Kokerboom Upgrade Project - Ecological Study

PREPARED FOR:

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EndemicVision is a multidisciplinary environmental management and consulting company with more than 20 years of experience in field.

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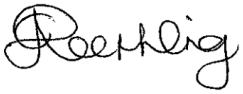
The author of this report, Chrizette Neethling, does hereby declare that she is an independent consultant on behalf of EVision and has no business, financial, personal or other interest in the activity, application or appeal in respect of which she was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of the specialist performing such work. All opinions expressed in this report are her own.



Signed: **C.D. Neethling**

Dated: 8 September 2021

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Report Requirements

Report Requirements - GN R326 2014 EIA Regulations, 11 June 2021		
	Requirement	**Addressed**
1	A specialist report prepared in terms of these Regulations must contain— (a) details of— (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	EIA Main report
1	(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	EIA Main report
1	(c) an indication of the scope of, and the purpose for which, the report was prepared	Yes
1	(c)(i) an indication of the quality and age of base data used for the specialist report;	Yes
1	(c)(ii) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Yes
1	(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Yes
1	e) a description of the methodology adopted in preparing the report or carrying out the specialized process inclusive of equipment and modelling used;	Yes
1	f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan that identifies alternative sites;	Yes
1	g) identification of any areas to be avoided, including buffers;	Yes
1	h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Yes
1	i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Yes
1	j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Yes
1	k) any mitigation measures for inclusion in the EMPr;	Yes
1	l) any conditions for inclusion in the environmental authorisation;	Yes
1	m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Yes
1	n) a reasoned opinion. whether the proposed activity, activities or portions thereof should be authorized; (i) regarding the acceptability of the proposed activity or activities and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Yes
1	(o) a description of any consultation process that was undertaken during the preparation of the specialist report;	EIA Main Report
1	(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto;	EIA Main Report
1	(q) any other information requested by the competent authority	EIA Main Report
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

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Definitions and Acronyms

Acronyms	Description
BMM	Black Mountain Mining (Pty) Ltd
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Areas
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan/Programme
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NWA	National Water Act

1. Executive Summary

Black Mountain Mining (Pty) Ltd is currently planning to upgrade the Kokerboom Reservoir and associated pipeline on portion 01 and remaining extent of the farm Aggeneys 56, extending from the reservoir approximately 4km North-East of Aggeneys towards the town. The pipeline starts at the Kokerboom reservoir and continues around the town towards the town connection at the corner of Steinkopf Road and Hartebees Street. The Kokerboom upgrade project is located within the Bushmanland, Khâi-Ma local municipality, Northern Cape Province. EndemicVision Environmental Services (Pty) Ltd was appointed by Black Mountain Mining (Pty) Ltd to conduct an ecological impact assessment.

Based on the DFFE national screening tool, the terrestrial biodiversity theme was rated as very high, whilst the animal species theme and civil aviation theme rated as high. Both the paleontology and plant species themes were rated as moderate. The very high terrestrial biodiversity theme rating is based on the locality of the project within Critical Biodiversity Areas (CBA) 1 and 2. The following ecological specialist triggers required verification for this development:

- A relatively undisturbed or 'natural' site, with indigenous vegetation;
- Some other possible significant natural features;
- Legal Requirement in terms of biodiversity legislation;
- Lack of information about the receiving environment;
- The potential of the specific project to pose a threat to biodiversity; and
- The potential of biodiversity and/or ecosystems to pose a threat to the proposed project.

The field assessment and desktop review of the available ecological information for the area was conducted to identify and characterize the ecological features of the site.

The project area is situated in the Succulent Karoo Hotspot which is already under severe pressure due to mining, overgrazing, climate change and illegal harvesting activities (SKEP, 2009). The Bushmanland Inselbergs of the Succulent Karoo Hotspot has a total area of 31 400 hectares and includes a total of 429 flora species, of which 67 are endemic to this hotspot area and 87 are listed on the IUCN red list (SKEP, 2009). A single Important Bird Area (IBA) contains populations of the Red Lark (*Certhilauda albescens*) on farms Haramoep and Black Mountain Mine Nature Reserve (SKEP, 2009) which is located within 20 kilometres from the project site.

The project site is mainly located on degraded and/or previously transformed areas. Approximately 10% of the project area, the area where the Kokerboom reservoir will be placed, is regarded as natural. The remainder of the project area, the pipeline, will have a 15 metre wide footprint parallel to the existing Kokerboom pipeline and the communication line. The development is further partially located within the footprint area of an existing gravel road.

The site falls primarily within Bushmanland Arid Grassland (76%), Aggeneys Gravel Vygieveld (20%) and Bushmanland Inselberg Shrubland (4%) vegetation types. The Aggeneys Gravel Vygieveld and Bushmanland Arid Grassland vegetation types are least threatened, whilst the Bushmanland Inselberg Shrubland's conservation status is threatened (Mucina & Rutherford, 2011).

The five habitat (fine-scale vegetation) units intersected by this linear development includes Washes (28%); Plains Rocky (20%); Plains Sandy Flat (19%); Mountains (4%) and Transformed (29%) areas surrounding Aggeneys town.

The site has a low abundance of provincially protected flora species as defined by the Northern Cape Nature Conservation Act (Act 9 of 2009). A total of two provincially protected trees, and less than 40 provincially protected succulents were recorded on site. A moratorium (Provincial Gazette Extraordinary, 1 April 2005; Gazette 968, No. 3) exists prohibiting the removal of *Aloidendron dichotomum* from the wild.

The faunal representation of the project area is considered sparse and isolated. The presence of three provincially protected fauna species were confirmed on site. A dense Cape Ground Squirrel breeding colony nesting along the residential areas; evidence of ungulate activity and rodent species along the route and herpetofauna species (Ground agama) were found along the Northern edge of Aggeneys. No avifauna migratory or breeding activity were observed.

Two alternative layouts were assessed for the proposed Kokerboom reservoirs to ensure the least possible biodiversity impact. Alternative Layout 1 (0.43ha) is the preferred alternative, being closer to the existing road while alternative layout 2 (0.57ha) is more into the natural veld. Both alternative layouts are in the untransformed part of the Bushmanland Inselberg Shrubland vegetation type and is rated moderately sensitive.

Cumulative impacts associated with the upgrade include the permanent loss of vegetation where the reservoirs will be constructed. Alternative Layout two has an additional cumulative impact on the surface water hydrological flow regime since the reservoir will overland water flow from the upper to lower gradients.

Alternative layout 1 has 10 impacts associated with it, whilst alternative layout 2 has 11. The additional impact associated with alternative layout 2 is the alteration of the surface water flow regime of the area. The only moderate impact associated with both these alternative layouts is the loss of protected plant specimens. Most of the protected flora species on site, *Aloidendron dichotomum* and *Anacampseros* sp., can however be successfully relocated and the risk can hence be mitigated by means of rehabilitation.

Northern Cape Nature Conservation Act permits are required for the destruction and/or disturbance of protected flora and fauna. Topsoil should be harvested at the reservoir area and can be used in the succulent nursery or for concurrent rehabilitation.

Phased dozing should be implemented during the clearance and construction phase of the project to ensure that fauna species present can move from the disturbance into the surrounding natural areas. All transplantable flora species must be moved to the Gamsberg succulent nursery in Aggeneys to be used in the rehabilitation of the pipeline and/or directly relocated to other rehabilitation areas.

2. Introduction

2.1. Project Description

Black Mountain Mining (Pty) Ltd is planning to upgrade the existing Kokerboom reservoir and associated pipeline that primarily provides water to Aggeneys town. The Kokerboom upgrade project entails the upgrading of infrastructure to improve the water storage capacity from less than 6 hours to 48 hours. This project forms part of the existing Pella pipeline that supply water from the Orange River system to surrounding towns.

Sedibeng Water Board is in possession of a valid General Authorisation (Section 21 c&i) for the Pella Pipeline (File number 27/2/1/D182/1/3/4/5; dated 15 October 2015). This authorization was issued for the initial upgrading of the Pella pipeline and stipulate conditions that must be met for the Pella pipeline crossing certain ephemeral streams.

This project is the continuation of upgrading the pipeline. This project does not cross any ephemeral streams but is frequented by washes defined as overland ephemeral sheet or erosion areas created from significant rainfall events and hence these conditions do not apply.

The total project footprint area is about 15 hectares which runs parallel to the existing Kokerboom pipeline. In addition to the pipeline, two prefabricated reservoir tanks will be installed. Two alternative locations for the Kokerboom reservoir were considered. Alternative 1 is located slightly further from the nearby rivulet/stream than alternative 2 and is therefore preferred.

The Kokerboom reservoir upgrade will consist of the construction of two 5200 m^3 prefabricated reservoir tanks consisting of AZ150 Aluminium Zinc coated steel sheets and lined with PVC. Excavation will ensure that the new reservoirs are placed at a similar height and/or level as the existing Kokerboom reservoir. The current bulk water supply pipeline with a 250 mm internal diameter needs to be replaced for 7.8 km of which 7.1 km will be upgraded to 400 mm diameter pipeline and 0.7 km to 315 mm diameter pipeline. The upgrade of the Kokerboom pipeline necessitates the construction of the new pipes parallel to the current pipeline to ensure uninterrupted water supply. The existing pipeline will be removed at mine closure.

In summary, the project activities will be:

- Site Clearance and Construction:
  - Kokerboom reservoir (two reservoir tanks);
  - Kokerboom pipeline;
- Rehabilitation; and
- Maintenance.

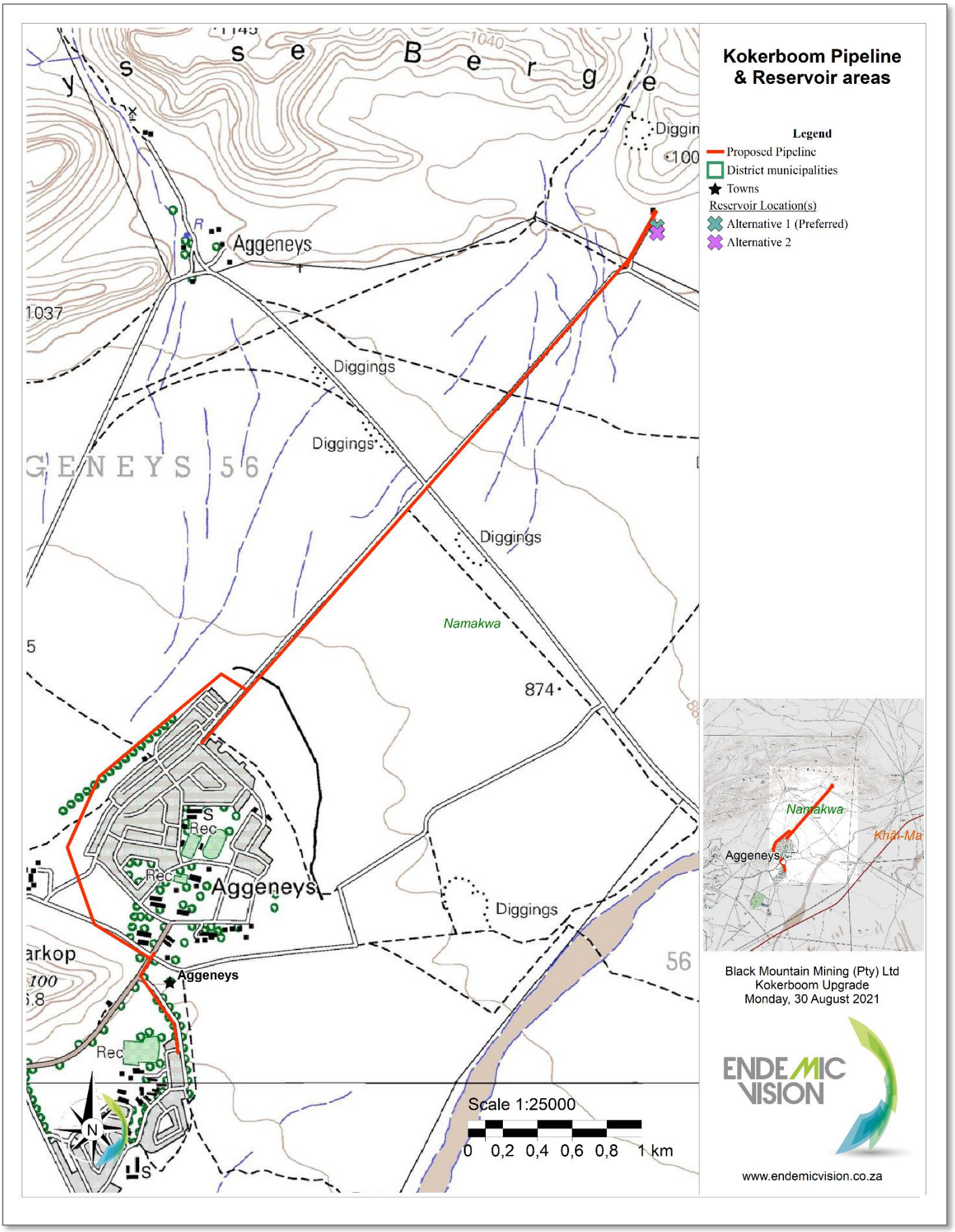

Figure 1: Kokerboom Project Upgrade Locality Map

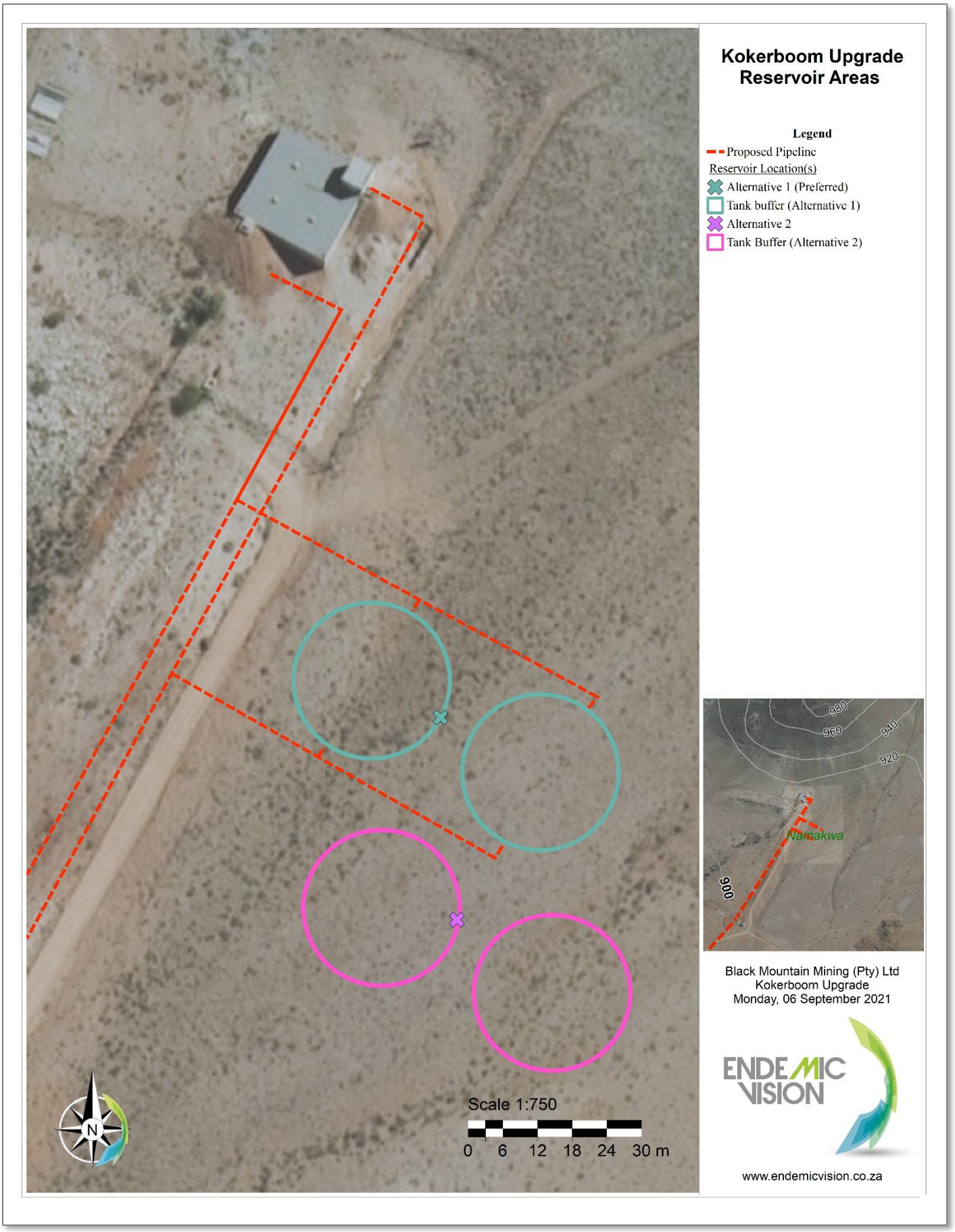

Figure 2: Kokerboom Pipeline Reservoir Areas

3. Terms of Reference

This study is a general biodiversity evaluation and includes:

- Desktop analysis to determine perspective of the biodiversity and related issues of the site;
- Fieldwork to locate and describe the current state of vegetation on the site;
- Baseline Establishment:
  - Key focus on the impact footprint(s) of the site;
  - Establishing a baseline description against which impacts can be identified and measured;
- Flora Analysis:
  - Determine the species composition, diversity, structure and conservation status;
  - Generate a vegetation map showing the site in relation to National Vegetation Units;
  - Provide site photos that show the current state of the vegetation (i.e. natural, transformed, disturbed etc.);
  - Impact analysis on botanical aspects;
- Fauna Analysis:
  - Possible unique species habitats;
  - Expected species, species conservation status;
  - Impact analysis on faunal aspects; and
- Hydrological Analysis:
  - Evaluation of hydrological regime and possible impacts.

