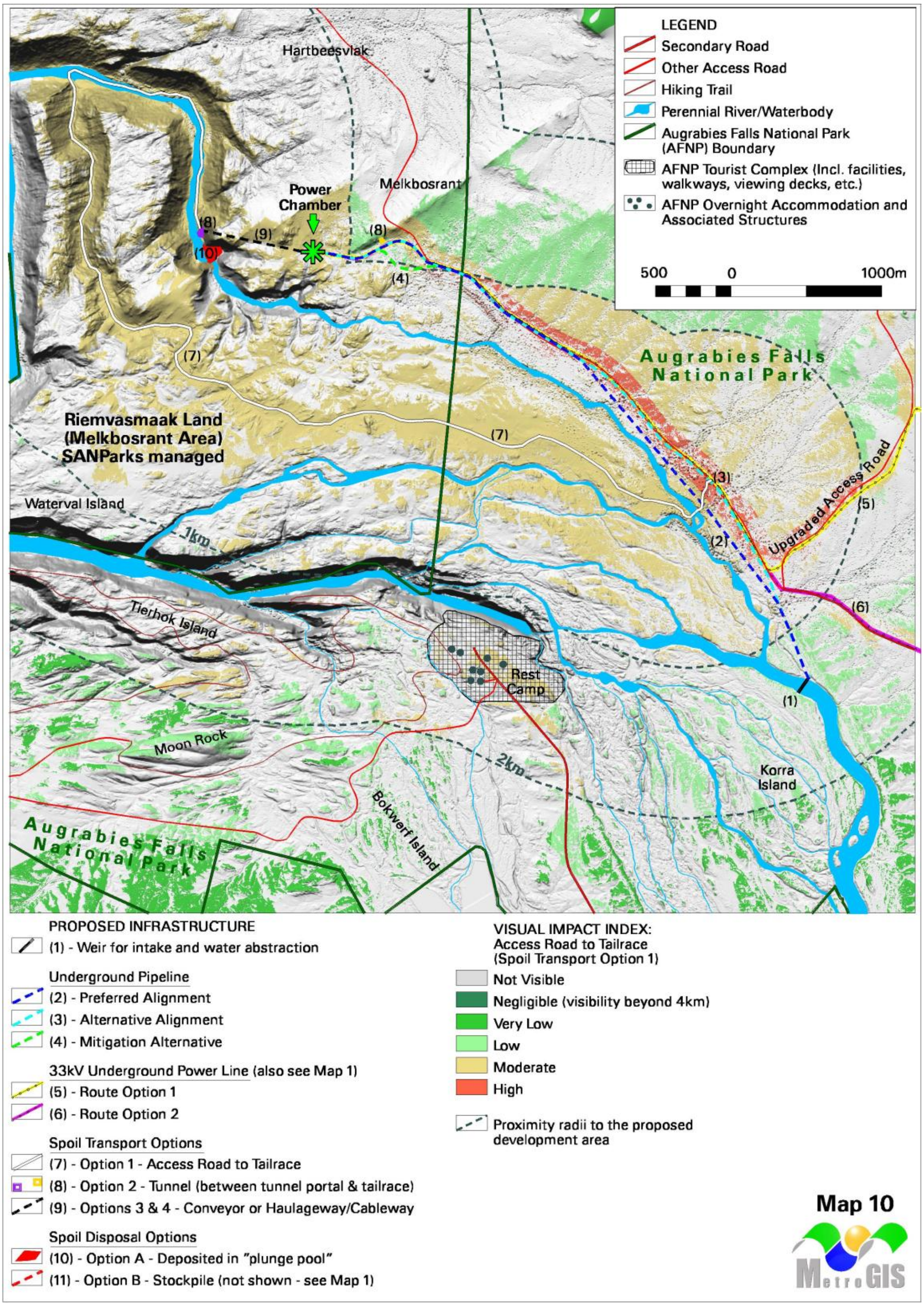
The visual impact for the stockpile/crusher site is restricted to the Riemvasmaak access road traversing in close proximity to the site. This road is generally not utilised by tourists or visitors to the AFNP, but may have a **high-moderate** visual impact when viewed. Refer to **Map 12.**