3.1. Legal Overview

The legal references that apply to this project is summarized below.

3.1.1 National Environmental Management Act (NEMA) (Act No 107, 1998):

NEMA requires that measures be taken to "prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." In this context ecological degradation could take place if the project area is permanently altered from a functional ecological state to a polluted, impacted site.

3.1.1.1 NEMA EIA Regulations (GN R326 of 2014)

The requirements of the NEMA EIA regulations 2014, appendix 6, as amended in 2017 (GN R326) are also complied with and referenced below.

Table 1: Requirements - GN R326 2014 EIA Regulations

Requirements of Appendix 6 - GN R326 2014 SA Regulation, 7 April 2017		Addressed in the Specialist Report
1. (1)	A specialist report prepared in terms of these Regulations must contain-	
a)	Details of -	
i.	the specialist who prepared the report; and	Declaration of consultant independence;
ii.	the expertise of that specialist to compile a specialist report including a curriculum vitae;	Curriculum Vitae available
b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Declaration of consultant independence
c)	an indication of the scope of and the purpose for which, the report was prepared; (cA) an indication of entire quality and area of base data used for the specialist report (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Executive Summary Final Impact Statement; Cumulative Impacts

Requirements of Appendix 6 - GN R326 2014 SA Regulation, 7 April 2017		Addressed in the Specialist Report
d)	the date and season of the site investigation and the relevance of tire season to the outcome of the assessment;	Assumptions and Limitations
e)	a description of the methodology adopted for preparing the report or carrying out the specialized process inclusive of equipment and modelling used	Approach and Methods
f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Assessment of alternatives
g)	an identification of any areas to be avoided, including buffers;	Ecological Sensitivity
h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Ecological Sensitivity
i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Assumptions and limitations
j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Impact Assessment
k)	any mitigation measures for inclusion in the EMPr,	Mitigation measures
l)	any conditions for inclusion in the environmental authorisation;	Executive Summary
m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation	Executive Summary
n) i. ii.	a reasoned opinion- whether the proposed activity, activities or portions thereof should be authorized; (iA) regarding the acceptability of the proposed activity or activities and if the opinion that the proposed activity, activities, or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable the closure plan;	Conclusion Recommendations
o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

3.1.2 National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004):

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Act provides for the listing of species as threatened or protected, fewer than one of the following categories:

- **Critically Endangered:** any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered:** any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- **Vulnerable:** any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future, although it is not a critically endangered species or an endangered species.
- **Protected species:** any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The National Environmental Management: Biodiversity Act (NEM:BA) regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Regulations have been published in Government Notices R.506, R.507, R.508 and R.509 of 2013 under NEMBA. According to this Act and the regulations, any species designated under Section 70 cannot be propagated, grown, bought, or sold without a permit. Below is an explanation of the three categories:

- Category 1a: Invasive species requiring compulsory control. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.

- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Cat 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Cat 3 plants to exist in riparian zones.

Two adult *Prosopis* sp. trees, listed as Category 3 species were found on site.

3.1.3 Northern Cape Nature Conservation Act, No. 9 of 2009:

The Northern Cape Nature Conservation Act provides inter alia for the sustainable utilization of wild animals, aquatic biota and plants as well as permitting and trade regulations regarding wild fauna and flora within the province. The Act also lists protected fauna and flora under 3 schedules ranging from Endangered (schedule 1), Protected (schedule 2) to Common (schedule 3). The majority of mammals, reptiles and amphibians are listed under schedule 2, except for listed species which are under schedule 1. A permit is required for any activities which involve species listed under schedules 1 or 2.

In this context, some indigenous genera and protected species were found on-site and is included in the respective species lists.

3.1.4 National Water Act, No. 36 of 1998:

The National Water Act intends to provide for fundamental reform of the law relating to water resources; to repeal certain laws; and. to provide for matters connected therewith.

Water uses applicable to the Kokerboom upgrade project include section 21(c) impeding or diverting the flow of water in a watercourse and section 21(i) altering the bed, banks, course or characteristics of a watercourse.

3.1.5 Conservation of Agricultural Resources Act, No. 43 of 1983

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilization of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under Category 2 must be grown within a demarcated area under permit. Category 3 plants include ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the flood line of water courses and wetlands.

Two adult *Prosopis* sp. trees, listed as Category 3 species according to the Conservation of Agricultural Resources Act (Act No. 43 of 1983), were recorded in this area. Soil erosion protection measures are important along the slopes.

3.2. Ecological Triggers

Under the Department of Environmental Affairs and Development Planning Guideline for Biodiversity specialists (Brownlie, S. 2005) the following evaluation criteria were used to determine ecological triggers.

A 'trigger' means a characteristic of either the receiving environment or the proposed project which indicates that biodiversity is likely to be a 'key issue' and may require the detailed investigation by an appropriately qualified and experienced specialist.

Table 2: Evaluation Criteria

Site Trigger	Applicability to Kokerboom Upgrade Project
A relatively undisturbed or 'natural' site, with indigenous vegetation	PARTIALLY APPLICABLE The site has limited areas qualifying as natural and indigenous vegetation. The majority of the areas have been previously disturbed by the existing gravel road, Kokerboom Pipeline and the adjacent communication line.
Wetlands	NOT APPLICABLE No wetland areas on site.
River systems	PARTIALLY APPLICABLE No NFEPA rivers will be impacted upon. The pipeline will however cross isolated washes.
Some other possible significant natural features	APPLICABLE Limited quartz patches with *Anacampseros* sp. communities were found on site. Individual provincially protected trees were also present.
Dune systems	NOT APPLICABLE
Legal Requirement in terms of biodiversity legislation	APPLICABLE This refers to legislation about the management of protected trees, protected fauna and flora and alien invasive species.
Lack of information about the receiving environment	NOT APPLICABLE This area is part of Bushmanland inselbergs of the Succulent Karoo Hotspot and has habitat types generally known and previously investigated.
The presence of important biodiversity pattern	NOT APPLICABLE
The presence of important ecological processes	NOT APPLICABLE
The presence of important ecosystem goods and services;	NOT APPLICABLE

Site Trigger	Applicability to Kokerboom Upgrade Project
The potential of the specific project to pose a threat to biodiversity;	NOT APPLICABLE The development footprint on natural veldt is less than <15 hectares. The proposed pipeline is a parallel activity with a total width of 15 meters which should not detrimentally impact the movement patterns of biodiversity in the area.
The potential of biodiversity and/or ecosystems to pose a threat to the proposed project	NOT APPLICABLE Access to the site is relatively easy, no human/environmental risk interfaces present.
The potential for making a significant contribution to biodiversity conservation objectives	NOT APPLICABLE A limited amount of protected species will be impacted upon by this project.

4. Assumptions and Limitations

There is a limitation on the potential number of bulb species encountered on site as some of these species do not flower every year and some only flower under specific conditions. The site assessment is further not representative of all four seasons and some species may have been absent.

In terms of fauna, visual sightings as well as the presence of dung and/or tracks were used to confirm species present. Migratory species may frequent the area but was not observed during the site assessment.

5. Assessment Approach

This assessment and report are conducted according to the EIA Regulations (Government Notice Regulation 982, 2014; as amended Government Notice Regulation 517, 2021) in terms of the National Environmental Management Act (NEMA) (Act 107 of 1998) as amended in 2017.

Best practice guidelines are used where applicable and referenced.

The following environmental management principles are applied in this study:

- The precautionary principle - risk-averse approach towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems.
- Recommendations and mitigation measures must demonstrate how the proponent intends complying with the principles contained in section 2 of the NEMA, which, amongst other things, indicates that environmental management should:
  - Avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity; Avoid degradation of the environment.
  - Avoid jeopardising ecosystem integrity.
  - Pursue the best practicable environmental option using integrated environmental management; Control and minimise environmental damage.
  - Pay specific attention to management and planning procedures of sensitive, vulnerable, highly dynamic or stressed ecosystems.
  - Protect the environment as the people's common heritage.

Site assessments were conducted during August 2021. The assessments include a description of the biodiversity of the site, the current status of the site and a mapped overview of the distribution of important species on the site.

Ecological assessment and mitigation management plan is presented for the potential impacts of the following project phases:

- Clearance and construction;
- Rehabilitation; and
- Maintenance phases.

5.1. Risk Assessment Method

To ensure compliance with the NEMA regulations, all possible impacts are assessed which includes the direct, indirect as well as cumulative impacts.

The assessment of impacts includes inputs from the impact assessor; specialists; project engineers and stakeholders. The impact assessment is framed from the literature review, environmental screening, and the site assessment.

The site visit was conducted on 18 August 2021 to determine the impacts on site.

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives understudy for meeting a project need. Assessment of impacts will be based on EIA Regulations (NEMA EIA Regulations, 2014 amended 2021). The various environmental impacts and benefits of this project are discussed in terms of impact status, probability, duration, scale/extent, and magnitude/severity.

The significance of the aspects/impacts of the process will be rated by using a matrix derived from Plomp (2004) and adapted to some extent to fit this process. These matrixes use the consequence and the likelihood of the different aspects and associated impacts to determine the significance of the impacts.

The significance of the potential impacts will be determined through a synthesis of the criteria below:

- Impact Status

The nature or status of the impact is determined by the conditions of the environment before construction and operation. A discussion on the nature of the impact will include a description of the cause of the effect, the aspect that will be affected and how it will be affected. The nature of the impact can be described as negative or positive.

Table 3: Impact of Nature Rating

RATING	DESCRIPTION	RATING
Positive	A benefit to the receiving environment	(+ve)
Negative	A cost to the receiving environment	(-ve)

Probability This describes the likelihood of the impact actually occurring.

Improbable: The possibility of the impact occurring is very low, due to the circumstances, design or experience.
Probable: There is a probability that the impact will occur to the extent that provision must be made, therefore.
Highly Probable: It is most likely that the impact will occur at some stage of the development.
Definite: The impact will take place regardless of any prevention plans, and there can only be relied on mediatory actions or contingency plans to contain the effect.

Duration: The lifetime of the impact.

Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a period shorter than any of the phases.
Medium-term: The impact will last up to the end of the phases, whereafter it will be negated.
Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a period that the impact can be considered transient.

Scale: The physical and spatial size of the impact

Site: The impacted area extends only as far as the activity, e.g. footprint.
Local: The impact could affect the whole or a measurable portion of the above-mentioned properties and adjacent properties.
Regional: The impact could affect the area including the neighboring residential areas.

Magnitude/ Severity: Does the impact destroy the environment or alter its function.

Low: The impact alters the affected environment in such a way that natural processes are not affected.

Medium: The affected environment is altered, but functions and processes continue in a modified way.

High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance This is an indication of the **importance of the impact** in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.

Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.

Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.

High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The ratings of the identified impacts were undertaken quantitatively. A risk matrix will be used to determine the significance of the impacts. The magnitude of the impact, the extent of the impact, the reversibility of the impact, the duration of the impact and the probability of the impact occurring were taken into consideration. The assessment has been conducted without implementing any mitigation or management measures and then with the implementation of management and mitigation measures. During the process, a score was determined to divide the significance of the impacts into negligible, low, moderate and high.

The following scale is used to determine the significance score of the impact.

Table 4: Impact of significance rating

Aspect	Description	Weight	Significance Rating	Weight	Score Color
Duration	Short term	1	(Duration, Scale, Magnitude) x Probability		
	Medium-term	3			
	Long term	4			
	Permanent	5	Negligible	<20	
Scale/Extent	Site	1			
	Local	2			
	Regional	3	Low	<40	
Magnitude/Severity	Low	2			
	Medium	6			
	High	8	Moderate	<60	
Probability	Improbable	1			
	Probable	2			
	Highly probable	4	High	>60	
	Definite	5			

6. Site Overview

6.1. Reservoir Area (North)

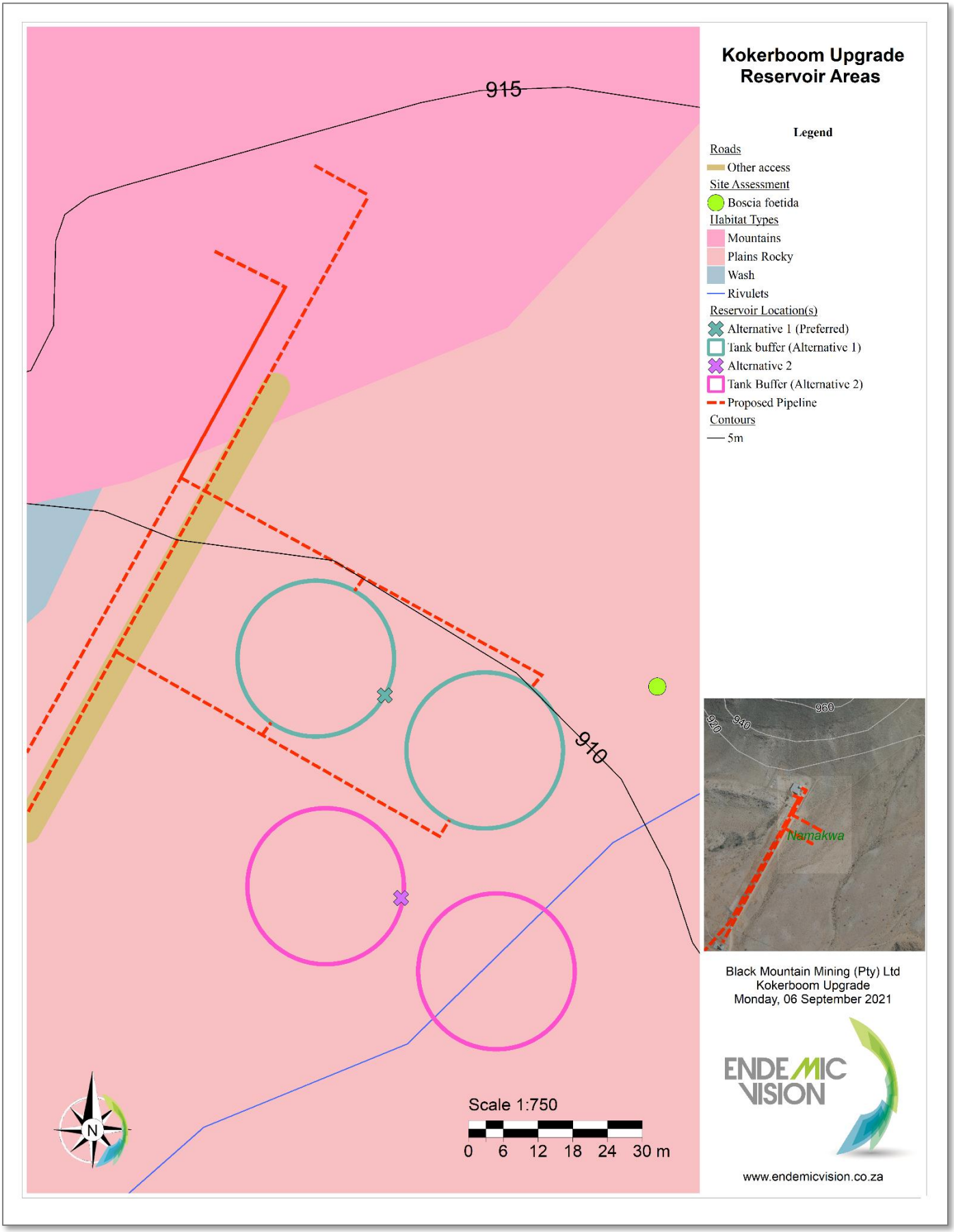

Figure 3: Reservoir Areas

The area where the Kokerboom reservoirs will be placed is located in the plains rocky vegetation unit and mainly consists of quartz cobbles and dwarf shrubs. This area is slightly sloped with a gradient between 1:15 and 1:19. The existing Kokerboom reservoir is located on a higher elevation at 915m above sea level, the inselberg has a high point of 1050m above sea level. The elevation range is 205m with the lowest point of the pipeline 845m above sea level.