The 33kV-132kV substation and overhead power line

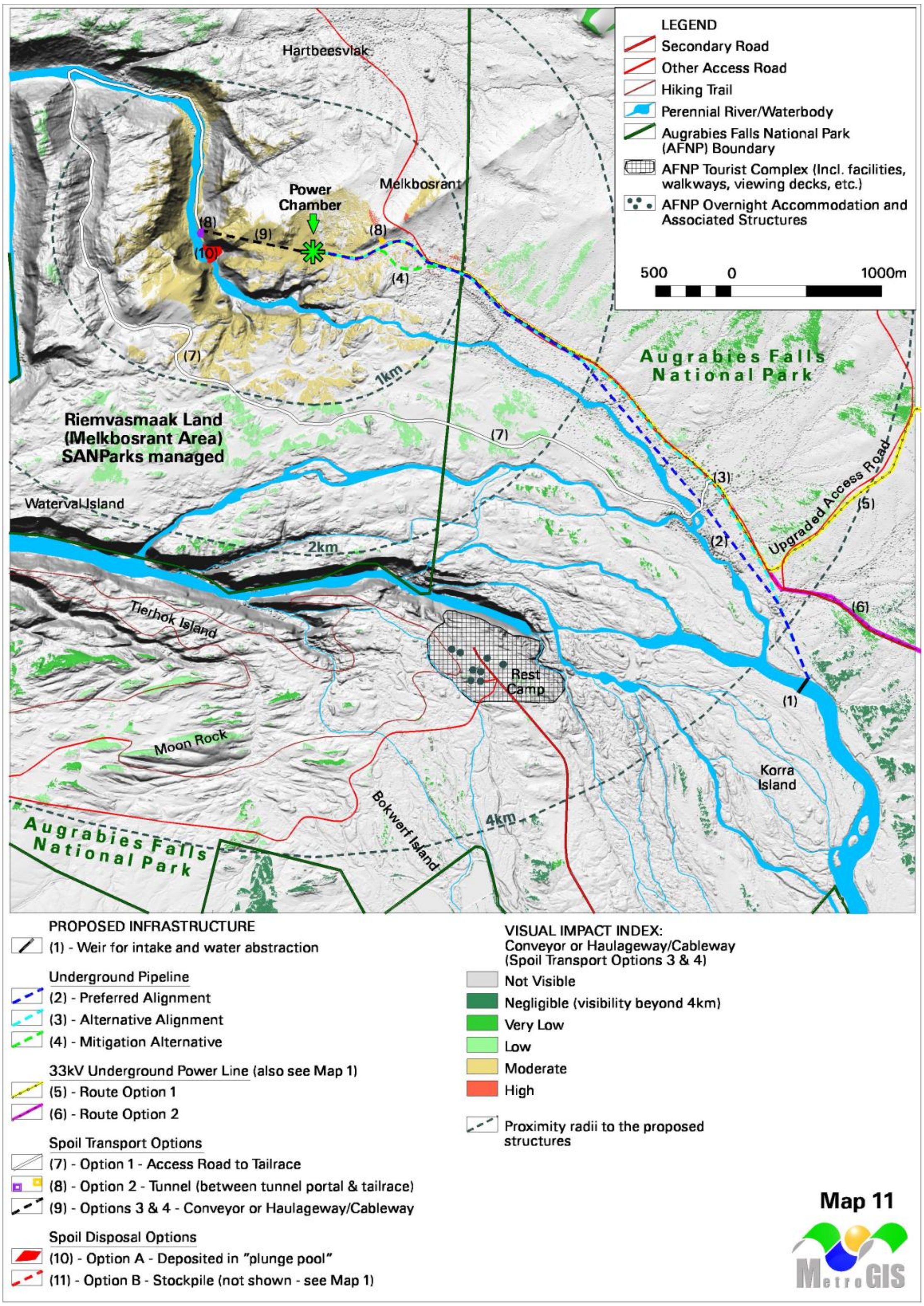
Sensitive visual receptors located within a 1km radius of the proposed 33kV-132kV substation and overhead power line include a section of the secondary road north of the Orange River, residents of the *Omdraai* homesteads and observers residing along the eastern outskirts of Augrabies. These receptors may experience a **high** visual impact of the proposed infrastructure. See **Map 8**.