One of the portable reservoirs of Alternative 2 is located within the rivulet East of the reservoir locations, where limited *Boscia foetida* trees are present.

The Kokerboom pipeline partially overlies the existing gravel road used for maintenance of the existing Kokerboom reservoir and pipeline. The section of the Kokerboom upgrade project between the reservoirs and the existing pump station will have two parallel pipelines for the conveyance of water.

Figure 4: Reservoir area with quartz cobbles and scattered dwarf shrubs and few *Boscia foetida* shrubs along the washes

6.2. Pipeline Area

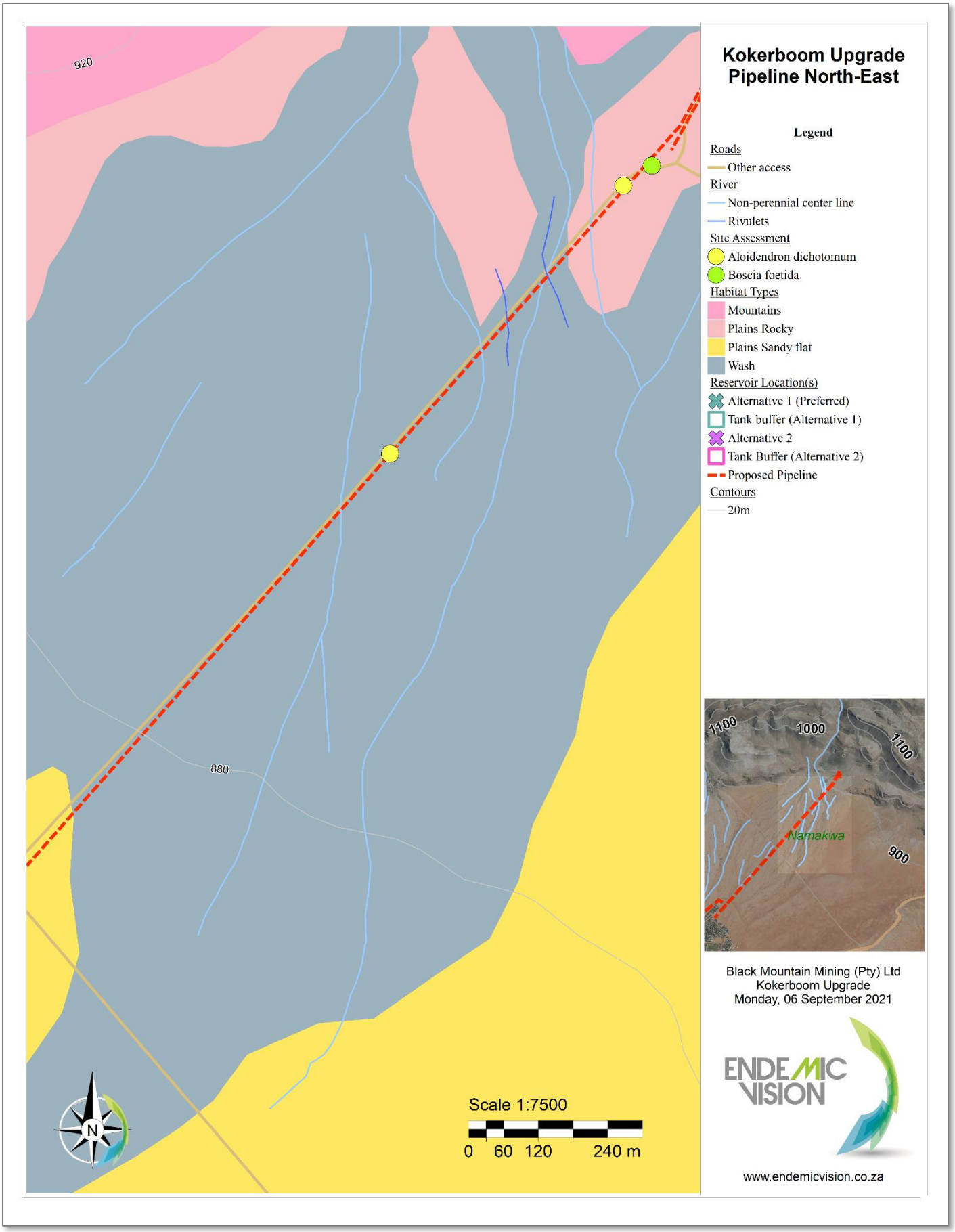

Figure 5: Pipeline Area inside fenced area (North-East Part 1)

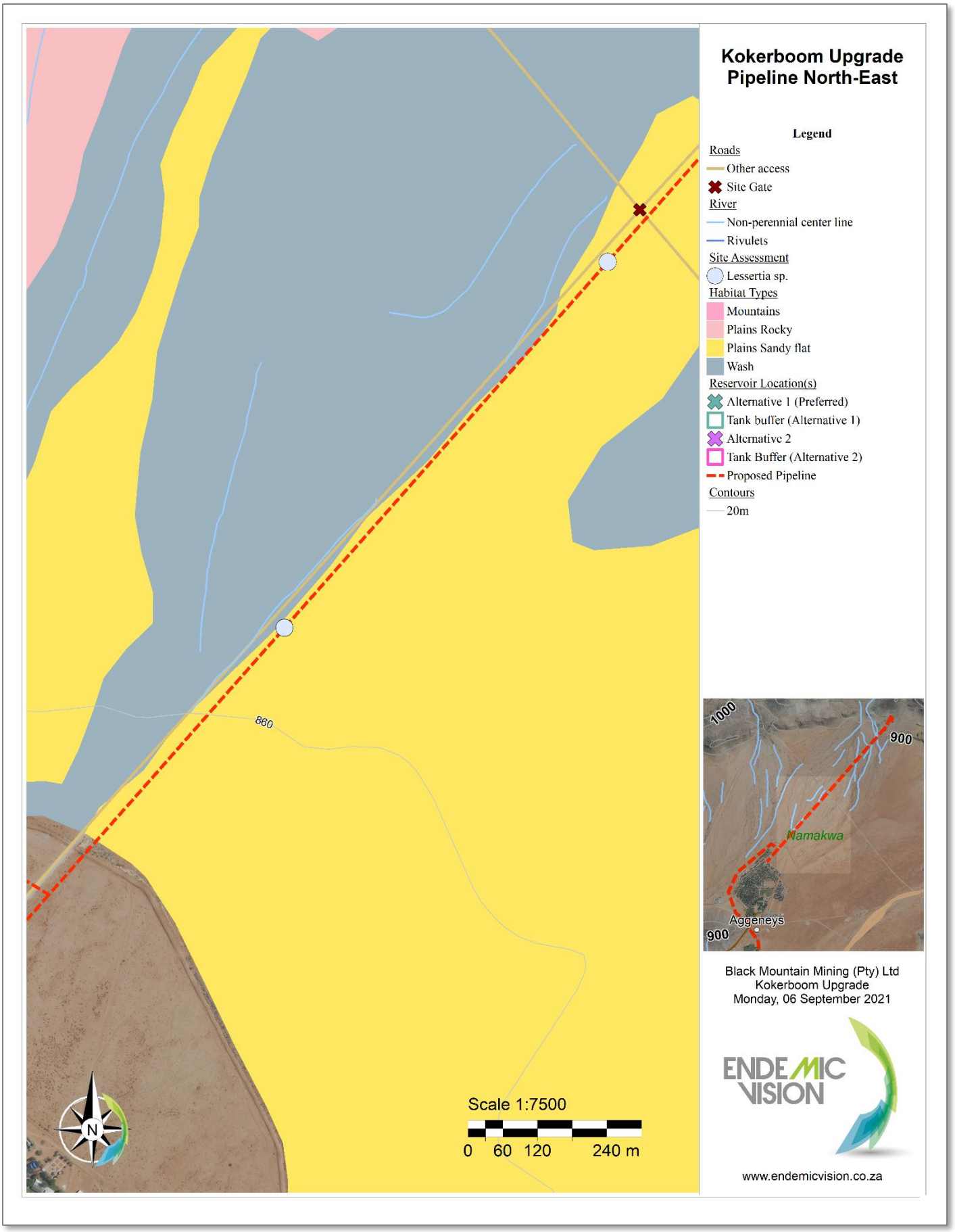

Figure 6: Pipeline Area outside fenced area (North-East Part 2)

Springbok (*Antidorcas marsupialis*) were found grazing in the North-Eastern fenced section of the pipeline. This area mainly consists of washes and plains rocky on the higher elevation areas. It has a steeper gradient than the not fenced and/or open areas

located closer to Aggeneys town. Two *Aloidendron dichotomum* trees were found within the proposed pipeline's 15m construction area, and a single *Boscia foetida* tree were located just south of the existing pump station.

Washes in the area appeared to have increased vegetation compared to surrounding open veld despite the permanent impacts of the gravel road fragmenting them. *Rhigozum trichotomum* shrubs are common along washes. Two adult *Prosopis glandulosa* trees, listed as Category 3 species according to the Conservation of Agricultural Resources Act (Act No. 43 of 1983), were recorded in this area.

Figure 7: Fauna and Flora presence on the Kokerboom Pipeline (North-Eastern Section between reservoir and gate)

Figure 8: Gate to Fenced section of pipeline and Kokerboom reservoir respectively

The area between the gate and Aggeneys town had several tracks, nesting sites, droppings and even carcasses which indicate a higher faunal diversity than that of the fenced area. The carcass found appeared to be ungulate species *Raphicerus campestris*

(Steenbok) and further indicates the presence of predators in this area. Residents of Aggeneys town appear to hike with their dogs in this area as well.

Droppings of different sizes were recorded, as well as several ungulate tracks. Smaller fauna, presumably rodent species, were also recorded in this area based on the size of the smaller droppings and nesting sites found under shrubs. No nesting sites of larger fauna was found on site.

Protected flora species, *Lessertia frutescens* (Cancer Bush), were also present in this area.

Figure 9: Fauna and Flora presence on the Kokerboom Pipeline (Northern Section between town and fenced area)

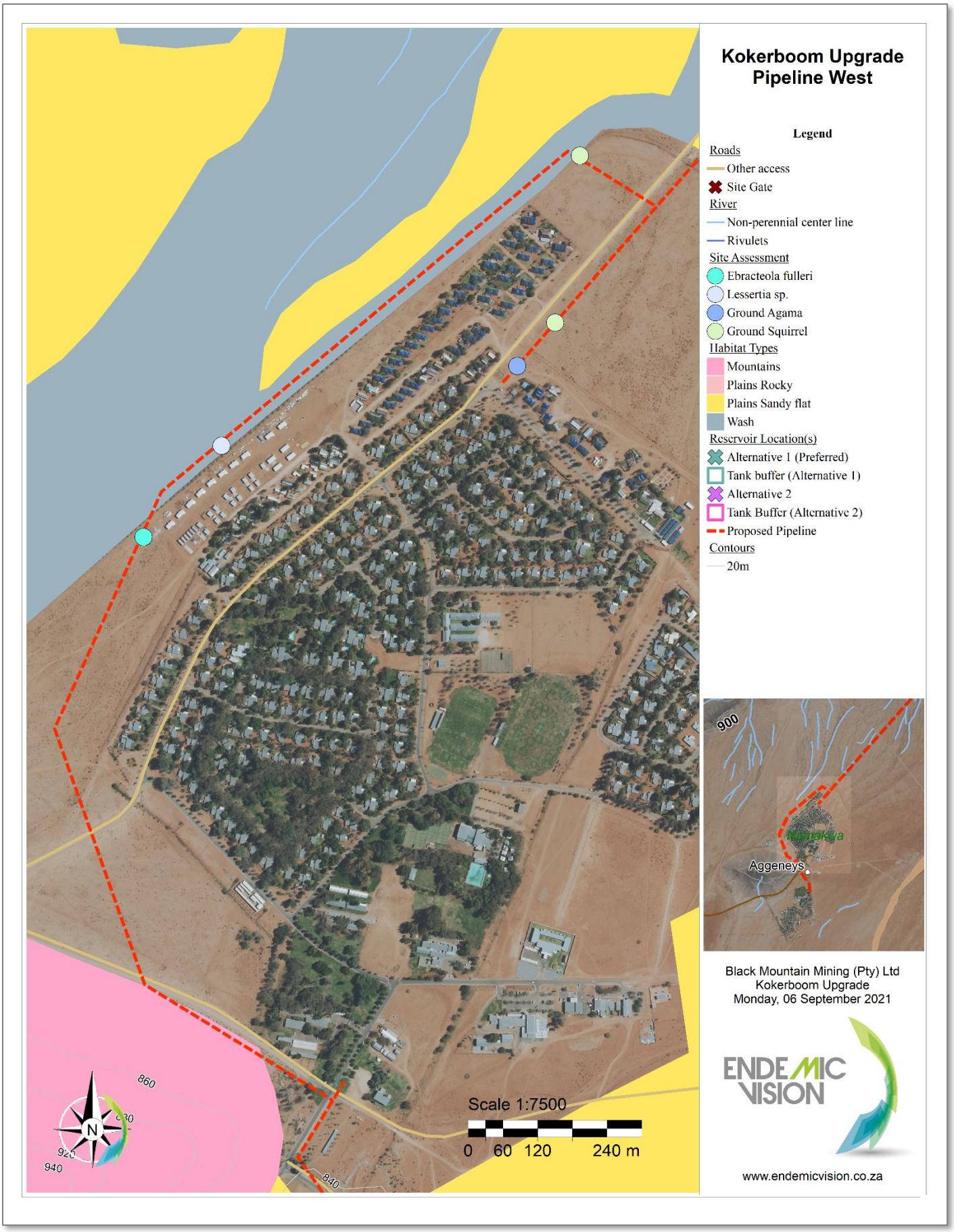

Figure 10: Pipeline Area (West of Aggeneys)

Alongside the western boundary of Aggeneys town limited quartz patches were found with *Anacampseros* (*Avonia*) sp. present. *Ebracteola fulleri* were also present, but no protected trees were found along this section of the pipeline.

The entire western boundary of Aggeneys town is classified as Washes since an artificial berm was constructed around the town to prevent flooding. The berm was constructed prior to 1985 already and has become a drainage area with improved vegetation structure including *Rhigozum trichotomum* shrubs present.

Numerous Cape ground squirrels (*Geosciurus inauris*) nesting sites were present surrounding the town infrastructure and active nests were observed along the Northern boundary of Aggeneys town. A ground agama (*Agama aculeata*) was also observed in one of the active ground squirrel nests.

Figure 11: Fauna and Flora presence on the Kokerboom Pipeline (Western Section alongside town)

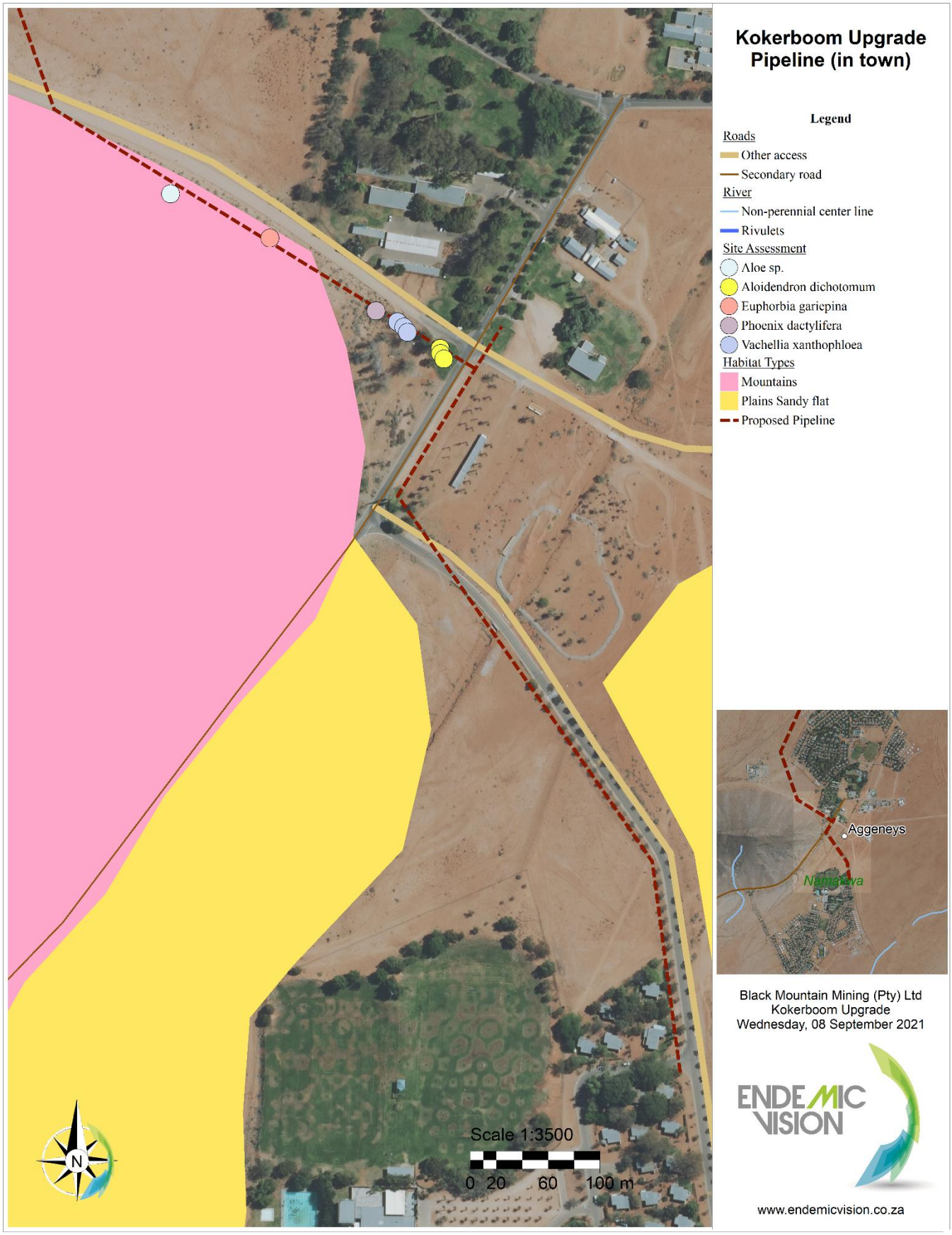

Figure 12: Pipeline Area (in Aggeneys town)

The proposed pipeline will cross town gardens, some with protected species planted for recreational purposes. *Aloe microstigma* and *Euphorbia gariepina* were observed in the Mountain habitat along the edge of Maanhaarkop.

The Kokerboom pipeline will run along the town entrance road and Steinkopf road. The trees lining Steinkopf road might be affected by the pipeline. These areas are mostly transformed and has limited natural occurring protected vegetation.

Figure 13: Fauna and Flora presence on the Kokerboom Pipeline (Southern section in town)

7. Geology, Topography and Soils

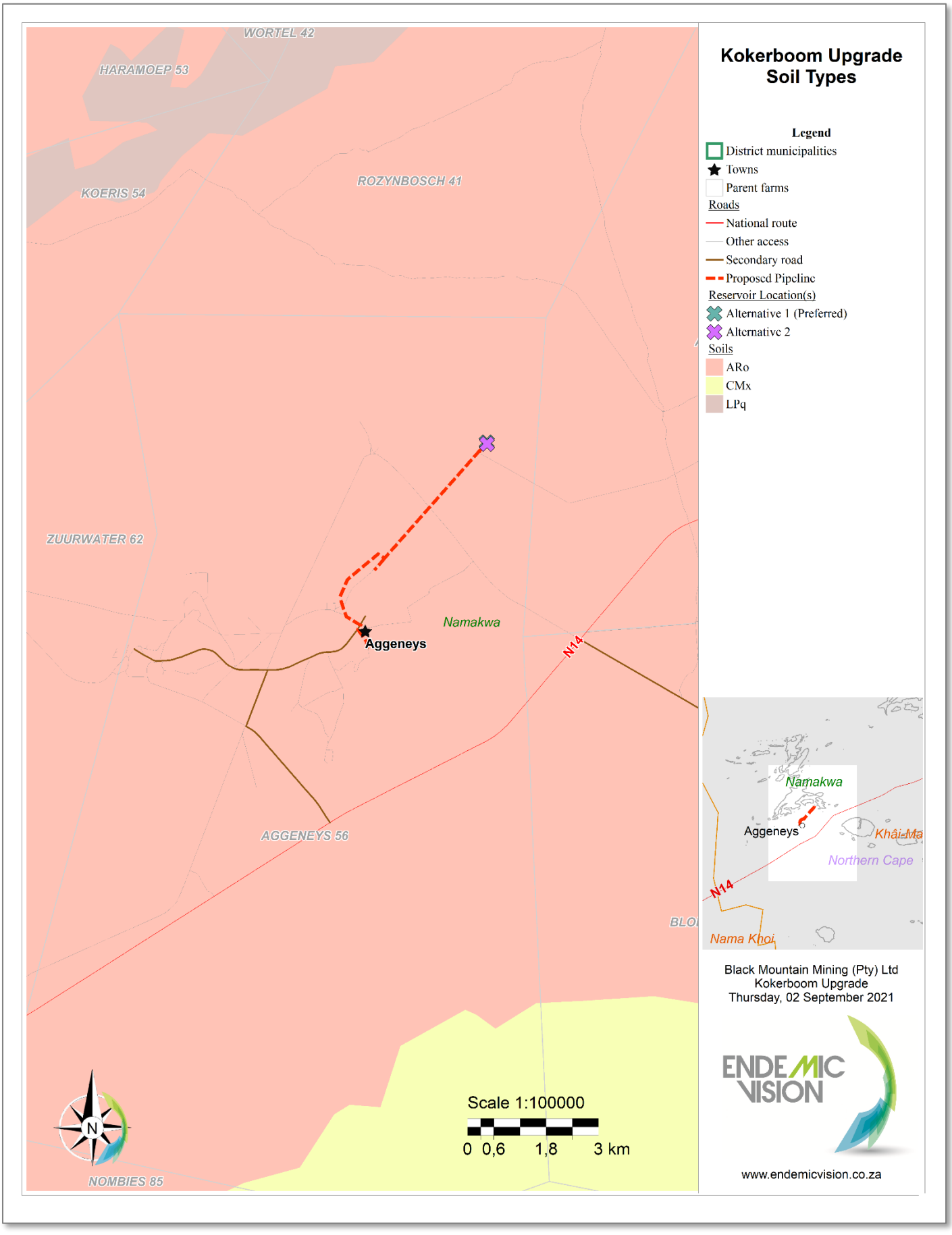

Figure 14: Kokerboom upgrade Soil Types

The area consists mainly of aeolian sand deposits with an increase in rock size towards the mountain on the north and individual quartz patches along the western edge of Aggeneys town.

The soil type is consistently Ferralic Arenosols (ARo) for the entire extent of the Kokerboom Upgrade project. The South African taxonomic equivalent is the Hutton soil form. Hutton soils are deep sandy aeolian soils with low moisture and nutrient holding capacities.

Figure 15: Soil profile visible where maintenance works were being undertaken

The soil type of the area is hence relatively shallow with dorbanks. Fine quartz pebbles were present along the entire extent of the pipeline, with varying pebble size. Areas with a denser, more homogenous layer of quartz had *Anacampseros* sp.

Figure 16: Quartz pebbles

The soils on the foot/lower slopes of Maanhaarkop and Aggeneys se Berge (Reservoir location) had larger cobbles amidst the quartz pebbles.

Figure 17: Foot slopes with cobbles

8. Water Resources

8.1. Drainage Regions

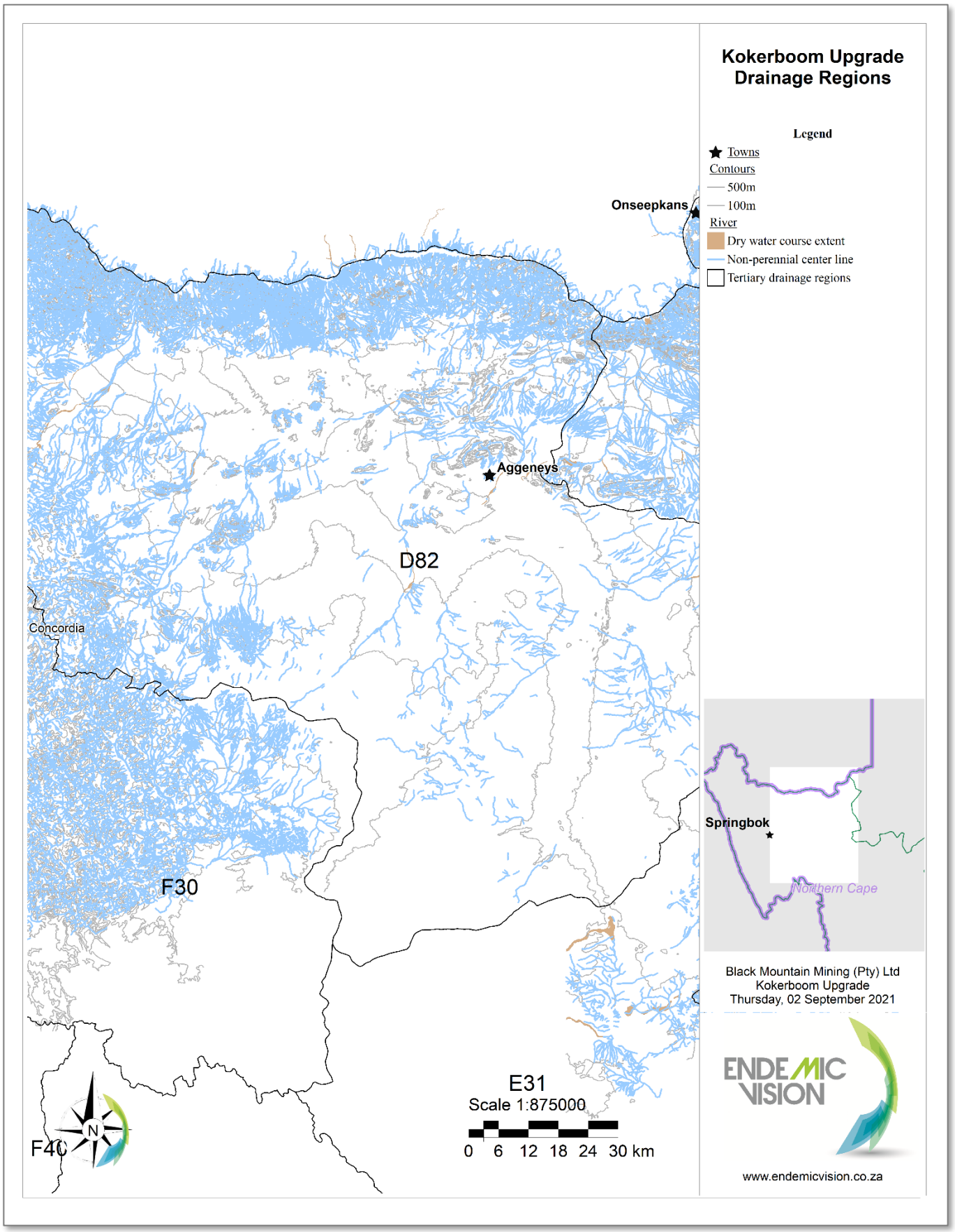

Figure 18: Tertiary Drainage Regions

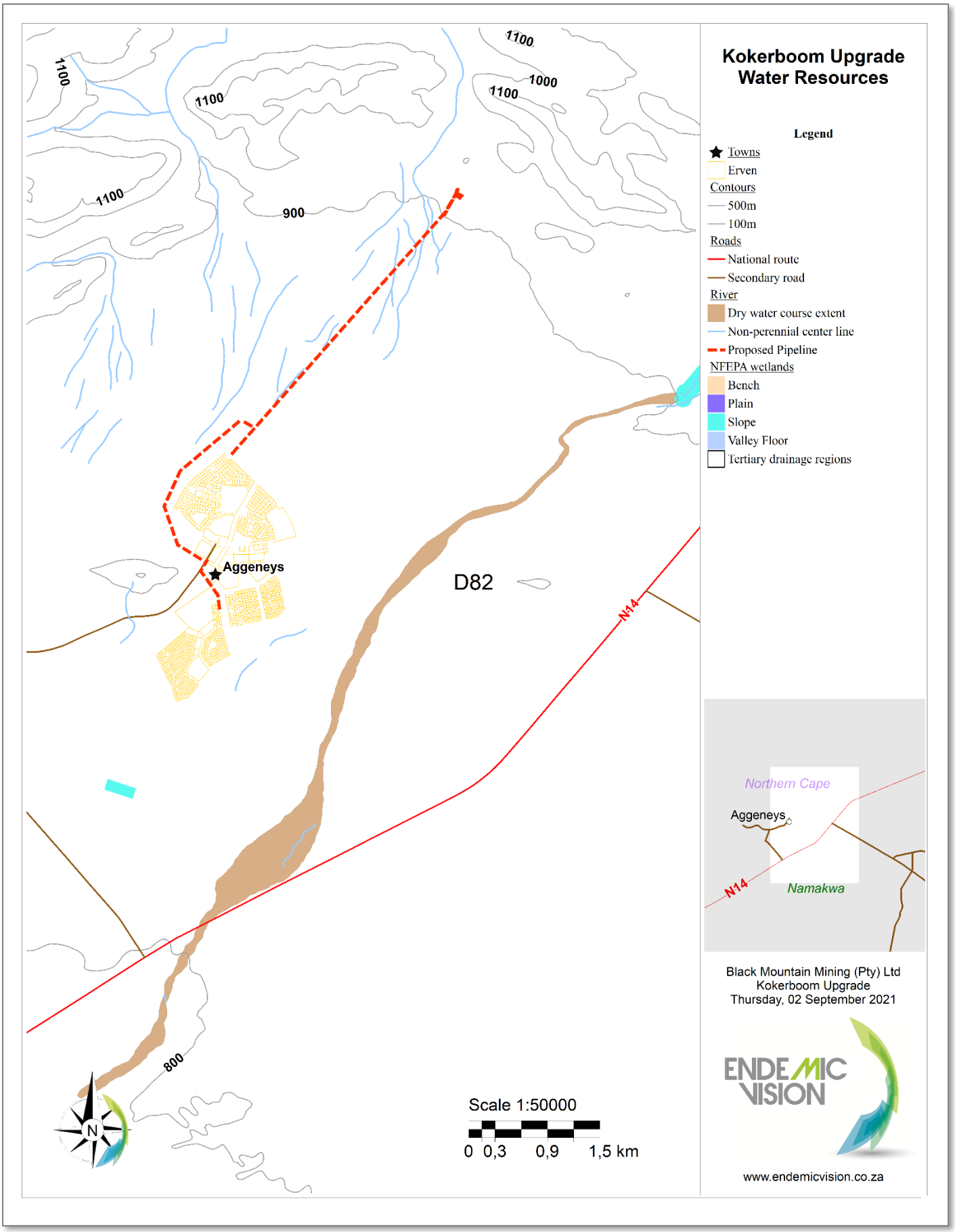

Figure 19: Water Resources

The Kokerboom Upgrade project is located in the D82 Tertiary catchment area in the Orange River basin water management area. Aggeneys is located in the Quaternary Catchment Area D82C. The Mean Annual Evaporation exceeds the Mean Annual Precipitation which further highlights the arid nature of the region and lack of surface water resources such as wetlands and river systems.

Table 5: Quaternary Information (WSP, 2016)

Quaternary	Catchment Area		MAP (mm)	MAE (mm)	MAR (Million m^3/a)
	Gross	Net			
D82C	3 996	0	83	2 650	0.00

Washes (illustrated as non-perennial center lines) are important for ecological processes in the region. The isolated washes that are directly intersected are relatively short erosion / sheet features caused by significant past rainfall events. These washes are not headwaters, are not linked to other rivers and do not flow into any NFEPA rivers or any other main streams. They can be better described as isolated features between inselbergs.