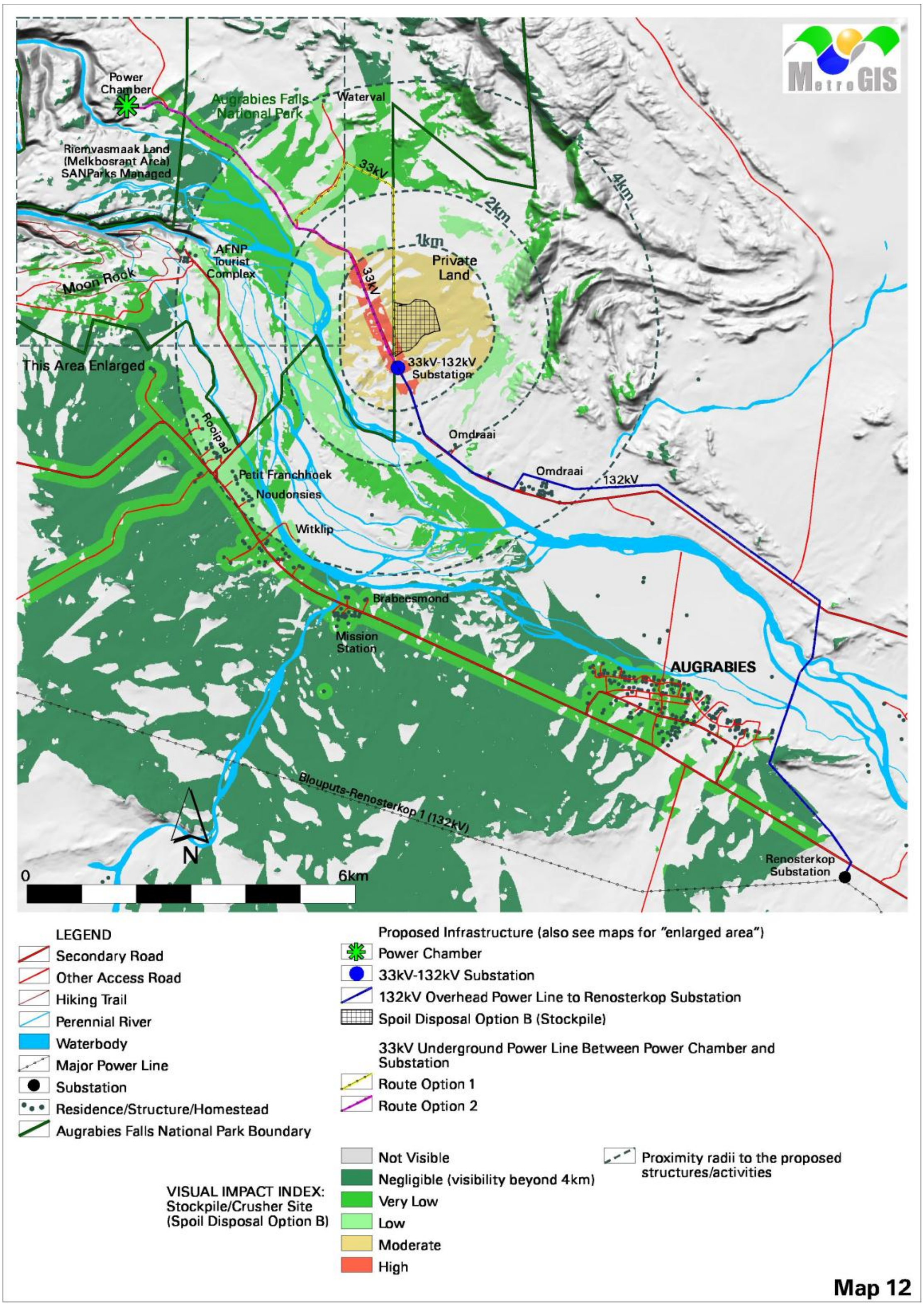
Map 9: Visual impact index: The weir and water conveyance pipelines.