The proposed Kokerboom pipeline will be located on previously impacted areas within the existing Kokerboom pipeline footprint and road reserves. The washes do have some landscape contribution that is represented by the abundance of washes throughout the landscape, but the ones impacted upon have been subjected to past alteration during the construction of the existing Kokerboom pipeline and the gravel road linking the existing Kokerboom reservoir to Aggeneys town.

9. Vegetation Cover

9.1. Vegetation Types

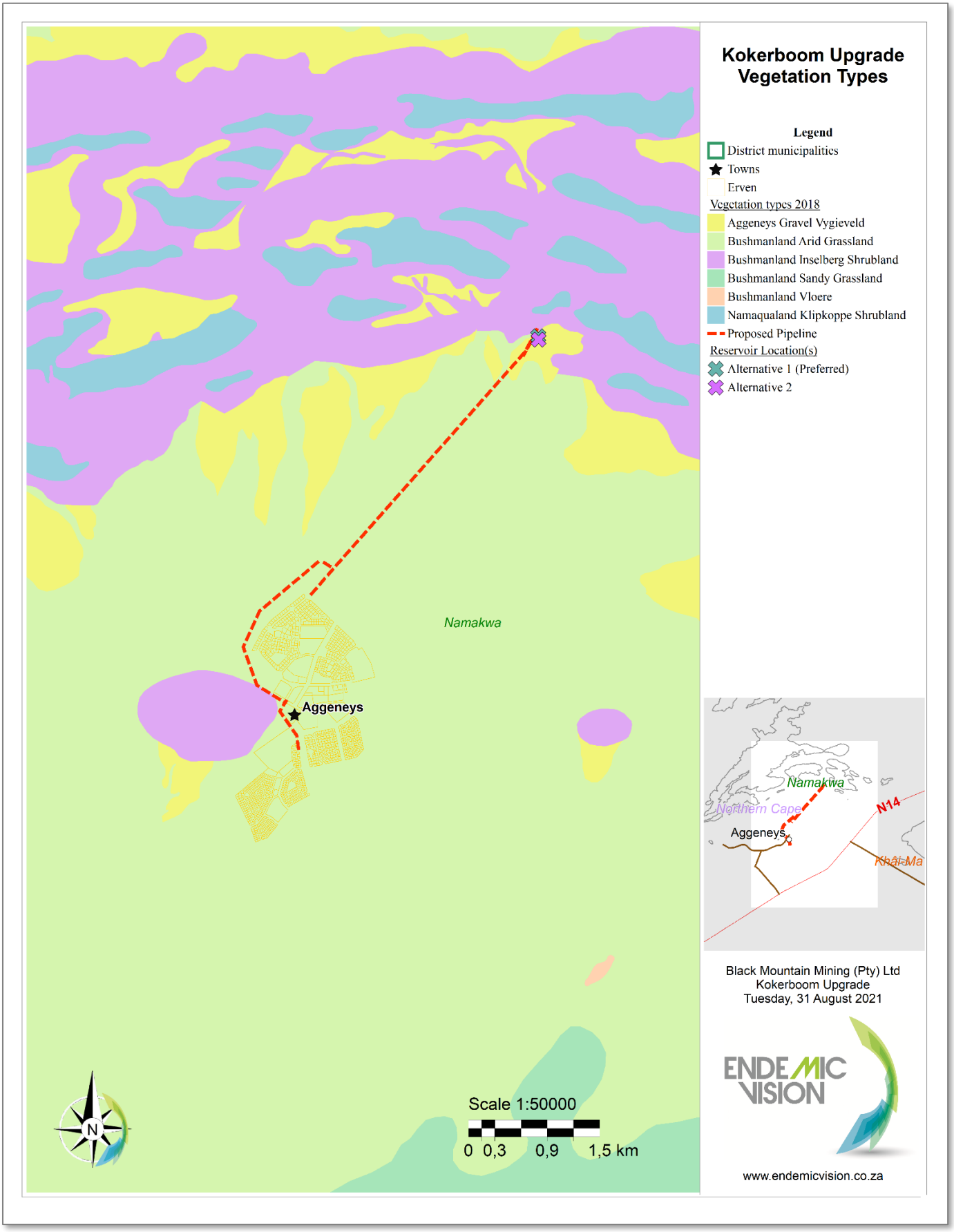

Figure 20: Vegetation Types

The proposed upgrade of the Kokerboom pipeline falls within the Richtersveld bioregion of the Succulent Karoo Biome and the Bushmanland bioregion of the Nama-Karoo Biome (Mucina & Rutherford, 2006).

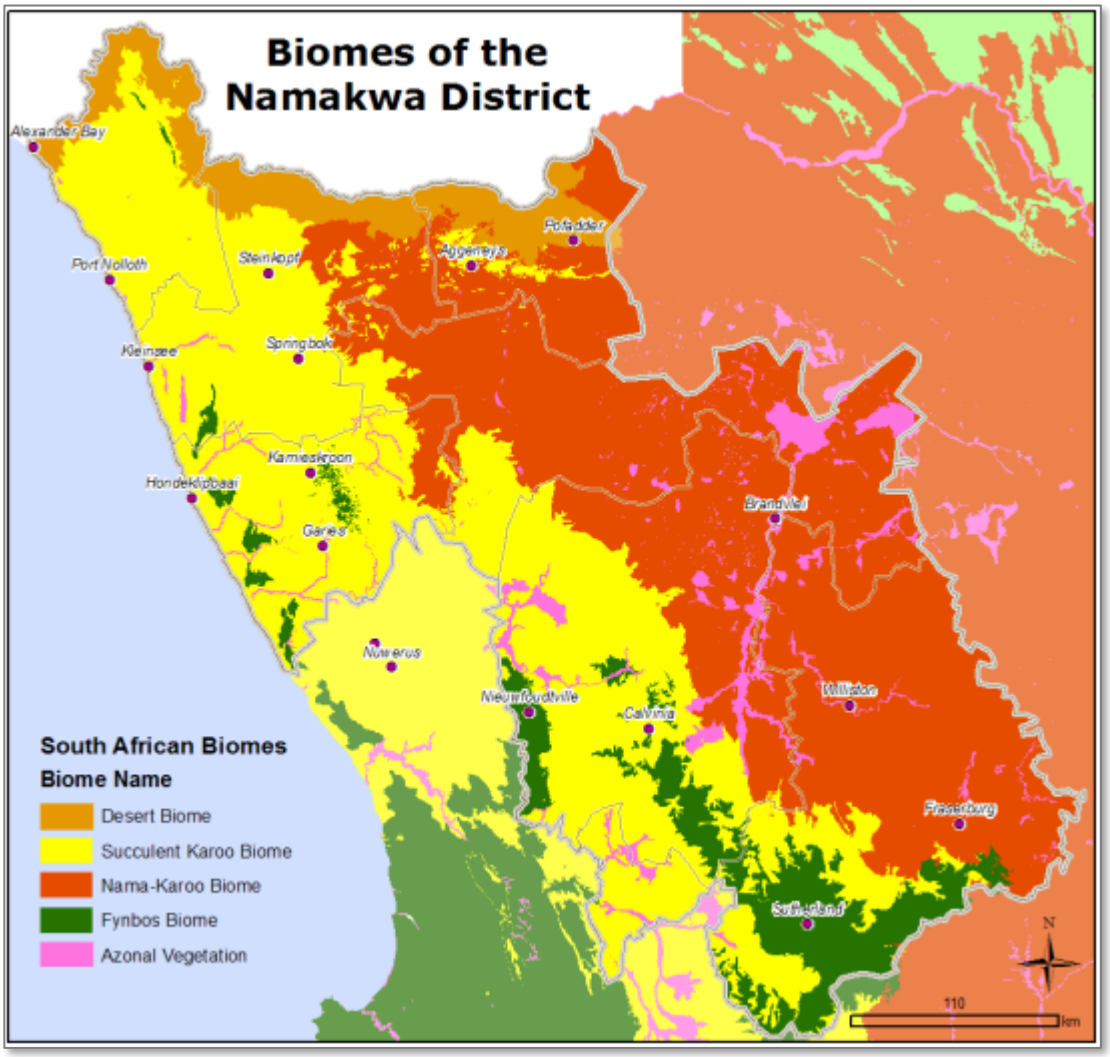

Figure 21: Biomes of the Namakwa District

The site falls partially in the Aggeneys Gravel Vygieveld (SKr 19), Bushmanland Arid Grassland (NKb 3) and Bushmanland Inselberg Shrubland (SKr 18) vegetation types.

The Aggeneys Gravel Vygieveld consists of flat or slightly sloped plains with a surface quartz layer. It is home to several endemic species which includes *Adromischus nanus*, *Dinteranthus puberulus*, *Dinteranthus vanzylii*, *Lapidaria margaretae*, *Anacampseros bayeriana*, *Conophytum achabense*, *Conophytum angelicae* subsp. *angelicae*, *Conophytum burger*, *Conophytum calculus* subsp. *vanzylii*, *Conophytum friedrichiae*, *Conophytum limpidum*, *Conophytum lydiae*, *Conophytum maughanii*, *Conophytum praesectum*, *Conophytum ratum*, *Lithops dorotheae*, *Lithops julii* subsp. *fulleri*. Several Namaqualand- and Gariep endemics are also housed in this vegetation type.

The Bushmanland Arid Grassland vegetation type is home to endemic species *Dinteranthus pole-evansii*, *Larryleachia dinteri*, *Larryleachia marlothii*, *Ruschia kenhardtensis*, *Lotononis oligocephala*, *Nemesia maxii* and Bushmanland endemic *Tridentea dwequensis*. This vegetation type comprises extensive to irregular plains on a slightly sloping plateau and is usually dominated by *Stipagrostis* grass species.

The Bushmanland Inselberg Shrubland vegetation type includes the mountains of Aggeneys ("Aggeneys se berge") which makes out part of the most important inselbergs within this vegetation type (Mucina & Rutherford, 2006). It is further home to the Namaqualand endemic *Whitehead bifolia*, the Gariep endemic *Ceraria fruticulosa*, *Cheiridopsis pillansii* and *Hoodia alstonii*. The succulent shrub *Huernia barbata* subsp. *ingeae* is the only endemic taxon of this vegetation type. The most important inselbergs in this vegetation type include Achab se berg, Aggeneys se berg, Ghaamsberg, Goob se berg, Naib se berg and Namiesberge.

The vegetation type status is listed below for each of the relevant vegetation types.

Table 6: Vegetation types and status

#	Vegetation Unit	Extent (ha)	% Area Remaining	Biodiversity Target (%)	Ecosystem status	Protection level (%)	Statutorily conserved
SKr 19	**Aggeneys Gravel Vygieveld**	6 222	97	18	Least Threatened	0	Not Protected
NKb 3	**Bushmanland Arid Grassland**	4 547 895	99	21	Least Threatened	0	Augrabies Falls National Park; Goegap Nature Reserve
SKr 18	**Bushmanland Inselberg Shrubland**	80 913	Not known	34	Threatened	0	Not Protected

9.2. Listed and Protected Flora Species

Dense stands of protected flora will not be transformed by the Kokerboom upgrade, although individual specimens might be affected. *Anacampseros* sp. were found to be several specimens in a small area, although stands do not exceed more than 20 specimens. Most of the areas have been previously disturbed and/or transformed during the construction of the existing Kokerboom pipeline, the communication lines, the other access roads and/or the stormwater berm on the west of Aggeneys town.

Table 7: Protected Flora Species confirmed on site

Species	Synonym	NCNCA Status	NFA Status	IUCN Red List
Aloidendron dichotomum	*Aloe dichotoma*	Schedule 1	Not listed	N/A
Anacampseros sp.	*Avonia sp.*	Schedule 2	N/A	N/A
Lessertia frutescens	*Sutherlandia frutescens*	Schedule 1	N/A	N/A
Aloe microstigma.		Schedule 2	N/A	Least Concern
Euphorbia gariepina		Schedule 2	N/A	Least Concern
**Vachellia xanthophloea*	*Acacia xanthophloea*	Not listed	Not listed	Least Concern
**Vachellia sieberiana*	*Acacia sieberiana*	Not listed	Not listed	Least Concern

*Species in town gardens are to be avoided and hence retained.

9.3. Alien and/or Invasive Flora Species

The only invasive species recorded on site is *Prosopis glandulosa* (Honey Mesquite) located along the side of the existing gravel road inside the North-Eastern fenced area.

10. Fauna

The presence of fauna is of low diversity with relatively moderate levels of activity. Avifaunal activities were high in Aggeneys town, and Cape ground squirrels (*Geosciurus inaurus*) were quite frequent in the areas directly adjacent to the town. Other ungulates and smaller fauna species (rodents) were present between the town and the access gate towards the Kokerboom reservoirs. Springbok *(Antidorcas marsupialis*) are kept inside the fenced area towards the proposed site of the Kokerboom reservoirs. The carcass of a Steenbok (*Raphicerus campestrus*) was found towards the north of Aggeneys town.

The presence of a single herpetofauna species were visually confirmed during the site assessment, namely the Ground Agama (*Agama aculeata*).

Listed fauna species expected to occur, but not confirmed during the site assessment include:

- Gerbils (*Gerbillurus*)
- Round-eared Elephant Shrew (*Macroscelides proboscideus*)
- Cape Hare (*Lepus capensis*)
- Common Duiker (*Sylvicapra grimmia*)
- Slender Mongoose (*Galarella sanguinea*)
- Cape Grey Mongoose (*Galarella pulverulentus*)
- Black backed jackal (*Canis mesomelas*)
- Caracal (*Caracal caracal*)
- Chacma baboon (*Papio ursinus*)

Other listed species which are not expected to occur on site are the Leopard (*Panthera pardus*), Honey Badger (*Mellivora capensis*), Brown Hyena (*Hyaena brunnea*).

Table 8: Protected Fauna Species confirmed on site

Species	Common Name	NCNCA Status	IUCN Red List
Agama aculeata	Ground Agama	Not listed	Not listed
Antidorcas marsupialis	Springbok	Schedule 2	Least Concern
Raphicerus campestrus	Steenbok	Schedule 2	Not listed
Geosciurus inaurus	Cape Ground Squirrel	Schedule 2	Least Concern

Figure 22: Ground Agama

Figure 23: Cape Ground Squirrels and their nests

11. Ecological Sensitivity

11.1. Critical Biodiversity areas and Broad-scale processes

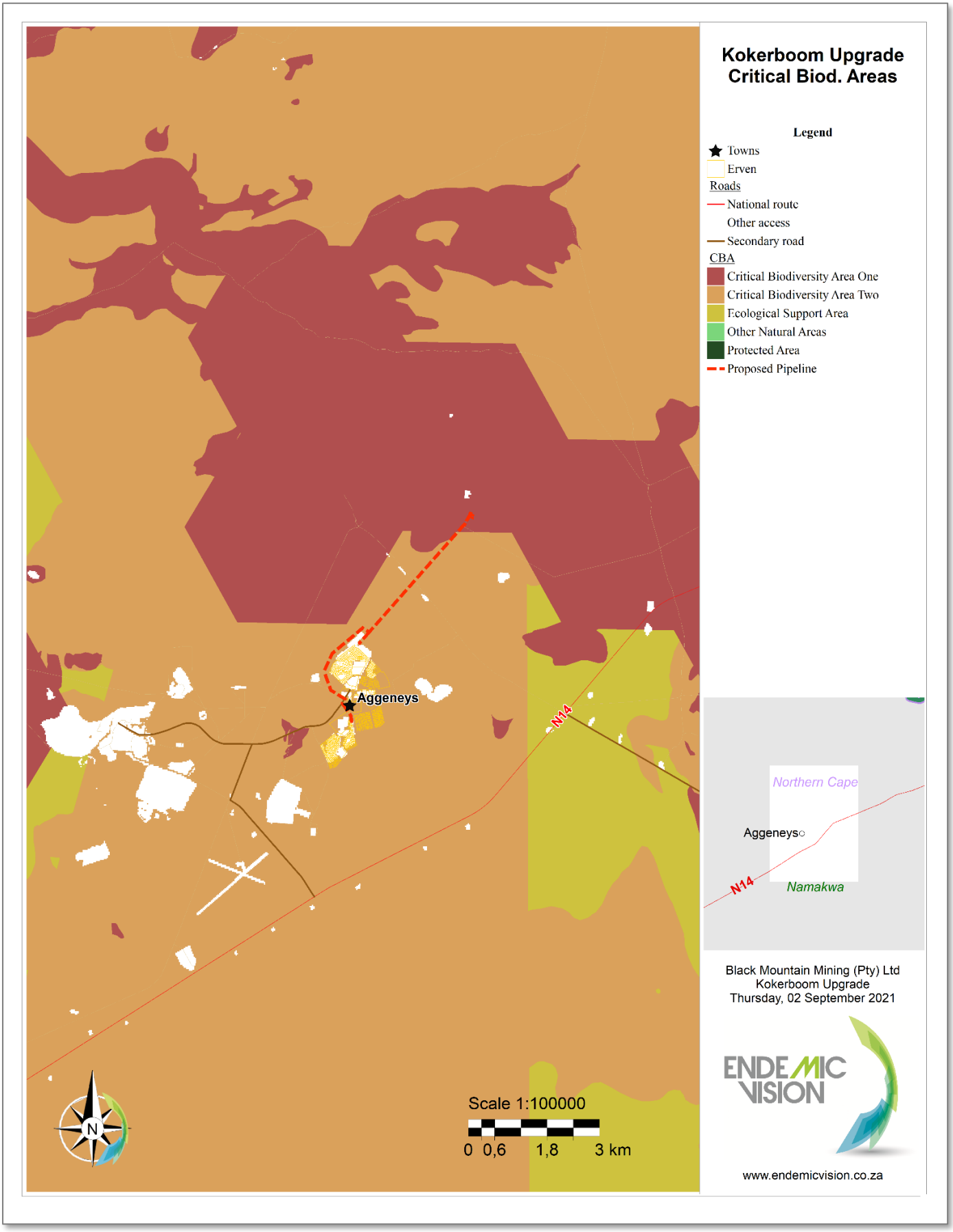

Figure 24: Critical Biodiversity Areas

Critical biodiversity areas (CBA) map (Figure below) is used to inform decision making about the best locations for development. The proposed pipeline and associated reservoirs fall under the Environmental Management Framework and Strategic Environmental Management Plan of the Namaqua District Municipality (2011), and is located mainly in Critical Biodiversity Area Two, and partially in Critical Biodiversity Area One.