Map 10: Visual impact index: The access road to the tailrace.



Map 11: Visual impact index: The conveyor or cableway/haulage-way.



Map 12: Visual impact index: The stockpile/crusher site.

6.6. Visual impact assessment: methodology

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.

For the purposes of standardising the assessment of potential impacts amongst the various specialists involved in the project, the applicant has prescribed the following methodology.

Method of assessing the significance of potential environmental impacts

This section outlines the proposed method for assessing the significance of the potential environmental impacts outlined above. As indicated, these include both operational and construction phase impacts.

For each impact, the EXTENT (spatial scale), MAGNITUDE and DURATION (time scale) would be described. These criteria would be used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the EIAR would represent the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented.[4]

The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

Table 2: Assessment Criteria for the Evaluation of Impacts.

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 10 km radius of the candidate site.
	Local	Within a 10 km radius of the candidate site.
	Site specific	On site or within 100 m of the candidate site.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period**	Up to 3 years
	Short Term	Up to 5 years after construction
	Medium Term	5-15 years after construction
	Long Term	More than 15 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in **Table 2.**

[4] The applicant will be requested to indicate at the Draft EIAR stage which alternative and mitigation measures they are prepared to implement.

Table 3: Definition of Significance Ratings.

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact would be determined using the rating systems outlined in **Table 4** and **Table 5** respectively. It is important to note that the significance of an impact should always be considered in conjunction with the probability of that impact occurring.

Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in Table 6.

Table 4: Definition of Probability Ratings.

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 5: Definition of Confidence Ratings.

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 6: Definition of Reversibility Ratings.

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

Table 7: Visual impact assessment: primary impacts.

	Project	Key impacts	Extent	Magnitude	Duration	SIGNIFICANCE (Without mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction phase	Layout (preferred)	The potential negative visual impact of the project component on sensitive visual receptors in close proximity to the infrastructure or activities.	Local	Moderate	Construction (up to 3 yrs)	Moderate	Moderate	Probable	Sure	Reversible
	Layout (alternative)		Local	Moderate	Construction (up to 3 yrs)	Moderate	Moderate	Probable	Sure	Reversible
	Mitigation alternative		Local	Moderate	Construction (up to 3 yrs)	Moderate	Moderate	Probable	Sure	Reversible
	Upgraded Access Road		Local	Low	Construction (up to 3 yrs)	Moderate	Low	Probable	Sure	Reversible
	Transmission Route 1		Local	Low	Construction (up to 3 yrs)	Moderate	Low	Probable	Sure	Reversible
	Transmission Route 2		Local	Low	Construction (up to 3 yrs)	Moderate	Low	Probable	Sure	Reversible
	Spoil transport option 1 (Access Road to Tailrace)		Local	Moderate	Construction (up to 3 yrs)	Moderate	Moderate	Probable	Sure	Reversible
	Spoil transport option 2 (Tunnel)		Local	Low	Construction (up to 3 yrs)	Moderate	Low	Probable	Sure	Reversible
	Spoil transport option 3 (Conveyor)		Local	Moderate	Construction (up to 3 yrs)	Moderate	Moderate	Probable	Sure	Reversible
	Spoil transport option 4 (Haulageway/ cableway)		Local	Moderate	Construction (up to 3 yrs)	Moderate	Moderate	Probable	Sure	Reversible
	Spoil Disposal option A		Local	Low	Construction (up to 3 yrs)	Moderate	Low	Probable	Sure	Reversible

	Project	Key impacts	Extent	Magnitude	Duration	SIGNIFICANCE (Without mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
	Spoil disposal option B		Local	Moderate	Medium (5-15 yrs)	Moderate	Moderate	Probable	Sure	Reversible
Operational phase	Layout (preferred)	The potential negative visual impact of the project component on sensitive visual receptors in close proximity to the under-ground infrastructure.	Local	Moderate	Long term (15 yrs >)	Moderate	Moderate	Probable	Sure	Reversible
	Layout (alternative)		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Mitigation alternative		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Upgraded Access Road		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Transmission Route 1		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Transmission Route 2		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
Decommissioning phase	Layout (preferred)	The potential residual visual impact of the project component after the decommissioning of the power station.	Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Layout (alternative)		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Mitigation Alternative		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Upgraded Access Road		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Transmission Route 1		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
	Transmission Route 2		Local	Low	Long term (15 yrs >)	Moderate	Low	Probable	Sure	Reversible
Cumulative Impact		The potential contribution of the project infrastructure to the increase of similar developments within the region.	Regional	Moderate	Long term (15 yrs >)	Moderate	Moderate	Probable	Sure	Reversible
No-Go Option		The positive visual impact of retaining	Regional	High	Long term (15 yrs >)	High	N.A.	Probable	Sure	N.A.