Critical Biodiversity Areas are defined as areas of landscape that needs to be maintained in a natural or near natural state to ensure continued existence and functioning of species and ecosystems, as well as the delivery of ecosystem services.

Table 9: Critical Biodiversity Area Map categories (SANBI, 2018)

CBA Map category	Description	Desired state	Examples of compatible land use
Protected area	Areas that are formally protected in terms of the Protected Areas Act. Each protected area has a management plan.	As per each protected area's management plan.	• Conservation-related land uses
Critical Biodiversity Area (CBA 1)	Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species, or ecological processes in these areas.	Maintain in natural or near-natural ecological condition.	• Open space • Low impact ecotourism or recreation
Critical Biodiversity Area 2 (CBA 2)	Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses.		
Ecological Support Area 1 (ESA 1)	Areas that support the ecological functioning of protected areas or CBAs or provide important ecological infrastructure.	Maintain in at least semi-natural ecological condition.	• Low impact ecotourism or recreation • Sustainably managed rangelands • Certain forms of low-density housing
Ecological Support Area 2 (ESA 2)		No further intensification of land use	• Intensive agriculture
Other natural area 10NA>	Natural or semi-natural areas that are not required to meet biodiversity targets or support natural ecological processes.	Best determined through multi-sectoral planning processes.	From a biodiversity perspective, these areas can be used for a range of intensive land uses
No natural remaining (NNR|	Areas in which no natural habitat remains.		

The area classified as Critical Biodiversity Area one is mostly natural despite it being located adjacent to the existing Kokerboom pipeline and reservoir. This section of the proposed Kokerboom upgrade project is on a south facing slope which are regarded as important climate change refugia.

The classification as CBA 2 Areas is however not a true representation of the CBA Category since the exact location of the proposed infrastructure overlies previously disturbed and/or transformed areas. The CBA map is based on the electronic databases available for the area and the biodiversity knowledge for the Namakwa district is still considered as being limited with fine-scale biodiversity studies only covering isolated areas within the district (Namakwa District Biodiversity Sector Plan, 2008).

11.2. Succulent Karoo Hotspot – Bushmanland Inselbergs

The Bushmanland Inselbergs, which primarily includes Achab se berg, Aggeneys se berg, Ghaamsberg, Ghoop se Berg, Naib se berg and Namiesberge, is one of the priority areas of the Succulent Karoo Hotspot. The proposed Kokerboom reservoir will be located on the foot of the Aggeneys mountains (Aggeneys se berg), alongside the existing Kokerboom reservoir.

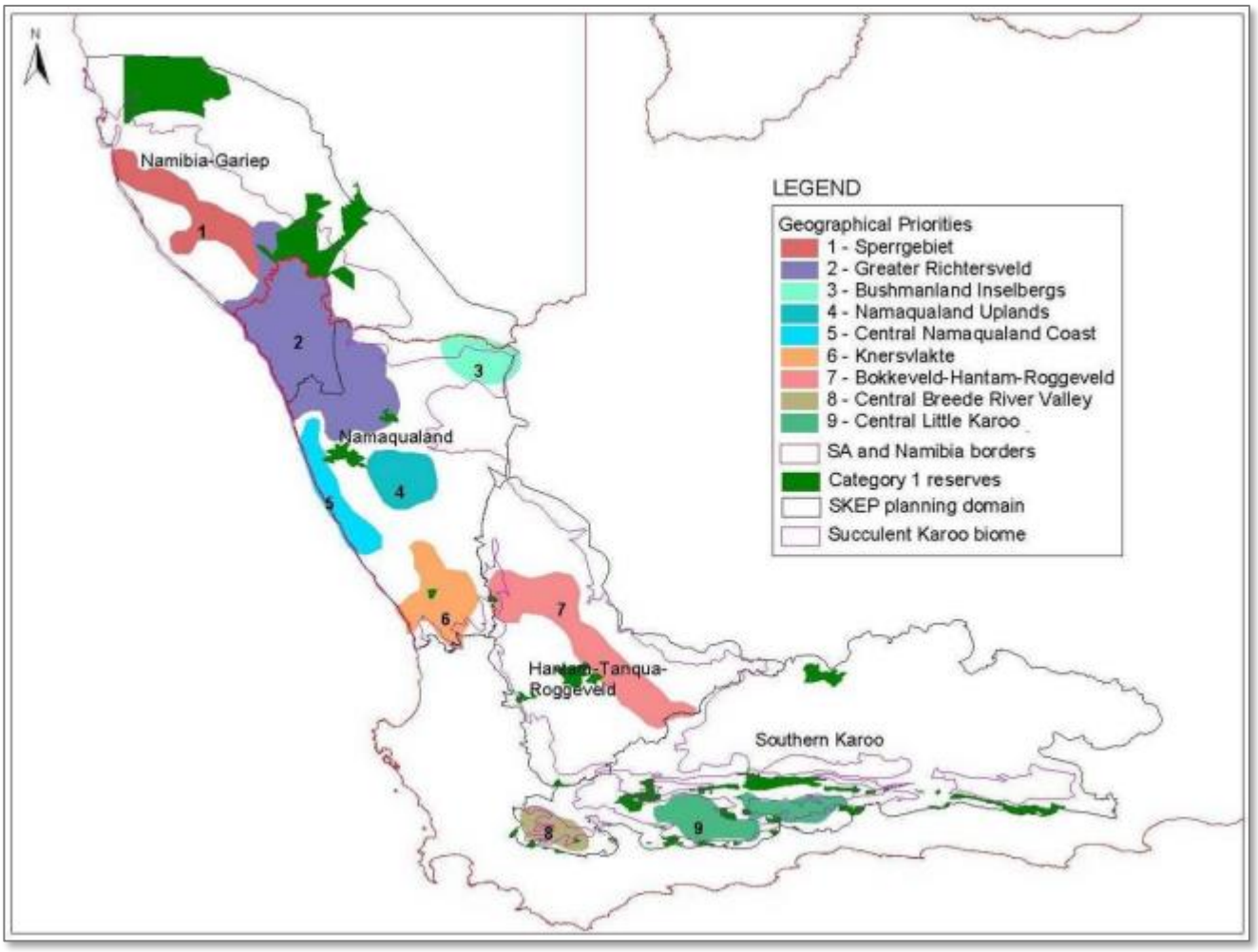

Figure 25: Bushmanland Inselbergs priority area of the Succulent Karoo Hotspot (SKEP, 2009)

The Bushmanland Inselbergs play an important role in the east west migration patterns of rock loving species, whilst serving as refugia for other fauna and flora species. These inselbergs have a total footprint of 31 400 hectares and sustains 429 floral species, of which 67 are endemic to the Succulent Karoo hotspot and 87 have been included in the IUCN Red List by 2009.

Populations of the Red Lark (*Certhilauda albescens*) have been recorded on a farm slightly more than 10 kilometres North west of the proposed Kokerboom upgrade site. No evidence of the presence of this species were however found during the site assessment.

11.3. Sensitivity Mapping

An ecological sensitivity map was generated from site assessment results, data interpretation of the results, the literature on sensitive systems and their categorization using known SA data sets (SANBI, BGIS, and IUCN listing notices).

The ecological status, considering the biotic and abiotic elements and the way they interact is considered for this assessment.

Specific habitats that affect flora and fauna interactions with the environment are found on the site including the washes in the plains and the food sources surrounding the Aggeneys town area where specifically Cape Ground Squirrels were nesting.

Ecological sensitive areas are investigated and presented spatially to assist in the evaluation of the baseline area and possible impacts.

Information is integrated by focusing on the following aspects:

- Watercourses, in this case washes and rivulets.
- Location of important species and populations (unique populations of species of conservation concern and/or protected species that will affect legal compliance (*DAEARLD and DFFE*)).
- Mountain habitats representing Bushmanland Inselbergs.

The map depicts areas according to categories Low (for low biodiversity impact), Medium or High (for high biodiversity impact).

- Insignificant Sensitivity Rating
  - Very low ecological sensitivity;
  - Previously modified, disturbed and/or transformed areas;
  - Negligible impact on ecological processes and terrestrial biodiversity; and
  - The extent of the impact is temporal and insignificant in the context of the extent of biodiversity.

- Low Sensitivity Rating
  - Low ecological sensitivity;
  - Previously modified, disturbed and/or transformed areas that have resumed functionality;
  - Negligible impact on ecological processes and terrestrial biodiversity; and
  - The extent of the impact is little, temporal and insignificant in the context of the extent of biodiversity.

- Moderate Sensitivity Rating
  - Moderate ecological sensitivity;
  - Relatively undisturbed sites and/or previously transformed sites that have resumed functionality;
  - Little ecological impact provided that all mitigation measures are complied with fully; and
  - Secondary impacts of development will be low (like erosion and/or partial habitat destruction).

- High Sensitivity Rating (including High sensitivity induvial specimens)
  - High ecological sensitivity and high biodiversity value;
  - Intact areas or restored/rehabilitated areas;
  - Development is undesirable here and should only proceed with caution where all other alternatives have been investigated and failed; and
  - The individual specimens must be avoided as far as practicable and/or relocated.

11.3.1 Reservoir Alternative Layout 1

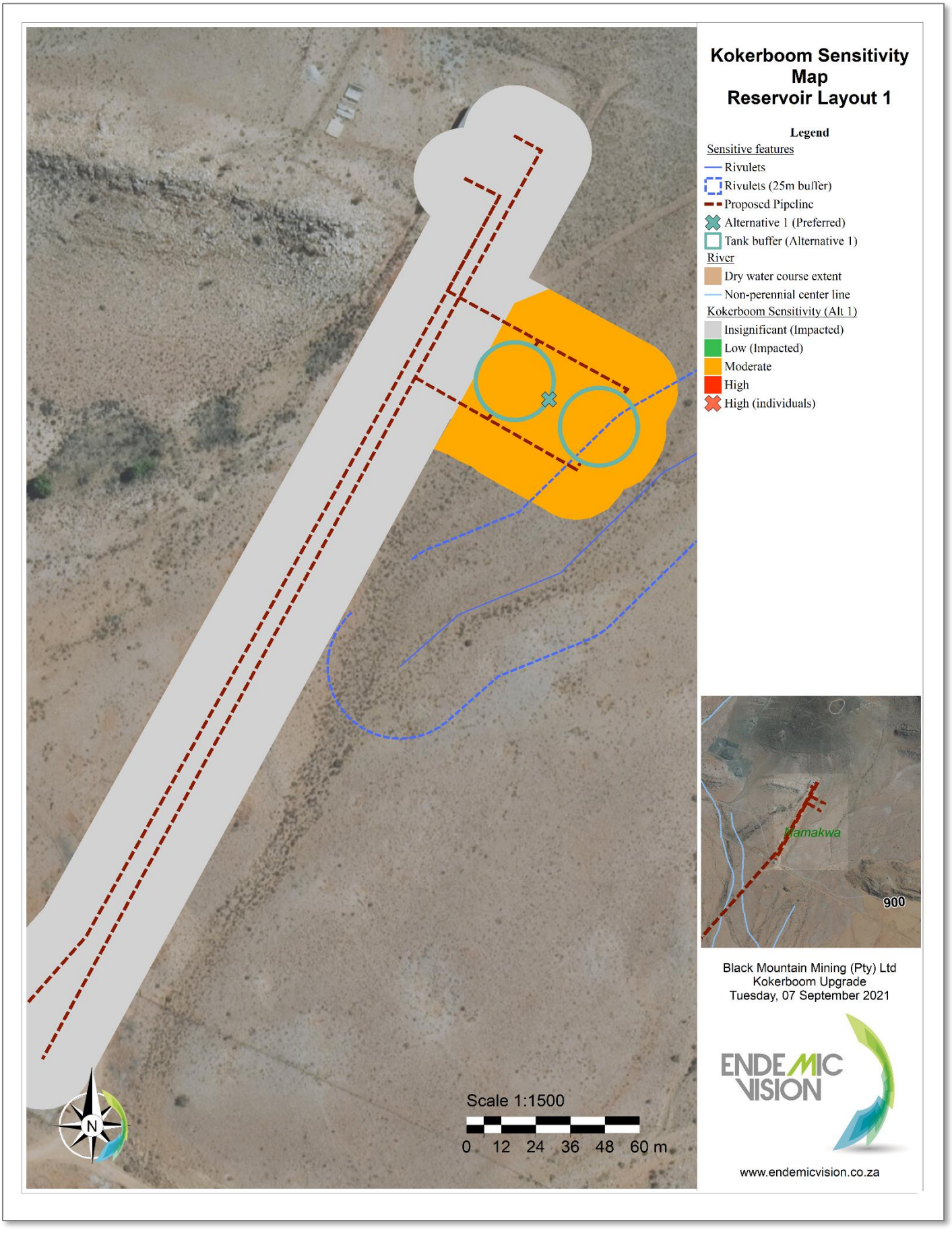

Figure 26: Sensitivity map Reservoir Alternative Layout 1

11.3.2 Reservoir Alternative Layout 2

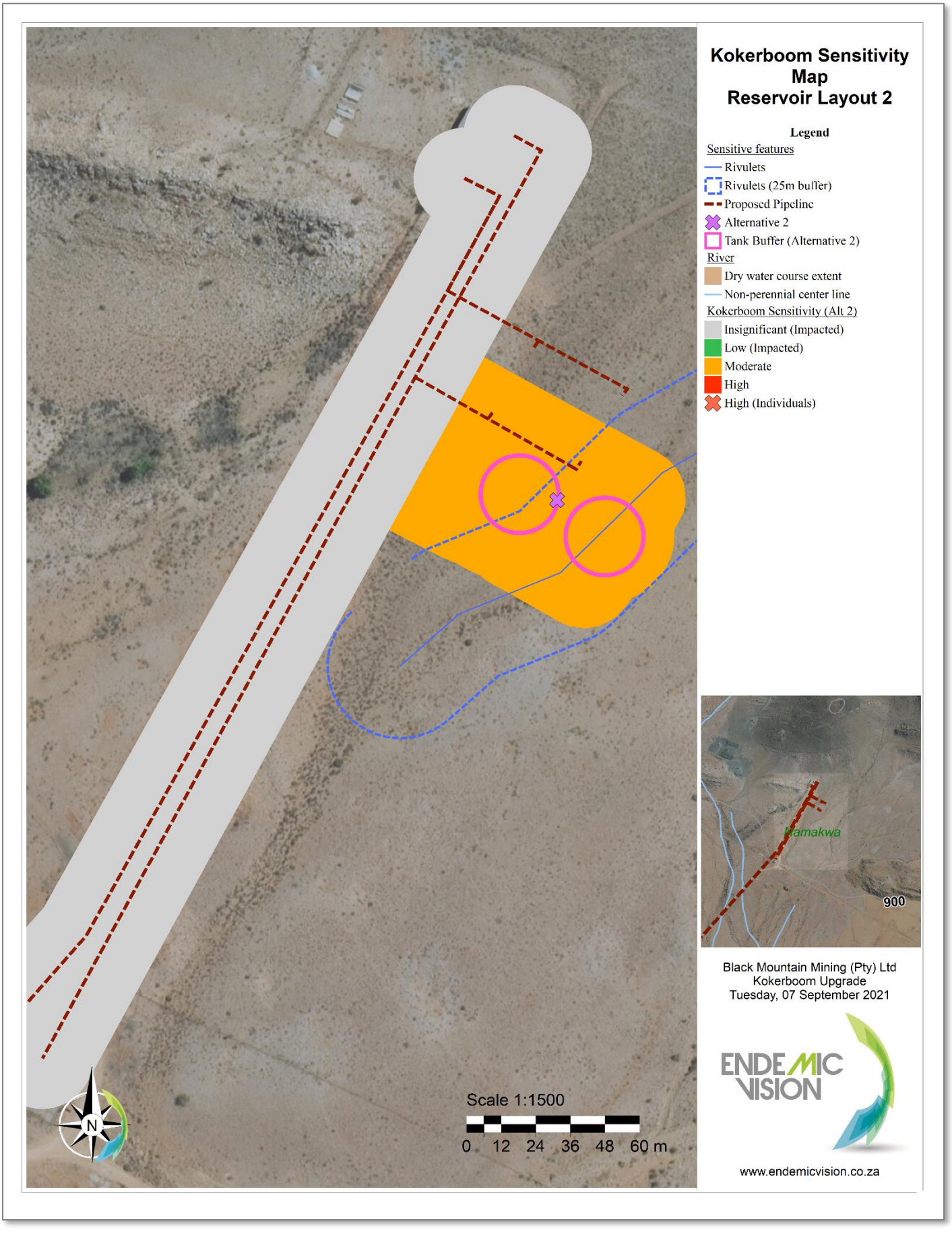

Figure 27: Sensitivity map Reservoir Alternative Layout 2

11.3.3 Pipeline Area

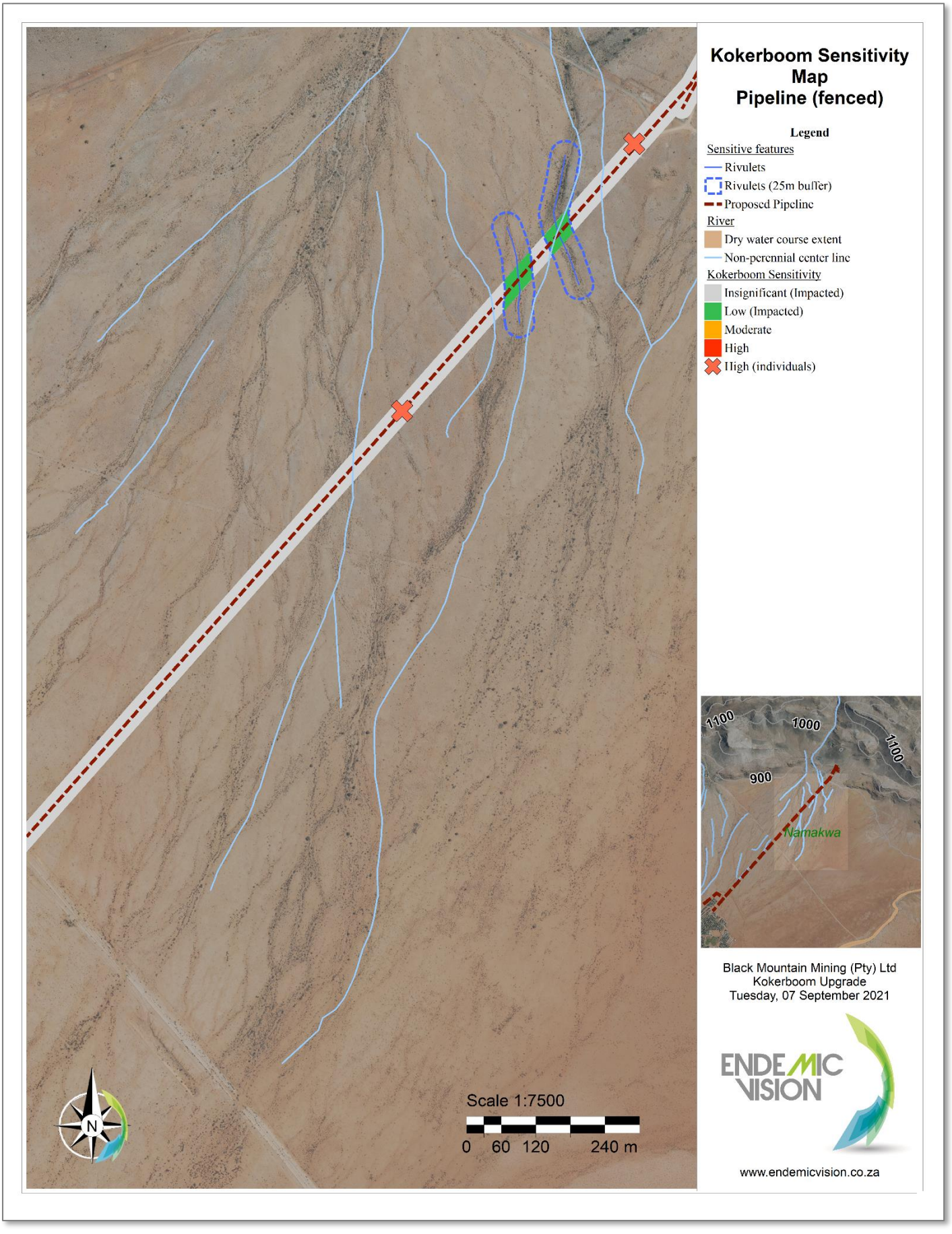

Figure 28: Sensitivity Map Pipeline (North-Eastern Fenced Area)

Figure 29: Sensitivity Map Pipeline (North-Eastern Open Area)

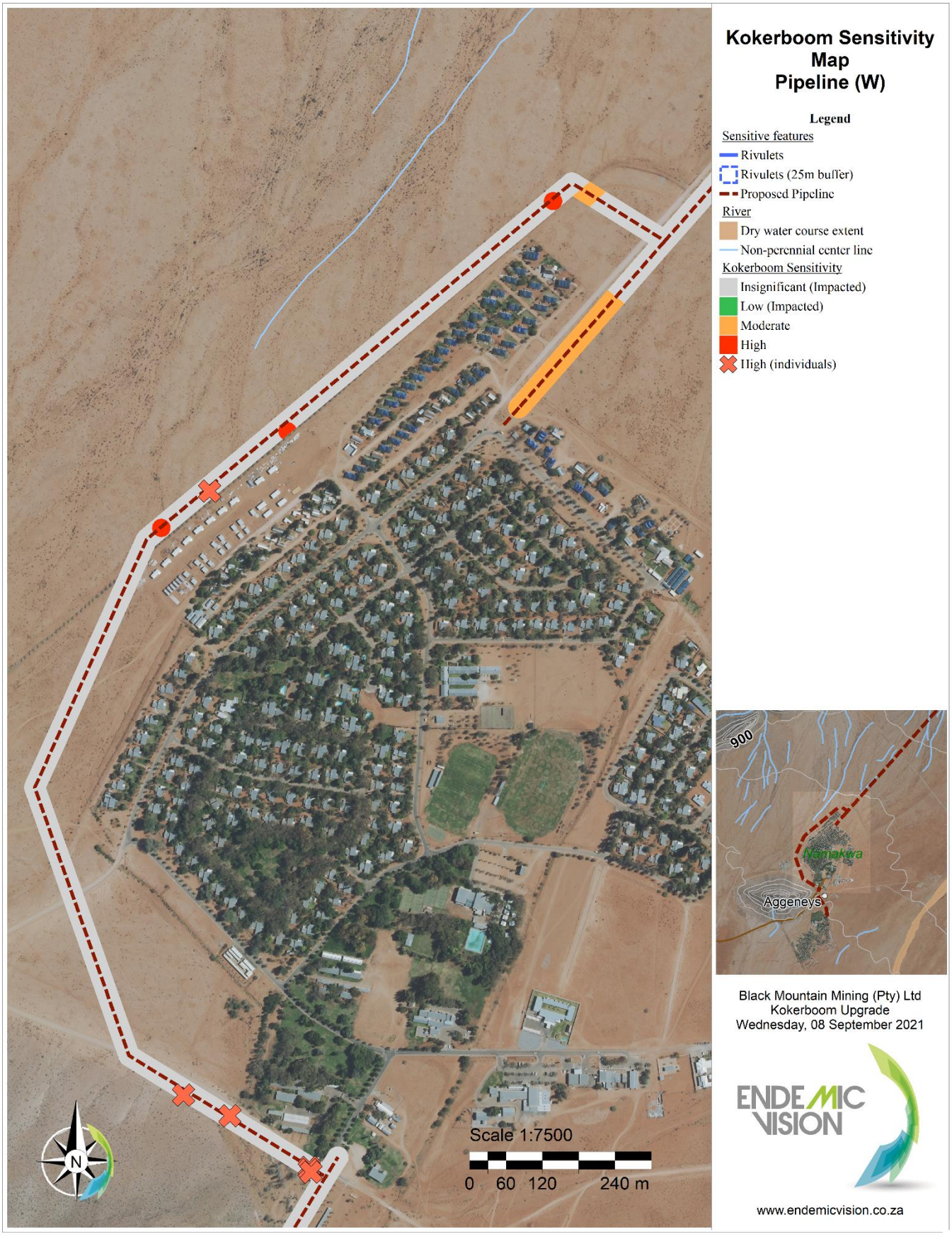

Figure 30: Sensitivity Map Pipeline (West of Aggeneys town)

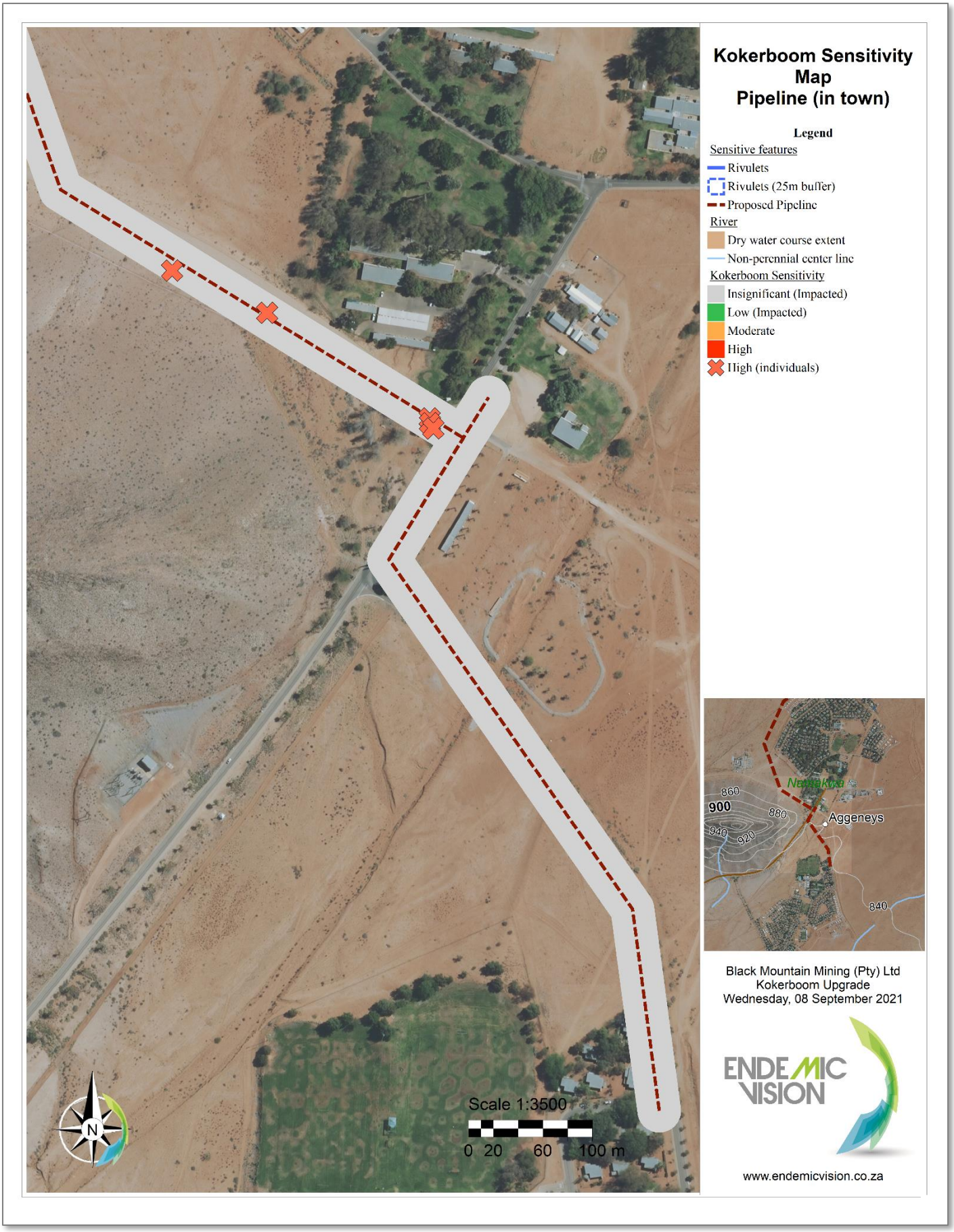

Figure 31: Sensitivity Map Pipeline (in town)

11.3.4 Moderate and High Sensitivity Areas

The natural areas where the reservoirs (alternative layout 1 or 2) will be located are considered as having moderate sensitivity since these areas are mostly untransformed and falls within the transitional edge of the Bushmanland Inselberg vegetation type. *Geosciurus inauris* nesting sites are also rated as having moderate sensitivity due to their protection status according to the Northern Cape Nature Conservation Act. Fauna permits are hence required for the destruction of these nests.

Patches of and/or protected species are rated as having high sensitivity. *Aloidendron dichotomum*, *Aloe microstigma* and *Anacampseros* sp. can be transplanted. The relevant permits should however be obtained for all individual flora specimens prior to their relocated. Where *Lessertia frutescens* and *Euphorbia gariepina* will be impacted, seed must be collected, when possible, to aid in rehabilitation.

The protected flora specimens on site are detailed under section 9.2 of this report and requires a provincial flora permit prior to removal, cutting and/or transplantation.

11.3.5 Buffer Areas around sensitive features

All sensitive features encountered on site are buffered, but due to their degraded state not regarded as having high sensitivities. The natural rivulet where the reservoir's will be located is considered as natural/undisturbed and is hence rated as having a moderate sensitivity. This rivulet is isolated and not connected in the landscape, but its surface water flow hydrology will be impacted by the cut and fill activities associated with the levelling of the proposed reservoirs.

12. Assessment of Alternatives

Two alternative locations for the reservoirs were assessed. The impacts of these are however similar, but the preferred location will avoid one wash and hence have a smaller impact footprint with regards to surface water hydrology.