	Project	Key impacts	Extent	Magnitude	Duration	SIGNIFICANCE (Without mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
		the area within the AFNP and surrounds undeveloped, in a natural state and with no visual intrusions.								

6.7. Visual impact assessment: secondary impacts

6.7.1. Potential visual impact on the visual character of the landscape and the sense of place of the region (operational phase).

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.) play a significant role. A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

The proposed infrastructure is partially located within a National Park, and within a natural area of particular and unique rugged beauty. The natural environment is not only of a high quality, but is also unique. The presence of the Augrabies Falls within this setting contributes to this uniqueness, and is in itself a feature of national significance and of irreplaceable value.

Against this backdrop, the anticipated visual impact of the facility on the regional visual quality, and by implication on the sense of place of the region, is expected to be of **moderate** significance during the construction phase of the project. If the project infrastructure is located below ground for the duration of the operational phase, the expected visual impact will be of **low** significance.

6.7.2. Potential visual impact on tourism potential north of the Orange River (operational phase).

Tourism access and development within the Augrabies Falls National Park is limited to the area south of the river. This corresponds with the zoning of the Park, which has allocated both low and high intensity leisure activity zones in this area. The northern part of the Park is zoned as Remote and Primitive. Should this project proceed, however, the zoning of the Park may need to change. In this respect, the area to the north of the river may be considered for tourism development in the future. The presence of the power station infrastructure should not be a limiting factor if all the project infrastructure is located below ground.

The land earmarked for the proposed hydropower stations however has a very low threshold for development (i.e. it can spoil the character very easily) and guard should be taken against the inappropriate proliferation of similar development proposals or future expansion to existing developments.

6.8. The potential to mitigate visual impacts

- The construction of industrial infrastructure in conservation of formally protected areas (especially National Parks) should occur in accordance with the Zoning Plan of the relevant park[5]. An area zoned for conservation and tourism should ideally not support power generating infrastructure or any other industrial style infrastructure as it is a clear conflict of land use

[5] It was recommended that the Riemvasmakers enter into a co-management agreement (by the committee who approved the de-proclamation) to develop this land as a protected area (with possible tourism developments) with financial benefit to them. No agreement was ever reached, leaving the status quo (and park zones) unchanged.

and may impact on the sense of place, even if it is only for the duration of the construction phase.

- Plan all infrastructure in such a way and in such a location that clearing of vegetation is minimised. Consolidate infrastructure and make use of already disturbed sites rather than pristine areas wherever possible.

- Mitigation of visual impacts associated with the construction of access roads is possible through the use of existing roads wherever possible. Where new roads are required to be constructed, these should be planned carefully, taking due cognisance of the local topography.

  Roads should be laid out along the contour wherever possible, and should never traverse steep slopes at 90 degrees. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems.

  Access roads, which are not required post-construction, should be ripped and actively rehabilitated. It should be taken into consideration that this vegetation type would take years (if ever) to recover to it's former status if left by itself, thus rehabilitation of vegetation should be planned properly and a management programme followed to ensure optimal rehabilitation.

- For potentially visible above-ground structures, implement materials and architectural forms that utilise and compliment the natural rock and soil colour and texture. This can greatly reduce the visibility of the proposed structures.

- No night time lighting is proposed and should not be allowed without input from a visual specialist.

- Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of all construction sites. Construction should be managed according to the following principles:

  - Ensure that vegetation is not unnecessarily cleared or removed during the construction period.
  - Reduce the construction period through careful logistical planning and productive implementation of resources.
  - Plan the placement of lay-down areas and any potential temporary construction camps along the corridor in order to minimise vegetation clearing.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
  - Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.
  - Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
  - Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
  - Ensure that all infrastructure and the site and general surrounds are maintained and kept neat.
  - Rehabilitate all disturbed areas, construction areas, roads, slopes etc. immediately after the completion of construction works. Due to the

sensitive nature of the vegetation, an ecologist should be consulted to assist or give input into rehabilitation specifications.

- During operation, the maintenance of the structures (e.g. the substation), the access roads, the power line servitude and other ancillary structures and infrastructure will ensure that the facility does not degrade, thus aggravating visual impact.

- Roads must be maintained to forego erosion and to suppress dust, and rehabilitated areas must be monitored for rehabilitation failure. Remedial actions must be implemented as a when required.

- Monitor rehabilitated areas for rehabilitation failure, and implement remedial actions as and when required.

- Once the power station has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated. An ecologist should be consulted to give input into rehabilitation specifications.

  This recommendation relates to the substation and overhead power lines and tracks. Underground infrastructure (e.g. subterranean power lines) should be left in place rather than digging this up and creating an additional impact.

- All rehabilitated areas should be monitored for at least four years following decommissioning, and remedial actions implemented as and when required.

The possible mitigation of both primary and secondary visual impacts as listed above should be implemented and maintained on an on-going basis.

7. PREFERED ALTERNATIVES AND OPTIONS

The preferred alternative for the underground water conveyance pipelines is the **Alternative alignment**. This alignment has the greatest potential to consolidate the linear infrastructure as it would traverse adjacent to the existing access road, rather than require an additional servitude. It is further located outside of the *Closed Woodland (Zizphus mucronata)* Special Management Area and would therefore not require the removal of these vegetation units. The **Mitigation Alternative** is acceptable if utilised together with **Alternative Alignment**.

The 33kV underground power line options both follow existing road alignments, thereby affording the opportunity to once again consolidate the servitudes. The shorter option (**Route Option 2**) is preferable, due to its constrained length.

The spoil transport options, in the event that neither of the spoil disposal options is considered feasible, favour the **Option 2** (tunnel between portal and tailrace). This is strictly based on a visual perspective, as the tunnel is not visible to observers. The spoil transport Option 1 (new access road to the tailrace) is the least preferred of the three options, as it is expected to have the greatest potential visual impact on observers located at the AFNP tourist complex (especially during the construction phase of the project). Options 3 and 4 are acceptable, provided the cableway/conveyor structures are removed after the construction phase and the alignment rehabilitated to its natural state.

Spoil disposal **option A**, depositing the spoil material into a "plunge pool" deep enough to cover all visible traces thereof, would nullify any potential visual impact related to this option. This is strictly from a visual perspective and may not otherwise be considered "best practise" to dump/deposit material "on-site". It will however nullify the relatively extended (up to ten years) potential visual impacts associated with the stockpile/crusher site option (soil disposal option B).

8. CONCLUSION AND RECOMMENDATIONS

The proposed Riemvasmaak Hydro Electric Power Station, substation, associated overhead power line and additional infrastructure (e.g. possible stockpile, conveyor, etc.) have the potential to negatively impact on the scenic resources of the region. This is especially relevant for the construction phase of the project. The movement of equipment and large construction vehicles, as well as the activities related to the construction phase (e.g. the transportation of spoil material) is expected to be visible from areas considered sensitive to visual intrusion. During the operational phase of the project, the visual impact is expected to be virtually entirely negated due to the placement of the project infrastructure underground, the limited servicing and maintenance requirements of the equipment, and the absence of night-time lighting.

The substation, overhead power line and stockpile/crusher site (if required) may be the only structures evident for the duration of the operational phase. These are not situated within the AFNP, are generally remotely located away from sensitive visual receptors and are not overtly intrusive.

Considering the above, it is the opinion of the author that the significance of impacts may be reduced to an acceptable level by implementing recommended mitigation measures. In this respect, the proposed project is considered acceptable from a **purely visual perspective** (i.e. not considering potential land use conflicts).

The outcome of the visual impact assessment report (i.e. whether the project proposal should be supported or rebutted) still hinges on the principle of whether it is desirable to construct commercial power generation infrastructure within areas that have specifically been earmarked for conservation and tourism activities.

9. IMPACT STATEMENT

In light of the results and findings of the Visual Impact Assessment undertaken for the proposed Riemvasmaak Hydro Electric Power Station options and associated 33kv and 132kv Power Lines alternatives, it is acknowledged that the receiving environment adjacent to the corridors may potentially be transformed for the entire operational lifespan of the infrastructure.

The following assessments are relevant for this project:

- Potential visual impact on users of secondary and other roads in close proximity of the proposed power station (i.e. where visible within a 1km of the proposed infrastructure) is expected to be of **moderate** significance for all options and may be mitigated to **low**.

- The potential visual impact on residents of built-up areas and towns within the region is expected to be of **low** significance for all options, before and after mitigation.
- The visual impact on sensitive visual receptors (i.e. users of roads and residents of homesteads and settlements) within the region beyond the 1km offset is expected to be of **low** significance for all options, before and after mitigation.
- Potential visual impact on tourists and visitors to the Augrabies Falls (especially the AFNP Tourist Complex and local hikes and walks along the gorge) are expected to be of **moderate** significance and may be mitigated to **low.**
- The visual impact of the 132kV overhead power line expected to be of **moderate** significance. No mitigation is possible.
- The anticipated visual impact of construction is likely to be of **moderate** significance, both before and after mitigation.
- The anticipated visual impact of the facility on the regional visual quality, and by implication on the sense of place of the region is expected to be of **moderate** significance during the construction phase and **low** during the operational phase.
- Potential visual impact on tourism potential north of the Orange River is expected to be **low** as the project infrastructure will be placed below ground.

The proposed Riemvasmaak Hydro-Electric Power Project is located on Remainder of Farm no. 497 (private land) and Portion 1 of Farm no. 498 (SANParks land) within the Augrabies Falls National Park, and the infrastructure would be located within an area which is currently zoned as either Primitive or Remote, as demarcated in the Augrabies Falls National Park (AFNP) Management Plan (2013). The proposed options also fall within the priority natural areas buffer as well as the viewshed protection areas.

In terms of the above, the proposed project would ordinarily be fatally flawed from a visual perspective[6] and from a Conservation Management[7] perspective, as it would compromise infrastructure incompatible with the AFNP overall, and its land use zoning. However, the applicant has obtained legal opinion indicating that the AFNP may be rezoned to accommodate the infrastructure pending an Environmental Authorisation.

Therefore, the recommendation of this VIA is that the project as proposed be supported, provided the following is in place:

- That all mitigation of visual impacts as proposed during planning, construction, operation and decommissioning is implemented;
- That the SANParks authority endorses the proposal and
- That the Augrabies Falls National Park Zoning Plan is legally and successfully revised to accommodate the development.

[6] The Protected Areas Act controls development in protected areas and areas adjacent thereto. Until such a time as the AFNP Management Plan is revised, the proposed site is still located within and / or close to a Protected Area.

[7] Until such a time as the AFNP Mangement Plan is revised, the proposed site is still located within land use zones incompatible with such development.

10. MANAGEMENT PROGRAMME

The management programme 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 8: Management Programme: Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the Proposed Riemvasmaak Hydro Electric Power Station.		
Project Component/s	Riemvasmaak Hydro Electric Power Station and associated infrastructure.	
Potential Impact	Primary visual impact of the facility due to the presence of primary and ancillary infrastructure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (i.e. within 1km of the site) as well as within the region.	
Mitigation: Target/Objective	Optimal planning of infrastructure to minimise visual impact.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that transmission or distribution power lines are buried within the Riemvasmaak and SANParks areas	Developer / design consultant	Early in the planning phase.
Ensure that other project components (e.g. power chambers) are placed underground	Developer / design consultant	Early in the planning phase.
Ensure that water conveyance infrastructure is placed underground (i.e. within a pipeline)	Developer / design consultant	Early in the planning phase.
Plan all infrastructure in such a way and in such a location that clearing of vegetation is minimised. Consolidate infrastructure and make use of already disturbed sites rather than pristine areas wherever possible.	Developer / design consultant	Early in the planning phase.
Make use of existing roads wherever possible. Where new roads are required to be constructed, these should be planned carefully, taking due cognisance of the local topography. Roads should be laid out along the contour wherever possible, and should never traverse steep slopes at 90 degrees. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems. Plan roads and other infrastructure in such a way and in such a location that clearing of vegetation is minimised. Consolidate infrastructure and make use of already disturbed sites rather than pristine areas wherever possible.	Developer / design consultant	Early in the planning phase.
For potentially visible above ground structures, implement materials and architectural forms that utilise and compliment the natural rock and soil colour and texture. This can greatly reduce the visibility of the proposed structures	Developer / design consultant	Early in the planning phase.
Consult a lighting engineer in the design and planning of lighting to ensure the correct specification and placement of	Developer / design consultant	Early in the planning phase.