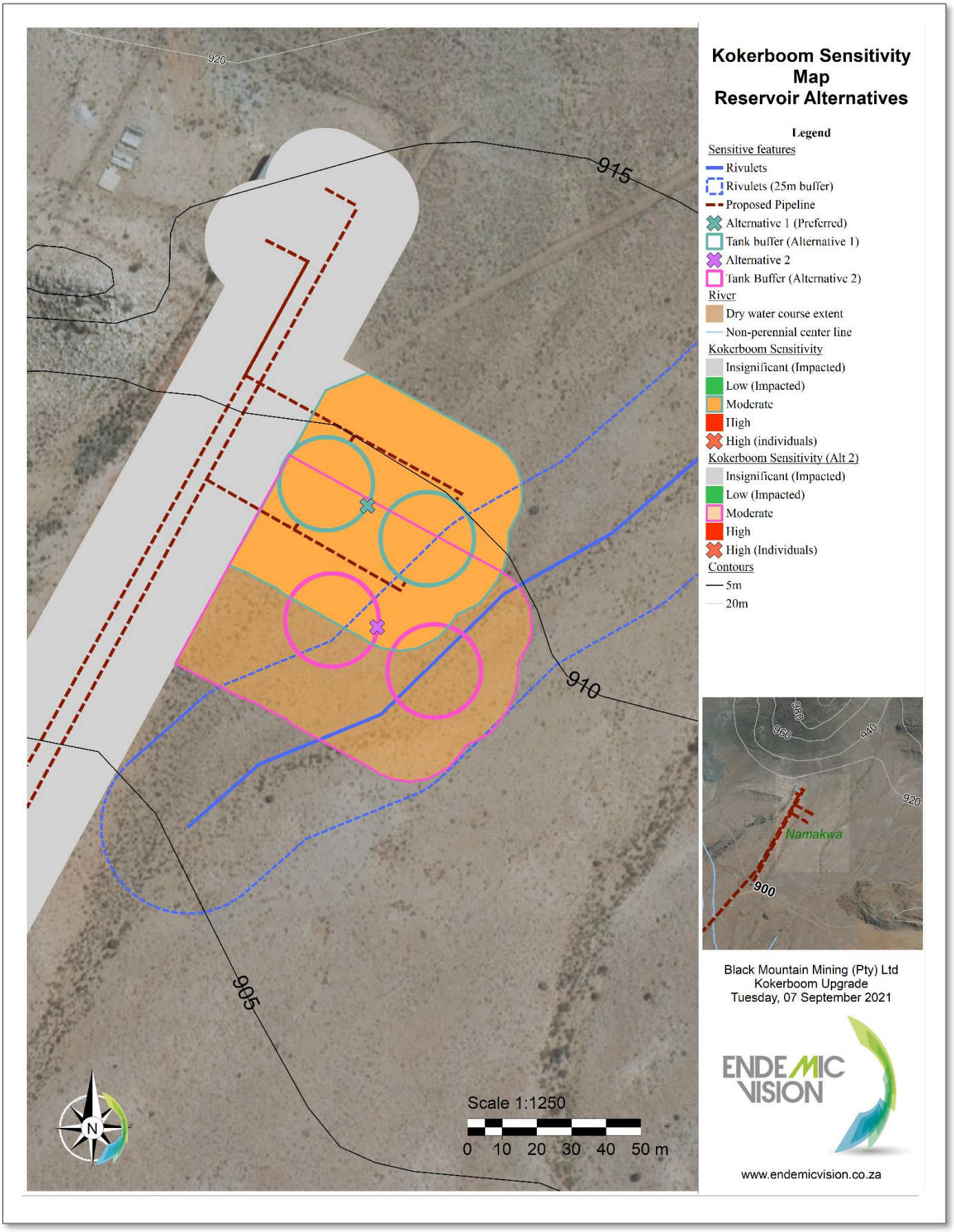

Figure 32: Alternative locations of the proposed Kokerboom reservoir

12.1. Impact Assessment

12.1.1 Alternative Layout 1

Table 10: Risk Assessment Alternative Layout 1

#	Element	Project Phase	Activity	Impact Description	Impact Type Degree of loss	Duration	Scale	Severity	Initial Probability	Initial Score Before mitigation
1	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of protected plant specimens	Direct Negative Moderate	Long term	Site	Medium	Definite	**55**
2	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of vegetation cover	Direct Negative Low	Long term	Site	Low	Definite	**35**
3	Soil	Site Clearance & Construction	Clearing Soils	Changes in soil functionality: loss of topsoil	Direct Positive Low	Medium term	Site	Low	Probable	**12**
4	Soil	Site Clearance & Construction	Construction: earth works	Changes in soil functionality: compaction	Direct Negative Low	Long term	Site	Low	Highly Probable	28
5	Fauna	Site Clearance & Construction	Disturbance: fauna and flora	Disturbance of fauna engagement patterns	Direct Negative Low	Short term	Local	Low	Probable	**10**
6	Ecology	Site Clearance & Construction	Disturbance: fauna and flora	Loss of habitats	Indirect Negative Low	Medium term	Site	Medium	Highly Probable	**40**
7	Biodiversity	Site Clearance & Construction	Disturbance: fauna and flora	Change in species composition	Direct Negative Moderate	Long term	Site	Low	Probable	**14**
8	Water - Surface	Site Clearance & Construction	Construction: earth works	Changes in surface hydrological patterns and processes	Direct Negative Moderate	Medium term	Site	Medium	Probable	**20**
9	Ecology	Rehabilitation	Rehabilitation	Ecological system impacts: Ecological process & function restoration	Direct Positive Low	Long term	Site	Medium	Probable	**22**
10	Flora	Maintenance	Maintenance	Loss of vegetation cover	Direct Negative Low	Long term	Site	Low	Definite	**35**

12.1.2 Alternative Layout 2

Table 11: Risk Assessment Alternative Layout 2

#	Element	Project Phase	Activity	Impact Description	Impact Type Degree of loss	Duration	Scale	Severity	Initial Probability	Initial Score Before mitigation
1	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of protected plant specimens	Direct Negative Moderate	Long term	Site	Medium	Definite	**55**
2	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of vegetation cover	Direct Negative Low	Long term	Site	Low	Definite	**35**
3	Soil	Site Clearance & Construction	Clearing Soils	Changes in soil functionality: loss of topsoil	Direct Positive Low	Medium term	Site	Low	Probable	**12**
4	Soil	Site Clearance & Construction	Construction: earth works	Changes in soil functionality: compaction	Direct Negative Low	Long term	Site	Low	Highly Probable	28
5	Fauna	Site Clearance & Construction	Disturbance: fauna and flora	Disturbance of fauna engagement patterns	Direct Negative Low	Short term	Local	Low	Probable	**10**
6	Ecology	Site Clearance & Construction	Disturbance: fauna and flora	Loss of habitats	Indirect Negative Low	Medium term	Site	Medium	Highly Probable	**40**
7	Biodiversity	Site Clearance & Construction	Disturbance: fauna and flora	Change in species composition	Direct Negative Low	Long term	Site	Low	Probable	**14**
8	Water - Surface	Site Clearance & Construction	Construction: earth works	Changes in surface hydrological patterns and processes	Direct Negative Low	Medium term	Site	Medium	Probable	**20**
9	Water - Surface	Site Clearance & Construction	Construction of reservoir(s)	Changes in surface hydrological patterns and processes	Direct Negative Moderate	Permanent	Site	Medium	Definite	60
10	Ecology	Rehabilitation	Rehabilitation	Ecological system impacts: Ecological process & function restoration	Direct Positive Low	Long term	Site	Medium	Probable	**22**
11	Flora	Maintenance	Maintenance	Loss of vegetation cover	Direct Negative Low	Long term	Site	Low	Definite	**35**

12.2. Mitigation Measures

Table 12: Mitigation measures

Environmental Management Objective	Avoidance Measures	Reduction Measures	Remedial Measures	Monitoring Measures
Ensure vegetation protection through the project life cycle	No unauthorised site clearing or disturbance at the site without an ECO present. Demarcate all areas that require vegetation clearance to reduce footprint and peripheral damage.	Vegetation clearing to commence only after walk through has been conducted and necessary permits obtained. The final development area should be surveyed for species suitable for search and rescue, which should be translocated prior to the commencement of vegetation clearance or construction.	Ensure all vegetation is stockpiled for re-use in rehabilitation and/or relocated to other areas ready to be rehabilitated. Collect seeds from all specimens earmarked for removal to aid in rehabilitation.	Monitor survival of relocated species post-relocation to aid future relocation strategies. All other DFFE and DAEALRD monitoring requirements must be complied to.
Manage topsoil, seedbank and organic matter resource	The project site and loose material will not be exposed to rain resulting in excessive erosion, siltation and general disturbance. Apply topsoil concurrently and keep stockpiling to a minimum.	Provide temporary stabilization of disturbed areas that are not actively under construction. Reduce compaction, subsoil, soil quality and contamination impacts on soils by restoring areas as soon as practically possible.	Where areas are significantly impacted (because of impact or delay in restoring areas) and unlikely to reach soil quality / characteristics originally proactive remediation must be implemented.	Monitor equipment for pollution potential: All vehicles must be regularly inspected for leaks. Conduct routine site inspections to assess the effectiveness of and the maintenance requirements for erosion and sediment control systems
Manage interaction with fauna during construction	Demarcate all open excavations to prevent faunal injuries and/or deaths.	The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the demarcated construction footprint. Fauna permits must be obtained if any faunal species are to be disturbed and/or their habitats destroyed (including Cape Ground Squirrel Nests).	Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person. Faunal sweeps within habitats such as bush clumps should take place before clearing and any fauna located should form part of a search and rescue and relocated to safety. Phased dozing are to be applied to ensure animals move out of the area prior to earth works (gradual/slow clearing of areas where nests are present).	
Limit faunal habitat destruction and fragmentation during site clearance and construction	Take breeding seasons into account when scheduling construction activities.	Reduce the footprint size by proper planning and restricting activities to previously disturbed areas as far as practicable.	Encourage natural recovery by means of storm water diversions and landscaping, as well as replacement of topsoil.	

Environmental Management Objective	Avoidance Measures	Reduction Measures	Remedial Measures	Monitoring Measures
To minimise destruction or degradation of biodiversity	All indigenous species is retained as far as possible and where alien species are encountered they are removed. The selection of laydown areas will consider already disturbed areas first. All construction staff should undergo an environmental induction from a suitably qualified person regarding the importance of footprint management. All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises, as well as to minimize dust generation. All vehicles and machines to remain on demarcated roads and access routes.	Any fauna directly threatened by the project activities should be removed to a safe location by the responsible person from the Environmental team.	Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.	
Manage rehabilitation sustainability through proper planning	Ensure a rehabilitation plan is in place that incorporate physical and biophysical (biotic and abiotic remediation) designs specific to the site conditions.	Reduce rehabilitation costs by implementing rehabilitation according to the rehabilitation plan and review plan and monitoring results annually to adjust for continual improvement.	Manage flood impacts on rehabilitation works as they occur.	Monitor the rehabilitation plan and rehabilitation success annually.
Reduce impact on surface hydrology and consequential secondary impacts	Storm water isolation berms must be constructed to isolate clean and dirty surface water areas.	Storm water berms must be vegetated immediately to protect against wind and water erosion and possible failure.	Restoration of the hydrological regime as well as storm water control during operations will be required to ensure minimal silt and loose soils wash downwards towards the veld which is most susceptible to such disturbance.	Maintenance of storm water berms must be done as required. Stormwater berms must address possible siltation in the vicinity of washes.

12.3. Risk assessment with Mitigation measures implemented

12.3.1 Alternative Layout 2

Table 13: Risk Assessment Post-Mitigation - Alternative 1

#	Element	Project Phase	Activity	Impact Description	Final Probability	Final Score Residual
1	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of protected plant specimens	Improbable	**11**
2	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of vegetation cover	Highly Probable	**28**
3	Soil	Site Clearance & Construction	Clearing Soils	Changes in soil functionality: loss of topsoil	Improbable	**6**
4	Soil	Site Clearance & Construction	Construction: earth works	Changes in soil functionality: compaction	Probable	**14**
5	Fauna	Site Clearance & Construction	Disturbance: fauna and flora	Disturbance of fauna engagement patterns	Improbable	**5**
6	Ecology	Site Clearance & Construction	Disturbance: fauna and flora	Loss of habitats	Probable	**20**
7	Biodiversity	Site Clearance & Construction	Disturbance: fauna and flora	Change in species composition	Improbable	**7**
8	Water - Surface	Site Clearance & Construction	Construction: earth works	Changes in surface hydrological patterns and processes	Improbable	**10**
9	Ecology	Rehabilitation	Rehabilitation	Ecological system impacts: Ecological process & function restoration	Highly Probable	**44**
10	Flora	Maintenance	Maintenance	Loss of vegetation cover	Probable	**14**

12.3.2 Alternative Layout 2

Table 14: Risk Assessment Post-Mitigation - Alternative 2

#	Element	Project Phase	Activity	Impact Description	Final Probability	Final Score Residual
1	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of protected plant specimens	Improbable	**11**
2	Flora	Site Clearance & Construction	Clearing Indigenous Vegetation	Loss of vegetation cover	Highly Probable	**28**
3	Soil	Site Clearance & Construction	Clearing Soils	Changes in soil functionality: loss of topsoil	Improbable	**6**
4	Soil	Site Clearance & Construction	Construction: earth works	Changes in soil functionality: compaction	Probable	**14**
5	Fauna	Site Clearance & Construction	Disturbance: fauna and flora	Disturbance of fauna engagement patterns	Improbable	**5**
6	Ecology	Site Clearance & Construction	Disturbance: fauna and flora	Loss of habitats	Probable	**20**
7	Biodiversity	Site Clearance & Construction	Disturbance: fauna and flora	Change in species composition	Improbable	**7**
8	Water - Surface	Site Clearance & Construction	Construction: earth works	Changes in surface hydrological patterns and processes	Improbable	**10**
9	Water - Surface	Site Clearance & Construction	Construction of reservoir(s)	Changes in surface hydrological patterns and processes	Highly Probable	**48**
10	Ecology	Rehabilitation	Rehabilitation	Ecological system impacts: Ecological process & function restoration	Highly Probable	**44**
11	Flora	Maintenance	Maintenance	Loss of vegetation cover	Probable	**14**

12.4. Cumulative Impacts

The Kokerboom upgrade project will have no detrimental cumulative impacts on the surrounding environment since it is 90% located on previously transformed and/or degraded areas. The project further has a relatively small footprint size, and the pipeline will only have a disturbance width of 15 meters which should prove insignificant to the migration and movement patterns of most fauna species present.

The permanent loss of vegetation cover where the reservoirs will be located is a cumulative risk associated with both alternative layouts.

Alternative layout two however has an additional cumulative impact, namely the permanent alteration of the surface water flow hydrology since the one reservoir will be permanently located within the rivulet.

13. Conclusion

The Kokerboom upgrade project is located mostly on already disturbed and/or impacted areas alongside an existing road. The site however appears to be in a sound ecological state and the fauna species present appear to have adapted to the fragmentation caused by the existing road.

A single protected tree species, *Aloidendron dichotomum*, occur within the footprint of the proposed Kokerboom upgrade project. Construction activities should however be able to avoid destruction of these specimens. Other protected flora populations of *Anacampseros* sp. can be successfully relocated and/or temporarily stored to aid rehabilitation of the footprint. *Lessertia frutescens* were seeding at the time of the site assessment and seed can hence be stored and re-introduced during the rehabilitation phase of the project.

Alternative reservoir layout 1 has a smaller footprint size and less risks associated with it. Alternative layout two has an additional impact relating to the alteration of the surface water hydrological flow patterns. This risk is considered a cumulative impact. Neither alternatives pose any threats to protected and/or listed biodiversity species. The preferred layout is however Alternative layout 1 located furthest from the wash/rivulet to the East of these alternatives.

14. Recommendations

It is recommended that all mitigation measures be implemented to ensure minimal harm to the environment. The most significant mitigation measures are summarized below.

All necessary permits must be obtained prior to site clearance. No unauthorised site clearing or disturbance at the site without an ECO present and no clearance to take place prior to the demarcation of all areas that require vegetation clearance. All vegetation that can be re-used in rehabilitation and/or relocated to other areas must be stockpiled. The relevant permits for the disturbance of fauna on site must also be obtained.

The project site and loose material must not be exposed to rain resulting in excessive erosion, siltation, and general disturbance. Disturbed areas that are not actively under construction must be temporarily stabilized and dust abatement techniques applied to unvegetated areas. Compaction of soil must be minimized by limited stockpiling periods. Hydrocarbon management on site is important to prevent soil degradation and/or loss of topsoil.

Access to the site should be controlled and personnel should not be allowed to wander off into the adjacent veld. The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden and faunal sweeps within habitats such as bush clumps should take place before clearing and any fauna located should form part of a search and rescue and relocated to safety.

Any nationally protected trees within close proximity of the development footprint to be identified as no-go areas. Any fauna directly threatened by the project activities should be removed to a safe location by the responsible person from the Environmental team.

Storm water isolation berms must be constructed to isolate clean and dirty surface water areas and these berms should be maintained as required. The hydrological regime must be restored post-construction.

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