lighting and light fixtures for the facility and the ancillary infrastructure. The following is recommended: ○ Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself); ○ Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights; ○ Making use of minimum lumen or wattage in fixtures; ○ Making use of down-lighters, or shielded fixtures; ○ Making use of Low Pressure Sodium lighting or other types of low impact lighting. ○ Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.		
Performance Indicator	No ancillary infrastructure is apparent from surrounding areas.	
Monitoring	Not applicable.	

Table 9: Management Programme: Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Proposed Riemvasmaak Hydro Electric Power Station.		
Project Component/s	Construction site	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing and resulting erosion.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (i.e. within 1km of the site).	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate works areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that vegetation is not unnecessarily cleared or removed during the construction period.	Developer / contractor	Early in the construction phase.
Reduce the construction period through careful logistical planning and productive implementation of resources.	Developer / contractor	Early in the construction phase.
Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.	Developer / contractor	Early in and throughout the construction phase.
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Developer / contractor	Throughout the construction phase.
Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then	Developer / contractor	Throughout the construction phase.

disposed regularly at licensed waste facilities.		
Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).	Developer / contractor	Throughout the construction phase.
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	Developer / contractor	Throughout the construction phase.
Rehabilitate all disturbed areas, construction areas, servitudes etc. immediately after the completion of construction works. Consult an ecologist to give input into rehabilitation specifications.	Developer / contractor	Throughout and at the end of the construction phase.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of vegetation clearing during construction (by contractor as part of construction contract). Monitoring of rehabilitated areas quarterly for at least a year following the end of construction (by contractor as part of construction contract).	

Table 10: Management Programme: Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Riemvasmaak Hydro Electric Power Station.		
Project Component/s	Riemvasmaak Hydro Electric Power Stations and Associated 33kv and 132kv Power Lines.	
Potential Impact	Visual impact of facility degradation and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (i.e. within 1km of the site).	
Mitigation: Target/Objective	Well maintained and neat facility.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Maintain the general appearance of the facility as a whole, including the access roads and servitudes.	Developer / operator	Throughout the operational phase.
Maintain roads to forego erosion and to suppress dust.	Developer / operator	Throughout the operational phase.
Monitor rehabilitated areas, and implement remedial action as and when required.	Developer / operator	Throughout the operational phase.
Performance Indicator	Well maintained and neat facility with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of the entire site on an on-going basis (by operator).	

Table 11: Management Programme: Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the Proposed Riemvasmaak Hydro Electric Power Station.		
Project Component/s	Riemvasmaak Hydro Electric Power Stations and Associated 33kv and 132kv Power Lines.	
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (i.e. within 1km of the site).	
Mitigation: Target/Objective	Only the infrastructure required for post decommissioning use of the site retained and rehabilitated vegetation in all disturbed areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Remove above ground infrastructure not required for the post-decommissioning use of the site. Leave underground infrastructure (i.e. 33kV power lines) in place.	Developer / operator	During the decommissioning phase.
Rehabilitate access roads not required for the post-decommissioning use of the site. Consult an ecologist to give input into rehabilitation specifications.	Developer / operator	During the decommissioning phase.
Monitor rehabilitated areas quarterly for at least a year following decommissioning, and implement remedial action as and when required.	Developer / operator	Post decommissioning.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of rehabilitated areas quarterly for at least a year following decommissioning.	

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